BELARUS 1221.2/1221B.2 1221.3

1221 – 0000010РЭ

OPERATORS MANUAL

2009

Operators manual was composed by engineer of the first Department of Constructive and Experimental Work, M.V. Gutko, with participation of key specialists of CEWB-1 RUE “Minsk Tractor Works”

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Operators manual contains short description and specifications of tractors Belarus 1221.2/1221B.2/1221.3 produced by Minsk Tractor Works. The main tractors operating rules are set forth, the information about their adjustments and maintenance is provided.

Operators manual is meant for tractor operators, who operate BELARUS tractors.

In view of P/A “MTW” policy directed to constant upgrading of produced goods, the construction of some units and parts of Belarus tractor may undergo changes which are not reflected in present edition.

Some technical data and illustrations given in this book may differ from those on your tractor. Dimensions and weights are approximate (advisory). For detailed information please consult your Belarus Dealer.

Table of contents

INTRODUCTION

Manual contains construction depiction, specifications, operation and maintenance rules of Belarus 1221.2/1221B.2/1221.3 tractors.

Tractors BELARUS 1221.2/1221B.2 are equipped with index “S” 100kW engine certified under the 1st stage of Directive 2000/25/EC, with hydraulic hoist, modified-design casing.

Tractors BELARUS 1221.3 are equipped with index “S” 100kW engine certified under the 2nd stage of Directive 2000/25/EC, with hydraulic hoist, modified-design casing.

Long-term and reliable tractor performance is secured in the case of proper operation and timely maintenance.

ATTENTION! Prior to putting new tractor in operation, study this manual and strictly observe all the recommendations in order to avoid accidents, injures or mutilations.

Note: In the text of this manual references “left” or “right” are taken from viewpoint of observer standing behind along tractor strike.

Note: In connection with carrying out regular works on improving Belarus tractors and working conditions alterations, not represented in this edition, may be made in design.

It is forbidden to reequip and change tractor construction without conformation to manufacturing works.

TO CONSUMERS ATTENTION!

Your tractor is equipped with range-type gearbox. In addition the ranges are shifted with toothed couplings, and gears within each range are shifted by virtue of synchronizers.

To throw into the range proceed as follows:

- Depress the clutch pedal and await complete tractor stop;
- Throw into the required range smoothly, without jerks, using the range engaging lever;
- Smoothly release the clutch pedal.

To change the gear proceed as follows:

- Depress the clutch pedal;
- Shift the gearshift lever smoothly, without sharp jerks, and hold it in depressed position until the gear is completely actuated;
- Smoothly release the clutch pedal.

You can change the gears in motion within the range only during the hauling operations on the hard-surface and dirt roads. Never attempt to change the gears in motion

when a tractor unit is used in the cross-country conditions (arable fields, peat beds, sandy soil etc.) because sudden stop of the tractor-machine unit can occur. Cross the mentioned sections with previously selected gear.

Failure to comply with the stated operation rules will cause quick wearing out of gear splines and tooth-type couplings as well as synchronizers impairment

Attention! If you hear skirr when shifting ranges and gears with the clutch pedal being depressed, immediately turn to a repair shop for malfunction repair.

Observe the rules of PTO switch. When switching PTO move control lever smoothly with 2…4 sec. hang-up in the centre of motion from neutral position to PTO switch in order to prevent shaft breaking, reducer gears breaking and tail breaking of PTO.
When adjusting operating and parking brakes make sure that the ground is horizontal, the engine is not running, rear wheels from front and back are supported by wedges to exclude accidental movement of the tractor.

Adopted abbreviations and symbolic notations.

ADL —automatic differential lock;
AB — accumulator battery;
RADL — rear axle differential lock;
PFE — paper filter element;
TDC — engine piston top dead center;
PTO — power take-off shaft;
PIS — power intake shaft;
HLL — hydraulic lift linkage;
HSU — hydrostatic steering unit;
SMS — shift-time maintenance service;
SPTA — spare parts, tools and accessories;
RHL — rear hitch linkage;
SFE — safety filter element of engine air cleaner;
GB — gearbox;
TMU — tractor-machine unit;
CC — clutch coupling;
MS — maintenance service;
THM — towing hitch mechanism;
MFE — main filter element of engine air cleaner;
FDA — front driving axle;
FPTO — front power take-off;
SM — season maintenance;
CAC — engine charge air cooler;
TC — engine turbocharger.

International Symbols

Manufacturer uses standard international symbols regarding instruments and operating controls.
Symbols with their meaning are given below.

 — see operators manual

 — brake

 — parking brake

 — horn

 — alarm signaling

 — fuel level in the tank

 — coolant

 — starting preheater plug

 — engine speed

 — engine oil pressure

 — engine coolant temperature

 — off/stop

 — on/start

 — continuous change

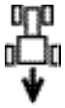
 — lever — down

 — control operating direction

 — fast

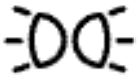
 — slow

 — forward

 — reverse

 — battery charging condition

 — cab dome light

 — marker lights

 — turning signals

 — headlights main beam

 — headlights lower beam

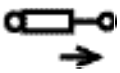
 — working headlights

 — differential lock

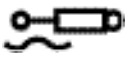
 — PTO engaged

 — FDA engaged


— lever — up


— control valve spool “lift” position


— control valve spool “drop” position


— control valve spool “float” position


— oil pressure in gearbox


— air pressure in pneumatic system


— high voltage


— coolant level


— trailer-train lights


— air filter impurity


— fan


— windshield washer


— front windscreen wiper


— rear windscreen wiper


— trailer turning signal


— oil pressure in HPS


— oil pressure in transmission


— brake fluid level


— pressure in breaking system

SAFETY REQUIREMENTS

Strict observance of safety precautions and exact complying with the rules of tractor control and its maintenance secure absolute safety of its operation.

General instructions

1. Study this operators manual attentively before operating the tractor. Poor knowledge of the tractor operation and service may lead to accidents.
2. Only specially trained and skilled operators, who have passed accident-prevention and fire safety briefings, are allowed to operate the tractor.
3. If tractor is equipped with safety belt use it during the operation. If tractor is not equipped with safety belt, contact the dealer.
4. Do not take a passenger into the cab, if additional seat and hand rails are not installed. There is no any other safe space for a passenger in the cab!
5. Keep all warning plates clean.
6. Replace any damaged or missing warning plate.
7. Carefully inspect the tractor, trailed machine, mounted implement and hitch before commencement of operations. Before starting operations make sure that they are in good order. Trailed agricultural machines and transport trailers should have rigid hitches, preventing their swaying and rear-end collision with the tractor during a hauling.

Safety measures during tractor operation

Warning! Do not ever start the engine while being outside the operator's workplace. Always stay in the cab in the operators seat when starting the engine or operating the controls.

7. Before starting the engine, make sure that the parking brake is applied, the PTO control lever is in «Disengaged» position, the gearshift and range selector levers are in «Neutral» position. Make sure the gearbox pump drive shifter is in «Engine-Driven» position.
8. Always stay in the operators seat when starting the engine or operating the controls.
9. Before starting motion, warn the people around and those working on the trailed machines with the horn.
10. Do not leave the tractor in motion.
11. Before leaving the cab do not fail to disengage the PTO, stop the engine, apply parking brake and remove the switch key.
12. Do not operate the tractor indoors without proper ventilation. The exhaust gases may cause fatal outcome!

13. Stop the tractor immediately if the engine or steering system fails. Remember, that with the engine shut down you will have to apply much more forces to the steering wheel in order to control the tractor.
14. Do not work under raised agricultural implements. Do not leave mounted implement in raised position during long-term stops.
15. If the tractor front part rises off the ground when heavy implements are mounted at the rear hitch linkage mechanism, install the front ballast weights.
16. When operating with front loader, fill rear tires with liquid ballast and adjust a maximum wheel turning angle to 30° at the most with adjusting screw (20) fig. Д-25.
17. Before lifting or lowering a mounted agricultural implement, and when turning, make sure in advance there is no danger of contact with anyone around or interference with some obstacle.
18. Cardan shaft, transmitting rotation from the tractor PTO to the implements of the unit, should be fitted with appropriate guards.
19. Make sure of proper mounting of any additional equipment or auxiliary device and make sure they are designed for use with your tractor.

    Bear in mind that your tractor, when improperly employed, may be dangerous both for you and for the people around. Do not use implements, which are not designed for installation on this tractor.
20. To prevent tractor roll-over, be careful during the driving the tractor. Select a safe speed, corresponding to the road conditions, especially during cross-country driving, driving over ditches, slopes and sharp turns.
21. When working on hillsides, increase tractor wheel tread to maximum width.
22. Avoid making sharp turns at full load and at high travel speed.
23. When using the tractor for hauling operations, follow the rules:
    - Increase wheel tread to 1600 mm (64'') at least;
    - Interlock the brake pedals, check and, if necessary, adjust the brakes for simultaneous action;
    - Check the parking brake performance;
    - Check condition of the light and audible signaling devices;
    - Cargo trailers must be fitted with rigid hitches as well as be connected with safety chain or rope;
    - Never travel downhill "free wheel" with transmission in neutral position or clutch disengaged. When traveling downhill use the same gear as you would when going uphill;
    - Never use a trailer without independent brakes, if its gross weight exceeds the half of the tractor total actual mass. The faster you move and the more load you tow, the longer safety distance must be;
    - Disengage the FDA to avoid extensive wearing out of drive components and tires;
    - Do not use the RADL at speed exceeding 10 km/h and while turning.
    - Do not stop the tractor on the slopes. If it's necessary to stop,

engage the 1st gear and apply the parking brake.

24. When you use PTO-driven equipment, stop the engine and make sure that PTO drive end has stopped completely, before you leave the cab and uncouple the equipment.
25. Do not wear loose clothes when operating the PTO or when you are in the vicinity of the rotating equipment.
26. When working with stationary machinery driven from the PTO, do not fail to apply the parking brake and block the rear wheels of the tractor from the front and rear sides. Also make sure the machine is secured in its place.
27. Make sure the guard of the PTO drive end is installed, and if the PTO is not used, shift the PTO mode control switch into mid-position.
28. Do not carry out cleaning, adjustment and maintenance of the PTO-driven equipment when the engine is running.

Safety measures during tractor maintenance

29. Never refuel the tractor when the engine is running.
30. Never smoke while refueling the tractor.
31. Never fill the tank fully. Leave place for fuel expansion.
32. Never add petrol or mixtures to the diesel fuel. Such combinations may enhance the fire or explosion hazard.
33. Use properly summer and winter fuel grades. Fill in a fuel tank at the end of each day to minimize night water condensation.
34. Perform all operations, relating to engine and tractor cleaning, preparation for work, maintenance, etc., when the engine is shut down and brakes are applied.
35. The cooling system operates under pressure, which is maintained by the valve installed in the filler cap. It is dangerous to remove the cap when the engine is hot. To avoid face and hands burns be careful while opening radiator filler cap when the engine is hot. Put close cloth on the cap and take on a glove in advance.
36. To avoid skin burns, be careful when draining cooling liquid or water from the cooling system, hot oil from the diesel, hydraulic system and transmission.
37. Be careful when servicing storage batteries, because electrolyte causes burns if it comes into contact with the skin.
38. To avoid danger of explosion keep any type of open flame away from engine fuel system and storage batteries.
39. Keep the tractor, its equipment, especially brakes and steering control, in operable state in order to ensure your own safety and safety of people around.
40. Do not make any alternations in the tractor or its separate components without consulting your dealer and or manufacturing works. Otherwise the tractor will be deprived of after-sales service.
41. To avoid the fuel splash-out while refueling the tractor by mechanized method, remove the screen filter from the fuel tank filler neck. Screen filter is designed only for manual refueling of the tractor in the field.
42. Refuel the tractor using only oils and lubricants recommended by the manufacturing works. It is *strictly forbidden* to use other lubricants!

Safety requirements during operation and maintenance of electrical equipment

44. To avoid damaging the semiconductor devices and resistors, comply with the following precautions:
    - Do not disconnect the storage battery while the engine is running. This will cause a peak voltage in charging circuit and lead to immediate damage to the diodes and transistors;
    - Do not disconnect electric wires until the engine is stopped and electric switches are in the “OFF” position;
    - Do not cause a short circuit by the wrong connection of electrical wires. A short circuit or reverse polarity will cause damage to the diodes and transistors;
    - Do not connect a storage battery into the electrical equipment system until it has been checked for correct voltage and terminals polarity;
    - Do not check for current flow by means of spark test as it will immediately result in transistors breakdown;
    - It is prohibited to switch off the battery disconnect switch when the engine is running;
    - It is prohibited to operate the tractor without storage battery.

Hygienic requirements

- Daily fill the thermos with fresh clean drinking water;
- First-aid kit should be completed with bandages, iodine tincture, ammonia spirit, borated petrolatum, sodium carbonate, menthol valerate and analgin;
- Use cab natural ventilation or cab air heating and cooling unit according to operation conditions.
- If the time of continuous tractor operation during a work shift exceeds 2,5 hours it’s necessary to use personal noise protection equipment according to GOST 12.4.051-87 (earplugs, antiphons

Fire safety requirements

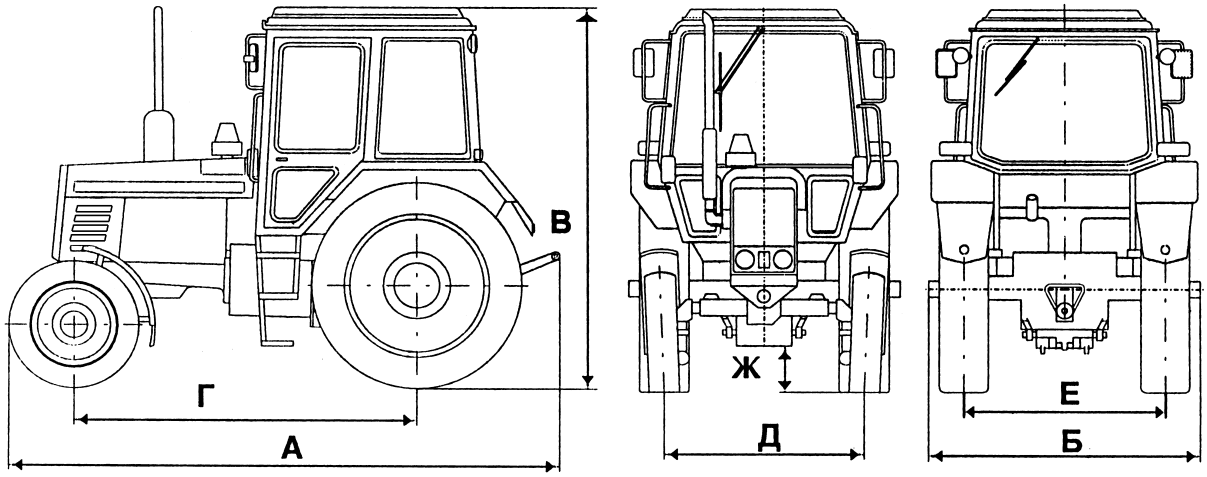
1. The tractor should be equipped with firefighting equipment – shovel and fire-extinguisher. It’s prohibited to operate the tractor without fire-extinguishing means.
2. Never refuel the tractor when the engine is running.
3. Do not smoke while refueling the tractor.
4. Never fill the tank fully. Leave place for fuel expansion.
5. Never add petrol or mixtures to the diesel fuel. Such combinations may enhance the fire or explosion hazard.
6. Places of tractors parking, storage of fuel and lubrication materials should be plowed around with a strip having at least 3 m width and provided with fire-extinguishing means.
7. Refuel the tractors with fuel and lubrication materials by mechanized method with the engine shut down. Use lighting at night. It is not recommended to fill in fuel tanks with the help of buckets.
8. When performing repair operations in the field with the application of electro-gas welding clean parts and assembly units from plant remains.
9. Prevent collector and muffler pollution with the dust, fuel, straw, etc.
10. Prevent straw reeling on the rotating parts of machines aggregated with the tractor.
11. When washing parts and assembly units with kerosene or gasoline take

measures to prevent the flaming of the washing liquid fumes.

12. Do not operate the tractor in the fire dangerous areas when the bonnet and other guard devices are taken off the engine heated parts.
13. Do not use open fire for heating up the oil in the engine pan, when filling in fuel tanks, and for burning off the contaminant pollution of the radiator core.
14. When the fire seat occurs cover it with sand or with canvas cloth or other close cloth. Use the carbon-dioxide fire extinguisher. Do not extinguish burning fuel with water
15. See that there are no flammable materials near exhaust manifold and muffler when the engine is running.

TECHNICAL DATA

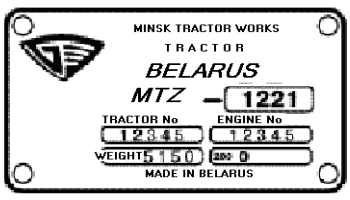
Weights and dimensions

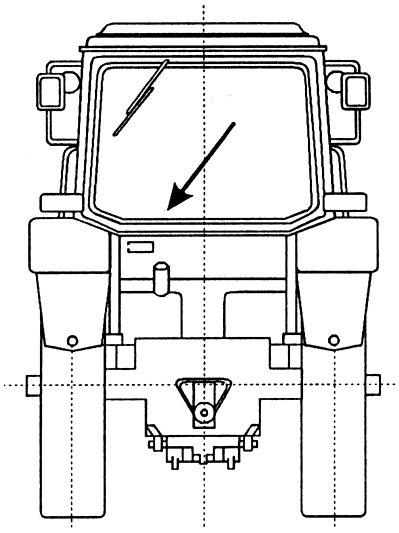


Designation		Value
А	Length, mm (with loads)	4500±40
Б	Width, mm	2300±10
В	Height, mm	2850±50
Г	Wheelbase, mm	2760±30
Д	Front track width, mm	1540...2090
Е	Rear track width, mm	1530...2150
Ж	Ground axles under axle tubes, mm	(not less than) 620
	Operating weight (as shipped from plant), kg	5370±100

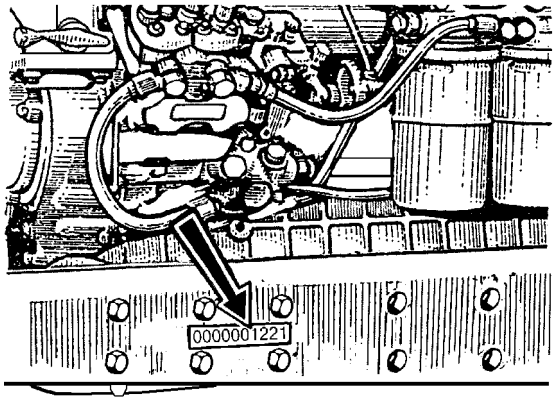
Identification numbers of tractor constituents

Tractor identification plate indicates tractor serial number and engine serial number.

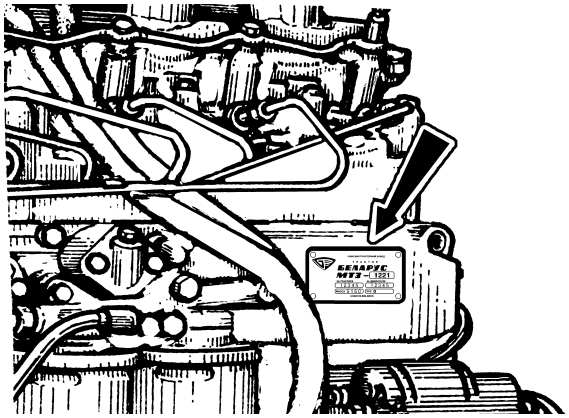




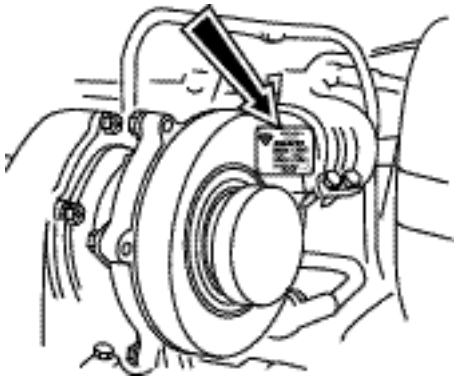
Tractor serial number is duplicated on the right sidemember and on the plate of right and left sidemembers.



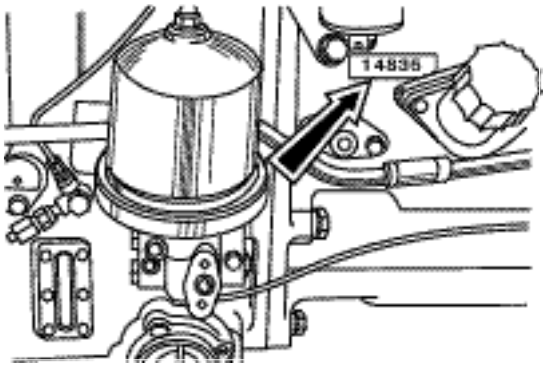
Engine serial number is also indicated on the engine identification plate located on the left side of cylinders block



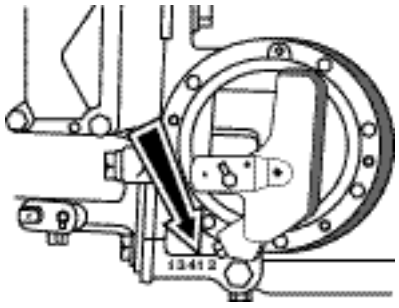
Engine turbocharger identification number



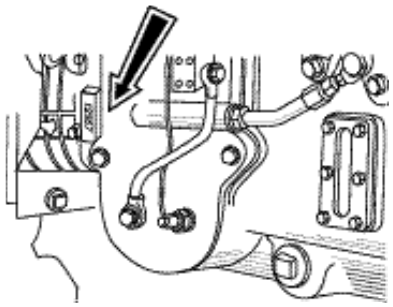
Clutch coupling identification number



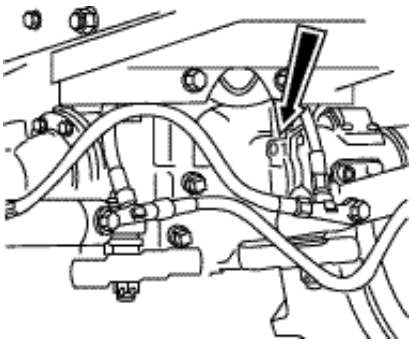
Gearbox identification number



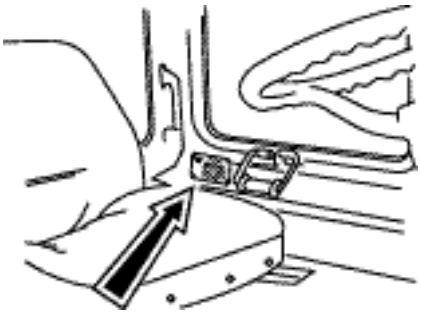
Transmission identification number



Front driving axle identification number



Cab serial number and OECD certificate number



Engine

Engine model	Д-260.2 or Д-260.2С	Д-260.2S2
Make	MMP (Minsk motor plant)	MMP (Minsk motor plant)
Type	six-cylinder, in-line	six-cylinder, in-line
Cycle	4 stroke	4 stroke
Fuel injection system	direct injection	direct injection
Compression ratio (calculated)	16	17
Cylinder bore	110 mm	110 mm
Piston stroke	125 mm	125 mm
Displacement	7,12 l	7,12 l
Firing order	1-5-3-6-2-4	1-5-3-6-2-4
Engine aspiration	turbo-charged	turbo-charged
Cooling system	liquid	liquid
Rated speed	2100 rev/min	2100 rev/min
Maximum no-load speed	2275 rev/min	2270 rev/min
Minimum idle speed	800±50 rev/min	800±50 rev/min
Rated power	98,0±2,0 kW	100±2,0 kW
Peak torque	520 N·m	559 N·m
Fuel rate	235±11,8 g/kW·h	240±12 g/kW·h
Engine weight (dry)	650 kg	710 kg

Engine fuel system

Fuel pump

Type: six-plunger, in-line with priming pump: PP6M10P1f-3492 «MOTORPAL» (Czechia) or 363.1111003-40.03 «YAZDA» (Russia).

Regulator: mechanical, variable speed, with fuel supply corrector, automatic engine fuel feed, smoke suppression

Injector ФДМ-22 with five-hole closed-type atomizer.

Pressure at the beginning of fuel injection — 21,6…22,4 MPa (220…228 kgf/cm^2).

Fuel injection advance angle till UDC — 22°±1°.

Air cleaner

Type: Dry with three-stage cleaning, changeable paper filter element and clogging indicator.

Filter elements: paper filters – elements made of highly porous paperboard.

Turbocharger: TKP-7 type, radial inward turbine and radial-flow compressor, assembled on one shaft.

Installation of foreign producers turbochargers is possible.

Engine cooling system

Type: Pressurized liquid cooling system with automatic temperature control by friction clutch and two thermostats.

Oil cooling: by oil-to-water heat exchanger, built into cylinder block.

Normal operating temperature
from 80°C to 97°C. Cooling system capacity: 24 L

Engine lubrication system

Type: Combined, with oil-to-water heat exchanger built into cylinders block.

Oil filters: centrifugal filter and filter with changeable paper filter element.

Oil pressure at minimum speed – 0.08 MPa (0.8 kgf/cm^2), **at rated speed**– 0.28…0.45 MPa (2.8…4.5 kgf/cm^2),

Lubrication system capacity — 22 l., including engine crank case— 18 l.

Oil system capacity — 22 l, including engine crank case — 18 l.

Engine Starting System

24 V starting motor

Starting aid:
Heating plugs (for tractors “BELARUS-1221.3”)

Clutch coupling

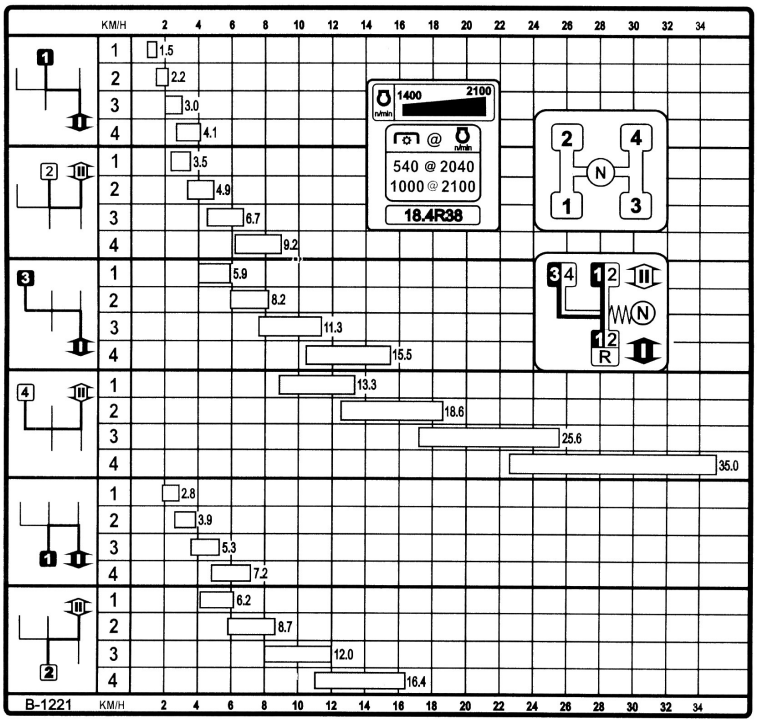
Type: Dry friction, double-disk, with tangential suspension of pressure disk.

Disk diameter: 340 mm.

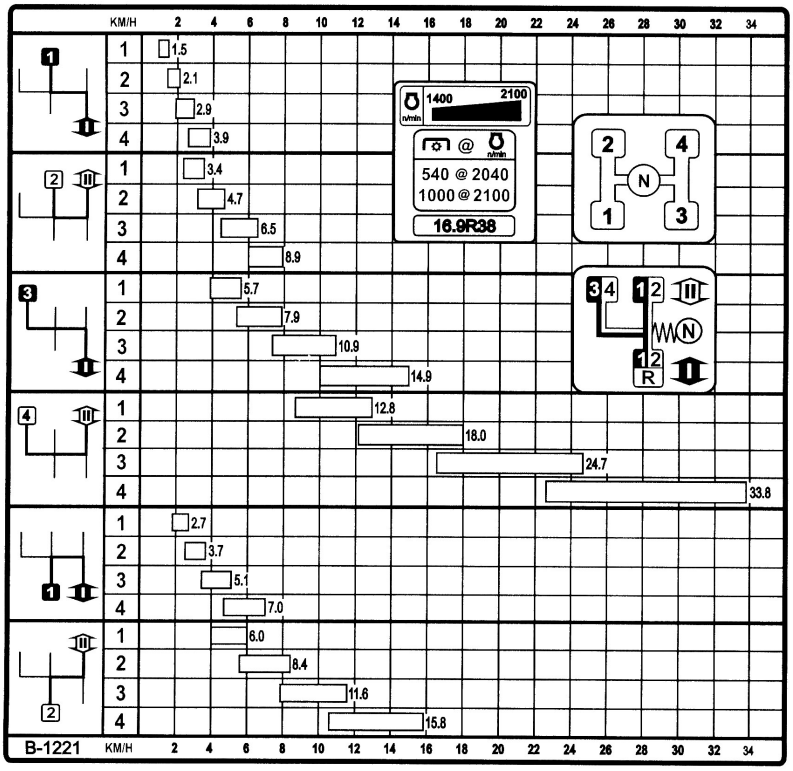
Gearbox

1. Type: 16/8, mechanical, step-wise, range. It provides with 16 forward gears and 8 reverse gears

Tractor design travel speeds in km/h
(GB 16/8, tyres 18,4R38)

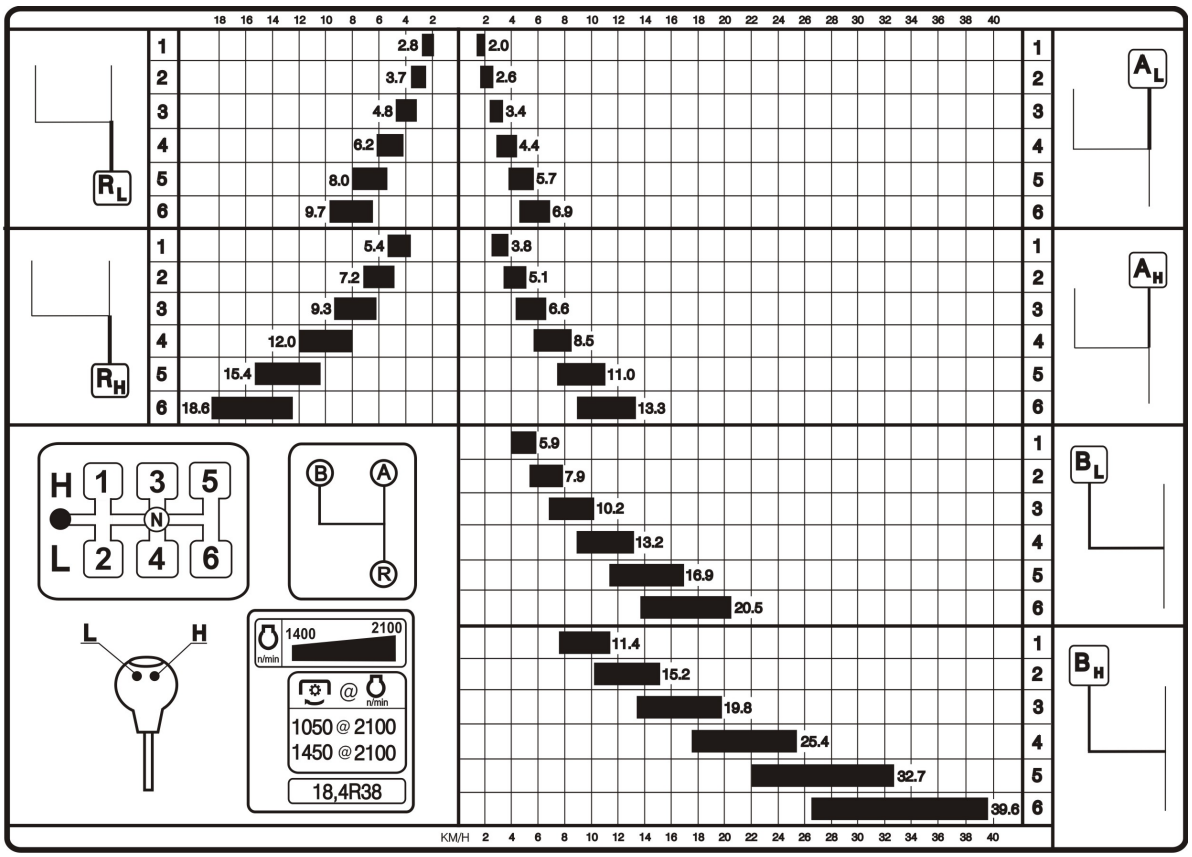


Tractor design travel speeds in km/h
(GB 16/8, tyres 16,9R38)

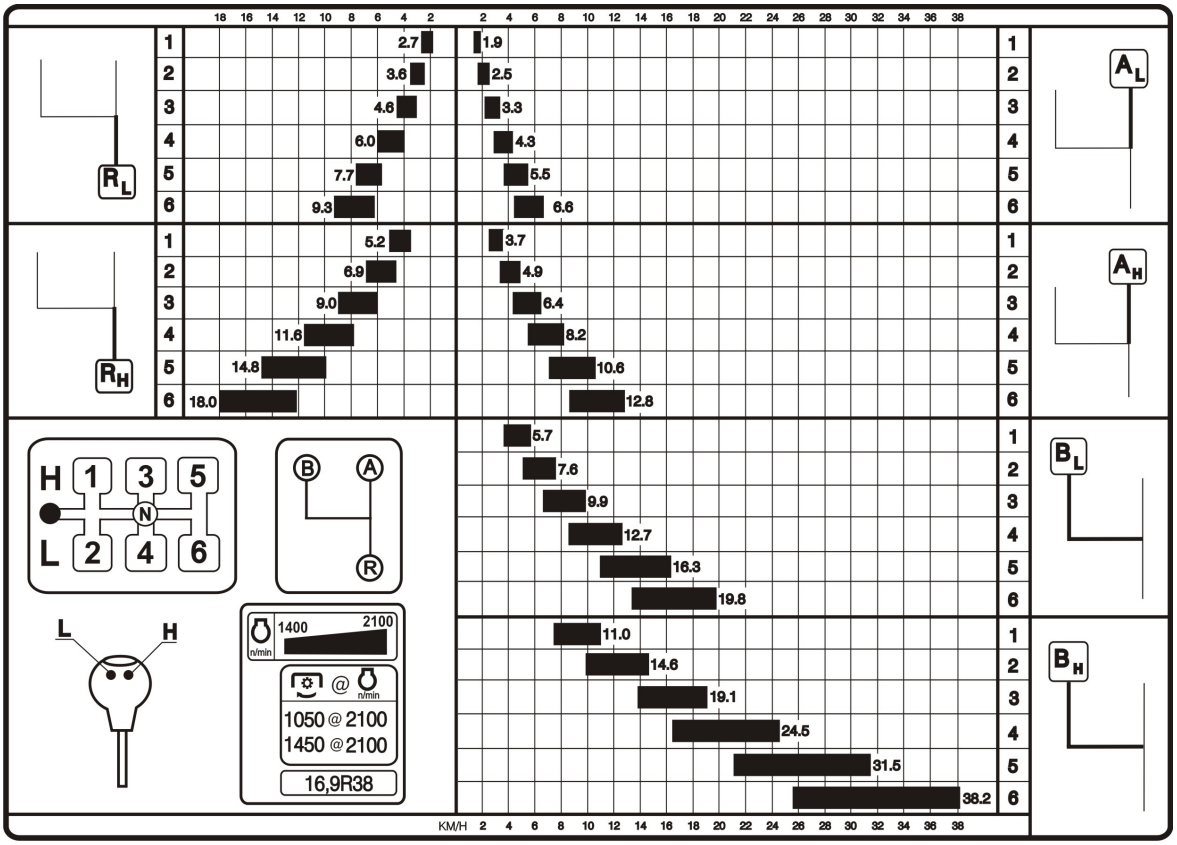


2. Type: 24/12, 16/8, mechanical, step-wise, range. It provides with 24 forward gears and 12 reverse gears.

Tractor design travel speeds in km/h (GB 24/12, tyres 18,4R38)



Tractor design travel speeds in km/h (GB 24/12, tyres 16,9R38)



Rear axle

Main gear: a pair of bevel gears with spiral tooth.

Final drives: a pair of spur gears for each sideboard.

Rear-axle drives: planetary type.

Differential lock: Oil-actuated friction clutch

Brakes

Service Brakes: on rear wheels: two-disk or three-disk, dry with mechanical servo drive. Disk diameter: 204 mm (or eight-disk, operating in oil sump (on order))

Parking brake: On rear wheels through differential lock on final drives and rear-axle drives. Dry-disk type with mechanical hand control. Disk diameter: 180 mm (or 4-disk, operating in oil sump (on order))

Front driving axle

Type: two-point, portal

Main gear type: bevel gears with spiral tooth.

Differential type: self-locking, excessive friction

Final gears type: planetary

Drive gear type: built in GB single parallel-shaft reduction gear unit with hydraulically operated multiplate clutch; cardan shaft.

Hydraulic distributor of FDA control: hydraulically operated, spool-type, electrically controlled

PTO drive

Type: independent, two-speed and synchronous

Drive clutch: Planetary reduction gear with band brakes

Drive: Mechanical, by lever on control panel

PTO end speed:

Independent drive

I — 540 rpm; N=60 kW (82 h. p.),
II — 1000 rpm; N=90 kW (123 h. p.)

Synchronous drive

4,36 rev/meter of travel when fitted with tires 16,9R38.

4,17 rev/meter of travel when fitted with tires 18,4R38.

Output shaft: SAE standard 6-spline for 540 rpm and 21-spline for 1000 rpm.

Rotation: Clockwise

Steering

Type: hydrostatic (H.S.).

Feed pump: NSH14, gear-type, left-handed rotation.

Volume constant — 14-16 cm^3/rev.

Metering pump type — gerotor type models: Danfoss; Rexroth Hydraulic; Lifam.

Volume constant – 160 cm^3/rev.

Relief valve pressure— 14 MPa (140 kgf/cm^2).

Antishock valves pressure — 20 MPa (200 kgf/cm^2).

Actuating mechanism: two hydraulic bilateral cylinders.

Bore — 50 mm,

Cylinder stroke— 200 mm

Steering wheel range of adjustment:

- in angle of slope - from 40° to 25° with fixation on every 5°,
- in height – within the range of 100 mm.

Backlash in the steering wheel not less than 25°.

Hydraulic lift linkage (HLL)

Type: unit-principle with hydraulic lift device (with two plunger cylinders) It provides 4 control modes of agricultural implements position:

• height control mode;

• power control mode;

• position control mode;

• combined (mixed) control mode.

Outlets: 3 pairs and one drain line (rear).

Oil feed pump

Type: gear-type. Pump capacity — not less than 56 l/min at 2100 rpm.

Distributive valve: hydraulic spool-type РП70-1221 or RS-213 «MITA», 3-section with fixation of spools in "float" position. It has the following positions: "Up", "Neutral", "Down" and "Float".

Hydraulic lift distributor:
820-4634010. hydraulic spool distributor
Cylinder: piston cylinder
(2 pcs.) — bore 90 mm,
stroke — 220 mm.

Rear mounting unit:

Type: swinging four-bar linkage of category II

Lifting capacity: at distance of 610 mm from lower links balls — 35kN (3500 kgf)

Electrical equipment

Voltage: 12V

Power system: two 12 V accumulator batteries, with capacity 120 A•h.

Alternator with built-in rectifier and regulator, power 1150 Wt.

Lighting and light alarm system:

- front driving lights with high/low beam;
- front and rear work lights;
- front and rear lamps;
- dash board light and rear registration plate light;
- hazard warning lights;
- lights of "road-train" sign.

Power consumers connection: 9-contact composite plug.

Dash board, electrical tachospeedometer and control lamp units.

Heating plugs (for "BELARUS-1221.3" tractors):
Nominal voltage 24V

Other equipment:

Front and rear window wipers; windshield washer; dome light.

Pneumatic system

Compressor

Type: single-cylinder, air-cooled

Trailer brakes control

Type: pneumatic, single-wire, locked with tractor service brakes.

Tires

Front:

Main: 420/70R24 or 14,9R24;

On order: 11.2R24.

Rear:

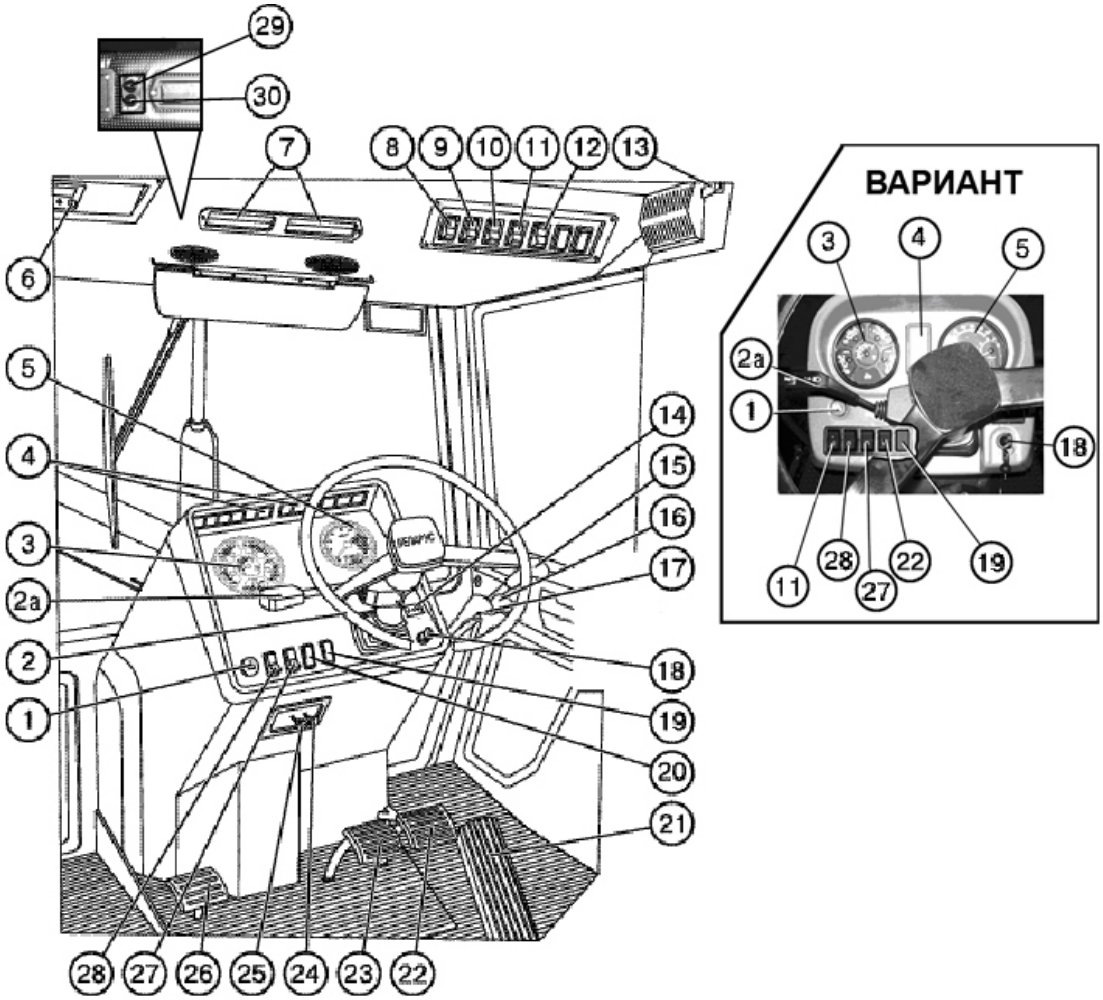
Main: 18,4R38;

On order: 16.9R38, 11.2R42.

Wheel Track:

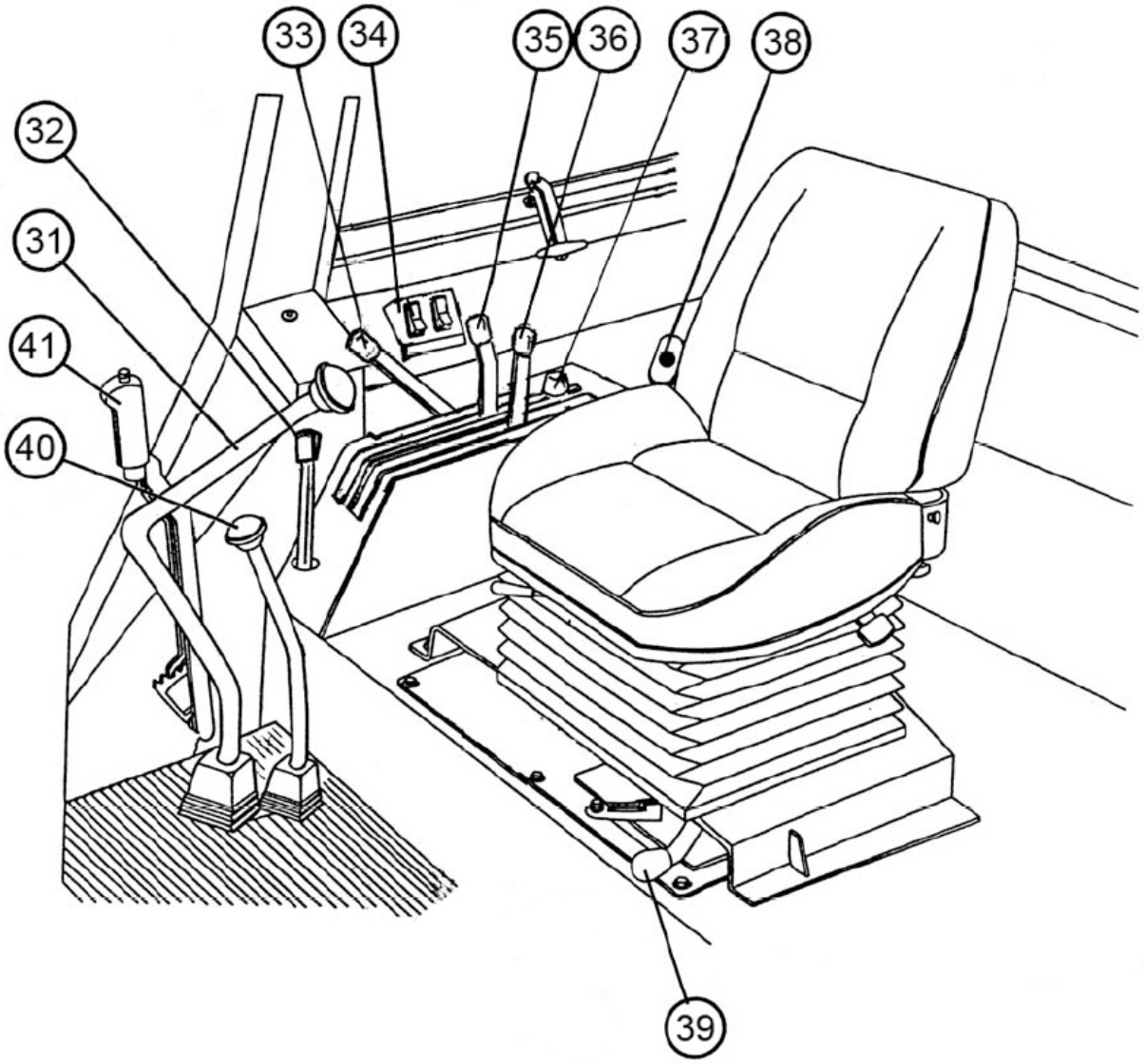
- front wheel track 1540...2090 mm,
- rear wheel track 1530...2150 mm.

OPERATING CONTROLS AND INSTRUMENTS



ВАРИАНТ	VARIANT

1. Hazard warning lights switch
2. Steering wheel
2a. Switch located under steering wheel
3. Dash board
4. Warning lights blocks
5. Electrical tachospeedometer
6. Panel for electrical equipment installation
7. Air recirculating shutters
8. Windshield wiper switch
9. Cab ventilating and heating systems switch
10. Rear work lights switch
11. Front work lights switch
12. Switch of “road-train” sign lights
13. Cab dome light switch
14. Tachospeedometer programming unit (5)
15. Control lever of hydraulic system right rear outlets
16. Control lever of hydraulic system right side outlets
17. Control lever of hydraulic system left rear outlets.
18. Instruments and starter switch
19. Blind plug
20. Blind plug. Battery disconnect switch for tractor BELARUS-1221B.2
21. Gas pedal
22. Right brake pedal
23. Left brake pedal
24. Steering column tilt control
25. Engine stop lever (when engine completed with double-lever fuel pump „Motorpal“ (Czechia) or JSC «YAZDA» (Russia)
26. Clutch pedal
27. Windshield washer switch
28. Lights switch
29. Conditioner switch and refrigerating output adjustment (if conditioner is installed)
30. Switch of air consumption adjustment (if the conditioner is installed)

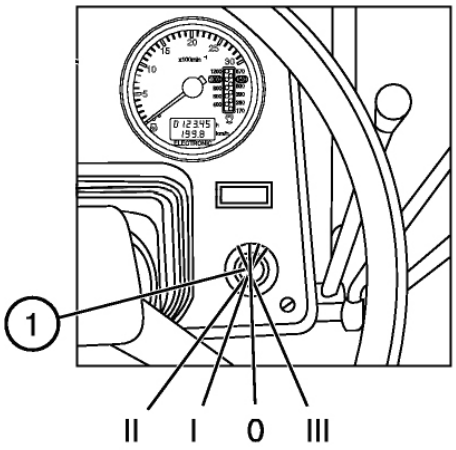


31. Range Shift Lever
32. PTO control lever
33. Fuel delivery control lever
34. FDA and rear axle differential lock control unit
35. Position control lever
36. Draft control lever
37. Stop of position control lever
38. Battery disconnect switch
39. PTO shift lever (independent - synchronous)
40. Ranges shift lever
41. Parking brake lever

Important: Before operating tractor for the first time, study all of the controls and instrument locations and their functions.

The given information will help you to study the controls and instruments so that the tractor may be operated safely.

Starter and instruments switch (1)



The switch (3) has 4 positions:

- 0 — "Off";
- I — "Instruments, control lamps unit, radio equipment power supply "On"
- II — "Starter "On" (non-fixed position);
- III — «Radio power supply when the engine is stopped»

1. Instrument board

The scheme of the instruments dashboard 80-3805010-Д1 and 826-3805010 is given in the section “Appendix”.

The instrumentation includes:

- instruments combination (P2) with sensors;
- the electric tachospeedometer (P1) with the control board (A3) and sensors;
- the electric light and audible alarms combined into two pilot lamp units (HG1 and HG2) with the instruments dashboard 80-3805010-Д1 or into the pilot lamp unit and meter combined with the instruments dashboard 826-3805010.

To switch on the instruments, turn the starter and instrumentation switch key to the “I” position. Then the voltage will be applied to the terminal “K3” of the switch, then to the relay of instruments power supply, to the fuse (F2) of the unit and further – to the units (HG1 and HG2), tachospeedometer (P1), alarm device (HA2), combination meter (P1) and speed sensors (BV1 and BV2).

The instruments pointers shall move to the zero position of the scale or to the position corresponding to the true value of the parameter controlled by the system at the moment.

In case of deviation of instruments readings from their true values, detect the cause of the fault following the recommendations below.

1.1 Tachospeedometer AP70.3813 (Fig. 1)

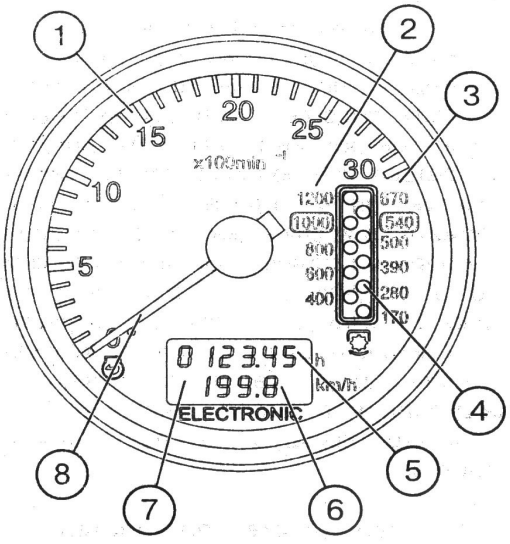


Рис. 1. Tachospeedometer (P1):

1. Engine crankshaft rotational speed scale, rpm.
2. PTO II rotational speed scale –1000 rpm.
3. PTO I rotational speed scale –540 rpm.
4. PTO rotational speed display (LED).
5. Engine running hours indication, h.
6. Tractor speed indication, km/h.
7. Display of engine running hours and tractor speed (LCD)
8. Pointer indicator of the engine crankshaft speed

The electric tachospeedometer installed in the dashboard operates as follows:

• on setting the starter and instrument switch in position “I” when the tractor is stopped, the display (7) shows the engine running hours (5);

• when the tractor is moving, the display (7) shows the tractor speed indication (6) (km/h), while the indication (5) disappears. The electric signal of the speed comes from the speed sensors mounted on the rear axle cover (BV1, BV2). The speed readings are taken through a signal from the sensor mounted on the pinion of the final drive of the wheel rotating at lesser speed. The calculated speed is higher than the actual one, because no tractor skid is the taken into account;

• on starting the engine, the pointer indicator (8) moves round the index dial (1) to display the rotational speed of the engine crankshaft. At the same time, the display (4) shows the PTO speed indication (rpm). The scale (3) is assigned to the PTO I and the scale (2) – to the PTO II. The electric signal of the rotational speed is taken from the phase winding of the alternator.

1.2. Tachospeedometer control board (Fig. 2)

The control board is installed in the instruments dashboard and serves for programming the tachospeedometer to the specific model of the Belarus tractor.

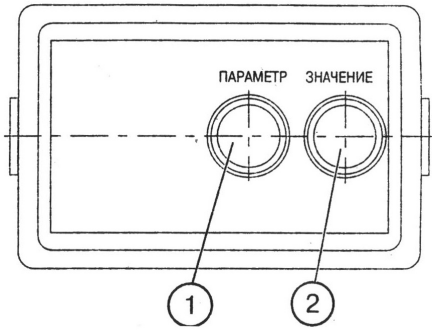


Fig. 2. Control board (A3):

1. Button for setting the tachospeedometer to the programming mode and selecting the programming parameter on the tachospeedometer display (7).2. Button for selecting the value of the coded parameter shown on the display (7)

1.3 Programming the tachospeedometer AP70.3813

ATTENTION! The tachospeedometer has been programmed just to your tractor model at the factory. Re-programming is required only in case of tyre type changing**.** Do not reprogram the tachospeedometer, if not necessary.

The tachospeedometer shall be programmed to ensure the correct display of the following tractor’s parameters: engine rotational speed, tractor motion speed and PTO rotational speed (540 and 1000).

Programming procedure:

– remove the control unit cover;

– press the button (1) to enter the programming mode (Fig. 2).

1. To ensure the correct display of the tractor motion speed, it is necessary to program the tachospeedometer to the number of teeth of the pinion at the place of installation of

the speed sensors (parameter “Z”) and rear wheel rolling radius (parameter “R”). To do this:

– press the button (1) of the board and call the parameters “Z” and “R” in turn to the display (3) of the tachospeedometer (4);

– press the button (2) of the board and set the number of teeth (Z) according to Table 1 and value Rk according to Table 2:

Table 1

Number of teeth (Z)	Tractor model
54 (56)*	“BELARUS-1221” and modifications

* With driven gear 1522-2407122

Table 2

Tyre mark	18,4R38
Rk, m	0,829
Number coded	830

3. To ensure the correct display of the engine and PTO rotational speeds (540 and 1000), program the engine model (parameter “D”):
– press the button (1) and call the parameter “D” to the tachospeedometer display (3);

– press the button (3) and set the necessary engine model according to Table 3:

Table 3

Engine model	Д-260.2	Д-260.2С	Д-260.2S2
Rated rotational speed, rpm	2100	2100	2100
Number programmed	260. 2C	260. 2C	260. 2C

On the expiry of seven seconds after programming, the instrument returns automatically to the operating mode. Refit the board cover.

Note: If no information on the type of the tyre fitted is available, it is allowed to measure the value Rk as a distance from the wheel axis to the ground prior to beginning the operation of the tractor.

1.4. Connecting the tachospeedometer

To connect the tachospeedometer to the instrumentation system, a 9-contact block is provided on the rear panel of the instrument (Fig. 3).

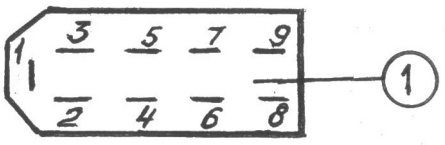


Fig. 3.

The identification of the block outputs is given in Table 4.

Table 4

Output	Identification
1	to the terminal "–"
2	to the power supply unit "+12B"
3	to the board output "Parameter selection"
4	to the board output "Parameter value"
5	to the board output "Mode"
6	to the speed sensor BV2 (left wheel)
7	to the speed sensor BV1 (right wheel)
8	to the phase winding "W" of the alternator
9	to the instrument backlight lamps

1.5. Tachospeedometer diagnostics and troubleshooting

1. No instrument backlight:
Check the power supply wire connected to the output "9" of the 9-contact block of the instrument (Fig. 3) – check if the backlight lamps are intact.

2. Jerking and jumps of the pointer of the engine rotational speed indicator over the dial: poor contact on the alternator terminal and, therefore, poor signal from the phase winding of the alternator. Repair.

3. Jerking of the pointer and understating the reading of the engine rotational speed:
- Check and adjust the tension of the alternator driving belt.

4. Over- or understated readings of the engine and PTO's rotational speeds (with the nominal movement of the pointer):
- Check the correctness of programming the instrument according to the engine model (parameter "D"): (see item 1.3);

5. The counter of astronomical hours of the engine running fails to accumulate the operating time: Check the connection of the wire to the contact "8" of the instrument block and the presence of the frequency signal from the phase winding of the alternator.

6. Over- or understated readings of the tractor speed:

- Check the correctness of the instrument programming according to the rolling radius of the rear wheels (Rk) (see item 1.3);

- Check the correctness of the programming according to the number of teeth of the half-axle pinion (Z) (see item 1.3).

7. No readings of the tractor motion speed: Check the presence of signals from both the speed sensors (BV1, BV2).

8. The readings "02…07" km/h appear on the instrument indicator when the tractor is moving:
- the numbers "02…07" and, 12 seconds later, "0" appear from the right side of the scale – no signal from the right speed sensor (BV1).
- the numbers "02…07" and then "0" appear from the left side of the scale – no signal from the left speed sensor (BV2).

1.6. Combined indicator КД 8083

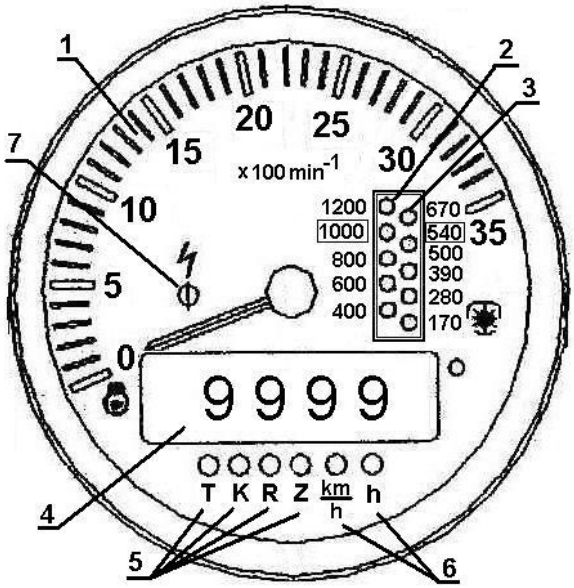


Fig. 4. Tachospeedometer (P1):

1 – Engine rotational speed indicator (pointer indicator).

2 – PTO 1000 rotational speed scale (opposite to the respective value of the PTO rotational speed).

3 – PTO 540 rotational speed scale (opposite to the respective value of the PTO rotational speed).

4 – Five-digit indicator.

5 – LED's lighting up in the mode of programming the coefficients "K", "R" and "Z" (opposite to the respective LED).

6 – LED's lighting up in the mode of display of the motion speed "km/h" and total engine running time "h" (opposite to the respective LED).

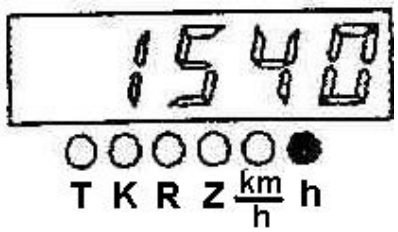
7 – Alarm of the overvoltage in the tractor on-board power system (red) operates, if the voltage exceeds 18.5 V.

In this case the instrument is switched off because the protective device operates. Should the voltage drop down to 16.5 V, the indicator returns to the operating state and the overvoltage indicator goes out.

Indicator operating procedure

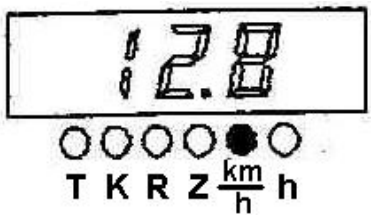
On switching on the power supply, the indicator is switched to the main operating mode. In case of absence of signals from the speed sensors the digital indicator (4) shows the reading of the total engine running time and the LED located next to the symbol "h" lights up.

Total engine running time:



Appearance of the pulses from the speed sensors at the input of the pulse indicator causes the switching-on to the motion speed indication mode. Then the measured

calculated speed reading is shown on the digital indicator and the LED located next to the symbol “km/h” lights up.
The calculated motion speed (km/h).

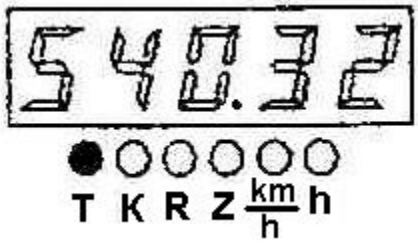


1.7 Programming the indicator КД8083
Programming procedure:

- remove the control board cover;

- press the button (1) of the control panel and hold it down for at least 2 seconds;

- the display (7) shows the mode “Adjusted total engine running time”. In this case, the LED located next to the symbol “T” lights up.



- press repeatedly the button (1) to switch over cyclically the programmable parameters;

- press the button “2” to enter the required value of the selected parameter, then the least significant digit (the first on the right) of the selected parameter of the indicator starts blinking with the period of 0.3 s;

- set the required value of the less significant digit of the selected parameter by pressing the button “2”;

- press shortly the button “1”; then the second from the right digit of the digital indicator shall start blinking;

- set the required value in the second from the right digit of the parameter to be corrected by pressing the button “2”;

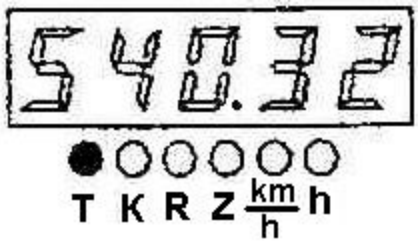
- press shortly the button “1”; then the third from the right digit of the digital indicator shall start blinking;

- pressing the button “2” set the required value in the third from the right digit of the parameter to be corrected

- fix the entered value of the parameter by pressing the button “1”;

- on pressing the button “1” next time, the switching to the next parameter will occur.

To exit the programming mode, enter the adjusted time mode, press and hold down the button (2) for at least 2 s; then the readings “8.8.8.8.8” shall be shown in the five-digit indicator for 1-4 seconds and all the LEDs of the PTO’s scales shall light up.



1. To display correctly the tractor motion speed, it is necessary to program the following parameters in the following order:

2. Gear ratio of the wheel reduction gear (parameter “K1”) from Table 5:

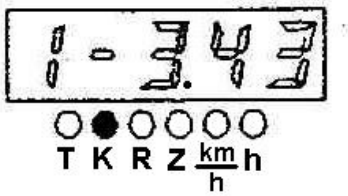


Table 5

Gear ratio of the wheel reduction gear (K1)	Tractor model
3.43	Belarus-1221 and modifications

according to the number of gear teeth at the place of installation of the speed sensors (parameter “Z1”) from Table 6:

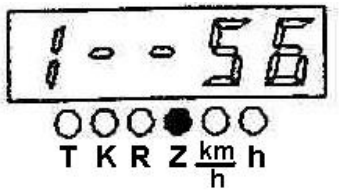


Table 6

Number of teeth (Z1)	Tractor model
54 (56)*	Belarus-1221 and modifications

* With driven gear 1522-2407122

rear wheel rolling radius (parameter “R”) from Table 7:

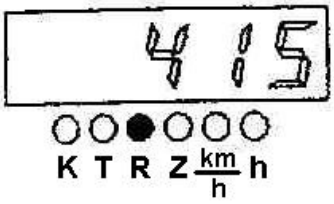


Table 7

Tyre mark	18.4R38
Rk, m	0,829
Number coded	830

2. To display correctly the engine rotational speed, it is necessary to program the gear ratio of the alternator drive (parameter “K2”) from Table 8 in the specified order:

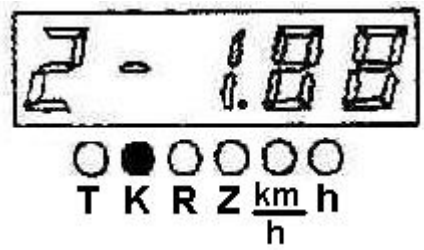
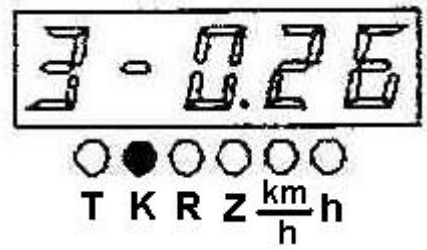


Таблица 8

Gear ratio of the alternator drive (K2)	Engine mark		
2.41	Д-260.2	Д-260.2С	Д-260.2S2

3. To display correctly the PTO’s rotational speed (540 and 1000), it is necessary to program the gear ratio of the PTO 540 “K3” and PTO 1000 “K4” from Table 9 and the number of teeth of the pinion at the place of installation of the PTO sensor “Z2”:



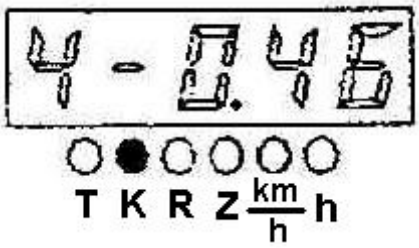
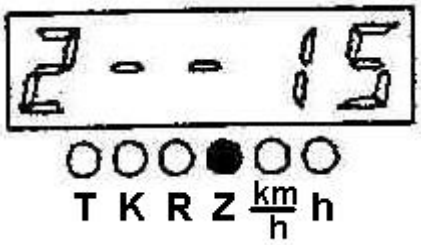


Table 9

The gear ratio of the PTO drive	Engine mark		
	Д-260.2	Д-260.2С	Д-260.2S2
540 (K3)	0.26	0.26	0.26
1000 (K4)	0.46	0.46	0.46



- in case of absence of the PTO rotational speed sensor (signal from the phase winding of the alternator serves as indication of the PTO rotational speed), the entered value of the parameter “Z2” shall be equal to 0.

1.8. Indicator Diagnostics and Troubleshooting

1. The diagnostics of the faults according to items 1-3 and 5 is similar to that of the tachospeedometer;

2. Over- or understated readings of the engine rotational speed and PTO's rotational speed (with the normal movement of the pointer):

Check the correctness of programming the instrument according to the gear ratio of the alternator drive (parameter "K2"): (see item 1.7);

3. Over- or understated readings of the tractor speed:

1. Check the correctness of programming the instrument according to the rolling radius of the rear wheels (R) (see item 1.7);
2. Check the correctness of programming according to the number of teeth of the half-axle pinion (Z1) (see item 1.7);
3. Check the correctness of programming of the gear rate of the wheel reduction gear (K1) (see item 1.7).

4. No readings of the tractor motion speed:

Check the presence of the signals from the both speed sensors (BV1, BV2).

5. Signalling of operation of the speed sensor as in case of absence of a signal from one of them:

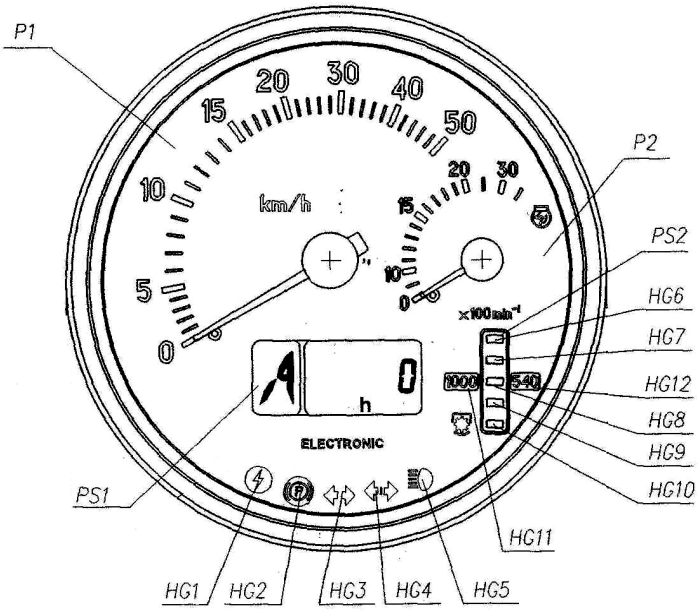
a) in case of absence of the signal from the right wheel speed sensor (BV1) within 12 s after starting the motion the symbol "□" is displayed on the right of the digital indicator; check the connection and serviceability of the right wheel speed sensor;

b) in case of absence of the signal from the left wheel speed sensor (BV2) within 12 s after starting the motion the symbol "□" is displayed on the left of the digital indicator; check the connection and serviceability of the left wheel speed sensor.

1.9 Combined indicator АР80.3813 and combined indicating unit КД8105 (mounted on the tractors with the instrument dashboard 826-3805010)

The combined indicator (hereinafter referred to as the CI) and the control board (hereinafter referred to as the CB) monitor the operational parameters of the systems and units of the Belarus tractors and provide the operator with the information on malfunction or failure of a particular system.

The CI includes the indicators and alarm lamps monitoring the following parameters:



P1 – speed indicator (pointer-type);

P2 – engine rotational speed indicator (pointer-type);

PS1 – LCD, multifunction indicator (precise description and principle of PS1 operation see below)

PS2 – PTO rotational speed indicator (light indicator);

HG1 – pilot lamp-alarm of the overvoltage in the on-board power supply system (red);

HG2 – pilot lamp-alarm of the parking brake application (red);

HG3 – pilot lamp-indicator of switching on the turn indicators of the tractor (green);

HG4 – pilot lamp-indicator of switching on the turn indicators of the trailer (green);

HG5 – pilot lamp-indicator of switching on the upper beam of the headlights (blue);

HG6, HG10 – PTO scale segments (yellow);

HG7… HG9 – PTO scale segments (green);

HG11, HG12 – scale range indicator of the PTO 1000 and 540, respectively (yellow);

Operating principle of the PTO rotational speed indicator:

1. In the absence of the PTO rotational speed sensor, the designations of the “540” and “1000” scales as well as the indicator of the scale ranges HG11, HG12 light up simultaneously on starting the engine (when a signal comes from the phase winding of the alternator).

The indication of the PTO scale segments (with the account of the selected value of the coefficient “**KV2”**) occurs on reaching the calculated PTO rotational speed equal to 750 (rpm).

For reference: the indication of the PTO scale segments occurs on reaching the engine rotational speed of 1400-1500 (rpm) and more.

Here, depending on the selected PTO speed mode (540 or 1000), the lit PTO scale segments designate the rotational speed values according to Table 10.

Table 10

Values of operation of the “1000” scale segments (rpm)	Segment location on the scale	Values of operation of the “540” scale segments (rpm)
1150	HG6	650
1050		580
950	HG8	500
850		420
750*	HG10	320

2. In the presence of the PTO rotational speed sensor installed over the pinion of the PTO shank, the combined indicator selects automatically the range (320-750 or 750-1250) depending on the rotational speed of the shank that is accompanied visually by switching on the backlight of the digital designation of the scale – “540” (HG11) or «1000» (HG12), here the threshold values of operation of the scale segments change in accordance with the requirements of Table 10.

The five LED 5 scale segments (HG6 … HG10) of the PTO light up starting from the bottom one including the segment with the current value of the PTO rotational speed included in the range of the lit state of that segment.

Notes:

- (*) is the rotational speed value, at which the “1000” scale designation is switched on;
- the “540” scale designation is only switched on in the presence of the signal from the sensor and switched off when the “1000” designation is switched on or in case of signal absence for more than 3 s.
- the exact value of the PTO rotational speed can be seen on the indicator PS1.

PS1, the LCD multifunction indicator displays simultaneously:

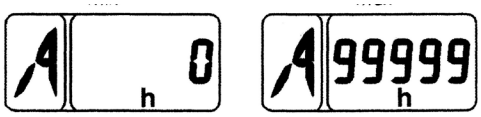
LCD information fields

1. Digital designation of the position of the gearbox control level (digits from 0 to 6) or lettering of the reduction gear switch (letters L, M, H, N);
2. Current numerical value of one of the parameters of the tractor systems.

The combined indicator receives the information on the position of the gearbox control lever from the transmission control unit (if the complex electronic control system (CECS) is available) or from the control unit of the range reduction gear (if provided). This parameter is displayed on the information field “1”. If the control units are absent or not connected or in case of wire breakage, the letter “A” is displayed in the information field “1”.

The information field “2” displays the following parameters:

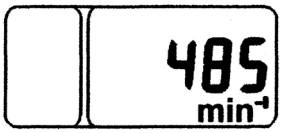
1. Total astronomic time of running the engine in hours.



The counter accumulates the information on the total engine running time and saves it on switching off the power supply.

The reading range is from 0 to 99999 hours of the engine running.

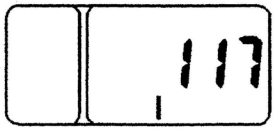
2. PTO rotational speed:



In this mode, the PTO rotational speed is displayed in the digital form depending on the signal from the PTO rotational speed sensor.

The mode is active if the tractor is equipped with the PTO rotational speed sensor.

3. Volume of the fuel remaining (if the frequency fuel volume sensor FFVS is provided):



In this mode, the current volume of fuel in the tank (in litres) is displayed.

Attention! This mode is only available on the stopped tractor in the absence of signals from the speed sensors.

NOTE. To switch over between the indication modes “Total astronomic time of running the engine”, “PTO rotational speed”, “Volume of the fuel remaining” and fault messages, press the “Mode” (Режим) button of the control panel.

HG1 is the indicator of the overvoltage in the on-board power supply system:

It lights up when the voltage of the on-board power supply system of the tractor exceeds 19 V and goes out when the power supply voltage level drops down to 17 V;

In this case the CI is fully de-energized and restores its serviceability when the voltage drops down to the rated value.

HG2 is the indicator of the parking brake application:

The “Parking brake” indicator starts blinking on operation of the parking brake switch;

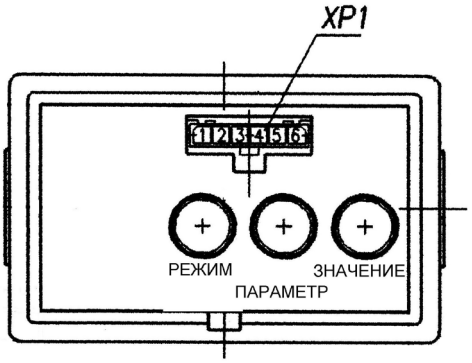
HG3, HG4 is the indicator of switching on the turn indicators of the tractor and trailer:

It blinks when the right or the left turn indicator is switched on by the steering-wheel-mounted multifunction switch.

HG5 is the indicator of switching on the upper beam of the road headlights; it lights up when the upper beam of the road headlights is ON.

Note! The indicators light up and go out synchronously with the changes in the states of the system sensors.

Indicator control board



РЕЖИМ – MODE

ЗНАЧЕНИЕ – VALUE

ПАРАМЕТР - PARAMETER

The programming board makes it possible to perform the manual programming of the combined indicator by means of the “Parameter” (Параметр) and “Value” (Значение) buttons and to modify the mode of display of the parameters to be shown on the LCD.

The diagnostic connector **XP1** located on the front panel of the control board makes it possible to perform the automatic programming (reprogramming) of the CI by means of a special instrument (if provided). Should such an instrument be unavailable, the programming shall be performed by means of the above buttons.

1.10 CI programming procedure

1. On selecting the fixed value of the programming parameter:

1.1. On pressing the “Parameter” (Параметр) button for the first time, the LCD is switched to the mode of viewing the parameter to be programmed and its numerical value. On pressing this button repeatedly, the parameters are switched over cyclically.

1.2. On pressing successively the “Parameter” button, the numerical value of the set parameter to be programmed changes.

1.3. The mode is exited automatically if neither “Parameter” (Параметр) nor “Value” (Значение) button has been pressed within 7.0 sec.

On exiting the mode, the last values of the parameters selected by the “Value” (Значение) button are saved.

2. When entering the unfixed value of the programming parameter:

2.1. Select the parameter, the values of which shall be set, by means of the “Parameter” (Параметр) button;

2.2. Press twice the “Mode” (Режим) button; the least digit of the numerical value starts blinking;

2.3. To change the value of the blinking digit of the parameter, use the “Value” (Значение) button;

2.4. To go to the more significant digit, press the “Parameter” (Параметр) button;

2.5. To exit the mode of programming an unfixed value of any parameter, press twice the “Mode” (Режим) button;

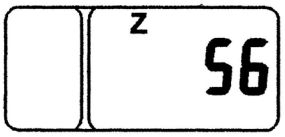
2.6. On exiting the above mode, the digits of the entered value of the parameter become lit steadily;

2.7. The newly entered value is set the last in the list of the parameter values allowed to be programmed;

Entering the parameters to be programmed:

1. To display correctly the tractor motion speed, it is necessary to program in the specified order the following parameters:

Parameter “Z” is the number of pinions teeth of the final shafts of the driving wheels (right and left), over which the (rotational) speed sensors are installed;

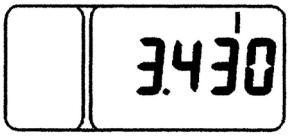


Select from the Table:

Number of teeth (Z)	Tractor model
54 (56)*	Belarus-1221 and modifications

* With driven gear 1522-2407122

Parameter “I” is the multiplying factor of the gear rate of the wheel reduction gear;

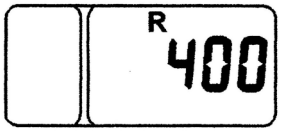


Select from the Table

Gear ratio of the wheel reduction gear (I)	Tractor model
3,43	Belarus-1221 and modifications

Parameter «R»

R is the rear wheel rolling radius (mm);

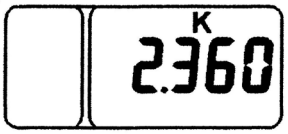


Select from the Table

Tyre mark	18,4R38

Rk, m	0,829
Number coded	830

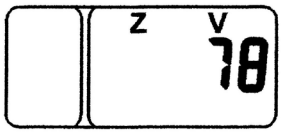
2. To display correctly the engine rotational speed, it is necessary to program in the specified order the gear ratio of the alternator drive (parameter “K”) from Table 8-6:



Select from the Table

Gear ratio of the alternator drive (K2)	Engine mark		
2.41	Д-260.2	Д-260.2С	Д-260.2S2

3. To display correctly the PTO’s rotational speeds (540 and 1000), it is necessary to program in the specified order the gear ratio PTO “KV2” and the number of teeth of the pinion at the place of installation of the PTO sensor “ZV”:



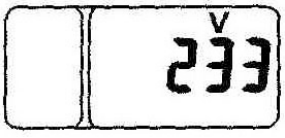
Select from the Table

Gear ratio of the PTO drive	Tractor model
	Belarus-1221 and modifications
(KV2)	0.46

- in the absence of the PTO rotational speed sensor (the signal from the phase winding of the alternator serves as a signal for indication of the PTO rotational speed) the value of the parameter “ZV” to be entered shall be equal to 0.

- in the absence of the PTO rotational speed sensor (the signal from the phase winding of the alternator serves as a signal for indication of the PTO rotational speed) the value of the parameter “ZV” to be entered shall be equal to 0.

4. To display correctly the residue of fuel in the tank (if the FFRS sensor is installed), it is necessary to program the fuel tank volume “V” in the specified order:



For tractors with plastic fuel tank, set the value of 140 litres.

Also, when pressing the “Parameter” (Параметр) button in the programming mode, the list of programmable parameters displays the independent parameter of the ad-

justed content of the counter of the astronomic time of running the engine. This parameter is unavailable for measurement; it presents the precise (to 1/10 hours) value of the number of hours of the engine running.

On switching on the backlight of the instrument scales (the main light switch (MLS) is set to the positions II “The backlight of the instrument dash and clearance lights are ON” and III “The consumers of the position II and front road headlights and clearance lights are ON”), the brightness of the PTO indicator segments and LCD is automatically reduced.

IMPORTANT! Each time the power supply of the CI is switched ON, the functioning of the pointer indicators and PTO indicator scale elements is tested. Within one second after this, the indicator pointers deviate from the initial marks above the following first marks of the scales (above “5” for the motion speed and above “10” for the rotational speed), and all the segments and designations “540” and “1000” of the PTO scale are switched on.

1.11 Connecting the tachospeedometer

To connect the tachospeedometer to the instrumentation system, a 13-contact block (XP1) and a 9-contact block (XP2) are provided on the rear panel of the instrument (Fig. 5).

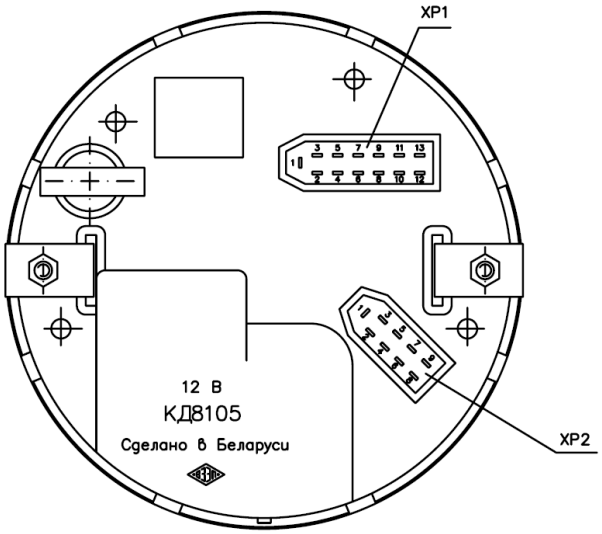


Fig. 5

The identification of the outputs of the blocks is given in Tables (11) and (12).

Table 11

Contact	Address of the XP1 connector output
1	To the terminal “–“ (common)
2	To the power supply unit “+12 V”
3	To the PTO rotational speed sensor
4	To the rotational speed sensor “Left wheel”
5	To the transmission control unit
6	To the rotational speed sensor “Right wheel”
7	
8	To the phase winding of the alternator
9	To the switch of the backlight
10	To the switch of the headlight upper beam
11	To the switch of the trailer turn indicators
12	To the switch of the parking brake
13	To the switch of the tractor turn indicators

Table 12

Contact	Address of the XP2 connector output
1	To the terminal “–“ (common)
2	To the control board contact “Indication mode”
3	To the control board contact “Parameter selection”
4	To the control board contact “Parameter value”
5	
6	
7	To the fuel volume sensor
8	To the control board contact “M”
9	To the control board contact “+UBZ”

1.12. Indicator Diagnostics and Troubleshooting

1. No instrument backlight:
Check the power supply of the output “9” of the 13-contact block (XP1) of the instrument (Fig. 5);

2. Jerking and jumps of the pointer of the engine rotational speed indicator over the dial: poor contact on the alternator terminal and, therefore, poor signal from the phase winding of the alternator. Repair.

3. Jerking of the pointer and understating the reading of the engine rotational speed:
- Check and adjust the tension of the alternator driving belt.

4. Over- or understated readings of the engine and PTO’s rotational speeds (with the normal movement of the pointer):

- Check the correctness of programming the instrument according to the gear ratio of the alternator drive (parameter “K”): (see item 1.10);

5. The counter of astronomical hours of the engine running fails to accumulate the operating time:

- Check the connection of the wire to the contact «8» of the instrument block (XP1) and the presence of the frequency signal from the phase winding of the alternator.

6. Over- or understated readings of the tractor speed:

1. Check the correctness of the instrument programming according to the rolling radius of the rear wheels (R) (see item 1.10);

2. Check the correctness of the programming according to the number of teeth of the half-axle pinion (Z) (see item 1.10).

3. Check the correctness of programming the multiplying factor of the gear rate of the wheel reduction gear (I) (see item 1.10).

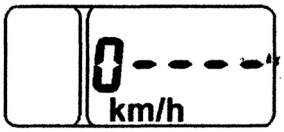
7. The "FUEL" reading appears on the indicator display

Check the connection and serviceability of the frequency fuel volume sensor (FFVS) to the contact "7" of the block (XP2).

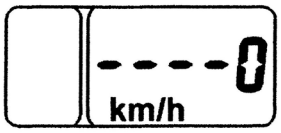
8. No readings of the tractor motion speed:

- Check the presence of the signals from the both speed sensors (BV1, BV2).

9. The "0km/h----" or "----0km/h" readings appear on the indicator display within 10-12 s after starting the motion of the tractor:



- no signal from the left speed sensor (BV2) check the serviceability of the sensor.



- no signal from the right speed sensor (BV1) check the serviceability of the sensor.

ATTENTION! The speed readings are affected considerably by the speed sensor setting and adjustment performed when replacing or repairing the speed sensor. The gap "S" between the end face of the sensor (2), Fig. …, and projection of the tooth of the final pinion (6) of the rear axle shall be as specified in Table … below

Every message about faults (**Example:** 0----, FUEL) is shown according to the priority on the LCD regardless the information displayed. On pressing successively the "Mode" (Режим) button, the messages shall be paged. When viewing the last message and pressing repeatedly the "Mode" button, the LED is switched to the

mode of displaying operating parameters specified below over the cycle. The faults are displayed on the LCD each time the instrument is switched on until the fault is eliminated.

Note:
- On switching on the power supply of the CI, the LED shows the information in the indication mode selected until the power supply of the CI is switched off in case of absence of the messages about faults.

1.13 Setting and Adjustment of the speed sensors (BV1, BV2) (Fig. 6)

The speed sensors (2) are fastened by means of the bolts (3) to the cover of the rear axle housing (1) in the zone of the left and right final pinions (6) of the final drives.

The gap “S” between the end face of the sensor and projection of the tooth of the final pinion shall be adjusted by means of the spacers (5) as follows:

1. measure the dimension “H” from the surface of the cover (1) to the tooth projection;
2. select and place the necessary number of spacers for setting the gap “S” corresponding to the measured value “H” (see Table 13);
3. install the ground wire (4) and tighten the bolts (3).

Table 13

H, mm	Number of spacers (Pos. 5)	S, mm	Note
11,25-12	4	1,05-1,6	When using the cover (1) with the thickness S=6 mm
12,1-13	3	0,8-1,8	
13,1-13,73	2	0,9-1,53	
13,25-14	2	1,05-1,8	When using the cover (1) with the thickness S=8 mm
14,1-15,73	1	0,9-2,53	

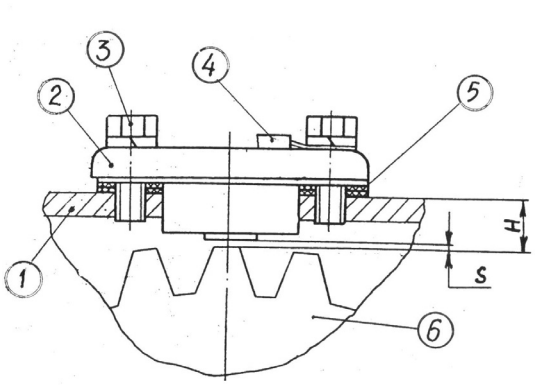


Fig. 6. Setting the speed sensors:

1 – cover of the rear axle cover;
2 – speed sensor (BV1, BV2);
3 – bolt;
4 – ground wire;

5 – adjusting spacers;

6 – final pinion.

1.14 Combination meter (fig. 7)

Engine cooling fluid temperature indicator (4)

(with the emergency temperature control lamp) The indicator scale has three zones:

- operating – 80 - 100°C – green;
- engine warm-up zone – 40 - 60°C - yellow
- non-operating (overheating) – 100 - 120°C – red.

Attention! When the emergency temperature control lamp flashes on stop the engine, find and repair the fault.

Voltage indicator (2)

(with the control lamp of additional accumulator battery charging)

It displays the accumulator battery voltage, when the engine is not running and the starter switch key (3) (page. Г3) is in the “I” position. When the engine is running, it indicates the voltage at the generator terminals. The voltage indicator scale has the following zones:

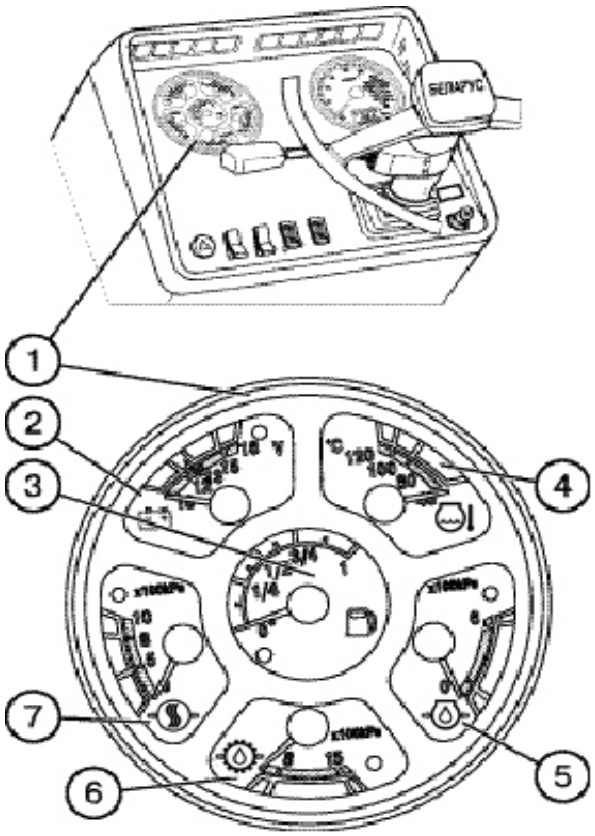


Fig. 7. Combination meter

Scale zone, colour	Power supply system state	
	when the engine is running	when the engine is not running
13,2 – 15,2 B – green	normal charging mode	
10,0 – 12,0 B – red	generator is not working	Accumulator battery is run down
12,0 – 13,2 B – yellow	No charging of accumulator battery (low charging voltage)	Accumulator battery has normal charging
15,2 – 16,0 B – red	Accumulator battery over-charging	
12,7 – 12,0 – yellow		Start of battery discharge
white hairline in yellow zone		The rated emf of the accumulator battery is12.7 V

IMPORTANT! When the engine is running and voltage meter pointer is in the green zone the indicator should not burn.

Engine oil pressure indicator (5) (with emergency pressure drop control lamp)
The indicator scale has three zones:
— operating — 1,0 – 5,0 kgf/cm^2;
— non-operating — 0,0 – 1,0 и 5,0 – 6,0 kgf/cm^2.

IMPORTANT! See after the emergency pressure drop control lamp. If the lamp burns during the engine running, stop the engine immediately, find and repair the fault.

Indicator of the air pressure in the pneumatic system (7) (with the emergency pressure control lamp)
The indicator scale has three zones:
— operating — 5,0 – 8,0 kgf/cm^2;
— non-operating — 0,0 – 5,0 and 8,0 – 10,0 kgf/cm^2.

Gear oil pressure indicator (6) (without emergency lamp)
The indicator shows gear oil pressure and oil pressure in hydraulically operated FDA drive clutch.

The indicator scale has three zones:
— operating — 8,0 – 15,0 kgf/cm^2;
— non-operating — 4,0 – 8,0 and
15,0 – 18,0 kgf/cm^2.
Normal indicated values — 9…12 kgf/cm^2.

Indicator of the fuel level in the tank (3) (with emergency lamp of reserve level)
The instrument has four sectors:

0 – 1/4 – 1/2 – 3/4 – 1.

Never allow the fuel tank to run dry.

1.15 Connection of the combination meter

To integrate the combination meter to the instrumentation system, the rear panel is provided with two blocks X1 and X2 (Fig. 8).

The purpose of the contacts of the blocks of the combination meter is shown in Tables 15, 16.

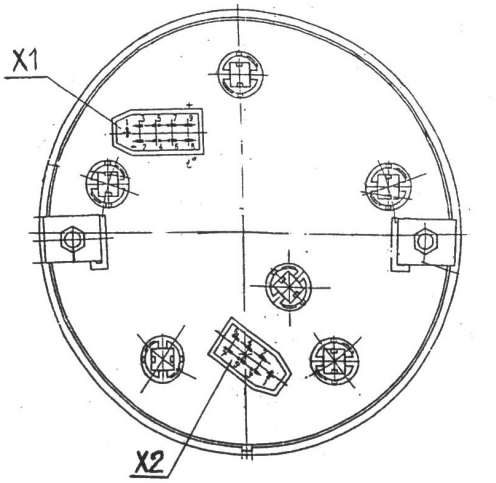


Fig. 8. Blocks for connecting the combination meter (rear view):
X1 – 9-contact block;
X2 – 7-contact block.

Block «X1»

Table 15

Contact	Address
1	To the instrument backlight switch
2	To the “–” terminal of the battery
3	Monitoring the storage battery charging
4	Buzzer
5	To the sensor of the oil pressure in the engine (BP1)
6	To the sensor of the emergency temperature of the engine cooling fluid (SK1)
7	To the sensor of the emergency oil pressure in the engine (SP2)
8	To the sensor of the cooling fluid temperature (BK1)
9	To the “+” SB terminal (12 V)

Block «X2»

Table 16

Contact	Address
1	Reserved
2	Reserved
3	To the fuel level sensor (BN1)
4	To the gearbox oil pressure sensor (not used)
5	To the sensor of emergency drop of the air pressure (SP4)
6	To the sensor of the reserve fuel level (BN1)
7	To the sensor of the air pressure (BP2)

1.16 Combination meter diagnostics and troubleshooting

1. No backlight of the instrument scales on setting the SA10 central light switch:

1. Check the presence of the power supply voltage at the terminal “1” of the block “X1” (to the instrument backlight switch) and at the terminal “9” (to the power supply unit “+ 12 V”).

In case of absence of the voltage, eliminate the open circuit. If the voltage is present:

2. Check the state of the backlight lamps and replace them, if necessary.

2. The temperature indicator (1), Fig. 9, operates jointly with the thermistor-type temperature sensor BK1 (ДУТЖ-02М, resistance range: 243…22.5 Ω).

2.1. The temperature indicator pointer goes off-scale:

1. Breakage of the wire to the terminal “9” of the block “X1” (“+” 12 V of the SB);
2. Breakage of the wire to the terminal “2” of the block “X1” (“–” of the power supply);
3. If there is no breakage, the temperature indicator is faulty.

2.2. The pointer of the temperature indicator is set before the initial point of the scale:

1. Breakage of the wire to the terminal “9” of the block “X1” (“+” 12 V of the SB);
2. Breakage of the wire to the terminal “8” of the block “X1” (to the temperature indicator BK1);
3. Fault of the temperature sensor**;**
4. Fault of the temperature indicator.

3. Indicators of the:

oil pressure in the engine (2), air pressure in the pneumatic system (4), oil pressure in the gearbox (3) operate with rheostat-type sensors (0…184 Ω), respectively ДД-6М (BP1), ДД-10-01М (BP2) и ДД-20М (BP3).

IMPORTANT! To avoid inaccuracy in the temperature indication, use the ДУТЖ – 02М temperature sensors mentioned above.

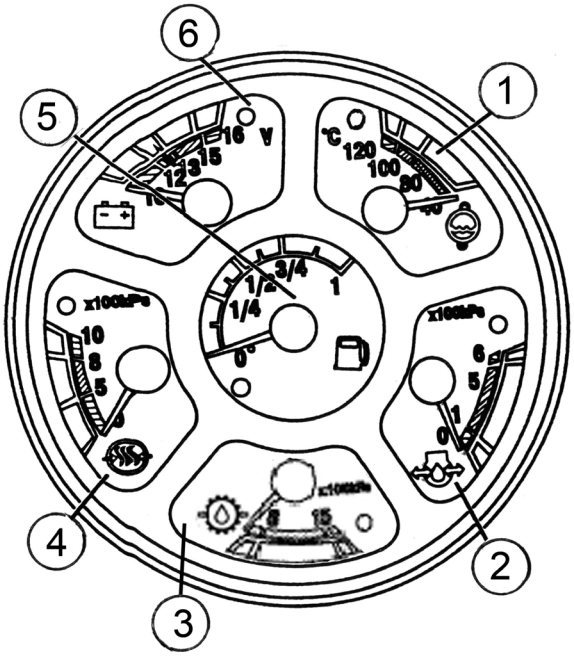


Рис. 9 Instrument board

3.1. The indicator pointer is set before the initial point of the scale:

1. Breakage of the wire to the terminal “2” of the block “X1” (“–” of the power supply);
2. Breakage of the wire to the terminal “9” of the block “X1” (“+” of the power supply);
3. If there is no breakage, the pressure indicator is faulty

3.2. The indicator pointer goes off-scale:

1. Breakage of the wires to the terminal “5” of the block “X1”, to the terminals “4”, “7” of the block «X2» or short circuit inside the indicator;
2. The pressure indicator is faulty.

4. Fuel level indicator (5).

It operates with the rheostat sensor (BN1) of the type (ДУМП-21М (320…0 Ω)) installed in the fuel tank

NOTE! If there is no fuel in the tank when switching on the indicator; the indicator pointer shall be at the initial point of the scale. If the indicator is switched off or there is a wire breakage, the indicator pointer shall go off-scale.

4.1. The indicator pointer is before the initial point of the scale:

1. Breakage of the wire to the terminal “9” of the block “X1” (to the terminal “+12V”);
2. Breakage of the wire to the terminal “3” of the block “X2” (to the fuel level sensor);
3. The fuel level sensor is faulty;

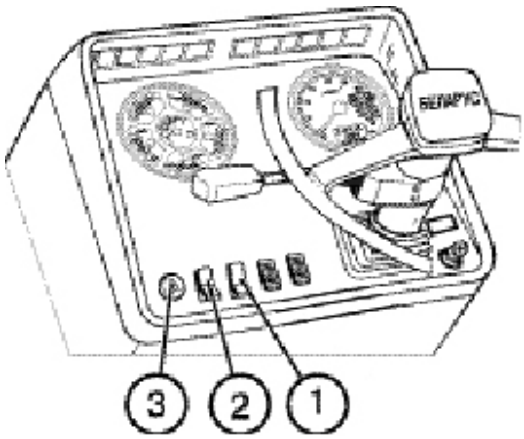
if there is no breakage and the sensor is in good repair, replace the combination meter or repair the fuel level indicator.

4.2. The indicator pointer goes off-scale:

1. Breakage of the wire to the terminal «2» of the block “X1” (output “–“ of the power supply);
2. If there is no breakage, the fuel level indicator is faulty. Repair the indicator or replace the combination meter.

Front windscreen washer switch (1)

Pressing the button (1) windscreen washer the switches on.



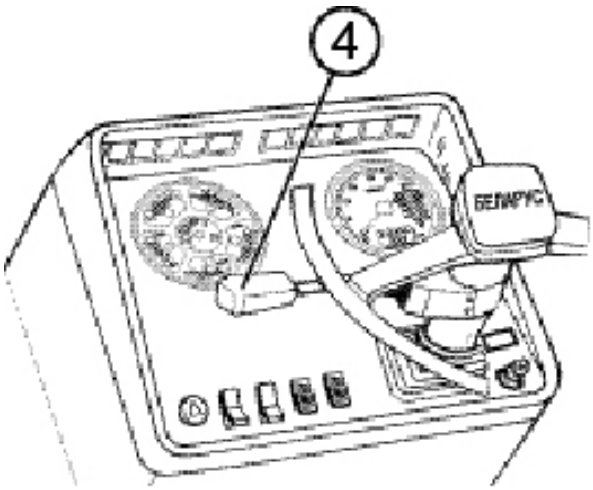
Three-position light switch (2)

The button (2) has three positions:
1 — “OFF”;
2 — “Dashboard lighting, clearance lights and number plate light ON”;
3 — “All control lamps units including the front headlights ON”.

Fault signalling switch (3)

Pressing the button (3) switches the fault signalling on. There is a control lamp inside the button, which blinks simultaneously with the flashing light signalling.

Steering-Wheel-Mounted (Multifunction) switch (4)



It ensures the switching-on of the turn indicators, toggling the beam of the road headlights (lower/upper beam), upper beam warning and horn beep.

Turn indicator

Turning the lever (4) of the steering-wheel-mounted switch forward or backwards switches on the right or left turning indicator, respectively.

NOTE: After completing the turn of the tractor, the lever automatically returns to the neutral position.

Horn beep

Pressing the switch lever end the beep switches on.

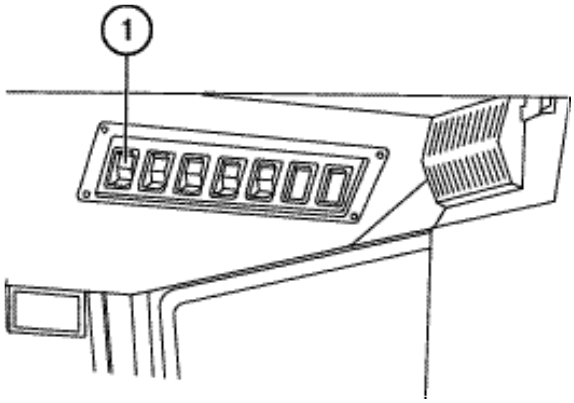
Upper/lower beam

When the road headlights are switched on pushing the lever switches on the “upper beam” and pulling the same lever switches on the “lower beam”.

Pulling the lever further from the “lower beam” position up to the stop switches on the upper beam (non-fixed position). Releasing the lever puts it back in the “lower beam” position.

Front windscreen wiper switch (1)

Pressing the button (1) switches on front windscreen wiper.



Cab heater and fan switch (2)

Pressing the button (2) switches on the cab air ventilation.

The switch has 3 positions:

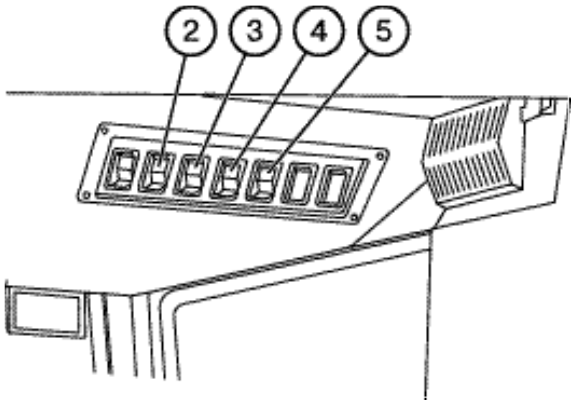
1 — “OFF”(the upper part of the button is sunk to the maximum);

2 — “Low air supply mode ON”;

3 — “High air supply mode ON”.

Rear working lights switch (3)

Pressing the button (3) switches the rear working lights and the roof backlight lamp.

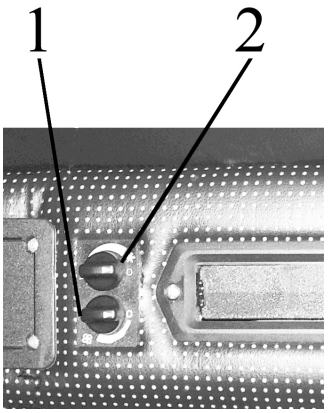


Front working lights switch (4)

Pressing the button (4) switches on the front working lights and the button back-light lamp.

“Road-train” sign lighting switch (5)

On pressing the button (5), the three orange lights on the roof forepart are switched on and the button is backlit.



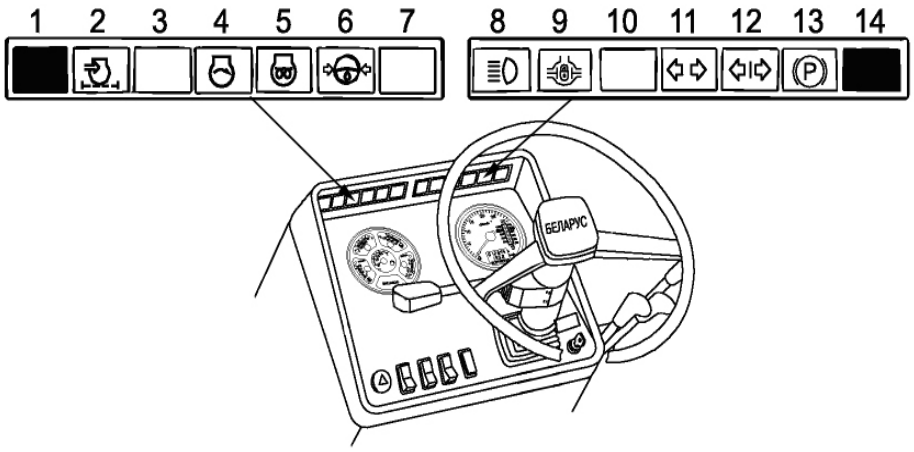
Conditioner control

On the conditioner control unit there are switches (1) и (2).

1 – Airflow adjustment switch;

2 – Conditioner switch off and refrigerating capacity adjustment.

Check indicators of the dashboard (Dashboard 80-3805010-Д1)



1 and 14 – Buttons for testing the serviceability of the control lamps unit. On pressing the button, all the lamps shall be lit.

2 – Air filter blocking. The control lamp (orange) lights up when the maximum allowed level of filter blocking is exceeded and it needs cleaning.

3 – Reserved.

4 – Engine start lamp: This orange control lamp lights up on turning the starter switch key to position II to indicate that the starting system functions properly. If the lamp blinks at the frequency of 1.5 Hz, the gearbox control lever is not in neutral position or the engine starting locking switch circuit is out of order. If the lamp blinks at the frequency of 3.0 Hz, there is a failure in the alternator phase winding circuit. Eliminate the fault and restart.

5 – Starting aid lamp (orange).

6 – HPS emergency oil pressure. The lamp (red) lights up when oil pressure in HPS feeding system is below the allowable level.

7 – Reserved.

8 – Upper beam indicator: Blue control lamp lights up when switching on the upper beam of the front headlights.

9 – Rear axle differential locking control lamp. The lamp (green) is on when switching automatic differential locking (ADL).

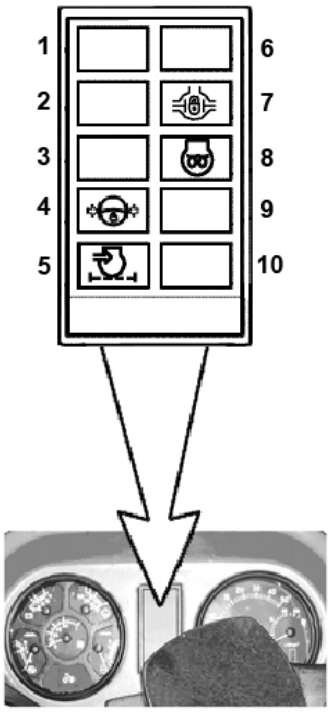
10 – Reserved.

11 – Tractor turn indicator (green).

12 – Trailer turn indicator (green).

13 – Parking brake indicator (red).

Control lamps of the dashboard (dashboard 826-3805010)



1 – Reserved indicator (green)

2 – Reserved indicator (green)

3 – Reserved indicator (red)

4 – HPS emergency oil pressure. The lamp (red) lights up when oil pressure in HPS feeding system is below the allowable level.

5 – Air filter blocking (orange). The control lamp lights up when the maximum allowed level of filter blocking is exceeded and it needs cleaning.

6 – Reserved indicator (blue).

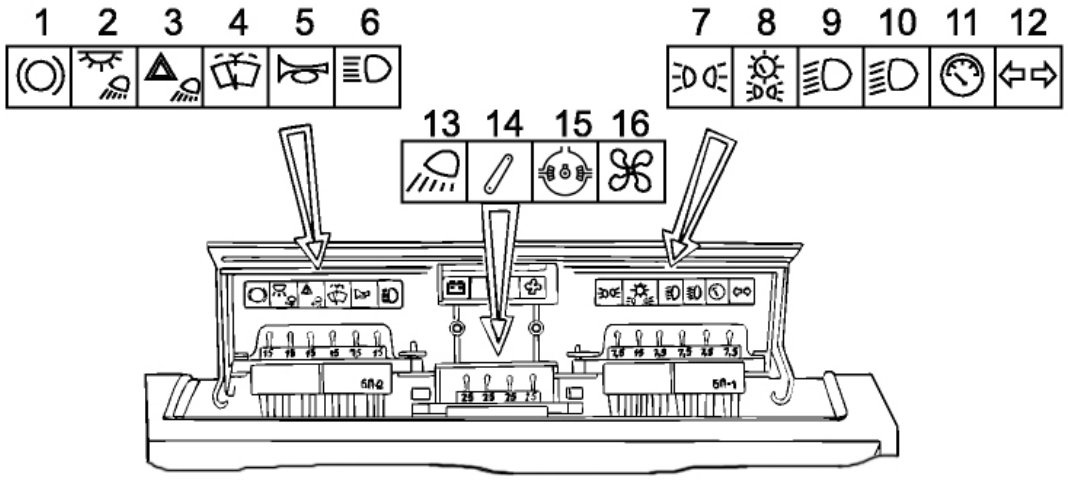
7 – Rear axle differential locking control lamp (green). The lamp (green) is on when switching automatic differential locking.

8 – Starting aid lamp (orange)

9 – Reserved indicator (red).

10 – Reserved indicator (red).

Fuses



Three electric circuit fuse boxes are installed in the dashboard. To get access to the fuses, remove the screw on the dashboard cover and open it.

The fuses protect the following electric circuits of the tractor against overloads:

1 — Braking signal (15 A);

2 — Cab light and rear working lights (15 A);

3 — Fault signalling (15 A);

4 — Windscreen wiper and washer (15 A);

5 — Horn (7.5 A);

6 — Upper beam of the road headlights (15 A);

7 — Left clearance lights (7.5 A);

8 — Right clearance lights and backlights of the dashboard and registration plate (15 A);

9 – Lower beam of the left road headlight (7.5 A);

10 – Lower beam of the right road headlight (7.5 A);

11 – Instrumentation, control lamps blocks, parking brake indicator (7.5 A);

12— Turn indicator relay (7.5 A);

13— Front working lights (25 A);

14— HMS supply (25 A);

15— Side board supply (PTO, DL) (15 A);

16— Heating system fan (25 A).

The storage battery charging circuit is protected with the fuse rated at 60 A.

WARNING! To prevent the electric wiring from burning, never apply fuses of higher current rating than specified above. If the fuse blows often, detect the reason and eliminate it.

In case of fuse blowing due to a short circuit, proceed as follows:

1. Connect the wires from the pilot lamp to the terminals of the fuse box at the place of the fuse blown.

a) If there is a short circuit, the lamp will be lit with incandescence,

b) If the circuit and consumer are intact, the lamp will not be lit or will be lit dimly.

2. Check the circuit from the fuse to the consumer and ensure that the lamp is not lit or is lit dimly (in the presence of a switched on consumer in the circuit);

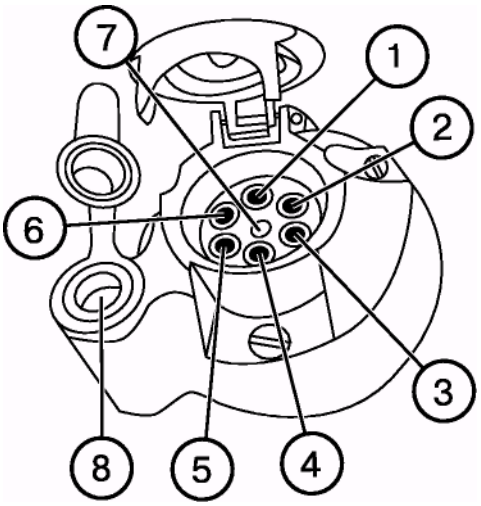
3. Fit a new fuse.

During the operation, the contact resistance between the fuse and its holders can increase due to oxidization.

It results in increase of the voltage drop in the circuit and heating causing the circuit failure. The defect is detected by the disturbance of the operation of the consumer (reduction of the power) and heating of the fuse. Eliminate the defect by cleaning the holder and fuse from the oxide film.

Electric equipment connector components

A combined multipin socket is designed for connecting the trailer electrical equipment or electrical equipment of trailed agricultural implement and service lamp. It is installed on the cab's rear support. A plug of the wire bundle of the hitched machines and a plug of service lamp are connected to the socket.

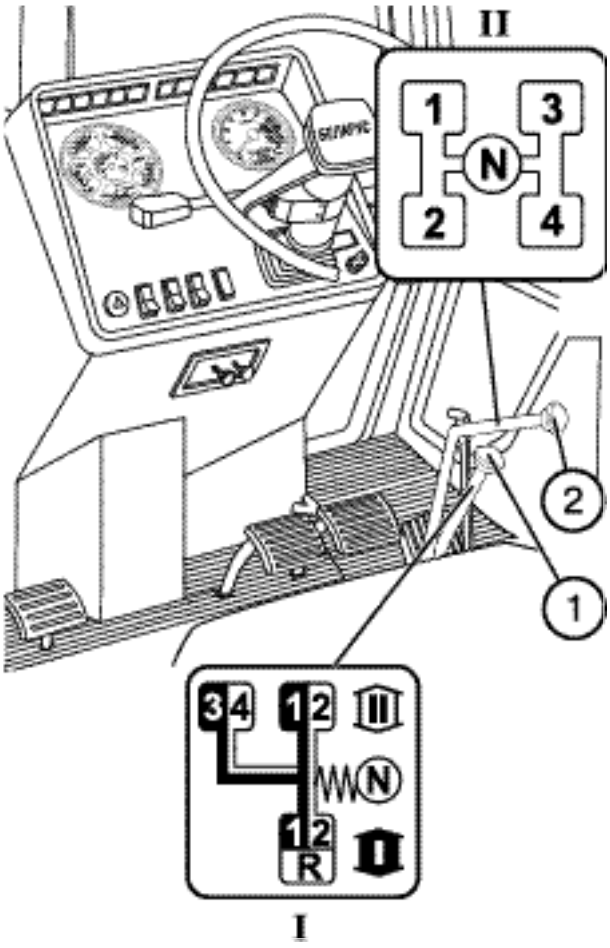


Socket connection terminal marking:

1 – Turn indicator, left;
2 – Horn;
3 – "Ground";
4 – Turn indicator, right;
5 – Right clearance light;
6 – Stop light;
7 – Left clearance light;
8 – Service lamp connection.

Gearbox control (16F+8R)

The gearbox is controlled by two levers: a lever of ranges shifting (1) and a lever of gears shifting (2).
Select the required ranges and gears in accordance with the shifting patterns I and II as shown on the figure below.



IMPORTANT! In order to shift the gear correctly smoothly, without jerks, move the gear shifting lever (2) in accordance with the pattern (see the figure above) and keep it pressed until the gear is switched.

Gearbox control (24F+12R) (if installed)

Gears shifting lever (2)

The shifting pattern is shown in the figure on the right (pattern I).

“On” button (2a) of gearbox reducer low gear (L).

On” button (2в) of gearbox reducer high gear (H).

Ranges shifting lever (1)

The shifting pattern is shown in the figure on the right (pattern II).

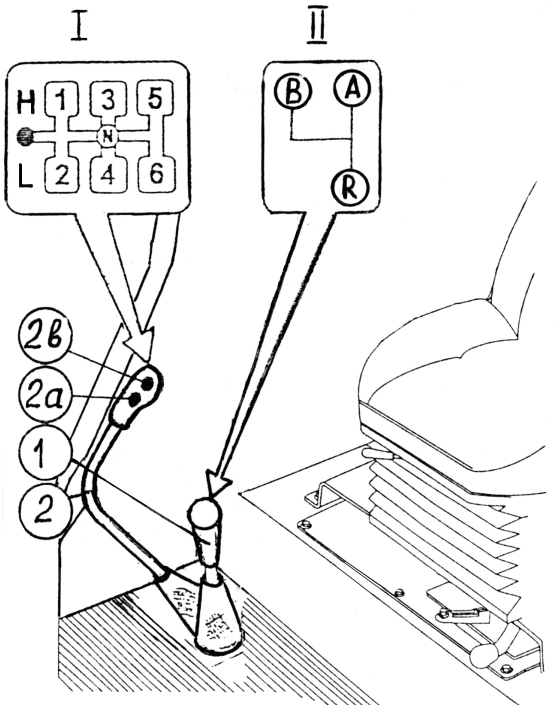
A – two low ranges of forward motion;

B – two high ranges of forward motion;

R – two ranges of reverse motion;

H –high pass of gearing;

L – low pass of gearing.



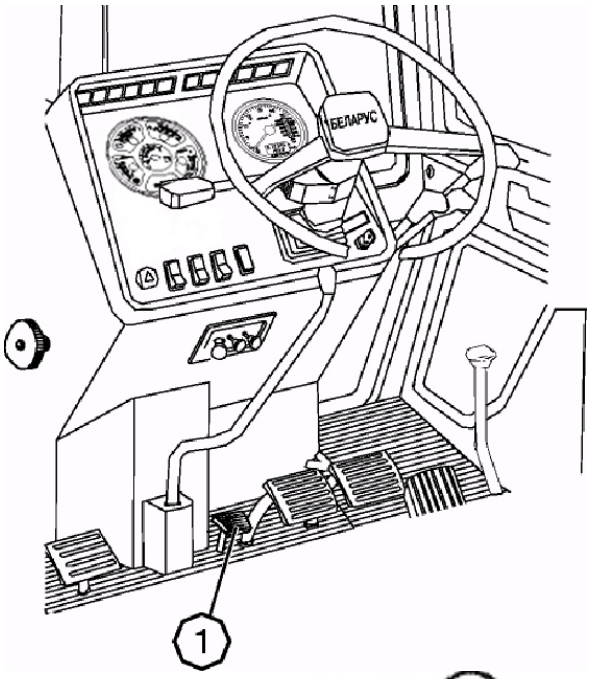
Control of the rear axle differential lock

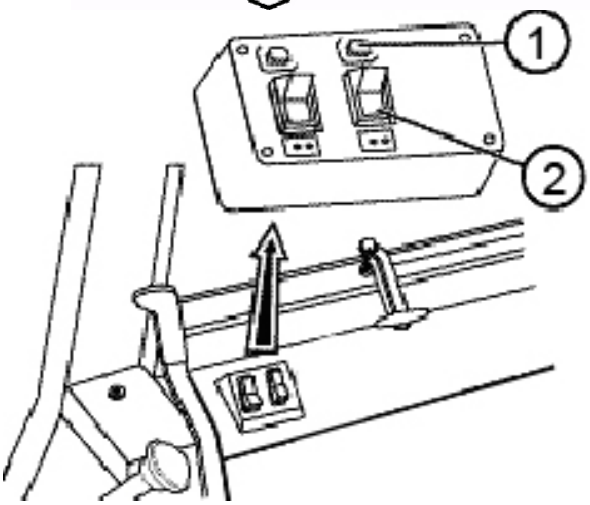
The rear axle differential lock is controlled by the button (4), located on the dashboard near FDA control button (2).

Three position button (4) has the following positions:

- "Automatic locking" — on pressing the upper part of the button (fixed position);
- "Differential lock is switched off — middle position (fixed);
- "Forced blocking" — on pressing the lower part of the button (unfixed). When the button is released it automatically switches to the middle position ("Differential lock is switched off").

On switching on the differential lock alarm lamp (3) lights up, which goes off when the differential lock switches on automatically and when the button (4) is put in the middle position.





Important! Engage the forced differential lock only shortly to overcome road obstacles and carry out the field and transportation works.

Warning: Do not use the differential lock at the speeds exceeding 10 km/h and when turning the tractor. Otherwise the tractor control becomes difficult, power transmission is quickly worn out, the safety is endangered.

Electrical schematic of FDA and rear axle differential lock control system is given in the section "Appendix".

FDA drive control

FDA drive is controlled by the button (2), located on the board above the right control unit. The button (2) has three fixed positions:

- “FDA is automatically “on” — on pressing the upper part of the button;
- “FDA is “off” — middle position of the button;
- “Forced FDA engagement” — on pressing the lower part of the button.

On engaging FDA drive the alarm lamp (1) lights up. The lamp goes out on putting the button (2) in the middle position and in the moment of switching off the drive in the automatic mode.

Attention!

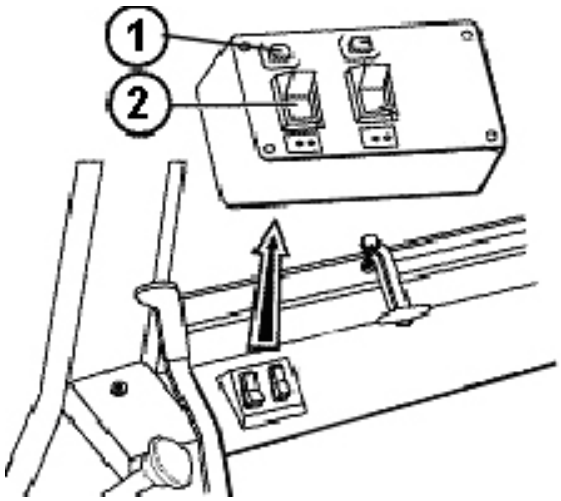
1. Operating on the roads with hard surface switch off the FDA (middle position of the button (2) in order to prevent tyres and drive parts from increased wear.

2. Use the forced FDA engaging mode shortly only to overcome obstacles and when operating on reverse,

3. It is categorically forbidden to operate in the mode of forced FDA engagement when the speed is over 15 km/h.

4. It is categorically forbidden to use FDA in the mode of automatic engagement by the reverse motion.

Electrical schematic of FDA and rear axle differential lock control system is given in the section “Appendix”.

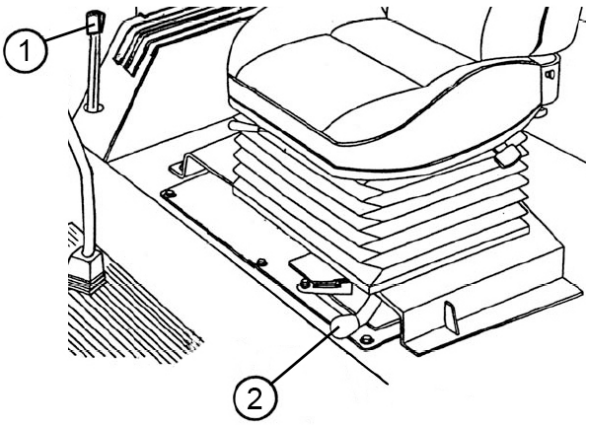


Note: A braking relay is installed in the electrical line of FDA drive control, it ensures automatic switching on of FDA when pressing synchronized pedals of tractor brakes.

Switching on rear PTO shaft

The lever (1) has 2 positions:

- “PTO is engaged” — extreme upper position,
- “PTO is disengaged” — extreme lower position.



Independent and synchronous PTO drives

The lever (2) has three positions:

- “Independent drive is engaged” — extreme right position;
- “Synchronous drive is engaged — extreme left position;
- “Disengaged” — middle position.

Engage the synchronous PTO drive only at low gears on minimum engine idle speed doing the following:

- Start the engine and set the minimum idle speed;
- Press home the clutch pedal and engage I or II gear;
- Release the clutch pedal slowly and simultaneously turn the lever (2) in the extreme left position.

Important! Use the PTO synchronous drive only at low gears at tractor motion speed not higher than 8 km/h. Otherwise tractor power train may get seriously damaged.

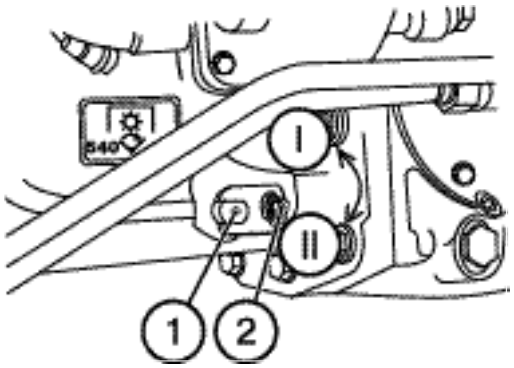
Speed switch of independent PTO drive

Independent drive lever (1) has two positions:

I — 540 rpm — extreme, contraclockwise;

II — 1000 rpm — extreme clockwise.

To set a required PTO speed release the bolt (2), turn the lever (1) and tighten the bolt (2).

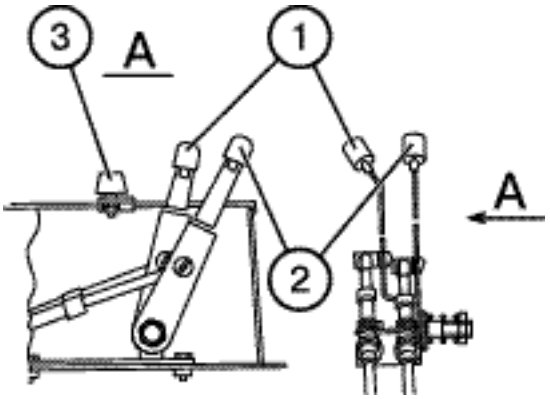


Hydraulic lift linkage control

The hydraulic lift linkage is controlled using two control levers (1) and (2), located on the right control board inside the cab.

The draft control lever (2) is the nearest to the operator's seat and has the following positions:

- Extreme forward — maximum depth of ploughing (“9”).
- Extreme rearward — minimum depth of ploughing (“0”). Full range of the lever's positions is denoted with number from “0” to “10”.



The position control lever (1) has following positions:

- Extreme rearward (“1”) — transport position of rear lift device.
- Extreme forward (“9”) — minimum height of the implement above the ground.

The maximum lifting height of the implement using the lever (1) is eliminated by adjustable stop (3).

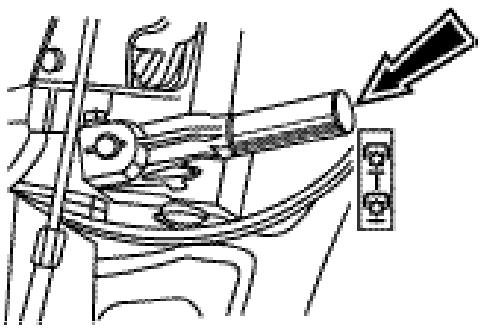
Note: The mixed control is carried out by means of the limitation of the tillage depth using the lever (1) during draft control operations.

Hydraulic system pump control

The control lever has two positions:

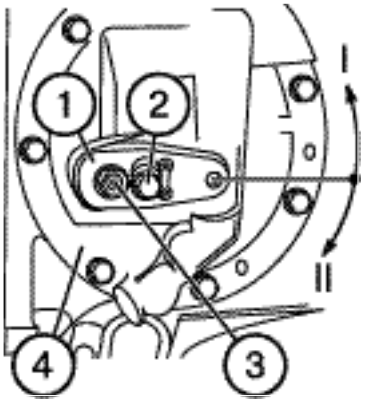
• “The pump is engaged” – upper position;

• “The pump is disengaged” – lower position.



Important! Disengage the pump at cold start or maintenance. Engage the pump at the engine minimum idle speed only.

Gearbox oil pump control



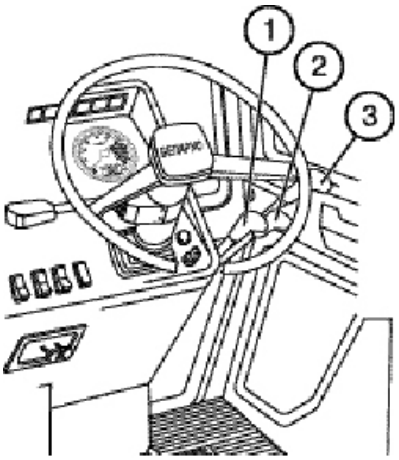
The gearbox oil pump control lever (1) can have two fixed positions:

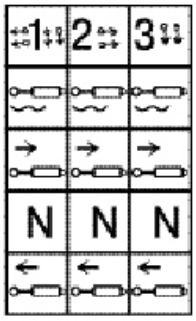
I — "Pump drive from engine" (normal operating position) — the lever (1) is turned counterclockwise (when looking at GB from the left tractor side) relative to the axis (3) until the lower edge of the lever slot stops and is fixed by the bolt.

II — non-working position.

Important! Set the lever (1) in the position II when there is a necessity to remove and to mount the assembled GB pump drive (4) and then fix the lever (1) in the position I again.

Hydraulic system distributor control

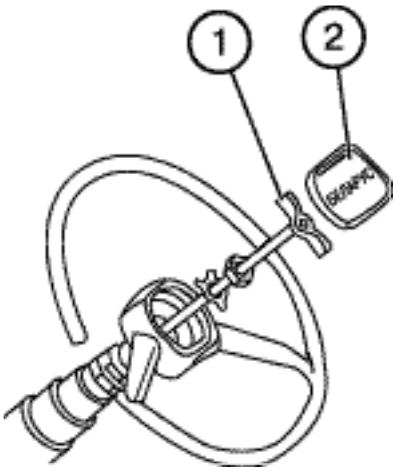




Each of the three remote levers (1, 2, 3), controls the remote cylinders and has four positions:

- "Neutral" — low middle (fixed);
- "Lift" — low (non-fixed); after releasing the lever returns to "neutral";
- "Positive lowering" — upper middle (non-fixed) between the "float" and "neutral". After releasing the lever returns to «Neutral";
- "Float" — upper (fixed)

Changing of steering wheel position



To adjust the height of the steering wheel, proceed as follows:

- Remove the cover (2);
- Unscrew the clamp (1) for 3…5 turns;
- Set the steering wheel in the required position;
- Tighten the clamp (1) manually and fix the cover (2) back.

Note: Steering wheel height adjustment range is 100 mm.

The steering column can tilt to four different positions from 25° to 40° relative to horizontal line in increments of 5°). In order to tilt the steering column, pull the handle (3) on.

“BELARUS” 80-6800010/ 80B-6800000 seat

The 80-6800010 seat is distinguished from the 80B-6800000 seat by the mounting seat and a possibility to complete the 80-6800010 seat with elbows and a safety belt.

Important! Before operating the tractor Adjust the seat to the most comfortable position. All adjustments should be made while sitting in the seat.
The seat is considered correctly adjusted according to the weight if it moves on the half of its travel under the operator's weight (suspension travel is 100mm).

Seat adjustments:

According to the driver's weight from 50 till 120 kg.

Seat adjustments are carried out by the lever (1). To adjust the seat to larger weight move the lever pawl (1) to the position “A” and tight the springs using to-and-fro motion. To adjust the seat to the smaller weight move the lever pawl to the position “B” and release the springs using to-and-fro motion.

Back inclination adjustment within the range from 15° to 20°(for the seat 80-6800010).

Carried out by the flywheel (2). To increase the angle of the back inclination turn the flywheel clockwise, to reduce it turn the flywheel contraclockwise.

Back inclination adjustment within the range from 5° to 25°P (for the seat 80Б-6800000)

Carried out by the lever (2). Lift the lever upwards to the stop, move the back and release the lever. The back will be fixed in the given position.

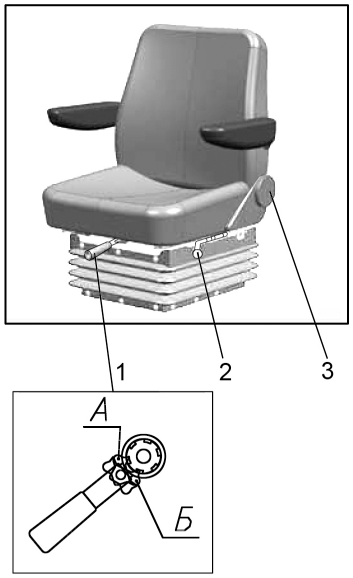
Longitudinal seat adjustment within the range of 160 mm.

Carried out by the lever (3). To move the seat forward/backward pull the lever upwards, move the seat and release the lever. The seat is automatically fixed in the necessary position.

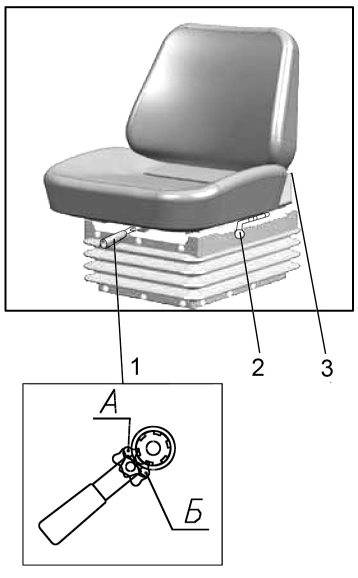
Height adjustment within the range of 60 mm. The seat has three height positions “lower”, “middle” and “upper”. To move the seat from the “lower” position to the “middle” one or from the “middle” position to the “upper” one smoothly lift the seat upwards to the clickwork (the indicator click sounds). To move seat from the “upper” position to the “lower” one move the seat sharply upwards to the stop and move down.

Note: It is not possible to move the seat from the “middle” position to the “lower” position.

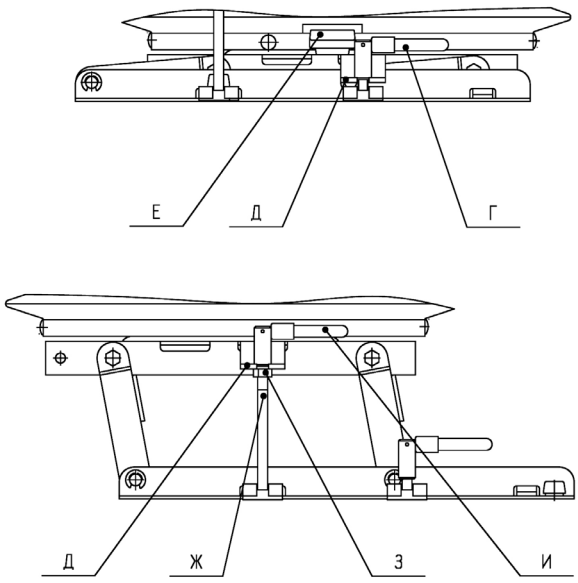
80-6800010



80B-6800000

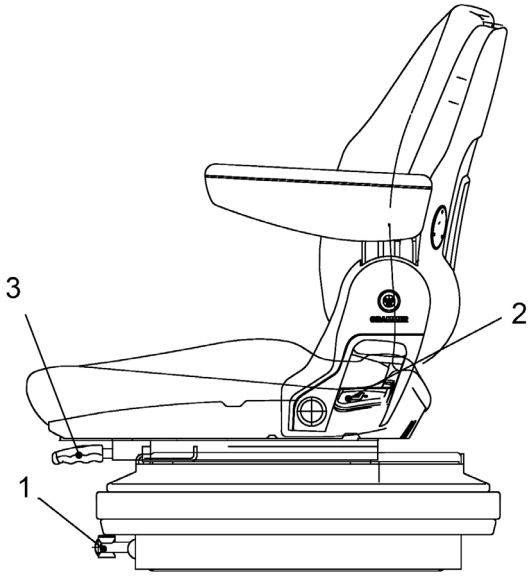


“Reverse position” (for the tractor with the reverse control panel “BELARUS-1221B.2”). To set the seat to the reverse position it is necessary to turn the clamps “Г” off and move them out of the panel brackets edges “Д”, lift the lever “Е” and turn the seat half-way (180°). Sharply lift and pull it the seat upwards. Set the screws “Ж” into the slots of the panel brackets “Д”, put the screw «3» on in the brackets to the stop and fasten the clamps “И” with the turning torque 44 … 56 Nm.



The seat Grammer MSG85/721
(if installed)

Important! Prior to beginning the operation of the tractor, adjust the seat to the position being the most convenient for you. Perform all the adjustments while sitting on the seat.



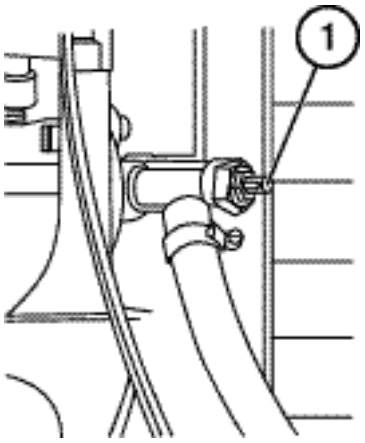
Seat adjustments:
According to the driver's weight within the range from 50 to 130 kg with the mass indication every 10 kg. Carried out by the lever (1). To adjust the seat to the bigger weight turn the handle clockwise, to adjust the seat to the lower weight turn the handle contraclockwise.
Adjustment of back inclination from -10° до 35°.
Carried out by the lever (2). Lift the lever upwards to the stop, move the back and release the lever. The back is fixed in the necessary position.
Longitudinal seat adjustment within the range of 150 mm.
Carried out by the lever (3). To move the seat forward/backward pull the lever upwards, move the seat and release the lever. The seat is automatically fixed in the necessary position.
Height adjustment within the range of 60 mm. The seat has three height positions “lower”, “middle” and “upper”. To move the seat from the “lower” position to the “middle” one or from the “middle” position to the “upper” one smoothly lift the seat upwards to the clickwork (the indicator click sounds). To move seat from the “upper” position to the “lower” one move the seat sharply upwards to the stop and move down.

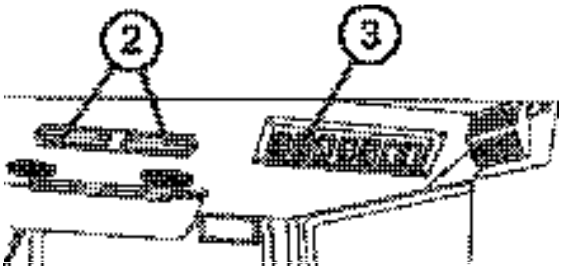
Note: It is not possible to move the seat from the “middle” position to the “lower” position.

Cab Heater Control

To put the cab heater into operation, proceed as follows:

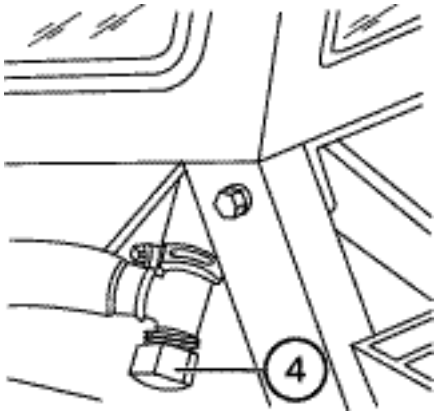
1. Open the cock (1) from the left-hand side of the engine over fine fuel filter. Turn the cock handle counterclockwise against the stop. Make sure the coolant circulates in heater system slightly turning off the drain plug (4) from the right-hand side of the cab. Tighten the drain plug.
2. Turn on the heater fan using the switch (3), located on the upper panel of cab roof.
3. By opening or closing recirculation shutters (2) you can control the amount of fresh air coming into the cab from the outside. Adjust the airflow direction through controlled channels.





Note: If you want to warm-up air in the cab quickly, open the recirculation shutters fully and switch the heater fan to high speed using switch (3).

Drain plugs (4) from the left-hand side and from the right-hand side of the cab are provided for system emptying filled with water in the frost season. To avoid ice plugs, aerate the system with compressed air, but before it close water dump valves from water radiator and engine cylinder block and replace the radiator cap.

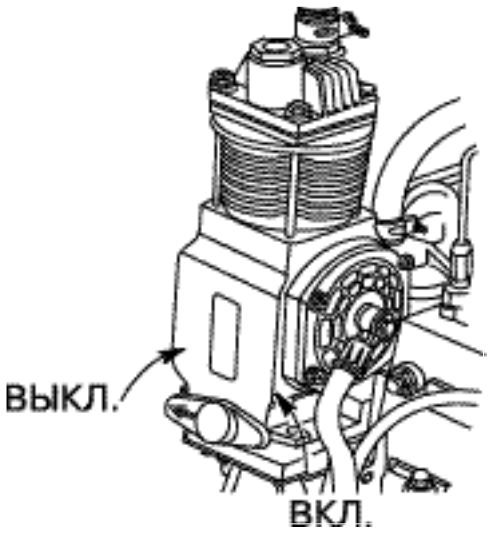


Note: For vent mode of the system in the warm season the cock (1) has to be closed.

Pneumatic system compressor control

The handle of compressor control has two positions:

- "Compressor ON" – when turning the handle so that the arrow on the arm is directed backwards to tractor motion;
- "Compressor OFF" – when turning the handle so that the arrow is directed forward to tractor motion.



Выкл.	Disengage
Вкл.	Engage

Reversible Control Station BELARUS -1221B.2)

Tractors are equipped with the reversible control station to broaden the possibilities of unitizing with the forward-mounted agricultural machines.

The components of the reversible control station are as follows:

- additional rear-located steering column with metering pump;
- double foot controls of the engine throttle, clutch and service brakes;
- mechanism of seat reversal;
- additional horn button and the engine emergency modes indicators.

ATTENTION!

1. Tractor reverse control station intends only for the field operations at the reverse running.
2. When running at the reverse mode, lock the standard service brake.
3. Never drive the tractor at the reverse mode over the general-purpose roads, during operations, not connected with agriculture, and by lift-on/lift-off of the tractor.

Reversible station controls.

The additional reverse controls are located at the rear side of the cab as shown in the figure below:

1 - the clutch is disengaged when pressing the pedal. Clutch engagement takes place by pedal release.

2 –steering wheel of tractor turning (it is taken from the steering column of forward motion (9)).

3 –brakes pedal. Both tractor brakes and pneumatic drive of trailer brakes are engaged by depressing the pedal.

4 –foot throttle. Fuel feeding is increased by pressing the foot throttle.

5 – horn button.

6 –fuel delivery control lever. Extreme rearward position (on reverse) corresponds to full fuel delivery, extreme forward position corresponds to engine stopping.

7 –gearbox ranges selecting lever (see pattern I).

8 –transmission speed control lever (see pattern II).

9 –steering column of forward motion.

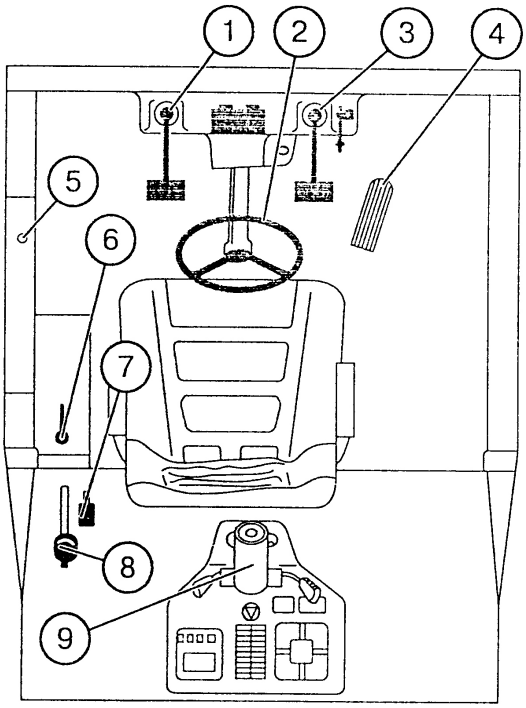
To adjust the tractor for reverse operation, proceed as follows:

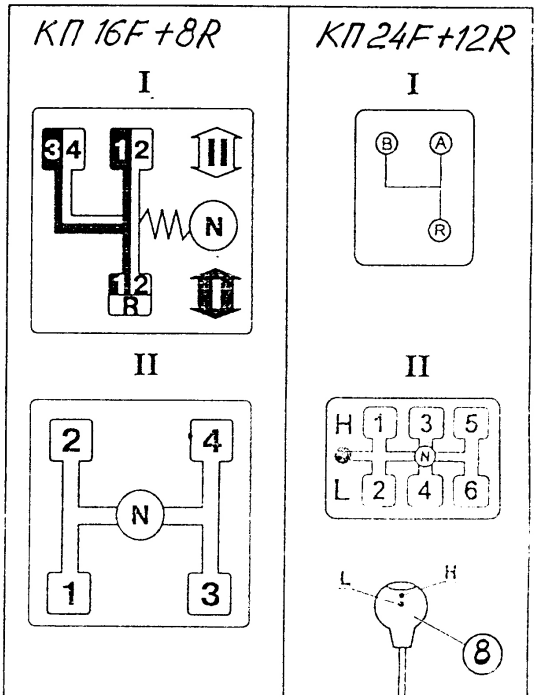
• lock the standard brake pedals;

• transfer the steering wheel to the additional steering column. For that purpose turn off the handwheel of the steering wheel fixation, transfer the steering wheel and fix it at the required height;

• turn the revolving seat for reverse operations;

• set the HPS switch cock to the “reverse” position.





DESCRIPTION AND OPERATION

Engine

The tractor is equipped with a Д-260.2/Д-260.2С/Д-260.2S2 six-cylinder in-line in-line, four-stroke turbo-charged, direct-injection liquid-cooled diesel engine (with a charge air cooler with coolant for the Д-260.2S2 engine).

The engine is started by means of an electric starter.

The engine (Fig. E-1, E-2) consists of a cylinder block, two cylinder heads, crank mechanism, valve control as well as feed, lubrication, cooling and starting systems and electric equipment.

The **cylinder block** (20) (Fig. E-1) is designed as a monoblock consisting of a rigid iron casting.

Six replaceable sleeves (15) made of special cast iron are installed in the cylinder block bores.

The sleeve is installed in the cylinder block at two centring 'belts'. At the upper belt the sleeve is restrained with a shoulder, while at the bottom one it is packed with two rubber rings.

From the bottom, the cylinder block is closed with a crankcase casting (1) made of aluminium alloy.

The two interchangeable **cylinder heads** (18) (one per three cylinders) are iron cast.

The cylinder head contains the inserted valve seats made of heat and abrasion resistant alloy. In the cylinder head, the injectors (14) (Fig. E-2) (three per head) are installed.

The provide the tightness of the joint between the cylinder heads and the cylinder blocks, a gasket (19) made of asbestos-steel cloth is inserted. The bores for the cylinder sleeves and the oil passageway are edged with sheet steel. When assembling the engine at the manufacturing plant, the cylinder holes in the gasket are additionally edge-formed with Teflon rings.

The **crank gear** (Fig. E-1) includes a crankshaft (25), together with main- and connecting-rod bearings, a flywheel (22), pistons (14) in assembly with piston rings and pins, and connecting rods (13).

The **crankshaft** is a steel member made with counterweights and supported on seven bearing saddles. Crankpins are made with pockets intended for additional centrifugal cleaning of oil. They are stopped with threaded plugs.

Valve timing drive and oil pump drive gear as well as a water-pump, alternator and air-conditioner compressor (if installed) drive pulley are mounted on the crankshaft front-end.

To reduce the crankshaft torsional vibration amplitude, the pulley is fitted with a liquid-type torsional vibration damper (3) (Fig. E-1).

The **piston** is made of aluminium alloy. A combustion chamber is made in the piston crown. Three compression piston rings and one oil ring with an expander are installed in the upper part of the piston. The top compression piston ring has a tapered face. A "non-resistive" spacer is installed under the top ring.

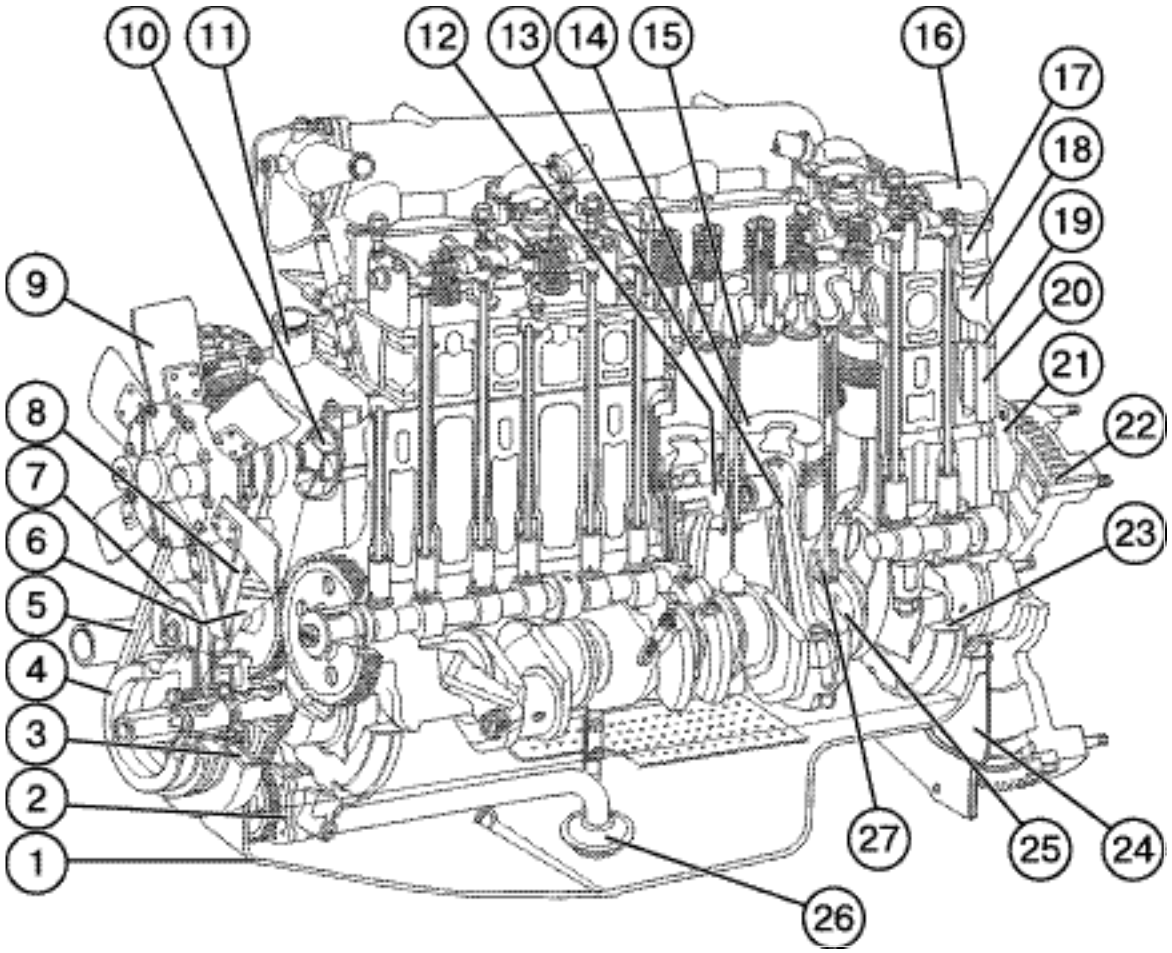


Fig. E-1. Д-260.2 engine (longitudinal section):

1 – crankcase; 1 – oil pump; 3 – vibration damper; 4 – crankshaft pulley; 5 – fan driving belt; 6 – valve-timing gear cover; 7 – jockey; 8 – alternator driving belt; 9 – fan; 10 – water pump; 11 – thermostat housing; 12 – piston pin; 13 – connecting rod; 14 – piston; 15 – cylinder sleeve; 16 – cap; 17 – cylinder head cover; 18 – cylinder head; 19 – cylinder head gasket; 20 – cylinder block; 21 – rear sheet; 22 – flywheel; 23 – counter-weight; 24 – cover; 25 – crankshaft; 26 – oil pump header; 27 – piston cooling jet

The **piston pin** is a hollow member made of chrome-nickel steel. Pin axial displacement in the piston-pin bosses is checked by piston-pin retaining circlips.

The **connecting rod** is an I-section steel part, with a bushing pressed into its top end. To lubricate the piston pin, the connecting rod top end and the bushing are provided with drilled passages. The bottom end consists of the rod and cap which bear the same markings. The connecting rod caps are not interchangeable. Besides, the connecting rods have group designations of the mass of top and bottom ends; these are marked on the end-face of the top rod end. The engine shall be fitted with connecting rods belonging to the same group.

The **main- and crankpin bearing inserts** of the crankshaft are thin-walled parts made of bimetal strip. The shells are manufactured in two sizes as to the inner diameter, in accordance with the rated diameter of the crankshaft necks.

The **flywheel** is made of cast iron and bolted to the crankshaft flange. A steel gear rim is pressed onto the flywheel.

The **valve actuating and timing gear** (refer to Fig. E-2) consists of timing gears, camshaft, inlet and outlet valves, as well as their fitting and driving parts.

The **camshaft** (1) is driven from the crankshaft through the valve timing gears and rides on four supports.

The **tappets** (2) are steel members, with spherical bottoms. The camshaft cams are made with a slight tilt that forces the tappets to rotate when in operation.

The tappet **pushrods** (5) are made of a steel bar. The downwardly concave part of the tappet and cup the push-rod cup are hardened.

The **valve rocker arms** (7) are made of steel and rocks on rollers installed in supports. The rocker-arm roller is hollow, with six radial bores for arm lubrication. Displacement of the rocker arms along the roller is restricted by spreader springs.

The **inlet and outlet valves** (3) are made of high-temperature steel and free to move in their guide bushes. The bushes are press-fitted in the cylinder heads. Each valve closes under the force of two springs: outer (12) and inner (10) fixed on its stem by means of a valve spring retainer (9) and valve locating split cones (10).

The sealing collars (18) fitted on the valve guiding bushes keep oil from leaking down into the engine cylinders through gaps between the valve stems and guiding bushes.

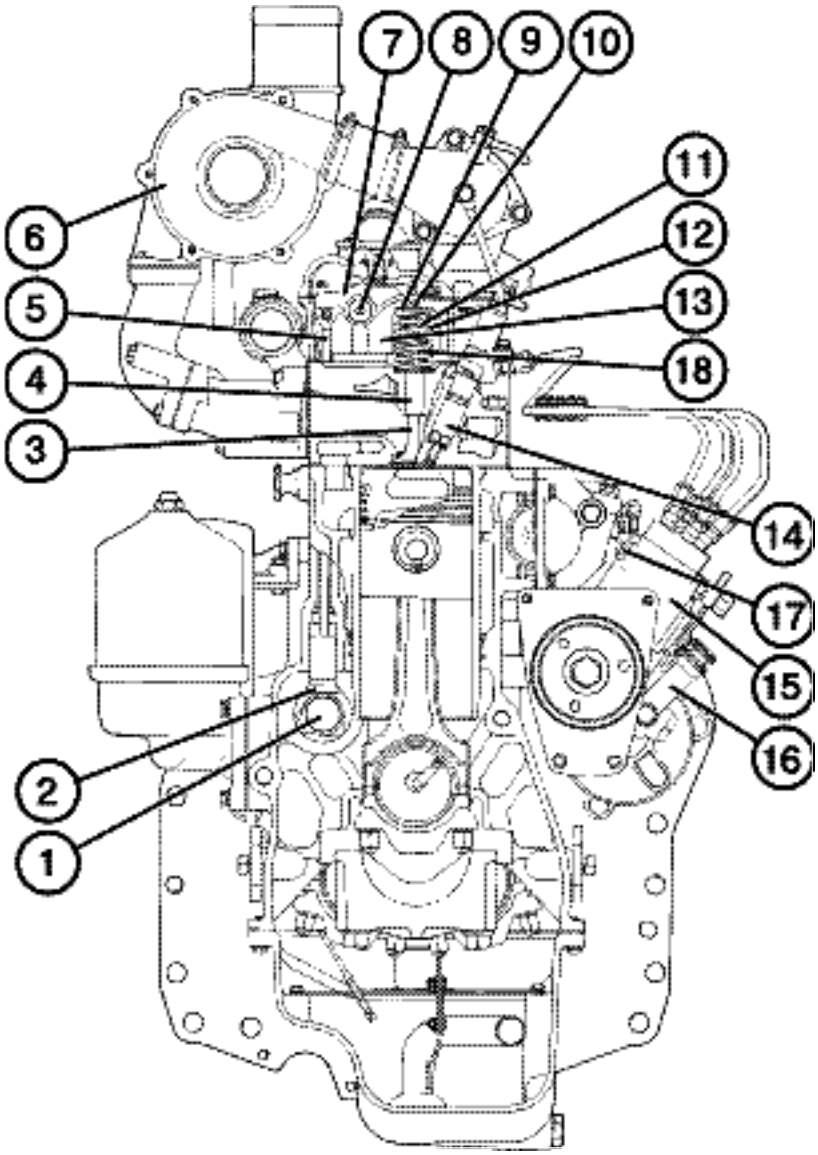


Fig. E-2. Д-260.2 diesel engine (cross section):

1 – camshaft; 2 – tappet; 3 – valve; 4 – valve guiding bush; 5 – pushrod; 6 – turbocharger; 7 – rocker arm; 8 – roller; 9 – spring retainer (disk); 10 – split cones; 11 – inner spring; 12 – outer spring; 13 – support; 14 – injector; 15 – fuel pump*); 16 – boost fuel hand-pump; 17 – plug to bleed air from the oil pump head; 18 – sealing collar

*) The distributive-type fuel pump shown in Fig. E-2 is not used at present. The Д-260.2/Д-260.2C/Д-260.2S2 engines are equipped with in-line pumps Type 363-40 (YAZDA Open Joint-Stock Company, Russia) or PP6M10P1f (Motorpal, Czechia).

The Д-260.2 engine may be equipped with the PP6M10P1f-3492 fuel pump manufactured by the Motorpal Joint-Stock Company (Czechia).

The adjusting parameters of the fuel pumps are shown in the Table below

Parameter description	Unit of measurement	Value
		PP6M10P1f-3492 (Д-260.2)
1. Average fuel feed per cycle through induction (high-pressure) pipelines, at 100 min^{-1} rpm, no less than	mm^3/cycle	150
2. Camshaft rated speed	min^{-1}	1050±10
3. Average fuel feed per cycle through pump high-pressure pipelines, at rated RPM	mm^3/cycle	80±2
4. Irregular fuel feed through induction pipelines , at rated RPM, no more than	%	6
5. RPM at regulator action commencement	min^{-1}	1080±10
6.Complete fuel-feed cutoff automatically by the regulator – within the RPM range	min^{-1}	1170 not more than
7. Average fuel feed per cycle by pump sections, at diesel-engine speed: 800 min^{-1} 500 min^{-1}	mm^3/cycle	 83±2.5 70±3.5
8. Pressure at pneumatic adjuster start/end action, at n = 500 min^{-1}	MPa	0.005…0.01 0.025…0.03
9. Average fuel feed per cycle, at 500 min^{-1} and no-supercharging pressure condition	mm^3/cycle	55.5…64.5

Note: The parameters to be adjusted as per items 3…7 should be checked with the pneumatic adjuster arbitrarily disconnected (air pressure in the pneumatic adjuster is 0.05…0.06 MPa).

In case of a difficult engine start or smoky exhaust, as well as after replacing or installing the fuel pump after adjustment and/or repair, be sure to check the timing angle of the fuel pump.

To check the timing angle, proceed as follows:

- set the regulator control levers to a position corresponding to maximum fuel feed;

- disconnect the injection pipeline from the union of the first pump section; connect a fuel injection timing meter (momentoscope) instead (a female-swivel nut with a short tube coupled through a rubber pipe with a 1…2-mm inner dia. glass tube);

- turn the crankshaft clockwise with the help of a wrench, until fuel free of bubbles flows from the device glass tube;

- remove some fuel from the glass tube by shaking the latter;

- turn the crankshaft in the opposite direction (counter-clockwise) through 30…40°;

- observe the fuel level in the glass tube when rotating slowly the engine crankshaft; stop the crankshaft rotation the instant the fuel begins to rise;

- read the position of the locating pin arrow on the valve control mechanism cover.

If it is within “21…23” on the graduated scale located on the vibration damper housing, then the setting angle of fuel injection advance is correct, i.e. the first cylinder piston is in the position corresponding to 21…23° to TDC.

If the arrow is outside the stated range, proceed with re-adjustment; to do this:

- bring the locating pin arrow in coincidence with mark “22” of the graduated scale on the vibration damper housing by turning the crankshaft;

- remove the hatch cover;

- back off 1…1.5 turn three M10 nuts which fasten the fuel-pump drive gear to the fuel pump drive flange;

- remove some fuel from the injection meter glass tube, if any;

- using a wrench, rotate the fuel pump shaft by its nut in one and the other direction within the limits of the slots on the fuel pump-drive gear surface, until the injection meter glass tube is full;

- set the fuel pump shaft to its extreme (counter-clockwise) position within the limits of the slots;

- remove part of the fuel from the device glass tube;

- rotate slowly the fuel pump shaft clockwise until the fuel in the glass tube begins to rise ;

- at the moment when fuel starts to rise in the glass tube, stop rotation of the shaft and tighten home the nuts fastening the gear to the fuel pump drive flange;

- re-check the instant of fuel feed onset;

- disconnect the injection meter and replace it with the injection (high-pressure) pipeline and fasten the hatch cover back in place.

The engine **feed circuit** (refer to Fig. E-3) consists of an air-cleaner, air-delivery conduit, induction and exhaust manifolds, turbocharger, exhaust silencer, fuel tank, coarse and fine fuel filters, fuel pump, injectors, as well as fuel-injection and delivery pipelines.

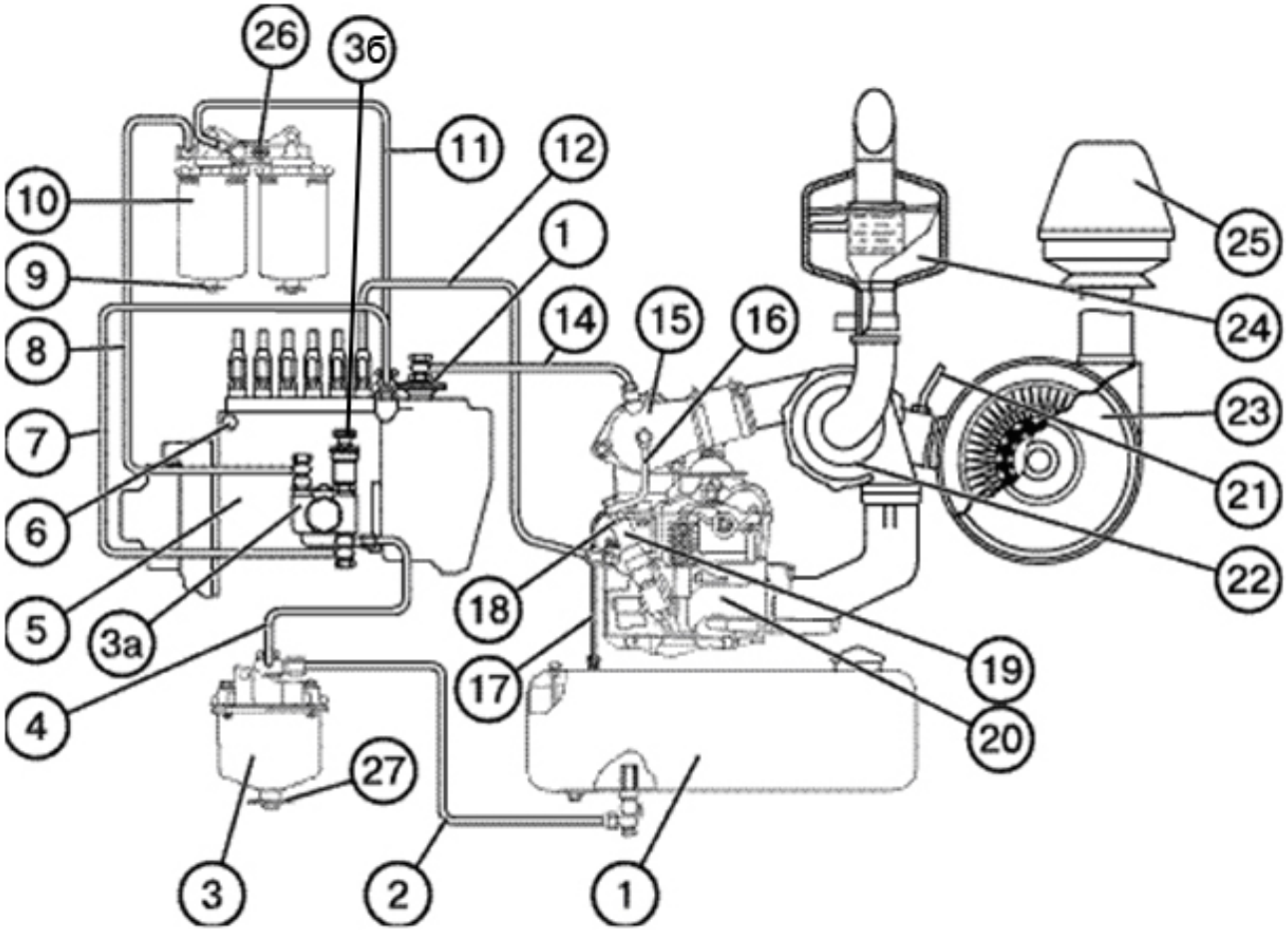


Fig. E-3. Fuel feed circuit diagram:

1 – fuel tank; 2 – connecting pipe from the fuel tank; 3 – coarse fuel filter; 4 – ; 4 – connecting pipe from the coarse fuel filter; 5 – fuel pump; 6 – plug to bleed air from the oil pump head; 7 – fuel offtake pipe from the lower-pressure chamber to the fuel-lift pump; 8 – pipe to deliver fuel from the fuel-lift pump to the fine fuel filter; 9 – plug to drain sludge; 10 – fine fuel filter; 11 – fuel offtake pipe from the fine filter to the lower-pressure chamber of the pump; 12 – fuel injection pipe; 13 – pneumatic adjuster; 14 – air-delivery pipe from the turbocharger downstream air-delivery conduit to the pneumatic adjuster; 15 – induction manifold; 16 – fuel overflow pipe; 17 – fuel drainage pipeline; 18 – fuel overflow pipe; 19 – injector; 20 – cylinder head; 21 – air-cleaner clogging indicator pipeline; 22 – turbocharger; 23 – air-cleaner; 24 – exhaust silencer; 25 – coarse air filter (monocyclone); 26 – air-bleeding plug; 27 – plug to drain sludge.

The **air cleaner** (refer to Fig. E-4) is a dry-type filter with paper filtering cartridges. It provides the three-stage purification. The first stage – preliminary inertial cleaning; the second and third – dry cleaning in master 6 and check 5 paper filtering elements.

To warn of the extent of air-cleaner clogging, a pilot lamp is installed in the instrument panel pilot lamp cluster. The electric air cleaner clogging sensor operates at the induction-pipe depression of 650 ± 50 mm of water.

Fuel is to be cleaned from mechanical impurities by a **coarse fuel filter** (3) (refer to Fig. E-3) which includes a screening element. Sludge is drained from the filter through a drainage plug (27) located in the bottom part of the cup housing.

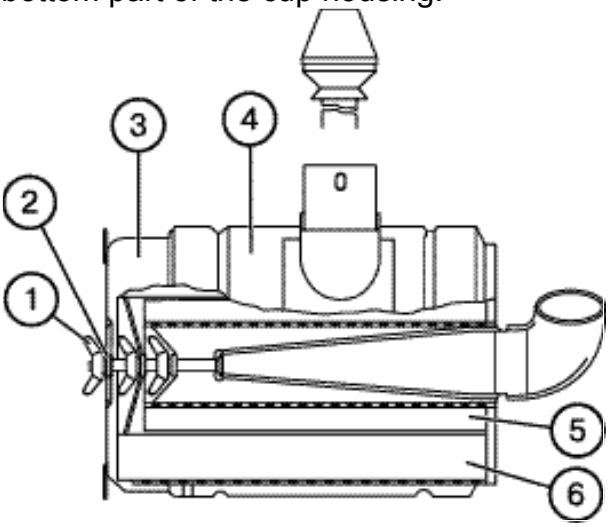


Fig. E-4. Air cleaner:

1 – winged nut; 2 – washer; 3 – pan; 4 – housing; 5 – check filter element; 6 – master filter element.

The **fine fuel filter** (refer to Fig. E-3) has a replaceable filter element which is installed in the filter housing.

The fine fuel filter is intended for multiple usage, subject to regular replacement of filter elements and rubber gaskets, and observance of the operating instructions.

To bleed air from the diesel-engine feed circuit, the filter housing is provided with a plug (26), refer to Fig. E-3.

Fuel injection into the cylinders is achieved by injectors (19) (refer to Fig. E-3) (ФДМ-22), closed-type, with five-bore nozzles.

The diesel fuel injection pump (5) (refer to Fig. E-3) is an in-line type six-plunger member with a pneumatic anti-smoking adjuster.

The fuel pump is driven off the crankshaft, through fuel distribution gearing.

The **fuel pump** forms an integral unit with the fully-variable regulator and piston-type fuel-lift pump.

The **regulator** houses a fuel supply corrector, automatic fuel-feed enrichment unit running at start-up revolutions, and an anti-smoking pneumatic adjuster.

The **fuel-lift pump** (3a) (refer to Fig. E-3) is mounted on the fuel injection pump body and actuated by the camshaft eccentric.

To bleed the air from the feed system, a hand-

operated piston-type boost pump (3b) is provided; and a plug (6) serves to bleed the air from the fuel-pump head.

Fuel supply is controlled by the pedal or lever.

To stop the engine (also in emergency), the engine stop handle is provided.

Fuel pump parts are lubricated from the engine lubrication system.

Turbocharger

The turbocharger (refer to Fig. E-6) serves to charge air into diesel cylinders, using the energy of exhaust gases. It consists of a centrifugal one-stage compressor (2) and a centripetal radial-flow turbine (7)..

The turbine wheel (7) is cast of heat-resistant nickel allow and welded to the rotor shaft (12). The compressor wheel (2) is an aluminium casting and is attached on the rotor shaft by means of a special nut (3).

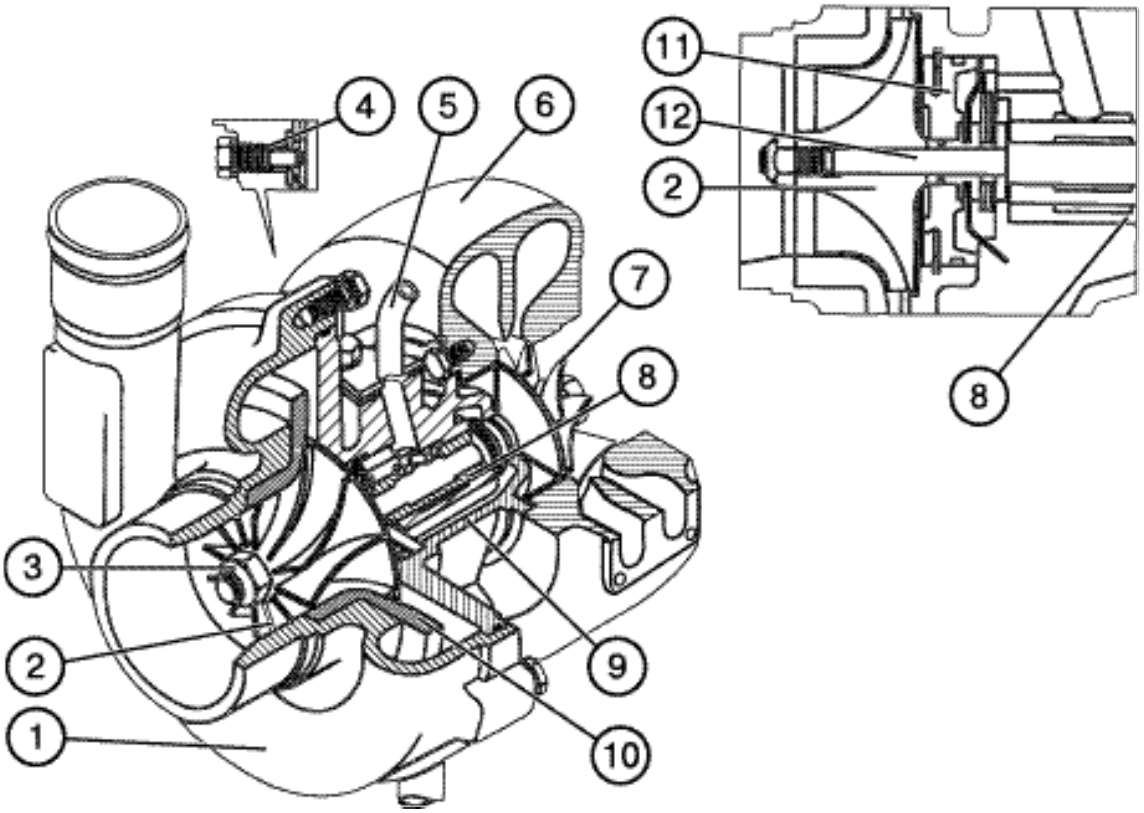


Fig. E-6. Turbocharger

1 – compressor housing; 2 – compressor wheel; 3 – special nut of the compressor wheel; 4 – fixing nut; 5 – oil-delivering pipe with a mounting flange; 6 – turbine body; 7 – turbine wheel; 8 – bearing; 9 – intermediate body; 10 – diffuser; 11 – disk; 12 – shaft

The principle of operation of the turbocharger is that exhaust gases from the cylinders enter the gas-turbine chamber from the exhaust manifold. While expanding, the gases rotate the turbine wheel together with its shaft, the other end of which is fitted with the compressor wheel.

From the turbine, the gases are discharged into the atmosphere through an exhaust pipe.

The air pressure differential downstream the compressor in the rated mode of the engine running shall be 0.05…0.08 MPa (0.5…0.8 kgf/cm^2).

Installation of the charge air cooler (CAC) (BELARUS-1221.3)

The charge air cooler (13) (Fig. E-7) is installed in front of the water radiator (14) and connected to the turbocharger (15) and the engine induction manifold (16) through a system of air-ducts (1, 4, 10) and junction branch-pipes (3, 5, 11).

The CAC is designed as an air-to-air heat exchanger consisting of a core member in the form of ribbed tubes, reservoirs, and junction branches. Air is delivered from the turbocharger to the CAC, cools in the latter, thus, improving the power and economic as well as ecological characteristics

of the engine, and flows to the diesel suction manifold.

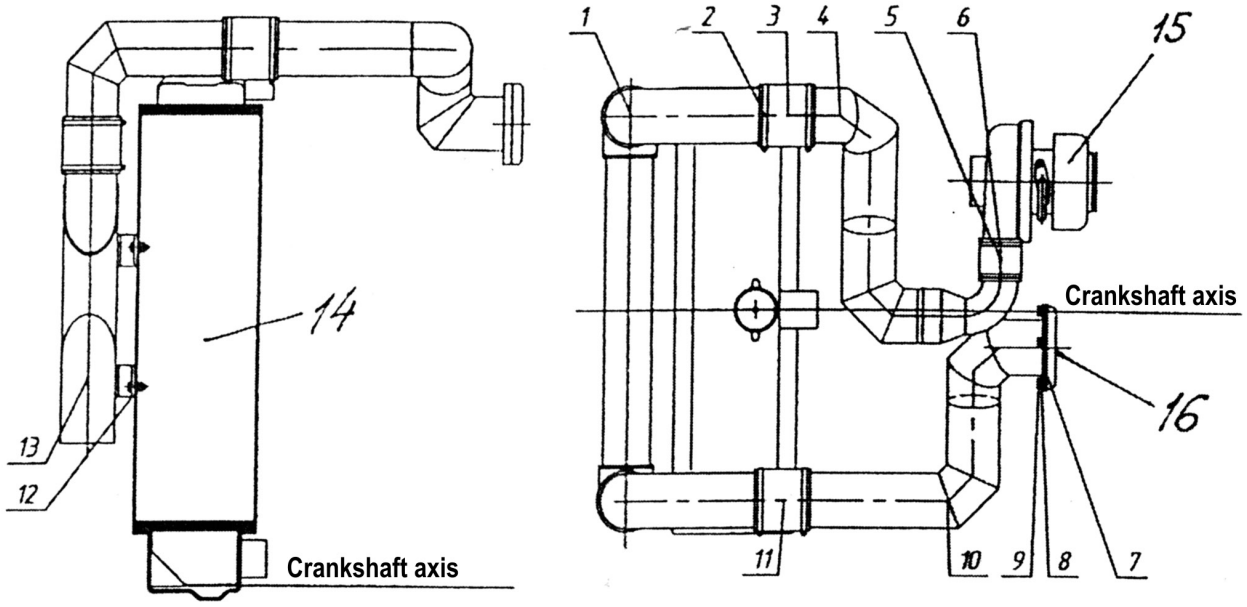


Fig. E-7. CAC outfit:

1, 4, 10 – air ducts; 2, 6 – clamp; 3, 5, 11 – junction branch-pipes; 7 – gasket; 8 – washer; 9 – bolt M8x16; 12 – nut; 13 – cooler (CAC); 14 – water radiator; 15 – turbocharger; 16 – engine induction manifold.

The engine **lubrication system** is combined: some parts are force-lubricated, the others are splashed lubricated. The system comprises an oil pump, oil filter with a paper filter element, centrifugal oil pump, and an oil-to-liquid heat exchanger. The lubrication system diagram is shown in Fig. E-8.

The **oil pump** (20) is a gear-type, single-stage unit driven from the crankshaft. It is provided with an overflow valve which opens at a pressure of 0.7…0.75 MPa (7…7.5 kgf/cm^2) and passes oil from the discharge chamber into the suction chamber.

The oil filter is of the single-flow type, with a paper filter element. The filter is provided with an overflow valve (1). The valve opens in case of excessive clogging of the filter element as well as when attempting to start a cold engine and returns oil into the main pipeline while bypassing the filter element. This valve is not adjustable. Besides, the filter is provided with a relief valve (21) adjusted to maintain a pressure within 0.28…0.45 MPa (2.8…4.5 kgf/cm^2) limits in the lube system.

With the engine running, oil, filtered and cooled in the oil-to-liquid heat exchanger (3), is supplied to all the bearings of the crankshaft and camshaft through the passageways in the cylinder block. The pistons (15) are cooled through the nozzles (16) built into the engine block main journals. For lubricating the turbocharger (7) and compressor (9) of the tractor pneumatic system, oil is delivered via separate pipes downstream of the heat exchanger (3).

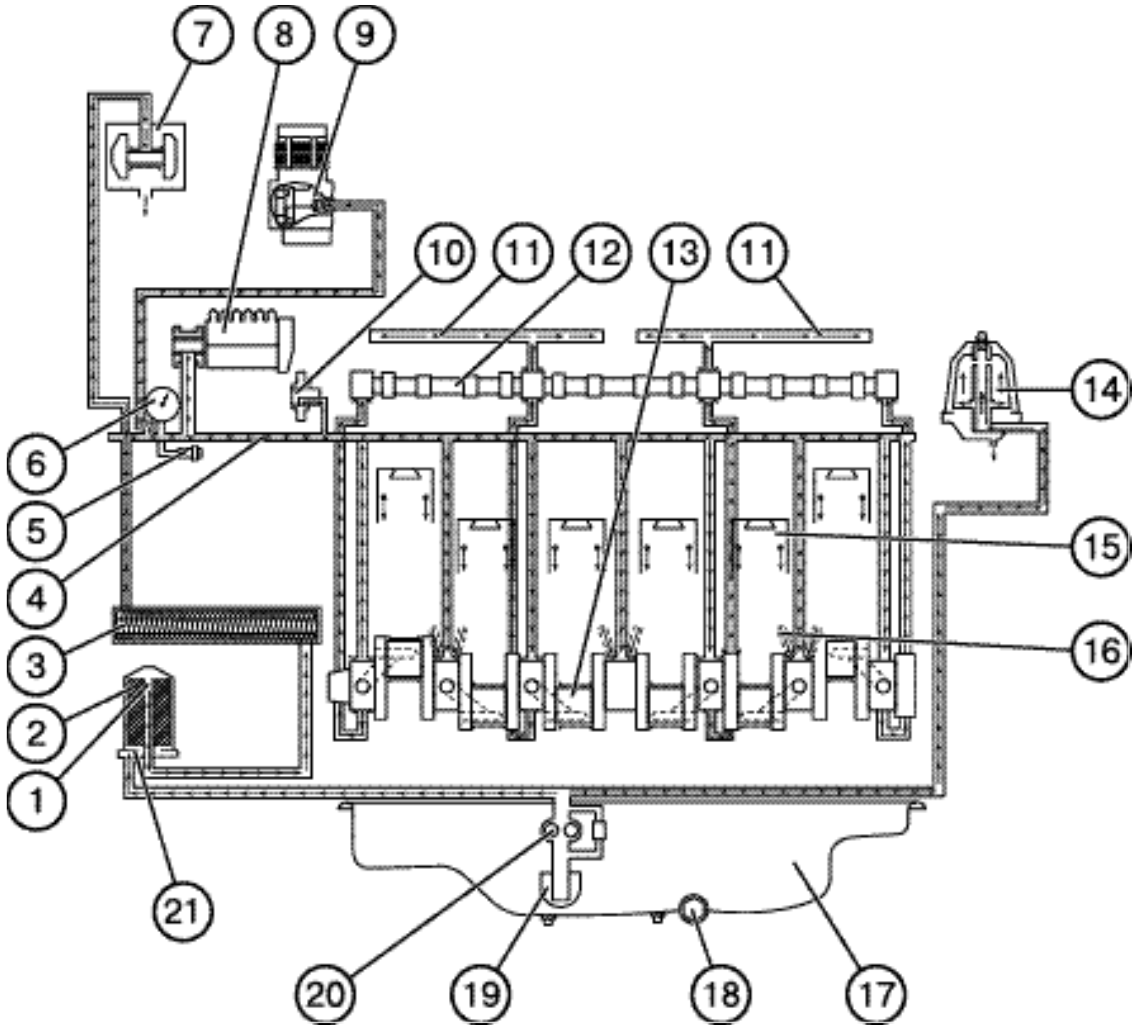


Fig. E-8. Lubrication system diagram:

1 – overflow valve; 2 – oil filter, paper; 3 – heat-exchanger; 4 – main oil pipeline; 5 – oil pressure sensor; 6 – manometer; 7 – turbocharger; 8 – fuel pump; 9 – compressor of the pneumatic system; 10 – intermediate pinion; 11 – oil passageway to rocker arm axle; 12 – camshaft; 13 – crankshaft; 14 – centrifugal oil filter; 15 – piston; 16 – cooling nozzle; 17 – oil pan; 18 – drain plug; 19 – oil pickup; 2 – oil pump; 21 – relief valve.

The **engine cooling system** is of a liquid closed type, with forced circulation of the coolant. The system consists of a cooling jacket, water pump, radiator, fan with automatically controlled viscous coupling, two thermostats, expansion tank, connecting hoses and drain cocks.

Thermal state of the diesel is regulated by changing the air flow passing through the cooling system radiator as well as by means of two thermostats.

The coolant temperature is monitored by the temperature indicator and light alarm whose sensors are located in the thermostat covers. The normal heat condition of the engine corresponds to the coolant temperature of 80…97°C.

The engine lubricating oil is cooled in an oil-to-liquid heat-exchanger built into the engine block. To control the oil pressure, the sensors of oil pressure gauge and pressure warning indicator installed in the heat-exchange pipe tap are used. The normal engine heat condition as to lubricating oil is within 80…120°C.

The **radiator** is of finned tubular design. A steam valve in the radiator filler neck maintains the pressure within 0.045…0.05 MPa (0.45…0.50 kgf/cm^2), while an air valve monitors the vacuum within 0.008…0.01 MPa (0.08…0.10 kgf/cm^2).

The fan runs in the two operating modes:

- automatic;
- forced.

The automatic mode is provided through a viscous friction coupling (12) (refer to Fig. E-8) as follows: at the coolant temperature below 80°C the return spring (7) holds the valve (10) closed; viscous liquid flows over to the clutch reserve cavity; the driving (11) and driven (13) disks are rotating with a gap in-between and, thus, ensure the fan switched-off state (in this case, the fan rotational frequency shall not exceed 1,500 rpm).

At the diesel coolant temperature exceeding 80°C, the thermosensitive element opens the valve (10) acting through the rod (17) and pusher (9) against the force of the return spring (7). The viscous liquid flows over into the head cavity through a hole in the driving disk and fills in the gap between the driving and driven disks, with the result that the disk are engaged, and the fan is turned on in its normal operating duty.

Attention: With the compressor running, the **forced mode** of fan operation shall be chosen**.**

To switch over the fan to the **forced (continuous) operation mode** proceed as follows:

- screw out the nut (4) of the stop (5) by 4…5 turns (about 5 mm);
- turn the fan by hand so that the stop (5) would enter the hole (3) in the driving disk (11). To lock the driving and driven disks, press the stop (5) by hand.

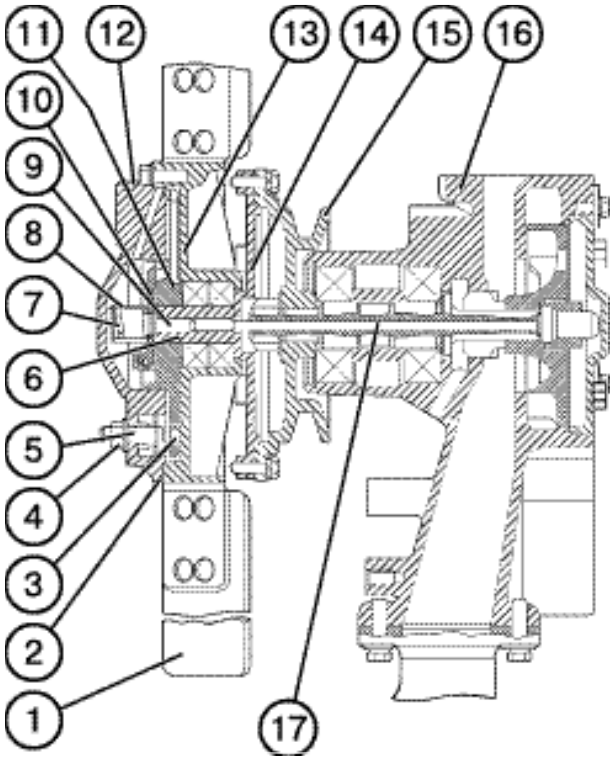


Fig. E-9. Pump assembled with the clutch:

1 – fan blade; 2 – driven cover; 3 – hole for stop; 4 – stop nut; 5 – stop; 6 – stem; 7 – return spring; 8 – spring holder; 9 – pusher; 10 – valve; 11 – driving disk; 12 – clutch; 13 – driven disk; 14 – drive shaft; 15 – water pump pulley; 16 – water pump; 17 – rod.

Electrical Equipment and the Starting System

One of electric assembly units to be installed on the engine is an 1150 W 14 V alternator represented by a contactless five-phase homopolar generator with one-end magnet excitation, built-in rectifier unit and integral voltage regulator. The alternator is driven from the crankshaft pulley, with a V-belt.

The engine is started by a 5.5 kW 24 V electric starter. The starter is switch on remotely, by means of an electromagnetic relay and starter switch.

To facilitate the engine starting at low temperature, the remotely-controlled glow plugs are used installed in the cylinder heads. The plugs, when switched on, heat the air sucked into the cylinders.

Compressor of the pneumatic system

To ensure the reliable operation of the tractor pneumatic system, the engine is equipped with a single-piston, single-stage compressor. The compressor is mounted on the fuel distribution unit cover flange and driven from the fuel-pump drive gear.

Note: With the compressor running, the **forced mode** of fan operation shall be chosen.

Power Transmission Train

The power train incorporates a clutch, transmission gearbox, FDA drive, FDA, and rear axle. It serves to transmit torque from the engine crankshaft to the front and rear wheels.

Clutch

The clutch (Fig. E-10) is of friction, double-dry-disk, permanently closed type.

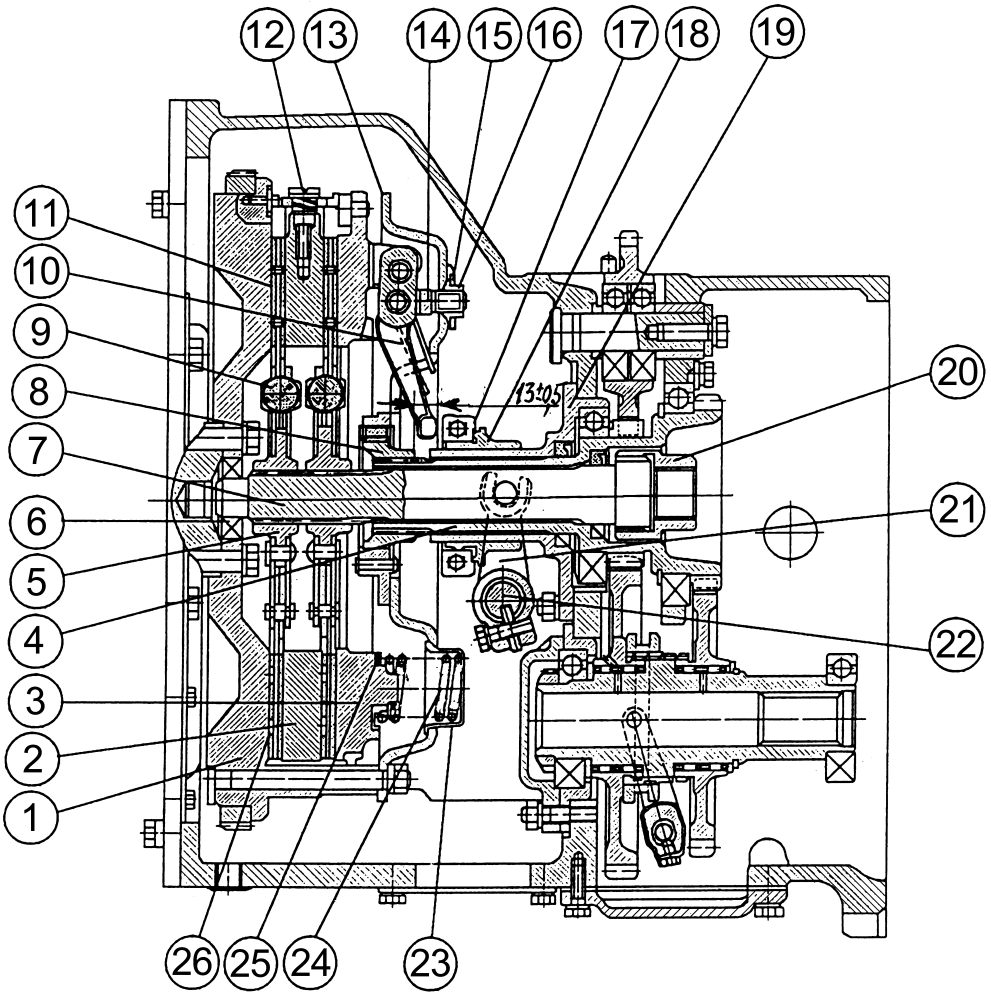


Fig. E-10. Clutch:

1 – flywheel; 2 – intermediate disk; 3 – pressure disk; 4 – input shaft; 5 – clutch hub; 6 – bearing; 7 – power shaft; 8 – hub; 9 – vibration damper; 10 – release lever; 11 – friction pad; 12 – leverage; 13 – bearing disk; 14 – fork; 15 – washer; 16 – adjusting nut; 17 – throw-out bearing; 18 – retractor; 19 – bracket; 20 – coupling bushing; 21 – fork; 22 – fork control axle; 23 – shell; 24 – pressure spring; 25 – heat-insulation liner; 26 – driven disk.

The driving parts of the clutch are the flywheel (1), pressure disk (3), and the intermediate disk (2) with three spikes on its surface which enter special slots of the flywheel. Two driven disks (26) together with vibration dampers (9) mounted on the power shaft (7) form the clutch driven unit. Nine pressure springs (24) ensure the required thrust force on the friction surfaces of the driving and driven units of the clutch to deliver engine power to the transmission.

The intermediate disk (2) has leverages (12) which provide automatic adjustment of its position when disengaging the clutch.

Forks (14) give support to the release levers. The forks are attached to the bearing disk by means of adjusting nuts (16) fixed with washers (15).

Clutch control (BELARUS-1221.2/1221.3)

The clutch is disengaged by stepping on the clutch pedal (1) (Fig. E-11) which acts through the linkage (1), (8), (5) onto the retractor (18) (Fig. E-10) and the throw-out bearing (17).

When the pedal (1) is released (Fig. E-11), the clutch is engaged by the pressure springs (24) (Fig. E-10). The spring (10) of the servounit (Fig. E-13) makes the clutch engagement easier and always presses the lever (9) against the cab floor when the clutch is engaged.

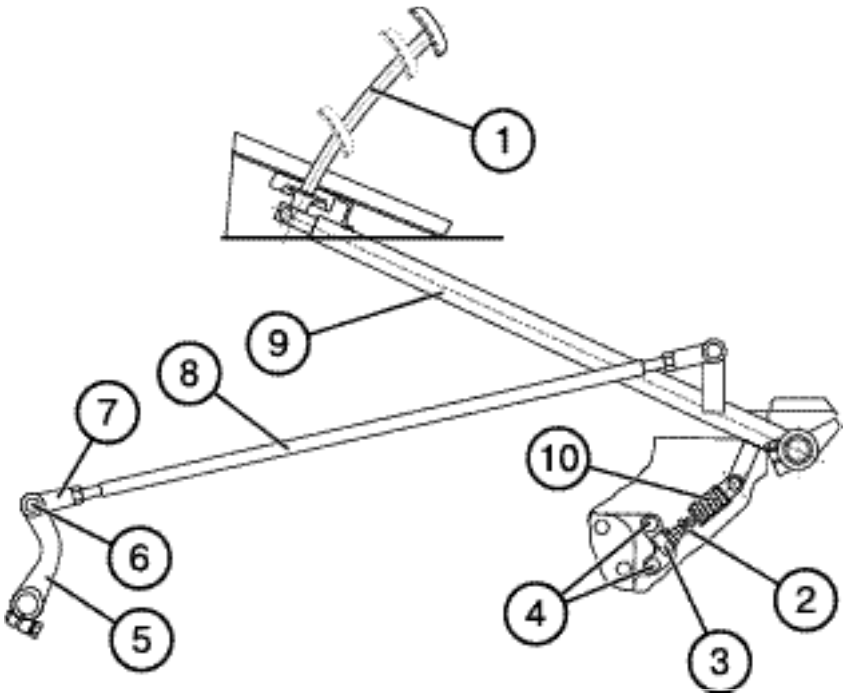


Fig. E-11. Clutch control:

1 – pedal; 2 – servounit adjusting bolt; 3 – bracket; 4 – fastening bolt; 5 – lever; 6 – pin; 7 – fork; 8 – rod; 9 – lever; 10 – servounit spring.

Clutch control (BELARUS-1221B.2)

I. Forward run

The clutch is disengaged by stepping on the pedal (1), Fig. E-11a acting upon the operating cylinder (2) of the hydraulic booster (6) and then upon the rod (9) and lever (10) of the shaft of the clutch disengagement forks. The hydraulic booster reduces the efforts needed to press the pedal when disengaging the clutch; also, it controls the travel of the lever (10) in proportion to that of the pedal.

On releasing the clutch pedal, all the clutch control components return to their initial position by the force of contracting springs (4, 8). To operate the hydraulic booster, a discharged oil flow is used supplied from the HSU metering pump through pipeline (12). After the hydraulic booster the oil is drained in to the HSU reservoir via the discharge oil pipeline (11).

With the engine inoperative, the control train functions as a mechanical one (Fig. E-11).

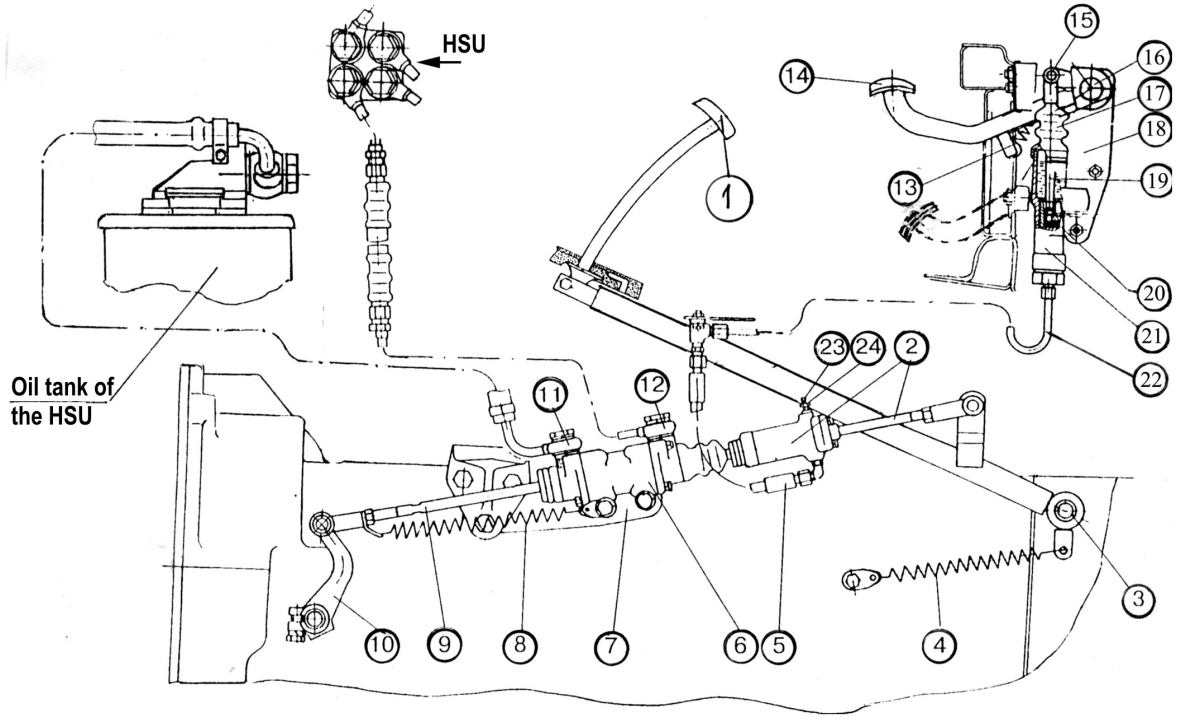


Fig. E-11a. Clutch control of a reversible tractor:

1 – clutch pedal; 2 – operating cylinder with a rod; 3 – axle; 4, 8 – contracting spring; 5 – hose; 6 – hydraulic booster; 7 – bracket; 9 – rod; 10 – lever; 11 – discharge oil pipeline; 12 – delivery pipeline; 13 – backward spring; 14 – overhung pedal; 15 – pin; 16 – axle; 17 – boot; 18 – bracket; 19 – piston rod; 20 – piston; 21 – master cylinder; 22 – oil pipeline; 23 – cap; 24 – overflow valve.

II. Reverse.

The hydrostatic drive consisting of an overhung pedal (14) with backward spring (13), master cylinder (21), oil pipeline (22), and operating cylinder (2) with a rod is used in this case.

The clutch is disengaged by means of the pedal (14) which acts on the piston rod (19) and piston (20) of the master cylinder. Under the action of the piston, the fluid passing through the oil pipe (22) and hose (5) causes the hydraulic booster (6) pushrod to move and, thus, to release the clutch in the manner described for the forward run of the tractor. As this takes place, the body of the service cylinder (2) and the rod as well as the pedal (1) remain stationary in the initial position.

Clutch casing

The clutch casing houses drives of a continuous PTO, HLL oil pump, and oil pump of the transmission gearbox hydraulic system.

Transmission gearbox (GB) (16F+8R)

The transmission gearbox (Figs. E-12, E-14) is a 16/8 mechanical-type fixed-ratio unit (4 forward and 2 reverse gear ranges) with the intra-range gear shifting by means of synchronizers. The GB provides 16 forward and 8 reverse speeds as well as FDA and synchronous PTO drive. The GB consists of housing, speed-gear assembly, downshift gear shaft and reverse gear, gear cluster, secondary gear-shaft, control mechanism, and the GB hydraulic system.

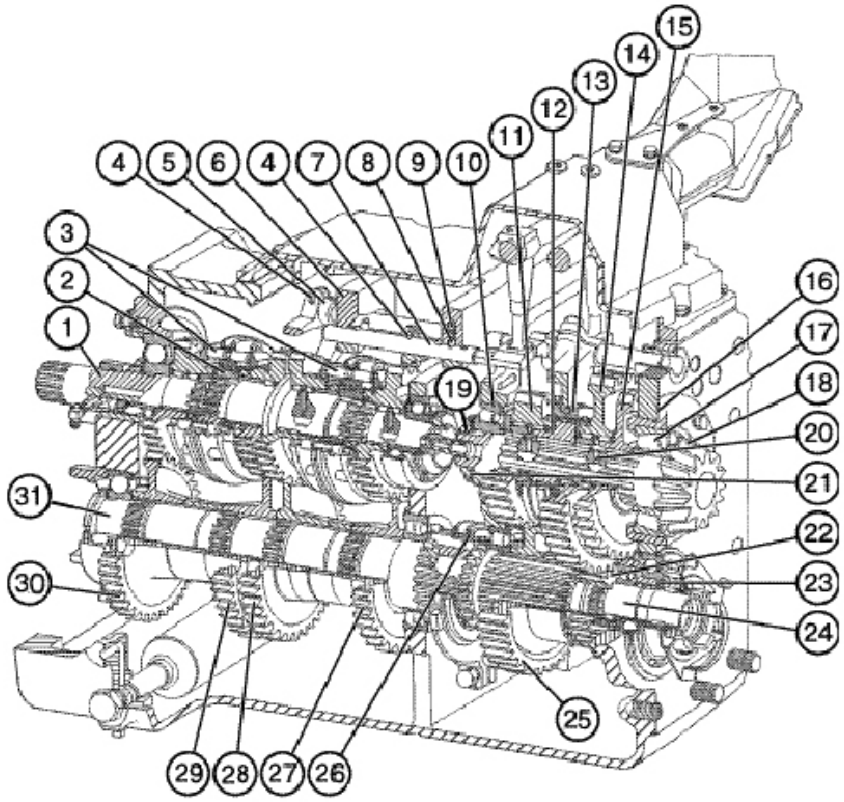


Fig. E-12. Transmission gearbox:

1 – primary shaft; 2, 20 – bushings; 3 – synchronizer; 4 – forks; 5, 7 – dog; 6 – fork assembly; 8 – ball; 9 – spring; 10, 17 – bearings; 11, 14, 15, 22, 23, 25, 27, 28, 29, 30 – gears; 12 – half-coupling; 13, 26 – toothed couplings; 16, 21 – adjusting shims; 18 – secondary shaft; 19 – nut; 24 – gear-cluster shaft; 31 – intermediate shaft

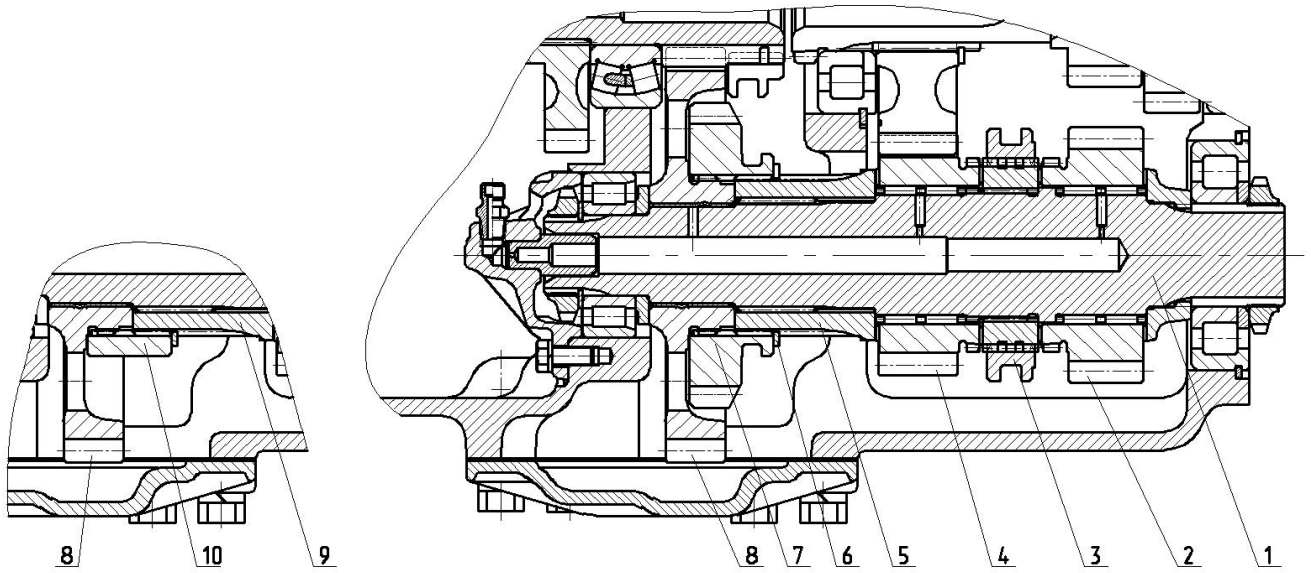


Fig. E-12.2. Shaft of downshift gears:
1 – primary shaft; 2, 4, 7, 8 – gears; 3 – coupling; 5, 9, 10 – bushings; 6 – retaining ring

The speed-gear assembly consists of a primary shaft (1) (Fig. E-12.1) in assembly with free needle bearing-mounted gears. The male splines carry two splined bushings (2) with inertia-type cone synchronizers (3) mounted thereon.

The driven gears (27,28,29,30) are fitted on the intermediate shaft (31) with slight interference.

The gears (22) and (25) are fitted on the gear-cluster shaft (24). The rear shaft bearing is located in the gear (23) boss of the synchronous PTO and FDA drive.

The secondary gear-shaft (18) is installed in the GB housing on the tapered roller bearings (10) and (17). The FDA driving gear (15) is fitted immovably on the shaft. The boss of this gear houses a driven gear (14) on needle bearings. The bushing (20) carries a driven gear (11) on its boss. The half-coupling (12) is mounted between the gears (11) and (14) on the shaft (18) splines. The entire set of parts on the shaft (18) is tightened up by the nut (19).

The gear (4) of the 1st and 2nd ranges and the gear (2) of the reverse are fitted on the shaft of downshift gears and reverse (1) (Fig. E-12.2). The gear (8) is mounted on the shaft by means of a bronze bushing. Depending on the standard equipment of the gearbox, the design of the shaft of downshift gears differs as follows:

1) if the gearbox provides for the possibility of installation of the speed-reduction gear, the splined bushing (5) is fitted with the speed-reduction gear wheel (7) connected with the splines of the gear (8) and fixed by means of the retaining ring (6) on the bushing (5);
2) if the gearbox does not provide for the possibility of installation of the speed-reduction gear, the splined bushing (9) is fitted with the bushing (10) connected with the gear (8) through the splines and fixed by means of the retaining ring (6) on the bushing (9).

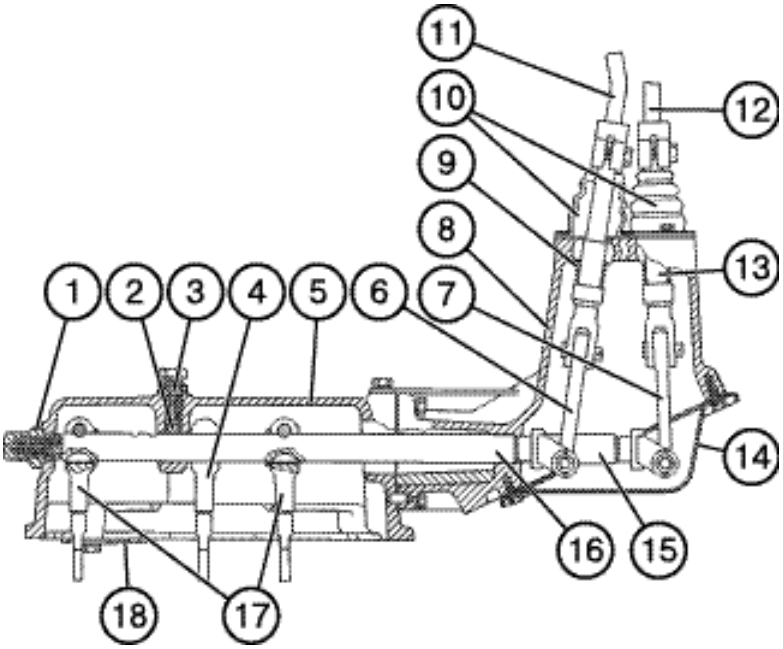


Fig. E-13. Synchronized transmission gearbox control mechanism:

1 – stop; 2 – ball; 3 – spring; 4 – arm; 5 – cover; 6, 7 – levers; 8 – casing; 9 – sphere socket; 10 – boot; 11 – speed-range change-over fork; 12 – gear shifting fork; 13 – spring; 14 – cover; 15, 16 – shafts; 17 – arms; 18 – gear gate.

GB control mechanism

The GB control mechanism (Fig. E-13) comprises the gear-shift and speed-range change-over mechanisms. The gear-shift mechanism is installed in the fork member (6) (Fig. E-12) and in the casings (5) and (8) (Fig. E-13). The engagement is achieved through the lever (7), shaft (15) and arm (4). The dogs (5) and (7) are installed in the fork member (6) (Fig. E-12) with the forks (4) fixed thereto. To exclude simultaneous engagement of two speeds, the locking balls are located between the dogs (5) and (7). To hold the forks (4) in the neutral and engaged positions, the spring-loaded ball-point locks (8) are provided.

The speed-range change-over mechanism consists of a fork (11) of the range change-over handle, lever (6), shaft (16) and arms (17) located in the bodies (5) and (8) as well as parts installed in the transmission gearbox casing.

The toothed couplings (13, 26) (Fig. E-12.1) and (3) (Fig. E-12.2) are moved by forks (1, 4, 14) (Fig. E-14) attached on the dogs (2, 5, 15), respectively. The toothed couplings (13, 26) (Fig. E-12.1) and (3) (Fig. E-12.2) are fixed in neutral and engaged positions by the parts (8, 11, 12) (Fig. E-14).

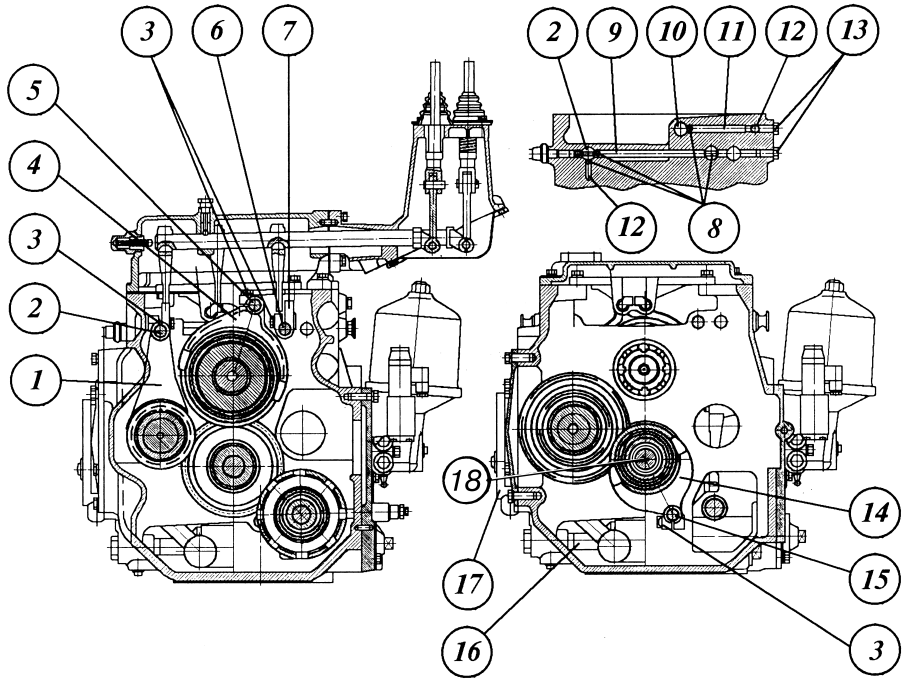


Fig. E-14. Gearbox:

1, 4, 14 – forks; 2, 5, 6, 10, 15 – dogs; 3, 13 – bolts; 7 – dog; 9 – pin; 11 – lock; 12 – spring; 8 – ball; 16 – filter; 17 – pump casing; 18 – inner shaft.

To exclude simultaneous engagement of the two toothed couplings (26) (Fig. E-12.1) and (3) (Fig. E-12.2) the locking balls (8) (Fig. E-14) are installed in holes in the GB casing (Fig. E-14).

24F+12R gearbox (GB) (option)

The transmission gearbox (Fig. E-15.1) is a mechanical-type fixed-ratio unit with speed ranges. It consists of a speed-gear assembly, downshift gear and reverse shaft, gear cluster, secondary shaft which are installed in the casing as well as the control mechanism and hydraulic system units.

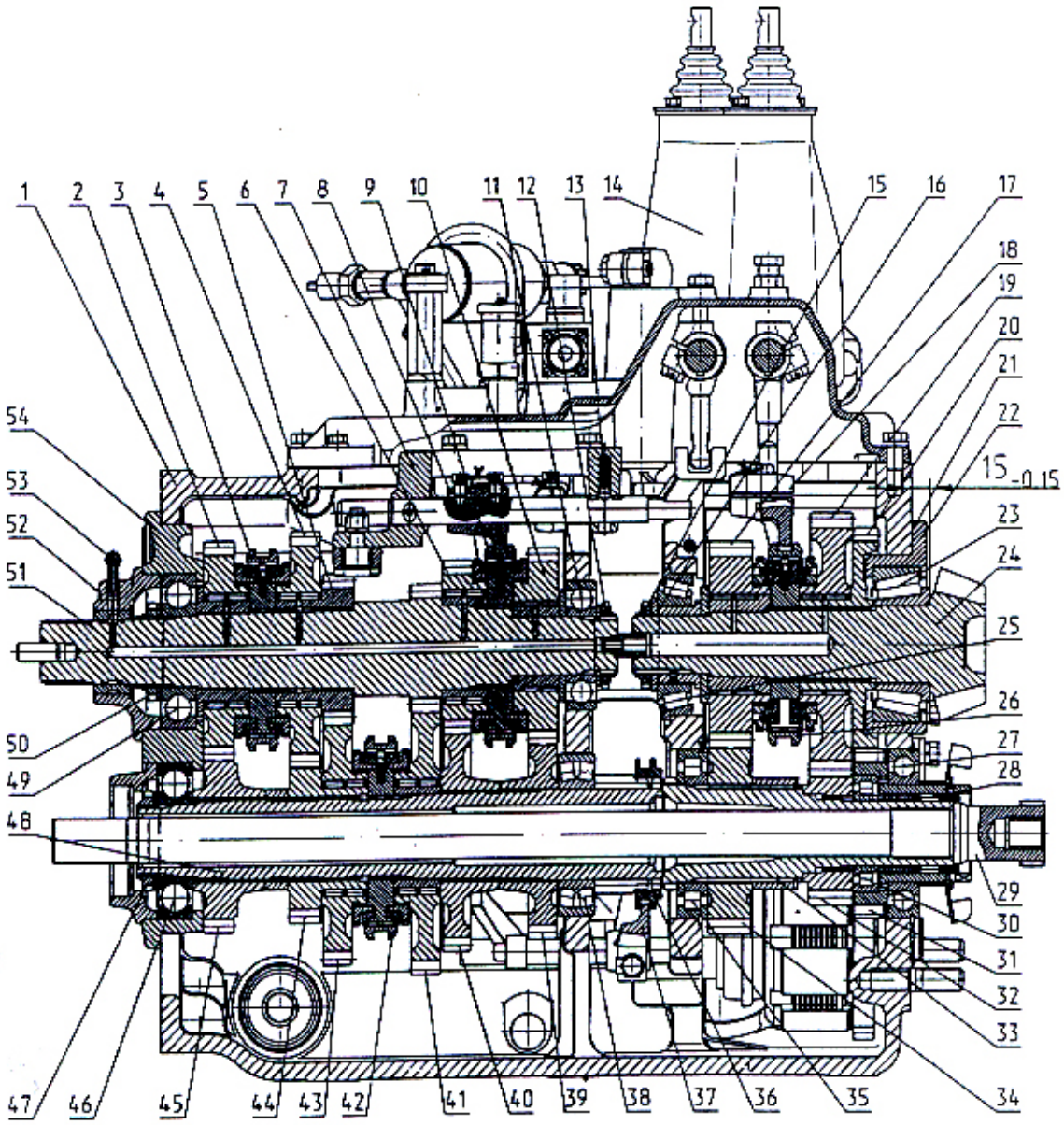


Fig. E-15.1. Transmission gearbox (longitudinal section):

1 – casing; 2, 4, 5, 6, 10, 17, 19, 20, 31, 32,34, 39, 40, 41, 43, 44, 45 – gears; 3, 9, 26, 42 – synchronizers; 7 – fork asembly; 8, 18, 37 – forks; 11, 23, 25, 27, 28, 30, 35, 38, 46, 49 – bearings; 12, 15, 47, 50 – nuts; 13 – ball-point lock; 14 – control mechanism; 16, 21 – adjusting shims; 22 – bearing seat; 29 – continuous PTO drive shaft; 33 – gear-cluster shaft; 36 – toothed coupling; 48 – intermediate shaft; 51 – primary shaft; 52 – lubrication delivery cup; 53 – oil pipeline; 54 – cover.

The **speed-gear assembly** is mounted on the cover (54) and consists of the primary shaft (51) with driving pinions (2, 4, 6, 10) mounted in needle bearings riding thereon. These pinions ensure engagement of the 5th, 6th, 3rd and 4th gear, respectively. The driving pinion of the 1st gear is made integral with the shaft (51) and the driving pinion of the 2nd gear is fixed rigidly on the shaft. The needle bearings are force-lubricated through the oil pipeline (53) and holes drilled in the shaft. The male splines of the shaft carry two inertia-type synchronizers (4) and (9); the latter effect engagement of the 5th, 6th, 3rd, and 4th gears. The primary shaft rests on ball bearings mounted in the cover (54) and casing (1).

The intermediate shaft (48) carries the press-fitted driven pinions (54, 40 and 39) of the 5th, 6th, 3rd and 4th gear, respectively. The driven pinions (43 and 41) of 2nd and 1st gears, respectively, rest on needle bearings. An inertia-type synchronizer (42) to help engagement of the 1st and 2nd gears.

The downshift and reverse gear shaft 3 (see Fig. E-15.2) is mounted in the body (4) and rests on bearings (1 and 12). The shaft also carries a driven pinion (10) which is coupled to the shaft through bushings (9), forward driving pinion (8) and reverse pinion (5) running in needle bearings. These pinions are coupled with the shaft through a toothed coupling (6). Bushing (16) which sits on male splines of the shaft is locked on the shaft by means of a retaining ring (7).

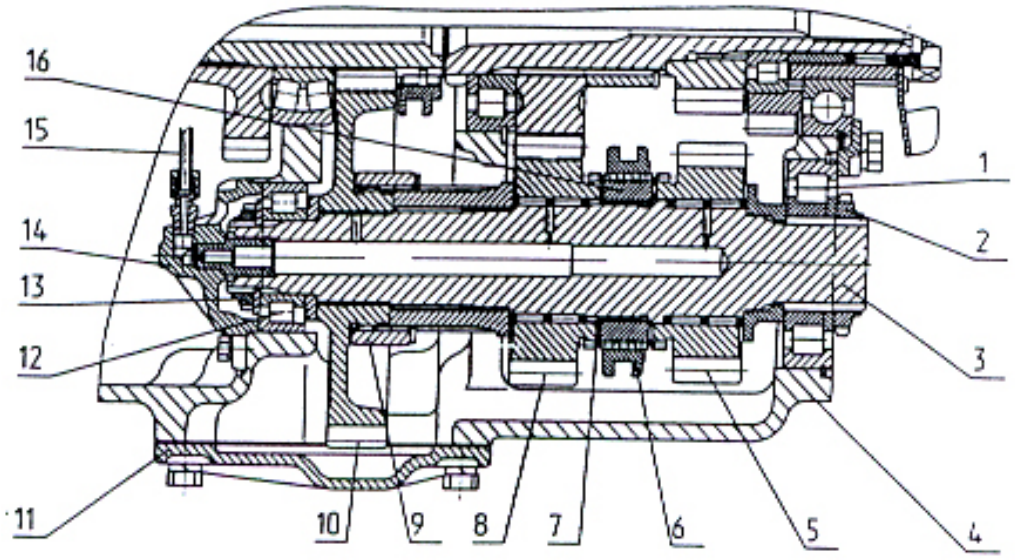


Fig. E-15.2 Downshift and reverse gear shaft:

1, 12 – bearings; 2, 13 – nuts; 4 –casing; 5, 8, 10 –pinions; 6 – toothed coupling; 7 – retaining ring; 9 – bushing; 11 – cover; 14 – oil delivery cup; 15 – oil pipeline; 16 – bushing

The **gear-cluster shaft 33 (see Fig. E-15.1)** is installed in the casing (1) and rests in bearings (27) and (35). Gears (32) and (34) are splined-mounted on the shaft and locked with retaining rings. The PTO driven pinion (31) is mounted on the shaft in roller bearings (28) and (30).

The **secondary shaft 24 (see Fig. E-15.1)** is installed in the body (1) in tapered bearings (23) and (25). The bearings are adjusted by shims (16), while the position of the shaft bevel pinion relative to the body end-face (size $15_{-0.15}$) is adjusted through selection of the adjusting shims (21). The FDA and synchronous PTO drive pinion (20) and the synchronizer (26) boss are rigidly fixed on the shaft. The driven pinions (17) and (19) rest in needle bearings; the latter are force-lubricated through the holes drilled in the shaft. The shifting between the pinions is made with the locked-on-dog fork (18) by means of the synchronizer (26). The dog is installed in a recess in the casing (1) and fixed with a ball-point lock.

The sets of components on the primary, intermediate, secondary as well as down-shift-and –reverse gear shafts are tightened up by nuts (12, 15, 47 and 50).

Transmission Gearbox Control Mechanism

The transmission gearbox mechanism comprises a gear-shift mechanism and a speed-range change-over mechanism with an electro-hydraulic system of change-over between high “H” and lower “L” stages of the GB reduction gear.

The **gear-shift mechanism (Fig. E-15.3)** is mounted in the speed-gear assembly, fork member (7) and the control mechanism (14) cover (see Fig. E-15.1).

The cover (54) (Fig. E-15.1) houses the dogs with shifting forks of 1st, 2nd and 5th, 6th gears fastened thereto. The dogs are fixed in the cover with ball-point locks. The position of forks on the dogs is adjusted by means of tapered screws.

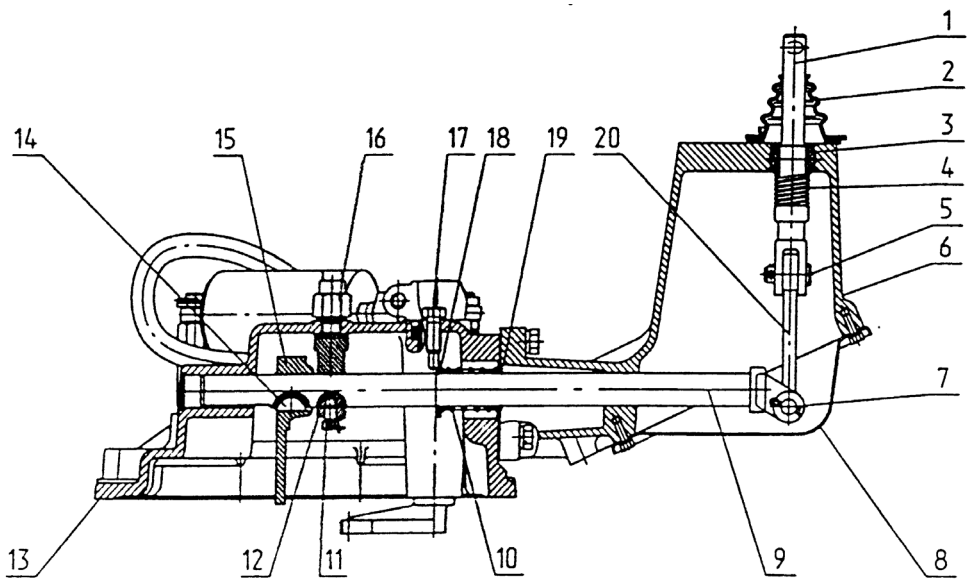


Fig. E-15.3. Gear-shift mechanism:

1 – fork; 2 – boot; 3 – sphere socket; 4 – spring; 5, 7 – pins; 6 – casing; 8 – cover; 9 – shaft; 11 – bolt; 12 – bushing; 13 – cover; 14 – key; 15, 20 – levers; 16 – pick-up; 17 – screw; – 18 – washer; 19 – retaining ring.

Three dogs, a fork (8), ball-point lock (13) and parts of the two gear engagement lockout mechanism are installed in the fork assembly (7). The member is attached to the transmission gearbox casing (1).

The shaft (9) with the arm (15) and bushing (12) fitted thereon is installed in the supports of cover (13) and casing (6) (see Fig. E-15.3). The two bushings (18) and spring (10) are installed between the retaining rings (19). The bushing end-faces abut the screw (17) and the casing (6) end-face. This arrangement serves to set the gear-shift lever to neutral. The shaft (9) is coupled with fork (1), with the gear-shift lever fixed thereto through the pins (5 and 7) and lever (20). The fork (1) is located in the casing (6), in the sphere socket (3) and spring-loaded with the spring (4).

The **speed range change-over mechanism (Fig. E-15.4)** is installed in the transmission gearbox casing (1) and cover of the gear-shift mechanism (14) (see Fig. E-15.1).

In the casing (1), the fork (37) for changing-over the toothed coupling (36), the fork for changing-over the toothed coupling (6) (see Fig. E-15.2) and the fork (18) for changing-over the synchronizer (26) (see Fig. E-15.1) are mounted on the dogs. The dogs are locked in the body with ball-point locks.

In the control mechanism (Fig. 15.4), the shaft (9) together with arms (10) keyed thereto rests in the supports of cover (12) and housing (18). The shaft (9) is locked with a ball-point lock (14) and is connected to fork (1) with attached speed-range change-over lever by means of pins (5 and 7). The fork (1) is located in the casing (18), in the sphere socket (3) and preloaded with spring (4).

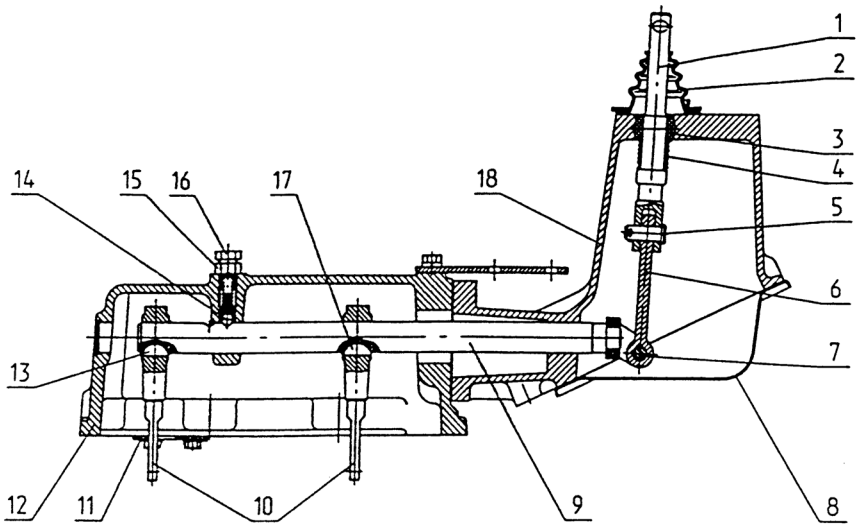


Fig. E-15.4. Speed-range change-over mechanism:

1 – fork; 2 – boot; 3 – sphere socket; 4 – spring; 5, 7 – pins; 6, 10 – levers; 8 – covers; 9 – shaft; 11 – link; 13, 17 – keys; 14 – ball-point lock; 15 – nut; 16 – bolt; 18 – casing.

The **high-to-low reduction gear stage switch-over mechanism of the transmission gearbox** (Fig. E-15.5) is mounted on the gear-shift mechanism cover and consists of a cylinder (11) fixed on the axle (12), pusher (7) and lever (5) mounted on the roller (4). The fork (16) is connected with the lever (5) by means of the pin (6). The lever of the roller (4) meshes with the dog of the fork (18) (Fig. E-15.1) and forces the synchronizer (26) coupling to move as the roller rotates. The position of lever (5) is adjusted by changing the length of the pusher (7) with further locking by a check-nut (8). The cylinder (11) communicates with the hydraulic system through an electro-hydraulic valve (14). The sensor (15) connects the valve (14) to the electric circuit when the gear-shift lever is in its neutral position, only. The drawn-in position of the cylinder corresponds to the lower “L” stage of the transmission gearbox reduction gear. Pressure-sensitive pick-ups (10) serve to indicate the engaged state of the reduction gear.

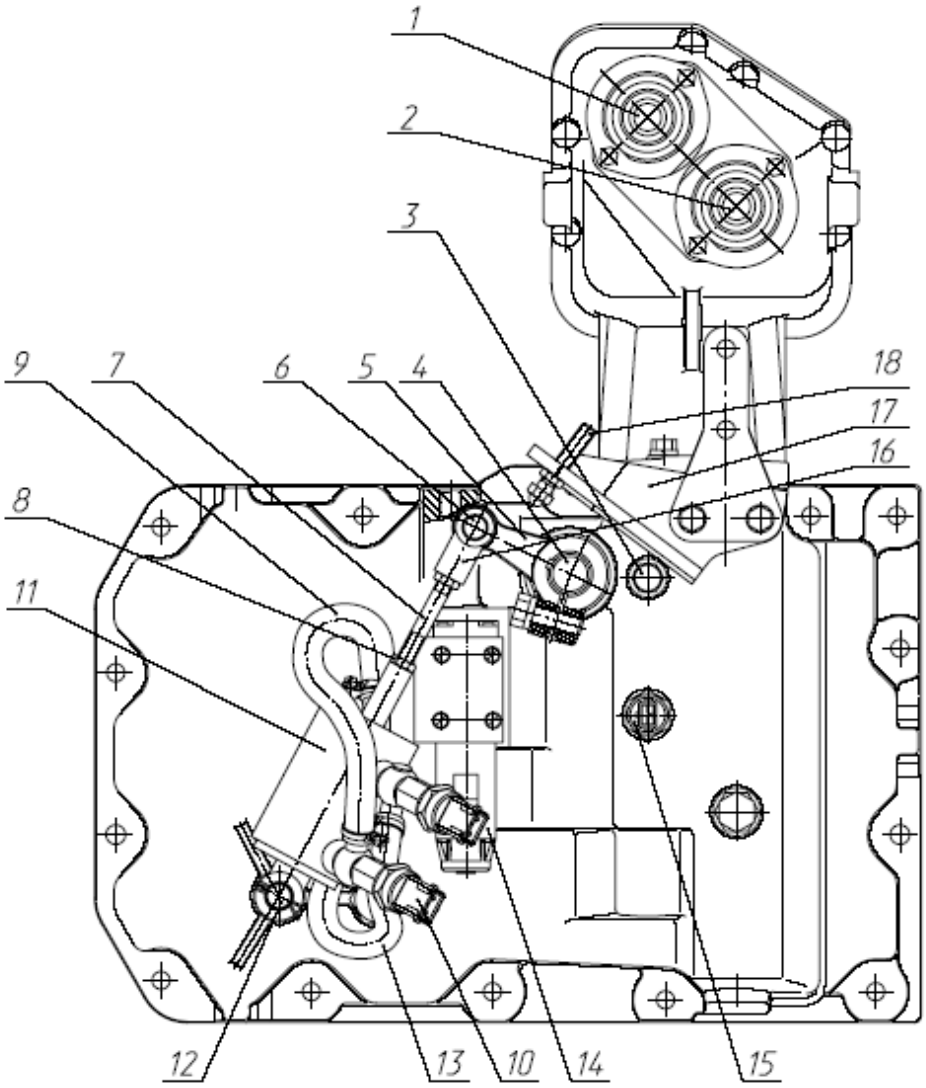


Fig. E-15.5. High-to-low reduction gear stage switch-over mechanism:

1 – gear-shift fork; 2 – speed range change-over fork; 3 – bolt; 4 – roller; 5 – lever; 6 – pin; 7 – pusher; 8 – check-nut; 9, 13 – oil pipelines; 10 – pressure-sensitive pick-up; 11 – hydraulic cylinder; 12 – axle; 14 – electro-hydraulic valve; 15 – sensor, 16 – fork, 17 – bracket, 18 – adjusting screw.

Transmission Gearbox Reduction Gear Control System

The electro-hydraulic control system (Fig. E-15.6) involves a control panel (1) located in the tractor cab to the right of the driver, a gear-shift and reduction gear stage switch-over lever (3), GB neutral pickup (5), sensors (7 and 8) mounted on the reduction gear switch-over hydraulic cylinder (11) (Fig. E-15.5), electro-hydraulic distributor (6) located atop of the transmission gearbox cover, and connecting cables (4) with terminal blocks (9). The system is supplied with power from the on-board power system through a fuse block (2). Voltage is applied following the engine start-up.

The handle of the lever (3) contains the pushbuttons (10 and 11) and indicators (LEDs) (13, 12) to signal the high or low reduction gear stage ON-state, respectively.

The panel (1) contains also the indicators (15 and 14) to signal the ON-state of the high or low reduction gear stage and reduction gear control relay.

The system allows the reduction gear stages to be switched over when the lever (3) is in its neural position only (contacts of the transmission gearbox neutral position pickup (5) are closed).

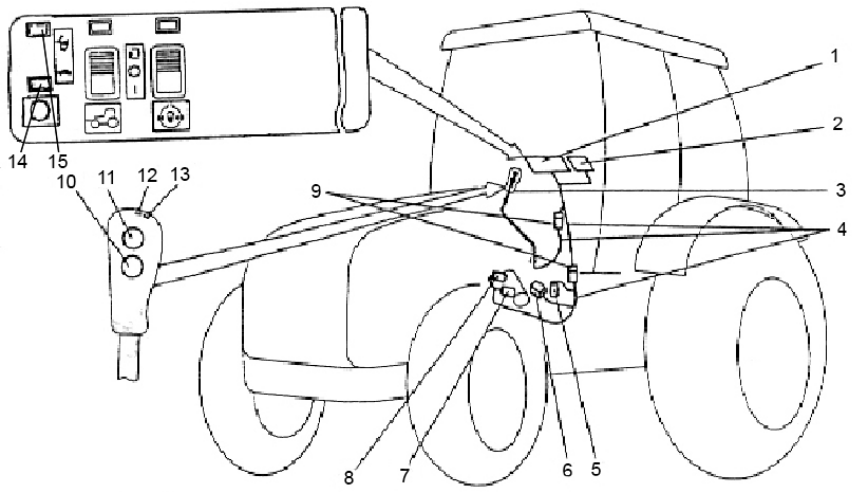
Signals are applied to sensors (13, 12) and (15, 14) from respective pressure-sensitive pickups (8, 7).

Following the engine start-up, the default setting is the reduction gear low stage ON. In this case, the LED indicators (13, 15) should be on.

Switch over to the reduction gear high stage is to be effected by depressing the pushbutton (11). Now, the LED indicators (13, 15) should go off, while LEDs (12, 14) turn on.

Switching over from high to low stage is achieved be depressing the pushbutton (10).

The control system circuit diagram for the GB reduction gear, DL and FDA control is given at the end of the “Manual”.



ATTENTION! The reduction gear stages shall be only changed-over from the lower stage to the higher one and vice versa when the tractor is fully stopped.

Fig. E-15.6

1 – control panel; 2 – fuse box; 3 – gear-shift and reduction gear stage switch-over lever; 4 – connecting cables; 5 – transmission gearbox neutral position pickup; 6 – reduction-gear electrical distributor; 7 – higher stage pressure pickup; 8 – lower stage pressure pickup; 9 – terminal blocks; 10 – lower stage switch-on pushbutton; 11 – higher stage switch-on pushbutton; 12 – higher stage LED indicator; 13 – lower stage LED indicator; 14, 15 – pilot lamps.

Engine Starting Interlock

As a precautionary measure against the engine starting when the range is switched on, the tractor is equipped with a special interlock device (Fig. E-15.7). The interlock consists of a switch (8) located in the transmission gearbox casing on the left side, balls (6) and pins (7, 7a).

On switching the range on, the interlock mechanism opens the switch contacts and breaks the circuit of the starter intermediate relay (1).

The shims (9) are provided to adjust the instant of contact opening (9).

ATTENTION! Before proceeding to starting the engine, set the transmission gearbox speed-range change-over lever to its neutral position!

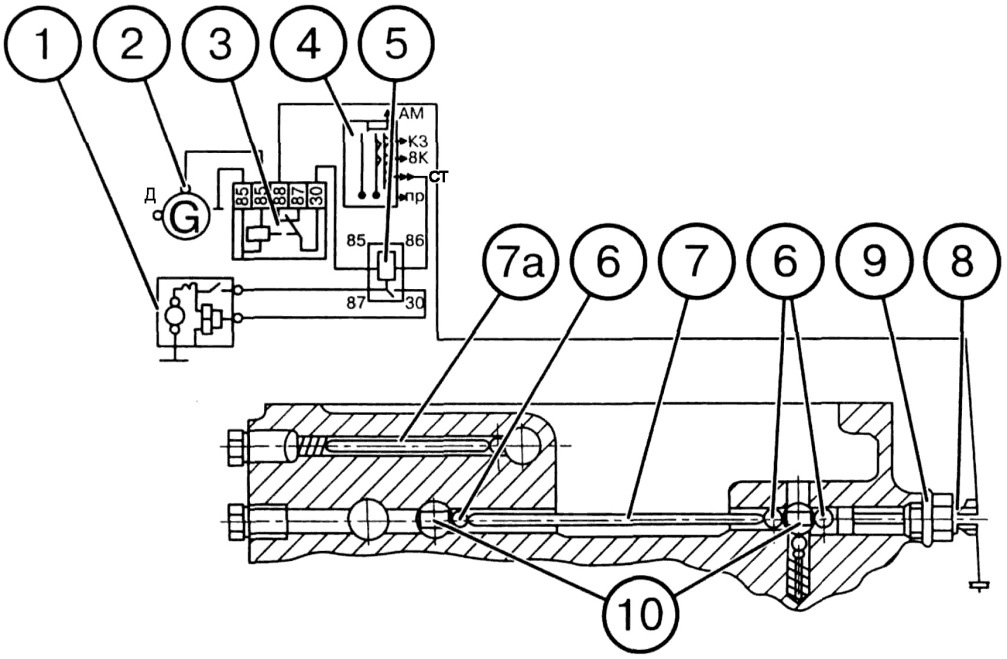


Fig. E-15.7. Diagram of interlocking the engine starting:

1 – starter; 2 – alternator; 3 – interlock relay; 4 – starter switch; 5 – starter relay; 6 – interlock mechanism balls; 7 – pin; 7a – lock; 8 – unlock switch; 9 – adjusting shims; 10 – range switch-over dogs

Rear Axle

The rear axle (Fig. E-16) consists of the final drive, differential assembled with a hydraulically-driven friction clutch used for locking, hub drives located in the rear axle housing, and the will transmission assemblies located in the half-axle housings.

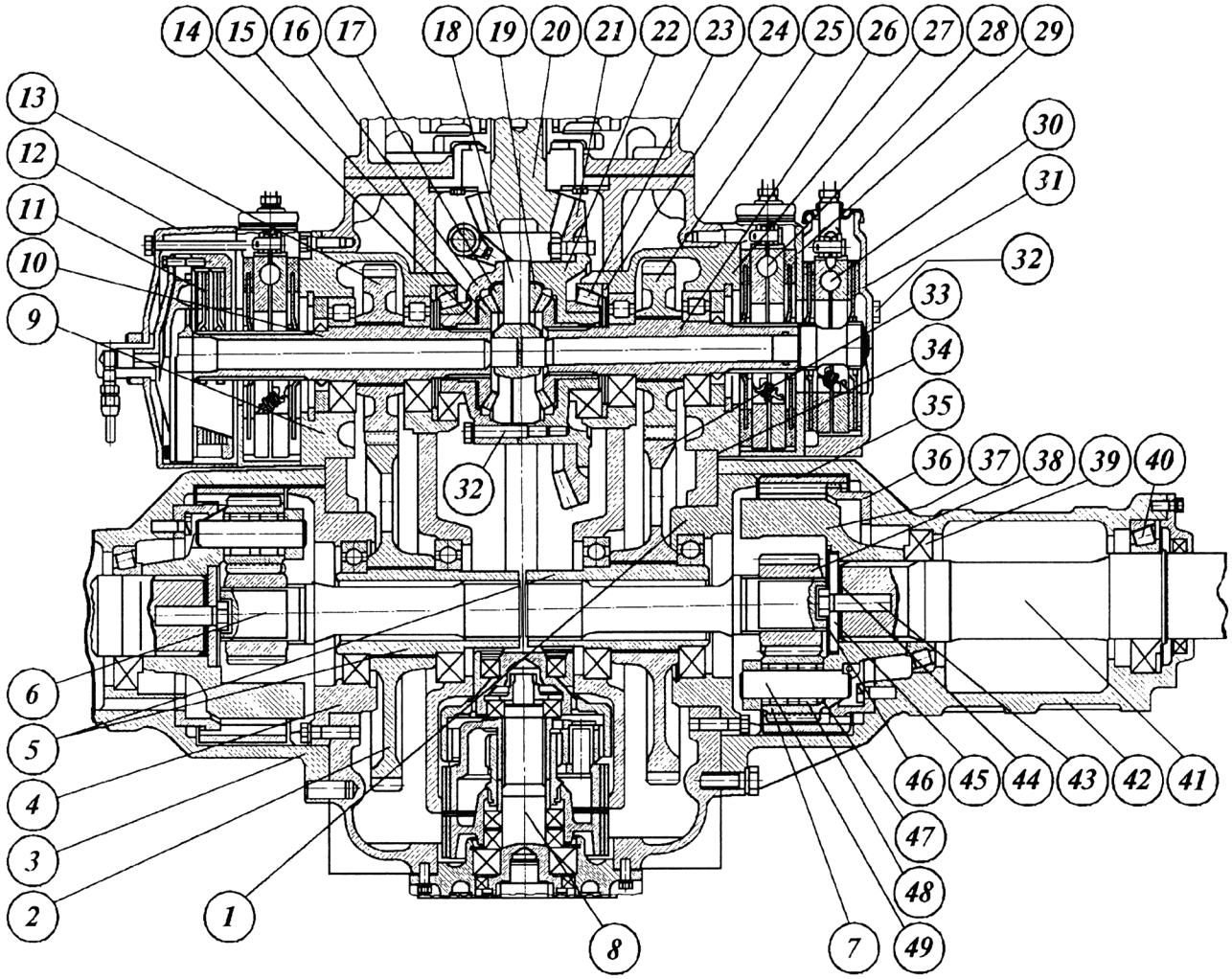


Fig. E-16. Rear axle:

1, 4, 9, 27 – bearing bodies; 2 – hub-drive gear; 3 – left-hand half-axle housing; 5 – hub-drive gear bushings; 6 – torsion bar; 7 – differential pinion; 8 – PTO; 10 – left-hand hub-drive pinion shaft; 11 – differential lock clutch; 12 – differential lock housing; 13 – hub-drive pinion; 14 – half-axle gear bearing washer; 15 – half-axle gear; 16 – differential cover; 17 – differential pinion; 18 – differential spider; 19 – spherical washer; 20 – final drive pinion; 21 – final drive gear; 22 – differential case; 23 – bearing; 24 – thrust ring; 25 – hub-drive pinion; 26 – right-hand pinion shaft; 28 – service brake; 29 – service brake housing; 30 – parking brake; 31 – parking brake housing; 32 – bolt; 33 – hub-drive gear; 34, 44 – adjusting shims; 35 – crown gear; 36 – crown gear hub; 37 – cage; 38 – sun gear; 39, 40 – bearings; 41 – half-axle; 42 – right-hand half-axle; 43 – bolt; 45 – thrust washer; 46 – arresting plate; 47 – washer; 48 – rollers; 49 – differential pinion axle.

Final Drive

The final drive of a bevel circular-arc teeth type consists of a final-drive bevel pinion (20), which is integral with the transmission gearbox secondary shaft, and a final drive gear (21), the latter being bolted to the differential case (22).

Differential

The differential of the closed lockable bevel-pinion type consists of the case (22) and cover (16) fastened together by means of the bolts (32), four differential pinions (17) together with spherical washers (19) and two thrust washers (14). The differential case is installed as an assembly in the rear-axle housing in two roller bearings (23). To lock the differential, the hydraulically-controlled friction multiple-disk clutch (Fig. E-17) which interlocks the cross and the differential pinions with the left-hand half-axle gear of the differential.

Hub Drives

The hub drives consist of two pairs of straight spur pinions and gears (13, 2) and (25, 33) (Fig. E-16).

The hub-drive pinions (13, 25) are mounted in the splines of shafts (10, 26) which are running in roller bearing bodies. The differential is locked axially by means of the bearings (23).

The shafts (10) and (26) link the half-axle gears (15) with the hub-drive pinions and the brake disks through their spline joints.

The hub-drive gears (2, 33) are mounted on splined bushings (5) which are mounted on ball bearings.

The adjusting shims (34) with the thickness of 0.2 mm and 0.5 mm are inserted between the flanges of the bearing bodies (9, 27) and the rear axle housing for adjustment of the axial clearance in the bevel roller bearings (23) and backlask in the final drive pinion-to-gear (20), (21) pair. The bevel roller bearings shall be so adjusted that the torque needed for turning the differential would be 5 to 8 N-m. The backlash in the final drive shall be within the range 0.20…0.55 mm.

Wheel Transmissions

The wheel transmissions are made up of two straight-spur planetary trains, located in the half-axle housings (3, 42), torsion bars (6) made with splines which link the hub-drive gears (2, 33) with the above-mentioned planetary trains through splined bushings (5).

The planetary train consists of a fixed crown gear (35) mounted on the boss (36) and bolted to the housing (42); carrier (37); sun gear (38) seated on the splines of torsion bar (6) and four differential pinions (50) running on the rollers (48) of the axles (49).

The half-axle bearings (39, 40) are adjusted by formation of stocks of shims (44) with the thickness of 0.2-mm and 0.5 mm.

Differential Lock Clutch and Three-Disk Service Brake

The multiple-disk hydraulically controlled differential lock clutch (1) (Fig. E-17) is located in casing (8) which is bolted to the rear axle housing through the housing of the left-hand three-disk brake and the bearing body. The three-disk dry service brake housing (17) contains the brake disks (16), pressure disks (13), intermediate disk (11), balls (15) and brake release springs (not shown).

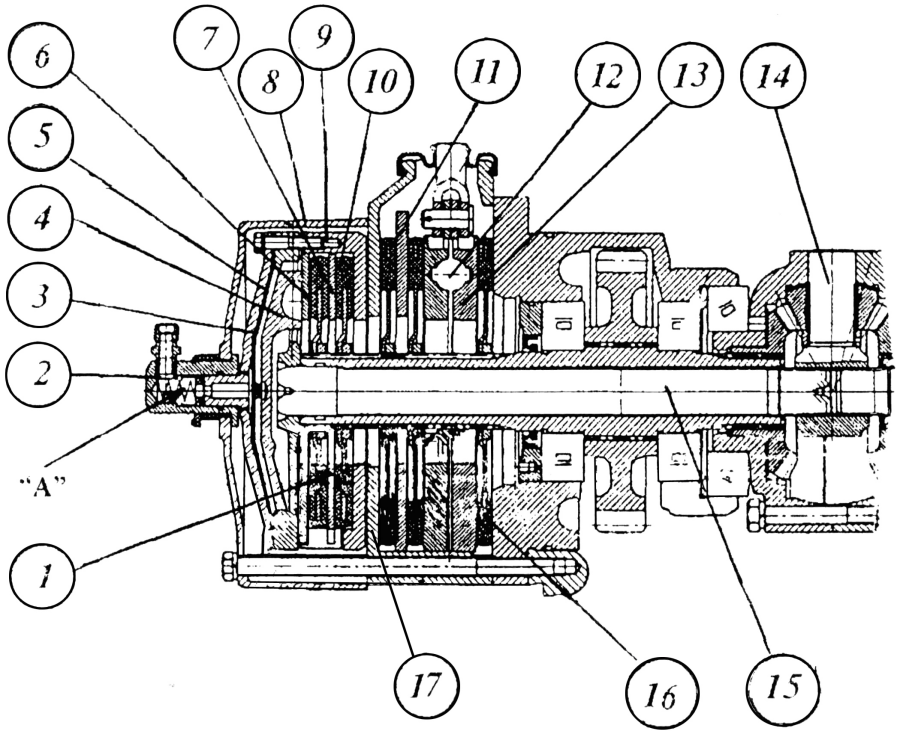


Fig. E-17. Differential lock clutch:

1 – lock clutch; 2 – adapter; 3 – diaphragm cover; 4 – pressure disk; 5 – diaphragm; 6 – release disk; 7 – intermediate disk; 8 – housing; 9 – clutch body; 10 – locking; 11 – brake intermediate disk; 12 – ball; 13 – pressure disk; 14 – differential spider; 15 – lock-up shaft; 16 – brake disk; 17 – left-hand three-disk brake housing.

The clutch consists of lock-up shaft (15) which is spline-coupled with the differential spider (14), body (9), pressure disk (4), release disk (6), diaphragm (5), cover (3), adapter (2) and disks (10) spline-mounted on the left-hand wheel transmission pinion.

Under the action of oil delivered under pressure to the rod-end chamber "A" from the ADL control hydraulic system, the diaphragm (5) in conjunction with the pressure disk (4) moves and presses disks (10) against the bearing surfaces of the clutch body (9), intermediate disk (7) and release disk (6) so that the differential (the differential spider with the left-hand half-axle gear) gets locked. When the front wheels turn to a certain degree from the straight-line motion, the rod-end chamber "A" opens to the discharge line, and the differential unlocks.

Automatic Differential Lock-Up (ADL)

The ABD feature is designed to improve the tractor traction and adhesion properties and off-road capability. It consists of a two-disk hydraulically operated lock-up clutch (Fig. E-17) and an electro-hydraulic control system. The latter ensures two operation modes: “automatic” and “forced”.

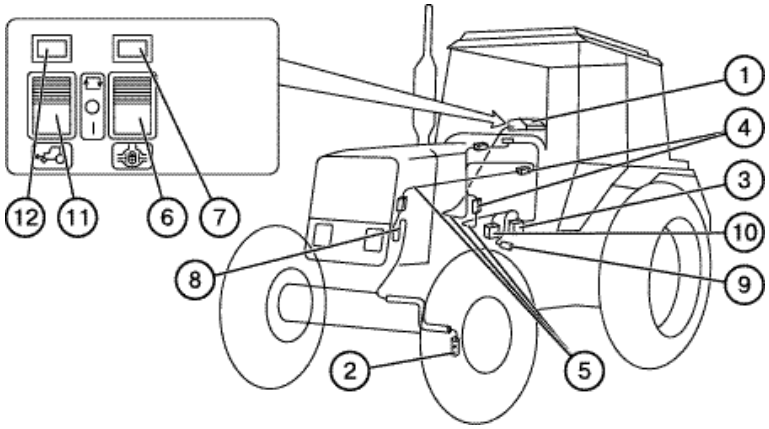


Fig. E-18. Rear axle differential lock and FDA drive control system:

1 – control panel; 2 – steering wheel turning angle sensor; 3, 10 – control electro-hydraulic distributors for the DL and the FDA drive, respectively; 4 – terminal blocks; 5 – connecting cable; 6 – DL control key; 7, 12 – indicator lamps; 8 – loop; 9 – automatic FDA drive control sensor; 11 – FDA drive control key

The **electro-hydraulic DL control system** of the rear axle (Fig. E-18) is composed of a panel (1), turning angle sensor (2) of steering wheels; installed on the left-hand FDA reduction gear, DL control electro-hydraulic distributor (3) located on the right-hand GB cover and coupled through an oil pipeline with the DL clutch, and connecting cables (5) with terminal blocks (4). The system is supplied with power from the on-board electrical circuit via a safety fuse in the fuse box installed in the dashboard. The system is powered after starting the engine. The key (6) for controlling the DL control and DL indicator lamp (7) are installed on the panel (1) face. The latter is located over the right-hand side tractor control panel.

How to Use the Rear Axle DL Control Key (6)

1. When performing jobs with great amount of relative slippage of the rear wheels, depress the upper part of the key (6) (fixed position), thus, activating the automatic mode of differential lock-up. Now the electromagnet of the DL control electro-hydraulic distributor (3) is energized, the electro-hydraulic distributor spool valve moves and disconnects the lock clutch from the discharge line and connects it with the feed port. Then, the lock-up clutch operates and interlocks the differential and the rear wheels. The differential is unlocked automatically when the steering wheels turn to a certain degree.
2. If a short-time interlocking of the rear wheels is necessary, including occasions of turning, press the lower part of the key (6) and hold it in this depressed position. When released, the key (6) returns to its middle, fixed position, and differential interlock unlocks.

Service Brakes (BELARUS-1221.2/1221.3)

The tractor is equipped with three-disk dry brakes of an increased standard size. The disks of the left- and right-hand brakes (2) (Fig. E-20) are spline-mounted on the rear axle hub drive pinions. The brakes consist of housings (1), friction disks (2), pressure disks (4), balls (5) and contraction springs (6).

The brake actuator is of mechanical type. Each brake is activated by a separate pedal (23).

To brake both wheels at the same time, interlock of the pedals with a latch strip (24). When the right-hand brake pedal is depressed, the stop-signal lamps light up.

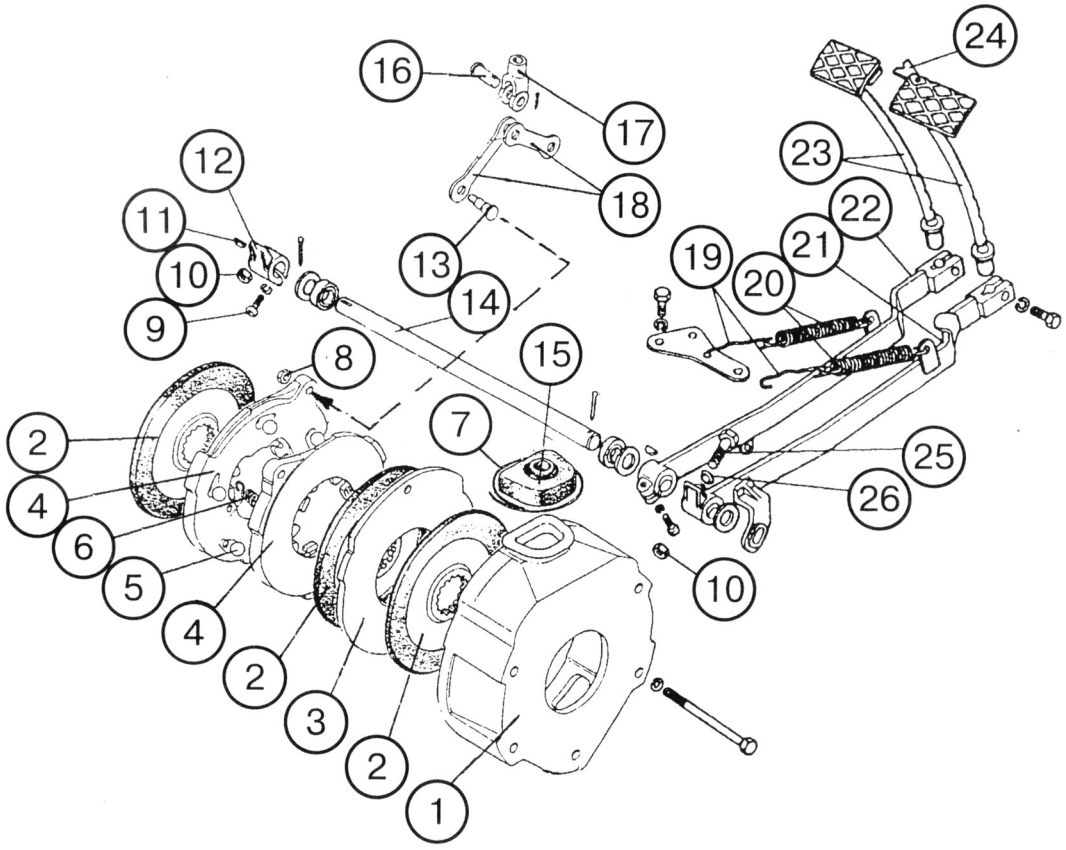


Fig. E-20. Service brakes and their controls (exploded view):

1 – housing; 2 – brake disk; 3 – intermediate disk; 4 – pressure disk; 5 – ball; 6 – spring; 7 – wire; 8 – nut; 9 – bolt; 10 – check nut; 11 – key-tongue; 12 – lever; 13 – pin; 14 – axle; 15 – boot; 16 – pin; 17 – fork; 18 – tie-rod; 19 – hooks; 20 – contraction spring; 21, 22 – lever; 23 – stem with pad (pedal); 24 – latch strip; 25 – adjusting bolt; 26 – spherical washer.

Parking brake

The tractor is equipped with a dry two-disk parking brake of reduced standard size (with the diameter of 178 mm), attached to the housing of the right-hand service brake. The brake disks (5) (Fig. E-21) are mounted on the splines of the shaft (3) located inside the right-hand hub-drive pinion shaft and is connected to the rear-axle differential spider.

The parking brake is applied with the help of lever (11) placed on the right-hand wall of the cab. The lever is locked when set to work by means of a stop catch (12) on the toothed sector (13).

With the parking brake applied, the differential spider interlocks with the rear axle housing through the shaft (3), pressure disks (2), brake disks (5), and casing (18).

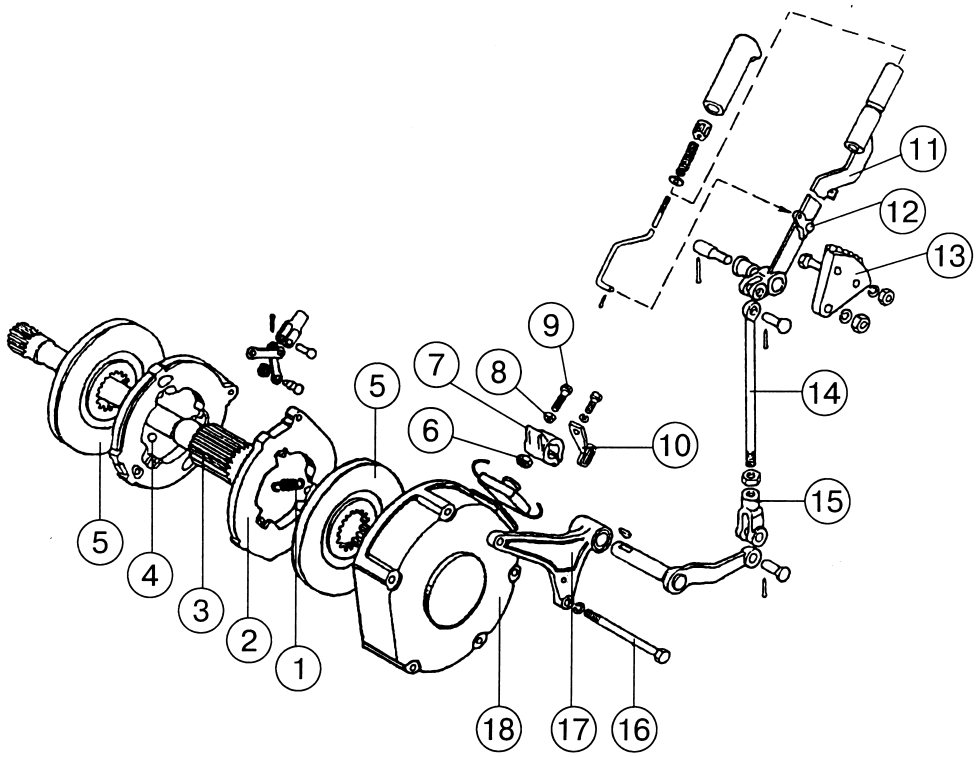


Fig. E-21. Parking brake structure and control:

1 – spring; 2 – pressure disk; 3 – shaft; 4 – ball; 5 – brake disk; 6 – check-nut; 7, 11 – lever; 8 – spherical washer; 9 – adjusting bolt; 10 – brake cock drive lever; 12 – stop catch; 13 – sector; 14 – tie-rod; 15 – fork; 16 – bolt; 17 – bracket; 18 – case.

Service Brake Controls (BELARUS-1221B.2)

For operation in reverse, the reversible tractors are equipped with hydrostatic service brake controls which act onto lever (4) (refer to Fig. E-21.1) of the right-hand straight-ahead brake pedal. An additional, reverse brake pedal (2) actuates the master brake cylinder (3) which is connected with the service brake cylinder (5) through pipeline (1). The latter exerts its effect on lever (4) of the right-hand straight-move brake pedal by means of lever (6) and tie-rod (11). In the reversal operation mode, the both pedals should be interlocked with the latch strip.

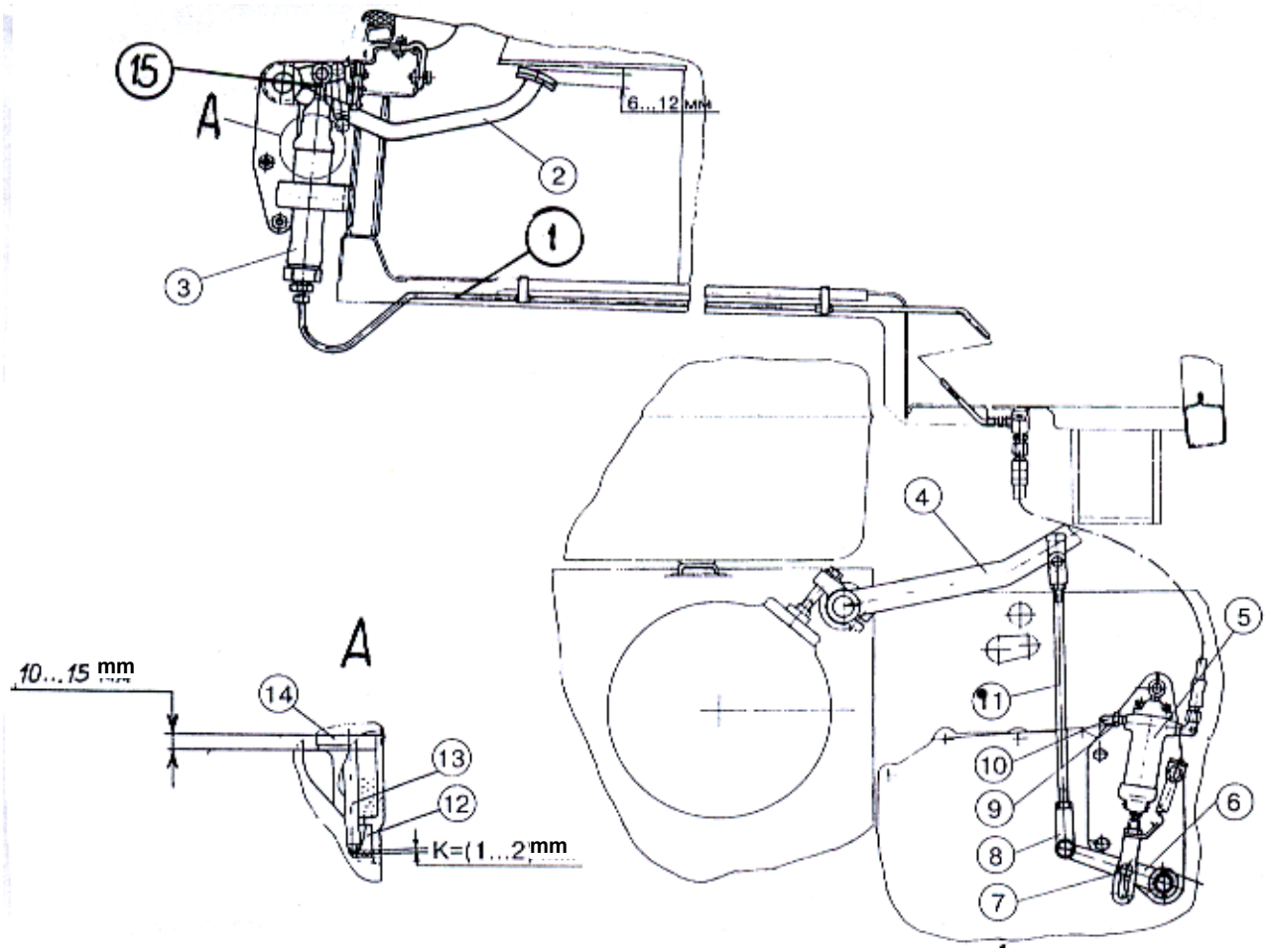


Fig. E-21.1. Brake control in the reverse operation mode:

1 – pipeline; 2 – reversal brake pedal; 3 – master brake cylinder; 4 – right-hand straight-ahead brake pedal lever; 5 – service brake cylinder; 6 – lever; 7 – pin; 8 – fork; 9 – overflow valve; 10 – cup; 11 – tie-rod; 12 – piston; 13 – pusher; 14 – boot; 15 – fork.

"Wet" Brakes and Rear Axle Differential Lock Clutch (Option)

The tractors can be equipped with multiple-disk service and parking brakes operating in an oil bath.

The rear axle differential lock clutch is mounted in the brake casing and shares a common oil bath; therefore it also made as a "wet" one.

The arrangement of the brakes and lock clutch is shown in Fig. E-21.2.

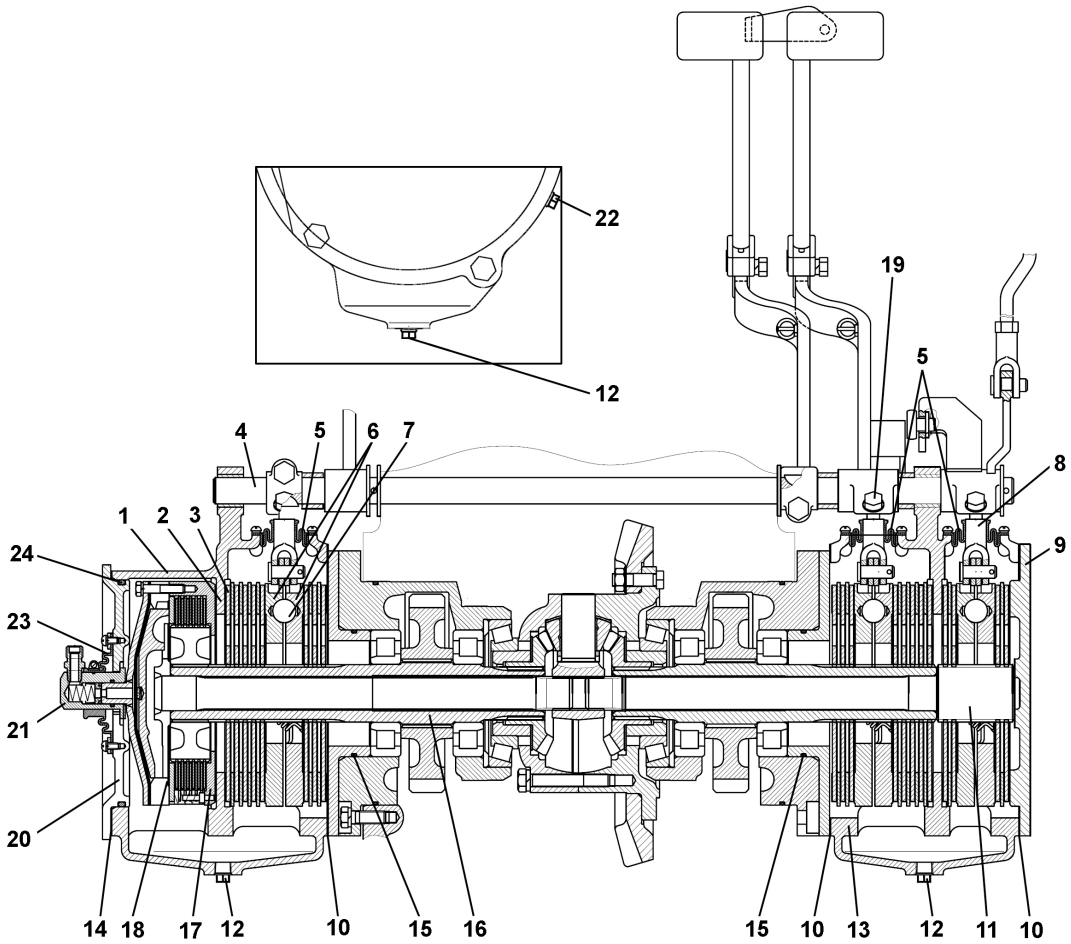


Fig. E-21.2. "Wet" brakes and differential lock

1 – brake casing; 2 – friction disk; 3 – intermediate disk; 4 – pedal axle; 5 – protective boot; 6 – pressure disk; 7 – ball; 8 – parking brake; 9 – cover; 10 – gasket; 11 – parking brake shaft; 12 – drain plug; 13 – brake casing; 14 – gasket; 15 – O-ring; 16 – final drive pinion; 17 – lock clutch; 18 – boss; 19 – adjusting bolt; 20 – cover; 21 – adapter; 22 – inspection and filler plug; 23 – sealing boot; 24 – O-ring.

Service brakes

The service brakes are of 8-disk type. The friction disks (2) are installed in splined ends of the hub drive pinions (16). The pressure disks (6) are similar in design to those used in dry brakes, but with a reduced angle of gradient for balls, to ensure the required force of compression of the packs of the friction and intermediate packs.

Attention! The pressure disks of dry and "wet" brakes have the same physical and fixing dimensions, but they are not interchangeable. It is strictly prohibited to install the disks designated for dry brakes on "wet" brakes or vice versa. Otherwise, the safety of tractor operation could be substantially jeopardized.

The intermediate disks (3) are fixed from turning in their cases (1, 13) by means of shoulders made over the outer profile. The leak-proofness of the oil baths is ensured by the O-rings (15, 24), gaskets (10, 14) and rubber boots (5, 23). The cases are provided with inspection (22) and drain (12) plugs.

Parking Brake

A 4-disk parking “wet” brake (8) is installed in the same case as the multiple disks service brake. Its components are unified with those of the service brake.

Differential Lock “Wet” Clutch

The lock-up clutch (17) comprises six disks with brake ceramic-metal linings fitted on the splined boss (18) connected with the hub drive pinion (16). A pack of six friction and five intermediate disks is compressed as oil under pressure is fed to the diaphragm space. The frictional torque developed thereby ensures interlocking of the rear axle differential. The clutch is made in a single case with the service brake. It shares a common oil bath with the brake and is sealed by means of the cover (20) and special corrugated boot (23) slipped over the adaptor (21) which delivers oil to the head space of the diaphragm.

Brake Actuators

The service and parking brake actuators are of mechanical type and consist of the leverage and pedals.

The actuators of service and parking brakes of “wet” type are fundamentally the same as those used in dry brakes on a respective tractor model.

Pneumatic equipment

Single-Line Pneumatic Actuator of the Trailer Brakes

The tractors can be equipped with either single- or double-line pneumatic actuator of the brakes of the trailers equipped with such actuator.

The pneumatic system is also used to inflate tyres as well as for other purposes where energy of compressed air is required.

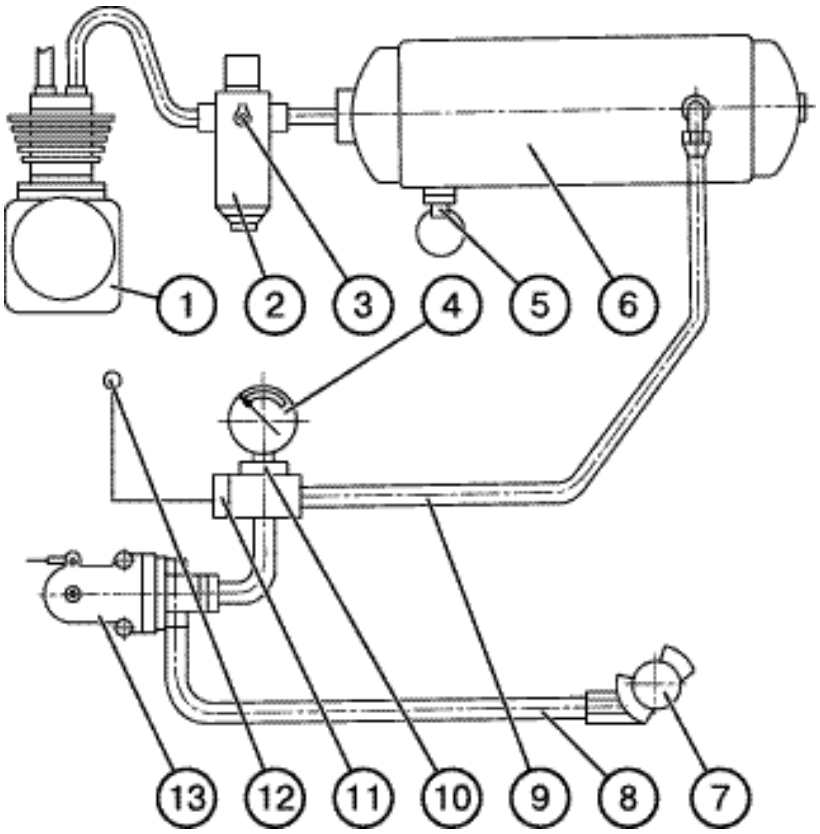


Fig. E-21.3. Single-line pneumatic actuator of the trailer brakes

1 – compressor; 2 – pressure regulator; 3 – air bleeder valve; 4 – air pressure indicator; 5 – condensate draining cock; 6 – bottle; 7 – coupling head; 8 – connecting duct; 9 – duct; 10 – pressure sensor; 11 – emergence pressure sensor; 12 – emergence pressure indicator lamp; 13 – brake valve.

Air intake into the system is made through the engine inlet duct. Air is compressed in the compressor (1) and then fed to the air bottle (6) via pressure regulator (2). The latter helps maintain the required pressure in the bottle. Compressed air is supplied from the air bottle to the brake valve (13) through the duct (9). From there, air goes to coupling head (7) and further to the trailer pneumatic system via the control duct (8).

The trailers' and farm machinery brakes are controlled in two modes: direct and automatic.

On coupling the trailer with the single-line pneumatic actuator, the trailer head is connected to the coupling head (7) and air is fed to the pneumatic actuator of the trailer. On stepping on the brake pedals or applying the parking brake, the compressed air escapes from the connecting duct (8) into the atmosphere through the valve brake (13).

The air distributor on the trailer operates to feed the compressed air from the trailer bottle into the brake chambers that causes the braking of the trailer. In case of emergence uncoupling of the trailer, the coupling heads get disconnected, air from the duct escapes to the atmosphere and the trailer gets braked automatically.

The **direct brake control** is achieved at the cost of the pressure drop in the connecting duct (8) to 0 MPa when braking the tractor. At that time, the delivery of compressed air into the pneumatic system of the trailer is stopped.

The **automatic brake control** (automatic braking) is effected due to a pressure drop in the trailer feed duct in case of rupture of the coupling and detachment of the trailer.

The pneumatic actuator is provided with a valve-type connecting head (7). The connecting head valve prevents the air escape in case of use of the pneumatic actuator without trailer (for example, when inflating the tyres) and in case of emergency detachment of the trailer. On coupling the duct of the tractor with that of the trailer, the coupling head valve opens to ensure the passage of compressed air from the tractor's pneumatic drive to the trailer. The connecting ducts should be couple together at zero pressure in the tractor air bottle (6).

The air pressure in the bottle (6) is monitored by the air pressure indicator (4) and red indicator lamp of air emergency pressure (12) (installed in the dashboard), air pressure sensors (10) and air emergence pressure sensor (11).

The air bottle (6) is provided with the cock (5) for draining condensate. To drain condensate move the pusher ring aside and upwards.

The air intake from the pneumatic actuator (for inflating the tyres, etc.) is performed through the air bleeder valve (3) of the pressure regulator (2).

Double-Line Pneumatic Actuator of the Trailer Brakes

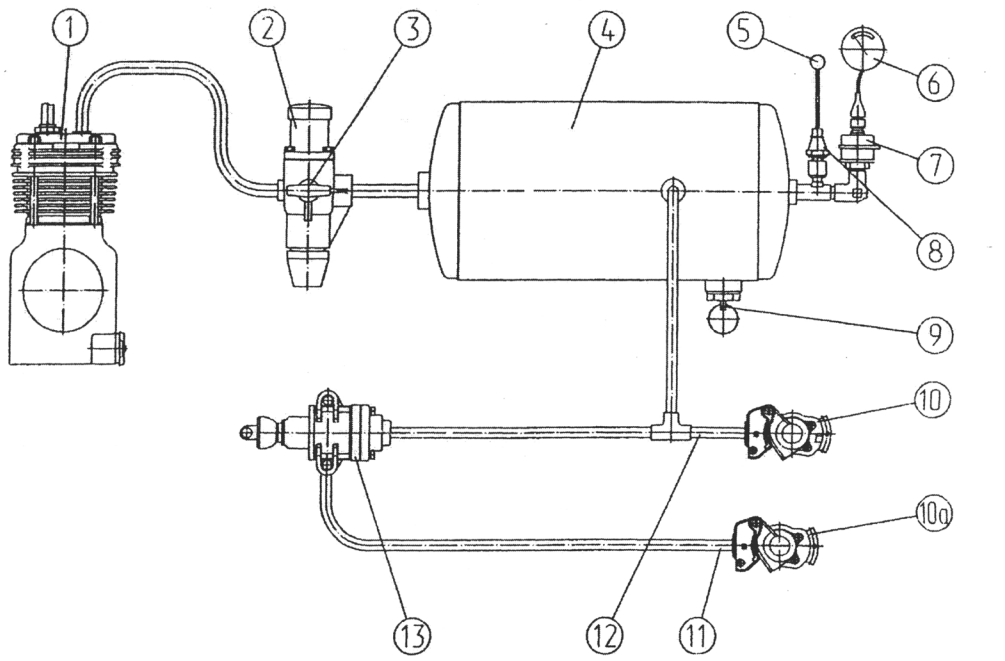


Fig. E-21.4. Double-line pneumatic actuator of the trailer brakes

1 – compressor; 2 – pressure regulator; 3 – air bleeder valve; 4 – air bottle; 5 – emergence pressure indicator light; 6 – pressure indicator; 7 – pressure sensor; 8 – emergence pressure sensor; 9 – condensate drain cock; 10, 10a – coupling heads; 11 – control duct; 12 – feed duct; 13 – brake valve.

Air intake into the pneumatic drive is made through the engine inlet duct. Air is compressed in the compressor (1) and, then, fed to the air bottle (4) via a pressure regulator (2). The latter helps to maintain the required pressure in the bottle. Compressed air is supplied from the air bottle to the brake valve (13) and into the feed duct (12) with a coupling head (a red lid) which is permanently under pressure. The brake valve (13) is connected with the coupling head (10a) (with yellow lid) through the control duct (11). There is no pressure in this head.

The trailers' and farm machinery brakes are controlled in two modes: direct and automatic.

In case of use of the trailer with double-line pneumatic actuator, the coupling heads of the trailer are connected to those (10) (with a red lid) and (10a) (with a yellow lid), i.e. to the feed duct (12) and to the control duct (11). Here compressed air is fed continuously to the trailer through the fed duct (12). On stepping the brake pedals or applying the parking brake, compressed air is delivered to the trailer through the brake valve (13) and control duct (11). The air distributor on the trailer operates to feed the compressed air from the trailer bottle into the brake chambers that causes the braking of the trailer.

The **direct brake control** is achieved through the pressure increase in the control duct (11) up to 6.5…8.0 kgf/cm^2 when braking the tractor. As this takes place, the feed duct (12) remains under pressure, and compressed air supply to the trailer's pneumatic system is still retained.

The **automatic brake control** (automatic braking) is effected due to a pressure drop in the trailer feed duct in case of rupture of the coupling and detachment of the trailer.

The coupling ducts are fitted with coupling valve-type heads (10, 10a) at

their ends. The valve of the coupling heads prevents the exit of air when the pneumatic drive is used with no trailer attached (for example, when inflating tyres) and in case of emergence detachment of the trailer. On coupling the duct of the tractor with that of the trailer, the coupling head valve opens to ensure the passage of compressed air from the tractor's pneumatic drive to the trailer. The connecting ducts should be couple together at zero pressure in the tractor air bottle (4).

The air pressure in the bottle (4) is monitored by the air pressure indicator (6) and red indicator lamp of air emergency pressure (5) (installed in the dashboard), air pressure sensors (7) and air emergence pressure sensor (8).

The air bottle (4) is provided with the cock (9) for draining condensate. To drain condensate move the pusher ring aside and upwards.

The air intake from the pneumatic actuator (for inflating the tyres, etc.) is performed through the air bleeder valve (3) of the pressure regulator (2).

Rear PTO

The rear PTO is provided with the two-speed independent (540 and 1,000 rpm) and synchronous (4.18 revolutions per metre en route) drives.

The **independent drive** is provided from the bearing disk of the clutch via a two-speed PTO drive reduction gear, inner GB shaft (18) (Fig. E-14), drive shifting clutch (27) (Fig. E-22) onto the crown gear shaft (26) of the PTO epicyclical reduction gear.

The **synchronous drive** is provided via the shift clutch (27) which couples the epicyclical reduction gear shaft (26) with GB pinion.

The epicyclical PTO reduction gear is located in the rear axle housing and consists of the crown gear (22) coupled with shaft (26), three satellites (23) on axles (21), cage (25) and sun gear (24).

The sun gear (24) is connected with the engagement drum (17) through a spline joint. The drum is connected to shaft (20) and forms, together with the brake band (16), an engagement band brake.

The cage (25) is made integral with the brake drum (19) connected with the shaft (2) and forms, together with the brake band (18), an engagement band brake.

The inner bore of the shaft (20) houses replacement PTO end-pieces (10) – 8 spline (540 rpm) or 21 spline (1000 rpm). The roller (3) of movable ends of the brake band has an eccentric with lever (5) to effect adjustment of the clearance in the band brakes from outside, by simple rotation of the roller (3).

The rear axle casing houses two adjusting screws (11). These are connected to the control roller (6) and levers (4), (5).

The **PTO is engaged** when the brake band (16) is tensioned and the brake band (18) is released. In this case, the engagement drum (17) and the sun gear (24) connected thereto are brought to rest. Rotational motion is transferred from the crown gear (22) to the cage (25) and PTO shaft (20) through satellites (23) running about the stopped sun gear (24).

The PTO is disengaged when the brake band (18) is tensioned and the brake band (16) is released. In this case the PTO replacement end-piece is brought to standstill (10).

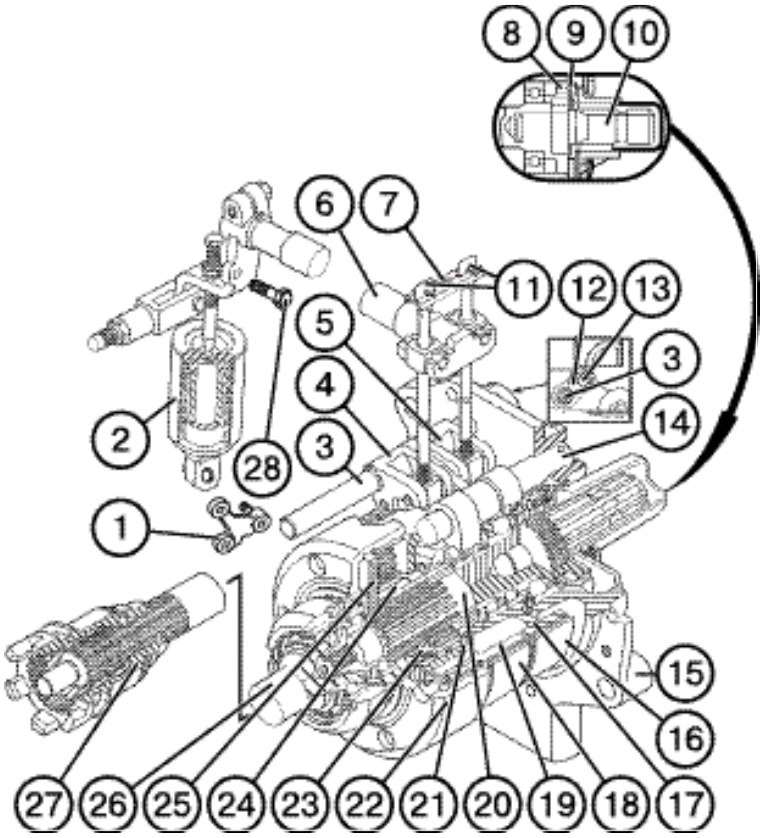


Fig. E-22. Rear PTO epicyclical reduction gear:

1 – bracket; 2 – hydraulic cylinder; 3 – eccentric axle; 4, 5 – lever; 6 – control roller; 7 – stop plate; 8 – end-piece fixing bolt; 9 – replacement end-piece stop plate; 10 – replacement end-piece; 11 – adjusting screws; 12 – stop plate; 13 – stop plate fixing bolt; 14 – axle; 15 – rear cover; 16, 18 – brake bands; 19 – brake drum; 20 – PTO shaft; 21 – satellite axle; 22 – crown gear; 23 – satellite; 24 – sun gear; 25 – cage; 26 – crown gear shaft; 27 – drive independent/synchronous shift clutch

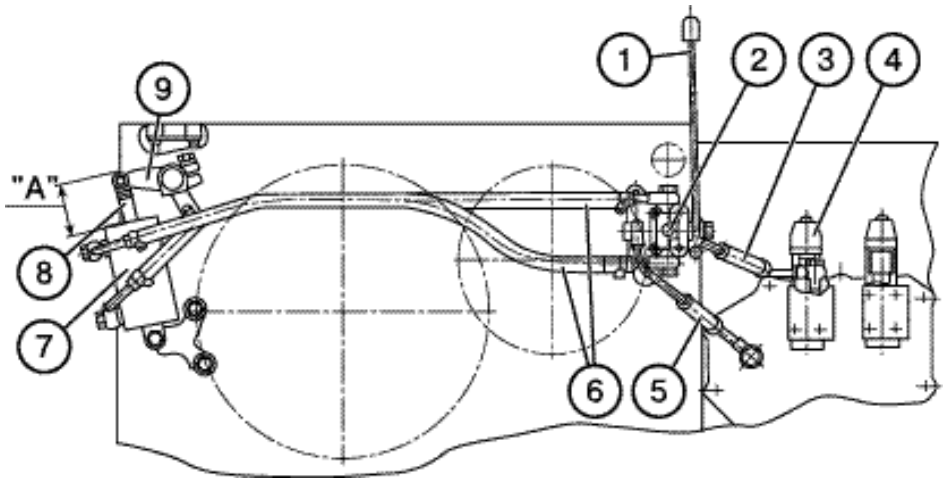


Fig. E-23. Rear PTO control mechanism:

1 – tie-rod; 2 – control cock; 3 – oil tape-off pipeline; 4 – FDA drive electro-hydraulic distributor; 5 – drain pipeline; 6 – PTO hydraulic cylinder oil pipelines; 7 – hydraulic cylinder; 8 – rod; 9 – lever.

Rear PTO Control Mechanism

The tractor is equipped with a hydrificated control mechanism of the rear PTO (Fig. E-23). This mechanism consists of a control cock (2) in assembly with tie-rod (1), hydraulic cylinder (7), which is connected to control shaft (6) (Fig. E-22), and oil pipelines (3), (5) and (6) (Fig. E-23). The pressure oil pipeline (3) connects cock (2) with the FDA control cock. The control pipeline (6) communicates the cock (2) with hydraulic cylinder (7).

The tie-rod (1) has two positions:

- "PTO engaged" – uppermost position;
- "PTO disengaged" – lowermost position.

Distance "A" between the rod (8) head of the cylinder (7) and the cover on a correctly adjusted PTO shaft is:

- 64 ± 2 mm (PTO engaged);
- 41 ± 2 mm (PTO disengaged).

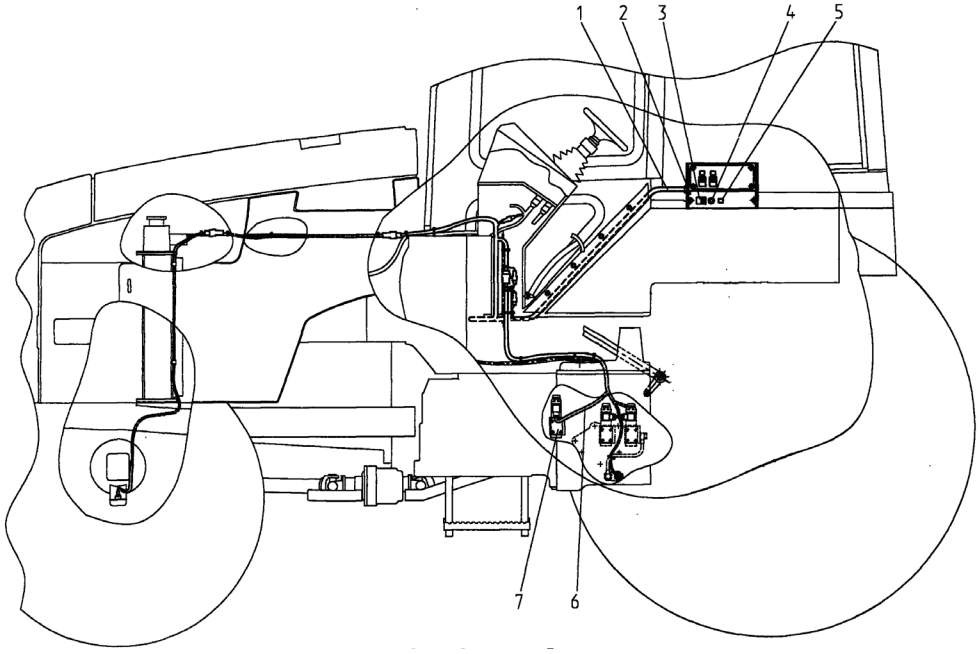


Fig. E-24. Front PTO control mechanism.

1 – bundle; 2 – control panel; 3 – switch; 4 – pushbutton; 5 – pilot lamp; 6 – bundle; 7 – electro-hydraulic distributor

Front PTO control mechanism

The front PTO is controlled by means of the electro-hydraulic system.

The electric part of the front PTO control system is incorporated in the integrated system for controlling the real axle DL (differential lock), FDA (front driving axle) drive and front PTO. It consists of the switch (3), pushbutton (4), pilot lamp (5) and relay, which are arranged in the control panel located in the cab to the right from the operator and interconnected by means of the cab bundle (1) (that of the integrated system for controlling the DL, FDA and front PTO) according to the attached electric diagram. This bundle is connected with the transmission bundle (6) (that of the integrated system for controlling the DL, FDA and front PTO), which

is connected, in turn, to the electro-hydraulic distributor (7) for switching on the front PTO drive.

The system if supplied with power from the on-board power system according to the attached electric circuit diagram. The supply voltage is applied to the system after starting the engine.

The electro-hydraulic distributor (7) controls the oil flow delivered to the hydraulic cylinder of the control mechanism of the band brakes of the front PTO epicyclical reduction gear. The switch (3) has two fixed positions:

- Engagement of the front PTO drive (press the smooth portion of the switch);
- Disengagement of the front PTO (press the corrugated portion of the switch).

To engage the drive of the front PTO, it is necessary to set the switch (3) to the position “Engagement of the front PTO drive” with the engine running and then press the pushbutton (4) for starting the front PTO and release the same. When doing this, the contacts of the relay in the control panel (2) get closed and the electromagnet of the electro-hydraulic distributor (7) is energized, the slide of the electro-hydraulic distributor (7) moves and oil is delivered to the rod-free cavity of the hydraulic cylinder for controlling the front PTO, and the rod cavity is connected with the drain.

The engagement of the front PTO drive is signaled by means of the pilot lamp (5).

To disengage the front BOM, it is necessary to set the switch (3) to the position “Disengagement of the front PTO (press the corrugated portion of the switch).

When doing this, the contacts of the relay in the control panel (2) get open, the electromagnet of the electro-hydraulic distributor (7) is de-energized, the slide returns to the initial position, the rod-free cavity of the hydraulic cylinder is connected with the drain, oil is delivered to the rod cavity, the front PTO drive is disengaged and the pilot lamp (5) goes out.

When stopping the engine, the front PTO is disengaged automatically. Therefore, to engage the front PTO drive after the next starting of the engine, it is necessary to press the pushbutton (4) (repeat the operations for engaging the PTO).

Front driving axle (FDA)

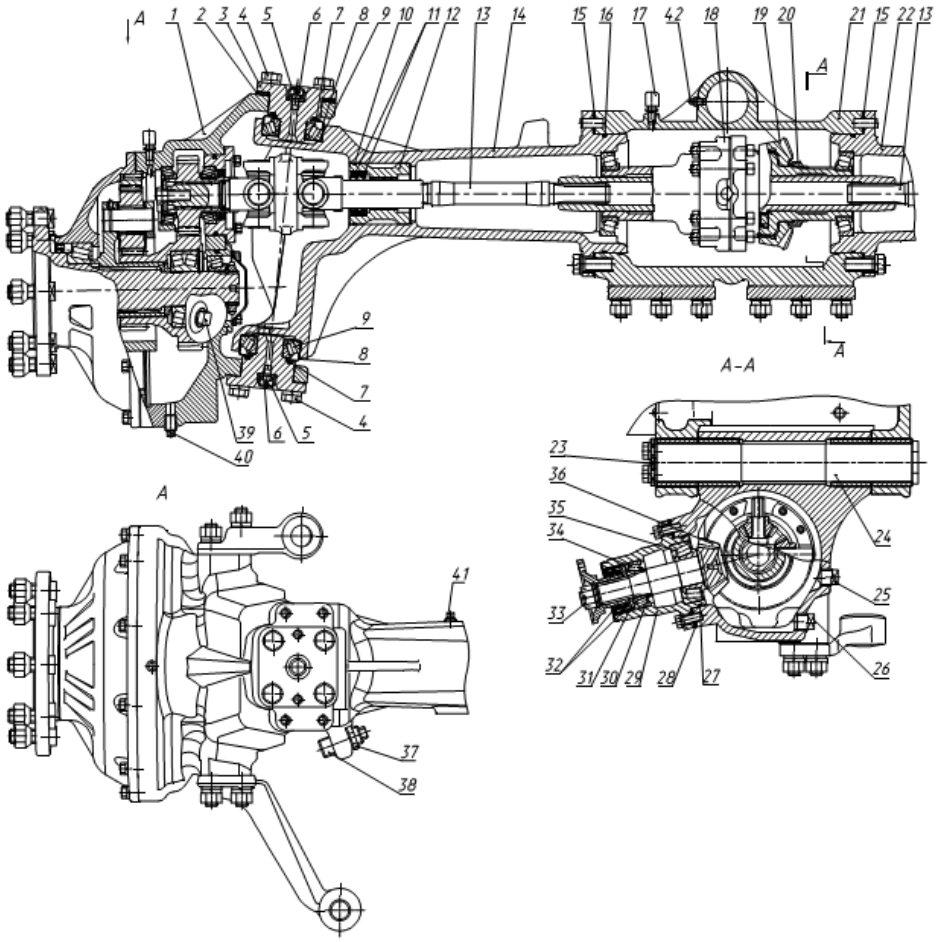


Fig. Д-25

1 – reduction gear of final drive; 2, 15, 28 – adjusting shims; 3 – pivot axle; 4 – bolt; 5 - cap; 6 – oiler; 7, 10, 16, 27 – rubber plug; 8 – barrel; 9, 34, 35 – conical roller bearing; 11, 32 – collar; 12 – fixed block; 13 – half-axle shaft; 14 – left arm support; 17 – breather; 18 – differential; 19 - conical driven gear; 20 – nut; 21 – FDA casing; 22 – right arm support; 23 – washer; 24 – axis pin; 25 – plug; 26 – drain plug; 29 – pinion carrier; 30 – adjusting washers; 31 – obturator ring; 33 – nut; 36 – conical driving gear; 37 – locknut; 38 – screw; 39 – filler plug; 40 – drain plug, 41- filler plug, . 42- oiler.

The front driving axle (FDA) is intended for transferring the torque from the engine to the front steerable wheels of the tractor. It consists of the final drive, differential and wheel reduction gears.

Left arm support 14 and right arm support 22 (see fig. Д-25), connected to the FDA casing by bolts, make up an axle beam. The FDA casing is equipped with a breather 17, maintaining normal pressure in the axle beam and main gear housing.

The oil is poured in the axle beam till the lower edge of the filler opening through the plugs 41, installed in the arm supports 14 and 22.

Axle beam oil draining is carried out by means of turning off the drain plug 26 in the FDA casing. Oil filling through the hole in one of the arm supports is carried out till the greasing in the second arm support reaches the lower edge of the filler opening. FDA should be filled up on the horizontal surface.

FDA casing 21 is connected with the beam by the axis pin 24, on which the axle together with the wheels can swing in the diametral plane, deflecting through the angles, limited by the rests in the arm supports when they get into contact with the tractor beam. The axis is prevented from the axial movement by the washer 23. The axis is oiled through the oiler 42.

The main gear.

The main gear is a pair of conical gear members with helical teeth.

The axle drive gear 36 (fig. Д-25) is installed in the pinion carrier 29 on two roller conical bearings. Bearings preload is adjusted by means of adjusting washers 30, after that bearings are tightened up by the nut 33. The driven gear 19 is set on the splines and a center pilot of the differential casing 18 and is prevented from the axial movement by the nut 20

The main gear mesh adjustment is provided by the gasket seals 28, 15, installed between the driving gear cage flange and FDA housing, and also between the left and right arm supports and FDA housing, respectively. Before the mesh adjustment, the differential bearings are adjusted by means of gasket seals 15.

The hole for the plug 25 serves for testing the main gear mesh adjustment.

The outflow of oil from the main gear and axle beam housing is prevented by the collars and rubber rings, installed in the fixed blocks, arm supports and in the main gear pinion carrier.

To prevent affluent of oil in front of the driving gear collar, the obturator ring 31 is installed on its splined end. Spiral flutes are threaded along the outer diameter. A sleeve-type bearing with cross grooves is installed in the fixed block 12.

Differential.

Differential – is a self-locking type with enhanced friction. In the differential casing 1 (fig. Д-26) and a cover 7 bolted together, there are two pairs of planetary gears on the floating axes 5, side gears 8, press-on carriers 4 and friction disks – driving 2 and driven 3.

The self-locking differential automatically connects both half-axes and excludes separate wheels slipping, increasing the driving force of the front wheels. The locking is carried out when putting the front axle into operation.

Herewith the planetary gears shafts work under load and move in the channels-backfalls in the casing and cover of the differential over a value of spacings between friction disks, respectively. The force is transmitted from the axes to the planetary gears, which transmit it to the carriers, and the carriers in their turn compress the friction disks till they bear against the walls of the casing and differential covers. Driving disks, having outer cogs, are connected to the cogs of the housing and differential cover, driven disks (by inner cogs) – to the side gears. The frictional force of the compressed disks units the side gears and the housing with the differential cover, thus locking the differential.

When turning the tractor and when the front axle is engaged and external forces exceed the frictional forces in the frictional disks, the frictional discs will slip.

The differential is installed on two roller conical bearings in the brackets of front axle beam. The differential bearings are adjusted by the gasket seals 15 (fig. Д-25).

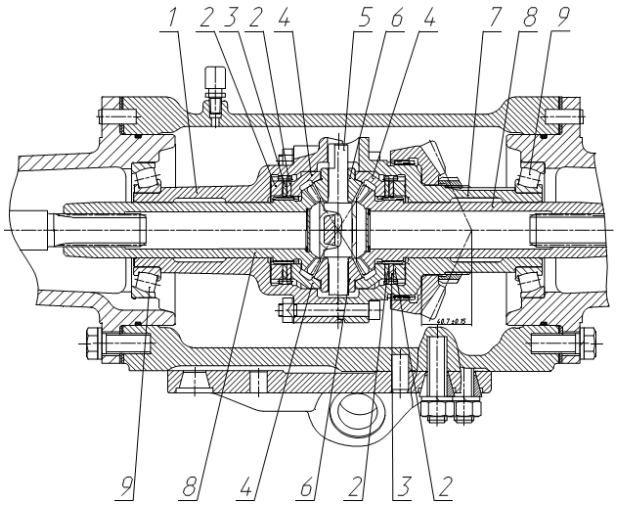


Fig. Д-26

1 – differential casing; 2 – driving disk; 3 – driven disk; 4 – press-on carrier; 5 – axis of planetary gears; 6 – planetary gear; 7 – differential cover; 8 – side gear; 9 – conical roller bearing.

Wheel reduction gears.

Wheel reduction gears of planetary-cylindrical type are meant for the transfer and increase of the torque from the FDA differential at different turning angles of controlled frond driving wheels.

The reduction gears are installed in the casings 35 and are connected by the axle beam by means of axes 3 (fig Д-25) and can turn relative to FDA beam on two bearings 9. The axes are connected with the casing of the wheel reduction gear by means of the bolts 4. The screw 38 and the back nut 37 serve for the adjustment of the wheel reduction gears turning angle.

Pivot axles (fig. Д-25) are oiled through the oilers 6, installed on the axes. The oilers are protected by the rubber caps 5 from dirt entry. The barrels 8 with seal rubber rings 7 are installed in the axle beam arm supports preventing dirt entry to the bearings. The bearings 9 of the pivot are adjusted by the shims 2, positioned only under the upper axles 3.

The wheel reduction gear 1 (fig Д-25) consists of a double turning joint, cylindrical and planetary gears, control levers of front wheels turning.

The double turning joint 24 (fig Д-27) with the FDA differential by means of half-axle shaft with splined ends 13 (fig Д-25) from the one side, and from the other side - with the drive pinion 17 (fig Д-27) of the cylindrical gear.

The driving gear is installed on two roller conical bearings 18. One of them is inslalled the housing boring of the the reduction gear 35, the other one – in the barrel 22. The double turning joint is fixed in the gear member by the washer 15 and the bolt 14 with the bent plane.

The bearings 18 are adjusted by means of the shims 21, which are installed between the barrel and the reduction gear casing.

The drive pinion of the wheel reduction gear is engaged with the gear train (the driven pinion of the cylindrical gear) 34, the second crown of which is a sun gear or the driving part of the planetary gear set. The driven part of the planetary gear set, connected with the tractor wheel is a wheel flange, which is tightly through the splines connected with the carrier 5, three planetary pinions 11, and the epicyclic gear 12 serves as a deferred gear, accepting the torque reaction.

The epicyclic gear is installed in the reduction gear cover and is fixed from turning by 3 plungers 13. A sealing gasket is installed between the cover and reduction gear casing. The sun gear is installed in the wheel flange on the conical double-row bearing 33, which is fixed from the one side by the stopper ring 36, being in contact with the carrier, from the other side – by two lock rings 31, 32.

The planetary gears are turning on the axes 7, installed in the carrier borings 5. The planetary gears bearings are cylindrical rollers 8. One rollers race is a ground face of the axis 7, the other one is a ground inner face of the planetary gear 11.

The washers 10 prevent the planetary gears and rollers from moving in the axial direction. To prevent the axial deflection of the planetary gears axes a forcing fit in the connection of the carrier with the axes. To check the correctness of piercing and for additional fixation the screw 9, installed in the axes groove, is used.

The wheel flange is fixed on two roller bearings. One of them is installed in the reduction gear cover 6, the other one – in the barrel 30, which is installed in the boring of the reduction gear casing, closed by the cover 28 and is fixed to by the bolts. The sealing gasket is installed between the barrel and the cover.

The bearings are adjusted by the nut 26 tightening. The washer 27 is installed between

the bearing 29 and the nut 26. To prevent turning-off the nut collar is center-punched in the wheel flange groove.
The reduction gear casing is filled with oil to the lower brim of the filler opening, in which the plug 39 is installed (fig Д-25), the reduction gear casing is emptied by means of drain plug 40 turning-off.

The inner cage of the reduction gear is compressed by the collars 3 and 20 (fig Д-27). The mud collector 4 is installed to prevent dirt entry the operating edges of the collar. The rubber rings 19, 23, 25 gasket the swivel member borings and the splines of double turning joint. To keep the normal pressure in the wheel reduction gear cages the breather 16 is installed in the reduction gear casing.

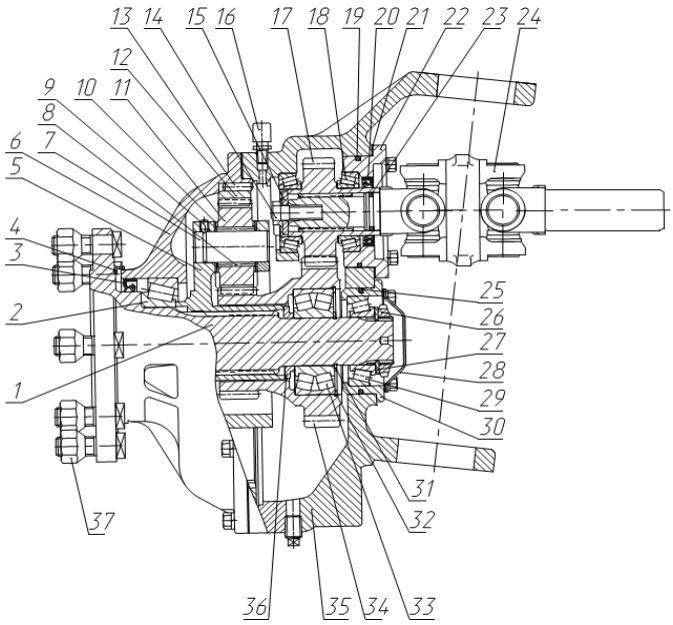


Fig. Д-27

1 – wheel flange; 2, 18, 29 – conical roller bearing; 3, 20 - collar; 4 – mud collector; ; 5 - carrier, 6 – reduction gear cover; 7 – planetary gears axis; 8 - rollers; 9 - screw; 10 – backup washer; 11 – planetary gear; 12 – epicyclic gear; 13 - plunger; 14 - bolt; 15 - washer; 16 - breather; 17 – driving gear; 19, 23, 25 – rubber ring; 21 – shims; 22 – driving gear barrel; 24 – universal doubled turning joint; 26 - nut; 27 - washer; 28 - cover; 30 - barrel; 31, 32 – lock ring; 33 – conical double-row roller bearing; 34 – gear train; 35 – reduction gear casing; 36 - ring; 37 – wheel nut

Electro-hydraulic FDA Drive Control System

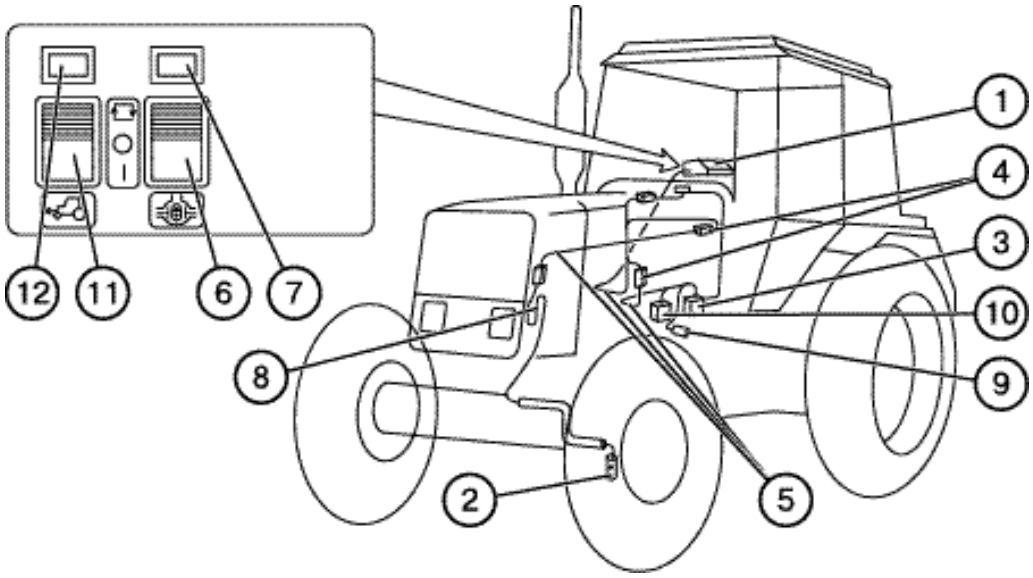


Fig. E-28. Rear axle differential lock-up (DL) and FDA drive control system:
1 – control panel; 2 – steering wheels turning angle sensor; 3, 10 – control electro-hydraulic distributors for the DL and the FDA drive, respectively; 4 – terminal blocks; 5 – connecting cable; 6 – DL control key; 7, 12 – indicator lamps; 8 – loop; 9 – automatic FDA drive control sensor; 11 – FDA drive control key.

The electro-hydraulic control system of the rear axle (Fig. E-28) consists of the panel (1), automatic control sensor (9) FDA reduction gear, FDA drive clutch control electro-hydraulic distributor (10) located on the right-hand GB cover and connecting cables (5) with terminal blocks (4). The system is supplied with power from the on-board power system via a safety fuse in the fuse box installed in the dashboard. The system is powered after starting the engine. The key (11) of the FDA drive control and the FDA drive engagement indicator lamp (12) are installed on the panel (1) face. The latter is located over the tractor right-hand side control panel.

Note: A braking relay is provided in the FDA drive control electric circuit. It ensures the automatic engagement of the drive when stepping on the interlocked service-brake pedals.

How To Use the Front Driving Axle Control Key (11)

1. When performing jobs with great extent of slippage of front wheels, press the upper part of the key (11) having activated the automatic FDA drive control mode. When it will be done, the automatic control is exercised depending on tractor slippage, which is sensed by sensor (9) of automatic control. When rear wheels are slipping, the sensor (9) closes contacts and energizes the electromagnet of the control electro-hydraulic distributor (10). When slipping intensity drops, the sensor (9) beaks contacts to de-energizing the electromagnet and disengage the FDA drive, respectively.
2. If the job requires operation with forward and reverse moves, with the FDA engaged all the way through, depress the lower part of the key (11). To disengage the FDA drive, press the key (11) to its middle position.

ATTENTION!
1. When reversing, NEVER engage the automatic FDA drive control mode; use the forced drive only. Use the forced drive mode of the FDA for short-run jobs only: to clear an obstacle or when running the tractor in reverse.
2. Be sure to disengage the FDA when on surfaced roads to avoid accelerated wear of the front wheel tyres, drive parts and FDA.

Hydraulic Lift Linkage (HLL)

The HLL is intended for controlling and operating the tractor aggregated with mounted, semi-mounted and pull-type agricultural machines and implements attached to the rear hitch linkage (RHL).

The hydraulic system is composed of controls, an oil tank with filter, oil, pump, two- or three-section flow-through distributor, hydraulic power lift and power lift drive.

The **operating controls** of the hydraulic system (7), (8) (Fig. E-29) are located in the tractor cab, with the exception of the pump engagement handle (the design is left unchanged) and additional position control handle (8a) (Fig. E-29) located on the rear of the tractor on the hydraulic power lift.

Control of External Loads – these are three handles of the flow-through distributor located on the right-hand side of the steering wheel (the design is left unchanged).

Positions of the handle (from bottom to top) are: “Lift”, “Neutral”, “Drop” and “Floating”.

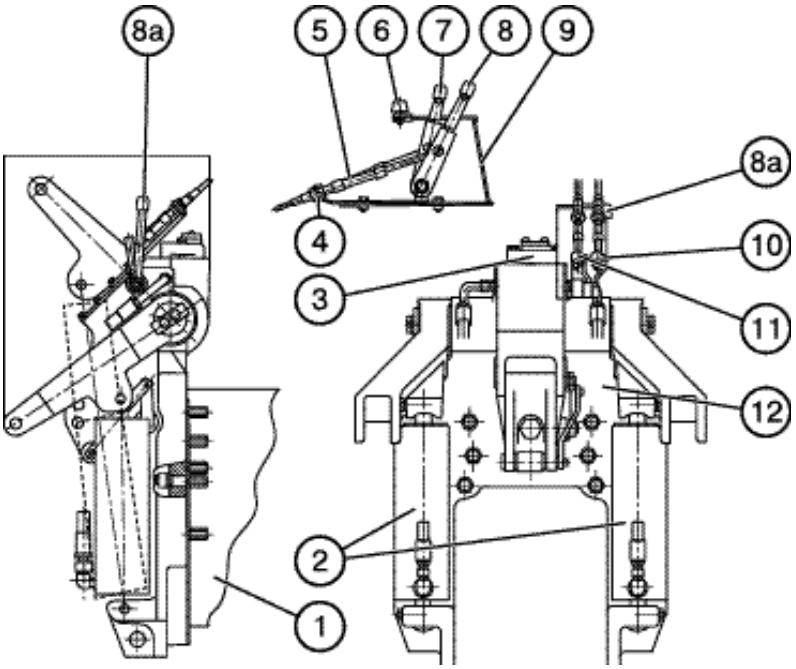


Fig. E-29. Hydraulic power lift of the HLL (monoblock):

1 – rear axle casing; 2 – power ram cylinders; 3 – regulator-distributor; 4 – brackets; 5 – position (10) and draft (11) lever control ropes; 6 – adjustable RHL travel limiter; 7 – draft control handle; 8 – position control handle; 8a – additional position control handle; 9 – right-hand side control panel; 10 – position lever; 11 – draft lever; 12 – casing.

The **draft control handle** (7) (Fig. E-29) is located on the right-hand control panel (9), the first from the operator's seat. The operational range of the handle positions is marked with digits from 1 to 9 that corresponds to the entire span of ploughing depths from minimal to maximal ones, respectively.

The **position control handle** (8) (Fig. E-29) is located next to the draft control handle (7). Its operating range is marked with the same digits which cover RHL positions from the upper transport position down to the lowermost position, respectively.

The **additional position control handle** (8a) (Fig. E-29) is located on the rear of the tractor on the hydraulic power lift. Pulling this handle towards the operator standing behind the tractor and looking along the tractor forward travel lifts the RHL and pushing the same from the operator lowers the RHL.

The RHL travel limiter (6) is located in the slot of the right-hand side panel, in which the position control handle (8) moves.

The positions of the oil tank, oil pump filter and the distributor to control external loads are unchanged. The distributor is of a sectional flow-through type; it has priority in control over the hydraulic power lift.

Hydraulic Power Lift (Fig. E-29, E-30)

The hydraulic power lift (Fig. E-29) is installed on studs, on the rear wall of the rear axle casing (1) and consists of a control unit and a regulator-distributor (3) built in a single casing (monoblock) which houses two hydraulic single-acting power cylinders (2).

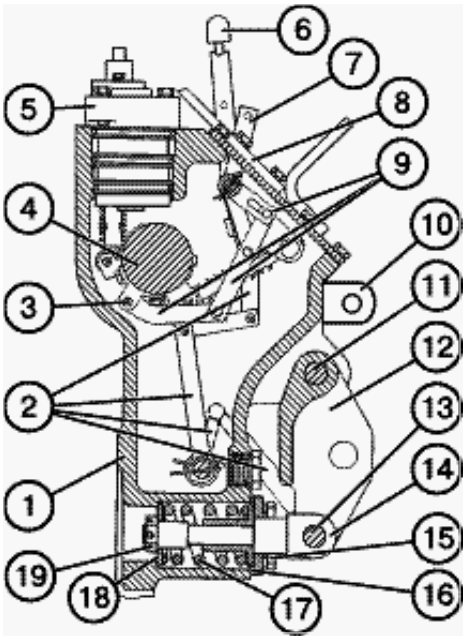


Fig. E-30. Hydraulic power lift construction:

1 – monoblock; 2 – draft sensor leverage; 3 – position sensor; 4 – RHL lifting levers shaft; 5 – regulator-distributor; 6 – position lever; 7 – draft lever; 8 – lid; 9 – position sensor leverage; 10 – lifting levers; 11 – shackle axle; 12 – draft sensor coupling link; 13 – pin; 14 – draft sensor rod; 15 – cover; 16 – adjusting shims for draft sensor spring; 17 – draft sensor spring; 18 – dish; 19 – nut

The control unit is mounted in the monoblock (1) (Fig. E-235) and consists of a position sensor in the form of a bracket attached to shaft (4) of the RHL lift levers (10); draft sensor involving the coupling link (12) mounted on axle (11) in the monoblock (1) and coupled with rod (14) on pin (13). The spring (17) preloaded by the nut (19) is fitted on the rod (14). Through a leverage system (9) the position sensor (3) is connected to position handle (6). The pin (13) of the rod (14) is coupled with draft handle (7) through leverage (2).

The control unit operates as follows: **When the position control is used**, the draft handle (7) (Fig. E-30) should be shifted to its foremost position, in the direction of the tractor forward travel. Further control of the hitch linkage is achieved by means of the position lever (6) (Fig. E-30) and handle (7) via ropes (5) (Fig. E-29). When moving the lever (6) backward, the hitch linkage is lifted and then moving the lever (6) forward, the hitch linkage is lowered. This adjusting process is performed by means of the regulator-distributor built in the monoblock (1) and controlled be means of the position sensor (3).

When the draft control is used, the position handle (6) should be shifted to its foremost position, in the direction of the tractor forward travel, corresponding to the bottom position of hitch drop links. The draft control handle (7) is set to the required ploughing depth; further the process of adjustment is fulfilled by the built-in regulator-distributor (5) under control of the draft sensor.

Using the position control handle (8) (8) (Fig. E-29) for limiting the ploughing depth when operating in the draft control mode makes it possible to achieve the **combination adjustment.**

The **Regulator-Distributor** (5) built-in into the monoblock (1) is an adjusting element of the hydraulic power lift. It is a slide-valve gauge whereby the operating position like “Lift”, “Drop”, “Neutral” and RHL automatic control can be achieved.

The hydraulic power lift drive (Fig. E-34) consists of a bracket (4) with the draft (7) and position (8) handles mounted on it. The latter are connected to the draft (11) and position (10) levers, respectively, by means of two-way ropes (5). The control levers are locked by spring-loaded friction disks.

Hydraulic System Operation

The hydraulic system for controlling the three-point RHL is equipped with the regulator-distributor built in the monoblock. The regulator-distributor provides the system in the following modes:

- draft control;
- position control;
- combination control.

The efficient use of these modes depends on the machines to be ganged and agrotechnical conditions.

Position control

Provides for precise and sensitive control of the mounted equipment such as sprayer, land leveller, etc. above the ground. The position control can be used with land-treatment machines, semi-mounted ploughs with extendible cylinders, etc.

However, this adjustment type is not recommended for use on uneven fields. The position control on a field with uneven surface can cause shocks caused by quick vertical movements of the coupling arrangement.

Draft control

It is the most suitable mode for operation with mounted or semi-mounted implements, the work members of which are deepened into the soil. The system is sensitive to the draft variations (caused by the variations of the soil resistance depending on the depth of the soil treatment) through the central connecting rod of the central rod of the hydraulic lift linkage. The hydraulic system respond to these variations by lifting or lowering the implement so that the draft would be maintained at a constant level. The system responds to the compression and tension forces in the central rod, i.e. it is a double-action system.

HLL Operation

The HLL is controlled by means of two handles located on the right-hand control panel in the cab:

- draft control handle (2); and
- position control handle (3).

Position control

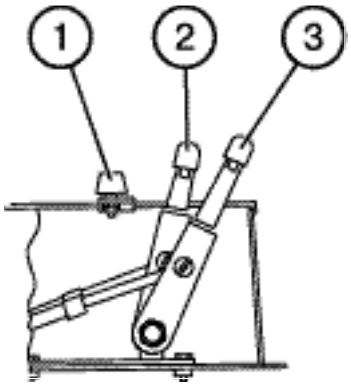
1. Set the draft control handle (2) to the foremost position in the direction of the tractor travel.
2. Set the necessary height on the implement above the soil by means of the position control handle (3).

The digit “1” on the control panel corresponds to the transport position of the RHL and the digit “9” – to the minimum height of the implement above the soil.

If it is necessary to restrict the maximum lifting height (for example, due to the possibility of breakage of the parts of the rear axle), set the maximum lifting height by means of the handle (3) and move the adjustable stop (1) to the latter.

Draft control

Use this method of adjustment when working with the mounted implements (ploughs, cultivators). Move the draft control handle (2) to the foremost position in the direction of the tractor forward travel (digit “9” on the control panel).



Connect the implement to the RHL by means of the position control handle (3).

On entering the furrow move the handle (3) to the foremost position and adjust the desirable soil treatment depth by means of the handle (2).

On leaving the furrow and subsequent entering the same (when performing the tillage), use the position control handle (3) without touching the draft control handle (2).

If it is impossible to achieve the constancy of the soil treatment depth due to unevenness of the soil density, limit the maximum depth by means of the position control handle (3) (combination control mode) having memorized the respective digit on the control panel.

Hydraulic lilt linkage based on the electro-hydraulic regulator of the RHL control

The tractor is equipped with two Ц 90x220 vertical hydraulic cylinders built in the lift (without regulator) controlled from the electro-hydraulic regulator. The schematic hydraulic diagram of he hydraulic system with the electric-hydraulic regulator of the RHL control in shown in Fig. E-31

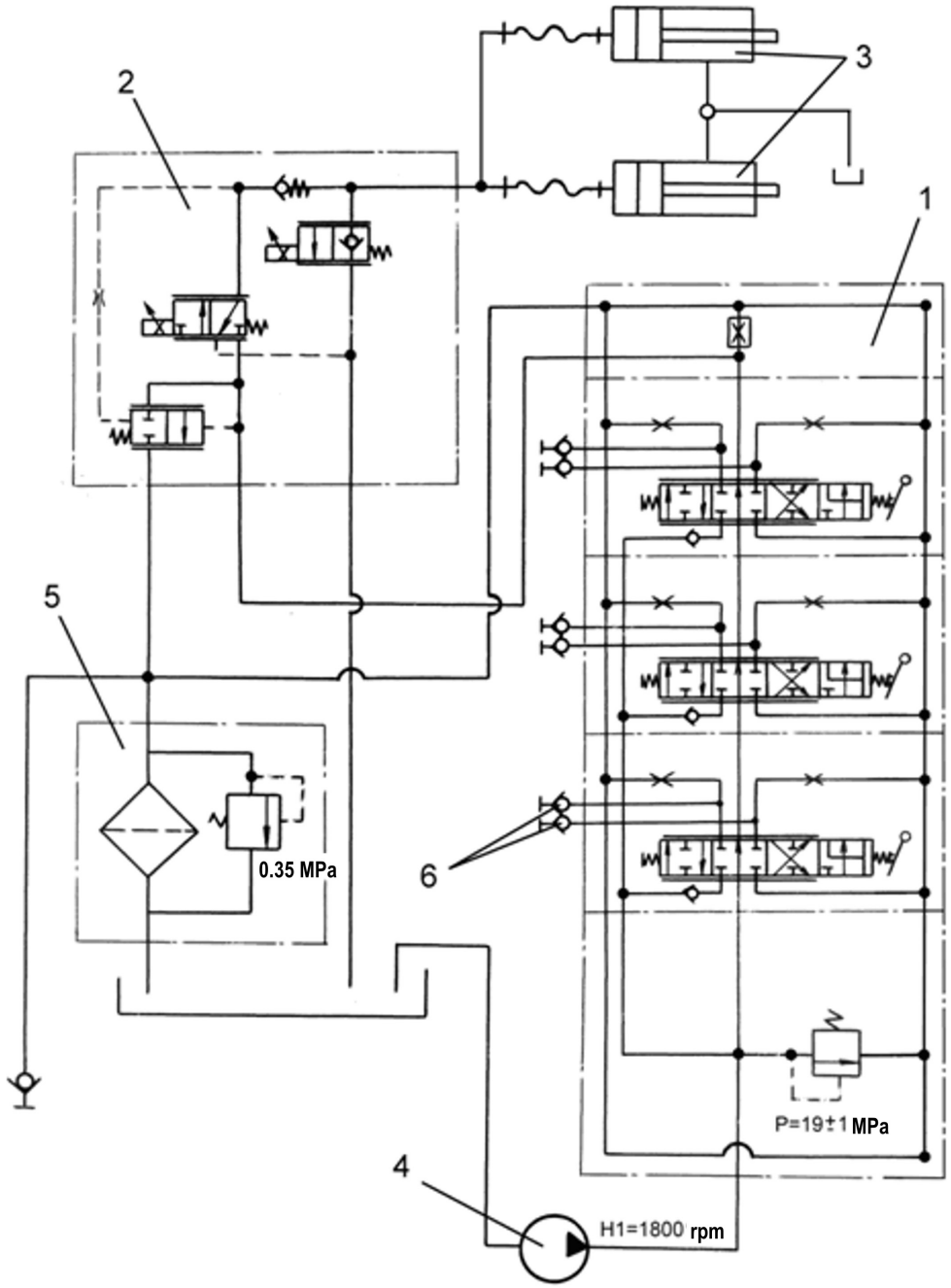


Fig. E-31. Schematic hydraulic diagram

1 – RS 213 “Mita” hydraulic distributor; 2 – EHR5-OC electro-hydraulic regulator; 3 – Ц80x220 hydraulic cylinders; 4 – НШ32-3 pump; 5 – drain filter; 6 – quick-connection couplings.

The functions of control of the RHL and hydroficated working members of the external consumers are implemented in the new hydraulic system (Fig. E-32) at the cost of the electro-hydraulic block (3) mounted on the oil tank (1). The lever control of the distributor (2) and НШ32-3 the gear pump are similar for all the versions of the above hydraulic systems.

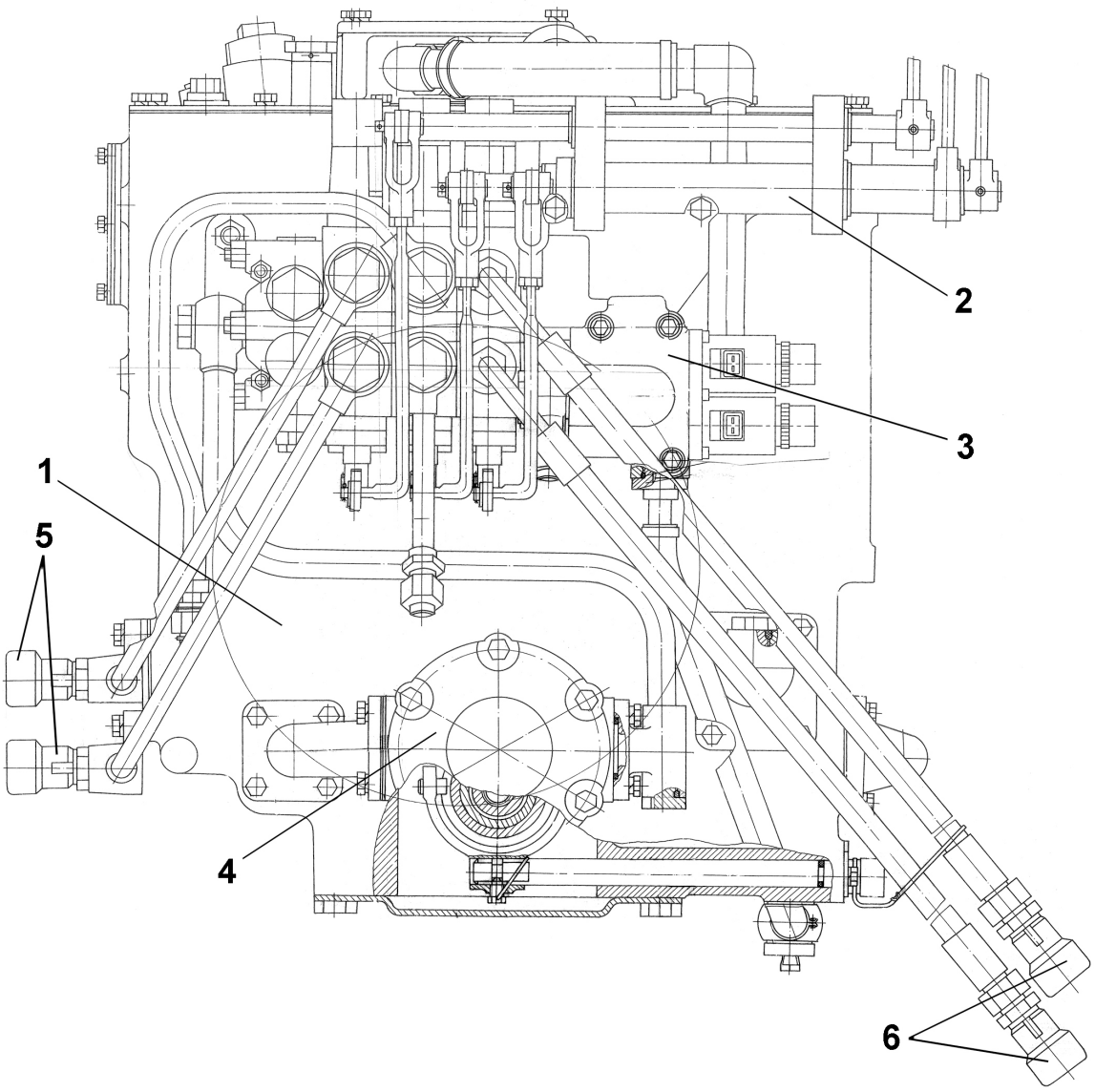


Fig. E-32. Casing of the hydraulic units assembled with the other ones

1 – oil tank; 2 – distributor control; 3 – electro-hydraulic unit (RS 213 “Mita” + adaptor + EHR5); 4 – НШ32-3 pump; 5, 6 – side leads.

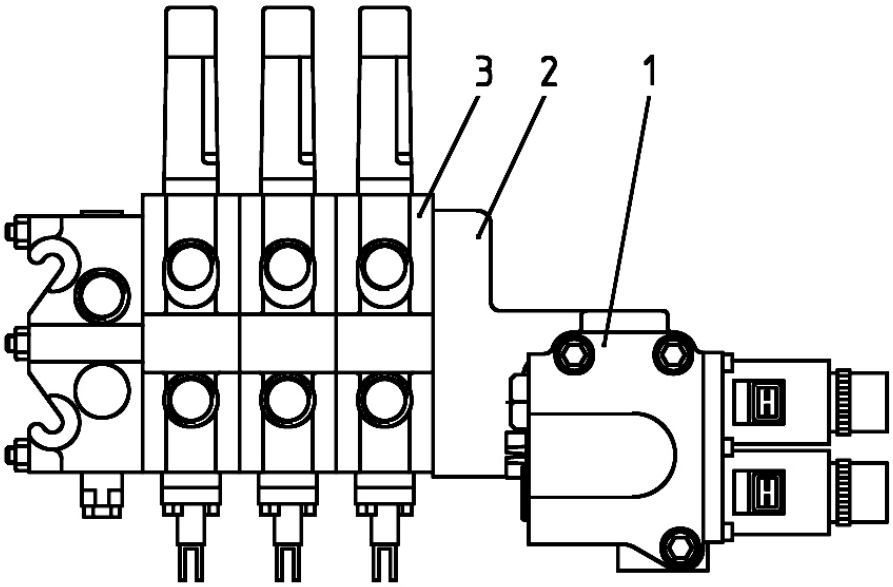


Fig. E-33. Electro-hydraulic unit

1 – EHR5-OC electro-hydraulic regulator; 2 – adaptor plate; 3 – RS 213 “Mita” distributor (Finland)

The electro-hydraulic unit (Fig. E-33) consists of distributing sections of the RS213 “Mita” distributor manufactured in Finland, EHR5-OC electro-hydraulic regulator manufactured by the Bosch Company (Germany) and adaptor plate (2) manufactured by the MTZ.

The construction arrangement of the EHR5-OC electro-hydraulic regulator is shown in Fig. E-34.

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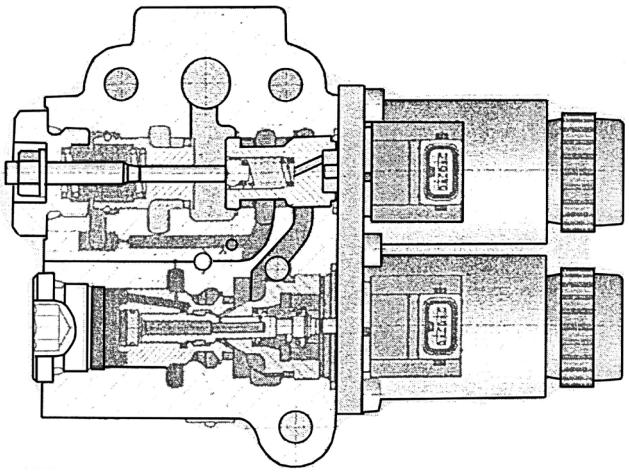


Fig. E-34. EHR5-OC electro-hydraulic regulator

The EHR5-OC electro-hydraulic regulator (Fig. E-34) is controlled by two proportional magnets with the use of the electronic RHL control system (see Fig. E-37)

Electronic RHL control system

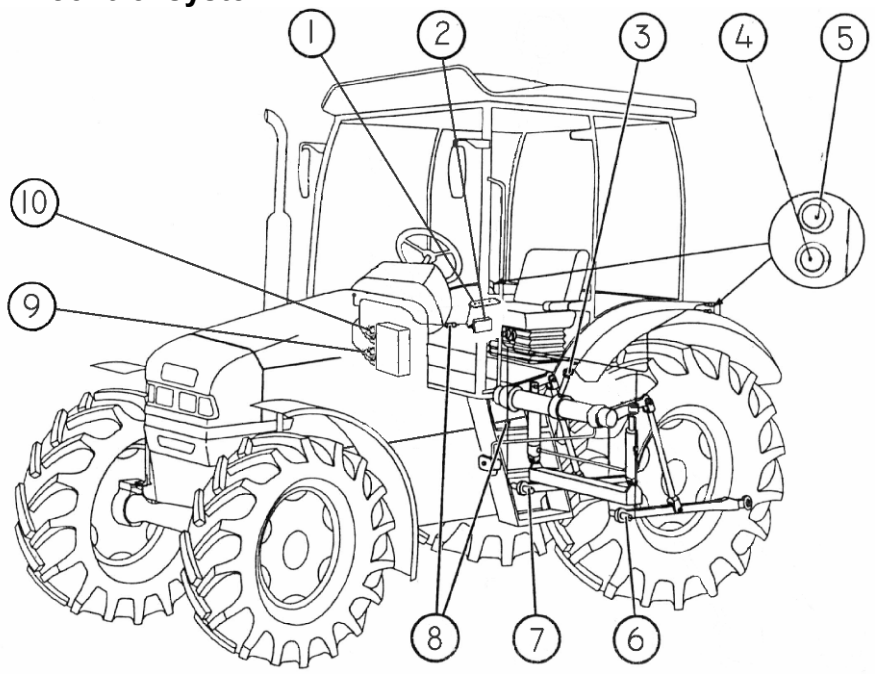


Fig. E-35. Electronic RHL control system

1 – RHL control panel; 2 – electronic unit; 3 – RHL position sensor; 4 – button for remote control of lowering the RHL; 5 – button for remote control of lifting the RHL; 6 – left-hand force sensor; 7 – right-hand force sensor; 8 – connecting cables with electric connectors; 9 – solenoid valve for lowering; 10 – solenoid valve for lifting.

The electronic part of the regulator control includes the following components:

- RHL control panel (1);
- Buttons (4, 5) for remote control of the RHL;
- Electronic unit (2);
- Force sensors (6, 7);
- RHL position sensor (3);
- Solenoid valves for lifting (10) and lowering (9);
- Connecting cables with electric connectors (8).

The electronic part of the system operates as follows. On turning the key switch of the starter and instrumentation to the position “Instrumentation energized”, the power supply voltage is fed from the electric equipment system through an single-terminal block with violet wire (on the right side under the dashboard) to the electronic unit 2 of the system. The electronic unit polls the sensors and system control components and, after analysis, gives necessary commands to the regulator solenoids. The system is controlled either from the control panel 1 located in the tractor cab or by means of the remote control buttons 4 and 5 located on the fenders of the rear wheels.

RHL Control Panel

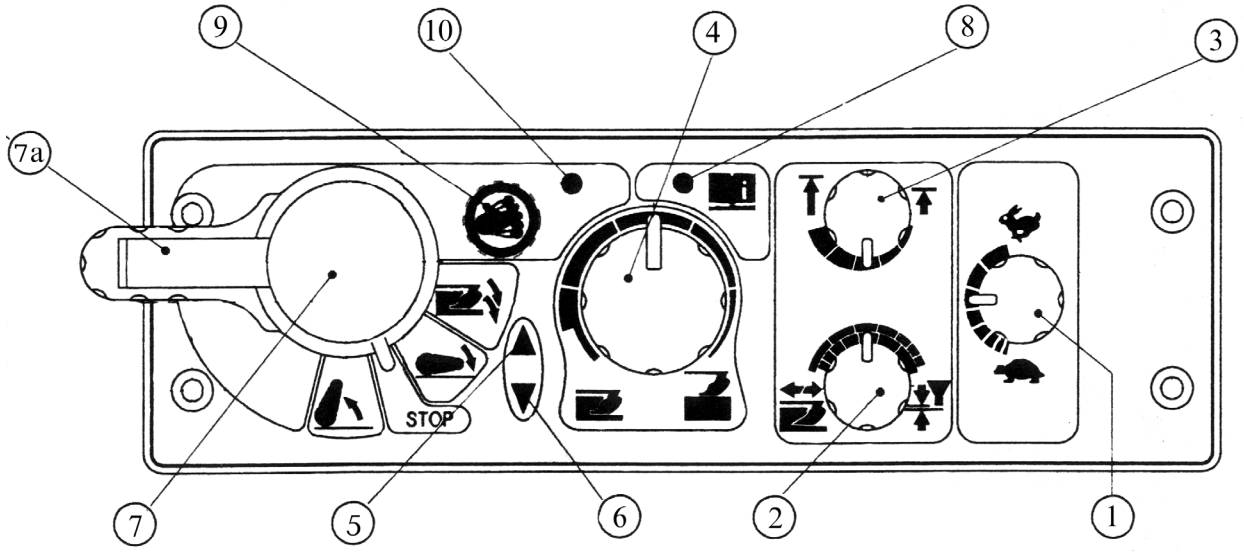


Fig. E-36. RHL control panel

1 – lowering speed control handle (clockwise – quicker, anti-clockwise – slower); 2 – handle for selecting the control method (clockwise – position one, anti-clockwise – draft one, intermediate – combination control); 3 – handle for control of limitation of the hitch linkage lifting (clockwise – maximum lifting, anti-clockwise – minimum lifting); 4 – handle for controlling the soil treatment depth (clockwise – less depth, anti-clockwise – more depth); 5 – hitch linkage lifting indicator (red); 6 – hitch linkage lowering indicator (green); 7 – hitch linkage control handle (upwards – lifting, downwards – lowering, when pressing the handle more in the bottom position – deepening the implement during the soil treatment, intermediate position – disabled); 7a – interlock switch (transportation) – mechanic interlock of the handle (7) in the top position by shifting the switch to the right; 8 – diagnostic alarm (see “Fault Diagnostics”), 9 – damping button, 10 – damping indicator.

The procedure of control of the rear hitch linkage is as follows:

- depending on the character of job, set the control method by means of the handle (2) (Fig. E-36);
- set the treatment depth and height of the implement lifting in the transportation position by means of the handles (4) and (3), respectively.
- to lower the hitch linkage, shift the handle (7) to the bottom fixed position. In this case, the indicator (6) goes out.

When performing the job, it is necessary to set the optimum conditions of operation of the mounted implement:

- combination of the control methods by means of the handle (2);
- lowering speed by means of the handle (1);
- soil treatment depth by means of the handle (4).

In case of the draft control, the system limits automatically the correction frequency to Hz in average.

In case of intense heating of the hydraulic system oil, the correction frequency should be reduced by shifting the handle (2) to the position method of control and the handle (1) – towards the turtle.

In case of raising ("popping") of the agricultural implement when passing through the pressed soil areas gashes, deepen the agricultural implement by pressing the handle (7) more downward. On releasing the handle (7) it will return to the fixed position of lowering. When it will be done, the agricultural implement reaches to mode of the preliminary specified depth set by the handle (4).

To raise the agricultural implement, shift the handle (7) to the upper position. When lifting the implement, the indicator (5) lights up.

ATTENTION! To avoid the failure of the HLL pump, it is prohibited to operate the tractor unless the indicator (5) goes out after lifting the implement.

It is necessary to know the following peculiarities of starting the work with the rear hitch linkage control system:

1. On starting the engine, the diagnostic indicator (8) lights up to indicate the serviceability and locking of the control system;
2. To unlock the system, it is necessary to set the handle (7) once to the working position (lifting or lowering). When it will be done, the diagnostics indicator (8) shall go out.
3. After unlocking the system when switching on the same for the first time, the automatic limitation of the speed of lifting of the rear hitch linkage is provided for the safety reasons. Setting the lever (7) to the "Lifting" position repeatedly disables the limitation of the lifting speed.
4. The lifting and lowering of the rear hitch linkage by means of the remote control buttons on the fenders of the rear wheels can be performed in any control modes (the handles can be set to arbitrary position). In this case, the cab control system is blocked.

WARNING: When using the remote control units, never stand between the tractor and the implement ganged. To avoid accidents, it is strictly prohibited to use the buttons of mechanical movement of the regulator solenoid valves.

The work with the control system shall be started in the sequence described in paragraphs 2 and 3.

ATTENTION! To avoid more deepening of the agricultural implement, in case of emergency stop of the tractor the control handle (7) shall be set to the "Neutral" position. After starting the movement, shift the handle to the "lowering" position (the agricultural implement will e deepened to the preliminarily set depth).

In addition to the above functions, the electronic control system of the RHL is provided with the "damping" mode (damping of oscillations of the mounted agricultural implement in the transportation mode).

The damping mode shall be enabled in the following order:

- Set the handle (7) to the "lifting" position (when it will be done, the RHL will be lifted to the top position and disengaged automatically);
- Press the "Dampind" button (9) (when it will be done, the RHL will be lowered from the top position by 3% from the full stroke of the RHL).

ATTENTION!

1. The "Damping" mode can be only enabled, when the handle (7) is set to the "Lifting" position.

2. When performing he field works (ploughing, cultivation, etc.), the "Damping" mode shall be disabled.

Fault Diagnostics

The BOSCH electronic hydraulic control system is provided with the self-testing capability and issues the code information to the operator by means of the diagnostics indicator (8) (Fig. E-35b) on the RHL control panel. In case of absence of faults, the indicator is illuminated continuously after starting the engine. After upward or downward manipulations of the RHL control handle (7) (Fig. E-35b), the indicator is switched off. On shifting the control handle downwards, the green indicator (6) (Fig. E-35b) of lowering the RHL lights up; on shifting the same upwards, the red indicator (5) (Fig. E-35b) of lifting the hitch linkage lights up.

Should there be some faults in the system (after starting the engine) the diagnostics indicator starts to issue the code information about the fault and, if necessary, the operation of the system is locked.

The fault code is issued as a two-digit number, the first digit of which is equal to the number of indicator blinks after long pause and the second one – to the number of indicator blinks after short pause. For example, long pause – three blinks of the indicator, short pause – six blinks of the indicator.
It means that in the system there is a fault under the code “36”. Should there be several faults, the system indicates the fault codes one after another with separating them with a long pause.

All the faults are divided into the three groups: complex, medium and light.

On detecting ***complex*** faults, the control is ceased and the system is switched off. The system cannot be controlled from the control panel and remote control buttons. The diagnostics indicator issues the fault code. After elimination of the fault and starting the engine, the operation of the system is resumed.

In case of ***medium*** faults, the control is ceased and the system is locked. The system cannot be controlled from the main control panel, but can be controlled from the remote control buttons. The diagnostics indicator issues the fault code. After elimination of the fault and starting the engine, the operation of the system is resumed.

In case of ***light*** defects the diagnostics indicator issues the defect code. The system is not locked and can be controlled. After elimination of the defect, the diagnostics indicator goes out.

When the system detects a fault, proceed as follows:

1. Stop the engine;
2. Set the controls on the main control panel as follows

(Fig. E-35b):

- handle (7) for controlling the hitch linkage – to the “off” position;
- handle (3) for controlling the lifting limitation – to the “minimum lifting” position;
- handle (4) for controlling the soil treatment depth – to the “minimum depth” position;
- handle (1) for controlling the lowering speed – to the medium position;
- handle (2) for controlling the “draft – position” mode – to the medium position.

3. Start the engine and, if there are no defects, proceed to work. If the defects have not been eliminated, perform the system diagnostics and eliminate the faults.

The possible defects and methods of their check-up are given in the table below.

The connection diagram of the RHL control system is shown in Fig. E-37.

ATTENTION!

1. The electric connectors of the control system of the hitch linkage shall be only disconnected when the engine is stopped.
2. The specified voltage values shall be measured when the engine is running with observing the safety precautions for working with energized electric appliances.
3. The contact numeration in the bundle connectors is indicated on the parts of the connector bodies.

List of possible defects and methods of their check-up

Defect code	Defect description, possible cause	Defect check-up method
Complex defects		
11	Fault in the circuit of control the solenoid valve for lifting. Open circuit in the winding of the electromagnet (10) or in the electromagnet control bundle (Fig. E-37).	Disconnect the bundle from the electromagnet and check the electromagnet for open circuit by means of a tester. The electromagnet resistance shall not exceed 2…4 Ω. If the electromagnet is free of fault, check the electromagnet control bundles for mechanical damage and check the wire from the electromagnet connector terminal to the terminal (2) of the 25-contact connector of the electronic unit for breakage by means of a tester.
12	Fault in the circuit of control the solenoid valve for lowering. Open circuit in the winding of the electromagnet (9) or in the electromagnet control bundle (Fig. E-37)	Disconnect the bundle from the electromagnet and check the electromagnet for open circuit by means of a tester. The electromagnet resistance shall not exceed 2…4 Ω. If the electromagnet is free of fault, check the electromagnet control bundles for mechanical damage and check the wire from the electromagnet connector terminal to the terminal (14) of the 25-contact connector of the electronic unit for breakage by means of a tester.
13	Fault in the circuit of control the solenoid valve for lowering or lifting. Short circuit in one of electromagnets or between the electromagnet control wires in the bundle (Fig. E-37).	Disconnect the bundles from the electromagnets and check the electromagnets for short circuit by means of a tester. The electromagnet resistance shall not exceed 2…4 Ω. Alternatively, measure the electromagnet consumption current when applying the voltage of 6 V to the electromagnet. The current shall not exceed 3.2 A. Disconnect the connector from the electronic unit and check the terminals (2) and (14) for short circuit (when doing this, the electromagnets shall be disconnected).
14	Fault in the control circuit of the solenoid valves for lowering and lifting. Wire breakage in the electromagnet control bundle (Fig. E-37).	Check the system bundles for mechanic damages. Disconnect the connectors from the electronic unit and electromagnets and check the wire from the terminal (6) of the electronic unit connector to the terminals of connectors of the electromagnets. Check the presence of the supply voltage on the terminal (5) of the electronic unit connector (when doing this, the engine shall be running). If the voltage is absent, check the reliability of connection in the single-terminal block with violet wire on the right under the dashboard and fuse. The fuse is located in the medium fuse block on the dashboard. The voltage is applied to the fuse after turning the switch of the starter and instrumentation to the “instrumentation energized” position.
15	Fault of the remote control buttons. Short circuit be-	Check the bundles from the remote control buttons for mechanical damage. Disconnect each button in

Defect code	Defect description, possible cause	Defect check-up method
	tween the wires or locking of one of the remote control buttons. In this case, the hitch linkage begins move up- or downwards immediately after starting the engine (Fig. E-37).	turn until the defect is eliminated. When disconnecting the buttons, the engine shall be stopped. If the defect does not disappear when the buttons are disconnected, it is necessary to disconnect the connector from the electronic unit and check the terminals (10) and (12), (20) and (12) for short circuit by means of a tester.
16	Electronic unit fault. Stabilized supply voltage of the control panel is below the required level. Possibly, short circuit in the connectors of the sensors of force and RHL position due to penetration of water into the connectors (Fig. E-37).	Disconnect the main control panel from the common bundle. Measure the stabilized power supply voltage on the contacts (6) (minus) and 4 (plus) of the control panel connector, which shall be 9.5-10 V (after turning the switch of starter and instrumentation to the "instrumentation energized" position). In case of missing or insufficient supply voltage, it is necessary to check the reliability of connection of the electronic unit connector. Disconnect in turn the sensors of force and RHL position.
22	Fault of the position sensor. Breakage of the sensor wire or the sensor is not connected or not adjusted (Fig. E-37).	Check: • the reliability of connection of the electric connector to the position sensor (3) (Fig. E-35c); • the bundle connected to the sensor for mechanical damage; • the correctness of setting the RHL eccentric, i.e. in case of maximum lowering of the RHL, the sensor shall be pressed to the minimum extent and vice versa; • the correctness of adjustment of the position sensor (if the defect becomes apparent when the RHL is in the bottom position, the sensor shall be screwed in and it becomes apparent when the RHL is in the top position, the sensor shall be screwed out). The adjustment shall be performed when the RHL is in the top position.
Medium defects		
23	Control panel fault. The potentiometer (4) of the soil treatment depth (Fig. E-37) is faulty.	Check the reliability of connection of the connectors of the control panel and electronic unit as well as check the bundle for mechanical damage. Check the output voltage according to the electric diagram.
24	Control panel fault. The potentiometer (3) of the top RHL position (Fig. E-37) is faulty.	Check the reliability of connection of the connectors of the control panel and electronic unit as well as check the bundle for mechanical damage. Check the output voltage according to the electric diagram.
28	Control panel fault. The RHL control lever (7) (Fig. E-37) is faulty.	Check the reliability of connection of the connectors of the control panel and electronic unit as well as check the bundle for mechanical damage. Check the output voltage according to the electric diagram.
31	The right-hand force sensor	Check the connection of the cable to the force sensor

Defect code	Defect description, possible cause	Defect check-up method
	is faulty. Cable breakage or shirt circuit in the sensor (Fig. E-37).	and check the cable for mechanical damage. Overload of the force sensor is also possible.
32	The left-hand force sensor is faulty. Cable breakage or shirt circuit in the sensor (Fig. E-37).	Check the connection of the cable to the force sensor and check the cable for mechanical damage. Overload of the force sensor is also possible.
Light defects		
34	Control panel fault. The RHL control rate potentiometer is faulty (Fig. E-37)	Check the reliability of connection of the connectors of the control panel and electronic unit as well as check the bundle for mechanical damage. Check the output voltage according to the electric diagram.
36	Control panel fault. The potentiometer of combination of the ploughing modes (draft-position) is faulty (Fig. E-37)	Check the reliability of connection of the connectors of the control panel and electronic unit as well as check the bundle for mechanical damage. Check the output voltage according to the electric diagram.

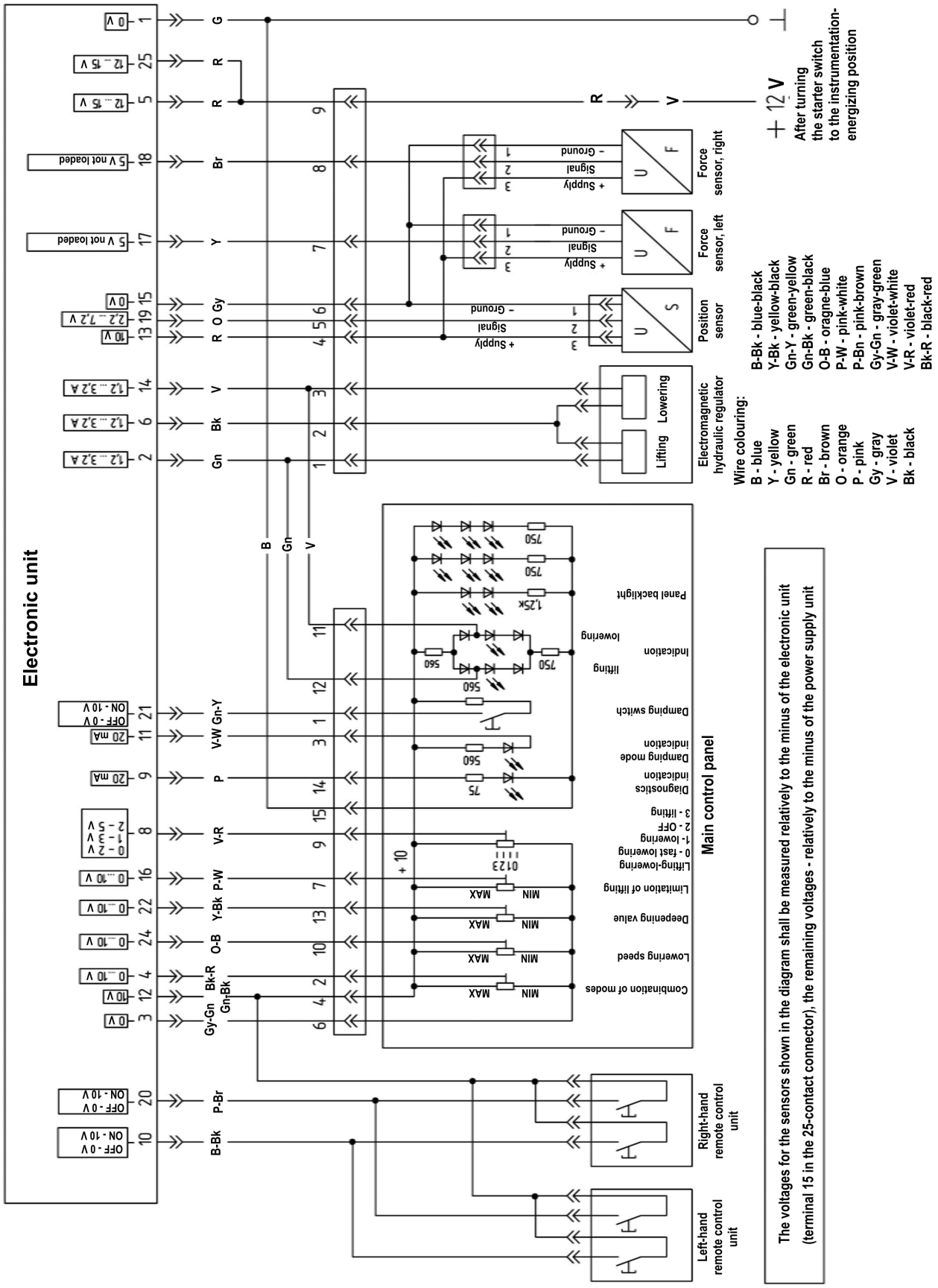
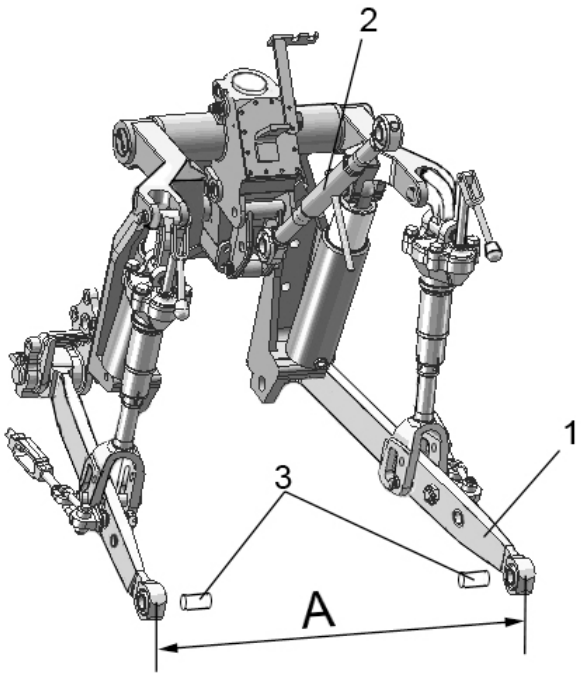


Fig. E-37. Electric connection diagram of the RHL control system

Rear Hitch Linkage (RHL)

The second-category three-point hitch linkage with the third-category connecting points serves for ganging the mounted and semi-mounted agricultural machines and implements with the following coupling members:

- the length of the suspension axle "**A**" (conventional distance between the joints of the lower rods) is 870/1010 mm, respectively, for the 2nd and 3rd category;
- the diameter of the holes of the rear joints of the lower connecting rods is equal to 37.4 mm.
- the diameter of the pin of the upper rod is 31.75 mm.



ATTENTION! Prior to ganging the machines, read carefully this section.

The tractor is equipped with the one-piece connecting rods (1) with the length of 885 mm and the upper rod (2) with the third-category joints. For operation with the second-category machines, the SPTA kit of the tractor contains the adaptor bushings (3) for the lower rods for the suspension axle of the implement ∅28 mm and adaptor bushings and fingers ∅22 mm and ∅25 mm for connecting the upper rod to the implement.

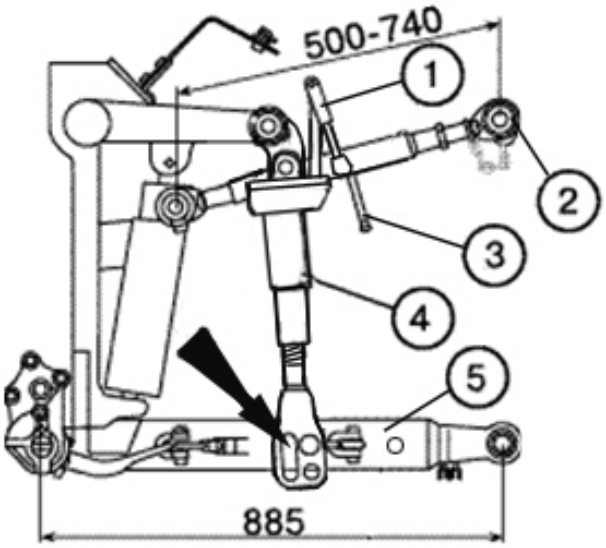
Upper rod and angle braces

The length of the upper rod (2) is adjustable within 500...740 mm by means of the handle (3).

The RHL is provided with two gear-type (adjustable) angle braces. Their length can vary within 580...665 mm by rotating the handle (1).

When the tractor is shipped from the manufacturer, the length of the both angle braces is set to the standard value of 640 mm.

To facilitate the change of the angle brace length, their fork is provided with two holes for setting the pin.



IMPORTANT! Adjust the position of the machine by means of the right-hand angle brace only.

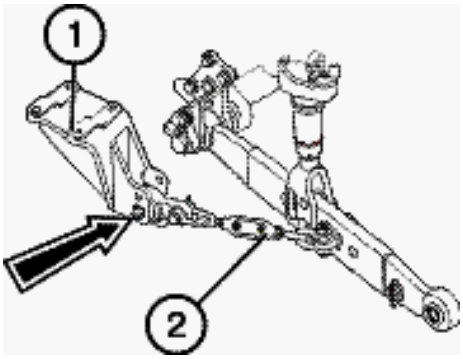
To follow the relief of the field area to be treated when working with wide-cut machines and to avoid damage of the angle braces, connect the angle braces (4) with the lower rods (5) through the slots (indicated by an arrow).

IMPORTANT! When doing this, the slots of the angle brace fork shall be behind the hole as seen in the direction of the tractor forward travel to avoid the damage of the angle brace.

To increase the RHL carrying capacity, the forks of the angle braces and the tie-link ear can be repositioned by one hole backwards. In this case, the length of the tie-links shall be increased by inserting an additional shackle from each side.

External tie-links

Partial locking



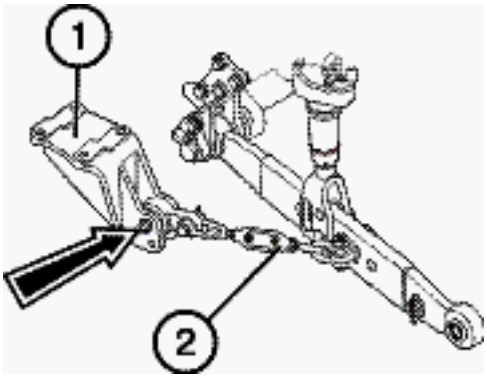
The horizontal movement of the implement in the working position shall be provided by connecting the tie-links to the lower holes of the brackets (1) and adjusting the length by means of the tie-links (2) to ensure the implement swinging to each side by at least 125 mm or in accordance with the operating manual for the implement.

When working with ploughs, adjust the length of the right-hand tie-link to the treatment depth.

ATTENTION! The implement swinging amplitude shall be obligatorily ensured to be at least 125 mm to avoid breakage of the tie-links when lifting the implement to the transportation position.

When transferring the implement to the transportation position, tension the tie-links (2). The swinging of the implement within 20 mm to both sides is allowed.

Full locking

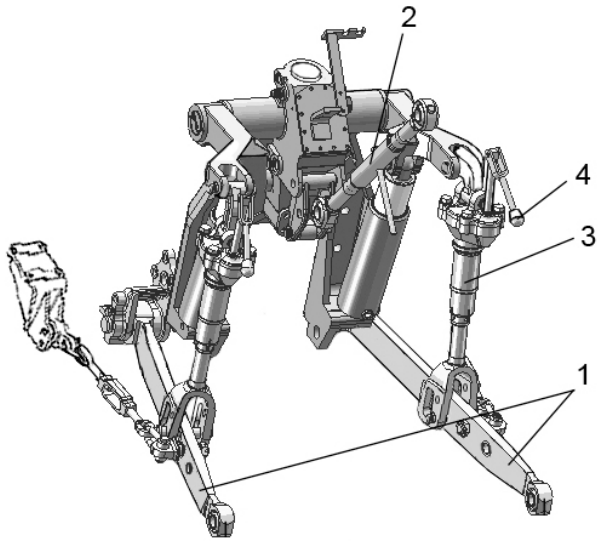


To provide the full locking of the implement in the working position, connect the tie-links (2) to the upper hole of the bracket (1) and reduce their length as much as possible having ensured the implement swinging within 20 mm to both sides.

Mounting the agricultural implements onto the tractor

The most kinds of equipment can be mounted on the tractor by performing the following operations:

1. Lower the hitch linkage to the bottom position. Align the axles of joints of the lower rods (1) and pins of the implement and attach the implement to the lower rods. Lock the pins with cotter pins. Stop the engine.
2. Lengthen or shorten the upper rod (2) and connect the same to the implement by means of the rear joint pin. Lock the pin with a linchpin with a ring.
3. If necessary, adjust the upper rod to the initial or required length.
4. If necessary, adjust the sideways tilt of the implement by means of the right-hand angle brace (3). To increase the angle brace length, turn the handle (4) clockwise and vice versa.
5. Attach the necessary remote mount equipment.
6. Prior to beginning the work, check to make sure that:
   - the parts of the tractor is not in dangerous vicinity of those of the implement;
   - the upper rod is not in contact with the PTO enclosure when the implement is in the bottom position;
   - the cardan drive from the PTO is not too long with large joint angles and there are no thrust forces;
   - the PTO is not in contact with the cardan drive of the machine;
   - lift slowly the implement and check the presence of the clearances between the tractor and the implement in the lifted position;
   - check the presence of the required side swinging of the lower rods and adjust it be means of the tie-links, if necessary.



IMPORTANT! When mounting the mounted or semi-mounted equipment on the tractor or when hitching the trailed equipment to the tractor by means of the draft hitch, make sure that there is a sufficient clearance between the implement and the tractor.

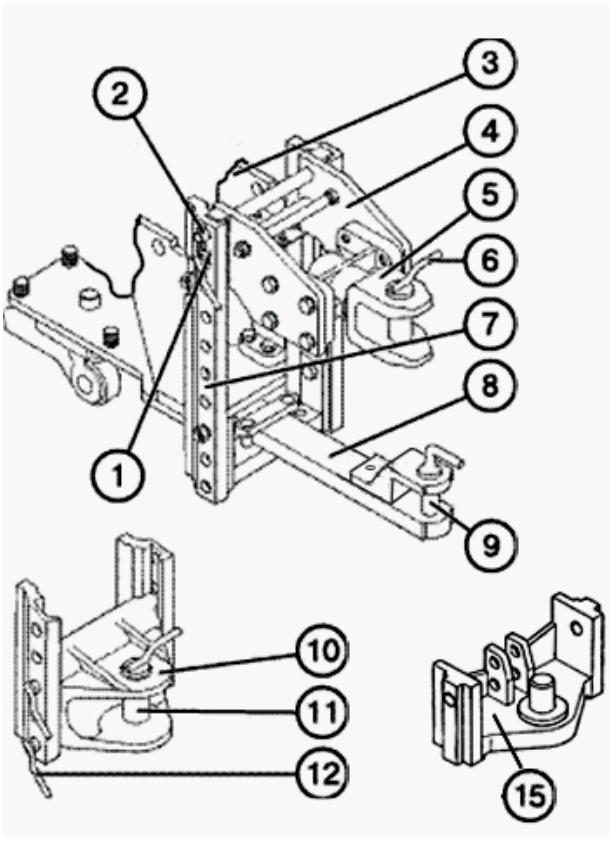
CAUTION! Some mounted or semi-mounted equipment can touch the cab and damage the same. It could cause the breakage of the cab glasses and injure of the operator. Check the presence of a sufficient clearance (at least 100 mm) between the implement lifted to the top position and the tractor cab.

Universal traction-hitch mechanism

The towing arrangement for working with two-ale trailer consists of the towing jaw (5) with the pivot (6). The jaw body is connected with the plates (4) which enter the slot of the guiding side pieces (3, 7) and fixed by means of four pins (12). The pins are locked by means of a linchpin (2) and stopped by the ring (1). The height of the towing jaw with the body can be varied by repositioning the same on the holes in the side pieces (3, 7).

The towing jaw (10) with the pivot (11) is intended for work with semi-trailers. The hitch pin (python) (15) can be also used for this purpose.

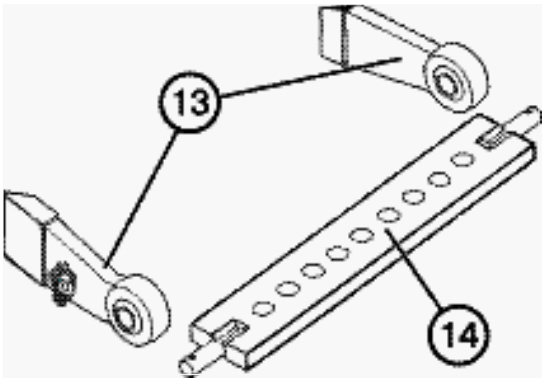
The drawbar (8) with the pivot (9) is intended for hitching the semi-trailed and trailed agricultural machines to the tractor.



Crossbar (single) (14)

The crossbar complies with international standards and is intended for hitching the trailed and semi-mounted machines to the tractor.

It is mounted onto the RHL suspension axle (rear joints of the lower rods (13)) and connected with the machines having a fork instead of loop and makes it possible to improve the manoeuvrability of machine-tractor aggregate.



Coupling hook

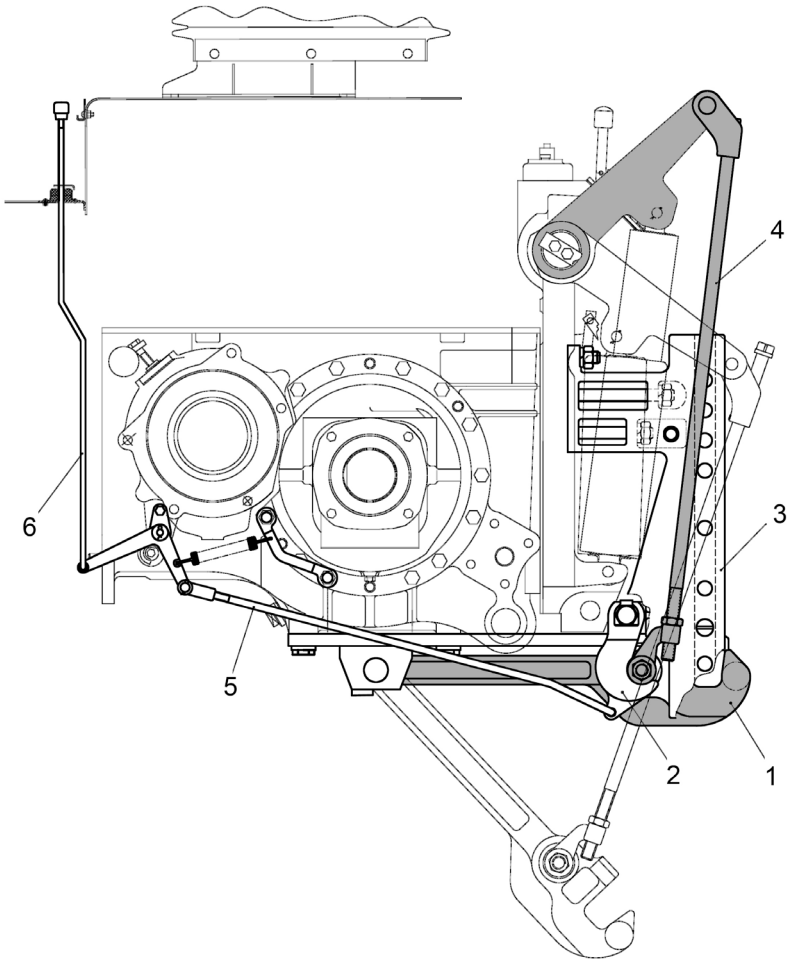
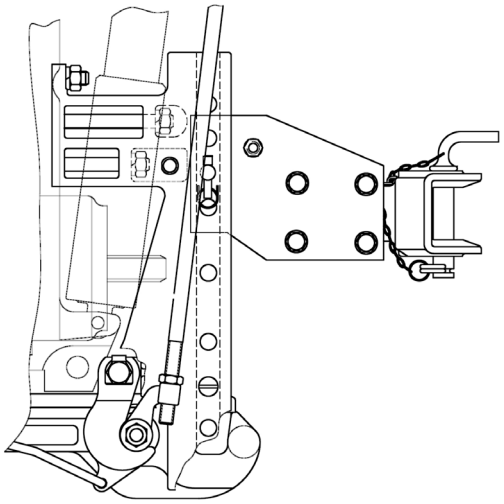


Fig. E-38. Coupling hook

The coupling hook (hydroficated) is intended for working with semi-trailers and agricultural machines based on them. It is mounted on the tractor with the lift-type guides of the traction-hitch mechanism. It can be delivered complete with the towing jaw intended for working with trailers and trailed agricultural machines.

The coupling hook consists of the following basic parts: 1 – hook with axle; 2 – bracket with grips; 3 – guides of the traction-hitch mechanism; 4 – lifting rods; 5 – control rod; 6 – control handle.



Variant with towing jaw

Adjustment of the hydroficated hook control mechanism and peculiarities of adjustment with the electro-hydraulic regulator of the RHL control

ATTENTION! Prior to beginning the work with semi-trailers as well as prior to each adjustment of the position sensor (in case of mounting of the EHR) determining the position of the lift levers (1) and (2) (see Fig. E-38), it is necessary to turn out the screws (3) (see Fig. E-39) from the shackles (4) to ensure the free travel of the levers to avoid breakage of pins (5) of the angle braces.

If the tractor is equipped with the EHR, the position sensor shall be set in the following order: Screw in the sensor (12) with applying the hand torque until full taking up of its travel (up to the stop) and then screw it out by 0.5...1.0 revolutions and stop by means of a locknut (with applying the hand torque too).

To adjust the control mechanism, proceed as follows:

1. Lift the lift levers to the maximum possible height, which can be determined by the position sensor and position handle of the distributor, adjust the length of the lifting bars by means of the screws (3), turn in the screws (3) into the shackles (4) until the heads of the screws rest against the surfaces of the shackles 6 and stop them with locknuts. When it will be done, the grips (7) shall pass under the hook axle 8 without striking against it.
2. Set the pawl E of the handle (10) onto the bracket (11).
3. Ensure the clearance «Д» between the grips (7) and the hook axle (8) when lowering and lifting the same by adjusting the length of the rod (9).
4. Lift the levers to the top position and move the handle (10) down. When it will be done, the grips (7) shall be positioned under the hook axle.
5. Make sure that the grips ensure the locking of the hook in the working position when lowering the levers.

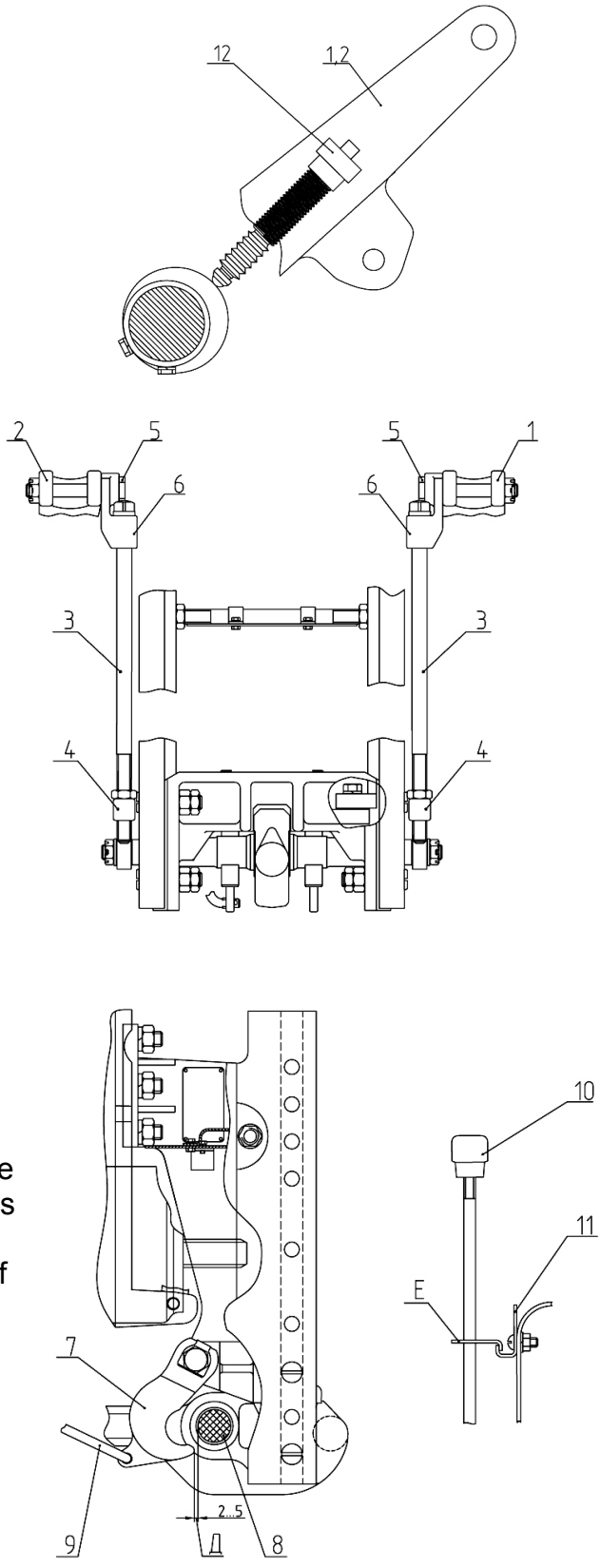


Fig. E-39

Hydrostatic Steering Unit (HSU)

The HSU unit is designed to control turning of the steering wheels and to reduce steering wheel efforts when turning the tractor. The HSU unit consists of a measuring pump (6) (Fig. E-40), two hydraulic cylinders (9, 13) to perform the turn, feed pump (16) together with engine-operated drive, and hydraulic pipe fittings. The oil vessel is a separate HSU oil tank (2).

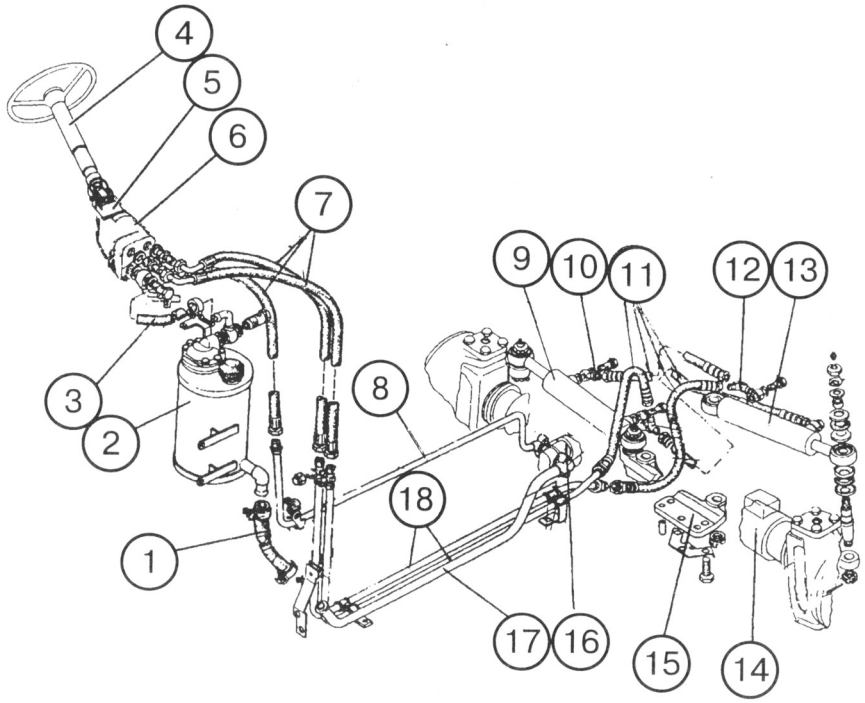


Fig. E-40. HSU schematic diagram:
1 – intake oil duct hose; 2 – HSU oil tank; 3 – hose; 4 – steering column; 5 – column bracket; 6 – measuring pump; 7 – high-pressure hose; 8 – oil tubing; 9, 13 – turn hydraulic cylinders; 10 – adaptor; 11 – high-pressure hose; 12 – T-branch; 14 – front drive axle; 15 – bracket; 16 – feed pump; 17 – intake oil duct; 18 – oil tubings

HSU Structure and Operation

The gerotor-type measuring pump (6) is installed on the steering column bracket (5), turn hydraulic cylinders (9, 13) – on the front drive axle (14), on the front-end of the tractor, feed pump (16) – on the engine. The measuring pump is connected to the turn cylinders, feed pump and HSU oil tank (2) by means of oil tubings (8, 17 and 18) and hoses (1, 7, 11).

On straight forward travel of the tractor, the cylinder cavities are closed by the dispensing pump slide-valve bands; hence, the oil fed to the dispensing pump from the feed pump is returned into the HSU oil tank. When turning the steering wheel, slide valve (3) (Fig. E-39) of the measuring pump shifts with respect of sleeve (5), thus, ensuring oil feed to the turn hydraulic cylinders in the amount proportional to the angle of turn of the steering wheel.

Measuring Pump

The measuring pump (Fig. E-41) consists of a pumping unit (I), distributor (II), a non-return valve (9), two anti-shock valves (7), safety valve (6) and two anti-vacuum valves (8).

The gerotor pumping unit is made up of a body-mounted stator (1) and rotor (2); the latter is connected to slide valve (3) through a driven shaft (4). The distributor consists of a casing (10), sleeve (5) and slide valve (3) spline-seated on the steering column shaft driven end-piece.

The safety valve (6) limits maximum pressure in the oil discharge duct to within 14…15 MPa (140…150 kgf/cm^2).

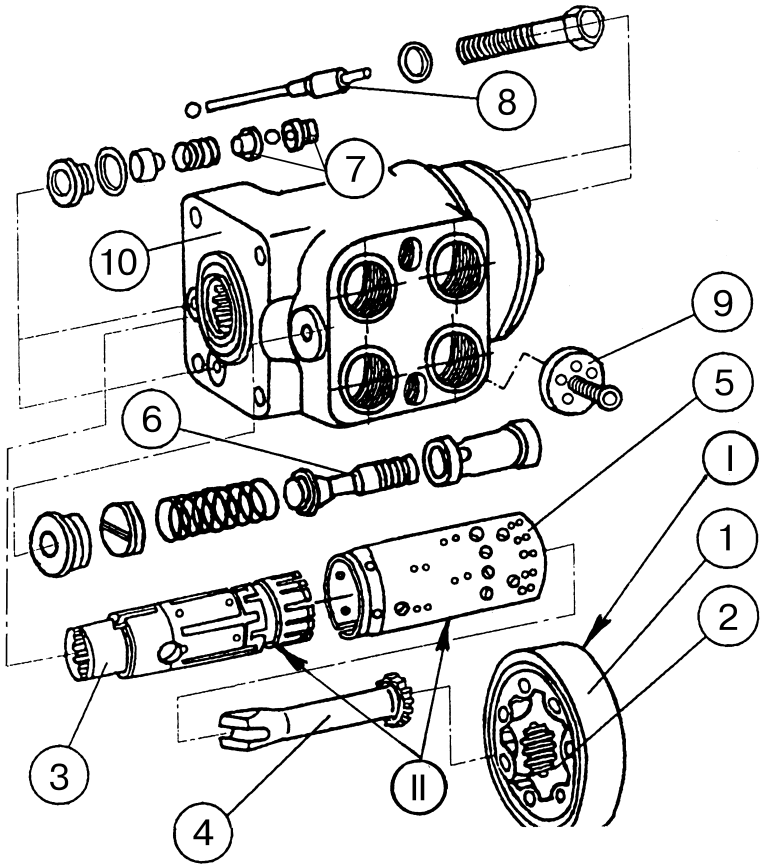


Fig. E-41. Measuring pump (exploded view):
1 – stator; 2 – rotor; 3 – slide valve; 4 – driven shaft; 5 – sleeve; 6 – safety valve; 7 – anti-shock valve (2 off); 8 – anti-vacuum valve (2 off); 9 – non-return valve; 10 – casing; I – pumping unit; II – distributor

The anti-shock valves (7) limit pressure in the cylinder ducts in case of impact loads. Pressure setting for the anti-shock valves is within 20…21 MPa (200…210 kgf/cm^2).

The anti-vacuum valves (8) make it possible to ensure supply of the required amount of working fluid to the hydraulic cylinder in an emergency and on operation of the anti-shock valves.

Hydraulic Cylinders of the Steering Gear Mechanism

Two hydraulic piston cylinders (9, 13) (Fig. E-40) enable the driver to turn the front steering wheels of the tractor; they are installed in front of the FDA (14).

Hydraulic cylinder rods are connected to the front wheel reduction gears through tapered fingers, and the cylinder tubes are attached to the FDA housing on brackets (15). The FDA housing has a number of holes intended for re-arrangement of cylinder tubes when adjusting the front-wheel tracks.

Spherical joints are installed in the cylinder tube lugs and in the rod heads. These joints require regular lubrication through specially provided pressure lubricators (refer to Section M: “Scheduled Maintenance”).

HSU of a Reversible Tractor (BELARUS-1221B.2)

The HSU of a reversible tractor is a modification of the “Belarus” 1221 HSU and includes all its components, namely:

- • Two steering wheel hydraulic cylinders installed on the tractor’s FDA;
- Measuring pump mounted on the steering wheel column;
- 14…16 cm^2/rev. feed pump mounted on the engine.

Besides, to make a turn when «in reverse» mode, an additional steering post is installed on the cab rear wall, in assembly with a measuring pump. Also provided is a “forward travel-reverse” changeover valve, which is mounted on a safety screen between the engine and the cab, at the left, if viewed in the direction of the tractor forward travel.

Connected to the valve are oil ducts from the feed pump and the discharge ducts from measuring pumps for forward and reverse travel.

The HSU schematic is made so that, when changing over from forward travel operation to the run “in reverse”, and conversely, it is necessary but to set the “forward travel-reverse” changeover valve lever to the required position.

To reposition the steering wheel, unscrew the steering wheel lock knob, put the steering wheel on a respective steering column (either forward or reverse travel, as required) and lock it at a height convenient for operation.

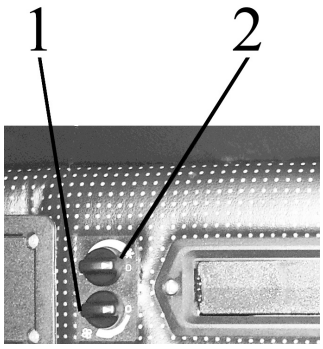
Recommendations for using. Prior to starting the engine, it is necessary to make sure that the reverse cock handle has been set to the position corresponding to the selected direction of travel of the tractor.

IMPORTANT! The reverse cock shall be only repositioned when the engine is not running to avoid the feed pump breakage or rupture of the oil discharge pipeline of the steering control.

Air Conditioning and Cab Heating System

Control of the climatic control system in the air-conditioning mode

The control panel of the climatic control system is located at the centre of the upper panel of the cab. The control panel comprises the switches (1) and (2).



The switch (1) can be used for varying the air flow rate by varying the rotational speed of the fan. The switch (2) can be used for varying the temperature of cold and dried air escaping from the deflectors in the air conditioning mode.

ATTENTION: The air conditioner can be only switched on and operated when the engine is running

To switch on the air conditioned, proceed as follows:

- Turn the switch (2) (Fig. 2.7) clockwise at the angle of 180° to the beginning of the blue scale;
- Then turn the switch (1) to one of the three designated positions (the fan rotor has three rotational speeds). After 3-5 minutes adjust the desired temperature in the ca by means of the switch (2);
- he shutters located on the upper panel near the operator's head can be used for controlling the mixture of outer and recirculation air;

To switch off the air conditioner, I is necessary to turn both switches (1) and (2) anti-clockwise to the "0" position.

ATTENTION: during the operation in the cooling mode, the heater cock shall be closed to prevent the simultaneous operation of the systems of heating and air cooling.

Control of the climatic control system in the heating mode

ATTENTION: the engine cooling system shall be only filled with coolant with low freezing point.

To ensure the efficient operation of the heating system, observe the following recommendations:

1. After filling the cooling system with coolant, start the engine and let it run at medium speed without opening the cock so that the coolant in the cooling system would be warmed up to 70-80°C, then open the cock, increase the rotational speed of the engine and let it run for 1-2 minutes until the heater radiator is filled with coolant. Make sure that the coolant circulates through the heater. The temperature of the heater radiator shall rise. At the same time, the coolant level in the radiator of the engine cooling system will be lowered;

2. Add coolant to the radiator of the engine cooling system to the necessary level (MAX mark on the expansion tank);

3. To speed up the warming-up of the cab, switch on the heater fan and open the recirculation shutters;

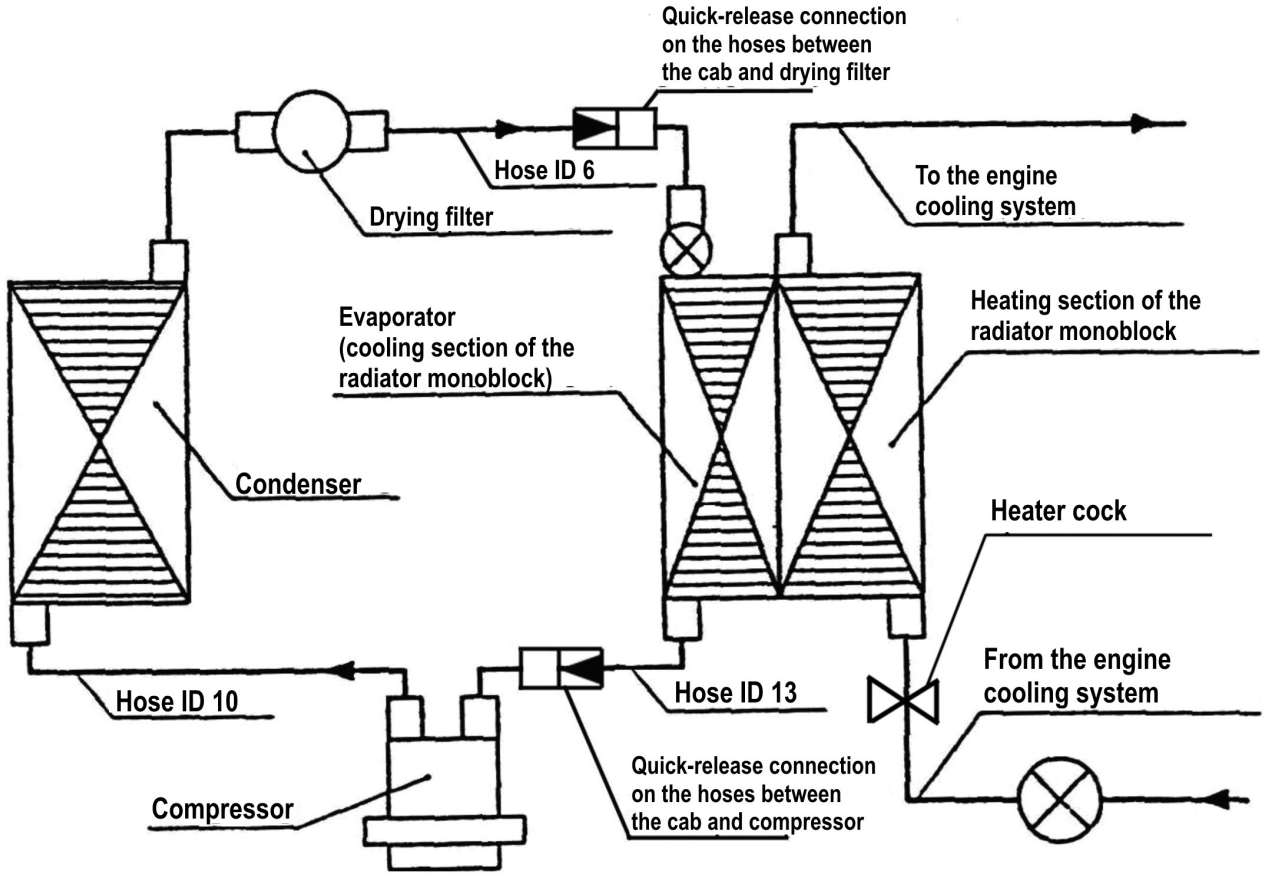
4. To drain the coolant from the heater and engine cooling system place the tractor on a level ground. Remove th cap of the expansion tank of the engine cooling system, open the cock on the cylinder block in the rear part of the engine and disconnect the heater hoses before entering the cab posts.

ATTENTION: during the operation in the heating mode, the switch (2) shall be fully set to the off position to prevent the simultaneous operation of the systems of heating and air cooling.

General arrangement and operation of the air conditioning and cab heating system

The air conditioning and cab heating system is intended for creating and maintaining the normal microclimate in the tractor cab. The air conditioning system consists of two circuits, the cooling and heating ones. The schematic diagram of the system is given below.

The cooling circuit includes the compressor, condenser, drying filter with the pressure sensor, monoblock of the evaporator and radiator of the heater (cooler-heater), fan of the cooler-heater, connecting hoses with the complete set of quick-release couplings, electric cables, air filters, cold air control and fan switch. The heating circuit is supplemented with the hoses connected with the tractor engine cooling system and cooler-heater.



Schematic diagram of air conditioning and cab heating

The components of the air conditioning system are arranges as follows:

- compressor – on the left of the semiframe, at the bottom;
- condenser – before the aftercooler radiator;
- drying filter – on the condenser frame;
- pressure sensor – on the drying filter;
- heater-cooler – under the roof, above the ventilation compartment panel;
- cold air control and fan switch – on the panel of the upper compartment;
- service valves – on the fittings near the compressor and drying filter.

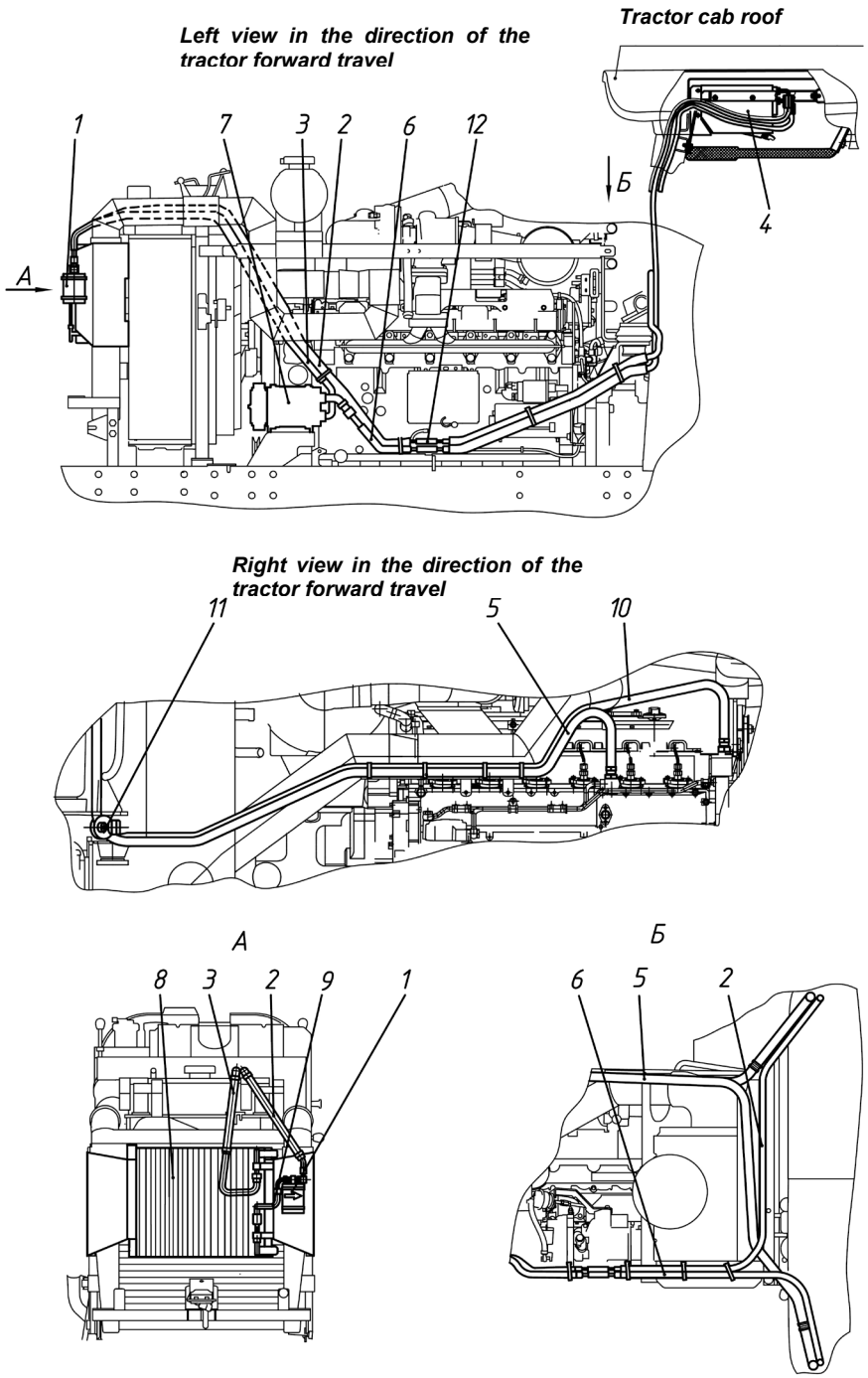


Diagram of arrangement of the basic components of the air conditioning and cab heating system

To the diagram of arrangement of the basic components of the air conditioning and cab heating system:

1 – drying filter; 2 – pipeline for feeding the coolant from the drying filter to the heater-cooler; 3 – pipeline for feeding the coolant from the compressor to the condenser; 4 – heater-cooler; 5 – pipeline for feeding the coolant from the engine cooling system to the heater-cooler; 6 – pipeline for feeding the coolant from the heater-cooler to the compressor; 7 – compressor; 8 – condenser; 9 – pipeline for feeding the coolant from the condenser to the drying filter; 10 – pipeline for draining the coolant from the heater-cooler to the engine cooling system; 11 – shut-off cock; 12 – quick-release couplings.

The climatic-control system begins functioning in the air conditioning mode when the engine is running, the desired rotational speed of the fan is set be means of the switch (1) and the switch (2) is set to the beginning of the blue scale.

When it will be done, the voltage is applied to the electromagnetic clutch of the compressor via control circuit. The clutch is engaged to transmit the rotation from the engine crankshaft pulley to the compressor shaft. The compressor pumps the coolant through the air conditioning system components. At the same time, the coolant absorbs the heat from the air passed through the cooler-heater and then release the heat into the environment via condenser.

The air conditioning system is capable of maintaining automatically the specified temperature, which is set by turning the switch (2) controlling the thermostat. When turning the switch clockwise, the temperature decreases and when turning the same anti-clockwise – increases. The protection against critical modes is ensured by the pressure sensor and thermostat. The sensor switches the system off in case of overpressure (exceeding 2.6+0.2 MPa) or insufficient pressure (below 0.21±0.03 MPa). The thermostat switches the system off in case of excessive decrease of the temperature of the cooling section of the radiator monoblock. The system capacity is controlled by means of the fan rotational speed and thermostat. In this case the compressor can be operated either continuously or cyclically.

The main parameters and technical characteristics of the air conditioning and cab heating system are given in the table below.

Description of the parameter (characteristic)	Value
Cold productivity, kW	6.4
Heat productivity, kW	8.7
Operating voltage, V	12
Electrical power consumption, W	260
Mechanical power consumption, kW	1.4 to 8.0
Coolant	R134a, ozone-saving
Compressor	DELPHI SP15
Compressor drive belt	SPA/S-932

To maintain the system in the serviceable condition in case of non-regular operation, it is recommended to switch on the system in the cooling mode once 15 days in the cooling mode (at the outer temperature exceeding 15°C) for 15-20 minutes.

Regardless the operating conditions, it is necessary to check the operation of the system at the service station using special equipment once a year.

When putting the tractor for short-term storage, no preparatory works should be performed for the air conditioning system. During the storage, it is necessary to switch on the air conditioner with the engine running for 15-20 minutes once 15 days. In this case, the air temperature in the tractor cab shall not be below 20°C.

When putting the tractor for long-term storage, it is necessary to check the operation of the air conditioning system using special equipment once a year. If necessary, add coolant. During the storage, no service works should be performed.

When taking the tractor from the storage, it is necessary to perform the service of the air conditioning system at the

specialized service station using the diagnostic equipment.

PRECAUTIONS:

1. Only the specially trained personnel shall be allowed to perform the maintenance and repair of the air conditioning system components.

2. Any works related to uncoupling of the air conditioning system components shall be performed by the training personnel using special equipment for maintaining the air conditioners. The system contains high pressure even in inactive state.

3. Prior to stopping the tractor engine, make sure that the air conditioner is off.

4. The r134a coolant is neither toxic, nor flammable. It does not form explosive mixtures. The coolant boiling temperature under normal conditions is minus 27°C. If the liquid coolant gets in contact with the skin, it evaporates instantly and can cause the frostbite of the exposed areas of the skin.

5. When unhitching the tractor, it is allowed to uncouple the closed air-conditioning system by disconnecting the quick-release couplings.

TRACTOR PREPARING FOR OPERATION

GENERAL REQUIREMENTS

When putting a new tractor into operation proceed as follows:

- clean the tractor;
- take the protective poly-chlorine vinyl covers off;
- attentively inspect the tractor, check its completeness, remove storage batteries, bring them into operation and replace into the same position;
- install the drain cocks of the radiator and diesel cylinders' block which are enclosed to the tractor and kept in a separate packing box;
- check tightening of the carving joints and, if needed, tighten;
- unpack the muffler laid in a tractor's cabin and install it on an exhaust manifold so that an exit cut of the pipe is turned forward the tractor movement. Then install a tension band at a distance of 8…12 mm from the muffler socket flank. Clamp nuts are to be tightened with torque of 44…56 N·m;
- check oil level in the engine crankcase, transmission, front driving axle housing and final drive reducers, in the oil tanks of hydraulic system and hydrostatic steering system, and if necessary, add more;
- empty the fuel out of the fuel tanks and fill them with settled fresh fuel: in winter – with winter fuel, in summer – with summer one.

When emptying the fuel out of the fuel tanks hold the embedded part of the polyethylene fuel tank with the wrench S=19;

- fill the diesel cooling system with coolant fluid up to the level of upper flank of the filler neck;
- check and if necessary, adjust tension of the generator belt;
- lubricate tractor's mechanisms and components in accordance with the recommendations of the present Operators manual;
- check and, if necessary, adjust the tires to the normal inflation.

ATTENTION! Before operating a tractor, make sure that all the guards (guards of rear PTO shank, etc.) are in place.

PREPARING FOR STARTING AND STARTING THE ENGINE

Normal temperature starting (+4°C and above)

IMPORTANT! Start the engine and perform the devices control only when sitting in an operator's seat.

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

- Apply a parking brake of a tractor;
- Open a fuel tank cock;
- Fill a fuel supply system with fuel and bleed it for air removal;
- Put fuel supply control levers in mid-position, and PTO control lever - in «Off» position;
- Put the transmission gearshift levers in neutral position;
- Switch "Storage battery" button on;
- Turn the key-start switch to the position «I» (fixed). At the same time an oil pressure warning light will illuminate in the block of the warning lights indicating emergency oil pressure in the hydrostatic steering system, and a warning light indicating oil pressure in the engine (a buzzer sounds) as well as air pressure indicator (if it is less than acceptable), voltage indicator and fuel-level indicator (if the fuel tank is filled

with fuel up to a reserve level) will light up in the dashboard;

- Turn the key-start switch to the position «II» («Start»).

  Before turning the key-start switch to the position «II», hold it in the position «I» for less than 2 seconds.
- Before starting the engine, hold the key-start switch for less than 15 seconds. If the engine fails to start, wait for 30…40 seconds before starting a new attempt. If the engine fails to start after 3 attempts, find the defect and rectify it.
- When the engine starts, check all indicator lights and data of the dashboard (coolant fluid temperature, oil pressure in the engine and gear box, storage batteries charge, etc.). Idle the engine at 1000 rpm until the pressure stabilizes in the operating range.

IMPORTANT! Your tractor is equipped with turbocharged engine. High speed of the turbocharger demands reliable lubrication when starting the engine. While starting the engine for the first time or after a long period of storing, rotate a crankshaft by the starter for about 10 seconds without fuel feeding to provide lubrication of turbocharger's bearings. Idle the engine for 2...3 minutes before loading it down.

Cold temperature starting (+4°C and below). For tractor "BELARUS-1221.3"

IMPORTANT! To avoid damage of the drive train, do not push or tow the tractor to start the engine.

- Hold the key-start switch in the position «I» for more than 2 seconds. At this time a starting aid warning light will illuminate in the warning lights block indicating that preheater plugs are engaged. Hold the key-start switch in this position. As soon as the warning light begins to flash, the engine is ready for starting.
- Turn the key-start switch to the position «II» and start the engine as prescribed above for normal temperature starting. After the engine starts the warning light goes out and audible warning is off.

If the preheater plugs' warning light flashes with the frequency of 2 Hz after the engine starts and operates within 3 minutes, it indicates that relay contacts of the preheater plugs are sealed.

Then stop the engine, turn a ground switch off and eliminate the defects.

To start the engine at ambient temperatures of - 20° C and below it is necessary to use special circulation heater of the coolant fluid in combination with the means of engine start heating.

NOTE: Circulation heater of the coolant fluid should be used only for cooling system filled with antifreeze.

Use oil of winter types*) in the crank case, transmission, hydraulic system and hydrostatic steering system during stabilized cold ambient temperatures in accordance with recommendations of the given Operators manual.

Keep the batteries fully charged.

Use pure winter diesel fuel without water adding. To avoid defects, empty fuel gravity filter and fuel tanks from sediment every day.

* If there is no winter motor oil you may use a mixture of summer motor oil with10-12% of diesel fuel.

IMPORTANT! Fill the tanks at the end of each operating day to prevent condensation in the fuel tank.

Breakaway and tractor moving

NOTE: Refer to the travel speed chart in section «B» of this manual for desired speed range selection (p. B6).

1. Tractors with 16F+8R gear box

To drive a tractor, please, do as follows:

- Reduce engine speed.
- Depress the clutch pedal.
- Select a desired gear range of the gear box:
  - Move the lever (1) to an extreme right-hand (spring-loaded) position and pull it to yourself or push the lever away to select a desired range: I (low) or II (high) ones accordingly;
  - Return the lever to neutral position («N») and then turn the lever to the left to select a desired gear range in accordance with shift pattern I.
- Select a desired speed with the lever (2) as per shift pattern II.
- Turn off a parking brake, release a clutch pedal smoothly and simultaneously speed up the engine – a tractor starts moving.

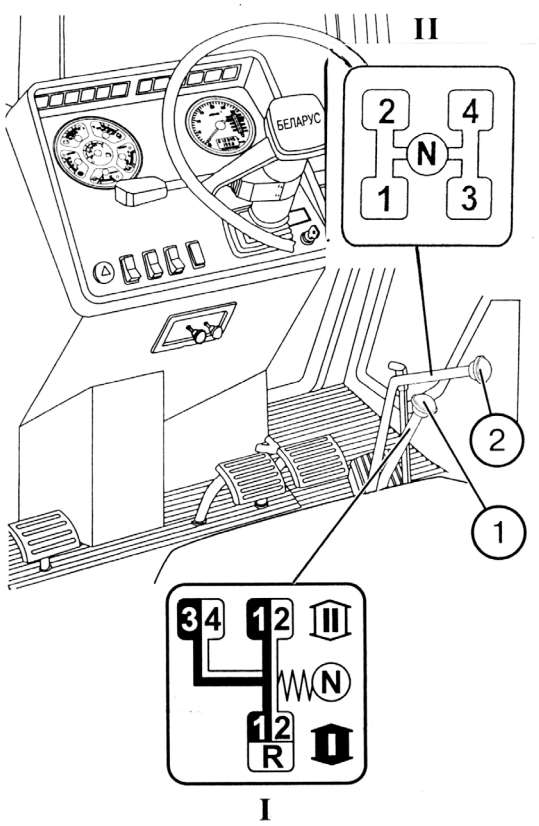
WARNING! Always depress a clutch pedal before selecting a required gear range or gear in the gear box.

IMPORTANT!

Shift gear ranges (by gear clutch) only when a tractor is stopped**.**

To shift a gear smoothly without sharp pushes, displace the gear shift lever (2) in accordance with pattern II (see the picture above) and hold it in a pressed position till the gear is fully shifted.

While operating a tractor, do not keep your foot on a clutch pedal. It will result in clutch slipping, its overheating and breaking.



Do not start driving a tractor with heavy traction loading (for example, a plough buried in soil). After shifting a gear, turn the parking brake off and engage the clutch smoothly. After a tractor starts moving, increase fuel feeding smoothly.

2. Tractors with c 24F+12R gear box (optional)

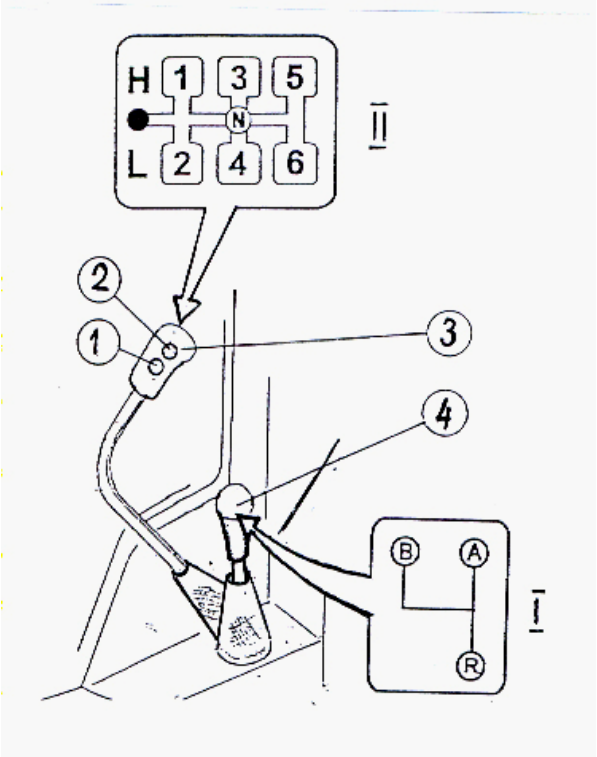
To drive a tractor, please, do as follows:

- Reduce engine speed.
- Fully depress the clutch pedal.
- Select a required gear range of the gear box, doing the following:
  - Move the lever (4) to any of the positions «A», «B» or «R» in accordance with gear range shift pattern «I».
  - Push the button (1) to switch the lowest range of the gear box reducer (L) or button (2) to engage the highest range of the reducer (H).
  - Select a desired gear by shifting a lever (3) from neutral position «N» to one of the positions 1, 2, 3, 4, 5, 6 in accordance with gear shift pattern «II».
  - Turn off the parking brake, release a clutch pedal smoothly and simultaneously speed up the engine. A tractor starts moving.

IMPORTANT! Engaging «L» and «H» ranges of the reducer is possible only if the gear shift lever (3) is set to a neutral position.

IMPORTANT! To avoid noisy shifting, shift a range gear (4) only when a tractor is stopped.

While operating a tractor, do not keep your foot on a clutch pedal. It will result in clutch slipping, its overheating and breaking.



IMPORTANT! To shift a gear smoothly without sharp pushes, displace the lever (3) according to gear shift pattern II and hold it in a pressed position till the gear is fully shifted.

WARNING! Always depress a clutch pedal before selecting a required gear range or gear in the gear box.

Working brakes

When driving on the road at transport speed, both brakes pedals must be locked together with a latch.

Steering control

Important! "Belarus" tractor is equipped with hydrostatic steering system. If the engine is stopped, an oil pump, which is put in action by the engine crankshaft, no longer feeds the hydrostatic steering system. As a result it automatically proceeds to a manual mode which requires more effort to steer the tractor while turning.

Stopping the tractor

To stop the tractor:

- reduce engine crankshaft rpm;
- depress the clutch pedal;
- set the gear shift levers to a neutral position;
- apply working brakes to stop the tractor;
- apply the parking brake.

INPORTANT! To stop the tractor in an emergency situation, simultaneously press the clutch pedal and both interlocked brake pedals as quickly as possible.

Stopping the engine

IMPORTANT! Before stopping the engine, put an implement down to the ground, and let the engine run at 1000 rpm for about 3...5 minutes. It will allow decreasing the temperature of the coolant fluid of the engine.

To stop the engine, proceed as follows:

- set the fuel feeding control lever to a zero position*;
- switch PTO off;
- put all distributor handles to a neutral position;
- pull the implement down to the ground using an appropriate control handle;
- turn a ground switch off (to avoid storage batteries discharging).

Power take-off shaft

IMPORTANT! To avoid shock loads on the PTO, reduce engine speed to approximately 900 rpm when engaging the PTO, then increase engine speed. Similarly, to reduce overstressing the tractor PTO braking bands, reduce PTO rpm at first by engine speed slowing down before disengaging the PTO. It is particularly important for implements having a high moment of inertia. These implements should always be fitted with a free-running coupling.

There are two interchangeable PTO shaft tails. When operating with a 6-splined shaft tail, run the engine at 2037 rpm to obtain standard PTO speed of 540 rpm.

* To stop the tractor which is equipped with "MOTORPAL" (Czech Republic) or «YASDA» (Russia) fuel pump, pull a handle (28a) to yourself, page Г1.

When a 6-splined shaft tail is replaced with a 21-splined one, switch PTO drive to 1000 rpm and run the engine at 2156 rpm to obtain standard PTO speed of 1000 rpm.

Warning! To avoid unexpected movement of the implement, disengage the PTO after each use.

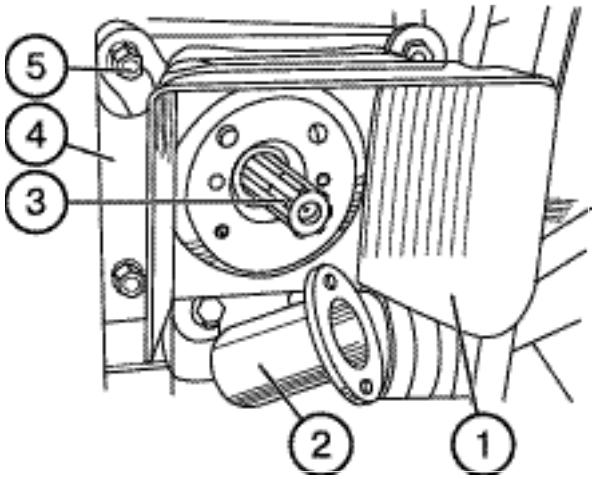
The PTO-driven equipment not requiring high power take-off, must have 6-splined coupling to run at 540 rpm. In this case it is necessary to set 2037 rpm of the engine.

The PTO-driven equipment which requires high power take-off operates at 1000 rpm of PTO shaft tail and is provided with 21-splined coupling to be attached to PTO shaft tail.

Two-speed PTO switch position	Engine speed (rpm)	PTO speed (rpm)
Power mode (6-splined, speed I, 82 h.p.)	2037 2100	540 556
High power mode (21-splined, speed II,123 h.p.)	2156 2100	1000 974

Changing PTO shaft tail

- Remove two bolts and tail cap (2).
- Unscrew four nuts (5), remove a housing (1) and a plate (4).
- Remove six bolts, the plate and take out the PTO tail (3).
- Install the other PTO shaft tail into a spline hole, mount the plate and all other removed parts in a reverse order.



Running-in

IMPORTANT! The first 30 hours of tractor operation influences greatly tractor performance and operation life, especially its engine.

Your new tractor will provide an effective and long operation in case of proper running-in procedure and other necessary services carried out at recommended intervals.

During the 30-hours running-in period, observe the following precautions:

1. Constantly check the devices' data, watch upon the lubrication, cooling and feeding systems' operation. Control the levels of oil and liquid in filling tanks.
2. Check the tightness and tighten the external fixing joints.
3. Do not overload the engine and avoid its smudging and speed drop. Overloading has place if the engine speed drops quickly, it is smudging and the engine does not respond to fuel feed increase. Operating at a high gear under load leads to an excessive wear of rubbing engine parts.
4. Operating a tractor at a too low gear, with light loading and at a high engine speed leads to fuel waste. You will save fuel consumption and minimize engine wear by selecting the correct gear range for each particular operation.

Carry out a tractor's running-in while doing light work (sowing, cultivating, moving, transporting). Load the engine by not more than 50% from its rated power.

6. Avoid continuous tractor operation without loading at maximum or minimum engine speeds modes.
7. Avoid continuous tractor operation at constant engine speeds mode.
8. To ensure proper operation of rubbing parts of the clutch coupling, engage the clutch coupling more often and more smoothly during running-in period.
9. Carry out daily maintenance in accordance with the recommendations prescribed in the present Manual.

After completing of 30-hours running-in, carry out technical service operations as prescribed in section Л «Routine maintenance», page Л 2.

Warning: To prevent injury, be sure that all tractor safety guards are in their places before starting the engine.

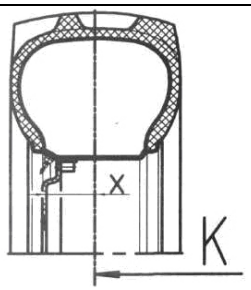
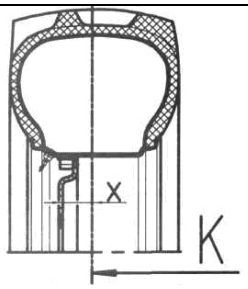
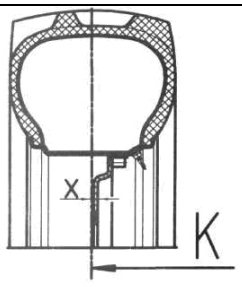
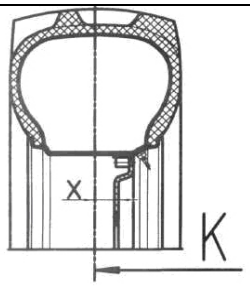
ADJUSTMENTS

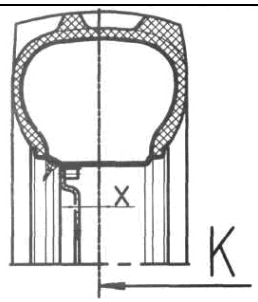
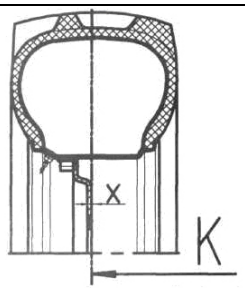
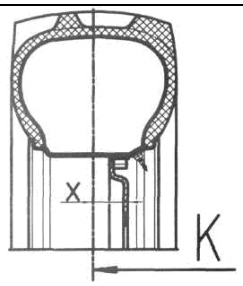
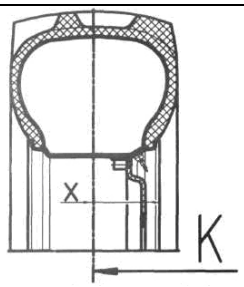
Front wheels tread setting

Front wheel tread can be adjusted from 1545 mm to 2090 mm. The tread size depends on the mutual location of a disk relative to a flange and a rim relative to a disk.

The variants of the tread adjustment are stated below in Table K-1.

Table K-1

Disk and rim installation variants		Disk offset X, mm	Tractor tread, mm (tyres 420/70R24)
Standard disk installation with the rim adjustments		+140	1540
		+90	1635
		-18	1850
		-68	1950

Disk and rim installation variants		Disk offset X, mm	Tractor tread, mm (tyres 420/70R24)
Disk and rim adjustments		+56	1700
		+6	1800
		-102	2020
		-152	2090

Front wheels toe-in adjustments

After a required tread width of the front wheels is set, check and if necessary adjust the toe-in by changing the length of the steering rod (2).

1. Inflate the tires to the required pressure (see Table on page Л17.)
2. Drive the tractor straight for several meters on a flat surface, then stop it and apply the parking brakes.
3. Measure the distance «B» behind the tractor between two opposite points on the end of the rim at the height of the horizontal wheels' axles.
4. Turn the parking brakes off and move the tractor forward so making the wheels turn for 180° approximately, then measure the distance «A» in front of the front driving axle between the same metering points as in case with the distance «B» measurement. The toe-in is adjusted properly if the distance «A» is (0...8) mm less than the distance «B». If the toe-in size exceeds the mentioned limits, adjust it doing the following:
5. Loosen the tightening of the lock-nuts (1) and (3) of the tube (2) of the steering rod.
6. Set the required toe-in size by rotating the tube to this or that direction.
7. Tighten the lock-nuts (1) and (3) with torque of 100…140 N·m.

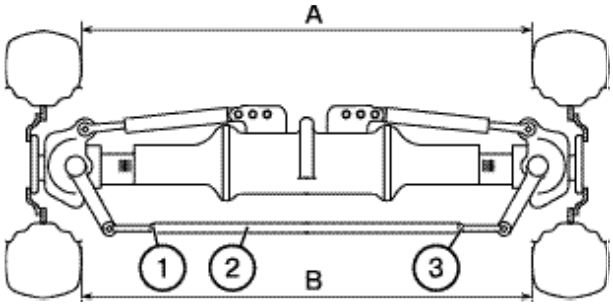


Fig. К-1.

Rear wheels tread setting

1. Jack up a rear part of the tractor until the wheels are above the ground.
2. Remove the nuts (1) and take off the wheels.
3. Loosen the clamping bolts (2) of the upper and lower shells (3) of the wheel's hub by 2...3 turns.
4. Using four dismantling bolts which are screwed into the upper and lower shells (two bolts into each shell), draw the shells (3) out from the wheel's hub in order to release a bevel clamp and the wheel's hub for making the hub move.
5. Move the hub along the semi-axle to obtain the required tread «L» (use a given table for tread adjustment by measuring the distance «K» from the end of the semi-axle to the end of the shells).
6. Remove dismantling bolts and tighten the bolts of the hub's fastening.
7. Install the wheel and repeat the procedure for the opposite rear wheel.

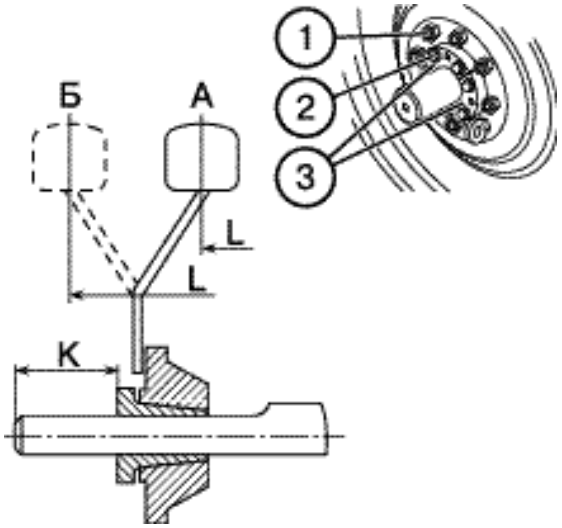


Fig. К-2.

Table К-2

Tread «L», mm		
Distance «К», mm	Wheels installation scheme	
(for tires 11,2R42)	«А»	«Б»
245	1420	—
205	1500	—
155	1600	—
55	1800	—
5	1900	—
245	—	1950
220	—	2000
170	—	2100

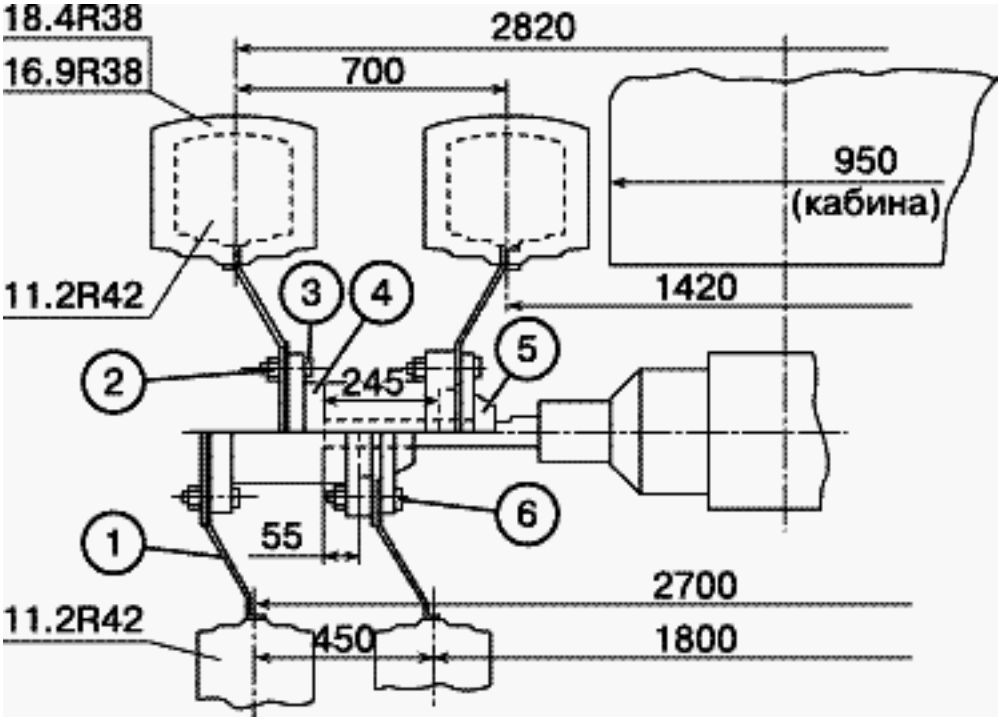
Tread «L», mm		
Distance «К», mm	Wheels installation scheme	
(for tires 18,4R38)	«А»	«Б»
1650	133	-
1800	58	-
200	-	222
2150	-	147

Tread adjustment when doubling the rear wheels

To install the hubs (basic and additional ones) of the external and internal wheels relative to the semi-axis of the rear axle and wheels disks, follow Picture К-2.

Rear wheels tread is adjusted steplessly.

Doubled rear wheels tread sizes



Кабина	Cab

Fig. К-4. Installation scheme of doubled rear wheels with spacer for rows of 450 mm or 700 mm:

1 — wheel; 2 — nut; 3 — bolt; 4 — spacer; 5 — hub; 6 — elongated bolt.

Recommendations of using the tractor in the inter-rows

Table К-4

Inter-row, mm	FDA		Rear axle	
	Tire size	Tread, mm	Tire size	Tread, mm
450 и 700	11,2R28	1800	11,2R42 doubled with spacer 1522-3109020-01	1800 and 2700 1420 and 2820

PTO adjustment

The distance “A” (see picture Ж-6) between an upper point of the cylinder rod head (8) and hydrocylinder head (7) is an external indication of the wear factor of the PTO brakes bands’ lining and of PTO adjustment necessity.

If PTO is adjusted and not worn out, the distance “A” should be as follows:

- 64 ± 2 mm (PTO is engaged); and
- 41 ± 2 mm (PTO is disengaged).

If the distance “A” is more than 80 mm (PTO is engaged) or less than 32 mm (PTO is disengaged), or if PTO is slipping, adjust a backlash in the band brakes.

ATTENTION!

1. Before starting PTO adjustment, set “an independent/synchronized PTO” modes shifter to a middle (neutral) position.
2. Start the engine and do all PTO adjustments only at a running engine. A parking brake is to be preliminary applied as well as the rear wheels are to be blocked by wedges fore and aft.

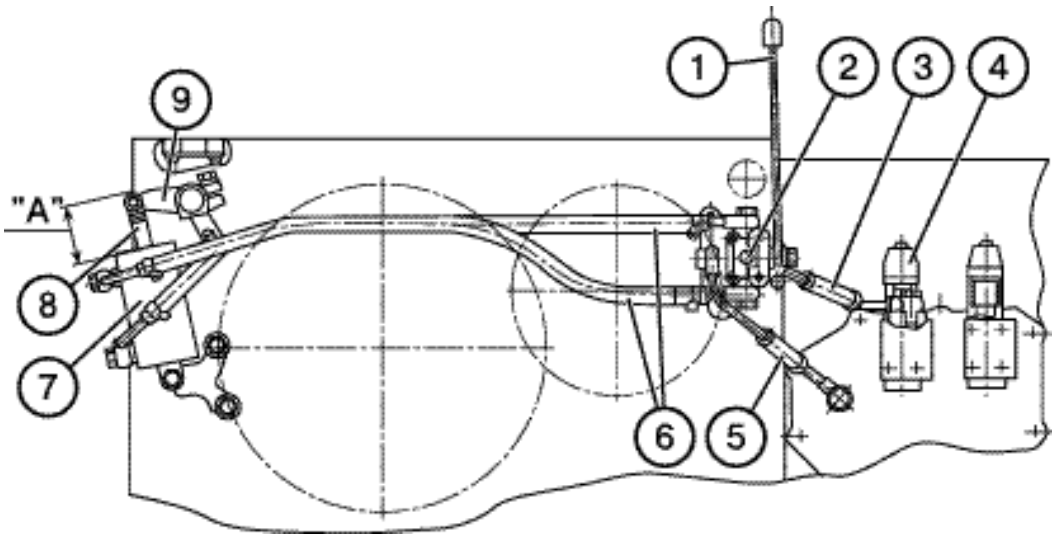


Fig. K-5.

External adjustment of PTO band brakes

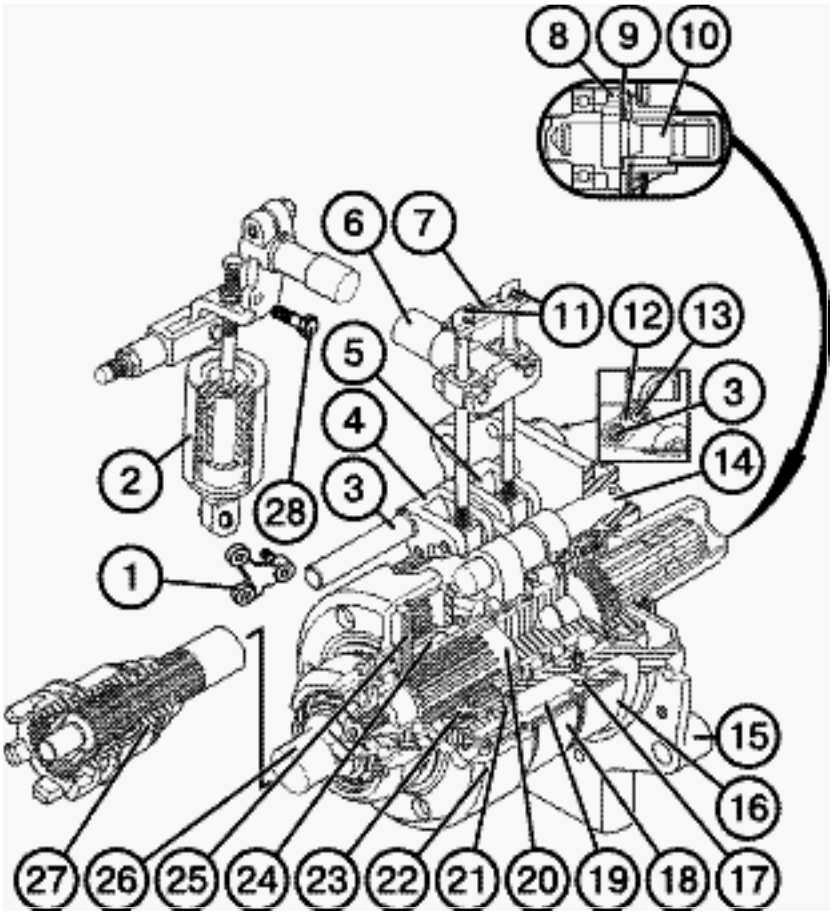


Fig. К-6

1. Set PTO rod (1) to position «Off» (an extreme lower position) as described in the figure К-5.
2. Remove a bolt (13) and a plate (12) as described in the picture К-6.
3. Using a wrench (S=14 mm) turn an eccentric control roller (3) clockwise by an angle of about 30°.
4. Reinstall the plate and the bolt (13) back.

Repeat the above-mentioned operations until a specified distance «A» is obtained for both PTO engaged and disengaged modes.

If you fail to obtain a specified distance “A” and a flat on the roller (3) moved from an extreme right (normal) vertical position to an extreme left one, do an internal adjustment of the PTO band brakes.

PTO internal adjustment

1. Move a PTO rod (1) up to position “On” (see Picture Ж-6).
2. Stop the engine.
3. Remove a bolt (13) and a plate (12) (see Picture Ж-7).
4. Turn an eccentric control roller (3) clockwise so making a flat be in an extreme right position.
5. Remove the parts on the cover of the rear axle housing to gain access to adjusting screws (11) (see picture Ж-7).
6. Fix the lever (9) (see Picture Ж-6) by setting a rod of 8 mm in diameter or a bolt M10 into a matched hole of the lever and rear axle housing (a bolt (28), see Picture Ж-7).
7. Splint and remove a plate (7) (see Picture Ж-7).
8. Fasten the adjusting screws (11) in turn with torque of 8...10 N•m (0,8...1 kgf m), then unscrew them by 1,5...2,0 turns each.
9. Reinstall and splint the plate (7).
10. Remove a bolt (28) from the lever (29).
11. Start the engine and check the pressure in the control system. It should be not less than 1 MPa (10 kgf/cm^2). The distance «A» should be 64 $\pm$ 2 mm and 41 $\pm$ 2 mm for engaged and disengaged PTO accordingly. If PTO is still slipping after PTO adjustments, change the band brakes with new ones and adjust PTO as indicated above.

FDA bearings adjustments

Tapered roller bearings (17), (20) of the FDA main gear (see Picture Ж-8) are to be adjusted with tightness of not more than 0,08 mm to eliminate a clearance.

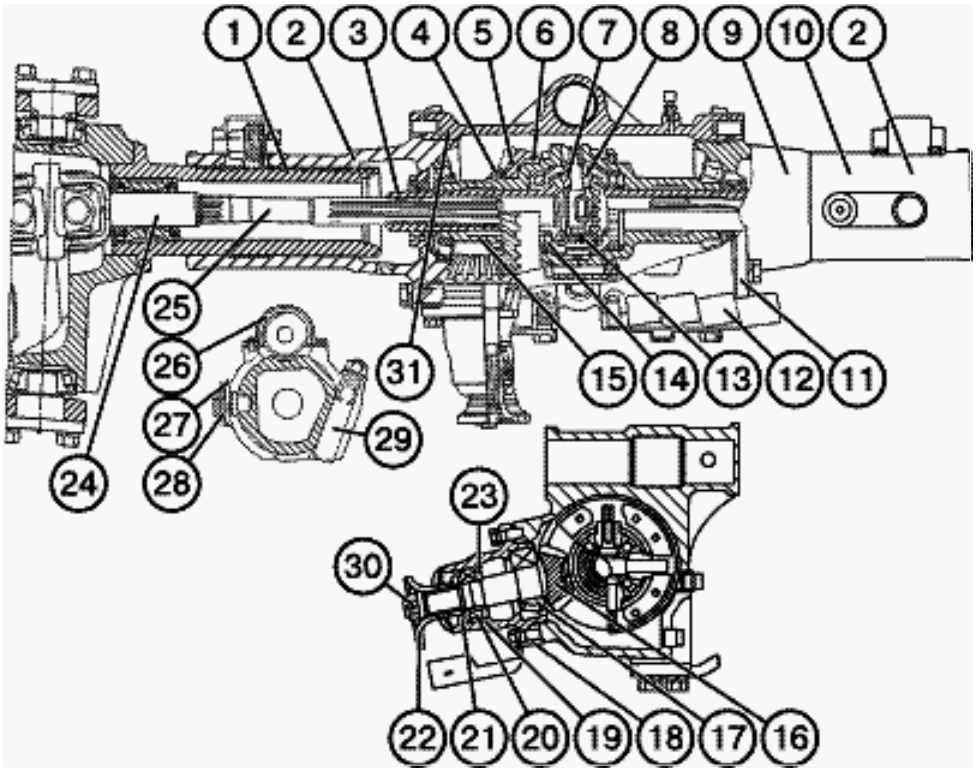


Fig. К-8

To choose a clearance, tighten a nut (30), check bearings axial play and turn a gear (16) over a flange (22). If there is an axial play the required tightness is to be provided by polishing of an adjustable washer (23). If the bearings are adjusted in a proper way, the torque of gear turning (16) is to be within limits of 0,6...2,0 N•m which corresponds to the force of 15...50 N on the radius of the flange openings (22). Splint the nut (30) without turning it off to match the slits with apertures for a cotter pin.

Tapered roller bearings (18) of the flange (1) (see Picture Ж-9) are to be adjusted without a clearance by tightening of a nut (17). After the clearance is adjusted, the nut is punched in two slits of the flange (1).

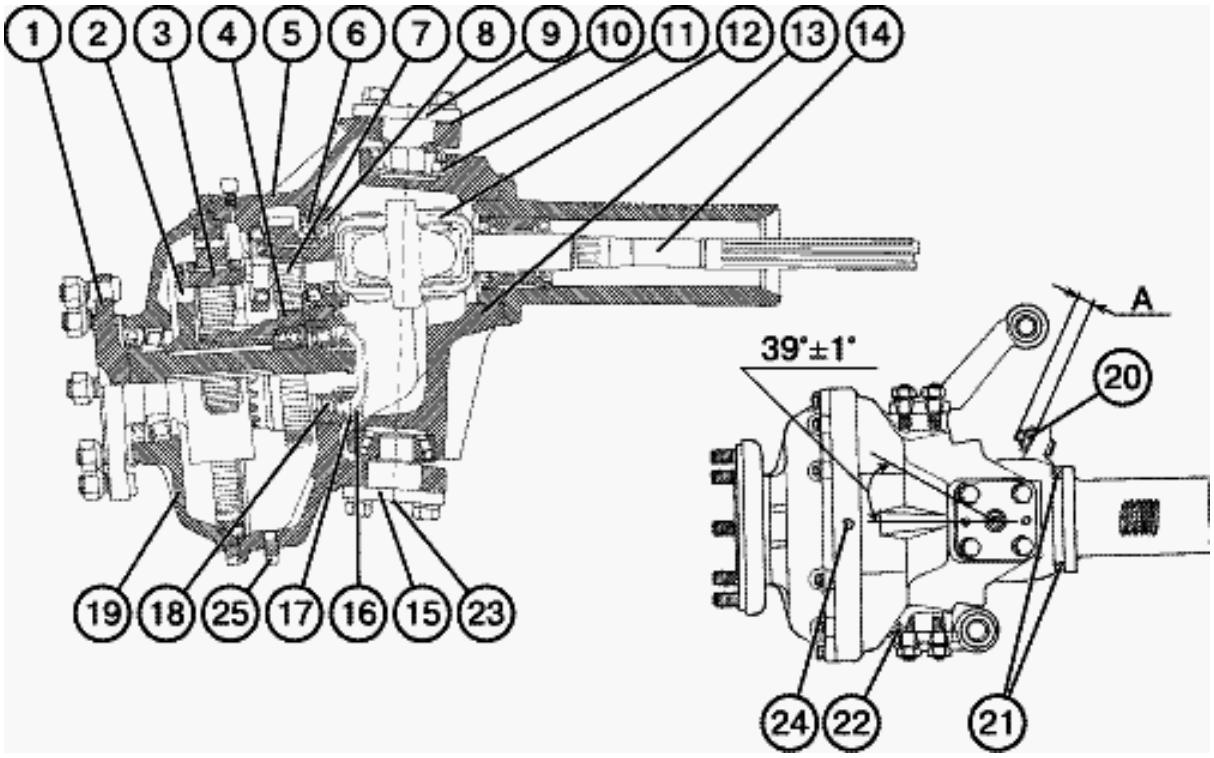


Fig. К-9

Tapered roller bearings (6) of the driving gear (7) (see Picture Ж-9) are to be adjusted without tightness with an axial play of not more than 0,05 mm. The adjustment is to be done using split adjustable gaskets (8) between a sleeve and a housing (5).

Tapered roller bearings (11) of the pivots' axles (9, 15) (see Picture Ж-9) are to be adjusted with tightness of 0,01…0,06 mm using the adjustable gaskets (10) between axles (9, 15) and a housing (5). Bearings' clearance is not allowed. If the bearings are adjusted properly the reducer shall turn relative to the pivots' axles with torque of 16…20 N•m.

Maximum rotation angle of the reducer housing (5) from the position which corresponds to an in-line motion, is to be within limits of 38...40°. Do adjustments using a screw (20) (see Picture Ж-9).

FDA drive switch adjustment

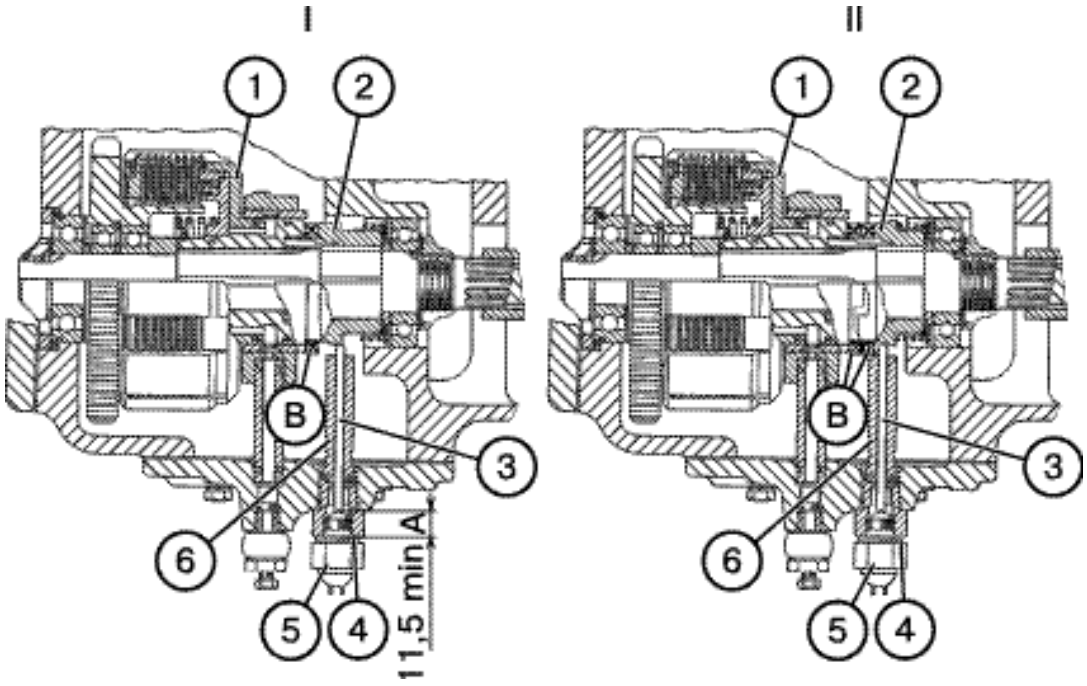


Fig. К-9а

If FDA can not be engaged in an automatic mode, or if it is necessary to change a switch of FDA driving gear sensor, do the following operations:

1. Semi-coupling (2) cams (B) are to be engaged with the cams of a drum (1) so as to get a pusher (3) moved maximum forward from the guide (6) (see Picture Ж-9а (I)).
2. Place an initial set of adjustable gaskets (4) in number of 5…6 units under the switch flank (5).
3. Removing the gaskets one by one, secure contacts closure of the switch (5).
4. Disengage the semi-coupling (2) cams (B) with the cams of the drum (1). At the same time the pusher (3) should be recessed to the maximum, and contacts of the switch should be opened (see Picture Ж-9а (II)). The switch (5) is adjusted properly if its contacts are closed in position I and opened in position II. Do checkup using an indicator lamp, or a signaling device on the control board by pushing a top part of the FDA control button.

Important! The distance “A” (Picture Ж-9а) from of the pusher end (3) to the switch flank (5) is to be not less than 11,5 mm. Non-observance if this requirement can lead to the switch damage.

Checkup and adjustment of the single –wire pneumatic system brake valve and its drive

Do the adjustment of the brake valve drive by the unpressed pedals of the operator brakes and a fully disengaged parking brake, which are to be preliminary adjusted.

1. Connect a pressure gage with a scale of not less than 1 MPa (10 kgf/cm^2) to a coupling head (with a black cover) of a tractor pneumatic drive

2. Engage an air compressor and charge an air receiver with air up to the pressure of not less than 0,77 MPa (7,7...8,0 kgf/cm^2) according to the pressure gage located on the dashboard.

3. The air pressure according to the pressure gage which is connected to the coupling head is to be not less than 0,77 MPa (7,7 kgf/cm^2) or not less than 0,53 MPa (5,3 kgf/cm^2) for Hungary and Germany. If it is not so, do the following operations:

4. Check the availability of the clearance of 1...2 mm between a pin (9) and upper edges of the slots in the levers. If there is no clearance, remove the pin (9) and adjust the length of the rod (5) turning the end (2).

5. Check and adjust if necessary compression of a spring (4) to the dimension of 36…38 mm turning the nuts (6). Then lock the nuts. Check the operating of the valve according to the section 3.

6. If the air pressure according to the pressure gage which is connected to the coupling head doesn't reach a required limit, replace the valve (3).

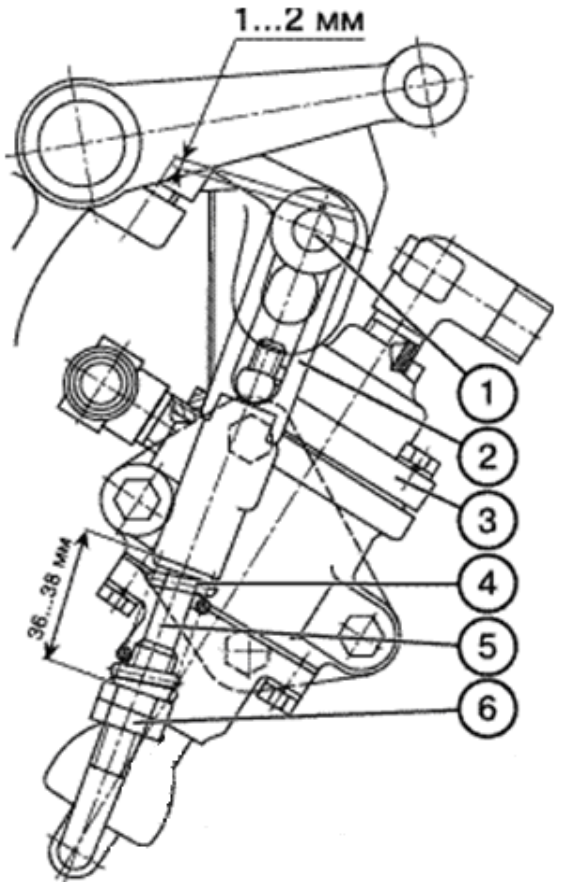


Fig. K-10.1

IMPORTANT! If the brake valve and its drive is adjusted properly the pressure according to the gage connected to the coupling head (with a black cover) should drop to a zero when shifting blocked brake pedals by full stroke or when fully engaging parking brake.

Checkup and adjustment of the double –wire pneumatic system brake valve and its drive

Do the adjustment of the brake valve drive by the unpressed pedals of the operator brakes and a fully disengaged parking brake, which are to be preliminary adjusted.

1. Connect a pressure gage with a scale of not less than 1 MPa (10 kgf/cm^2) to a coupling head (with a yellow cover) of a tractor pneumatic drive.

2. Engage an air compressor and charge an air receiver with air up to the pressure of 0,77 MPa (7,7...8,0 kgf/cm^2) according to the pressure gage located on the dashboard.

3. The air pressure according to the pressure gage which is connected to the coupling head (with yellow cover) of the control line is to be equal to zero. Shift the blocked brake pedals by full stroke. The pressure shall increase up to 0,65…0,8 MPa (6,5-8,0 kgf/cm^2). Release the brake pedals. Engage the parking brake moving its handle at maximum distance. The pressure shall increase up to 0,65…0,8 MPa (6,5…8,0 kgf/cm^2). If the pressure on the gage, connected to the coupling head does not correspond to the mentioned above, proceed as follows:

4. Check the availability of the clearance of 1...2 mm between a pin (1) and upper edges of the slots in the levers. If there is no clearance, remove the pin (1) and adjust the length of the rod (5) turning the end (2).

5. Check and adjust if necessary compression of a spring (4) to the dimension of 36…38 mm turning the nuts (5). Then lock the nuts. Check the operating of the valve according to the section 3.

6. If the air pressure according to the pressure gage which is connected to the coupling head doesn't reach a required limit, replace the brake valve (3).

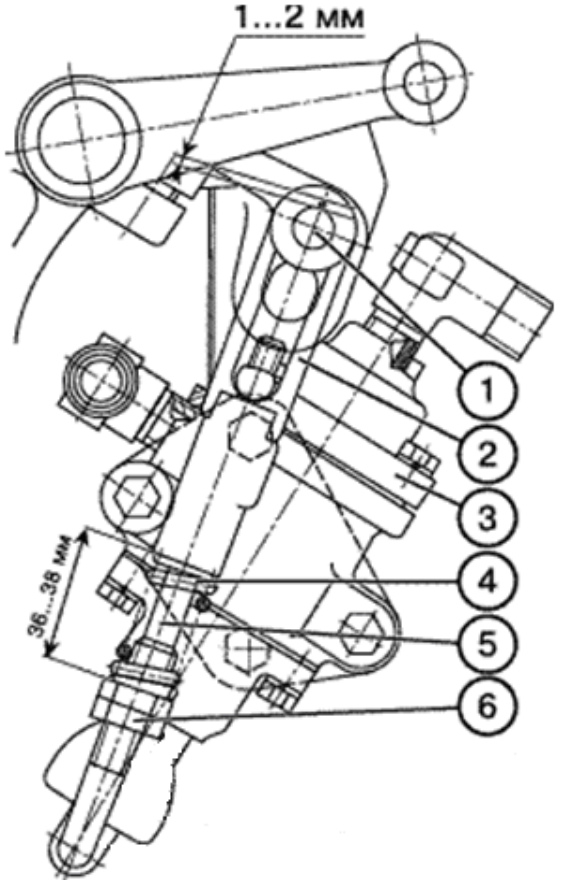


Fig. K-10.2

IMPORTANT! If the brake valve and its drive is adjusted properly the pressure according to the gage connected to the coupling head (with a yellow cover) of the control line should be equal to zero by the unpressed blocked brake pedals and fully disengaged parking brake.

Checkup and adjustment of a pneumatic system pressure regulator

If a pressure regulator is faulty or after its disassembling for cleaning or changing worn-out parts, do adjustments in the following order:

- connect a pressure gage with a scale graduation of 0,1…0,2 kgf/cm^2 and a scale of not less than 16 kgf/cm^2 to a receiver during check-up and adjustment works;
- remove a cap (1);
- screw a cover (2) into the body as far as it goes using a wrench;
- start the engine, engage an air compressor and charge the receiver with compressed air until a safety valve (6) starts functioning at air pressure of 8,5…12 kgf/cm^2. If the valve functions at a different air pressure, adjust it with a screw (8), a lock-nut (7) being preliminary loosened and then tightened;
- unscrewing the cover (2) slowly, adjust springs power (3), (4) so that air pressure in the receiver (at which an unloading valve (5) is being opened) makes 7,7…8,0 kgf/cm^2; fix the cover (2) in this position using a paint applied on a treaded part of the body and put the cap (1);
- open a condensate ejection valve in the receiver slightly and decrease air pressure to 6,5…7,0 /cm^2. Within mentioned air pressure limits the valve (5) should get locked and switch the compressor into the mode of air receiver charging with compressed air; then disconnect a test air pressure gage from the receiver.

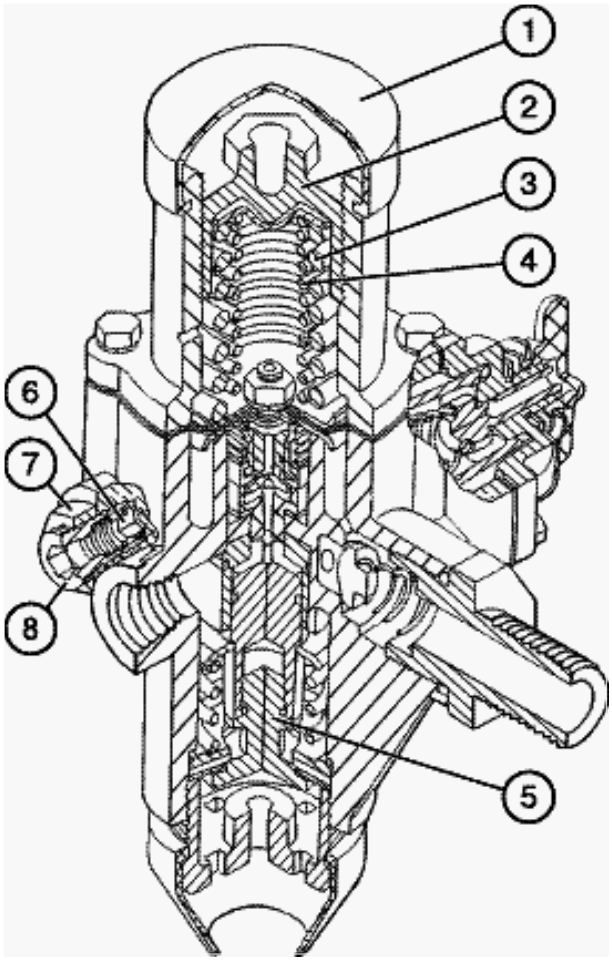


Fig. K-14

Clutch pedal free travel adjustment at forward motion (BELARUS-1221B.2)

The free travel of clutch pedal should stay within the ranges of 30…40mm.

To adjust the clearance between the tappet of the operating cylinder (2) and (2) and a hydraulic cylinder guide bar (3) proceed as follows.

a) disconnect the rod of the operating cylinder (2), removing the pin;

b) check that a piston of the operating cylinder (2) is in the extreme right position.

c) turning the rod fork of the operating cylinder (2) combine the openings of the pedal lever (1) and of a fork, after that turn the fork to 1,5…2 revolutions and connect with the pedal lever with the help of the pin, which corresponds to the pedal (1) stroke on the pad within the ranges of 8…11 mm;

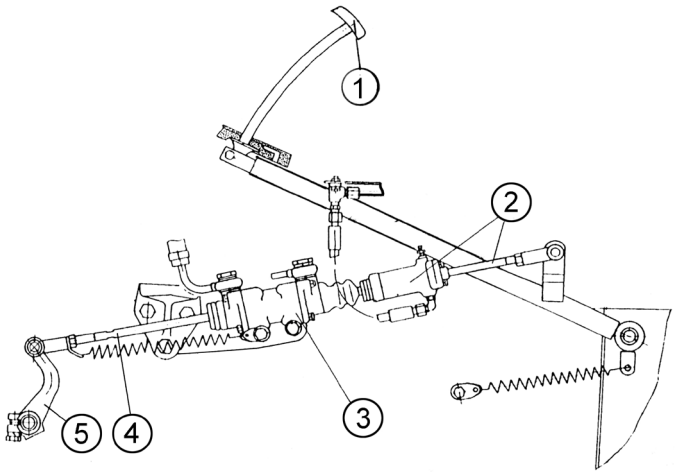
d) tighten up a nut on the rod and splint the pin.

To adjust the spacing between the release levers and a throw-out bearing proceed as follows:

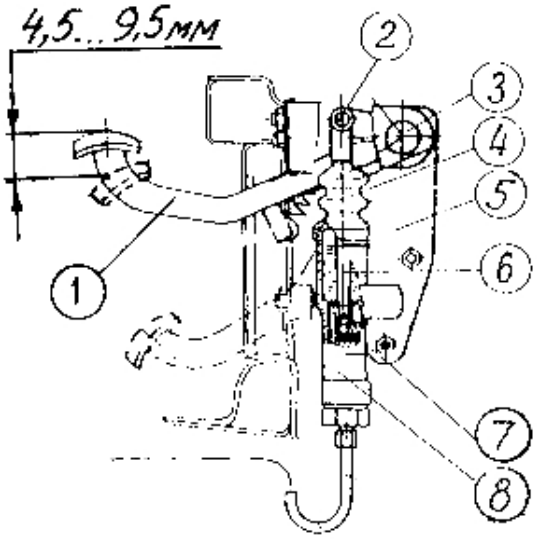
a) disconnect the rod (4) from the lever (5), removing the pin;

b) turn the lever (5) contraclockwise until the throw-out bearing thrusts against the release levers, then rotating the rod fork (4) combine the openings of the lever and of the fork, after that turn the rod fork to 5…5,5 revolutions and connect it with the lever with the help of the pin;

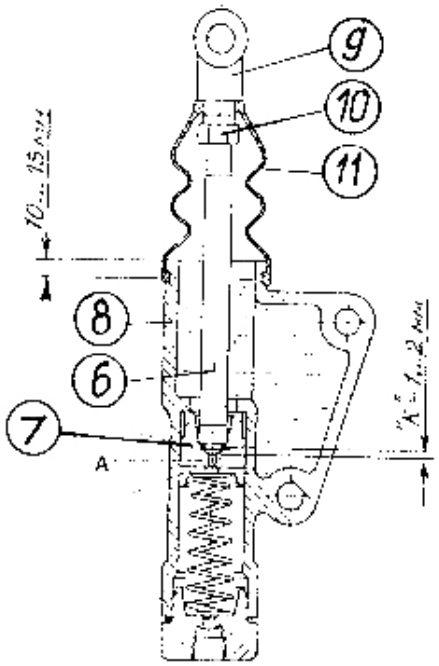
c) tighten up the nut on the rod and splint the pin.



Clutch pedal free travel adjustment at reverse motion (BELARUS-1221B.2)



- unlock and remove a pin (2);
- move a hood (11) out and loosen a lock-nut (10);
- rotating a fork (9) of a pusher (6) of the main cylinder (8), set a free travel of a pedal (1) on the pad within limits of 4,5…9,5 mm from the extreme upper position (a stop member) and until it touches a piston's (7) pusher (6). It corresponds to the clearance of 1…2 mm between a spherical button of the pusher and piston deepening;
- remove the lock-nut, install and lock the pin;
- check a brake fluid level in a chamber of the main cylinder which should be by 10…15 mm below the upper end of the main cylinder housing. Add a brake fluid if necessary;
- bleed a hydrostatic drive system, doing the following:
  - remove a safety cap (23) (Picture Д-11a) of a valve (24) and put a pipe on a valve head and sink a free end of the pipe into a tank with «Neva-M» brake fluid;
  - push the pedal (1) several times, and holding it pressed unscrew the valve by ¼ turn deflating air bubbles into the tank;
  - tighten the valve and release the pedal. Repeat these operations until the entire deaeration;
  - remove the pipe, put the cape back, and add a brake fluid. Mount the hood.



Brakes control adjustment at reverse motion

(BELARUS-1221B.2)

• Adjust a right pedal travel of a forward running working brake within the limits of 115…125 mm (see Section H «Routine maintenance»);

• Unlock and remove a pin (4). Move a hood (2) out and loosen a lock-nut of the fork (5);

• rotating the fork, adjust a free travel of the pedal (3) within limits of 6…12 mm. It corresponds to the clearance of K=1…2 mm between a pusher (7) and a piston (8) of the main brake cylinder (1);

• check a brake fluid level which should be within 10…15 mm from the upper end of the cylinder housing;

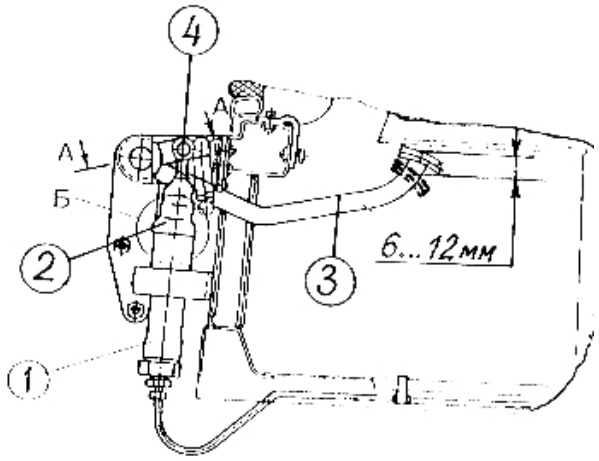
• bleed a hydrostatic brakes drive in the following order:

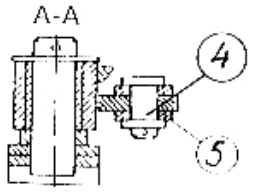
• remove a cap (10) (Picture Д-21.1) and put a pipe on an overflow valve (9) head of the working cylinder (5). Sink a free end of the pipe into a tank with a brake fluid;

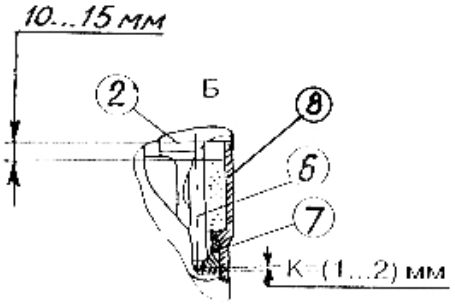
• unscrew the valve by 1/2… 3/4 turn and push the pedal (3) several times (Picture К-16) till a pedal travel resistance appears and then holding it so screw the valve and release the pedal. Repeat these operations until the entire deaeration of the system and feeling of a «tough» pedal;

• tighten the valve, remove the pipe, and put the cap back. Check «Neva-M» brake fluid level and add it if necessary.

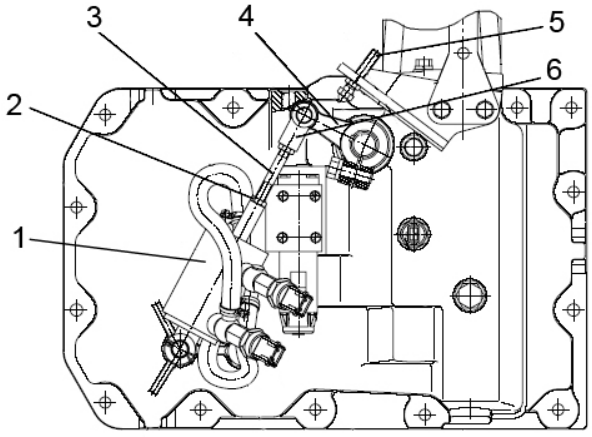
• using a fork (8) (Picture Д-21.1) secure a clearance-free connection of a pin (7) with an upper edge of the slot in the extreme upper position of the pedal (4) and when a working brake cylinder (5) rod is drawn inside to the maximum.







Adjustment of the hydraulic cylinder of the reduction mechanism high and low gears switch



To adjust the cylinder (1), move the piston inside the cylinder up to the stop. Turn the lever (4) contraclockwise engaging the GB reducing gear. Screw-in the cotter-pin (3) at 8-9 turns, then lock it with the nut (2). Screwing the fork (6) in or out, combine the openings in the lever (4) and in the fork (6) and lock with the nut. Turn the lever (4) clockwise, engaging the high gear of the GB reduction mechanism. Move out the cylinder (1) rod, combine the openings in the lever (4) and the fork (6). Connect the lever (4) and the fork (6) with the pin, put the washer and a lock-pin. Screwing the bolt (5) in or out, thrust a spherical part of the bolt against the lever (4), lock with the nut.

AGGREGATION

*The section "**TRACTOR AGGREGATION**" contains the necessary information on the peculiarities of the intended use of the BELARUS tractor of your model including the recommendations on the aggregation, selection of machines, conditions of safe use of the tractor and determining the steerability criterion, rules of correct completing of machine-tractor aggregates (hereinafter referred to as the MTA or tractor-based aggregate) as well as some other necessary documentation, making it possible to assess the possibility of using the tractor with machines within MTA's.*

The recommendations for aggregation of the specific agricultural technical means differing in their nomenclature and performance characteristics, including description of their design, information on their adjustment, procedure of completing the MTA and technique of performance of the works are provided in the applied operating documentation for agricultural machines.

3.1 Intended use of the tractor

- *Purpose and specialization:*

Wheeled universal agricultural-purpose tilling tractor providing the operation of machines as a power source.

- *Kinds of the main agricultural works to be performed:*

Cultivation and harvesting of row crops, sowing of cereal crops, harvesting of straw and grasses, transportation works, fertilizing and spraying of fields and gardens, overall tillage, harrowing and ploughing.

- *Method of use:*

Aggregation of machines with the help of three-point mounted attachments and hitching mechanisms within the MTA.

- *Conditions of aggregation of machines:*

The tractor provides the possibility of operation of the machines, the performance characteristics of which are compatible in the part of the aggregation capability with the characteristics of the tractor itself such as connecting dimensions, possibility of motion at the necessary speed, power take-off and realization of a tractive force under specific operation conditions, overall dimensions, allowable vertical static loads on the hitch mechanisms and the chassis.

- *Operation constraint:*

The possibilities of use of the tractor under specific conditions with the aggregated machines are determined by the allowable range of the rated tractive forces at the hook and power of the engine and limited by the maximum allowable loads on the tractor, hitching capabilities of the running gear and allowable skidding, working motion speed, allowable power take-off and mass of the machines to be aggregated.

- *Operation guidelines:*

The tractor shall be operated and the safety requirements when aggregating and servicing the same shall be met in full compliance with the Operating Manual for the tractor, normative documents for labour protection and road regulations. The manufacturer only guarantees the possibility of reliable and safe operation of the tractor provided the customer observes the rules and conditions of the operation, maintenance, transportation and storage specified in this Manual, as well as intactness of the seals. Subject to observance of all the guidelines of the tractor manufacturer, including the speed mode, it is allowed to use the tractor for performing non-agricultural kinds of works as a power source by aggre-

gating the machines within the MTA using standard working equipment intended for aggregating.

- *Qualification of the servicing personnel:*

The operation of the tractor by driving and aggregating the same shall be allowed to the people (hereinafter referred to as tractor drivers, operators) having passed special training and instruction on the matters of the labour protection, having the documents in the form provided by the legislation for the right of driving a tractor and having obtained the permit for operation of a specific tractor.

The owners as well as officials and other persons responsible for the technical condition and operation of the tractor are barred from allowing the tractor to participate in the road traffic and be operated with violation of the requirements of the road regulation and this Manual for the tractor. The owner of the tractor (or person responsible for its operation) shall read carefully this Manual and fulfil all the safety requirements and operation rules stated therein.

Should the owner of the tractor (or person responsible for its operation) does not work on the tractor him/herself, he/she shall make sure obligatorily that all the persons pertaining to the tractor have got the instructions for safety precautions and correct aggregation of the tractor with machines as well as read carefully the Operating Manual for the tractor and understood comprehensively the same.

The tractor driver working on the tractor bears the personal responsibility for observance of the road regulations and safety precautions as well as for correctness of using the tractor in accordance with the Operating Manual for the tractor. Prior to performing the works, the tractor driver shall read also the technical documentation for the machine to be operated with the tractor.

3.2 Types and classification of agricultural machine-tractor aggregates on the basis of BELARUS tractors

The agricultural aggregates operated on the basis of the BELARUS tractors are classified according to the following operational signs:

✓ **Kind of the process to be carried-out:** ploughing, sowing, planting, soil-cultivating, harvesting and others.

✓ **Method of performing the works:** mobile, performing the work in the process of motion; stationary-mobile, performing the work in the stationary or moving state; stationary, performing the work under stationary conditions, when the tractor does not move.

✓ **Type of driving the tools of the machine:** tractional, tractional-and-driven and driven. The tractor-based tractional aggregates utilize the whole useful power through a traction hitch mechanism or mounted attachment. The useful power of the tractional-and-driven MTA is utilized simultaneously by traction via traction hitch mechanism of the tractor and through mechanical and/or hydraulic power take-off via PTO shaft and free hydraulic outlets of the tractor. The driven MTA's perform the work under stationary conditions (the tractor does not move) through mechanical and/or hydraulic power take-off via PTO shaft and free hydraulic outlets of the tractor. A transport MTA is a particular example of the tractional aggregate.

✓ **The number of machines within the MTA:** single- and multi-machine aggregates. A machine performing several working functions, the process modules of which are not intended for using as separate technical means, is considered to be a single machine.

✓ **Arrangement of the tools relatively to the longitudinal plane of the tractor:** symmetrical and asymmetrical.

✓ **Arrangement relatively to the rear wheels and longitudinal plane of the tractor:** rear, left- and right-side (in the interaxle clearance between the front and rear wheels),

front and combined.

✓ **Quantity of the jobs to be performed:** similar tractor-based aggregates performing a single job; combined or complex ones performing two and more jobs simultaneously by means of several machines; combined ones performing several jobs be means of a single machine; universal ones equipped with replaceable tools capable of performing different operations in different time.

According to the method of aggregating with the tractor, the agricultural machines are divided into the following types:

1. **MOUNTED:** *to be fastened to the joints of the upper and lower rods of the traction hitch mechanism at three points.* The weight of the machine in the transport position is perceived completely by the tractor. The constructional elements of the machine in the transport position have no contact with the bearing area. When re-arranging the machine from the working position to the transport one, the point of connecting the machine with the tractor is moved forcedly to a new height**.**

2. **SEMI-MOUNTED:** *to be fastened at three points to the joints of the upper and lower rods of the traction hitch mechanism, but at only two points – to the joints of the lower roads of the traction hitch mechanism.* The weight of the machine in the transport position is perceived partially by the tractor and, to a greater extent, by its own transport wheels (usually one or two). When re-arranging the machine from the working position to the transport one, the point of connecting the machine with the tractor is moved forcedly to a new height**.**

The two-point articulated joint is implemented by fastening the link pins of the machine mounting axle with the joints of the lower rods of the traction hitch mechanism (the upper rod is not used). The option of use of a cross-bar from the equipment of the tractor or machine is also possible.

3. **SEMI-TRAILED:** *to be fastened commonly to the hitching mechanism at one point by means of a hitching loop*. The option of the two-point articulated joint with the mounted attachment (without using the upper rod) is also possible. The weight of the machine in the transport position is perceived partially by the tractor and, to a greater extent, by its own transport wheels (usually at least two). When re-arranging the machine from the working position to the transport one, the point of connecting the machine to the tractor is not repositioned.

The semi-trailed machines include also various general- and special-purpose transport facilities, such as general-purpose semitrailers, tank semitrailers, dump semitrailers and special semi-trailed transport facilities for mechanization of jobs in the agriculture. Transportation facilities aggregated by means of saddle-type coupling arrangement are particular examples of semi-trailed machines.

4. **TRAILED:** *to be coupled usually by means of a hitching loop to the hitching mechanism at one point*. The option of the two-point articulated joint with the mounted attachment (without using the upper rod) is also possible. The weight of the machine in the transport position is perceived completely by the machine's running gear, only the load from the weight of the machine's coupling arrangement is born by the traction hitch mechanism (or mounted attachment) of the tractor. When re-arranging the machine from the working posi-

tion to the transport one, the point of connecting the machine with the tractor is not repositioned.

The trailed machines include also various general- and special-purpose transport facilities, such as general-purpose trailers, tank trailers, dump trailers and special semi-trailed transport facilities for mechanization of jobs in the agriculture.

When aggregating the mounted, trailed, semi-mounted and semi-trailed machines, it is allowed to fasten their individual components (automatic control system boards, markers, limit rods, connecting accessories, brackets, etc.) subject to observation of all the guidelines of the Operating Manual.

5. ATTACHED: *to be fastened by fixing the assembly units (usually connecting frame) from the complete set of the machine to the mounting holes of the tractor.* The joints of the mounted attachment roads fixed at the top position against spontaneous lowering can serve as connecting accessories; in this case, the required position of the machine relatively to the bearing area may be achieved by extending the braces or attaching the special braces from the complete set of the machine. The weight of the attached technical facility is perceived completely by the tractor.

The equipment of this type includes the attached front and grab loaders. It is allowed to use the holes of the semiframe and rear-axle tube for fastening the auxiliary components (tension buckles, brackets, markers and hitches) included in the agricultural machines aggregated by means of three-point mounted attachments and traction hitch mechanisms of the tractor without special permit.

Attention!

1. Aggregation of the attached machines (loaders, bulldozers) is not related to the intended use of the BELARUS tractor.
2. No permit for joint operation of the BELARUS tractors with the mounted, trailed, semi-mounted and semi-trailed machines is required provided such operation comply fully with this Operating Manual for the tractor and does not fall outside the allowable framework of its use. In this case the Minsk Tractor Works shall not bear any responsibility for the failures, breakages and other troubles in the operation of the tractor arisen due to incorrect selection and/or improper use of the machines with the tractor. The agreement of the aggregation of the mounted, trailed, semi-mounted and semi-trailed agricultural machines is a recommended procedure.

3.3 Recommendations for selecting the agricultural machines for aggregating

The consumer shall select and purchase the agricultural machines to the tractor on his/her/its own based on his/her/its needs and with the account of the characteristics of the machine and tractor as well as local conditions (requirements of the agricultural technologies, soil conditions, personal experience, recommendations of the respective regional advisory centres and organizations for the agricultural production). It shall be kept in mind that the agricultural machines of the same purposes, but from different manufacturers can differ in the aggregation peculiarities and have different performance characteristics and adjustments.

Usually, the operational documentation for the machines manufactured by reputable manufacturers considers the matters of correct intended use of the machines including the recommendations for selecting and aggregating the tractor as well as safety procedure in sufficient details. In any case, the manufacturer (seller) of the machine shall provide you

on your request with the information on the basic minimum characteristics of the tractor which shall ensure the possibility of aggregation of the machine.

The formation of a tractor-based aggregate consists in determining the number and characteristics of the machines to be coupled with your tractor, the hitch (if necessary) and additional equipment to be used, adjustments and settings to be performed and the gear to be engaged. However, it is necessary first of all to purchase the machines. The procedure of formation of the tractor-based aggregates and peculiarities of the work are given in the operation manuals for the technical means to be aggregated. In every case, it is necessary to check the compatibility as to coupling members, load-carrying capacity of the mounted implements and tyres as well as allowable load on the traction hitch mechanism and axles of the tractor.

The BELARUS tractor can be aggregated with the machines having the rated resistance of the tools of 20,0 kN.

The grasp width of the aggregate and operating depth depend mainly on the specific resistance of the soils, which determine the range of operating speeds with the account of agricultural requirements. The heavier is the soil, the higher is the specific resistance. Changing of the speed for 1km/h changes the specific resistance by 1%.

Attention!

It is very important that the manufacturer (seller) of the machine would provide the information on the characteristics of the tractor, which would ensure the possibility of operation of the machine in sufficient details. If such information is unavailable, we recommend to refrain from purchase (operate) such a machine to avoid possibly heavier troubles in the process of its aggregation, which could cause the breakdowns of the tractor.

The possibility of aggregation and selection of the machines for the tractor can be determined independently by experimental or calculating method or on the basis of tests performed previously by the respective organizations, for example, zonal machine-testing stations, as well as recommendations of the machine manufacturer.

Calculation method of aggregation. When using the calculation method, the calculations are performed according to the appropriate formulae on the basis of the initial data and technical reference literature, the respective characteristics of selection of the tractor and machine are compared and on the basis of this comparison the conclusion on the possibility of their aggregation is made. This method can be recommended for approximate calculations in cases where experimental data are unavailable or where it is necessary to know immediately the approximate composition of the machine-tractor aggregate. Since the calculations use the medium values and all the peculiarities of the aggregation may not be taken into account, the tractor-based aggregate formed in such a way can be inoperable in some cases and its additional adjustment in the process of field work can be required. This method can be recommended for approximate calculations in cases where experimental data are unavailable or where it is necessary to know immediately the approximate composition of the machine-tractor aggregate.

When using reliable data and taking into account all the power inputs and local conditions, the possibility of aggregation of the machine with the tractor can be checked sufficiently accurately. Such operational calculations are recommended prior to purchasing a new machine.

Experimental method of aggregation. When using the experimental method, the ma-

chines are selected and aggregates are further completed by performing the practical check on the basis of the available operational documentation, normative and reference data as well as with the account of the gained experience of forming the aggregates at the specific farm or enterprise.

The initial data for selecting the machines to be aggregated with the tractors include the kind and characteristic of the soil to be ploughed or crops to be cultivated, dimensions and relief of the fields, agrotechnical requirements for the work to be performed (operating speed, agrotechnical clearance, track, tyre width, working travel direction, operation weight, aggregation method, vertical load on the coupling arrangement), draught resistance and power requirements of the working machines, haulage capacity and power of the tractor.

When selecting the machines, pay special attention to the variable characteristics of the conditions of operation of the agricultural machinery under field conditions. For example, the tractor with the drawbar category of 1.4 shall work with the three-furrow plough with the grasp width of 1.5 m under usual conditions, but on the areas with light soils and without slopes it ensures the operation of the four-furrow plough with the grasp width of 1.6 m.

When forming the machine-tractor aggregate, it is extremely significant to select correctly the gear, on which the tractor shall work. Of course, it would be more beneficial to work at high speed and with large grasp width and operating depth of the tools of the aggregated machines. Unfortunately, it is impossible to increase the speed of motion of the aggregate and its grasp width and operating depth. The higher is the speed, the lesser is the tractor's tractive force, therefore, it is necessary to reduce the grasp width and operating depth and vice versa. It is necessary to keep also in mind that the speed and operating depth are often limited by the agrotechnical requirements.

The determination and assessment of the possibility of aggregation of the BELARUS tractor with agricultural machines shall be performed in several stages.

Stage I

Data preparation and acquisition

a. Read carefully the Operating Manual for the tractor. Determine the main technical characteristics of the tractor: drawbar category, rated tractive force, engine power, allowable mechanical and hydraulic takeoff power, coupling dimensions/type (of the traction hitch mechanism or mounted attachment; PTO shanks, hydraulic outlets, electric socket and pneumatic head), positional relationship of the PTO shank end face relatively to the centre of the axis of the mounted attachment hanger or link pin of the traction hitch mechanism; standard equipment, speed and track range, availability of the necessary working equipment and maximum allowable weight of the tractor, allowable loads on the axles and wheel tyres and total weight of the trailer towed.

b. Read carefully the Operating Manual for the machine. Determine the main technical characteristics of the machine: draught resistance, mechanical (power intake shaft), electric and hydraulic power takeoff, coupling dimensions/type (of the hitch bar or tongue loop; coupling triangle; power intake shaft shanks, hydraulic outlets, electric plug and pneumatic heads), positional relationship of the power intake shaft shank end face relatively to the centre of the axis of the coupling triangle or hitch bar or tongue loop; possibility of modification of the standard equipment, power intake shaft type and rotation direction, operating speed range, full service weight with the adjustment rotor, presence of the brakes and cardan shaft (type, length, presence and type of the protective clutch). If necessary, consult with the seller (manufacturer) of the machine and request the missing data about the machine.

Stage II

Checking the assemblability

Assessment of the construction compatibility of the mating members of the tractor (traction hitch mechanisms, three point mounted attachments; hydraulic and electrical connections; pneumatic heads; PTO shanks) with the respective members of the machine including the compliance of the track and standard size of the wheels with the requirements of the technique of the works performed, location of the PTO, power intake shaft and cardan shaft of the machine as well as possibility of the installation of the system for automated monitoring of the process and installation of the monitoring board from the complete set of the machine in the cab.

Check the availability of the necessary equipment for aggregation in the standard equipment of the tractor: required type of traction hitch mechanism, pneumatic head, electric socket, required type of the PTO shank, wheel tyres of the required standard size for twinning, front or rear hitch linkage, reverse control station, spacers for twinning the wheels, availability of the hitching hoses and quick-connection cut-off clutches. The missing equipment of the tractor shall be acquired additionally. After checking the availability of the necessary working equipment and installation of the necessary additional equipment of the tractor, perform the completing and preparation of the MTA with the account of the recommendations of the operating documentation for the technical means to be aggregated.

When purchasing the new machines to be used together with the tractor, it is necessary to specify the presence of the necessary working equipment providing for the possibility of aggregating with the BELARUS tractor of your model.

For the machines located behind the tractor and driven from the PTO, it is necessary to order the cardan shaft of the necessary length and type, with the respective coupling dimensions. The machines driven from the PTO can be equipped with a reduction gear providing for rotation of the cardan shaft both clockwise and counter-clockwise. When purchasing the machine, it is necessary therefore to specify whether it is required to equip the machine with a reduction gear to be driven through the cardan shaft with the direction of rotation of the power intake shaft counter-clockwise, if looked from the side of drive of the machine towards the end face of the cardan shaft yoke.

Stage III

Checking the correspondence of the vertical static load on the traction hitch mechanism or carrying capacity of the mounted attachment to the load created by the machine with the account of the weight of the adjusting load.

Make sure in the possibility of lifting and lowering of the attached machine with the total operating weight by the mounted attachment. Keep in mind that the load created by the machine shall not exceed the recommended values of the carrying capacity of the mounted attachment and allowable vertical load on the traction hitch mechanism.

Stage IV

Checking the vertical static loads on the axles of the tractor including the steerability criteria and necessity of additional ballasting.

Determine the total weight of the tractor with the machine, load on the axles and maximum allowable load on the tyres, weight of the necessary ballast and adjusting load by the calculation or experimental method. The weight of the tractor within the MTA distributed between the tractor’s axles shall not exceed the permitted values. In any case. the load on the front and rear axles shall not exceed the total load-carrying capacity of the tyres according to the total load-carrying capacity of the rear or front wheels.

Stage V

Checking the possibility of motion of the tractor aggregated with the machine including checking the turn angles and maximum height of lifting of the mounted attachment until it rests against the tractor members, sufficiency of the length and free space of the cardan shaft when performing turns and transferring the machine to the transport position.

Stage VI

Assessment of the correspondence of the power capabilities of the tractor and power required by the machine (draught resistance and power consumption including that through the PTO). The assessment may be performed by the calculation tee given the initial data or based on the test report.

Stage VII

Checking the possibility of performing the work by the machine aggregated with the tractor.

a. Trial aggregation for performing the jobs in accordance with the purpose of the machine and with obligatory observance of the safety requirements.

b. Checking the fitting of the tractor within the row-spacing of the crops to be cultivated with determining:

- the correspondence of track and tyre profile width;
- agrotechnical clearance;
- protective zones to the tyres.

Stage VIII

Checking the total cross-country ability, static stability on slopes and efficiency of brakes under local conditions:

a. possibility of overcoming the ups and downs by the tractor with the machine loaded with process material;

b. possibility of motion along the slope.

Assess the clearance value and steerability of the tractor aggregated. During the motion, the front wheels of the tractor shall not be taken off the road surface. The front axle of the tractor shall perceive at least 20% of the load (steerability criterion $K_s \geq 0.2$) from its own operating weight in any case of its use.

Stage IX

Carrying out the control shifts for the purpose of determining the operating characteristics:

a. time and labour intensity of forming the MTA;
b. average operating speed;
c. productivity per 1 hour of basic (shift, operating time);
d. volume of the work performed for the reference time;
e. hourly (specific) fuel consumption.

3.4 Checking the correctness of forming the machine-tractor aggregate

The operation of the tractor with the aggregated machines being either overloaded or underloaded shall not be allowed. In the first case, there will be increased wear of the parts of the tractor, excessive fuel consumption and decrease of the productivity of the aggregate while in the second case there will decrease of the economic characteristics and, particularly, productivity and increase of the fuel consumption. Therefore, the tractor driver shall first of all make sure that the MTA has been formed correctly and its recommended

speed in the most favourable.

In the tractor operation there are **two main speed modes:**

а) **operating**

This mode is the main one. The variation of the operating motion speed which affects the quality of performing the job in accordance with the agrotechnical requirements. The operating manuals for individual machines contain the allowable operating speed ranges. Any variation of the working motion speed of the tractor with the aggregated machine including the operating manoeuvring during the operating motion is only allowable within the limits to be determined by the agrotechnical requirements. The initial operating speed is set usually within these limits together with the machine grasp width and operating depth (fit).

б) **auxiliary mode**

This mode is characterized by the tractor motion speed with the aggregated machine in the near transport speed (in idling when performing the turns and motion to another place) with the operating elements engaged. The speed mode of the tractor with the machine in the near-transport mode is generally limited by the safety requirements. Due to relatively short duration of the turns and necessity of following the guidelines for limitation the transport speed when moving from one field to another, the respective tractor speed in the mode is often close to the operating one.

If the machine to be aggregated has been selected, it is only necessary to determine the operating speed and respective gear.

The operating speed of the tractors during the operation under field conditions is limited first of all by the quality of the work to be performed. Besides, for traction machines it is limited by the tractive and hitching capabilities of the tractor and for traction and driven aggregates – by the allowable power of the PTO and hydraulic takeoff as well as by the throughput capacities of the machine tools.

Checking the correctness of formation of the aggregate according to the rotational speed of the engine crankshaft.

In practice, the operating motion speed of the tractor is selected based on the tachospeedometer readings. While knowing the range of agrotechenically allowable speeds, the tractor gear (motion speed), in which the tractor shall enter this range, is determined.

The normal load on the tractor should be considered such a load, at which the readings of the crankshaft rotational speed on the tachospeedometer would be lower (by not more than 6%) than the rated value specified in the manufacturer's documentation. Drop of the rotational speed by the value exceeding 6% indicates the engine overloading. The increase of the rotational speed above the rated one indicates the engine underloading.

The main condition of the optimal aggregation of the BELARUS tractor is proper use of the engine power which is characterized by the load factor expressing the degree of use of the tractor's rated power for performing the jobs by the aggregated agricultural machines. For each group of agricultural operations objectively approximate values of the degree of use of the engine's rated power exist. On the average the reserve power should make up 10…15% of the engine rated power.

The correctly selected operating mode of the tractor is understood as such aggregation of the tractor with observing all the operating rules and limitations, which ensure not only performance of the work in accordance with the agrotechnical requirements for the working operation to be performed, such as engine loading mode, speed mode of the aggregate, allowable skidding mode as well as compliance with all the recommendations for safe use of the tractor (speed selection, loading modes).

The engine loading degree can be varied by increasing or reducing the number of ma-

chines, varying the grasp width, operating depth as well as motion speed in the process of the operating motion of the aggregate. If the efficient loading of the engine by varying the number of machines and operating speed is impossible, the respective partial operating mode should be chosen by reducing the fuel feed.

The engine loading degree is determined by the crankshaft rotational speed. It is necessary to work at the crankshaft rotational speed slightly exceeding the rated value (indicated on the tachospeedometer). If the operating speed is below the required value, a lower gear shall be put in.

Allowable skidding mode. One of the main special requirements consists in observance of the allowable skidding limits: 16% for wheeled tractors with two driving axles and up to 18% for wheeled tractors with one driving axle. The MTA shall be completed and the speed mode shall be selected within the limits of allowable skidding. Excessive skidding of the tractor propulsion devices causes the destruction of structural particles of the soil with subsequent development of the wind and water erosion.

Wheel tread setting

Front wheels 420/70R24 (or 14.9R24)

Wheels position	Tread, mm
A	1540
B	1635
C	1850
Д	1950
A’	1700
B’	1800
C’	2020
Д’	2090

Wheels position with a disk overturn (A’, B’, C’, Д’) should be used in exceptional cases only.

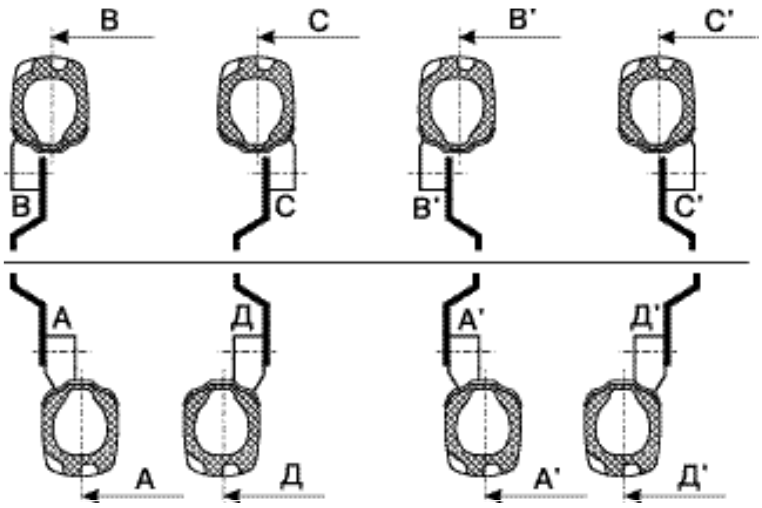


Fig. Л-1.

Rim fastening with reference to a disc:

A (A’), C (C’) — inner; B, (B’), Д (Д’) — outer;
C, Д — wheel exchange; A’, B’, C’, Д’ — disk overturn

.

Rear wheels

Tyre type	Wheel position	Tread size K, mm	Hub H setting-out size* to semi-axle end, mm
18,4R38	A C		
16,9R38	A C		

* A tread change by H-value corresponds to a hub position change equal to H/2 from each side.

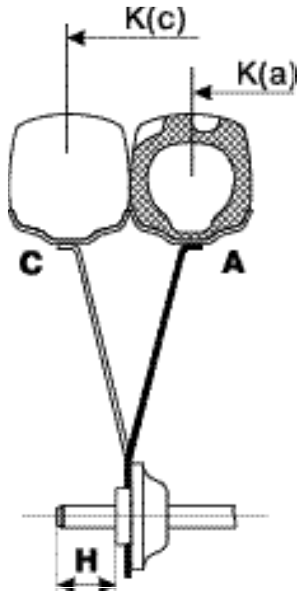
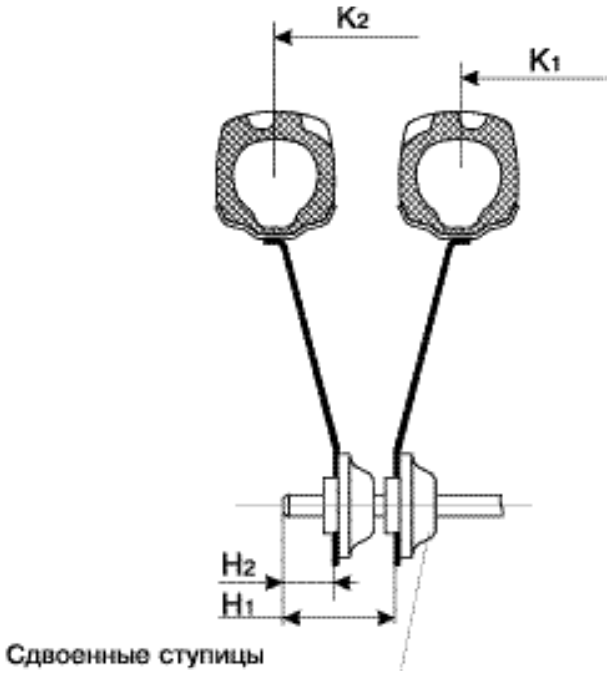


Fig. Л-2.

Rear wheels doubling for wheel specific pressure decrease on the ground

Tire type in a set	Tread size K_1, K_2, mm	Hub fixed size H_1, H_2, mm
18.4R38+18.4R38		
16.9R38+16.9R38		



Сдвоенные ступицы	Doubled hubs

Fig. Л-3

Rear wheels doubling for inter-row cultivation of the crops using extra tires (optional)

Inter-rows width M, mm	Wheels tread K_1, K_2, mm K		Cultivated crops
	front	rear	
	11,2R24	11,2R42+ spacer+ 11,2R42	
450 500	1800 (A') 1500 (B)	1800+2700 1500+2500	Sugar-beet
600	1820 (A')	1800+3000	Feeding beet, vegetables
700 750	1400 (A)* 1500 (B)*	1420+2850 1500+3000 (2930)	Maize, potatoes — in hackles*

A spacer 1522-3109020-01 is used for inter-rows of 450 mm and 700 mm; the spacers for other inter-rows width are developed and shipped by a buyer's request (optional).
Sizes in brackets are given for inter-rows of 750 mm

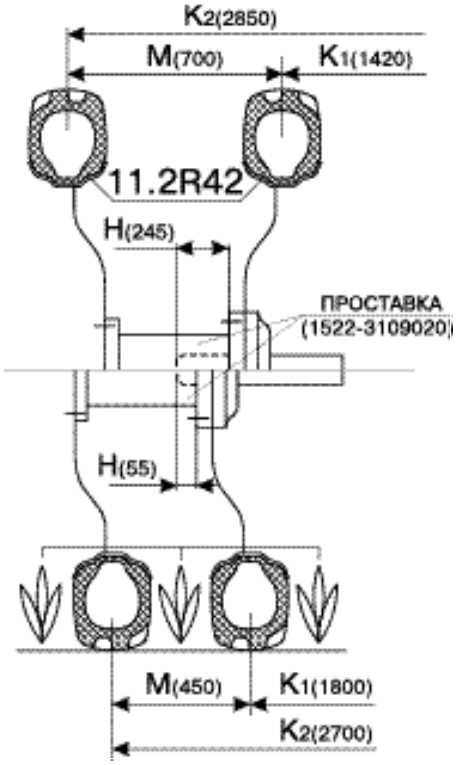


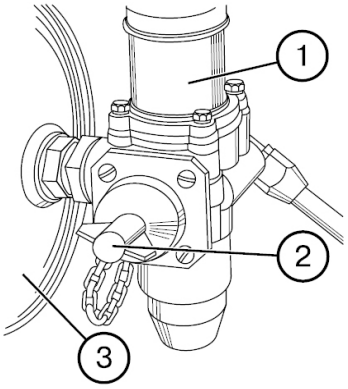
Fig. Л-4.

Проставка	Spacer

Inter-row cultivation of the crops using single tires of the main configuration

Inter-rows width M, mm	Wheels tread K, mm		Basic cultivated crops
	front	rear	
	420/70R24 or 14.9R24	18.4R38 or 16.9R38	
750	1540 (A)	1500	* Potatoes — in hackles, maize, cotton
800	1650 (B)	1600	
900	1800 (C)*	1800*	
1000	1980 (Д)	2000	

Tires inflation



Inflate the tires using an air bleed valve of a pressure regulator (1) in the following order:

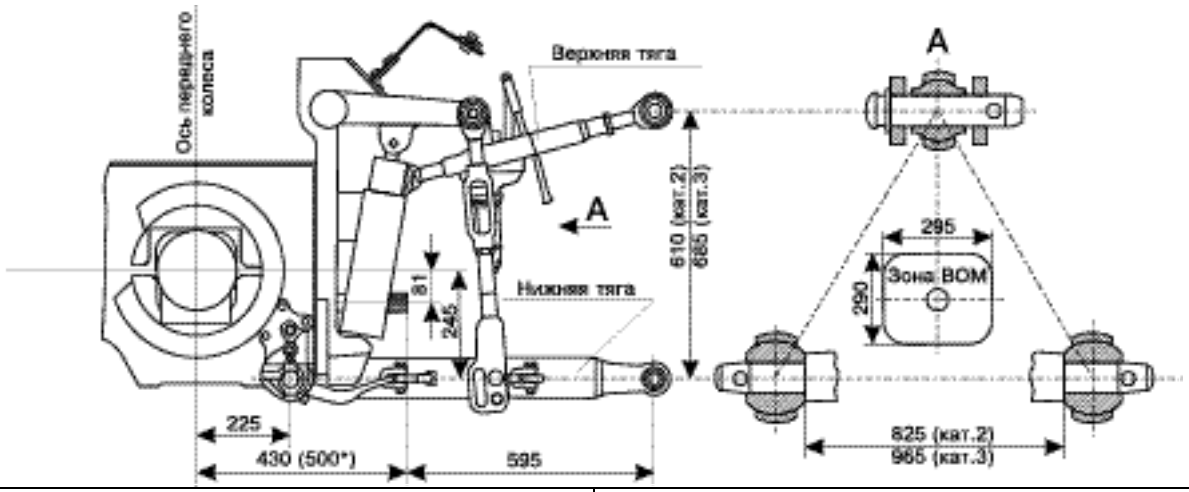
- bleed air from a balloon (3) of the pneumatic system through a valve of condensate ejection valve;
- unscrew a butterfly-nut (2) of an air bleed valve connecting pipe;
- connect a tire inflation hose to the air bleed connecting pipe and a tire's valve;
- switch a compressor on and inflate a tire up to a required pressure level, controlling it by a tire manometer;

IMPORTANT! If pressure in a balloon exceeds 7,7 kgf/cm^2, the compressor is switched over to idling by a pressure regulator and tires inflation stops automatically. Thus, control a pressure level by an indicator on the dashboard and decrease pressure through a condensate ejection valve if necessary.

- disconnect the pump from the tire's valve and the air bleed valve connecting pipe;
- switch a compressor off and screw a butterfly-nut on the air bleed valve connecting pipe;

Hitch and towing drawbar devices

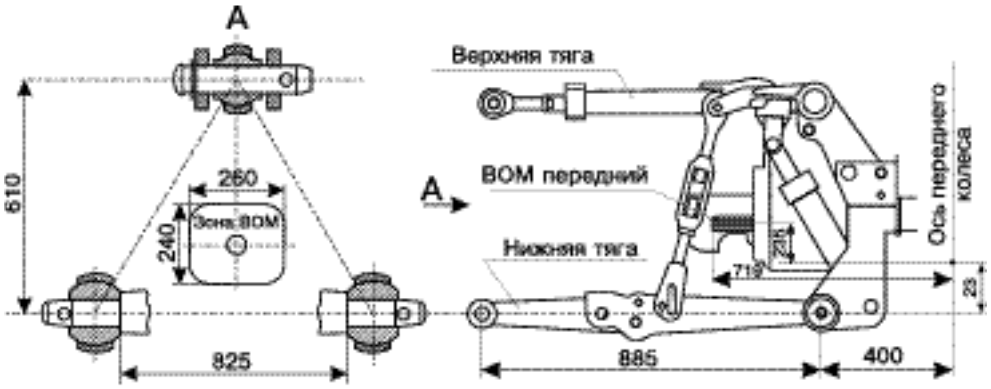
Rear hitch linkage HL-2 (3)
Implements: mounted ones (ploughs, cultivators, seeders, milling cutters, etc.), semi-mounted ones (ploughs, soil-cultivating machines, seeders, potato harvesters, etc.).



Ось переднего колеса	Front wheel axle
Верхняя тяга	Upper rod
Нижняя тяга	Lower rod
Зона ВОМ	PTO area
Кат.	Cat.

Fig. Л-5.

Front hitch linkage HL-2 (if installed)



Верхняя тяга	Upper rod
Нижняя тяга	Lower rod
ВОМ передний	Front power take-off shaft
Зона ВОМ	PTO area
Ось переднего колеса	Front wheel axle

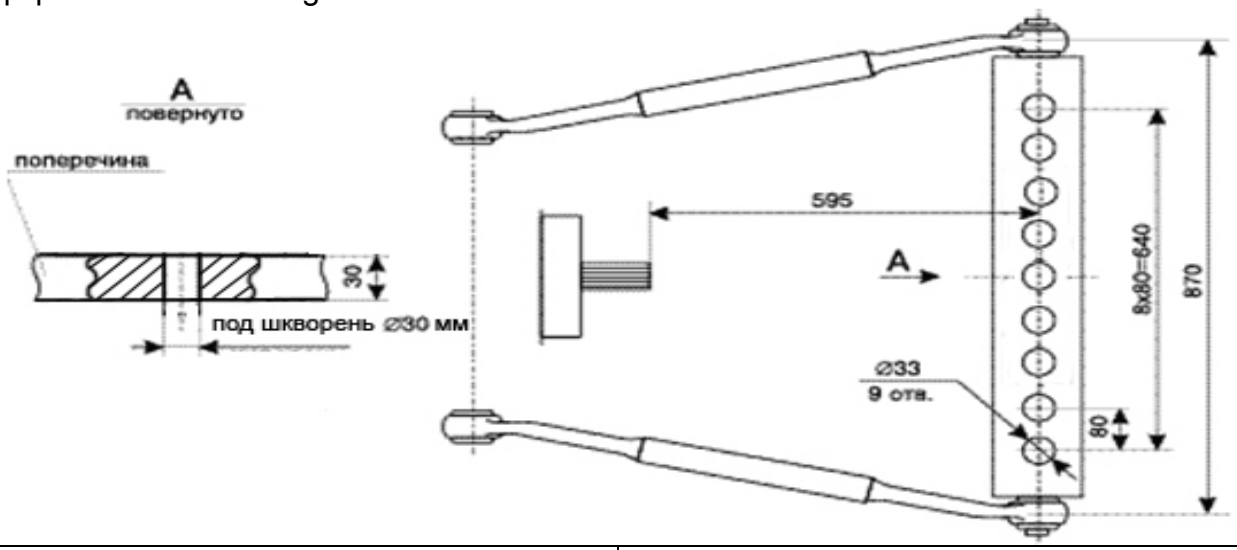
Fig. Л-6.

Characteristics	Rear HL-2 (3)		Front HL-2
	cat. 2	cat. 3	
Lower rods	solid		separable
Lower rods length: solid, mm	885		885
Links hinges width: upper, mm	51		51
lower, mm	38 or 45		38 or 45
Connecting elements rated diameter:			
upper rod pin, mm	22*	32	22 or 25
lower rods hinges, mm	28*	37	28
Distance between the PTO end and a suspension axle, mm	595		544
Loading capacity:			
on a suspension axle, kN	43		20
at 610 mm offset, kN	28		18

* Pin and transitional bushings in a tractor set of tools and accessories.

Towing drawbar TD-1 (cross-bar)

Implements: semi-mounted ones (seeders, potato planters, potato harvesters, vegetables harvesters, etc.), semi-trailers (mowing machines, press-pickups, haulm pickers, etc.), equipment with a trailing clevis on the towbar.



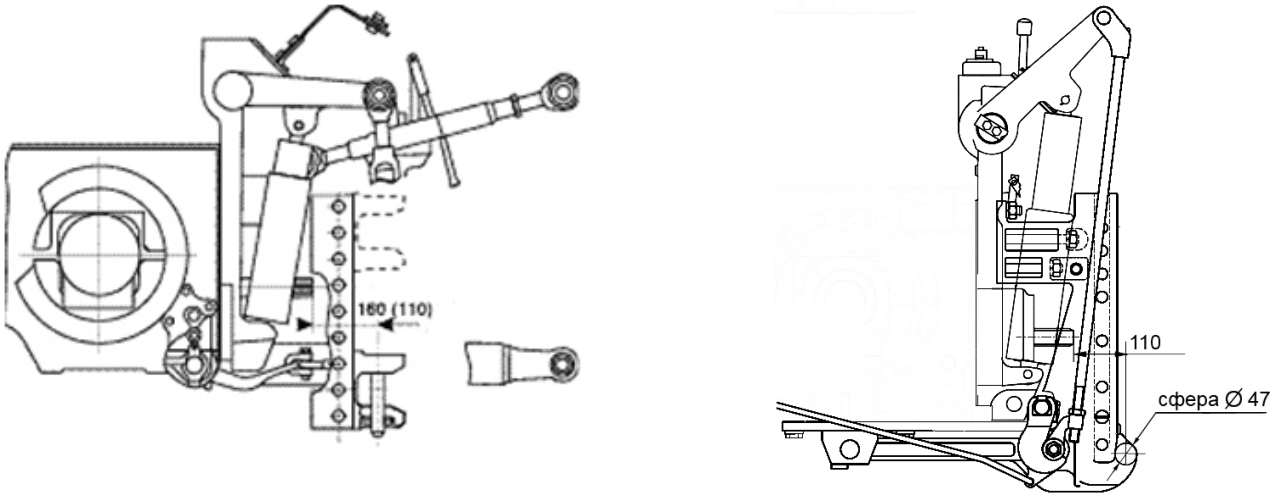
Повернуто	Turned
Поперечина	Crossbar
Под шкворень	For connecting pin
Отв.	Bore

Fig. Л-7.

TD-1 (with a lining for a hinge or without it)	A cross-bar on a suspension axle of a hitch linkage in a configuration HL-2
Distance between the PTO end and a connecting pin axis, mm	595
Connecting pin diameter, mm	30
Vertical load on a TD, kN	6,5
Implement turning angle with reference to a tractor, degrees	± 60

Towing drawbar TD-2 (TD-2B – clevis; TD-2K - hook)

Implements: semi-trailers (semi-trailers, fertilizer machines, etc.), trailers (disk harrows, soil-cultivators, hulling machines, coupling of harrows, cultivators, seeders, etc.).



Сфера	Sphere

Fig. Л-8.

Towing drawbar	A clevis (with a possibility of vertical movement)	Hook
Distance between the clevis or a hook sphere and a supporting surface, mm	493…898 (till the jaw axis) in a stepped way	457
Clevis position for the implements with PTO drive	Extreme lower or extreme upper	-
Distance between the PTO end and connecting pin axis, mm	160 or 110	110
Connecting pin diameter, mm	30	sphere Ø 47
Vertical load on a TD, kN	25	20
Implement turning angle with reference to a tractor, degrees	± 65	± 65

Towing drawbar TD-3B (clevis)

Implements: trailers (motor-type double-axle trailers, etc.), semi-trailers (the same as for a TD-1).

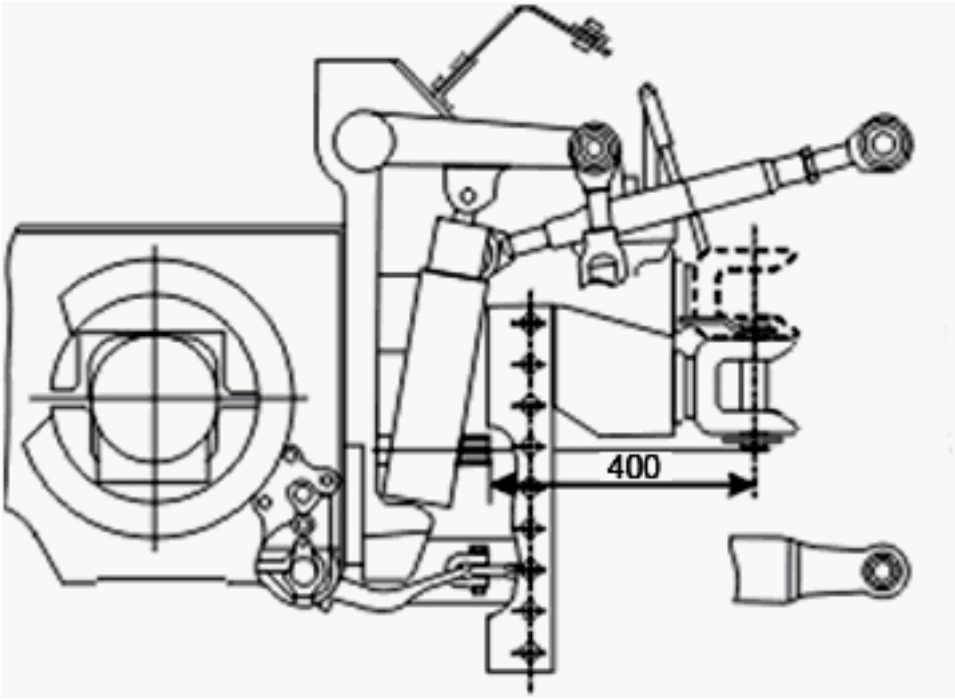


Fig. Л-9.

Towing drawbar	A rotating clevis (with a possibility of a vertical movement)
Distance between the clevis and a supporting surface, mm	435…905 or 589…1059 (with a clevis overturn) in a stepped way
Clevis position for the implements with PTO drive	Extreme lower or extreme upper including a clevis overturn
Connecting pin diameter, mm	40
Distance between the PTO end and connecting pin axis, mm	400
Vertical load on a TD, kN	12
Implement turning angle with reference to a tractor, degrees	± 55 (trailers) ± 85 (agricultural machines)

Towing drawbar TD-1M-01 (drawbar)

Implements: semi-trailers (the same as for a TD-2B and a TD-3B), trailers (the same as for a TD-2B and a TD-3B).

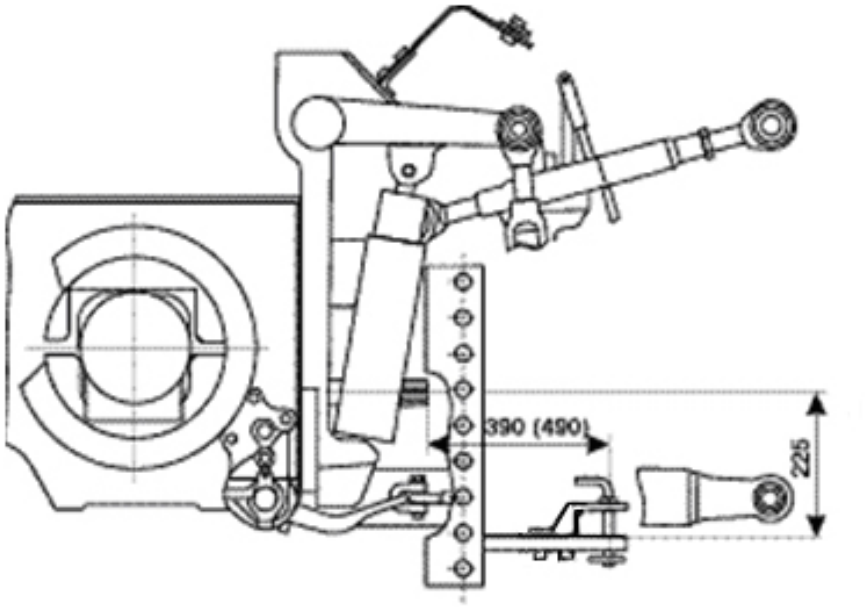


Fig. Л-10.

Towing drawbar	A clevis with a possibility of a position change with reference to the PTO end
Distance between the clevis and a supporting surface, mm	442
Distance between the PTO end and connecting pin axis, mm	390 or 490
Connecting pin diameter, mm	30
Vertical load on a TD, kN	12
Implement turning angle with reference to a tractor, degrees	± 85

3.5 Hitch linkage and hydraulic system use

Rear hitch linkage of HL-2 type is produced in accordance with GOST 10677 (corresponds to the cat.2 according to ISO 730/1) with the possibility of modification according to the connecting dimensions for HD-3 (Category 3). Due to this the tractors are equipped with transitional bushings of lower and upper rods, which are installed in the rods hinge pivots, connected to the implement.

Subject to their availability there is a possibility of connecting the implements with the dimensions, corresponding to the HD-2 (category 2).

Front hitch linkage of HL-2 type is produced according to GOST 10677 (corresponds to the cat. according to ISO 730/1). Supplied on request.

The rear hitch linkage consists of three rods (one upper and two lower ones) the front ends of which are coupled by means of joints with the tractor and the rear ends of which are coupled with the free joints for connecting with the link pins of the aggregated machines. It is intended for coupling the rear-mounted machines to the tractor, transmission of tractive force during the operation and adjustment of their position during the operation or motion in the transport state.

The hitch linkage provides the aggregation of the following types of the machines and implements:

- mounted ones using the three-point mounting (upper and lover rods);
- semi-mounted (lower rods);
- semi-trailed using the crossbar on the mounting axle (lower rods).

The external limit rods with adjustable length serve for preventing the attached machines from swinging.

The following adjustments of the rear hitch linkage in the vertical and horizontal planes by means of the upper rod, braces and limit rods are provided for ensuring the required position of the machine:

A. Altering the length of the upper rod

- equal penetration (equalizing the depth of travel of the tools located one after another in the direction of the tractor motion); if the frame of the mounted plough is tilted forward as seen in the direction of the tractor motion and the front plough body ploughs deeper than the rear one does, elongate the upper rod and shorten the same, if the front body ploughs with less deepness than the rear one does.

B. Altering the brace length.

- position of the machine in the horizontal plane;
- uniform operating depth provided by the tools of the mounted machine over the grasp width;

Important: The length of the left brace of the hitch linkage is 475 mm and not to be altered without special necessity, usually the length of the right brace is to be adjusted. When using the crossbar on the mounting axle and operating one-way ploughs, the length of the braces shall be equal.

D. Altering the length of both braces and upper rod for the transport position of the machine.

- clearance: at least 300 mm;

- sufficient safe distance between the members of the tractor and those of the machine excluding the contact of the machine members with the tractor (the clearance shall be at least 100 mm).

E. Altering the length of both braces

- when transporting the machine (with the top position of the hitch linkage), the limit rods shall be shortened to the maximum extent within the existing adjustment for limiting the swinging of the machine during the motion to avoid the damage of the tractor members in possible emergencies;

- when operating the mounted and semi-mounted soil cultivating machines with passive tools intended for overall tillage (share and chisel ploughs, stubble-breaking ploughs, deep tillers and other machines), it is necessary to ensure the free motion (swinging) of the lower rod in the horizontal plane to the distance of 125 mm to each side from the longitudinal plane of the tractor unblocking the limit rods; no limitation of the grasp width by means of the rods is allowed;

- when operating agricultural machines (except for ploughs, deep tillers and other similar machines for overall tillage of the soil with passive tools), ensure a partial blocking to limit the swinging of the lower rods in the horizontal plane to not more than 20 mm.

Attention!

Failure to follow the recommendations for adjusting the limit rods and braces can cause the rupture of the rods and support brackets or other breakages.

C. Adjusting the brace

During the operation, the braces are connected usually with the lower rods through the holes in the brace forks.

To improve the transversal contour following (cultivators, sowing machines, etc.) and reducing the loads on the hitch linkage during the operation with the wide-coverage machines, it is necessary to ensure the free movement of one lower rod in the vertical plane relatively to another rod. To do this, it is necessary to adjust the braces in such a way that a free movement of one lower rod in the vertical plane relatively to another rod would be achieved. Such adjustment is ensured by connecting the braces through the slots.

The rear hitch linkage is controlled by moving the respective hydraulic distributor control levers from the cab as well as by the external pushbutton panel which provide the positioning of the lower rods of the rear hitch linkage to the necessary height.

Attention!

The necessary peculiarities and method of adjustment of position of the machines aggregated by means of mounted attachments in accordance with the peculiarities of performing the job and agrotechnical requirements are given in the operation documentation for the machines. If such data are unavailable, obtain obligatorily the necessary information from the manufacturer or seller of the machine.

The universal hydraulic system for controlling and adjusting the hitch linkages of the tractor provides additionally the following functional capabilities for the rear hitch linkage:

- correction of the speed of lifting and lowering the lower rods;
- restriction of the height of lifting the lower rods;
- selection of the necessary method of adjustment of position of the lower rods;
- correction of the operating depth;
- possibility of operation with the machines provided with height-related method of adjustment of the height of travel of the tools (the depth is adjusted by the carrier wheel of the machine).

The hydraulic system provides the following methods of adjustment of the position of the mounted and semi-mounted machines and their tools:

a) having no carrying wheels:
power: the depth is adjusted in accordance with the draught resistance of the machine;
position: the machine is held in the specified position relatively to the tractor body;
combined: the power and position methods in any relationship;
b) provided with carrying wheels:
combined: the power and position methods in any relationship.

The hydraulic system for controlling the mounted attachments ensures the possibility of additional oil takeoff for providing the operation of the aggregated machines.

The tractor is provided with free hydraulic outlets for servicing the aggregated technical means by means of he applied high-pressure hoses.

The oil consumption is 45...55 l/min (depending on the technical state of the hydraulic pump). The oil takeoff by the hydraulic cylinders of the aggregated machine shall not exceed 16 l. The level in the hydraulic oil tank should be checked with the plugs of the working cylinders retracted.

The shutting off and rupture members included in the spare parts and accessories kit of the tractor (optionally) are provided for preventing the losses of oil when aggregating the technical means or unforeseen disconnection. The hydrostatic power intake is possible through one of the outlets for supplying the special-purpose hydraulic motors. To avoid the overheating of the hydraulic system, the work pressure shall not exceed 11 MPa (110 kgf/cm^2) that corresponds to the power of 11 kW, not more. A separate pipeline is provided for draining oil from the hydraulic motor with bypassing the distributor.

The tractor is equipped with fittings having the conditional flow passage Dc = 12 mm and connection thread M20x1.5. In case of necessity of connection of the aggregated machines with different thread, the required adaptors with the conventional flow passage of at least Dc = 12 mm should be manufactured.

ATTENTION! The oil in the working cylinders of the aggregated machine shall be clean and correspond to the brand used in the tractor. Failure to fulfil these requirements can cause failure of the hydraulic units of the tractor.

The adaptation and modification of the structural elements of the hydraulic system of the tractor except for those permitted by this Operating Manual is only allowed after consultation with the manufacturer.

3.6 Using the towing drawbar

The tractor can be equipped with towing drawbars of various types providing the aggregation of trailed and semi-trailed machines, the coupling arrangements of which meet the following requirements:

- compatibility of the coupling dimensions and the height of the drawbar position referring to the supporting surface;
- the machines are provided with fixed drawbars;
- the trailers hitches are equipped with a device facilitating the coupling of the trailer with/uncoupling of it from the towing drawbar of the tractor;
- the vertical load on the towing drawbar shall not exceed the values permitted by the tractor manufacturer.

The tractor is equipped with a rear lifting device in the form of vertical guiding plates. The device is intended for fastening the towing drawbar TD-2 and TD-3 of the design provided by the manufacturer.

It makes it possible to reposition the connection link of the TD to the height and facilitates the dismantling.

The towing drawbar TD-1 (the crossbar is on the mounting axle of the hitched drawbar HL-2) is only intended for aggregating with semi-mounted and semi-trailed machines for performing the jobs at the speed of $\leq$ 15 km/h. The crossbar has a number of holes for connection. The normally aggregated machine is coupled through the middle hole of the crossbar.

In case of necessity of matching the track of the tractor with the aggregated machine (mainly harvesting) with insignificant draught resistance, an asymmetric connection is allowed. The crossbar shall be acquired to the consumer's order.

Taking into consideration that the TD-2B, TD-3B and TD-1M-01 occupy a certain fixed height position, the connecting devices of the semi-trailed machines should be implemented with a regulated support, providing possibilities of positional height regulations of the machine drawbar loop.

3.7 PTO and drive of the machines

In case of correct location of aggregated machines power intake shaft (PIS) relatively to the tractor PTO, the cardan shafts of the standard design can be installed.

The rear PTO shaft provides a synchronous machines drive (active semi-trailers, planting machines etc.), alongside of it the use of the shank type is not important.

The motion speed should not exceed 10 km/h.

Front PTO shaft is used together with the front hitch linkage or with its bracket (without rods installation) and is designed for the drive of front hinge machines (rotary cultivators, moving machines, pumps, etc.)

To avoid the overloads of the PTO drive when aggregating with the inertial machines (pickup balers, fodder harvesters, etc.), it is necessary to use the cardan shaft with the overrunning clutch on the PIS side.

When using the rear PTO shaft at 540 rpm and front PTO shaft at 1000 rpm it is necessary to install a protective coupling from the PIS side, which limits the power take-off over the allowable values (not over 50-60 kW, respectively). It is possible to install the protective coupling also to protect the drive from overloading.

Characteristics of tractor PTO shafts shanks are given in the tables 1 and 2.

Attention!

1. For providing the protection of the PTO drive, it is expedient to equip the machine with a protective coupling.
2. To avoid the overloads of the PTO drive when aggregating with the inertial machines (fodder harvesters, etc.), it is necessary to use the cardan shaft with the overrunning clutch or combined clutch on the PIS side.
3. The working torque on the cardan shaft shall not exceed the allowable torque on the PTO.

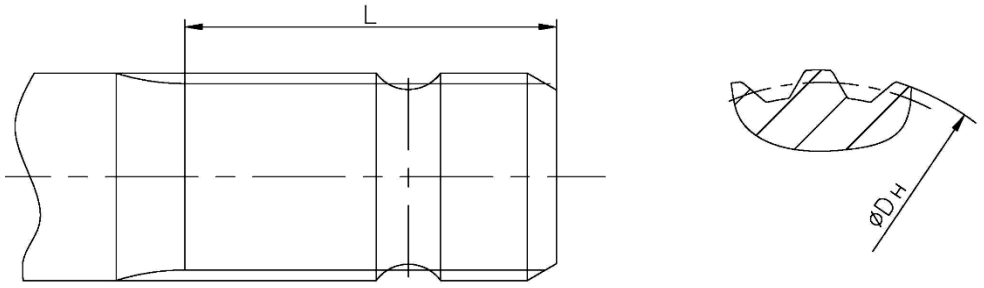


Fig.1

Characteristics of the PTO drive Table 1

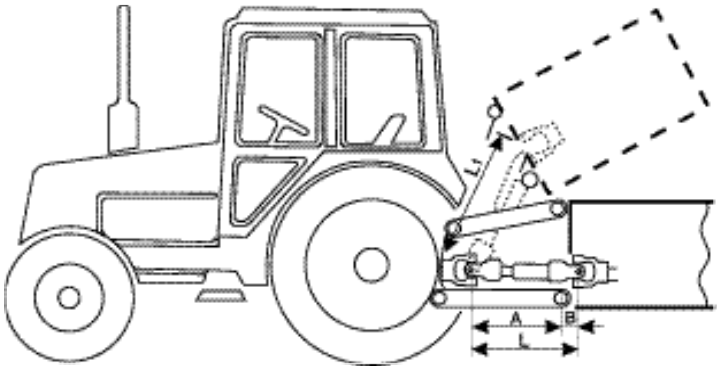
Characteristics	Designation (see Fig. 1)	**PTO1**	**PTO 1C**	**PTO 2**
Splines length, mm	**L**	76	78	64
Outer diameter, mm	**D_H**	35	38	35
Number of splines	**n**	6	8	21

Table 2

PTO	Shank type	Rotational speed, rpm		Transmitted power, kW (h.p.)
		of the PTO	of the engine	
Rear independent	PTO 1C	540	2037	60 (80)
	PTO 1	540	2037	60 (80)
	PTO 2	1000	2100	80 (120)
Front independent	PTO 2	1000	1845	50 (68)
Rear synchronous	PTO 1C PTO 1 PTO 2	4,18 rev/1 meter of travel		60 (80)

Schemes of attachment

A cardan shaft length is determined by distance L (the shaft is entirely moved) at horizontal position of the lower rods. A shaft lengthening is effected when lifting the implement, so it is necessary to check telescopic elements overlap in an upper position. A hinge inclination is more from a PTO side than from a power intake shaft side.



L1 > L; A > B

Fig. Л-12.

Cardan shaft length L is determined at the implement turning by a maximum angle with reference to a tractor. If equality A=B is not observed, a rotation irregularity is suddenly increases, resulting in the shaft overloading.

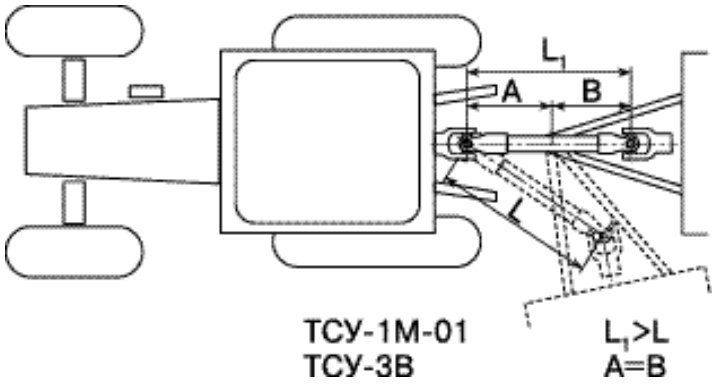
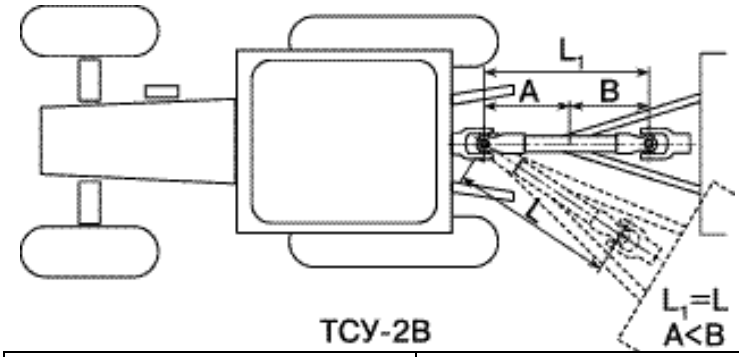


Fig. Л-13.

A cardan shaft length remains unchanged at the implement turning with reference to a tractor. A rotation irregularity of the cardan shaft appeared on the way is compensated by an angular velocity hinge installation.

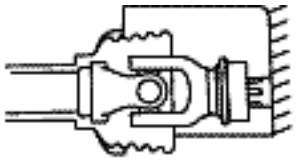


ТСУ	Towing drawbar

Fig. Л-14.

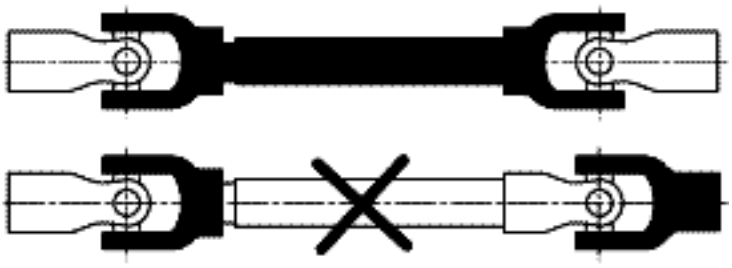
Cardan shaft installation

Installation of a cardan shaft with a protective casing in combination with a PTO protective cover ensures safety of the connection (Picture Л-15а).



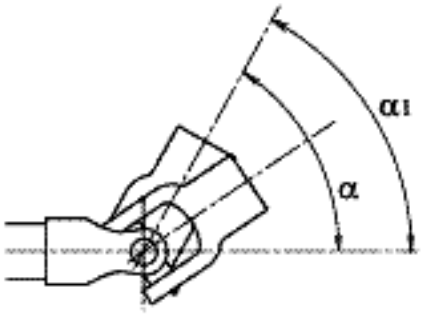
а)

End clevises should be in the same plane (Picture Л-15б).



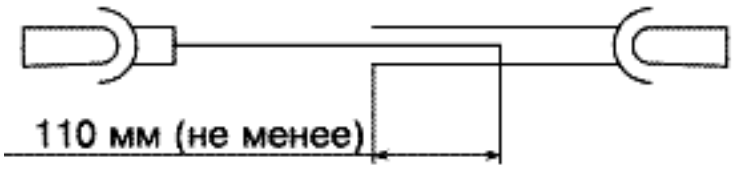
б)

PTO	Cardan hinges inclination angle (max. degrees)	
	Universal	Equal angular velocities
Engaged	22	25 (50 short-run)
Disengaged	55	55



в)

Cardan shaft telescopic elements overlapping should not be less than 110 mm to avoid disconnecting and jamming of the connection (Picture Л-15г).



г)

110 мм (не менее)	110 mm (not less)

Fig. Л-15.

3.8 Determining the weight of the tractor, machine and ballast, loads on the towing drawbar and hitch linkage, tyres and axles of the tractor and steerability criterion

The tractor and its structural members including also tyres are designed for trouble-free operation in a certain range of vertical loads and speeds specified in the Operation Manual for the tractor. In case of failure to follow the recommendations concerning the loading and speed modes of the tractor and tyres, the manufacturer does not guarantee its trouble-free operation and warns about inadmissibility of such operation. Each pneumatic tyre is designed for operation within a certain range of vertical loads. The width of this range is determined by the size and design features of the tyres.

Loads on the tires at different motion speeds

Tire	Load index	Speed symbol	Speed, км/ч	Load per one tire, kg, at inner pressure, kPa						
				60	80	100	120	140	160	180
14.9R24	126	A8	10	1260	1490	1700	1890	2070	2240	2550
			20	1180	1395	1585	1765	1930	2090	
			30	1025	1215	1380	1535	1680	1820	
			40	960	1135	1290	1435	1570	1700	
420/70R24	130	A8	10	1700	1875	2050	2230	2405	2585	
			20	1535	1720	1845	2030	2210	2335	2850
			30	1340	1500	1605	1765	1925	2035	(190kPa)
			40	1250	1400	1500	1650	1800	1900	
18.4R38*	146	A8	10		2925	3240	3555	3870	4185	
			20	2395	2655	2915	3170	3430	3690	
			30	2085	2310	2535	2760	2985	3210	
			40	1950	2160	2370	2580	2790	3000	
16.9R38**	141	A8	10		2275	2550	2880	3210	3530	
			20	1595	2090	2360	2630	2895	3165	
			30	1390	1815	2050	2285	2515	2755	
			40	1300	1700	1920	2140	2355	2575	

1. The pressure should be settled in the “cold” tires.
2. When performing the works demanding great towing forces on the hook set the pressure as for the speed of 30 km/h. When performing transport works on the roads with hard surface increase the pressure by 30 kPa.

* For tractors with FDA 1222-2300020-05

** For tractors with FDA 1222-2300020

The most accurate and reliable method of determining the weight and loads consists in weighing on the balance for motor transport means.

Attention!

The load on the hitch linkage, towing dawbar, axles, tyres and body of the tractor from the weight of the aggregated machines shall not exceed the maximum allowable values specified by the manufacturer. Here the load on the front axle of the tractor in every case of its use shall be always at least 20% of the own operating weight of the tractor without ballast weights and water solutions in the tyres.

The practical determination of the weight of the tractor and machines and vertical loads on the axles of the tractor is performed usually on any suitable balance having an appropriate capacity and intended for heavy-load motor transport means. Weighing on the balance makes it possible to determine also the real load on the coupling arrangements of the trailed, semi-trailed and semi-mounted machines.

The value of vertical loads on the coupling arrangements of the trailed, semi-trailed and semi-mounted machines can be determined by means of a special dynamometer.

Important: To determine the load on a certain axle of the tractor by means of a balance, the tractor shall be placed so that the wheels of the axle to be measured would be on the balance platform and the wheels of another axle – outside the weighting zone at the same level with the platform. We recommend measuring the load on a separate axle of the tractor within a MTA using the following technique:

Standard equipment A: Tractor with a rear-mounted machine or mountable ballast weights; the front hitch linkage is not used.

- the front axle (with the rear hitch linkage lowered) is weighed;
- the rear axle (with the rear hitch linkage lifted) is weighed.

Standard equipment B: Tractor with a front-mounted machine or mounted ballast weights; the rear hitch linkage is not used.

- the front axle (with the front hitch linkage lifted) is weighed;
- the rear axle (with the front hitch linkage lowered) is weighed.

Standard equipment C: Tractor with the front and rear machines and mounted ballast weights.

- the front axle (with the rear and front hitch linkage) is weighed;
- the rear axle (with the rear and front hitch linkage) is weighed.

The value of the load on the coupling arrangement of the machine can be determined using the following two methods:

1. On a balance.

The machine is placed on the balance in such a way that there would be only coupling arrangement of the machine on the balance with the support of the hitching loop (as regards the trailed and semi-trailed machines) or mounting axle (as regards the semi-mounted machines) resting upon the platform through a stand with the weight of less than 50 kg and height of 300…500 mm, while the remaining (major) portion of the machine would be outside the weighing zone. The load on the coupling arrangement of the machine can be only determined on a platform balance provided the length of the coupling arrangement is sufficient to place the machine outside the weighing zone.

2. By means of a dynamometer.

The load on the coupling arrangement of the machine can be determined by weighing the coupling arrangement on a beam crane through a dynamometer.

Allowable loads T on the axles of the tractor:

Axle	Range of the loads, min....max*, kN
Front Tf	11...40
Rear Tr	40...60
Total	80

***Note.**

1. The load on the front or rear axle should not be more than the total load-carrying capacity of single tyres of rear or front wheels.
2. In case of twinning the wheels with the tyres of the same or different standard sizes, their total load-carrying capacity should be reduced by 20%.
3. In case of setting the wheel track exceeding 1800 mm, the loads on the axles shall be reduced by 5% per each 100 mm of the track increase.

The soil compaction depends considerably on the number of passages of the tractor with the aggregated machines. Therefore, it becomes expedient to reduce the number of passages at the cost of combining the operations by means of combined aggregates.

Twinning the wheels makes it possible to reduce considerably the specific pressure on the soil and preserve the soil structure, especially, moistened fields. Twinning the wheels on dense soils makes it possible to improve the tractive and hitching capabilities of the power source, especially in combination with correct ballasting or loading of the tractor.

One of the wide spread means or aggregation is a hitched one through a rear hitch linkage. Here there is a necessity to provide the MTA with stiffness without worsening of tractor steerability.

The steerability criterion K_s is determined from the formula:

$$K_s = (m_f \cdot g) / M_T \cdot g \geq 0.2,$$

where g=9.8 m/s; m_f is a value of a portion of the operating weight of the tractor within the MTA perceived by the front axle of the tractor, kg; M_T – is the standard operating weight of the tractor (without the machine), kg.

The required controllability criterion is achieved by means of front ballast weights installation. If that is not enough – water (solution) is poured in the tires of front wheels.

To fill the tires up with water (solution), do the following:

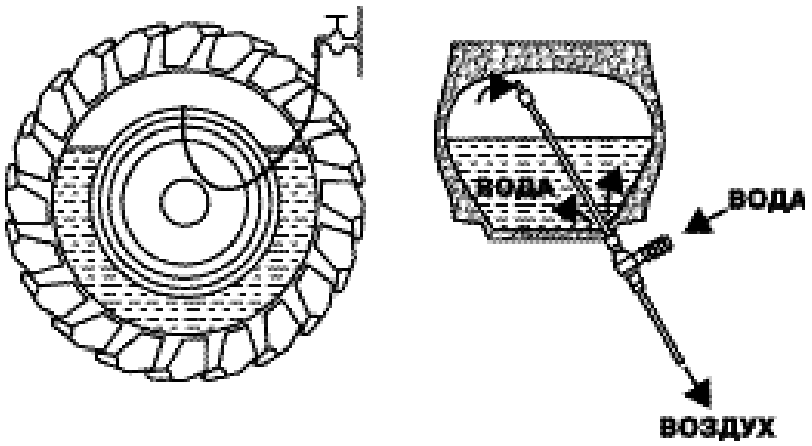
- release the wheels from loading;
- turn a wheel getting a nipple up;
- unscrew the nipple and set a combined valve (“air-water”) in through which water filling up and air discharge are effected.

The tire is to be filled up as per standards (to 75% of its volume). Water (solution) leakage through a combined valve outlet is an indicator that the tire is filled up. As soon as the tire is filled up, screw the nipple back and pressure the tire up to its operative standards.

It is required to add $CaCl_2$ in water on the basis of 300 g/l of water (a freezing-point is 25°C) in cold seasons.

IMPORTANT! When preparing a solution, do not pour water in $CaCl_2$ to avoid formation of hardly dissoluble clots of calcium chloride.

If a tractor is equipped with a front hitch linkage, a longitudinal stability of the agricultural aggregated unit can be provided with combined machines of front and rear location.



Вода	Water
Воздух	Air

Fig. Л-17.

Tires filling up with liquid

Tire	Water quantity, l (at 75 % of filling)	Water quantity, l (at 40% of filling)
420/70R24	183	97
14.9R24	172	91
18.4R38	412	219
16.9R38	356	189
11.2R24	80	42

A recommended water pouring should not exceed 40% of the full volume

3.9 Selection of ploughs, cultivators and harrows

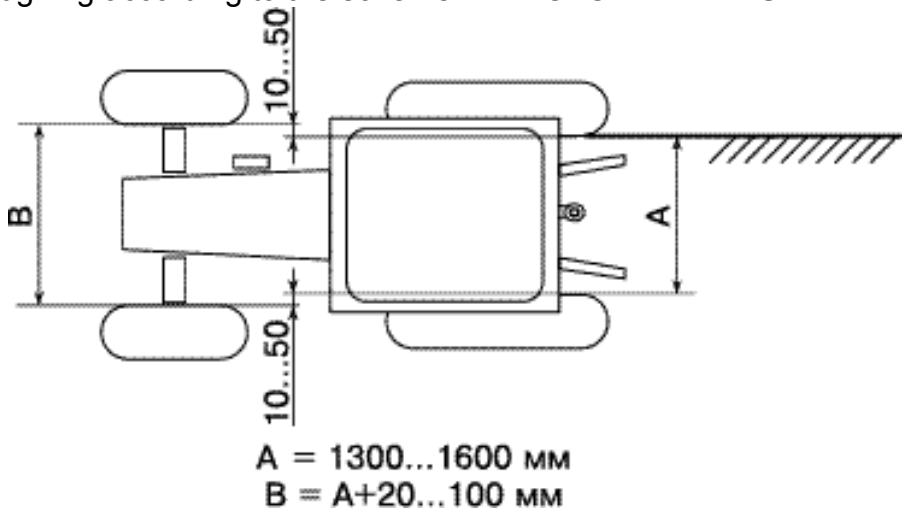
The selection of the ploughs,cultivators, harrows and other tilling machines for the basic and for the shallow works is made taking into consideration the allowable range of pulling forces, exerted by the tractor on the stubble – 18,0…27,0 kN.

Ploughing is the most power-consuming kind of work. According to the pulling values the tractor can be aggregated with a four-bodies share plough with a furrow grip width of 30…40 cm by 15..22 cm of cultivation depth on the middle-tight soil of normal humidity. Traditionally “Belarus” tractors in combination with units are used as per scheme of «tractor wheels are in a furrow». In this case a relevant wheels placing is required when working with standard, reverse and turning ploughs.
The type of the plough, the grip width (number of plough-bodies) depends on the soil, its mechanical makeup, debris infestation, tillage depth. One body of a plough requires approximately 15...20 kWt on the middle-tight soils by the tillage depth up to 20 cm and 35 cm of the body grip width.

To achieve a smooth ploughing, reverse (doubled) or turning ploughs providing one-sided layer turn are used.

Scheme of wheels placing when attaching 4…5-bodies ploughs.

Ploughing according to the scheme ***“TRACTOR WHEELS ARE IN A FURROW”***



мм	mm

Fig. Л-19.

To obtain a tread size, add a profile width of a relevant tire to A and B sizes.

Despite the variety of ploughs constructions there are some general principals and the order of their preparation to the work with the tractor.

The type of plough is selected according to the running range of the rated pulling forces, soils type, cultivation depth, and the type of the plough body is selected in accordance with the agrotechnical requirements.

- The plough is prepared so that the requirements concerning the technical state of the operating units, auxiliary devices were met.

- The part of the aggregate preparation is a correct adjustment of the mechanisms of the tractor hitch linkage for the set up operating conditions and a preliminary setting the rear cultivation depth. It is recommended to check the ploughs as well as other soil cultivating machines on a specially equipped test area with the hard surface and a striping, corresponding to the correct positioning of the operating units. Examining using a binder or

a long straight stick is enough in the field environment. If the blades of the ploughshare are situated at different height, and the plough bodies are in different planes, then the plough shall move unsteady, the drawbar resistance and the fuel consumption will increase.

3.10 Operating at reverse motion

A number of works (feedworks, sugar-beat harvesting, etc.) requires driving of the agricultural unit across a harvested field. In this case technological process fulfillment at reverse motion justifies extra costs. In this case mounted and semi-mounted implements are used (mini-harvesters, harvesters, etc.). A trailer for receiving grinded stuff which is connected to a tractor via front towing device (also if front weights are installed) or via cross-bar at a suspension axle of the front hitch linkage HL-2 can be attached to make a harvesting aggregate unit. Reset to a reverse gear and than to forward gear again takes 3...5 min.

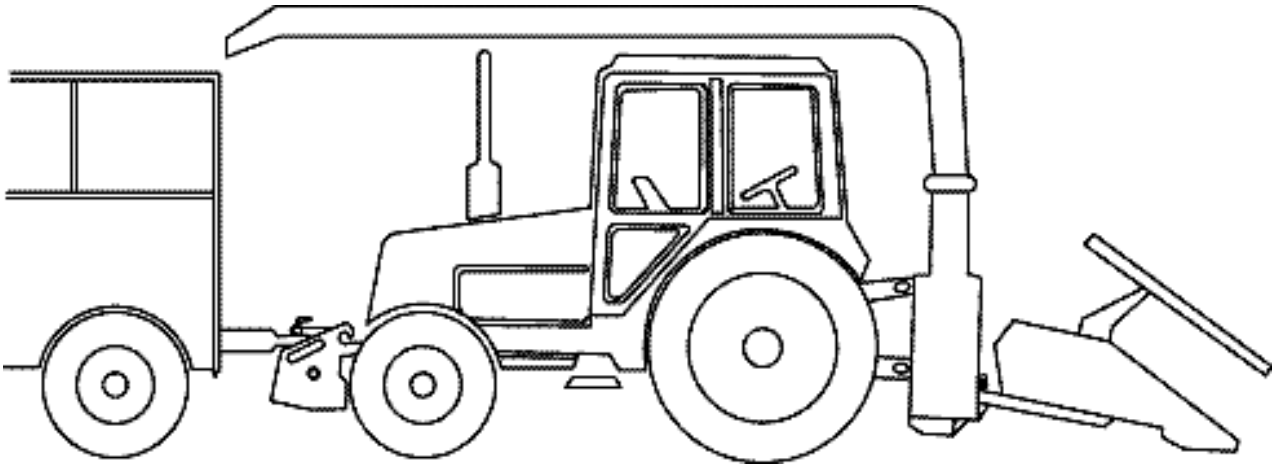


Fig. 2

Driving on the roads of general purpose is performed only at forward motion. The motion on reverse is not permitted as signaling and lighting equipment is designed only for forward motion.

3.11 Choosing travel speed

The speed of motion of the tractors on public roads can be limited by the technical possibilities of the tractor and aggregated machine in accordance with the sign provided on the technical mean, characteristics of the machines (method of aggregation, overall dimensions, operating weight and absence of the braking system) as well as motion conditions.

Table 3

Work to be performed by the tractor	Aggregation peculiarities	Motion speed, km/h, not more	Remarks

		than	
1. Towing trailers and semi-trailers	The tractor is only ballasted with standard basic or additional front and wheel weights manufactured by the Republican Unitary Enterprise “Minsk Tractor Works”		Selection of the towing drawbars for the aggregation is determined by the coupling dimensions and allowable static vertical load on the drawbar of the tractor
а) on public roads		30,0	
б) under field conditions and on roads without category		20,0	
2. Transfer of the agricultural machines to the place of operation and movement within machine-tractor aggregates from one field to another			
а) by means of the traction drawbars TD-1M, TD-2 and TD-3	The machine is equipped with the service brake system	30,0	Масса машины не более 6000 кг The machine weight is not more than 6000 kg
		20,0	The machine weight is not more than 6000 kg
	The machine is not equipped with the service brake system	20,0	The machine weight is not more than 6000 kg
		15,0	The machine weight is not more than 6000 kg
б) by means of TD-1, TD-1Ж-01		15,0	
в) by means of hitch linkage HL-2		20,0	The weight of the tractor within the MTA is not more than 6500 kg
		15,0	The weight of the tractor within the MTA is not more than 6500 kg
г) twinned rear wheels of the tractor		20,0	
д) twinned front wheels of the tractor		15,0	
е) Solution in the tyres of the tractor wheels -front -rear		 10,0 15,0	
3. Motion on slopes and sharp turns; overcoming obstacles at reverse with the implement in transport position		10,0	
4. Performing technological agricultural-purpose jobs	When selecting the working motion speed, it is necessary to follow the agrotechnical requirements for performing the job by the machine with the account of the working conditions, allowable tractor speed range, tractor configuration, recommendations of the manufacturer of the tractor and the implement.		

3.12 Safety of tractor aggregation

To ensure the trouble-free operation of the tractor and aggregated machines as well as to exclude accidents and emergencies, we recommend you to read carefully this Operating Manual for the tractor and follow strictly the recommendations contained herein at any time. Please, observe strictly all the safety recommendations and accident prevention regulations.

Failure to observe the accident prevention regulations can cause the threat for the life and material damage due to breakdown of the tractor or aggregated machine and loss of all the rights for the compensation for damages including that according to the warranties. Do not risk your health or life due to failure to observe the accident prevention regulations. The worker shall not be allowed to operate the tractor including aggregating the implements with it or performing its maintenance unless he/she has red and understood ALL the guidelines concerning the operation of the tractor and accident prevention regulations.

Attention!

The operating documentation (concerning both the tractor and the aggregated machine) shall be stored obligatorily in the cab so that it could be used in case of arising of any questions during the work. If the Operating Manual for the machine or tractor is lost, acquire a new one without delay.

Below are stated the accident prevention guidelines, which shall be observed rigorously when aggregating the tractor with various machines, but are often unconsciously ignored by you during the everyday use of the tractor and machines.

3.12.1 MOTION ON PUBLIC ROADS AND HAULING OPERATIONS

Actually for the half of the time of its operation, the tractor is used on transport communication driving on public roads. Therefore, the transport MTAs are subject to exclusive safety standards. The vehicles such as tractor trailers or semitrailers shall be equipped with service and parking brakes and safety chains (ropes). The load-carrying capacity of the vehicles (trailers, semitrailers, fertilizer distributors and spraying machines) depends on the relief of the locality, slope and condition of the roads. With the account of the allowable longitudinal slope of 12 degrees, the total weight of the semitrailer (trailer) equipped with brakes shall not exceed 12000 kg and that on relatively flat area (with the slope of less than 4%) with dry hard road pavement – not more than 15000 kg.

The tractor’s track value shall correspond to the conditions of the works to be performed, technical characteristics of the tractor and ensure the safe use of the tractor within machine-tractor aggregates. When driving the tractor on the slopes and sharp turns increase the tractor’s track for increasing the stability.

The service brake actuator is made as a single-wire scheme which is controlled from the workplace of the tractor operator. The parking brake actuator shall be located on the machine.

Aggregation of the general-purpose vehicles (trailers and semitrailers) shall be made through the towing drawbar TD-2 or TTD-3. For the safety reasons, the coupling with the towing drawbar TD-1Ж and TD-1 is strictly forbidden.

On rear left part of the machines such as trailers or semitrailers there shall be a sign of limitation of the maximum speed of the MTA. The hole with the diameter of 24 mm in the both cheeks of the lifting device serve as a place of attaching the safety chains (ropes) on the tractor (the fasteners are included in the standard equipment of the technical mean to be aggregated).

The tractor aggregation with the train (tractor + semi-trailer + trailer) is only allowed on dry roads with hard pavement and slopes not exceeding 4%. When driving to the public roads, the overall dimensions of the MTA shall not exceed: width – 2.6 m and height – 3.2 m.

In case of deviations from the provided norms, the consultation with the state authorities responsible for the traffic safety is required.

IMPORTANT! When performing the hauling operations on the roads with hard pavements, increase the pressure in the tyres to the maximum value allowed by the manufacturer.

To connect the signaling equipment of the facilities to be aggregated, the tractor is provided with a receptacle with a socket for supplying the instruments of the aggregated machine.

When driving the tractor on the public roads follow the following requirements:

1) The forward motion shall be only performed with the flashlight beacon switched on;

2) The reverse motion on the public roads is not allowed, because the light signalling devices are only oriented to the forward motion;

3) Using the working lights is not allowed because it causes the dazzling of other traffic participants;

4) The motion of the tractor aggregated with agricultural machines with the vessels filled (process material – fertilizers, seeds, etc.) on public roads is prohibited.

3.12.2 On the intended use of the tractor and machines within the MTA

- The tractor and machines either separately or within the MTA should be only used in accordance with their purpose as specified in the operating documentation for them, under the conditions and in the modes specified by the manufacturer. Using the technical means including of the tractor for any other purposes is considered to be unintended use. The manufacturer shall bear no responsibility for damages caused due to such use of the aggregate. In this case, the total responsibility shall be born by the user.
- The concept of "*intended use*" includes also meeting the conditions of the operation, maintenance and care specified by the manufacturer. The use, maintenance and care of the tractor and machines shall be carried out by the personnel appointed for this purpose and informed duly about the potential hazard.
- Observe the existing accident prevention prescriptions, such as commonly known safety regulations, medical recommendations for labour protection and road regulations.
- Any unauthorized modification of the construction of the aggregate releases the manufacturer from the responsibility for the damages caused by such modification. It is equally applied to the cases where faulty units have been improperly dismantled or repaired, the tractors or machines without full standard equipment or equipped otherwise than it is provided by the technical specifications have been used as well as where the

original manufacturer's parts and assemblies have been replaces by other special or un-original ones not provided for by the manufacturer or where the seals are broken.

3.12.3 General guidelines for observing the aggregation safety precautions

- Prior to beginning the work, check every time the tractor within the MTA for the motion and operation safety.
- Follow all the existing prescriptions concerning the safety precautions and accident prevention as specified in the instructions for labour protection.
- The plates attached to the machines aggregated contain the warnings and important guidelines for safe operation.
- Observe the traffic regulations.
- Prior to beginning the work, become familiar with all the parts and assemblies of the aggregated machine, control elements and functions to be performed. It would be too late to do this during the work!
- The clothes of the persons working on the tractor shall be tight-fitting. Wearing loose clothes is not allowed!
- To prevent a fire, keep the tractor and machines clean!
- Prior to starting the tractor and beginning of its operation, make sure that nobody is present near the tractor and machines. Take care of good vision from all the sides. Pay special attention to children.
- The machines shall be coupled with the tractor in strict compliance with the operation manuals. When doing this, use only recommended methods and equipment for aggregating.
- Be especially careful when connecting the machines to and disconnecting them from the tractor. When connecting or disconnecting the technical means, make sure that the used supporting facilities are positioned properly (assess the stability!).
- Mount the ballast weights and counterweights only in the fastening points provided for this purpose in accordance with the recommendations.
- Observe the allowable values of the vertical static loads on the axles, tyres, total operating weight and dimensions in the transport position!
- Check the condition of the transport equipment of the machines (lighting set, warning and safety devises). Mount this equipment on the machine!
- The disconnecting ropes for the rapid-action coupling shall hang freely and shall not become disconnected simultaneously in the bottom position.
- During the motion, it is forbidden to leave the cab of the tractor!
- The machines coupled with the tractor as well as ballast weights affect the transport characteristics, steerability and braking capability. Keep it in mind when driving and braking the tractor, especially within the MTA. Observe the distance! Take into account the possibility of skid, overhang and inertial mass of the aggregated machines in the turn!
- The tractor with the machines shall be only driven provided all the safety facilities of the machines are installed and brought to the appropriate working position!
- It is strictly prohibited to be in the working zones of the machines! It is prohibited to be in the zones of turning or revolution of the machines, their tools and other elements!
- The hydraulically folding frames of the machines shall be only actuated when there are no people in the turn or lifting zone!
- The remotely controlled elements of the machines (for example, having hydraulic control) can cause injuries (squeezing and cuts)! During the movement of the aggregate at high speed, the driven tools cause danger due to possibility of their extension under the

action of their inertial mass! Wait until the tools are completely stopped!

- Prior to leaving the cab of the tractor, lower all the machine elements to the ground, stop the engine and remove the ignition key!
- It is strictly prohibited to stand in the zone between the tractor and the machine, unless the transportation mean is secured against accidental rolling down by means of a parking brake and/or chock and the engine is stopped!
- The folding frame and bucket of the loader shall be secured in the transport position!
- Prior to starting the transportation on public roads, the swinging lever of the additional equipment of the machines, for example, packing wheel shall be turned inwards and fixed! The markers shall be also fixed in the transport position!
- The loading platform on the machine aggregated shall be only used for filling the machine with planting material and fertilizers! It is strictly prohibited to stand on the platform during the work!
- When driving the tractor on slopes and sharp turns, the track should be increased for improving the stability when there is such a necessity.
- Do not turn the tractor when the working units are sunken. Turn the tractor when all the working units are raised from the ground. In this case be especially attentive when aggregating the implements with a large grip width.

3.12.4 Mounted and semi-mounted machines

- Prior to aggregating the machines by means of the three-point hitch linkage as well as prior to disconnecting the machines from the three-point hitch linkage, the control units of the above mentioned attachment should be set to the position excluding the unintended lifting or lowering of the aggregate!
- When connecting the machine to the joints of the three-point hitch linkage, ensure the matching of sizes of the respective connecting members (category or type: tractor + aggregate)!
- The stay in the zone of the three-point mounted attachment is dangerous due to probability of serious injuries such as squeezing and cuts! When exercising the remote control during the mounting of the machine on the three-point mounted attachment, it is strictly prohibited to stand in the zone between the tractor and the aggregate!
- Ensure the reliable side fixation of the lower rods of the three-point hitch linkage of the tractor by means of rods, if the aggregate is in the transport position! When driving the tractor on public roads with the machine in the transport position or lifted aggregate, secure the three-point hitch linkage in the top position to prevent the aggregate from spontaneous lowering and ensure the sufficient clearance between the machine members and road (at least 300 mm)!

3.12.5 Trailed and semi-trailed machines

- Take measures excluding the involuntary rollback and movement of the machines fitted with the transport wheels!
- When connecting the trailed or semi-trailed machine to the tractor, ensure the matching of the sizes of the respective coupling members of the tractor and the machines!
- Observe the maximum allowable vertical static load on the traction hitch mechanisms of the tractor!
- When using the single-point hitch of the agricultural machines by means of the hitching loop (hitch bar or tongue), ensure the necessary mobility at the connection point

and exclude the possibility of jamming!

- The single-point coupling arrangement (hitch bar or tongue) of the machine shall have a support and safety connecting chain or rope.
- The coupling arrangement of trailed and semi-trailed machines shall be stiff to exclude the collision of such machines with the tractor.

3.12.6 For the machines driven from the PTO

- Only use the cardan shafts, which are recommended by the manufacturer of the machine! Inspect regularly the technical condition of the cardan shaft.
- The cardan shaft shall have an appropriate protective cover! The cover of the cardan shaft shall be secured against turning by means of a chain!
- Prior to connecting or disconnecting the cardan shaft, disengage the power takeoff, stop the engine and remove the ignition key!
- Control at all times the correctness and safety of installation of the cardan shaft!
- Prior to engaging the power takeoff, make sure that the selected rotational speed of the tractor's power takeoff does not contradict the allowable rotational speed of the aggregate!
- When using the synchronous power takeoff, make sure that the rotational speed depends on the motion speed and the rotation direction changes of opposite when reversing!
- Prior to engaging the power takeoff, make sure that no people are present in the dangerous zone of the aggregate!
- Never engage the power takeoff when the engine is stopped!
- When working with the power takeoff, make sure that there are no people in the zone of rotation of the power takeoff and cardan shaft!
- Disengage at all times the power takeoff when beginning driving on a step slope as well as in cases where its operation is unnecessary!
- After disengaging the power takeoff, the hazard due to the inertial mass remains for some time. Do not approach the connected machine during this time! Performing any works is only allowed after complete stop! Stop obligatorily the engine and remove the ignition key!
- Cleaning, lubricating or adjusting the aggregate driven from the PTO or cardan shaft shall be only performed provided that the power takeoff is disengaged, the engine is stopped and the ignition key is removed!
- The disconnected cardan shaft shall be secured on the respective bracket!
- After removing the cardan shaft, fit the protective cover to the end of the power takeoff!
- Inspect visually the cardan shaft, power takeoff and power intake shaft. Eliminate immediately the faults revealed!

3.12.7 Rules concerning the instruments and the mechanisms of the machines and tractor operating under the pressure

- Caution! Do not forget about the presence of high pressure in the hydraulic and pneumatic systems of the tractor and machines aggregated!
- When connecting the hydraulic cylinders and hydraulic motor from the complete set of the machine, check the correctness of connection of the hydraulic hoses!
- Prior to beginning connecting the hydraulic hoses to the hydraulic system of the

tractor, make sure that the hydraulic circuits of the tractor and aggregate are depressurized!

- When performing the hydraulic connection between the tractor and the machine, it is necessary to mark beforehand the components to be connected in order to avoid errors in the control of the units of the hydraulic system of the aggregated machine! Erroneous connection of the reverse function (for example, lifting or lowering) can cause an accident!
- When connecting the hydraulic hoses of the machine to the tractor's hydraulic system, make sure that the system is depressurized; observe the correctness of the connections between the hydraulic system of the tractor and the hydraulic system of the aggregate in accordance with marking the hoses and connecting diagram. The connecting diagram shall be given in the Operation Manual for the machine.
- Check regularly the condition of the hydraulic hoses. Should any damages or ageing signs be revealed, the hoses shall be replaced without delay! The new hoses intended for substituting the old ones shall comply completely with the manufacturer's requirements!
- To avoid injury when determining the leakage places, use appropriate aids! A liquid (hydraulic oil) flowing out under pressure can penetrate under skin and cause heavy injuries! In case of injury, call immediately for medical aid! Hazard of blood poisoning!
- Prior to beginning the work with the use of the hydraulic system of the tractor, lower the machine, depressurize the hydraulic system, stop the engine and remove the ignition key!
- Any works with the hydraulic and pneumatic connections of the hydraulic accumulators and receivers of the machines shall be performed with the pressure released!
- Improper installation and operation of the hydraulic accumulators with violation of the labour protection requirements can become a cause of heavy accidents.

3.12.8 Tyres, braking system

- Caution! Do not forget that the pneumatic systems of the tractor and aggregated machines contain high pressure.
- Each time prior to departure check the intactness and operability of the brakes!
- The brake system shall be regularly and thoroughly controlled! The braking system shall be only adjusted and repaired by a qualified specialist or reliable service department! Use the recommended brake fluid only! Pour the brake fluid in accordance with the operating documentation!
- When operating the machines with transport wheels, it is necessary to ensure the stable position of the machine (wheel chocks!) to prevent the involuntary rollback!
- Fitting the tyres requires appropriate habits! It shall be performed by means of special fitting tools!
- The repair works on the tyres and wheels shall be only performed by a qualified specialist with the use of appropriate fitting tools!
- Monitor regularly the pressure in the tyres! It shall correspond to the specified norms!

3.12.9 Maintenance and repair of the machine-tractor aggregates

- The repair, maintenance, cleaning as well as elimination of functional faults shall be performed on obligatory condition that the hydraulic system, driving mechanisms and engine are stopped and the ignition key is removed!
- Check regularly the degree of tightening of bolts and nuts! If necessary, retighten them! Pay attention to the fasteners of the tractor body, wheels, coupling arrangements

including the towing drawbars and three-point hitch linkages.

- Do not perform welding, brazing or mechanical works on the hydraulic accumulators.
- When performing the maintenance works on the lifted machine, ensure the stable position of the machine by means of the respective supporting structures!
- When replacing the tools of the machines having sharp cutting edges, it is necessary to use appropriate tools and gloves!
- The oil, grease and filters shall be disposed of appropriately!
- Prior to commencement of the maintenance works and repair of the electric equipment, disconnect obligatorily all the electrical instruments and devices!
- When performing the electric welding on the tractor and machine, set the battery disconnect switch to the OFF position and disconnect the cable and bundles from the storage batteries and alternator.
- Storing the gas implies high risk of explosion!
- The spare parts for the tractor and machines shall comply completely with the manufacturer's specifications! To ensure your safety, use original spare parts!

3.12.10 Additional guidelines for safety of aggregation

- The tractor is a high-technology product and belongs to the category of motor vehicles covered by the road regulations and other normative documents regulating the operation of railless transport.
- When reading the Operating Manual for the tractor, pay special attention to the recommendations for selecting the motion speed and maintaining the allowable loads on the traction hitch mechanism, mounted attachment, ales and tyres of the tractor. The possibility of safe motion of the tractor with satisfactory steerability and stability is evaluated by the **steerability criterion,** which is characterized by the ratio of the value of the load on the front axle of the tractor to its standard weight. The steerability criterion is determined by calculation.
- The aggregation of the technical means with the tractor is prohibited, if the value of the vertical static loads on the axles, tyres, towing drawbars and hitched linkages of the tractor obtained from the results of weighing, calculations and ballasting exceeds the allowable values specified in the Operating Manual for the tractor.
- To ensure the steerability, stability and stable traction, hitching and braking capabilities, especially, on the areas of fields with slopes and on soft soils, we recommend providing the load on the front wheels of the tractor within the MTA 25…40% of the standard operating weight of the tractor.
- **To ensure your safety** and prevention of operational failures and breakdowns of the tractor, it is necessary to perform the following actions:

- Determine the value of operating weights of the tractor, machine and process material.
- Determine the loads on the axles and tyres of the wheels of the tractor.
- Test the tractor within the MTA for compliance with the requirements for the minimum allowable load on the front wheels of the tractor with the machines in the transport position, allowable loads on the traction hitch mechanism, axles and tyres of the wheels, required load-carrying capacity of the mounted attachment for lifting the machine and total maximum load on the tractor axles.
- Ascertain the possibility of aggregation of a specific aggregate or machine from the results of weighing.
- Select the minimum necessary weight of the ballast.

- Determine the degree of loading the machine with the process materials ensuring the safe operation of the tractor.
- Determine the necessity of twinning the wheels and filling the tyres with water solution.
- Assign the required pressure in the tyres depending on the maximum load and speed under specific working conditions. The value of separate loads on the front and rear axles of the tractor within the MTA shall not exceed the total allowed load-carrying capacity of the front and rear tyres of the tractor, respectively, at the given speed and internal pressure as specified in the Table of load-carrying capacity of the tyres.

POSSIBLE DEFECTS AND WAYS OF THEIR ELIMINATION

Defect, external manifestation	Way of elimination
ENGINE	
Engine doesn't start	
Air in fuel system.	Pump over system by means of pump of manual fuel pumping. Remove air inflow in fuel system (see section “Description and operation”).
Oil pump is out of order.	Take off fuel pump from the engine and hand over to workshop for repair.
Fuel filters are littered.	Wash out the coarse fuel filter and replace filtering elements of fine fuel filter.
The engine is not enough warmed up.	Warm up diesel engine in cold weather by means of available means of start simplification.
The engine does not develop full power	
Lever of fuel pump control does not reach against arrester.	Adjust the rods of fuel pump control.
Filtering element of fine fuel filter is clogged.	Replace filtering element.
Faulty injectors.	Find the faulty injectors, wash and adjust them.
Wrong fuel injection advance angle.	Set the recommended injection advance angle.
Pressure of boost has decreased.	Remove turbocharger from engine and send it to workshop for repair.
Air gets in fuel system.	Pump over fuel system by means of pump of manual pumping.
Diesel engine fumes in all operating modes. **1. Black fume is emitted from the exhaust pipe**	
Engine air cleaner is clogged.	Carry out technical maintenance of air cleaner.
Injector atomizer needle hovers.	Find defective atomizer, wash out and replace injector, adjust atomizer.
Defective fuel pump.	Remove the fuel pump from the engine and send it for repair.
Engine overload.	Reduce diesel loading engaging low gear.
Wrong fuel injection advance angle.	Set the fuel injection advance angle (see section “Appendix”)
2. White fume is emitted from the exhaust pipe	
Engine is not heated.	Warm up the engine; maintain the cooling liquid temperature within 75 - 95°C during operation.
Hit of water in fuel.	Replace fuel.
Clearances between the valves and the rockers are not adjusted.	Adjust the clearances between the valves and the rockers
Fuel injection advance angle setting is dis-	Set the recommended fuel injection advance

Defect, external manifestation	Way of elimination
turbed.	angle.
3. 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 engine crankcase.	Drain the excessive oil, having set the level against the upper mark of oil-measuring rod.
The engine suddenly stops	
The fuel is not delivered.	Check up fuel in fuel tank, regularity of flu-epipes, filters and pumping pump.
The engine overheats	
There is not enough cooling fluid in the engine.	Add cooling liquid up to normal level.
Radiator is polluted outside.	Clear radiator.
Presence of dirt and scum in cooling system.	Clean and wash out cooling system from dirt and scum.
Valve of thermostat does not open completely.	Replace thermostat.
Insufficient tension of belt of fan.	
Break of spring of tension device.	Replace spring. At impossibility to replace spring it is supposed to block clutch of fan having clamped bolt with nut placket of generator and lever of idler.
Jamming of idler on axle.	Disassemble tension device and remove defect.
Oiling of fan driving belt and pulleys.	Remove driving belt and remove oil tracks from belt surface and pulleys.
Oil pressure on warmed up diesel engine below admissible	
Pressure index is defective.	Replace pressure index after check of oil pressure by control manometer.
Tightness of connections of oil pipelines is broken.	Reveal place of seal failure and restore it.
Oil pump is defective.	Reveal defects and eliminate.
Oil level in engine case is below admissible.	Add oil up to top label of oil meter core.
Jamming of safety valve in engine case of oil filter.	Wash out valve and adjust pressure in system of greasing.
Limiting wear of interfaces of neck of engine case — bearings.	Remove defect.
Turbocompressor	
Rotor of turbocompressor does not rotate (there is no specific sound of high tone)	
Presence of extraneous subjects interfering rotation of rotor.	Remove glow tube and outlet pipe, remove extraneous subjects.
Jamming of rotor in bearing.	Replace turbocompressor.
Increased emission of oil from the side of compressor or turbine, infringement of tightness of oil compaction of turbocom-	Remove turbocompressor from diesel engine and send to workshop for repair.

Defect, external manifestation	Way of elimination
pressor.	
Units of system of automatic control of clutch of fan	
At temperature of water at output from diesel engine above 97° C fan of cooling system does not switch off, or at temperature of water below 70° C fan of cooling system does not switch off.	
Defect in thermo power gauge or fan clutch.	Remove clutch of fan. Press rod into water pump against arrester and measure its overhang. Start diesel engine and warm up it to temperature of water 80-85° C on output; stop diesel engine and measure overhang of rod from water pump: 1. If over hang of rod has not increased in comparison with initial, replace thermo power gauge; 2. If overhang of rod increased for 6-8 mm, replace fan clutch; defective fan clutch send to workshop for repair. At impossibility of replacement of fan clutch it is supposed to block it according to above-mentioned method.
Coupling	
Coupling slips	
There is no clearance between the shifter bearing and release levers – “the clutch is half-disengaged” (no free travel of the pedal).	Adjust the clearance (see the section “Maintenance”).
No full engagement of clutch coupling (the lever does not moves back to the initial position) when releasing the clutch pedal because of disfunction of clutch control.	Reveal defects and eliminate.
Linings of driven disks are worn-out.	Replace linings or assembled driven disks.
Oiling of driven disks linings because of oil penetration into the dry room.	Reveal and eliminate the reason of oil penetration into the dry room.
There is not enough tension of compression springs (springs shrinkage at continuous skidding and clutch overheating).	Replace compression springs.
The clutch is not disengaged fully	
Increased clearance between the shifter bearing and release levers (increased free travel of the pedal).	Adjust the clearance (see section “Maintenance”).
There is no full travel of coupling lever at full pressing of clutch pedal.	Provide a full travel of coupling lever and correspondingly a full travel of hydraulic booster piston at full pressing of clutch pedal.
Release levers irregularly butt against re-	Adjust the position of release levers.

Defect, external manifestation	Way of elimination
lease bearing.	
Increased deformation of driven disks.	Check butt beats of driven disk linins in relation to the external diameter of hub splines – it must be not more than 0,8 mm on the radius of 165 mm. If it is impossible to flatten replace the disks.
Jamming of driven disk hub on the splines of transmission shaft.	Peel the splines, providing free travel of disks on the transmission shaft.
Transmission shaft bearing in the flywheel is disrupted.	Replace the bearing.
The clutch lever does not go back to the initial position when releasing clutch pedal	
There is no gap between piston and piston follower of the main cylinder on reverse.	Adjust (see section “Maintenance”).
There is no gap between the operating cylinder piston follower and hydraulic booster guide bar.	Adjust (see section “Maintenance”).
The piston of the main cylinder jams on reverse (it doesn't move to the initial position) because of cuff and sealing ring inflation, which leads to overlapping of compensation ports.	
The piston of the operating cylinder jams because of cuff inflation.	Using inappropriate brake fluid or presence of mineral oil, petrol, kerosene, diesel fuel in the brake fluid. Wash out carefully the whole system of hydraulic drive with brake fluid. Replace damaged cuffs and a sealing ring in the main and operating cylinder. Replace brake fluid. Bleed the hydraulic system with brake fluid on reverse.
Stiff transfer of hydraulic booster piston.	Replace hydraulic booster.
Clogging of the compensation port in the main cylinder on reverse.	Clean the compensation port of the main cylinder on reverse and remove air from the system.
Loss of pullback spring resistance.	Replace spring
There is no full travel of clutch lever when pressing clutch pedal	
There is no gap between the piston and the operating cylinder piston follower on reverse.	Adjust (see section “Maintenance).
There is no gap between the main cylinder follower and hydraulic booster guide bar.	Adjust (see section “Maintenance).
Presence of air in hydraulic system of clutch control on reverse.	Bleed hydraulic system with brake fluid on reverse.
Insufficient level of brake fluid in the tank of hydraulic system on reverse.	Pour the brake fluid to the tank of the main cylinder up to the level on reverse. Bleed the hydraulic system with brake fluid on reverse.
Impermeability violation of work spaces of the main and operating cylinders because of damage, wear-out of cuffs or sealing	Replace cuffs and a sealing ring in the main and operating cylinder. Make sure that there are no sharp edges, high spots

Defect, external manifestation	Way of elimination
ring.	or blisters on the face of the main and operating cylinders. Bleed the hydraulic system with brake fluid on reverse.
Bleeding of brake fluid in connections and pipelines in hydraulic drive system. Hydraulic system air leak.	Tighten the connections, replace damaged parts. Bleed the hydraulic system with brake fluid on reverse.
Clogging of hole in piston (on reverse), causing rarefaction in the main cylinder, from which air permeates into cylinder through condensations.	Clean the hole. Bleed the hydraulic system with brake fluid on reverse.
Plugging of hydraulic drive pipelines because of dent or clogging.	Replace pipelines. Bleed the hydraulic system with brake fluid on reverse.
Leak of oil through hydraulic booster sealing rings.	Replace sealing rings in hydraulic booster.
No pressure on clutch pedals on reverse.	Presence of air in hydraulic system. Cuffs and a ring in the main and operating cylinder are worn-out. Replace cuffs and a sealing ring in the main and operating cylinder. Make sure that there are no sharp edges, high spots or blisters on the face of the main and operating cylinders. Bleed the hydraulic system with brake fluid on reverse.
Flexible hose increases in volume, blows up, elongates.	Replace flexible hose.
Gear box, back axle	
Complicated switch in of gears	
“Drive” coupling.	Adjust.
Low pressure in hydraulic system of gear box	
Insufficient quantity of oil amount in case of transmission.	Add oil in case up to a label “П” ±5 mm on glass of oil-gauge glass.
Bedding of relief valve.	Wash out valve and adjust it in case of necessity.
Pollution of screen filter of hydrosystem of gear box.	Wash out filter.
High pressure in hydrosystem of gear box.	
Bedding of relief valve.	Wash out valve.
At the moment when tractor stops and when coupling is squeezed out pressure decreases to zero	
Drive of pump is carried out from moving system.	Switch pump to drive of diesel engine.
Increased noise in main conical pair	
Adjustment of interlock of pinions of main gear and bearings of differential is disrupted.	Adjust interlock and backlash in bearings. (see section “Maintenance”).
Brakes	
Unsatisfactory work of brakes (brakes do not hold)	
Adjustment of brakes operation is disturbed.	Adjust brakes control(see section “Maintenence”)

Defect, external manifestation	Way of elimination
Oiled and worn lining of brake disc.	Wash out overlays. If necessary replace discs.
Hit of air in system of hydro system because of decrease of level of brake liquid below label «Min» in tanks of main cylinder.	Add liquid up to label «Max». Pump over system of hydraulic drive.
Seal failure of working cavities of main and working cylinders because of damage of collars.	Replace collars. Pump over system.
Outflow of brake liquid through connections of pipelines, sleeves in places of damage.	Tighten captive nuts, clips, replace damaged details. Add liquid up to level. If it is necessary pump over system.
Non-disinhibition of brakes	
There is no free course of pedals.	Adjust (see section “Maintenance”).
Jamming of cuffs of main and working cylinders because of:	
Pollution and corrosion of working surfaces.	Replace protective covers. Clear cylinders, wash out, remove corrosion.
Swelling of cuffs owing to mineral oil hit.	Wash out system. Replace cuffs.
Incomplete return of pedals to a starting position after braking	
Jamming of profile flutes in press disks:	Replace press discs.
Relief or failure of squeezing springs of pedals, working cylinders, pressing discs.	Replace springs.
ATTENTION! Failure of tractor brakes often occurs when trailers and semi-trailers used with tractor do not have brakes blocked with tractor brakes. Using trailers and semi-trailers without brakes blocked with tractor brakes is not permitted if their weight exceeds half of tractor weight.	
Differential block does not work	
Clutch discs are greasy.	Eliminate oil running, wash out the disks.
Worn frictional overlays of lockup clutch disks	Replace assembled disks.
Diaphragm of clutch block is damaged.	Replace diaphragm.
Low pressure of oil, being brought to operative mechanism of block.	Check pressure, being brought to clutch of differential block. It should be 9…10 kilogram-force/sm^2.
Electro hydraulic valve of differential block control does not work.	Check serviceability of safety devices, relay and other elements of line, eliminate defect.
Back power take off does not transfer full torque or continues to rotate when disengaged	
Because of significant deterioration of frictional overlays of brake tapes or due to another reason adjustment of operation is disturbed.	Adjust mechanism of Power Take Off control (see section “Adjustments”).
Defect of control hydraulic system.	Contact a qualified specialist.
Front driving axle	
Insufficient draft of front driving axle	
Clutch of driving does not transfer torque:	
There is no oil pressure in clutch booster.	Disassemble and wash out details of distributor.

Defect, external manifestation	Way of elimination
Slipping of drive clutch	Check and regulate pressure in hydro system of transmission (9...10 kilogram force/sm^2). Replace worn out disks.
Defects in electric line of front driving axle control.	Determine and eliminate defects.
Insufficient size of torque being transferred by clutch because of oil leakage in hydro system:	
Deterioration of rubber sealing rings.	Replace rings.
Deterioration of piston rings and clutch drum;	Replace rings.
Deterioration of interfaced surfaces "holder – nave of drum", "drum – piston"	Replace worn out details.
Drive of front driving axle does not work in automatic mode	
Deterioration of adjustment or refuse from switch of automatic switch-on gauge.	Adjust position of switch or replace it.
High noise and heating in zone of main gear	
Gap in gears bearings of main gear.	Adjust bearings of gears.
Wrong gears engagement of the main gear.	Check and if it is necessary adjust interlock on spot of contact.
Noise at maximum angle of wheels rotation	
Wrong operation mode of front driving axle. Front driving axle works in compulsory mode.	Check mode of inclusion of FDA drive and install switch in position "switched off" or "automatic".
Wrong limiting angle of wheels turn.	Check and adjust.
Bang in pivot at movement	
Adjustment of pivots bearings is disturbed.	Check and adjust.
Bang in front driving axle at sharp turn of wheels	
Gaps in pins of steering draft and hydro cylinders of turn.	Check and adjust.
Dribbling of greasing through cuff of main gear flange	
Deterioration and damage of flange cuff.	Replace worn out parts.
Dribbling of greasing through breathers of wheel reduction gears	
Increased level of oil.	Check and adjust correct level.
Dribbling of greasing through cuff of main gear of wheel reduction gear.	
Increased backlash in gears bearings.	Check and adjust.
Deterioration and damage of cuff.	Replace cuff.
Angular frictions of wheels	
Axial backlash in bearings of wheel reducer pivots.	Check and adjust.
Increased backlash in bearings of front wheels.	Check and adjust backlash in flange bearings.
Backlash in bearings of hydro cylinders of hydrostatic steering.	Replace worn out details.
Increased deterioration and ply separation of front wheels tires	
Adjustment of wheels convergence is disrupted.	Adjust convergence as it is shown in section "Adjustments".
Inadequacy of air pressure in tires to recommended norms.	Maintain pressure in tires in accordance to recommendations (see section "Aggregation").
Front drive is constantly positively en-	Check switch-on – switch-off of front driv-

Defect, external manifestation	Way of elimination
gaged.	ing axle. When the disorder is found – eliminate it.
Steering	
Increased effort on steering wheel	
Lack or insufficient pressure in hydraulic system of steering (Pressure in hydrosystem of steering should be 140...155 kilogram-force/sm^2 (in arrester))	
Insufficient oil level in tank; feeding pump does not develop necessary pressure.	Fill in tank with oil up to necessary level and pump up hydrosystem for air removal
Safety valve of pump-dosator hovered in open position or it is adjusted to a low pressure.	Wash out safety valve and adjust pressure for 140...155 kilogram-force/sm^2 at diesel-engine work at nominal turns.
Significant friction or shimming in mechanical elements of steering column.	Check and eliminate reasons preventing steering column from fluent motion in mechanical elements.
Air leak into absorbent main line of system.	Check absorbing main line, eliminate leakage. Pump up system for air remove.
Steering wheel rotates without turn of steerable wheels	
Insufficient level of oil in oil tank.	Fill a tank up to demanded level and pump over hydrosystem for air removal.
Sealings of piston of hydrocylinder are worn out.	Replace sealings or hydrocylinder.
Steering wheel does not rotate to “neutral” position, “motoring” of pump-meter	
Increased friction or shimming in mechanical elements of steering column.	Eliminate reasons of friction and shimming.
Spline shank of steering column and pump-meter are installed out of axis alignment (end thrust of cardan shaft) or with insufficient backlash.	Release cardan. For increase of backlash install additional washers with thickness no more than 1,5 mm between pump-motor and bracket of steering column.
Increased gap of steering wheel	
Conical pins of hydrocylinders or steering drawbar are not tightened.	Tighten nuts of pins by moment 12...14 kilogram-force m and splint.
Increased backlash of spline connection «cardan of steering shaft — pump-meter».	Replace cardan bottom plug.
Unequal minimum radiuses of turn of tractor to the right-to the left	
Toe-in is not adjusted.	Adjust toe-in as it is specified in section “Adjustments”.
Incomplete corner of turn of directive wheels	
Insufficient pressure in hydrosystem of steering control.	Adjust pressure within limits 140...155 kilogram-force/sm^2.
Feeding pump has a defect.	Repair or replace pump.
Hydraulic lift linkage	
The unloaded mounted attachment is not lifted; when setting any handles of the distributor to the “lifting” or “lowering” position, no specific sound emitted by the pump under load	
Clogging of the safety valve of the tractor distributor.	Disassemble and wash the safety valve. Adjust the pressure maintained by the

Defect, external manifestation	Way of elimination
	safety valve.
The unloaded mounted attachment is not lifted; when setting any handles of the distributor to the "lifting" or "lowering" position, a specific sound emitted by the pump under load is heard. After stopping the engine and moving the position handle to the foremost position and then to the rear position and starting the engine, the mounted attachment is lifted (the power handle shall be in the foremost position).	
Clogging the orifice in the overload valve.	Remove the regulator-distributor from the tractor, remove a bypass valve from it, wash the valve and clean off the valve orifice.
The unloaded mounted attachment is not lifted; when setting any handles of the distributor to the "lifting" or "lowering" position, a specific sound emitted by the pump under load is heard. After stopping the engine and moving the position handle to the foremost position and then to the rear position and starting the engine, the mounted attachment is not lifted (the power handle shall be in the foremost position).	
Ingress of foreign particles under the spool edge.	Remove the cover from the regulator-distributor, set the position handle to the foremost position. The spool valve lock ring shall rest against the body of the regulator-distributor. Move the position handle to the rear position. The spool valve shall move upwards to the distance of at least 7 mm. If not so, remove the regulator-distributor, clean it from foreign particles jammed between the edges of the spool valve and body.
The loaded mounted attachment is not lifted or is lifted too slowly	
The fault becomes apparent as oil in the hydraulic system is warmed up – the pump is faulty.	Check the capacity of the pump. If the pump efficiency is below 0.7, replace the pump.
The fault becomes apparent at any oil temperature – clogging of the overload valve.	Remove the regulator-distributor, take the bypass valve away and wash it and the casing in diesel fuel.
The loaded mounted attachment is lifted slowly; after stopping the engine, the spontaneous mounted attachment lowering is noticeable by eye, the position corrections are frequent, the pressure "hanging-up" is possible	
Destruction of the rubber seals of the regulator-distributor.	Remove the regulator-distributor and replace rubber seals by new ones.
The pump is not unloaded over the whole range of travel of the mounted attachment with load when employing the position method of adjustment on reaching the specified position by the mounted attachment	
In case of minor displacements of the position handle towards the lowering position, the pump is shortly unloaded, on stopping the engine the leak-proofness is normal	
Jamming or loss of sealing of the valve-accelerator.	Remove the regulator-distributor; take away the bypass valve, disassemble and wash it. If necessary, hammer the valve ball to its seat.

Defect, external manifestation	Way of elimination
At move of position handle to side of lowering pump does not unload, by engine stop, tightness is normal	
Decapsulation of valve of pressure adjustment.	Turn out conical plug on upper surface of regulator, remove spring, hammer ball of valve to its seat, install parts back on their places.
The loaded mounted attachment independently falls to a small size after mounted implement achieves specified position of position handle («subsidence» of mounted implement)	
Decapsulation of antishrinking valve.	Remove regulator-distributor, turn out plug of antishrinking valve, remove spring, hammer ball to its seat, install parts back on their places.
Position of position handle on digits "0" and "9" does not correspond to transport and extremely low position of mounted implement	
Adjustment of positional cable in drive is disturbed.	By rotation of nuts, fixing frame of positional cable to arm in board or to arm on hydrolift, work out coincidence of corresponding positions of handles and mounted implement.
There is no lift of unloaded mounted implement or it occurs with pushes, at engaging of distributor pump «squeals»	
Insufficient quantity of oil in hydrosystem.	Make sure that there is oil in oil tank, add in case of necessity.
Spontaneous move of power and position handles on board	
Fastener of frictional washers on arm in board is weakened.	Adjust a fastener of spring by nut on arm axle till defect eliminates..
Electrical equipment	
Storage battery has low degree of charge	
Transitive resistance between plugs of storage battery and tips of wires due to relief and degradation is increased.	Smooth out plugs of connections, tighten and grease contact parts with technical vaseline. Tighten fastening of switch of "mass" and balks of "mass.
Generator is faulty (there is no pressure on clips "+" and "Д").	Remove generator and send it to workshop for repair.
Storage battery is faulty.	Replace.
Slipping of driving belt.	Adjust tension of belt of generator drive (see section "Maintenance").
Storage battery «boils» and it requires frequent add of water	
Storage battery is faulty.	Replace.
At engaging of starter crankshaft of diesel engine does not turn or turns very slowly	
Weak fastening of storage battery terminals or oxidation of wires tips.	Smooth out tips and tighten clips.
Storage battery has been discharged below admissible limit.	Charge or replace storage battery.
Collector and brushes are contaminated.	Clean collector and brushes.
Poor contact of brushes with collector.	Remove starter from engine and smooth out

Defect, external manifestation	Way of elimination
	collector, remove hang-up of brushes and replace them in case they are worn out.
Adjustment of solenoid starter switch is disturbed.	Adjust relay.
Blocker of engine start has actuated or its switch is faulty.	Install levels of gear box in neutral position, check running order of switch. In case of necessary, adjust position of switch with help of adjusting washers.
Engine is not ready to start at temperature below + 5°C.	Prepare engine for start at low temperatures.
After starting engine starter remains in engaged position	
Power disk has sticked to contact bolts of starter relay.	Stop engine, switch off battery by switch of “mass” and smooth out contacts of solenoid starter switch.
Drive gear does not jump out of mesh with crown of fly-wheel due to defect in spring of wishbone lever.	Replace return spring of wishbone lever.
Starting aid electromagnetic valve does not work	
Lack of contact in chain of electromagnet spool.	Check chain, tighten contacts of wires fastening.
Noise of enerator	
Slipping or extreme tension of generator belt.	Remove generator and send it to workshop for repair. Adjust tension of generator drive belt.
Electric tachospeedometer	
See defects of tachospeedometer in section “Operating controls and instruments”.	
Block of heating and cooling of air in cabin	
Warm air does not move to cabin	
There is no circulation of water through block of heating	
Cock on head on cylinders block s closed	Open cock.
Ice plugs in hoses of heater	Split ice, leak through hoses hot water.
Fan of heater does not work.	Remove fan defect, check fan regularity, and check fan turn-on circuit.
Warm air of high humidity enters cabin	
Outflow of water in heater radiator.	Remove outflow of water or replace radiator.
Water leakage in connections of heating system.	Tighten coupling collars.
Pneumatic system	
Pressure in receiver increases slowly	
Outflow of air from pneumatic system	
Nuts of pipelines, armature, coupling collars are poorly tightened or damaged	Reveal places of outflow and eliminate them by tightening of connections or by replacement of damaged parts.
Rubber sealing of connecting head is damaged	Replace damaged sealing.
Tie of nut connecting head sealing ring is	Tighten.

Defect, external manifestation	Way of elimination
weakened	
Dirt hits under valve of connecting head	Clean.
Contact of dustproof cover with rod of connecting head valve	Remove.
Parts of valve are deformed: diaphragm is torn, fastening of cover in brake valve is weakened	Check conditions of valve parts, in case of necessity change them, tighten bolts of fastening.
Adjustment of valve drive is disturbed.	Adjust (see section “Adjustments”).
Work of pressure regulator is disturbed	Remove and send to workshop for repair.
Filter is littered.	Wash out filter.
Air outflow through compressor valves.	Remove head of compressor, clean valves and seats from coke formation. Replace damaged parts.
Hang-up and deterioration of compressor piston rings.	Remove head and compressor cylinder, clean rings from coke formation. In case of necessity replace them.
Pressure in receiver quickly falls down by the engine stop	
Air outflow in connecting elements of pneumatic system.	Remove leakages.
Pressure in receiver goes down rapidly at pressing of brakes pedals	
Перекошен, засорен или поврежден впускной клапан тормозного крана. Inlet valve group of brake valve is cobbled, contaminated or damaged.	Remove cobble, clean valve or replace it.
Diaphragm of brake valve is disturbed.	Replace diaphragm.
Insufficient pressure in receiver	
Air outflow.	Remove air outflows.
Work of pressure regulator is disturbed.	Adjust pressure regulator.
Absorbing and pressure valves of compressor are out of order.	Clean valves from coke formation, in case of high wear replace them.
High wear of piston rings, hang-up of compressor rings.	Clean piston rings from coke formation or replace piston rings.
Increased emission of oil by compressor to pneumatic system.	
Hang-up or deterioration of piston compressors.	Clean piston rings from coke formation or replace piston rings.
Regulator of pressure switches compressor on idle at pressure not less than 77...0,80 МПа (7,7...8,0 кгс/см^2), on travel — not less than 0,65 MP(6,5 kilogram-force/sm^2), or more than 0,70 MP (7,0 kilogram-force /sm^2)	
Contamination of cavities and channels of pressure regulator.	Wash out and clean.
Unlocking of regulator cover.	Adjust pressure of switching in and switching off of compressor.
Loss of elasticity, damage or wrecking of rubber parts, shrink of springs.	Replace damaged parts.
Cobble, hang-up of adjustable part of regulator.	Check mobility of valves, grease in case of necessity.
Regulator of pressure often works (it switches on compressor) without air takeoff from receiver	
Air outflow from pneumatic system or regu-	Reveal and remove air outflow.

Defect, external manifestation	Way of elimination
lator of pressure, damage of return valve of regulator.	
Regulator works in mode of safety valve	
Adjusting cover is wrapped on bigger size.	Adjust regulator.
Jamming of unloading piston of diaphragm	Disassemble regulator of pressure and eliminate jamming.
There is no gap between unloading valve and bottom cover, outlet holes in cover are littered.	Turn off cover, clean outlet holes and check gap availability.
There is no air supply in connecting hose through air takeoff valve	
Rod of air takeoff valve in regulator of pressure is insufficiently sunk.	Screw a nut on the union of connecting pipe.
Regulator of pressure switched compressor to idle.	Reduce pressure in balloon below 0,65 MP (6,5 kilogram-force /sm^2).
Displacement of rubber ring on air takeoff valve.	Turn off cover, check position and condition of rubber ring.
Brakes of trailer operate inefficiently	
Brake valve does not provide pressure 0,77…0,80 MP (7,7…8,0 kilogram-force /sm^2) in main pipe.	Adjust brake valve and its drive (see section “Adjustments”).
Brake valve does not provide pressure drop to zero in connecting pipe.	Adjust brake valve and its drive (see section “Adjustments”).
Pressure in connecting pipe slowly drops to zero.	Check condition of connecting pipe, atmospheric valve hole, brake pedal stroke.
Work of trailer brake system of is disturbed.	Adjust.
Brakes of trailer are released slowly	
Adjustment of brake valve and its drive is disturbed.	Adjust. (see section “Adjustments”).
Work of trailer brake system is disturbed.	Adjust.
Air-conditioner	
The electromagnetic clutch of the compressor (while turning the temperature regulator, no specific metallic click is heard) fails to function.	
The electric equipment is faulty.	Check the serviceability of the block of pressure sensors using a tester or multimeter: there shall be no open circuit between the leads of the block of sensors (red and pink wires). Check the integrity of the connections of the electric circuits from the compressor clutch to the air-conditioner control panel.
Coolant leakage has occurred.	Detect the coolant leakage place. Detection of the coolant leakage places, replacement of the hoses and components of the air-conditioner shall be performed by trained personnel with the use of special equipment.
The air-conditioner fan motor does not op-	The electric equipment is faulty.

Defect, external manifestation	Way of elimination
erate	Check the integrity of the respective fuse (25A, see the electric diagram) in the fuse block located in the instrument dashboard. Replace the blown fuse. Check the presence of voltage at the air-conditioner “M7” motor using a test lamp when the switch is set to the ON position and the presence of chassis on the engine. If the electric circuits are in good order, but no voltage is applied to the air-conditioner “M7”, replace the switch.
When the air-conditioner is switched to the cooling mode, warm air is supplied to the cab	Destruction of the seal of the cock ПО-11 (or ВС11). Replace the cock ПО-11 (or ВС11)
Coolant leakage from the ventilation compartment of the cab	Rupture of the heater tubes (“unfreezing” of the heater due to incomplete drainage during the operation with water in the cold season of the year). Replace the climatic unit of the air-conditioner.

SCHEDULED MAINTENANCE

Maintenance service (MS) is necessary to keep the tractor in good condition during operation.

Failure to maintain the prescribed frequency and low quality of MS results in a greatly reduced life of the tractor, in an increase in the number of failures, a fall in the engine power and higher costs of operating the tractor. The operator must daily check the tractor, preventing loosening of the fasteners, leaks of fuel, fluids and oil, accumulation of dirt and other deposits, which can cause a fault, fire or accidents.

Caution! If no special instructions are available, stop the engine and engage the parking brake before any MS works, adjustments, etc. If guards and casings were removed, make sure that they are installed to their respective places before you start working on the tractor.

IMPORTANT! Observe the rules of storage and disposal of waste. Never pour liquids to the soil. Use special containers for safe storage of waste.

Refill capacities, l

Engine crankcase / lubrication system	18/22
Engine cooling system (OZH-40 or OZH-65 or Tosol-A40M/A65M)	24
Transmission	43
Fuel pump*	0.25
FDA wheel reduction gear (each)	2.0
FDA final drive	3.9
Hydraulic system oil tank	22.0
HSU oil tank	7.5
Fuel tank	140
Auxiliary fuel tank (if installed)	120
Service brake master cylinder tank (BELARUS-1221V.2)	0.20
Clutch master cylinder tank (BELARUS-1221V.2)	0.20
Left wet brake and DL clutch housing	1.50
Right wet brake and parking brake housing	1.00

* Refilling the fuel pump with oil is required when installing a new or repaired one.

Recommended fuels, oils, lubricants and special liquids

Assembly unit name	Qty. of assembly units, pcs.	F&L grade name and designation				F&L weight (volume) filled into tractor when changing (refilling), kg (dm³)	F&L change (refilling) interval, hrs
		Main	Backup	Reserve	Foreign		
1	2	3	4	5	6	7	8
1. Fuel							
Fuel tank	1	At ambient temperature of 0°C and higher				(140±1)	Shift-time refilling
		Diesel fuel, STB 1658-2006 with sulfur content not exceeding 350 ppm (0.035%) S grade, type 1 or 2	None	Blended biodiesel fuel of B.R.XX DtL grades (XX stands for content by volume of rapeseed oil bio-component in fuel) — TU BY 500048572.001-2008	Diesel fuel, EN 590:2004 with sulfur content not exceeding 350 ppm (0.035%)		
		At an ambient temperature of minus 20°C and higher, or minus 30°C and higher,					
		Diesel fuel, STB 1658-2006 with sulfur content not exceeding 350 ppm (0.035%) F grade, type 1 or 2	None	Blended biodiesel fuel of B.R.XX DtZ grades (XX stands for content by volume of rapeseed oil bio-component in fuel) — TU BY 500048572.001-2008	Diesel fuel, EN 590:2004 with sulfur content not exceeding 350 ppm (0.035%)		
		At an ambient temperature of minus 44°C and higher					
		Diesel fuel, STB 1658-2006 with sulfur content not exceeding 350 ppm (0.035%) Class 4, type 1 or 2	None	None	Diesel fuel, EN 590:2004 with sulfur content not exceeding 350 ppm (0.035%)		

1	2	3	4	5	6	7	8
2. Oils							
Diesel engine crankcase	1	Summer				(18.0±0.18)	250
		Motor oil Lukoil-Avangard SAE 15W-40	Motor oils M-10DM, M-10G_{2K} State Standard ГОСТ 8581—78	None	Castrol Turbomax SAE 15W-40 Hessol Turbo Diesel SAE 15W-40 Essolube XD-3 + Multigrate Shell Rimula TX Shell Rimula Plus Teboil Super NPD (power) Royal Triton QLT (U 76) Neste Turbo LE Mobil Delvac 1400 Super Ursa Super TD (Texaco)		
		Winter					
		Motor oil Lukoil-Super SAE 5W-40	Motor oils M-8DM, M-8G_{K2} State Standard ГОСТ 8581—78	None	Shell Helix Diesel Ultra SAE 5W-40 Hessol Turbo Diesel SAE 5W-40 API CF-4		

1	2	3	4	5	6	7	8
Brake housing (wet brakes)	2	Motor oil M-10G2 State Standard ГОСТ 8581—78 (summer grade) Motor oil M-8G2 State Standard ГОСТ 8581—78 (winter grade)	Motor oil M-10V2 State Standard ГОСТ 8581—78, Motor oil M-10G2k (summer grade) State Standard ГОСТ 8581—78 Motor oil M-8G2k (winter grade) State Standard ГОСТ 8581—78	Motor oil, same as into transmission housing	Motor oil, same as into transmission housing	(2.5±0.1) to the level of check plugs	1,000 (500)
Transmission housing (C, GB and ZM)	1	Motor oil M-10G2 State Standard ГОСТ 8581—78 (summer grade) Motor oil M-8G2 State Standard ГОСТ 8581—78 (winter grade)	Motor oil M-10V2 State Standard ГОСТ 8581—78 Motor oil M-10G2k (summer grade) State Standard ГОСТ 8581—78 Motor oil M-8G2k (winter grade) State Standard ГОСТ 8581—78	Motor oil is the same as in engine crankcase	Motor oil SAE 15W-40 (summer) SAE 5W-40 (winter)	(43±0.4) at that, the oil level must be between the ‘P’ and ‘P+7’	1,000 (250)

1	2	3	4	5	6	7	8
FDA wheel reduction gear housing (portal, planetary /parallel-shaft)	2	TAp-15V transmission oil State Standard ГОСТ 23652—79	TAD-17i transmission oil, TSp-15K State Standard ГОСТ 23652—79, TEP-15M TU 38.401-58-305-2002	None	HESSOL BECHEM HYPOID SAE 80W-90 API GL5; GL4	(4.0±0.04)	1000, or seasonal
FDA housing (portal, planetary /parallel-shaft, with long beam)	1	TAp-15V transmission oil State Standard ГОСТ 23652—79	TAD-17i transmission oil, TSp-15K State Standard ГОСТ 23652—79, TEP-15M TU 38.401-58-305-2002	None	HESSOL BECHEM HYPOID SAE 80W-90 API GL5; GL4	(3.9±0.04)	1000, or seasonal
HSU tanks with hydraulic units (cylinder, metering pump)	1	Multigrade				(9.0±0.35)	1000, or seasonal
		Industrial oil BECHEM Staroil No. 32 TU 903.201.042-05 ADDINOL Hydraulikol HLP 32 TU 903.201.044-05 TNK Gidravlik HLP 32 TU 236.915.052-08	Industrial oil IGP-18 TU 38.101413 -97 (winter) MGE-46V TU 38.001347-2000 (summer)	None	None		

1	2	3	4	5	6	7	8
Front PTO reducer	1	TAp-15V transmission oil State Standard ГОСТ 23652—79	TAD-17i transmission oil, TSp-15K, TSp-10 State Standard ГОСТ 23652—79, TEP-15M TU 38.401-58-3 05-2002	Motor oil M-10G2 State Standard ГОСТ 8581—78	HESSOL BECHEM HYPOID SAE 80W-90 API GL5; GL4	(3.2±0.2)	1000, or seasonal
Tank of HLL with hydraulic units	1	Multigrade				(25.25 ± 0.5)	Season. Seasonality of oil use refers to operation
		Hydraulic oil BECHEM Staroil No. 32 TU 903.201.042 -05 ADDINOL Hydraulikol HLP 32 TU 903.201.044 -05 TNK Gidravlik HLP 32 TU 236.915.052 -08	Industrial oil IGP-18 TU 38.10 1413 -97 (winter) MGE-46V TU 38.001 347-2000 (summer)	None	None		
HSU	1	Multigrade					

1	2	3	4	5	6	7	8
tanks with hydraulic units (cylinder, metering pump)		Industrial oil BECHEM Staroil No. 32 TU 903.201. 042-05 ADDINOL Hydraulikol HLP 32 TU 903.201. 044-05 TNK Gidravlik HLP 32 TU 236.915. 052-08	Industrial oil IGP-18 TU 38.10 1413 -97 (winter) MGE-46V TU 38.001 347-2000 (summer)	None	None	(9.0±0.35)	1000 or season
3. Lubricants							
Clutch release yoke bearing	1	Litol-24 grease State Standard ГОСТ 21150—87	BECHEM LCP-GM	Solid oil S grease State Standard ГОСТ 4366—76 or Solid oil ZH grease State Standard ГОСТ 1033—79	BECHEM LCP-GM	0.02 ± 0.001	250
FDA reducer pin bearing	4	Litol-24 grease State Standard ГОСТ 21150—87	BECHEM LCP-GM	Solid oil S grease State Standard ГОСТ 4366—76 or Solid oil ZH grease State Standard ГОСТ 1033—79	BECHEM LCP-GM	0.12 ± 0.006	1,000 (250)
Swivel of steering cylinder	4	Litol-24 grease State Standard ГОСТ 21150—87	BECHEM LCP-GM	None	BECHEM LCP-GM	0.05 ± 0.003	250

1	2	3	4	5	6	7	8
Rear hitch linkage pivoting shaft bushing 6)	2	Litol-24 grease State Standard ГОСТ 21150—87	BECHEM LCP-GM	Solid oil S grease State Standard ГОСТ 4366—76 or Solid oil ZH grease State Standard ГОСТ 1033—79	BECHEM LCP-GM	0.02 ± 0.001	500
Rear hitch linkage brace	2	Litol-24 grease State Standard ГОСТ 21150—87	BECHEM LCP-GM	Solid oil S grease State Standard ГОСТ 4366—76 or Solid oil ZH grease State Standard ГОСТ 1033—79	BECHEM LCP-GM	0.01 ± 0.001	1,000
4. Special fluids							
Clutch hydraulic drive tank and cylinders (for BELARUS-1221V.2)	1	Neva-M brake fluid TU 2451-053-36732629-2003	None	None	DOT3, DOT4 (Germany)	(0.4±0.1)	1,000 (8—10)
Brake hydraulic drive tank and cylinders	1	Neva-M brake fluid TU 2451-053-36732629-2003	None	None	DOT3; DOT4 (Germany)	(0.4±0.1)	1,000 (500)

1	2	3	4	5	6	7	8
Cooling system (with heat exchanger) of MMW engines	1	Low-freezing coolant Tosol Dzerzhinsky TC-40 (up to minus 40°C) Tosol Dzerzhinsky TC-40 (up to minus 65°C) TU 2422-050-36732629-2003. Low-freezing coolant OZH-40 (up to minus 40°C) State Standard ГОСТ 28084—89. Low-freezing coolant Sibur-Premium OZH-40 (up to minus 40°C) OZH-65 (minus 65°C) TU 2422-054-52470175-2006	Coolant OZH-40 (up to minus 40°C) OZH-65 (up to minus 65°C) State Standard ГОСТ 28084—89	None	MIL-F-5559 (BS 150), (USA) FL-3 Sort S-735 (UK)	For BELARUS-1221.2/1221V.2 (26.5±0.2) For BELARUS-1221.3 (33.5±0.5)	once in 2 years

Maintenance after running-in (30 service hours)

1. Inspect and wash the tractor.
2. Listen how all components of the tractor operate.
3. Check tightening of the cylinder head fastening bolts (Operation 37).
4. Check clearance between valves and rockers (Operation 23).
5. Clean the impellers of the engine centrifugal oil filter and the gearbox (Operations 14, 15). Clean the GB strainer (Operation 17).
6. Check the generator belt tension (Operation 8).
7. Discharge sediment from fuel tanks, coarse and fine filters of the engine (Operations 7, 24).
8. Check and, if necessary, adjust the clutch, brake pedal free travel and the air system (Operations 26, 26a, 28, 28a).
9. Check condition of the batteries, clean the terminal connections and vent holes (Operation 29).
10. Change the oil in:
    - engine crankcase (Operation 18),
    - power train housings (Operation 43),
    - wheel reduction gears and FDA final drive (Operation 44).
11. Replace the paper filter elements of the engine and hydraulic system filters (Operations 19, 33).
12. Lubricate the clutch release yoke bearing (Operation 20).
13. Discharge condensate from pneumatic system receivers (Operation 5).
14. Check and as necessary restore the tightness of the air cleaner and intake (Operation 25).
15. Check and as necessary tighten the external threaded connections (Operation 42).
16. Check operation of the engine, steering, brakes, controls, illumination and signaling systems (Operation 6).
17. Lubricate the bearings of FDA wheel reduction gear supports (Operation 10).
18. Lubricate the pivots of the steering cylinders (Operation 9).

Maintenance table

Nos. of operations	Contents of works	Interval, every hrs						
		10	125	250	500	1,000	2,000	total
1	Oil level in engine	×						
2	Coolant level in engine	×						
3	Oil level in hydraulic system tank	×						
3a	Oil level in HSU tank	×						
4	Transmission oil level	×						
5	Remove condensate from cylinder of pneumatic system	×						
5a	Check operation of the engine, HSU, brakes and instruments	×						
6	Check fluid level in the housings of main cylinders of clutch and service brake control drives (BELARUS-1221V.2)	×						
6a*	Check fastening of air conditioner hoses	×						
6b*	Check/clean air conditioner condenser	×						
6c*	Check/clean air conditioning drainage pipes	×						
6d*	Remove condensate from the charge air cooler (CAC) tank of the engine (BELARUS-1221.3)	× winter	× summer					
6e	Check/adjust tension of drive belt of air conditioner compressor		×					
7	Discharge sediment from the coarse fuel filter and fuel tanks		×					
8	Check generator belt tension		×					
9	Lubricate steering cylinder pivots		×					
10	Lubricate bearings of FDA reducer kingpin axles		×					
11	Air pressure in tires		×					
12	Check the engine air cleaner		×					
12a	Check and tighten fasteners of wheel hubs and nuts		×					
13	Clean the centrifugal oil filter of the engine			×				
14	Clean the GB centrifugal oil filter			×				
15	Check the oil level in the hub casings and FDA final drive			×				
16	Rinse the GB oil strainer			×				
17	Change engine oil			×				
18	Replace the engine oil filter PFE			×				
19	Lubricate the clutch release yoke bearing			×				

Table, continued

Nos. of operations	Contents of works	Interval, every hrs						
		10	125	250	500	1,000	2,000	total
20	Turbocharger (tightening fasteners)			×				
21	Front wheel toe-in			×				
22	Check and adjust valve clearances in the engine				×			
23	Discharge sediment from the fuel fine filter of the engine				×			
24	Check tightness of connections of the air cleaner and intake				×			
25	Check oil level in the wet brake housings				×			
26	Adjust free travel of the clutch pedal (BELARUS-1221.2/1221.3)				×			
26a	Adjust free travel of the clutch pedal (BELARUS-1221V.2)				×			
27	Steering wheel play				×			
8	Brake pedal and parking brake lever travel				×			
28a	Brake pedal travel (BELARUS-1221V.2)				×			
29	Batteries				×			
30	Draft and position control signal mixer				×			
31	Clean the filter of the air pressure regulator in the pneumatic system				×			
32	Check tightness of pneumatic system lines				×			
33**	Replace the oil filter of the hydraulic system				×			
33a**	Replace the HSU oil filter				×			
34	Clean generator				×			
35	Clean the cab heating and ventilation system filter				×			
35a*	Replace filter drain	Each 800 service hours or once a year						
36	Check bearings of FDA reducer kingpin axles				×			
36a	Check tightening of the clamp bolts of the CAC air ducts (BELARUS-1221.3)				×			
37	Tighten engine cylinder head fastening bolts					×		
38	Clean engine air cleaner					×		
39	Clean engine fuel coarse filter					×		
40	Replace the engine fuel fine filter PFE					×		
41	Play in HSU rod joint					×		
42	Check and tighten the outer bolted connections					×		

Table, continued

Nos. of operations	Contents of works	Interval, every hrs						
		10	125	250	500	1,000	2,000	total
43	Change oil in the transmission and the hydraulic system and HSU oil tanks					×		
44	Change oil in the FDA final drive and wheel reduction gears					×		
45	Lubricate the RHL right brace					×		
46	Lubricate the RHL arms pivoting shaft					×		
47	Check engine injectors					×		
48	Generator					×		
49	Bearings of the FDA reducer flange (check, adjust)					×		
51	Engine fuel pump						×	
53	Flush the engine cooling system						×	
54	Flush the engine air breathers						×	
55	Adjusting the engine centrifuge							×
56	Adjust oil pressure in the gearbox							×
57	Maintenance of the cab ventilation and heating system							×

* If an air-conditioner is installed

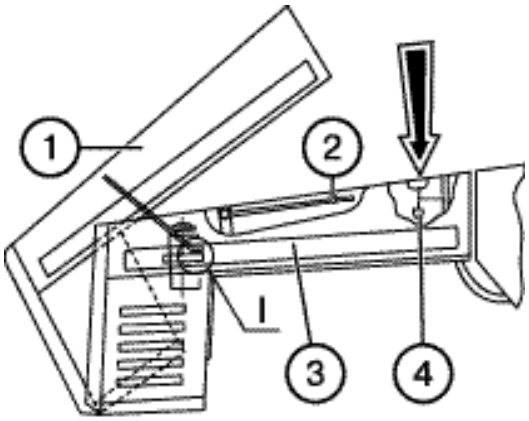
.service hours 1,000Subsequent changes after each **

Providing access to components for maintenance

Important! After the maintenance, set in place all removed guards and casings before starting work.

Hood (BELARUS-1221.2/1221V.2)

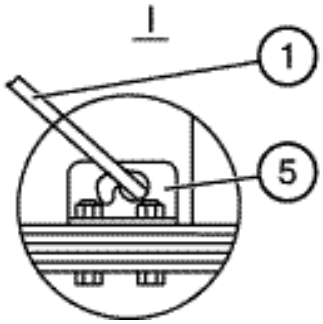
The hood is hinged in the front of the tractor to ensure its rapid tilting forward to access the engine components.



To raise the hood:

Pull the lever (4) of the latch (if you are at the left side of the tractor) and raise the hood (3).

Holding the hood with your right hand, release the bar (1) of the detent (2) and enter the free end of the bar (1) into the shaped notch in the bracket (5). See Fig. I.



Important! Make sure that the hood (3) is securely fixed in the raised position.

To lower the hood:

Slightly raise the hood to release the bar (1). Fix it with the detents (2).

Lower the hood and fix with the upper latch, applying a force from your hand in the direction of the arrow.

Hood (BELARUS-1221.3)

The mask and hood are hinged on supports located on the front of the frame immediately behind the heat exchanger block of engine cooling. The fastening of the mask and hood is designed to allow quickly opening them and thus having a quick access to separate units of the tractor.

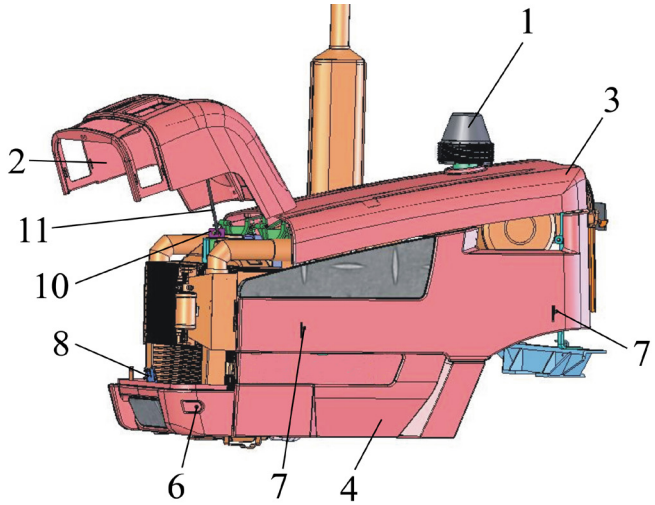
To remove the left side panel (4), open two locks (7) on the left side and remove the side panels (4).
To remove the right side panel (5), open the two locks (7) on the right side and remove the side panel (5).

To open the hood 3 and lock it open, proceed as follows:
- close the mask (2) if it was in the open position;
- remove the monocyclone (1);
- open the lock (15) by pulling the cable (9);
- grip the edge of the hood (3) (near the cab) and open it to its highest position;
- fix the hood (3) with the rod (12) in the bracket (13).

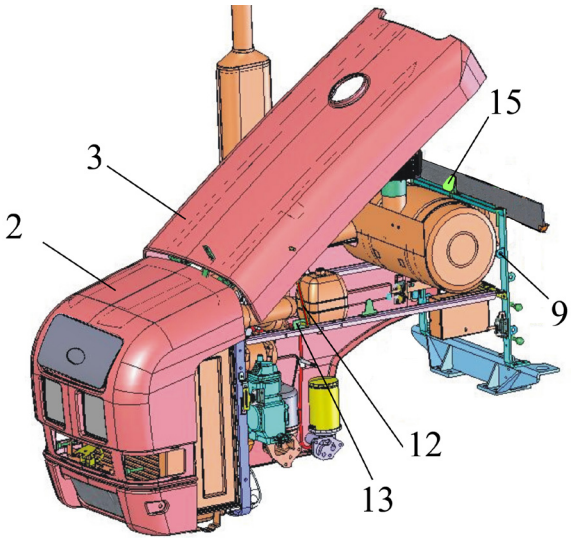
To open the mask (2) and lock it in raised position, proceed as follows:
- close the hood 3 if was open;
- open the lock (8) by pulling the cable (6);
- grip the bottom edge of the mask (2) and open it to its highest position;
- fix the mask (3) with the rod (11) in the bracket (10).

Do not open the hood (3) and mask (2) simultaneously.

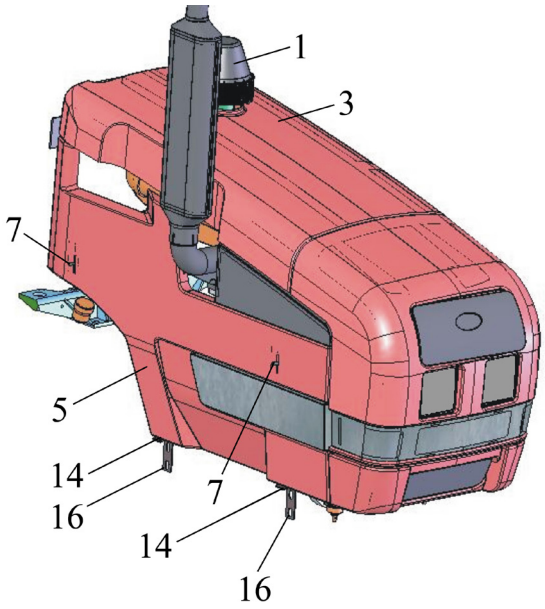
ATTENTION: before you start maintenance works in the area under the mask and hood, make sure they are securely locked open!



Mechanism of locking the mask open



Mechanism of locking the hood open



Unmount-mount facing sides

1 – monocyclone; 2 – mask; 3 – hood; 4 – left side; 5 – right side; 6 – cable; 7 – lock; 8 – lock; 9 – cable; 10 – bracket; 11 – arm; 12 – arm; 13 – bracket; 14 – latch; 15 – lock.

To install the sides (4) and (5), proceed as follows:

- install the latches (14) of the sides to the seats on the brackets (16);
- fasten the sides (4), (5) with the locks (7).

To lower and close the hood (3), proceed as follows:

- slightly raise the hood (3) to release the rod (12);
- secure the rod (12) in the clamp on the hood (3);
- lower the hood (3) to its low position until a distinctive click is heard (the lock (15) engages);
- install the monocyclone (1);

To lower and close the mask (2), proceed as follows:

- slightly raise the mask (2) to release the rod (11);
- secure the rod (11) in the clamp on the mask;
- lower the mask (3) to its low position until a distinctive click is heard (the lock (8) engages);

Scheduled maintenance operations

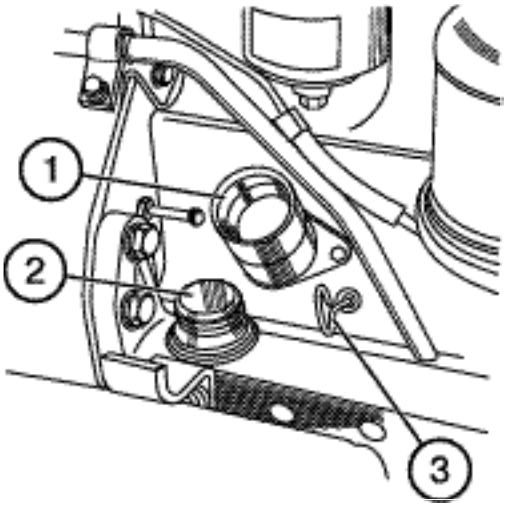
After every service 10 hours or daily (whichever is earlier)

Operation 1. Oil level in engine

Check the oil level, installing the tractor on an even surface and not earlier than 3-5 minutes after stopping the engine when the oil fully flows down to the crankcase:

Remove the oil level gauge (3) from the right side of the engine, wipe it clean and reinsert it into place until it stops;

Remove the oil level gauge and determine the oil level. It must be between the top and bottom oil level gauge marks. As necessary, add oil through the filler neck (1), removing the cap (2).

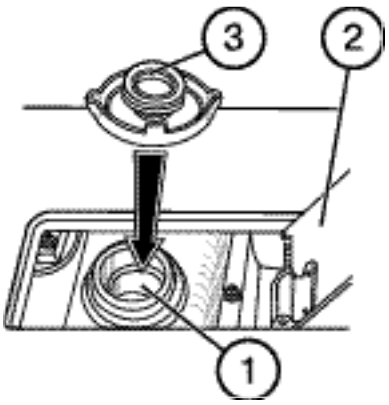


IMPORTANT! Do not operate the engine with the oil level below the bottom oil level gauge mark.

IMPORTANT! Do not add oil to a level above the top oil level gauge mark. Excessive oil will burn up, creating a false impression of high oil consumption for fumes.

Operation 2. Coolant level in engine

Caution! The engine cooling system operates under pressure which is maintained by a valve in the heat exchanger cap. It is dangerous to remove the cap on a hot engine. Let the engine cool down, put a thick cloth on the cap and, slowly opening the cap, remove the pressure from the system before you completely remove the cap. Avoid exposure of open parts of the body to hot coolant.



With a screwdriver blade inserted into the recess of the hatch (2) in the upper front part of the hood, tilt back the cover to gain access to the heat exchanger cap (3). Remove the cap, taking the above precautions, and check the coolant level that must be up to the upper end of the filler neck (1).

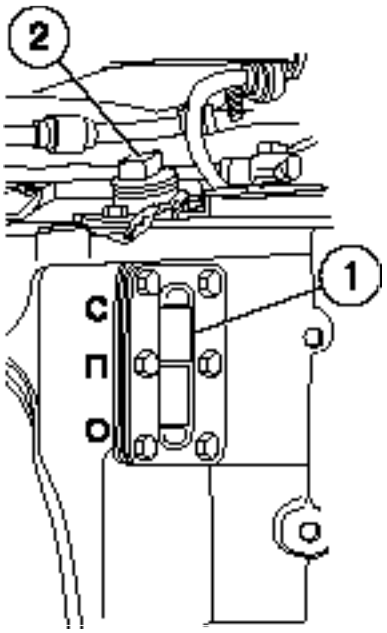
IMPORTANT! Do not let the level drop lower than 40 mm from the upper end of the filler neck.

Operation 3. Oil level in hydraulic system tank

Before you check the oil level, install the tractor on a flat, horizontal surface. Stop the engine and brake the tractor with the parking brake.

Check the oil level in the hydraulic system tank by the oil gauge glass (1) on the left side of the tractor. The level should be between the marks “0” and

“П” ± 5 mm, and for machines that require high intake of oil, at the level of mark “С”. As necessary, add oil to the level of the mark “П”, removing the threaded cap (2).

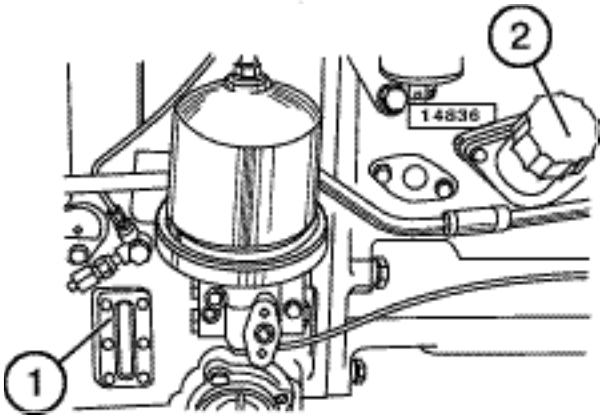


ATTENTION! If you want to refill a hydraulic system unitized with machines having single-acting cylinders, the cylinders of the machines and the hitched device must have their rods pulled in.

Operation 3a. Oil level in HSU tank

Check the oil level in the HSU tank (5) by performing the following operations:

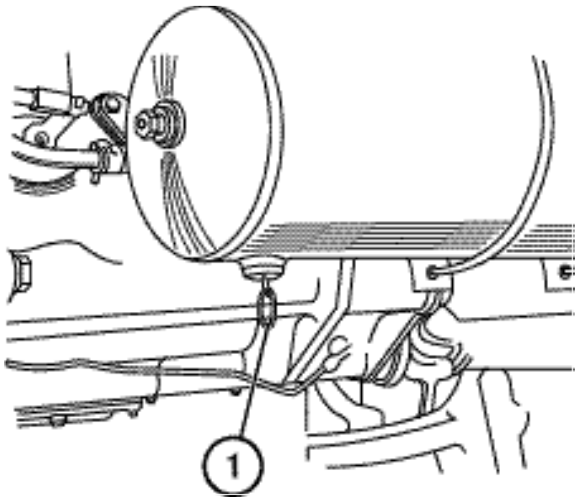
- Remove the filler neck cap (3);
- Remove the strainer (4) from the filler neck;
- Check the oil level by the strainer, which must be between the filter bottom (the lower limit) and the middle of the strainer (the upper limit). As necessary, add oil until the middle of the strainer.



Operation 4. Transmission oil level

Check the oil level by the oil-gauge glass (1) on the right side of the GB, following the requirements set forth in the Operation 3. The oil level must be between the marks “0” and “П”. As necessary, add oil, removing the filler neck cap (2).

Operation 5. Discharge condensate from cylinders of the pneumatic system



Pull the ring (1) towards and up, open the valve and hold it open until the complete condensate and dirt are fully discharged. Discharge condensate from the two cylinders on the left and right sides of the tractor.

Operation 5a. Check operation of the engine, steering, brakes and lighting and signaling devices

The engine must work steadily in all modes.

The controls, brakes, light and sound signaling devices must be in good condition.

Operation 6. Check fluid level in the housings of main cylinders of clutch and service brake control drives (BELARUS-1221V.2)

Slide the covers from the housings of the main cylinders of clutch and brake control, and check the fluid levels that must be 10 to 15 mm below the upper ends of the housings, but not less than ¾ of the upper cavity volumes. As necessary, add fluid to the level. Install the covers to place.

Operation 6a*. Check fastening of air conditioner hoses

The conditioner hoses must be securely fastened with tension bands. Do not allow contact of the hoses with tractor's moving parts.

Operation 6b*. Check/clean the air conditioner condenser

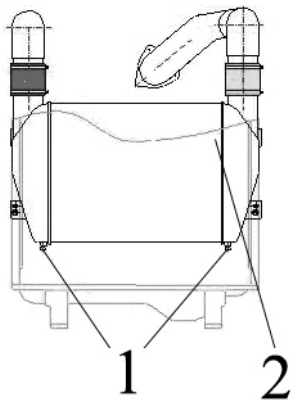
Check cleanliness of the air conditioner core. If it is clogged, clean the air conditioner with compressed air. Direct air flow with the hood open perpendicularly to the condenser plane top-down. Straighten folded finning with a special comb or plastic (wooden) plate. In case of severe clogging of the condenser, rinse it with hot water under pressure of 0.15 to 0.2 MPa max and blow with compressed air.

Operation 6c*. Check/clean drain pipes of condensate

Blue drain pipes are to the right and left of the heat exchanger pipe under the ceiling panel. Check and, as necessary in order not to allow plugging, clean the drain pipes. A sign of a clean drain pipe is water dripping when the conditioner is operating in hot weather.

Operation 6d*.* Discharge condensate from the engine heat exchanger (CAC) tanks (BELARUS-1221.3)

To remove condensate from the engine CAC heat exchanger tanks, proceed as follows:
- unscrew the two caps 1 in the bottom of the intercooler (2) and let condensate drain;
- screw the plugs 1.



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* If an air-conditioner is installed.

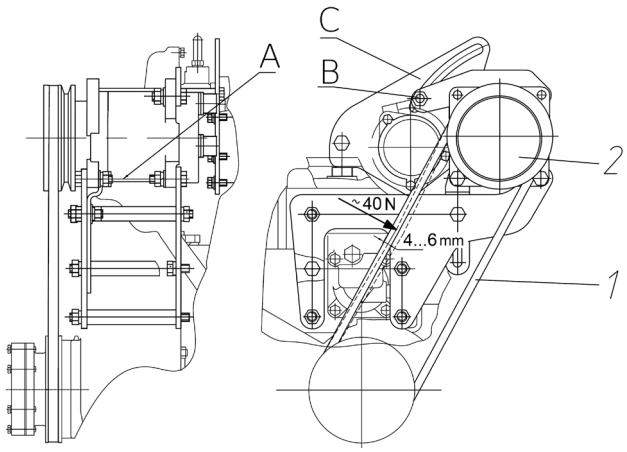
After every 125 service hours

Perform the operations of the previous MS and the following ones:

Operation 6e. Check/adjust tension of the air conditioner compressor drive belt.

Tension of the air conditioner compressor drive belt (1) (Figure 3.4) is deemed normal if deflection of its branch from the engine crankshaft pulley to the compressor pulley as measured in the middle point is 4 to 6 mm when a force of (39 ± 2.0) N is applied perpendicularly to the middle part of the branch.

Adjust tension of the belt (1) by turning the compressor (2) around the rotation axis A and tightening the threaded coupling (B) in the groove of the sector (C). After adjustment, the belt deflection under a force of (39±2.0) N, applied perpendicularly to the middle part of the branch, must be 4 to 6 mm.

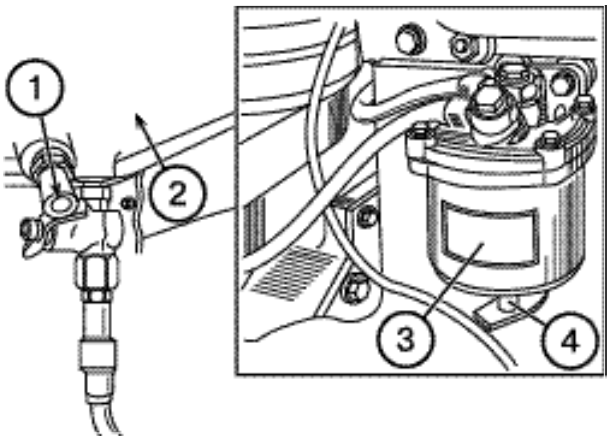


Operation 7. Discharge sludge from the coarse fuel filter and from the fuel tanks.

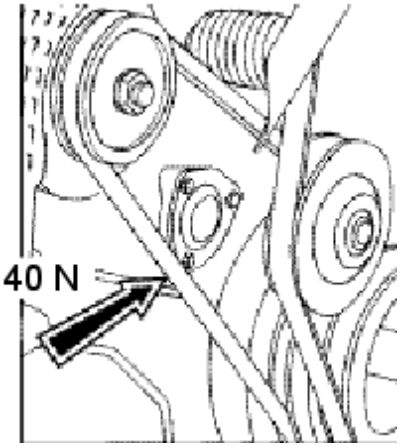
Open the drain plugs (1) of the fuel tanks (2) and the drain plug (4) of the filter casing (3).

Drain sediment and water until pure fuel emerges from the plugs. Discharge sediment to a special container and properly dispose of it.

Close the drain plugs of the fuel tanks and filter.



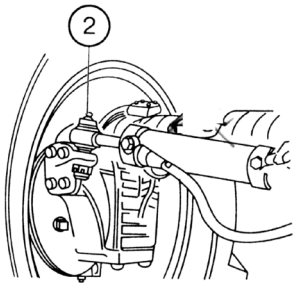
Operation 8. Check generator drive belt tension



The generator belt tension is deemed normal if the deflection of its branch between the pulleys of the crankshaft and the generator is 30 to 33 mm when it is pushed with a force of 40 N.

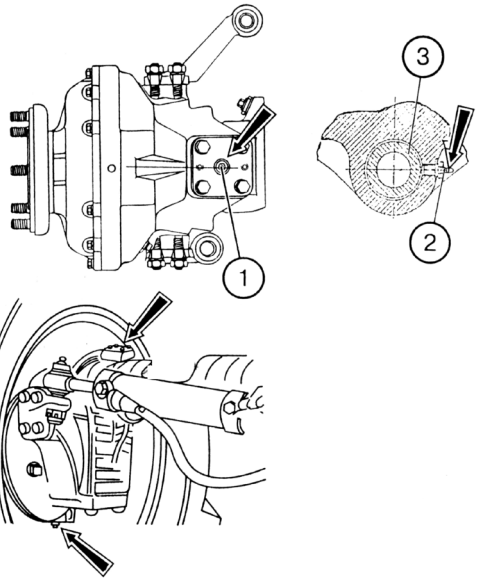
To adjust the belt tension, loosen the generator fastening and turn the generator housing to provide the required tension. Tighten the strip fastening bolt and the nuts of the generator fastening bolts.

Operation 9. Lubricate the steering cylinder joints



Using a gun, lubricate the joints through the lubricators (2) (4 lubrication points) with Litol-24 grease or its analogs (Bechem LCP-GM).

Operation 10. Lubricate bearings of the FDA reduction gear kingpin axles and the pivot axis hubs

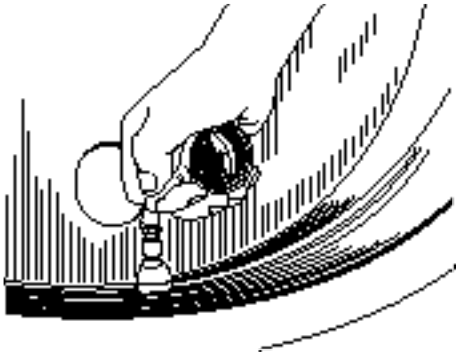


• Splint the lubricators (1) with Litol-24 or Bechem LCP-GM grease making 4 to 6 injections (4 lubrication points).

• Grease the lubricator (2) with the lubricant specified above until the lubricant emerges from the gaps between the FDA housing and the front bar.

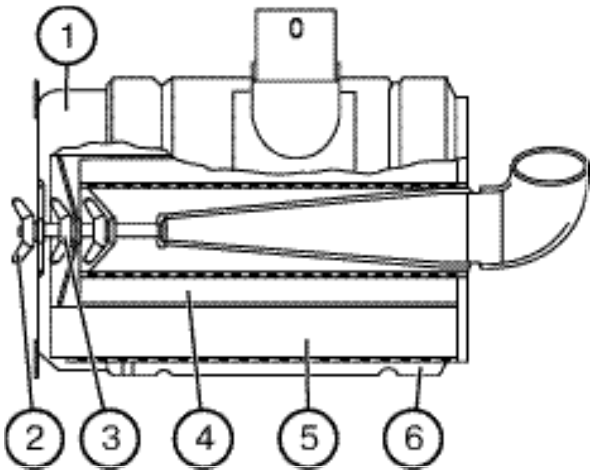
3 — pivot axis hub.

Operation 11. Air pressure in tires



Check condition of the tread and air pressure in the tires. If necessary, bring the pressure to the rated in accordance with the load as specified in the section “Combining”.

Operation 12. Check the engine air cleaner



Check condition of the paper filter elements (PFE) for presence of paper break and correct installation of the PFE.

To check the basic filter element (BFE), proceed as follows:

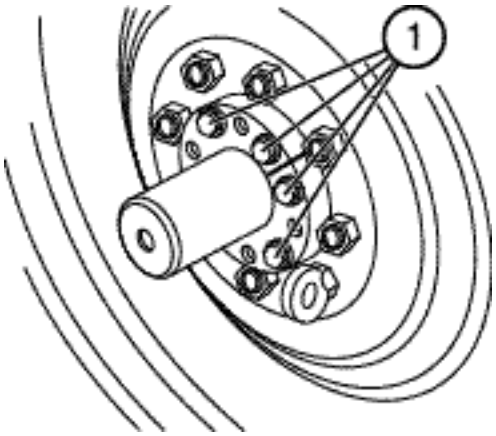
- unscrew the butterfly nut (2) and remove the pan (1);
- unscrew the butterfly nut (3) and remove the BFE (5);
- check the monitor filter element (4) for contamination without removing it from the casing (6).

ATTENTION! Removing the monitor filter element (4) from the casing (6) is not recommended.

Contamination of the monitor filter element (4) indicates that the BFE is damaged (the paper shutter broken, the bottoms unstuck). In such a case, rinse the MFE and replace the BFE.

Note: In case of strong dust, perform the Operation 12 every 20 hours of engine operation.

Operation 12a. Check and tighten fasteners of wheel hubs and nuts



Check the tightening torques and, as necessary, tighten:

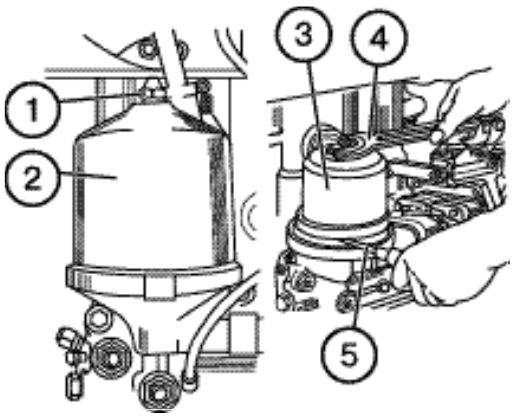
- bolts (1) of the rear wheel hubs to a torque of 360 to 500 N•m;
- nuts fastening the rear wheels to the hubs — 300 to 350 N•m;
- nuts fastening the front wheels to the flanges — 200 to 250 N•m;
- nuts fastening the front wheel disks to the rim brackets — 180 to 240 N•m

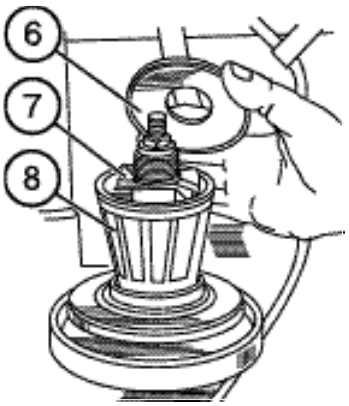
After every 250 service hours

Perform the previous MS and the following operations:

Operations 13, 14. Clean the centrifugal oil filters of the engine and GB.

- Remove the nut (1) and cap (2).
- Insert the screwdriver (5) or a rod between the filter casing and the rotor bottom to prevent rotation of the rotor (3), and turning the rotor nut with the key (4) remove the carrier of the rotor (3).
- Remove the cover (6), the impeller (7) and filter mesh (5) of the rotor. As necessary, clean and rinse the mesh.
- Using a non-metallic scraper, remove deposits from the inner walls of the rotor carrier.
- Clean all parts, rinse them in diesel fuel and blow with compressed air.
- Assemble the filter, performing the disassembling operations in the reverse order. Before assembling the carrier with the rotor housing, lubricate the O-ring with motor oil.
- Align the balance marks on the carrier and the rotor housing. Screw the carrier fastening nut with a small force until the carrier fully lands on the rotor.





- The rotor must rotate freely without jamming.
- Install the cap (2) and tighten the nut (1) to a torque of 35 to 50 N•m.

Note: After the engine stops, a noise of rotating rotor must be heard for 30 to 60 seconds. This indicates that the filter is working properly.

Operation 15. Check the oil level in the hub casings and FDA final drive

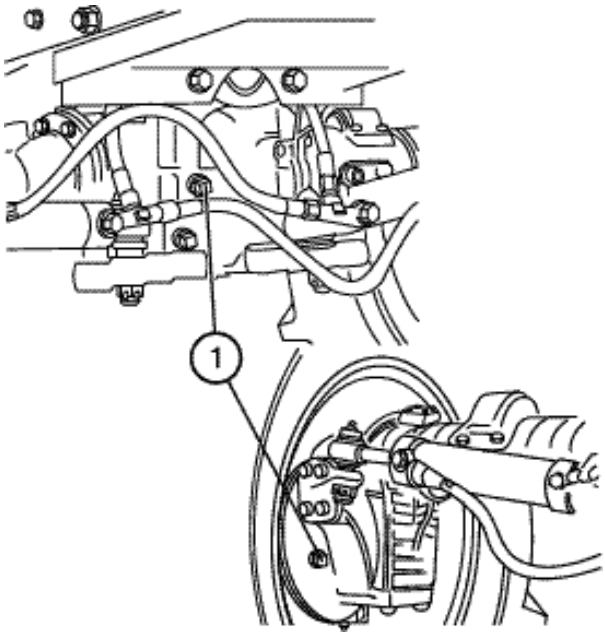
Check the oil level:

• In the hub casings (left and right). As necessary, add oil to the level of the check-filler hole plugged with the plug (1).

• In the FDA final drive. As necessary, add oil to the level of the check-filler hole plugged with the plug (1).

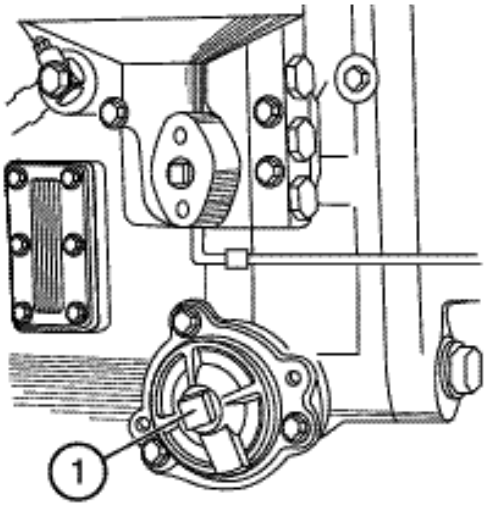
Grades of oils to fill:

Transmission oils: Tap-15V, TAD-17i, TSp-15K, or their equivalents.

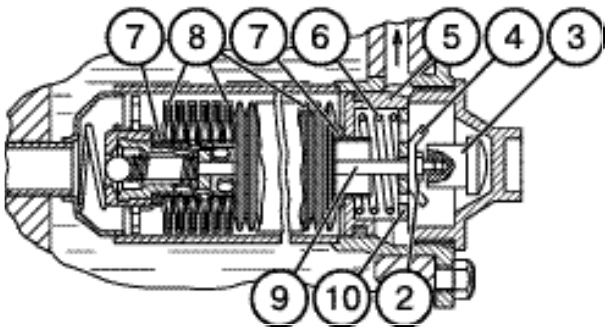


Operation 16. Rinse the GB oil strainer

- Unscrew and remove the strainer cover (1). Grasping by the button (3), take the strainer assembly out from the GB housing.
- Unscrew the button (3), the locknut (2) and the butterfly nut (4) from the rod (9).
- Remove the washer (10), spring (6), piston (5), O-ring (7) and the mesh elements (8).
- Rinse the mesh elements in pure diesel fuel.
- Assemble the strainer in the reverse order.

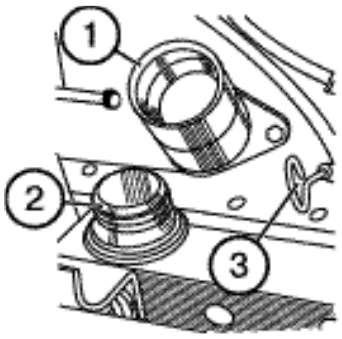


Note: Make sure that the sealing rings (7) are installed on the both sides of the package of mesh elements.

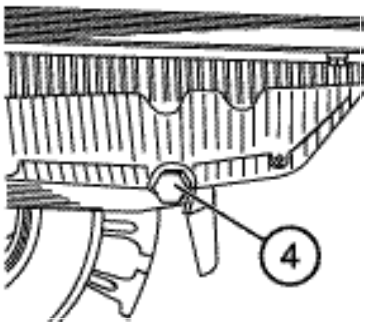


Note: Screw the butterfly nut (4) to get the washers (10) flush with the end face of the piston.

Operation 17. Change engine oil

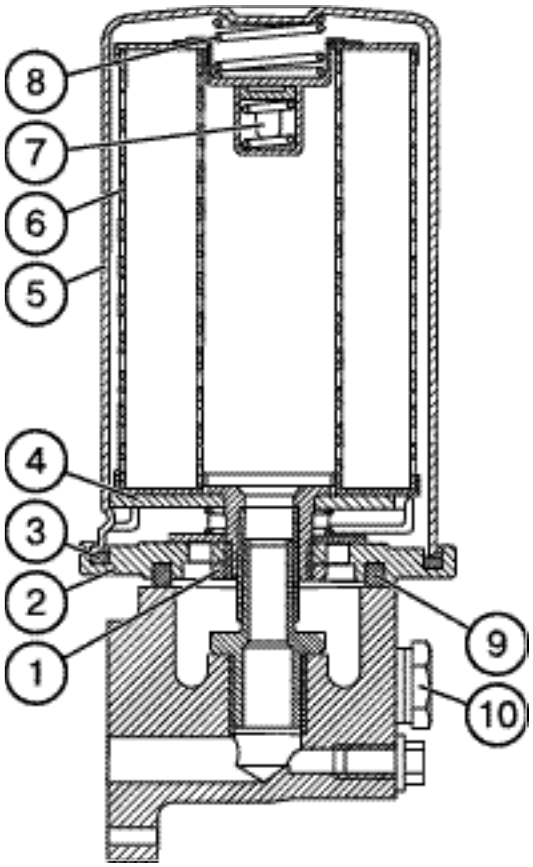


- Warm up the engine to its normal operating temperature (70°C min.).
- Install the tractor on an even surface, stop the engine and brake the tractor with the brake.
- Remove the cover (2) of the oil filler neck and unscrew the drain plug (4). Discharge oil into a suitable container for storage of waste oils.



- Install the drain plug (4) to place and fill in fresh clean motor oil through the oil filler neck (1).
- Install the cover (2) of the oil filler neck to place.
- Start the engine and let it operate for 1-2 minutes.
- Check the oil level with the probe (3) as described in the Operation 1.
- If necessary, add oil to the level.

Operation 18. Replace the PFE of the engine oil filter (performed simultaneously oil change)

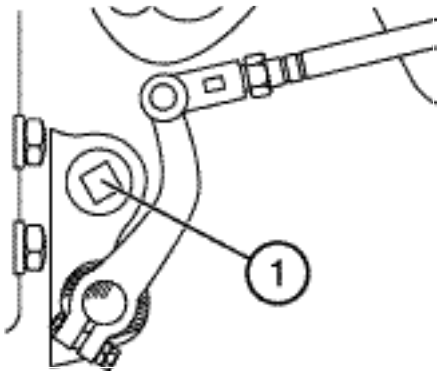


- Unscrew the cap (5) assembled with the paper filter element (6).
- Unscrew the nut (1) and remove the bottom (2) with the gaskets (3) and (9).
- Press on the clamp (4) moving it inside the cap (5) by 3 to 4 mm and then rotate it to align the three lugs on the clamp (4) with the grooves of the cap (5).
- Remove the clamp (4), PFE (6), relief valve (7), spring (8).
- Rinse all parts with diesel fuel.
- Install a new filter element, performing the operations in the reverse order. If necessary, replace the gaskets (3) and (9). Tighten the nut (1) to a torque of 50 to 70 N•m. Lubricate the gasket (9) with motor oil.
- Screw in the filter assembly to an additional 3/4 turn after the gasket (9) touches the housing (10).

ATTENTION! Screw in the filter only by force of hands, grasping the cap (5) of the filter.

Operation 19. Lubricate the clutch release yoke bearing

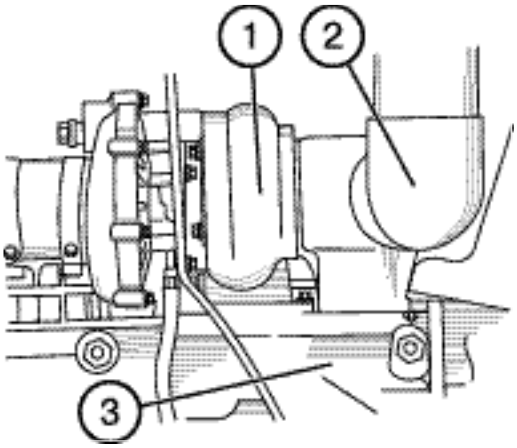
- Remove the plug (1) from the left side of the clutch housing.
- Using a gun, make 4 to 6 injections of Litol-24 grease through the lubricator screwed into the housing of the release yoke to lubricate the release bearing.



Note: Do not inject excessive amounts of grease, as excessive grease will accumulate inside the clutch housing and can get to the dry friction surfaces.

Operation 20. Turbocharger

Check tightening of fasteners of the turbocharger (1), exhaust manifolds (3) and exhaust pipe bracket (2). As necessary, tighten the fasteners to a torque of 35 to 40 N•m.



Operation 21. Front wheel toe-in

The front wheel toe-in must be within 0 to 8 mm. If necessary, perform adjustment operations in accordance with the recommendations in the section “Adjustments”.

After every 500 service hours

Perform the operations of the previous MS and the following ones:

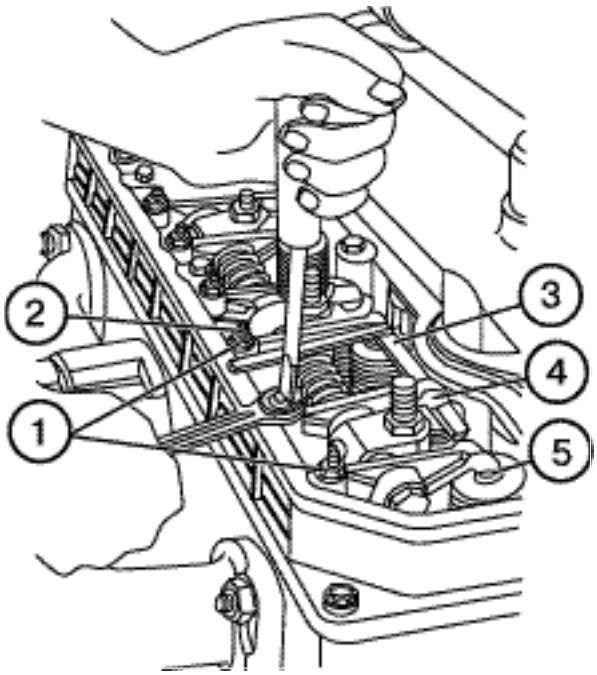
Operation 22. Check and adjust valve clearances in the engine

Note: Check the clearances on a cold engine after checking the cylinder head bolt tightening (Operation 37).

- Remove the cover caps from the cylinder heads.
- Check tightening of the bolts and nuts fastening the rockers arm shaft brackets (60 to 90 N•m).
- Turn the crankshaft until the valves overlap in the first cylinder (the inlet valve starts opening, and the exhaust valve ends closing).
- Adjust the clearances in the 3, 5, 7, 10, 11 and 12 valves (counting from the fan).

ATTENTION! The clearance between the ends of the valve rods (5) and the arm shaft strikers (4) must be 0.25 to 0.30 mm for the inlet valves and 0.40 to 0.45 mm for the exhaust valves.

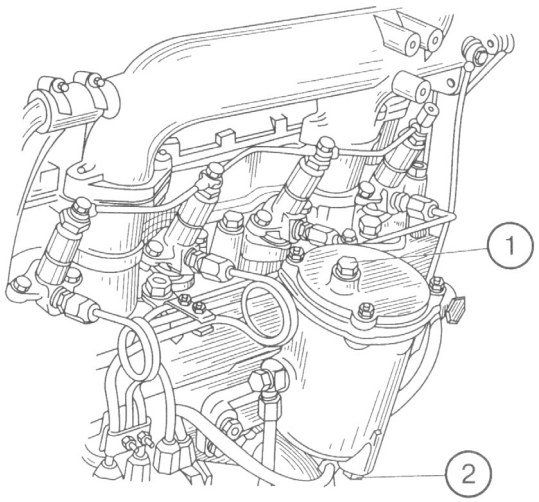
- Crank the crankshaft to 360°, making an overlap in the sixth cylinder, and adjust clearances in the 1, 2, 4, 6, 8 and 9 valves.



- To adjust the clearance, release the locknut (1) of the adjustment screw (2) and using a key and screwdriver set the necessary clearance by the probe (3). After setting the clearance, tighten the locknut (1) and re-check the clearance with the probe.
- After adjusting, install the removed parts to their places.

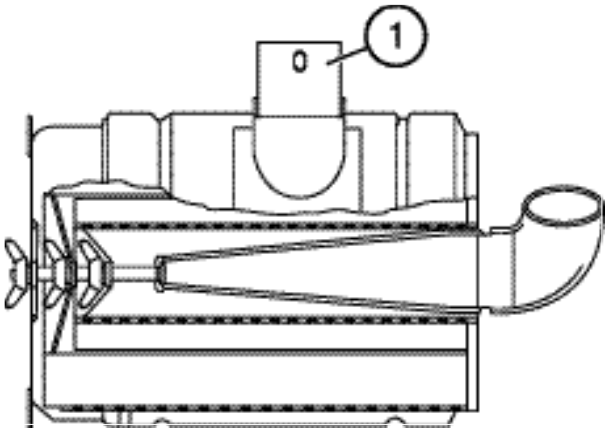
Operation 23. Discharge sediment from the fuel fine filter of the engine

- Unscrew the air-bleed plug (1) by 2…3 turns.
- First unscrew the sediment discharge plug (2) and discharge sediment from the filter housing until clean fuel emerges. Screw the plugs (1) and (2).



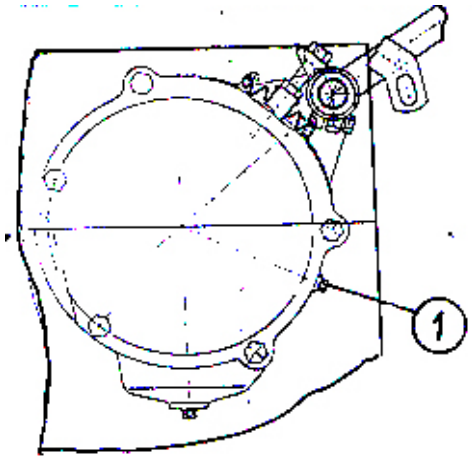
Operation 24. Check tightness of connections of the air cleaner and intake

- Remove the monocyclone.
- Start the engine.
- Set the medium idle speed.
- Close the suction pipe (1) of the air cleaner. The engine must stop at this.
- Otherwise, identify and eliminate leakages in the air cleaner and intake joints.



Operation 25. Check oil level in the wet brake housings

- Check oil level in the left and right housings. The oil level must be up to the lower edge of the check-fill hole plugged with the plug (1).



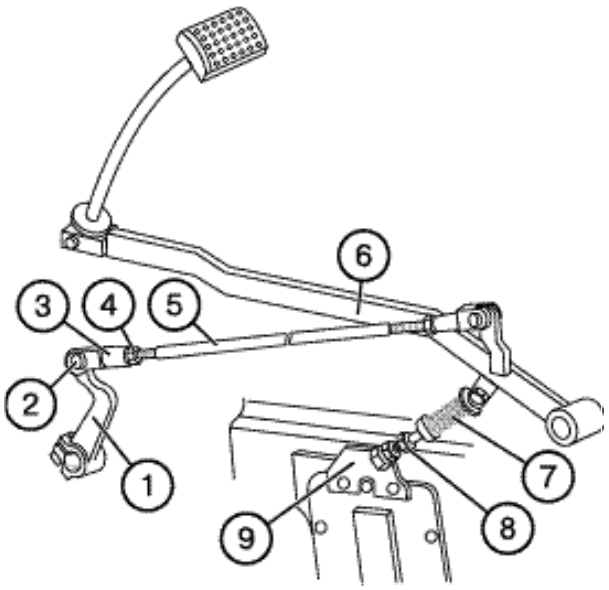
Operation 26. Adjust free travel of the clutch pedal (BELARUS-1221.2/1221.3)

Free travel of the clutch pedal must be 40 to 50 mm.

IMPORTANT! A too long pedal travel will not let the clutch to be fully disengaged and will make the gear switching difficult. A too short pedal travel will result in slip of the clutch plates, rapid wear of the plates and overheating of clutch parts.

- To adjust the clutch pedal free travel:
- Unsplint and remove the pin (2), having disconnected the rod (5) from the lever (1).
- Loosen the locknut (4).
- Unscrew the screw (8) so that the pedal shaft (6) move up to stop against the cabin floor.
- Turn the lever (1) counterclockwise until it stops, that is, when the release bearing touches the clutch toggle levers.
- Unscrewing the fork (3), align the holes in the fork and the lever (1) and then screw in the fork into the rod (5) by 5 to 5.5 turns (that is, shorten the rod).
- Assemble the clutch pedal leverage in the reverse order.

IMPORTANT! Make sure that the clutch pedal always safely returns up to stop against the floor in the area of pedal free movement. Otherwise, adjust the servo-unit spring force (7) using the bolt (8) or change the position of the bracket (9) turning it around the axis of the fastening bolt.

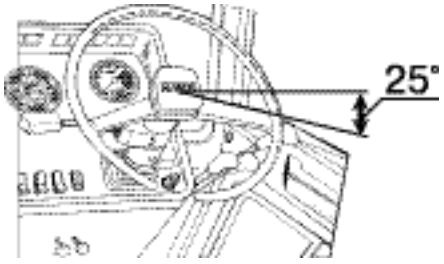


Operation 26a. Adjust free travel of the clutch pedal (BELARUS-1221V.2)

Perform the operations described in the section “Adjustments”.

Operation 27. Steering wheel play

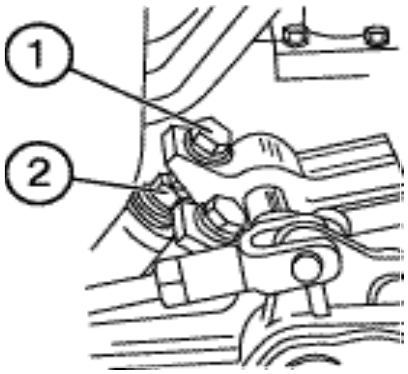
With the engine running, the steering angular play must not exceed 25°. Otherwise, check and eliminate plays in the joints of cylinders, steering link and steering column.



Operation 28. Brake pedal and parking brake lever travel

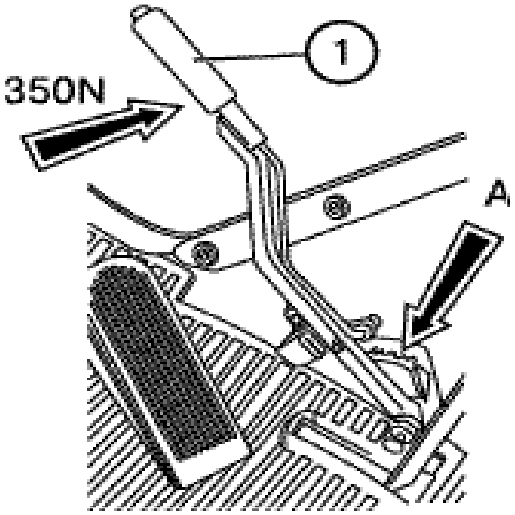
The full travel of the right service brake pedal under a force of 120 N on the pedals must be 115 to 125 mm. Otherwise, adjust the brakes as follows:

- Loosen the locknut (2) of the adjustment bolt (1) of the right service brake.
- Screwing in or out the bolt, adjust the travel of the right service brake pedal.
- Repeat the same for the left service brake pedal.

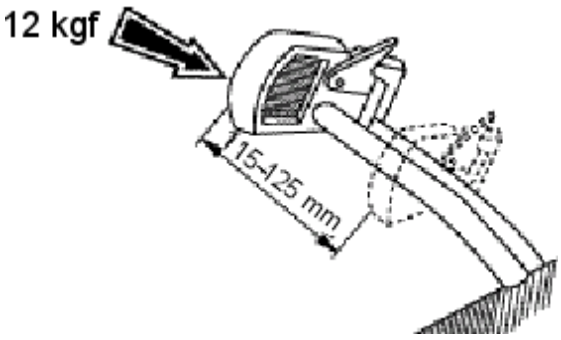


Note: The left service brake pedal travel must be by 5 to 20 mm less for simultaneous actuation of the brakes when braking with interlocked pedals.

The parking brake must be fully engaged when the lever (1) is locked on the third or fourth tooth of the sector (A) under a force on the handle of 400 N.



IMPORTANT! The minimum travel of the interlocked service brake pedals under a force of 250 N must not be less than 105 mm.



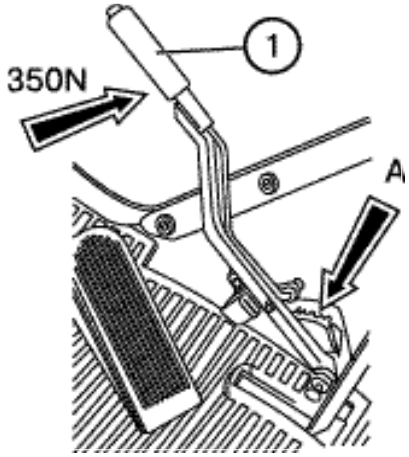
Before adjusting the parking brake, install the tractor on an even surface, stop the engine and lock the rear wheels from front and rear:

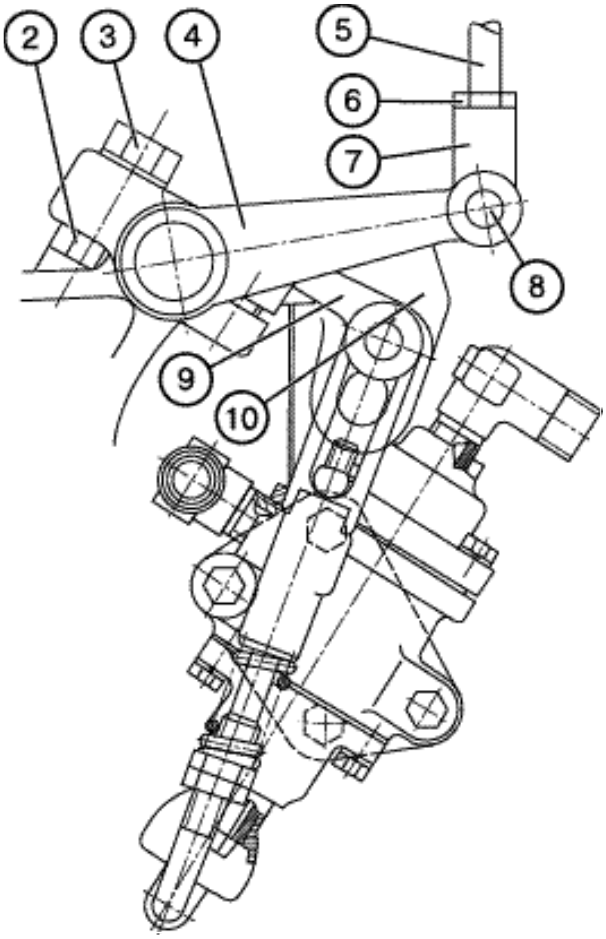
- Shift the lever (1) to the extreme front (off) position.
- Loosen the locknut (2) of the adjustment bolt (3) of the parking brake (on the right side of the tractor).
- Screwing in or out the bolt (3), obtain a complete disengagement of the parking brake at the fourth tooth of the sector (A) under a force on the lever (1) of 350 N.
- Lock the bolt (3) with the nut (2).

If the tractor is equipped with a pneumatic system and works with trailers equipped with pneumatic brakes, adjust the parking brake as follows:

- Shift the lever (1) to the extreme front (off) position.
- Loosen the locknuts (2) and (6) and remove the pin (8).
- Turn the lever (4) so that the upper edge of the groove in the lever (9) align with the upper edge of the groove in the lever (10).
- If necessary, adjust the length of the rod (5) with the fork (7), setting the pin (6) and splint it.
- Turning the adjusting screw (3), adjust the lever (1) so that the parking brake be fully engaged on the 3rd or 4th tooth of the sector A under a force on the lever of 350 N.
- Tighten the locknuts (2) and (6).

IMPORTANT! With the brake pedals interlocked, unsimultaneity of wheel braking must not exceed 1 m as measured by the wheel footprints.



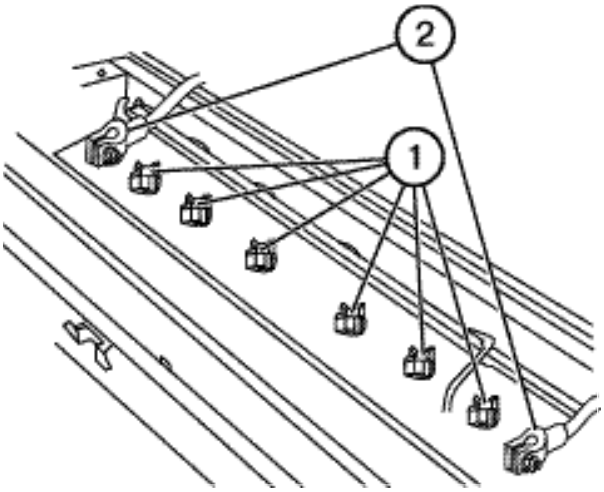


Operation 28a. Brake pedal travel (BELARUS-1221V.2)

Perform the operation described in the section “Adjustments”.

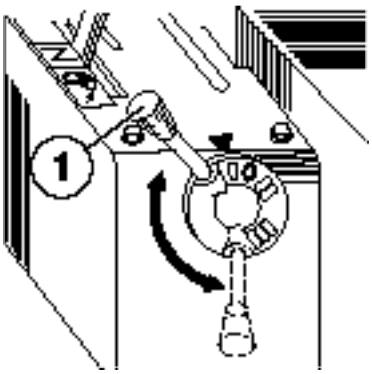
Operation 29. Batteries

CAUTION! The batteries contain sulfuric acid that causes severe burns in case of skin exposure. Avoid exposure of hand skin, eyes and clothing to the acid. When the acid gets onto external body parts, rinse them with a strong jet of pure water. In case of ingestion, drink plenty of water or milk. In case of contact with the mucous membrane of an eye, rinse it with plenty of water for 15 minutes and then call for medical assistance. Keep sparks or flames away from the area of electrolyte, as this can cause an explosion. Charge the batteries in a ventilated room. When servicing batteries wear protective goggles and gloves.



- Check the electrolyte level (it must be above the edges of the separators by 10 to 15 mm, i.e. corresponding to the top mark on the battery body). If necessary, add distilled water **(filling with electrolyte is not recommended)**;
- Check the electrolyte density, in case of a drop in density by 0.03 g/cm³ recharge the battery. Do not measure the electrolyte density immediately after filling with distilled water because the readings will not be correct;
- Wipe the battery surface with 10% solution of baking soda and then wash with water;
- Lubricate the terminals of two lead-in wires with a thin layer of petrolatum and tighten;
- The battery must be properly secured on the tractor;
- If there are ventilation holes in the plugs 1, clean them

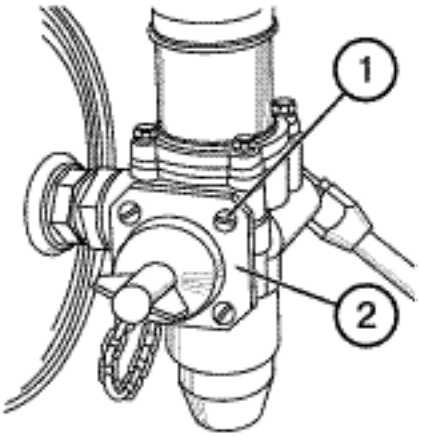
Operation 30. Draft and position control signal mixer (if installed)



Lift the rear hitch mechanism to its highest position. The lever (1) must rotate in the zone between the marks I and III.

If the lever travel does not match the above requirements, please contact a qualified technician to adjust tension of the signal mixer control cable.

Operation 31. Clean the filter of the air pressure regulator in the pneumatic system



To clean the filter element:

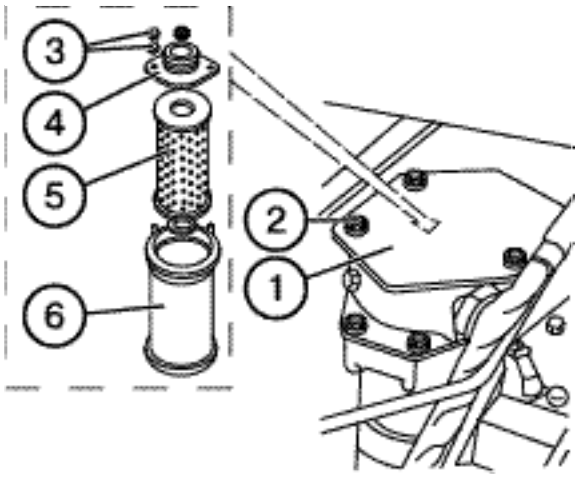
- Remove the bolts (1) and cover (2).
- Take out the filter element, wash it in detergent solution and blow with compressed air.
- Assemble the strainer in the reverse order.

Operation 32. Check tightness of pneumatic system lines

- Bring the air pressure in the pneumatic system to 6.0 to 6.5 kgf/cm² (by readings of the air pressure indicator on the dashboard) and stop the engine.
- Check by the pointer that the pressure drop for 30 minutes did not exceed 2 kgf/cm². Otherwise, find the location of air leak and fix the fault.

Operation 33. Replace the oil filter of the hydraulic system

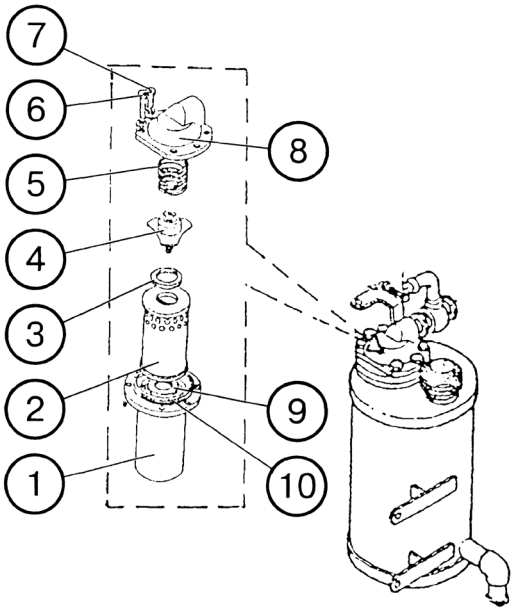
Note: Perform subsequent replacements of the oil filter in the hydraulic system every 1,000 service hours.



- Remove the screws (2), cover (1) and take out the filter element assembly using the stop (4).
- Remove the nuts (3), stop (4) and filter element (5).
- Wash the casing (6) in detergent solution.
- Install a new filter element and reassemble the filter performing the operations in the reverse order.
- Install the filter assembly to the tank of the hydraulic system, close with the cover (1) and fasten with the bolts (2).

Operation 33a. Replace the HSU tank oil filter

Replace the HSU oil filter proceeding as follows:



- Unscrew the four bolts (7) (M6×16) and remove the filter assembly;
- Unscrew the two bolts (6) (M6×25) and disconnect the filter cover (8) from the carrier (1);
- Remove the filter element (2), spring (5), pressure relief valve assembly (4) and O-rings (3), (9);
- Rinse the carrier (1) in a washing liquid;
- Install a new filter element and reassemble the filter performing the operations in the reverse order as compared to disassembling.
- Install the filter assembly into the HSU tank making sure that the seals (10) and the seals between the carrier and the tank are installed correctly. Tighten the bolts (6, 7).

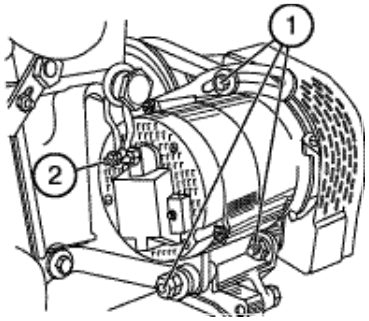
NOTE: Perform subsequent replacements of the oil filter in the HSU and hydraulic system every 1,000 service hours.

Operation 34. Clean generator

Clean the generator from dust and dirt.

Check and, if necessary, tighten the bolts fastening the generator.

Check the tightening torque of the generator terminals and other electrical equipment (starter, battery switch, etc.)

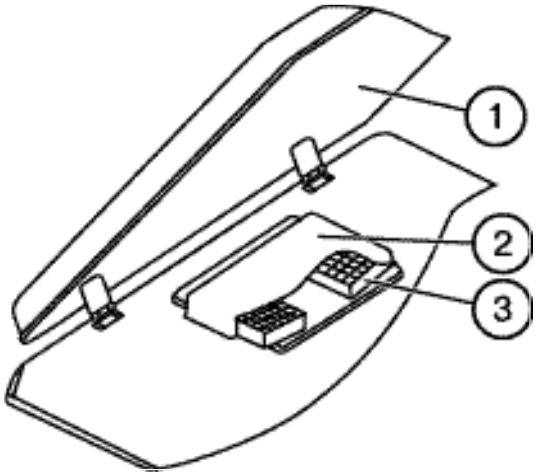


Operation 35. Clean the cab heating and ventilation system filter

Note: In wet conditions, such as in the early morning hours before servicing the filter do not switch on the fan, because any water particles trapped in the filter are difficult to remove.

- Raise the cab roof (1).
- Remove the two mounting bolts and filter cover (2) together with the two filtering elements (3).

Lightly shake the elements to remove free dust particles from the filter.



ATTENTION! Be careful not to damage the filter!

- Clean the filters with compressed air under a pressure not exceeding 2 bar. Hold the hose nozzle not closer than 300 mm from the filter in order not to damage the PFE.

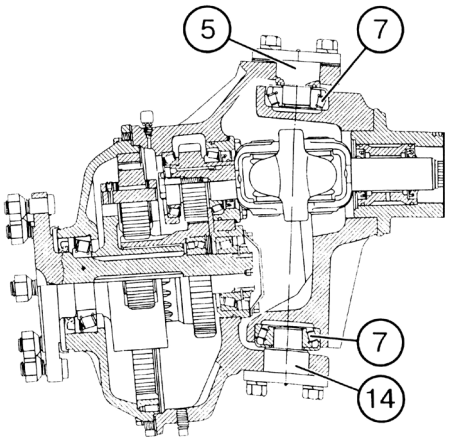
Direct the air jet through the filter in the direction opposite to the normal flow as indicated by the arrows marked on the filter housing.

- Install the filter performing the operations in the reverse order.

Note: When operating the tractor in conditions of high dust exposure, clean the filter more frequently.

Operation 35a*. Replace filter drain

ATTENTION: for replacement of the filter drain, contact a special service station. Replace only using special equipment.



Operation 36. Check bearings of FDA reducer kingpin axles.

Check and if necessary adjust the bearings (7) of the axles (5, 14) as described in the section “Adjustments”

Operation 36a. Check tightening of the clamp bolts of the CAC air ducts (BELARUS-1221.3)

Check and tighten up as necessary the bolts fastening the CAC air ducts. The tightening torque of the CAC air duct clamp bolts must be 10 to 15 N•m.

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* The operation is performed each 800 service hours or once a year

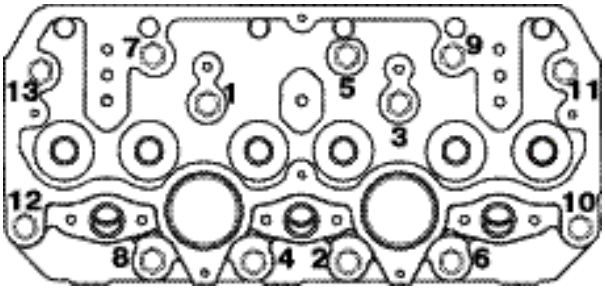
After every 1,000 service hours

Perform the operations of the previous MS and the following ones:

Operation 37. Tighten engine cylinder head fastening bolts

Check tightening of the fastening bolts of the cylinder heads on a hot engine proceeding as follows:

- Remove the caps and covers of the cylinder heads.
- Remove the rocker shafts with the rockers and poles.
- Using a torque spanner, tighten all the bolts fastening the heads to a torque of 190 to 210 N•m in the sequence shown in the figure on the right (for simplicity, the figure shows one cylinder head).



Note: Before tightening the bolts, loosen them by 1/6 turn.

- Install the rocker shafts to places and adjust the clearances between the rockers and the valves (See Operation 21 of this Manual).
- Install the covers and caps of the cylinder heads to place.

ATTENTION! Perform the first check of bolt torque of the cylinder heads after running in the tractor.

Operation 38. Clean engine air cleaner

- Remove the monocyclone (7), clear the mesh, swirler and ejection slots from dust and dirt.
- Unscrew the butterfly nut (2) and remove the pan (1);
- Remove the basic filter element (5). Pay attention to the condition of the monitor filter element (4).

ATTENTION! Pollution of the KFE indicates a damaged BFE (the paper shutter broken, the bottoms unstuck).

Note: Taking out the MFE (4) from the casing (6) is not recommended.

If the BFE has no damage, blow it with compressed air first from inside, then outside to completely remove dust.

ATTENTION! To avoid a break of the paper shutter, air pressure must not exceed 0.2 to 0.3 MPa.

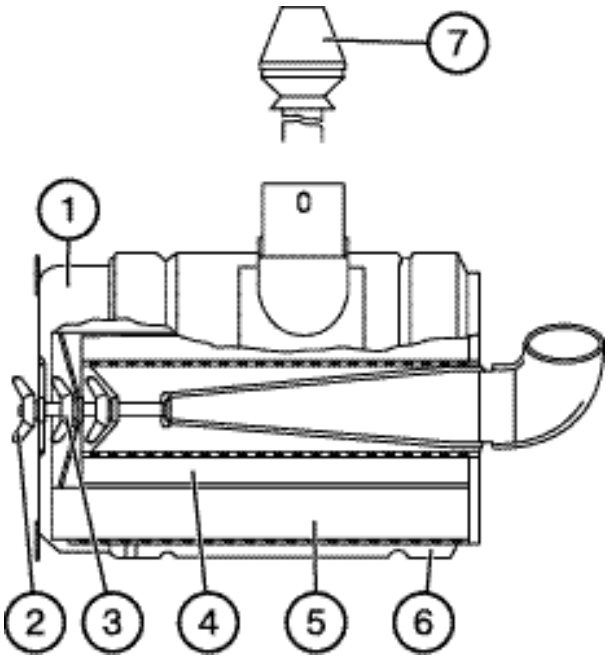
Direct the air jet at an angle to the BFE surface. Avoid contamination with oil or mechanical damage to the BFE.

- If blowing with air is inefficient, rinse the BFE in washing solution. The concentration of solution is 0.02%. To wash the BFE, dip it in the washing solution for 0.5 hours, then rinse extensively in this solution for 15 min.

Rinse the BFE in pure water at 35 to 45°C and dry for 24 hours.

ATTENTION! Do not blow the BFE with exhaust gases and do not rinse it in diesel fuel.

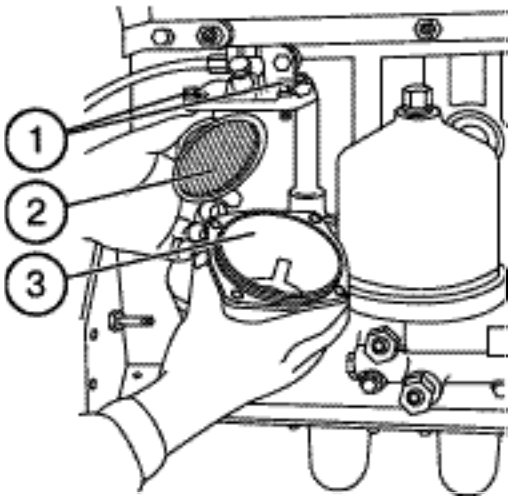
- Clean the exhaust pipe, inner surfaces of the housing and air pan from dust and dirt.
- Check condition of the sealing rings.
- Make sure that the BFE is correctly installed in the housing and tighten the butterfly nut by hand.
- Perform the Operation 24 to check tightness of the air cleaner and intake.



Operation 39. Clean engine fuel coarse filter

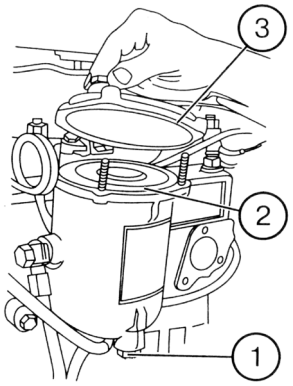
Rinse the engine fuel coarse filter, performing the following operations:

- Shut off the fuel tank valve.
- Unscrew the screws (1) fastening the carrier (3) and remove the bowl.
- Unscrew the reflector with mesh (2) and remove the diffuser.
- Wash in diesel fuel the reflector with mesh, diffuser and filter bowl.
- Assemble the filter parts in the reverse order.
- Fill the system with fuel. Purge the system and bleed air from the fuel system as specified in the Operation 38.



Operation 40. Change filter elements of fine fuel filter

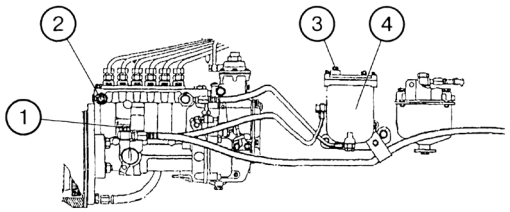
- Unscrew the plug (1) and discharge sediment.
- Unscrew the four nuts and remove the cover (3).
- Rinse the housing and cover with pure diesel fuel.
- Check the cover seal and, if necessary, replace it.
- Install a new filter element.
- Fill the filter housing with fuel.
- Install the cover and tighten the fastening nuts.

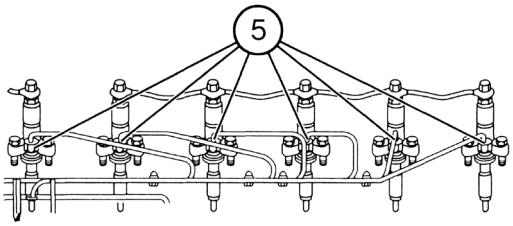


IMPORTANT! After cleaning or replacing the filter element (or after full consumption of fuel from the tanks), it is necessary to bleed air from the system before you start the engine.

To bleed air from the system:

- Loosen the plug (3) of the fine filter (4).
- Unscrew the handle (1) of the hand-priming pump.
- Check whether the fuel tank valve is opened and whether there is fuel in the tanks.
- Loosen the plug (2) on the fuel pump.
- Quickly purge the system with the boost pump until clean fuel without air bubbles emerges from the plug. Tighten the fuel pump plug (2). Keep on purging the system until without air bubbles emerges from the fine filter plug (3). Tighten up the plug.
- Screw the handle (1) of the hand-priming pump.





Note: If the engine start is difficult, loosen in turn the captive nut (5) of each injector fuel line, while cranking the crankshaft to remove air from the lines. Crank the crankshaft for 10 to 15 seconds for each line and tighten the captive nut without stopping cranking. If any disturbances are observed, loosen and screw each nut with the engine running.

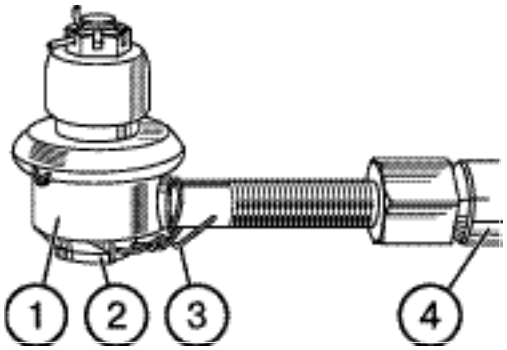
Operation 41. Check play in the steering link joints

When the engine is running, turn the steering wheel in both directions to check the free travel and play in the joints (1) of the steering link (4).

If there is play in the joints, proceed as follows:

- Remove the locking wire (3).
- Screw in the threaded plug (2) so as to eliminate the gap in the joint.
- Lock the plug with wire (3).

Note: If tightening of threaded plugs does not eliminate a gap in the joints, disassemble the joint and replace worn parts.



Operation 42. Check and tighten external fasteners

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

- Nuts of front and rear wheel hugs and bolts of rear hubs.
- Front beam — half-frame — side plates — front hitch linkage and PTO (if installed).
- Engine — clutch housing.
- Clutch housing — GB housing.
- GB housing — rear axle housing
- Rear axle housing — rear hitch linkage bracket.
- Rear axle housing — universal hitch.
- Front and rear cab supports.
- Nuts of FDA driveline flanges.
- Front fender brackets — FDA wheel reduction gears.
- Rear axle housing — top cover (two rear bolts M20).
- Bracket and fingers of the steering hydraulic cylinder.
- FDA-housing – sleeves –reduction gear wheels
- Hydraulic hoist fasteners (if installed)

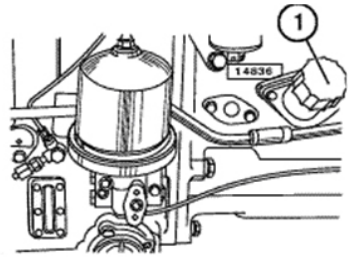
Operation 43. Change oil in the transmission housings, hydraulic system oil tanks, HSU and wet brake housings

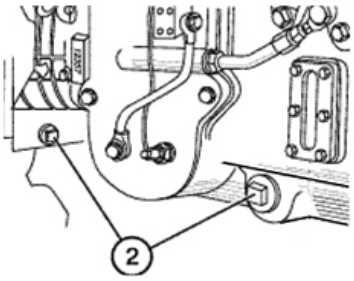
Before changing oil, operate the tractor to warm up the transmission and hydraulic system oil.

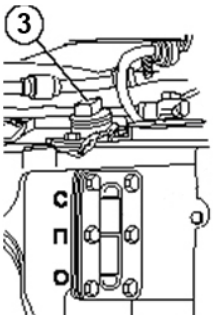
- Install the tractor on an even surface, lower the rear hitch linkage rods to the lowest position, stop the engine and brake the tractor with the parking brake.
- Lock the rear wheels with wedges on both sides.
- Remove the cover (1) of the oil filler neck of the transmission, the plug (3) of the hydraulic system oil tank and the plug (5) of the HSU oil tank.
- Remove the drain plugs (2, 4, 6) from housings of the gearbox, rear axle, hydraulic system oil tanks and HSU respectively and discharge oil into a container for collection of waste oil. Properly dispose of waste oil.

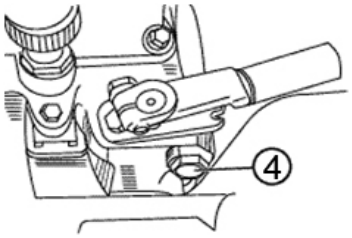
Caution! Be careful to avoid contact with hot oil.

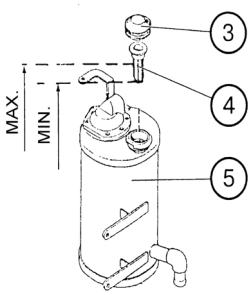
- Install the drain plugs (2, 4, 6) to place and fill the transmission housing, the hydraulic system and HSU oil tanks with fresh oil to the required level.





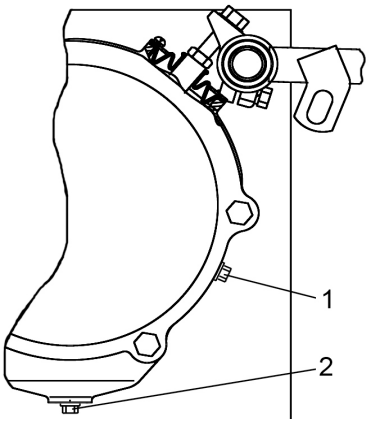




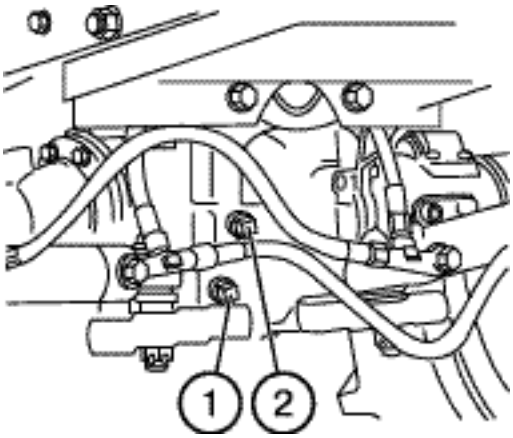


• Change oil in a multi-disk brake housings operating in oil bath, proceeding as follows:

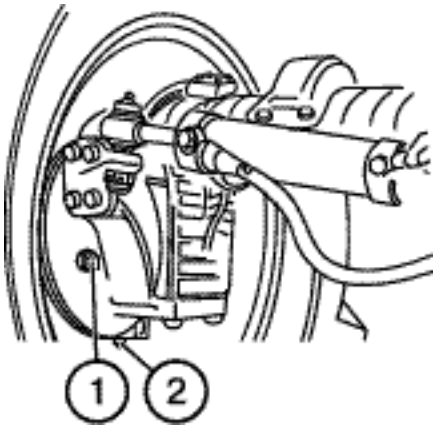
- unscrew the check-fill plugs (1) of the left and right housings;
- unscrew the drain plugs (2) and discharge oil as described above;
- screw the drain plugs (2);
- fill the housings with fresh motor oil.
- screw in the filler plugs (1);



Operation 44. Change oil in the FDA final drive and wheel reduction gears



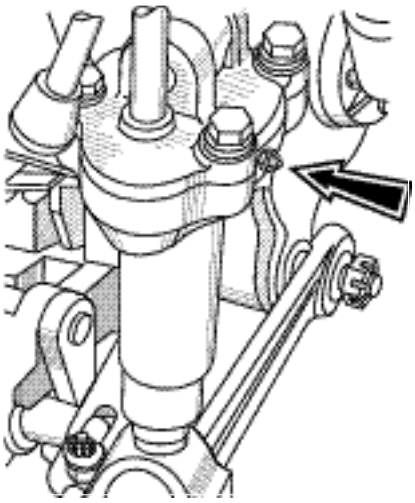
- Operate the tractor and warm up the oil in the FDA housings.
- Install the tractor on an even, horizontal surface. Stop the engine. Engage the parking brake and lock the wheel with wedges on both sides.
- Remove the check-fill plugs (2) and the drain plugs (1). Discharge oil into a special container to collect waste oils. Properly dispose of oil.
- Install the drain plugs to place and tighten them.
- Fill the housings with fresh transmission oil to the lower edge of the check-fill holes.
- Install to place and tighten the plugs (2).



Note: Change oil also during the seasonal MS.

Operation 45. Lubricate the RHL right adjustable brace

Using a gun, lubricate the adjustment mechanism of the right brace (one lubrication point). Make 4 to 6 injections through the lubricator in the upper part of the brace. Lubricant: Litol-24 (or Bechem LCP-GM).



Operation 46. Lubricate the RHL pivoting shaft

Using a gun, inject grease into two lubricators located on the linkage bracket until the grease emerges from gaps. Grease: Litol-24 or Bechem LCP-GM.

Operation 47. Check injectors

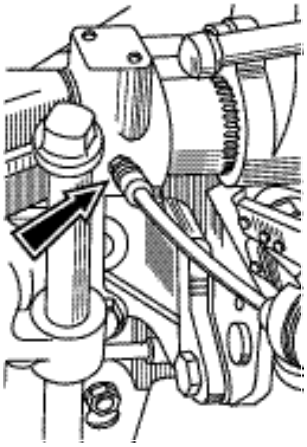
IMPORTANT! The injectors must be cleaned and adjusted by a qualified expert in shop.

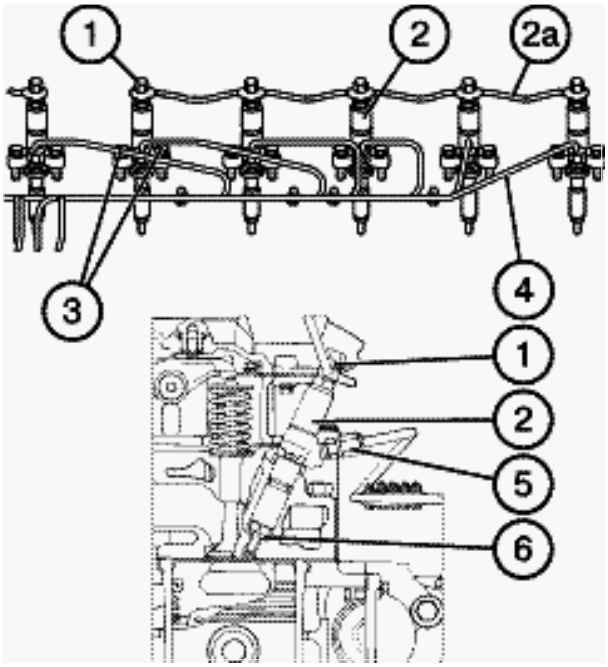
Caution! Diesel fuel going out from the injector under a high pressure can penetrate deeply into the skin tissue of the hand resulting in serious injuries. Never use your hand to check injector leaks. Use paper or cardboard. Wear goggles. Before disconnecting the fuel lines, stop the engine to remove the pressure. Before you start the engine, firmly tighten connections of the fuel lines. In case of skin contact with a fuel jet, immediate seek medical help to avoid blood poisoning.

Note: It is convenient to have spare injectors ready for use.

To replace the injectors, proceed as follows:

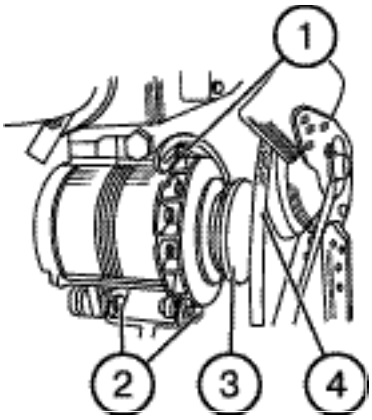
- Completely clean the surfaces adjacent to the removed parts.
- Unscrew the captive nuts (5) and disconnect the fuel injection pipes (4) from the injectors (2) and the fuel pump (not shown).
- Remove the fuel injection pipes (4).
- Remove the six bolts (1) and the drain pipe. Sort out copper washers (two washers on each banjo bolt).





- Remove the bolts (3) fastening the injectors and remove the injectors (2).
- Send the injectors to a shop for maintenance.
- Install new injectors and removed parts in the reverse order. Tighten the bolts (3) fastening the injectors evenly in 2-3 steps. Final tightening torque is 20 to 25 N•m
- Purge the fuel system as specified in the Operation 40.

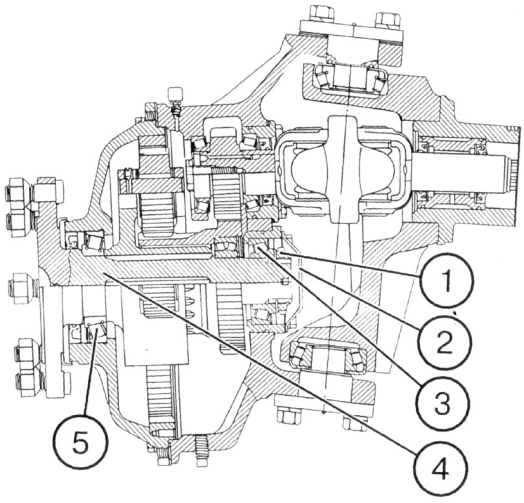
Operation 48. Generator



- Loosen the bolts (1) and (2), turn the generator in the direction of the engine unit and remove the generator drive belts (4) from the pulley (3).
- Check free rotation of the rotor and wear of the bearings.

If necessary, remove the generator and send it to a shop for repair.

Operation 49. Flange bearings of the FDA planetary/parallel-shaft reduction gear



Check and, as necessary, adjust the tapered roller bearings (3, 5) without play, proceeding as follows:

- Unscrew the screws and remove the cover (2);
- Tighten the nut (1) to a torque of 180 to 200 N•m (18 to 20 kgf•cm), and then unscrew it by 15 to 20°;
- Unstake the nut in two flange slots (4). Install the cover (2) to place.

After every 2,000 service hours

Perform the operations of the previous MS and the following ones:

Operation 51. Engine fuel pump

The delivery commencement angle of the fuel pump must be within the limits specified the table on the right. Only a qualified technician should check and adjust the delivery commencement angle.

Remove the pump and send it to shop for bench check of conformity to the adjustment parameters (speed mode, rated delivery per stroke, delivery per stroke, etc.).

Model of fuel pump	Adjustment of timing angle, deg. to UDC		
	D-260.2	D-260.2S	D-260.2S2
363-40 OJSC YAZDA, Russia	20±1	15±1	—
Motorpal P P 6M 10P 1f, Czech Republic	16±1	16±1	—
363-40.02T OJSC YAZDA, Russia	—	–	6±0.5

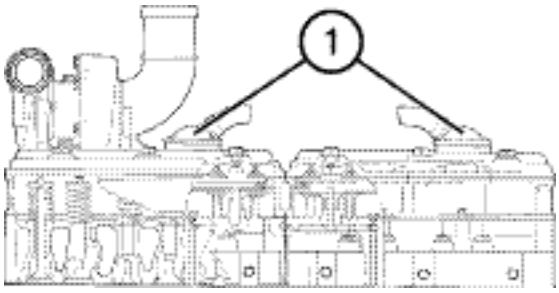
Operation 53. Flush the cooling system

To flush, use a solution of 50-60 g of sodium carbonate and 1 liter of water.

Proceed as follows:

- Pour 2 liters of kerosene into the water heat exchanger and fill the system with the prepared solution.
- Start the engine and work for 8 to 10 hours, then discharge the solution into a special container and flush the cooling system with pure water.

Operation 54. Flush the engine air breathers



- Remove the air breather housings (1), remove the air breathers from the caps of the cylinder head covers, rinse them in diesel fuel and blow with compressed air. Assemble the air breathers in the reverse order.

Overall maintenance

Operation 55. Adjust oil pressure in the engine lubricating system

If the oil pressure in the lubrication system of a warmed-up engine at a rated crankshaft speed is below 0.28 MPa (2.8 kgf/cm²), stop the engine and correct the fault. Check tightness of the oil lines and serviceability of the relief valve in the oil filter. One way to increase the pressure is adjustment of the relief valve, paper oil filter in a special shop.

Operation 56. Adjust the relief valve of the gearbox centrifuge

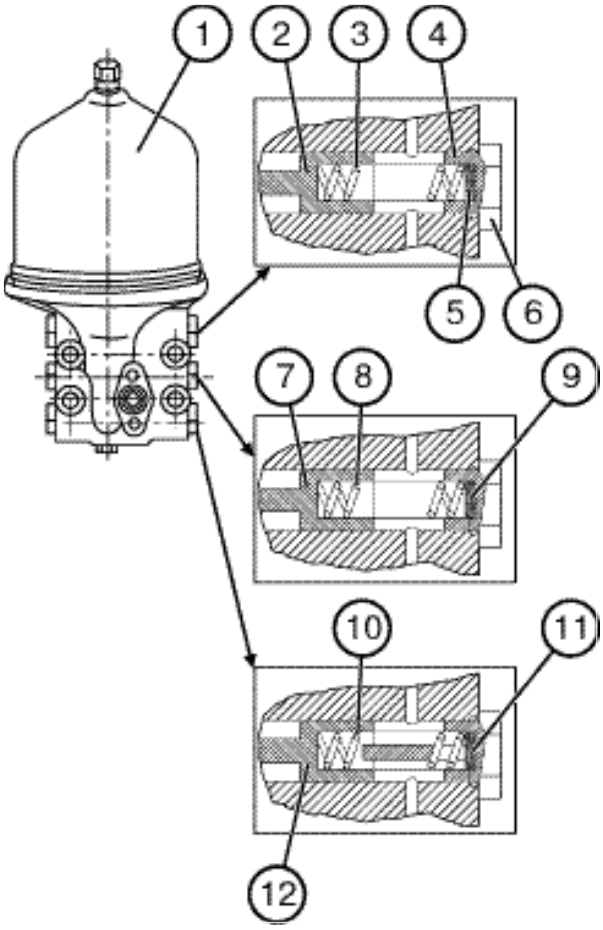
The valve (2) maintains an oil pressure in the system of 0.9 to 1.0 MPa (9 to 10 kgf/cm²).

If the pressure drops below the specified limit, adjust the valve (2) by installing additional washers (5) between the spring (3) and the plug (6).

IMPORTANT! If the pressure drops below 0.7 MPa (7.0 kgf/cm²), stop the tractor and contact a technician.

The valve (7) maintains an oil pressure before the rotor of the centrifuge. It must be 0.75 MPa (7.5 kgf/cm²).

The lubrication valve (12) is set for a pressure of 0.2 ± 0.05 MPa (2.0 ± 0.5 kgf/cm²) and maintains the oil pressure in the GB lubricating system. Adjust the valves with the washers (9) and (11).

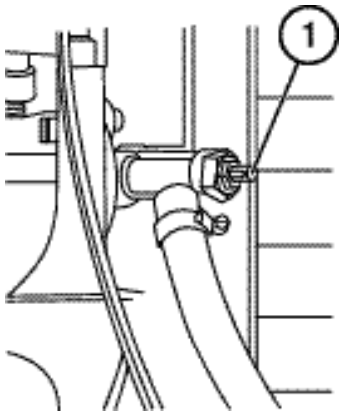


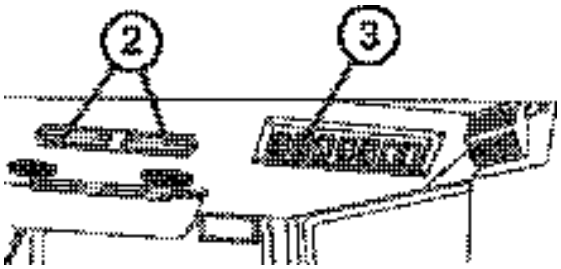
Operation 57. Maintenance of the cab ventilation and heating system

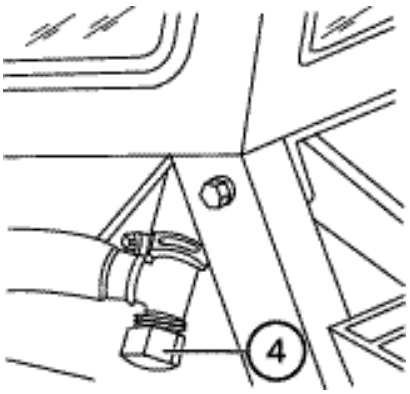
For efficient operation of the ventilation and heating system, perform the following operations:

1. After pouring a cooling fluid (water) into the cooling system, start the engine and without opening the valve (1) on the left side of the engine let the engine operate at medium speed to warm up the coolant in the system to 50 to 60°C, and then open the valve (1) to fill the heat exchanger with the fluid.
2. Make sure that the fluid is circulating through the heater, slightly opening the drain plug (4) on the right side of the cab. The heat exchanger must start warming up, at that the coolant level in the water heat exchanger of the engine must drop.
3. Add the coolant to the heat exchanger to the upper edge of the filler neck (Operation 2, p. N7).
4. For a quick warm-up of the cab, switch on the heater fan switch (3) and open the recirculation valves (2).

5. To discharge the coolant from the heater and the engine cooling system, install the tractor on an even surface, open the heater valve (1), remove the cap of the engine water radiator, remove the left and right drain plugs (4) and open the drain valves of the water radiator and the cylinder block of the engine.
6. During the warm season, the valve (1) must be closed for operation of the system in the ventilation mode.







ATTENTION! During the cold season, to avoid ice plugs, if the cooling system is filled up with water, blow the heating system with compressed air, first closing the valves for draining water from the water radiator and the cylinder block of the engine and install the water radiator cap to place.

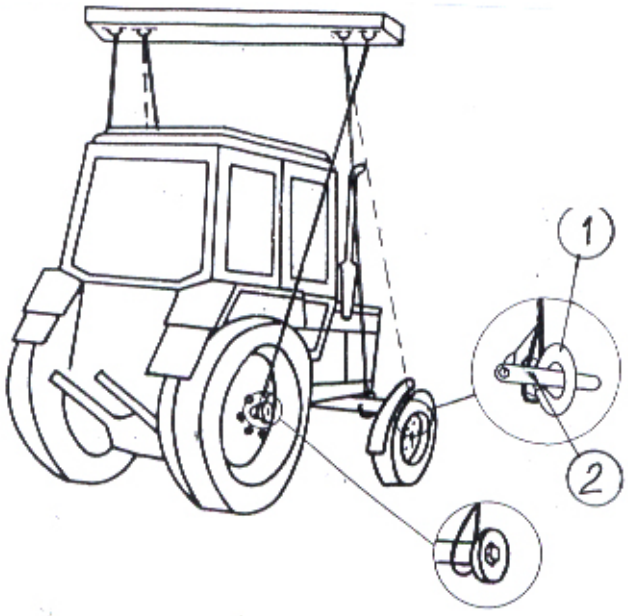
TRACTOR TRANSPORTATION AND ITS TOWING

Tractors are transported by railway, auto transport, on trailers, by towing and under own power.

In case of tractor transportation:

- Put gearshift levers to the first gear;
- Engage the parking brake;
- Fasten tractor to the platform with wires 3…5 mm in diameter, chains, bracing wires.

For loading/unloading tractors use lifting machines with carrying capacity not less than 10 ton-force.



Fasten ropes to the FDA beam or eyebolt (1) and rear wheels half-axles as shown on the pattern below. If you fasten ropes to the eyebolt (1), run load-handling device under eyebolt shank and lock in with stopper (2) through eyebolt.

When hydrostatic steering unit pump is disengaged, tow tractor not faster than 10 km/h on distance up to 5 km.

To connect towing rope use eye ring, fastened to the front balance weights and weights bracket.

When towing tractor strictly fallow road laws.

Attention! When lifting the tractor using its eye-bolts it may move forward (backward) up to 1,5m.

It is forbidden to use drawbar to lift a tractor.

It absolutely forbidden to tow a tractor with FDA with front wheels uplifted**.**

TRACTOR STORAGE

Before long-term storage of the tractor complete the following operations:

- Clean the tractor.
- Put the tractor in the shed or indoors.
- Lubricate all grease-points:
  - FDA;
  - Hydrostatic steering unit;
  - Clutch;
  - Mounting mechanism;
- Drain oil from engine crankcase, transmission, hydraulic steering tank, wheel-hub drives and main gear of FDA and fill with neat oil.
- Drain oil from fuel tanks and fill them with about 5 l of preservative fuel.
- Start the engine and let it run for about 5-10 min for filling the feeding system.
- Lift rear hitch links to the uppermost position and switch on lock mechanism (rear hitch with autonomous power cylinder).
- Take off the batteries, charge them and store in dry ventilated room with temperature 15-20°C. Check and charge them monthly.
- Jack up tractor front and rear axle and put it on the stands for tires unloading.
- Drain coolant from engine cooling system and cabin heating system.
- Slacken generator and fan belts.
- Cover exhaust pipe opening.
- Make couple turns of the crankshaft not less than once in a month.

To use tractor after long-term storage complete the following operations:

- Take the tractor from stands and adjust tire pressure according to the norm.
- Fill up fuel tanks.
- Check coolant and oil level in all tanks and capacities.
- Install full-charged batteries.
- Uncover exhaust pipe.
- Start the engine and check all devices, controllers and systems of the tractor.
- Check light and audible signaling devices.
- Let the tractor work without working load and make sure it is all right.

IMPORTANT: Before and after long-term storage operations related to the engine are to be made in accordance with operating manual of engine manufacturing plant.

SUPPLEMENT

Adjusting parameters of Д-260.2/Д-260.2S/Д-260.2S2 engine

Designation	Measuring unit	Description
Oil pressure in the lubrication system of warmed-up engine at rated speed of crank shaft	MPa (kgf/cm^2)	0,28-0,45 (2,8-4,5)
Coolant temperature in coolant system	°C	80-95
Alternator belt tension at 40 N (4 kgf) applied to the belt mid-way between pulleys of alternator and of crankshaft	mm	29+4
Clearance between the rocker arm pane and a valve plug end face on cold engine for valves		
• intake valves	mm	0,25…0,30
• exhaust valves	mm	0,40…0,45
Injection timing angle before T.D.C.	degrees	20±1 (15±1)**)or 16±1**/6±0,5***)
Pressure at the beginning of injector nozzle needle lifting	MPa (kgf/cm^2)	21,6+0,8 **(220+8)/240+12*****)
Tightening torque for main threaded joints:	N•m (kgf•m)	
• cylinder heads anchor bolts		190-210 (19-21)
• main bearings bolts		220-240 (22-24)
• nuts of crankpin bearings bolts		100-120 (10-12)
• flywheel mounting bolts		160-180 (16-18)
• balance weight mounting bolts		100-120 (10-12)
• injectors mounting bolts		30-35 (3,0-3,5)*
• crankshaft pulley bolts		160-200 (16-20)
• centrifugal oil filter cap nuts		35-50 (3,5-5,0)
• mounting bolts of torque vibration damper		
• air cleaner wing nuts		80-100 (8-10)
		8-10 (0,8-1,0)

* With preliminary tightening torque 15…20 N•m (1,5…2,0 kgf•m).
** With fuel pump 363-40 or PP6M10P1f respectively for Д-260.2S engines
*** For Д-260.2S2 engines

Fuel pump 363.1111005-40.02 adjusting parameters (JSC “YAZDA”) at bench check

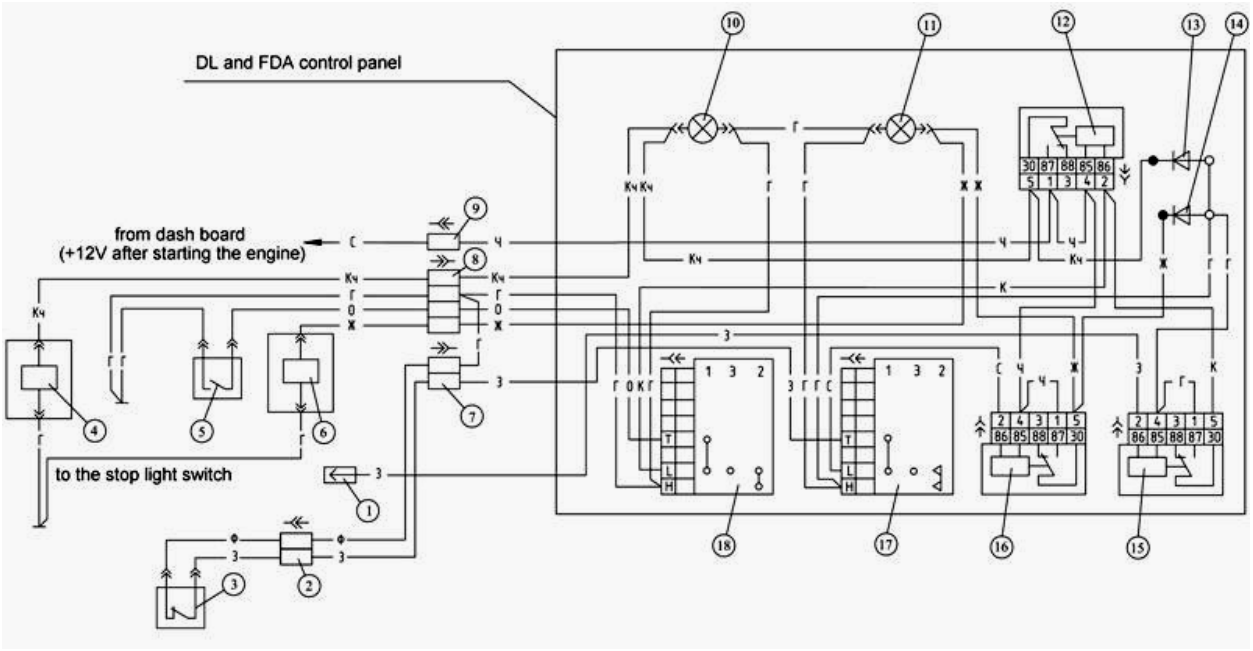
Designation	Measuring unit	Value
1. Average cyclic fuel feed in high-pressure lines at rated speed of 100 rpm, not less	mm^3/cycle	140
2. Rated speed of pump camshaft	rpm	1050+10
3. Average cyclic fuel feed in high-pressure lines at rated speed	mm^3/cycle	70±2
4. Non-uniformity of fuel feed in high-pressure lines at rated speed, not higher	%	6
5. Rotational speed at the moment of governor actuation	rpm	1075±10
6. Full automatic cessation of fuel feed by the governor in the range of rotational speed	rpm	1150 not higher
7. Average cyclic fuel feed by pump sections at rotational speed: 800±10 rpm	Mm^3/cycle	80…86 72…79
8. Pressure at the moment pneumatic corrector activates/ switches off at n=500 rpm	kgf/cm^2	0,1…0,2/ 0,2…0,3
9. Cyclic fuel feed at rotational speed of 500 rpm with no supercharger pressure	mm^3/cycle	66…74

Note: Check of the adjusting parameters, given in the items 1...7, should be done at force-disengaged pneumatic corrector (air pressure in pneumatic corrector is 0,8…1,0 kgf/cm^2).

Fuel pump PP6M10P1f-3492 adjusting parameters at bench check

Designation	Measuring unit	Value
1. Average cyclic fuel feed in the high-pressure lines at rotational speed of 100 rpm, not less	mm^3/cycle	150
2. Rated speed of pump camshaft	rpm	1050+10
3. Average cyclic fuel feed in pump high-pressure lines at rated speed	mm^3/cycle	80±2
4. Non-uniformity of fuel feed in high-pressure lines at rated speed, not higher	%	6
5. Rotational speed at the moment of governor actuation	rpm	1080±10
6. Full automatic cessation of fuel feed by the governor in the range of rotational speed	rpm	1170 not higher
7. Average cyclic fuel feed by pump sections at rotational speed: 800±10 rpm 500±10 rpm	mm^3/cycle	83±2,5 70±3,5
8. Pressure at the moment pneumatic corrector activates/ switches off at n=500 rpm	MPa	0,005…0,01/ 0,025…0,03
9. Cyclic fuel feed at rotational speed of 500 rpm with no supercharger pressure	mm^3/cycle	55,5…64,5

Note: Check of the adjusting parameters, given in the items 3...7, should be done at force-disengaged pneumatic corrector (air pressure in pneumatic corrector is 0,05…0,06 MPa).

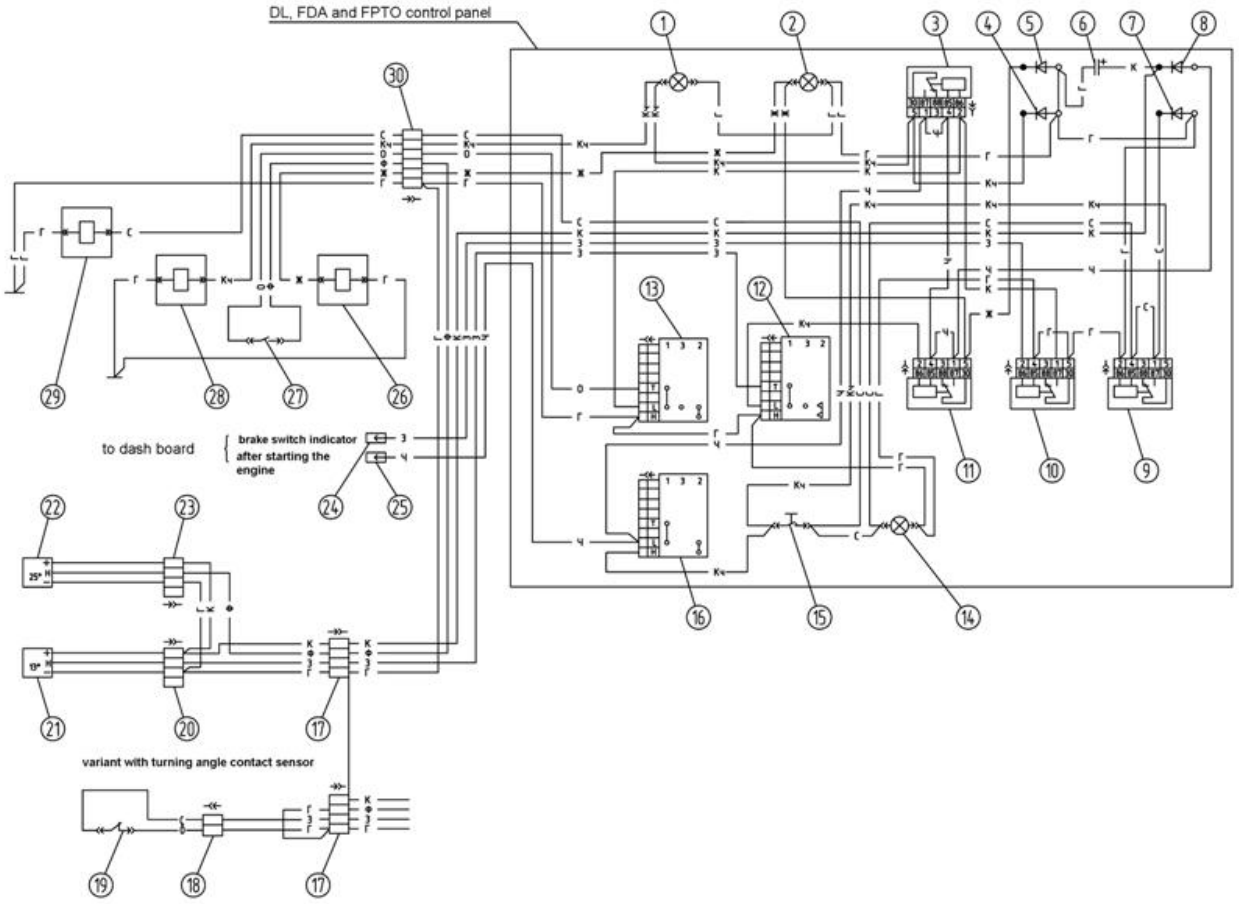


Wire colors: Г – blue; Ж – yellow; З – green; К – red; Кч – brown; О – orange; С – grey; Ф – violet; Ч - black

Circuit diagram of the control system of the rear axle and FDA DL.

1,2,7,8,9-connecting blocks; 4-eloctromagnet of FDA electro-hydraulic distributor; 5-FDA automatic control switch; 6-electromagnet of DL electro-hydraulic distributor; 10- lamp of FDA signaling indicator; 11-lamp of DL signaling indicator; 12-FDA switch relay;

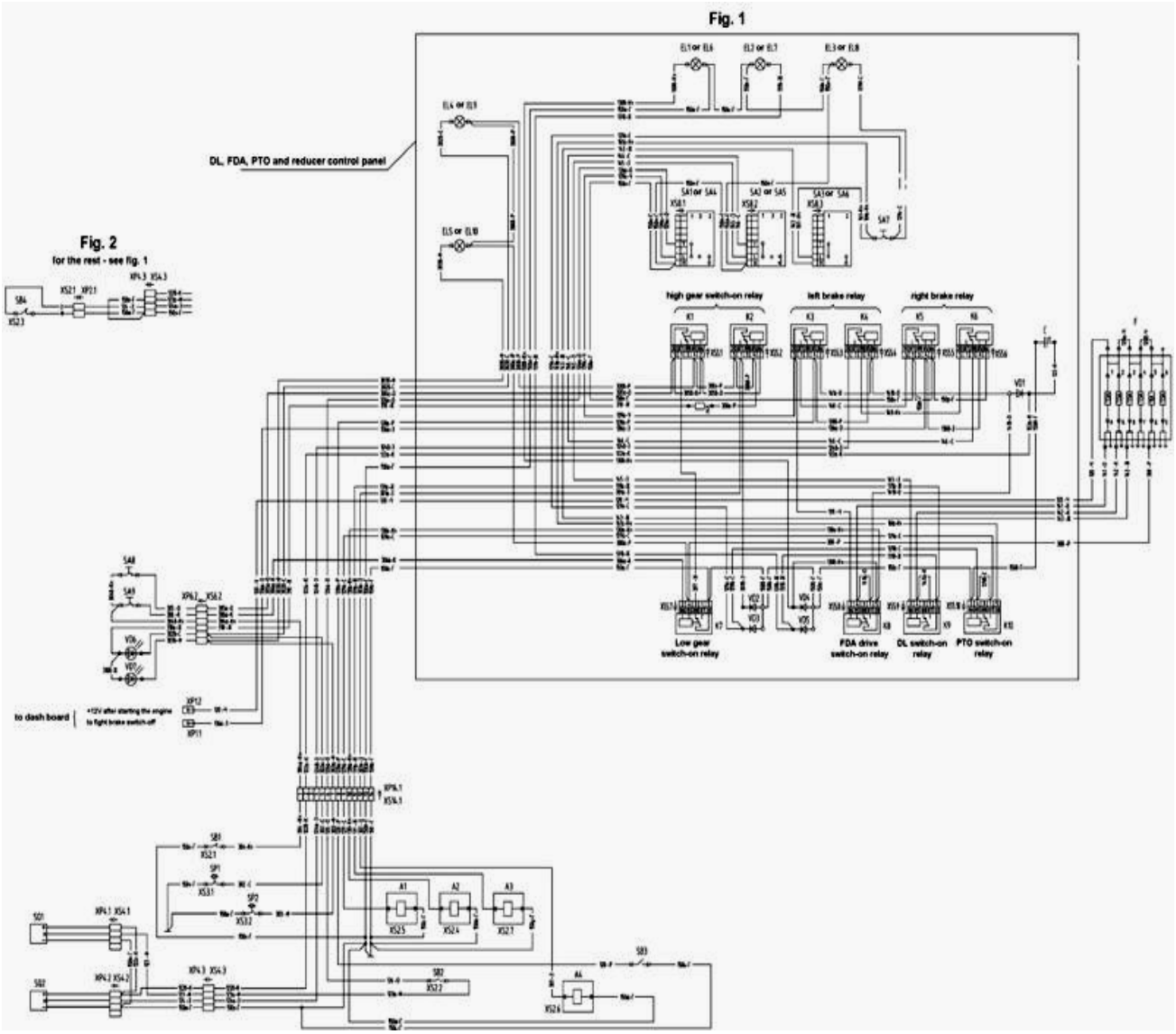
13, 14-diodes; 15-braking relay; 16-DL engaging relay; 17-three-way switch of DL control; 18- three-way switch of FDA control.



Wire colors: Г – blue; Ж – yellow; З – green; К – red; Кч – brown; О – orange; Р – pink; С – grey; Ф – violet; Ч - black

Circuit diagram of control system of rear axle DL, FDA DL and front PTO DL.

1-Indicator lamp of FDA drive switch; 2-Indicator lamp of DL switch; 3-FDA drive switching relay; 4, 5, 7, 8-diode; 6-condenser; 9-front PTO switching relay; 10-braking relay; 11-DL switching relay; 12-three-way switch of DL control; 13-three-way switch of FDA drive control; 14-Indicator lamp of front PTO switch; 15-front PTO disconnect switch; 16-front PTO two-way switch; 17, 18, 20, 23, 24, 25, 26, 30-connecting block; 19-contact sensor of ±13° front wheels turning angle (for DL); 21-contactless sensor of ±13° front wheels turning angle (for DL); 22-contactless sensor of ±25° front wheels turning angle (for FDA); 26-electromagnet of DL hydraulic distributor; 27-automatic control sensor of FDA drive (skidding); 28-electromagnet of FDA drive hydraulic distributor; 29-electromagnet of front PTO hydraulic distributor.



Code Designation	Fig.	Note
1221-8700250-Д	1	with FDA-1524 (or with FDA-1525)
-02	2	with FDA-1222

Wire colors: Г – blue; Ж – yellow; З – green; К – red; Кч – brown; О – orange; Р – pink; С – grey; Ф – violet; Ч - black

DL, FDA, PTO and reducer control scheme

Indications on DL, FDA, PTO and reducer control scheme

A1...A4 – Electromagnet of discrete hydraulic distributor (A1 - PTO, A2 - FDA, A3 - DL, A4 - reducer);

C - Condenser NA-25B-4700мкФ;

EL1...EL5 – Indicating lamp 12.3803-31 ТУ РБ 300228919.037-2002 (EL1 - FDA, EL2 - DL, EL3 - PTO, EL4 – high gear, EL5 – low gear);

EL6...EL10 – Indicating lamp 2202.3803-034 ТУ 37.003.1109-82 (EL6 - FDA, EL7 - DL, EL8 - PTO, EL9-high gear, EL10 - low gear);

F – Fuse block БП-1 ТУ РБ 03428193.095-97;

K1...K10 - Relay 90.3747 ТУ 37.003.1418-94;

SA1 - Commutator П147М-06.49 ТУ РБ 14795799.001-97 (SA1 - FDA);

SA2 - Commutator П150М-06.14 ТУ РБ 14795799.001-97 (SA2 - DL);

SA3 - Commutator П147М-01.17 ТУ РБ 14795799.001-97 (SA3 - PTO);

SA4 - Commutator П147-06.17 ТУ 37.003.701-75 (SA4 - FDA);

SA5 - Commutator П150-06.17 ТУ 37.003.701-75 (SA5 - DL);

SA6 - Commutator П147-01.17 ТУ 37.003.701-75 (SA6 - PTO);

SA7...SA9 – Switch-off 12-1 ЦИКС 642241.001 ТУ (SA7-PTO, SA8-high gear, SA9-low gear);

SB1 – Switch-off ВК12-41 ТУ РБ 3734210.004-97 (gear box neutral position);

SB3 – Switch-off ВК12-2 ТУ РБ 3734210.004-97 (DL (left brake));

SB2, SB4 – Switch-off ВК12-51 ТУ РБ 3734210.004-97 (SB2 – FDA automatic switch-on, SB4 - DL (±13°));

SP1,SP2 – Pressure sensor ДСДМ-М ТУ РБ 07513211.004-94 (SP1-high gear, SP2-low gear);

SQ1,SQ2 – Switch-off ЭВИТ-С3 ТУ РБ 37334210.004-97 (SQ1-FDA (±25°), SQ2-DL (±13°));

VD1...VD5 - Diode КД206А ТТ3.362.141ТУ;

VD6 – LED lАЛ307КМ аАО.336.076 ТУ (high gear (red));

VD7 - LED АЛ307НМ аАО.336.076 ТУ (low gear (yellow));

XP1.1,XP1.2 – plug-in socket 502601;

XP2.1 – plug-in socket 502602;

XP4.1...,XP4.3 – plug-in socket 502604;

XP6.1 – plug-in socket 502606;

XS2.1 – female socket 602602;

XS4.1...,XS4.3 – female socket 602604;

XS5.1...,XS5.10 – female socket 607605;

XS6.1 – female socket 602606;

XS8.1...,XS8.3 – female socket 605608;

XS2.1...XS2.3 – Female socket 0-0282189-1 (two-contact, black);

XS2.4 – Female socket 0-0282189-2 (two-contact, grey);

XP2.5,XS2.6 – Female socket 0-0282189-4 (two-contact, green);

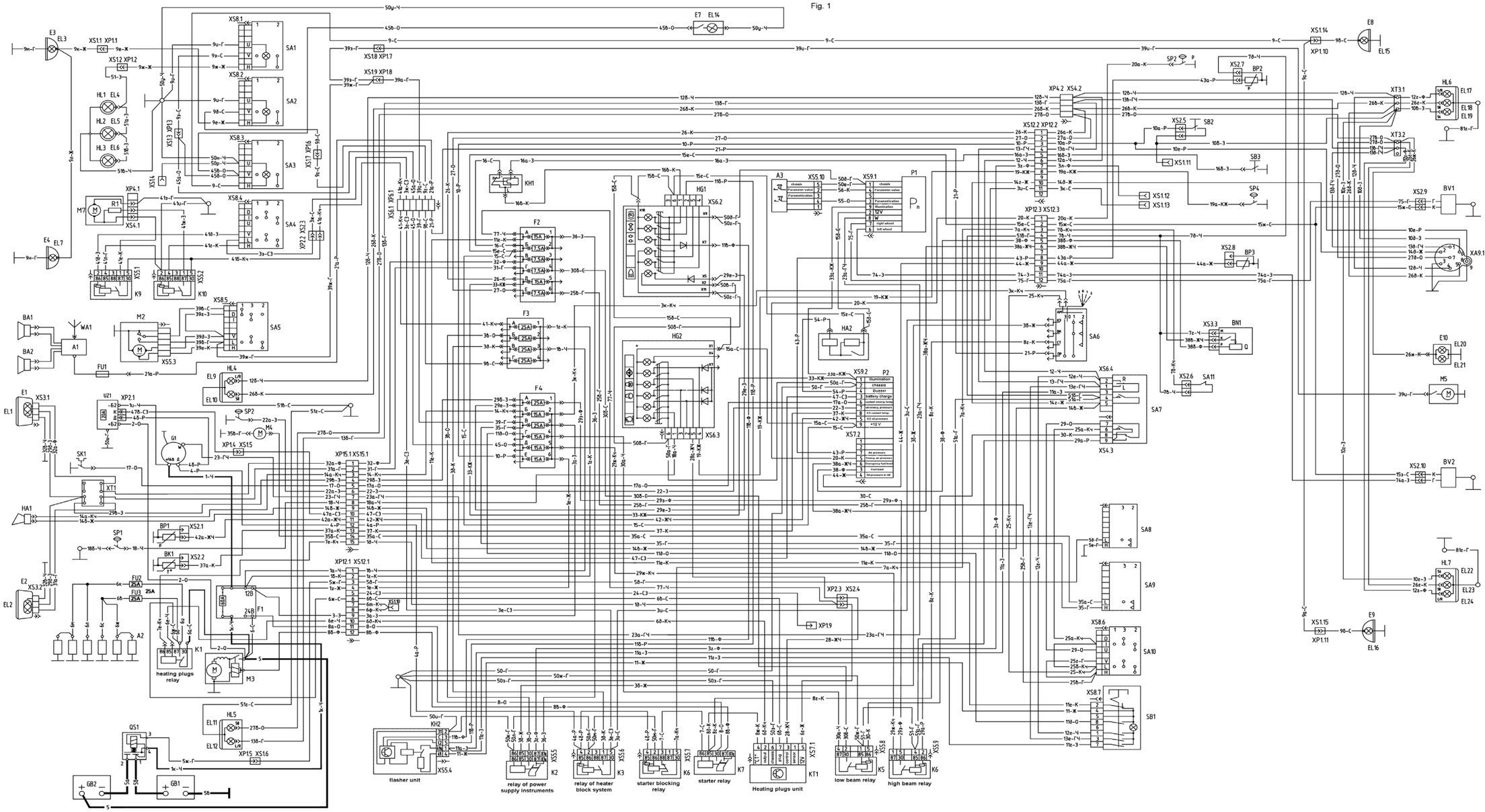
XS2.7 – Female socket 0-0282189-7 (two-contact, yellow);

XP3.1,XS3.2 – Female socket 0-0282191-1 (three-contact, black);

XP14.1 – Cable plug 0-0182649-1;

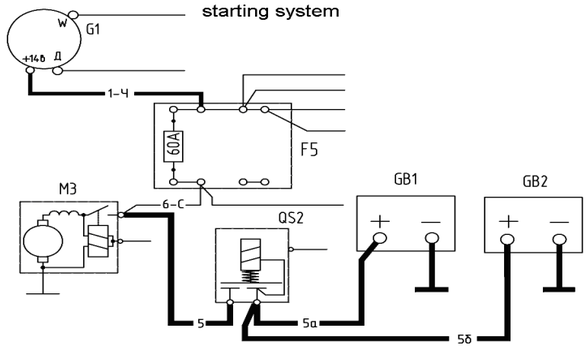
XS14.1 – Set socket 0-0182641-1.

Fig. 1

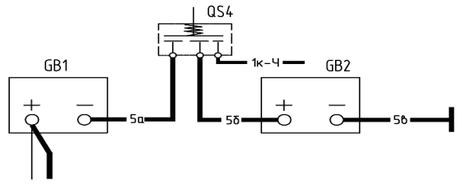


Electrical scheme of tractor connections

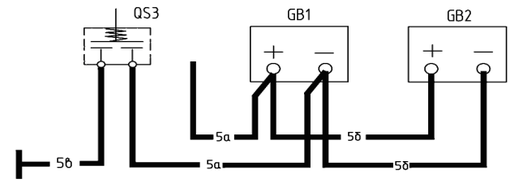
Variant with 12 V starting system



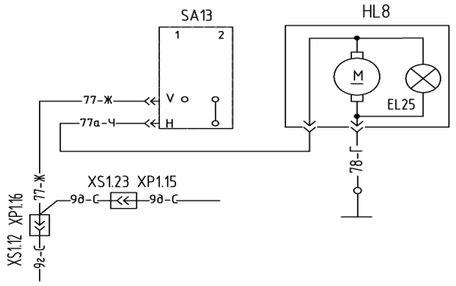
Variant with 24 starting system, with manual battery disconnect switch



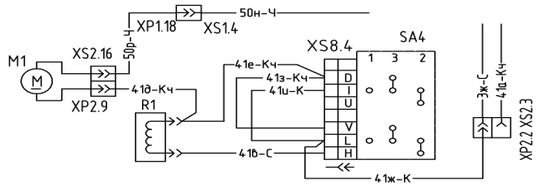
Variant with 12 V starting system, with manual battery disconnect switch



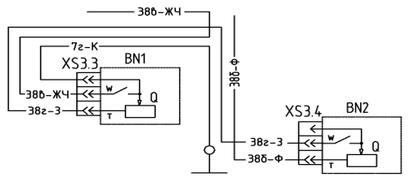
Variant with code beacon



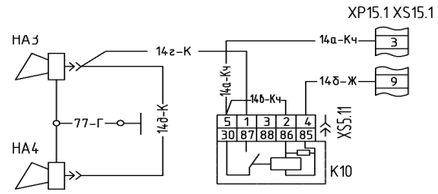
Variant with heater 80-8101720 (90 W)



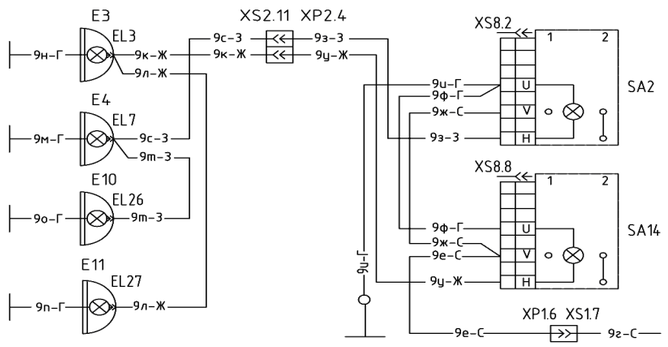
Variant with additional fuel tank



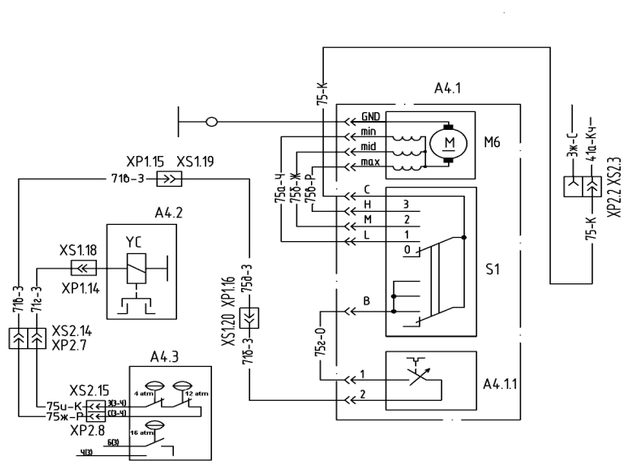
Variant of audible beep connections



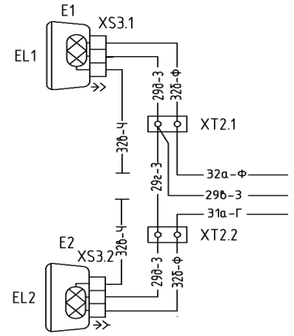
Variant with operating lights on the cover



Variant with conditioner

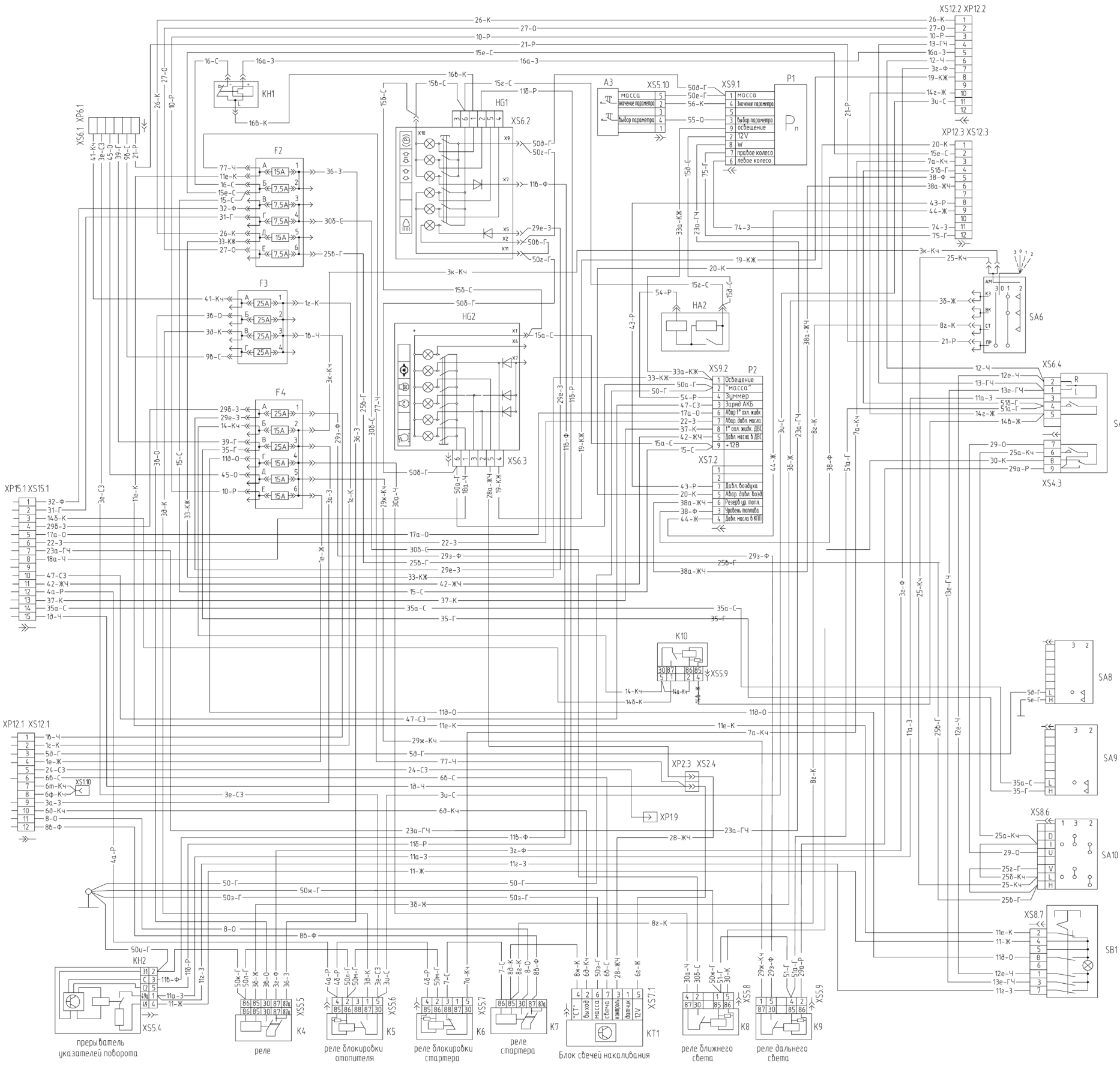


Varaint of lights connections using linking panels installed on the radiator shell of the cooling unit



Variants of tractor connections

80-3805010-Д1 instrument board scheme



Flasher unit	Relay	Relay of heater blocking	Relay of starter blocking	Starter relay	Heating plugs unit	Low beam relay	High beam relay

XS 5.10

Chassis	5
Parameter value	2
	3
Parameter selection	4
	1

XS 9.1

1	Chassis
4	Parameter value
5	
3	Parameter selection
9	Illumination
2	12 V
8	W
7	Right wheel
6	Left wheel

XS 9.2

1	Illumination
2	Chassis
4	Buzzer
3	Battery charge
6	Emerg. coolant temperature
7	Emerg. oil pressure
8	ICE coolant temperature
5	Oil pressure in ICE
9	+12 V

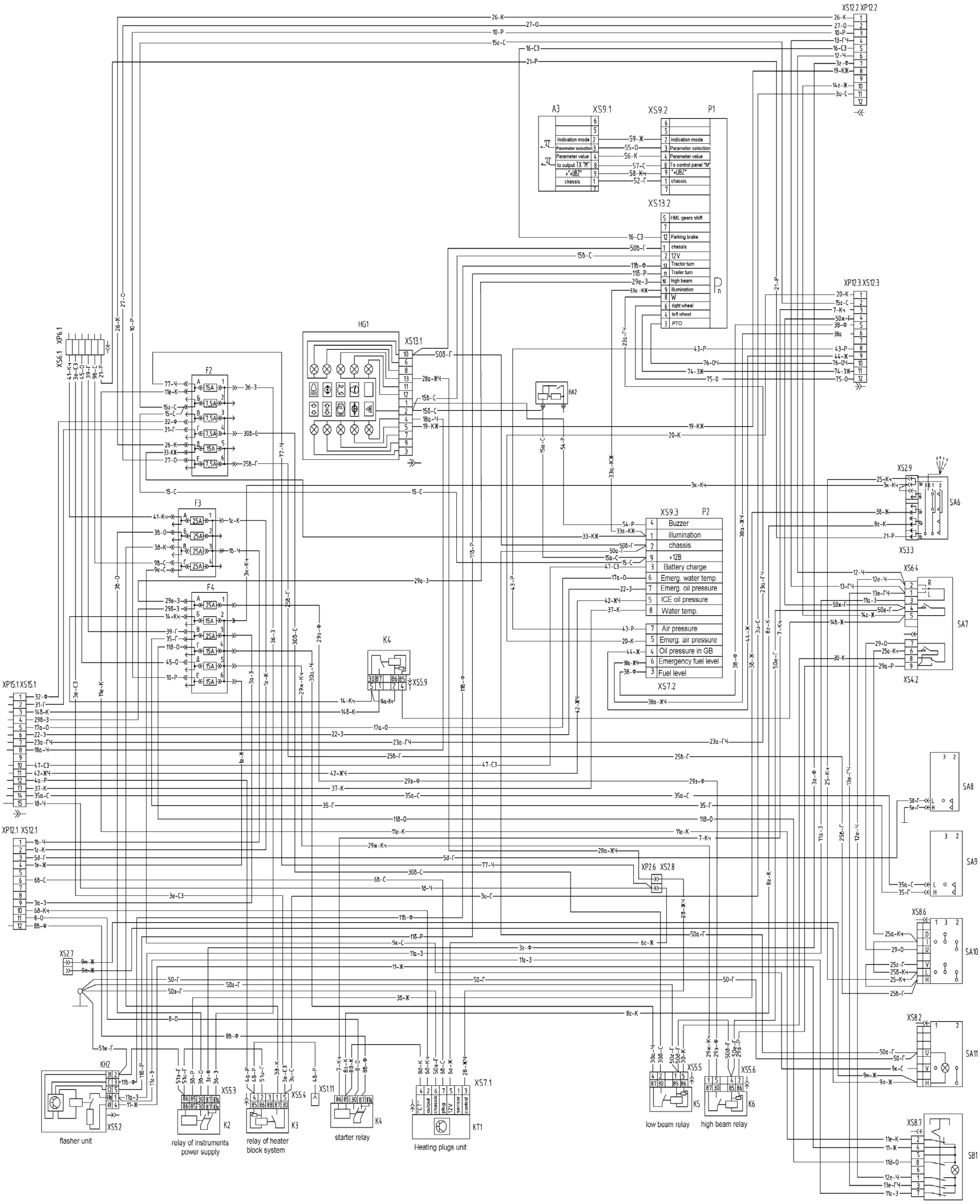
XS 7.2

1	
2	
7	Air pressure
5	Emerg. air pressure
6	Reserve fuel level
3	Fuel level
4	Oil pressure in GB

XS 7.1

«CT»	4
Output	2
Chassis	6
Plug	7
Control	3
Sensor	1
12 V	5

826-3805010 instrument board scheme



Parts list of electric scheme of tractor and dash board units

Designation	Description	Кол-во
A1	Stereo tape-recorder	1
A2	Heating plug	6
A3	Control unit	1
A4	Conditioner	1
A4.1	Air handling unit	1
A4.1.1	Regulator of output air temperature	1
A4.2	Condensing unit	1
A4.3	Pressure sensors unit	1
M6	Fan electric engine	1
S1	Fan modes switch	1
YC	Compressor electromagnet clutch	1
A5	Electric torch heater	1
BA1,BA2	Loud speaker	2
BK1	Temperature gauge sender	1
BN1…BN3	Gasoline tank unit	3
BP1	Engine oil pressure sensor	1
BP2	Air pressure sensor	1
BV1…BV3	Speed sensor	3
E1, E2	Road lights	2
E3, E4, E5, E6, E8…E11	Operating lights	8
E7	Room lamp	1
E10	Number plate light	1
EL1, EL2	Lamp АКГ12-60+55-1	2
EL3,EL7,EL8, EL13,EL15, EL16,EL25… EL27	Lamp АКГ12-55-1	9
EL4 ...EL6, EL9,EL10, EL20,EL21	Lamp A12-5	7
EL11,EL14, EL17,EL19, EL22,EL24	Lamp A12-21-3	7
EL18,EL23	Lamp A12-10	2
F1...F4	Fuse blocks	4
FU1	Fuse	1
FU2, FU3	25 A fuse link	2

Designation	Description	Кол-во
G1	Alternator 14V,1150W	1
GB1,GB2	Accumulator battery 12V, 88 ampere-hour	2
HA1	Low-frequency audible beep	1
HA2	High-frequency audible beep	1
HA3	Indicating relay	1
HG1,HG2	Indicating lamps unit	2
HL1...HL3	Light of tractor-trailer unit sign	3
HL4,HL5	Front light	2
HL6,HL7	Rear light	2
HL8	Beacon	1
K1	Heating plugs relay	1
K2	Relay of instruments power supply	1
K3...K6, K8...K10	30A cut-in relay	7
K4	20A cut-off relay	1
K7	Starter relay	1
KH1	Disconnector of hand brake indicating lamp	1
KH2	Turning indicators disconnector	1
KT1	Heating plugs unit	1
M1	Fan electric engine (90W)	1
M2	Pantograph wiper	1
M3	Starter	1
M4	Electric washer	1
M5	Windscreen wiper	1
M7	Fan electric engine (120W)	1
P1	Tachospeedometer	1
P2	Instrument board КП-5	1
R1	Ballast resistor of fan engine	1
QS1	24 V batteries remote switch-off	1
QS2	12 V batteries remote switch-off	1
QS3	12 V batteries manual switch-off	1

Designation	Description	Number
QS4	24 V batteries manual disconnector	1
SA1	Disconnector of tractor-trailer unit sign	1
SA2, SA3,SA11	Operating lights switch-off	3
SA4	Fan switch	1
SA5	Windshield wiper switch	1
SA6	Starter disconnector with start blocking	1
SA7	Combined switch	1
SA8	Battery disconnect switch	1
SA9	Screen washer disconnect	1
SA10	Light switch	1
SA12	Switch-off of start blocking	1
SA13	Beacon switch-off	1
SB1	Alarm signaling switch-off	1
SB2	Brake light switch-off	1
SB3	Hand brake light switch-off	1
SK1	Emergency temperature sensor	1
SP1	Air cleaner impurity sensor	1
SP2	Emergency air pressure sensor	1
SP3	Emergency oil pressure sensor	1
UZ1	Voltage changer	1
WA1	Aerial wire	1
XS12.1 XS12.2	Socket ШС32П12Г-М-7	2
XS12.3	Socket ШС32ПК12Г-МТ-7	1
XS15.1	Socket ШС36У15Г-М-6	1
XP12.1 XP12.2	Plug ШС32ПК12Ш-МТ-7	2
XP12.3	Plug ШС32П12Ш-М-7	1
XP15.1	Plug ШС36ПК15Ш-МТ-6	1
XA9.1	Agricultural implements socket	1
XT1	Branching unit	1
XT2.1,XT2.2	Two-wire connecting panel	2
XT3.1,XT3.2	Three-wire connecting panel	2

Wires colors:

Г – blue
Ж – yellow
З – green
К – red
Кч – brown
О – orange
Р – pink
С – grey
Ф – violet
Ч – black
ГЧ – blue-black
ЖЧ – yellow-black
ЗЖ – green-yellow
КЖ – red-yellow
ОЧ – orange-black
СЗ – grey-green