MTZ
2022
2022V

2022-0000010РЭ

OPERATION MANUAL

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Tractors MTZ 2022/2022V. Operation manual / V.G.Levkov/

The Operation Manual contains description and technical specification of tractors MTZ 2022/2022V manufactured by Minsk Tractor Works.
Main procedures of machines' maintenance are set forth, adjustment and servicing data are given.
The Manual is intended for tractor operators engaged in the operation and maintenance of MTZ tractors.

As the policy of MTZ is aimed at the constant improvement of machines under manufacture, changes in the design of some components, not elucidated in the present edition, may be introduced. Address your local "MTZ" dealer for more details.

Contents

TO ATTENTION OF OPERATORS!

1. Before starting the tractor, carefully study the present manual and strictly observe all operation and maintenance directions.
2. Be sure to run-in the tractor for 30 hours. Before the first maintenance (125 hours) load diesel up to 80% of rated power.
3. Your tractor is equipped with range gear box. Ranges are shifted by means of tooth-type couplings and synchronizers, and gears within each range are selected by synchronizers.
First the range is shifted, then the gear is put in.

TO SHIFT THE RANGE:

- press the clutch pedal and wait until tractor comes to a full stop;
- using the range shifting lever, smoothly and without jerks shift the required range; ranges are shifted according to recommendations given in section "Tractor pre-starting procedure".

TO PUT IN GEAR:

- press the clutch pedal;
- smoothly and without jerks pull the gear shifting lever and hold it pressed until the gear is fully put in;
- smoothly release the clutch pedal.

Change gears on the go within one range only during transport works on hard roadway covering. DO NOT shift gears when moving in cross-country conditions (ploughed field, sand soil, peat terrain) due to abrupt stops. In this case move on such terrain using the earlier put in gear. Non-observance of these regulations will result in premature wear of tooth-type coupling pinion's splines, as well as damage of synchronizers.

CAUTION! If, with clutch pedal pressed, ranges and gears are put in with grinding sound, immediately consult your local dealer and correct malfunction.

4. Observe rules of PTOS engagement. To avoid damage of the shaft, reduction gear pinions and PTOS during PTOS switching, pull steering lever smoothly with travel delay by 2…4 starting from the middle of travel from neutral to PTOS switch.
5. The operating and parking brakes should be adjusted only on horizontal ground with the engine shut down and wedges placed from the front and behind rear wheels to avoid accidental movement of the tractor.
6. The tractor shall not be operated without a storage battery in the electrical equipment.

INTRODUCTION

The present manual contains description of the design, technical data, directions for operation and maintenance of agricultural high-power wheeled tractors MTZ 2022 and MTZ 2202V (reversible model).

Tractor MTZ 2022 has 4×4 wheel arrangement and has been designed for performing various agricultural works using mounted, half-mounted and trailing machines and implements, for transportation, using loading-unloading mechanisms, harvesting complexes, as well as for driving stationary agricultural machines.

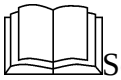
Tractor MTZ 2022V is a reversible model, designed for prolonged operation in the reverse mode. The difference lies in the additional reversible steering post that includes an additional steering column, duplicate transmission control, brakes, fuel supply system, as well as special reversible seat to be used for direct and reverse movement.

Abbreviations and symbols:

DAI - differential automatic interlock;
SB - storage battery;
DL - differential lock;
TDC - top dead center;
PTOS - power take off shaft;
HTDS - hydraulic three-dimensional steering;
RLM - rear lift mechanism;
HLS - hydraulic lift mechanism;
CL - clutch;
GB - gear box;
TC - turbo-compressor;
M - maintenance;
DSM - daily shift maintenance;
IVR - integral voltage regulator;
PIS - power intake shaft;
FDA - front drive axle;
TCM - traction-coupling mechanism;
UCS - universal control system of agricultural machinery;
FPTOS- front power take off shaft;
HPH - high-pressure hose;
MTA - machine-tractor assembly;
SPK - spare parts, tools and appliances kit;
SAC - supercharged air cooler;
SCU - starter control unit;
ILCU - incandescent lamps control unit

INTERNATIONAL SYMBOLS

The manufacturer uses standard International symbols to describe functioning of devises and controls.


See the manual


Brake


Parking brake


Signal


Emergency alarm


Fuel


Cooling liquid


Plug of pre-start heater

Diesel engine revolutions


diesel oil pressure


Diesel coolant temperature


Shut-off/ stoppage


On/start up

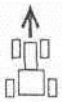

Smooth adjustment

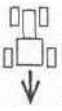

Lever down


Steering manipulations


Fast


Slowly

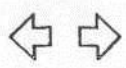

Forward


Back


Battery charging


Cabin ceiling light

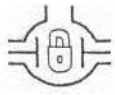

Side lights


Turn light


Headlight


Lower light

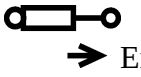

Operation head-lights


Differential lock


Power take off shaft is on


Front drive axle is on


Lever up


External cylinder “ extending”


External cylinder “ pull-in”


External cylinder “ equilibrium”


Oil pressure in KP


Air pressure in the pneumatic system

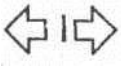

Air filter clogging

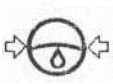

Fan

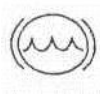

Wind shield wiper


Front wind shield wiper


Rear wind shield wiper


Trailer turn signal


Oil pressure in HTDS


Braking fluid level in tanks of main cylinders

1. SAFETY REGULATIONS

1.1 GENERAL PROVISIONS

1.1.1 Strict observance of regulations ensures tractor operating safety, improves its reliability and increases operation life.
1.1.2 The tractor can be operated by at least 17-yers old persons who received tractor operator license and passed occupational and fire safety tests.
1.1.3 Carefully study the present manual before using the tractor. Insufficient knowledge of tractor control and maintenance can be the reason of accidents.

1.2 SAFETY REQUIREMENTS IN TRANSPORTATION AND REACTIVATION

1.2.1 During transportation and loading/unloading operations follow directions set forth in section 8.
1.2.2 In preserving the tractor and additional equipment follow requirements for fire safety and hygiene when handling chemical substances, used cleaning cloth and oil paper.

1.3 REQUIREMENTS FOR TRACTOR'S TECHNICAL CONDITION

1.3.1. The tractor must by run-in in compliance with section 6.5. The tractor must be in complete and technically operational.
1.3.2 Do not allow dismantling of protective housings and fencing being part of design, as well as other parts and assembly units, that effect safety of its operation (fan protective grid, rear PTOS housing, etc.)
1.3.3. Technical state of the brake system, steering, illumination and alarm systems, chassis should comply with safety requirements, relative standards and the present manual.
1.3.4. Trailing agricultural machines and transport trailers should be provided with rigid hitching to avoid swing and run-over the tractor.
1.3.5. Tractor's controls should be reliably fixed in operation positions.
1.3.6. Keep all warning plates clean. Damaged or lost plates should be replaced for new ones.
1.3.7. Don't allow leakage of electrolyte, water, fuel, oil and braking fluid.
1.3.8. Make the right choice of summer and winter fuel grades. To avoid moisture condensation during the night, fill in the tank at the end of each working day. Use only oils and lubricants recommended by manufacturers. The use of other greases and lubricants is STRICTLY FORBIDDEN.

1.4. SAFETY REGULATIONS IN TRACTOR OPERATION

CAUTION! Don't start the engine being out of operator's working place. Always be inside the cabin on the operator's seat when starting the engine and manipulating controls.

1.4.1. Before starting the engine, the parking brake should be switched on lever of the power take-off shaft (PTO) should be in the "brake" position, levers of changing ranges and putting in gears – in "Neutral" position. The switch of the gear box pump drive should be in the driving position "off the diesel".

1.4.2 Before starting movement, give a warning signal to those around and working on trailing machines, make sure the parking-stand-by brake is switched off, and slowly start the movement. During transportation works use fastening belts (supplied as option).

1.4.3. Don't leave the tractor while on the move.

Before leaving the cabin, switch the PTOS off, shut down the diesel, engage the parking brake and pull out the starter key.

1.4.4. Don't operate the tractor inside the premises with not sufficient ventilation, exhaust fumes may be the cause of fatal outcome!

1.4.5. If the diesel or steering fail immediately stop the tractor. Remember, that much more effort should be applied to the steering wheel to drive the tractor with the diesel stopped.

Don't work under lifted agricultural implements. Don't leave mounted tools in the lifted position during prolonged stops.

1.4.6. If the tractor's front part breaks away off the ground when mounting heavy machines on the hinging mechanism, place front ballast loads.

1.4.7. No passengers are allowed in the cabin during tractor operation (A passenger is allowed only if an additional seat is installed in the cabin).

1.4.8. Don't operate the tractor with defective instrumentation.

1.4.9. Don't allow the diesel fuming and drastic drop in revolution frequency due to overloading.

1.4.10. During an accident, or excessive increase of revolutions frequency of the diesel crankshaft, immediately stop fuel supply, pull diesel shut-down knob back, and brake the tractor.

1.4.11. Switch on an independent rear PTOS drive only with non-operational diesel, or at minimum frequency of crankshaft rotation at the time of starting up or shutting down the diesel.

1.4.12. When the tractor operates without using rear PTOS, put the switching handle of the independent drive and PTOS control handle in position "switched off".

1.4.13. To switch on PTOS, move the control lever smoothly with 2…4 s delay in the middle of the travel from neutral to the PTOS switching time to avoid breakage of the drive shaft, reduction gear pinions and PTOS end.

1.4.14. After disconnecting PTOS driven machines, remove the cardan drive and cover the PTOS end with a protective cup.

1.4.15. Do not lower the mounted machine by putting RLM control lever in position “forced lowering”.

1.4.16. Before starting the diesel, put gears and ranges shifting levers in neutral position. During starting there should be no people under, in front and at the back of the tractor, as well as between the tractor and the machine connected to it.

1.4.17. When hitching and mounting agricultural machinery and tools to the tractor, the operator’s assistant should keep himself at safe distance till the full stop. Hitching (mounting) can be started only upon operator’s signal.

1.4.18. In case of malfunctioning immediately stop the tractor and correct the problem.

1.4.19. When ganging the tractor up to agricultural machinery, observe safety regulations for these machines’ operation.

1.4.20. Before mounting agricultural machines on the tractor, make sure automatic grips of lower and upper RLM tie-rods are clean and serviceable. Operation with non-serviceable, clogged with mud and foreign particles interior surfaces of automatic grips, is not allowed.

1.4.21. Before lifting and lowering of a mounted agricultural tool, and when the tractor is turning, make sure in advance there is no danger to touch or brush against any obstacle.

1.4.22. To avoid damage of the tractor or an agricultural machine, movement and turning of the tractor with a mounted agricultural machine can be started only after putting PTOS control lever in “brake” position.

1.4.23. Lower the mounted machine in the operational position and lift it in the transport position only during rectilinear movement of the assembly.

1.4.24. The cardan shaft that passes rotation of the tractor’s PTOS to the assembly tools should be fenced.

1.4.25. Make sure that any additional equipment or auxiliary device is properly installed, and also that they are intended for use with your tractor.

Remember, that your tractor, if improperly operated, can be dangerous for you and other people. Don’t use equipment that is not intended to be installed on the tractor.

1.4. 26. When tractor assemblies operate in the column, the interval between them should be 30 meters minimum.

1.4.27. The movement of the tractor assembly on slippery roads with DAI switched on is allowed at the speed of 12 km/h maximum.

1.4.28. When operating on slopes, increase the tractor's wheel track to maximum.
1.4.29 Don't make sharp turns when fully loaded and at high movement speed.
1.4.30. During dark time operation switch on illumination devices.
1.4.31. Stop the diesel and switch off PTOS to clean, lubricate, adjust and repair the tractor.
1.4.32. When using PTOS driven equipment brake the PTOS end and shut down the diesel before leaving the cabin.
1.4.34. When operating stationary PTOS driven machines, always engage the parking brake and block rear wheels on both sides. Make sure, the machine is securely fixed.
1.4.35. Make sure, PTOS end is properly protected, and if PTOS is not used, replace PTOS end cup.
1.4.36. The tractor is allowed to operate across slopes with up 9° steepness only in the daytime at the speed of 10 km/hour maximum and wheel span 1800 mm minimum.
1.4.37. When operating or moving in the transmission line area, the distance from the top point of the tractor assembly to wires should not be less than:

TL voltage, up to kV	11	20-25	110	154-220	330-500
Horizontal distance, m	1.5	2	4	6	9
Vertical distance, m	1	2	3	4	6

1.4. 38. Don't allow operation with heavy machines without front ballast load.

1.5. SAFETY REGULATIONS DURING TRANSPORT WORKS AND TRACTOR TOWING

1.5.1. During transportation works observe traffic regulations in force on the territory of the country.
1.5.2. Transportation works can be performed only by operators with at least two years tractor driving experience and having passed examinations in traffic regulations.
1.5.3. When using the tractor in transportation works:

- increase tractor's wheel span to at least 1900 mm;
- check brakes functioning;
- interlock brakes pedals, check and adjust, if necessary, simultaneous functioning thereof;
- check functioning of the parking brake;
- check the state of light and sound alarm instruments;
- transport trailers should have rigid hitching and additionally connected with reserve chain or steel rope;
- never descend the hill with gear switched off (coasting). Use one gear for moving uphill and downhill;
- don't operate with a trailer without self-contained brakes, if its mass exceeds half of the total actual tractor's mass. The faster you move and the larger is the mass being towed, the longer safe distance should be.

1.5.5. Before starting the work, switch the compressor on, check the state of the brakes pneumatic drive, air pressure in the system. Correct malfunctioning revealed.
1.5.6. Trailers ganged up to the tractor, should be equipped with the braking system capable of:

a) trailer braking while on the move;
b) brakes engagement when the trailer is disconnected from the tractor;
c) trailer retaining when parked on slopes;
d) prevention of trailer' s pushing action on the tractor during sharp change in movement speed.
   The trailer should be connected to the tractor by a reserve chain.

1.5.7. Transportation of people in trailers is not allowed.
1.5.8. To avoid overturning, be careful when driving the tractor. Select safe speed in accordance with road condition, in particular, when moving on the cross-country terrain, crossing ditches, slopes and during sharp turns.
1.5.9. Movement speed when making a turn should not exceed 5 km/hour, on slippery road – 3 km/hour. Put in 1^{st}, or 2^{nd} gear when descending the hill. Movement speed on rail road approach lines should not exceed 10 km/hour.
1.5.10. During trailer loading (unloading) brake the tractor with the parking-reserve brakes.
1.5.11. Tractor can be towed with non-operational HTDS at the speed of 10 km/hour maximum and to the distance of 5 km.
1.5.12. When used with a trailer on public roads, the tractor should have road train identification sign switched on according to "Traffic regulations".

1.6. SAFETY REGULATIONS DURING MAINTENANCE

1.6.1. Maintenance should be carried out on horizontal site, with diesel shut down and wedges placed on both sides of rear wheels. PTOS end must be braked, mounted machines lowered and tractor braked.
1.6.2. To lift the tractor use the jack, and when raised put supports under the front axle beam, half-axles of rear wheels or basic parts of the tractor frame.
1.6.3. Observe safety regulations when using lifting-transport mechanisms.
1.6.4. To avoid fuel splashing during mechanical tractor refueling, remove meshed filter from the fuel tank neck. The meshed filter is intended only for manual refueling in field conditions.
1.6.5. To examine places to be controlled and adjusted, use portable lamp with voltage not more than 36 V. The lamp should be protected by wire mesh.

1.6.6. The tools and appliances used for maintenance should be serviceable, serve the purpose and be safe in use.
1.6.7. Don’t inflate tires without gauging pressure.
1.6.8. When servicing storage batteries:
a) avoid electrolyte dropping on skin;
b) wipe batteries with cloth soaked in ammonium solution (salmiac);
c) when adjusting electrolyte level add only distilled water;
d) do not check the battery charging by short circuiting terminals;
e) do not connect the storage battery with reverse polarity.
1.6.9. To avoid failure of electronic units in the electrical equipment system observe the following precautionary measures:

- do not disconnect SB terminals with the diesel in operation. This results in peak voltage in the charge circuit and inevitably causes diodes and transistors failure.
- Do not disconnect electrical wiring before diesel stoppage and switching off all electric switches;
- Do not cause short circuiting arising due to improperly connected wiring. Short circuiting or wrong polarity lead to damage of diodes and transistors;
- Do not switch of the electrical equipment system using the starter and instruments’ switch, as well as “ground” switch before diesel completely stops;
- Do not connect SB to the electrical equipment system without prior examination of terminals' polarity and voltage;
- Do not check electric current “by sparking”, as this will immediately lead to transistors’ break down.

1.6.10. The cooling system operates under pressure, sustained by the valve installed in the surge tank cover. It’s dangerous to remove cover on hot diesel. To avoid face and hands burn, be careful when opening the tank neck cover of the hot diesel. Put cloth on the plug and use gloves.
1.6.11. To avoid danger of explosion, don’t allow open flame source close to the diesel fuel system and storage batteries
1.6.12. To avoid burns be careful when draining coolant from the cooling system, hot oil from diesel, hydraulic system and transmission.
1.6.13. To assembly and dismantle the diesel use steel rope fixing it to eye bolts provided on the diesel.
1.6.14. Switch off SB when using electrical welding during maintenance works.
1.6.15. Do not introduce any alterations in the tractor design, or its components without notifying the manufacturer. Otherwise, claims under the warranty are not accepted.
1.6.15a The tractor shall not be operated without SM as part of the electrical equipment.

1.7. FIRE SAFETY REGULATIONS

1.7.1. The tractor should be equipped with fire-fighting implements – a spade and a fire extinguisher.
1.7. 2. Never refuel the tractor with diesel functioning.
1.7.3. Do not smoke when refueling the tractor.
1.7.4. Do not fill in the fuel tanks to the full. Leave some space for fuel expansion.
1.7.5. Never add benzene or mixtures to the diesel fuel. These combinations may increase danger of explosion and inflammation.
1.7.6. Tractors' parting lot, fuel and lubricants storage sites should be surrounded with at least 3 m wide ploughed zone and provided with fire-fighting implements.
1.7.7. Refuel the tractor mechanically with diesel shut down. Use illumination at night. The use of buckets for filling in fuel tanks is not recommended.
1.7.8. Remove vegetation remains from assembly units and parts when using electric and gas welding during repair works under field conditions.
1.7.9. Do not soil the muffler and collector with dust, fuel, straw, etc.
1.7.10. Do not allow reeling of straw up the rotating parts of machines ganged up to the tractor.
1.7.11. When rinsing parts and assembly units in kerosene or benzene, take measures to exclude inflammation of rinsing fluids' vapors.
1.7.12. Do not allow tractor's operation in fire dangerous areas with hood and other protective items taken off heated diesel parts.
1.7.13. Do not use open flame to heat oil in the oil pan, during filling in fuel tanks or burning out soil in the radiator core.
1.7.14. When place of ignition arises, bury it with sand, cover with tarpaulin or some other dense material. Use carbon dioxide fire extinguisher. Do not pour water on burning fuel.
1.7.15. Check that during diesel operation there were no inflammable materials close to the exhaust collector and muffler.
1.7.16. When harvesting hay or straw, or operating in fire highly dangerous areas, use spark traps complete with muffler in the exhaust system, or use them separately.

1.8. SAFETY REQUIREMENTS IN STORAGE

1.8.1. When putting the tractor for storage, during maintenance in storage, or removing from storage, observe relative requirements of the present section and safety regulations under GOST (state standard) 9.014-78.

1.8.2. During storage the tractor should be placed on specially manufactured supports or trestle to exclude its turning over or accidental shifting.

1.9. HYGIENE REQUIREMENTS

1.9.1. First aid kit should be supplied with bandages, iodine, salmiac, boric vaseline, validole and analgine.

1.9.2. Depending on environmental conditions, use natural cabin ventilation, or air conditioner/ heater.

2. GENERAL DATA

Farm high-power wheeled tractor MTZ 2022 of 3.0 class traction with 4 x 4 wheel arrangement is designed for different agricultural works using mounted, half-mounted, trailing machines, loading-unloading mechanisms, harvesting complexes, for driving stationary agricultural machinery, including transportation in various climatic zones.

The tractor is equipped with an in-line six-cylinder diesel engine with turbo-charging and intermediate cooling of supercharged air, having rated power of 210 h/p with 2100 rev/min of the crankshaft.

Straight behind the diesel engine there are power transmission mechanisms, the clutch, gear box, rear axle with differential interlock, rear power-take-off shaft with four-speed independent drive (590; 720; 1105 and 1460 rev/min at 2100 rev/min of the diesel engine).

The clutch – two-disk, dry permanently closed, with hydrostatic control drive.

Gear box – synchronized, fixed-ratio, range-type, allows 24 front movement gears and 12 reverse movement gears.

The tractor chassis – drive rear wheels, drive and guide front wheels. Front wheels' tires size – 420/70R24, rear wheels' tires size – 580/70R42.

The front drive axle of MTZ: portal, with one-piece beam and planetary-cylindrical wheel reduction gears.

Tractor's steering – hydraulic, three-dimensional, to ensure ease and simplicity of tractor control in different applications.

Additional balance loads are installed on the front beam to improve tractor's coupling characteristics and steering ability.

Hydraulic system of RLM control with three-section distributor, electro-magnetically controlled governor, gauges, panels and BOSCH electronic control unit provide tractor operation with agricultural machines and implements using power, position and mixed control of implements position relative to the tractor frame, and power take-off to drive agricultural machinery tools. The tractor is equipped with a pneumatic system that controls hydraulically driven trailers' brakes and one-tube and two-tube pneumatic brakes system.

Tractor's brakes –hydraulically driven, wet, multi-disk, installed on drive pinions of vehicle-borne gears.

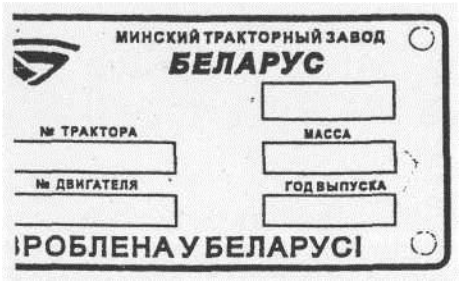
The cabin is solid, comfortable, air-conditioned, it has cylindrical shape and up-to-date exterior and interior design. To improve operator's working conditions the tractor is provided with toned, spherical, injury-safe glass, sun-proof curtains, enlarged cabin space, more convenient location of side panel levers, additional folding back seat, additional rear window. Frameless door and glued windscreen spherical glass provide excellent all-round visibility.

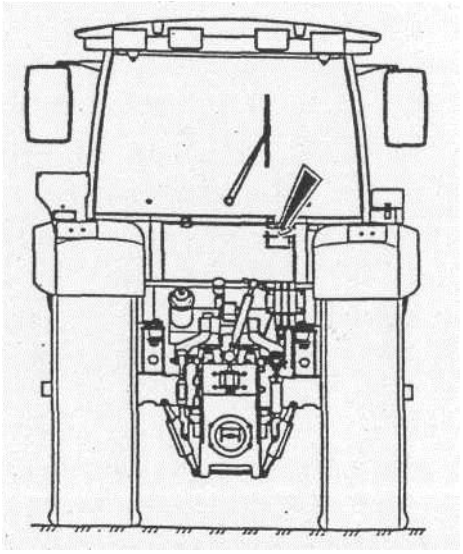
Lining and wings are of modern design.

Two fuel tanks with total capacity of 357 l are installed under the cabin floor on the right side of the tractor.
The diesel is shielded with a forward – swung hood and removable sides. In the open position the hood is fixed with a rod.
Optionally, the tractor can be supplied with auxiliary equipment (RLM cross-bar, additional seat, PTO-driven front mounted mechanism, etc.).
Tractor MTZ 2022V is equipped with reversible steering post intended for prolonged operation in the reverse mode with agricultural machinery mounted on the rear hinge mechanism.

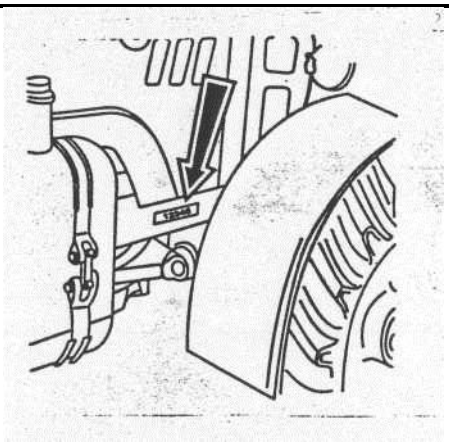
SERIES NUMBERS OF TRACTOR'S COMPONENTS

The company's plate with series numbers of the tractor and diesel is attached in the cabin right-side niche on the tractor rear.

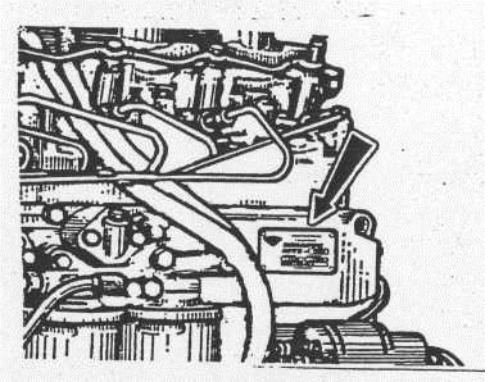




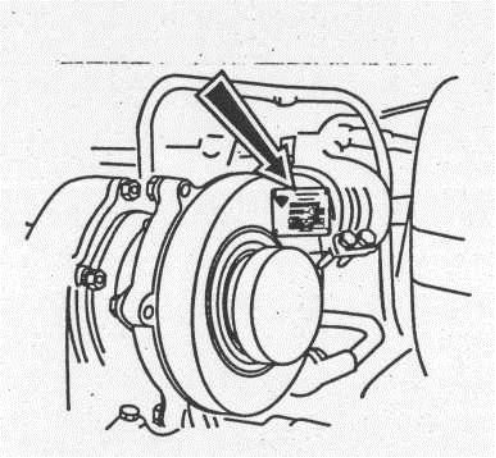
Series number of the tractor is duplicated on the right-side frame girder, and right-side plate of the front ballast.



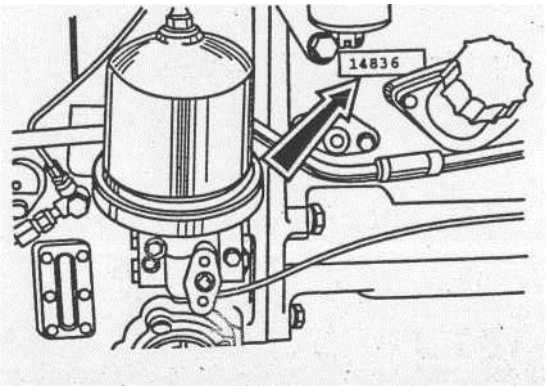
Series diesel number is duplicated on the company's plate fixed to the cylinder block (on the left side).



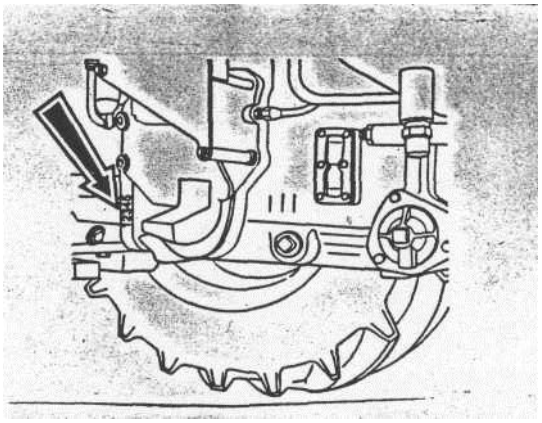
Series number of the diesel turbo-compressor.



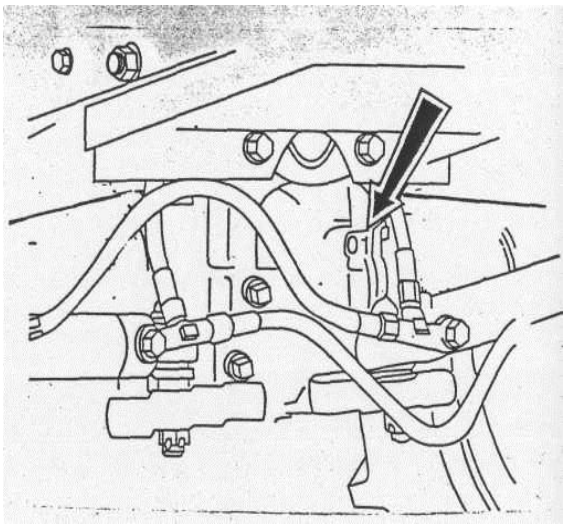
Clutch series number.



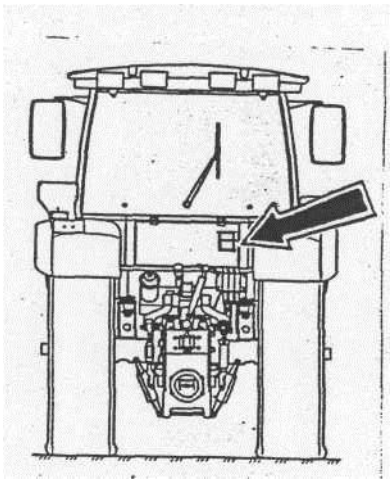
Series chassis number is punched on the right side of the rear axle body



Series FDA number is punched on the FDA body in frond of the tractor.

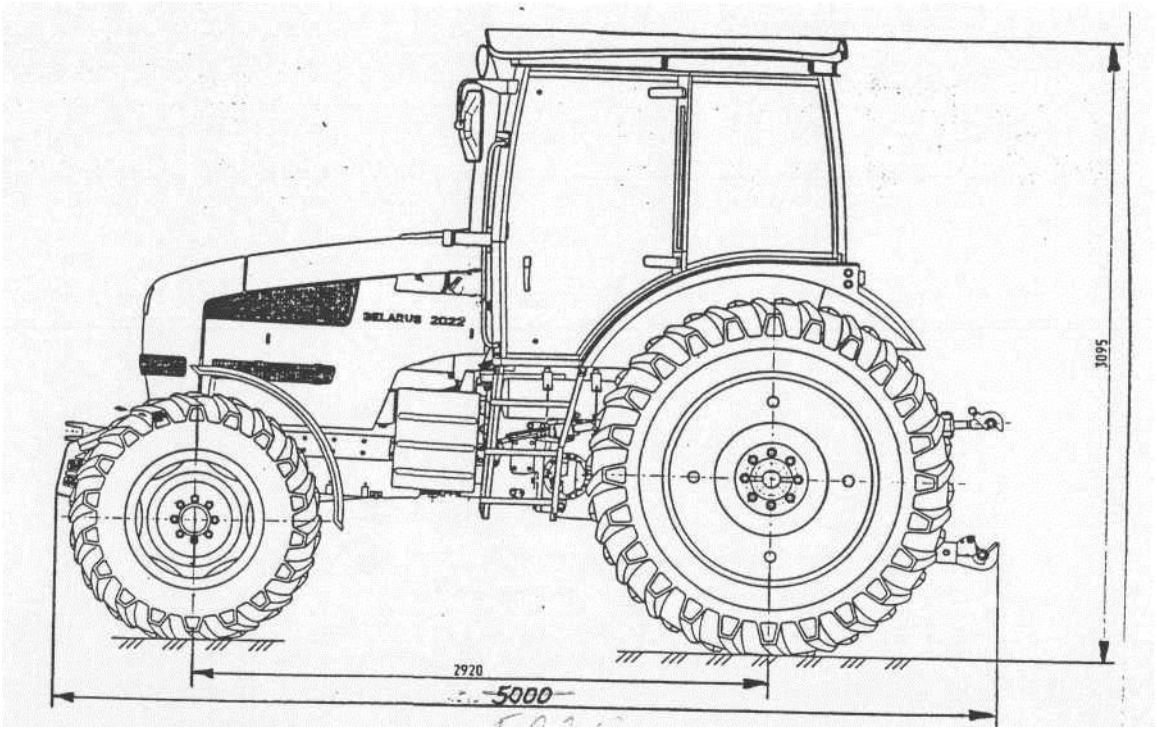


The cabin series number and number of the OECD certificate. The plate is fixed in the cabin right-side niche under company's plate.

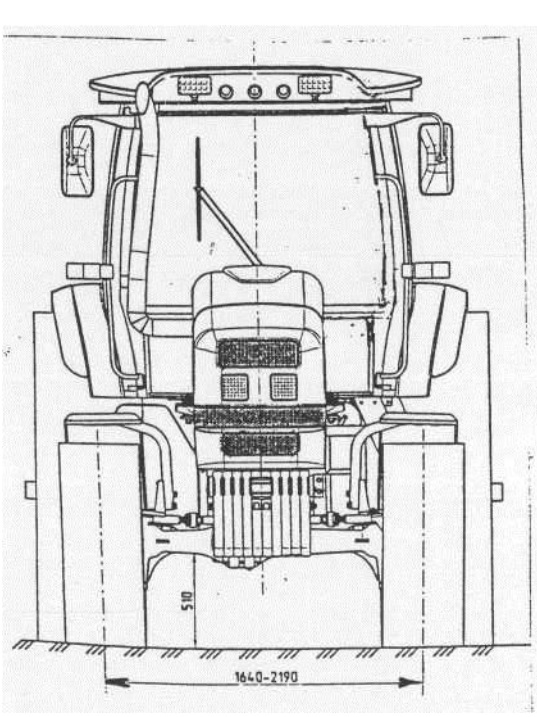


3. TECHNICAL DATA

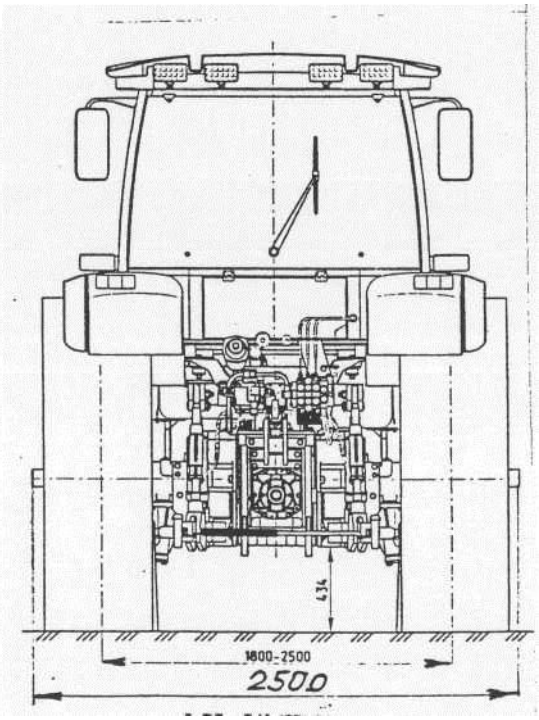
Dimensions



Left-side view



Front view



Rear view

General data

Description	Unit of measurement	Value
Type of tractor	-	Agricultural, general purpose
Tractor make	-	MTZ
Tractor model	-	2022; 2022V
Rated travel speed using tires 580/70R38 at nominal diesel crankshaft rotation:	Km/hour	
Forward motion		
Range 1		
Gear 1		1.79
Gear 2		2.38
Gear 3		3.10
Gear 4		3.99
Gear 5		5.13
Gear 6		6.65
Range II		
Gear 1		3.46
Gear 2		4.60
Gear 3		5.99
Gear 4		7.71
Gear 5		9.90
Gear 6		12.85
Range III		
Gear 1		5.35
Gear 2		7.10
Gear 3		9.24
Gear 4		11.90
Gear 5		15.29
Gear 6		19.83
Range IV		
Gear 1		10.33
Gear2		13.72
Gear 3		17.85
Gear 4		22.98
Gear 5		29.53
Gear 6		38.30
Rear motion		
Range I		
Gear 1		2.51
Gear 2		3.34
Gear 3		4.35
Gear 4		5.60
Gear 5		7.20
Gear 6		9.34

Continuation of table 3.1

Description	Unit of measurement	Value
Range II		
Gear 1	Km/h	4.86
Gear 2		6.46
Gear 3		8.40
Gear 4		10.82
Gear 5		13.90
Gear 6		18.03
Nominal traction force	kN (kgs)	30 (3000)
Tractor dimensions (nominal)		
* length in travel condition (with loads), rear hinge system including	mm	5230 +/- 50
* width, at ends of rear wheels half-axles	mm	2500 +/- 20
* height, cabin top	mm	3090 +/- 30
Tractor wheelbase	mm	2920 +/- 50
Tractor wheelspan	mm	
* front wheels (stepwise)	mm	1640-2190
* rear wheels (stepless-stepwise)	mm	1800-2500
Angle of rolling static stability, minimum	degrees	35
Ground clearance (with standard tires)		
under rear axle body	mm	430 (550 for tires 580/70R42)
Minimum turning radius from the center of the track of the outside front wheel with 1800 mm wheelspan and braked inside rear wheel	m	5.3
Tractor mass (as dispatched from the manufacturer)	kg	6830 +/- 100 (6900 +/- 100 - 2022V)
Allowable load on axles (not accounting for tires carrying capacity):	kN	
* front axle		50
* rear axle		75
Braking distance at the speed of 30 km/h with cold brakes, maximum	m	13
Depth of ford being crossed	m	0.85
Full mass of towed trailer (brakes of the tractor and trailer interlocked)	kg	25000
DIESEL		
Type	-	D-260.4 or D-260.4C2
Number of cylinders	pieces	6
Firing order	-	1-5-3-6-2-4
Cylinder diameter	mm	110
Piston stroke	mm	125
Displacement volume	L ($cm)^3$	7.12 (7120)

Continuation of table 3.1

Description	Unit of measurement	Value
Compression ratio	-	15.0
Cooling system	-	Fluid-type with forced circulation of cooling fluid from centrifugal pump
Lubrication system	-	Combined
Oil cooling system	-	In-built fluid-oil heat exchanger
Thermal mode adjustment	-	Automatic, using two thermostats and a ventilator with viscous coupling driven by thermal- power element depending on the diesel temperature
Rated diesel power	hp (kW)	210 (154)
Operational diesel power	hp (kW)	200 (147)
Specific fuel consumption at rated power	g/h.p.h (g/kW.h)	162 (220)
Specific fuel consumption at operational power	G/h.p.h (g/kW.h)	170 (230)
Rated frequency of crankshaft rotation	Rev/min	2100^{+40}_{-25}
Maximum frequency of idle run rotation, max.	Rev/min	2275
Maximum stable frequency of idle run rotation	Rev/min	800
Frequency of crankshaft rotation at maximum torque	Rev/min	1400
Maximum torque value	N.m (kgs.m)	807.5 (82.3)
Correct coefficient of torque allowance, minimum	%	15 +10 / -3
High pressure fuel pump	-	363.1111005-40.04 (YAZDA) or PP6M10P1f-3493 “Motoplan”, Czeck Republic
Angle of lead of power supply to TDC	degrees	YAZDA: 19-21 ^{0} (D-260.4); 16-18 ^{O} (D-260.4C); “Motorpal” 21-23 (D260.4); 17-19 (D-260.4C)
type	-	6- plunger, in-line (“Motorpal”, YAZDA)
Direction of camshaft rotation	-	Right-side
Type of booster pump	-	Piston, eccentric driven
Hand mump type	-	piston
Rotation frequency governor	-	Variable-speed with automatic fuel supply dresser at starting regimes and pneumatic corrector
injector	-	17/171.1112010-01 (D-260.4); 17/171/1112010-0101 (D-260.4C)

Continuation of table 3.1

Air purifier “Donaldson” - with dry three-step purification, with built-in mono separator		
Starting system	-	Electric starter with pre-start heating plug
Mass of the dry diesel	kg	700 +/- 3%
Make of turbo-compressor	-	TKP-7 or S2A; “Shwitzer” K27 (TBP4 “Garret” (France) or G22-02 “Turbo” (Check republic) – for D-260.4C)
Relative oil consumption, in % to fuel consumption during warranty service life, max.	%	1.1
Relative oil consumption for burning loss after 60-hors operation, in % to fuel consumption, max.	%	0.4
POWER TRANSMISSION		
Clutch	-	Friction-type, dry, constantly closed, two-disk
Clutch control drive	-	Hydrostatic
Gear box	-	24F + 12R; mechanical, stepwise, with constant mesh gears, shifting between six gears in each of four ranges in forward motion, and two ranges of reverse motion is effected by synchronizers, ranges are shifted by tooth-type couplings and synchronizers.
Rear axle	-	Supplied with final drive- a pair of cone gears with circular teeth; differential; vehicle-borne drives – a pair of cylindrical gears and final planetary-type drives; with mechanical differential interlock with hydraulic drive and electric- hydraulic control.
Front drive axle MTZ	-	Portal, beam-type with planetary-cylindrical final drives. The final drive –a pare of cone gears with circular teeth, with self-lock differential.
FDA drive	-	From GB via friction electrically-hydraulically controlled coupling, cardan shaft
FDA control	-	Electrical-hydraulic distributor provides automatic control and forced drive switching on.
Brakes control drive	-	Hydrostatic, isolated
Brakes	-	Wet, multi-disk, effect rear, and via FDA drive disk brake – front wheels. Control is interlocked with trailer’s brake.
Parking-reserve brake	-	Multi-disk, wet, integrated with working brakes, with an individual mechanical drive. Control is interlocked with the pneumatic drive of trailer’s brakes.

Continuation of table 3.1

The drive for trailers' brakes control	-	Pneumatic one-pipe (optionally – two-pipe), interlocked with tractor's brakes control
Pneumatic system pressure limited by safety valve	Mpa (kgs/cm^2)	0.85…1.00 (8.5…10)
Controller-sustained pressure	Mpa (kgs/cm^2)	0.65…0.80 (6.5…8.0)
REAR PTO		
Drive	-	Four-speed, independent
End rotation frequency		
* independent drive (standard)	Rev/min	540 at 1924 rev/min of the diesel to transmit power not more than 60 kW; 1000 at 1909 rev/min of the diesel to transmit full power
* independent (economical) drive	Rev/min	540 at 1603 and 1000 at 1615 rev/min of the diesel
Size of the end and rotation direction	-	Ends of type 1; 1C*; 2; 3 (clockwise, if one looks at the end face)
FRAME, CHASSIS		
Tractor' frame	-	Half-frame
Frame suspension	-	Stiff
Chassis	-	Front and rear drive wheels with pneumatic tires Guide front wheels Rear wheels can be doubled using an attachment
Tires :		
front wheels		4220/70R24; 480/65R24
rear wheels		580/70R42;580/70R38; 650/65R42
STEERING		
Type	-	Hydraulic, three-dimensional
Type of supply pump	-	Gear
Displacement volume	cm^3/rev	14-16
Rated pressure made by supply pump	Mpa (kgs/cm^2)	16 (160)
Rotation direction	-	Left-side
Type of metering pump	-	Gerotory
Displacement volume	cm^3/rev	160
Pressure of safety valve adjustment	Mpa (kgs/cm^2)	14+ 1.5 (140 + 15)
Pressure of shock proof valves adjustment	Mpa (kgs/cm^2)	20 +2 (200 + 20)
Type of turning mechanism	-	Two-rod hydraulic cylinder or two hydraulic cylinders 50 x 250 mm in diameter
Force of steering wheel turn with operational supply pump	N	30
Steering wheel play	degrees	25

*) Available in spare parts kit

Continuation of table 3.1

HYDRAULIC SYSTEM		
Hydraulic system type	-	Remote-cylinder hydraulic system allowing for power, position and mixed control of agricultural machines position and dampening of agricultural machinery swing in travel position
Pump	-	Gear-type, right-hand rotation
Model	-	NSH32M-3
Drive	-	From diesel via the pinion of PTO independent drive
Maximum pump capacity	l/min	56
Pressure of safe valve adjustment	Mpa (kgs/cm^2)	20 $-^{2.0}$ (200 $^{-20}$)
Hitch cylinders (2 pieces)	Mm	TS 90 x 250
Distributor	-	3-section, 4-position, flow type by BOSCH
Controller	-	Electric-hydraulic, type EHR4 by BOSCH
Electric magnets supply voltage	V	12
REAR HITCH		
Hitch mechanism	-	Articulated, four-link, category 3
Load- lifting capacity, with load gravity center 610 mm off the suspension axis	kN (kgs)	46 (4600)
TRACTION-COUPLING MECHANISM		
Type	-	General-purpose; includes towing mechanism (yoke), and (optional) connecting device of “python” type, and trailing mechanism (towing bar)
Towing mechanism (TSU-38)	-	Lifting-type, height adjusted
*distance from PTO face to towing yoke opening axis in horizontal plane	-	400 +/- 10
* distance from ground surface to horizontal towing yoke axis	mm	400-850 (in 65 mm)
CABIN		
See section 2 “General data”	-	One-seat, with safe rigid frame, thermal-noise-vibration proof, with a heating system, ventilation and air heater-type filtration, equipped with a seat adjusted according to operator’s weight and height, rear view mirrors, air conditioner, front and rear windshields’ wipers and washers, illumination ceiling lamp and radio set compartment. Cabin doors are lockable, the left door is locked with a key

Continuation of table 3.1

Reversible steering post (2022V)		
* steering column	-	Additional, with a metering pump
* fuel supply control	-	Duplicated, steel rope
* clutch and brakes control	-	Duplicated pedal drives for clutch and brakes control
* seat	-	Main seat, reversed by 180 ^{0} by reversing mechanism
ELECTRICAL EQUIPMENT AND INSTRUMENTATION		
Rated voltage:		
* tractor-system voltage	V	12
* starting system	V	24
Supply system	-	Storage batteries (2 pcs.) 12 V, capacity 120 A.h each, connected in parallel, starting discharge at –18 ^{0}C – 500A, 12V generator, 2000W power, alternated current with built-in rectifier and voltage regulator
Illumination and light alarm system	-	- front road illumination head lights (high beam, lower beam) – 4 pieces; - front (2 pcs.) and rear (4 pcs.) operation headlights, containing side lights and tractor turning alarm lights; - rear lamps (2 pieces) containing side lights, turning alarm lights and brake alarm lights; cateyes; - license plate illumination lamp; - cabin ceiling light; - emergency alarm lights
Sound alarm system	-	A set of two horn tone signals and one horn-less signal
Emergency sound alarm system	-	Buzzer (upon diesel oil pressure drop or rise of cooling liquid temperature above rated value

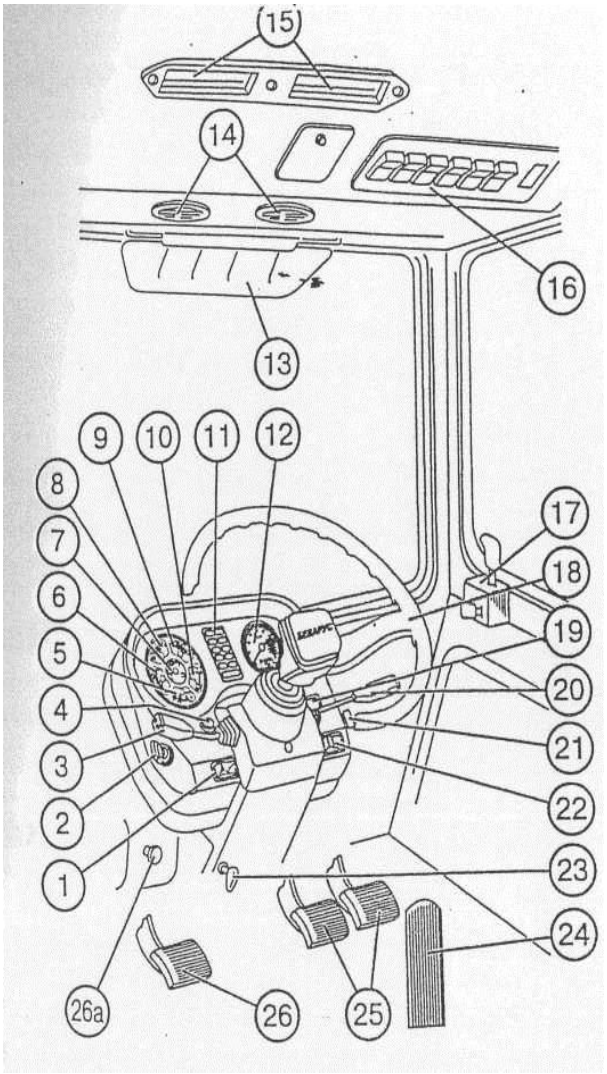
Continuation of table 3.1

Tachometer-speedometer		Electrical (complete with programming panel)
Control lamps		Signaling system of high beam; tractor and trailers' turns, parking brake, air filter clogging, HTDS oil pressure; engagement of differential and FDA interlocking; braking fluid pressure in brake master cylinders; diesel starting up, means of easing diesel start up.
BALLAST LOADS		
Mass of one load	kg	45 +/- 1.5
Total mass	kg	510 +20 + additionally 420
AUXILLIARY WORK EQUIPMENT (optional)		
Front mounting mechanism (MM)	-	MM-2
* load-lifting capacity of lower tie-rod axis	kg	250
Automatic front MM coupling	-	SA-1
Crossbar of the rear hinging mechanism		
* distance from PTO end face to hitching point	mm	675
* vertical movement of hitching point	mm	200-980 (stepless)
* diameter of connecting opening	mm	32
* horizontal movement of hitching point	mm	400 (on both sides space 8)
* vertical static load	kgs	600
Hitching device (towing bar):		
* distance from PTO end face to hitching point in horizontal plane	mm	400; 500
* distance from ground surface to hitching point	mm	465
* allowable vertical load:		
* with 400 mm overhang from PTO end face	kgs	2000
* with 500 mm overhang from PTO end face	kgs	1500
Support for rear wheels doubling	pieces	2
Additional seat	-	For a passenger
Front PTO:		
* drive	-	Independent, one-speed
* rotation frequency of the PTO end with 1845 rev/min rotation frequency of the diesel crankshaft	rev/min	1000
* direction of the end movement	-	Clockwise (when looking at the end)
* end size	-	PTO 2; 21 slots

Continuation of table 3.1

Transmitted power, maximum	h.p. (kW)	60 (44)
Towing- hitching device TSU-2P “Python”	-	Non-adjustable
Outside diameter of the connecting rod	mm	44.6
*distance from PTO end face to the center	mm	110
* allowable vertical load	kgs	3000
* distance from ground surface to hitching point	mm	530

4 CONTROLS AND INSTRUMENTATION



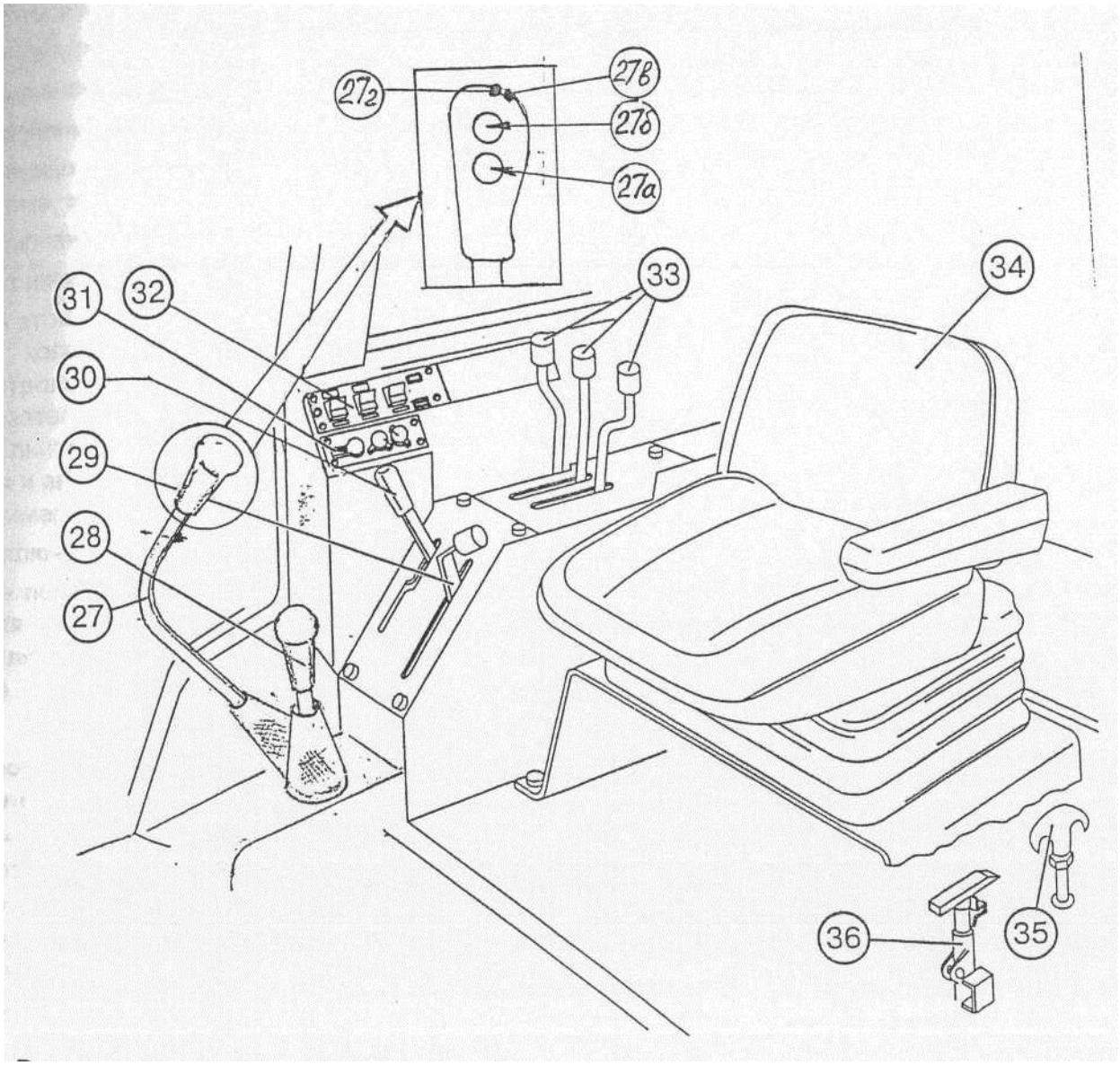
6. Indicator of air pressure in the pneumatic system
7. Fuel level indicator
8. Voltage indicator;
9. Indicator of cooling fluid temperature
1. *Front operation headlights switch (on cabin railing)
2. Starter and instruments' switch
3. Multifunctional switch (turn indicator, high beam, lower beam, sound alarm)
4. Storage battery remote switch (combination of instruments (pos. 5, 6, 7, 8, 9, 10)

5 Oil pressure indicator in GB

*) road headlights switch (on cabin railing – optional)

10. Indicator of oil pressure in the diesel lubrication system
11. A block of control lamps
12. Tachometer-speedometer
13. Windshield visor
14. Air distributors
15. Recirculation shutters
16. A set of switches (operation headlights, heater fan, rear windshield wiper, headlights " road train"
17. Door lock
18. Steering wheel
19. Tachometer-speedometer control
20. Switch of front windshield wiper and washer
21. Switch of the emergency light alarm
22. Central light switch
23. Control lever of steering column tilt fix
24. Pedal of fuel supply control
25. Brake pedal
26. Clutch pedal

26a. Diesel shut down lever (when fuel pump with two control levers is installed)



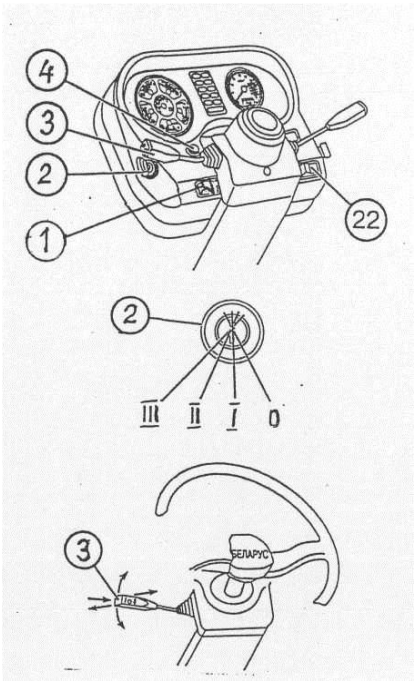
27. Gear shift lever
27a. Push button of switching lower (L) step of GB reduction gear
27b.Push button of switching higher (H) step of GB reduction gear
27c. Indicator of switching on lower step of GB reduction gear
27d. Indicator of switching on higher step of GB reduction gear
28. Range shift lever
29. Fuel supply control lever
30. PTO switching lever
31. Control unit of hydraulic mounting system (see section 5.12)
32. Control unit for interlocking the differential, FDA and mode of RLM damping (see sections 5.3; 5.4 and 5.7)
33. Control lever of the hydraulic system distributor
34. Seat
35. Lever for shifting PTO modes (independent drive/neutral)
36. Parking brake lever

Starter and controls switch (2)
It has four positions:

0 – switched on
I – instruments, control lamps, a radio set, a tape recorder are switched on

II - sparking plugs are switched on (position is not fixed) with this, in the block of control lamps (with diesel cold) start up control lamp lights, and in the oil pressure indicator -–a control lamp of emergency pressure lights and sound signal sounds (buzzer);

III – starter is switched on (position is not fixed), after diesel start up control lamp goes down and sound alarm switches off



MULTIFUNCTIONAL (UNDER STEERING WHEEL) SWITCH (3)

It allows to switch turn lights, change front headlights' high/lower beam, high beam signal, sound alarm.

TURN INDICATORS are switched by moving lever from the middle position forward or back. After tractor's turn the lever is automatically reset.

SOUND ALARM is activated by pressing the lever in axial direction. Signal is switched on in any position of the switch.

CHANGING HIGH/LOWER BEAM OF HEADLIGHTS (after pushing button (22) in position <3>, page 36, is effected by moving lever up/down along the steering column axis: high beam – lower fixed position; lower beam – middle fixed position; high beam blinking – by moving upwards to the end from the middle position (non-fixed position).

SWITCH OF FRONT OPERATION HEADLIGHTS (1).*

When pressing switch key (1), front operation headlights, installed on cabin handrail are switched on. Simultaneously light key indicator is on.

PUSHBUTTON (4) OF REMOTE SB SWITCH

When pushing the button, batteries are activated, repeated pushing switches them off.

*) The switch of road illumination headlights installed on cabin handrail is optional.

Combination of instruments
It includes six indicators (5, 6, 7, 8, 9, 10) with signal lamps (6a, 7a, 8a, 9a, 10a)

GB oil pressure indicator (5)
The indicator scale has three zones:
- operation zone – from 800 to 800 kPa (8…15 kgs/cm^2);
- non-operation zone (two) – from 400 to 800 kPa (4…8 kgs/cm^2) and from 1500 to 1800 kPa (15…18 kgs/cm^2).

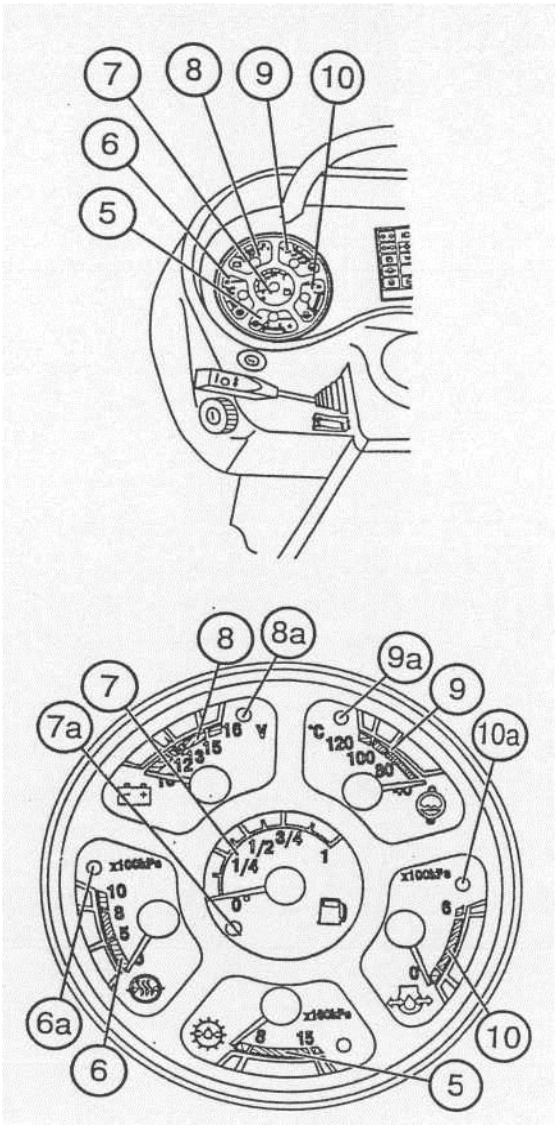
Indicator of air pressure in the pneumatic system (6)
The indicator scale has three zones:
- operation zone – from 500 to 800 kPa (5…8 kgs/cm ^{2});
- non-operation zones (two) – from 0 to 500 kPa (0-5 kgs/cm ^{2}) and from 800 to 1000 kPa (8…10 kgs/cm ^{2}).

The indicator scale has the built-in red color signal lamp (6a), which lights when pneumatic system pressure drops to below 500 kPa (5 kgs/cm ^{2}).

Fuel level indicator (7) with reserve fuel orange color signal lamp (7a). The scale has the following divisions < 0-1/4 – ½, ¾, -1>.

Voltage indicator (8)
It displays SB voltage with non-operational diesel, when starter switch key (2) is in position <I>. With diesel in operation, the indicator displays generator terminals voltage. The voltage indicator scale has built-in red color control lamp. It lights when additional storage battery terminals' voltage drops to below allowable limit.

IMPORTANT! If voltage indicator (8) shows absence of SB charging, check the state and tension of the generator driving belt.

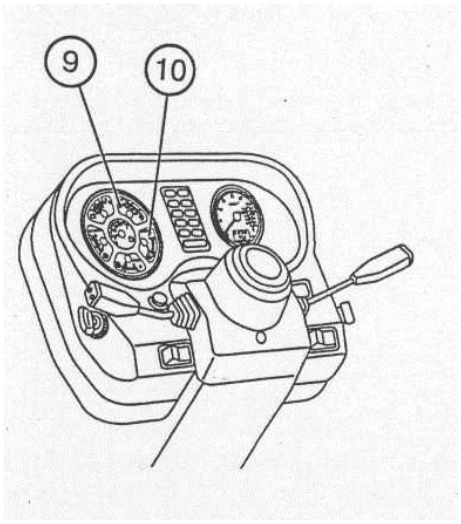


The voltage indicator scale has the following zones:

Table 4-1

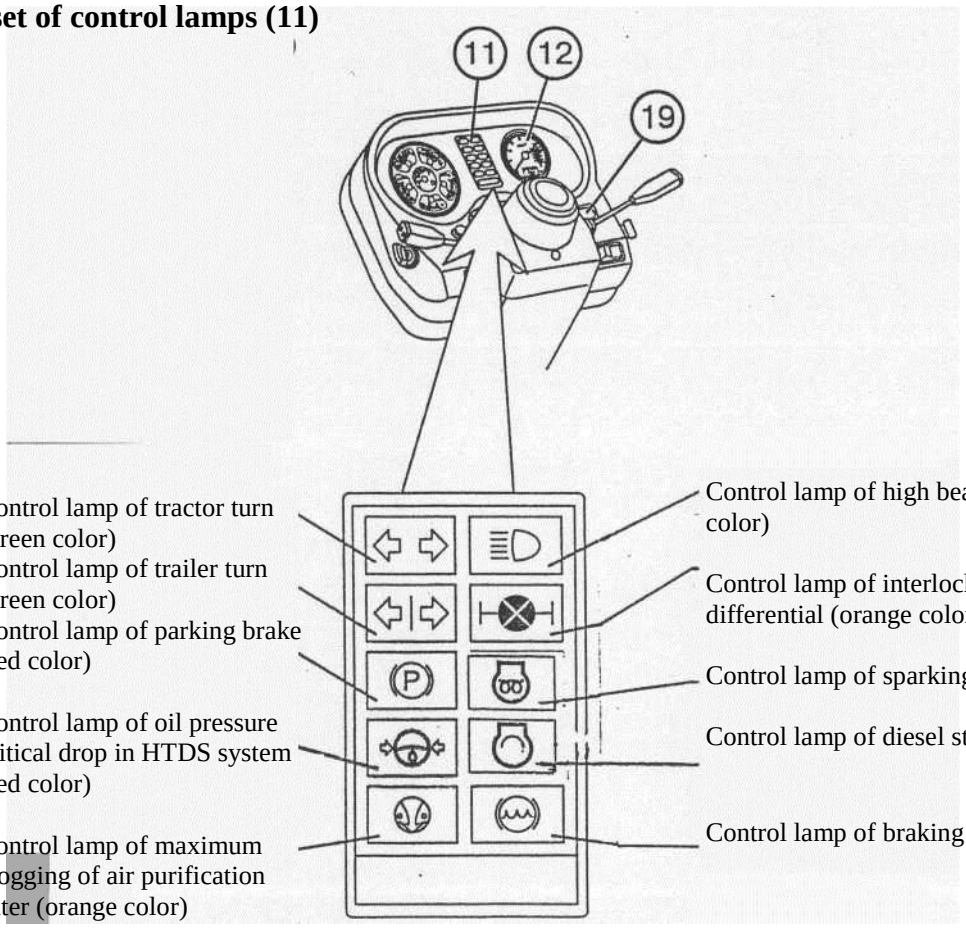
Scale zone, color	Supply system state	
	With diesel in operation	With non-operational diesel
10.0 –12.o V red	SB is charged	Generator doesn't function
12.0-13.2 V yellow	SB is normally charged	No SB charge (low charging voltage)
13.2 – 15.2 V Green		Normal charging mode
15.2 – 16.0 V red		SB recharging
White mark in the yellow zone	Normal, EMF of the SB is 12.7V	

Indicator of diesel cooling fluid temperature (9) with excessive temperature indicator (9a) (red color)
The instrument scale has three zones:
- operation zone – 80-100 ˚C;
- non-operation zones (two) – 40-80 ˚C and 100…120 ˚C



Indicator of oil pressure in the diesel lubrication system (10) with a red color control lamp of emergency pressure drop (10a)
The indicator scale has three zones:
- operation zone – from 100 to 500 kPa (1…5 kgz/cm^2)
- non-operation zones (two) – from 0 to 100 kPa (0…1 kgs/cm^2) and from 500 to 600 kPa (5…6 kgs/cm^2)

A set of control lamps (11)



Tachometer-speedometer (12)

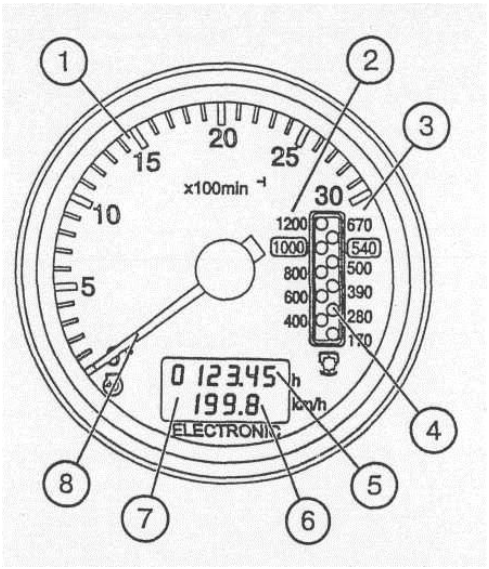
Electrical tachometer-speedometer installed on the instrument panels operates as follows:

- When tractor stops and after starter and instruments switch is put in position < I >, the display (7) indicates (5) total diesel operating time in hours;
- Upon diesel start up the pointer indicator (8) moves along the circular scale (1) to indicate frequency of diesel crankshaft rotation. Meantime, display (4) shows PTO rotation frequency (rev/min). Scale (3) – for PTO I, and scale (2) – for PTO II. Electric signal of rotation frequency is sent from the generator phase winding;
- During tractor travel display (7) indicates movement speed (km/h), while indication (5) disappears. The electric signal of movement speed is sent from speed sensors installed on the rear axle cover.

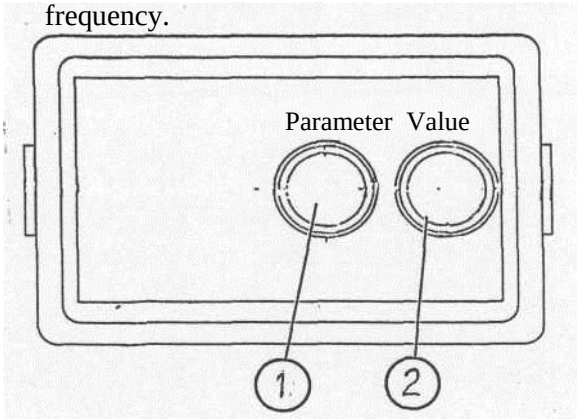
Tachometer-speedometer (12) control panel (19)

The control panel is installed on the instruments' board and is used for programming tachometer-speedometer according to tractor MTZ models, radius of rear wheels swing and diesel models.

NOTICE! Tachometer-speedometer has been programmed exactly for your tractor model at the manufacturer. Re-programming will be required only upon changing of tires type. Do not re-program the tachometer-speedometer, if not required.

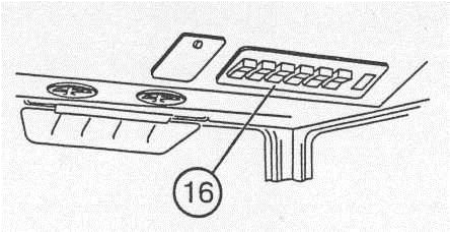


1. Scale of diesel crankshaft rotation frequency, rev/min.
2. Scale of PTO II rotation frequency –1000 rev/min.
3. Scale of PTO I rotation frequency – 540 rev/min.
4. Display of PTO rotation frequency.
5. Indication of diesel operating time, hours.
6. Indication of tractor movement speed, km/h.
7. Display of diesel operating time and tractor movement speed.
8. Pointer indicator of diesel crankshaft rotation frequency.



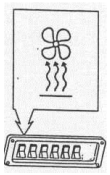
1. Pushbutton for entering parametric code on the tachometer-speedometer display (7).
2. Pushbutton for entering to the tachometer-speedometer display (7) of coded numbers' values when programming according to tractor models, radius of rear wheels swing and diesel models.

A set of switches (16), (fan, heater, operation headlights, front and rear,
rear windshield wiper, road train headlights).

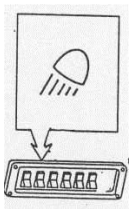


Switch of cabin heater fan has three positions:

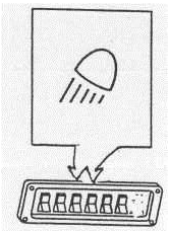
1. Switched on:
2. The 1st operation mode is switched on (small air supply).
3. The 2nd operation mode is switched on (large air supply).



Switches of front operation headlights
When pushing the key front operation headlights and key light indicator are on.

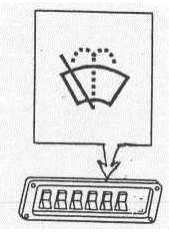


Switches of rear operation headlights
When pushing the keys rear operation headlights and keys' light indicators are on.



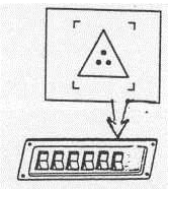
Switch of rear windshield wiper has three positions:

1. Switched off
2. Windshield wiper is switched on
3. Windshield wiper and washer (not fixed) are switched on.



Switch of "road train" sign lights

When pushing the key road train signal lamps and key light indicator are switched on.

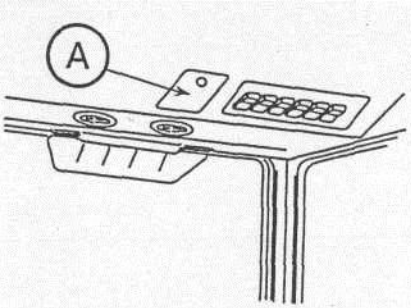


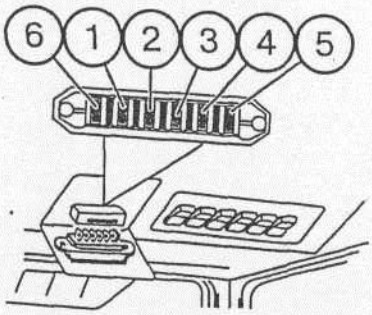
Fuses

Fuse box is installed under cover “A”.

Five fuses protect from overload the following electric circuits:

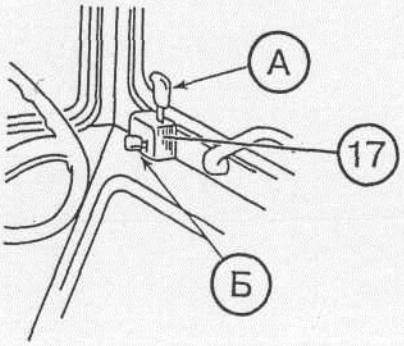
1. Cabin ceiling light and “road train” sign (7.5 A)
2. Rear windshield wiper and washer (7.5A)
3. Two pairs of front operation headlights (25
4. Two pairs of rear operation headlights (25 A)
5. Cabin ventilation and heating system (15 A)
6. Reserve (15 A)





Cabin door lock (17)

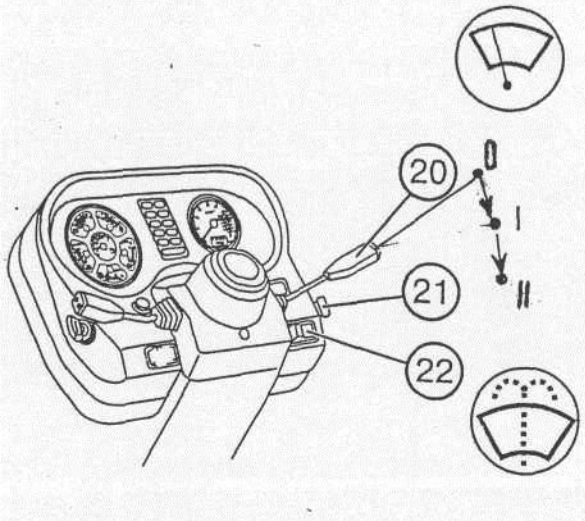
Handle (A) is designed for opening the cabin door: pull the handle back to open the door . Push handle (B) back to interlock the door from possible opening from outside.



Multifunctional switch, the right-hand (20) provides:

- switching on two-speed electric front windshield wiper;
- switching on front windshield washer.

To switch on the windshield wiper shift the switch handle from position “switched off” (the end front position “0”) to position “I” back (1st speed), or “II” (2nd speed). All positions are fixed. To switch on the windshield washer (not fixed) shift the handle up from any of the three switch positions.



Switch of light emergency alarm (21)

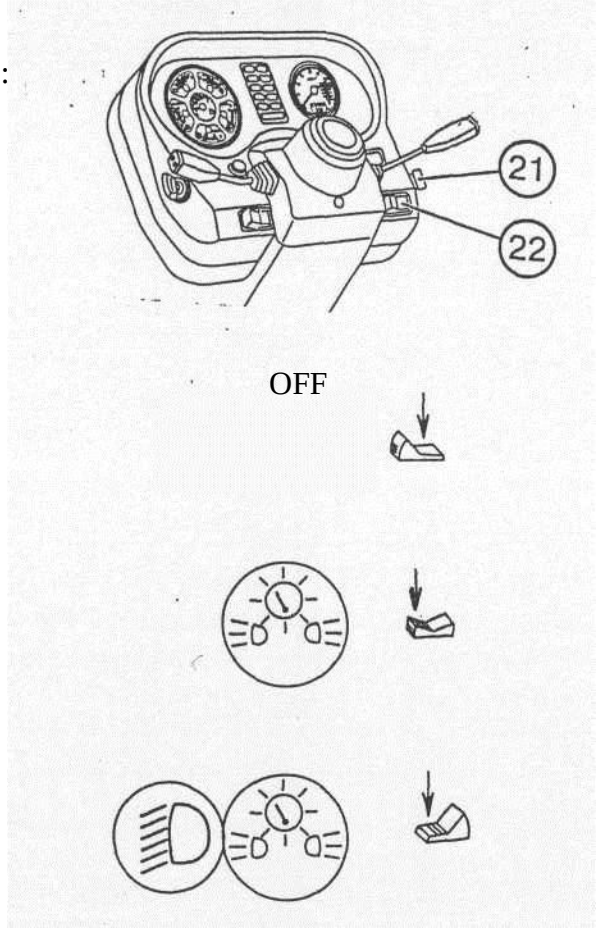
Press button (21) to switch on light emergency alarm. The control lamp built-n the button is blinking as light alarm blinks.

Central light switch (22)

It has three positions:

1. Switched off. The right button part is pressed.
2. Front and rear side lights are switched on, instruments illumination, license plate illumination, trailing machine side lights, auxiliary trailing machine headlights, information display and processing panel. Middle position.
3. All systems from position “2” and front road headlights are switched on.
   Left button side is pressed.

:



Fuse boxes

Two electric circuits' fuse boxes BP-1 and BP-2 are installed under the instruments panel.

To get access to fuses unscrew screw (A) and remove cover (B).

Eleven fuses protect the following electric circuits from overload:

FB – 1

1. Instruments' power supply (7.5 A);
2. Interrupter of turn indicators (7.5 A);
3. Lower light of the right-hand road headlight (7.5 A);
4. Lower light of the left-hand road headlight (7.5 A);
5. Right-hand side lights and instruments panel illumination (15 A);
6. Left-hand side lights (7.5);

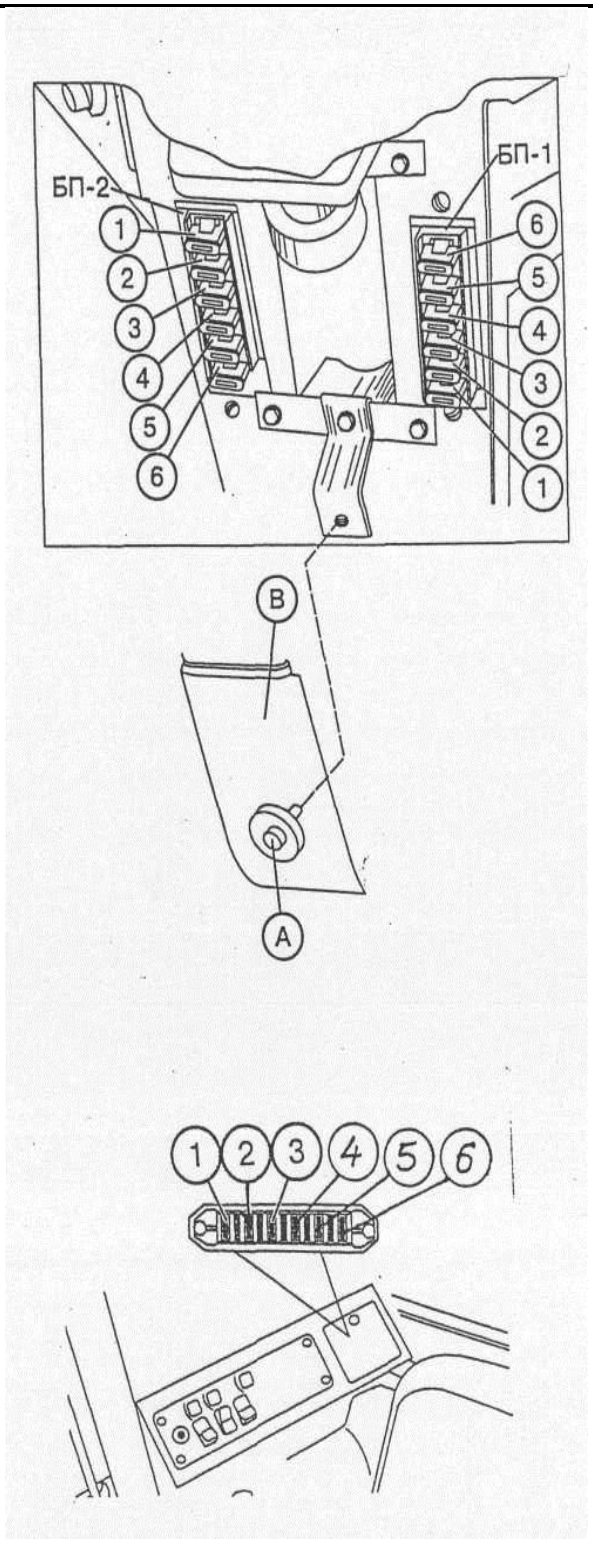
FB-2

1. High light of road headlights (15 A);
2. Sound signal (15 A);
3. Sparking plugs of the pre-start heating;
4. Emergency light alarm(15 A);
5. Front windshield wiper and washer (15 A);
6. Stop light (15 A);

Safety system unit for control of FDA, DL, RLM and GB reduction gear

Fuses (7.5 A) protect the following circuits:

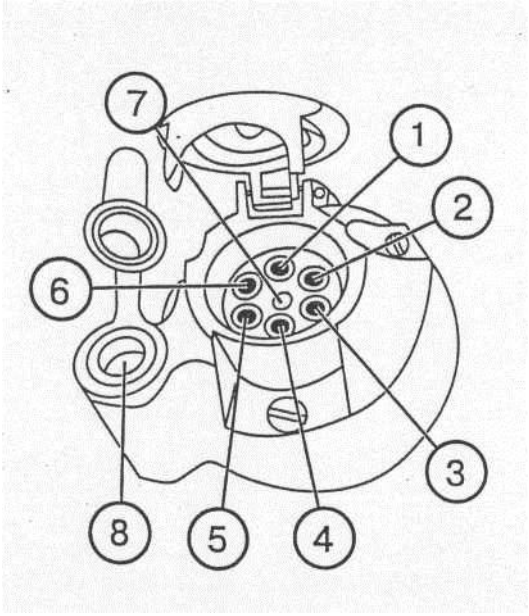
1. Front drive axle;
2. Rear axle DL;
3. Reserve;
4. Suppression of RLM damping;
5. Control of GB reduction gear;
6. Reserve.



CAUTION! To avoid tractor wiring burning, never use fuses with strength of current over the rated values given below. If a fuse blows too often, find out the reason and correct it.

Connecting elements of electrical equipment

Combined multifunctional socket is intended for connecting current consuming elements of a trailer or hitched agricultural implement, as well as a portable lamp. It is mounted outside to the rear cabin wall. The socket is connected to wiring bundle plug of machines being hitched and portable lamp plug.



Socket terminals' markings:

1. Stop light;
2. Left-hand turn indicator;
3. Left-hand side lamp;
4. Sound alarm device;
5. "Ground";
6. Right-hand turn indicator;
7. Right-hand side lamp;
8. Socket for connecting portable lamp.

Gears shifting lever (27)
Shifting diagram is shown in the figure to the right (diagram I)
Button (27a) switches lower GB reduction gear step (L).
Button (27b) switches higher GB reduction gear step (H).

Range shifting lever (28)

Shifting diagram is shown in the figure to the right (diagram II).

Fuel supply control lever (29)

Push the lever forward to increase fuel supply, and visa versa.

PTO control lever (30)

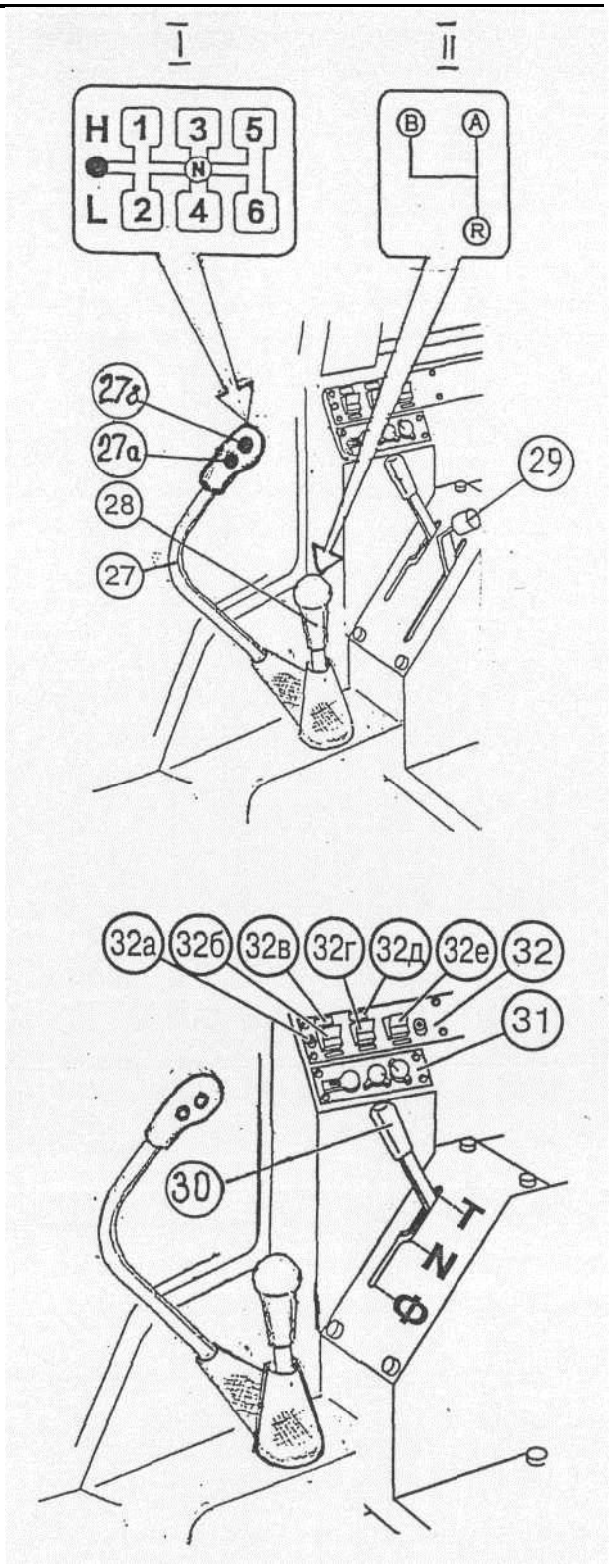
It has three positions:

- smooth lever movement from position < N > (neutral) down to the end switches PTO on (position “Ф” (friction clutch);
- to switch PTO off, move the lever from the end front position to position “N” (neutral);
- to brake PTO end (position “T” (brake), move the lever up to the end.

HLS control unit (31)
(see section 5.12)

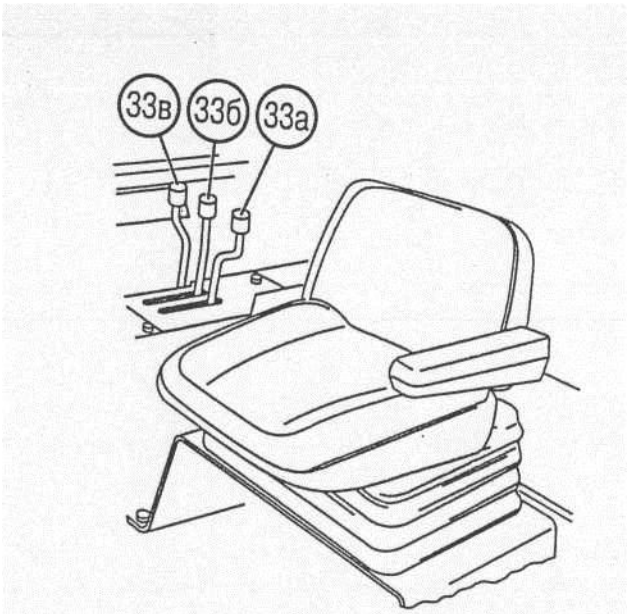
Control unit for rear axle DL and FDA (32)

- sound alarm button (32a);
- key for FDA drive control (32b);
- light of FDA switched on state (32c);
- key for control of rear axle DL (32d);
- light of rear axle DL switched on state (32e);
- key for switching on “damping” of hinging mechanism swing (32f).



Levers for control of hydraulic system distributor (33a, 33b, 33c)

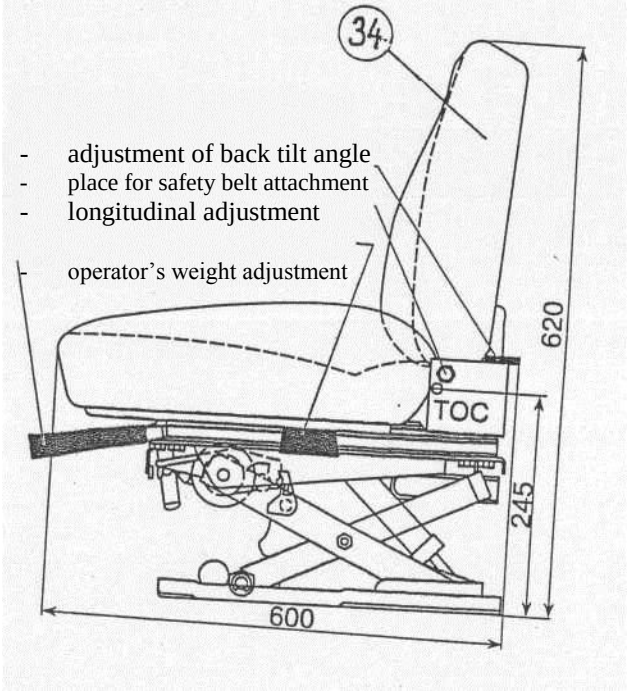
Control levers are located on the cabin right-hand side panel. They have the following positions: “neutral”, “lowering”, “floating”, and “lifting”.
Lever (33a) controls left-hand tractor distributor section along the motion direction, and left-hand rear outlets of the hydraulic system.
It is fixed in positions “floating” and “neutral”. Lever (33b) controls the middle distributor section and middle rear outlets of the hydraulic system. It is fixed in “floating” and “neutral” positions.
Lever (33b) controls right-hand distributor’s section and right-hand real outlets of the hydraulic system. It is fixed in all positions.



Seat (34)

It can be adjusted according to:

- Weight of an operator. To adjust for greater weight, rotate the lever clockwise, and visa versa.
- Longitudinal adjustment. Move the lever upwards to the end and move the seat forward or backwards.
- Back tilt. Move the back tilt adjustment lever upwards to the end, then lower and fix the back in the required position.
- Height adjustment. Move the seat upwards by hands (to increase the seat height). To decrease the seat height, sharply jerk the seat up to the end and then lower it by pushing downwards (after pushing the seat drops to the lowest position all by itself).



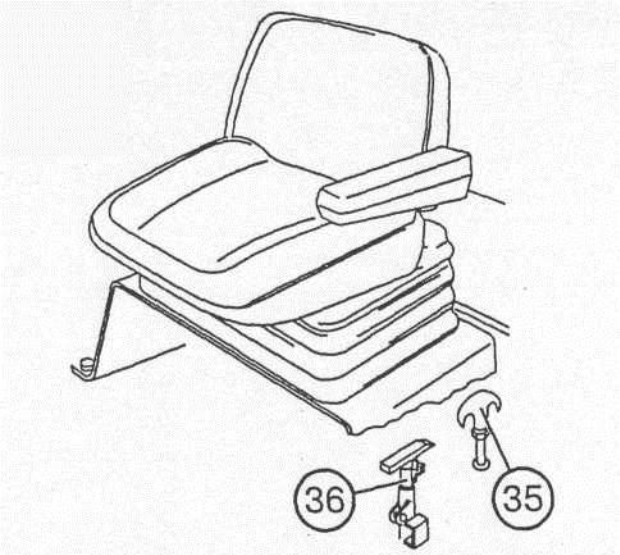
Handle (35) for switching on the independent PTO drive

The handle (35) has two positions:

- "Independent PTO drive is switched on" - the end lower position;
- "Switched off" (neutral) – the end top position.

Parking brake control lever (36)

- "Parking brake engaged" - top end position,
- "Parking brake disengaged" - end low position.



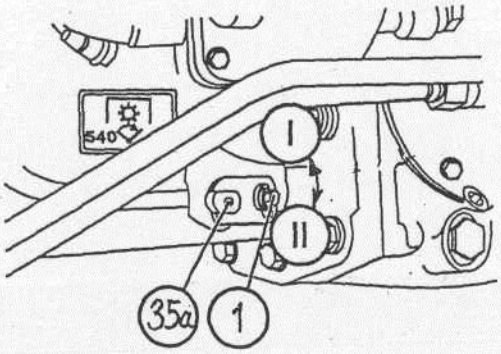
Switch for changing velocity of PTO independent drive (35a)

The independent drive switching lever (35a) has two positions:

I – 590 and 1105 rev/min – the end, anti clockwise;

II - 720 and 1460 rev/min – the end, clockwise.

To set the required velocity of PTO rotation, loosen bolt (1), turn the lever and tighten the bolt.



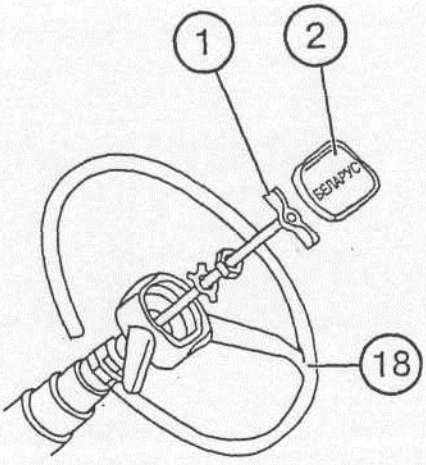
Steering wheel (18)

1. Position of the steering wheel can be adjusted by height within 100 mm.

To make adjustment do the following:

- take the cover off (2);
- unscrew fastener (1) by 3…5 turns;
- move steering wheel (18) back or forward, choosing the position most comfortable for operation;
- screw the fastener up and put the cover in place.

2. Tilt of the steering column can be changed stepwise in the range of 25°– 40°with 5° space. To change the steering column tilt pull back handle (23) (see page 29), tilt the column and steering wheel to the required position, release the lever and slightly lower the column to the fixed position.



Lever for switching GB pump (37)

It has two positions:

- "pump switched on" - lever (37) is turned anti clockwise before being fixed and locked with bolt (A);
- non-operational position – lever (37) is turned clockwise before being fixed.

Operational lever position – "pump switched on" (bolt (A) is tightened).

NOTE. If cover (B) needs to be dismantled, lever (37) must be put to non-operational position. Upon drive setting turn the lever to position "pump switched on" again and fix it with bolt (A).

Handle for switching off compressor drive (38)

It has two positions:

- "compressor switched on" - when lever (38) is set with an arrow to the right (towards the cabin);
- "compressor switched off" - when the lever is set with an arrow to the left.

Switch on the compressor with non-operational diesel or at minimum revolutions of the idle run.

Roller for switching on HLS pump (39)

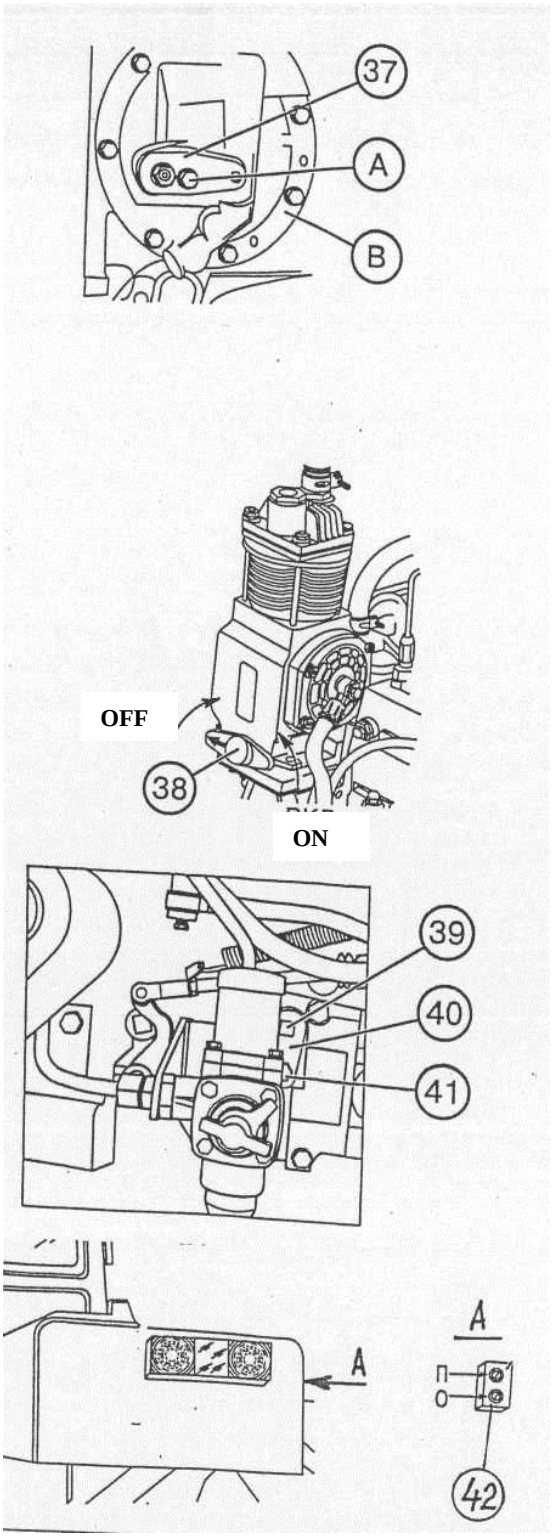
It has two positions:

- "pump switched on" - the roller is turned clockwise to the end;
- "pump switched off" - the roller is turned anti clockwise to the end.

Before turning roller (39) to any of the two positions, loosen bolt (41) by 1.5…2 turns and turn roller (39) together with lock plate (40)
Tighten bolt (41).

External HLS control panels (left and right hand) (42)

When pressing upper button (P), RLM is lifted, when pressing button (0) – lowers.



CAUTION! When using external controls, don't stand between the tractor and machine (implement) being mounted to avoid injures.

4.1. REVERSIBLE CONTROL POST (MTZ 2022V)

To improve possibilities of ganging up tractors to front mounted agricultural machines they are equipped with a reversible control post.
Elements of reverse control:

- auxiliary steering column with a meter pump;
- duplicated pedal drives for control of friction clutch, brakes, fuel supply;
- seat reversing mechanism;
- auxiliary sound alarm button and light of emergency modes of diesel operation.

NOTICE!

1. Tractor's reversible control post is designed only for agricultural operations when moving in reverse direction.
2. Be sure to interlock forward motion brake pedals when working in the reverse order.
3. Do not drive in reverse on public roads, in operations not related agriculture, or loading/unloading the tractor itself.

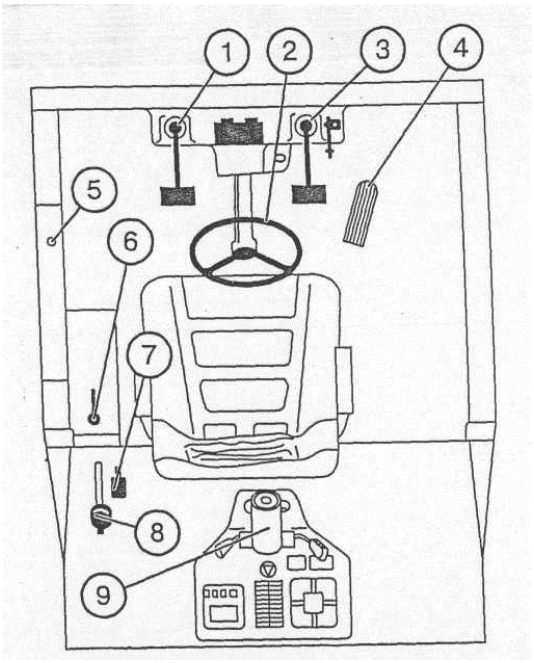
4.1.1 Reversible post controls

Additional controls are placed in the rear cabin section, as shown in the figure to the right.

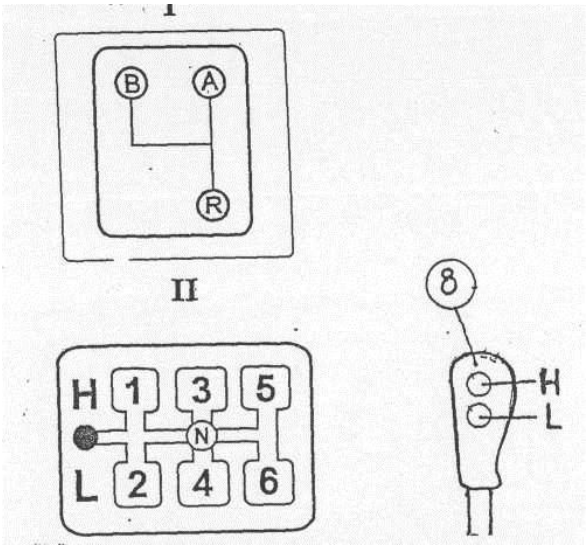
1. Clutch pedal. Press the pedal to disengage the clutch, release it to engage it.
2. Brakes pedal. Press the pedal to engage both brakes of the tractor and pneumatic drive of trailer brakes.
3. Pedal of fuel supply control. Press the pedal to increase fuel supply.
4. Sound alarm button.
5. Lever of fuel supply control. The end rear position (on the reverse post) corresponds to maximum fuel supply, the middle end – diesel shut down.
6. GB range shifting lever. (see shifting diagram II)
7. GB gear shifting lever (see shifting diagram II).
8. Forward motion steering column.

Do the following operations to work in reverse:

- interlock forward motion braking pedals;
- reinstall the steering wheel on the auxiliary column. To this end, unscrew the hand wheel fixing the steering wheel, reinstall the steering wheel and fix it at the required height.
- Install the reversible seat for operation in the reverse.
- Fulfill operations from Section 5.2 to transfer clutch control in the reverse mode.



1- clutch pedal; 2- steering wheel; 3- brakes pedal; 4- fuel supply control pedal; 5- sound alarm button; 6 – fuel supply lever; 7- GB range shifting lever; 8 – gear shifting lever; 9 – forward motion steering wheel.



“L” – button of switching lower step of GB reduction gear;
“H” – button of switching higher step of GB reduction gear.

Observe the following sequence of operations to adjust the seat for the work in reverse:

- Lower clamps (1) and push them aside to release cheek-pieces (3) of the upper lifting mechanism frame;
- Applying effort upwards and downwards, bring the seat to the utmost position;
- Pull handle (4) to release turning mechanism and turn the seat by 180°;
- Insert clamps in-between cheek-pieces and tighten them to the end.

Follow reverse order to put the seat in the forward motion position.

Seat adjustments are independent and can be performed while on the move.

Use handle (7) to make adjustments according to operator's weight. By turning the handle clockwise, the seat is set for larger weight, while turning it anti clockwise – for smaller one.

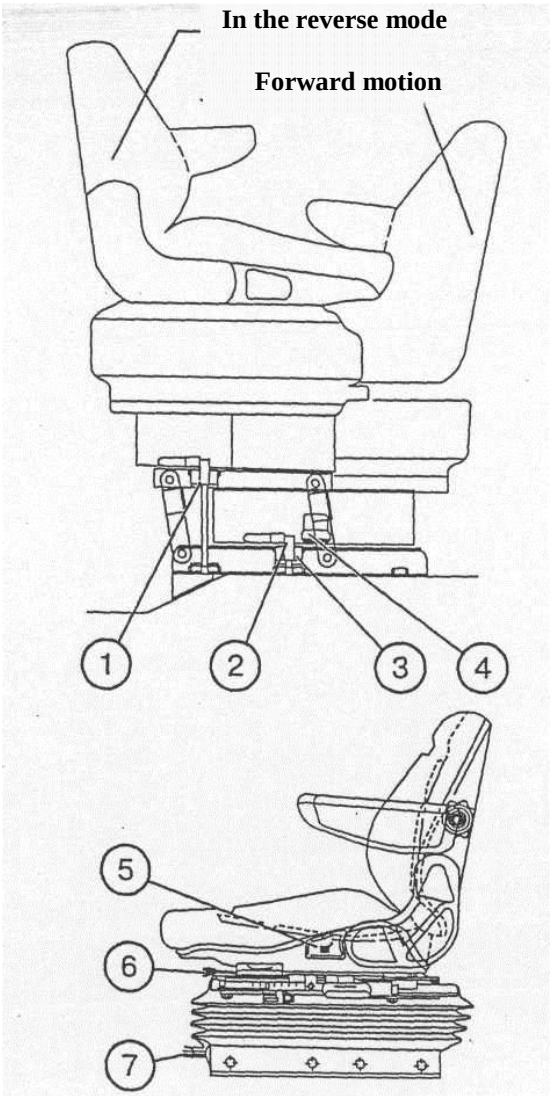
Longitudinal adjustment is effected by lever (6), which should be pushed to the end right side to shift the seat forward or back.

To increase the seat height pull it manually upwards in a stepwise manner.

To reduce the seat height sharply jerk the seat upwards to the end, and then lower it by pushing downwards.

Seat back tilt angle is adjusted by lever (5). To change the back tilt, pull lever (5) up to the end, set required tilt and< having lowered the lever, fix it in the required position.

Besides the seat described above, the tractor may be equipped with another seat MTZ (see page 39 for adjustment).



1, 2 – clamp; 3 - cheek-pieces, 4-turning lever,5. adjustment of back tilt angle; 6 – longitudinal adjustment; 7- weight adjustment.

4.2. PROGRAMMING OF TACHOMETER-SPEEDOMETER (12)

To program tachometer-speedometer use control panel (19) and do the following:

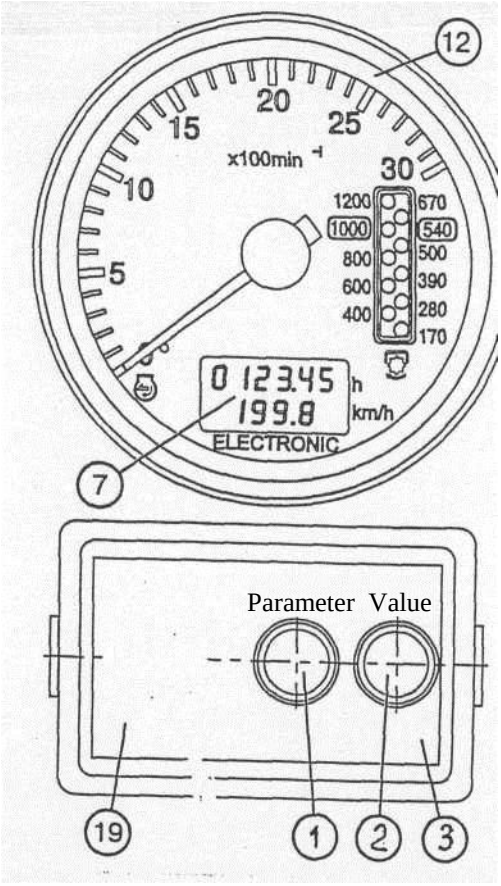
- take cover (4) off panel (19);
- press button (I) to enter programming mode;

1. program tachometer-speedometer according to the number of pinion teeth where diesel revolutions sensor is installed (parameter "I"); to this end:

- press button (I) and enter figure "I" on display (7) of tachometer-speedometer (12);
- press button (2) and set the value of the number of teeth (Z) according to the below given table:

Table 4.2

N of teeth (Z)	Tractor model
69	MTZ 570; 590; 80; 1; 890; 900; 922; 950; 1025 and modifications thereof
23	MTZ 1021, 1221; 1222; 2022



2. Program radius of rear wheel rolling (parameter "2"):

- press button (1) and enter figure "2" on display (7);
- press button (2) and enter value Rk according to table below.

NOTE: If data on the type of tires assembled is not available, before putting the tractor in operation one can measure Rk as distance from wheel axle to support surface. Then enter on display coded number, closest to value measured.

Program the diesel model (parameter <3>);

- Press button (1) and enter figure <3>on display (7) of the tachometer-speedometer;
- Press button (2) and enter the required diesel model

Seven seconds after programming is over the device automatically is set in the operation mode. Put the panel cover in place.

5. DESIGN AND OPERATION OF THE TRACTOR COMPONENTS

5.1. DIESEL ENGINE

The tractor is equipped with a six-cylinder, in-line, four-stroke diesel D-260.4*, with turbo-supercharging, intermediate supercharged air cooling, direct fuel injection, fluid cooling.

The diesel is started with an electrical starter.

Diesel (pp. 47, 48) consists of a cylinder block, two cylinder heads, crank mechanism, gas distribution mechanism, and also fuel and air supply, lubrication, cooling, starting, electrical equipment systems.

Cylinder block (20) has a mono-block design and looks like a rigid cast iron casting.

The boring block has six removable cylinder sleeves (15) made of special-grade cast iron. Sleeves are installed in the cylinder block along two centered belts. In the upper belt the sleeve is fixed with a clamp, and in the lower one it is sealed with two rubber rings

From below the cylinder block is covered with cast oil crank case (1) made of aluminum alloy.

Two interchangeable **cylinder heads** *(*18) (one for three cylinders) are iron cast.

Cylinder heads have insert valve seats made of heat-resistant and wear-resistant alloy. Cylinder heads are provided with injectors (14), page 48, (three for each head).

To seal space between heads and cylinder block, a filler piece (19) of asbestos-steel cloth is placed (page 47). Openings for cylinder sleeves and oil duct are backlined with sheet steel. During diesel assembly at the manufacturer's filler piece cylinder openings are additionally backlined with fluoroplastic rings.

Crank mechanism includes crankshaft (25) with main and crankpin bearings, flywheel (22), pistons (14), including rings and pins, connecting rods (13).

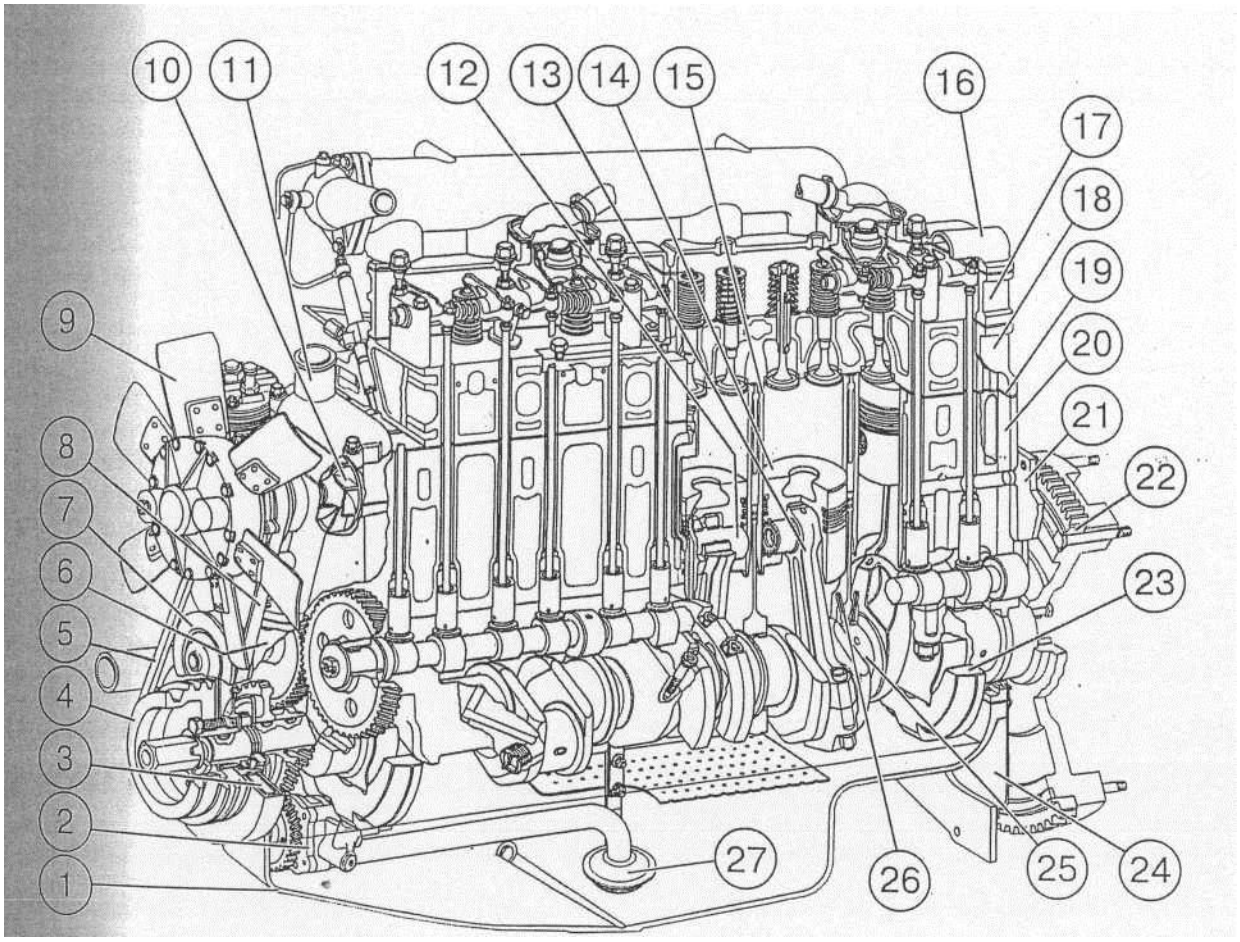
Crankshaft is a steel seven-bearing structure with counter-balances. Connecting rod necks are provided with cavities for additional centrifugal oil purification, covered with threaded plugs

The front shaft end bears: pinion for driving gas distribution mechanism, oil pump drive pinion, water pump, generator and air conditioning generator (if available) drive pulley.

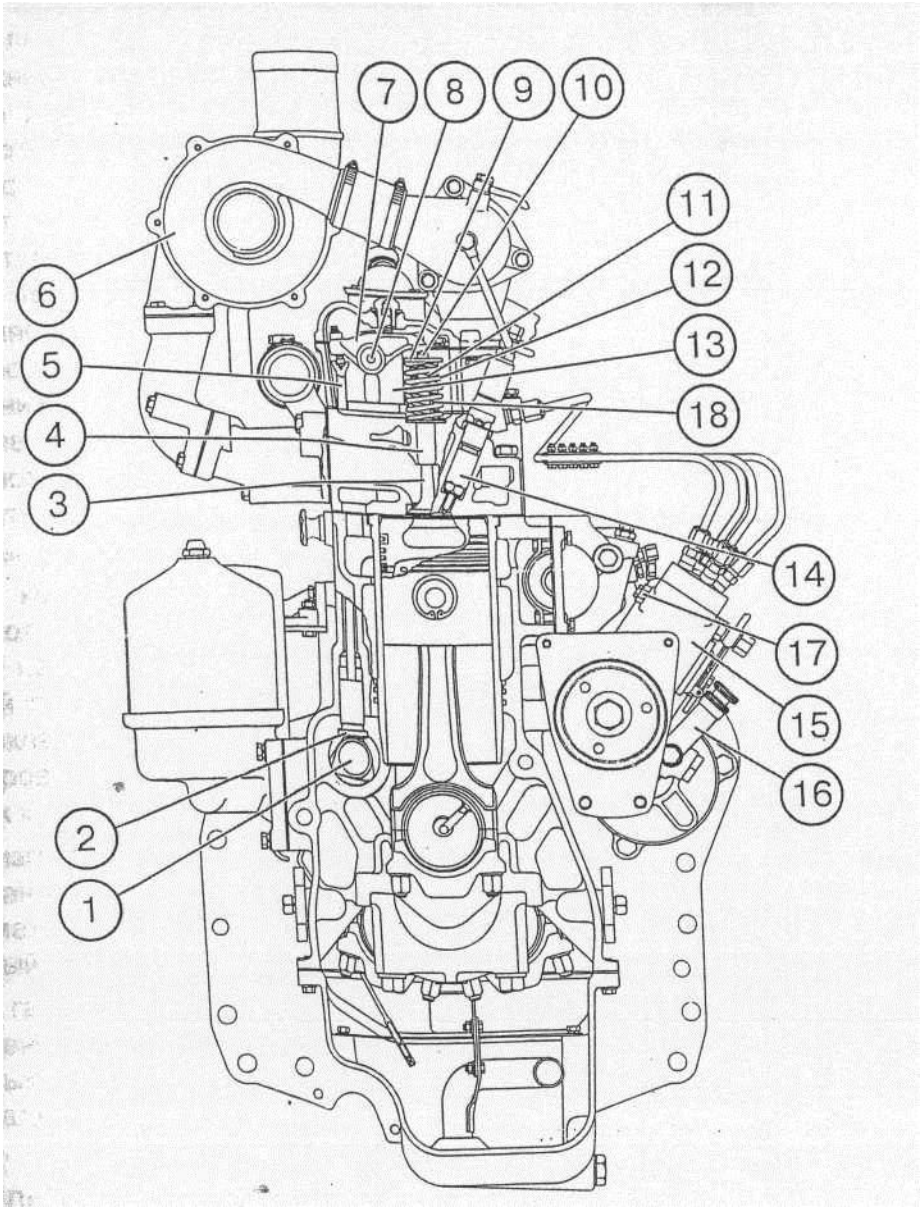
To reduce the level of crankshaft torsion vibrations, the pulley is provided with fluid torsion vibration damper (3).

Piston is made of aluminum alloy. The piston bottom has combustion chamber. The upper section thereof is provided with two compression and one oil-control rings with an expander. The upper compression ring is trapezoid-shaped and has barrel-like profile coated with chrome; the second compression ring is of the "minute" type. To accommodate the upper ring the piston is provided with "niresistive" insert (see figure on page 49).

*) The tractor may be equipped with diesel D-260.4C



1 – oil crank case; 2 – oil mump; 3- torsion vibration damper; 4 – crankshaft pulley; 5 – fan drive belt; 6 – cover of distribution pinions; 7 – stretcher pulley; 8 – generator drive belt; 9 – fan; 10 – water pump; 11 – casing of thermostats; 12 – piston pin; 13 – connecting rod; 14 – piston; 15 – cylinder sleeve; 16 – cover cup (2 pieces); 17 – cylinder head cover (2 pieces); 18 – cylinder head (two pieces); 19 – cylinder head filler piece (one piece); 20 – cylinder block; 21 rear sheet; 22 – flywheel; 23 – counter balance; 24 – cover; 25 0 crankshaft; 26 – piston cooling injector; 27- oil receiver.



1 – distribution shaft; 2 – pusher; 3 – valve; 4 – guide bushing; 5 – rod; 6 – turbo compressor; 7 – rocker; 8 – roller; 9 – valve plate; 10 – dentils; 11 – inside spring; 12 – outside spring; 13 – fixed member; 14 – injector; 15 – fuel pump*; 16 – manual fuel supply pump; 17 – plug for air removal from fuel pump head; 18 – sealing ring.

*) Presently, distribution-type fuel pumps shown above are replaced with in-line fuel pumps "Yazda", Russia, or "Motorpal", Czech republic.

Connecting rod is a steel T-shape device. A bushing is pressed in its upper head. Openings are provided in the upper connecting rod and sleeve section for piston pin lubrication. The lower head consists of a lower connecting rod section and a cover with a similar marking. Connecting rods' covers are not interchangeable. Besides, connecting rods are marked by upper and lower heads, put on the end face of upper connecting rod head. One group connecting rods should be installed on the diesel.

Inserts of main and crankpin bearings of the crankshaft are thin-walled and made of bimetal strop. Inserts have two sizes of inside diameter according to the nominal size of crankshaft necks.

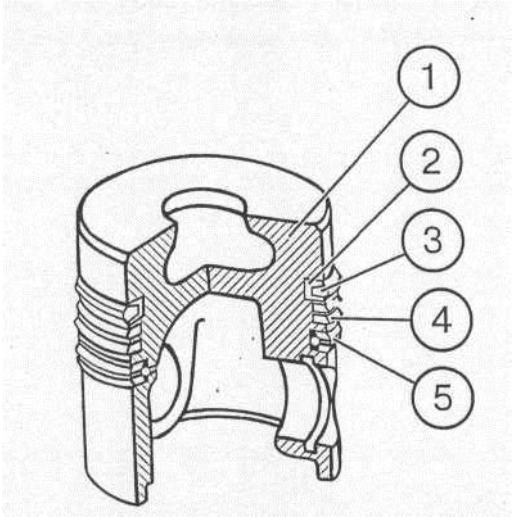
Flywheel is made of cast iron and is fastened to the crankshaft flange with bolts. A steel toothed ring is compressed on the flywheel.

Mechanism of gas distribution consists of pinions, inlet and exhaust camshaft, as well as parts of installing and driving thereof.

The camshaft is a four-bearing structure being rotated by the crankshaft via gear pinions.

Pushers (2), page 48, are made of steel and have spherical bottoms. Camshaft cams have slight tilt that imparts rotational movement to pushers.

Rods (5) of pushers are made of steel bar. Spherical part coming inside the pusher and the rod cup are tempered.



1- piston; 2- "niresist"-type insert; 3- upper compression ring; 4 – the second compression ring; 5- oil-control ring with an expander.

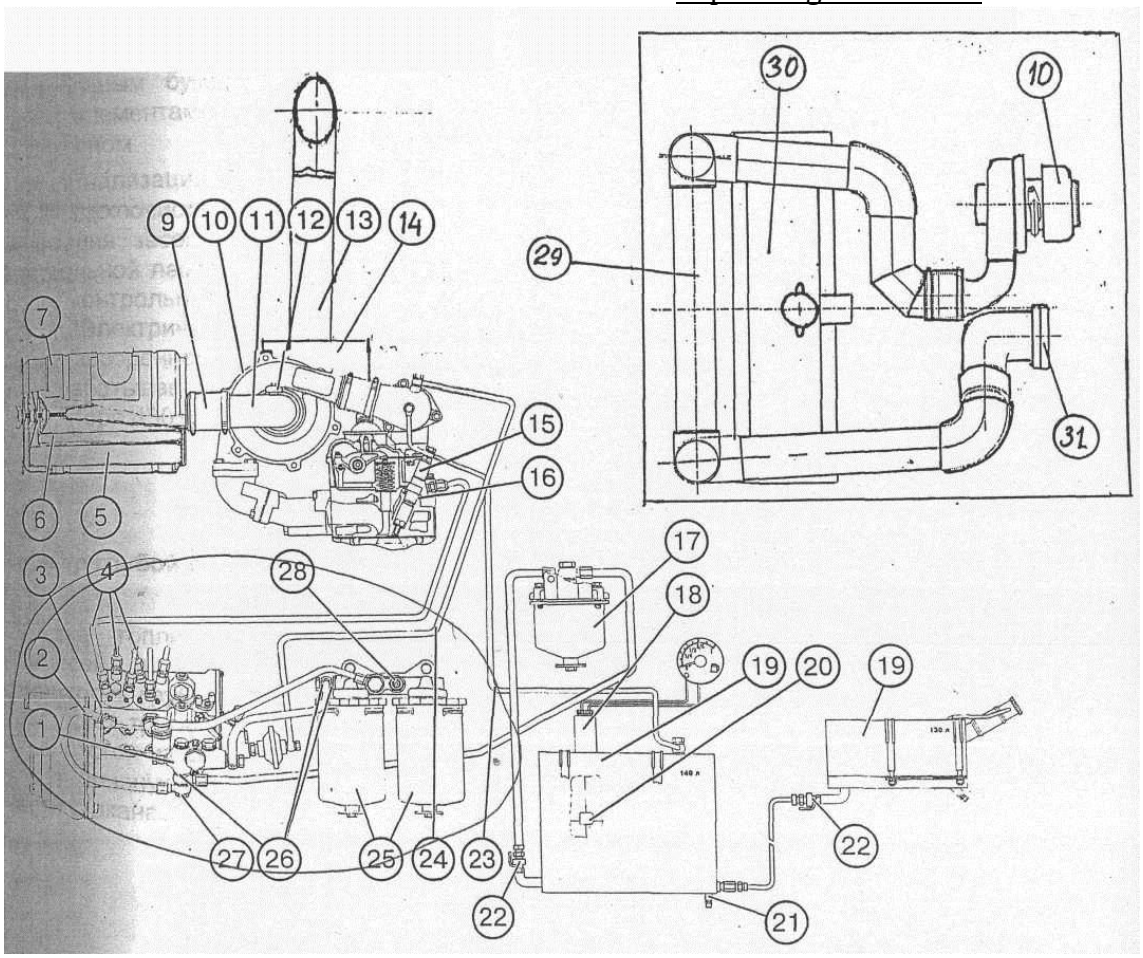
Valves' rockers (7) are made of steel and sway on rollers installed in fixed members. The rocker's roller is shallow and has six radial openings for lubrication of rockers. The rockers motion along rollers is limited by distance springs.

Inlet and exhaust valves (4) are made of heat-resistive steel. They move in guide bushings compressed in cylinder heads. Each valve is closed by two springs: the outside (12) and inside (11), which are fastened to its rod by way of a plate (9) and dentils (10)

Sealing rings (18) installed on valves' guide bushings exclude oil trapping in diesel cylinders via spacing between valves' rods and guide bushings.

Diesel supply system consists of an air purifier, air intake pipeline, intake and exhaust manifolds, turbo compressor, supercharged air cooler, muffler, fuel tanks,
fuel coarse and fine filters, fuel pump, injectors, high and low pressure fuel lines.

Supercharged air cooler



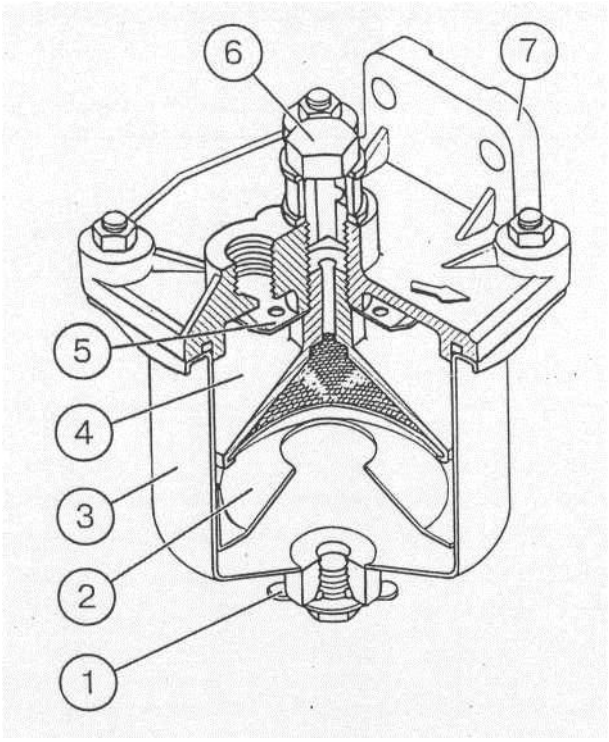
1 – booster pump; 2 – by-pass pipeline; 3 – fuel pump, 4- high pressure fuel lines; 5 – main filtering element; 6 – control filtering element; 7 – air purifier; 9 – sleeve; 10 –turbo compressor; 11 – by-pass; 12 – air purifier clogging light; 13 – exhaust pipe; 14 – muffler; 15 – injector; 16 – guard ring; 17 – fuel coarse filter; 18 – filler neck; 19 – fuel tank; 20 – fuel level float; 21 – coupler of sediment drain; 22 – stop valve, 23 – drainage pipeline; 24 – pneumatic corrector pipeline; 25 – fuel fine filter; 26 – sealing ring; 27 – bolt; 28 – air outlet plug; 29 – supercharged air cooler; 30 water radiator (for reference); 31 - input diesel manifold.

*) Diesels equipped with in-line fuel pumps have a fine filter with a paper filtering element in the supply system.

Donaldson Air purifier (G100317) is of dry type and uses paper filter cartridges as filtering element. It has three steps of dry purification through the main and control paper filtering elements and in-built mono cycle/
The control lamp on the instruments' panel shows the degree of an air purifier clog up. An electrical sensor of air purifier clogging up operates at the manifold vacuum 459 +/-50 mm of water

Fuel coarse filter

Fuel is purified of mechanical impurities and water by **the coarse filter** having meshed filtering element (4). The filter sediment is drained through the drain plug (1) in the lower part of the barrel (3).



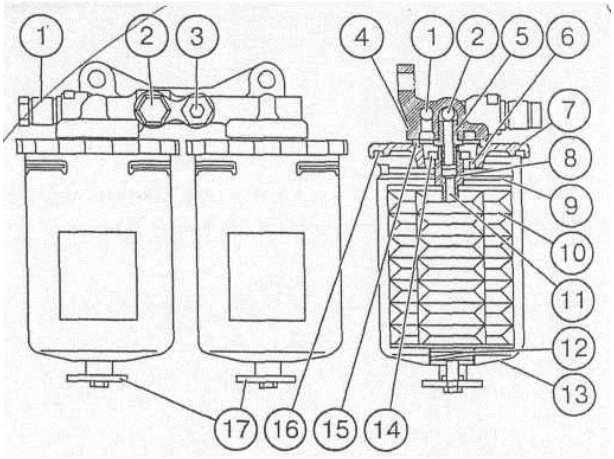
1 – plug; 2 – damper; 3 – barrel; 4 – meshed reflector; 5 – scatterer; 6 try square; 7 – filter body.

Fuel fine filter

It has two changeable filtering elements (0) adopted to diesels D-243. Each filtering element is installed in a separate knock-down filter-cartridge

Fuel fine filter is intended for multi-use purposes under condition filtering elements and rubber spacers (15, 16) are periodically replaced, and operation regulations are observed.

To outlet air from the supply system a plug (3) is provided in the filter body.

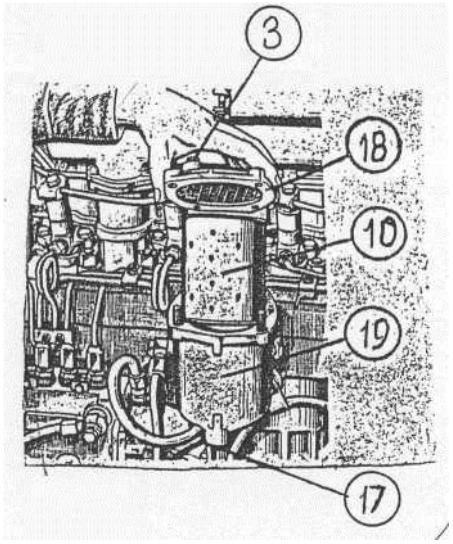


1 – input duct; 2 – exhaust duct; 3 – air outlet plug; 4 – filter body; 5 – coupling; 6 – inlet opening; 7 – bottom; 8 – coupling; 9 – clamp; 10 – filtering element; 11 – fuel outlet duct; 12 – spring; 13 – cup; 14 – nut; 15,16 – spacer; 17 – escape plug; 18 – plug; 19 – body.

Fine fuel filter

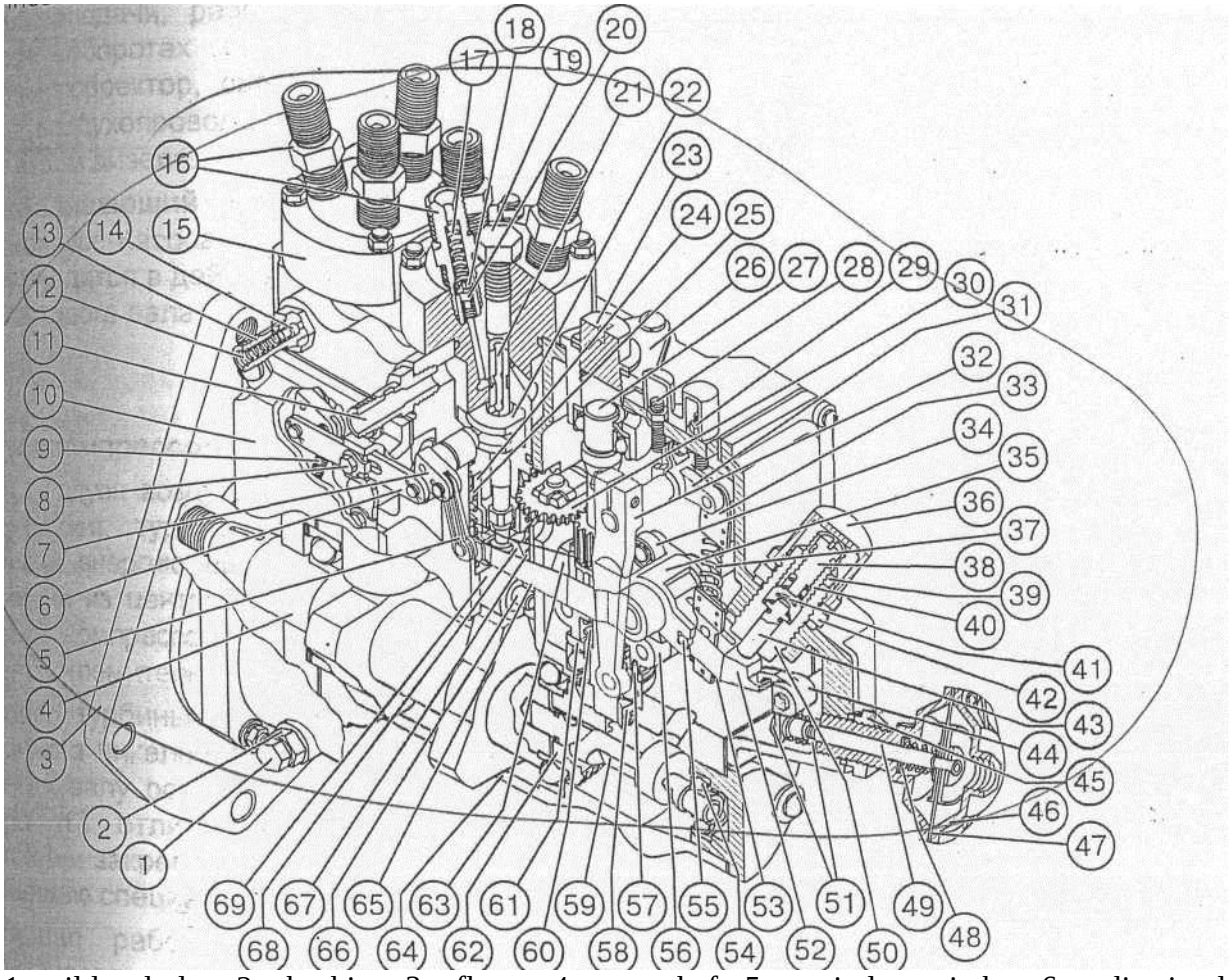
is designed for diesel engines equipped with in-line fuel pumps 363.11110005404 (YAZDA, Russia), or PP6M10PIF-3493 (Czech republic). It has one changeable filtering element installed in the body (19).

Injectors (15) of closed type with five openings atomizer (see figure on page 50) inject fuel.



FUEL PUMP

High pressure fuel pump is of a distribution type*) and has two sections with fuel dosage by means of supply end change, and a pneumatic anti-fume corrector. The fuel pump is driven by the diesel crankshaft via gas distribution pinions.



1 - oil level plug; 2 – bushing; 3 – flange; 4 – cam shaft; 5 – main lever tie-bar; 6 – adjusting lever; 7 – metering drive bushing; 8 – bolt; 9 – start spring; 10 – cover; 11 – fuel supply coupling; 12 – damper spring; 13 – damper body; 14 – damper piston; 15 – plunger bushing; 16 – high-pressure couplings; 17 – spring; 18 – supercharging valve; 19 – technological plug; 20 – reverse valve; 21 – plunger; 22 – meter; 23 – plug; 24 – tooth bushing; 25 –upper plate spring; 26 – upper governor cover; 27 – governor shaft; 28 - <stop> screw; 29 – maximum revolutions screw; 30 – intermediate pinion; 31 – lever bushing; 32 – control lever; 33 – governor spring shackle; 34 –main level bearing; 35 – main lever; 36 – corrector cup; 37 – governor spring; 38 – limiter; 39 – check-nut; 40 –lever; 41 –corrector spring; 42 - check nut; 43 – corrector tie-rod; 44 – lever; 45 – check nut; 46 – pneumatic corrector cover; ,47 – diaphragm; 48 – spring; 49 – pneumatic corrector tie-rod; 50 – corrector body; 51 – check-nut; 52 – corrector lever; 53 – plate; 54 – bearing; 55 – corrector lever axis; 56 – governor bushing; 57 – splint; 58 – driven pinion; 59 – supercharged pump drive shaft; 60 –governor damping spring; 61 – governor shaft adjusting washer; 62 drive pinion; 63 drive pinion; 64 – pump body; 65 – plunger pusher; 66 – pusher roller axis; 67 – pusher spring; 68 – lower spring plate; 69 – pusher roller.

The fuel pump is aggregated with an all-mode governor and a piston-type booster pump.

The governor has a fuel supply corrector, an automatic fuel supply dresser, operating at starting revolutions velocity, and connected to the inlet diesel collector via an air conduct.

The booster pump is installed on the high pressure pump body and is actuated by the camshaft eccentric.

Turbo compressor

The turbo compressor uses exhaust gases \energy to charge air into diesel cylinders. It consists of a centrifugal one-step compressor (6) and a radial centripetal turbine (1).

The turbine wheel (1) is made of heat resistant nickel alloy welded to the rotor shaft. The compressor wheel (6) is aluminum alloy cast, being fastened to the rotor shaft by a special nut (7)

The turbo compressor principle of operation is that exhaust gases outgoing under pressure from cylinders, pass through the exhaust collector to the gas turbine chamber and, being expanded, rotate the turbine wheel, at the other end of which is the compressor wheel.

Gases go out through the exhaust pipe.

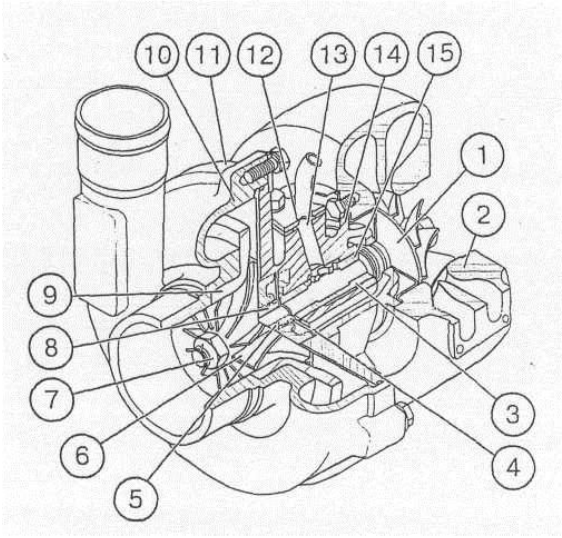
The excessive air pressure behind the compressor at the rated diesel operation mode should be 0.07…0.10 MPa (0.7…1.0 kgs/cm^2).

To remove air from the supply system, the manual, booster, piston –type pump (1) and a plug (see figure on page 50), as well as a plug (see figure on page 48) installed in the fuel pump head.

To supply fuel use pedal (24) (see figure on page 27) or lever (29) (see figure on page 28).

To stop the diesel with an in-line pump use lever (26a).

To lubricate the fuel pump parts use diesel lubrication.



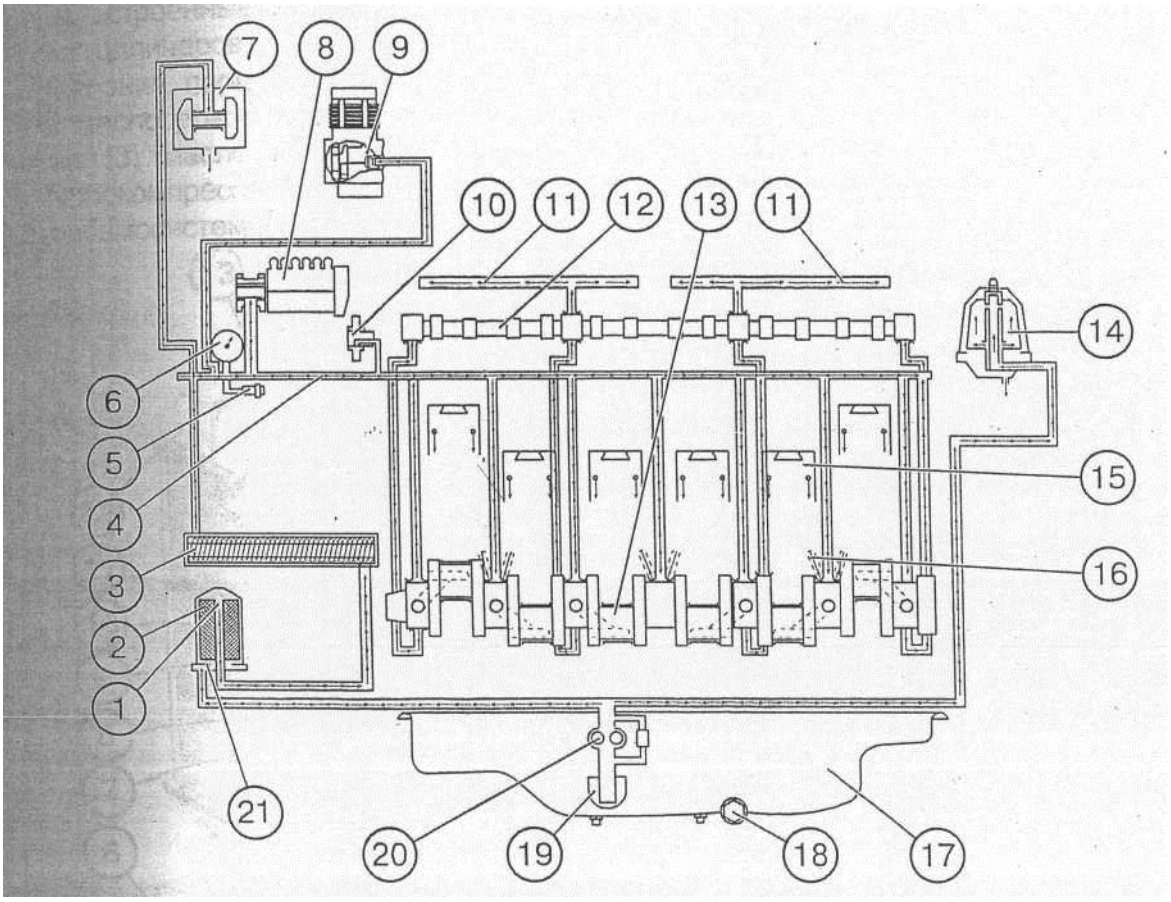
1 – turbine wheel and shaft; 2 – turbine body; 3 – bearing; 4 – oil deflector; 5 – sealing ring; 6 – compressor wheel; 7 – special nut; 8 – bushing; 9 – diffuser; 10 – disk; 11 – compressor body; 12 – stop ring; 13 – fixing element; 14 – medium body; 15- bushing.

SUPERCHARGED AIR COOLER
(see figure on page 50)

Supercharged air cooler (SAC) (29) is connected to the turbo compressor (10) and inlet diesel collector (31) by way of air manifolds and hoses.
SAC is an air heat exchanger consisting of the core in the form of aluminum pipes, tanks and manifolds. It is installed in front of water radiator and attached to radiator poles. Air is conducted to the SAC from the turbo compressor and cooled, improving diesel power and economic characteristics, and then comes to the diesel inlet collector

LUBRICATION SYSTEM is of a combined design; some parts are lubricated under pressure, others – by spraying. It consists of an oil pump (20), oil filter (2) with paper filtering element, centrifugal oil filter (14), fluid-oil heat-exchanger (3). Lubrication system diagram is shown below.

Oil pump (20) is of pinion, one-section design driven by the crankshaft. It gas a by-pass valve being opened under pressure over 0.7…0.74 MPa (7…7.5 kgs/cm^2), by-passing oil from the charging cavity to the inlet suck cavity.

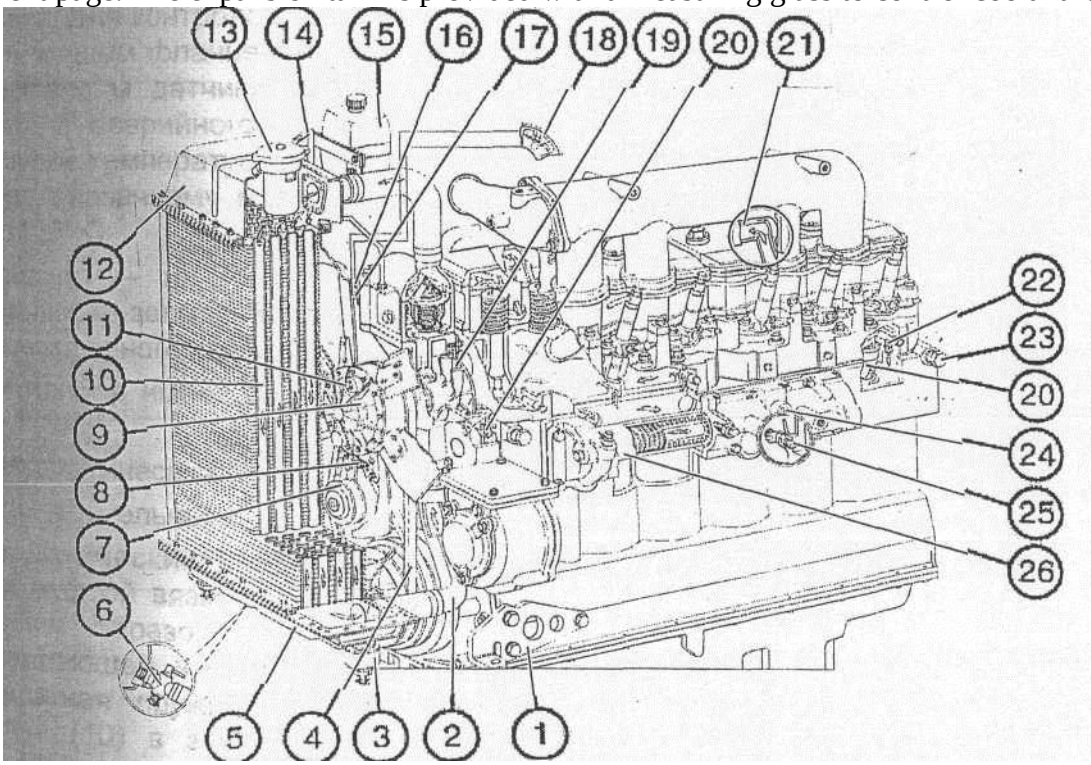


1- by-pass valve; 2 – paper oil filter; 3 – heat exchanger; 4 – main oil duct; 5 - emergency oil pressure sensor; 6 – pressure gauge; 7 - turbo compressor; 8 – fuel pump; 9 – pneumatic compressor; 10 – intermediate pinion; 11 – oil duct of rocker axle; 12 – distribution shaft; 13 – crankshaft; 14 – centrifugal oil filter; 15 – piston; 16 – piston cooling nozzle; 17 – oil crankcase; 18 – drain plug; 19 – oil drain; 20 – oil pump;21 safety valve.

The oil pump intakes oil via oil pick-up (19) from oil crankcase (17) and through ducts of the cylinder block supplies to the full flow oil filter (2) with a paper filter element, an part of oil – to centrifugal oil filter (14) for purification and subsequent drain in the crankcase.

The filtering element of the oil filter has a by-pass valve (1) which, with excessive clogging of the filtering element, or when starting cold diesel, is opened and supplies oil to the oil dust by-passing the filtering element. The valve is not adjustable. Besides, the filter has a safety valve (21) adjusted to sustaining pressure in the lubrication system at 0.28…0.45 MPa (2.8…4.5 kgs/cm ^{2})

During diesel operation oil, purified in the filter and cooled in the fluid-oil heat exchanger (3), via cylinder block ducts is supplied to all bearings of the crankshaft and the distribution shaft. Via nozzles (16) built-in main support of the cylinder block, oil is supplied to cool pistons (15).
Oil is supplied for lubrication of turbo compressor (7) and tractor's pneumatic system from heat exchanger (3) via individual ducts.
The cooling system *) of the diesel is of fluid closed type with forced circulation of cooling fluid. It consists of the water jacket, a water pump, a radiator, a fan with an automatically controlled viscosity pipe coupling, two thermostats, expansion tank with a radiator plug having steam air valve, connecting rods and drain valves. The water pump with a viscosity friction coupling is shown on the next page. The expansion tank is provided with a measuring glass to control coolant level.



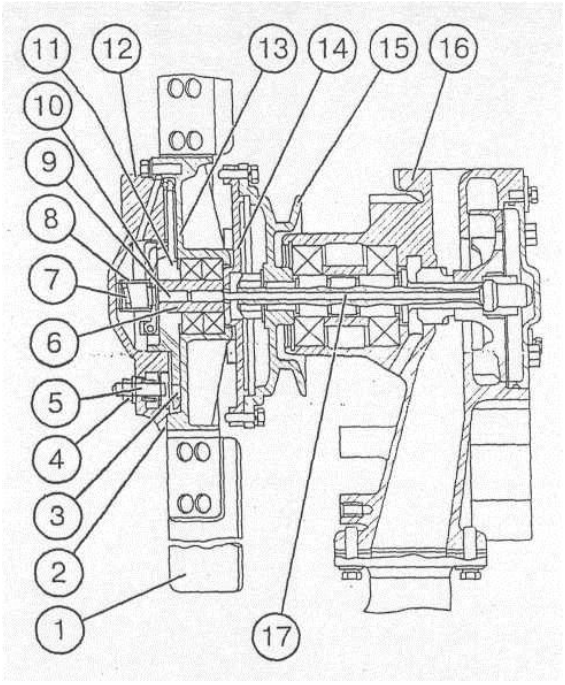
1 - a diesel fastening arm; 2 – water pump manifold;3 - shock absorber of water radiator rubber suspension; 4 – water pump drive belt; 5 – lower radiator tank; 6 – radiator water drain valve; 7 – water pump belt tensioning roller; 8 – automatic tension spring; 9 – automatically switched fan with a coupling; 10 – water radiator core; 11 – stopper of the forced fan switching mechanism; 12 – upper radiator tank; 13 – water radiator fill-in neck cover; 14 – steam air pipe; 15 – expansion tank; 16 – cooling fluid temperature sensor; 17 – emergency sensor of cooling liquid temperature; 18 – indicator of diesel cooling fluid temperature (including emergency temperature signal lamp); 19 – water pump impeller; 20 – water jacket cavity of the cylinder block; 21 – water intake pipe; 22 – ducts for directing flows of cooling fluid system; 23 – eye-bolt; 24 – plug; 25 – valve to drain fluid from cylinder block (installed on the opposite side of the diesel); 26 – fluid-oil heat exchanger.

*) deaeration and compensation loop type.

Thermal state is adjusted by changing the amount of air passing through the cooling system radiator, and also by two thermostats.
The cooling liquid temperature is controlled using the remote thermometer, sound and light signal instruments, sensors of which are located in the thermostats' body cover. The rated diesel temperature mode corresponds to cooling liquid temperature of 80…97 °C.
The fluid-oil heat exchanger built-in diesel body cools diesel lubrication oil. To control oil pressure, the heat exchanger exhaust flange is provided with operation and emergency pressure sensors. The rated diesel temperature mode in what concerns lubrication oil is 80…120 °C.
Radiator is of pipe and plate design and is provided with an in-fill neck with no steam air valve.
The fan has two operational modes:

- automatic;
- forced.

The automatic mode is ensured by the viscosity friction coupling in the following way: at cooling fluid temperature below 80 °C , the return spring (7) keeps valve (10) closed, and viscous fluid overflows to the reserve coupling cavity, dive (11) and driven disks (13) rotate with space in-between, providing minimum fan rotation. In this case fan rotation should not exceed 1500 rev/min.



1 – fan blade; 2 – driven cover; 3 – stoppage opening; 4 – stopper nut; 5 – stopper; 6 – end; 7 – return spring; 8 –yoke – 9 pusher; 10 valve 11- drive valve; 12 – coupling; 13 – driven disk; 14 – drive shaft; 15 – water pump pulley; 16 – water pump; 17 - rod

When cooling liquid temperature exceeds 80 ^{0} C, the thermal sensitive element by means of rod (17) and pusher (9), overcoming return spring (7) opens valve (10). Viscous fluid overflows to the operation cavity via drive disc opening, and fills the space between dive and driven disks, resulting in these disks coupling, thus switching the fan in the operation mode.

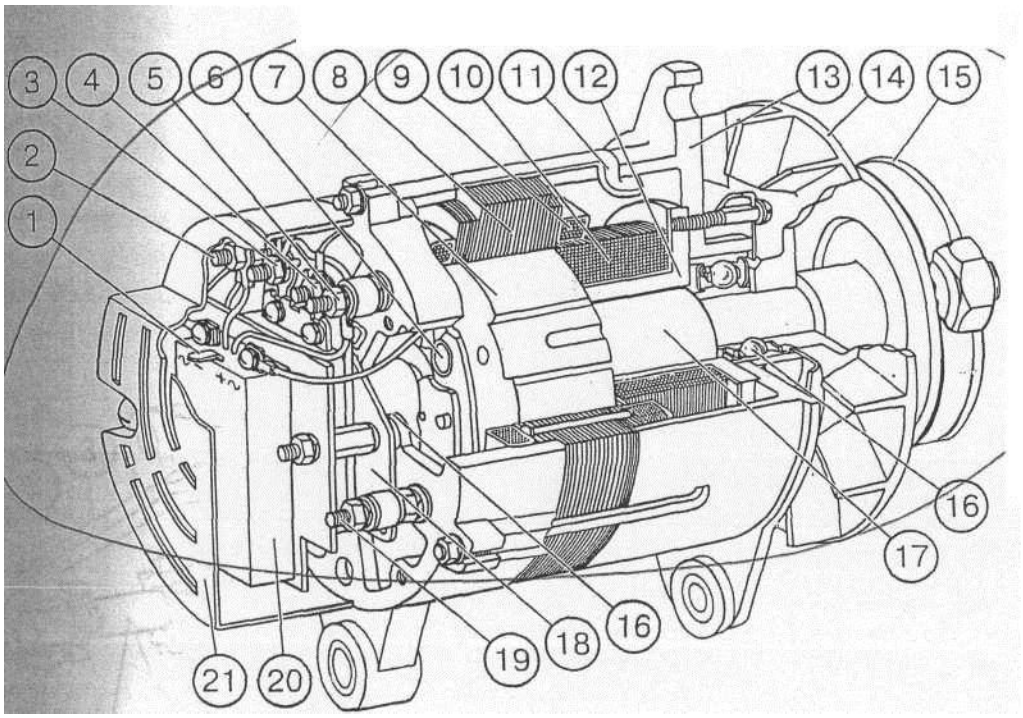
CAUTION! Switch on forced fan operation mode when the pneumatic system compressor is operational.

Do the following to change for the forced (permanent) fan operation mode:

- unscrew nut (4) of stopper (5) by 4…5 turns (about 5 mm);
- manually rotate the fan until stopper enters opening (3) of drive disc (11). If needed, press stopper (5) with a hand to stop drive and driven discs.

Electrical equipment and starting system

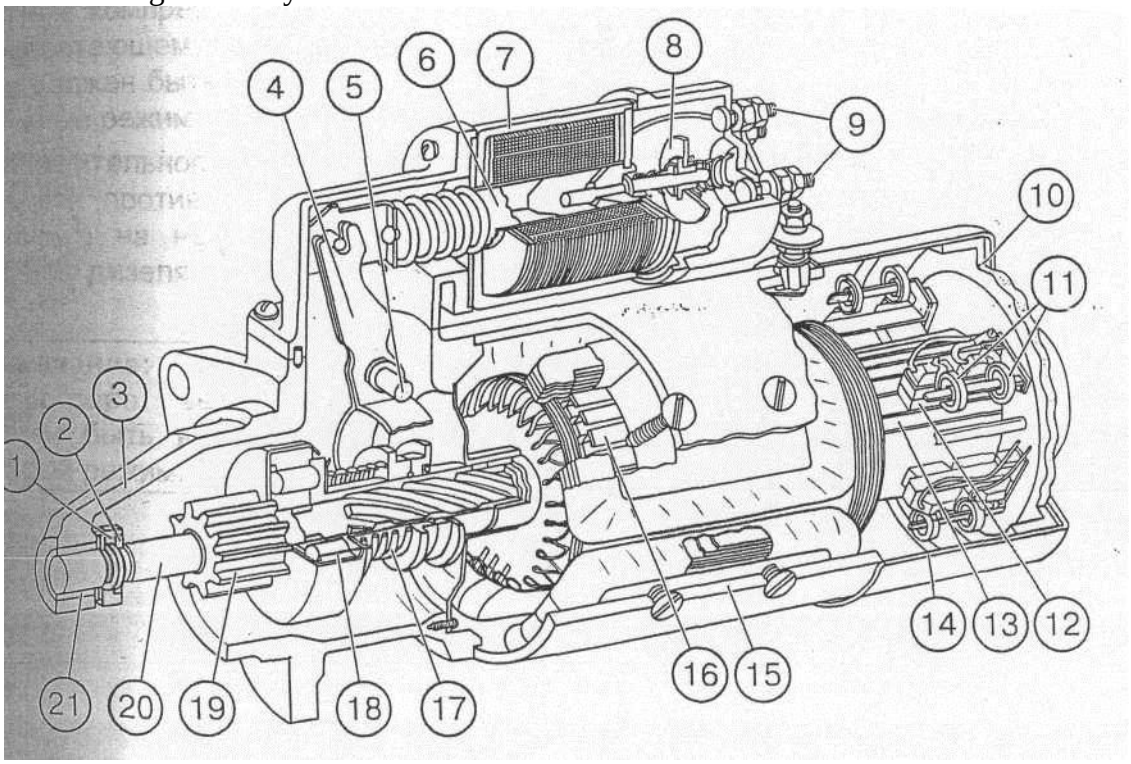
The diesel is equipped with 1250 W and 14 V generator.



1 – lead of the additional storage battery charge; 2 – terminal “+14 V”; 3 – terminal “D” (lead of excitation winding end); 4 – lead of the excitation winding start; 5 – terminal “+28V”; 6 – rectifier block; 7 – rotor; 8 – stator; 9 – stator coil; 10 – excitation coil; 11 – generator tightening bolt; 12 – generator coil cup; 13 – generator front cover; 14 – fan; 15 – pulley; 16 – one-time grease closed type ball bearings; 17 – rotor bushing; 18 – 14 V integral voltage regulator; 19 – terminal “W”; 20 – 28 V integral voltage regulator; 21 – cover of the regulation device.

Generator is of brushless inductive design, alternating current with two levels of voltage regulation (14 and 28 V) with built-in power and auxiliary rectifiers and electronic voltage regulators. The generator is intended for operation within an electric equipment system and diesel start at rated voltage of 24 V and vehicle-borne voltage of 12 V.

The first voltage level (terminals "+14 V", "D"; "W" ("-") is used for the vehicle-borne supply line, the second voltage level (terminal + 28 V) is used for additional storage battery charging.
The generator can operate both in an independent excitation mode (with a storage battery), and in the self-excitation mode (without storage battery). The generator is driven by the wedge belt from the crankshaft pulley.
The diesel starting device consists of an electric starter 20.3708 with voltage of 23 V and power 5.9 kW.
The starter is a direct current electric motor of series excitation. It is remotely switched on by way of an electric- magnetic relay and a starter switch.



1 – yoke; 2 - half-ring; 3 – starter cover; 4 – starter switching lever; 5 – switching lever axle; 6 – the core of the traction relay and a shackle 7 – traction relay; 8 – contact disc with a rod; 9 – contact bolts; 10 – rear starter cover; 11 – a spring; 12 – a brush; 13 – a collector; 14 - safety housing; 15 – starter body; 16 – starter armature; 17 – a spring; 18 – coupling of free drive movement; 19 – driving pinion; 20 armature shaft; 21 – bushing.

To start the diesel at low ambient temperature incandescent bulbs are used that heat pre-start air inletting diesel cylinders.

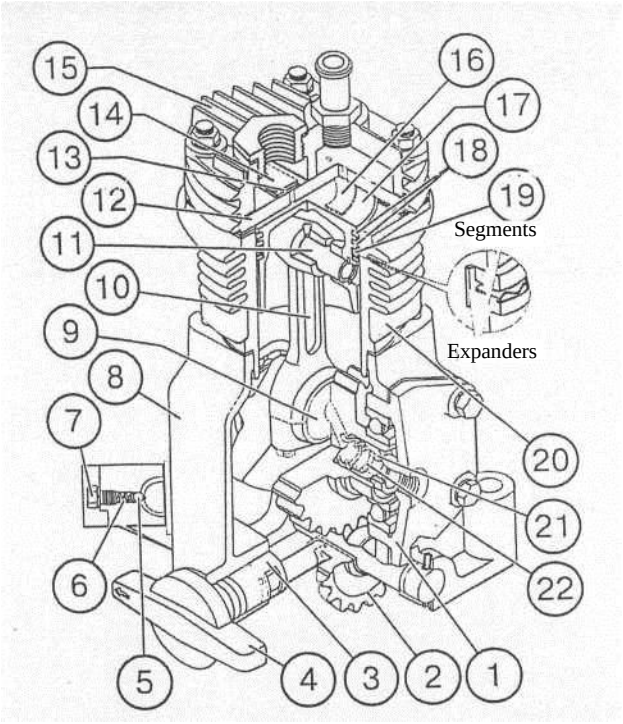
Compressor

To drive trailer's pneumatic brakes and tires inflation the diesel is equipped with a piston, one-cylinder, one step compressor. During tractor's operation in agricultural works, not requiring compressed air power, the compressor should be switched off.

The compressor is installed on the distributor cover flange and is driven by the fuel pump driving pinion. The compressor is cooled by air. When the compressor is in operation, the fan should be switched to the forced mode.

The compressor has capacity of 180 l/min at back pressure of 0.6 MPa (6 kgs/cm^2) and rated diesel rotation frequency.

NOTE: When the compressor is in operation, the diesel fan should be switched to the forced mode.



1 – roller bearing cut; 2 – intermediate compressor driving pinion; 3 – compressor switching shaft with an eccentrically located pin; 4 – compressor switching lever; 5 – shaft fixing arm; 6 – spring; 7 – fixing arm bolt; 8 – crankcase; 9 – crankshaft and a driving pinion; 10 – connecting rod; 11 – piston pin; 12 – plate; 13 – forced drought valve; 14 – limiter; 15 – cylinder head; 16 – inlet valve; 17 – piston; 18 - compression rings; 19 – segments, expanders (oil-control ring); 20 – cylinder; 21 – sealer; 22 – spring.

5.1.1. Possible diesel failures and methods of removal thereof

Failure, appearance	Correction method
Diesel doesn't start	
Air in the fuel system	Pump the system with fuel manual pipe. Remove air ingress in the fuel system.
Fuel pump failure	Remove the fuel pump from the diesel and take it for repair
Fuel filters are clogged	Rinse coarse fuel filter and replace filtering elements of fine fuel filter.
Diesel doesn't develop capacity	
Fuel pump control lever doesn't come to the end	Adjust fuel pump control bars
The filtering element of the fine fuel filter is clogged.	Replace the filtering element of the fine fuel filter
Injectors failed.	Find out failed injectors, rinse and adjust.
Injection advance angle is not properly adjusted	Set the required angle of injection advance.
Diesel smokes in all operation modes	
A. Black fumes get out the exhaust pipe	
Diesel air purifier is clogged.	Carry out air purifier maintenance.
Injector nozzle needle floats.	Find out failed injector, rinse or replace the nozzle, adjust the injector.
Fuel pump is failed.	Take off the fuel pump and take it for repair to the workshop.
B. White fumes get out the exhaust pipe	
The diesel is overcooled	Heat up the diesel, during operation keep cooling fluid temperature within 70 –95 °C
Water entrapped in fuel.	Replace fuel.
No space between valves and rockers	Adjust space between valves and rockers.
Angle of injection advance is not properly adjusted.	Set the recommended angle of injection advance

Continuation of table 5-1

Failure, appearance	Correction method
C. Blue fumes get out the exhaust pipe	
* Oil entrapped in the combustion chamber due to wear of piston group parts.	Replace worn out parts of the piston group.
* Excessive oil in the diesel crankcase	Drain out excessive oil having set the level according to the upper mark of the oil metering rod.
Diesel overheats	
* Insufficient amount of cooling liquid in the system	Fill in the cooling liquid to the normal level.
* The radiator is dirty outside.	Clean the radiator.
* Dirt and scale in the cooling system.	Clean and rinse the cooling system off dirt and scale.
* The thermostat valve doesn't open completely	Replace one or two thermostats
* The fan belt is not tight enough: * The tightening device spring is broken;	Replace the spring. If that is not possible, temporarily interlock the tightening device, having tightened generator bar and tightening pulley with a bolt an a nut. But first, tighten the belt.
* Jamming of the tightening pulley at the lever axle.	Dismantle the tightening device and correct the failure
* Oiling of the fan and pulley's belt.	Remove the driving belt, and clean oil traces from belt and pulley' surface.
Underrated oil pressure of the heated diesel	
* oil indicator or sensor are failed.	Replace the oil pressure indicator or sensor after gauging oil pressure with a reference gauge.
*Oil conducts sealing is no good.	Find out the sealing problem and correct it.
* Oil pump is failed.	Find out the problem and correct it.
* Oil level in the diesel crankcase is lower than rated value	Fill –in oil to the upper mark of the oil measuring rod
* Jamming of the safety valve in the oil filter body	Rinse the valve and adjust pressure in the lubrication system.
* Excessive wear of the coupling "crankshaft necks – bearings".	Correct the trouble.

Continuation of table 5-1

Malfunction, appearance	Correction method
Turbo compressor	
* Rotor of the turbo compressor doesn't rotate (no typical high-tone sound):	
* Foreign matter hinder rotor rotation	Take off inlet and exhaust manifolds, remove foreign matter.
* Rotor is jammed in the bearing.	Replace turbo compressor.
* Increased oil injection on the side of the compressor or turbine, leaks from oil sealing of the turbo compressor.	Take the turbo compressor off the diesel and send for repair.
Starter	
* During starter switching diesel crankshaft doesn't rotate (or rotates very slowly):	
* storage battery clamps are not properly tightened, or wiring lugs are oxidized	Strip lugs and tighten clamps.
* storage battery discharged lower allowable limit	Charge or replace the battery.
* collector and brushes are dirty;	Clean collector and brushes.
*brushes have poor contact with collector;	Take the starter off the diesel, scrape the collector, or replace brushes if worn out.
*burnt starter relay contacts;	Scrape starter relay contacts.
*starter driving coupling slips (worn out coupling rollers, or yoke cracked);	Replace starter drive.
* After diesel start, the starter remains switched on:	
* the power disc is stuck to contact bolts of starter relay;	Stop the diesel, switch off the battery and clean contacts of the traction relay.
* driving pinion stays engaged to the flywheel ring due to break of push lever spring.	Replace the return spring of the push lever.

Continuation of table 5.1

Failure, appearance	Correction method
Generator	
* Voltage indicator doesn't show charging after diesel start and further on during operation:	
*positive clamp torn off, or short-circuited on the generator body;	Disconnect the rectifier, weld and insulate damaged site, and if the trouble is not corrected, replace the excitation coil.
*excitation coil open-circuit	
*short -circuit in straight and opposite rectifiers' polarity of one phase;	Replace the rectifier.
*short-circuiting of one of stators phases on generator body;	Replace the starter.
*generator doesn't develop full capacity:	
* torn off wiring leading to the regulator;	Solder and insulate the damaged site.
* one of stator's phases torn off;	Replace the stator.
* turn short-circuiting of the stator winding;	Replace the stator.
* turn short-circuiting of the excitation coil winding.	Replace the excitation coil.
* Generator noise:	
* driving belt slips or is too tight;	Adjust driving belt tension.
* ball bearings are worn out;	Replace ball bearings.

Continuation of table 5-1

Failure, appearance	Correction methods
The units of the automatic fan clutch control system	
* If water temperature exceeds 97 ˚C at the diesel outlet, the cooling system fan doesn't switch on , or with water temperature below 70 ˚C, the cooling system fan doesn't switch off: • fault with thermal power sensor, or a fan clutch.	*remove fan clutch; *press the rod in the water pump to the end, and measure how far it extends; *start the diesel and heat it to bring water temperature at the outlet to 80-85 ˚C; stop the diesel and measure rod extension from the water pump; 1. If extension didn't increase against the initial, replace thermal power sensor; 2. If extension increased by 6-8 mm, replace fan clutch, and send faulty clutch for repair. I f the clutch can't be replaced, interlock it by the given above method (see " The diesel cooling system").
Tachometer-speedometer	
*During tractor travel the tachometer-speedometer shows constant speed of 0.2 km/h:	
*One of speed sensors failed.	Replace sensor
*During diesel operation tachometer doesn't indicate rev/min:	
*open-circuit from phase winding to tachometer – speedometer;	Correct the trouble.
*no signal from generator phase winding.	Replace the generator.

5.2. THE CLUTCH

Diesel flywheel (1) is provided with dry, two-disc clutch of permanently closed type.

The driving elements of the clutch are flywheel (1), pressure clutch plate (3) and middle plate

(2) with three pins on the outside surface, coming in special flywheel grooves (1), driven clutch elements are two driven discs (24) provided with torsion vibration damper (90) installed on the power shaft (7). Required pressure effort of friction surfaces of driving and driven coupling parts are provided by nine outside and nine inside springs (22). An elastic element is installed between floating bushing (8) connected to the driving shaft (9), and support plate (12).

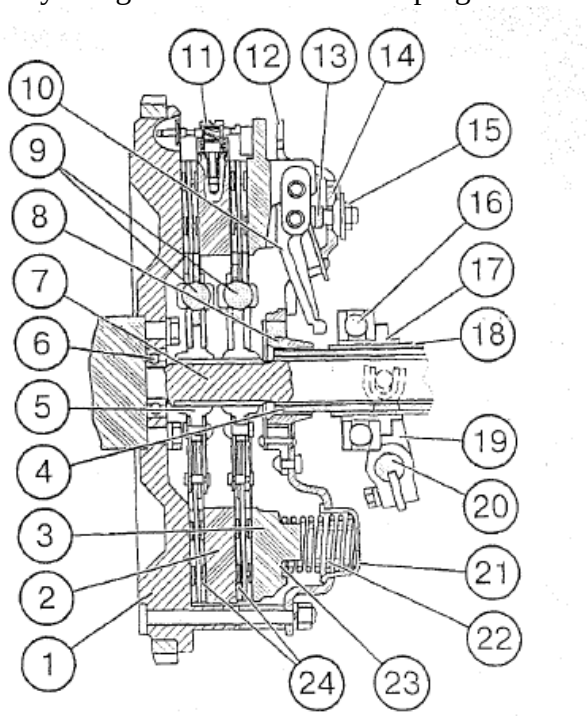
The middle disc (2) has lever mechanisms (11) that ensure disc (2) equal distance setting between flywheel friction surface (1) and pressure clutch plate (3). Yokes (13) serve as squeeze clutch levers supports.

They are fixed on the support disc by way of adjusting nuts and fixing washers (14).

Clutch is engaged and disengaged by shifter (17) and squeezing bearing (16) moving along bar (18). Shifter yoke (19) with roller (20) are connected to clutch pedal via hydraulic static drive.

Squeeze bearing (16) is lubricated by means of the press-grease cup screwed in the shifting neck.

The grease cup is on the left side of the clutch body. To get access unscrew the plug.

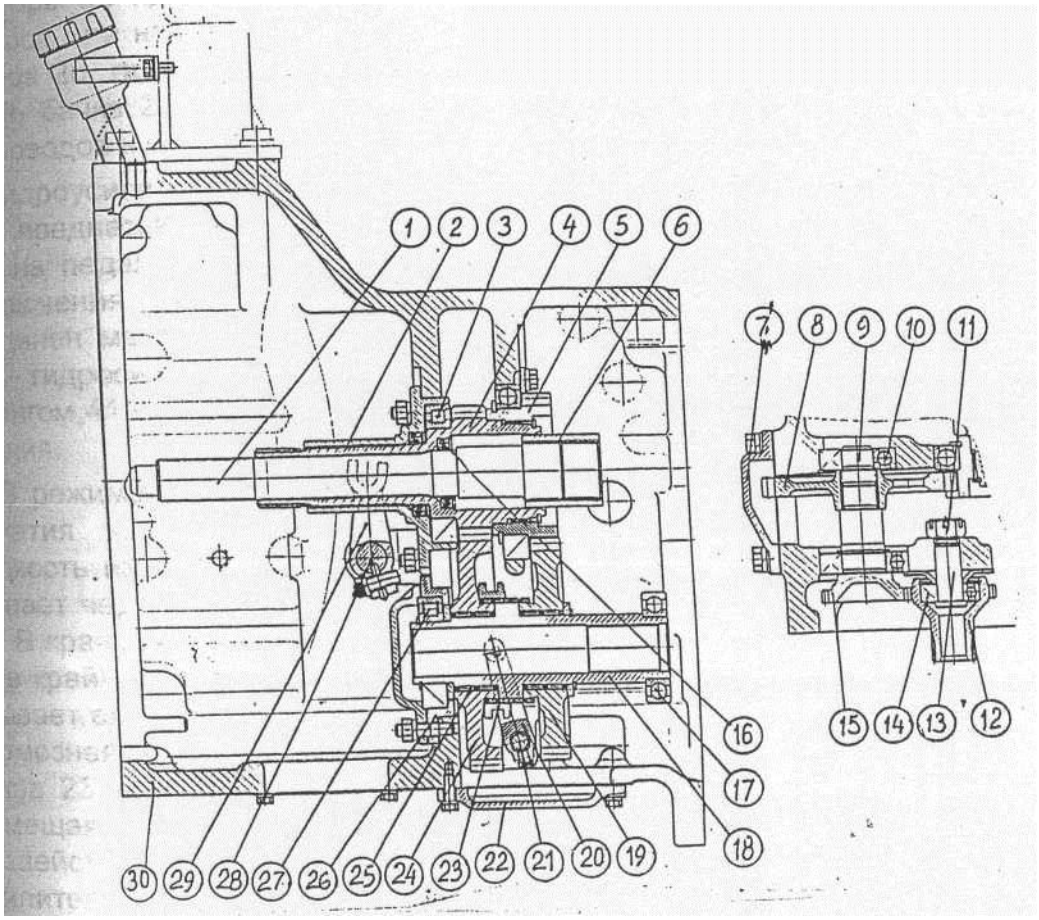


1. – flywheel; 2 – middle disc; 3 – pressure clutch plate; 4 – driving shaft; 5 – bushing; 6 – bearing; 7 – power shaft; 8 – floating bushing; 9 – torsion vibration damper; 10 – squeeze lever; 11 – lever mechanism; 12 – support disc; 13 – yoke; 14 – washer; 15 – nut; 16 – bearing; 17 – shifter; 18 – shifter bar; 19 – switch off yoke; 20 – control roller; 21 – cup; 22 pressure clutch springs; 23 insulating washer, 24 – driven discs.

5.2.1. CLUTCH BODY

Clutch body (30) contains drive and driven shafts with pinions, oil pump drives of HLS and transmission hydraulic system. Drive shaft (4) is mounted on two bearing supports. The shaft has a toothed ring and splints with installed pinion (5) forcing pinion (19) of the independent PTO (18) of driving the driven shaft to rotate, and pinion (8) that drives oil pumps. Power shaft (1) passes through shaft (4) which via splint pushing (6) transmits torsion moment from the clutch to GB input shaft. Driven shaft (18) is mounted on two bearings (17, 27) in clutch and GB bodies. The shaft of needle bearings bears (25) driven pinions (19, 24) of two-speed independent PTO drive. Fixed pinions (19, 24) are connected with the shaft by way of toothed clutch (23) being moved by means of yoke (20) and roller (21).

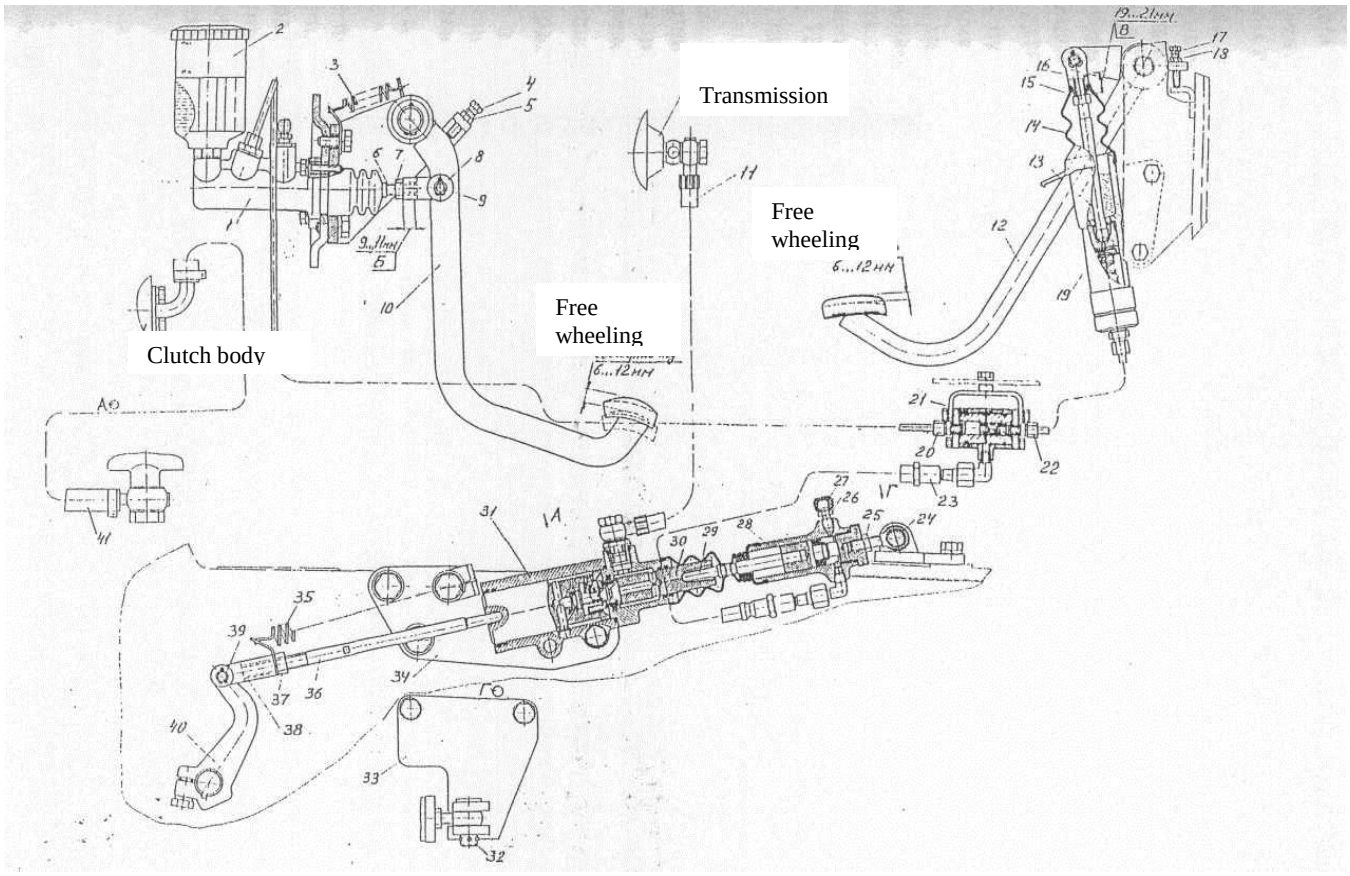
HLS oil pump is driven by means of pinions (5) and (8), and transmission hydraulic system pump – by pinions (5), (8) and shafts (15), (12).



1 – power shaft; 2 – bar; 3 – 3, 10, 14, 17, 25, 27 – bearings; 4 – drive shaft; 5 – pinion; 6 - splint bushing; 7 – cover; 8 – pumps drive pinion; 9 , 15 – shaft-pinion; 11 – nut; 12 – shaft-pinion; 13 – shaft – 16 – sealing ring; 18 – driven shaft; 19 – pinion; 20 – yoke; 21 – roller; 22 – cover; 23 – toothed clutch; 24 – pinion; 26 – cup; 28 – roller; 29 – yoke; 30 – body.

CLUTCH DRIVE

The clutch drive is intended for clutch control both for forward travel and driving in reverse.
The clutch drive is of hydraulic static design with suspended pedals and a hydraulic booster.
The drive consists of main cylinders (1) (for forward travel), and 19 – (for driving in reverse), suspended pedals 10 (forward travel) and 12 (driving in reverse), valve 21 (for automatic
changing tractor forward travel mode to reverse mode, and visa versa), operation cylinder 28, hydraulic booster 31, lever 40, tank 2, connecting pipelines and oil conduits.
Hydraulic booster 31 is of static model and is intended for reduction of effort applied on pedals 10 and 12 in the process of clutch disengagement. It is connected via oil conduit 11 to the transmission hydraulic system pump, and via hose 41 to clutch body drain.
In the forward movement mode when pressing pedal 10 breaking fluid from main cylinder 1 via pipeline 20 is supplied to cock 21. In cock 21 piston moves to the end right position closes pipeline inlet 22. Then via hose 23 braking fluid is supplied to operation cylinder 28, thus moving piston 29. Piston 29 actuates pusher 30 of hydraulic booster 31, resulting in hydraulic booster 31 operation, extension of the piston and tie-bar 36, shifting lever 40, which is via roller pushing the clutch, leads to disconnection of the engine from transmission.
In the reverse operating mode, when pressing pedal 12, braking fluid via pipeline 22 from
main cylinder 19 is supplied to cock 21. In cock 21 the piston moves to the end left position and closes pump line inlet 20. Then braking fluid via hose 23 is supplied to wheel cylinder
28, performing described above functions.
In the clutch drive system “Neva M” TU 2451-053-36732629-2003, or “ROSDOT” TU-004-36732629-99 braking fluids are used.



CLUTCH CONTROL

1 – forward movement main cylinder; 2 – tank; 3 – spring; 4, 17 –bolt; 5, 7, 15, 18, 25, 37 – nut; 6, 13, 30 – pusher; 8;, 16, 38 – yoke; 9, 32, 39 – pin; 10 – forward travel clutch pedal; 11 – oil conduit; 12 – reverse mode clutch pedal; 14 – sheathing; 19 – reverse mode main cylinder; 20, 22 – pipe line; 21 – cock; 23 – hose; 24 – support; 26 – by-pass valve; 27 – safety cup; 28 – operation cylinder; 29 – piston; 31 – hydraulic booster; 33, 34 – arm; 35 – pull out spring; 36 – tie-bar; 40 – lever; 41 – hose.

Adjustment of clutch control

There are several stages of clutch control adjustment:

1. **Adjustment of clearance between a piston and pusher 6 of main cylinder piston 1 (forward travel)**
   - insert pusher 6 of main cylinder 2 in yoke 8, having observed distance B, then tighten nut 7.
   - by screwing and unscrewing bolt 4 to set clearance between piston and pusher 6 of main cylinder piston 2, adjust free pedal movement 10 to within 6…12 mm (as measured by cover center);
   - tighten check nut 5.

2. **Adjustment of clearance between piston and main cylinder piston pusher 19 (reverse mode operation);**
   - take off cover 14;
   - unlock pusher 13;
   - insert main cylinder pusher 13 in yoke 16, having observed distance B;
   - tighten nut 15 and put on cover 14;
   - by screwing and unscrewing bolt 17 to ensure clearance between piston of main cylinder piston 19 pusher 13, adjust pedal 12 free travel within 6…12 mm (as measured by cover center);
   - tighten check nut 18.

3. **Adjustment of clutch shifter free travel:**

   - remove spring 35;
   - disconnect tie-bar 36 from lever 40, pulling pin 39 out;
   - unlock yoke 38;
   - turn lever 40 anti clock-wise to the end of pressure bearing to squeeze levers and, turning yoke 38, align lever and yoke openings;
   - tighten yoke 38 by 5…5.5 turns and connect to lever 40 by means of pins 39;
   - tighten check nut 37, secure pin 39 with a cotter pin, put spring 35 in place.

4. **Adjustment of clearance between piston 29 of cylinder 28 and pusher 30 of hydraulic booster 31:**
   - - remove wheel cylinder 28 from arm 33,having pulled out pin 32;
   - set piston 29 in cylinder 28 to end right position up to the cover;
   - set piston 29 of cylinder 28 until it smoothly touches pusher 30 of hydraulic booster 31, and by screwing or unscrewing support 24, align support and arm openings 33;
   - screw in support 25 by ½ turns, place pin 32, tighten it with a pin, tighten check nut 25.

Circulate oil through clutch control hydraulic system.

Circulating oil through clutch control hydraulic system

Before the operation fill braking fluid in tank 2 of forward travel main cylinder, and compensation chamber of main cylinder 19 for reverse movement mode.

1.To circulate oil through the hydraulic system for forward travel, do the following:

- fill braking fluid in tank 2 to level "MAX";;
- take safety cup 27 off cylinder 28 and put rubber hose on by-pass valve head 26, having dipped it in braking fluid reservoir;
- press clutch pedal several times; keeping it pressed, unscrew by-pass valve 26 by one fourth of the turn and let excessive braking fluid with air bulbs out into the braking fluid reservoir;
- tighten by-pass valve 26 and release clutch pedal;
- pump the system until air bulbs in braking fluid being drained disappear completely;
- take the hose off and put safety cup 27 in place;
- check braking fluid in tank 4 and refill, if necessary.

2. To circulate oil in the hydraulic system for reverse movement mode, do the following:

- take case 14 of main cylinder 19;
- check braking fluid in main cylinder compensation chamber 19, which should not be less than 15 mm lower from upper compensation chamber rim;
- the order of bleeding the hydraulic system is similar that of forward travel mode.

3. Checking hydraulic system bleeding as per item 1.

CAUTION! During hydraulic system bleeding:

- **for forward travel keep braking fluid level in tank 2 within marks "MIN" and "MAX";**
- **for the reverse movement mode keep braking fluid level in main cylinder compensation chamber 19 not lower than 15 mm from compensation chamber upper rim.**

Upon checking clutch control adjustments, check noise of clutch disengagement; to this end:

- start the tractor and set diesel rotation frequency to 1400 +/- 100 rev/min;
- pull the parking brake back to the full;
- press clutch pedal to the full and in at least 5 seconds shift GB gear, which should be noiseless.

If this requirement is not observed, check adjustments anew.

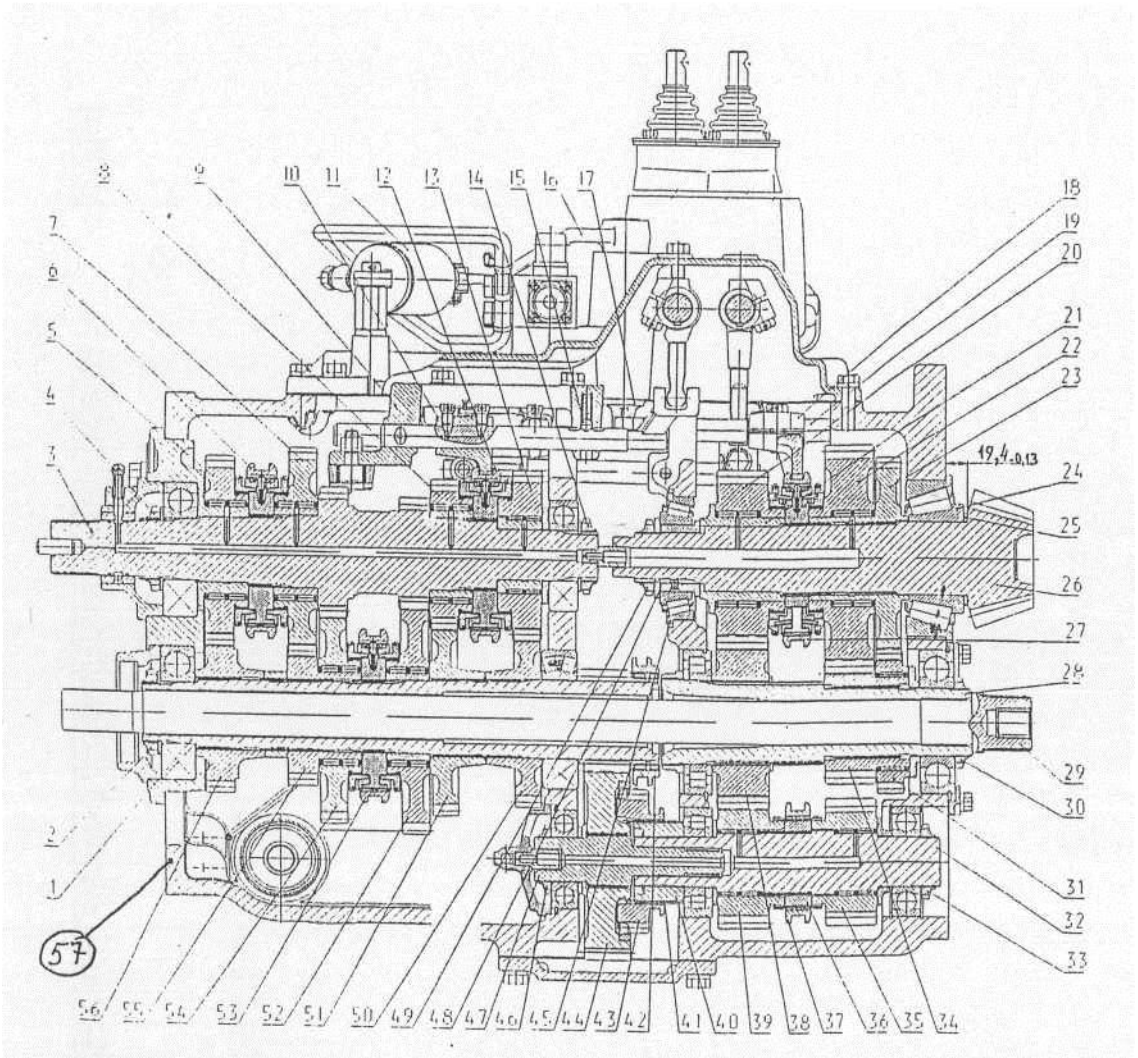
Possible clutch malfunctions

Table 5-2

Malfunction, appearance	Correction methods
GB gears are shifted with grinding sound (not full clutch disengagement)	
Clutch control is not adjusted	Make adjustments
Squeeze levers are out of level	Make adjustments
Driven discs' bushings jam in power shaft cotter pins	Clean and grease cotter pins. If worn out or damaged, replace discs or the power shaft.
Increased wobbling of driven discs' blades	Replace discs
Flywheel bearing is destroyed	Replace the bearing
Air entrapped in the system	Find out the trouble. Bleed the hydraulic dive system
Loss of pressure in operation cavities of main and operation cylinders due to sealing rings damage	Replace sealing rings. Bleed the system.
Oil leakage through sealing rings of the hydraulic booster.	Replace sealing rings in the hydraulic booster
Clutch slips (not full clutch engagement)	
Clutch control is not adjusted	Make adjustments
Oiling of driven discs lining and adjacent friction surfaces	Remove causes of oil trapping. Rinse oiled surfaces with benzene.
Lining of clutch driven discs is worn out	Replace lining or discs in assembly
Shrinkage of pressure springs	Replace springs
Jamming of main and operation cylinders' pusher due to swelling of sealing rings	Replace sealing rings. Bleed the system
The hydraulic drive system is impossible to bleed in the reverse mode (MTZ – 2522V/2822V)	
Damage or wear out of the sealing ring of main cylinder rod of the reversing mechanism	Replace sealing rings. Bleed the system.

5.3 GEAR BOX

The gear box is of mechanical, step-wise, permanently clutched pinions, range-type (four front travel ranges and two ranges of reverse movement mode) design, with six gears within each range shifted by means of synchronizers. The gear box provides 24 gears for forward travel and 12 gears for reverse movement, as well as front drive axle drive.



1 – intermediate shaft; 2, 4, 14, 30, 33, 46, 49 – nuts; 3 – main drive; 5, 7, 8, 13, 20, 22, 23, 31, 34, 35, 38, 39, 43, 44, 50, 51, 52, 54, 55, 56 – pinions; 6, 12, 27, 53 – synchronizers; yokes' body; 10, 18 – yokes; 11- hydraulic cylinder; 15 – ball fixing element; 16, 17 – levers; 19 – drag bar; 21, 36, 40 – bushings; 24, 45 – roller bearings; 25, 48 – adjusting washers; 26 – main output shaft; 28 – shaft of pinions block; 29 – shaft of independent PTO drive; 32 – shaft of reduced gears and reverse movement; 37, 42 – toothed clutches; 41 – stop ring; 47 – shaft; 57 – GB body.

5.3.1. Gear box design

The gear box (see figure on page 72) consists of the body, gear block, reduced gears and reverse movement shaft; pinions block; main output shaft – a pinion; control mechanism an hydraulic system.

Gear assembly consists of main output shaft that bears drive pinions (8), (13), (5) and (7) installed on needle bearings. They provide shifting of gears 3, 4, 5, and 6 correspondingly, and 1 and 2 gears shifting pinions are made as one assembly with shaft (3).Shaft splines carry two synchronizers (6) and (12), shifting gears 3, 4, 5 and 6.

Countershaft (1) bears with interference driven gears (51), (50), (56) and (55) for gears 3, 4, 5 and 6 correspondingly are installed on needle bearings. Shaft splines bear synchronizer (53) for switching gears 1 and 2.

Reduced gears and reverse movement shaft (32) has pinion (39) of forward travel ranges I and II, and pinion (35) of reverse movement ranges I and II. Splined bushing (40) bears movement reducing pinion (43). Driven pinion (44) is installed on splines of shaft (47). If movement reducer is not installed, pinion (44) is connected to reduced gear shaft via pinion (43) and splined bushing (40). Bushing (40 is connected to shaft (32) by means of splines, and pinion (43) is fixed on bushing (40) by retaining ring (41) to prevent its axial travel.
Toothed coupling (37) serves to connect pinions (35) and (39) to the shaft.

Pinion assembly shaft (26) bears pinions (34) and (38) installed on splines. Pinion hub (34) has FDA diving pinion (31) installed on needle bearings.

Main output shaft-pinion (26) is installed in GB case on coned roller bearings (24) and (45). They are adjusted by means of washers (48), and main output shaft (26) extension (dimension $19.4\ ^{-0.13}$) is adjusted by selecting of adjustment washer (25). The shaft has immobile FDA driving pinion (23). The hub has driven pinion (22) installed on needle bearings. Bushing (21) carries driven pinion (20) installed on needle bearings. Shifting between pinions (20) and (22) is effected by way of synchronizer (27)
Parts' assemblies on all shafts are tighten by nuts (2), (4), (14), (30), (33), (46) and (49).

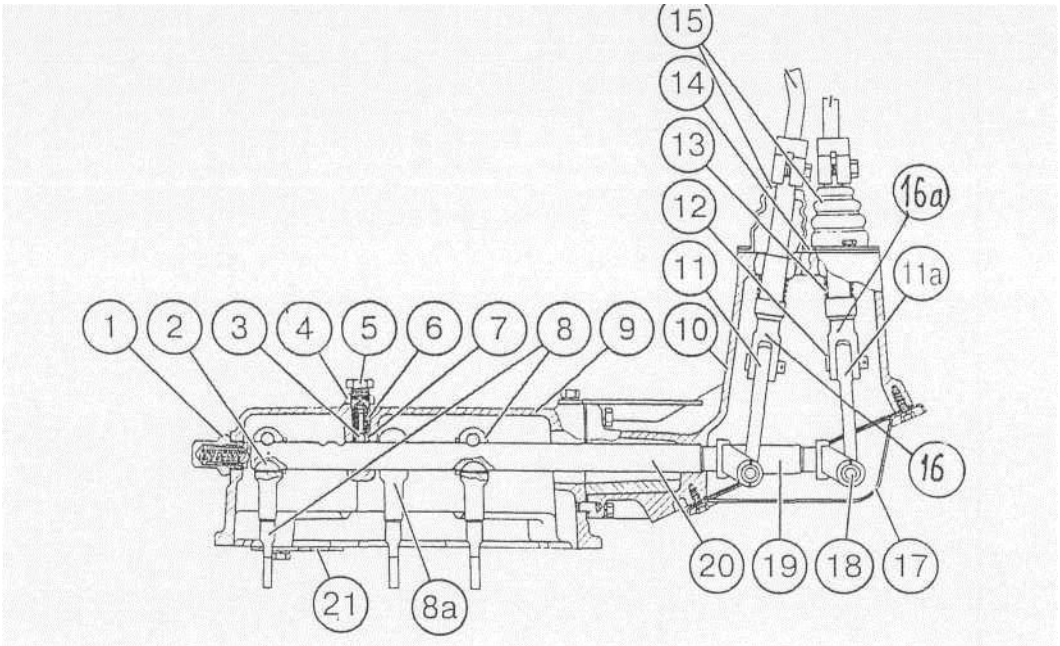
5.3.2 GB control mechanism

The GB control mechanism consists of a mechanism for shifting gears and a mechanism for shifting ranges with an electric-hydraulic system for switching higher ("H") and lower ("L") stages of GB reduction gear.

Gears shifting mechanism is mounted in yokes' case (9) (page 73), in control cover (9) and body (57) (page 72). Gears are shifted by means of yoke (16a) of GB shifting lever via lever (11a), shaft (19) and lever (8a). The yokes' case has three carriers on which yoke (10) (page 72) and levers are installed. To prevent simultaneous shifting of two gears locking steel balls are installed between carriers. To fix carriers and yokes in neutral and shifted positions, spring ball fixing elements are provided.

Range shifting mechanism consists of yoke (16), range shifting handle, lever (11), shaft (20) and levers (8). These parts are mounted in control cover (9) and case (10).

The range shifting mechanism also has electric-hydraulic system for control of shifting higher and lower stages of the reduction gear. It includes hydraulic cylinder (11) (page 72), levers (16) and (17) , carrier (19) and yoke (18), The reduction gear control system is described below. Tooth-type couplers (37) and (42) are moved by yokes fixed on carriers (not shown). Synchronizer (27) is switched by the electric-hydraulic system. Position of tooth-type couplers (37) and (42) in neutral and switched on state is fixed by parts (6, 7a, 11) (page 77). In one of its positions the synchronizer is fixed with a ball with a spring and a pin. To exclude simultaneous shifting of tooth-type couplers (37) and (42), the GB case has locking steel balls (6) and pin(7) (page 77).



1 – limiter; 2 – key; 3 – ball; 4 – nut; 5 – bolt; 6 – spring; 7 – bushing; 8, 8a – lever; 9 – cover; 10 – case; 11, 11a – lever; 12 – pin; 13 – spring; 14 – sphere; 15 – sheath; 16, 16a – yoke; 17 – cover; 18 – pin; 19,20 – carriers; 21 – link.

5.3.3 System of GB reduction gear control

Electric-hydraulic system consists of control panel (1) situated the tractor cabin on operator's right, lever (3) for gears shifting and reduction gear stages, sensor (5), GB neutral, sensor (7) and (8), installed on hydraulic cylinder for shifting reduction gear (see item 11 on page 72), electric hydraulic distributor (6), located on top of GB cover, connecting cables (4) with shoes (9). The system is connected to vehicle-borne electric circuit via fuses box (2). Electric power is supplied to the system after diesel start.

Lever handle (3) has buttons (10, 11) and signal devices (light-emitting diodes) (13, 12) of lower and higher reduction gear stages correspondingly.

Panel (1) has signal devices (15, 14) of switching of lower and higher stages of the reduction gear and relay of reduction gear control.

The system allows to shift reduction gear stages only with lever (3) in neutral position (contacts of GB neutral sensor (5) are closed)

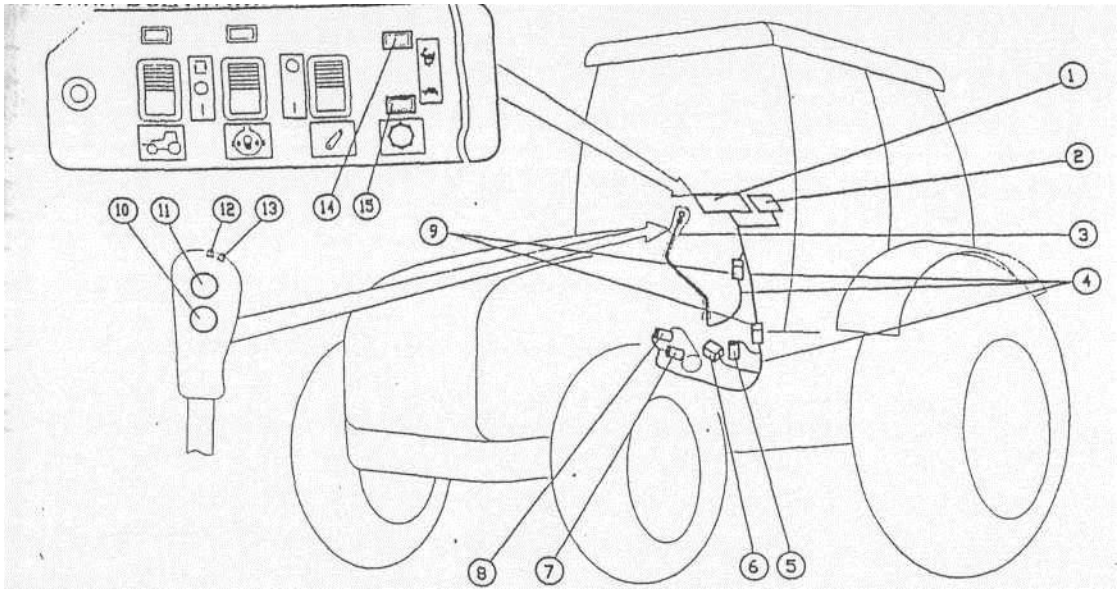
Signals are sent to LEDs (13, 12) and (15, 14) from relative pressure sensors (8 and 7).

After diesel start in the initial position lower reduction gear stage is switched on. In this case signal devices (13 and 15) should be alight.

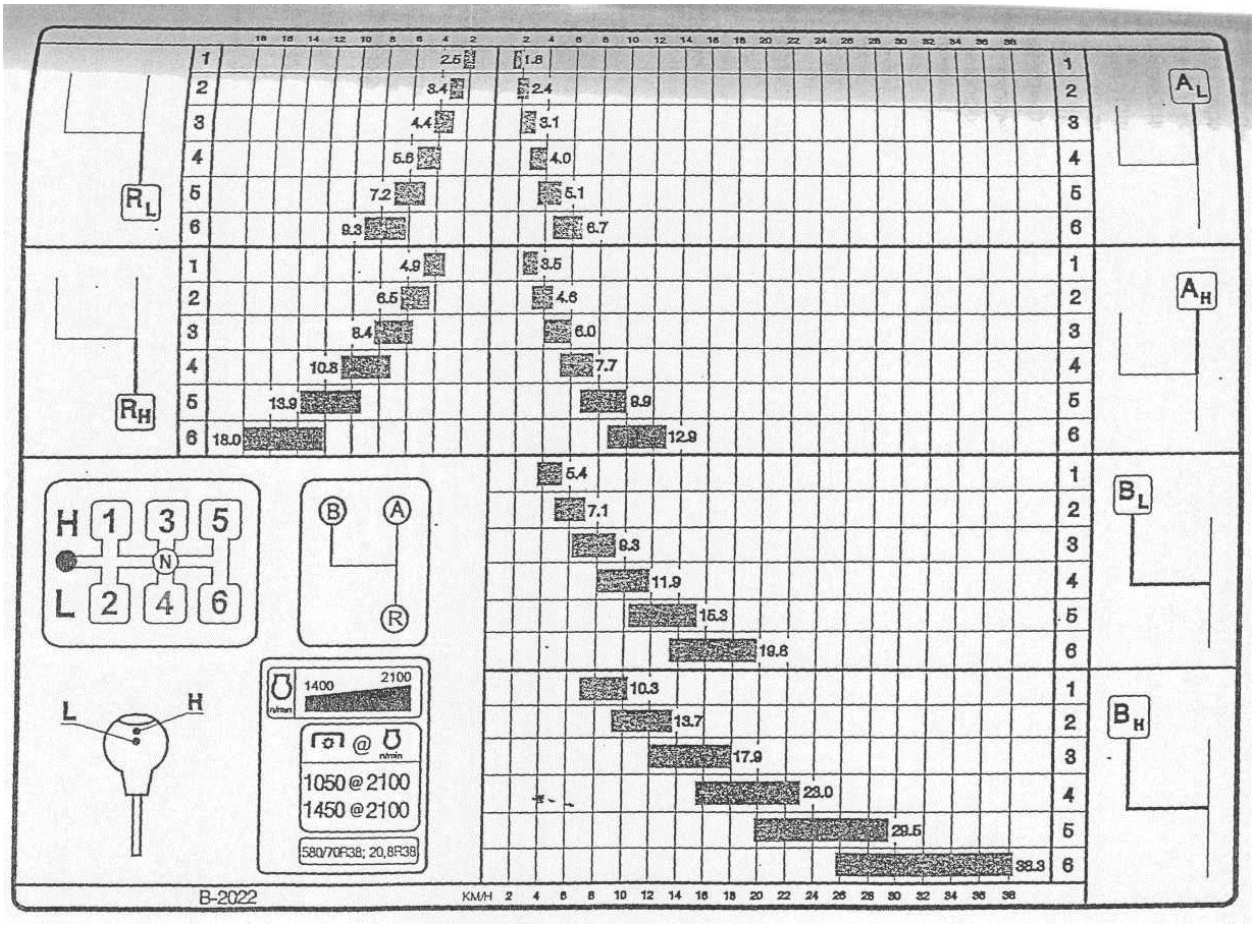
Higher reduction gear stage is shifted by pressing button (11) with signal devices (13 and 15) going down, and signal devices (12 and 14) lighting.

To shift from higher to lower stage press button (10).

Electric diagram of the system of GB reduction gear control is shown on page 232.



1 – control panel; 2 – a box of fuses; 3 – lever for shifting of reduction gear shifts and stages; 4 – connecting cables; 5 – GB neutral sensor; 6 – reduction gear electric distributor; 7 – higher stage pressure sensor; 8 – lower stage pressure sensor, 9 – connecting shoes; 10 – lower stage switching button; 11 – higher stage switching button; 12 – higher stage light emitting diode; 13 – lower stage light emitting diode; 14, 15 – control lamps.



Gears diagram of the tractor

5.3.4 Diesel start locking

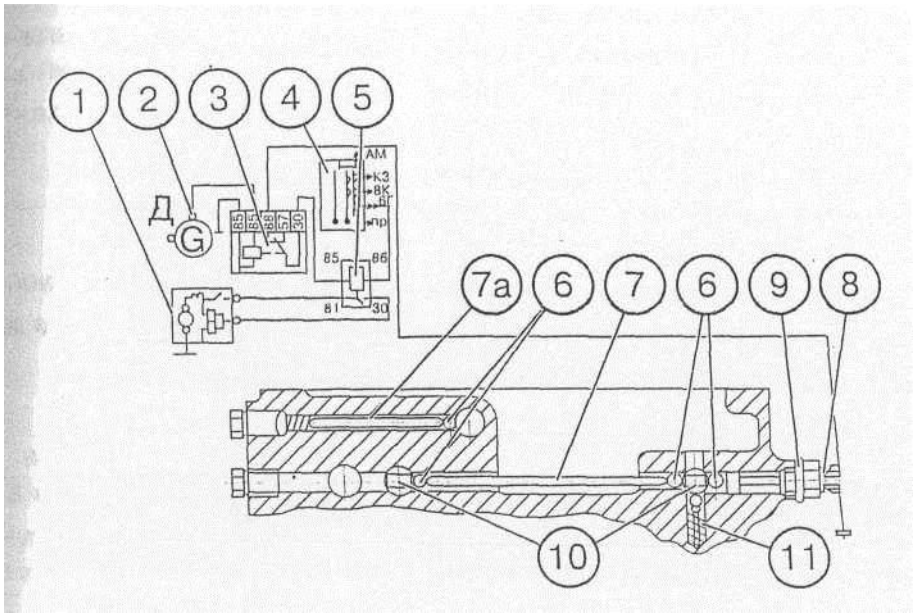
To rule out the possibility of starting diesel with gear engaged, the tractor is equipped with a special locking device

The locking device consists of switch (8) installed in GB case on the left, balls (6) and pins (7, 7a).

With range switched, the locking mechanism disconnects contacts of the switch and breaks the intermediate relay circuit of starter (1) and starter relay tie-rod (5)

To adjust switch disconnection washers (9) are provided.

BEFORE STARTING DIESEL, SET GB RANGE SHIFTING LEVER IN THE NEUTRAL POSITION!



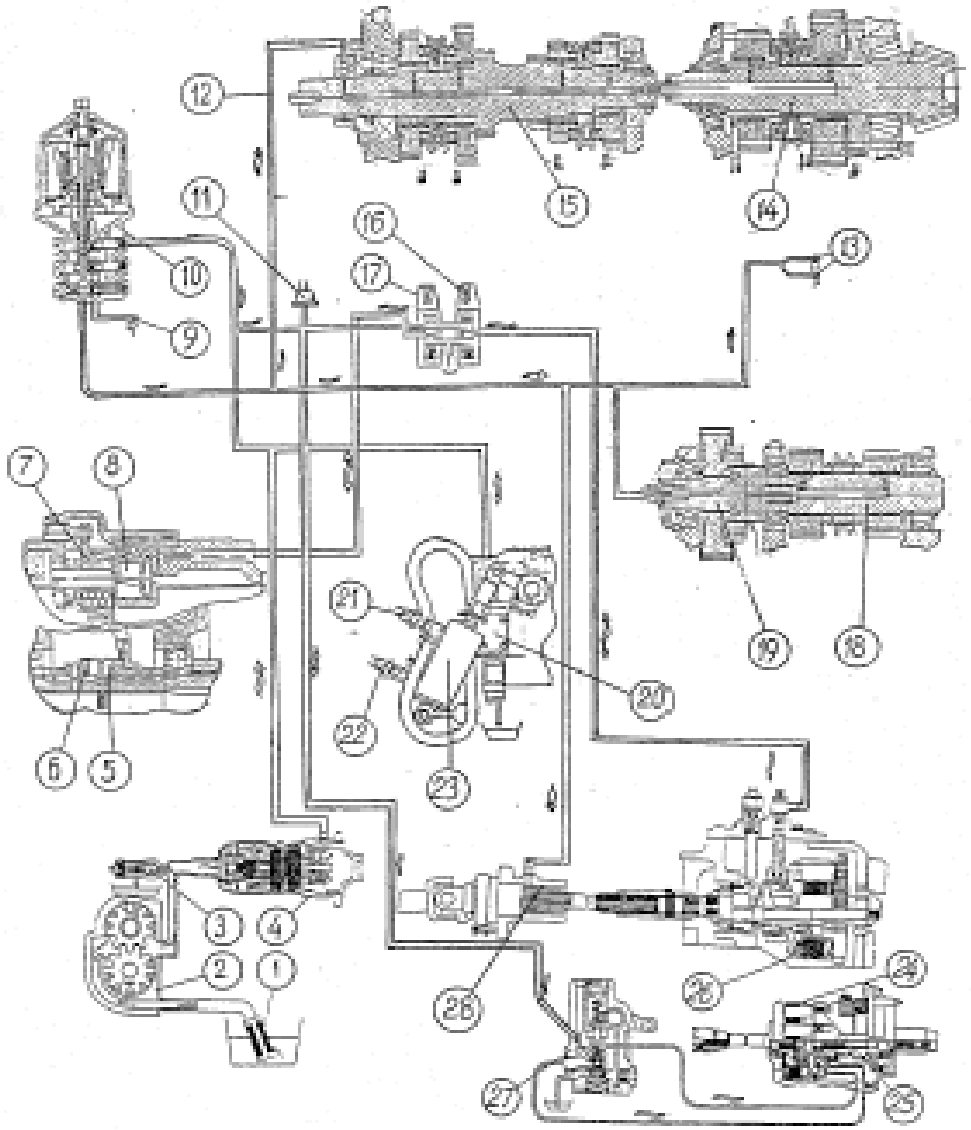
1 – starter; 2 – generator; 3 – locking relay; 4 – starter switch; 5 – starter relay; 6 – balls of the locking mechanism; 7, 7a – pins; 8 – lock switch; 9 – adjustment washers; 10 – range shift carriers; 11 – fixing element.

5.3.5. Possible GB malfunctions

Table 5-3

Malfunction, appearance	Correction methods
Low pressure in the hydraulic system	
Insufficient amount of oil in the transmission case	Fill in oil to mark “P” on oil measuring window
Soiling of the hydraulic system mesh filter	Rinse mesh filter
Sticking of control valve of the filter-distributor	Rinse the valve of filter-distributor
High pressure in the hydraulic system	
Sticking of control valve of the filter-distributor	Rinse the valve of filter-distributor
Oil drain ducts in the transmission are clogged	Rinse drain ducts
No pressure in the hydraulic system	
Hydraulic system pump drive is switched off	Switch on the pump
Insufficient amount of oil in the transmission	Fill in oil to mark “P”
Noise when shifting gears	
Clutch is not disengaged to the full	Adjust the clutch
Wear out of coned surfaces of synchronizers and pinions	Replace worn out parts
High noise	
Insufficient amount of oil in the transmission	Fill-in oil to mark “P”
Wear-out or breakage of bearings and other transmission parts	Replace bearings and other elements

5.3.6. The hydraulic system of transmission control and lubrication



1 – oil intake filter; 2 – six-pinion oil pump. 3 – safety valve; 4 – oil filter (meshed) 5, 6 – cam half-clutches for rear axle DL; 7 – shift yoke; 8 – piston for switching rear axle DL; 9 – greasing of rear axle differential; 10 – centrifugal oil filter-distributor; 11 – oil pressure gauge; 12 – oil conduct to shafts and bearings; 13 – lubrication of rear axle planetary reduction gear; 14 – main outlet shaft; 15 – main valve; 16 – electric hydraulic valve of FDA control; 17 – electric hydraulic valve of rear axle DL; 18 – reverse movement shaft; 19 – shaft of movement reducer; 20 – electric-hydraulic valve for shifting GB reduction gear; 21 – oil pressure sensor (lower stage of GB reduction gear); 22 – oil pressure sensor (higher stage of GB reduction gear); 23 – hydraulic cylinder for GB reduction gear switching; 24 – PTO friction clutch; 25 – friction clutch for braking PTO end; 26 – friction clutch for driving FDA; 27 – hydraulic distributor for PTO control; 28 – gliding yoke support for FDA dive.

The hydraulic system is designed for control of GB reduction gear, FDA dive, rear PTO, rear axle DL; as well as transmission bearings lubrication, cooling of its components and oil purification. Six-pinion oil pump (2) with switched off driving mechanism, is installed to the left of clutch case.

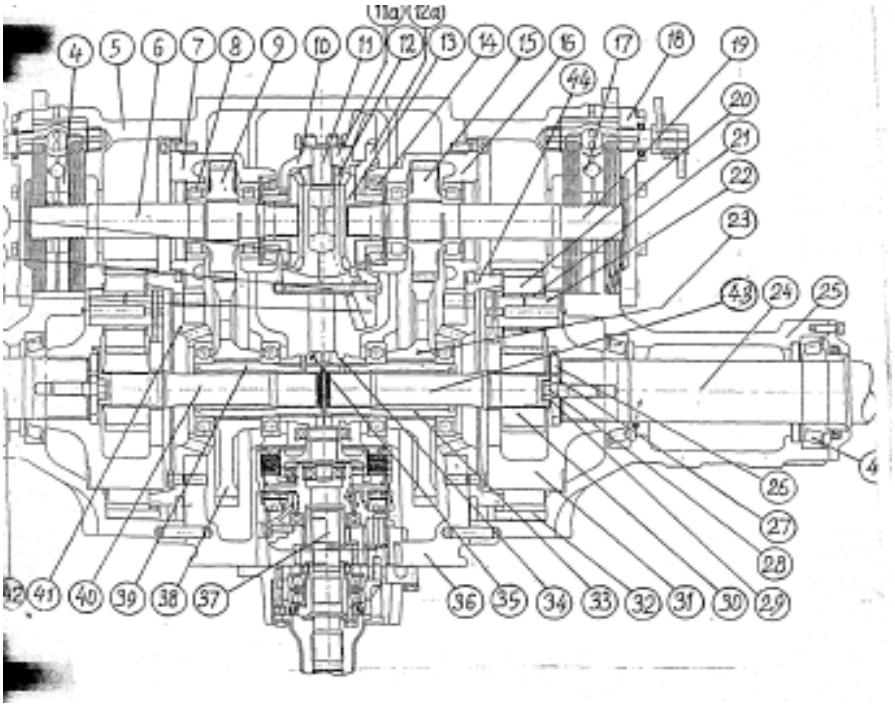
The pump sucks oil from the transmission refuel tank via meshed intake filter (1) and supplies it to the hydraulic system through safety valve (3), adjusted to pressure 18…20 kgs/cm^2, to full-flow meshed filter (4) and on to centrifugal filter-distributor (10). Purified oil under pressure of 9…10 kgs/cm^2 is supplied to electric-hydraulic valves (16, 17, 20) to control FDA drive, rear axle DL and GB reduction gear, correspondingly. Under pressure oil is also supplied to hydraulic distributor (27), controlling rear PTO, sending oil to friction clutches (24, 25). Electric hydraulic valves are connected by way of oil conduits to actuating mechanisms: friction clutch for driving FDA (26), piston for switching rear axle DL clutch on and off (5,6); hydraulic cylinder (23) for switching lower and higher stages of gear box reduction gear.

Purified by centrifugal oil pump, oil is supplied to lubrication system under pressure 2.0…2.5 kgs/cm^2, sustained by lubrication valve (lower valve of filter-distributor). Through main pipeline (12) oil is supplied to bearings of GB shaft bearings (14, 15, 18, 19), planetary reduction gears of rear axle end transmissions (13), gliding yoke supports of FDA drive (28).

Oil drained through lubrication valve and filter-distributor middle valve, lubricates the differential and rear axle main gear (9).

5.4. REAR AXLE

The rear axle consists of the main gear, differential, electrically-hydraulically driven lock cam clutch; tractor-borne gears located in the rear axle body, and finite gears located in half-axles' coupling.



1 – driven pinion; 2 – bolt; 3, 13 – half-axle pinion; 4, 17 – brake; 5, 25 – coupling; 6, 19 – drive pinion shaft; 7, 16 – cup; 8 – roller bearing; 9 – pinion of the drive tractor-borne gear; 10, 11a, 12a – differential body; 11 – differential spider; 12 – satellite gear;14 – coned roller bearing; 15 – pinion drive tractor-borne gear; 18 – cover; 20 – satellite gear; 21 – roller; 22 satellite gears' axle; 23 – driven pinion; 24, 42 – half-axle; 26 – washer; 27 - a set of spacers; 28 – bolt; 29 – locking plate; 30 – sun gear; 31 – carrier; 32 – crown gear; 33 - driven gear bushing; 34 – cam movable clutch; 35 – cam immovable clutch; 36 – body; 37 – rear PTO; 38 – driven gear; driven gear bushing; 40, 43 – shaft; 44 – cup.

5.4.1. Main gear

The main gear has coned shape with circular teeth, and consists of driving coned pinion, made in assembly with secondary GB shaft (see page 72) and driven pinion (1), fastened with bolts (2) between differential bodies (10, 11a, 12a).

5.4.2. Differential

Differential is a coned, closed locked structure, consisting of three bodies (10, 11a, 12a) connected by bolts (2), a spider (11), four satellite gears (12) with spherical washers. The differential body in assembly is mounted in rear axle case (36) on two coned roller bearings (14). The differential is locked by electrically-hydraulically driven cam clutch (34, 35), mounted on bushings (33, 39) of drive gears (9, 15), and by means of shafts (6, 19) locks differential half-axle gears (3, 13).

5.4.3. Tractor-borne gears

Tractor-borne gears consist of two pairs of spur pinions (9, 38) and (15, 23).
Drive pinions (9, 15) are set on spline shafts (6, 19) mounted on roller bearings (8) in cups (7, 16).

Shafts of drive pinions (6) and (19) by way of spline connections couple half-axle pinions of the differential and drive pinions of tractor-borne and brake discs (4, 17).
Driven pinions (22, 38) are set on spline bushings (33, 39), mounted on ball bearings on rear axle body (36) and cup (41, 44). Between cups' flanges (7, 16) and rear axle body, 0.20 and 0.50 mm thick adjustment spacers are installed. By changing the number of the latter axial clearance in coned roller bearings (14) and side clearance of main gear pinions' engagement are adjusted.

5.4.4. Finite gears

Finite gears comprise of two spur planetary gears situated in hoses (25, 42), and spline shafts (43, 40), connecting driven pinions (23, 38) to planetary gears.
The planetary gear consists of fixed crown pinion (32) mounted on cup teeth (44), carrier (31), sun pinion (30), four satellite gears (20) rotating on satellite gears' axles (22) on roller bearings (21).
Coned roller bearings (45) of half-axles (24, 42) are adjusted by selecting a set of 0.2 mm and 0.5 mm thick spacers put between half-axle end face and washer (26).

5.4.5. Mechanism of differential lock

Cam hydraulically controlled clutch for differential locking is mounted on driven pinions (1, 7) spline bushings (2, 6) of the tractor-borne gear. It consists of half-clutch (4) fixed on the bushing with pin (3), and movable half-clutch (5) mounted on bushing splines (6) and driven by electrical-hydraulic system (see page 82).

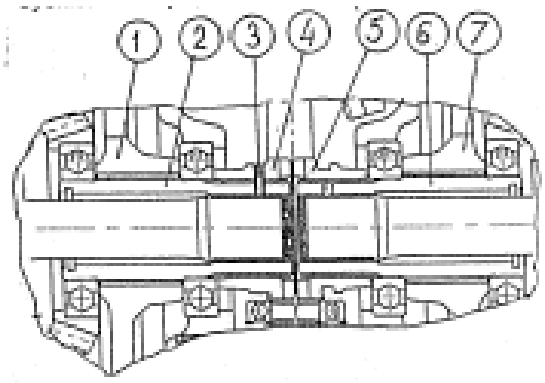
Differential is locked through engagement of half-clutches (4, 5) by moving half-clutch (5) under impact of yoke (13), moved by piston (11) when oil is supplied under pressure to duct "A" in the rear axle upper cover (14). Piston with yoke and squeeze springs (12) are installed in arm (8) fastened to cover 3M. When half-clutches are engaged, spline bushings (2, 6) and drive pinions of planetary finite gears interlock.

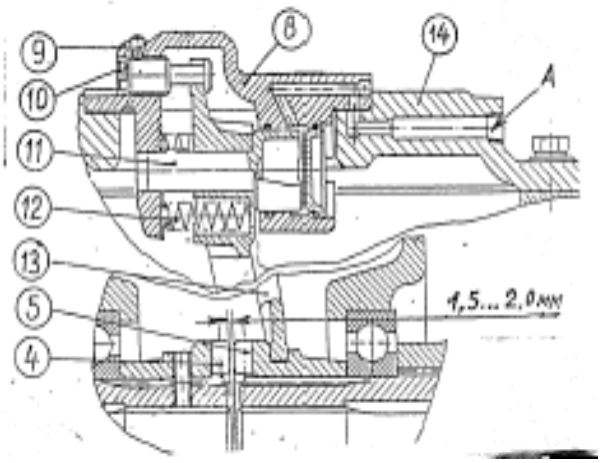
Differential is unlocked automatically under impact of squeeze springs (12) when duct "A" is in communication with drain (pressure relief).

Adjustment of locking mechanism

No adjustments are required in the process of operation. After repair works adjust clearance of 1.5…2.0 mm between end faces of cam half- clutches (4, 5), having performed the following operations:

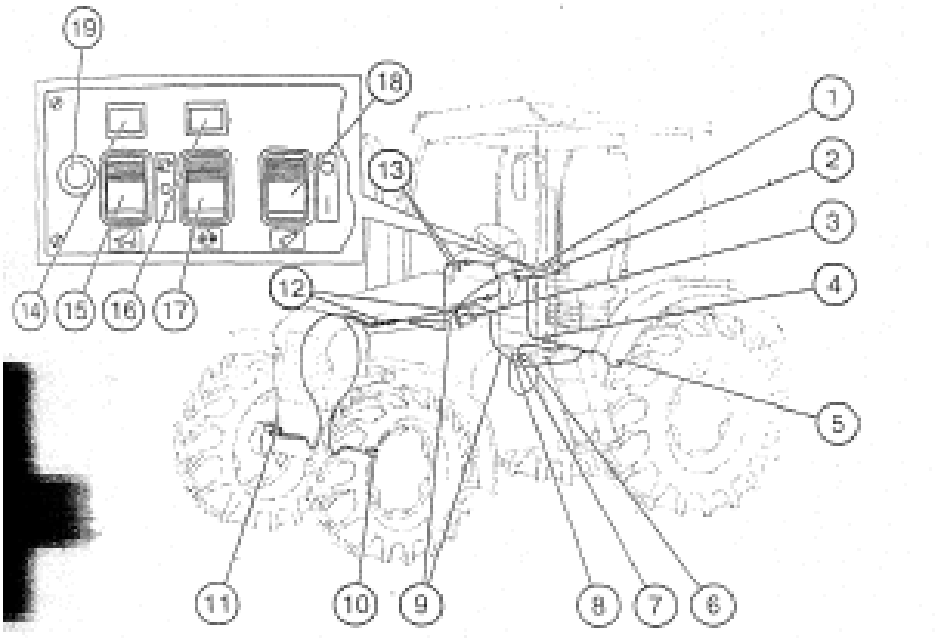
- set cams of half-clutch (4) opposite to cams of half-clutch (5) with arm taken off;
- install and fasten the arm and tighten stopper (9);
- while unscrewing screw (10) bring movable half-clutch (5) to the end of end face of fixed half-clutch cams (4), and then screw up the screw by 1…1.5 turns to ensure required clearance and tighten screw (9).





5.4.6. System of differential lock (DL) control for rear axle

The system of rear axle DL control consists of control panel (1), situated in the tractor cabin to the right of an operator, sensor (10) of dive wheels turning angle, two sensors (13) of work brakes operational state situated under brake pedals electrical hydraulic distributor (6), installed on the right GB cover and hydraulically connected to hydraulic cylinder for switching cam clutch of rear axle DL, connecting cables (9) with connector assembly (4) and shoes (12). The system operates from tractor-borne electric circuit through box of fuses (2). The system power supply is switched on after diesel start from start relay block (3).



The control system for rear axle differential lock (DL), and front drive axle (FDA) drive:
1 – control panel; 2 – box of fuses; 3 – starting relays block; 4 – connector; 5 – reverse sensor; 6 – electric-hydraulic distributor of DL control; 7 – sensor of automatic FDA dive switching; 8 – hydraulic distributor of FDA drive switching; 9 – connecting cables; 10 – sensor of drive wheels turn angle; 12 – connecting shoes; 13 – sensors of the switched state of work brakes; 14, 16 – signal elements; 15 – switch for FDA drive control; 17 – DL control switch; 18 – HLS switch; 19 – sound alarm switch (2022V).

Panel 1 accommodates pushbutton switch (17) for rear axle DL control, and signal element (16) indicating switched on state of rear axle DL.
Pushbutton (17) has three positions:

- "Automatic lock" (upper part of the pushbutton is pressed – fixed position);
- "Forced lock" (lower part of the pushbutton is pressed – non-fixed position);
- "Lock is switched off" (middle part – fixed position).

When pushbutton (17) is in position "lock is switched off", power is not supplied to electric-hydraulic distributor (6), head end of the cylinder piston communicates with exhaust and DL clutch is unlocked.
With pushbutton (17) in position "automatic lock" (when rear wheels have considerable relative slippage during work performance), electric-hydraulic distributor (6) is switched on and directs flow of oil under pressure to head end of the hydraulic cylinder piston, cam clutch is switched on, and DL is blocked. Differential is unblocked automatically when drive wheels turn to more than 13 ^{0} angle to any side, or when one or both work brakes are engaged.
If short-term locking of rear wheels is required, during turning including, press lower part of pushbutton (17) to position "forced lock" and keep it pressed. Releasing the pushbutton results in unlocking ("lock is switched off").

CAUTION! With locking switched on, tractor movement speed should not exceed 12 km/h. DO NOT operate the tractor with permanently switched on differential locking when travelling on hard surface roads!

5.4.7. Possible rear axle malfunctions

Table 5-4

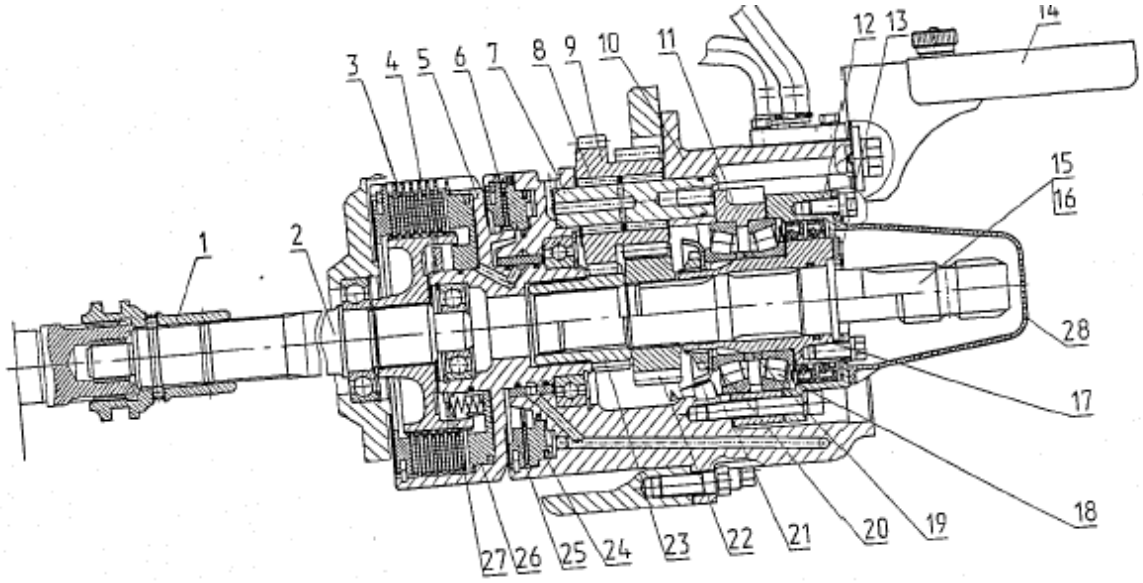
Fault, appearance	Correction methods
Increased noise in the main gear	
Wrong adjustment of main gear pinions engagement according to contact spot and side clearance	Make adjustment of main gear engagement according to contact spot. Make adjustment of the side clearance in main gear set engagement (0.25…0.55 mm)
Adjustment of main gear cone bearings is disturbed	Make adjustment of bearings tension
Low oil level in the transmission body	Check oil level in the transmission body, re-fill, if necessary

Continuation of table 5-4

Malfunction, appearance	Correction methods
Damage of pinions' teeth	Check the state of pinions' toothed rings. Cracks and pitting are not allowed Replace pinions with damaged teeth in set
Differential locking doesn't function	
Low pressure of oil supplied to hydraulic cylinder piston head end of the locking clutch. Electrical-hydraulic distributor of lock control doesn't function	Check oil pressure. If pressure is below 900 kPa, find out and correct the fault. Check operation ability of fuses, relays and other electric circuit elements, easiness of the control valve, correct the trouble
Low pressure in the transmission hydraulic system	
Shortage of oil in the transmission body. Meshed filter of the hydraulic system is soiled. The by-pass valve of filter-distributor hangs.	Re-fill oil to mark "P" on oil-measuring window. Rinse meshed filter. Rinse filter-distributor valve
High pressure in the transmission hydraulic system	
The by-pass valve of the filter-distributor hangs.	Rinse filter-distributor valve
No pressure in the hydraulic system	
The hydraulic system pump drive is switched off. Shortage of oil in the transmission	Switch on the pump. Re-fill oil to mark "P"
Noisy gears shifting	
Clutch is not disengaged to the full. Wear-out of coned surfaces of synchronizers and pinions	Adjust the clutch. Replace worn-out parts.
High noise	
Shortage of oil in the transmission. Wear-out or destruction of bearings and other transmission parts.	Re-fill oil to mark "P". Replace bearings and other parts.

5.5. REAR POWER TAKE-OFF SHAFT

Rear PTO has an independent drive with four speed modes, that are provided by a two-speed reduction gear in the clutch body, and replaceable ends (15) (540 rev/min) and (16) (1000 rev/min) in PTO reduction gear. The drive is effected from the diesel via two pairs of cylindrical pinions in the clutch body, GB interior shaft, shifting clutch and PTO reduction gear. Clutch (1) is used for switching the drive on and off.



1 – shifting clutch; 2 – drive shaft; 3 – friction disc; 4 – intermediate disc; 5 – drum; 6 – brake disc; 7 – intermediate axle; 8 – roller; 9 – pinion; 10 – body; 11 – valve; 12 – cover; 13 – thrust washer; 14 – sheath; 15, 16 – replaceable ends; 17 – bushing; 18 – coned roller bearing; 19 – ring; 20 – washer; 21 – nut; 22,23 – pinion; 24 – brake piston; 25 – thrust disc; 26 – friction gear piston; 27 – spring; 28 – cover.

Reduction gear of the power take-off shaft is mounted in the rear axle body and consists of driven (22) and drive pinions (23) axially placed and interconnected by means of three equally spaced intermediate pinions (9) assembled on axles (7) in reduction gear body (10).

Drive and driven pinions have spline openings, by way of which they are connected to replaceable ends (15, 16) depending on the required operation mode: with pinion (22) – 540 rev/min*; pinion (23) – 1000 rev/min*.

Ends are mounted on coned roller bearings (18) and fixed with thrust washer to avoid axial movement. To replace the end, take off washer 13, change the end and fix it. The end faces bear marks: “540” and “1000” correspondingly.

*) To put gear switch (35a) to position “I” (see page 40)

To engage and disengage PTO, multi-disc friction clutch and PTO brake are used. Drive shaft (2) clutch splintes of the friction gear are provided with metal-ceramic lined discs (3), and in drum (5) slots, connected to drive pinion (23) reduction gear by way of splintes, and intermediate discs (4). With PTO switched on, under oil pressure piston (26) squeezes discs, thus connecting PTO reduction gear to drive shaft (2).
With friction clutch switched off, piston (26) resets under impact of springs (27). Stand-by driven PTO brake eliminates the end move and stoppage. The brake is mounted in reduction gear body (10) and consists of piston (24), friction disc (6) and thrust disc (25).

Friction disc (6) is mounted on drum splintes (5). When pressure rises in the brake booster, piston (24) squeezes discs (6) and (25), braking drum and PTO end.
In neutral position, the end can be easily rotated "by hand".

Note: 1. Axial clearance in coned roller bearings (18) should not exceed 0.10 mm. Make adjustment by selecting rings (19) Torque nuts (21) to 220 Nm. 2. With PTO speed switch (35a) (see page 40) put in position "II", and replaceable ends in place , as shown above, two additional speeds of independent PTO are obtained (720 and 1460 rev/min).

5.5.1 Rear PTO control

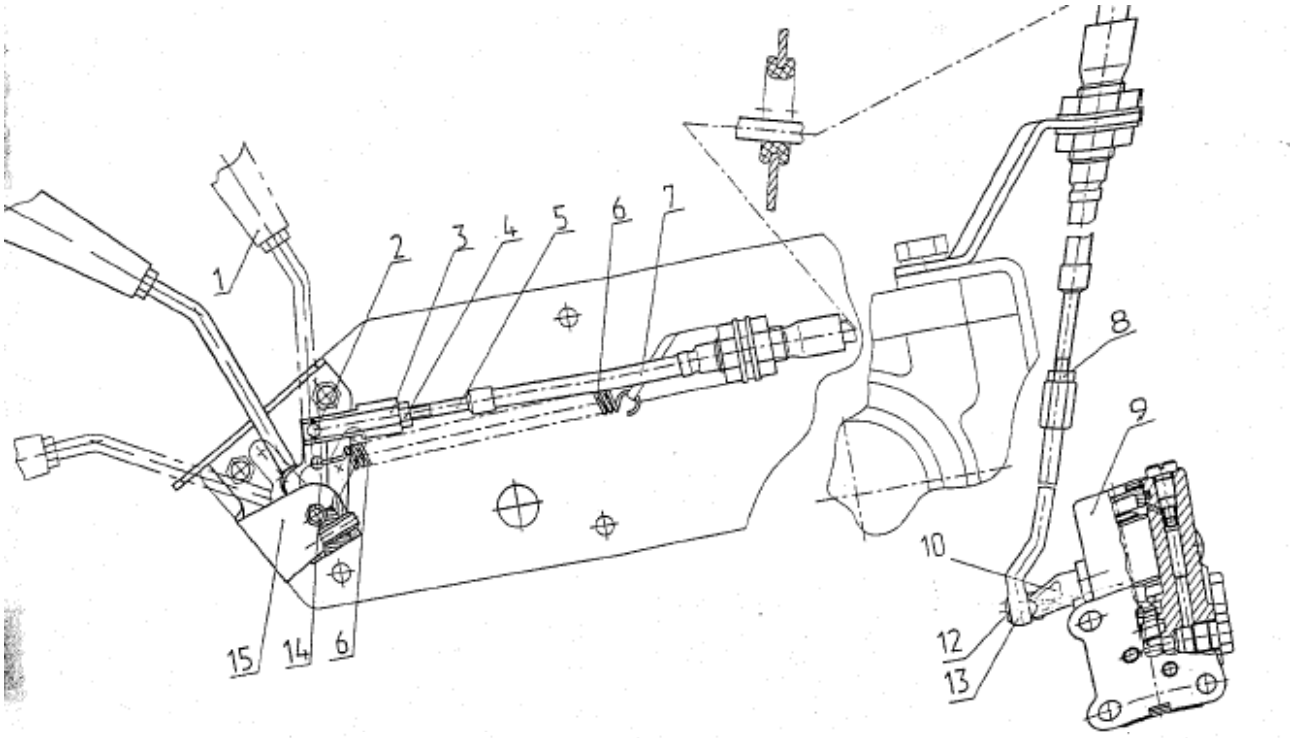
Rear PTO is controlled by handle (1) (see figure below) of lever (15) located on the console of side control panel (lever 30, page 28). It moves by means of steel rope (7) and tie-rod (13) rotating lever (10) for control of distribution control valve (9), which is intended for control of oil supplied to friction gear and brake.
Handle (1) (figure on page 86a) has three positions:

- end front – "PTO switched on";
- end rear – PTO end brake switched on";
- middle – "PTO and brake switched off".

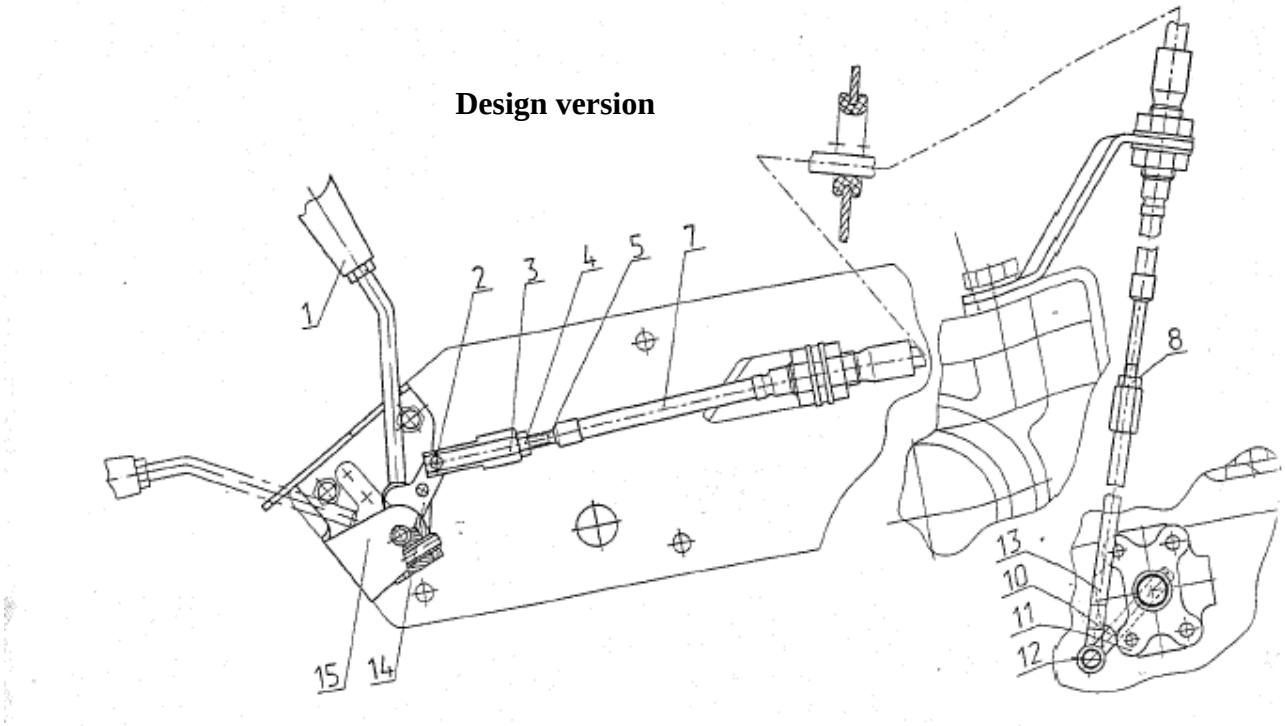
Distribution lever (10) is fixed in three positions with diesel in operation: upper – "PTO switched on"; lower – "brake switched on", and middle (neutral) – "PTO and brake switched off".

When diesel is not operational, or when pressure in the transmission hydraulic system drops to below 0.8 mPa, handle (1) under effect of spring (6) automatically resets from the end upper position to neutral. Make following adjustment of rear PTO control:

- set handle (1) and lever (10) of distributor (11) in neutral position;
- by changing length of steel rope rod(5) (by screwing yoke up or down yoke (3) , having in advance released check nut (4) and tie-rod (13) (screwing it up or down the rod, having in advance released check nut (8), align openings in yoke (3) and lever (14) of switch (15), as well as in tie-rod (13) and lever (10) of distributor (11), bring them together with your fingers (2, 12) and fix with pin. After completing adjustments tighten check nuts (4) and (8).



Design version



1 – control handle; 2 – pin; 3 – yoke; 4 – check nut; 5 – steel rope rod; 6 – spring; 7 – steel rope; 8 – check nut; 9 – distributor; 10 – lever; 11 – tap; 12 – pin; 13 – tie-rod; 14 – lever; 15 lever.

- Check operation of the control mechanism. With force of maximum 30 N (3 kgs) applied, handle (1) should move easily and with no jams , and be fixed accurately in three positions with diesel in operation. With non-operational diesel it should reset from end front position to neutral by means of spring (6).

In the hydraulic version of PTO control (see illustrated design version below), instead of distributor (9) a cock (11) with a damper (in the form of pneumatic coupler that ensures smoothness of PTO start) can be installed.

The difference against described above design lies in the absence of return spring (6) and neutral handle (1) position. The control handle has two fixed positions: the end front – (PTO switched on), and end rear – "brake of PTO end switched on".

CAUTION! To engage PTO, smoothly push the control handle with 2…4 s delay in the middle of shifting from neutral to PTO switch on.

For the latter design version: (when shifting from rear position to PTO switch on) to avoid breakage of drive shaft, reduction gear pinions and PTO end.

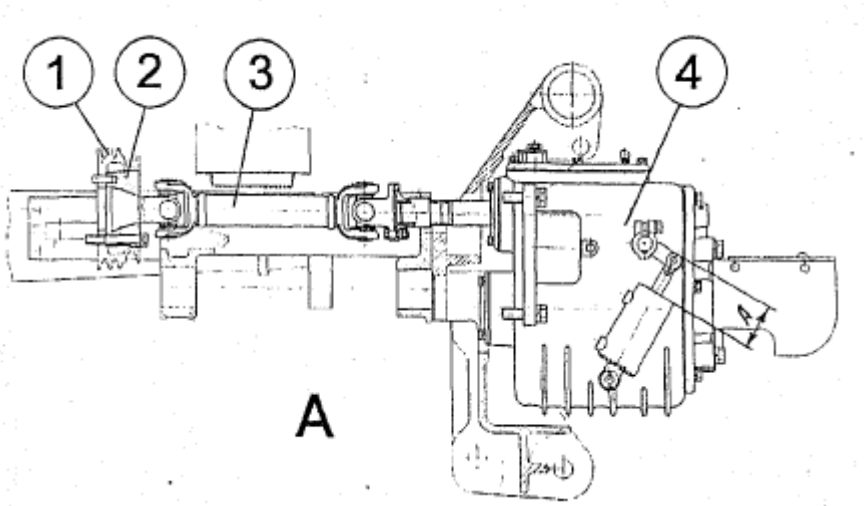
5.5.2 Possible rear PTO malfunctions

Table 5 – 5

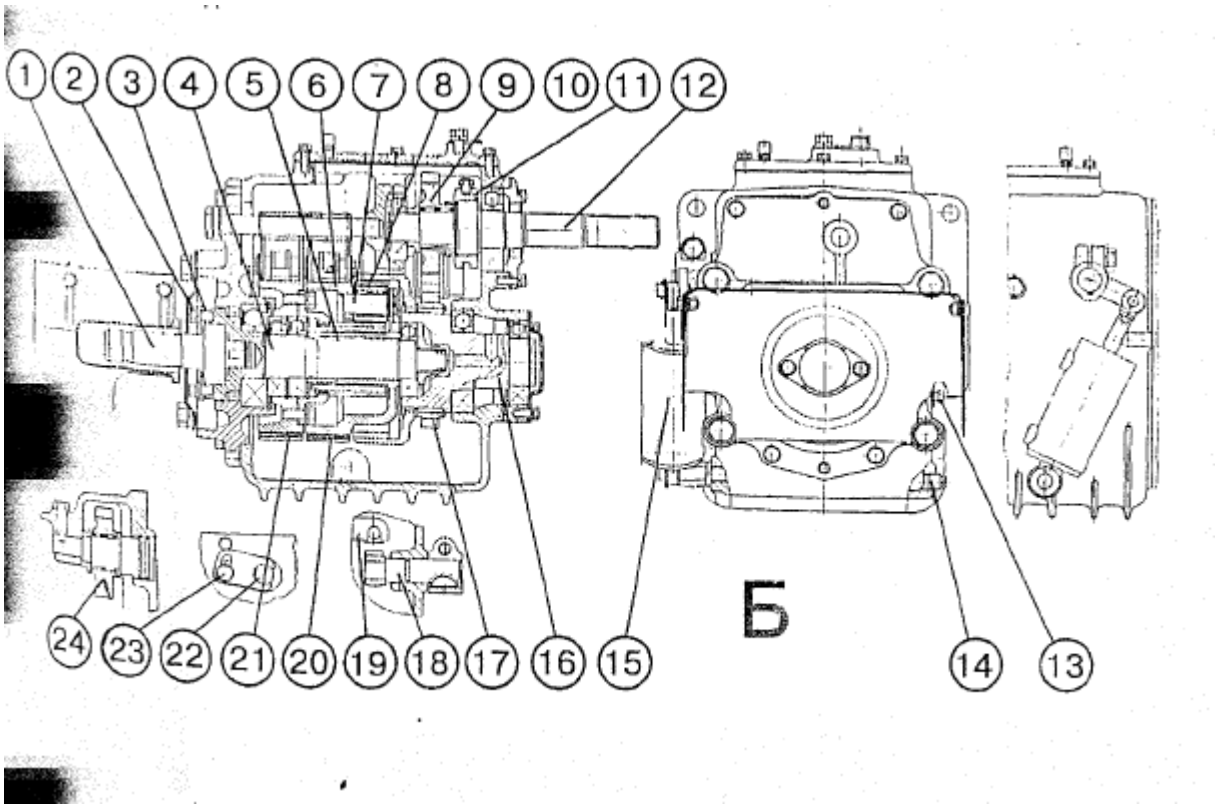
Malfunction, appearance	Correction methods
Rear PTO doesn't fully transfer torque, or keeps rotating after PTO brake is engaged	
Control adjustment is violated	Using distributor adjust control
Low oil pressure in the transmission hydraulic system.	Adjust reduction valve of transmission HS.
Low oil pressure at the outlet to friction gear and PTO brake due to: a) leakage in the distributor, friction gear and PTO brake; b) distributor main valve seizure	Check pressure, if required, check sealing rings of the friction gear and PTO reduction gear brake, or replace distributor. Dismantle distributor, clean and rinse parts, remove causes of seizure, replace damaged parts, if necessary.
Violation of friction gear or brake operation due to pistons hang or wear-out of friction discs	Rinse friction gear and brake parts in pure diesel fuel, replace friction discs, if required.

5.6. FRONT PTO (ONCE INSTALLED)

The front PTO (FPTO) is design for driving agricultural machinery, being mounted on front hinge mechanism. It is independently driven with clock-wise rotation of the end, if looking at its end face. It provides the end frequency rotation of 1000 rev/min at diesel rotation frequency of 1845 rev/min and power output of 44 kW (60 h/p) maximum.
FPTO (fig A) is driven by pulley (1) of diesel crankshaft and reduction gear (4) via distance piece (2), permanently installed in pulley (1), and crankshaft (3).



1 – pulley; 2 – distance piece (spacer); 3 – crankshaft; 4 – FPTO reduction gear “A” – distance of rod extension

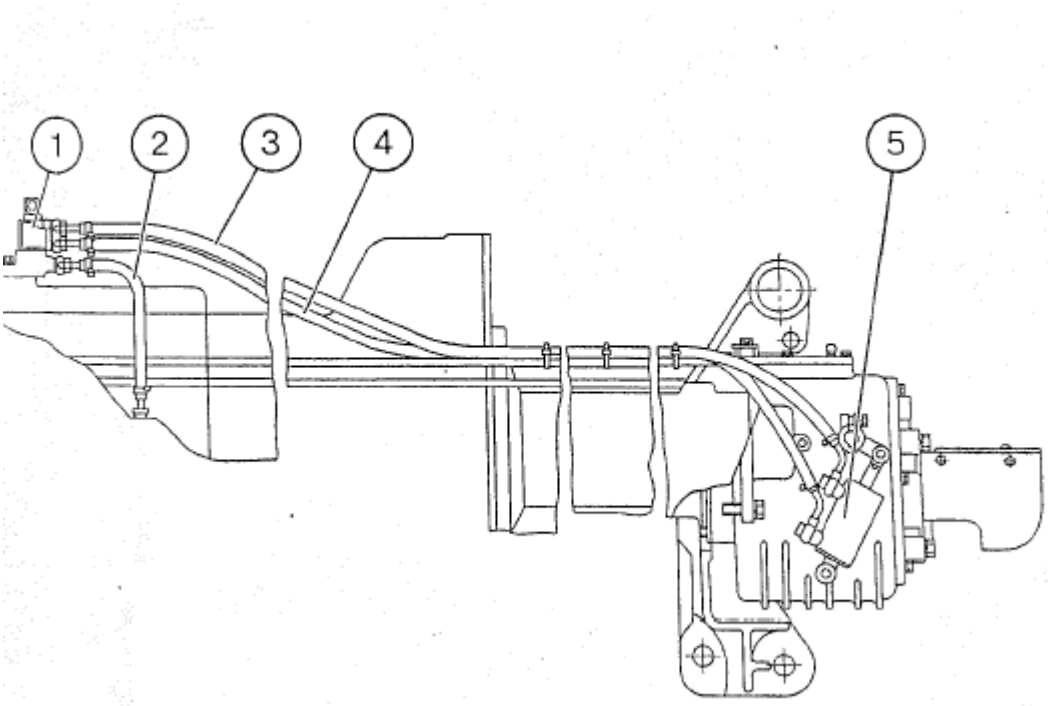


In FPTO reduction gear (figure B, page 89) power is transferred from shaft (12) to end (1) by means of shifted toothed clutch (11) installed on shaft (12), pinion (10), intermediate pinion (24), pinion (17) mounted on shaft (16), which is connected to crown pinion (9) of the planetary reduction gear.

FPTO is unified with rear PTO planetary reduction gear of tractors MTZ-80. It is controlled by hydraulic cylinder (5), connected to turn roller (18) effecting levers (19) of belt brakes.

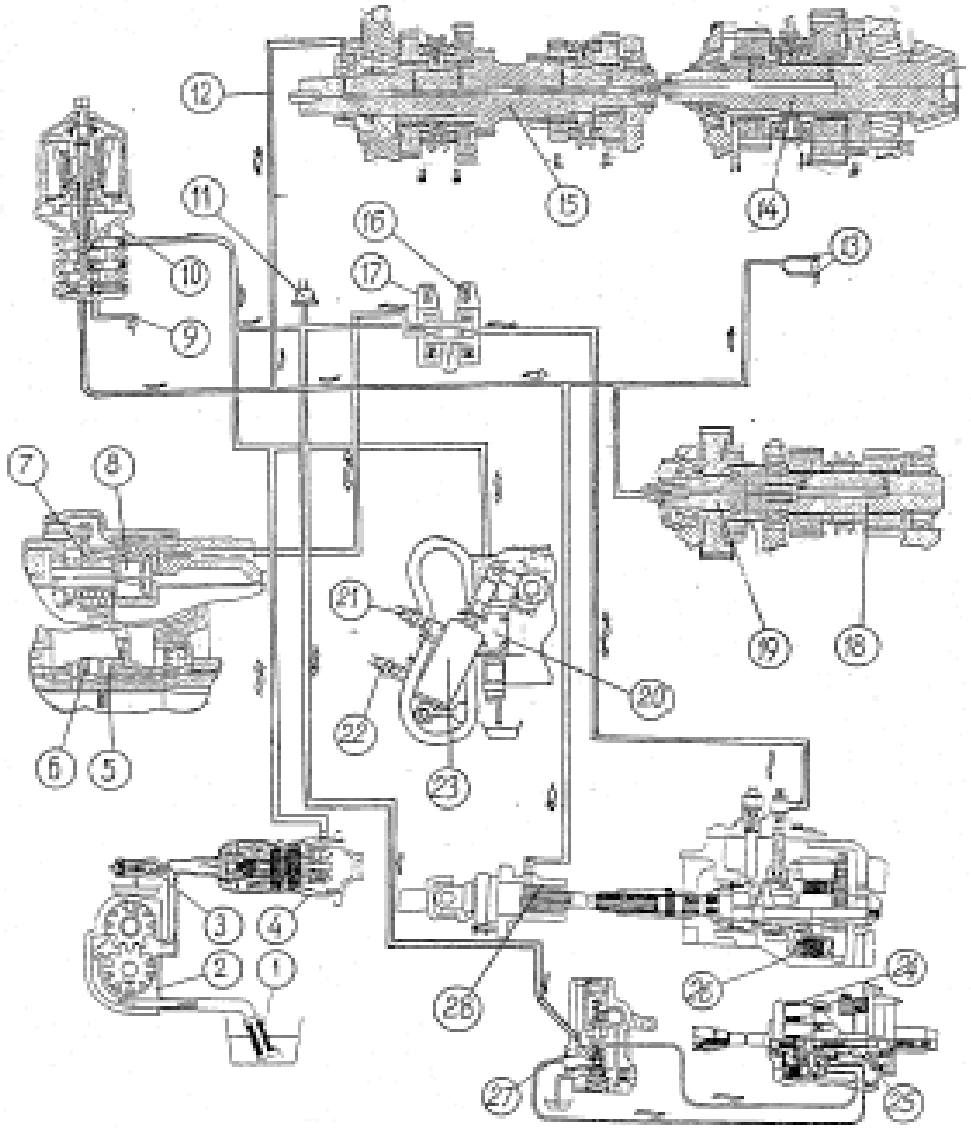
Hydraulic cylinder (5) rod (see figure below) moves by changing oil flow direction in electric-hydraulic distributor (1).

Oil flow coming along forced pipelined (2) is directed either to pipeline (3) connected to rod end head of cylinder (5) (FPTO is switched off – rod is drawn in), or to pipeline (4), connected to piston end head of cylinder (5), (FPTO is switched on – the rod is withdrawn).



1 - electric-hydraulic distributor; 2 – forced oil conduit; 3 - oil conduit of hydraulic cylinder rod head end; 4 – oil conduit of hydraulic cylinder piston head end; 5 – hydraulic cylinder.

5.3.6. The hydraulic system of transmission control and lubrication



1 – oil intake filter; 2 – six-pinion oil pump. 3 – safety valve; 4 – oil filter (meshed) 5, 6 – cam half-clutches for rear axle DL; 7 – shift yoke; 8 – piston for switching rear axle DL; 9 – greasing of rear axle differential; 10 – centrifugal oil filter-distributor; 11 – oil pressure gauge; 12 – oil conduct to shafts and bearings; 13 – lubrication of rear axle planetary reduction gear; 14 – main outlet shaft; 15 – main valve; 16 – electric hydraulic valve of FDA control; 17 – electric hydraulic valve of rear axle DL; 18 – reverse movement shaft; 19 – shaft of movement reducer; 20 – electric-hydraulic valve for shifting GB reduction gear; 21 – oil pressure sensor (lower stage of GB reduction gear); 22 – oil pressure sensor (higher stage of GB reduction gear); 23 – hydraulic cylinder for GB reduction gear switching; 24 – PTO friction clutch; 25 – friction clutch for braking PTO end; 26 – friction clutch for driving FDA; 27 – hydraulic distributor for PTO control; 28 – gliding yoke support for FDA dive.

The hydraulic system is designed for control of GB reduction gear, FDA dive, rear PTO, rear axle DL; as well as transmission bearings lubrication, cooling of its components and oil purification. Six-pinion oil pump (2) with switched off driving mechanism, is installed to the left of clutch case.

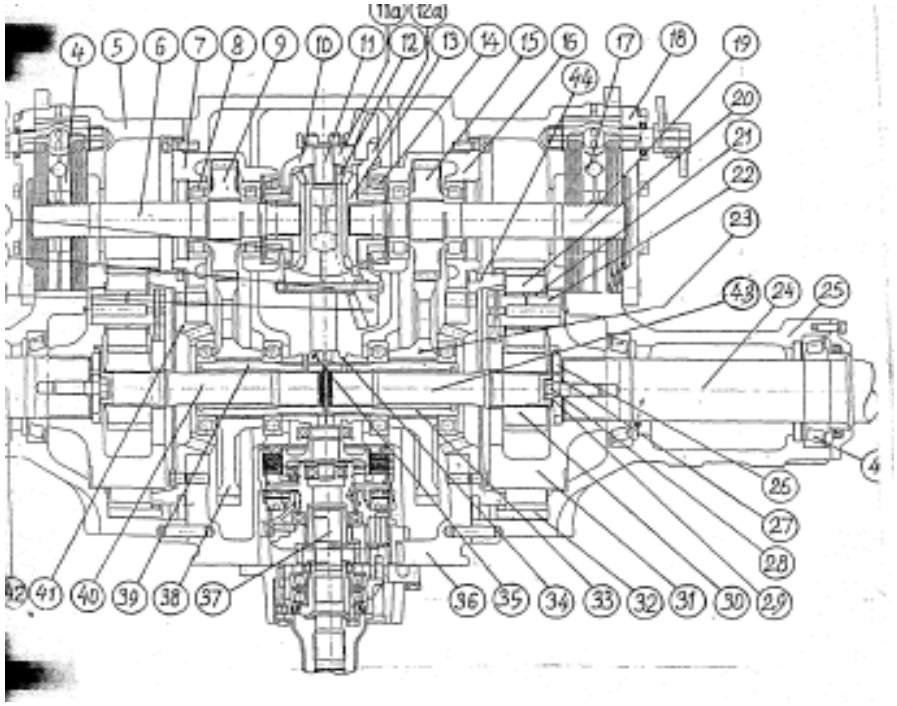
The pump sucks oil from the transmission refuel tank via meshed intake filter (1) and supplies it to the hydraulic system through safety valve (3), adjusted to pressure 18…20 kgs/cm^2, to full-flow meshed filter (4) and on to centrifugal filter-distributor (10). Purified oil under pressure of 9…10 kgs/cm^2 is supplied to electric-hydraulic valves (16, 17, 20) to control FDA drive, rear axle DL and GB reduction gear, correspondingly. Under pressure oil is also supplied to hydraulic distributor (27), controlling rear PTO, sending oil to friction clutches (24, 25). Electric hydraulic valves are connected by way of oil conduits to actuating mechanisms: friction clutch for driving FDA (26), piston for switching rear axle DL clutch on and off (5,6); hydraulic cylinder (23) for switching lower and higher stages of gear box reduction gear.

Purified by centrifugal oil pump, oil is supplied to lubrication system under pressure 2.0…2.5 kgs/cm^2, sustained by lubrication valve (lower valve of filter-distributor). Through main pipeline (12) oil is supplied to bearings of GB shaft bearings (14, 15, 18, 19), planetary reduction gears of rear axle end transmissions (13), gliding yoke supports of FDA drive (28).

Oil drained through lubrication valve and filter-distributor middle valve, lubricates the differential and rear axle main gear (9).

5.4. REAR AXLE

The rear axle consists of the main gear, differential, electrically-hydraulically driven lock cam clutch; tractor-borne gears located in the rear axle body, and finite gears located in half-axles' coupling.



1 – driven pinion; 2 – bolt; 3, 13 – half-axle pinion; 4, 17 – brake; 5, 25 – coupling; 6, 19 – drive pinion shaft; 7, 16 – cup; 8 – roller bearing; 9 – pinion of the drive tractor-borne gear; 10, 11a, 12a – differential body; 11 – differential spider; 12 – satellite gear;14 – coned roller bearing; 15 – pinion drive tractor-borne gear; 18 – cover; 20 – satellite gear; 21 – roller; 22 satellite gears' axle; 23 – driven pinion; 24, 42 – half-axle; 26 – washer; 27 - a set of spacers; 28 – bolt; 29 – locking plate; 30 – sun gear; 31 – carrier; 32 – crown gear; 33 - driven gear bushing; 34 – cam movable clutch; 35 – cam immovable clutch; 36 – body; 37 – rear PTO; 38 – driven gear; driven gear bushing; 40, 43 – shaft; 44 – cup.

5.4.1. Main gear

The main gear has coned shape with circular teeth, and consists of driving coned pinion, made in assembly with secondary GB shaft (see page 72) and driven pinion (1), fastened with bolts (2) between differential bodies (10, 11a, 12a).

5.4.2. Differential

Differential is a coned, closed locked structure, consisting of three bodies (10, 11a, 12a) connected by bolts (2), a spider (11), four satellite gears (12) with spherical washers. The differential body in assembly is mounted in rear axle case (36) on two coned roller bearings (14). The differential is locked by electrically-hydraulically driven cam clutch (34, 35), mounted on bushings (33, 39) of drive gears (9, 15), and by means of shafts (6, 19) locks differential half-axle gears (3, 13).

5.4.3. Tractor-borne gears

Tractor-borne gears consist of two pairs of spur pinions (9, 38) and (15, 23).
Drive pinions (9, 15) are set on spline shafts (6, 19) mounted on roller bearings (8) in cups (7, 16).

Shafts of drive pinions (6) and (19) by way of spline connections couple half-axle pinions of the differential and drive pinions of tractor-borne and brake discs (4, 17).
Driven pinions (22, 38) are set on spline bushings (33, 39), mounted on ball bearings on rear axle body (36) and cup (41, 44). Between cups' flanges (7, 16) and rear axle body, 0.20 and 0.50 mm thick adjustment spacers are installed. By changing the number of the latter axial clearance in coned roller bearings (14) and side clearance of main gear pinions' engagement are adjusted.

5.4.4. Finite gears

Finite gears comprise of two spur planetary gears situated in hoses (25, 42), and spline shafts (43, 40), connecting driven pinions (23, 38) to planetary gears.
The planetary gear consists of fixed crown pinion (32) mounted on cup teeth (44), carrier (31), sun pinion (30), four satellite gears (20) rotating on satellite gears' axles (22) on roller bearings (21).
Coned roller bearings (45) of half-axles (24, 42) are adjusted by selecting a set of 0.2 mm and 0.5 mm thick spacers put between half-axle end face and washer (26).

5.4.5. Mechanism of differential lock

Cam hydraulically controlled clutch for differential locking is mounted on driven pinions (1, 7) spline bushings (2, 6) of the tractor-borne gear. It consists of half-clutch (4) fixed on the bushing with pin (3), and movable half-clutch (5) mounted on bushing splines (6) and driven by electrical-hydraulic system (see page 82).

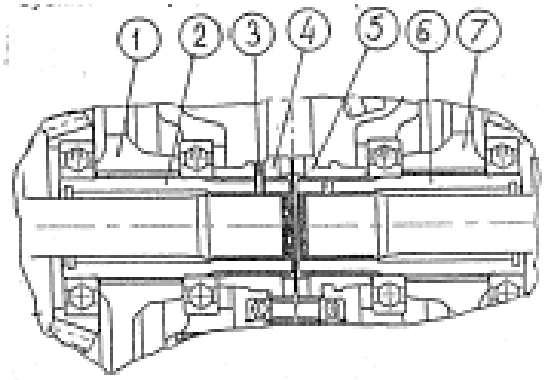
Differential is locked through engagement of half-clutches (4, 5) by moving half-clutch (5) under impact of yoke (13), moved by piston (11) when oil is supplied under pressure to duct "A" in the rear axle upper cover (14). Piston with yoke and squeeze springs (12) are installed in arm (8) fastened to cover 3M. When half-clutches are engaged, spline bushings (2, 6) and drive pinions of planetary finite gears interlock.

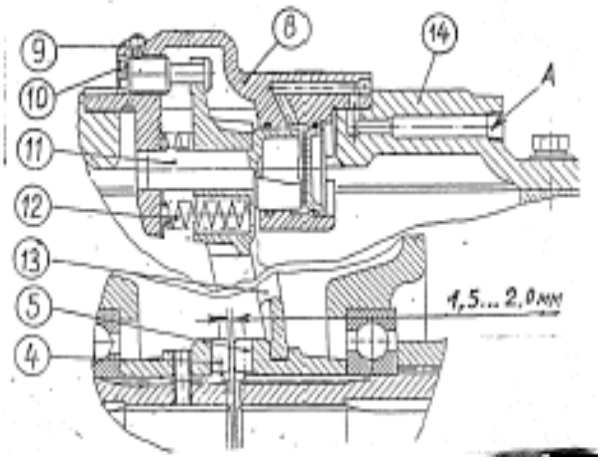
Differential is unlocked automatically under impact of squeeze springs (12) when duct "A" is in communication with drain (pressure relief).

Adjustment of locking mechanism

No adjustments are required in the process of operation. After repair works adjust clearance of 1.5…2.0 mm between end faces of cam half- clutches (4, 5), having performed the following operations:

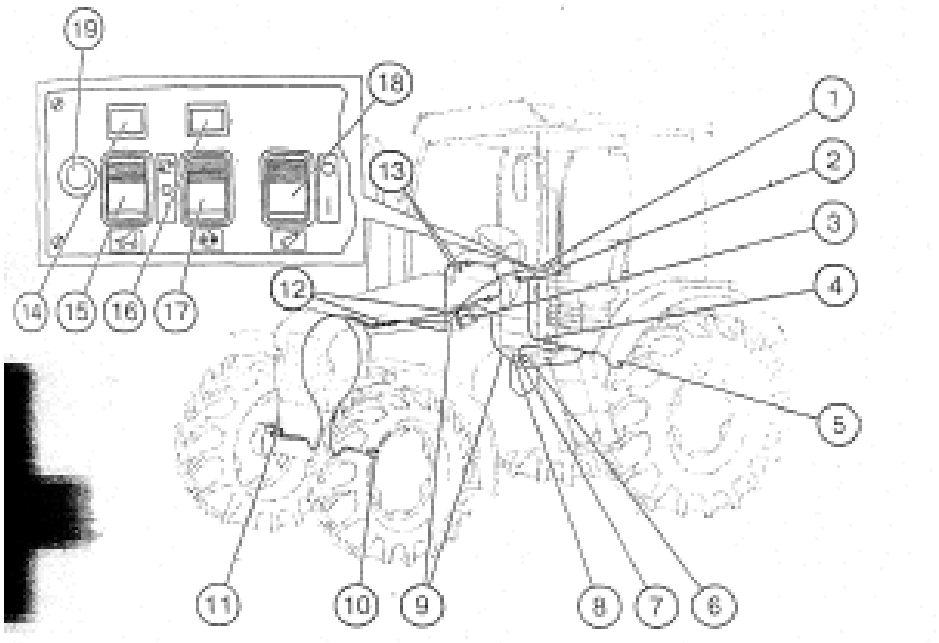
- set cams of half-clutch (4) opposite to cams of half-clutch (5) with arm taken off;
- install and fasten the arm and tighten stopper (9);
- while unscrewing screw (10) bring movable half-clutch (5) to the end of end face of fixed half-clutch cams (4), and then screw up the screw by 1…1.5 turns to ensure required clearance and tighten screw (9).





5.4.6. System of differential lock (DL) control for rear axle

The system of rear axle DL control consists of control panel (1), situated in the tractor cabin to the right of an operator, sensor (10) of dive wheels turning angle, two sensors (13) of work brakes operational state situated under brake pedals electrical hydraulic distributor (6), installed on the right GB cover and hydraulically connected to hydraulic cylinder for switching cam clutch of rear axle DL, connecting cables (9) with connector assembly (4) and shoes (12). The system operates from tractor-borne electric circuit through box of fuses (2). The system power supply is switched on after diesel start from start relay block (3).



The control system for rear axle differential lock (DL), and front drive axle (FDA) drive:
1 – control panel; 2 – box of fuses; 3 – starting relays block; 4 – connector; 5 – reverse sensor; 6 – electric-hydraulic distributor of DL control; 7 – sensor of automatic FDA dive switching; 8 – hydraulic distributor of FDA drive switching; 9 – connecting cables; 10 – sensor of drive wheels turn angle; 12 – connecting shoes; 13 – sensors of the switched state of work brakes; 14, 16 – signal elements; 15 – switch for FDA drive control; 17 – DL control switch; 18 – HLS switch; 19 – sound alarm switch (2022V).

Panel 1 accommodates pushbutton switch (17) for rear axle DL control, and signal element (16) indicating switched on state of rear axle DL.
Pushbutton (17) has three positions:

- "Automatic lock" (upper part of the pushbutton is pressed – fixed position);
- "Forced lock" (lower part of the pushbutton is pressed – non-fixed position);
- "Lock is switched off" (middle part – fixed position).

When pushbutton (17) is in position "lock is switched off", power is not supplied to electric-hydraulic distributor (6), head end of the cylinder piston communicates with exhaust and DL clutch is unlocked.
With pushbutton (17) in position "automatic lock" (when rear wheels have considerable relative slippage during work performance), electric-hydraulic distributor (6) is switched on and directs flow of oil under pressure to head end of the hydraulic cylinder piston, cam clutch is switched on, and DL is blocked. Differential is unblocked automatically when drive wheels turn to more than 13 ^{0} angle to any side, or when one or both work brakes are engaged.
If short-term locking of rear wheels is required, during turning including, press lower part of pushbutton (17) to position "forced lock" and keep it pressed. Releasing the pushbutton results in unlocking ("lock is switched off").

CAUTION! With locking switched on, tractor movement speed should not exceed 12 km/h. DO NOT operate the tractor with permanently switched on differential locking when travelling on hard surface roads!

5.4.7. Possible rear axle malfunctions

Table 5-4

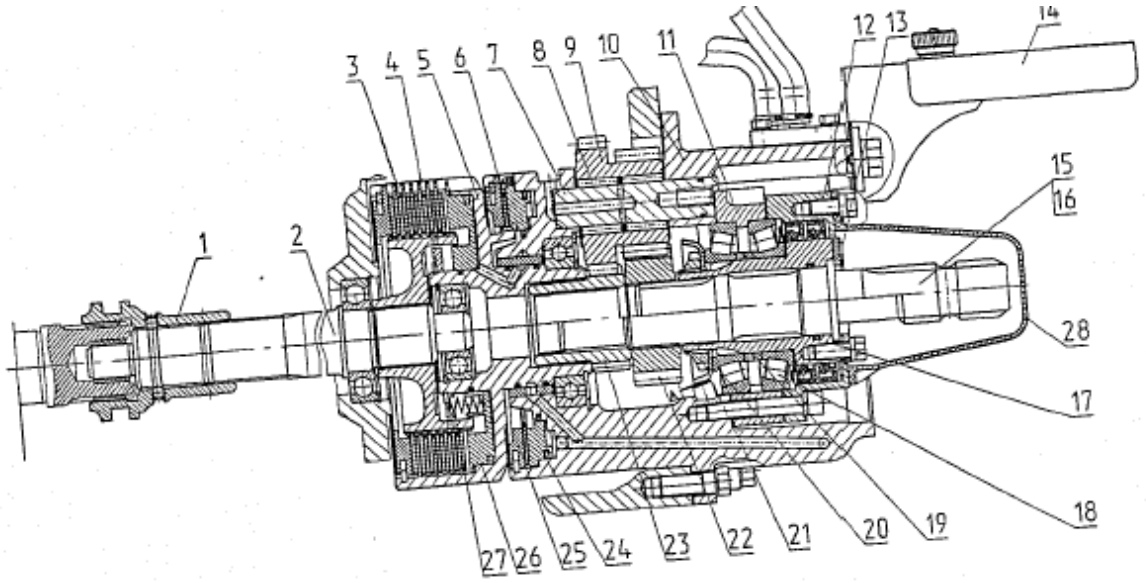
Fault, appearance	Correction methods
Increased noise in the main gear	
Wrong adjustment of main gear pinions engagement according to contact spot and side clearance	Make adjustment of main gear engagement according to contact spot. Make adjustment of the side clearance in main gear set engagement (0.25…0.55 mm)
Adjustment of main gear cone bearings is disturbed	Make adjustment of bearings tension
Low oil level in the transmission body	Check oil level in the transmission body, re-fill, if necessary

Continuation of table 5-4

Malfunction, appearance	Correction methods
Damage of pinions' teeth	Check the state of pinions' toothed rings. Cracks and pitting are not allowed Replace pinions with damaged teeth in set
Differential locking doesn't function	
Low pressure of oil supplied to hydraulic cylinder piston head end of the locking clutch.	Check oil pressure. If pressure is below 900 kPa, find out and correct the fault.
Electrical-hydraulic distributor of lock control doesn't function	Check operation ability of fuses, relays and other electric circuit elements, easiness of the control valve, correct the trouble
Low pressure in the transmission hydraulic system	
Shortage of oil in the transmission body.	Re-fill oil to mark "P" on oil-measuring window.
Meshed filter of the hydraulic system is soiled.	Rinse meshed filter.
The by-pass valve of filter-distributor hangs.	Rinse filter-distributor valve
High pressure in the transmission hydraulic system	
The by-pass valve of the filter-distributor hangs.	Rinse filter-distributor valve
No pressure in the hydraulic system	
The hydraulic system pump drive is switched off.	Switch on the pump.
Shortage of oil in the transmission	Re-fill oil to mark "P"
Noisy gears shifting	
Clutch is not disengaged to the full.	Adjust the clutch.
Wear-out of coned surfaces of synchronizers and pinions	Replace worn-out parts.
High noise	
Shortage of oil in the transmission.	Re-fill oil to mark "P".
Wear-out or destruction of bearings and other transmission parts.	Replace bearings and other parts.

5.5. REAR POWER TAKE-OFF SHAFT

Rear PTO has an independent drive with four speed modes, that are provided by a two-speed reduction gear in the clutch body, and replaceable ends (15) (540 rev/min) and (16) (1000 rev/min) in PTO reduction gear. The drive is effected from the diesel via two pairs of cylindrical pinions in the clutch body, GB interior shaft, shifting clutch and PTO reduction gear. Clutch (1) is used for switching the drive on and off.



1 – shifting clutch; 2 – drive shaft; 3 – friction disc; 4 – intermediate disc; 5 – drum; 6 – brake disc; 7 – intermediate axle; 8 – roller; 9 – pinion; 10 – body; 11 – valve; 12 – cover; 13 – thrust washer; 14 – sheath; 15, 16 – replaceable ends; 17 – bushing; 18 – coned roller bearing; 19 – ring; 20 – washer; 21 – nut; 22,23 – pinion; 24 – brake piston; 25 – thrust disc; 26 – friction gear piston; 27 – spring; 28 – cover.

Reduction gear of the power take-off shaft is mounted in the rear axle body and consists of driven (22) and drive pinions (23) axially placed and interconnected by means of three equally spaced intermediate pinions (9) assembled on axles (7) in reduction gear body (10).

Drive and driven pinions have spline openings, by way of which they are connected to replaceable ends (15, 16) depending on the required operation mode: with pinion (22) – 540 rev/min*; pinion (23) – 1000 rev/min*.

Ends are mounted on coned roller bearings (18) and fixed with thrust washer to avoid axial movement. To replace the end, take off washer 13, change the end and fix it. The end faces bear marks: “540” and “1000” correspondingly.

*) To put gear switch (35a) to position “I” (see page 40)

To engage and disengage PTO, multi-disc friction clutch and PTO brake are used. Drive shaft (2) clutch splintes of the friction gear are provided with metal-ceramic lined discs (3), and in drum (5) slots, connected to drive pinion (23) reduction gear by way of splintes, and intermediate discs (4). With PTO switched on, under oil pressure piston (26) squeezes discs, thus connecting PTO reduction gear to drive shaft (2).
With friction clutch switched off, piston (26) resets under impact of springs (27). Stand-by driven PTO brake eliminates the end move and stoppage. The brake is mounted in reduction gear body (10) and consists of piston (24), friction disc (6) and thrust disc (25).

Friction disc (6) is mounted on drum splintes (5). When pressure rises in the brake booster, piston (24) squeezes discs (6) and (25), braking drum and PTO end.
In neutral position, the end can be easily rotated “by hand”.

Note: 1. Axial clearance in coned roller bearings (18) should not exceed 0.10 mm. Make adjustment by selecting rings (19) Torque nuts (21) to 220 Nm.
2. With PTO speed switch (35a) (see page 40) put in position “II”, and replaceable ends in place , as shown above, two additional speeds of independent PTO are obtained (720 and 1460 rev/min).

5.5.1 Rear PTO control

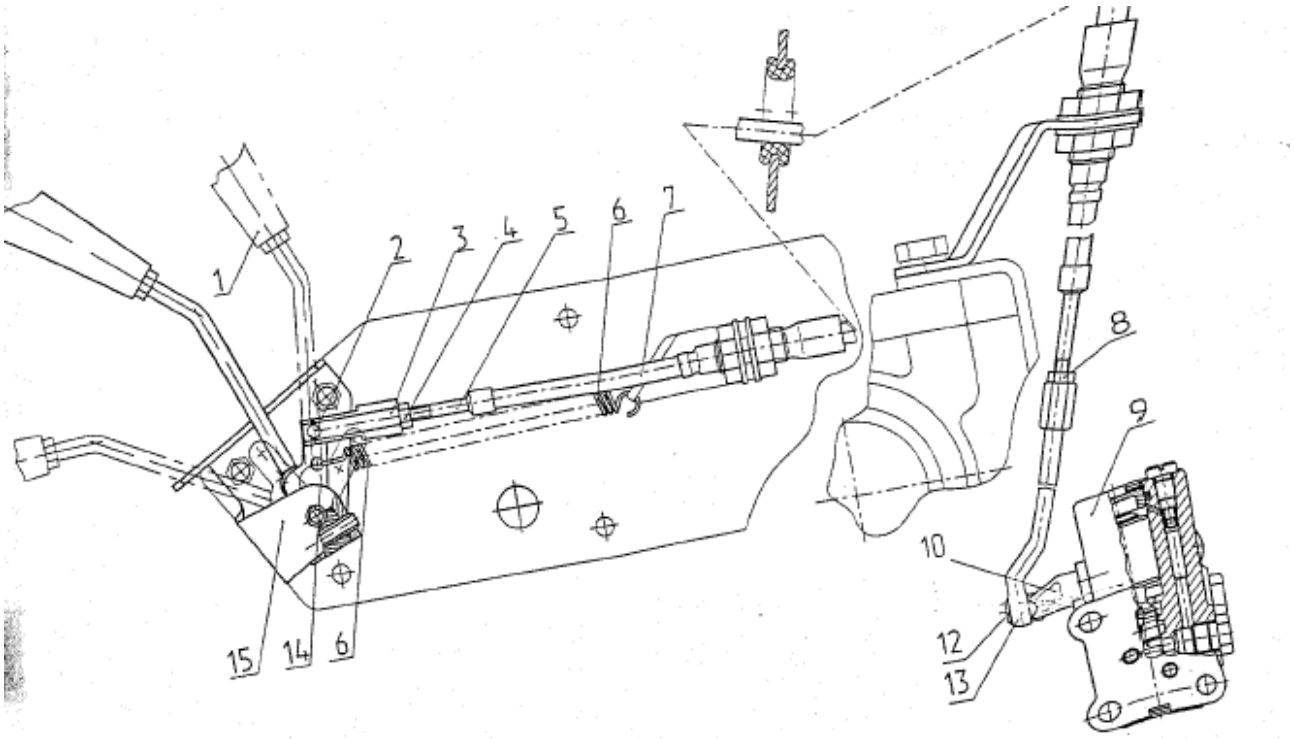
Rear PTO is controlled by handle (1) (see figure below) of lever (15) located on the console of side control panel (lever 30, page 28). It moves by means of steel rope (7) and tie-rod (13) rotating lever (10) for control of distribution control valve (9), which is intended for control of oil supplied to friction gear and brake.
Handle (1) (figure on page 86a) has three positions:

- end front – “PTO switched on”;
- end rear – PTO end brake switched on”;
- middle – “PTO and brake switched off”.

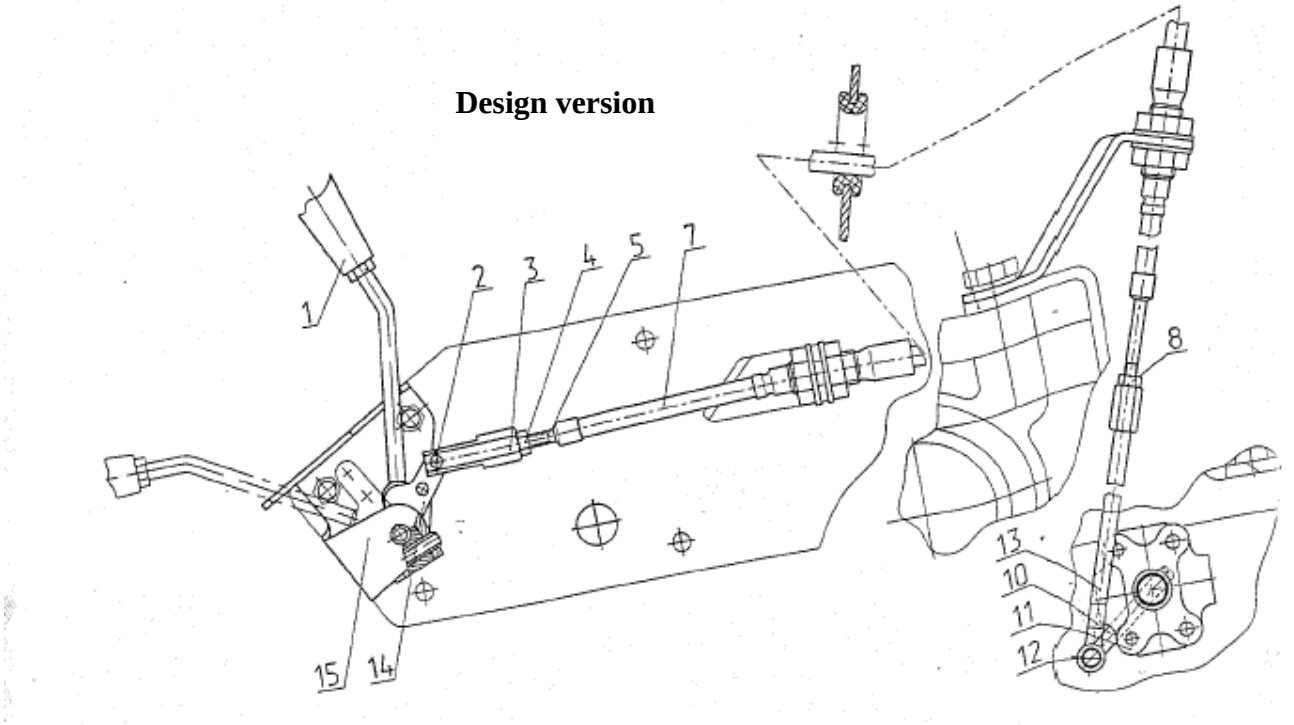
Distribution lever (10) is fixed in three positions with diesel in operation: upper – “PTO switched on”; lower – “brake switched on”, and middle (neutral) – “PTO and brake switched off”.

When diesel is not operational, or when pressure in the transmission hydraulic system drops to below 0.8 mPa, handle (1) under effect of spring (6) automatically resets from the end upper position to neutral. Make following adjustment of rear PTO control:

- set handle (1) and lever (10) of distributor (11) in neutral position;
- by changing length of steel rope rod(5) (by screwing yoke up or down yoke (3) , having in advance released check nut (4) and tie-rod (13) (screwing it up or down the rod, having in advance released check nut (8), align openings in yoke (3) and lever (14) of switch (15), as well as in tie-rod (13) and lever (10) of distributor (11), bring them together with your fingers (2, 12) and fix with pin. After completing adjustments tighten check nuts (4) and (8).



Design version



1 – control handle; 2 – pin; 3 – yoke; 4 – check nut; 5 – steel rope rod; 6 – spring; 7 – steel rope; 8 – check nut; 9 – distributor; 10 – lever; 11 – tap; 12 – pin; 13 – tie-rod; 14 – lever; 15 lever.

- Check operation of the control mechanism. With force of maximum 30 N (3 kgs) applied, handle (1) should move easily and with no jams , and be fixed accurately in three positions with diesel in operation. With non-operational diesel it should reset from end front position to neutral by means of spring (6).

In the hydraulic version of PTO control (see illustrated design version below), instead of distributor (9) a cock (11) with a damper (in the form of pneumatic coupler that ensures smoothness of PTO start) can be installed.

The difference against described above design lies in the absence of return spring (6) and neutral handle (1) position. The control handle has two fixed positions: the end front – (PTO switched on), and end rear – "brake of PTO end switched on".

CAUTION! To engage PTO, smoothly push the control handle with 2…4 s delay in the middle of shifting from neutral to PTO switch on.

For the latter design version: (when shifting from rear position to PTO switch on) to avoid breakage of drive shaft, reduction gear pinions and PTO end.

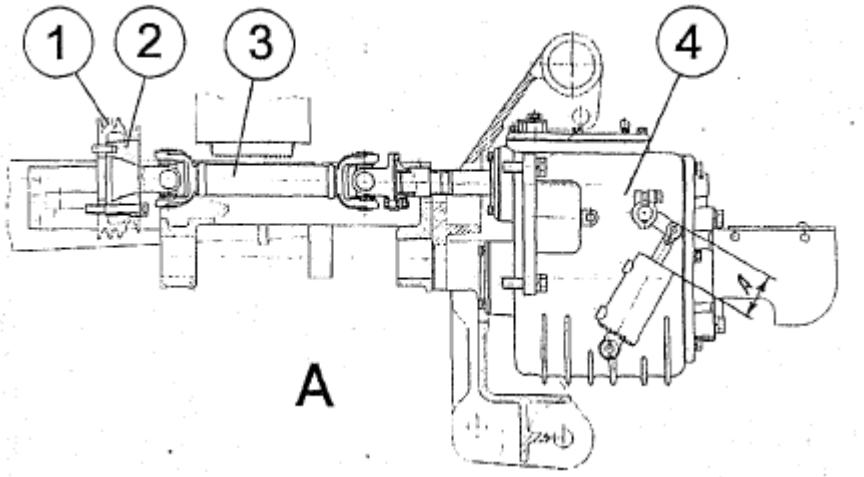
5.5.2 Possible rear PTO malfunctions

Table 5 – 5

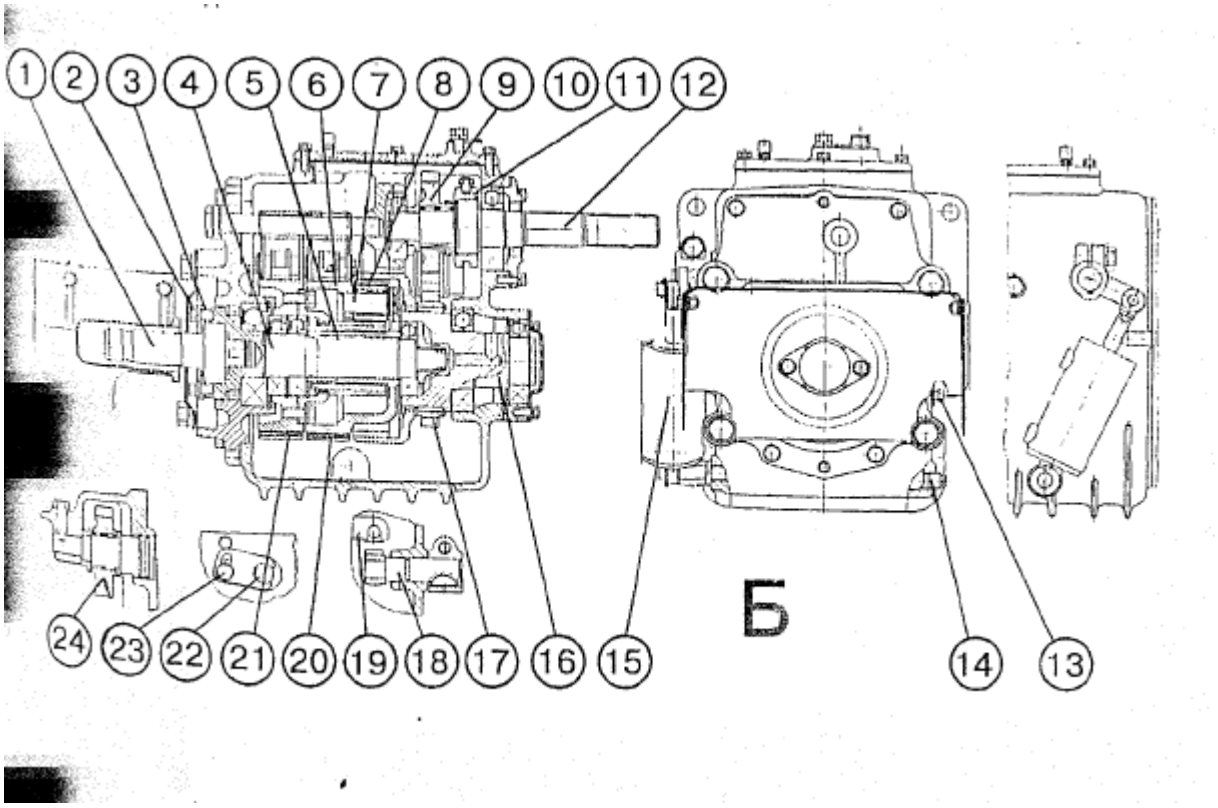
Malfunction, appearance	Correction methods
Rear PTO doesn't fully transfer torque, or keeps rotating after PTO brake is engaged	
Control adjustment is violated	Using distributor adjust control
Low oil pressure in the transmission hydraulic system.	Adjust reduction valve of transmission HS.
Low oil pressure at the outlet to friction gear and PTO brake due to: c) leakage in the distributor, friction gear and PTO brake;	Check pressure, if required, check sealing rings of the friction gear and PTO reduction gear brake, or replace distributor.
d) distributor main valve seizure	Dismantle distributor, clean and rinse parts, remove causes of seizure, replace damaged parts, if necessary.
Violation of friction gear or brake operation due to pistons hang or wear-out of friction discs	Rinse friction gear and brake parts in pure diesel fuel, replace friction discs, if required.

5.6. FRONT PTO (ONCE INSTALLED)

The front PTO (FPTO) is design for driving agricultural machinery, being mounted on front hinge mechanism. It is independently driven with clock-wise rotation of the end, if looking at its end face. It provides the end frequency rotation of 1000 rev/min at diesel rotation frequency of 1845 rev/min and power output of 44 kW (60 h/p) maximum.
FPTO (fig A) is driven by pulley (1) of diesel crankshaft and reduction gear (4) via distance piece (2), permanently installed in pulley (1), and crankshaft (3).



1 – pulley; 2 – distance piece (spacer); 3 – crankshaft; 4 – FPTO reduction gear “A” – distance of rod extension

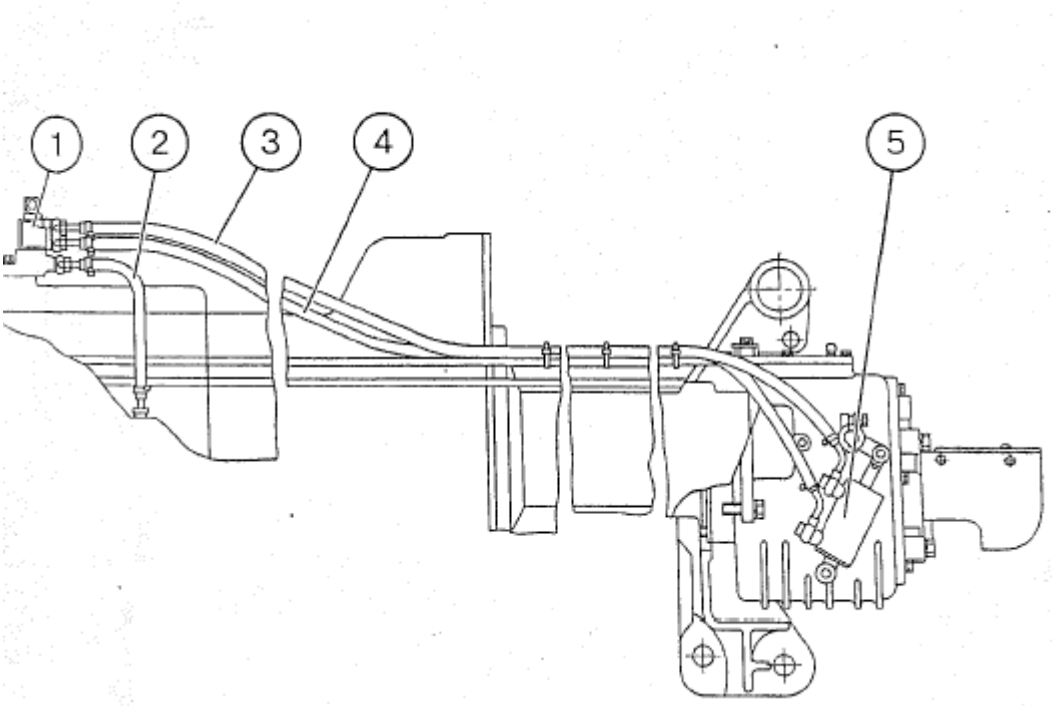


In FPTO reduction gear (figure B, page 89) power is transferred from shaft (12) to end (1) by means of shifted toothed clutch (11) installed on shaft (12), pinion (10), intermediate pinion (24), pinion (17) mounted on shaft (16), which is connected to crown pinion (9) of the planetary reduction gear.

FPTO is unified with rear PTO planetary reduction gear of tractors MTZ-80. It is controlled by hydraulic cylinder (5), connected to turn roller (18) effecting levers (19) of belt brakes.

Hydraulic cylinder (5) rod (see figure below) moves by changing oil flow direction in electric-hydraulic distributor (1).

Oil flow coming along forced pipelined (2) is directed either to pipeline (3) connected to rod end head of cylinder (5) (FPTO is switched off – rod is drawn in), or to pipeline (4), connected to piston end head of cylinder (5), (FPTO is switched on – the rod is withdrawn).



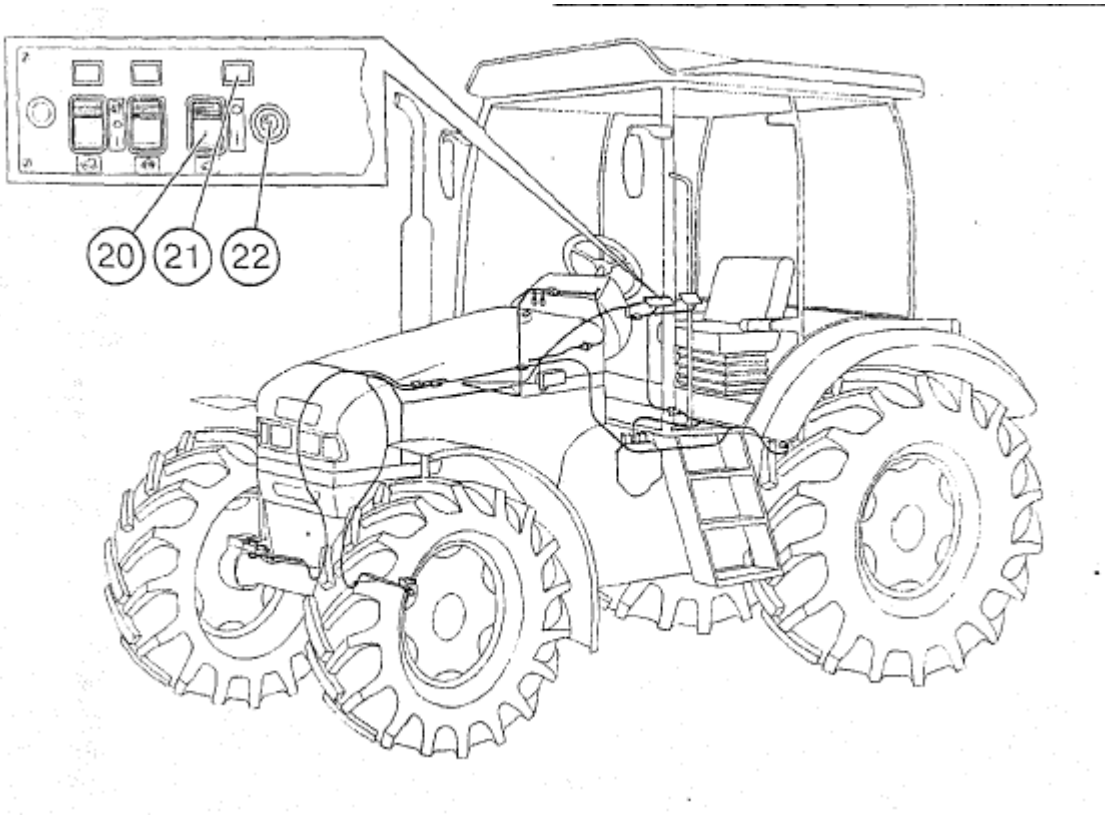
1 - electric-hydraulic distributor; 2 – forced oil conduit; 3 - oil conduit of hydraulic cylinder rod head end; 4 – oil conduit of hydraulic cylinder piston head end; 5 – hydraulic cylinder.

Control of front PTO (if installed)

1. With minimum stable diesel revolutions, engage FPTO drive; to this end turn lever (22) (figure B, page 89), mounted on top of reduction gear body, anti clockwise, having released bolt (23) in advance. To disengage the dive, turn lever (22) clockwise. After switching is completed, tighten bolt (23).
2. Switching FPTO on and off is carried out in the following way (see figure below):
   - to switch FPTO on, press lower part of key (20), then push button (22) and release it. After that indicating lamp (21) should light (yellow color), which means that FPTO is switched on;
   - to switch FPTO off, press upper part of key (20), signal lamp (21) goes out, which indicates that FPTO is switched off.

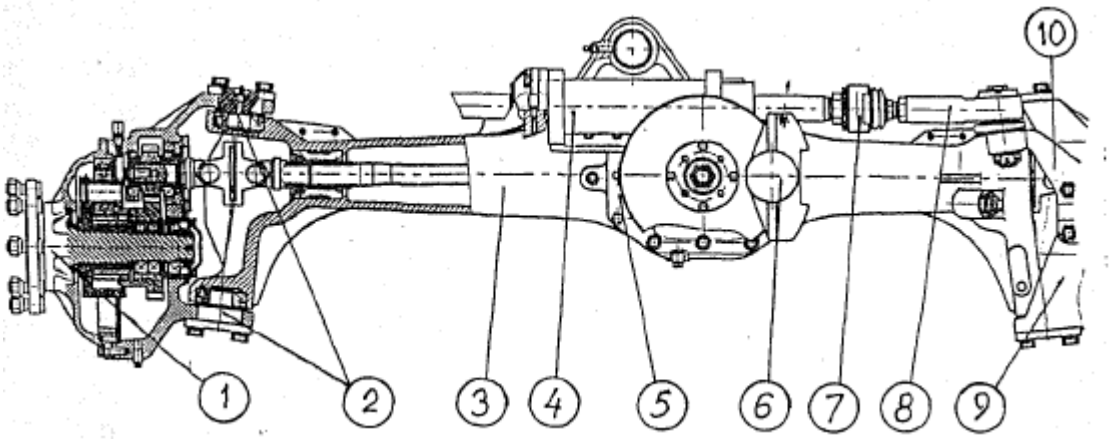
CAUTION!

- When FPTO is not used, switch FPTO drive off.
- Before starting the diesel make sure that key (20) and pushbutton (22) are in position "FPTO is switched off" (indicating lamp (21) doesn't light).
- When the control system is deenergized (generator out of order, belt breakage, etc.), switch off the drive, as shown above in item 1, to exclude before time failures of FPTO reduction gear parts.



3. Switch FPTO with diesel idling, and only after tractor acceleration increase diesel rotation frequency to required value.
4. To replace end (1) (figure B, page 89), switch off FPTO, stop the diesel , unscrew six bolts (3), take out plate (2), pull out the end (1) and mount the required one, having lubricated in advance centering surface with thin layer of consistent grease. Follow reverse order for assembly operation.
5. When changing oil in the reduction gear, new oil should be refilled to control plug level (13).
6. Periodically check extension of control cylinder rod (size "A", figure A, page 89). If in position "FPTO switched off" the rod extends less then by 25 mm, or in position "FPTO switched on" – more than 90 mm, replace lining of belt brakes (20, 21) (figure B, page 89) of the planetary reduction gear.

5.7. FRONT DRIVE AXLE



1 – left finite reduction gear; 2 – king pin axle; 3 - front drive axle beam; 4 – two-rod hydraulic cylinder of steering control; 5 – central reduction gear; 6 – central brake; 7 – axial spherical hinge; 8 – steering tie-rod; 9 – right finite reduction gear; 10 – arm.

The front drive axle is designed for torque transfer from the diesel to driven drive front wheels. FDA consists of whole cast beam (3), central reduction gear (5) with main gear and differential fastened by bolts to FDA beam, finite gears' reduction gears (1, 9), connected to axle beam by means of king pin axles (2). Central reduction gear body has two-rod hydraulic cylinder (4), coupled with steering knuckles' arms (10) by means of axial spherical hinge (7) and tie-rod (8).

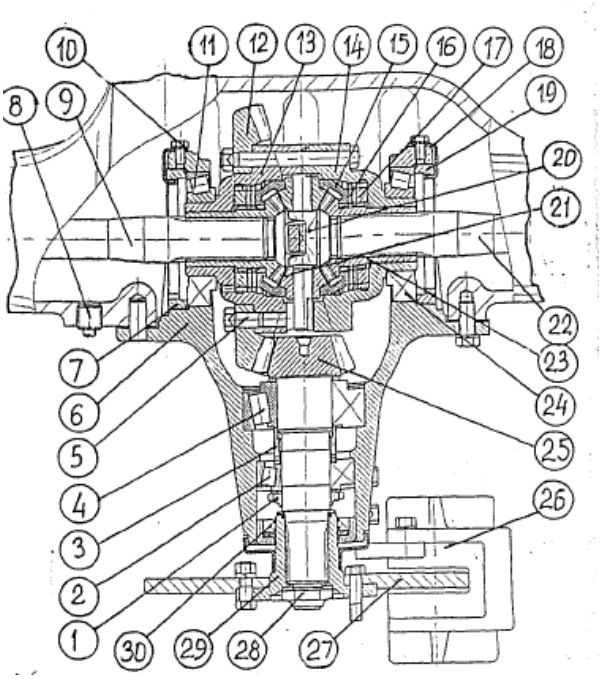
5.7.1. CENTRAL REDUCTION GEAR WITH FINAL DRIVE AND DIFFERENTIAL

Body of central reduction gear (6) is fastened to FDA beam with bolts. The body houses coned pinions (12, 25) of the final drive increased friction self-locking differential, consisting of half-axle pinions (23), differential (15) cups, discs (16, 17), satellites (21), satellites' axles (20) installed in boxes (13, 14) that are tightened with bolts (5). Self-locking differential automatically unites both half-axle shafts (9, 22) to function as one assembly, when front wheels slip separately. Under impact of axial forces cups squeeze discs (16, 17), locking half-axle pinions to differential boxes, resulting in differential locking during straight movement. When tractor is making a turn, outside forces exceed friction in discs, which start to slip, and differential unlocks.

Central disc brake comprises of disc (27), fastened to flange (29) fixed by nut (28) to splined end of the drive pinion of final drive (25), and carriage (26), that is fastened to central reduction gear body (6) with brake blocks, driven with hydrostatic drive, thus ensuring braking of front wheels, when tractor is braked with linked pedals of working brakes.

Tension of bearings *(2, 4)* of the drive pinion is adjusted by some grinding of distance sleeve (3) and tightening of nut (2) to required torque.

Tension of bearings (11, 24) and engagement of final drive pinions (12, 25) are adjusted by nuts (7, 19) with retaining plates (18) and bolts (10).



1 – nut; 2, 4 – coned roller bearing; 3 – distance sleeve; 5 – bolt; 6 – body; 7, 19 – adjustment nut; 8 – control –refilling plug; 9, 22 – half-axle shaft; 10 – locking bolt; 11, 24 – coned roller bearing; 12 – driven pinion; 13, 14 – differential box; 15 – cup; 16, 17 – discs; 18 – retaining plate; 20 – axle; 21 – satellite; 23 – half-axle pinion; 25 – drive pinion; 26 – carriage; 27 – brake disc; 28 – nut; 29 – flange; 30 – sealing ring.

5.7.2. FINAL DRIVE REDUCTION GEAR BOX

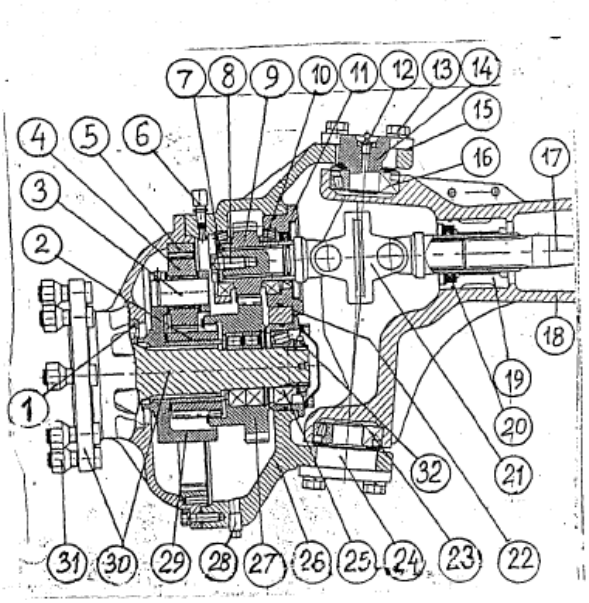
Planetary-cylindrical reduction gear is designed for transfer and increase of torsion movement from FDA differential at different turning angles of front drive wheels.

Reduction gear consists of double hinge, cylindrical and planetary gear, hinge pin and levers for control of front wheels turn. Double hinge (21) on one side is connected to FDA differential by means of shaft (17), and from the other side – to drive pinion (9) being in engagement with driven pinion (27) of cylindrical pinion. The drive pinion is set on coned roller bearings (10). Toothed ring of pinion (27) is in constant engagement with sun pinion (2) of the planetary gear, which, via satellites (4), axles (3), carrier (29) and crown pinion (5) bring to rotation flange (30) of the front wheel. The flange is mounted in coned roller bearings (1, 25), adjusted by nut (32).

Pivot connection is formed by upper and lower axles (14, 24), and coned roller bearings (16, 23) installed in body bores (26) of steering knuckle and axle beam (18).

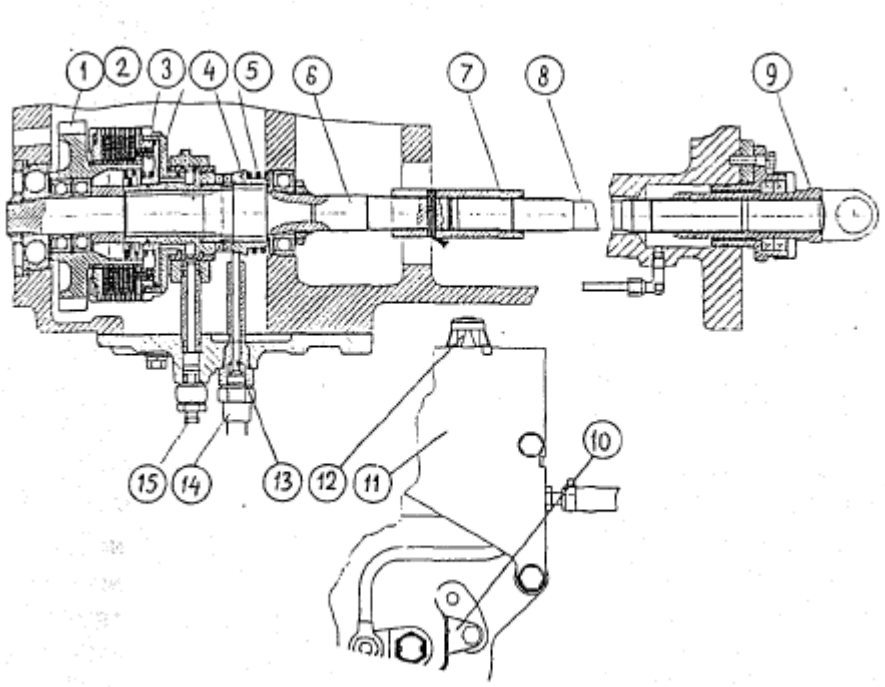
Tension of bearings (16, 23) is adjusted by spacers (15).

Bearings clearance (10) of drive pinion is adjusted by spacers (22).



1, 25 – coned roller bearing; 2 – sun pinion; 3 – axle; 4 – satellite; 5 – crown pinion; 6 – breather; 7 – plate; 8 – plate; 9 – drive pinion; 10 – coned roller bearing; 11 – cup; 12 – oil cup; 13 – bolt; 14 – upper axle of king pin; 15 – spacer; 16, 23 – coned roller bearing; 17 – half-axle shaft; 18 – axle beam; 19 – yoke; 20 – sealing ring; 21 – double hinge; 22 – spacer; 24 – lower axle of king pin; 26 – body; 27 – pinion; 28 – drain plug; 29 – carrier; 30 – flange; 31 – nut; 32 – nut.

5.7.3. Drive of front drive axle



1 – pinion; 2 – piston; 3 – drum; 4 – jaw half-clutch; 5 – spring; 6 – shaft; 7 – spline bushing; 8 – torsion bar; 9 – crankshaft yoke; 10 – clamp; 11 – shield; 12 - electric-hydraulic distributor; 13 – pusher; 14 – switch; 15 – plug.

FDA drive is designed for transfer of torsion movement from gear box countershaft by means of driving pinion of synchronized PTO, multi-disc friction hydraulically controlled clutch, torsion bar and crankshaft to front drive axle.

Switching PTO drive on/off is carried out by means of hydraulically pressed clutch upon sensor signal, which is effected by the overrunning clutch depending on rear wheels slippage.

FDA drive is situated in GB case on the right of tractor travel; in this case torsion bar passes through clutch body. Support of crankshaft sliding yoke is installed in clutch body.

The drive consists of the following main parts and assemblies. Shaft (6) is mounted in GB case on roller bearings. On the shaft pinion (1) freely rotates (with clutch disengaged). It is in permanent engagement with the pinion of synchronized PTO drive; with clutch being engaged, the pinion is connected by a set of friction discs with drum (3) of hydraulically pressed clutch, discs are pressed by piston (2)under oil pressure. The drum and jaw half-clutch (4) of the overrunning clutch are installed on shaft splines (6), and splined joint allows the drum to rotate by 45^{0} in relation to the shaft. The half-clutch is constantly spring-loaded (5) to drum knuckles and can axially move and act on pusher (13) of automatic drive switching sensor (item 7 of the figure on page 97). Torsion bar (8) connects shaft (6) by way of splined bushing (7) with crankshaft sliding yoke.

Operation of FDA drive

With no slippage forward travel of the tractor, shaft (6) (figure on page 95), connected to FDA wheels, has greater rotation frequency, than pinion (1) and drum (3) rotate against shaft. Drum (3) cams axially move the half-clutch along shaft splines, squeezing spring (5).

With this, contacts of switch (14) of the drive automatic switching on sensor are open and hydraulic distributor electric magnet is deenergized, and there is no pressure in the friction clutch booster.

When rear wheels slip and exceed the rated value, frequency of shaft (6) rotation drops to an extend for drum (3) to start rotating in reverse direction and spring (5) resets half-clutch (4) to initial position. By its coned part the half-clutch moves pusher (13), switch (14) closes electric circuit of the electric magnet of hydraulic distributor (10), oil under pressure is supplied to the clutch booster, moving piston (2). With this, a set of discs squeezes, blocking pinion (1) with drum (3), and providing transfer of torque.

With forced FDA switching on, oil is supplied to the clutch booster irrespective of rear wheels slippage. When FDA is switched off, the distributor shuts off pressurized duct, and from the clutch booster oil is forced to drain.

General arrangement and operation modes of the FDA drive control system are described below. Diagnostics opening covered with plug (15) is provided for checking pressure in the drive clutch booster. Switch (14) and electric-hydraulic distributor (12) are protected with clamp (10) and shield (11).

5.7.2. The system of FDA drive control
(see fig. on page 97)

The system includes panel (1), drive wheels turn angle sensor (11), installed on the FDA right side, reverse sensor (5), installed on the right GB side, two sensors (13) of work brakes switching on, sensor (7) of automatic FDA drive switching on, electric-hydraulic distributor (8) installed on the GB cover right side, electrical cables (9), connector (4) and sockets (12).

The system is supplied is similar to described above rear axle DL system.

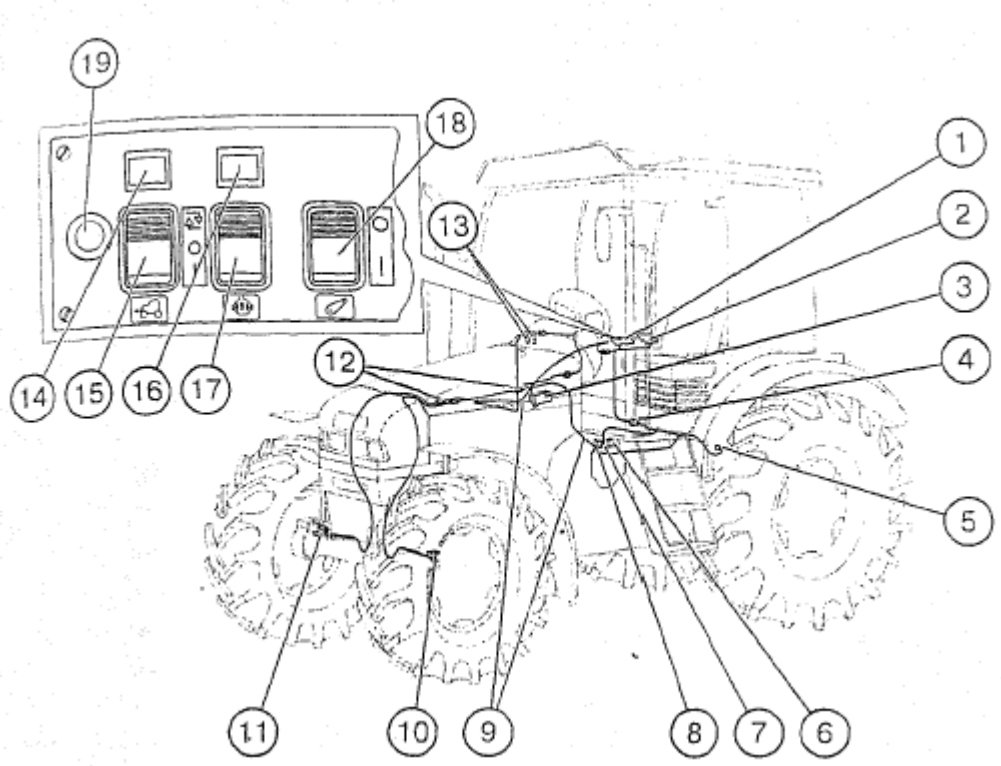
Automatic switching sensor (7) consists of pusher (13), guide and switch (14), (page 95).

Key-type switch (15) for FDA drive control and indicating lamp (14) of drive switched on state, are placed on panel (1).

Switch (15) has three positions:

- “Automatic FDA control” (upper fixed);
- “ Forced FDA switching on” (lower fixed);
- “ FDA switched off” (middle fixed).

With switch (15) position “FDA switched off”, power is not supplied to electric-hydraulic distributor (8), FDA drive clutch is connected to drain, and FDA drive is switched off.



The control system for rear axle differential locking (DL) and front drive axle (FDA) drive:
1 – control panel; 2 – a box of fuses; 3 – a box of starting relay; 4 – plug-and-socket; 5 – reverse sensor; 6 – hydraulic distributor of DL control; 7 – sensor of automatic FDA drive switching on; 8 – hydraulic distributor for FDA drive control; 9 – connecting cables; 11 – sensor of drive wheels turning angle (25 degrees); 12 – connectors; 13 – sensor of work brakes switched on state; 14, 16 – indicator lamps; 15 – switch for control of FDA drive; 17 – switch of DL control; 18 – HLS switch; 19 – sound alarm switch (2022V).

With switch (15) in position "Automatic FDA control", FDA drive automatically switches on when travelling forward by means of sensor (7), giving signal of switching on depending on slippage, to the solenoid of electric-hydraulic distributor (8), which sends oil flow under pressure to FDA drive clutch. FDA drive automatically switches off when front wheels turn at a certain angle in any direction.
When switch (15) is set to position "Forced FDA switching on", FDA drive is switched on by force both when travelling forward or moving in reverse irrespective of front wheels turning angles and slippage.

CAUTION!
- when pressing interlocked brake pedals, FDA drive switches on irrespective of switch (15) position.
- When travelling on hard surface roads, be sure to SWITCH FDA OFF (middle position of key (15)) to avoid increased wear-out of front wheels' tires and drive parts.
- When tractor operates in the reverse mode, use only forced FDA switching. DO NOT switch FDA by force with tractor movement speed over 15 km/h.

5.7.5. Adjustment of the switch of FDA drive automatic switching on sensor

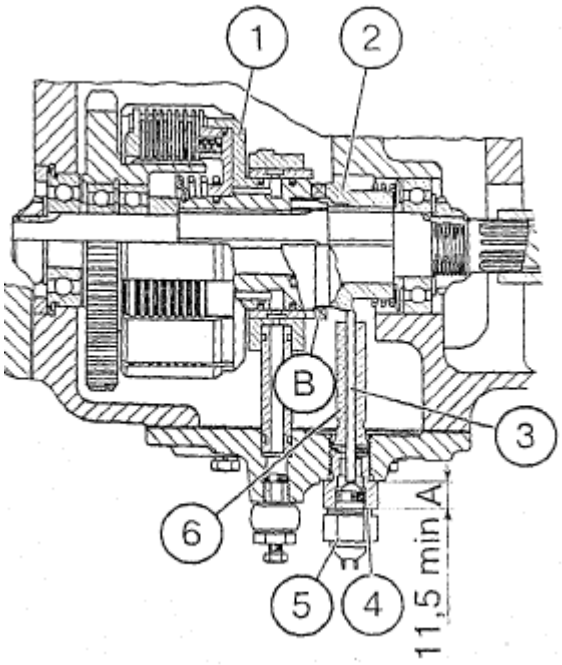
Make adjustment of switch (5) after assembling hydraulically loaded clutch and cover (6) installation on transmission in the following order:

1. Turn drum (1) and put it in position I , when cams of half-clutch (2) and drum (1) are fully brought together, pusher (3) is extended to its utmost position.
2. Put initial quantity (5 – 6 pieces) of adjustment spacers (4) under switch end face.
3. Removing adjustment spacers (4) one by one, get such switch (5) position when its contacts are closed.
4. Put half-clutch (2) to position II, when cams of half-clutch (2) and drum (1) are fully disengaged, and pusher (3) is sunk in its utmost position.
5. Check contacts opening of switch (5) in position II.

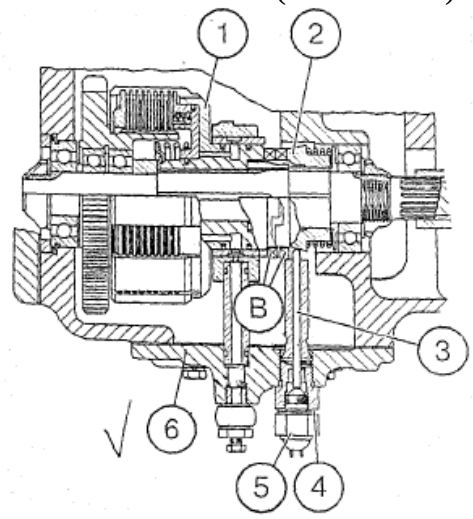
The switch is thought to be properly adjusted, if in position I its contacts are closed, and in position II – open. Consult the control lamp in making checks. Checks can be made by indicating lamp on the control panel, in this case key of FDA drive control should be in upper position.

Note:
In position I, size A from pusher end face (3) to switch (5) end face of less than 11.5 mm is not allowable.
Violation of the requirement may lead to switch (5) failure.

Position I (switched on)



Position II (switched off)



1 – drum; 2 – half –clutch; 3 – pusher; 4 – spacer; 5 – switch; 6 – cover.

5.7.6. Possible FDA malfunctions

Table 5-6

Malfunction, appearance	Correction methods
Increased final drive noise	
Abnormal backlash in drive pinion bearings of final drive	Address high-skilled specialist or dealer
Oil leakage on wheel reduction gear	
Sealing rings of wheel flange or steering knuckle are worn-out or damaged	Replace sealing
Increased wear-out and separation of front wheel tires	
Improper convergence adjustment	Make adjustments
Non-compliance of tires' air pressure with recommended rated values	Adjust tires' pressure according to manufacturer's recommendations
FDA constantly operates in the forced switched on mode	Observe directions laid out in the present manual
Driving clutch doesn't transfer torque	
No pressure in the clutch booster	Disassembly the distributor, rinse the body and slide valve
Electrical part of the system is faulty	Find out and correct the trouble
Torque is not sufficiently transferred	
Leakage in the hydraulic system of drive control:	
-wear-out of rubber sealing rings;	Replace sealing rings.
- wear-out of piston and drum sealing rings;	Replace sealing rings
- wear-out of adjacent surfaces: bearing race –drum bushing, drum-piston;	
- wear-out of a set of discs;	Replace worn-out parts
- slippage of FDA drive clutch	Adjust pressure in the transmission hydraulic system (9…10 kgs/cm^2)
Insufficient oil pressure in the transmission hydraulic system	Make adjustments
The drive doesn't operate in the automatic mode	
Switch of sensor automatic switching on is poorly adjusted	Adjust the switch

5.8. BRAKES

Tractors are equipped with left-side and right-side working brakes with foot pedals control (5, 6) (see figure on page 104), and a parking brake with hand independent mechanical control by means of handle (9)at left operator's hand, effecting working brakes (see figure on page 102).

Working brakes are driven hydraulically by means of left and right main wheel cylinders (7), left and right working cylinders (9, 11), correspondingly (see figure on page 104). Brakes are independently mechanically controlled by means of a handle via lever system.

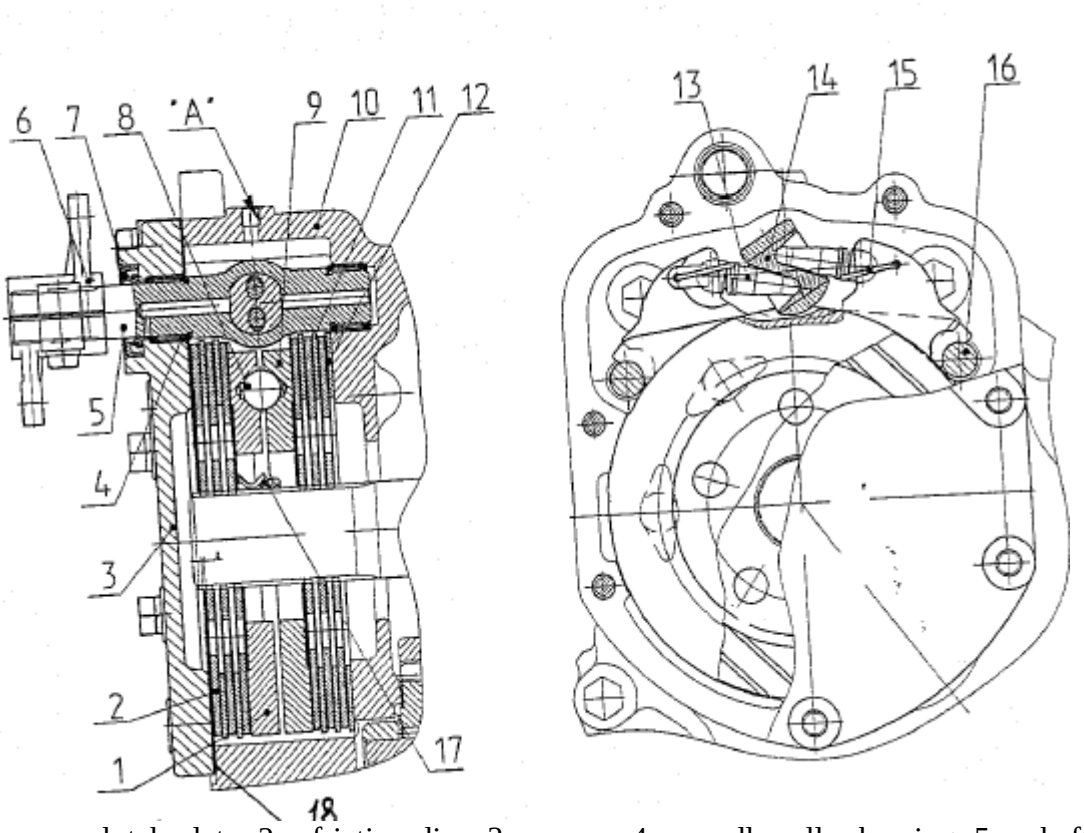
Table 5-7

Brakes	Brakes control	Brakes drive	Brakes type	Installation place
Working	Foot operated	Hydrostatic	"Wet" disc	Drive pinion shafts of final drives
Parking	Hand operated	Mechanical, with independent working brakes drive		

5.8.1 WORKING BRAKES

Left and right multi-disc “wet” brakes are mounted on shafts of final drive driving pinions. Each brake consists of six friction discs (2) with metal-ceramic lining; five intermediate discs (11, 12), two pressure clutch discs (1,9) brought together by four springs (17), six steel balls (8) placed in drop-like hollows of pressure clutch plates; two pushers (13) with springs (15), cam (14), shaft (5) mounted on two needle roller bearings (4) with sealing ring (7); lever (6) and cover (3) with spacers, fastened to pipe (10) by seven bolts.

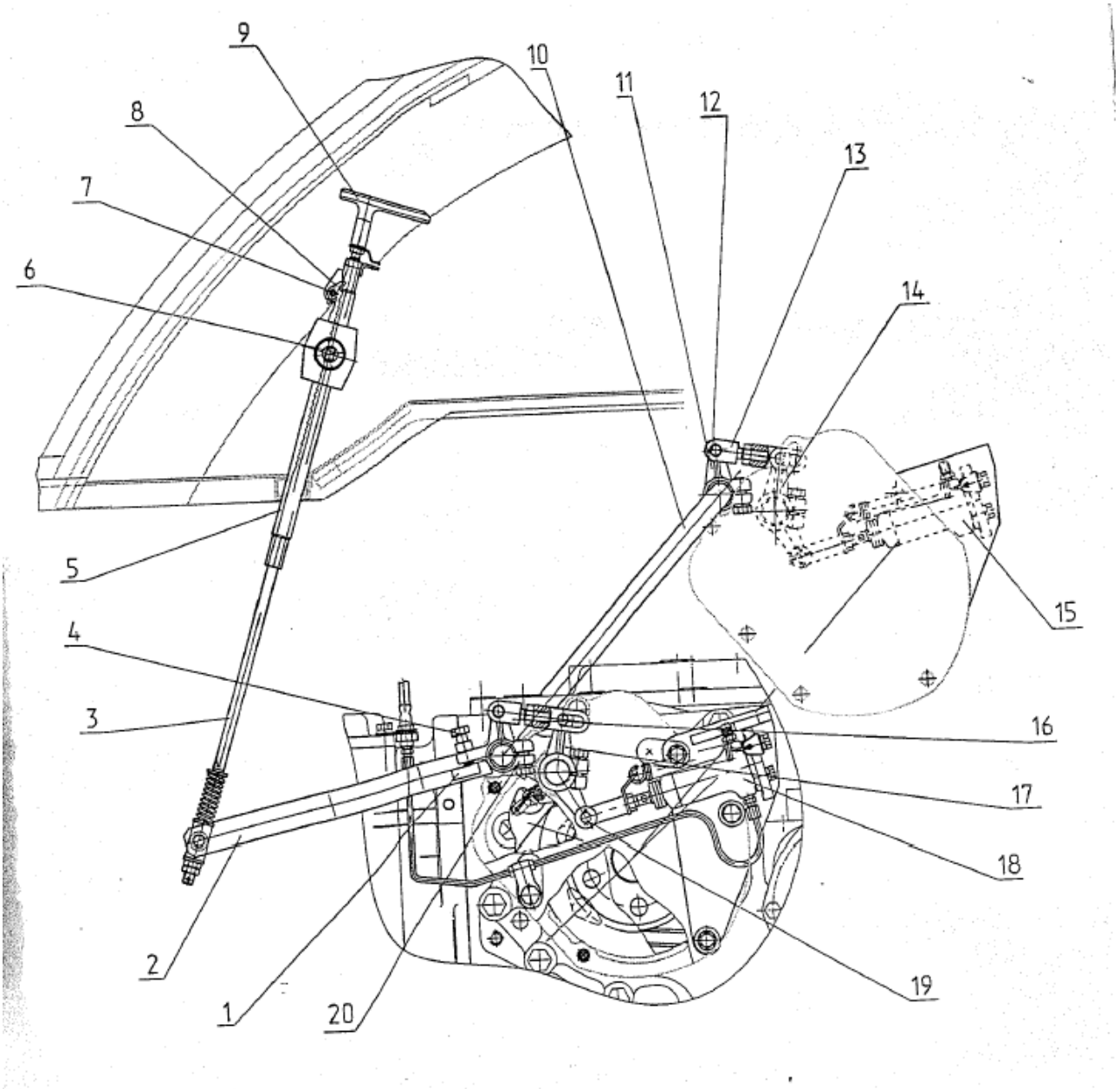
When pressing brake pedal, force is transferred to lever (6) via hydraulic drive system, rotating shaft (5), and its cam (14) acts on pushers (13); pressure clutch plates (1, 9) rotate relatively each other and as a result of that balls (8) roll out of hollows and spread pressure clutch plates. The whole set of discs (2, 11, 12) compresses and brakes the shaft on which it is installed. Braking discs are lubricated and cooled by oil supplied from transmission lubricating system through opening “A”. Assembly clearance of 1.2…1.8 mm between discs is provided by placement of required number of spacers (18).



1, 9 – pressure clutch plate; 2 – friction disc; 3 – cover; 4 – needle roller bearing; 5 – shaft; 6 – lever; 7 – sealing ring; 8 – ball; 10 – pipe; 11, 12 – intermediate disc; 13 – pusher; 14 – cam; 15 – spring; 16 – pin; 17 – spring; 18 – spacers (1…3 pieces); “A” – opening for oil conduit.

5.8.2 Parking brake

Main working brakes with independent drive of rear wheels are used as parking brakes.



1 – stop-plate; 2 – lever; 3 – tie-rod; 4 – adjustment bolt; 5 – draw-out mechanism; 6 – axle; 7 – fixation pin; 8 – fixing lock; 9 – handle; 10 – brakes roller; 11, 20 – lever; 12 pin; 13, 16 – tie-rod; 14, 17 – brakes lever; 15 – right-hand main cylinder; 18 – left-hand main cylinder; 19 – pin.

The drive (see figure on page 102) consists of the draw out mechanism (5) unified with the mechanism of tractor MTZ 1523, mounted on axle (6), which is fastened to cabin left side off the operator's seat, and mechanical transmission, comprising of lever (2), freely set on brakes roller (10) with its hub, levers (11 and 20) connected to the roller by way of keyed joints.

To lever (2) plate (1) is welded, abutted by adjusting bolt (4), screwed in left-side brake lever (20).

Levers (11 and 20) via tie-rods (13 and 16) are connected to two-arm levers (14 and 17), fastened to splined ends of left and right brakes. Their lower arms are connected to main cylinders' (15, 18) rods by means of yokes and pins.

When pulling tie-rod (3) using draw-out mechanism handle (9), the effort is transferred to lever (2), and from its stop (1) – to bolt (4), thus rotating lever (2) and roller (10), connected with it by means of key, lever (11), tie-rods (13 and 16), brakes levers (14 and 17), moving pressure clutch plates (1, 9) of brakes (see figure on page 101) via shaft (5), cam (14) and pushers (13).

Pressure clutch plates, rotating towards each other, and with their contour grooves' tilted surfaces rolling on balls (8) expand, thus squeezing sets of brakes discs (2, 11) and braking final drives' driving pinions.

When turning handle (9) (see figure on page 102) with tie-rod (3) by $35…40^0$ around its axis, tie-rod toothed comb disengages fixing lock (8), and tie0rod is free to go downwards, unbraking driving pinions of rear wheels' final drives.

5.8.3. Brakes hydraulic drive

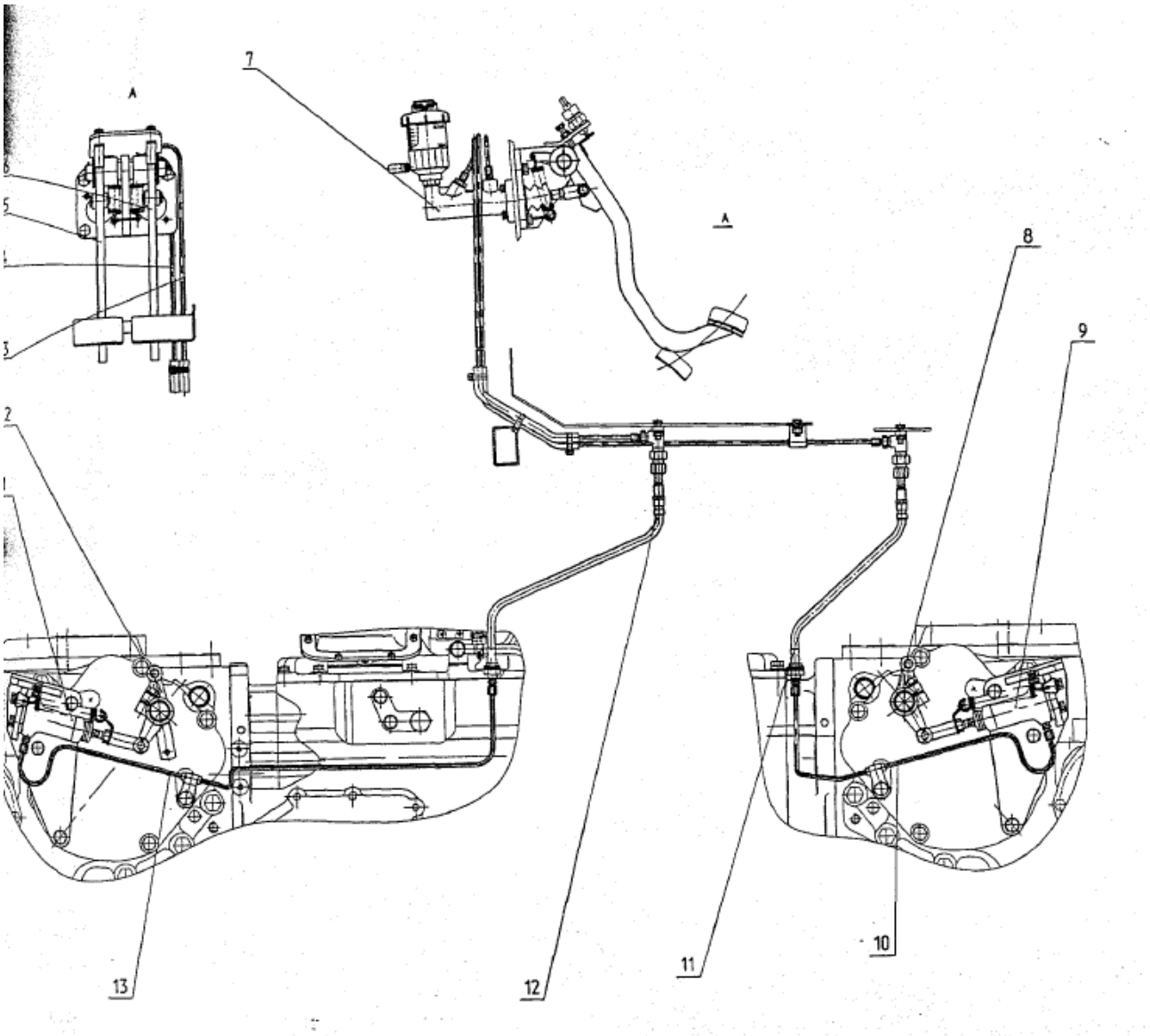
(see figure on page 104)

Brakes hydraulic drive provides independent control of main brakes using two pedals (5, 6) and consists of two wheel cylinders (7) with rods jointed to brake pedals; two wheel cylinders (1 and 9), interconnected by pipelines (3, 4, 10, 13) and hoses (11, 12) with main cylinders (7). Wheel cylinders' rods are joint coupled with levers (2, 8) of main brakes correspondingly.

When pressing pedals the force via hydraulic drive can be transferred to:

- left main brake – via lever (8);
- right main brake – via lever (2).

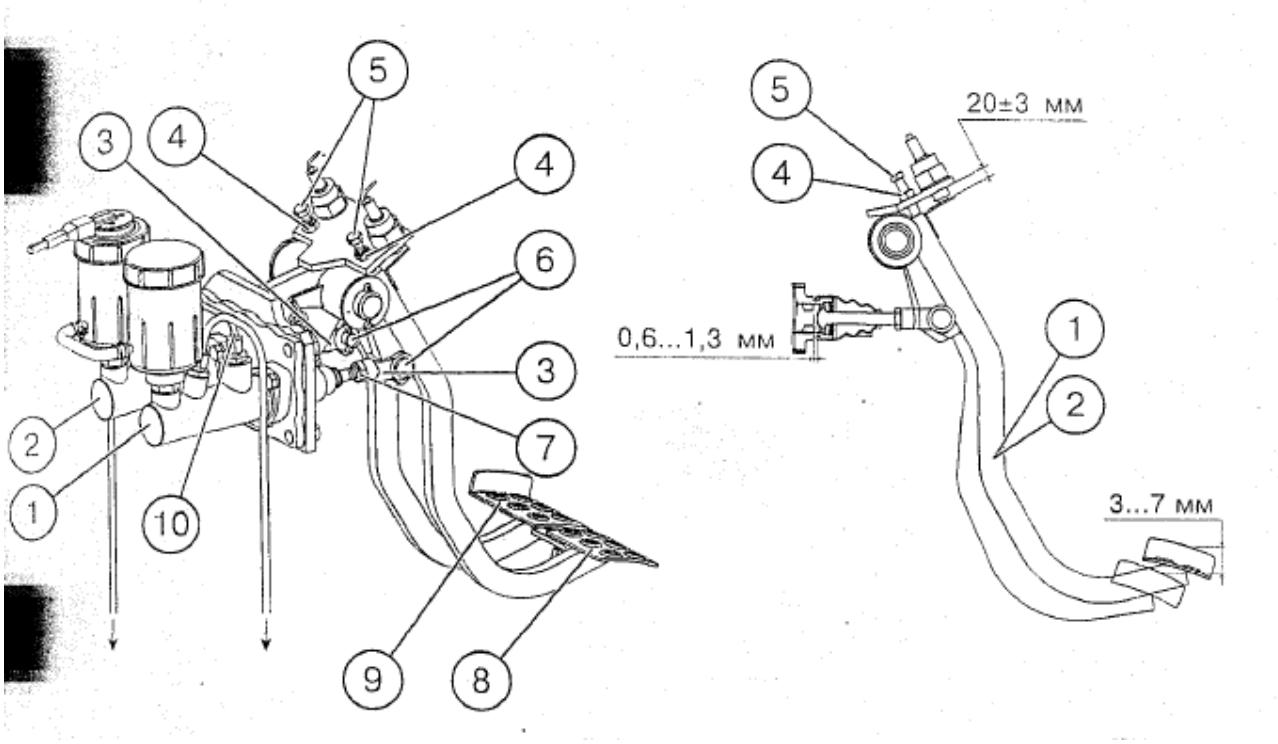
Brakes hydraulic drive



1 – right-side wheel cylinder; 2 – right-side brake lever; 3,4,10,13 – pipelines; 5 – left-side brake pedal; 6 – right-side brake pedal; 7 – wheel cylinders; 8 - right-side brake lever; 9 – left-side wheel cylinder; 11, 12 – brakes flexible hoses

5.8.4. Brakes adjustment

A. Adjustment of main brakes of tractor MTZ 2022



CAUTION! To avoid injury make adjustment of main and parking brakes on horizontal terrain and with diesel stopped. To exclude accidental tractor movement place wedges from behind and in front of rear wheels.

Make adjustment of tractor's brakes in the following order:

1. Using stop adjustment bolts (8) and screwing them in to the depth of 20 +/- 3 mm, align pedal pads (8,9). Tighten nuts (4). Pedals must be locked with a bar.
2. Adjust free travel of pedals (8,9) within 3…7 mm, having fulfilled the following operations:

2.1 unlock and take off pins (6), disconnect yokes (3) from pedals' rods (8, 9).

2.2. Unscrew check nuts (7) by several turns and by screwing yokes (3) up or down, shorten or elongate rods of hydraulic cylinders (1,2) to obtain required free travel of pedals.

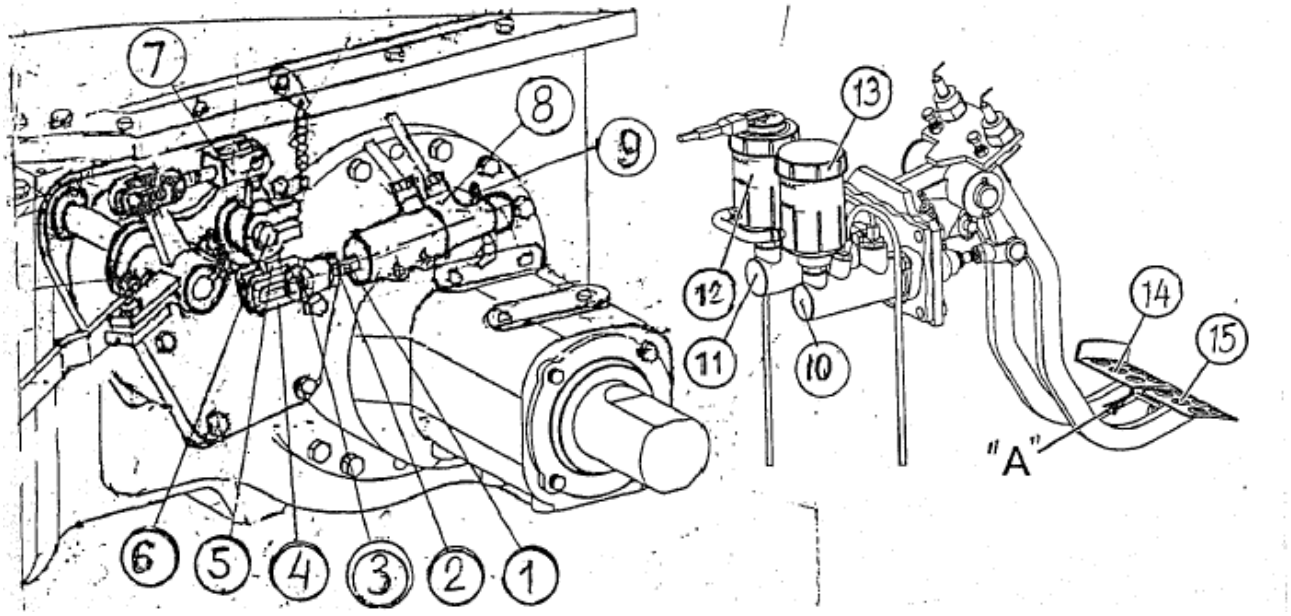
2.3. Tighten nuts (7), put pins (6) and secure them with a cotter-pin.

Free pedals travel of 3…7 mm corresponds to clearance between piston and pusher of each wheel cylinder equal to 0.6 –1.3 mm.

2.4. Pedals should not touch cabin elements. Height of pedal pads, if necessary, should be adjusted by bolts (5) and length of hydraulic cylinders' rods, providing free pedals travel of 3…7 mm.

*) Adjustment can be made without disconnecting yoke from pedals by rotating cylinders' rods with check nut released.

3. Set rod (1) length of the left brake (8) hydraulic booster to 120 mm, if measured between where hydraulic booster abuts piston and axis of pin connecting lever (5) with yoke (4), correspondingly, with piston fully drawn in, and pin (3) must touch yoke slot from hydraulic cylinder side.



Make adjustment using yoke (4), and carry out the following operations:

- unscrew check nut (2) by several turns.
- Remove a cotter pin and take off pin (3), having disconnected yoke (4) from lever (5).
- Screwing yoke (4) up or down the rod of hydraulic booster (8), set dimension to 120 +/- 1 mm.
- Tighten check nut (2), put and secure pin (3) with a cotter pin.
- Similarly adjust length of hydraulic booster rod of the right brake.

4. Fill in the drive hydraulic system with braking fluid and run through the hydraulic system in the following sequence:

- fill in tanks (12, 13) of wheel cylinders (10, 11) with braking fluid up to marks “max” (up to level 15 +/- 5 mm from the tank top. In the process of running through control fluid level and don’t allow its drop below mark “min”.
- Remove protective cups (9) off by-pass valves of main brakes’ hydraulic boosters, put pipes on valves’ heads, submerging free end of pipes in reservoirs with 0.5 l minimum capacity and half-filled with liquid fluid.
- Interlock pedals (14, 15) with locking bar “A”.
- Unscrew wheel cylinders valves by ½…3/4 turns, and after that press interlocked brake pedals several times. **PRESS FAST, RELEASE SMOOTHLY!**

Keep on pressing (bleeding air from the brakes) at least 10 times, until air bulbs from pipes submerged in fluid, stop coming.

- Keeping pedals pressed, tighten by-pass valves of both hydraulic boosters, and then release pedals.
- Press interlocked brake pedals 4…5 times and, keeping them pressed, unscrew valve of the left hydraulic booster, and after full pedal travel, when part of fluid with air withdraws from the system, screw the valve up. Repeat the operation several times until air completely withdraws from the system.
- Repeat bleeding air operation in the same sequence for the right brake hydraulic drive.
- **To bleed hydraulic drive of FDA brakes**, remove protective cup from air outlet valve (5) (see figure on page 104) of FDA brake and put a pipe on the valve head, having submerged free pipe end into braking fluid reservoir. Unscrew valve by ½…3/4 turns and bleed the system with pedals interlocked, as described above.
- Add fluid to both tanks (12, 13) up to mark "max" (10…20 mm from tank top), remove pipes from valves and put protective cups in place.

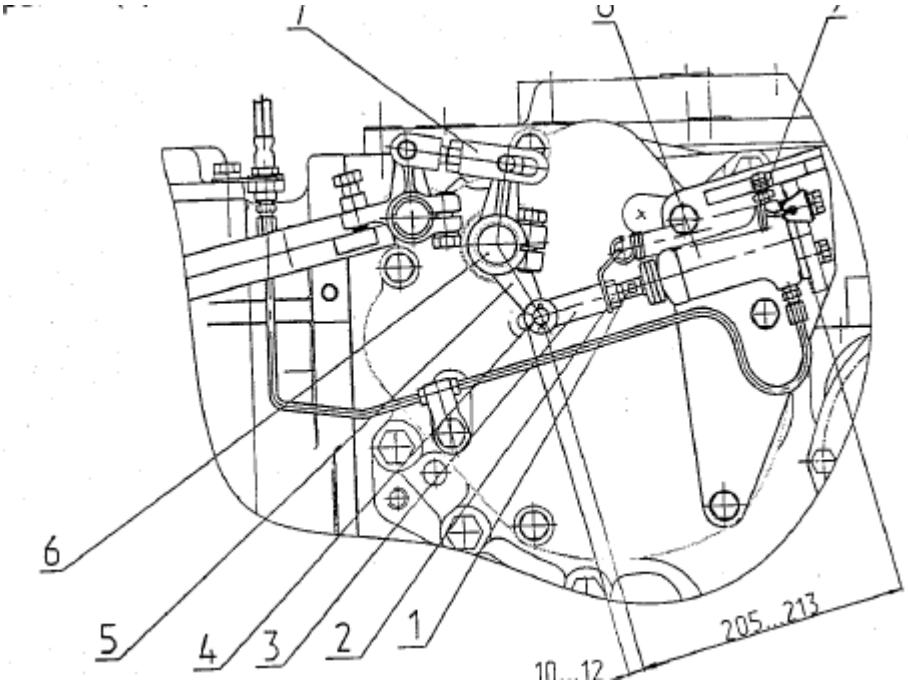
Check full travel of each unlocked pedal at force of 300N, which should be within 100-120 mm. If full travel value exceeds the above-mentioned limits, make adjustments fulfilling the following operations:

- loosen check nut (2) of hydraulic booster rod;
- screw yoke (4) up or down the rod of the left or right hydraulic booster;
- secure yokes with check nuts.

Check efficiency of brakes operation during tractor movement on dry hard surface road with clutch disengaged. After pressing interlocked brake pedals with effort 590…600 N, with tractor travel speed of 20 km/h, braking distance should not exceed 6.4. Difference of the beginning of rear wheels braking should not be more than 0.5 m, as estimated by imprint with straight movement direction. If necessary, adjust synchronism of braking start by changing length of the hydraulic booster rod, screwing yoke (4) up or down the hydraulic booster rod.
If the thread is too small to make adjustment of pedal required travel, do the following for normal brakes functioning:

- loosen coupling bolt of lever (5);
- disconnect both arms of lever (5) from yokes (4, 7);
- rearrange lever in slots of brake shaft (6);
- connect yokes to the lever, tighten the bolt and repeat adjusting operations.

3. Set wheel cylinder (8) length of the left brake to within 205…213 mm, if measured from cylinder end face to pin (4) axis, connecting lever (5) to yoke (3), with piston fully inside. Pin (4) travel when force 350…400 N is applied to lever (5), on arm of 60 mm, should be within 10…12 mm.



Make adjustment by means of yoke (3), doing the following operations:

- disconnect tie-rod (7) of the parking brake drive from lever (5);
- unscrew check nut (2) on the cylinder rod by several turns;
- rotating wheel cylinder rod (1) by flats, adjust cylinder length and travel of wheel cylinder yoke pin to required limits;
- tighten check nut (2), connect tie-rod (7) of the parking brake drive.

If adjustment of required dimensions proves to be impossible, dismount lever (5) from brake shaft (6), having before loosened tension of the bolt of lever (5) hub, and install it back , having rotated by one slot in the required direction (rotation by one slot changes dimensions by 8 mm).
Similarly, adjust dimensions of the right brake cylinder.

4. Fill drive hydraulic system in with braking fluid “Neva-M”, and bleed the hydraulic system observing the following sequence:

- Fill-in tanks of wheel cylinders (1) and (2) (see figure on page 106) with braking fluid “Neva_M” to marks “MAX” (or to level 15 +/- 5 mm from tanks top). In the process of bleeding watch the fluid level, not allowing it drop below mark “MIN”;
- Take protective cup off stop valve (9) of left brake wheel cylinder (8), put a pipe on the valve head, having submerged free pipe end in a reservoir with at least 0.5 l capacity, filled by half with braking fluid;
- Interlock pedals (8, 9) with a locking bar;
- Unscrew stop valve (9) by ½…3/4 turns, and after that press interlocked braking pedals several times. ***PRESS FAST, RELEASE SMOOTHLY!***

Keep pressing the pedal for at least 10 times, before air bulbs stop coming out of the pipe, submerged in fluid;

- keep pedals pressed, tighten stop valve of the left wheel cylinder and release pedals;
- press interlocked braking pedals 4…5 times and, keeping them pressed, unscrew stop valve of the left wheel cylinder, and after full pedal travel, when part of fluid and air will withdraw from the system, tighten the valve;
- following the same procedure, bleed hydraulic drive of the right brake;
- fill- fluid in both tanks to mark "MAX" (or 10…20 mm from tank top), put protective cups in place.

Check full travel of each unlocked pedal individually with force 300 N , which should be within 100-120 mm. If the value of pedals' full travel goes beyond the above-mentioned limits, make adjustment by carrying out the following operations:

- loosen check nut (2) of the wheel cylinder rod;
- screw yoke (3) up or down the rod of the left or right wheel cylinders;
- secure yokes with check nuts.

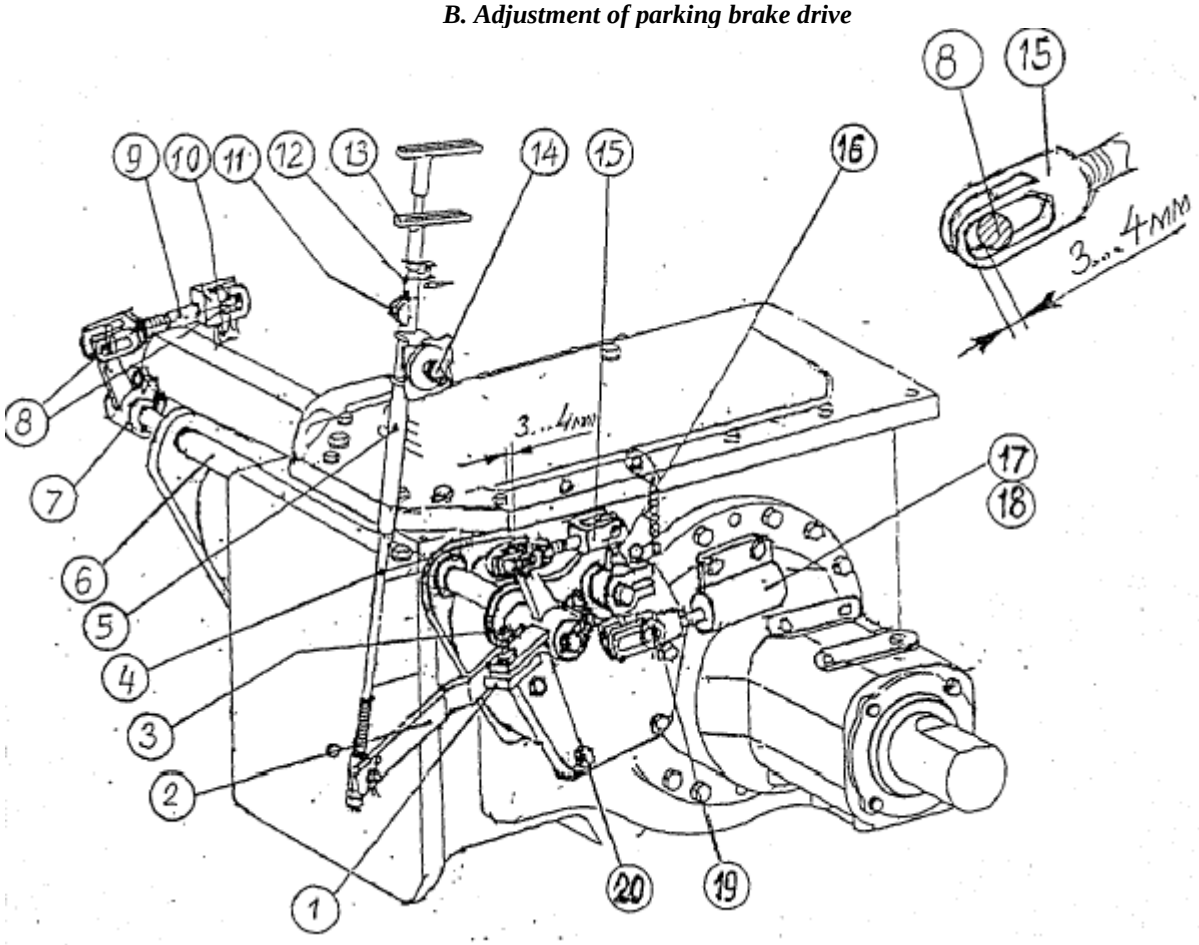
Check efficiency of brakes operation during tractor movement on dry hard surface road, with clutch disengaged. When pressing interlocked brake pedals with force 590-600 N, the braking distance at tractor movement speed of 20 km/h should not exceed 6.4 m.

Difference of the beginning of rear wheels braking should not be more than 0.5 m, if estimated by imprint with straight movement. If necessary, adjust synchronism of braking by changing length of wheel cylinder rod, screwing yoke (3) up or down the wheel cylinder rod.

If the thread on the rod is not sufficient to make adjustment of the required pedal travel, do the following operations for normal brakes functioning:

- loosen coupling bolt of lever (5);
- disconnect both arms of lever (5) from yokes (3, 7);
- rearrange lever in braking shaft slots (6);
- connect yokes to the lever, tighten the bolt and repeat adjusting operations.

B. Adjustment of parking brake drive



Make adjustment of parking brake drive with handle (13) travel of 120 mm maximum.

Before adjustment of the parking brake, make adjustment of the main brake.

Observe the following sequence to adjust control of mechanical brakes drive (parking brakes):

1. push handle (13) with tie-rod (4) to the end low position. The fixing pin (12) should be in the arm slot.
2. Adjust length of left brake tie-rod (15) within (75 +/- 2) mm , right brake tie-rod (9) – (78 +/-) mm in such a way, that pin (8) of the right brake touched oval yoke slot, and pin of the left brake had clearance of (3…4) mm, with brake handle in the end lower position.
3. All pins should easily rotate in couplings "yoke – lever head", and move along yoke slots without jams.
4. Make final adjustments of hand mechanical control of braking start synchronism (by imprint of tires' tread on dry asphalt) on assembled tractor during movement, with brakes tension by means of the lever with force of 400 N.

   If required, correct the adjustment by changing length of tie-rods (9) and (15).

NOTICE! When adjusting length of tie-rod, don't allow length of threaded tie-rod section in the yoke to be less than 12 mm. Torque tie-rod yokes' check nuts to 40…45 Nm.

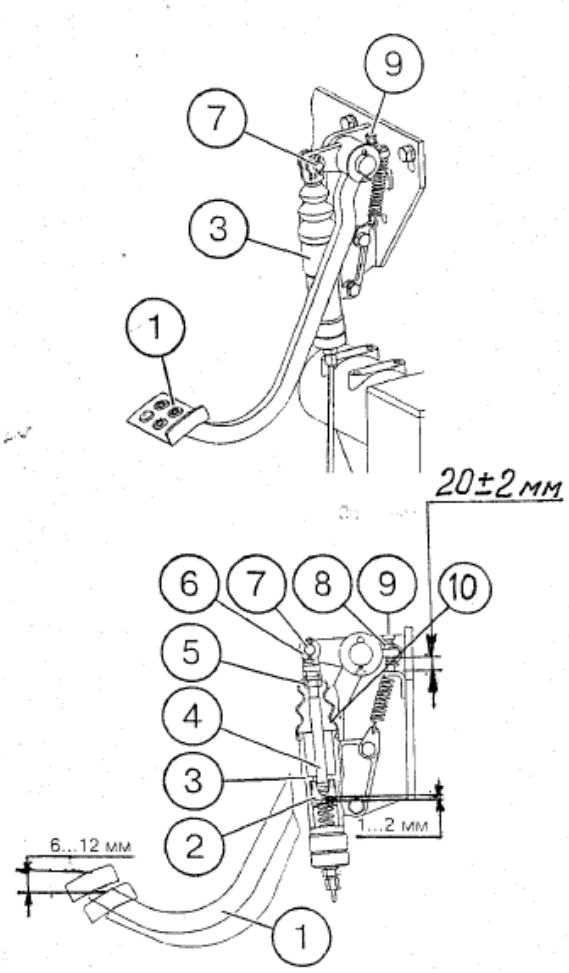
C. Adjustment of main brakes of tractor MTZ 2022V in the reverse mode

IMPORTANT! Make brakes adjustment only after checking and adjusting forward travel main and parking brakes

Observe the following sequence to adjust brakes with reversible control post:

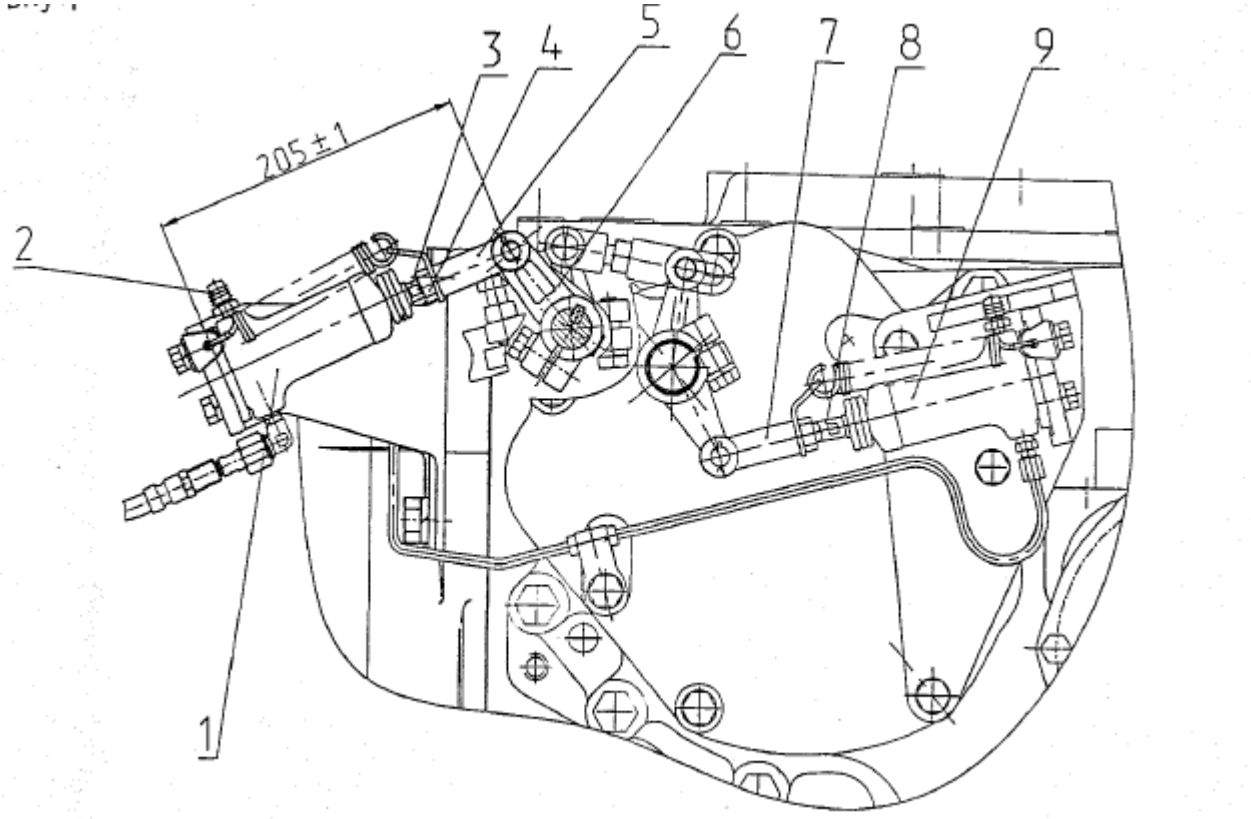
1. Check and, if necessary, adjust size 20 +/- 2 mm, by screwing down stop bolt (9) to the given depth. After adjustment of stop bolt (9), secure nut (8).
2. Adjust free travel of pedal (1) within 6…12 mm, which corresponds to clearance of 1…2 mm between pusher (4) of wheel cylinder (3) and piston (2). For adjustment do the following operations:

- Take off a cotter pin and remove pin (7).
- Take off protective sheath (10) and unscrew check nut (5) by several turns.
- Screwing yoke (6) up or down pusher (4), set free pedal travel (1) to within given above limits. Full pedal travel should be 90 – 110 mm.
- Secure nut (5), cotter-pin pin (7) , and put the sheath in place.



1 – pedal of the reversible main break; 2 – piston; 3 – wheel cylinder of the reversible post; 4 – pusher; 5 – check nut; 6 – yoke; 7 – pin; 8 – check nut; 9 – adjustment stop bolt; 10 – sheath.

3. Set preliminary length of wheel cylinder reversing gear (1) to within 204…206 mm, and adjust it in a way to provide free coupling of yoke (5) with lever (6), with wheel cylinder rod (3) fully pushed inside. Make adjustment by screwing yoke (5) up or down rod (3) of cylinder (1), having in advance unscrewed check nut (4). After completing adjustment secure the nut with a cotter-pin.



4 Fill in the drive hydraulic system with braking fluid “Neva-M” and bleed it by doing the following operations:

4.1 Remove protective sheath (10) (see figure on page 110), and fill expansion chamber of wheel cylinder (3) with braking fluid to level 10…15 mm from chamber upper rim.

4.2 Remove rubber cup off stop valve (2) of wheel cylinder (1). Put hose on the valve head, submerging its free end into 0.5 l capacity glass reservoir, half filled with braking fluid.

4.3 Unscrew valve (2) of wheel cylinder by 1/2…3/4 turn and press brake pedal several times. ***PRESS PEDAL FAST, RELEASE SMOOTHLY!***

Repeat these operations until air bulbs stop getting out of the pipe submerged into fluid.

4.4 Keeping pedal pressed, tighten stop valve (2), then release the pedal, take pipe off the valve and put the cup in place.

4.5 Check and, if necessary, add braking fluid to the expansion chamber up to the required level. Put sheath (10) in place of wheel cylinder (3).

5. Check synchronism of rear wheels braking start during movement. When braking starts asynchronous, make adjustment of length of rod (8) of wheel cylinder of the left or right brake by means of yoke (7).

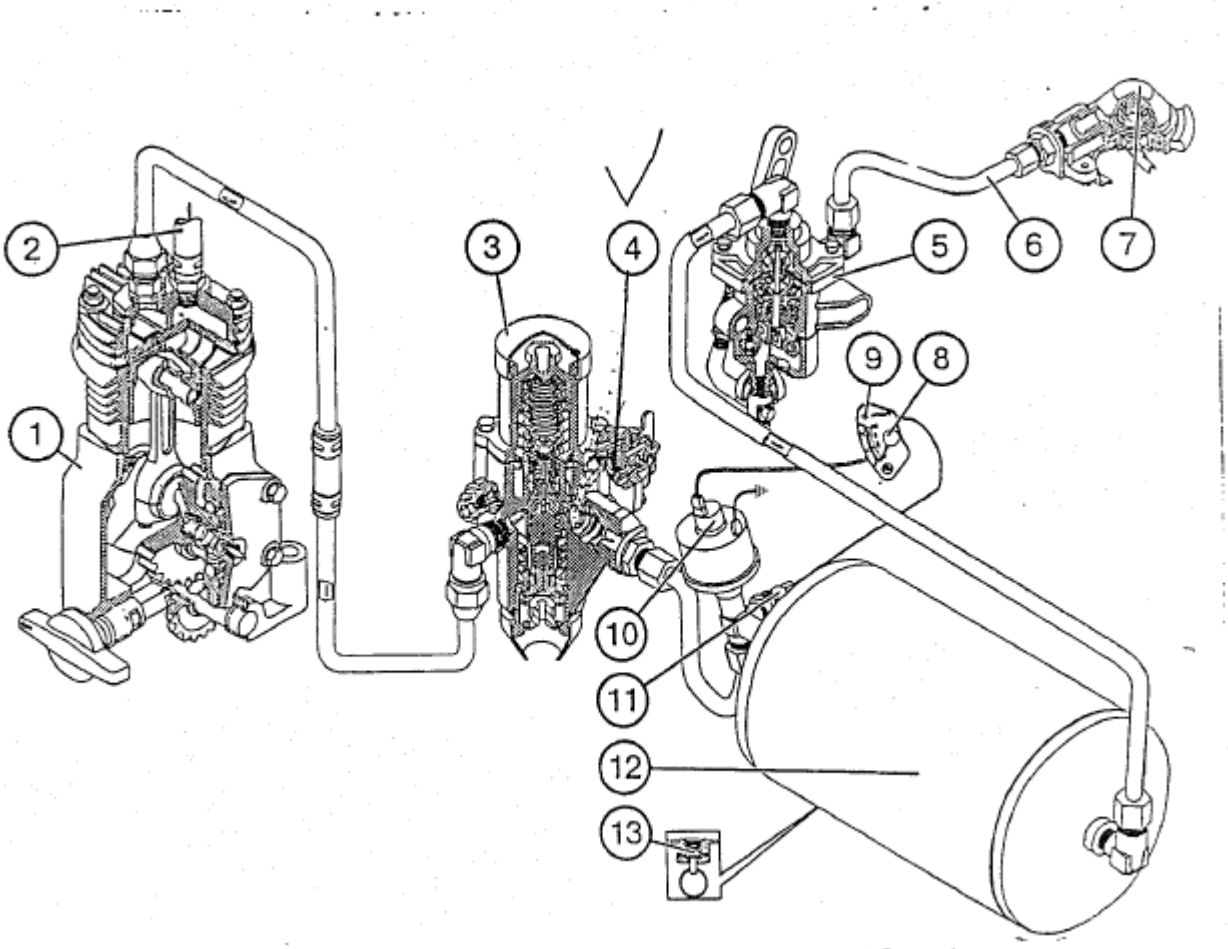
5.8.5. Possible brakes malfunctions

Table 5-8

Malfunction, appearance	Correction methods
Low braking efficiency	
Increased travel of pedals	Make adjustment, as shown in section "Adjustments"
Air entrapped in the hydraulic drive system due to braking fluid level drop below mark "Min" in wheel cylinders' tanks	Add fluid to mark "Max". Bleed the hydraulic drive system.
Loss of pressure in end head cavities of wheel cylinders due to damage of sealing rings.	Replace sealing rings. Bleed the system.
Leakage of braking fluid through pipeline couplings, hoses in broken places	Tighten coupling nuts, clamps, replace damaged parts. Add fluid to the required level. If necessary, bleed the system.
Brakes do not release	
No free pedals travel.	Make adjustments
Jamming of pistons of wheel and master cylinders and hydraulic boosters due to:	
• soiling and corrosion of working surfaces;	Replace protective sheathes. Clean cylinders , rinse, remove rust. Replace sealing rings
• swelling of sealing rings due to mineral oil entrapping.	Rinse the system. Replace sealing rings.
Not full return of pedals to initial position after braking:	
• loosening or breakage of pedals' return springs, wheel cylinders, pressure clutch plates	Replace springs.
Jamming of brakes control lever on the brakes' roller.	Take the lever off the roller, clean seat on the roller, grease and install it in place.
One of main brakes doesn't release	
Loosening or breakage of return springs of pressure clutch plates.	Replace them.
No synchronism in braking of the right and left wheels	
Wear-out of disc friction surfaces of one of brakes.	Replace discs
Main brakes are not properly adjusted.	Make adjustment.

5.9. PNEUMATIC DRIVE OF TRAILER'S BRAKES

Pneumatic drive provides control of brakes for trailers and agricultural machines, equipped with pneumatic brakes drive, as well as tires inflation. See pneumatic drive diagram below.



1 – compressor; 2 – main pipe-line from inlet diesel collector; 3 – pressure regulator; 4 – air intake valve; 5 – braking valve; 6 – control manifold; 7 – connecting head; 8 – air pressure indicator; 9 – emergency pressure signal lamp; 10 – pressure sensor; 11 – emergency pressure sensor; 12 – cylinder; 13 – condensate removal valve.

Air intake into compressor (1) is effected from inlet diesel collector via manifold (2). In compressor (1) air is compressed and via pressure regulator (3) is sent to cylinder (12), from which air under required pressure is supplied to brake valve (5). With brake pedals not pressed, air via brake valve (5) and control main pipeline (6) is supplied to coupling head (7) and further on to pneumatic drive of trailer's brakes.

Pressure regulator (3) has air bleed-off valve (4) used for tires inflation.

Air pressure in cylinder (12) is controlled by pressure indicator (8) with signal lamp (9) (red color) of air emergency pressure in combination with pressure sensors (10) and emergency pressure sensors (11).

Valve (13) is provided for condensate removal from cylinder (12).

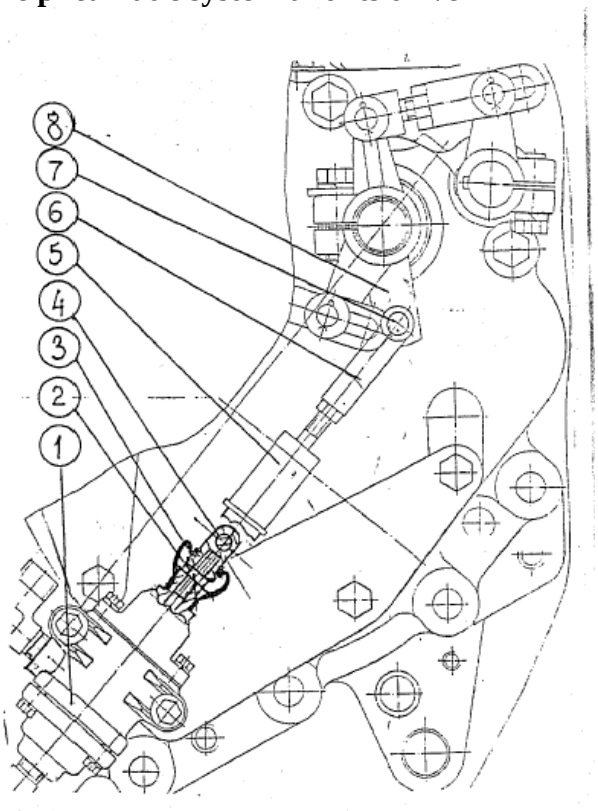
Connecting head (7) is of valve type. The valve prevents compressed air outlet when the pneumatic drive is used without a trailer (for tires inflation).
Trailers' brakes are controlled in two modes: direct and automatic. Direct control is effected by reducing pressure in the control main pipe-line (6) during tractor braking. In this case supply of compressed air to trailers' pneumatic system ceases.
Trailer's brakes are automatically engaged in case of emergency disconnection of a trailer from tractor due to pressure drop to zero level in trailer's coupling manifolds.

IMPORTANT! Before connecting or disconnecting pneumatic main pipe-lines of a tractor and trailer, engage the parking brake.

5.9.1 Check and adjustment of the brake valve of the pneumatic system and its drive

Make adjustments with free position of tractor brakes' controls.

1. Connect pressure gage with scale at least 10 kgs/cm^2 (1000 kPa) to the coupling head of tractor's pneumatic drive.
2. Switch the compressor on and fill cylinder with air to pressure of 770-800 kPa according to indicator on the instrument panel.
3. Air pressure as indicated by pressure gauge, connected to the coupling head, should be not less than 770 kPa. If it is below the mentioned value, perform the following adjustment operations:
4. Check length of tie-rod (5) with built-in compensator in assembly. The tie-rod length should provide free (with no tension) connection to lever (8) by means of pin (7). If necessary, adjust length by rotating yoke (6).
   If air pressure according to pressure gauge connected to the coupling head, doesn't reach required value, perform the following operations:
5. Disconnect tie-rod (5) from eyelet (4) and take rubber sheath (3) off brake valve (1) to get access to check nut (2).
6. Unscrew eyelet (3) by 2…3 turns and by unscrewing check nut (2) set air pressure to 770 kPa minimum.
7. Screw eyelet (4) in check nut (2) to the end and secure the eyelet with a check nut.



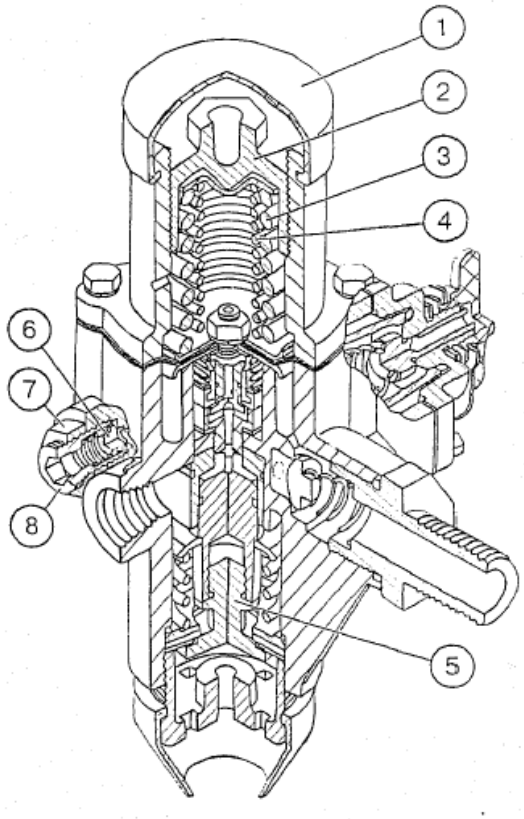
1 – brake valve; 2 – check nut; 3 – jacket; 4 – eyelet; 5 - tie-rod; 6 – yoke; 7 – pin; 8 – lever.
8 – Put on jacket (3) and connect tie-rod (5) to eyelet (4).

IMPORTANT! When brake valve and its drive are properly adjusted, pressure as indicated by the pressure gauge, connected to the coupling head, should drop to zero with full movement of interlocked brake pedals, as well as with parking brake engaged.

5.9.2 Check and adjustment of pressure regulator

With abnormal operation of pressure regulator, as well as after its disassembly for rinsing, lubrication or replacement of worn-out parts, make adjustment in the following sequence:

- Connect to the cylinder a pressure gauge with scale factor of 10…20 kPa and scale for at least 1600 kPa.
- Remove cup (1);
- Using a wrench screw cover (2) to the body end;
- Start the diesel and compressor, and pressurize the cylinder until safety valve (6) operates under pressure 850…1000 kPa. If valve (6) operates under pressure beyond given limits, make adjustments by means of screw (8), having loosened check nut (7) in advance;
- By slowly unscrewing cover (2), adjust springs' (3, 4) force, so that air pressure in the cylinder, at which relief valve (5) opens, was 770-800 kPa;
- Mark cover (2) position with paint on threaded body part, and put cup (1) in place;
- Half open cylinder condensate relief valve, and reduce air pressure in cylinder to 700…650 kPa. At such pressure values relief valve (5) should close and switch compressor over to filling the cylinder with air;
- Disconnect the pressure gauge from the cylinder.



1 – cup; 2 – cover; 3 – outside spring; 4 – inside spring; 5 – relief valve; 6 – safety valve; 7 – check nut; 8 – adjustment screw.

5.9.3. Possible malfunctions of the pneumatic system and trouble-shooting methods

Table 5-9

Malfunction, appearance	Correction methods
Slow pressure rise in the cylinder	
Air leakage from the pneumatic system:	
• nuts of pipe-lines, fittings, and fastening clamps are not properly tightened or damaged;	Find out leakage sites and eliminate them by tightening couplings or replacing damaged parts.
• rubber sealing of the coupling head is damaged;	Replace damaged sealing.
• tension of sealing ring nut of the coupling head got loose;	Tighten the nut.
• mud got trapped under the coupling head valve;	Clean the valve.
• dust-proof cover is in touch with valve spindle of the coupling head;	Correct the problem.
• valve elements are deformed: diaphragm torn, fastening of cover in the brake valve got loose;	Check the state of valve elements and replace them, if required; tighten fastening.
• valve drive adjustment disturbed;	Make adjustment.
• operation of pressure regulator is disturbed;	Remove and send for repair.
• filter is clogged.	Rinse the filter.
Slow pressure rise in the compressor	
Air leakage via compressor valves.	Take off compressor head, clean valves and seats of coke sediments.
Hang up or wear of compressor piston rings.	Remove head and cylinder of the compressor, clean rings of coke sediments and replace them, if required
Pressure in the cylinder drops fast after diesel stop	
Air leakage along pneumatic system coupling elements.	Remove leakage.

Continuation of table 5-9

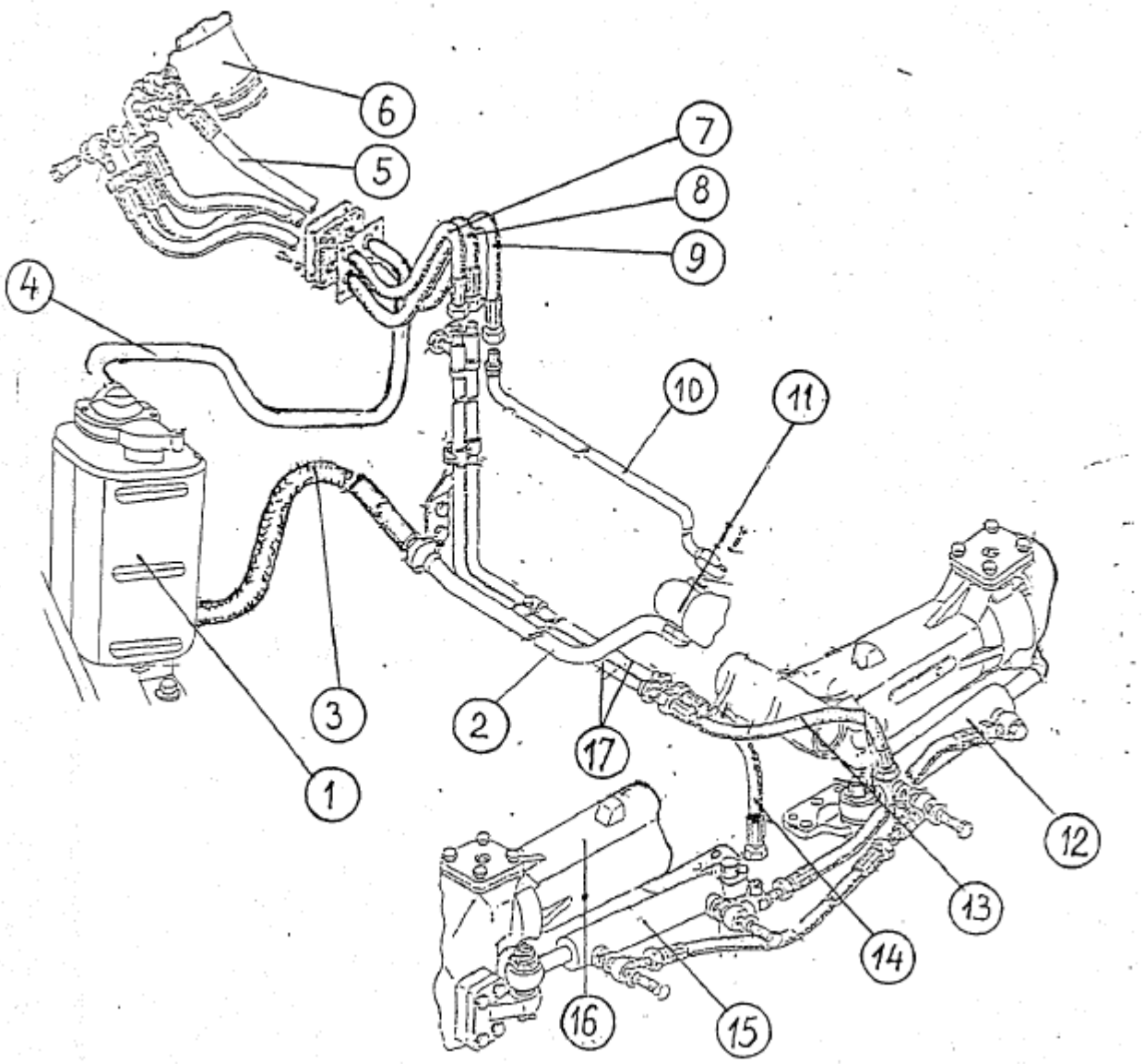
Malfunction, appearance	Correction methods
Pressure in the cylinder drops fast upon pressing brake pedals	
The inlet valve is skewed, clogged or damaged.	Remove skewness, clean or replace the valve.
Brake valve diaphragm is damaged.	Replace the diaphragm.
Insufficient pressure in the cylinder	
Air leakage.	Eliminate air leakage.
Operation of pressure regulator is disturbed.	Adjust pressure regulator.
Draw-in or forced compressor valves are faulty.	Clean valves of coke sediments, and replace valves, if considerably worn-out.
Great wear or damage of compressor piston rings.	Clean piston rings of coke sediments, or replace them.
Compressor injects too much oil in the pneumatic system	
Damage or wear of compressor piston rings.	Clean piston rings of coke sediments, or replace them.
Pressure regulator switches on compressor during the idle run with pressure less than 0.77…0.80 mPa (770…800 kPa), and during working stroke – with less than 0.65 Mpa (650 kPa), or more than 0.70 MPa (700 Kpa)	
Soiling of cavities and ducts of pressure regulator.	Rinse and clean.
Adjustment cover is unlocked.	Make adjustment of compressor pressure switching on/off.
Loss of elasticity , damage or destruction of rubber parts, shrinkage of springs.	Replace damaged parts.
Skewness of adjusting regulator section.	Check valves mobility, grease, if necessary.
Pressure regulator often starts (switches the compressor on) without air intake from the cylinder	
Air leakage from the pneumatic system or pressure regulator, damage of regulator check valve.	Establish and remove air leakage.

The end of table 5-9

Malfunction, appearance	Correction methods
Regulator functions in the mode of a safety valve	
Adjustment cover is too deeply screwed in.	Adjust the regulator (see page 117).
Seizure of balance piston of the diaphragm assembly.	Dismantle pressure regulator and correct seizure.
No clearance between balance valve and lower cover, outlet cover openings are clogged.	Unscrew the cover, clean outlet openings and check for clearance.
No air is supplied to connecting hose via air bleed-off valve	
The rod of air bleed-off valve in the pressure regulator is not sufficiently recessed.	Thread connecting hose nut on the coupling.
Pressure regulator has switched the compressor over into the idle run.	Reduce pressure in the receiver to below 0.65 MPa (650 kPa).
Displacement of the rubber ring on air bleed-off valve.	Unscrew the cover, check position and state of the rubber ring.
Inefficient operation of trailer's brakes	
Brake cock doesn't provide pressure 0.77…0.80 Mpa (770…800 kPa).	Adjust brake valve and its drive (see page 116).
Brake valve doesn't provide pressure drop to zero in the main connecting pipe-line.	Adjust the brake valve and its drive (see page 116).
Operation of trailer's braking system is disturbed.	Adjust it.
Slow release of trailer's brakes	
Adjustment of brake valve and its drive is disturbed.	Make adjustments (see page 116).
Operation of trailer's braking system is disturbed.	Make adjustments.

5.10 HYDRAULIC STEERING

Hydraulic steering (HTDS) is intended for steering of drive wheels' turn, reducing steering wheel force during tractor turn. It consists of metering pump (6), two hydraulic cylinders (12, 15), or one two-rod hydraulic cylinder (see figure on page 124), that effect tractor turn, oil supply pump (11) driven by diesel and hydraulic fittings. Oil tank (1) of 6 l capacity serves as oil reservoir. It has paper oil filter with 25 mkm fine filtration.



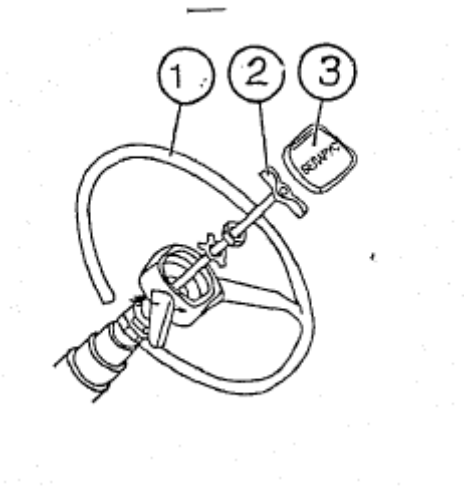
1- oil tank; 2 – draw-in oil conduit; 3 – hose, 4 – drain hose; 5 – hose; 6 – metering pump; 7, 8, 9 – high-pressure hoses, 10 – forced oil conduit; 11 – supply pump; 12 – left-side hydraulic cylinder; 13, 14 – high-pressure hose; 15 – right-side hydraulic cylinder; 16 – front drive axle; 17 – steering oil drive.

5.10.1. Design and operation of HTDS

Metering pump (6) is mounted on the steering column arm, turn hydraulic cylinders are installed on arms in front of FDA (or one two-rod turn hydraulic cylinder is built-in reduction gear body behind FDA beam). Oil supply pump (11)is installed on the diesel. The metering pump is connected to cavities of turn hydraulic cylinders by means of hoses (7, 8), oil conduits (17) and hoses (13, 14); by means of hoses (4, 5) – to oil tank (1); by way of oil conduit (10) and hoses (9) – to supply pump. During straight forward movement cylinder cavities are closed by belts of metering pump control valve, and oil from the supply pump comes to the metering pump and returns back to oil tank. When steering wheel is rotated, main valve of the metering pump shifts, providing oil supply to turn hydraulic cylinder cavities in the amount proportional to angle of steering wheel rotation.

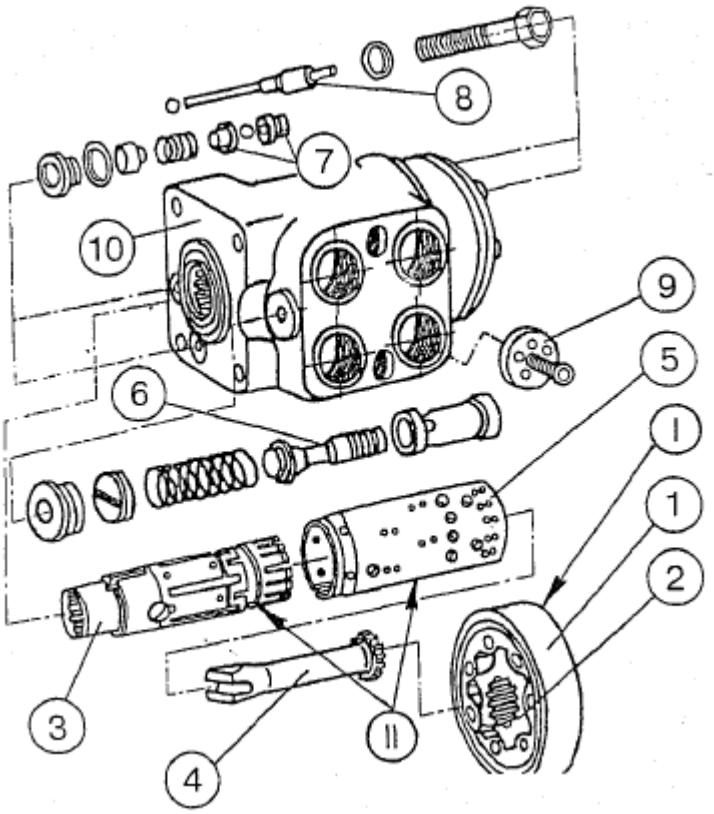
5.10.2. HTDS of the reversible tractor MTZ 2022V

Design of HTDS requires no rearrangement of HTDS system pipe-lines
when shifting from forward movement to reverse mode, and visa versa.
To steer the turn when operating in the reverse mode, the rear cabin wall bears auxiliary steering column with a metering pump, connected to four high-pressure hoses, to be connected to cavities of turn hydraulic cylinder, supply pump and forced main pipe-line of front travel metering pump. To rearrange steering wheel (1) from forward travel to reverse movement mode, remove cover (3), unscrew clamp (2), reinstall the wheel on auxiliary steering column, and adjust the position, as shown in section 4 (page 40).



5.10.3. Metering pump

The metering pump (see figure below) consists of rocking unit I, distributor II, check valve (9), two shock-resistant valves (7), safety valve (6) and two vacuum-resistant valves (8).



1 – stator, 2 – rotor; 3 – main valve; 4 – driven shaft; 5 – sleeve; 6 –safety valve; 7 – shock-resistance valves; ; 8 – vacuum-resistant valves; 9 – check-valve; 10 – body; I – rocking assembly; II- distributor.

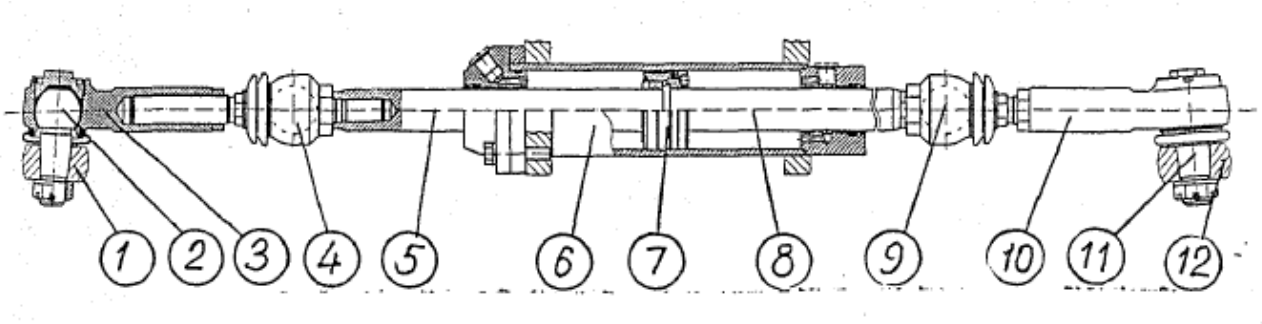
Rocking assembly I consists of stator (1) fixed to body (10), and rotating rotor (2), coupled to main valve (3) via driven shaft (4).
Distributor II consists of body (10), sleeve (5) and main valve (3), connected by slots to the end of steering column driven shaft.
Safety valve (6) limits maximum pressure in the forced main pipe-line to within 17.7…18.0 Mpa (175…180 kgs/cm^2).
Shock-resistant valves (7) limit pressure in cylinders' main pipe-lines during shock loads. Pressure in shock-resistant valves is adjusted to 22.5…24.5 Mpa (225…245 kgs/cm^2).
Vacuum-resistant valves (8) ensure required supply of working fluid to the hydraulic cylinder in the emergency mode and during operation of shock-resistant valves.

5.10.4. Hydraulic cylinder of steering control

Two piston hydraulic cylinders (12, 15) (see figure on page 121) provide tractor's drive wheels turn and are mounted in front FDA. Rods of the hydraulic cylinder are connected to FDA steering knuckles via coned pins, and hydraulic cylinders' bodies are connected to arms on the FDA body.

Spherical joints with grease cups used for periodic joints greasing are installed in eyelets of hydraulic cylinders' bodies and rods' heads.

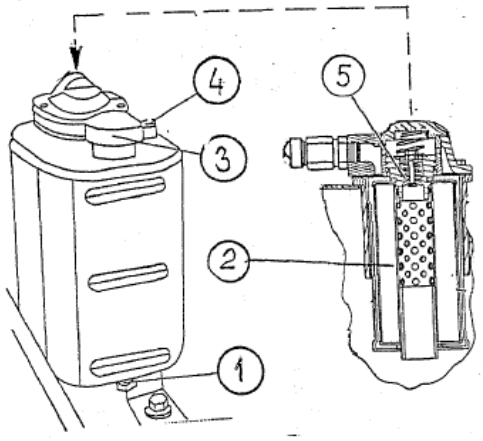
The tractor may be equipped with two-rod steering hydraulic cylinder, built-in the reduction gear body behind FDA beam (see figure below). Piston rods (5, 8) act on steering knuckles' arms (91, 12) via coaxial joints (4, 9), tie-rods (3, 10) tie-rods' and tie-rods' joints (2, 11).



1, 12 – steering knuckle arm; 2, 11 – tie-rod joint; 3, 10 – tie-rod; 4, 9 – spherical coaxial joint; two-rod hydraulic cylinder; 5, 8 – rod; 7 – piston.

Oil tank of HTDS

The oil tank of the welded structure has 6 l capacity and is fixed to gear box body. It houses drain filter (2) with replaceable paper filtering element of 25 mkm fine filtration. Oil is filled via neck with plug (3). The oil filter has safety valve (5). Oil level is controlled by means of oil measuring rod (4). Drain plug is intended for oil drain (1).



5.10.5. Possible malfunctions of hydraulic steering and correction methods

Table 5-10

Malfunction, appearance	Correction methods
Increased steering wheel force	
No or insufficient pressure in the steering wheel hydraulic system due to:	Rated steering wheel hydraulic system pressure – 140…155 kgs/cm^2 (at pedal stop).
• insufficient oil pressure in tank; supply pump doesn't develop required pressure;	Fill the tank with oil to the required level and bleed the hydraulic system to remove air.
• safety valve of the metering pump hangs up in the open position , or is adjusted to low pressure;	Rinse safety valve and adjust to pressure 140…155 kgs/cm^2 with rated diesel revolutions.
• considerable friction or jamming in mechanical steering column elements;	Find out and remove causes hampering free travel in mechanical elements of the steering column.
• air ingress in the draw-in main pipe-line system.	Check the draw-in main pipe-line, remove leakage. Bleed the system to remove air.
Steering wheel rotates without driven wheels turning	
Insufficient oil level in the oil tank.	Fill the tank with oil to the required level and bleed the hydraulic system to remove air.
Hydraulic cylinder piston sealing is worn out.	Replace sealing or the hydraulic cylinder.
Increased initial effort at the beginning of steering wheel rotation	
Increased oil viscosity (oil is cold)	Heat up oil with diesel in operation
The steering wheel doesn't return back to "neutral", "motoring" of the metering pump	
Increased friction or jamming of mechanical steering wheel elements.	Remove causes of friction and jamming.
Splined end of the steering column and metering pump are misaligned (outward thrust of cardan shaft).	Release cardan shaft. To increase clearance put additional 1.5 mm maximum thick washers between metering pump and steering wheel arm.

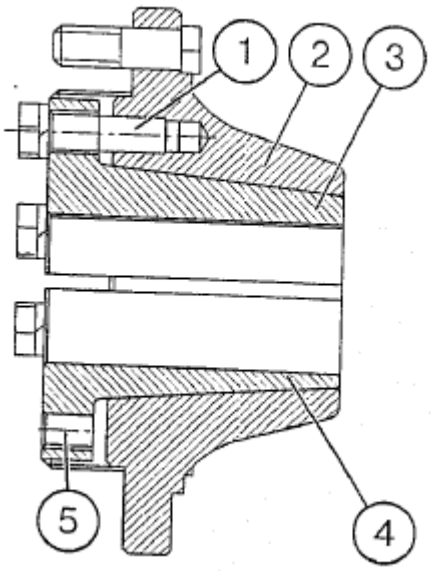
Completion of table 5-10

Malfunction, appearance	Correction methods
Increased steering wheel backlash	
Coned pins of hydraulic cylinders or tie-rods are not tightened.	Torque pins' nuts to 12…14 kgs.m and secure with cotter- pins.
Increased backlash of splined coupling "steering cardan shaft – metering pump"	Replace lower yoke of the cardan shaft.
Different minimum radii of tractor right-left turns	
Wheels convergence is not adjusted	Adjust wheels convergence
Turning angle of drive wheels is not complete	
Too low pressure in the steering hydraulic system	Adjust pressure to within 140-155 kgs/cm^2 (14…15.5 Mpa).
Gear-type supply pump is faulty.	Repair or replace the pump.

5.11. CHASSIS. TRACTOR WHEELS

Tractor's drive rear wheels are installed in hubs which consist of cut coned inserts (3,4) and body (2).

Inserts are tightened in the hub body by bolts (1) (M20).



1 – tightening bolts; 2 – hub body; 3 – upper insert; 4 – lower insert; 5 – dismantling openings.

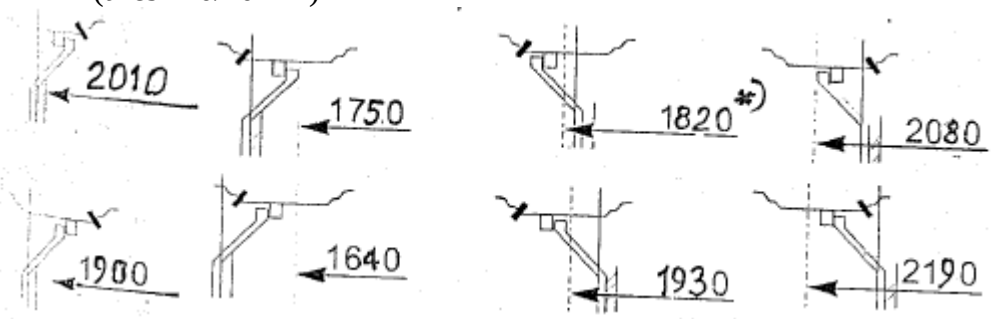
5.11.1. Changing tractor wheelspan

Tractor wheel span for front wheels may be changed within 1640-2190 mm, and for rear wheels – from 1800 to 2500 mm (tires 580/70R38).

Front wheels span is set according to disc location relative to hub and rim.

Diagram of span setting and sizes are given below

(tires 420/70R24)



*) as dispatched from the works

Rear wheels span is set by moving the hub with a wheel along the half-axle, and rearranging wheels from one side to another.

To change the wheel span, do the following:

1. Place tractor on even terrain.
2. Clean half-axle.

2- Jack up corresponding half-axle hose.

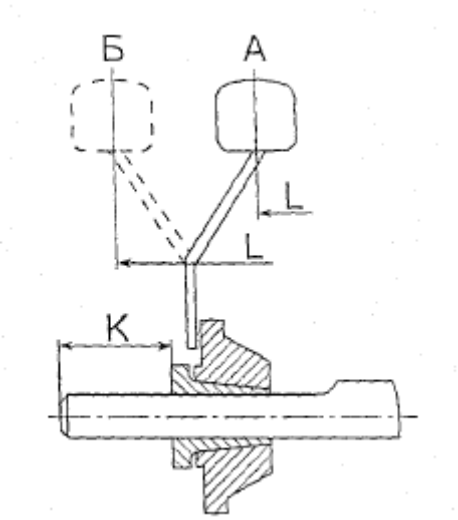
3 -Unscrew coupling bolts (1) (see figure on page 127) from each insert (3, 4), and using four of them for releasing inserts by having screwed them in dismantling threaded openings (5). The remaining two bolts should be released by three full turns each.

For dismantling, screw bolts in smoothly until an insert is released*.

4 Move the hub to the required span (use table 5-11 for wheel span setting by changing size "K" between half-axle end face and insert end face).

5 Screw in coupling bolts, using them for inserts tightening.

6 Torque bolts to 350…450 Nm (35…45 kgs.m) in several attempts until all bolts are properly torqued.



CAUTION! After tightening bolts, check that inserts' end faces extended relative each other by not more than 1…2 mm.

7 Adjust another wheel span.

8 Check and tighten coupling bolts after 3-10 hours of operation.

If double rear wheels need to be installed, use special distance pieces (see section 7 "ganging up").

If during changing rear wheels span, wheels were removed to install them back torque coupling nuts to 200…250 N.m (20…25 kgs.m).

Tire standard size	Wheel position	Span size "L", mm	Mounting dimension** of the hug K to half-axle end face, mm
580/70R38	A	1800…2110	155…0
	B	2230…2500	245…110
20,8R38	A	1800…2070	135…0
	B	2230…2500	245…110

* If inserts are impossible to extend using dismantling bolts, pour kerosine in inserts seats, wait for some time, and then screw in dismantling bolts tapping the hub body until inserts fully extend.

** Changing wheel span by value K corresponds to changing hub position by value K/2 on each side

5.12. HYDRAULIC MOUNTING SYSTEM (HMS)

The system is designed for connecting to the tractor mounted and semi-mounted machines, control over their operation, as well as operation of all hydraulically driven tools of all machinery being ganged up to the tractor

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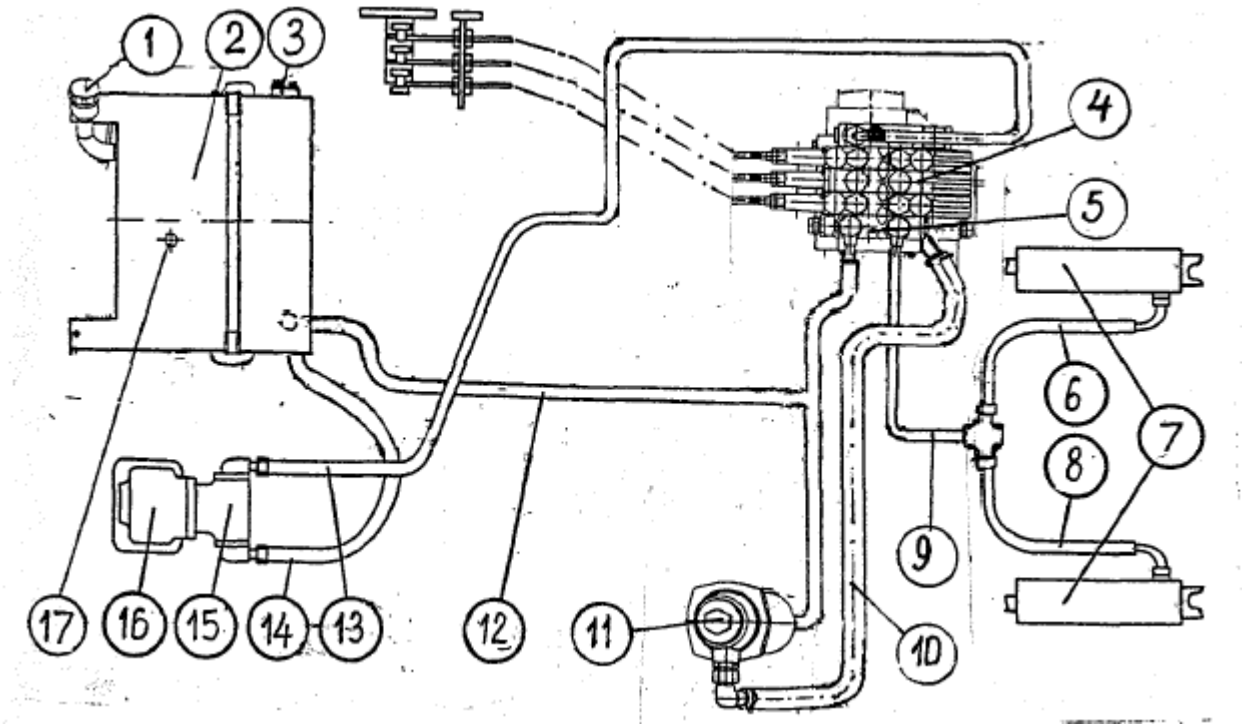
5.12.1. Hydraulic system

The hydraulic system operates the mounting mechanism, as well as hydraulically driven tools of agricultural machinery ganged up to the tractor. It allows to use height, power, positional or mixed regime of adjusting depth of travel of agricultural machinery tools.
The mounted device is operated by way of electromagnetic control, which provides power, positional and mixed adjustment method when operating mounted and semi-mounted tools. The hydraulic system (see diagram below) includes welded oil tank (2), installed on the upper surface of the clutch body, gear-type oil pump (15) and drive (16), mounted on the left side of the clutch body, main valve-valve regulator BOSCH (5), hydraulic distributor BOSCH (4), external hydraulic cylinders control and RMD two hydraulic cylinders (7) (TS 90- x 250), drain oil filter (11)fastened to rear axle upper cover. Hydraulic devices are interconnected by means of low-pressure main pipe-lines (10, 12), oil ducts and high-pressure hoses (6, 8, 9, 13).

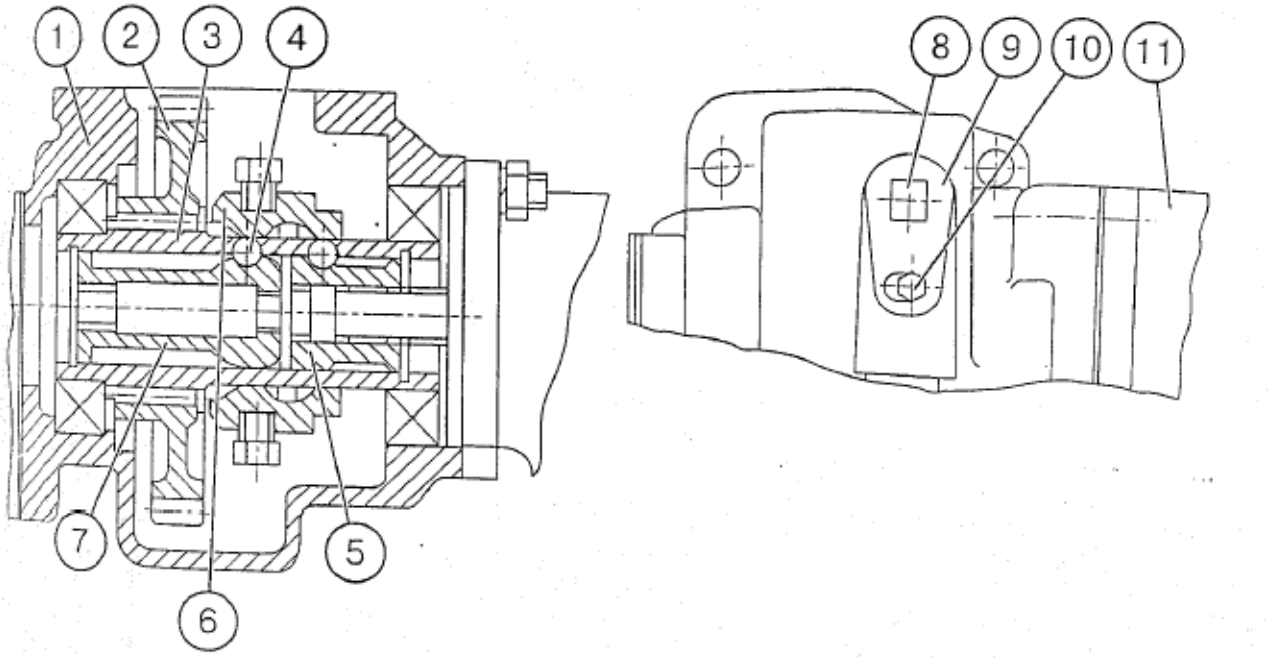


1 – oil filling neck plug; 2 – oil tank; 3 – oil level indicator; 9 – high-pressure oil conduct; 4 – distributor BOSCH for external hydraulic cylinders control; 6, 8 – high-pressure hoses; 7 – RMD hydraulic cylinders; 5* - main-valve – valve regulator BOSCH; 11 – drain oil filter; 10 – low-pressure oil duct; 12 – drain oil duct; 13 – forced oil duct; 14 – draw-in oil duct; 15 – oil HMS pump; 16 – oil pump drive, 17 – oil tank breather.
*) part of integral block BOSCH

Oil tank (2) – is of welded design with 35 l capacity.l is filled through filling neck plug (1). The oil tank is provided with breather (18) and oil level indicator (3). The bottom of the tank has oil drain plug.

Hydraulic system oil pump is of six-gear right-side rotation design. The pump drive is independent from clutch and is installed on the left side of the clutch body.

The drive consists of body (1), pinion (2) installed on shaft slots, rotating on two ball bearings. Balls (4), placed in shaft openings, engage or disengage the shaft with splined bushings (5, 7) by way of race (6) driven by yoke via four-faceted roller (8)



1 - drive body; 2 – drive pinion; 3 shaft; 4 – balls; 5 – pump shaft bushing; 6 – race; 7 – bushing; 8 switching roller; 9 stop plate; 10 – bolt; 11 – pump.

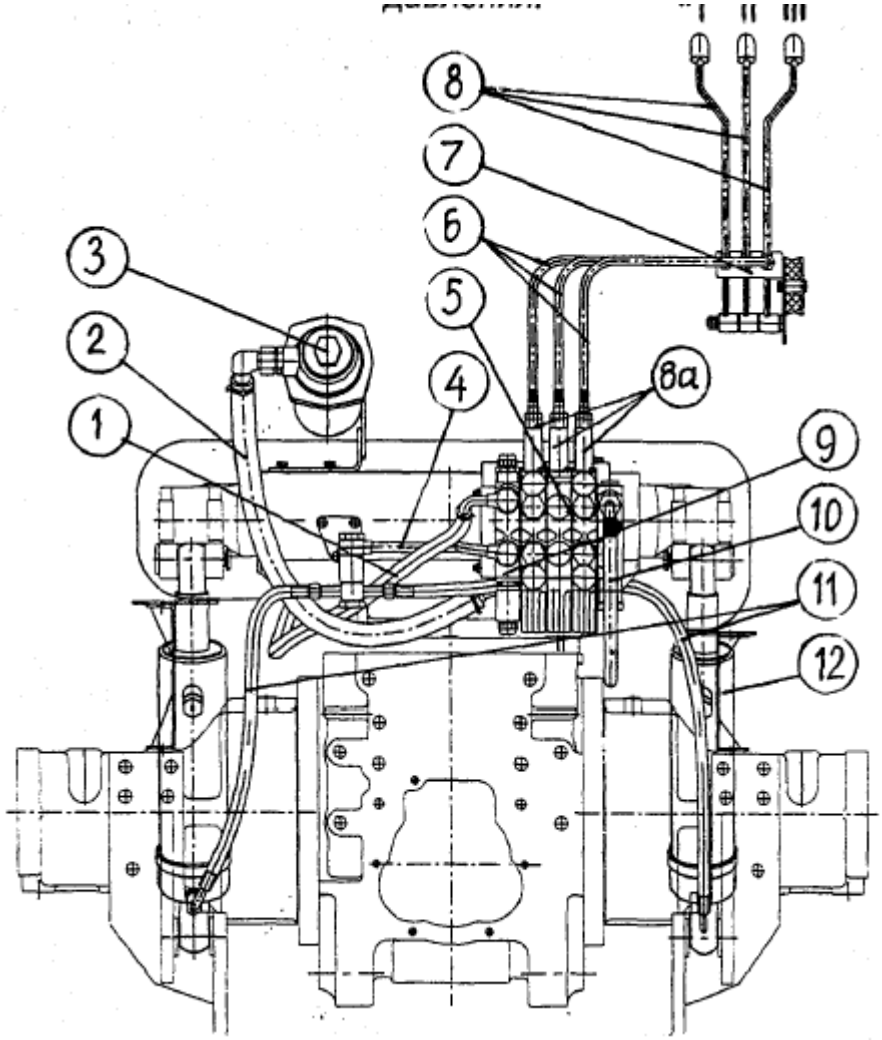
Pinion (2) is permanently engaged with PTO drive pinion. In disengaged position (see switching diagram) race (6) is shifted to the end right position, balls under centrifugal forces disengage bushing (5) , and shaft (3) with pinion (2) freely rotate in bearings. In the engaged position (race is shifted to the end left position) balls are brought to bushing (5) hollows by means of race cone (6), and rotation from pinion (2) via shaft (3) and splined bushing (5) is transferred to the pump shaft. The drive can bear the second pump (NSH 10/16) driven from splined bushing (7).

The drive provides 1980 rev/min of pump shaft at rated diesel revolutions, and clutch (3, 4, 5, 6, 7) allows to switch the mump on and off with diesel in operation at minimum idle run revolutions.
To switch the pump on/off:

Integral block BOSCH consists of main valve distributor, control of external hydraulic cylinders and regulator (9) with electromagnetic control of mounting device.

a) release bolt (10) by 1.5…2.0 turns;
b) using a wrench, turn via tetrahedron the switching roller (8) counter (clock-wise) as far as it goes.
c) tighten bolt (10)

Hydraulic distributor (5) is a three-section, four position, flow-type device made by BOSCH. Control valves of sections 2 and 3 are fixed in positions “neutral” and “floating”. Control valve of section 1 can also be fixed in position “lift”. It is provided with automatic reset from position "“lift" to position ”neutral” when rated pressure is reached.



11- high-pressure hoses; 9 regulator EHR –23 LS; 5 – hydraulic distributor; 8a – control valves (adapters; 6 – control steel ropes; 7 – arm; 8 – control levers; 12 – hydraulic cylinder TS 90 x 250 (2 pieces); “I” – lever of control valve 3; “II” lever of control valve 2; “III”- lever of control valve 1; 1 – drain hose; 2 – low-pressure oil conduit; 3 – drain filter; 4 – high-pressure oil conduit; 10 – forced oil conduit.

Outlet openings of distributor's sections are used for rear hydraulic system outputs. If front mounting mechanism is installed, hydraulic cylinders are filled from the central distributor's section by means of high-pressure hoses (HPH).

Control valves (4) of distributor (see figure on page 131) are controlled by two-way steel ropes, that provide control of main valves (4) of the distributor by means of levers (7) mounted on the panel to the right of operator's seat. Steel ropes' braiding is fixed by nuts in arms (6) and (8).

By shifting any lever (7) from "neutral" (N) forward as the tractor moves, control valve is set to position "lowering" and "floating", backwards shifting sets to position "lifting".

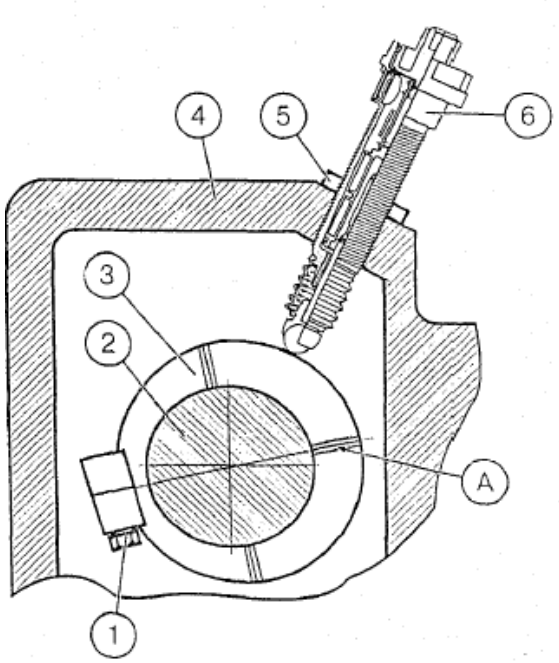
The system of mounting mechanism control and adjustment consists of electromagnetically controlled regulator, position sensor (movement induction sensor), power sensor (two force-measuring pins), control panel, electronic unit, wiring.

Position sensor (6) (see figure to the right) is screwed in rear axle cover seat (4) and controlled by eccentric (3) fixed on rotary shaft (2). To install the sensor do the following:

- lift RMD to utmost high position, so that mark "A" on ascending section of eccentric (3) was opposite moveable sensor rod (6);
- if necessary, release screw (1) and rotate eccentric (3) on shaft (2) until mark "A" coincides with moveable sensor rod; tighten screw (1);

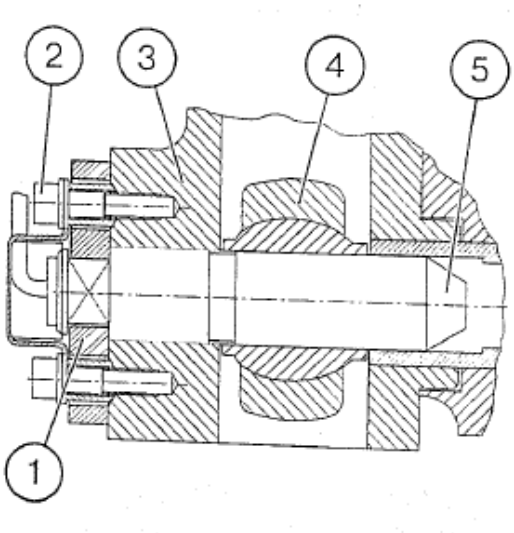
* manually screw the sensor in the eccentric to the end, then turn it back by 0.5…1.0 turn and secure with check nut (5). If sensor is properly installed, control lamp of RMD lifting goes down in the end position.

IMPORTANT! Do not over tighten nut (5) so as not to damage sensor (6) made of aluminum alloy.



1 – screw; 2 – rotary shaft; 3 – eccentric; 4 cover; 5 – check nut' 6 – position sensor.
"A" – mark on the ascending part of the eccentric.

Power sensor is made in the form of two power-gauging pins (5), being inserted in arm (3) and serving as an axle for fastening lower tie-rods (4). Position of the pin in the arm is determined by clamp (1), coming inside the slot of force-gauging pin and fixed on arm (3) with two bolts (2).

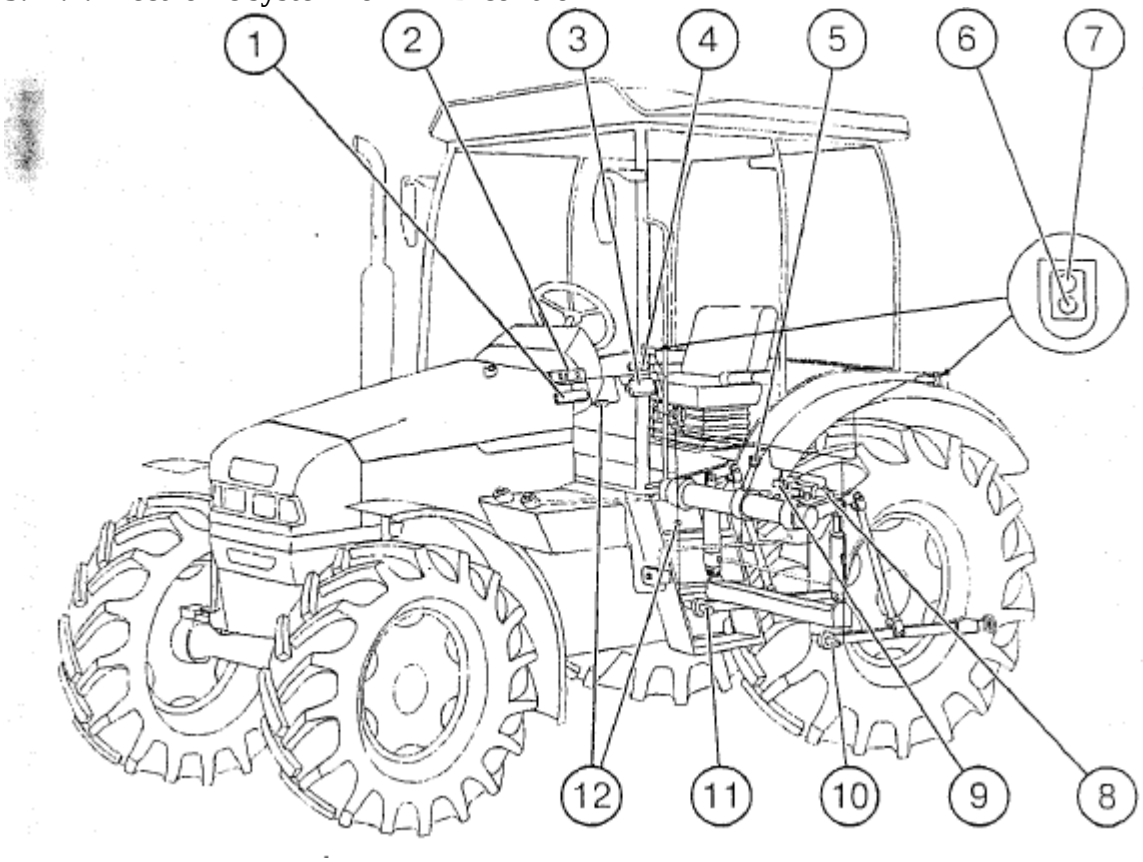


1 – clamp; 2 – clamp fixing bolt (2pcs.); 3 – arm; 4 – lower tie-rod; 5 – power-gauging pin (power sensor).

Control of rear mounting device using regulator BOSCH is carried out from the main control panel (see page 135) installed to the right of operator's seat, as well as by means of two remote pushbuttons (when ganged up machines and tools are mounted), situated on rear wheels' wings (see figure on page 134).

The following elements are brought out on the main panel (page 135):handle (1) for adjustment of lowering speed; handle (2) for selection of the control method; handle (3) for limitation of mounted mechanism lifting height; lever (4) for adjusting depth of soil tillage; handle (7) for lifting-lowering of rear mounted machines, as well as lamps: lifting/lowering signal lamps (5, 6) and diagnostics (8).

5.12.2. Electronic system for RMD control



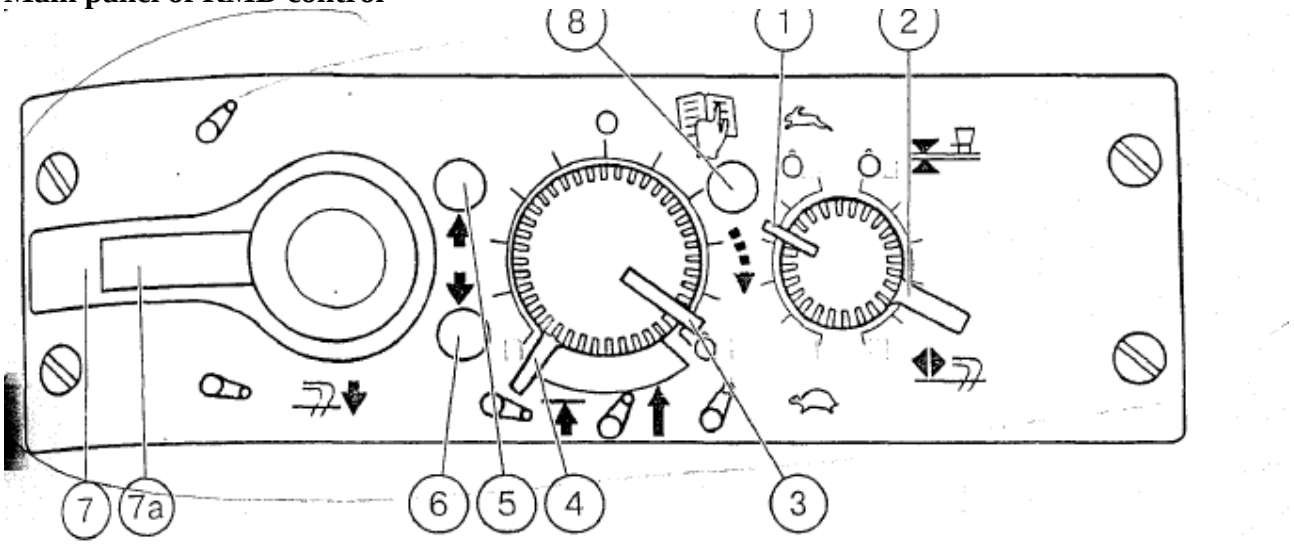
1 – a box of instrument panel relays; 2 – a box of instrument panel fuses; 3 – electronic unit; 4 – main RMD control panel; 5 – sensor of RMD position; 6 – remote control button for RMD lowering; 7 – remote button for RMD lifting control; 8 – electric lifting valve; 9 – electric lowering valve; 10 – left-side force sensor; 11 – right-side force sensor; 12 electric sockets.

Electronic section of regulator control includes the following elements:

- main RMD control panel (pos.4)
- remote RMD control buttons (pos. 6, 7);
- electronic unit (pos. 3);
- force sensors (pos. 10, 11);
- sensor of RMD position (pos.5);
- electromagnetic valves for lifting (pos.8) and lowering (pos.9);
- connecting cables with electric sockets (pos. 12).

Electronic part of the system operates as follows. After diesel start, voltage is supplied from box of relays (1) to electronic system unit(3) via box of fuses (2). The electronic unit polls sensors, system control elements and after analysis commands electromagnetic regulators. The system is controlled either from main panel (4) situated in the tractor cabin, or by remote control buttons (6, 7) installed on rear wheels' wings.

Main panel of RMD control



1 – handle for lowering speed control (up – faster, down – slower); 2 – handle for selection of adjustment method (upper position – positional, lower – power, in-between – mixed adjustment); 3 - handle for control of mounted machine lifting height limitation (clockwise – minimum limitation, anti clockwise – maximum limitation); 4 – lever for adjustment of soil tillage depth (clockwise – lesser depth, anti clockwise – greater depth; 5 – control lamp of mounted machine lifting (red light); 6 – control lamp of mounted machine lowering (green light); 7 lever mounted machine control (up – lifting, down – lowering, when pressing lever further down – putting the plough deeper, middle position – switch off); 7a – locking switch (transportation) – locks lever (7) in the upper position by shifting the switch to the right); 8 – control diagnostics lamp (see malfunctions diagnostics).

Rear mounting device is controlled as follows:

- use handle (2) to set control method, depending on the nature of activities;
- using handles (4) and (3) set ploughing depth and machine lifting height in the transport position.
- Move handle (7) to lower fixed position ,to lower mounted machine. In this case lamp (6) lights.

In the process of work make adjustment for optimal operation of the mounted machine:

- using handle (2), set combination of adjustment methods;

When the plough shallows up when tilling hard soil or pot holes, put it deeper by pressing lever (7) further down.

- handle (1) – correction speed;
- lever (4) – depth of soil tillage.

Adjustments sensitivity is provided by the automatic adaptation system, which suppresses unjustified high frequency of adjustments in the power mode. Meanwhile, averaged adjustment frequency equals about 2 Hz.

If the system intensively heats up, reduce correction frequency by moving handle (2) to the positional method side, and handle (1) towards “turtle”.

After handle (7) is released, it resets to fixed position "lowering" to the depth, set by handle (4).
To shallow the plough up, move handle (7) to upper position. During lifting lamp (5) lights.

CAUTION! To avoid RMD pump failure, do not operate the tractor if lamp (5) doesn't go out after tool lifting.

One has to know the following features of starting the system of rear mounting device control:

1. After diesel start diagnostics lamp (8) lights, which signals about operation ability and steering system locking;
2. To unlock the system, put lever (7) of lifting/lowering in the operation position several times. Diagnostics lamp (8) goes down.
3. After the system is unlock, due to safety considerations, during the first instance of switching on the speed of rear mounting device lifting is limited. Repeated setting of lever (7) in the operation position relieves lifting speed limitation.
4. Lifting/lowering of rear mounting device by means of remote buttons, located on rear wheels' wings, can be effected with any control mode (levers can be in arbitrary position). Control system in the cabin is locked in this case.

WARNING! When using remote buttons, do not stand between the tractor and machine being ganged up. To avoid accidents, in no way use buttons of mechanical transfer of electrical valves (8, 9) (page 134) for lowering/lifting of the mounted machine. They are intended for adjustment of the control system by skilled specialists.

Put the control system in operation in the order, given in items 2, 3.

CAUTION! To avoid still further tool (plough, etc) deepening during emergency tractor stop, shift control lever (7) to position "neutral". After tractor starts movement shift the lever to position "lowering" (the plough will be put to earlier set depth).

Besides functions described above, the electronic system of rear mounting device control has "damping" mode (damping of mounted machine swing in the transport mode).
Set damping mode in the following order:

- shift handle (7) to position "lifting" (RMD lifts to upper top position and automatically switches off);
- switch on "damping" mode (18) (page 82, 97) (RMD goes from the end upper position down by 3% of full RMD travel.

"Damping" switch may be situated on the main RMD control panel (pushbutton with mark, or DL, or FDA control panel (pushbutton with plate) (see page 82, 97).

ATTENTION!

1. "Damping" mode is active only when handle (7) is in position "Lifting".
2. During field works (ploughing, cultivation, etc.), "Damping" mode switch should be in position "Switched off"

Malfunction diagnosis

Electric hydraulic control system BOSCH has self-testing capability and upon finding the fault gives coded information for the operator by means of control diagnostics lamp (page 135, pos. 8) on the control panel. After engine start, if the system has no malfunctions, the control lamp is constantly alight. After shifting RMD control lever (page 135, pos.7) up or down, the control lamp goes down. When shifting the control lever down, green RMD lowering control lamp lights (page 135, pos. 6), upwards shifting leads to red control lamp lighting (mounting device lifting) (page 135, pos.5).When the system has malfunctions (after diesel start), the control diagnostics lamp gives coded information on malfunctions and, if required, the system operation is locked

Malfunction code is a two digit number, the first digit equals the number of control lamp blinking after long pause, the second digit corresponds to the number of blinking after a short pause.

For example, long pause – three times lamp blinking, short pause – six times lamp blinking. It means that the system has malfunction under code (36). When the system has several malfunctions, their codes are displayed one after another, separated by a long pause.

All malfunctions are divided into three groups: major, average and minor.

When ***major*** defects are detected, adjustment stops and the system switches off. It can't be operated neither by the main panel, nor by remote pushbuttons. The control lamp gives out malfunction code. After the malfunction is corrected and diesel start, the system operation is restored.

Average malfunctions result in system locking and stop of adjustment. The system is not controlled by the main panel, but is controlled by remote pushbuttons. The control lamp displays malfunction code. After the malfunction is corrected and diesel starts, the system operation is restored.

With minor defects the control diagnostics lamp displays malfunction code. The system is under control and not locked. After the defect is removed, the diagnostics lamp goes down.

When the system detects a malfunction, perform the following operations:

1. Shut down the diesel.
2. Arrange controls on the main control panel (page 135):
- shift mounting device control lever (7) in position " switched off";
- shift lift limitation lever (3) in position "0".
- Shift lever (4) (adjustment of soil depth tillage) in position "0";
- Shift lowering speed adjustment lever (1) in the middle position;
- Shift lever (2) for adjustment of "power-positional" mode in the middle position.

3. Start the diesel and, if there are no defects, begin the work. If malfunctions were not removed, make diagnostics of the system and correct problems

Possible malfunctions and methods of their detection are listed in table 5-12.

CAUTION!

1. Disconnect electric sockets of the mounting device control system only with diesel shut down.
2. Make measurement of the given voltage values with diesel in operation, observing safety regulations adopted for work with energized electric devices.
3. Numbering of contacts in bundle sockets is shown on sockets' bodies.

MAJOR DEFECTS

Table 5 –12

Defect Code	Description, possible cause	Method of defect check
11	Malfunction in the electromagnetic lifting valve control circuit. Break in the electric magnet winding or cable assembly of electric magnet control (8) (page 135)	Disconnect cable assembly from the electromagnet and test it for break. Electromagnet resistance should be 2…4 Ohm maximum. If the electromagnet is healthy, check cable assembly for mechanical damage and using tester check wire between terminal of electromagnet socket (page 143) and terminal (37) of 55- pole socket of the electronic unit for break (page 143, 144)
12	Malfunction in the electromagnet lowering valve control circuit. Break in the electric magnet winding or cable assembly of electric magnet control (9) (page 135)	Disconnect cable assembly from the electromagnet and test it for break. Electromagnet resistance should be 2…4 Ohm maximum. If the electromagnet is healthy, check cable assembly for mechanical damage and using tester check wire between terminal of electromagnet socket (page 143) and terminal (19) of 55-pole socket of the electronic unit for break (page 143, 144).
13	Malfunction in the electromagnet lowering or lifting control circuit. Short-circuit in one of electromagnets, or shorting of wires of electromagnets control in cable assembly 9page 135, pos.8, 9)	Disconnect cable assembles from the electromagnet, test electromagnets for short-circuit. Electromagnet resistance should be 1.6 Ohm maximum. You may also check electromagnet consumption current by supplying 6V voltage. Current should not exceed 3.2 A. Having disconnected the socket from the electronic unit, test terminals (19) and (35) for short circuit (page 143, 144). Electromagnets should be disconnected.

Continuation of table 5-12

Defect code	Description, possible cause	Method of defect check
14	Failure in the circuit of lowering and lifting electromagnetic valves control. Wire break in the cable assembly of electromagnets control.	Check the general system cable assembly for mechanical damage. Disconnect the socket from the electronic unit, disconnect terminal from electromagnets, and test wire between terminal (35) (page 144) of the electronic unit terminal and terminal (2) of electromagnets sockets. Test supply voltage on terminal (29) of the electronic unit socket (start diesel for this purpose). If there is no voltage, check how secure is connection of wires to a fuse, and a fuse itself. The fuse is in box of fuses (2) (page 134). Voltage is supplied to the fuse from relays box (1) after diesel start.
15	Defect of remote control pushbuttons. Wires short-circuit or locking of one of remote control buttons. Meanwhile, the mounting device starts lifting up or lowering down upon diesel start	Check cable assemblies to remote control buttons for mechanical damage. Sequentially switch off each button until defect disappears. When switching buttons off, shut down the diesel. If defect does not disappear after buttons are switched off, disconnect the socket from the electronic unit and test terminals (36) and (37) and (9) for continuity and short-circuit.
16	Electronic unit malfunction. Stabilized supply voltage to the control panel is lower than rated value. Short circuit of RMD power and position sensors sockets is possible due to moisture entrapped.	Disconnect general cable assembly from the main control panel. Measure stabilized supply voltage on contacts (6) (minus) and (4) (plus) of the main panel socket (page 144), which should be 9.5 V (diesel must be started). With lower supply voltage, or absence thereof, check if electronic unit socket is properly connected. Test contact (6) of main panel socket connection to tractor’s minus. Disconnect sensors of power and position one by one.

Continuation of table 5-12

Defect code	Description, possible cause	Method of defect check
17	Failure of the tractor electric supply system. RMD control supply voltage exceeds rated value (over 18 V). Possible generator fault.	Check supply voltage of the lifting device electronic control system from the box of relays (1) (page 134) via box of fuses (2) after diesel start. With supply voltage of 12V or over, check generator operation ability.
22	Failure of position sensor. Break of sensor wire, or the sensor is not connected.	Check: • if electric socket is properly connected to position sensor (5) (page 134); • cable assembly, connected to the sensor, for mechanical damage; • if RMD eccentric properly set, i.e., with max RMD lowering, the sensor should be in min pressed state, and visa versa; • adjustment of position sensor (if malfunctioning is manifested in the lowest RMD position, screw in the sensor, if it is in the top most position, the sensor should be unscrewed).

Average size defects

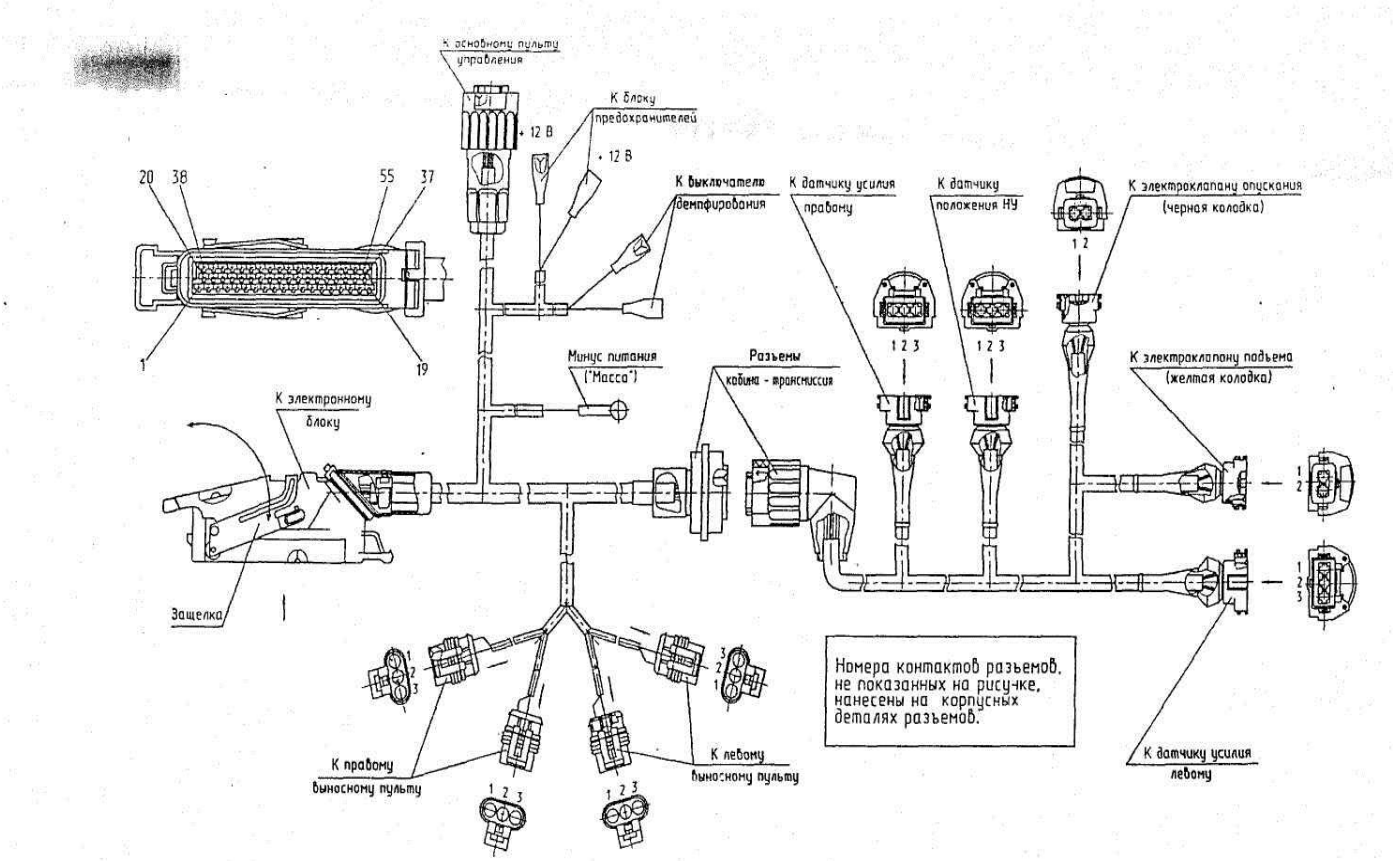
23	Malfunction of the main control panel. Potentiometer of depth ploughing is faulty (page 135, pos.4)	Check if control panel and electronic unit are properly connected, also check cable assembly for mechanical damage. Check output voltage according to electrical diagram.
24	Malfunction of the main control panel. Potentiometer of the RMD upper end position is faulty.	Check if control panel and electronic unit are properly connected, as well as cable assembly for mechanical damage. Check output voltage according to an electric diagram. (page 144)
28	Malfunction of the main control panel. RMD control lever is faulty (page 135, item 7)	Check if control panel and electronic unit are properly connected, as well as cable assembly for mechanical damage. Check output voltage according to electric diagram (page 144).

Continuation of table 5-12

Defect code	Description, possible cause	Method of defect check
31	Malfunction of the right-side power sensor. Cable break or sensor short-circuit (page 134, item 11)	Check cable connection to the sensor and check the cable for mechanical damage. Power sensor overload is also possible.
32	Malfunction of the left-side power sensor. Cable break or sensor short-circuit (page 134, item 10)	Check cable connection to the sensor and check the cable for mechanical damage. Power sensor overload is also possible.

Minor defects

33	Malfunction of tractor electric supply system. RMD control supply voltage is below rated value (less than 12 V). Burning of fuse in the box of relays (page 134, item 1), or poor fuse contact in the box of fuses (2)	Check supply voltage of the mounting device electronic control system from box of relays (page 134, item 1) via box of fuses (2) after diesel start. Supply voltage should not be less than 12V. If supply voltage is less than 12V, check the generator. Check if connection in the box of relays (1) and box of fuses (2) is reliable, as well as connection of wires.
34	Malfunction of the main control panel. RMD speed control potentiometer is faulty. (page 135, item 1).	Check if control panel and electronic unit sockets are properly connected, as well as cable assembly for mechanical damage. Test output voltage according to wiring diagram (page 144).
36	Malfunction of the main control panel. Potentiometer for mixing ploughing modes: power-positional, is faulty. (page 135, item 2)	Check if control panel and electronic unit sockets are properly connected, as well as cable assembly for mechanical damage. Test output voltage according to wiring diagram (page 144).
37	Electric-hydraulic regulator is faulty. It's possible that high-pressure mump is not switched on.	Check pressure of one of distributor sections foe control of external hydraulic cylinders, which should not be less than 180…200 kgs/cm^2. With diesel shut down, check movement of regulator control valve by acting on them by way of rubber cups of electromagnets. The control valve must move smoothly.

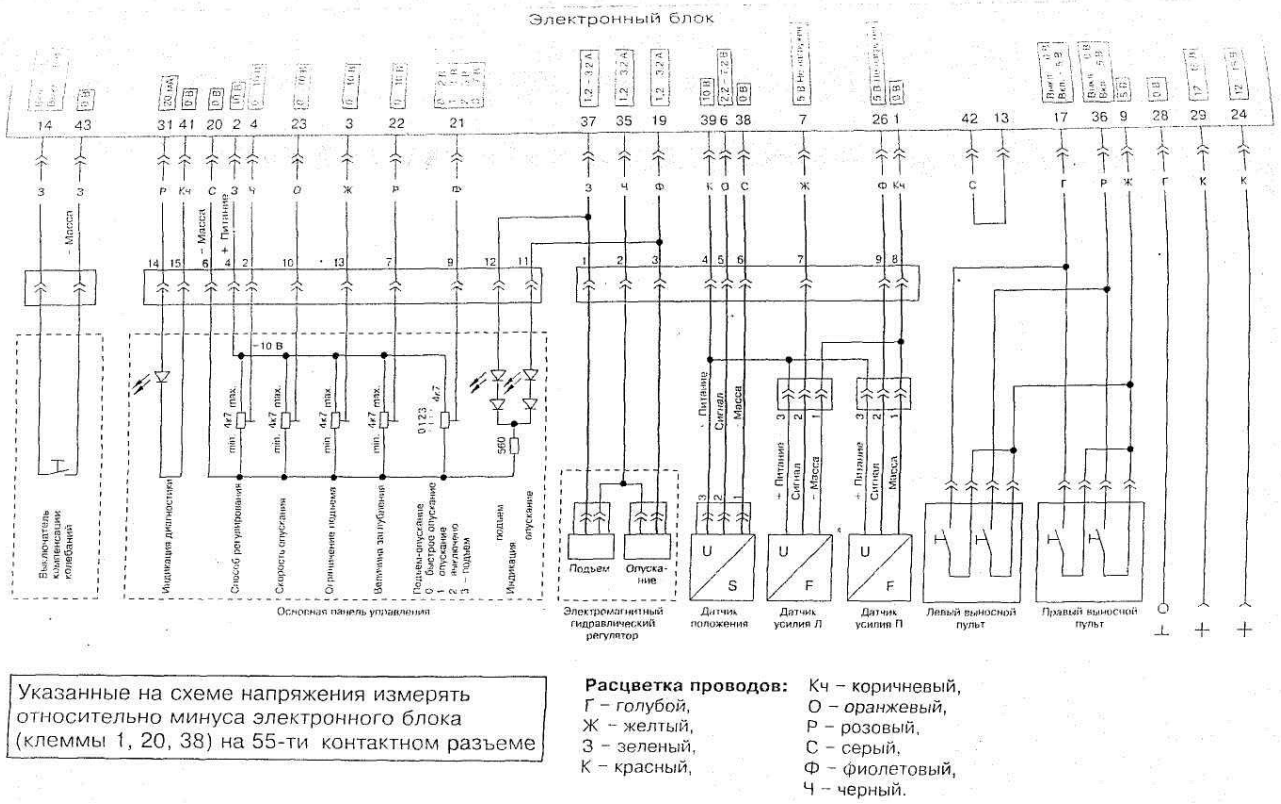


-к основному пульту управления – to the main control panel
- к блоку предохранителей – to the box of fuses
- к выключателю демпфирования – to the damping switch
- к датчику усилия правому – to the right-side effort sensor
- к датчику положения НУ – to the MD position sensor
- к электроклапану опускания (черная колодка) –to electric lowering valve)black shoe)
- к электронному блоку – to the electronic unit
- защелка – stop catch
- минус питания (масса)- supply minus (ground)
- разъемы (кабина – трансмиссия) – connectors (cabin – transmission)
- к электроклапану подъема (желтая колодка) – to electric lifting valve (yellow shoe)
- к правому выносному пульту – to the right-side remote panel
- к левому выносному пульту –to the left side remote panel
- к датчику усилия левому – to the left-side effort sensor
-

- Numbering of connectors' contacts not shown in the figure, are imprinted on base members of connectors.

Connecting cables of RMD control system

Electronic unit



- выключатель компенсации колебаний –switch of swing damping
- масса – ground
- индикация диагностики – diagnostics indication
- способ регулирования – adjustment method
- скорость опускания – speed of lowering
- ограничение подъема – lifting limitation
- величина заглубления – penetration value
- подъем–опускание, быстрое опускание, опускание, выключено, подъем – lifting-lowering, lowering, switched off, lifting
- индикация , подъем, опускание – indication, lifting, lowering
- питание, сигнал, масса - power, signal, ground
- электромагнитный гидравлический регулятор – electro-magnetic hydraulic controller
- датчик положения – position sensor
- датчик усилия – effort sensor
- левый выносной пульт- left-side remote panel
- правый выносной пульт – right-side remote panel

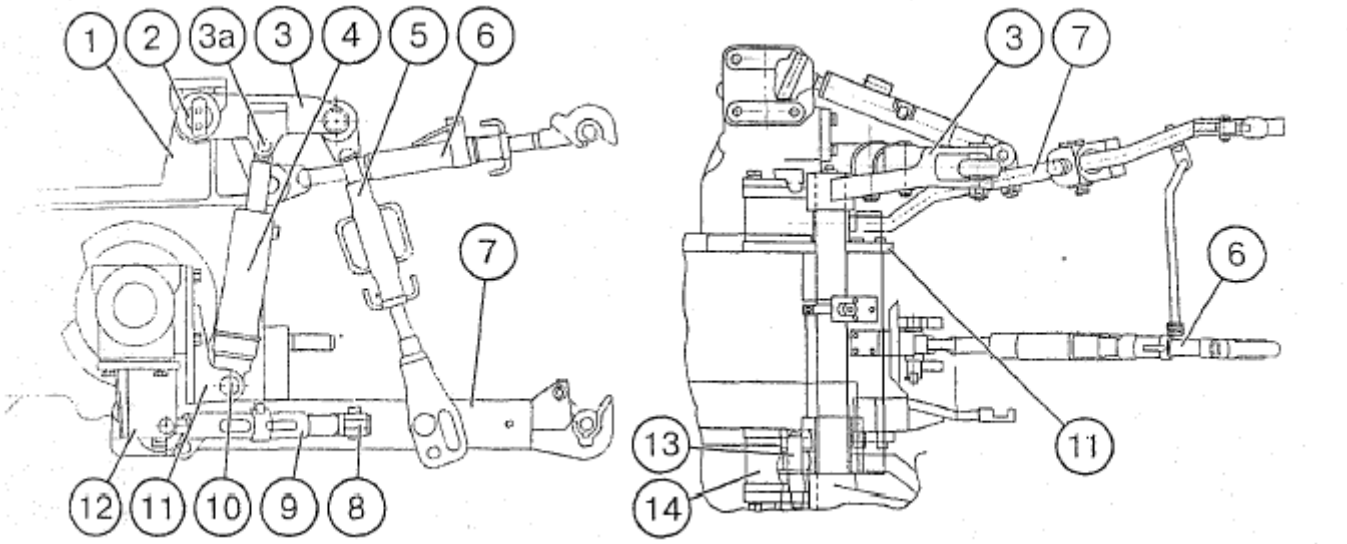
Make voltage measurements, shown in the diagram, relative to electronic unit “negative” (terminals 1, 20, 38) on the 55-contact connector assembly

Wiring colors:
Г – blue
Ж – yellow
З – green
К – red
Кч – brown
О – orange
Р – rosy
С – grey
Ф – violet
Ч – black

Wiring connection diagram of RMD control system.

5.12.3. Rear mounting device (RMD)

Rear mounting device is intended for coupling mounted and semi-mounted agricultural machinery to the tractor. Mounted machinery is ganged up to the tractor via three points: joints of lower tie-rod, upper tie-rod or my means of automatic pick-up hitch.
Rear axle hoses bear arms (11) on which two hydraulic cylinders are installed by means of pins (10). Cylinders' rods are connected to outside left-side and right-side levers (3) by means of pins (3a). Outside levers through splined openings are installed on shaft (2) on the rear axle cover (1) Levers (3) are connected to lower tie-rods (7) by means of braces (5)



1 – rear axle cover; 2 – rotation shaft; 3 – outside levers (left-side and right-side); 3a – pins of hydraulic cylinders' rods; 4 – hydraulic cylinders; 5 – braces; 6 – upper tie-rod; 7 – lower tie-rods; 8 – eyelets; 9 – ties; 10 – pins; 11 – arms; 12 – arms of ties; 13 – pins (force sensors); 14 – arms.

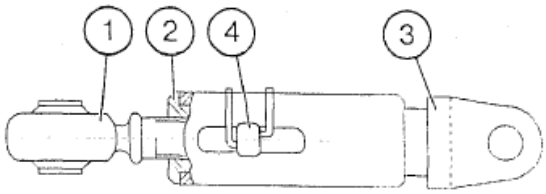
Lower tie-rods with their front joints are put in arms (14) (left-side and right-side) on special pins (13) which are force adjustment sensors. Lower tie-rods have eyelets (8) to which braces (9) are fastened with their yoke section by means of pins. Braids provide adjustment of transversal movements

5.12.3.1. Brace

The brace consists of screw (1), guide (2), crosshead (3), cotter pin (4).
Lateral side of guide (2) has a through groove and a through opening perpendicular to it.
The crosshead has two through openings in one plane.
Use the following procedure to adjust braces' length upon mounting agricultural machinery on rear ends of lower tie-rods.

- lift the machine to the upper position until rods of hydraulic cylinders fully extend.
- align opening on guide (2) with an opening on crosshead (3). In case of misalignment, rotate guide (2) clockwise or anti clockwise until openings are aligned.
- Insert cotter pin (4) in the opening and fix it with a spring clamp.

When the tractor operates with a plough, use brace groove to provide its horizontal travel. To this end, remove cotter pin (4) rotate guide (2) by 90 ^{0} and put the cotter pin in the crosshead opening (3).
The other braces' end with the joint is put in braces' arms (12)(page 145). Braces' arms are fixed on the lower part of hoses.
Upper tie-rod is fixed in the arm of towing-coupling device (see page 147).



1- screw; 2 – guide; 3 – crosshead; 4 – cotter pin.

5.12.4 General-purpose traction-coupling device (TCD)

TCD if the lifting type includes the yoke and (optional), towing beam and device of "Python" type.

Yoke (TCD-3V)

The yoke is intended for operating one and two-axle trailers.

It consists of traction yoke (1) with pivot and housing (2). The housing of the traction yoke is connected to arm (4) by means of pin (3). The height of housing with traction yoke can be changed by its movement along guides in arm (4) and is fixed by pin (3).

Trailing device (TCD –1M-01) traction beam

It is intended for coupling heavy trailing and semi-trailing machines. It consists of support arm (5), tie-rod (6) connected to the arm with pin (7).

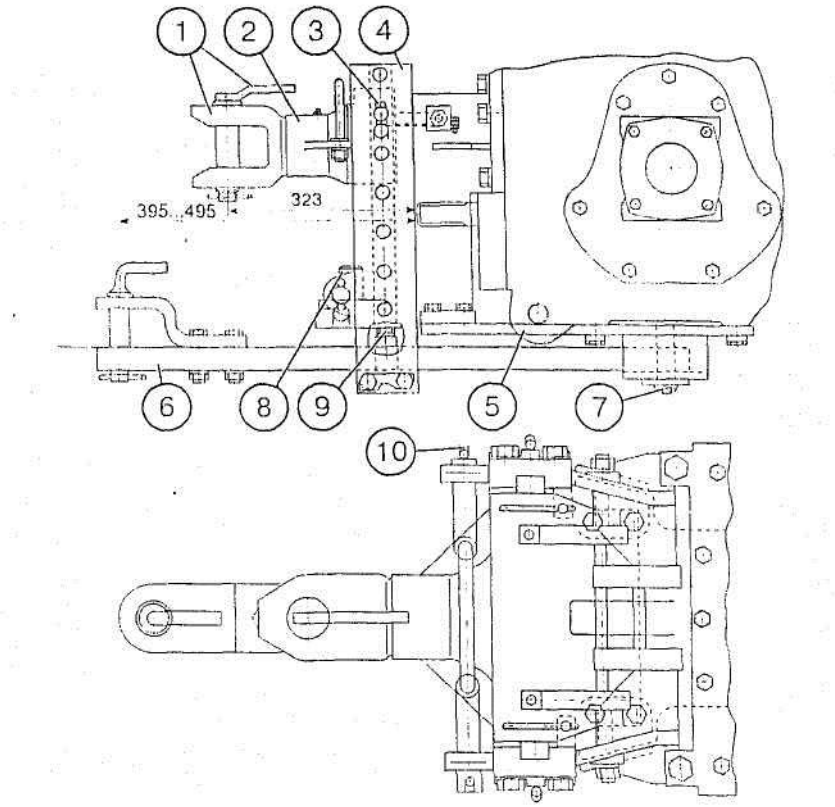
Tie-rod (6) can be adjusted to size 395 and 495 mm from PTO end face to the place of trailer yoke connection by rearranging pin (7) in tie-rod (6) openings.

Device of "Python" type (TCD-2P)

It is designed for operating the tractor with semi-mounted machines and one-axle trailers.

IMPORTANT! First remove tie-rod (6) of the mounting device.

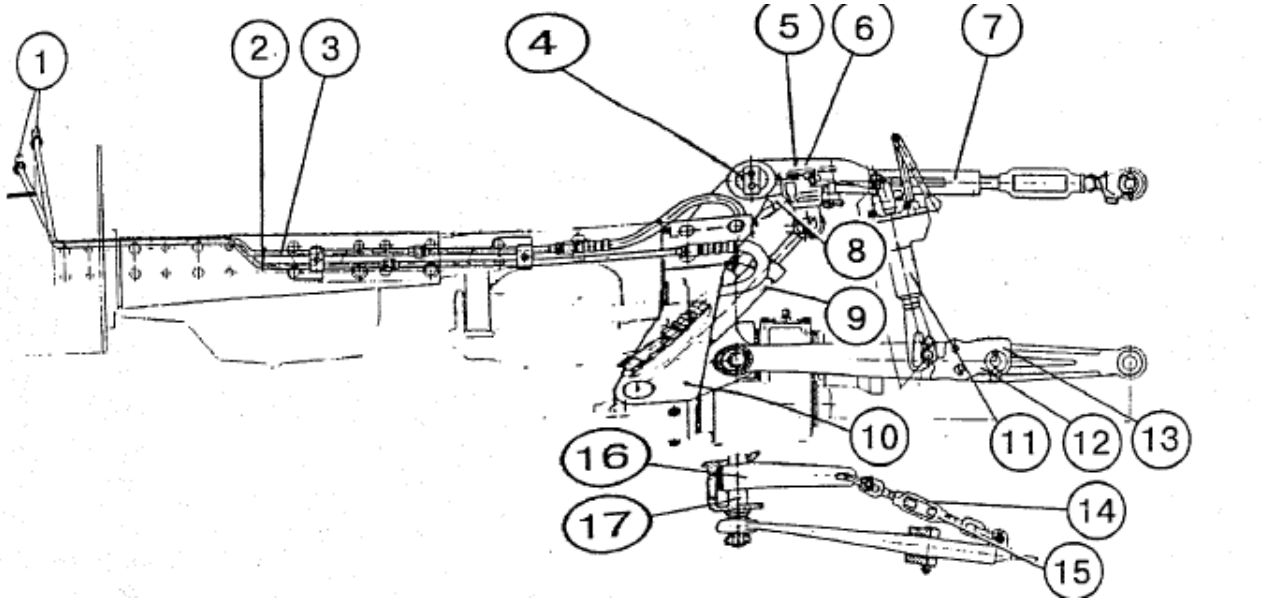
Device (item 8) is installed in arm guides (4) and fixed by bolts (9). To couple a trailer, remove pin (10), put trailer's towing shackle on pivot (8) and put pin (10) in place. The latter prevents trailer's towing shackle disconnection.



1 – traction yoke with pivot; 2 – housing; 3 – pin; 4 – arm; 5 – support arm; 6 – tie-rod; 7 pin; 8 – pivot; 9 – bolts; 10 – pin.

5.12.5 Front mounting device (FMD) (if installed)

FMD is designed for tractor operation as part of ganged up machines and intended for attaching mounted agricultural machines, operating in front of the tractor, and adjustment of their operational position.



- side outlets; 2 – oil conduit; 3 – oil conduit; 4 – rotation shaft; 5, 6 – levers; 8 – lever; 9 – hydraulic cylinder; 10 – arm; 11 – brace; 11, 12 – lower tie-rod; 14, 15 – braces; 16 – arm, axle of lower tie-rods.

FMD –equipped tractor can have independent power take-off shaft, installed on the front arm surface.

Procedure of coupling agricultural machinery to the FMD is similar to that of rear mounting device, except that it uses automatic coupling SA-1.

FMD has the mechanism for limiting down travel of lower tie-rods' front joints during operation with machines.

FMD is installed on the front beam plane and fastened to beam side surface and spars by means of plates. Oil conduits (2, 3) connect side outlets (1) to hydraulic cylinders (9) of the mounting device.

Double-action hydraulic cylinders on one side are fastened to arm (10), and by means of rods – to steering levers (5, 6) installed on steering shaft (4) splines. Steering levers with their braces (11) are connected to lower tie-rods (12, 13) of the mounted machine, put on axle (17), going through arm (10). The same axle also bears arms (16) connected to lower tie-rods by means of braids (14, 15)

The rotation shaft has lever (8) of lowering limitation mechanism. In operational position it rests against the pin, installed in arm (10).

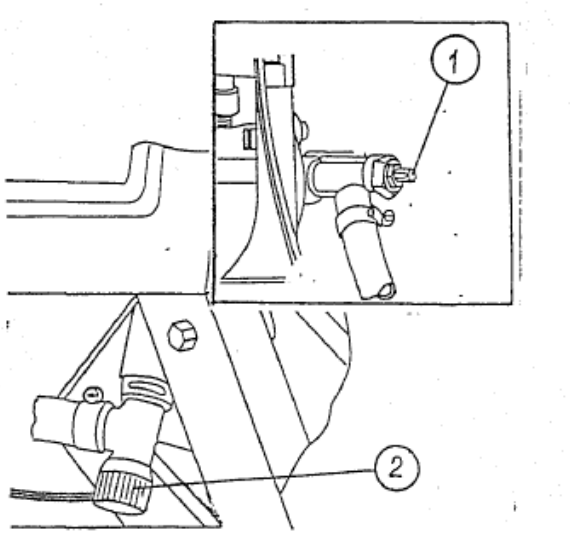
Upper tie-rod (7) with one end is connected to lever (8), and with another one – to an agricultural machine.

5.13. The system of cabin ventilation an heating

The ventilation and heating system includes a fan with a motor and a radiator that is installed in the cabin cover, as well as two air purification filters.

Observe the following recommendations for efficient operation of the ventilation and heating system:

1. After filling the cooling system with cooling fluid (water) start the diesel, and without opening the cock (1) on the right-side of the diesel cylinder block, let it operate at middle speed until cooling fluid in the cooling system heats up to 50-60 ^{0}C. After that, open the cock, increase diesel speed for 1-2 minutes until fluid fills the heater radiator. Having opened the right-side drain plug (2), make sure fluid circulates through the heater. The heater radiator must heat up. The level of cooling fluid in the diesel cooling system radiator will drop.
2. Fill in the diesel cooling system radiator with cooling fluid to the required level (up to mark “MAX” on the expansion tank).
3. To heat the cabin fast switch on the heater fan and open circulation shutters.



1 – cock; 2 – drain plug.

4. To drain cooling fluid from the heater and diesel cooling system, place the tractor on horizontal terrain, Remove expansion tank plug, unscrew left- and right-side drain plugs (2), open drain radiator and diesel cylinder block plugs.

CAUTION! During cold season blow through the heating system with compressed air to avoid formation of ice plugs, if soft water is used in the cooling system. To this end, close water drain cocks on the radiator and diesel cylinder block, and put expansion tank plug.

5. During warm season, cock (1) should be closed so that the system could operate in the ventilation mode.

5.14. ELECTRICAL EQUIPMENT

The tractor is equipped with direct current electrical equipment with 12V tractor-system rated voltage. The starting system voltage of 24 V is provided by two storage batteries connected in series, 12 V each.

The wiring diagram and list of complete parts are given in supplement on page 228-230.

The electrical equipment includes electric power sources, diesel start instruments, control and measurement instruments, lighting devices, light and sound alarm, switching devices and auxiliary equipment. Electrical equipment devices are connected according to one-wire principle, with metal tractor parts ("ground") to which negative terminals of electrical equipment devices are connected, serving the function of the second wire.

Source of tractor electric power are two storage batteries of 12V voltage and 120 A/h capacity each, and alternating current generator with built-in rectifier unit and integral voltage regulator.

Rated generator voltage is 14V, and rated power is 2000 W.

Diesel starting system consists of an electric starter with 24 V voltage and power of 4.0 kW, starter switch and devices, starter control unit, starter switching on relay, plugs with control unit.

Illumination, light and sound alarm devices include: two road head -lights with upper and lower beams, four front and four rear working head –lights, turn and side indicators, rear turn indicators, side lights and braking signal lamps, license plate illumination lamp, road train sign lamp, flashing beacon, cabin illumination ceiling lamp, switch of emergency light alarm, sound alarm and a set of horns, under-steering wheel switches, switches and relays for switching corresponding devices.

Control over tractor systems functioning is effected by means of:

- a set of devices, including an indicator of air pressure in the pneumatic system with a signal lamp of emergency pressure, an indicator of oil pressure in the gear box; an indicator of oil pressure in the diesel lubrication system with a signal lamp of emergency pressure, an indicator of cooling fluid temperature in the diesel cooling system with a signal lamp of emergency temperature, an indicator of fuel level in tanks with a control lamp of the reserve level, voltage indicator for the electrical equipment system;
- a box of control lamps;
- electrical tachometer-speedometer with a control panel;
- sound alarm (buzzer) of emergency modes – emergency oil pressure in the system of diesel lubrication, emergency temperature of cooling fluid in the diesel cooling system.

Purpose and functions of devices, making up the instruments combination, as well as an electrical tachometer-speedometer with a panel, and a box of control lamps, are described in section 4 " Controls and instrumentation".

Below are listed sensors of instrumentation and indicators of emergency modes, or operational ability of assemblies and systems of the tractor:

- sensor of cooling fluid temperature of the diesel cooling system;
- sensor of emergency temperature signal lamp for diesel cooling system;
- sensor of oil pressure in the diesel lubrication system;
- sensor of emergency oil pressure in the diesel;
- sensor of diesel air filter clogging;
- sensor of the indicator of pneumatic system air pressure;
- sensor of emergency drop of pneumatic system air pressure;
- switch of control lamp of parking brake engagement;
- sensor of fuel level indicator and signal lamp of reserve fuel level;
- temperature sensor of plugs control unit;
- sensor of emergency braking fluid level;
- sensor of emergency oil pressure in HTDS;
- sensor of GB oil pressure;
- stop light switches.

To obtain information about tractor operational parameters two sensors of rear wheels rotation frequency are used: sensor of PTO rotation frequency, signal from generator phase winding to provide control over rotation frequency of the engine crankshaft.

Switch of diesel start locking serves to exclude diesel start with gear shifted.

Auxiliary equipment includes:

- cabin air conditioning and heating system;
- front windshield wiper;
- rear windshield wiper;
- windshield washer.

Electric power consumers and their circuits are protected by fuses situated in boxes.

6. TRACTOR PRE-STARTING PROCEDURES

6.1. General requirements

Before putting new tractor in operation, do the following:

- wash the tractor;
- carefully examine the tractor, check it for completeness; remove storage batteries, bring them to operational state and install back;
- check tension of threaded connections, and tighten them up, if required;
- check oil level in the engine crankcase in the transmission, front axle housing, front wheels' reduction gears, hydraulic system oil tanks, and add it, if required.
- Drain available fuel from fuel tanks and fill them in with new stilled fuel: in winter – with winter-grade fuel, in summer – with summer grade one.
- check braking fluid level in tanks of main cylinders of clutch hydraulic –static drives and main brakes, add it, if required.
- fill in diesel cooling system with coolant up to level "MAX" on the expansion tank control window;
- check and adjust generator belt tension, if necessary;
- grease tractor mechanisms and assemblies according to supplement 11.8;
- check and bring air pressure to normal in tires, if necessary.

CAUTION! Before putting the tractor in operation, make sure protective guard shields are in place (rear PTO end shield, etc.

6.2. Diesel pre-starting and starting procedures

Start at normal conditions (+4 ^{0}C and above)

CAUTION! Start the diesel only from operator's working place.

IMPORTANT! Never start diesel with cooling system not filled in.

- engage tractor parking brake;
- open fuel tank cock;
- fill in fuel and bleed fuel supply system to remove air;
- shift fuel supply lever in the middle position, and PTO control lever in position "brake";
- install lever of gear and range shift of GB in neutral position;
- switch on SB;
- turn starter key to position "I" (fixed). In the control lamps box the lamp of emergency oil pressure in HTDS lights, and in the combination of devices – lamps of emergency oil pressure in the diesel (buzzer sounds), indicator of air pressure (if it is below the rated value), indicator of voltage and indicator of fuel level (if fuel in tanks is in reserve level);
- turn starter key to position "III" (Start) by-passing position "II" (Plugs) Meanwhile, in the box of control lamps, diesel start control lamp lights (orange).

- If after turning key to position "III" the control lamp is flashing at small frequency (about 1.5 Hz), it means that GB shifting lever is not in neutral position or break in the circuit if diesel start locking is possible. Control lamp flashing at greater frequency (about 3 Hz) testifies to the fact, that the circuit of the generator phase winding is faulty (terminal "W").
- Keep the key in before diesel start, but for not more than 15s; if diesel doesn't start repeat the attempt, but not earlier than in 30…40 seconds. If after the third try diesel doesn't start, find out and correct the problem.
- After diesel start check operation of all indicator lamps and devices' readings (cooling fluid temperature, oil pressure in the diesel and GB, storage batteries charging, etc.) Let diesel operate at 1000 rev/min until pressure gets stable in the operation range.

IMPORTANT! Your tractor is equipped with turbo charged diesel. High turbo charger revolutions require proper diesel lubrication. When starting diesel for the first time , or after prolonged storage, rotate the crankshaft using starter for 10 seconds with no fuel supply to provide lubrication of turbo charger bearings. Let diesel operate idle for 2…3 minutes before loading it.

Starting at low temperatures (+ 4 ^{0}C and below)

IMPORTANT! To avoid power transmission damage, do not push or tow the tractor to start diesel by towing.

- Turn starter key to position "II" (Plugs) In this case in the box of control lamps plugs' control lamp lights, giving signal of switching on and heating of pre-start air heating plugs. Keep the key in this position. As soon as the control lamp starts flashing, the diesel is ready for start.
- Turn starter key to position "III" and start the engine, as shown above for starting the diesel at normal conditions.
- To start diesel at ambient temperature below 20^0 C, use special circulation cooling fluid heater in combination with pre-start heating plugs.

NOTE: The circulation heater of cooling fluid is used for the cooling system, filled in with antifreeze.

- With stable low ambient temperature, use winter-grade oils* in the diesel crankcase, transmission, hydraulic system and HTDS in accordance with recommendations of the present manual. Keep storage batteries fully charged.

Use pure winter-grade diesel fuel with no water impurities. To avoid malfunctions, daily drain sediment from fuel filter sump and fuel tanks.

IMPORTANT! Fill in fuel tanks daily at the end of each working day to exclude condensate formation inside tanks.

*) If winter-grade oil is not available, you may use mixture of summer-grade motor oil with 10…12% of diesel fuel.

6.3. Tractor take off and movement

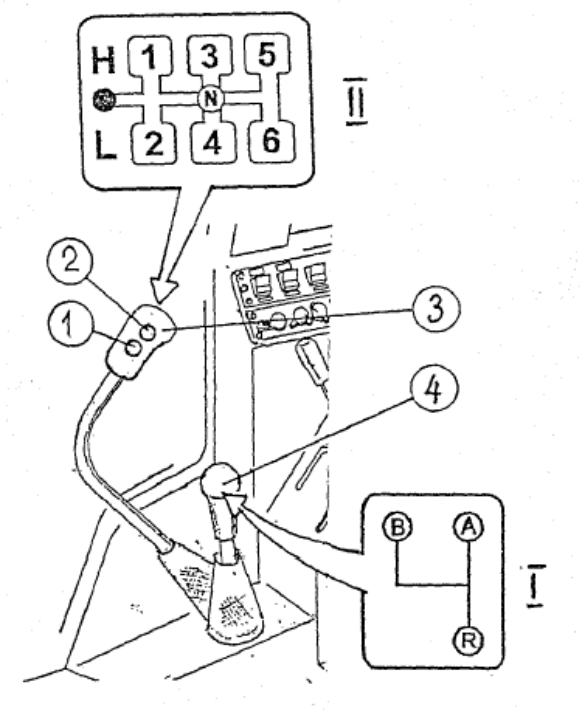
CAUTION! Tractor is equipped with one-person seat. During tractor operation no outsiders are allowed.

To bring tractor to motion fulfill the following operations:

- reduce diesel speed;
- press clutch pedal to the full; select required range. To this end:

- shift lever (4) to one of the positions “A”, “B” or “R” according to diagram of range shifting “I”;
- press pushbutton (1) to switch on lowest GB reduction gear stage (L) or pushbutton (2) to switch on higher reduction gear stage (H).
- Shift the required gear, having pushed gear shifting lever (3) from “neutral” to one of positions 1, 2, 3, 4, 5, 6 according to diagram of gear shifting “II”;
- Disengage the parking brake, smoothly release clutch pedal and increase diesel speed at the same time. Tractor starts movement.

IMPORTANT! To avoid noisy shifting, shift range shifting lever (4) only when tractor stops completely.
Do not keep your foot on the clutch pedal during tractor operation., as it will lead to clutch slippage, overheating and ultimate failure.



IMPORTANT! Shifting to reduction gear stages “L” or “H” is possible only after gear shifting lever (3) is put to neutral position.

IMPORTANT! To shift gear, smoothly (with no sharp jerks) push lever (3) according to shifting diagram II and keep it pressed until gear is fully shifted.

CAUTION! Always press clutch pedal before shifting to required range or gear in the GB.

6. 4.Tractor stop

To stop tractor:

- reduce diesel speed;
- press clutch pedal to the full;
- shift gear shifting lever and range shifting lever to neutral position;
- release clutch pedal;
- stop tractor by means of main brakes;
- engage the parking brake.

CAUTION! For urgent tractor stop sharply press clutch and brake pedals simultaneously.

6.4.1. Diesel stop

IMPORTANT! Before shutting diesel down, lower an agricultural machine down, let diesel operate at 1000 rev/min for 3…5 minutes. This will allow to reduce temperature of diesel cooling fluid.

To shut down diesel:

- shift lever of fuel supply control to position corresponding to zero supply*.
- Switch off PTO;
- Push all distributor handles to neutral position;
- Lower agricultural machine down to the ground;
- Switch off SB to avoid discharging

_____-

*) Pull diesel shut down auxiliary handle back (diesel is equipped with six –plunger in-line fuel pump “Motorplan”, Czeckia, or “YAZDA”, Russia)

6.5. Running - in

IMPORTANT! Initial 30 hours of tractor operation greatly effect operation parameters an operation life of the tractor, its diesel in particular.

Your new tractor will operate reliably and for a long time, if running-in is properly carried out, and servicing is made in recommended time intervals.

CAUTION! Initial 15 hours of operation should be spent at easy transport works, and remaining running-in time – at field works using HMS.

Take the following precautionary measures during 30-hours running-in:

1. Monitor readings of instrumentation, lubrication system operation, cooling and power systems operation. Check oil and fuel level in proper tanks.
2. Check tension and tighten outside fastening couplings.
3. Do not overload the diesel, do not allow fuming and speed reduction. Signs of overload are sharp drop of speed, fuming and diesel no response to increased fuel supply. High gear operation under load leads to exorbitant wear of friction diesel parts.
4. Tractor operation at too low gear with small load at high diesel speed results in fuel over-consumption.

Correct choice of gears for concrete work conditions saves fuel and reduces diesel wear.

5. avoid sustained unloaded operation at minimal or maximum diesel speed.
6. Avoid sustained tractor operation at constant diesel speed.
7. To guarantee alignment of friction clutch parts in the process of running-in, smoothly and more often engage the clutch.
8. Carry out regular daily maintenance in compliance with recommendations set forth in section 9 “Scheduled maintenance” of the present manual.

6.6 Maintenance after 30 hours running-in

1. Examine and wash the tractor.
2. Listen to functioning of all tractor assembles.
3. Check tension of diesel cylinder heads' fastening bolts, and tighten them, if necessary (operation 42).
4. Clean rotors of diesel and gear box centrifuges (operations 18, 19).
5. Check clearance between valves and rockers and make adjustments, if required.
6. Clean GB meshed filter (operation 20).
7. Check tension of generator belt (operation 13). Make adjustment, if necessary.
8. Drain sediment from fuel tanks, diesel fine and coarse filters (operation 12, 28).
9. Check and adjust, if necessary, free travel of clutch pedal, brake pedal and pneumatic system (operations 15, 31).
10. Check the state of storage batteries, clean terminal connections an ventilation openings (operation 32)
11. Change oil in:

- diesel crankcase (operation 21);
- transmission (operation 46);
- housing of front PTO reduction gear (if installed) (operation 51);
- wheel reduction gears and main FDA gear case (operation 50).

12. Replace paper filtering elements of diesel and hydraulic system filters (operation 22, 33).
13. Grease bearing of clutch shifter (operation 17).
14. Drain condensate from the pneumatic system cylinder(operation 7).
15. Check and, if necessary, restore air-tightness of air purifier and inlet duct (operation 37).
16. Check and, if necessary, tighten outside threaded connections (operation 43).
17. Control functioning of diesel, steering, brakes, controls, illumination and signal systems (operation 8).
18. Lubricate all greasing points with a gun (operations 9, 10, 53).

7. TRACTOR GANGING-UP

According to state standard (GOST) all technical means are subdivided into the following groups by way of their ganging up:

- ***Mounted machine*** – machine hitched to three-point mounting system. Mass of this machine in transport position is fully taken up by the power unit.
- Semi-mounted machine – machine, which mass in transport position is partly taken up by the power unit, but mainly by its own wheels. When the machine is rearranged from operational to transport position, the coupling point is transferred to new height position.
- **Semi-trailed machine** - similar to semi-mounted machine, except that when rearranging from operational to transport position the point of hitching to the power unit doesn't change by height.
- **Trailed machine** - machine which mass when in transport position is taken up by its chassis system. When rearranging the machine from operational to transport position, the articulated coupling to the tractor doesn't change its position by height.
- *Erected machine* - machine coupled to the power unit by means of auxiliary assembly units. Machine mass is fully taken up by the power unit, and in rare cases, partly.

Tractors MTZ 2022/2022V are equipped with standard towing-coupling and mounting devices, as well as a set of mounting openings, and provide all methods of ganging up. Besides, PTO and free extensions of the hydraulic system allow to drive tools of machines being ganged up, by mechanical or hydraulic-static methods.

Below are listed parameters of tractor's operation equipment, methodology of selecting technical means, data on allowable loading of the power unit as part of machine-tractor assembly (MTA).

Due to great variety of technical means being ganged up, the present section deals only with general recommendations on ganging up procedures.

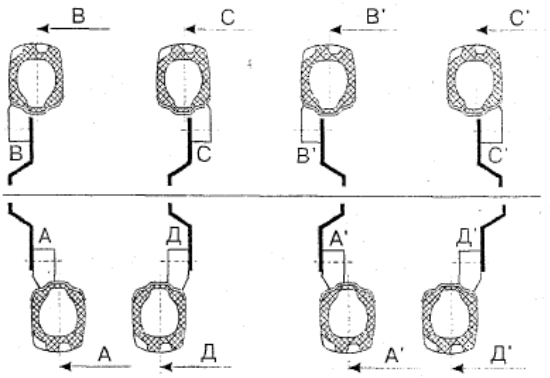
7.1. Wheel span adjustment

Front wheels

Table 7-1

Standard tires size	Wheels position	Wheel span, mm
420/70R24	A	1640
	B	1750
	C	1900
	D	2010
	A’	1820
	B’	1930
	C’	2080
	D’	2190

Wheel position with disc rotation (letters with primes) should be used only in exceptional cases.



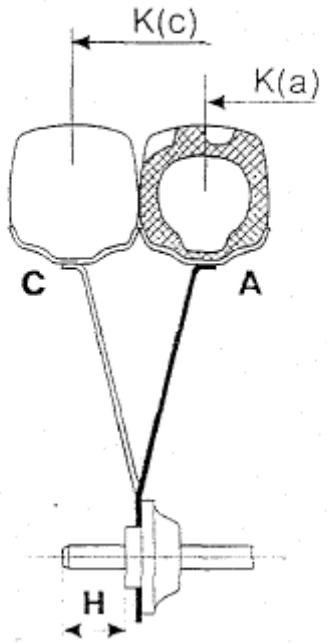
Rim fixing relative to disc:
A (A’), C (C’) – inside; B, (B), D (D’) – outside;
C, D – wheel rearrangement; A’, B, C’, D’ – disc turning round

Rear wheels

Table 7-2

Standard tires size	Wheel position	Wheel span K, mm	Size of hub H to semi-axle end face, mm
580/70R38	A	1710…2210	250…5
	C	2150…2650	250…0
20.8R38	A	1710…2210	250…0
	C	2150…2650	250…0

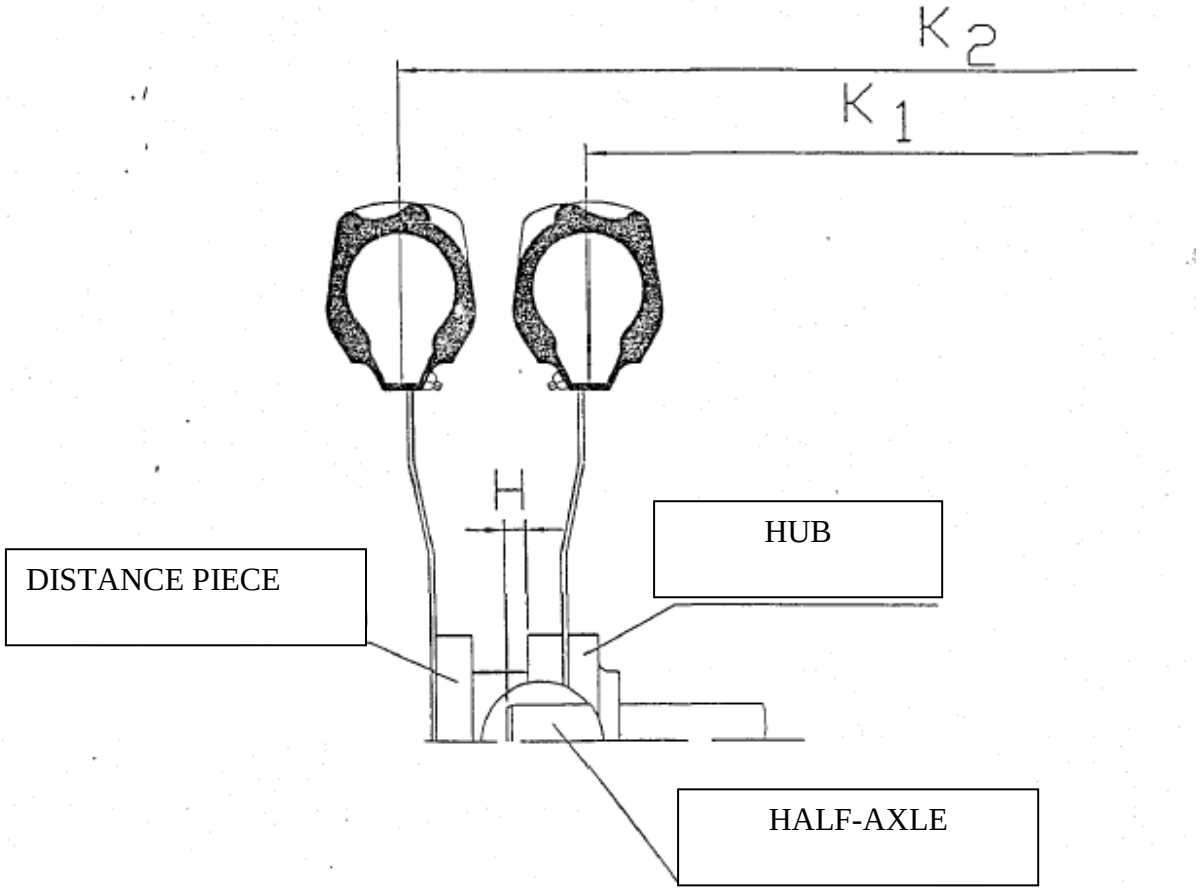
* Changing wheel span by value P corresponds to changing hub position by value P/2 on each side.



7.2. Rear wheels doubling to reduce unit pressure on soil

Table 7-3

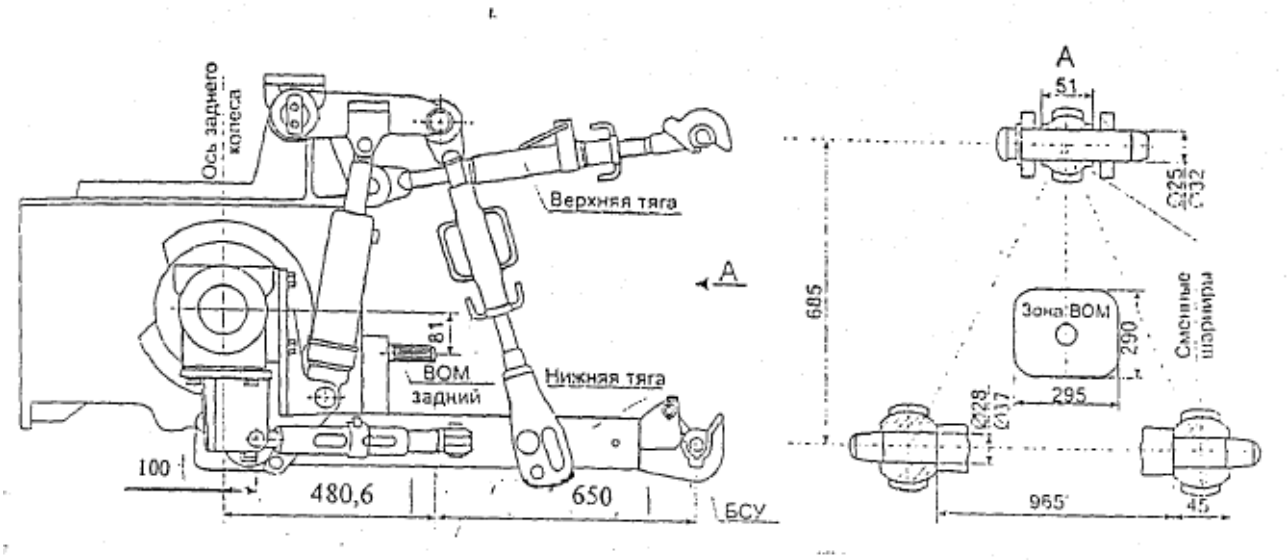
Standard tires size in assembly	Wheel span, K_1,K_2, mm	Mounting hub dimensions, N, mm	Distance piece
20,8R38 + distance piece + 20,8R38	K_1 = 1710, K_2 = 2905	250	2522-3109030



7.3. MOUNTING AND TOWING-COUPLING DEVICES

7.3.1. Rear mounting device MD-3

Mounted machines: (ploughs, cultivators, planters, tillers, etc.); semi-mounted machines (ploughs, soil tillage machines, planters, potato combine harvester, etc.)



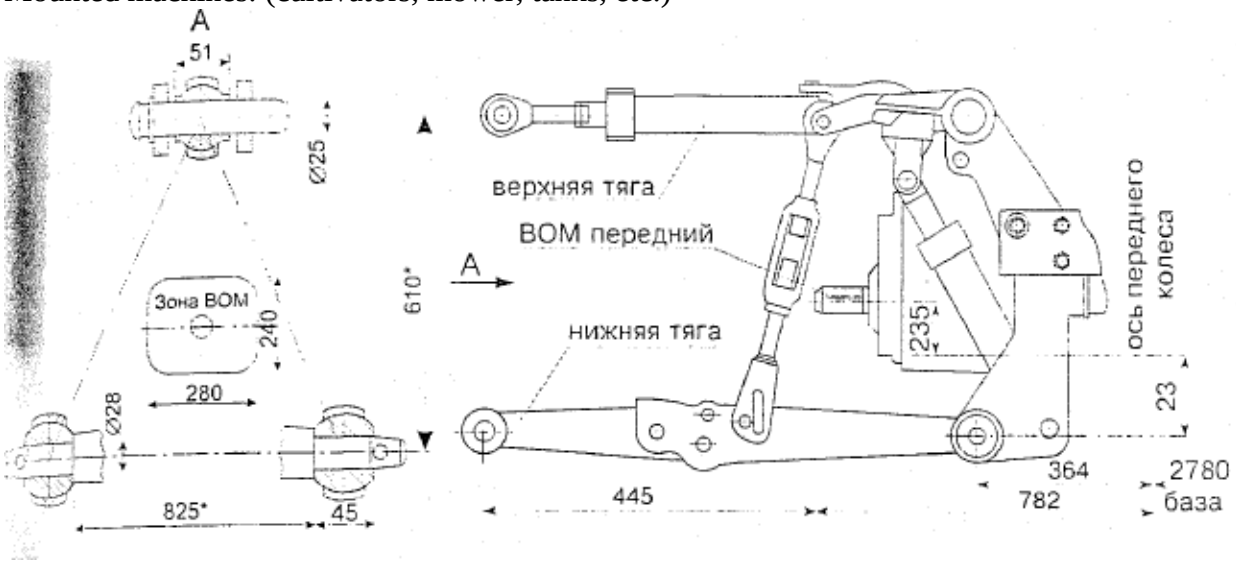
- ось заднего колеса –rear wheel axle
- верхняя тяга – upper tie-rod
- задний ВОМ – rear PTO
- нижняя тяга - lower tie-rod
- БСУ—fast-coupling device with changeable joints (FCD)
- Зона ВОМ – PTO area
- Сменные шарниры – changeable joints

Table 7-4

Description	Rear MD-3 (2)	
	cat. 3	Cat. 2
Lower tie-rods	One-piece with FCD	
Length of lower tie-rods, mm	1060	
Size of changeable joints of upper/lower tie-rods: - diameter, mm - width, mm	 51 45	 51 38
Nominal size of connecting elements: - pin of upper tie-rod, mm - joints of lower tie-rods, mm	 32 37.4	 25.5 28.7
Distance from PTO end face to suspension axis, mm	650	
Load capacity: -on suspension axle, kN - with overhang of 610 mm, kN	 60 48	

7.3.2. Front mounting device MD-2

Mounted machines: (cultivators, mower, tanks, etc.)



- зона ВОМ –PTO area
- верхняя тяга – upper tie-rod
- ВОМ передний – front PTO
- Нижняя тяга – lower tie-rod
- Ось переднего колеса – front wheel axle
- База- base

Table 7-5

Description	Device parameters
Lower tie-rods	Composite
Length of lower tie-rods, mm	885
Size of coupling elements of lower and upper tie-rods: - joint diameter, mm - joint width, mm	 25 or 28 51 or 45
Distance from PTO end face to suspension axle, mm	445
Load capacity, kN: - with overhang of 610 mm - on suspension axle	 23 25

* size refers to machine being mounted

7.3.3. Towing-coupling device TCD-1 (single cross-piece)

Half-mounted machines (planters, potato planters, potato combine harvesters, vegetable harvesting machines, etc.); half-trailed machines (mowers, pick-up presses, top-gathering machines, etc.)

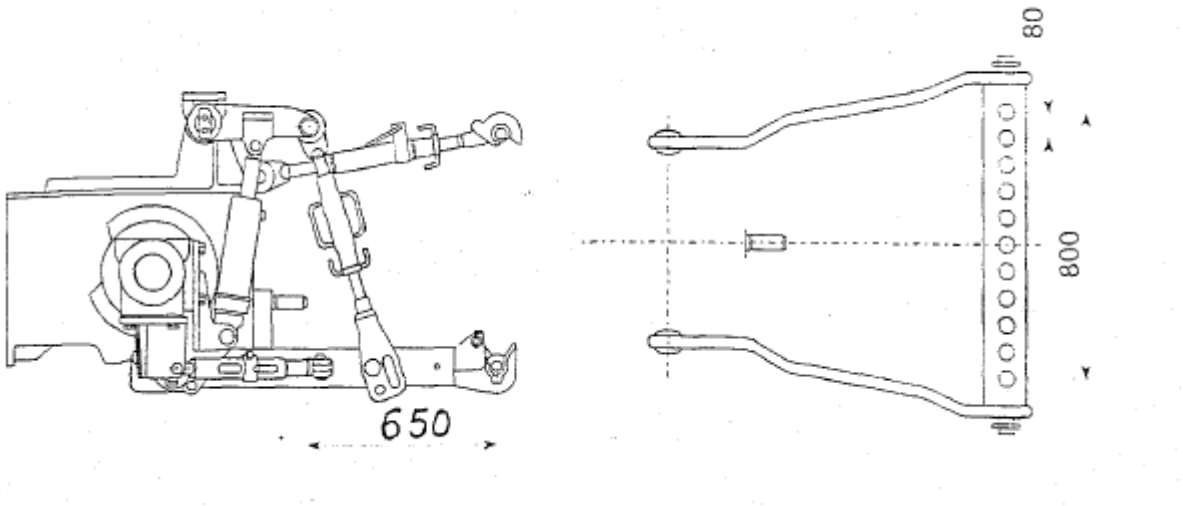


Table 7-6

Description	Device parameters
Coupler	TCD-1 (single cross-piece)
Installation place	Suspension axle of lower tie-rods
Distance from PTO end face to coupling pin axle, mm	650
Diameter of coupling pin, mm	30
Vertical load on TCD, kN	6.5
Machine turning angle relative to tractor, degrees	80

7.3.4. Towing-coupling device TCD-1M-01 (towing beam)

Half-trailed machines (same as for TCD-2V, TCD-2V), trailed machines (same as for TCD-2V and TCD-3V)

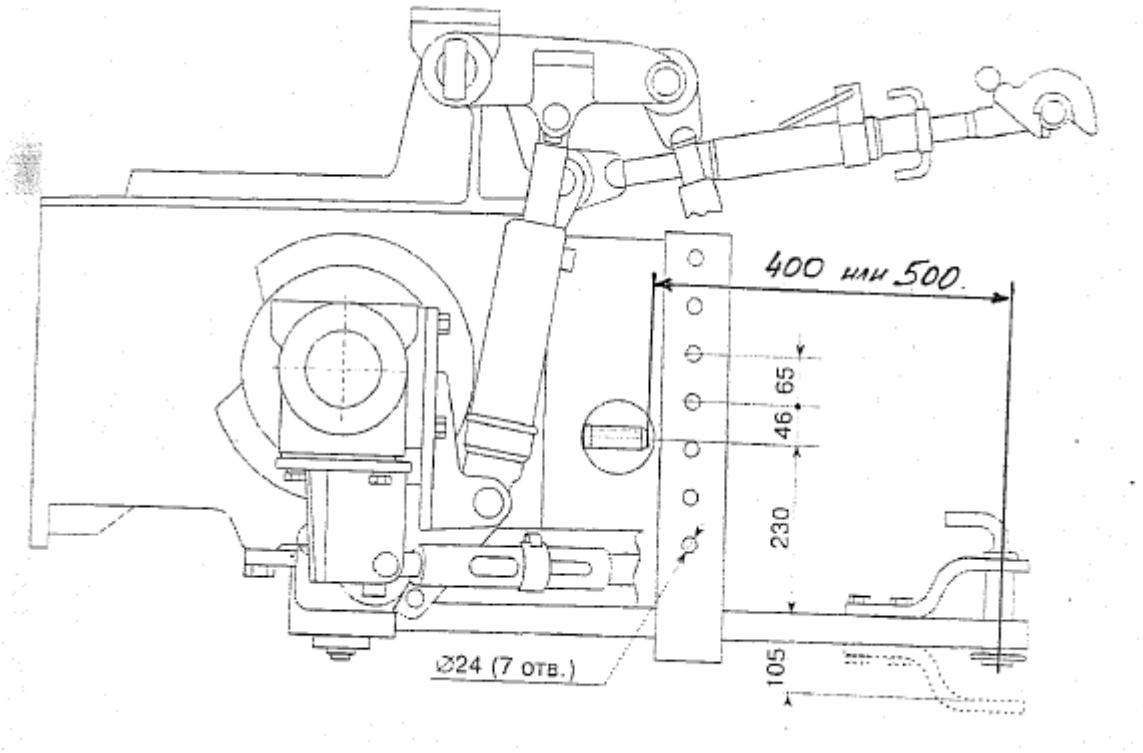


Table 7-7

Description	Device parameters
Coupling device	Yoke reversible relative to PTO end face
Distance from yoke to support surface, mm	412 or 517
Distance from PTO end face to axis of coupling pin, mm	Pto-1,1C,2- 400 or PTO-3-500
Diameter of coupling pin, mm	30
Vertical load on TCD, kN	12
Machine turning angle relative to tractor, degrees	85

Half-trailed machines: (half-trailers, fertilizer spreaders, etc.).
Trailed machines: (disc harrows, soil-tillage machines, coupled harrows, cultivators, planters, etc.).

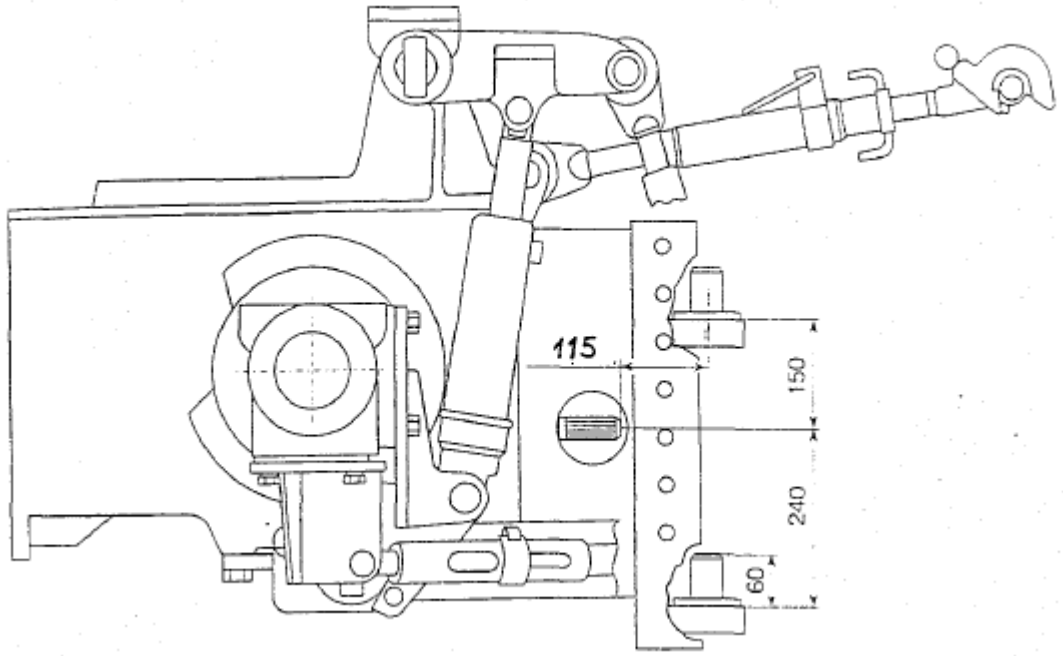


Table 7-8

Description	Device parameters
Coupler	“Python”-type
Distance from yoke to support surface for not PTO-driven machines, mm	507…897
Pin position for PTO-driven machines	Utmost lower, or utmost higher
Distance from PTO end-face to coupling pin axis, mm	115
Coupling pin diameter, mm	40
Vertical load on TCD, kN	25
Machine turning angle relative to tractor, degrees	+/- 50

7.3.6. Towing-coupling device TCD-3V (lifting type)

Trailed machines (two-axle, truck-type trailers, etc), half-trailed machines (same as for TCD-1ZH).

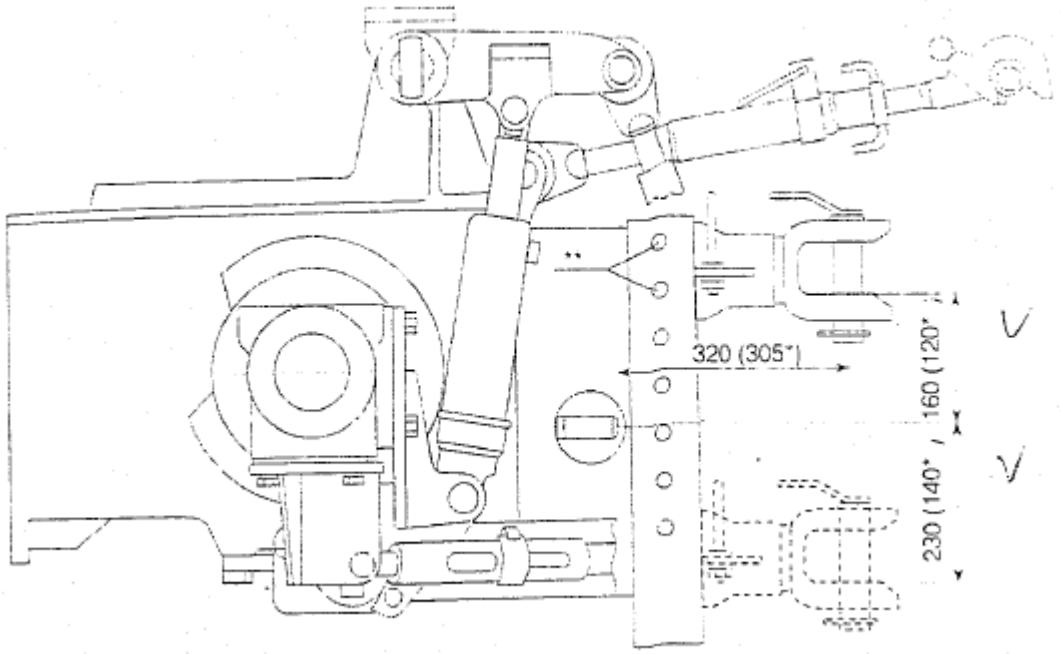


Table 7-9

Description	Device parameters
Coupler	Rotating yoke with vertical movement ability
Distance from yoke to support surface for not PTO-driven machines, mm	517…904 or 607…867 (with yoke reverse) stepwise, with 65 mm
Yoke position for PTO-driven machines	Utmost lower or utmost higher, yoke reversal including
Coupling pin diameter, mm	40
Distance from PTO end face to coupling pin axis, mm	320 (305*)
Vertical load on TCD, kN	12
Machine turning angle relative to tractor, degrees	+/- 45 (trailers) +/- 50 (agricultural machinery)

**) Yoke reversal. In this case two upper openings with 27 mm diameter in the lifting device guard arms are not used.

Rear mounting device MD-3 has been designed under category 3 with readjustment capability for category 2 coupling elements by changing independent joints of fast-coupling device (FCD). The use of changeable joints of category 3 and 2 allows to make simple readjustment and use machines from tractor sets of class 2 and 1.4 for operation in drastic climatic conditions or on hard soil.

The left-side brace is installed in size 740 mm, which shouldn't be changed with no particular need.

Besides major openings for coupling with lower tie-rods, braces have recess for ganging up with wide-grip machines for improved terrain follow (cultivators, planters, and so on).

Couplers SA-2 and SA-1 can also be installed on rear and front mounting devices, correspondingly.

Suspension axle of rear mounting device may have single cross-piece TMD –1. If PTO is used, cardan shaft with nominal length of 1000 mm may be recommended. In this case suspension axle should be installed in the middle of the cardan shaft, otherwise PTO drive will be overloaded.

The tractor has three pairs of free hydraulic drives for operating coupled technical means (if front MD-2 is not provided).

Oil consumption through outlets is 45…55 l/min (depending on the technical state of the hydraulic pump). Oil extraction by mounted machine hydraulic cylinders should not exceed 25 l. Check oil level in the hydraulic tank with drawn-in rods of operation cylinders.

To avoid oil leakage when ganging up of technical means or during unforeseen disconnection, stop and rupture devices are provided (Enclosing half-clutches and rupture devices are in tractor spare parts kit).

Hydraulic-static power take-off can be made via one of outlets for driving auxiliary hydraulic motor drives. To avoid hydraulic system overheating, operation pressure should not exceed 11 MPa, which corresponds to power of 10 kW maximum. To drain oil from the hydraulic motor by-passing distributor, an individual pipeline is provided.

The tractor is equipped with fittings with flow area Du = 12 mm and connecting thread of M20 x 1.5. If necessary, to couple to different fittings of machines being coupled, manufacture required adapters with flow area Du = 12 mm minimum yourself.

Towing-coupling device TCD –3V (lifting type), page 186, and TCD –2P ("Python"-type), page 165, are used according to purpose. Coupling element TCD –2P is situated 115 mm away from PTO end face, allowing to sustain considerable vertical load with sufficiently longitudinal stableness of MTA. Yoke of TCD-3V is located 320 mm away from PTO end face, which allows to gang up actively driven half-trailed and fully trailed machines, providing increased angle between the tractor and a machine during turns. To obtain required steering capacity criteria, vertical load on yoke TCD-3V is reduced as compared to TCD –2P.

Design of lifting device guides provide for installation of connecting lift (hook instead of yoke, etc.), manufactured by other companies.

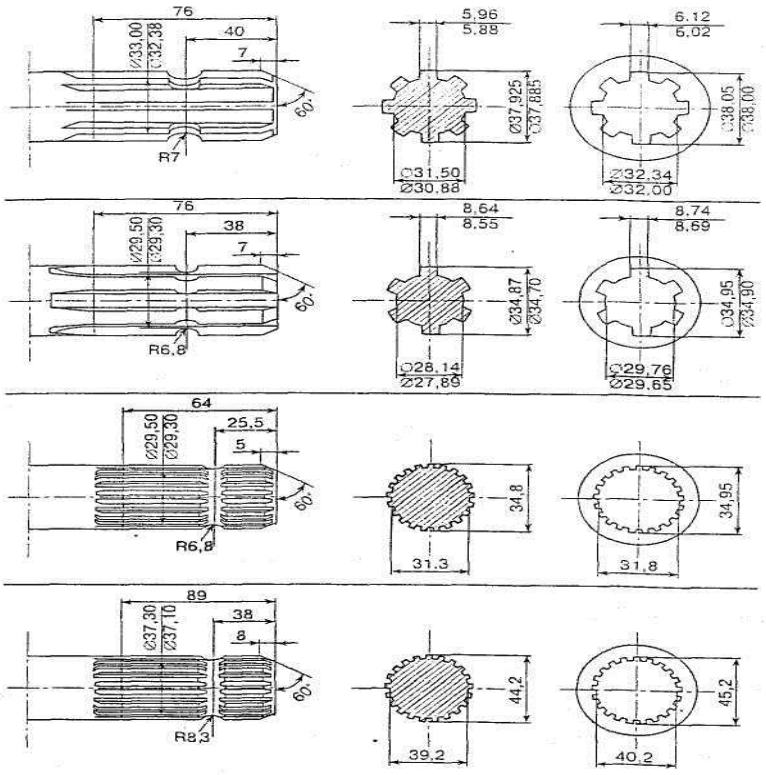
To mount PTO driven machines, the tractor is equipped with TCD-1M-01(towing beam) with changeable position of the coupling link relative to PTO under category 3 and 2 (500 and 400 mm correspondingly).

If TCD –1M-01 is installed (towing beam) TCD –2P “Python” is not provided. TCD-3V (yoke) can be installed in upper position when TCD-1M-01 and TCD-2P are installed. Also in all cases rear mounting device need not be dismantled.

Front mounting device of MD-2 type in its design is similar to the rear one. It is installed on front loads place and serves for making up combined assembles (cultivator – in front, planter from rear side, etc), echelon mounted devices (front and side mowers, etc.), as well as for transportation of individual machines from combined rear mounted devices for long travel.

7.4. PTO AND MACHINES' DRIVE

Tractor: PTO end Machine: PIS hub



PTO 1C
(8 splines)

PTO 1
(6 splines)

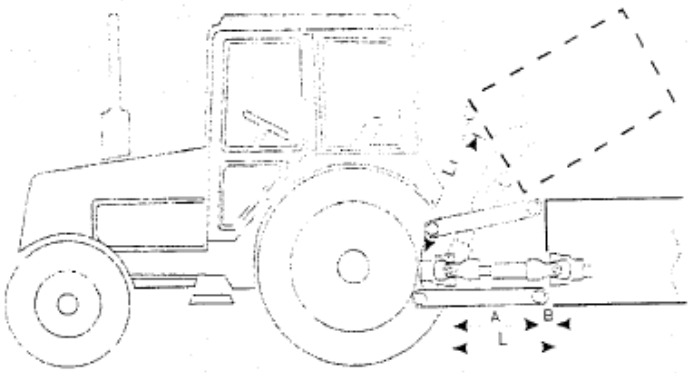
PTO 2
(21 splines)

PTO 3
(20 splines)

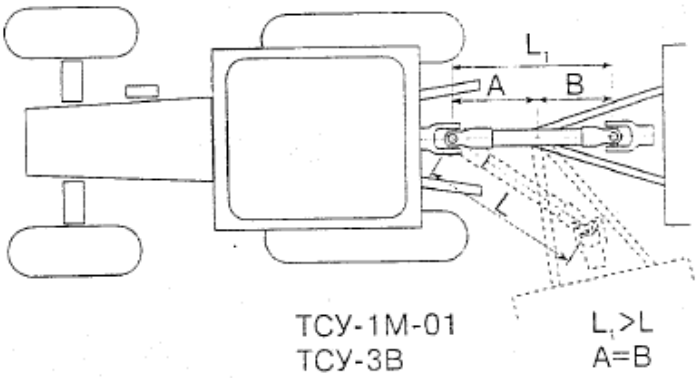
PTO	Type of the end	Rotation frequency, rev/min		Power transferred kW (h/p)
		PTO	Diesel	
Rear independent	PTO 1C PTO 1 PTO 3	540 540 1000	1924 1924 1909	60(80) 60(80) 185(250)
Front independent	PTO 2	1000	1845	50 (68)

7.5. COUPLING DIAGRAM

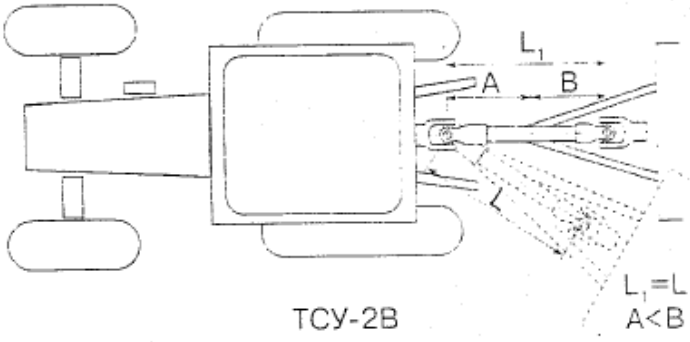
Length of cardan shaft is determined by distance L (shaft is fully shifted) with horizontal position of lower tie-rods. The shaft is extended during machine lifting, so check telescopic elements' overlapping. Tilting angle of the joint on the side of PTO is greater, than on the side of PIS.



Length of the cardan shaft L is determined when turning a machine to maximum angle relative to tractor. If equality A=B is not observed, rotation irregularity sharply increases, resulting in overload of the whole drive.

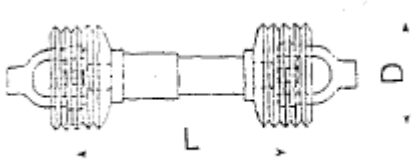


The cardan shaft practically doesn't change length during machine turn. Irregularity of cardan shaft rotation during the movement is compensated by adjustment of angular velocity joint.



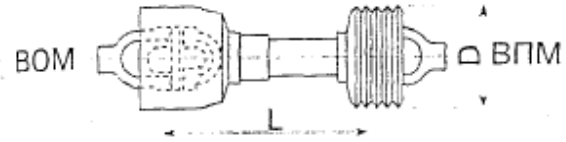
7.5.1. Cardan shafts with guard housing (machine accessory)

Cardan shaft of type 10



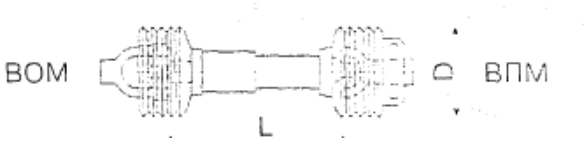
Telescopic, with general-purpose cardan joints and guard housing

Cardan shaft of type 20



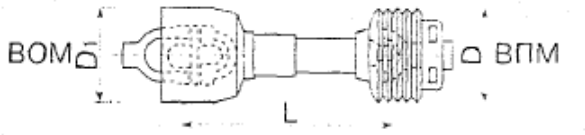
Telescopic, with general purpose cardan joint and joint of equal angular velocities, with guard housing.

Cardan shaft of type 40



Telescopic, with safety coupling and general-purpose cardan joints with guard housing.

Cardan shaft of type 50



Telescopic, with safety coupling and general-purpose cardan shaft of equal angular velocities, with guard housing.

Table 7-11

Cardan shaft designation*	Torque, N.m	Length of cardan shaft, mm		Housing diameter, D, mm
		L	L_1	
10.016	160	510	$L_1 = 1.35\ l$	150
10.040	400	560		175
				200
10.063	630	610 710		220
10.1000	1000	610 710		

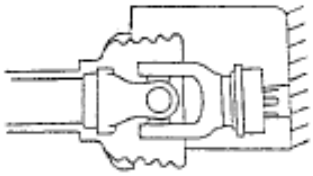
- Designation after the dot refers to cardan shafts of type 20, 40, 50
- L – distance between centers of fully shifted cardan shaft (nominal length).
- L1 – operation length of the cardan shaft.
- D1 = 1.75 – diameter of cardan joint housing of equal angular velocitis.

7.5.2. Cardan shaft installation

Table 7-12

Cardan shaft type	Coupler	The end type	Nominal length of cardan shaft, mm
10 or 40	MD-3	PTO 1C, 1, 3	610, 710
	TCD-1ZH	PTO 1C, 1,2	510
	TCD-1 TCD-3V	PTO3	710
20 or 50	TCD-2	PTO 1C, 1	710

Installation of cardan shaft with guard housing and protective PTO screen provide coupling safety.



End yokes must be in one plane.

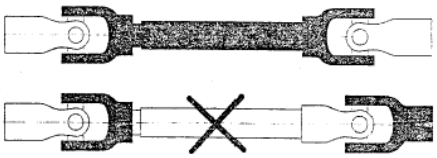
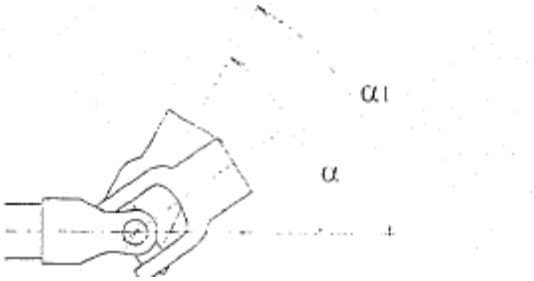


Table 7-13

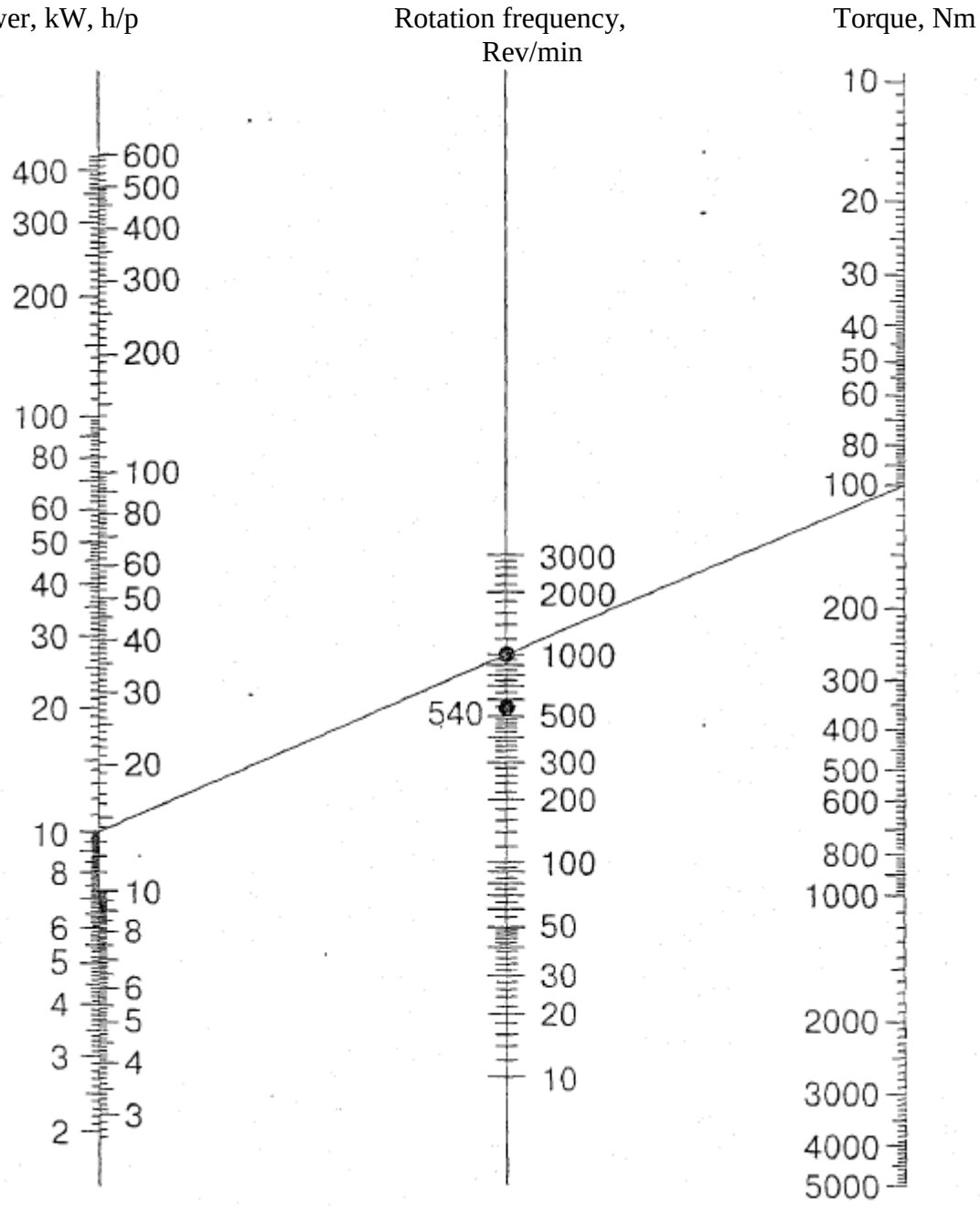
PTO	Angle (degrees, max) of cardan joints' tilt	
	General-purpose	Of equal angular velocities
Swithed on	22	25 (50 for short time)
Switched off	55	55



Overhang of telescopic cardan shaft elements should be 110 mm minimum, to avoid disconnection and jamming of the coupling

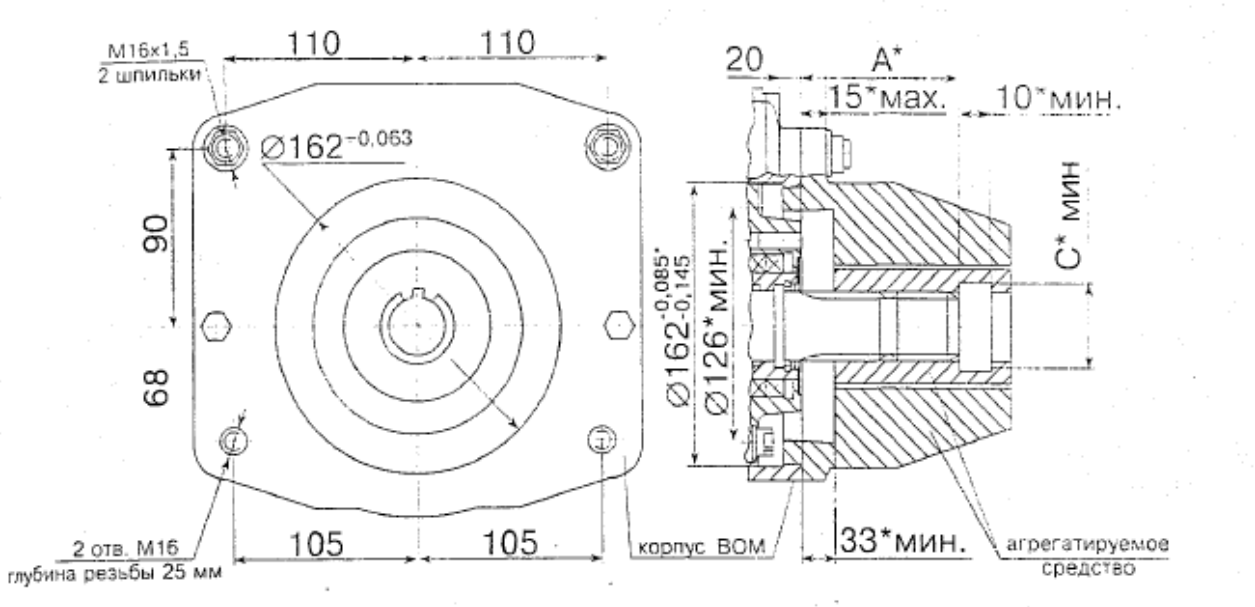
7.5.3. Selecting cardan shaft type

Usually, operation manuals of mounted machines list required power and rotation frequency of PTO. In selecting a cardan shaft the most important characteristic is torque, which can be determined in accordance with given below alignment shart:



* 1000 rev/min, 540 rev/min – Standard PTO rotation frequency.

7.5.4. Cardan-less PTO drive



- шпильки – pins
- 2 отв. Глубина резьбы 25 мм – two openings, thread depth
- корпус ВОМ –PTO housing
- агрегатируемое средство – coupled machine

Some machinery can be coupled directly to PTO without using the cardan shaft (reduction gears, hydraulic pumps, etc). In this case the body should be centered with 162 mm diameter in PTO cover, and to avoid abutment ductuli have to be provided on end face side and at the outlet of PTO end splines. If necessary, PTO cover fixing pins can be substituted by elongated versions of the same size, or lifting mechanism can be dismantled.
Coupling of machinery to rear and front PTO is similar

Table 7-14

Type of the end	A*	C* min
PTO 1; 1C;2	90	40
PTO 3	140	50

*) Dimensions refer to machine being ganged up.

7.6. SELECTION AND OPERATION OF AGRICULTURAL MACHINERY

The tractor can be ganged up to traction class 3 machines, and machines completed with wheeled tractor of class 4. Besides, under unfavorable conditions , on hard soils tractor may be coupled to machines in complete with tractors of class 1.4 and 2. Design of lifting and towing-coupling mechanisms, PTO and hydraulic drives according to international standards allows ganging up with foreign-made models.

To provide reliable, long-term and safe operation, observe recommendations on tractor loading and stability if tractor-machine assembly (MTA). Load on tractor front and rear axles as part of MTA are determined by calculations. More easy way of determining actual load on tractor axles is by weighing.
Index of longitudinal MTA stability is criteria of steering, which equals relation of load on driven axle to operational tractor weight.:

$$Ku = \frac{10^2 T_n}{m} \geq 0{,}2$$

Where, T_n – load on front axle, kN
m – operational tractor mass, kg

To improve towing-coupling capability of the tractor, and provide steering criteria, one has to use ballast. To provide rational loads distribution and reduce number of MTA passages, the use of combined assemblies is reasonable.
Three types of completeness are distinguished according to ballast installation:

- A – without front ballast;
- B – with front ballast;
- C - with front ballast and mortar in front tires.

$CaCl_2$ (25 parts by weight) dissolved in water (75 parts by weight) can serve as mortar poured in tires. The freezing temperature of such mortar is – 32 ^{0}C, specific weight is 1.2 (as measured by hydrometer.

Maximum safe loads on tractor's axles:

- *Front axle* - $T_{f\,min}$… $T_{f\,max}$ = 14.5…45.0 kN:
- *Rear axle* - $T_{r\,min}$ … $T_{r\,max}$ = 20.0…70.0 kN:

but not more than total single tires load capacity of front and rear wheels.
If wheels are doubled for tires of the same or different standard sizes, their total capacity should be reduced by 20%.

In all cases total load on tractor wheels should not exceed

$$T_f + T_r \text{ -< } 100 \text{ kN (} 10000 \text{ kgs)}$$

Loads obtained on tractor and machine propellers, used on fields, meadows and pastures, should be checked for compliance with norms of maximum pressure on soil and normal mechanical stress in soil. GOST gives complicated system of determining the given above indices. Pressure on soil is higher than air pressure in tires by approximately 0.02 MPa (maximum value is chosen).
Soil compaction depends to a great extend on the number of passages along the wheel track. So it's reasonable to reduce the number of passages by combining operations by way of combination of assemblies.

Wheels doubling allows to considerably reduce specific pressure on soil, preserve soil structure, wet fields in particular.
Wheels doubling on compacted soils allows to improve traction-coupling characteristics of the power unit, in particular, in combination with tractor proper ballast installation and loading.

Procedure of MTA assembly and operation features are given in operation manuals of machines being coupled. In all cases compliance with coupling elements, load capacity of mounted machines and tires, maximum allowable load on TCD and tractor axles.
Machine operating width and tillage depth mainly depend on specific soil resistance. It determines the range of operation speed with due account of agricultural requirements. The harder the soil the higher specific resistance.

In view of traction force of 27…36 kN, tractor of class 3 develops on stubble, approximate calculation of operation width of major power consuming agricultural machines with tractor MTZ 2022. Submitted results give possibility to select agricultural machines by operation width, including the use of echelon-principle in coupling devices (harrows, cultivators, planters, etc).

Specific resistance is given for soil tillage speed of 5 km/h. Changing speed by 1 km/h changes specific resistance by 1%.

Table 7-15

Machinery	Specific resistance, kN/M	Possible operation width, m
Ploughs: Soils: - Hard - average - light	 18…25 12…14 6…8	 1.2…1.6 2.1…2.5 up to 30
Disc harrows	1.6…2.1	Up to 15
Stubble breakers	6.0…10.0	3…5
Cultivators	1.6…3.00	Up to 15
Reaper	1.2…1.5	Up to 20
Combine harvesters: Silage combine Sugar beat harvester Potato harvester	 2.6…3.3 6…12 10…12	 Up to 3.0 Up to 3.0 Up to 2.7

To control MTA operation, the control panel of a mounted machine may be used. To install the panel, one can drill holes in the cabin side wall to fix it by means of self-threaded screws.

To gang up mounted technical means (spraying reservoirs, loaders , hay-stackers, etc), one can use erection openings of the tractor to install framing beams and other elements.

MTA assembling should take into account recommendations of a machine operation manual. The manufacturer recommends to use machines and tools that are designed for operating in its assembly. If there is no protocol of agreement as to ganging up of technical means, the works is not liable for tractor breakage, in cases of complicated ganging up in particular (mounted machines, combined and harvesting assemblies).

7.6.1. Tires load carrying capacity at various speeds of tractor travel.

Table 7-16

Standard tires size	Speed, km/h	Load on one tire, KN, and air pressure corresponding to it, MPa						Amount of mortar per each tire, l
		0.10	0.12	0.14	0.16	0.18	0.20	
420/70R24	30 10	15.45 19.00	17.20 21.15	18.80 23.15	20.35 25.00			183
580/70R38	30 10	31.50 38.75	35.05 43.10	38.35 47.20	41.35 51.00		58.15	507
20.8R38	30 10	28.52 39.98	32.90 46.13	42.69 49.35	39.06 54.75			500

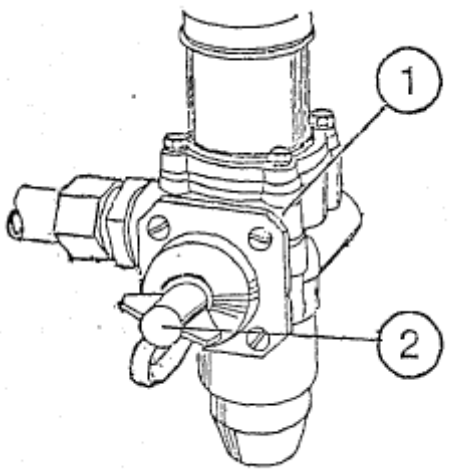
Tires inflation

Inflate tires via air intake valve of pressure regulator (1), having carried out the following operations:

- release air from the cylinder through condensate removal cock;
- unscrew wing nut (2) of coupling air bleed-off valve;
- connect air inflation hose to the coupling air bleed-off valve and tire valve;
- switch on the compressor and inflate tire to required pressure, checking by pressure gauge.

CAUTION! When pressure rises to 770 kPa, the compressor by means of pressure regulator is switched over to idle run, tires inflation automatically stops. So periodically check air pressure by pressure indicator in the panel of instruments and, if needed, reduce it by means of condensate release cock.

- disconnect hose from tire valve and coupling of air bleed-off valve;
- switch off the compressor and screw the wing nut up the coupling of air bleed-off valve.



7.6.2. Plaughing

Ploughing is one of most power consuming activities. Traditionally, MTZ tractors as part of ploughing assemblies are used according to principle “tractor wheels are in the furrow”. This requires corresponding arrangement of wheels when operating ordinary, reversible and rotating ploughs.

Still, the tractor can operate according to principle (tractor wheels – off the furrow” In this case wheels arrangement is simplified. Wheels doubling is getting reasonable to improve traction-coupling parameters of the tractor, in particular, when tires are filled with mortar. In this case it’s possible to operate crawler tractor ploughs after corresponding rearrangement thereof , as well as pull-type ploughs.

To obtain smooth tillage reversible (double) or rotating ploughs are used provided one side furrow turn over.

Relatively smooth field can be obtained when ploughing with ordinary ploughs, if beginning and finish of ploughing are carried out according to given recommendations.

Type of plough, operation width (number of ploughs) depend on soil, its

mechanical composition, stones availability, tillage depth. One plough requires about 15-20 kW of power (for average soils).

Operation width can be estimated, using specific resistance of ploughs, that depends on soil and its mechanical composition.

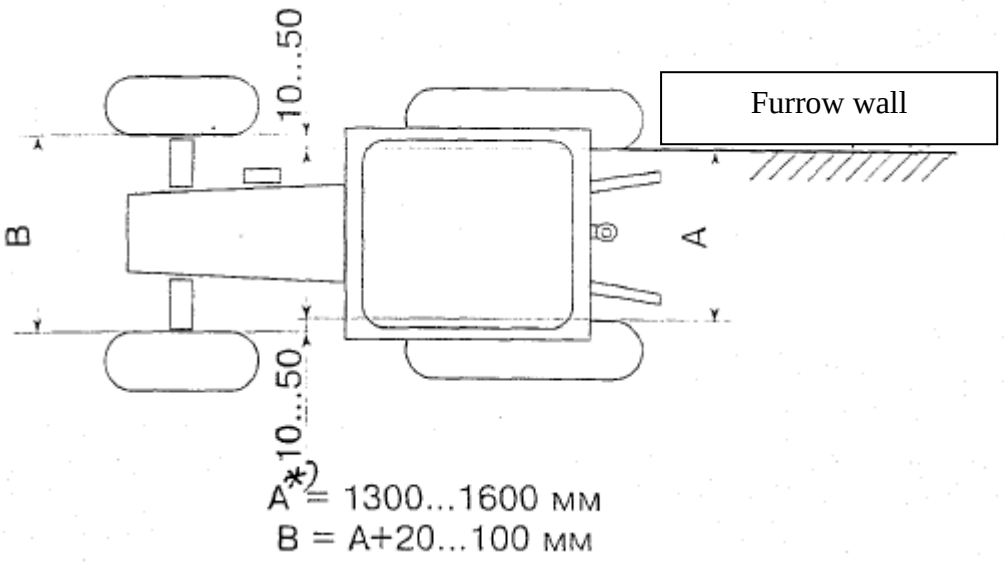
Table 7-17

Soil	Soil background	Specific resistance (P) of ploughs for soils, Kn/m2:			
		Clay	Heavy clay loam	Average clay loam	Clay sand
Black earth	Winter crop stubble	68	49	35	25
	Perennials	86	57	45	31
	Wild land	90	71	52	39
Ashen-gray soil	Winter crop stubble	66	47	34	26
	Perennials	74	56	43	30
	Wild land	92	71	50	40
Chestnut soil	Winter crop stubble	69	47	36	22
	Wild land	98	58	55	29
Alkaline soil	Winter crop stubble	-	82	73	65

B = 30 (A x P), where
B – operation plough width, m;
A – tillage depth, m;
P- specific resistance, KN/m2.

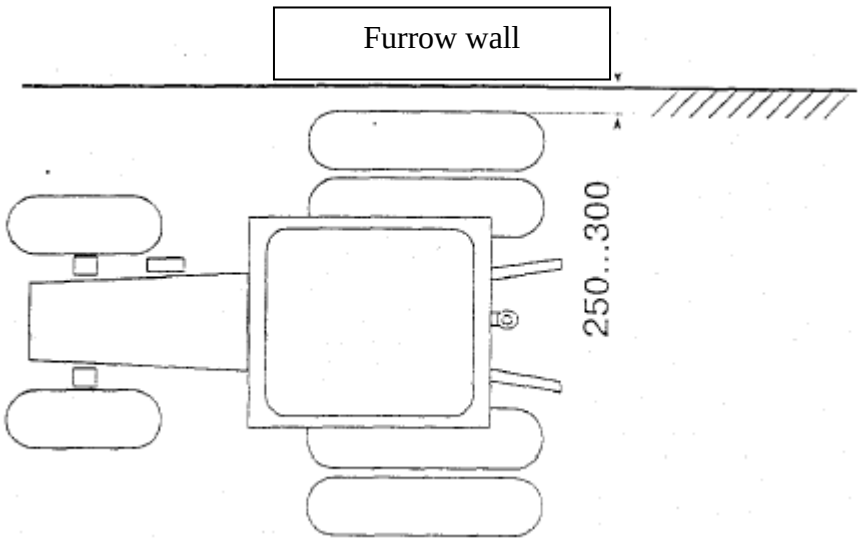
7.6.2.1. Wheels arrangement when 5…8 ploughs are mounted

Tractor wheels are in furrow



To calculate wheel track, add width of the corresponding tire contour to dimensions A and B.

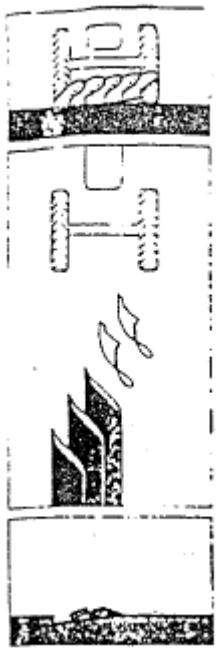
Tractor wheels are off the furrow



Rear wheels track is in accordance with doubling scheme

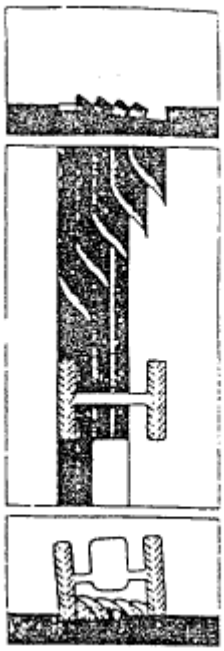
*) Size “A” should be 1220 mm minimum to avoid damage of rear wheels.

7.6.2.2. Field grading when using ordinary ploughs



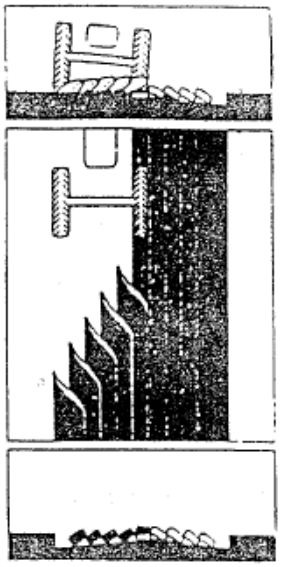
First passage

Only three last plough shares operate. The last share ploughs at about half the normal ploughing depth.



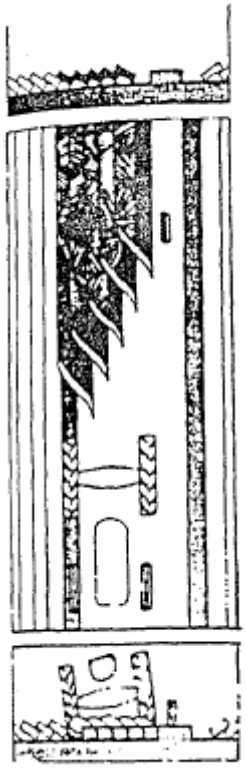
Second passage

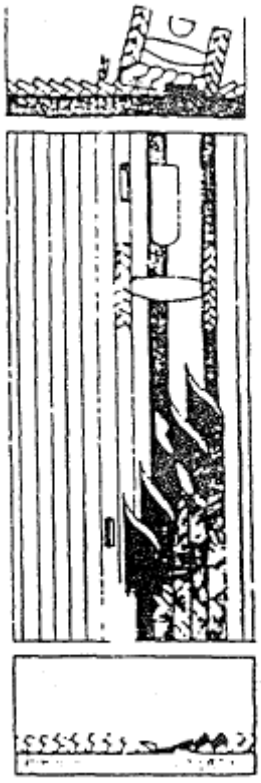
The right tractor wheel is in the furrow. The first share plaoughs at half the depth, the last one – at full depth.



Third passage

The right tractor wheel is in the first furrow after the second passage. The plough is set at half the depth of the first share, thus resulting in level surface. The last share is set to full length.





Ploughing completion

During the last passage ploughing is made to full length, leaving the field untilled by 1-2 furrows. During the last passage two first shares till two remaining furrows, and the last rear share ploughs already tilled soil by half the depth.

7.7. TRANSPORT WORKS

Practically half of tractor operation time is used for transportation and travelling on public roads. Due to this, transport MTA need to comply with stringent safety regulations.

According to GOST, machines like tractor trailers or half-trailers should be equipped with main and parking brakes and safety chains (steel ropes). Main brakes are driven according to one-wire scheme and controlled from operator's work place of the power unit. The parking brake drive must be installed on the machine.

Transport means are coupled by means of TCD –2P or TCD-3V (lifting device).

The use of TCD-1 (crosspiece) is strictly forbidden due to safety consideration.

Trailers or semi-trailers-type machines must bear sign of maximum speed limit of MTA, attached to rear left side.

Safety chains (steel ropes) are fixed to the tractor in one openings 24 mm in diameter, provided in the lifting device guard arm (fastening fixtures are included in the kit of mounted machine).

The tractor can be ganged up as part of road train (tractor + semi-trailer + trailer) only for dry hard-surface roads and 4% maximum grade.

Overall dimension of MTA travelling on public roads should not exceed 2.5 m in width and 3.8 m in height.

In case of deviation from these requirement, agreement of traffic police is required

IMPORTANT! For transport works on hard-surface roads increase air pressure in tires by 30 Kpa (0.3 kgs/cm2) over recommended values.

To connect signal alarm devices of mounted machines, tractor has connector for power supply of the mounted machine according to GOST and ISO.

Travel on public roads only forward. Movement in reverse is not allowed, as light alarm signals are arranged only for forward movement.

7.8. SELECTING MOVEMENT SPEED

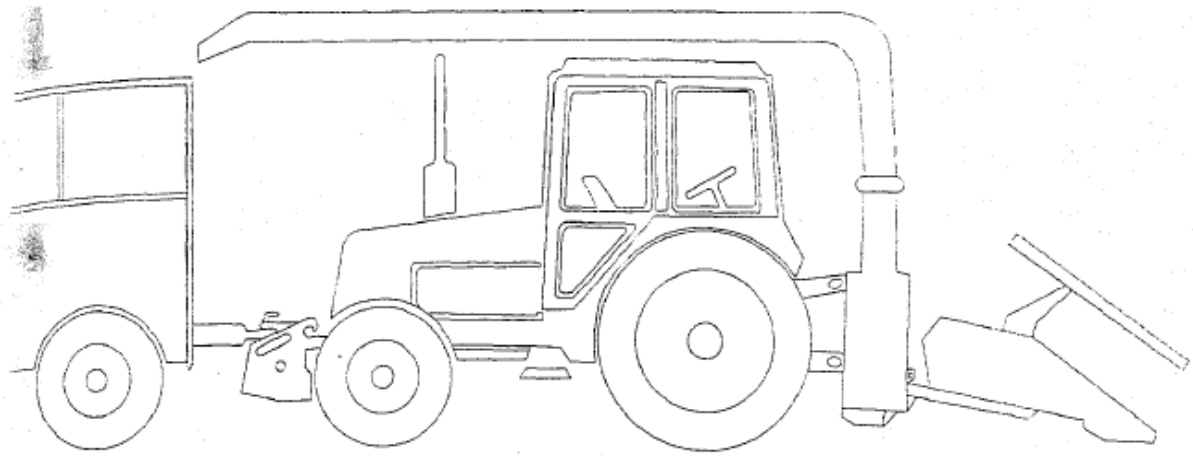
Table 7-18

Operation	Tractor features	Speed, km/h, max	Notes
Operation on slopes		10	
Sharp MTA turns		10	
MTA transportation to operation site (except transport vehicles)		20	Public roads
MTA transfer (from one field to another)	Mortar in tires	20	With no travel on public roads
	Double tires	20	
	Double tires	20	
Transport works	TCD-2P, TCD-3V		On public roads

Transport movement speed may be limited by coupled machine capabilities according to sign imprinted on it.

Load carrying capacity of a transport vehicle depends on terrain, slope and roads conditions. Accounting for allowed longitudinal slope of 12 degrees, total mass of a semi-trailer (trailer) must not exceed 12000 kg, for relatively level terrain – 14000…15000 kg.

7.9. REVERSE MODE OPERATION



A number of activities (fodder, sugar-beat harvesting, etc) require MTA movement on the field being harvested. In this case fulfillment of technological operations in the reverse mode justify additional expenses, as mounted and semi-mounted machines (reapers, combines, etc) are used. A trailer for grind vegetation may be included as part of the harvesting complex, ganged up by means of front towing mechanism, including when front loads are installed, or cross-piece on suspension axle of the front mounting mechanism MD –2.

Readjustment to reverse mode and visa versa takes 3…4 minutes.

8. TRANSPORTATION AND TOWING OF TRACTOR

Tractors can be transported by rail road, trucks and trailers, as well as by towing, or under its own power.

When transporting the tractor:

- shift GB lever to gear 1;
- engage parking-reserve brake;
- fasten tractor to platform using wire with 3…5 mm diameter, chains, tension members.

During tractor loading-unloading use lifting mechanisms having load carrying capacity at least 10 tons.

Fix steel ropes to front axle beam and half-axles of rear wheels, as shown in the diagram below.

Tractor can be towed with non-operational HTDS pump at speed of 10 km/h maximum and for distance of up to 10 km/h.

To connect towing steel rope, use an eyelet fixed to front ballast and loads arm.

Strictly observe traffic regulations when towing the tractor.

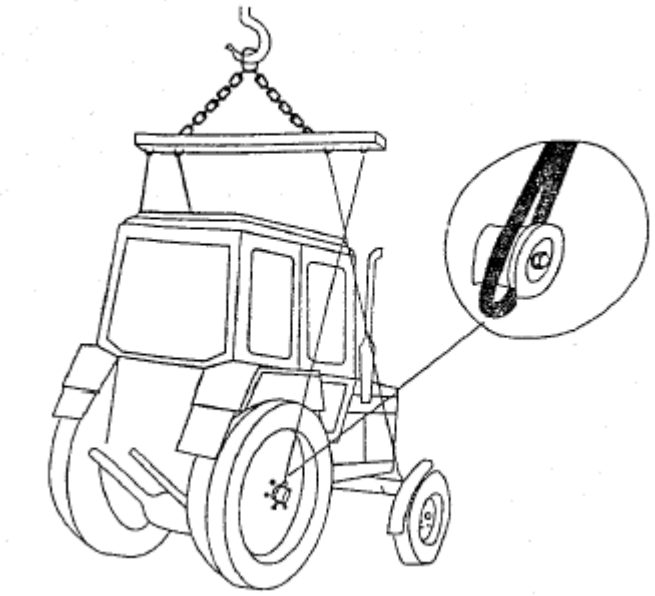


Diagram of tractor slinging

9. SCHEDULED MAINTENANCE

Operator must daily examine tractor to prevent fixing loosening, cooling fluid and oil leaks, clean tractor mechanisms, as well as regularly make scheduled preventive maintenance to provide its operation ability, fire safety and ***safety of operation as part machine-tractor assembly*.**

Instruction for operation and maintenance of RMD and HTDS hydraulic systems:

- In the process of maintaining hydraulic systems of the mounting mechanism and steering control, strictly observe intervals of oil and filters replacement. Do not use oil for filling-in (re-filling), that is not mentioned in recommendations of tractor operation manuals.
- Before filling-in and replacing filtering elements, clean fill-in plugs, necks, filter covers and adjacent surfaces off dirt and dust. When replacing filtering elements rinse inside surfaces of filter bodies and covers with diesel fuel.
- When ganging up with hydraulics-fitted agricultural machines, carefully clean clutches, adapters, connecting pipes and other elements of the tractor and agricultural machinery.
- If hydraulic mounting system operates under high loads (or with hydraulics – fitted agricultural machinery), and is filled-in with oil of unidentified origin, interval of filtering elements replacement should be shortened.

Remember, that pureness of oil in hydraulic systems is guarantee of its trouble-free operation.

Filling-in tanks, l

Table 9-1

Diesel oil crankcase/lubrication system	18/22
Diesel cooling system (OZH-40, OZH-65 or Tosol A 40M	36
Transmission	45
Fuel pump*)	0.25
FDA reduction gear (each)	2.0
Hydraulic system oil tank	35
HTDS oil tanks	6
Fuel tanks (two tanks)	357

*) when new or repaired oil pump is installed.

9.1 SCHEDULED MAINTENANCE CHART

Table 9-2

# of oper.	Description	Interval, hours						
		10		125	250	500	1000	2000
1	Check oil level in the diesel	X						
2	Check level of diesel cooling fluid	X						
3	Check oil level in transmission	X						
4	Check oil level in HTDS oil tank	X						
5	Check oil level in RMD hydraulic system oil tank	X						
6	Check braking fluid level in tanks of main cylinders of clutch and brakes hydraulic drive	X						
7	Drain condensate from pneumatic system cylinder	X						
8	Check brakes operation on the move, diesel operation, steering, illumination and alarm devices	X						
9	Lubricate joints of steering hydraulic cylinders			X				
10	Lubricate bearings of FDA axle pivots			X				
11	Check front wheels toe-in			X				
12	Drain sediment from fuel tanks and fuel coarse filter							
13	Check generator belt tension			x				
14	Check air pressure in tires			X				
15	Check and adjust clutch control mechanism			X				
16	Make service of diesel air purifier			X				
17	Crease bearings of clutch shifter			X				
18 19	Clean rotors of centrifugal oil filters of diesel and gear box				X			
20	Rinse meshed filter of transmission hydraulic system				X			
21 *	Change oil in diesel crankcase				X			
22	Replace filtering element of diesel oil filter				X			
23	Check tension of wheels fixing nuts				X			
24	Check oil level in front PTO reduction gear (if installed)				X			
25	Check oil level in axle beam and reduction gears of FDA finite gears				X			

26	Check and adjust clearances of diesel valves					X		
27	Check steering wheel backlash					X		
28	Drain sediment from fuel fine filter					X		
29	Check tension of bolts fastening of turbo compressor to exhaust pipe arm and outlet collector					X		
30	Check clearances in bearings of FDA reduction gears flanges					X		
31	Adjust travel of brake pedals and parking-reserve brake lever					X		
32	Make service of storage batteries					X		
33	Replace filtering element of RMD hydraulic system oil filter					X		
34	Replace filtering element of HTDS oil filter					X		
35	Check tension of generator fixing bolts					X		
36	Clean filtering element pneumatic system pressure regulator					X		
37	Check air-tightness of connections between air purifier and diesel inlet duct			X				
38	Check pneumatic system air-tightness					X		
39	Clean filter of cabin ventilation and heating system			X				
40	Change oil in oil tank of RMD hydraulic system					X		
41	Check and adjust bearings of FDA finite gear reduction gear						X	
42	Check bolts tension of fastening diesel cylinder heads						X	
43	Check tension of outside bolt connections						X	
44	Clean fuel coarse filter						X	
45	Rinse diesel turbo compressor						X	
46	Change oil in transmission						X	
47	Change oil in HTDS oil tank						X	
48	Change filtering element of fuel fine filter						X	
49	Check generator						X	
50	Change oil in FDA body						X	
51	Change oil in front PTO reduction gear(if installed)						X	
52	Check state of brakes						X	
53	Lubricate bushings of rotation shaft of rear (front) hinge and towing mechanism						X	
54	Check backlash in goints of steering tie-rod (FDA with two steering wheel hydraulic cylinders)						x	
55	Check fuel system							X
56	Check technical state of the starter							X
57	Rinse diesel breathers							X
58	Rinse diesel cooling system							x

9.2. MAINTENANCE PROCEDURES

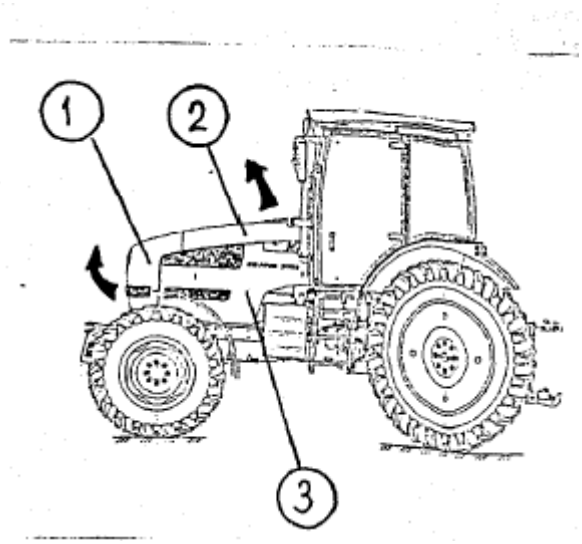
Operator must daily examine tractor to prevent fixing loosening, cooling fluid and oil leaks, clean tractor mechanisms, and do other preventive works to provide tractor operation ability, its fire safety, and safety of operation as part of machine-tractor assembly.

CAUTION! Before starting tractor repair or maintenance, shut down diesel and brake the tractor by parking-reserve brake.
If in the process of works protective shields were removed, make sure to reinstall them upon works completion.
Never drain used oil on the ground. Use special reservoirs for its collection and storage. When changing oil, drain it straight after operation, until it gets cold.
To check oil level put tractor on level horizontal site.

Before starting maintenance works, take off side panels, and raise engine hood. To this end:

- pull back lower front mask section (1), lift it and fix in the raised position with supporting tie-rod;
- press down catch handle and take off left and right-side panels (3);
- pull back handle of hood lock on the left side of tractor, raise hood (2) and fix it in raised position with by placing tie-rod in fixing arm opening.

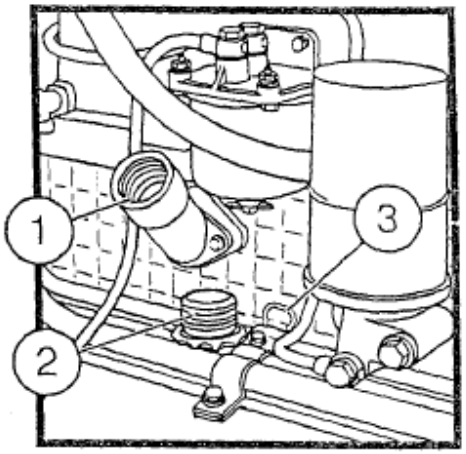
CAUTION! Make sure mask (1) and hood (2) are securely fixed in raised position.



1 – mask, 2 – hood, 3 – hood side panel.

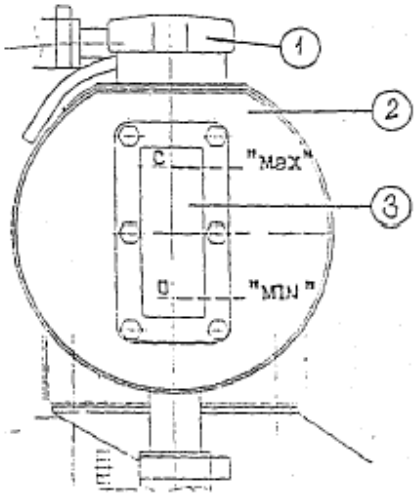
9.3. OPERATIONS OD SCHEDULED MAINTENANCE

9.3.1. After each 10 hours of operation, or daily



Operation 1. Checking diesel oil level.

Shut down diesel, wait for 3..5 minutes and check oil level. Oil level should be between upper and lower marks of dip stick (3). If necessary, remove cover (2) of oil-filling neck (1) and fill-up oil to upper mark of dip stick (3).



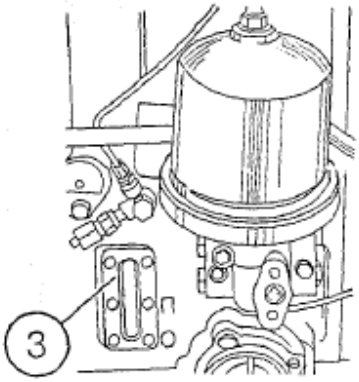
Operation 2. Checking cooling fluid level

Remove plug (1) of expansion tank (2) and fill up cooling fluid to level “max” © on level indicator (3). Put plug (1) in place.

CAUTION! Do not allow fluid level dropping below mark “min” (0). Do not fill up the cooling system with water!

Operation 3. Checking oil level in transmission

Visually check oil level on indicator (3), situated on the right side of transmission. Oil level should not be lower than 10 mm from mark “P”. If necessary, remove plug of oil-filling neck and refill oil to mark “P”. Normal oil level is about 0.5 mm from mark “P”.



Operation 4. Checking oil level in HTDS oil tank

- put tractor on a level horizontal site and shut down diesel;

- Check oil level on oil measuring stick (1);
- Oil level should be between upper and lower marks on the measuring stick;
- Remove plug (2) of oil filling neck and top oil up the upper mark.
- Put plug in place.

Operation 5. Check oil level in hydraulic system oil tank

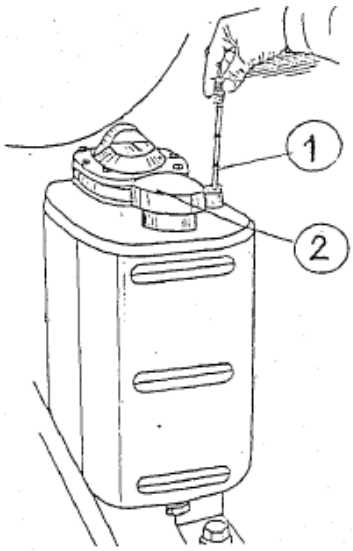
Check oil level in oil tank (2) on oil measuring stick (3).
Oil pressure should be between marks “0” and “P” of the oil measuring stick. If necessary, remove plug (1) off oil filling neck and top oil up mark “P” on oil measuring stick, and in this case RMD should be in end lower position.

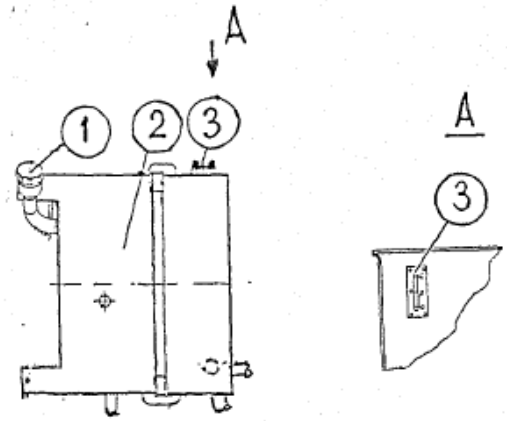
NOTE When tractor operates with machines that require increased oil take off, refill oil to mark “C” on oil measuring stick with hydraulic cylinders of the mounted machine drawn in.

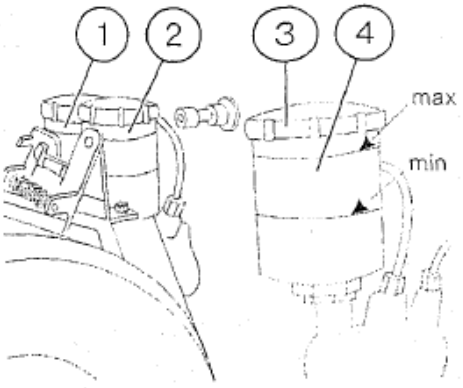
Operation 6. Checking fluid level in tanks of hydraulic drives of clutch and main brakes

Visually check fluid level in tank (4) of clutch master cylinder (on the left side as tractor moves), and tanks (1,2) of brakes master cylinders (on the right side as tractor moves). Fluid level should be between marks “min” and “max” imprinted on tanks’ housing. If necessary, full up liquid “Neva” (TU 6-01-34-93) to marks “max”, having unscrewed covers (3) first.

To control fluid level in tanks (1,2) of main brakes master cylinders, in cover of one of cylinders sensor (5) for braking fluid level is installed.



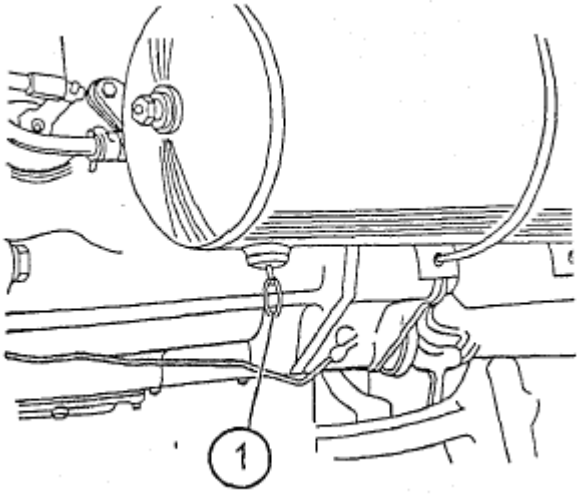




CAUTION! Filling in the system with fluids of other grades can lead to malfunctioning of hydraulic drives of clutch and main brakes control.

Operation 7. Removing condensate from pneumatic system cylinder

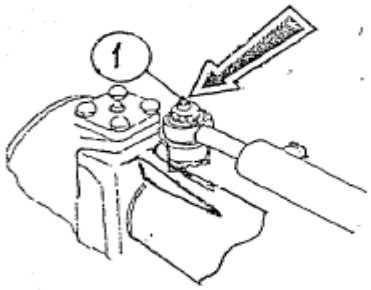
To remove condensate fron cylinder pull ring (1) to any side, and if compressed air available, keep it this way until condenaste is fully released.



Operation 8. Checking serviceability of diesel, steering, brakes, illumination and alarm systems

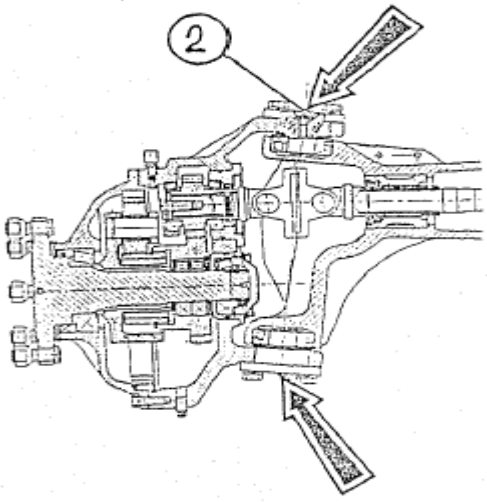
- Diesel should reliably operate in all modes.
- Controls, light and sound alarm instruments should be in running order.
- Left and right-side main brakes must operate in synchronism.

3.3.2. Within each 125 operation hours fulfill previous maintenance operations plus the following:



Operation 9. Lubrication of joints of steering hydraulic cylinders

Using grease gun, grease joints via oil cups with grease “Litol –24” or Behem LCP –G4 (4 greasing points for two steering control hydraulic cylinders, 2 greasing points for two-rod hydraulic cylinder).

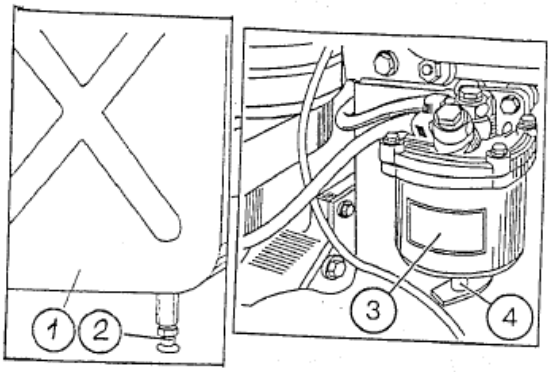


Operation 10. Lubricating bearings of lower and upper axles of reduction gear rod in finite FDA gear

* Lubricate oil cups (2) with grease “Litol –24 or “Behem LCP –GM” by making 4…6 injections (4 lubrication points)

Operation 11. Checking front wheels toe-in

Front wheels toe-in should be within 0…8mm.
If necessary, make adjustment as shown on page 216 (item 9.4.3).

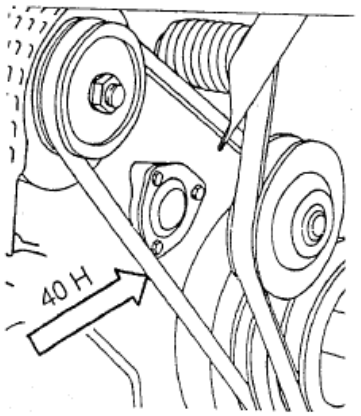


Operation 12. Drain of sediment from fuel tanks and fuel coarse filters

Unscrew plugs (2, 4) and drain from fuel tanks (1) and filter (3) correspondingly, until pure fuel appears. Screw plugs up.

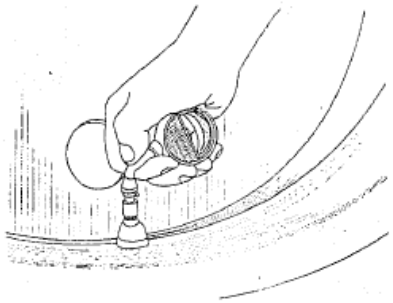
Operation 13. Generator belt tension

Belt tension is thought to be normal, if sagging on the side: crankshaft pulley-generator pulley is within 29…33 mm when pressed with force 40 N (4 kgs). To adjust belt tension, loosen generator fastening. Adjust belt tension by shifting generator body. Tighten bolt of bar fastening and nuts of generator fixing bolts.



Operation 14. Checking air pressure in tires

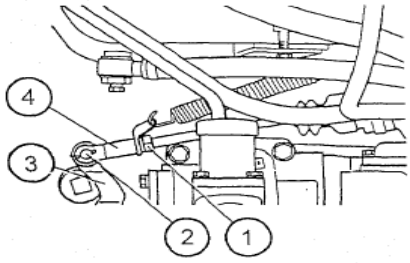
Air pressure in tires of front and rear wheels should be within 100…160 kPa
And 80…160 kPa correspondingly, depending on the type of works being performed. If necessary, bring pressure in tires to normal.



Operation 15. Adjusting mechanism of clutch control

Follow the following sequence to adjust mechanism of clutch control:

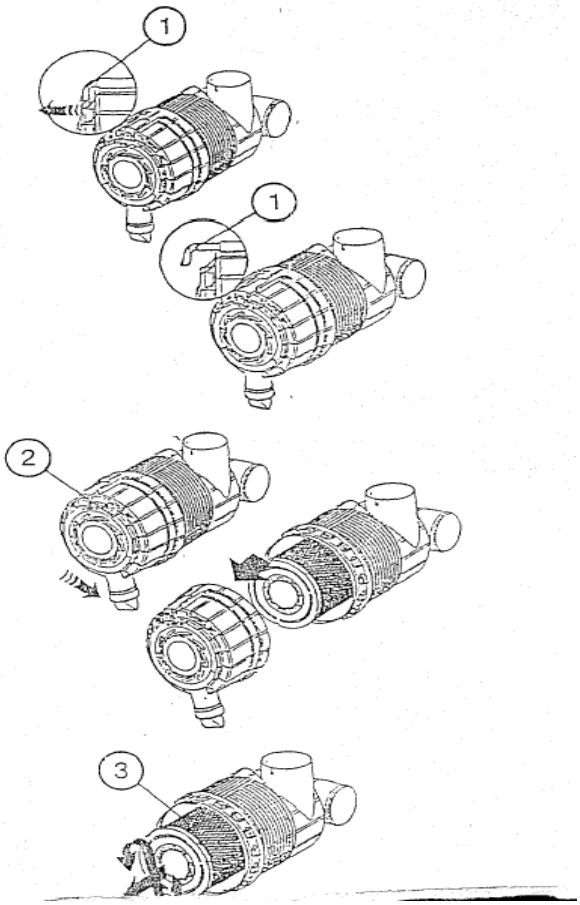
- loosen check nut (1), remove cotter pin and pull out pin (2);
- turn lever (3) anti clockwise to the end of pressure bearing up to squeeze levers, and turning yoke (4), align openings of lever and yoke. After that tighten yoke by 5.5 turns and connect to lever by way of pin (2);
- put parts back in place in the reverse order; secure the yoke and put aside cotter pin ends.



Operation 16. Maintaining air purifier

Use clogging indicator to control clogging of air purifier filtering elements. With high degree of clogging the signal lamp on the instrument panel of the box of control lamps lights. Make servicing of the air purifier in the following sequence:

- push forward hood mask in front of the tractor to get access to air purifier ;
- pull back catch (1) (yellow color), turn cover (2) anti clockwise by 12.5 ^{0} and remove it;
- remove main filtering element (3);
- check control filtering element (CFE) for dirt, without taking it out off the body.



CAUTION! Removal of CFE from the body is not recommended.
Soiling of CFE testifies to the fact, that MFE is damaged (breakage of paper curtain, ungluing of the bottom). In this case rinse CFE and replace MFE.

- Blow over the main filtering element with compressed air, first from inside and then from outside to remove dust. To avoid breakage of the paper curtain, air pressure should not exceed 0.2 – 0.3 mPa (2-3 kgs/cm $^{2)}$.

Air jet should be directed at an angle to filtering element surface. During servicing the filtering element must be protected from mechanical damage and oiling.
When compressed air blow over of soiled or oily filtering element proves to be inefficient, rinse it in soap paste solution OP-7 or OP-10 and water, heated to temperature of 40-50 ^{0}C.
Solution is made of 20 g of paste per one liter of water. If paste is not available, one can use solution of household detergents of the same concentration.
To rinse the element, submerge it in soap solution for half an hour, then rinse intensively for 15 minutes, then rinse in pure water heated to 35-45 ^{0} C and let it dry out for 24 hours. Do not use open flame and air with temperature over + 70 ^{0} C for drying.

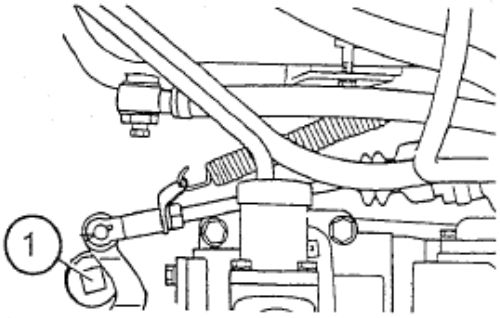
- Assembly the air purifier in the reverse sequence.
-

NOTE: When operating in very dusty conditions, check state of MFE after each 20 hours of tractor operation.

CAUTION! After assembly of the air purifier check air tightness of all outlet duct connections. To this end, start the diesel and at average frequency of diesel crankshaft rotation shut air purifier pipe. Diesel must stop fast. If not, find out the cause and correct it.

- Reinstall the hood mask.

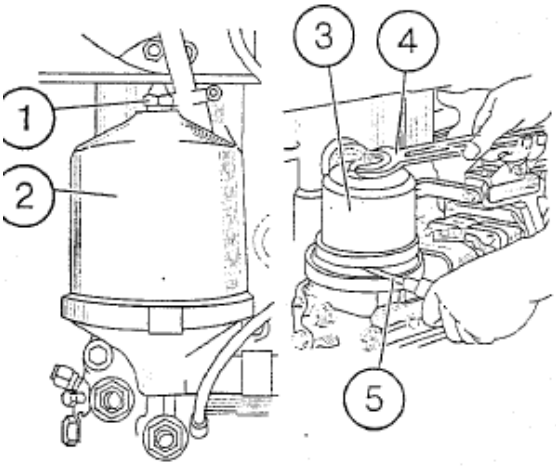
Operation 17. Lubricating bearing of clutch shifter



Unscrew plug (1) on the left-side of the clutch housing, insert in the opening the tip of lever-plunger injector and via shifter grease cup make four-six injections. Place plug (1) in place.

9.3.3. within each 250 hours of operation fulfill operations of the previous maintenance plus do the following:

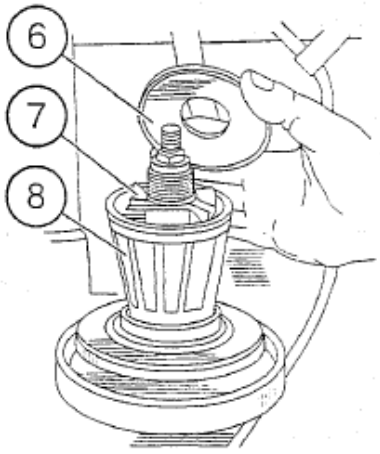
Operations 18, 19. Cleaning rotors of centrifugal oil filters of diesel and gear box, correspondingly



Unscrew nut (1) and remove cup (2). Using wrench (4) and screwdriver (5) remove rotor cup (3). Remove cover (6), impeller (7) and filter (8). Rinse meshed filter in diesel fuel. Scrape sediment off inside walls of rotor cup (3)

Grease rubber sealing ring with motor oil. During assembly align marks on the cup and rotor housing. Torque nut (1) to 35…50 Nm.

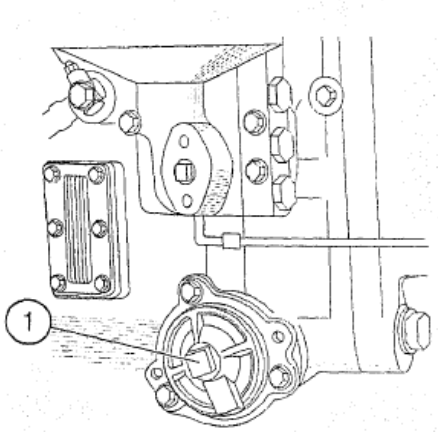
CAUTION! Diesel and gear box filters ıction properly, if upon shut down of ıted diesel, from under filters' caps light se of rotating rotors is heard.



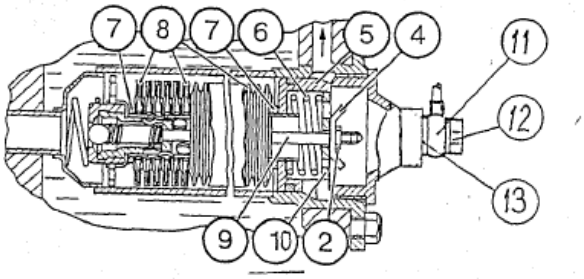
Operation 20. Rinsing meshed filter of gear box hydraulic system.

- Unscrew rotating elbow bolt (12), remove two rings (13), having disconnected oil conduit (11) from cover (1);
- Unscrew cover (1) of meshed filter and using clamp (4) pull out filter in assembly.

- Disassembly filter by sequentially unscrewing check nut (2) and clamp (4) with pin (9). Remove washer (1), spring (6), piston (5), sealing ring (7) and filtering elements (8).
- Carefully rinse elements in diesel fuel until dirt is fully removed;
- Assembly filter in reverse order, paying attention to rings (7) being installed on both sides of filtering elements set.



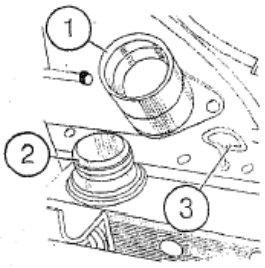
ATTENTION! Screw clamp (4) upon pin (9) until washer (10) is flush with piston end face (5).

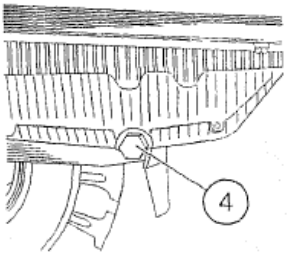


- Connect oil conduit (11) to cover (1), having installed rings (13) and bolt (18).

Operation 21*) Changing oil in diesel crankcase

- Heat diesel up to normal operation temperature (70^0 C minimum).
- Put tractor on plane surface, shut down diesel and brake tractor.
- Remove cover (2) of oil-filling neck and unscrew drain cock (4). Drain oil in proper reservoir for oil storage.
- Put drain plug in place, and through oil filling neck (1) fill in fresh motor oil HESSOL TURBO DIESEL SAE 15W-40 (API CF-) up to the upper mark of oil measuring stick (3)
- Put oil-filling neck cover (2) in place.
- Start diesel and let it operate for 1-2 minutes.
- Using dip stick (3) check oil level, as described in operation 1.
- If necessary, top oil up to level.





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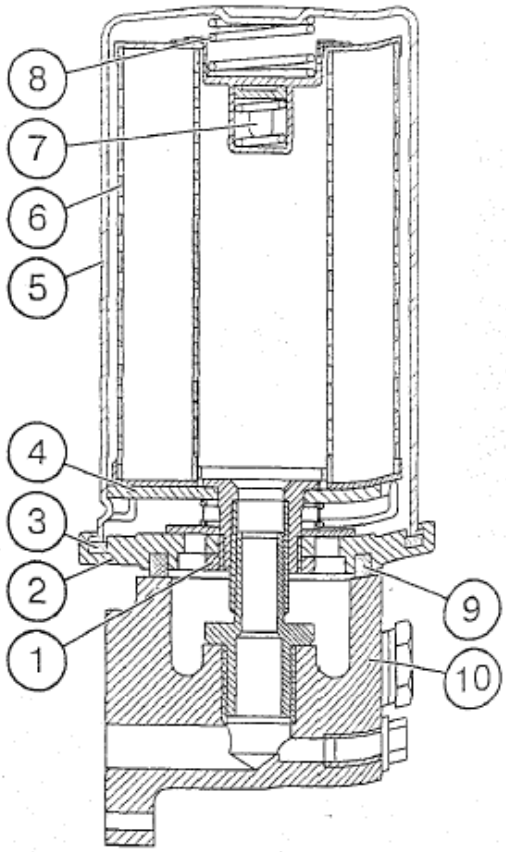
*) Within each 125 hours of operation when using motor oils M-8G $_2$; M-8G $_{2K}$, M-10G $_2$, M-4 $_3$ 08G $_2$.

Operation 22*) Replacing PFE of diesel oil filter (do at the same time with oil change):

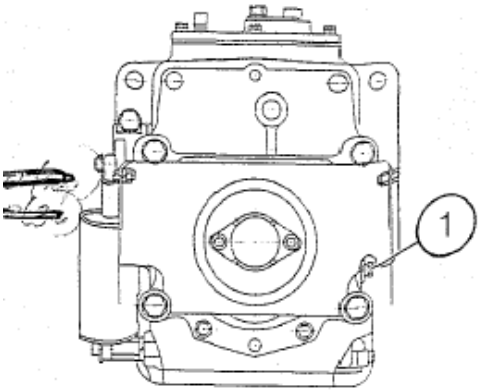
- Unscrew cap (5) with paper filtering element (6) as an assembly.
- Unscrew nut (1) and remove bottom (2) with washers (3 and (9).
- Press clamping (4) having pushed it inside the cap (5) by 3…4 mm, and than rotate it to align three projections of clamping (4) with cap grooves (5)
- Remove clamping , PFE, relief valve, spring (8).
- Rinse all parts with diesel fuel.
- Install new filtering element in reverse order. If required, replace washers (3) and (9). Torque nut (1) to 30…40 Nm. Grease nut (9) with motor oil.
- Screw filter as an assembly additionally by ¾ of turn after washer (9) touches body (10).



CAUTION! Screw filter in only manually by grasping filter cap (5).

Operation 23. Checking tightness of wheels fastening nuts

Check and, if necessary, torque wheels tightening nuts to:
- front wheels – 280…320 Nm;
- front wheels (disc – rim) – 160…200 Nm;
- rear wheels – 700…750 Nm.

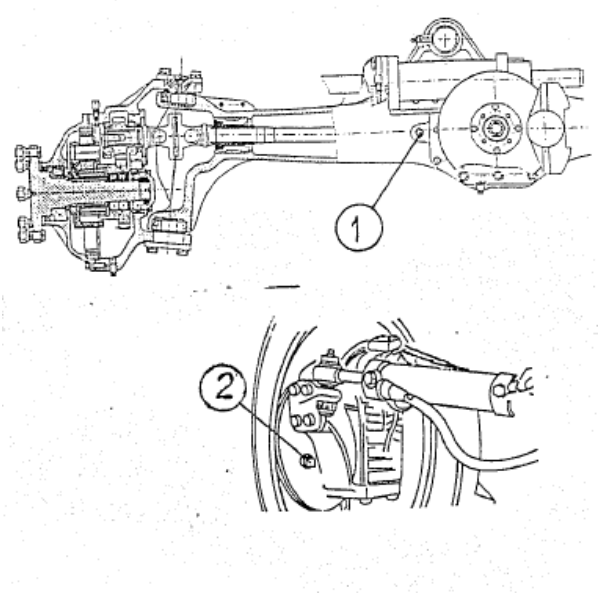


Operation 24. Checking oil level in front PTO reduction gear (if installed)

Unscrew plug (1) of control-fill-in opening (on the right-side of the reduction gear housing). Oil level should reach threaded plug opening.

*) Within each 125 hours of operation if motor oils complying with GOST are used.

Operation 25. Checking oil level in beam and reduction gears of final FDA drives



Check oil level:

- In crankcase of final reduction gears' drives. If required, fill-in oil to the level of control-fill-in opening, closed with plug (2).
- In front drive axle beam. If required, fill-in oil to the level of control – fill-in opening, closed with plug (1).

Grades of oils being filled-in:
- transmission oils: Tap 15V, TAD-17, or their analogues.

9.3.4. Within each 500 hours of operation fulfill previous, maintenance operations plus the following:

Operation 26. Checking and adjusting clearances in diesel valves

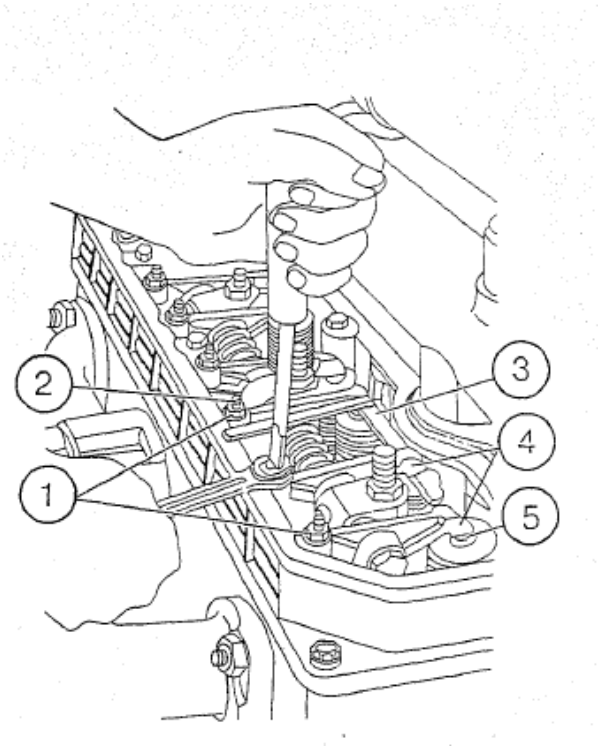
Check and adjust clearances also after cylinders' head is removed, fastening bolts are fastened, and valves start chattering.

NOTE: Check clearances with diesel cold, having checked tightening of bolts of cylinders' heads in advance.

- remove caps of cylinders heads' covers..
- check bolts and nuts tightening used for fastening of rocker axles posts (60…90 Nm).
- Rotate crankshaft until valves in the first cylinder overlap (inlet valve starts opening, and discharge valve terminates closing).
- Adjust clearances in valves 3, 5, 7, 10, 11 and 12 (numbering starts from the fan).

CAUTION! Clearances size between end faces of valves' rods (5) and heads of rockers (4) should be 0.25…030 mm for inlet valves, and 0.40…0.45 mm for discharge valves.

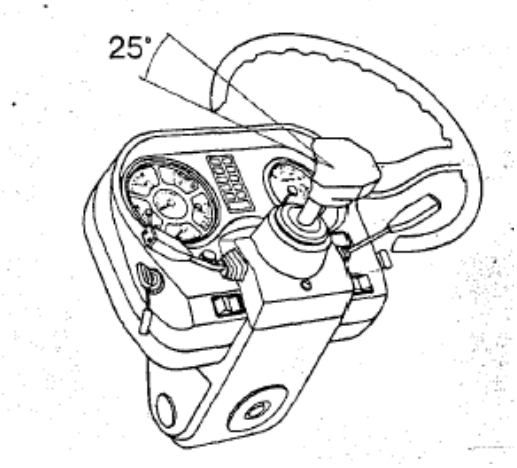
* Rotate crankshaft by 360 p, having set overlap in cylinder6, and adjust clearances in valves 1, 2, 4, 6, 8 and 9.



- To adjust clearance, loosen check nut (1) of adjustment screw (2) and set required clearance by clearance gauge (3) using a wrench and a screwdriver. After clearance is set, tighten check nut (1) check clearance anew using a clearance gauge.
- Having completed adjustments, put removed parts in place.

Operation 27. Checking backlash of steering

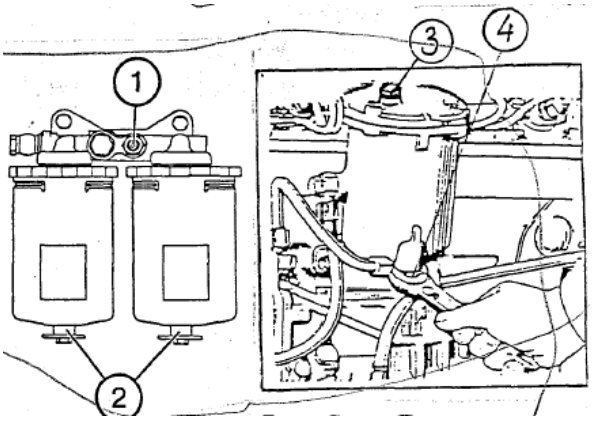
When steering backlash, exceeding 25p, appears, eliminate backlash in joints of steering trapezoid, tighten nut of turn levers, eliminate backlash in steering column and steering drive.



Operation 28. Drain of sediment from fuel fine filter

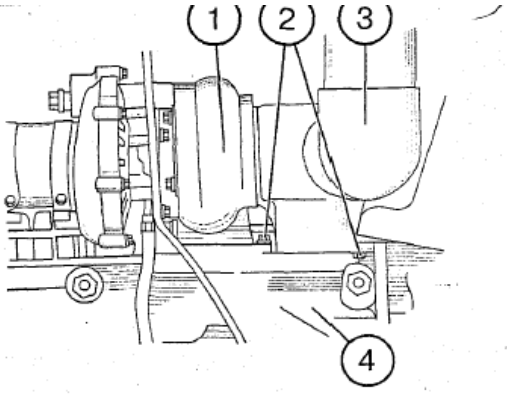
Turn plug (1) by 2…3 turns (plug (3) for in-line fuel pump) of air outlet.

- One by one unscrew cocks (2) of filter caps (cock (4) for in-line fuel pump diesel) and drain sediment until pure fuel comes out.
- Tighten cocks and bleed-in the fuel system (operation 48).



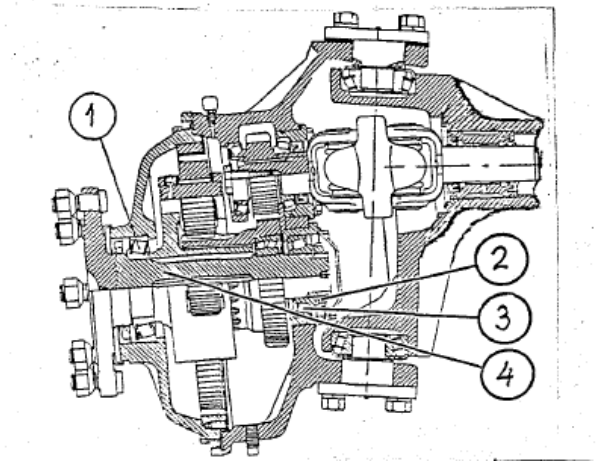
Operation 29. Checking tightening of fastening bolts and the exhaust pipe arm to diesel exhaust manifold

Check tightening of bolts (2) for fastening of turbo compressor (1) and exhaust pipe (3) to exhaust manifold. If required, torque bolts to 35…40 N.m (3.5…4.0 kgs.cm). No loosening of fastening is allowed.



Operation 30. Checking clearances in bearings of FDA reduction gear flange

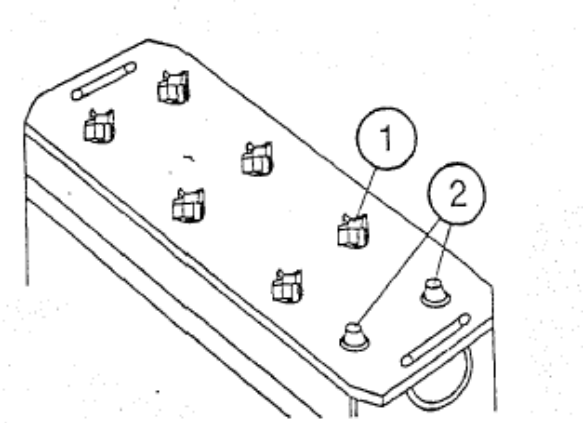
Check and, if required, adjust coned roller bearings (1, 3) of flange (4) without clearance using nut (2). Tighten the nut in order to chose clearance and secure it in two flange slots.



Operation 31. Adjusting travel of brake pedals and parking-reserve brake lever (See section 5.8)

Operation 32. Servicing storage batteries

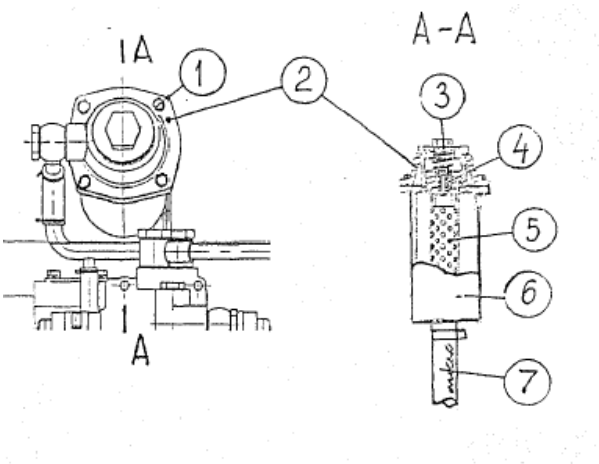
- To get access to SB and ground switch, push forward hood mask.
- Clean batteries of dust and dirt.
- Remove plugs of filling-in openings of storage batteries, check electrolyte level and density in each cell jar; if required, add distilled water to raise electrolyte level to over protective grid by 12…15 mm, or between control marks on transparent battery body.
- Check state of terminals (2) of output rods and ventilation openings in plugs. If required, grease terminals with technical vaseline and clean ventilation openings in plugs.



CAUTION! The battery contains sulphuric acid, that causes burns when in contact with skin, eyes or clothes.
When acids is in contact with outside bode parts, rinse them profusely with pure water, if it gets inside – drink big amount of water or milk. When acid contacts eyes, wash the profusely with pure water for 15 minutes and then consult a doctor.
Do not allow sparkle or flame in electrolyte zone – this may lead to explosion. Charge batteries in well-aired room. To service battery use goggles and gloves.

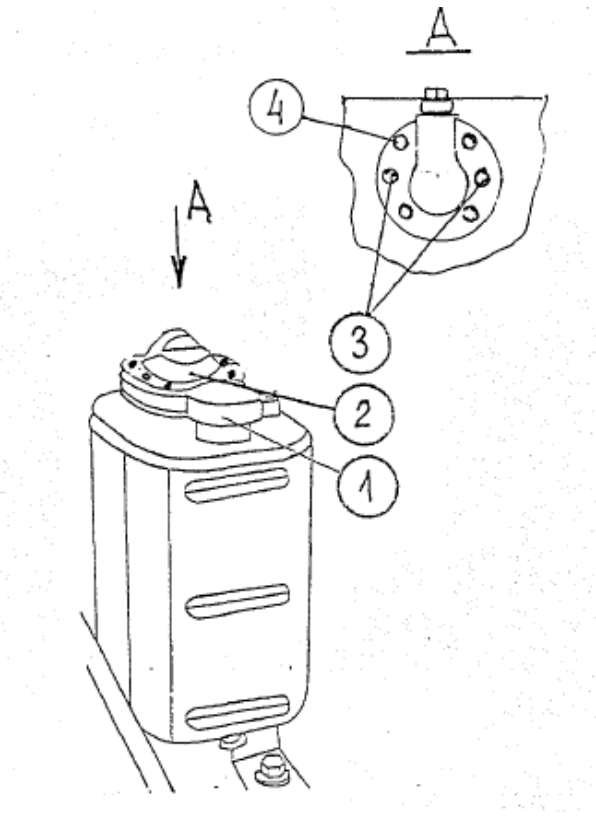
Operation 33. Changing filtering element of hydraulic system oil filter

- Unscrew bolts (1) and remove cover (2) in assembly with valve (4) and plug (3);
- Pull out filtering element (5);
- Clean inside body cavity (6)having disconnected hose (7) in advance;
- Install new filtering element, put in place cover in assembly and tighten bolts. Connect hose (7).



Operation 34. Replacing PFE of HTDS oil filter

- Unscrew four bolts (4) and remove cover (2) with filtering element and cup in assembly;
- Unscrew two bolts (3) and disconnect filtering element from the cup;
- Clean the inside cup cavity;
- Install new filtering element and assembly cover with filter elements an cup in assembly, having fixed them by bolts (3);
- Put filter element inside oil tank and tighten bolts (4);
- Check oil level and, if required, refill, having removed plug (1).



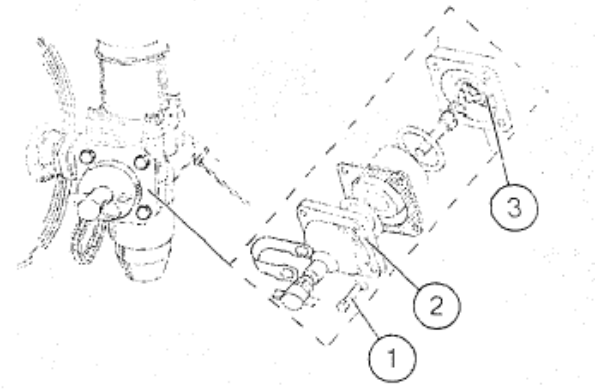
Operation 35. Checking tightness of generator fastening bolts

Check generator off dust and soil. Check fastening bolts tightness, reliability of fixing electric wiring contacts.

CAUTION! Next change PFE after each 1000 hours of operation.

Operation 36. Cleaning filtering element of the pneumatic system pressure regulator

- Unscrew bolts (1);
- Remove cover (2) and pull out filtering element (3);
- Rinse filtering element in washing solution and blow over with compressed air;
- Assembly filtering element in reverse order.



Operation 37. Checking air-tightness of air purifier connection to inlet duct (after each 125 hours of operation)

- start the diesel;
- set average idle run speed;
- shut inlet pipe to air purifier. Diesel must stop;
- if the diesel keeps on functioning, find out and correct non-tightness of connection between air purifier and inlet duct.

Operation 38. Checking air-tightness of pneumatic system

Air pressure in the pneumatic system within 30 minutes should not drop by more than 0.2 MPa (20 kPa), with free position brakes steering and switched off compressor.
Air pressure in the cylinder, sustained by regulator, should be 0.65…0.80 Mpa (650…800 kPa)

Operation 39. Cleaning filter of cabin ventilation and heating (after each 125 hours of operation)

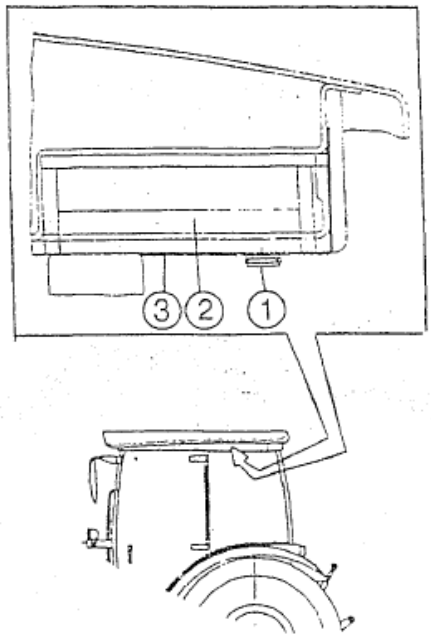
CAUTION! With high ambient humidity, before filter cleaning, do not switch on the fan, as it's difficult to remove dust from wet paper filtering element.

Filtering elements of the ventilation system are installed on both sides of the tractor cabin.

- To get access to the filter place a platform or small ladder;
- Unscrew two screws (1) with plastic heads under extended edge of cabin roof;
- remove panel (2) and pull out filter (3);
- shake dust out of filter by light knocks.

To check air tightness of charged air cooling system between turbo charger and diesel output manifold:

- Set maximum speed of diesel idle run;
- Put soap solution in places, where hoses and air ducts are connected;
- Find out and correct non-tightness of connections;



Take care not to damage paper filtering element!

- Clean filter by compressed air under pressure of 1 MPa maximum. Not to damage paper filtering element keep the hose tip not closer than 300 mm away from filter. Direct air jet through the filter opposite to normal air flow movement, indicated by arrows, imprinted on the filter.

Operation 40. Changing oil in the oil tank of RMD hydraulic system

After oil in the hydraulic system oil tank reaches operation temperature:

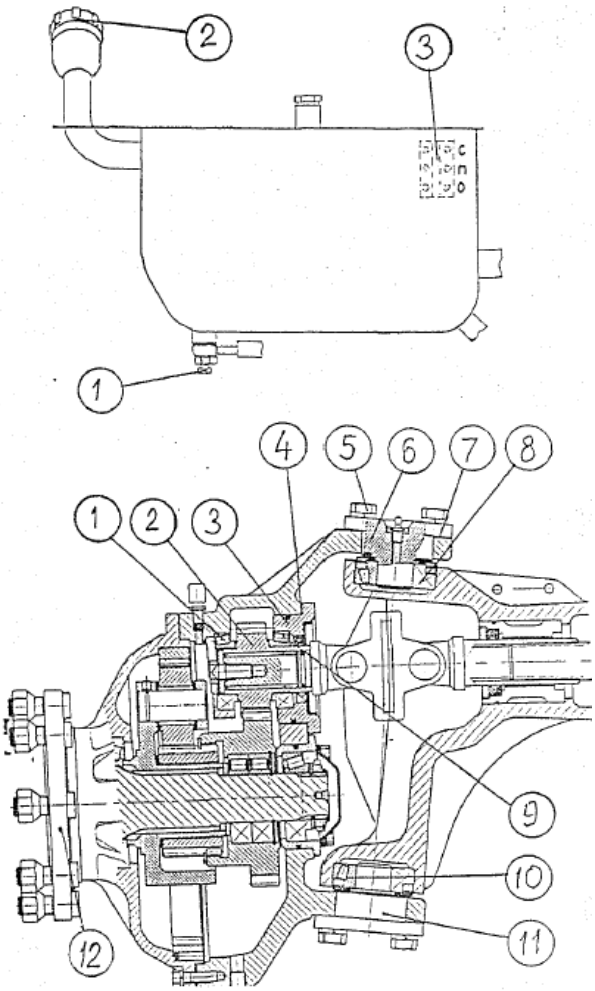
- unscrew plug (2) of the fill-in neck;
- unscrew cock (1) in the drain opening and drain oil out of oil tank in a special vessel;
- screw cock (1) up, fill in fresh oil to mark "F" of oil indicator (3), put plug (2) in place.

Operation 41. Checking/adjusting reduction gear bearings of FDA final drive

1. Bearings (1, 9) of drive gear (2) should have backlash not more than 0.05 mm. If necessary, make adjustment by changing the number of cut washers (4) between cup (3) and the housing.
2. Bearings (8, 10) of pin axles (6, 11) should be tight. If necessary, make following adjustments:

- Unscrew four bolts (5) and screw two of them in dismantling openings in axle (6) to shift out axle and release spacers (7);
- Take off needed number of spacers and put axle (6) in place, having tightened bolts (5). Tightness of bearings should be such, that cam rotation force applied to flange (12), was within 60-80 N;
- Put filter in place, fulfilling operation in the reverse order. Repeat operations and clean filter on the other tractor side.

NOTE: When tractor operates in very dusty conditions, clean filter after 8-10 hours of operation, i.e., each shift.

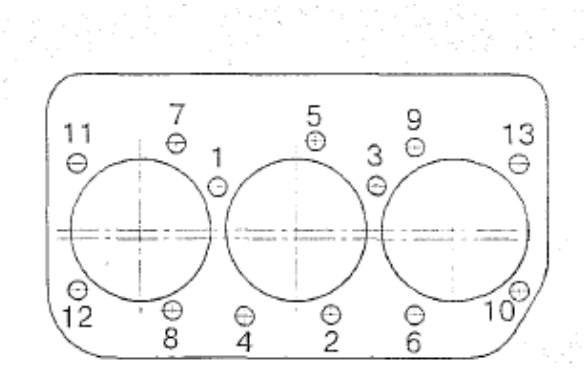


9.3.5. After each 1000 hours of operation fulfill operation of the previous maintenance plus do the following:

Operation 42. Checking bolts tightness of two diesel cylinder heads

With diesel heated up, tighten bolts in the following sequence:

- remove caps and covers of cylinder heads;
- remove rocker axles together with rockers and posts;
- using torque wrench, check tightness of all bolts that fix cylinder heads, in the order shown in figure to the right. Torque must be within 190…210 N.m (19…21 kgs.m).



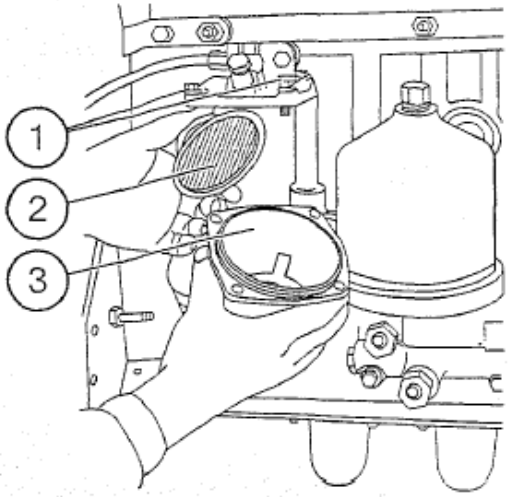
After bolts are tightened, put axle of rockers in place, check and, if necessary, adjust clearances between valves and rockers (see operation 26).

Operation 43. Checking tightness of outside bolted connections

Check tightness and, if required, tighten outside bolted connections: front and rear wheels, fastening of front wings' arms, front beam semi-frame; diesel – clutch housing; ; clutch housing – gear box housing; gear box housing – rear axle housing; rear axle housing – upper cover; rear and front cabin supports; nuts of front drive axle; bolts of cardan shaft flanges; bolts of half-axles' housings.

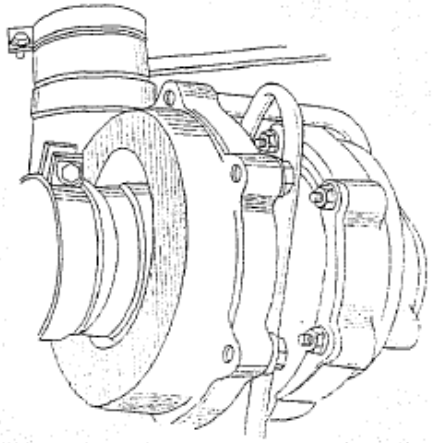
Operation 44. Cleaning fuel coarse filter

- Clean the outside filter surface, unscrew nuts (1) for cup fixing; remove cup (3), unscrew deflector (2) with mesh. Remove scatterer.
- Rinse deflector with mesh, scatterer and cup inside cavity in diesel fuel.
- Assembly filter in reverse order and bleed off fuel system (see operation 48).



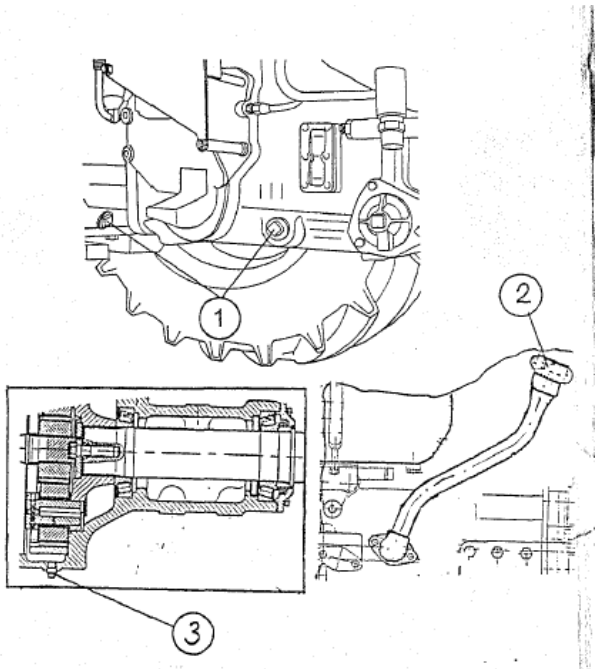
Operation 45. Rinsing turbo compressor

Take turbo compressor off diesel and without dismantling it, submerge in kerosine or diesel fuel for two hours, than blow over with compressed air and put in place.



Operation 46. Changing oil in transmission

1. Operate the tractor and heat oil in transmission.
2. Remove plug (1) of fill-in neck, situated on the clutch body on the right side;
3. Unscrew drain cocks (1) of the transmission and cocks (3) of half-axle hoses;
4. Drain oil from transmission housing into vessel intended for oil collection;
5. Put drain cocks in place and fill in fresh oil up to mark “F” on the oil indicator (see operation 3). Put plug (2) in place.
6. Operate the tractor for 5…10 min and check oil level. If necessary, fill in up to level.

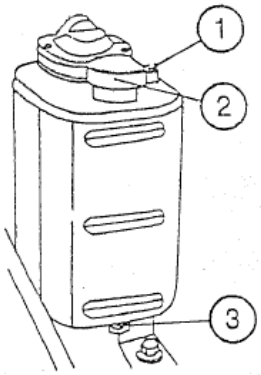


Operation 47. Changing oil in HTDS oil tank

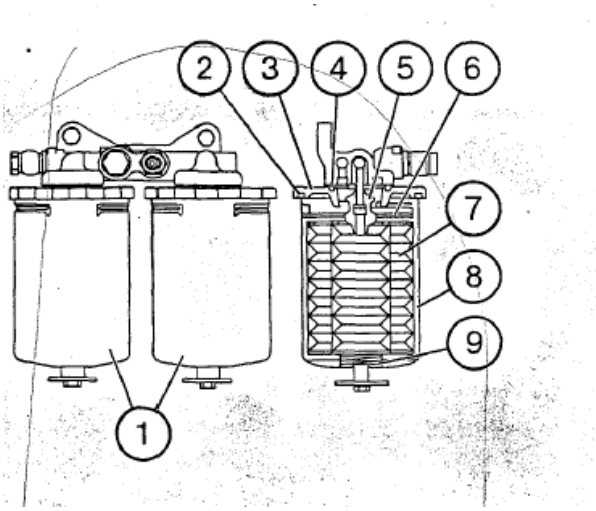
_ Heat oil in HTDS hydraulic system.

CAUTION! Take care not to get burnt when in contact with hot oil.

- Put tractor on horizontal terrain.
- Remove plug (2) of filling-in neck and drain cock (3). Drain oil in vessel for used oil. Dispose of oil correctly.
- Put drain cock in place and fill in fresh oil Hessol Bechem Staroil #32 Hydraulikoil up to upper mark level on oil measuring stick (1). Put plug of filling in neck in place.



Operation 48. Changing filtering elements of fuel fine filter



- Unscrew filters (1) in assembly.
- Disassembly each filter (1), having fulfilled the following operations:

- remove nut (5), bottom (3) with rings (2) and (4);
- pressing clamping (6) sink it inside cap (8) by 3..4 mm and rotate until three extensions of the clamping aligned with outlet cap grooves;
- take clamping, PFE (7) and spring (9) out of the cap;
- rinse inside cavities of caps, and all filter parts in diesel fuel.

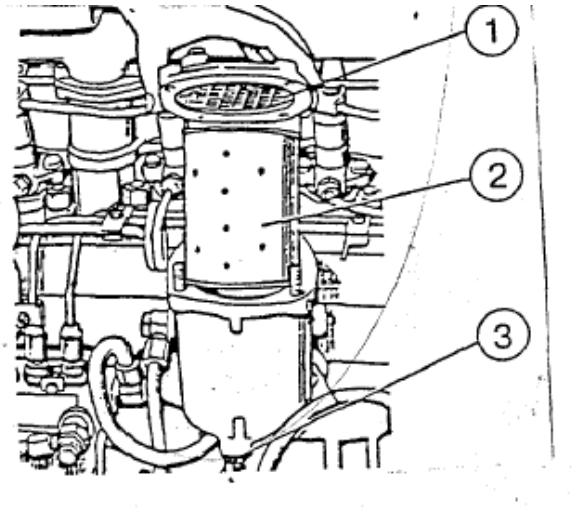
- Replace filtering elements for new ones and assembly filtering elements in the reverse order.
- Check state of rings (2) and (4) and, if needed, replace them.
- Torque nut (5) to 30-40 N.m.
- Grease ring (4) with motor oil and screw each filter by ¾ of turn after ring touches filter body.

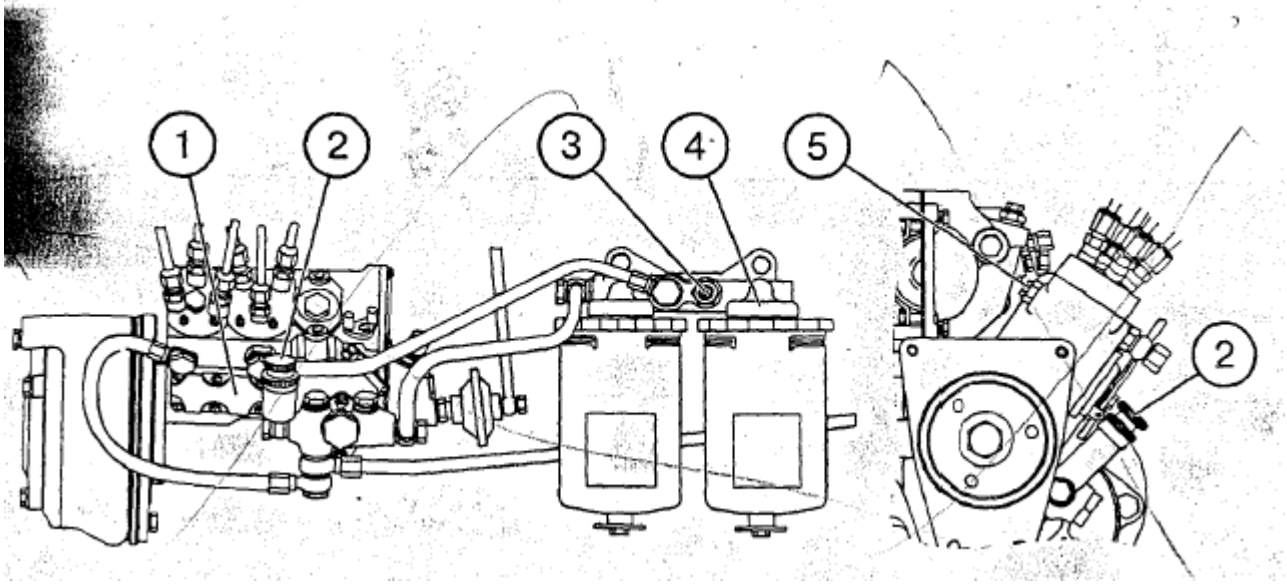
IMPORTANT! Screw filters in assembly (1) inside the body only by hand.

For diesel with in-line fuel pump:

- Unscrew cock (3) and drain sediment out.
- Unscrew four nuts and remove cover (1).
- Remove from the body and discard filtering element (2).
- Rinse body and cover with pure diesel fuel.
- Check cover sealing and, if necessary, replace it.

- Place new filtering element.
- Screw cover (3) up.
- Put cover and fixing nuts.
- Open fuel tank valve and fill in the system with fuel.





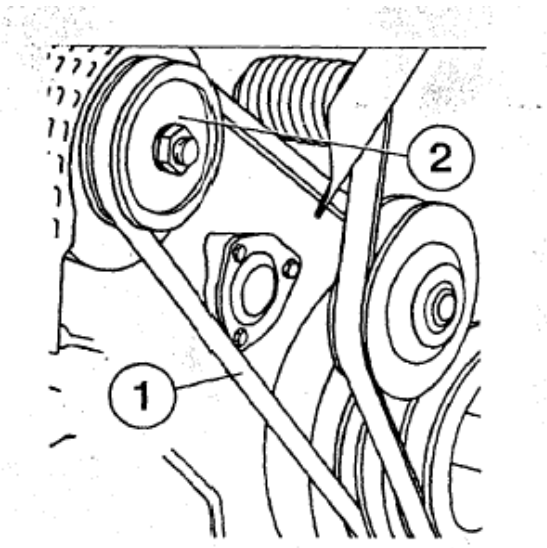
Release air from the fuel system, having fulfilled the following operations:

- Unscrew plug (5) by 2…3 turns to release air from fuel pump (1), installed on the block of cylinders' side.
- Unscrew plug (3) by 2…3 turns on body (4) of fuel fine filters

Operation 49. Checking generator

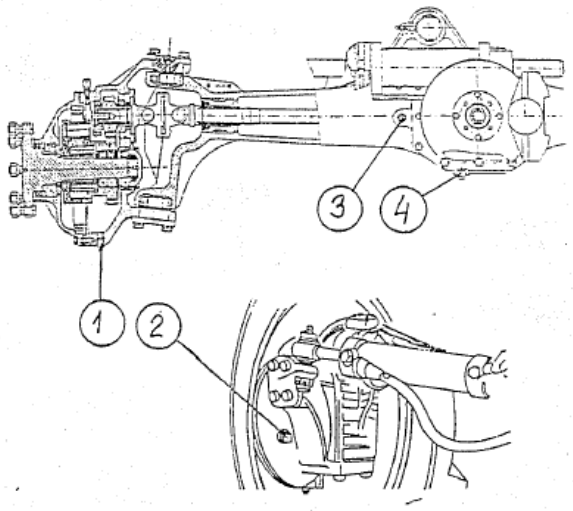
Take driving belt (1) off pulley (2) of the generator, and check rotation smoothness and backlash in rotor bearings. If rotor has backlash and jams, remove generator and send for repair to a workshop.

* Bleed fuel system off by manual pump (2), turn by turn screwing up (when fuel without air bulbs comes out) plug (3) on fine filter, then plug (5) on the fuel pump. Screw up lever (2) of manual pumping.



Operation 50. Changing oil in FDA bodies

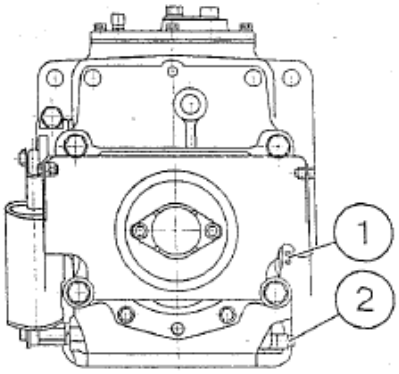
- Operate the tractor and heat up oil in FDA bodies.
- Put tractor on plane horizontal terrain. Engage parking brake and lock wheels on both sides with wedges.
- Remove control-fill-in plugs (2, 3) and drain cocks (1, 4). Drain oil in special vessels for used oil. Dispose of oil correctly.
- Put drain cocks (1, 4) in place, and tighten them.
- Fill in reduction gears' body and FDA beams with fresh transmission oil Tap-15V or TAD-17 up to the lower rim of control- filling-in openings (see "filling-in tanks").
- Put plugs (2, 3) in place and tighten them.



NOTE: Also change oil during seasonal maintenance

Operation 51. Changing oil in front PTO reduction gear (if installed)

Unscrew plug (2) and drain used oil. Fill-in fresh oil Tap-15V, or TAD-17i to the level of control-filling-in opening (1). (Filling-in reduction gear tank (4, 4a)).

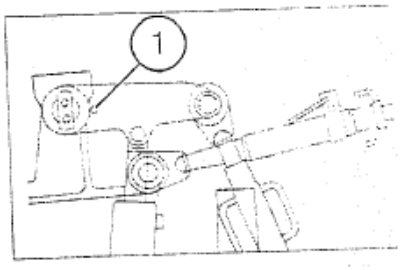


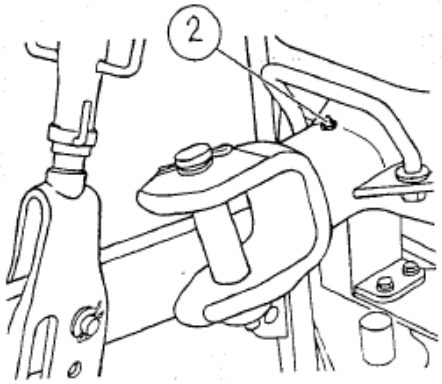
Operation 52. Checking state of brakes

Check main brakes for oil leaks on brake cover spacer and drive roller sealing ring. If required, replace worn-out parts and tighten fixing bolts.
Check and, if required, adjust travel of main brake pedals (see 5.8.4. "Adjustment of brakes").

Operation 53. Lubricating rotating shaft bushings of rear (front) mounting and towing mechanism

Clean two oil cups (1) situated on rear axle cover bosses, and also oil cup (2) of towing device. Lubricate them under pressure until grease comes out of clearances.

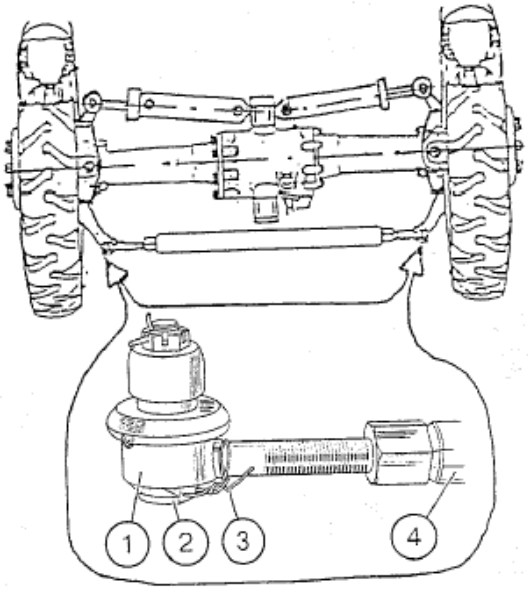




Operation 54. Checking backlash in joints if steering tie-rod *(*if FDA with two hydraulic cylinders of steering control is installed)

With operational diesel, rotate steering wheel to both sides to check free travel and backlash in joints (1) of steering tie-rod (4).
If there is backlash in joints, do the following operations:

- untie securing wire (3);
- screw up threaded plug (2) in a way to eliminate clearance in joint connection;
- secure plug with wire (3).



NOTE: If backlash in joints is not eliminated by tightening of threaded plugs, disassembly the joint and replace worn-out parts.

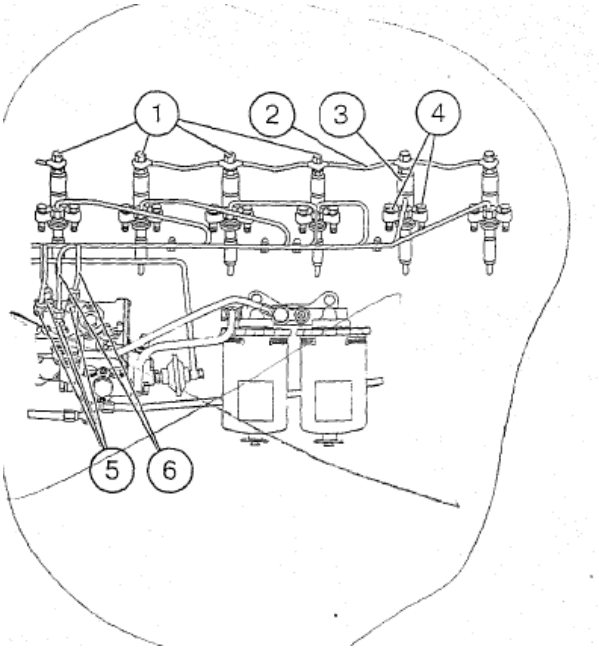
9.3.6. After each 2000 hours of operation fulfil operation of the previous maintenance plus do the following:

Operation 55. Checking fuel equipment

To check nozzles for injection pressure, dismantle them from the engine, having fulfilled the following operations:

- Unscrew coupling nuts (5) of fuel pump and nozzles' couplings;
- Remove high pressure pipes (6);
- Take off coupling nuts (1) from each nozzle together with sealing washers, and remove drain pipeline (2);
- Unscrew nozzles fastening bolts (4) and remove nozzles (3);
- Send nozzles to specialized workshop or dealer to be checked and adjusted.

NOTE: Pressure of nozzle injection should be 22…23 MPa The spray should be in the form of fog, with no continuos jets and leaks.



Angles of fuel injection start for diesels D—260.4 AND d-260.4C, equipped with fuel pumps YAZDA, or Motopal, should correspond to those given in table to the right. To check and adjust fuel pump, dismantle it from the diesel and send to specialized workshop.

Angles of fuel injection start (degrees)

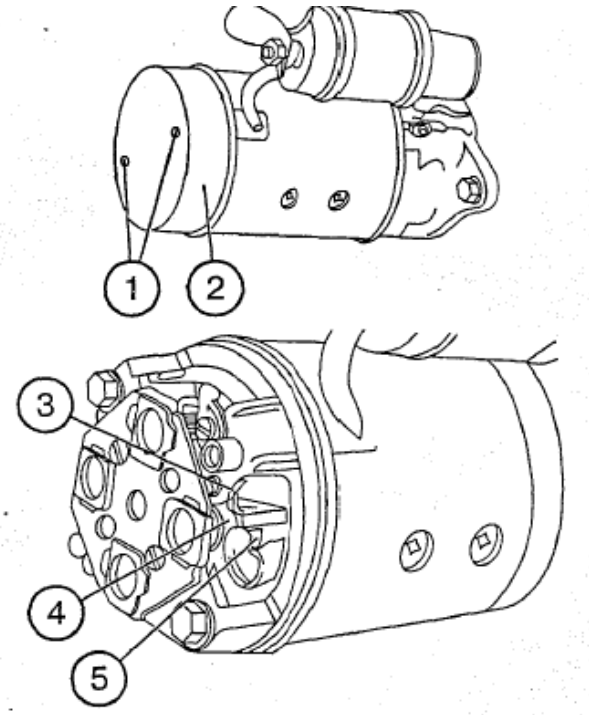
Diesel			
D-260.4		D-260.4C	
Fuel pump			
YAZDA	Motopal	YAZDA	Motopal
19…21	21…23	16…18	17…19

Operation 56. Checking technical state of the starter

Unscrew screws (1) and remove cover (2). Check state of collector (3), brush elements, easiness with which brushes (5) move in brush holders, and pressure of springs (4) on brushes.

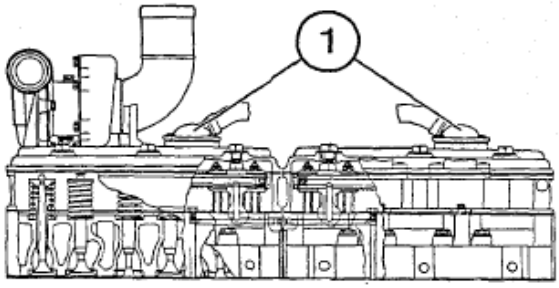
Working collector surface must be clean Pressure of brushes should be within 750…1000 gs.

If collector is appreciably worn out or burnt, send starter to specialized workshop for repair.



Operation 57. Rinsing diesel breathers

- Remove breathes bodies (1);
- Pull out breathers from their bodies;
- Rinse breathers in diesel fuel and blow over with compressed air;
- Assembly breathers and put them in place.



Operation 58. Rinsing diesel cooling system

- Make ready solution of caustic soda (50-60 g of soda per liter of water);
- Add 2 liters of kerosine in the water solution, and then fill in the system with prepared solution;
- Start diesel and let it operate for 8-10 hours;
- Drain solution in proper reservoir, rinse the system with pure water and fill in as recommended in the present manual.

9.4. MINTENANCE AS THE NEED ARISES

Operation 9.4.1. Adjusting oil pressure in diesel lubrication system

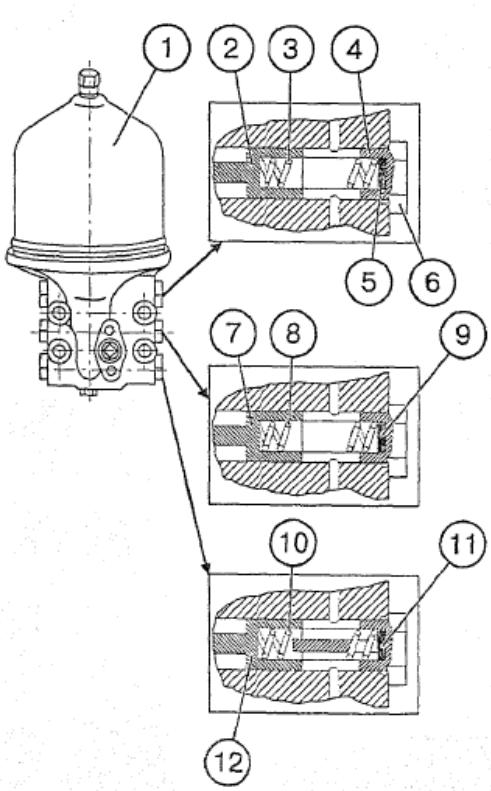
If oil pressure in the lubrication system of the heated diesel at rated frequency of crankshaft rotation is below 0.28 MPa, stop the diesel and correct malfunction. Check oil conduit tightness and serviceability of safety valve in the oil paper filter. One of the ways to raise pressure is fine adjustment of the filter safety valve in a specialized workshop.

Operation 9.4.2. Adjusting safety valve of gear box centrifuge

Valve (2) sustains oil pressure in GB hydraulic system in the range of 0.9… 1.0 MPa.
If pressure drops below the given value, make fine adjustment of the valve by placing additional washers (5) between spring (3) and plug (6).

IMPORTANT! If pressure drops below 0.7 MPa, stop tractor and address a mechanic.

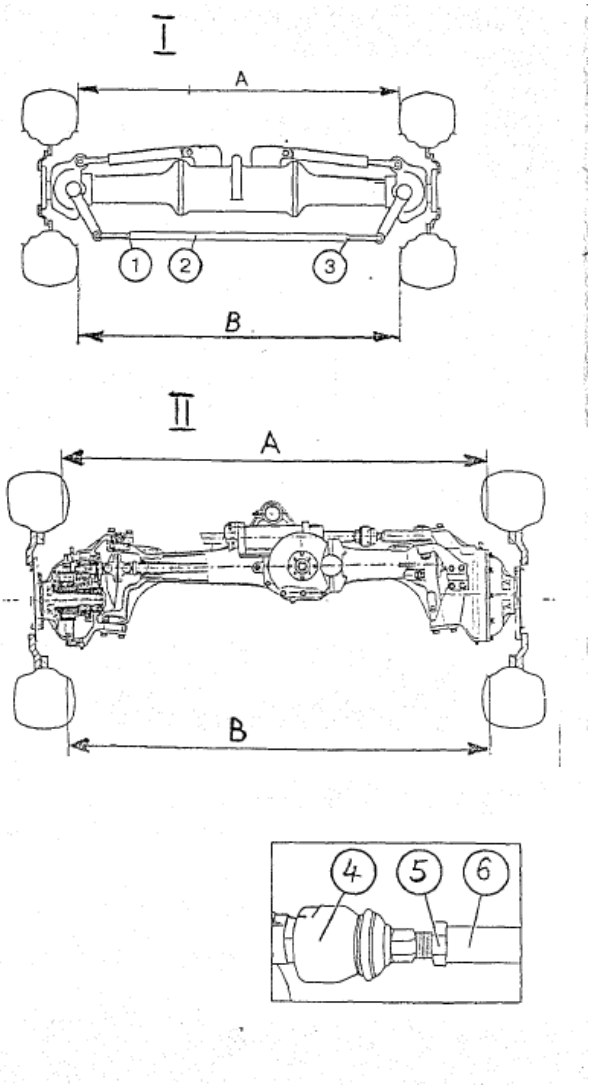
Valve (7) sustains oil pressure in front of centrifuge rotor. It should be 0.75 MPa and can be fine adjusted by placing washers (9).
Lubricating valve (12) is adjusted to pressure 0.15…0.25 MPa and keeps oil pressure in GB lubricating system. The valve is adjusted by washers (11).



Operation 9.4.3. Adjusting front wheels toe-in

After required span of front wheels is set, toe-in has to be adjusted by means of changing length of steering tie-rod (2).

1. Bring air pressure in tires to rated value (see table 7-22, section 7).
2. Drive tractor straight forward for several meters on plane terrain, stop the tractor and engage parking brake;
3. Measure distance "B" behind between opposite points at rim edge at the height of horizontal wheels' axis.
4. Disengage parking brake, roll tractor forward so that wheels turned by about 180 degrees and measure distance "A" in front of FDA between the same measuring points, as when measuring distance "B". Toe-in is set right, if size "A" is by 0…8 mm less than size "B". If toe-in value goes beyond given limits, make the following adjustments:



<u>I. FDA with two steering wheel hydraulic cylinders:</u>

- loosen tension of check nuts (1) and (3) of steering tie-rod (2).
- By rotating the rod in both directions, set required toe-in.
- Tighten check nuts.

<u>II FDA with two-rod steering wheel hydraulic cylinder:</u>

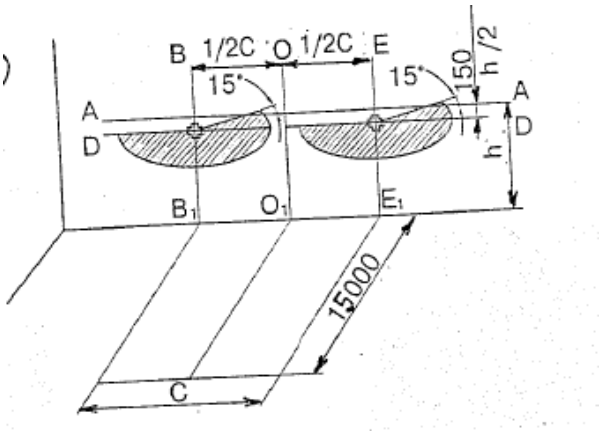
- loosen check nuts (5) of steering tie-rods (6);
- by rotating aligned spherical joint (4) (both left and right side) set required toe-in;
- torque check nuts to 70 N.m.

Operation 9.4.4. Adjusting external road head lights (on cabin railing)

- Place screen as shown in the figure.
- Measure distance between head lights' centers directly on the tractor, and their height from support surface, with air pressure in tires in compliance with recommended values. Mark centers of head lights A-A_1, B-B_1, E-E_1.;
- Put tractor on plain horizontal site perpendicular to screen, 15 m away from it till front head lights' scatterers. Longitudinal symmetry plane of the tractor must intersect the screen along line 0-01.
- Switch on lower light and first adjust position of one head light (cover the other one with dark cloth), and then the other one, havinig loosened their fastening on the arm.
- Head lights are properly adjusted, if line of spots' centers D-D is half the distance from support surface to the line of centers of of head lights A-A (h/2).

Peculiarities of adjusting built-in road head lights

- Put tractor at distance of 10 m from scatterers to screen.
- Mark all dimensions, as given above.
- Head lights are properly adjusted, if light spots are located higher, and line D-D is 150 mm lower than centers of head lights A-A.



Screen marking and front head lights adjustment:
A-A –line of head-lights' centers;
D-D – line of centers of light spots;
O-O1 – line of screen symmetry;
B-B1 –vertical axis of left head light spot;
E-E1 vertical axis of right head light spot;
C – distance between centers of exterior flash lights;
h – distance from support surface to the center of exterior flash lights.

10. TRACTOR STORAGE

Before putting tractor to long-term storage, carry out the following operations:

- Clean the tractor.
- Put tractor under shelter or inside a room.
- Lubricate under pressure all greasing points:

- FDA;
- HTDS;
- Clutch;
- RMD.

- Drain cooling fluid from the diesel cooling system.
- Drain oil from diesel crankcase, fuel pump body, clean rotor of the centrifugal oil filter.
- Drain oil from housings of power drive, oil HMS and HTDS tanks, wheel reduction gears of FDA main drive, and fill in fresh oil with additive AKOR-1.
- Fill in the diesel crankcase, fuel pump body with oil K-17 (GOST – 10877-76), or fresh dried oil with 55 of additive AKOR –1 (GOST 15171-78). When using AKOR-1, carefully mix motor oil and an additive.
- Start the diesel. Let it function at small rotation frequency for 15…30 s.
- Stop the diesel, drain conservation oil from diesel crankcase and fuel pump.
- Remove storage batteries, charge them and put for storage in dry ventilated room with temperature of 15…20 ^{0}C. Monthly check state of batteries and charge them.

- Lower RMD to its lowest position.
- Loosen tension of generator and fan belts.
- Cover exhaust pipe opening with sheath.
- Put tractor on supports to relive front and rear tires. Reduce pressure in tires to 70% of the rated operation pressure.
- During storage at least once a month rotate crankshaft by several turns

When re-starting tractor after prolonged storage, fulfil the following operations:

- Take tractor off supports and bring air pressure in tires to normal.
- Refill fuel tanks.
- Refill diesel with cooling fluid and oil. Check oil level in all fill-in tanks.
- Place fully charged storage batteries.
- Take sheath off the exhaust pipe.
- Start the diesel and check if all instruments, controls an system function properly.
- Check functioning of light and sound alarm systems..
- Operate the unloaded tractor and make sure it functions properly.

11 SUPPLEMENTS

11.1.Diesel parameters to be adjusted

Table S-1

Description	Unit of measurement	Value
Oil pressure in the heated diesel lubrication system at rated frequency of crankshaft rotation	MPa Kgs/cm^2	0.28-0.45 (2.8-4.5)
Cooling fluid temperature in the cooling system	^{0} C	80-95
Drive belt sag at effort of 40 N (4 kgs) on branch between generator and crankshaft pulleys	mm	29…33
Clearance between rocker pin and end face of valve rod with cold diesel, for valves:	mm	
- inlet	mm	0.25…0.30
- exhaust		0.40-0.45
Advance angle of fuel injection	degree	19…21 YAZDA 21…23 Motorpal
Pressure of needle rise start of the nozzle sprayer	Mpa (kgs/cm ^{2}) N.m (kgs.m)	21.6 +0.8 (220 +8)
Torque of main threaded connections:		
• bolts of cylinder heads fixing		190-210 (19-21)
• bolts of main bearing		220-240 (22-24)
• nuts of connecting rod bearings bolts		100-120 (10-12)
• bolts of flywheel fastening		160-180 (16-18)
• bolts of nozzles fastening		160-200 (16-20)
• bolts of counterbalance fastening		100-120 (10-20)
• bolts of crankshaft pulley		160-00 (16-20)
• nuts of centrifugal oil filter cap		35-50 (3.5-5-0)
• bolts of torsion vibration damper		80-100 (8-10)
• fly-nuts of air purifier		8-10 (0.8-1.0)

*) For certified diesels – 16-18 (YAZDA), 17…19 (Motorpal)
**) with subsequent additional tightening to 30…35 N.m ((3… 3.5 kgs .m)

11.2 PARAMETERS OF FUEL PUMPS TO BE ADJUSTED ON TEST STAND:

A. YAZDA (363.1111005-40.04)

Table S-2

Description	Unit of measurement	Value
1. Average cyclic fuel supply along high pressure lines at rotation frequency 100 rev/min, min	mm ^{2}/cycle	140
2. Rated frequency of cam shaft rotation	rev/min	1050+10
3. Average cyclic fuel supply along high pressure pipelines at rated rotation frequency	mm2/cycl	103…107
4. Non-uniformity of fuel supply along high-pressure pipelines at rated rotation frequency, max	%	6
5. Rotation frequency at regulator operation start		
6. Complete automatic fuel supply shut down by the regulator in rotation frequency range	rev/min	1075 + 10
7. Average cyclic fuel supply by pump sections at rotation frequency:		1150
- 800 $_0$ 10 rev/min		
- 500 $_0$ 10 rev/min		
8. Pressure of pneumatic corrector operation start at n = 500 rev/min		120.5…126.5
9. Cyclic supply at rotation frequency 500 rev/min and absence of charging pressure		92.5…99.5
	Kg/cm ^{2}	0.1…0.2
		0.2…0.3
	Mm ^{3}/cycle	82…90

NOTE: Check parameters to be adjusted according to items 1…7 with forced switching off of pneumatic corrector (air pressure in the pneumatic corrector is 0.8…1.0 kgs/cm ^{2})

B. 'MOTORPAL" (PP6M10P1F – 3493)

Table S2A

Description	Unit of measurement	Value
1. Geometric commencement of fuel delivery (as plunger moves).	Mm	3.5 o 0.05
2. Rated frequency of pump shaft rotation	Rev/min	1050 o 10
3. Frequency of cam shaft rotation, corresponding to diesel idle run.	Rev/min	400 o 10
4. Non-uniformity of fuel delivery by pump sections at rated rotation frequency, maximum	%	%
5. Non-uniformity of fuel delivery by pump sections in the mode of minimal idle run, max	%	%
6. Frequency of pump cam shaft rotation , corresponding to commencement of fuel supply switch off through nozzles	rev/min	1080…1090
7. Rotation frequency, corresponding to complete automatic shut down of fuel supply through nozzles	rev/min	1160…1170
8. Cyclic fuel delivery at frequency of pump camp		

shaft rotation 100 rev/min	mm ^{3}/cycle	160 o 6
9. Cyclic fuel delivery at rotation frequency:		
• 1050 rev/min		116…120
• 800 rev/min	mm ^{3}/cycle	120.5…125.5
• 500 rev/min		96.4…103.6

NOTES: 1. To check parameters use nozzles with sprayers Motorpal DOP 119S534.
2. Check parameters under item 9 at charging pressure 0.5 kgs/cm^2

B. DISTRIBUTION-TYPE FUEL PUMP

Table S-2B

Description	Unit of measurement	Value
1. Average cyclic fuel delivery by high-pressure pipelines at 40…100 rev/min	mm ^{3}/cycle	180…250
2. Rated frequency of camshaft rotation	rev/min	1050 + 5
3. Average cyclic fuel delivery by high-pressure pipelines at rated rotation frequency	mm ^{3}/cycle	104.4…107.6
4. Non-uniformity of fuel delivery by high-pressure pipelines at rated rotation frequency, max.	%	6
5. Rotation frequency at regulator operation commencement.	rev/min	1080+5
6. Complete automatic fuel delivery shut down by the regulator in the rotation frequency range.	rev/min	1130…1170
7. Coefficient of fuel delivery correction at rotation frequency of 725 + 25 rev/min.		1.09…1.15
8. Point of corrector operation commencement should be in the rotation frequency range.	rev/min	970…1030
9. Correction coefficient of cyclic delivery		
10. Pressure of commencement of pneumatic operation commencement	kgs/cm ^{2}	0.50…0.60
11. Cyclic delivery at rotation frequency of 500 rev/min and absence of charging pressure	mm^3/cycle	104…108

NOTE: Check parameters under items 1…8 with forced switching off pneumatic corrector.

11.3. SPECIAL FEATURES OF DIESEL DISASSEMBLY AND ASSEMBLY

During diesel disassembly pull pistons in assembly with tie-rods only upwards. Before withdrawing piston, remove carbon deposit from the upper part of cylinder sleeve.

When replacing parts of sleeve-piston group and crank mechanism, pay attention to dimension groups of parts.

Cylinders' sleeves and pistons are divided into three dimension groups (B, M, S) by inside diameter and outside skirt diameter, correspondingly.

Group designation is imprinted on the upper sleeve clamp and piston bottom.

Table S-3

Group Designation	Sleeve diameter,mm	Diameter of piston skirt mm
B	$110^{I\,0.06}_{I\,0.04}$	$110^{c0.05}_{c0.07}$
M	$110^{I\,0.04}_{I\,0.02}$	$110^{c0.07}_{c0.09}$
S	$110^{\mathrm{I}\,0.02}$	$110^{c0.09}_{c0.11}$

For one diesel assembly select pistons, connecting rods and piston pins of one weight group. Balance weight of connecting rods in assembly with pistons should not exceed 30 g.

Main and connecting rod necks and shells of crankshaft bearings have two nominal dimensions:

Table S-4

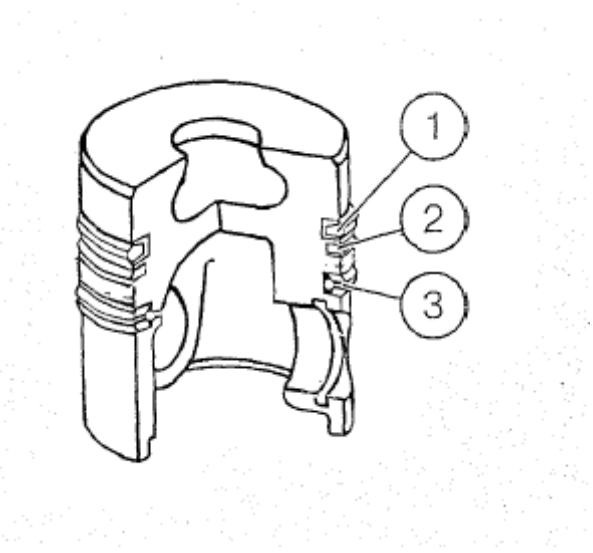
Designation	Diameter of shaft neck, mm	
	main	Connecting rod
1H	$85.25^{c0.085}_{c0.104}$	$73.00^{c0.100}_{c0.119}$
2H	$85.00^{c0.085}_{c0.104}$	$72.75^{c0.100}_{c0.119}$

Crankshafts, connecting rod and main necks of which are manufactured according to the second nominal value size, bear additional designation on the first cheek:

- "2К" – main necks of the second nominal value;
- "2Ш' – connecting necks of the second nominal value size;
- "2КШ" – connecting rod and main necks of the second nominal value.

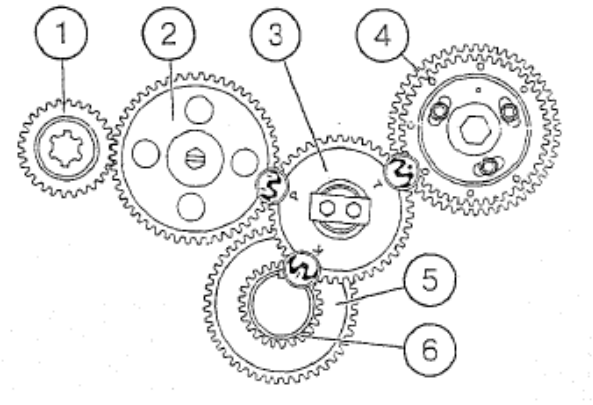
11.4. INSTALLATION OF PISTON RINGS

On each diesel piston three rings are installed: upper compression ring (1) of trapezoid type, the second compression ring of coned type, and oil-control ring of box type with spring expander. Compression coned rings (2) on the end face surface near the circlip bear marking “top”, which during installation must face piston bottom. Butt of oil control ring expander must not coincide with ring circlip. Put piston rings equally spaced along circumference.



11.5. INSTALLATION OF DISTRIBUTION MECHANISM GEARS

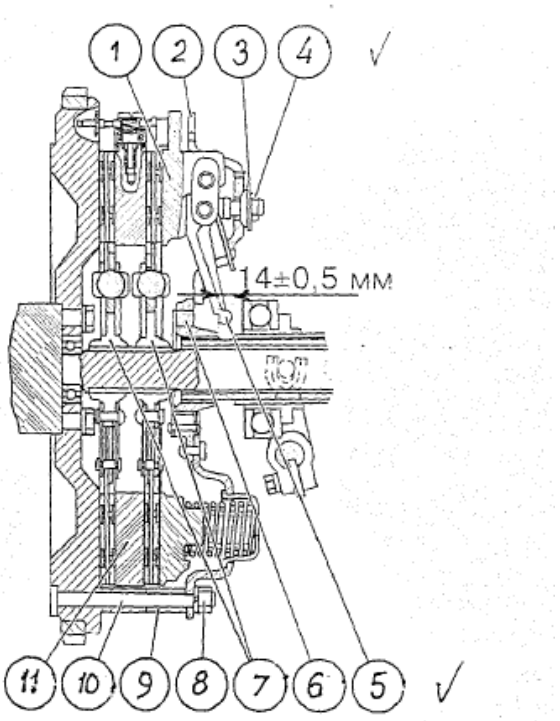
Install timing gears according marks they bear. Align letter marks on intermediate gear with corresponding marks of gears (6) of crankshaft and (2) camshafts, and gears (4) for driving fuel pump, as shown in the figure to the right.



1 – gear for driving HTDS hydraulic pump. 2 – camshaft gear; intermediate gear; 4 – gear for driving fuel pump; main for driving oil pump; 6 – crankshaft gear.

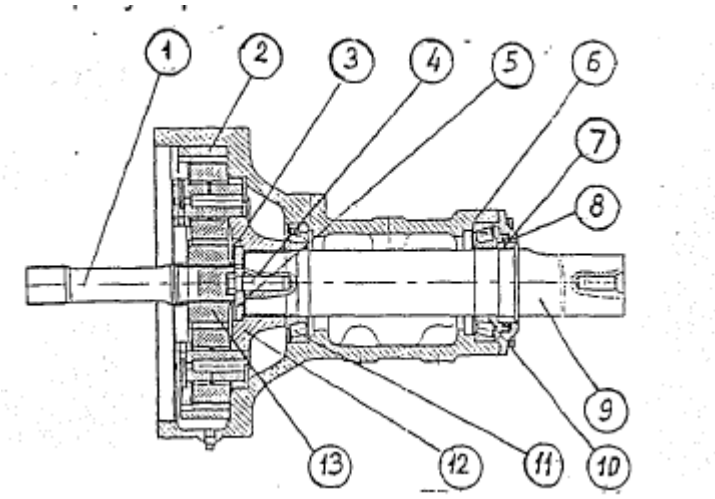
11.6. SPECIFIC FEATURES OF CLUTCH INSTALLATION AND ADJUSTMENT

1. Install six bushings on flywheel pins.
2. Install driven discs (7) on both sides of intermediate disc, with short ends of bushings facing each other.
3. Install support disc (2) in assembly with squeeze disc (1) In assembling discs use technological bolts M12 x 45, screwing them in squeezing disc (1) to the end of the support one (2).
4. Center driven discs using mandrel and unscrew technological bolts M12 x 45.
5. Adjust position of squeezing levers (5) using nuts (4) to dimension 14 o 0.5 mm from levers' support surfaces to the end face of support disc hub (6). Dimensional difference for individual clutch levers should not exceed 0.3 mm.
6. Secure adjustment nuts (4) with stop plates (3).



11.7. SPECIFIC FEATURES OF ASSEMBLY AND ADJUSTMENT OF REAR AXLE FINAL DRIVES

If parts and assembly units of final drives need to be changed, subsequent assembly and adjustment operations should be in the following order:



- Assemble by a forced fit heated in oil inside ring of outside bearing (10) on half-axle to the end inside bushing (7).
- Press-in outside rings of bearings (10, 11) in sleeve (6) to the end in sleeve bead.
- Install half-axle in assembly with inside ring of the outside bearing in the sleeve, and put inside ring of inside bearing (11) on half-axle.
- Put carrier in assembly (12) on half-axle , place washer (5) without a set of adjustment spacers and tighten bolt (4) in a way to select backlash in half-axle bearings, and turning half-axle moment was within 3…5 N.m.
- Using a calliper square, measure distance from half-axle end face to the outside washer surface through an opening in washer (5).
- Subtract washer thickness (12 mm) from measured value and calculate clearance between washer and half-axle end face.
- Unscrew bolt (4), remove the washer and fill in clearance with a set of spacers. Put
-

washer and stop plate (3) in place. Torque bolt to 500…550 N.m.

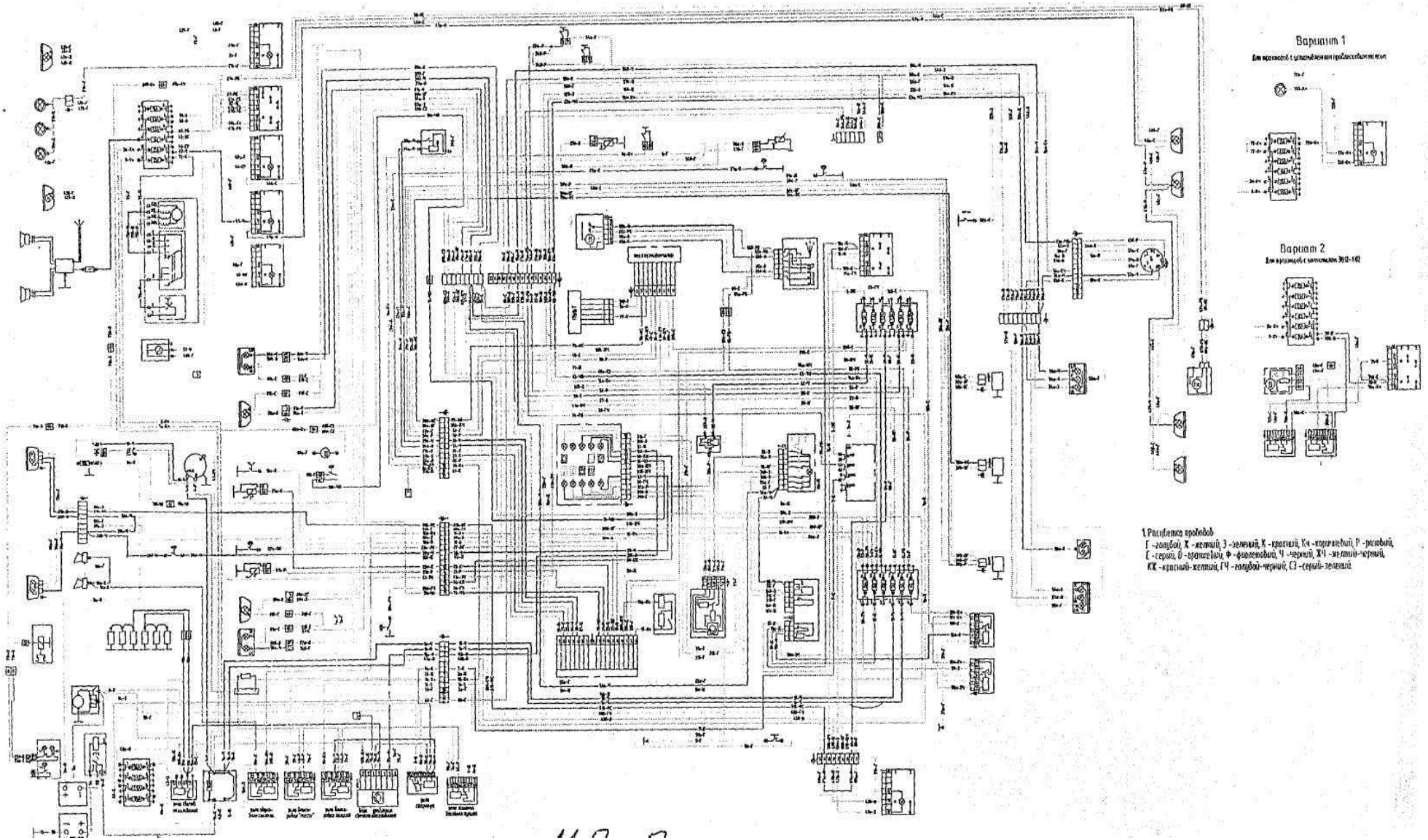
- Check half-axle turning moment. If it exceeds given above limits, increase number of spacers, and visa versa.
- Secure stop plate bolt, having greased plate surface, adjacent to washer, with grease Litol-24 or Bechem LCP-GM. Nibs of plate must go into grooves of carrier (12). If required, screw bolt up until a nib and groove align. Do not unscrew the bolt. !
- Install crown gear (2).
- Install sun gear (13) in assembly with shaft (1) in planetary gear carrier and check smoothness of rotation in assembly.
- Install cover (8) in assembly with sealing ring, having greased the sealing ring and rubber ring with grease Litol-24 or Bechem LCP-GM. Tighten bolys of cover fastening.

11.8. RECOMMENDED FUELS, OILS, LUBRICANTS/GREASES, FLUID AND THEIR SUBSTITUTES

Table S-5

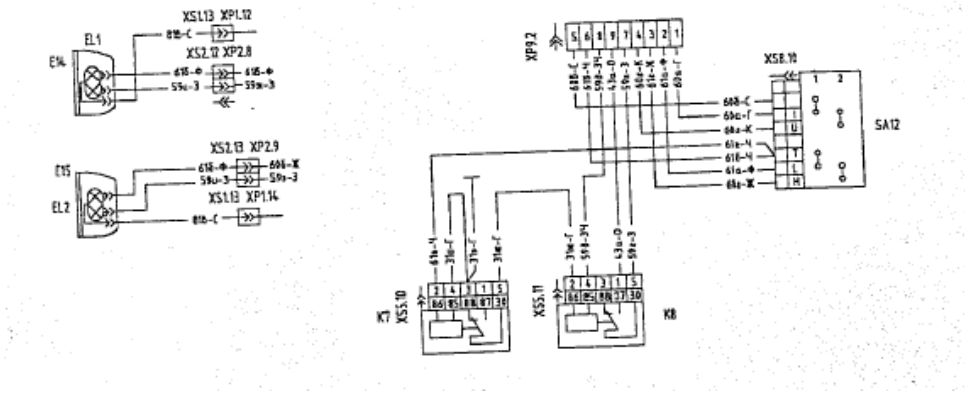
Description	Air temperature	Grades (main)	Substitutes (duplicate)
FUEL			
Diesel	From – 35 ^{0} C Up to +5 ^{0} C from +5 ^{0} C up to +30 ^{0} C	Diesel fuel 3-0, 2-35 A-0.4, 3-0.2 L-0.2- 40 (m) L-0.4-40 (s)	3-0.5-35, 975-68 SAE (USA) Mil-F-16884F; DEF 2402B, sort 47/0 Die SO Mil –F-896, 1 klass;DEF-24021, 1 klass BS8269 (Britain);ASTM-D-W-F (USA)
OILS			
Diesel	From – 45 ^{0} C up to +5 ^{0}C	M-8DM Novoil-M M-4/12G	M-8G $_{2k;}$Mobil ND 10W/20 (USA), HESSOL TURBO DIESEL SAE 15W/40 API CF-4;SHELL ROTELLA SX20W/20 (Britain); BELC –1; SAE 10W-30 API; MOBIL DELVAC 1200 (USA)
	From + 5 ^{0} C to +40 ^{0} C	M-10 DM	M-10G 2k; M-10G 2; SHELL ROTELLA TX 30 (Britain); HESSOL TURBO DIESEL SAE 15W-40 API CF-4 (Germany); MOBIL DELVAC XHP SAE 15W –40 (Britain); SHELL ROTELLA SX30 (Britain); BRITISH PETROLIUM VANELUS OIL SAE30 (Britain); ESSO ESTOR SDX SAE30 (USA); M7ADS 111 (Chechia)
Front PTO transmission		M10B $_2$ M10G $_2$ M12 By	SAE 30; Essolube DX30; Mobil Delvac Oil 1230; Rimula Oil 30 series 3; Energol Diesel 230
Front drive axle		TCp-15K Tan-15 V Tad-18i	SAE 80/90; Spirax EP80/90; Gear oul 80/90GP Mobilube GX 80/90; Gear oil 80/90EP
RMD hydraulic system; HTDS		Industrial oil Bechem staroil # 32; Bechem Staroil #32	M-8G 2k; I-30l; Hessoil Hydraulikoel HLP 32; m-G 2k; I-30A; Hessoil Hydraulikoil HLP 32
LUBRICANTS			
Bearings: Of clutch branches ; Axles of FDA pins; Axis of FDA beam oscillation; Rotation RMD shaft ; TCM	For all temperatures	Litol 24 Fat cup grease Technical cup grease	Beacon 3; Retinax A; Mobilux 3; Unedo 2,3; Bechem LCP-GM (TU RB 14733172.001)

BRAKING FLUID			
Tanks for control of brakes and clutch		Neva-M (DOT-3; DOT-4)	
COOLING FLUID			
Diesel cooling system		OZH-40 or OZH-65 (GOST 28084)	Tosol A-40N, AL-3SORTS-735 (Britain) Mil-F-5559 (BS 3150) (USA)

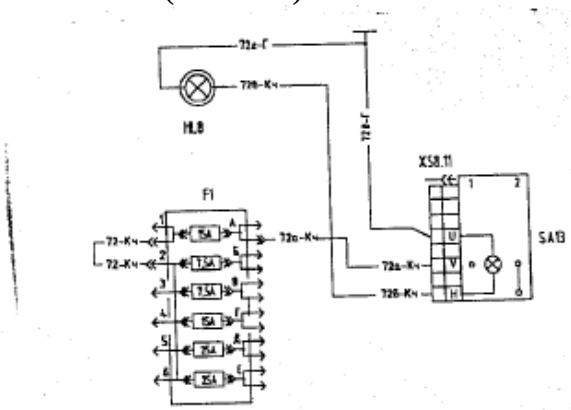


11.9. Circuit diagram

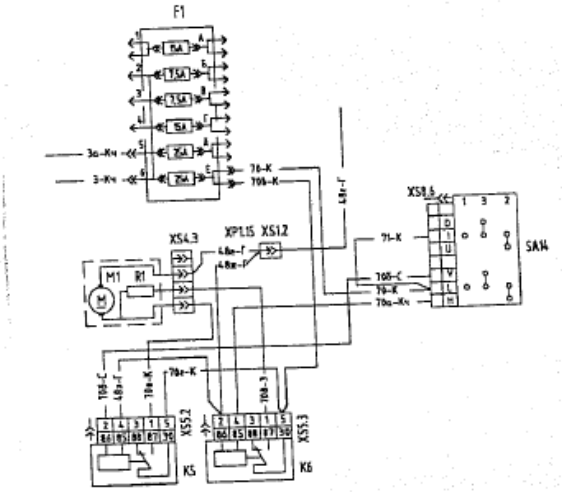
11.9(a) – Installation of road head-lights on lamps' arms (version 1)



11.9 (b) – Installation of flash beacon (version 2)



11.9 (c) – Installation of heater EV 12-102 (version 3)



Designation	Description	Quantity	Notes
X59.3, x59.4	Connector 602209	2	
X59.1, xs 9.2, xs9.5, xs9.6	Connector 1-480672-0	4	AMP, Germany
Xs12.1, xs12.3	Socket SHS 32UK12G-M-7	2	
XS 12.2	Socket SHS 32P12G-M-7	1	
XS15.1	Socket SHSP15G-M-6	1	
XS15.2	Socket SHS36U15G-M-6	1	
XS13.1	Connector 602213	1	
XT21	Panel P14.3723 TU RB 05882559.001-94	1	
WA1	Aerial “Sputnic-003”SICM 464621.005 TU	.	

1.9.1 LIST OF COMPONENTS FOR CIRCUIT DIAGRAM 11.9

Table 11.9

Designation	Description	Quantity	Notes
A1	Stereo tape recorder	1	
A2	Plugs	6	Part of engine set
A3	Control panel AP70.3709-01 TU AP 3813.001-98	1	
BA1, BA1	Loudspeaker		Part of recorder set
BK1	Sensor DUTZH-02M TU RB 07513211.001-95	1	
BK2	Temperature sensor 233.3828 tu37.459.259-00	1	
BN1	Fuel level sensor 38 0164 45 004	1	KMGU, Hungary
BP1	Pressure gauge DD-6M TU RB 600417525.009-2000	1	
BP2	Pressure gauge DD-10-01M TU RB 600417525.009-2000	1	
BP3	Pressure gauge DD-20M TU RB 600417525.009-200	1	
BV1,BV2	Speed sensor AP71.3843 TU AP 3843.002-2000	2	
E1,E2	Road head-light 08 7101 000 TU RB 28927023.003-98	2	
E3, E4,E10,E11, E12	Operation headlight 8724.304.301 TU RB 28927023.003-98	4	
E5	Cabin illumination ceiling light 0.50.09.814	1	
E13	License plate illumination lamp FP131-AP GOST 6964-72	1	
E6, E7	Operation head-light 8424.302/4 TU RB 28927023.003-98	2	
E14, E15	Road head-light 05.524.00	2	
EL1,EL2	Lamp HS4-60/55	2	Part of lamps set E1,E2
EL4-EL15	Lamp A12-5	7	Part of set HL1…
EL3,7,13,16	Lamp AKG 12-55-1	4	Part of set E3…
EL8,11,12,17 ,19,20,22	Lamp A12-21-3	7	Part of set HL4-6
EL18,24	Lamp 12-10	2	Part of set
F1	Box of fuses BP-4 TY RB 03428193.095-97	1	

F2	Box of fuses BP-3-01 TU RB 03428193.095-97	1	
F3	Box of fuses BP-11 TU RB 03428193.095-97	1	
F4	Box of fuses BP –1-01 TU RB 03428193.095-97	1	
F5	Box of fuses BP –1-01 TU-RB 03428193.095-97	1	
FU2,FU3	Fuse 25A	2	
G1	Generator AAN 5506, 14B,150A	1	
GB1,GB2	Storage battery 12V-120A/h TT 80-3700080D	1	
HA1	Sound alarm device C308 TU 37.003.1063-81	1	
HA2	Sound alarm device C309 TU-37.003.1063-81	1	
HA3	Alarm relay 733.3747 TU 37.003.074-76	1	
HG1	Box of control lamps AP10.3803 TU AP 3803.—1-99	1	
HL1…HL3	Road train head-light UP 101-G1 GOST 6964-72	3	
HL4,HL5	Head light 3713.3712 TU RB 05882559.010-95	2	
HL6,HL7	Head light 7303.3716 TU RB 05882559.010-95	2	
K1	Plugs' relay 161.3777 TU 37.476.013-2005	1	
K2,6…11	Relay 902.3747-10 TU 37.003.1418-94	1	
K3,K4	Relay 902.3747-20 TU 37 003.1418-94	2	
K5	Relay 738 3747-30 TU 37.003.1417-93	1	
KH1	Breaker of parking brake control lamp PC492 TU 37.003.1052-81	1	
KH2	Breaker of turn indicator 8586.6/0031 TU 8586.6/0031 Tla	1	
KT1	Box of plugs MUCH-01	1	
M2	Starter AZF 4617 TU	1	
M3	Windshield washer 122.5208 TU 37.459.176094	1	
M4	Drive 961.5205100 GOST 18699-70	1	
F1	Box of fuses BP-4 TU RB 03428193.095-97	1	
F2	Box of fuses BP3-01TU RB 03428193.095-97	1	
F3	Distribution unit ANP-BP-60	1	
F4	Box of fuses BP-1 TU RB 03428193.095-97	1	
F5	Box of fuses BP-2-01 TU RB 034 28193.095-97	1	
FU1	Fuse	1	Part of recorder
FU2	Fuse 15A	1	Part of wiring
G1	Generator AAN 5120 (14 V, 70-150A)	1	
GB1,GB2	Storage battery 12V, 120 Ah	1	

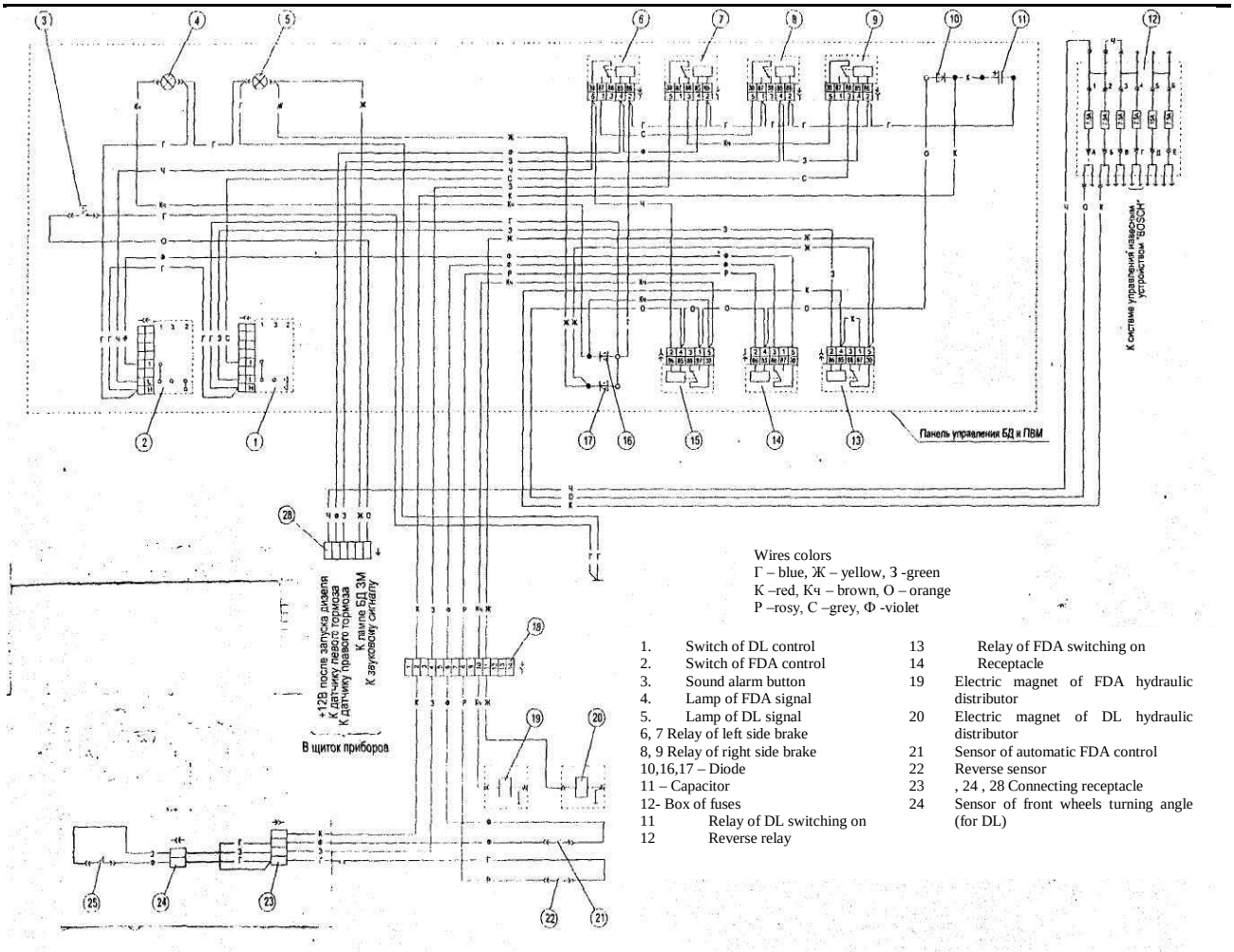
HA1	Sound alarm, horn C 308 TU 37.003.1063-81	1	
HA2	Sound alarm, horn C 309 TU 37.003.1063-81	1	
HA3	Signal relay 733.3747 TU 37 003.074-76	1	
HA4	Sound alarm device 20.3721-01	1	
HG1	Box of control lamps AP10.3803	1	
HL1…HL3	Road train head light FA-1 GOST 6964-72	3	
HL4,HL5	Front head light 3713.3712 TURB 05882559.010-95	2	
HL6,HL7	Rear head light 7303.3716 TU RB 05882559.010-95	2	
HL8	Alarm beacon MC-2-12-0 TU RB 07526946.049-93	1	
K1	Relay 16.3777 TU 37.459.280-2001	1	
K3	Relay 738.3747-30 TU 37.469.023-97	1	
KH1	Breaker of parking brake control lamp PC492 TU 37.003.1052-81	1	Can be changed with ERP-1
KH2	Breaker of turn indicators 8586.6/0031 TU 8586.6/0031 Tla	1	
KT1	Unit of BUS-1 TY RB 28981749.003-2000	1	
KT2	Box of plugs	1	
UZ1	Voltage converter 191.3759-01 TU84.214.008-02	1	
XA9.1	Socket P9-1 TU RB 334210.020-97	1	
	Pin connectors		
XP11-XP1.13	Receptacle 502601	13	
XP2.1-XP2-10	Receptacle 502602	10	
XP4.1	Receptacle 502604	1	
XP9.1-XP.9.4	Receptacle 1-480673-00	4	AMP, Germany
XP12.1, XP12.3	Plug SHC 32P12SH –M-7	2	
XP12.2	Plug SHC32PK12SH-M-7	1	
XP151,XP15.2	Plug SHC36PK15SH-M-6	2	
	Female receptacles		
XS1.1…XS1.16	Receptacle 602601	16	
XS2.1	Receptacle 602602	9	
XS 2.6	Receptacle 601202	11	
XS3.1	Receptacle 601203	2	
XS3.1	Receptacle 602604	2	

XS5.1	Receptacle 607605	11	
XS5.6	Receptacle 602205	1	
XS 6.1	Receptacle 602606	3	
XS 7.1	Receptacle 602207	2	
XS8.1	Receptacle 605608	9	
XS8.6	Receptacle 610608	1	
KT2	Relay 90.3747 TU 37.003.14 18-94	7	
M1	Fan EVI12-1 02 TU RB 500135046.002-2001	1	
M2	Windshield wiper 96.5205 GOST 18699-73	1	
M3	Starter AZF 4617	1	
M4	Windshield washer 96.5205 GOST 18699-73	1	
M5	Windshield wiper T240-5205 TU 213.201.027-01	1	
M6	Electric motor 9742.3730 TU 37.459.125-91	1	
P1	Tachometer-speedometer AP70.3813 TU AP 3813.001-98	1	
QS1	“Ground” switch TU RB 07513211.006-97	1	
R1	Additional resistor CD-50	1	
SA1	Switch 676.00.00/R TU RB 213.20.005-97	1	
SA2	Switch P150M-07.28 TU RB 14795799.001-97	1	
SA3-11	Switch P150M-07.28 TU 213.201.005-97	5	
SA6	Switch BK 12-31 TU RB 37334210.004-97	1	
SA7	Switch, under steering wheel PKP-3A TU RB 37334210.027-98	1	
SA8	Switch, under steering wheel PKP-1A TU RB 37334210.027-98	1	
SA9	Switch P147M-04.29 TU RB 14795799.001-97	1	
SA10	Switch of starter and devices 1202.3704-03	1	
SA12	Switch P147M-02.03 TU RB 14795799.001-97	1	
SA14	Switch P147M –04.11 TU RB 14795799.001-97	1	
SB1	Switch 245.3710 TU 37.469.019-96	1	
SB2	Switch VK12-21 TU RB 07512465.017-94	1	
SB3	Switch VK409 TU RB 37.003.478-76	1	
SK1	Sensor DATZH TU RB 07513211.011-97	1	
SL1	Sensor braking fluid emergency level AP 23.3829	1	
SP1	Sensor of air-conditioner switching on	1	Part of conditioner set

A5	Valve of fuel dresser	1	
BK1	Sensor of cooling fluid temperature indicator DUTZH-02M TU RB 07513211.001-95	1	
BP1	Sensor of oil pressure DD-6M TU RB 6004 17525.009-2000	1	
BP2	Sensor of air pressure DD-10-01M TU RB 600417525.009-2000	1	
BP3	Sensor of oil pressure in KPP DD-20M TU RB 600417525.009-2000	1	
BN1	Sensor of fuel level indicator 38 0164 45 004	1	KMGY
BV1,BV3	Speed sensor PM 71.384-02 TU BY 190245592.001-2006	3	
E1,E2	Road head light 08 7101 000 TU RB 78927023.004-2004	2	
E3,E4	Operation head light 8724.304/301 TU RB 28927023.003-98	6	
E5	Cabin illumination ceiling lamp 025009814	1	
E6,E7	Road head light 8724.304/4 TU RB 28927023.004-03	2	
E8	Lamp of license plate illumination FP131AP GOST 6964-72	1	
EL1,EL2	Lamp AKG12-60+55-1	2	Part of set
EL4	Lamp A12-5	7	Part of set
EL9	Lamp A12 –21-3	6	Part of set
EL3	Lamp AKG12 –55-1	8	Part of set
EL8	Lamp AC12-10	1	Part of set
MS	Motor reduction gear 475.3730 000 TU 37.459.155-93	1	
P1	Tachometer- speedometer AP70.3813.001-98	1	
P2	Combination of devices AP72.3801 TU AP 3801.005-98	1	
QS1	Switch 1212.3737-06 TU RB 07513211.006-97	1	
R1	Additional resistor CD-50 (50 Ohm, 4W)	1	
SA1	Switch P150-25.16 TU RB 14795799.001-97	1	
SA2	Switch P150M –07.28 TU RB 14795799.001-97	1	
SA3…	Switch P150M-25.52 TU RB 14795799.001-97	4	
SA6	Switch, under steering wheel PKP-3A TU RB 1000093400.001-2001	1	
SA7	Switch, under steering wheel PKP-1A TU RB 37334210.023-98	1	
SA8	Switch P147M-04.29 TU RB 14795.799.01-97	1	
SA9	Switch 1202.3704-03 TU 37.003.780-76	1	
SA11	Switch BK343M-0188 TU RB 14795799.001-97	1	
SA12	Switch BK12-21 TU RB 14795799.001-97	1	

SB1-SB3	Switch BK 12-21 TU RB 37334210.015-97	3	
SB5	Switch of emergency alarm	1	
SB4	Switch BK12-1 TU RB 07512465.017-94	1	
SB6	Switch BK 409 TU 37.003.478-76	1	
SK1	Sensor DATZH TU RB 07513211.011-97	1	
SL1	Level sensor AP23.3839 TU AP 3839.001-01	1	
SP1	Sensor DCF-65 TU RB 07513211.003-97	1	
SP2	Sensor DADM-03 TU RB 075132211.004-94	3	
SP4	Sensor DADV TU RB 07513211.004-94	1	
A1	Stereo tape recorder		
BA1,BA2	Loud speaker IZHSK 467286.002	2	Part of set
FU1	Fuse	1	-"-
A2	Sparking plugs	6	-"-
A4	Air conditioner MT-8100000 "Ebershpekher"	1	
A4.1	Air processing assembly	1	Part of set
A4.1.1	Regulator of outlet air temperature	1	
M1	Fan electric motor	1	
S1	Switch of fan modes	1	
A4.2	Compressor –capacitor unit	1	Part of air conditioner set
YC	Compressor electromagnetic clutch	1	
A 4.3	Box of pressure sensors	1	-"-
SP1	Minimum pressure sensor	1	(4kgs/cm2)
SP1	Maximum pressure sensor	1	(12 kgs/cm2)
SPI	Maximum pressure sensor	1	(16 kgs/cm2)
SP2, SP4	Sensor DADM-03 TU RB 07513211.004-94	2	
SP3	Sensor DCF-65 TU RB 07513211.011-97	1	
SP5	Sensor DADV TU RB 07513211.004-94	1	
SP6	Sensor MM 111D-01 TU 37.003.546-76	1	
UZ1	Voltage converter 191.3759 TU 84.214.008-02	1	
	Pin receptacles OST 37.003.032-88		
XP 1.1…	502601	11	
XP 2.1	502602	9	

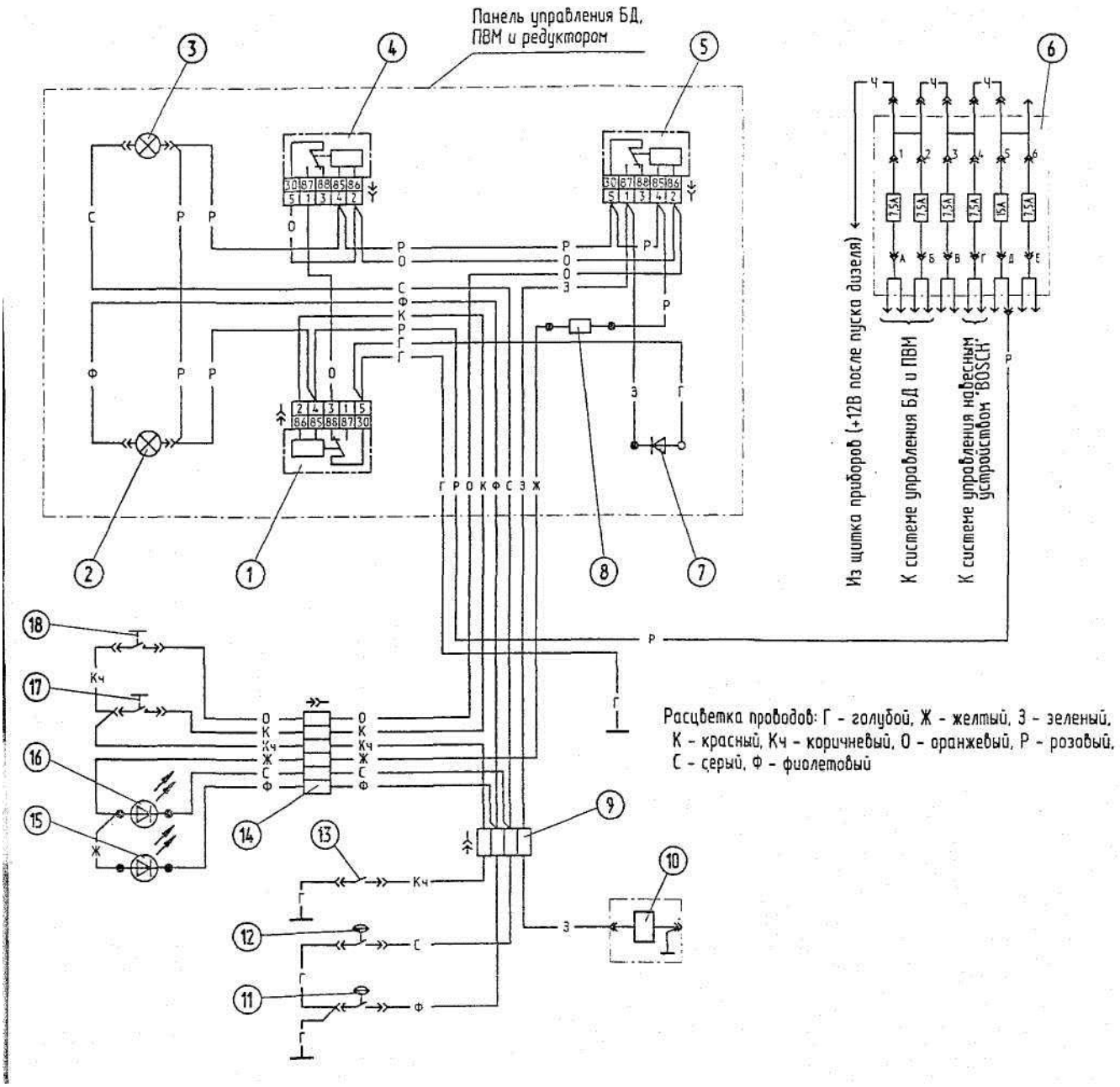
XP 4.1…	502604	2	
XP6.1	502606	1	
	Female receptacles OST 37.003.032-88		
XS 1.1	602601	17	
XS 2.1	601202	4	
XL 2.6	601202	3	
XS 2.4	602602	4	
XS 2.10	Sc 5.601.202	1	
	Pin receptacles OST 37.003.032-88		
XS3.1	601203	4	
XS 4.1	602604	3	
XS 5.1	602605	7	
XS 5.6	469.59.00.00	2	
XS 5.12	602205	1	
XS 6.1	602606	3	
XS 6.4	602606-XX-10	1	
XS 7.1	602207	3	
XS 8.1	602608	7	
XS 8.8	610608	1	
XS 9.2	602209	2	
XS 9.1	Receptacle AMP 1-480673-0	3	
XA 9.1	Socket P9-1 TU RB 334210.020-98	1	
XP 12.1	Plug SHR 32PK ESH1H 0 PO 364.028 TU	3	
XP 15.1	Plug SHR 36P15H4H-0 PO 364.028 TU	1	
XP 12.1	Socket SHR32PK12EG1H-0 PO 364 028 TU	1	
XS 15.1	Socket SHR 36 CK 15HG4H-0 PO 364.028 TU	1	
WA1	Aerial	1	



11.10 Electric diagram of the control system of rear axle DL and FDA

В щиток прибора – to device panel
После запуска дизеля- +12V after diesel start
К датчику левого тормоза- to sensor of left side brake
К датчику правого тормоза- to sensor of right side brake
К лампе БД ЗМ- to RA DL lamp
К звуковому сигналу – to sound alarm
Панель управления БД и ПВМ – control panel of DL and FDA
К системе управления навесным устройством Бош- to control system of mounting mechanism BOSCH

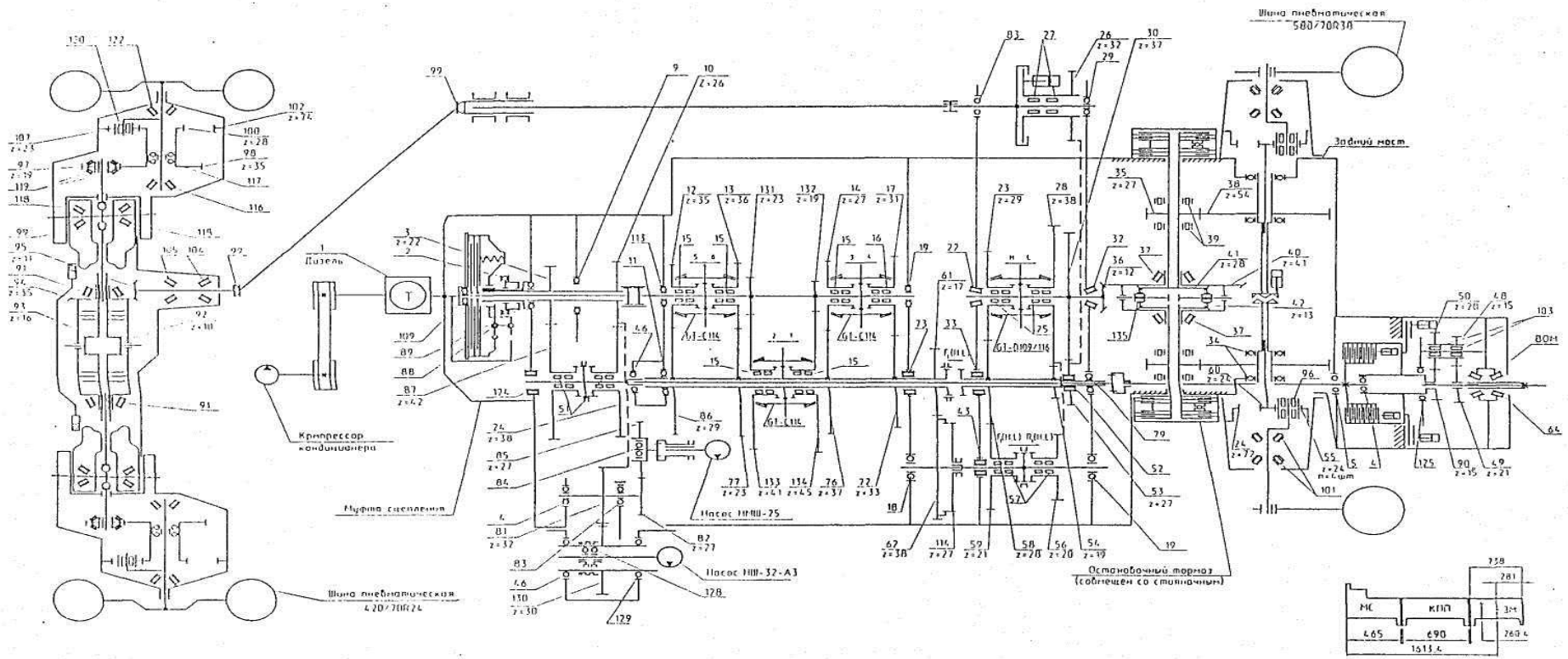
11.11 Electrical diagram of control system of gear box reduction gear



Панель управления БД…- control panel for DL, FDA and reduction gear
Из щитка приборов – from instrument panel
К системе управления БД…- to control system of DL and FDA
К системе управления…- to control system of mounting mechanism BOSCH.

1 – Relay of switching on lower degree
2 – Signal lamp of lower degree
3. – Signal lamp of higher degree
4,5 Relay of switching on higher degree
6 – box of fuses
7 – Diode
8 – Resistor
9,14 Connecting receptacle
10 – Electromagnet of reduction gear hydraulic distributor
11 – Pressure sensor of lower degree
12. Pressure sensor of higher degree
13– Sensor of GB neutral position
11 – LED of lower degree alarm
16 LED of higher degree alarm
17- Button of switching on lower degree
18- Button of switching on higher degree

11.12. Kinematic diagram of the tractor (see page 234)



- Дизель - diesel;
- Компрессор кондиционера - compressor of air conditioner;
- Муфта сцепления - clutch;
- Шина пневматическая - pneumatic tires
- Насос - pump;
- Остановочный тормоз (совмещен со стояночным) - stop brake (combined with parking brake)
- Задний мост - rear axl

Gear ratios of GB, FDA, PTO and rocker bearings (see kinematic diagram on page 233)

Gear ratios of main gears

Ranges		Gears	Gears in engagement	Gear ration		speed of movement (km/h)
				Gear box	Transmission	
Forward movement	I	1	$\frac{154}{137}\frac{67}{61}\frac{58}{59}\frac{28}{54}\frac{40}{36}\frac{38}{35}(1+\frac{24}{60})$	14.1176	385.881	1.7952
		2	$\frac{133}{131}\frac{62}{61}\frac{58}{59}\frac{28}{54}\frac{40}{36}\frac{38}{35}(1+\frac{24}{60})$	10.6257	290.435	2.3851
		3	$\frac{76}{14}\frac{62}{61}\frac{58}{59}\frac{28}{54}\frac{40}{36}\frac{38}{35}(1+\frac{24}{60})$	8.1658	223.272	3.1026
		4	$\frac{72}{17}\frac{62}{61}\frac{58}{59}\frac{28}{54}\frac{40}{36}\frac{38}{35}(1+\frac{24}{60})$	6.3454	173.441	3.9940
		5	$\frac{86}{17}\frac{62}{61}\frac{58}{59}\frac{28}{54}\frac{40}{36}\frac{38}{35}(1+\frac{24}{60})$	4.9389	134.996	5.1314
		6	$\frac{77}{15}\frac{62}{61}\frac{58}{59}\frac{28}{54}\frac{40}{36}\frac{38}{35}(1+\frac{24}{60})$	3.8083	104.0934	6.6327
	II	7	$\frac{154}{137}\frac{62}{61}\frac{58}{59}\frac{23}{58}\frac{40}{36}\frac{38}{35}(1+\frac{24}{60})$	7.3109	199.831	3.4665
		8	$\frac{133}{131}\frac{62}{61}\frac{58}{59}\frac{23}{58}\frac{40}{36}\frac{38}{35}(1+\frac{24}{60})$	5.5026	150.404	4.6057
		9	$\frac{76}{14}\frac{62}{61}\frac{58}{59}\frac{23}{58}\frac{40}{36}\frac{38}{35}(1+\frac{24}{60})$	4.2301	115.622	5.9912
		10	$\frac{72}{17}\frac{62}{61}\frac{58}{59}\frac{23}{58}\frac{40}{36}\frac{38}{35}(1+\frac{24}{60})$	3.2860	89.817	7.7126
		11	$\frac{86}{17}\frac{62}{61}\frac{58}{59}\frac{23}{58}\frac{40}{36}\frac{38}{35}(1+\frac{24}{60})$	2.5577	69.9104	9.9087
		12	$\frac{77}{15}\frac{62}{61}\frac{58}{59}\frac{23}{58}\frac{40}{36}\frac{30}{35}(1+\frac{24}{60})$	1.9787	3.904	12.851
	III	13	$\frac{154}{137}\frac{28}{54}\frac{40}{36}\frac{38}{35}(1+\frac{24}{60})$	4.7368	129.4224	5.3503
		14	$\frac{133}{131}\frac{28}{54}\frac{40}{36}\frac{38}{35}(1+\frac{24}{60})$	3.5652	97.4487	7.1086
		15	$\frac{26}{14}\frac{28}{54}\frac{40}{36}\frac{38}{35}(1+\frac{24}{60})$	2.7407	74.9124	9.2471
		16	$\frac{72}{17}\frac{28}{54}\frac{40}{36}\frac{38}{35}(1+\frac{24}{60})$	2.1290	58.4359	11.9039
		17	$\frac{86}{17}\frac{28}{54}\frac{40}{36}\frac{38}{35}(1+\frac{24}{60})$	1.6571	45.294	15.2939
		18	$\frac{77}{15}\frac{28}{54}\frac{40}{36}\frac{38}{35}(1+\frac{24}{60})$	1.2778	34.9765	19.8337
	IV	13	$\frac{154}{137}\frac{23}{58}\frac{40}{36}\frac{38}{35}(1+\frac{24}{60})$	2.4530	67.0486	10.3316
		14	$\frac{133}{131}\frac{23}{58}\frac{40}{36}\frac{38}{35}(1+\frac{24}{60})$	1.8463	50.4655	13.7266
		15	$\frac{26}{14}\frac{23}{58}\frac{40}{36}\frac{38}{35}(1+\frac{24}{60})$	1.4193	38.7942	17.8563
		16	$\frac{72}{17}\frac{23}{58}\frac{40}{36}\frac{38}{35}(1+\frac{24}{60})$	1.1025	30.135	22.9873
		15	$\frac{86}{17}\frac{23}{58}\frac{40}{36}\frac{38}{35}(1+\frac{24}{60})$	0.8582	23.4574	29.5310
		16	$\frac{77}{15}\frac{23}{58}\frac{40}{36}\frac{38}{35}(1+\frac{24}{60})$	0.6617	18.0864	38.3005
	I	1	$\frac{154}{137}\frac{62}{61}\frac{28}{56}\frac{40}{36}\frac{38}{35}(1+\frac{24}{60})$	10.0588	274.9402	2.5195
		2	$\frac{133}{131}\frac{62}{61}\frac{28}{56}\frac{40}{36}\frac{38}{35}(1+\frac{24}{60})$	7.5708	206.9349	3.3475
		3	$\frac{76}{14}\frac{62}{61}\frac{28}{56}\frac{40}{36}\frac{38}{35}(1+\frac{24}{60})$	5.82	159.0198	4.3545
		4	$\frac{72}{17}\frac{62}{61}\frac{28}{56}\frac{40}{36}\frac{38}{35}(1+\frac{24}{60})$	4.5211	123.5766	5.6056
		5	$\frac{86}{17}\frac{62}{61}\frac{28}{56}\frac{40}{36}\frac{38}{35}(1+\frac{24}{60})$	3.5190	96.1859	7.2019
		6	$\frac{77}{15}\frac{62}{61}\frac{28}{56}\frac{40}{36}\frac{38}{35}(1+\frac{24}{60})$	2.7134	74.1662	9.3401
	II	7	$\frac{154}{137}\frac{62}{61}\frac{28}{56}\frac{56}{28}\frac{23}{58}\frac{40}{36}\frac{38}{35}(1+\frac{24}{60})$	5.209	142.3392	4.8653
		8	$\frac{133}{131}\frac{62}{61}\frac{28}{56}\frac{56}{28}\frac{23}{58}\frac{40}{36}\frac{38}{35}(1+\frac{24}{60})$	3.9206	107.1629	6.4642
		9	$\frac{76}{14}\frac{62}{61}\frac{28}{56}\frac{56}{28}\frac{23}{58}\frac{40}{36}\frac{38}{35}(1+\frac{24}{60})$	3.014	82.3826	8.4086
		10	$\frac{72}{17}\frac{62}{61}\frac{28}{56}\frac{56}{28}\frac{23}{58}\frac{40}{36}\frac{38}{35}(1+\frac{24}{60})$	2.3413	63.9955	10.8245
		11	$\frac{86}{17}\frac{62}{61}\frac{28}{56}\frac{56}{28}\frac{23}{58}\frac{40}{36}\frac{38}{35}(1+\frac{24}{60})$	1.8223	49.8095	13.9074
		12	$\frac{77}{15}\frac{62}{61}\frac{28}{56}\frac{56}{28}\frac{23}{58}\frac{40}{36}\frac{38}{35}(1+\frac{24}{60})$	1.4052	38.4088	18.0355

FDA gear ratios

	Gears in engagement	Gear ratio	Total gear ration
Drive	$\frac{55}{30}\frac{26}{53}$	0,86486	18,47
Main pair	$\frac{94}{95}$	3,18 | 21,35	
Wheel reduction gear	$\frac{98}{97}(1+\frac{102}{100})$	6,71	

Rear axle	i=27.333
Main pair	$\frac{41}{12}$ = 3.417
Side gear	$\frac{54}{27}$ = 2
Final drive	i = $\frac{72}{24}$ = 4

Rear PTO drive

			Gears in engagement	Gear ratio	Shank reverse, min^{-1} *
Rear PTO	Independent	I	$\frac{87}{3}\frac{50}{90}\frac{49}{48}$	3.564	589
		II	$\frac{24}{10}\frac{50}{90}\frac{49}{48}$	3.224	651.3
		III	$\frac{87}{3}$	1.909	1100
		IV	$\frac{24}{10}$	1.461	1436.E

* at rated engine speed (2100 rev/min)

Rocker bearings

Pos. No.	Designation in catalogue	Quantity per tractor	Pos. No.	Designation in catalogue	Quantity per tractor
2	986714KC17	1	79	50312A	1
4	305A	1	83	207	2
5	208	1	84	104	1
9	5-1000921	1	88	ролик2.0х15.8а5	120
11	311A	1	89	12115	1
15	3KK 78x89x38	5	91	263212A	2
16	664913E	1	96	ролик6х27.8А3	448
18	50308A	1	99	704702K3C10	24
19	309A	2	101	7220A	4
22	67517A	1	103	ролик5х27.8А3	112
25	KK75x86x40	2	104	7508A	1
27	206	2	105	7609A	1
29	50406	1	109	180205K1C17	1
32	6-627613A1	1	113	311A	1
33	692215K1M	1	116	7509	2
34	217K5	4	117	3609	
37	30216Timken	2	118	27307	4
39	42311M1	4	119	2007109	4
43	692309M	1	120	ролик4х34.8-3	156
46	210	2	122	7514	1
51	KK 56x64x35	2	124	102210	1
52	K80x88x30	1	125	113	1
57	664910E	2	128	шарик 11.112 ГОСТ 3722-81	3
64	7212	2	129	210K5	1
73	3514H	1	135	Ролик 4х29.8 А2 ГОСТ 6870-81	100