

VAZ VEHICLES



VAZ-21213, VAZ-21214, VAZ-21214-20, VAZ-21215

REPAIR MANUAL

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Автомобили VAZ-21213, VAZ-21214, VAZ-21214-20, VAZ-21215
Руководство по ремонту автомобилей
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About this manual

This Manual provides information on routine maintenance and servicing and is intended for engineers and mechanics of service outlets, garages and workshops.

The Manual covers the following models:

VAZ-21213 model - an off-road vehicle, three-door body of all-steel unitary construction, with 1.7 litre carburettor engine;

VAZ-21214 model - with 1.7 litre Central Fuel Injection Engine;

VAZ-21214-20 model - with 1.7 litre Sequential Fuel Injection Engine;

VAZ-21215 model - with Turbo Diesel Engine.

The chapters of the manual give full descriptions of VAZ-21213 vehicle units. For general description, service and repair procedures applicable to other models, refer to Section 9 where you can also find the information on additional and alternative equipment fitted to the vehicles.

The Manual provides a detailed description of service operations on the base of OEM parts, with helpful information on fault diagnosis, along with clear indications on removal and refitting, dismantling and reassembly, adjustment and repair of various vehicle units.

We recommend to use special tools and working facilities as listed in Attachment No 2. Tighten the thread connections to torques specified in Attachment No 1. Basic adjustments and inspection checks are outlined in Attachment No 3. Refer to Attachment 4 for recommended lubricants and fuels.

Due to the on-going process of vehicle improvement aimed to enhance the VAZ vehicle reliability and performance, the manufacturer can make alterations and design changes which may fail to enter this publication. Such changes and alterations will be incorporated into our manuals at the earliest opportunity.

The Manual describes the vehicle design as of October 1999.

Section 1. General Data

Table 1-1

TECHNICAL SPECIFICATION

Features	VAZ-21213	VAZ-21214	VAZ-21214-20	VAZ-21215
General				
Number of seats	5	5	5	5
Kerb weight, kg	1210	1210	1210	1240
Payload, kg	400	400	400	400
Overall dimensions	Fig.1-1			
Maximum braking distance at GVW and 80 km/h on horizontal dry flat asphalt road, not greater, meters:				
• with service braking system applied	40	40	40	40
• with emergency system applied (either of two service braking circuits)	90	90	90	90
Maximum speed* in top gear, km/h:				
• with driver and passenger	137	137	137	130
• at full load	135	135	135	128
Acceleration time*, 0 to 100 km/h through gear shifting, seconds:				
• with driver and passenger	19	19	19	22
• at full load	21	21	21	24
Engine				
Model	21213	21214	21214-10	DHW (XUD-9SD)
Type	Four-stroke, petrol, carburettor	Four-stroke, petrol, CFI	Four-stroke, petrol, sequential injection	Four-stroke, turbo diesel
No of cylinders	four in-line	four in-line	four in-line	four in-line
Bore x stroke, mm	82x80	82x80	82x80	83x88
Capacity, litre	1.69	1.69	1.69	1.905
Compression ratio	9.3:1	9.3:1	9.3:1	21.5:1
Maximum power:				
as per GOST 14846 (net), at least, kW (h.p.)	58 (78.9)	58 (78.9)	58.5 (79.6)	55 (74.8)
as per ISO 1585, kW	58	58	58.5	55
Maximum crankshaft speed at maximum power, rpm	5200	5400	5000	4600
Firing order	1-3-4-2	1-3-4-2	1-3-4-2	1-3-4-2

* Measured using a special procedure

Features	VAZ-21213	VAZ-21214	VAZ-21214-20	VAZ-21215
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Power train

Clutch	<i>single dry plate, diaphragm spring</i>			
Clutch release mechanism	hydraulic, servo spring			
Transmission	5-speed, synchro units on all forward gears			
Gear ratio:				
• first gear	3.67	3.67	3.67	3.67
• second gear	2.10	2.10	2.10	2.10
• third gear	1.36	1.36	1.36	1.36
• fourth gear	1.00	1.00	1.00	1.00
• fifth gear	0.82	0.82	0.82	0.82
• reverse gear	3.53	3.53	3.53	3.53
Transfer case	two-gear, lockup differential			
Gear ratio:				
• top gear	1.2	1.2	1.2	1.2
• bottom gear	2.135	2.135	2.135	2.135
Transfer case differential	bevel gears, two pinion gears			
Drive line:				
• from transmission to transfer case	flexible coupling and CV joints			
• from transfer case to front and rear axles	two universal joints on needle bearings with grease nipples and yokes			
• from front axle to wheels	open, with CV joints			
Final drive ratio, front and rear axles				
• gear ratio	3.9	3.9	3.9	3.9
• differential		bevel, hypoid		
		bevel, two pinion gears		

Suspension and wheels

Front suspension	independent, lower track control arms (wishbones), coil springs, hydraulic telescopic shock-absorbers, anti-roll bar
Rear suspension	rigid axle beam with Panhard rod and four trailing arms, coil springs/hydraulic telescopic shock-absorbers
Wheels	pressed-steel disc
• wheel rim	127J x 406 (5J x 16)
Tyres	tubed, cross-ply or radial ply
size:	
• cross-ply tyres	175 x 406 (6.95 x16),
• radial-ply tyres	175/80R16

Features	VAZ-21213	VAZ-21214	VAZ-21214-20	VAZ-21215
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Steering

Steering mechanism	globoidal worm, double-crest roller, steering ratio 16.4
Steering linkage	three links, relay rod and two steering rods, drop arm, idler arm and swing arms

Braking system

Service braking system:	
• front brakes	disc-type, floating caliper, automatic disc-to-pad clearance adjustment
• rear brakes	drum-type, self-applying shoes and automatic shoe-to-drum clearance adjustment
• brake operation line	foot-type, hydraulic, dual circuit, split diagonally, vacuum servo unit and pressure regulator
Handbrake	cable-operated on rear wheels

Electrical system

Wiring diagram	single-wire, negative earth type
Voltage, volts	12
Battery	6CT-55A, 55 ampere-hour
Alternator	AC, integral diode plate and electronic voltage regulator
Starter motor	pre-engaged, solenoid switch and overrun clutch

Body

Type	all-steel unitary construction, monocoque, three-door, double-space
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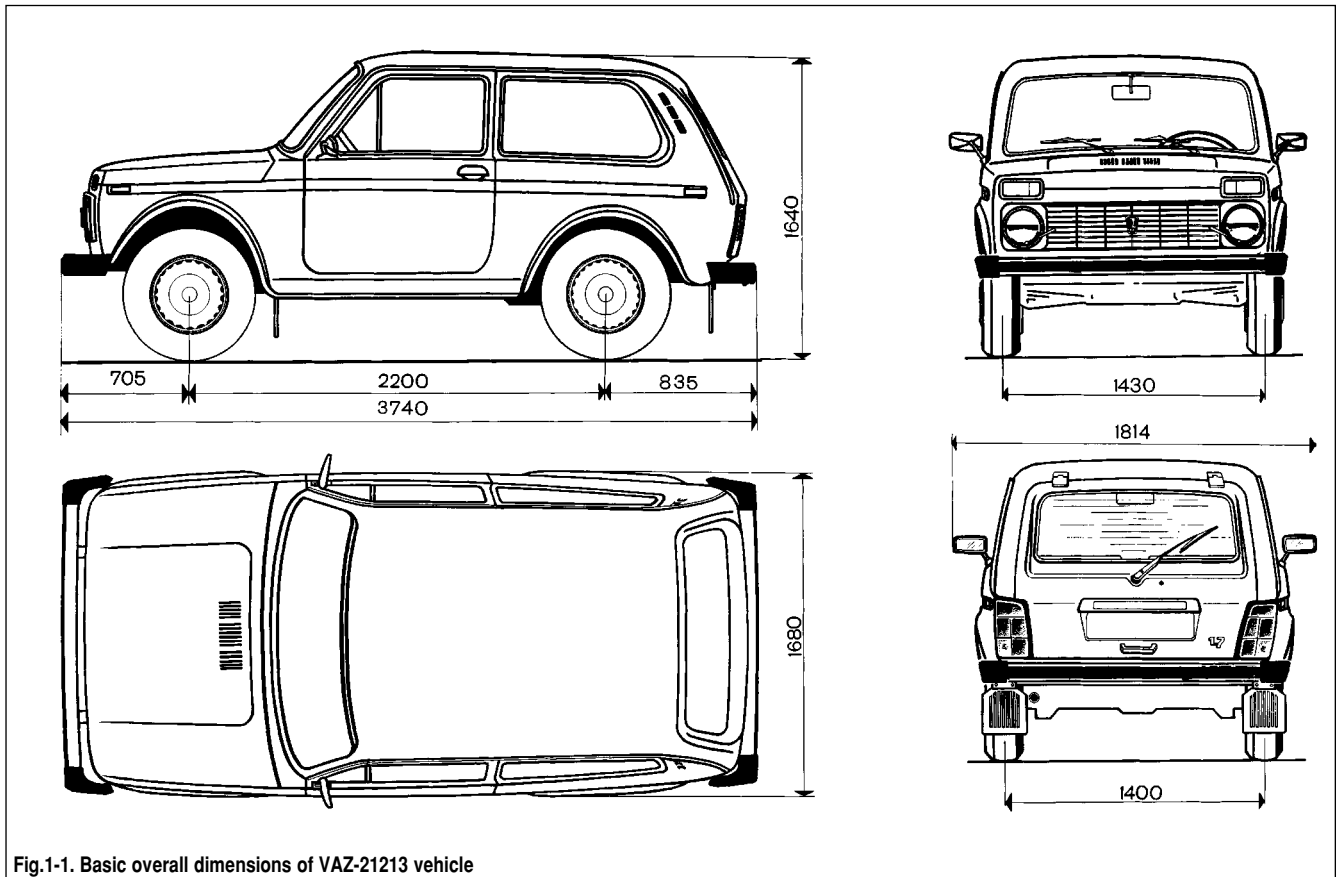


Fig.1-1. Basic overall dimensions of VAZ-21213 vehicle

Section 2. Engine

Refer to Fig.2-1 and Fig.2-2 for front and side sectional views of the engine.

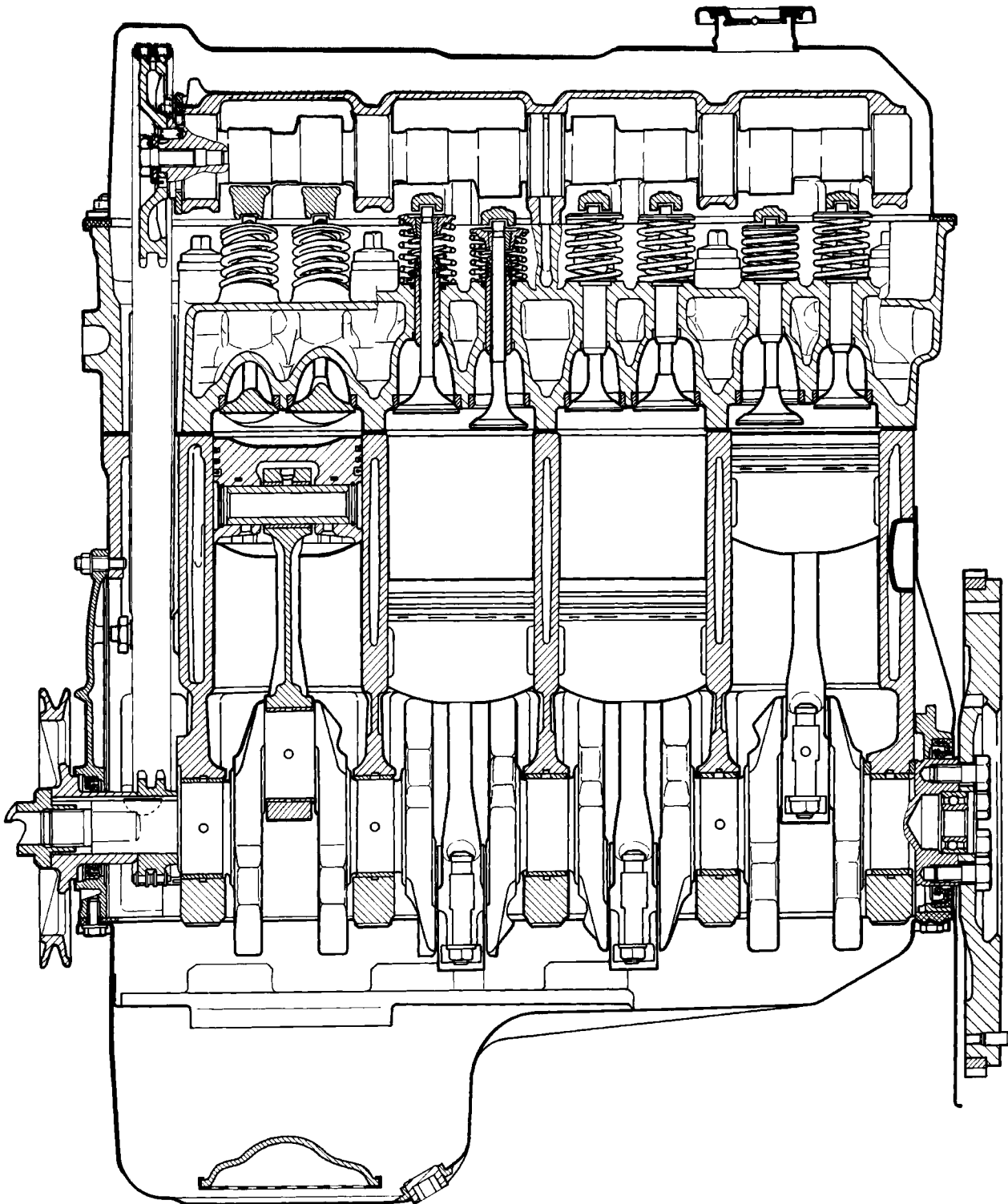


Fig.2-1. Side sectional view of the engine

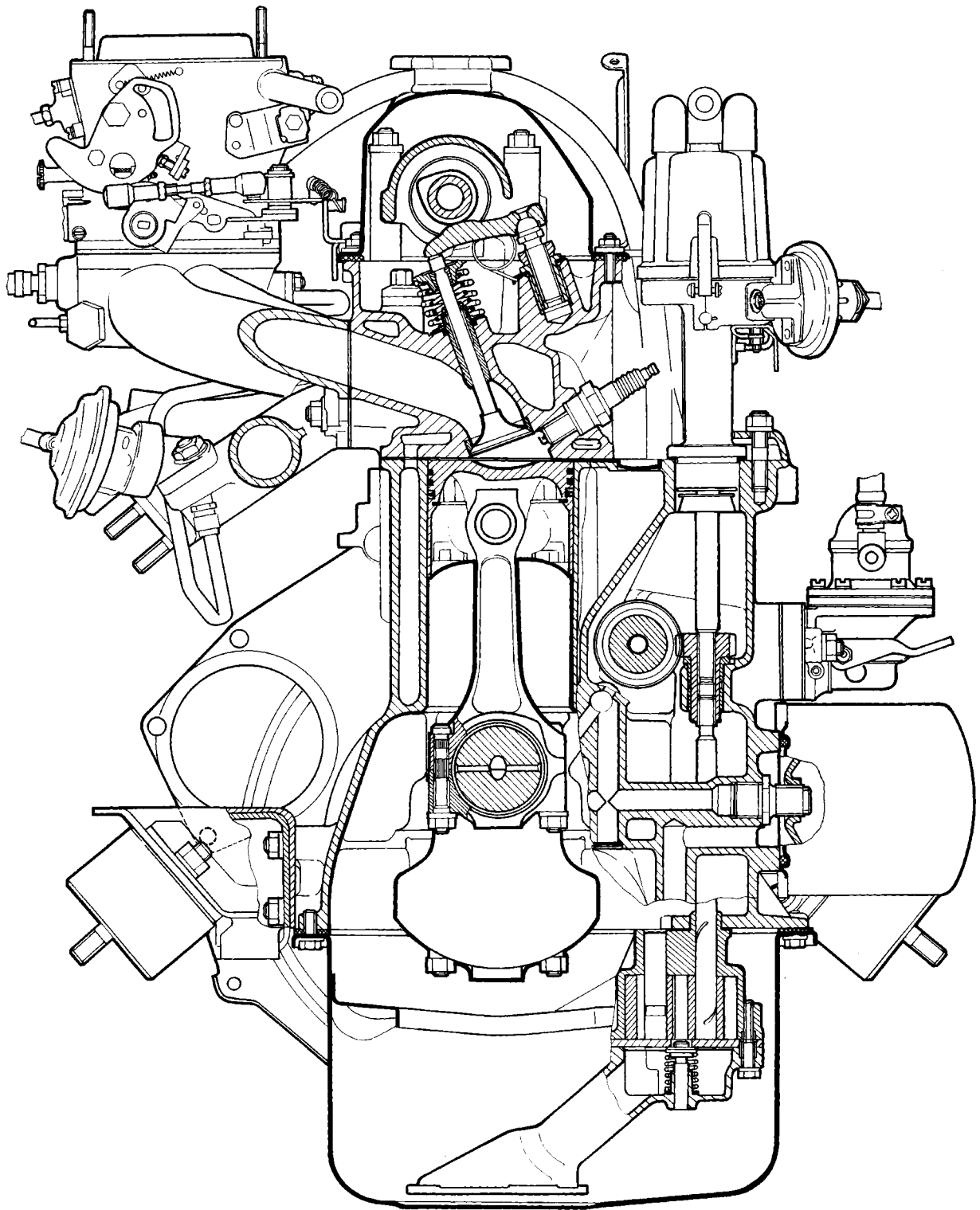


Fig.2-2. Front sectional view of the engine

Fault diagnosis

Symptom/fault	Remedy
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Engine fails to start

<ol style="list-style-type: none"> 1. No fuel to carburettor: <ul style="list-style-type: none"> - blocked fuel pipes or fuel filter; - clogged carburettor or fuel pump filters; - faulty fuel pump 2. Ignition system fault 3. Carburettor fuel cutoff solenoid fails to open at ignition switch-on: <ul style="list-style-type: none"> - disconnected, loose or broken wiring to solenoid or solenoid control unit; - faulty solenoid control unit; - defective fuel cutoff solenoid 4. Carburettor choke not opening at first flashes in cylinders 	<ol style="list-style-type: none"> 1. Carry out the following operations: <ul style="list-style-type: none"> - blow fuel pipes, clean fuel tank, renew fuel filter; - clean filters; - check pump operation and renew any damaged components 2. Refer to section «Ignition system» 3. Carry out the following: <ul style="list-style-type: none"> - check wiring and connections, renew damaged wires; - renew control unit; - replace solenoid with a new one 4. Eliminate any leakage of choke pull-down unit
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Engine idles erratically or stalls

<ol style="list-style-type: none"> 1. Incorrectly adjusted idle speed 2. Defective carburettor solenoid control system 3. Faulty carburettor: <ul style="list-style-type: none"> - blocked carburettor jets or internal passages; - water in carburettor; - broken choke control diaphragm 4. Ignition system fault 5. Vacuum leak through damaged hose between intake pipe and brake servo unit 6. Air leak through gaskets at connections between intake pipe and carburettor/cylinder head 7. Leaking distributor vacuum pipe 	<ol style="list-style-type: none"> 1. Adjust idle speed 2. Refer to «Engine fails to start» 3. Carry out the following: <ul style="list-style-type: none"> - blow carburettor jets and internal passages; - remove water from carburettor, drain sludge from fuel tank; - fit new diaphragm 4. Refer to section «Ignition system» 5. Replace damaged hose 6. Tighten retaining nuts or renew gaskets; eliminate carburettor flange deformation or fit new carburettor 7. Fit new pipe in place of damaged one
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Engine lacks power and has poor acceleration

<ol style="list-style-type: none"> 1. Partly open throttle 2. Choked air cleaner element 3. Ignition system fault 4. Faulty fuel pump 5. Faulty carburettor: <ul style="list-style-type: none"> - faulty accelerator pump; - blocked main jets; - partly open choke; - low fuel level in float chamber; - leaky throttle enrichment diaphragm 6. Restricted fuel tank vent pipe 7. Incorrect valve clearances 8. Misaligned timing marks 9. Insufficient cylinder compression - below 1 MPa (10 kgf/cm²): <ul style="list-style-type: none"> - broken or sticking piston rings; - poor valve-to-seat fitting; - excessively worn cylinders or piston rings 	<ol style="list-style-type: none"> 1. Adjust throttle linkage 2. Change filter element 3. Refer to section «Ignition system» 4. Check pump operation and renew any damaged components 5. Carry out the following: <ul style="list-style-type: none"> - check pump operation, renew damaged parts; - blow jets with compressed air; - adjust choke operation; - adjust float; - replace diaphragm 6. Blow pipe with compressed air 7. Adjust valve clearances 8. Adjust timing belt accordingly, align timing marks 9. Carry out the following: <ul style="list-style-type: none"> - clean piston rings or grooves from carbon deposits, renew damaged components; - replace damaged valves, regrind valve seats; - replace pistons, rebore and hone cylinders.
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Main bearing knocking

Typical knocking or thumping noticeable at sudden throttle opening at idle which intensifies with higher crankshaft rate. Excessive endfloat of crankshaft causes sharper irregular knocking, especially noticeable during smooth increase or decrease in crankshaft speed.

- | | |
|-----------------------------------------------------|------------------------------------------------------------|
| 1. Early ignition | 1. Adjust ignition timing |
| 2. Insufficient pressure oil | 2. Refer to subsection «Insufficient oil pressure at idle» |
| 3. Loose flywheel securing bolts | 3. Tighten bolts to torque specified |
| 4. Excessive main bearing running clearance | 4. Grind journals and renew bearing shells |
| 5. Excessive thrust washers-to-crankshaft clearance | 5. Fit new thrust washers, check clearance |

Big-end bearing knocking

Big-end bearing knocking is sharper than that of main bearings. It is noticeable during engine idle at sudden throttle opening. The origin of knocking can be easily identified through switching off spark plugs one at a time.

- | | |
|------------------------------------------------|-------------------------------------------------|
| 1. Insufficient oil pressure | 1. Refer to «Insufficient oil pressure at idle» |
| 2. Excessive big-end bearing running clearance | 2. Fit new bearing shells and regrind journals |

Piston slap

Thumping noise caused by piston «runout» in cylinder. Most noticeable at low crankshaft speed and under load.

- | | |
|-----------------------------------------------------|---------------------------------------------|
| 1. Excessive piston-to-cylinder bore clearance | 1. Renew pistons, rebore and hone cylinders |
| 2. Excessive gudgeon pin-to-piston groove clearance | 2. Fit new rings or new pistons with rings |

Knocking of intake or exhaust valves

Excessive valve clearances cause typical regular noise; its frequency is lower than the frequency of any other engine noise, since the valves are operated by camshaft rotating at half the crankshaft speed.

- | | |
|---------------------------------------|------------------------------------------------------------|
| 1. Excessive valve clearances | 1. Adjust clearances |
| 2. Broken valve spring | 2. Renew spring |
| 3. Excessive valve-to-guide clearance | 3. Replace worn parts |
| 4. Worn camshaft lobes | 4. Renew camshaft and levers |
| 5. Loose locknut of adjuster bolt | 5. Adjust clearance between lever and cam, tighten locknut |

Excessive noise of camshaft operation line

Noise from camshaft operation line is caused by clearances between engagement elements and becomes noticeable in general engine noise at low crankshaft speed.

- | | |
|------------------------------------------|-----------------------------------|
| 1. Loose chain caused by general wear | 1. Tighten chain |
| 2. Broken chain tensioner shoe or damper | 2. Renew tensioner shoe or damper |
| 3. Seized chain tensioner plunger rod | 3. Eliminate seizure |

Insufficient oil pressure at warm engine idle

- | | |
|--------------------------------------------------------------------|-----------------------------------------------------------------|
| 1. Foreign particles entrapped under oil pump relief valve | 1. Clean valve from foreign particles and flash, clean oil pump |
| 2. Seized oil pressure relief valve | 2. Renew valve |
| 3. Worn oil pump gears | 3. Repair oil pump |
| 4. Excessive main bearing running clearance | 4. Turn journals and renew bearing shells |
| 5. Excessive camshaft bearing journal-to-bearing housing clearance | 5. Renew camshaft or bearing housing |
| 6. Incorrect oil grade or inappropriate oil quality | 6. Change oil as recommended in Attachment 4 |

Excessive oil pressure on warm engine

- | | |
|----------------------------------------------------------|-----------------|
| 1. Seized oil pressure relief valve | 1. Renew valve |
| 2. Excessively tough spring of oil pressure relief valve | 2. Renew spring |

Excessive oil consumption

- | | |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ol style="list-style-type: none">1. Oil leaking through engine gaskets2. Restricted crankcase ventilation system3. Worn piston rings4. Broken piston rings5. Foul windows of oil scraper rings or foul slots in piston grooves due to wrong oil6. Worn or damaged valve oil caps7. Badly worn valve stems or guides | <ol style="list-style-type: none">1. Tighten fittings or replace gaskets and oil seals2. Wash components of crankcase ventilation system3. Rebore and renew pistons and rings4. Renew rings5. Clean windows and slots of carbon, change motor oil as recommended in Attachment 46. Renew oil caps7. Renew valves, repair cylinder head |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

Excessive fuel consumption

- | | |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ol style="list-style-type: none">1. Choke not fully opened2. Excessive resistance to vehicle motion3. Incorrect ignition timing4. Defective distributor vacuum unit5. High fuel level in carburettor:<ul style="list-style-type: none">- leaking needle valve or its gasket;- seizure or excessive friction hindering normal float operation6. Choked carburettor air jets7. Leaking part throttle enrichment diaphragm8. Carburettor solenoid failed to shut off fuel at overrun:<ul style="list-style-type: none">- no earthing of idle switch sliding contact;- broken wire between control module and carburettor idle switch;- faulty control module | <ol style="list-style-type: none">1. Adjust choke linkage2. Check and adjust pressures in tyres, braking system, wheel alignment3. Adjust ignition timing4. Renew vacuum unit or ignition distributor5. Carry out the following:<ul style="list-style-type: none">- check for any foreign matter entrapped between needle and valve seat; renew valve or gasket as applicable;- check and when necessary replace floats6. Clean jets7. Replace diaphragm8. Following to be done:<ul style="list-style-type: none">- clean solenoid contact surfaces;- check wiring and connections, renew damaged wire;- renew control unit |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

Engine overheating

Coolant temperature gauge needle is in the red sector. Start tracing the failure with checking coolant temperature gauge and its sender (Refer to section «Instrumentation»).

- | | |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ol style="list-style-type: none">1. Slackened pump and alternator drive belt2. Insufficient coolant in system3. Incorrect ignition timing4. Dirty radiator outside5. Defective thermostat6. Faulty radiator cap inlet valve (opening pressure is below 0.07 MPa (0.7 kgf/cm²))7. Defective coolant pump | <ol style="list-style-type: none">1. Adjust drive belt tension2. Top up coolant to cooling system3. Adjust ignition timing4. Clean radiator outside with water jet5. Renew thermostat6. Renew cap7. Check pump operation, renew or repair pump |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

Sudden coolant drop in expansion tank

- | | |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ol style="list-style-type: none">1. Damaged radiator2. Damaged cooling hoses or pipe gaskets, loose clips3. Leaking heater tap or heater matrix4. Leaking water pump seal5. Damaged radiator cap or cap seal6. Defective cylinder head gasket7. Leaks from fissures in cylinder block or cylinder head8. Leaks from fissures in water pump housing, water jacket return pipe, thermostat, expansion tank or intake pipe | <ol style="list-style-type: none">1. Repair or renew radiator2. Renew damaged hoses or gaskets, tighten hose clips3. Renew tap or heater matrix4. Renew seal5. Renew cap6. Renew gasket7. Check cylinder block and cylinder head for leakage; renew damaged components in case of evident cracking8. Check for leaks; renew components in case of fissures; minor leaks can be cured by adding a radiator sealant such as НИИСС-1 |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

Engine - removal and refitting

Put the vehicle on a lift or over an inspection pit and apply the handbrake. Take out the spare wheel and its supporting pipe. Disconnect the battery leads and withdraw the battery. Unbolt and remove the bonnet.

To remove the air cleaner, disconnect its hoses, remove the cover and filter element. Temporarily plug the carburettor.

Disconnect the throttle linkage and choke cable.

Disconnect the wires from the fuel cutoff solenoid, idle switch, oil pressure sensor, coolant temperature sensor, ignition distributor, alternator and starter motor.

Drain coolant from the radiator, cylinder head and heater unit. To do this, shift the heater tap control lever to the right, undo the caps on the cylinder block left side and radiator right-hand fluid cooler, screw instead the return hoses connectors, then undo the caps of the expansion tank and radiator.

Separate the fan cowl halves and remove the fan blower cowl. Disconnect the coolant supply and return hoses from the engine. Undo two bolts retaining the radiator to the body, release the top catch of the fan cowl, move the top radiator toward the engine and withdraw the radiator from the engine bay complete with the thermostat and associated hoses. Remove the fan cowl.

Undo the nuts holding the downpipe to exhaust manifold. Detach the downpipe from the bracket on the transmission and lower it down.

Slacken the clips, disconnect the hoses from the fuel pump and secure the pump in the position that excludes any fuel leakage. Detach the fuel return hose from the carburettor.

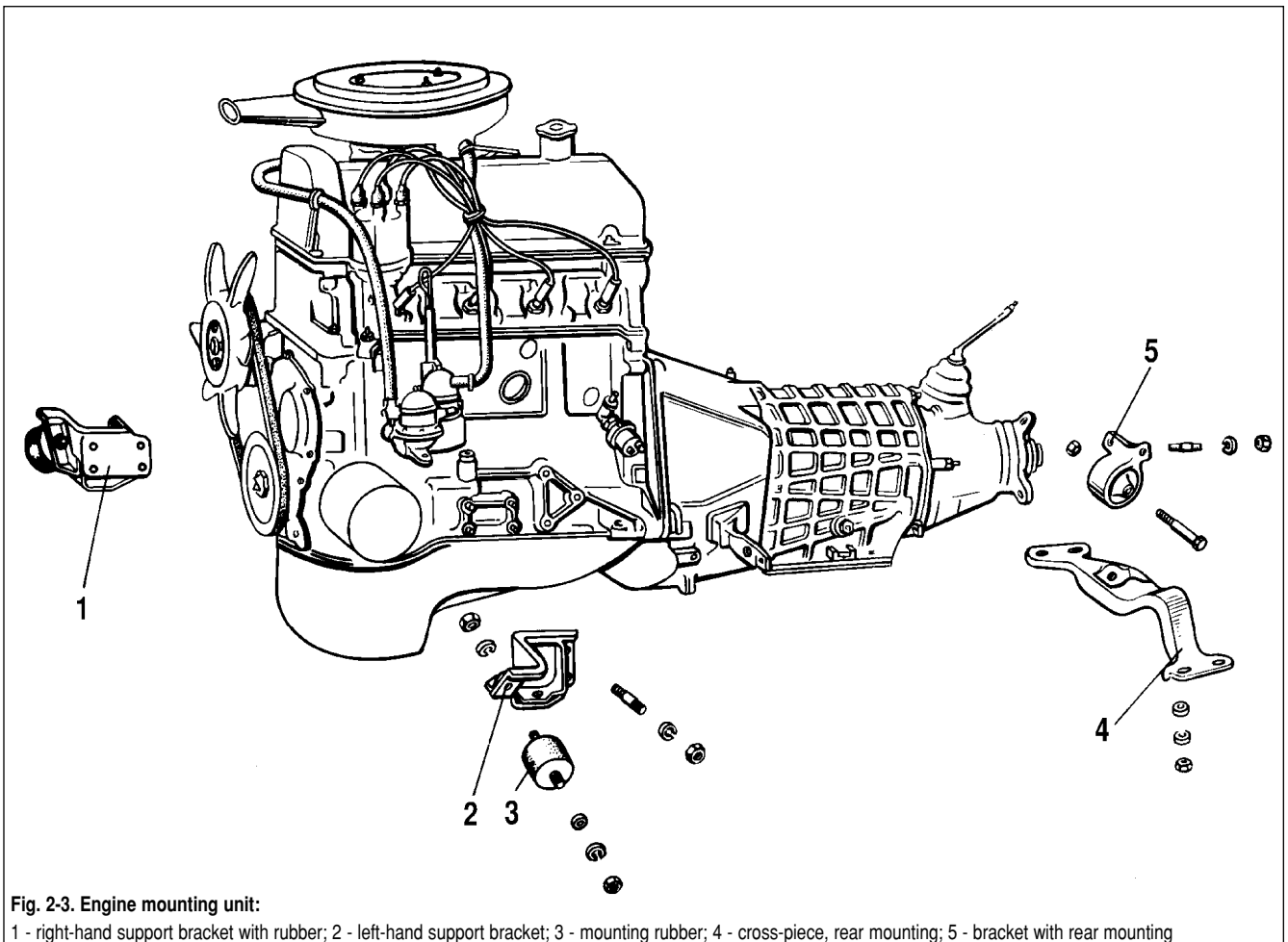
Release the clips and disconnect the hoses from the heater manifolds, detach the brake servo hose from the intake pipe.

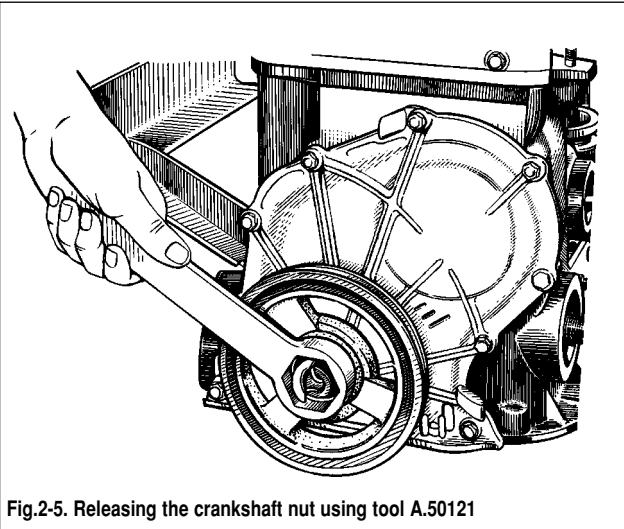
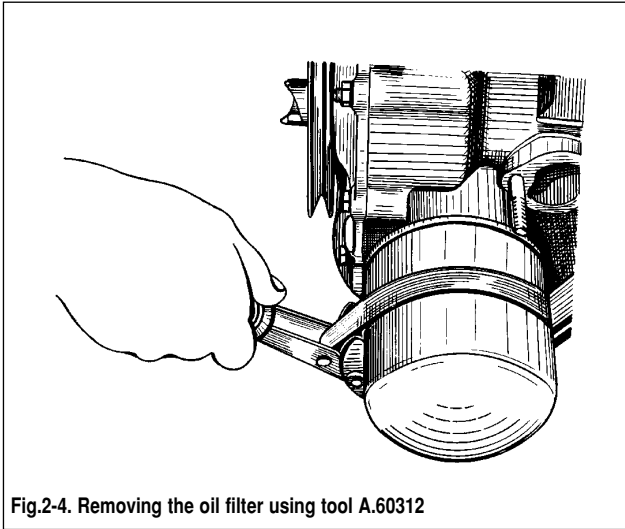
Use socket spanner 02.7812.9500 to unbolt the starter motor from the clutch housing. Undo the bolts holding the clutch housing cover to the lower clutch. Using A.55035 undo the clutch bellhousing to the cylinder block.

Hoist the beam TCO-3/379 and secure the engine right side to the lifting yoke at the front exhaust manifold stud, while the left side shall be secured through the clutch housing mounting hole.

Slightly tension the hoist, undo the nuts that retain front engine mounting rubbers 3 (Fig.2-3) to the side brackets, undo the nut and bolt holding the front axle housing to the engine brackets. Disconnect the engine negative lead.

Lift out the engine, first raise its top in order to take the bolts of the mounting rubber out of the bracket holes, then move the engine forward in order to release the input shaft from the bearing in the crankshaft flange.





Remove the starter motor heat shield, followed by the starter motor, hot air intake complete with the supply hose. Remove from the cylinder head two side brackets together with the front engine mounting rubbers.

Unbolt the clutch and withdraw it. Refitting is a reversal of the removal procedure. Draw special attention to the engine-to-transmission connection: the input shaft must precisely engage the clutch disc splines. Furthermore, for perfect engine/transfer box centering, the centering washers of the front engine mounting rubbers must be in the respective side brackets holes.

Engine - dismantling

Flush the engine, mount it on a stand for dismantling and drain the oil sump. Remove the carburettor, for that disconnect the hoses and throttle operating rod.

Remove the fuel pump and ignition distributor. Use spanner 67.7812.9514 to unscrew the spark plugs and coolant temperature sensor.

Remove the alternator and water pump drivebelt. Remove the alternator and its retaining bracket.

On the pump and exhaust manifold disconnect the coolant supply pipe from the heater.

From the pump and exhaust manifold disconnect the coolant supply pipe from the heater.

Use tool A.60312 to undo the oil filter with seal, remove the oil filter and seal (Fig.2-4).

Unscrew the oil pressure warning lamp sender. Remove the crankcase vent breather cover, crankcase and oil pump. Remove the oil separator drain pipe catch and take out the oil separator.

To remove the crankshaft pulley, secure the flywheel using A.60330/R (Fig. 2-10) and undo the nut using tool A.5012 (Fig. 2-5). Withdraw the valve cover and timing cover. Unbolt the

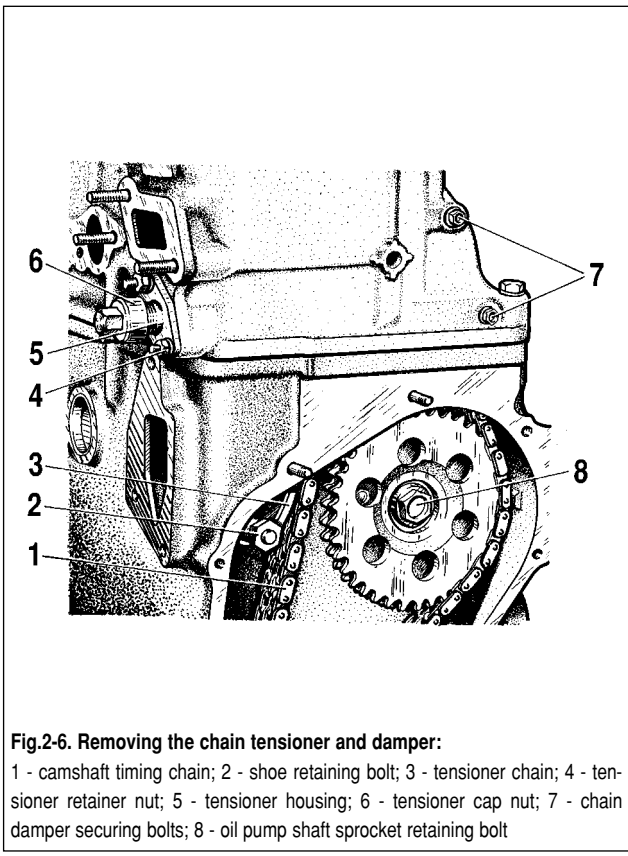


Fig.2-6. Removing the chain tensioner and damper:
 1 - camshaft timing chain; 2 - shoe retaining bolt; 3 - tensioner chain; 4 - tensioner retainer nut; 5 - tensioner housing; 6 - tensioner cap nut; 7 - chain damper securing bolts; 8 - oil pump shaft sprocket retaining bolt

camshaft and oil pump drive shaft sprockets.

Slacken chain tensioner cap nut 6 (Fig.2-6), undo nut 4 holding it to the cylinder head, remove the tensioner; then unbolt and remove chain tensioner shoe 3.

Undo the chain stop pin, remove the oil pump and camshaft sprockets, then take off the chain.

Loosen studs 4 nuts (Fig. 2-7). Remove the camshaft bearing housing. Undo studs 4 nuts, remove thrust flange 1 and withdraw the camshaft exercising maximum care not to damage the camshaft bearing housing surface.

Unbolt the cylinder head and withdraw it complete with the exhaust manifold and intake pipe.

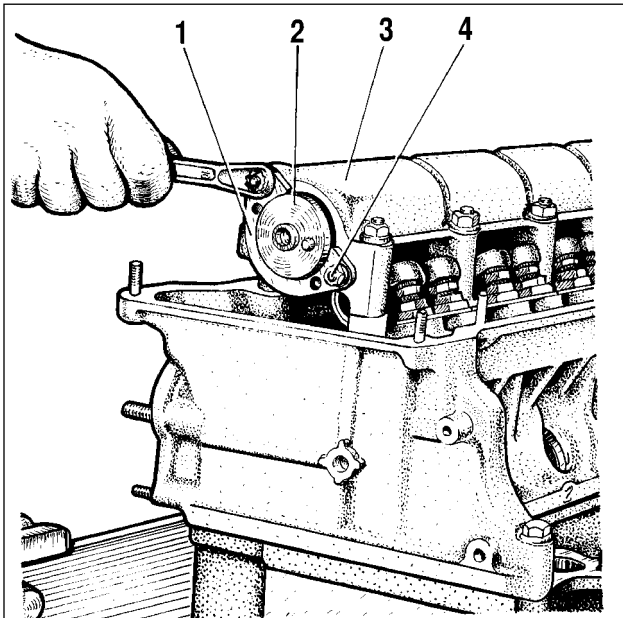


Fig.2-7. Removing the camshaft thrust flange:
 1 - thrust flange; 2 - camshaft; 3 - bearing housing; 4 - thrust flange securing stud

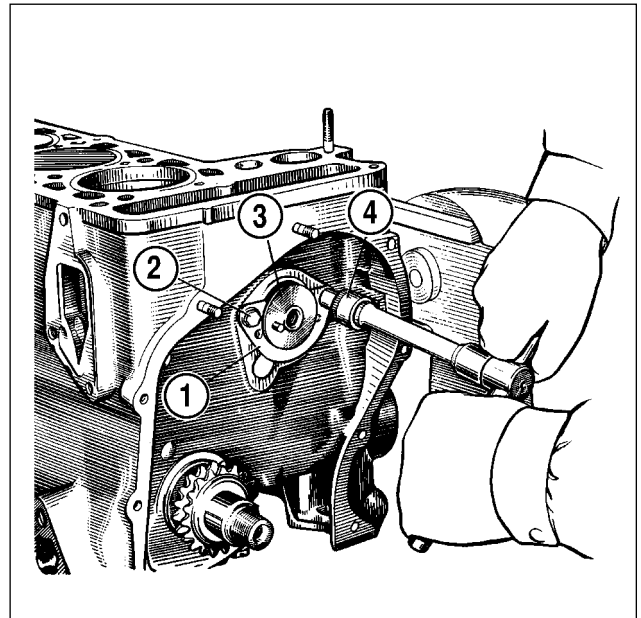


Fig.2-8. Removing the oil pump shaft:
 1 - thrust flange; 2 - flange securing bolt; 3 - oil pump shaft; 4 - wrench

Remove thrust flange 1 (Fig.2-8) of the oil pump drive shaft and take the shaft out of the cylinder block.

Using picker A.40005/1/7 (kit A.40005) drive the sprocket off the crankshaft (Fig.2-9).

Undo the connecting rod bolts, remove the big end cap and carefully lift the pistons with the conrods through the cylinders. Mark the piston, connecting rod, main and big-end bearing shells for position to facilitate the reassembly.

WARNING. When removing the pistons and conrods, do not press out the connecting rod bolts.

Fit tool 5 (Fig.2-10), undo bolts 3, remove washer 4 and the flywheel from the crankshaft. Remove the front clutch housing cover.

Using tool A.40006, take the input shaft bearing out from the crankshaft (Fig.2-11).

Remove the crankshaft oil seal retainer.

Unbolt the main bearing cap bolts, remove them complete with the lower bearing shells, then lift out the crankshaft, top bearing shells and rear bearing thrust washers.

Engine - reassembly

Follow the engine reassembly procedure as below:

Locate a clean cylinder block and screw in any missing dowels. Oil the crankshaft bearing shells, thrust washers, pistons and oil seals. Always fit new crankshaft oil seals when reassembling the engine after overhaul.

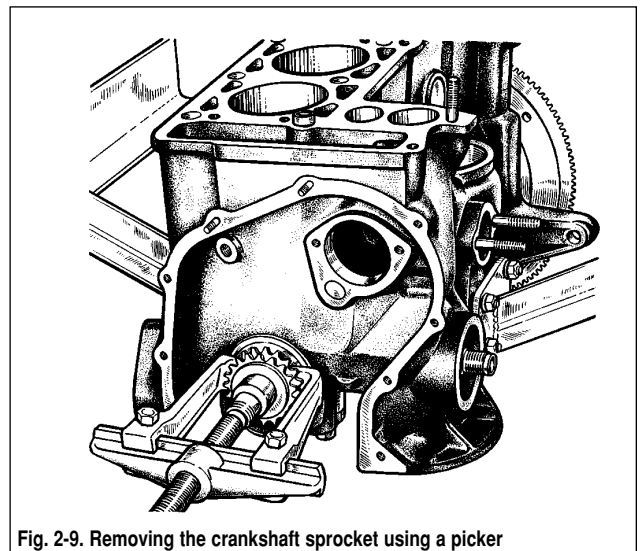


Fig. 2-9. Removing the crankshaft sprocket using a picker

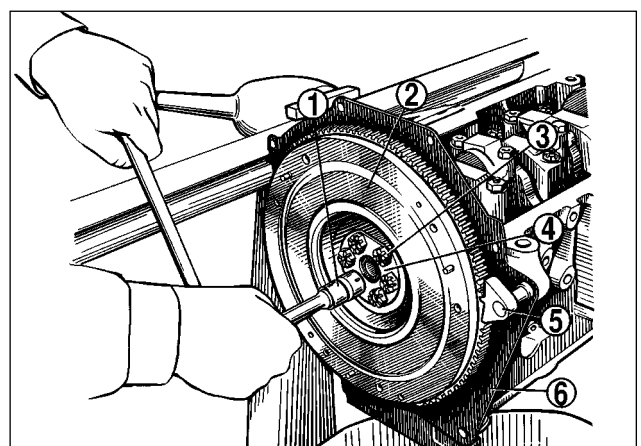
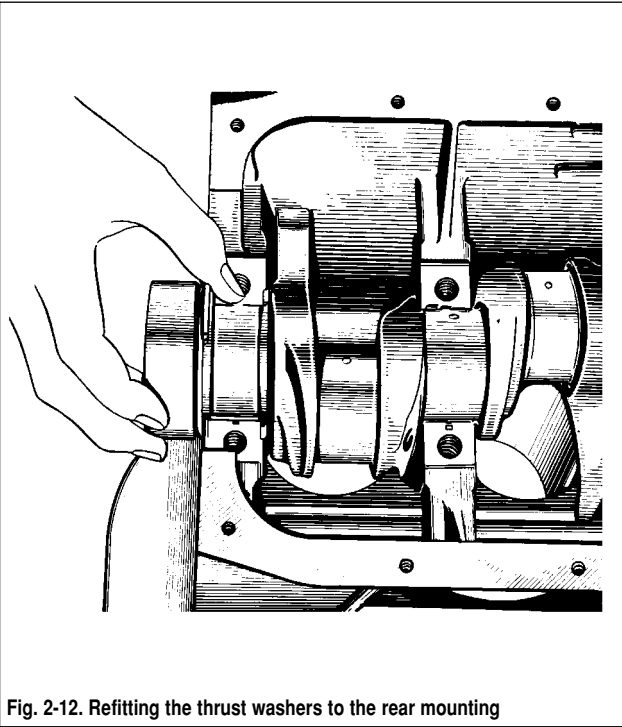
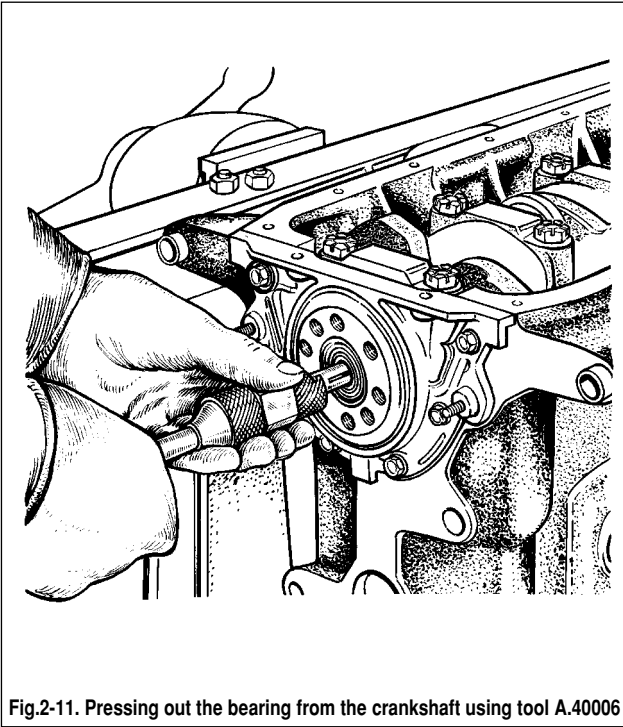


Fig.2-10. Removing the flywheel:
 1 - wrench; 2 - flywheel; 3 - flywheel securing bolt; 4 - washer; 5 - tool A.60330/R to lock the flywheel stationary; 6 - front clutch housing cover



Fit the centre main bearing shells without an oilway into the bearing recesses. Fit into other cylinder bores the bearing shells with an oilway, while into the relevant main bearing caps - the bearing shells without an oilway. Lower the crankshaft into position, then stick two thrust washers into the rear bearing recesses (Fig.2-12).

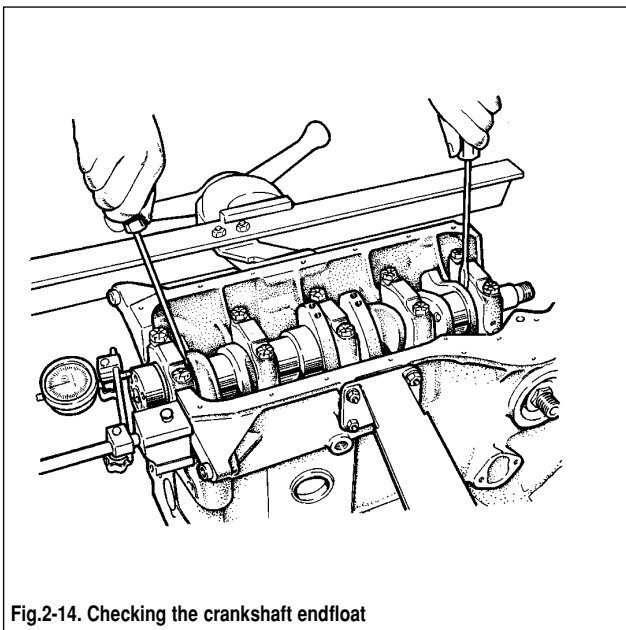
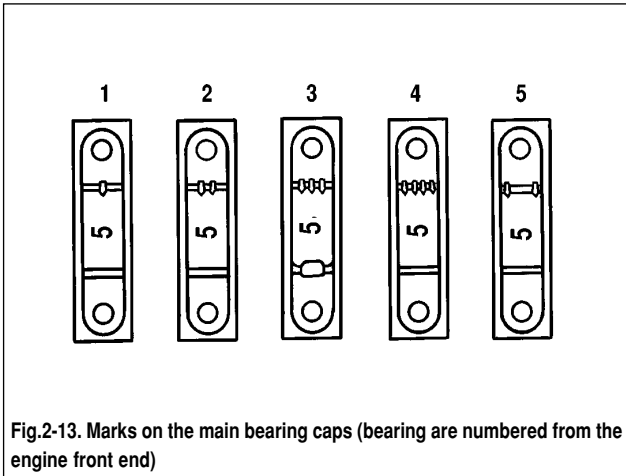
WARNING. The washers must be fitted so that their oilways face away from the bearings in the block and cap (anti-friction coat is applied on the washer surface). At the rear of the rear main bearing there fitted a sintered thrust washer (yellow), while at the front - a steel-aluminium thrust washer.

Locate the main bearing caps according to the marks on their outer surface (Fig.2-13). Tighten the cap securing bolts.

Check the crankshaft endfloat. To do this, turn the cylinder block to have the rear side up and position the dial gauge foot against the crankshaft flange (Refer to Fig.2-14). Moving the crankshaft up and down (using screwdrivers, for instance), check the crankshaft endfloat to be within 0.06-0.26 mm. If not, adjust accordingly and replace the old thrust washers with new ones or fit thicker thrust washers.

Locate the rear oil seal housing gasket on the crankshaft flange, insert the front clutch housing cover bolts into the respective bores (Fig.2-15). Place the oil seal housing on tool 41.7853.4011 and slide it to on the crankshaft flange; next secure it to the cylinder block with the bolts.

Locate front clutch housing cover 6 (Fig.2-10) over two centering pins (Fig. 2-16). Secure the cover to the rear oil seal housing with nuts.



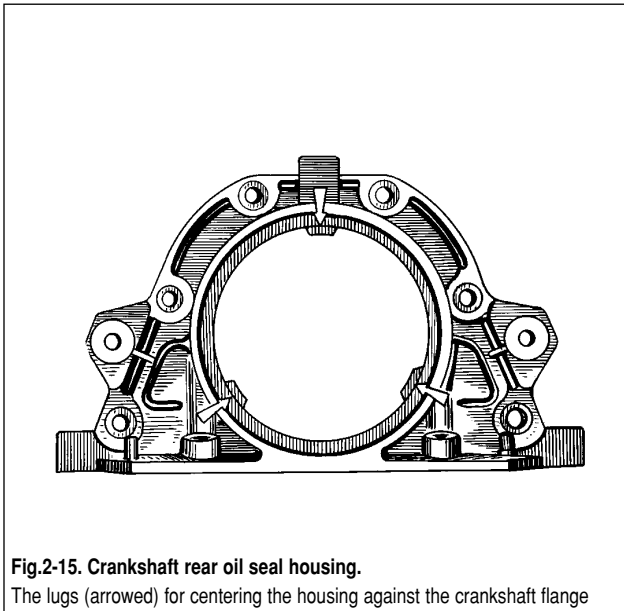


Fig.2-15. Crankshaft rear oil seal housing.
The lugs (arrowed) for centering the housing against the crankshaft flange

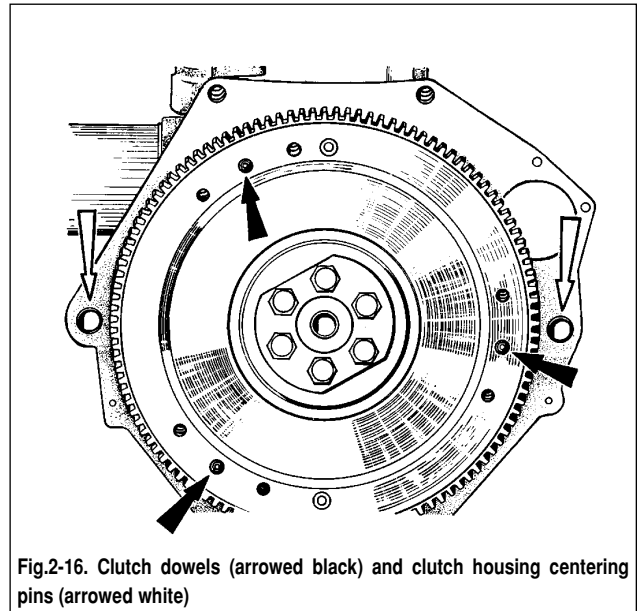


Fig.2-16. Clutch dowels (arrowed black) and clutch housing centering pins (arrowed white)

Locate the flywheel in position so that the marking (a cut-out) near the rim is against the No 4 cylinder crankpin axis. While holding the flywheel stationary with tool A.60330/R, bolt it to the crankshaft flange to the specified torque.

Using a ring compressor (tool 67.8125.9502), fit the pistons and connecting rods to the cylinders (Fig.2-17).

WARNING. The hole for gudgeon pin in the piston is 1.2 mm set off, so the arrows on the piston crown must face the timing belt end of the engine when inserting the pistons into the cylinders.

Press the big-end bearing shells into the connecting rods and caps. Guide the conrods and big-end caps onto the crankshaft journal, then tighten the connecting rod bolts. The big-end caps must be positioned so that the cylinder number on the cap is against the cylinder number on the connecting rod big-end.

Refit the crankshaft sprocket. Locate the oil pump shaft and secure it with the thrust flange.

Insert two centering pins into the cylinder block (Fig.2-17) and locate the cylinder head gasket over them.

WARNING. Always fit the new cylinder head gasket. Never re-use the old gasket.

Before refitting the gasket, remove any oil from the mating surfaces of the block and cylinder head. Make sure the gasket is perfectly clean and dry. Avoid any incidental oiling of the gasket.

Turn the crankshaft so that the pistons are midway in the cylinder bore.

Refit the cylinder head complete with the valves, exhaust manifold and intake pipe over the centering pins.

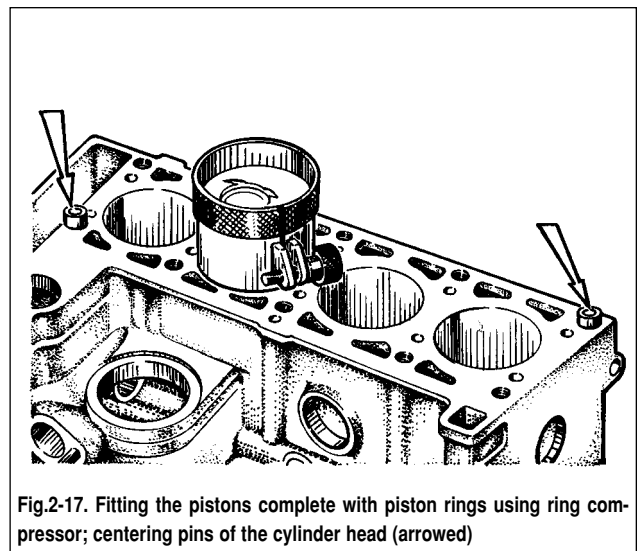


Fig.2-17. Fitting the pistons complete with piston rings using ring compressor; centering pins of the cylinder head (arrowed)

Tighten the cylinder head bolts in the established procedure (Fig.2-18) in four steps to ensure a reliable fit and exclude further tightening during vehicle servicing.

- 1st step - tighten the bolts 1-10 to 20 N•m (2 kgf•m);
- 2nd step - tighten the bolts 1-10 to 69.4-85.7 N•m (7.1-8.7 kgf•m), while the bolt 11 to 31.36 - 39.1 N•m (3.2-3.99 kgf•m);
- 3rd step - turn the bolts 1-10 to 90°;
- 4th step - turn again all bolts 1-10 to further 90°.

WARNING. The cylinder head bolts can be re-used only when their length is not in excess of 120 mm, otherwise renew the bolt.

Before reassembly, immerse the bolts, thread and head, into engine oil. Allow the excess oil drip for at least 30 minutes. Remove all entrapped oil from the bolt bores in the cylinder head.

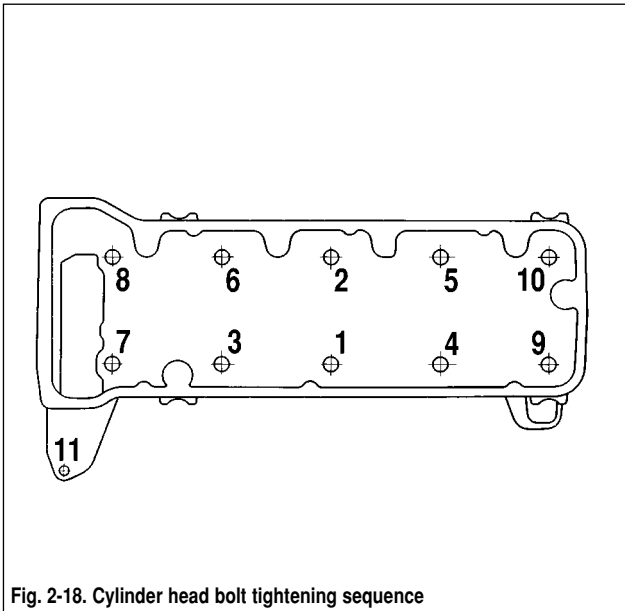


Fig. 2-18. Cylinder head bolt tightening sequence

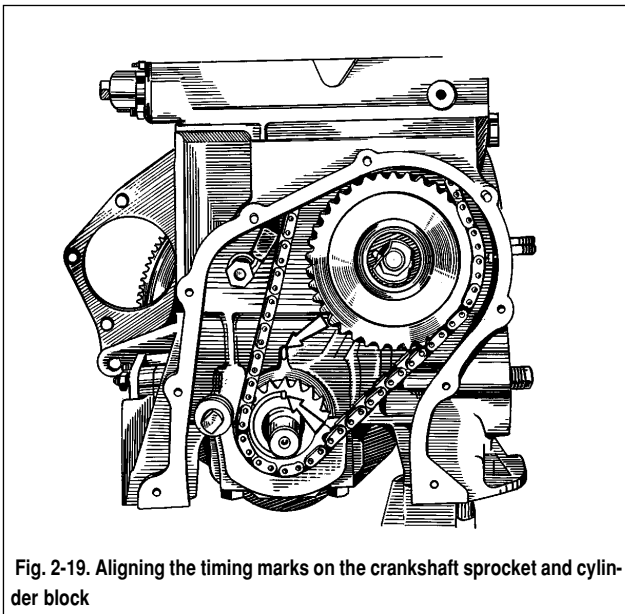


Fig. 2-19. Aligning the timing marks on the crankshaft sprocket and cylinder block

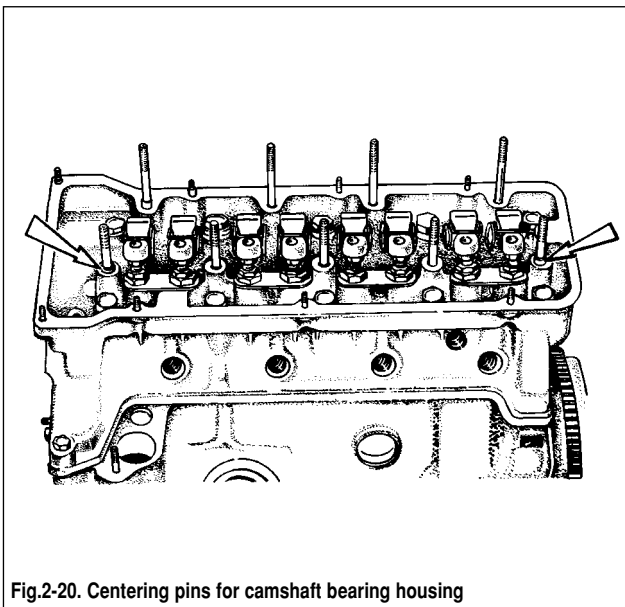


Fig.2-20. Centering pins for camshaft bearing housing

Turn the flywheel so that the mark on the crankshaft sprocket is against the cylinder block mark (Fig.2-19).

Check to see the camshaft bearing housing centering pins are in position (Fig.2-20). Refit the sprocket to the camshaft complete with the bearing housing and turn the camshaft so that the timing mark in the sprocket is aligned against the mark on the bearing housing (Fig.2-21). Remove the sprocket and without changing the camshaft position, refit the bearing housing to the cylinder head so that the centering pins are in the respective bores of the bearing housing. Secure the bearing housing, tightening the nuts in the sequence as shown in Fig.2-22.

Refit the chain vibration damper.

Refit the camshaft timing chain:

- fit the chain onto the camshaft sprocket and position the sprocket so its TDC mark is aligned with the respective mark on the bearing housing (Fig.2-21). Do not tighten the sprocket bolt fully;
- fit the sprocket to the oil pump shaft, but do not tighten the retaining bolt fully;
- fit the chain tensioner shoe and tensioner, but do not tighten the cap nut so that the tensioner spring can compress the shoe; screw the chain stop pin into the cylinder block;
- turn the crankshaft two turns forward to ensure the chain tension required; check the indentations in the sprockets are aligned with TDC marks in the cylinder block and bearing housing (Fig.2-19 and Fig.2-21);
- when the marks are aligned, hold the flywheel stationary with tool A.60330/R (Fig.2-10), then tighten the sprocket securing bolts and chain tensioner cap nut to the torques specified, bend the sprocket bolt lock washers; should the marks are not aligned, repeat the chain refitting procedure.

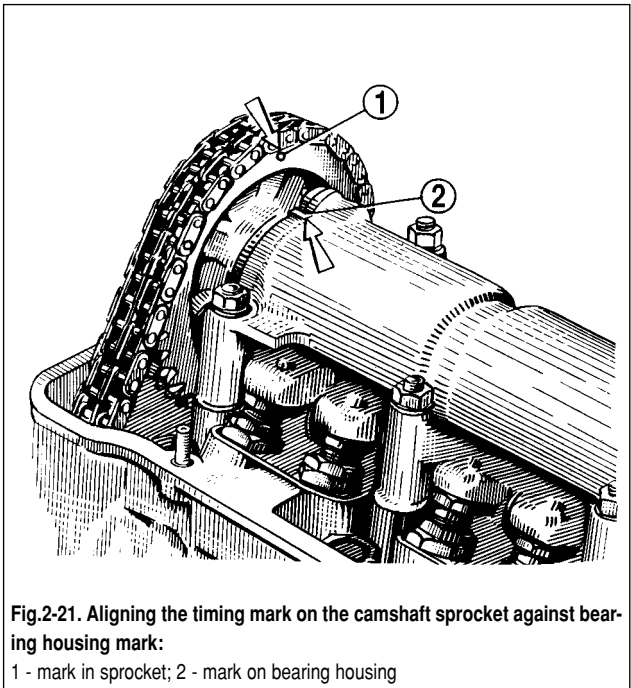


Fig.2-21. Aligning the timing mark on the camshaft sprocket against bearing housing mark:
1 - mark in sprocket; 2 - mark on bearing housing

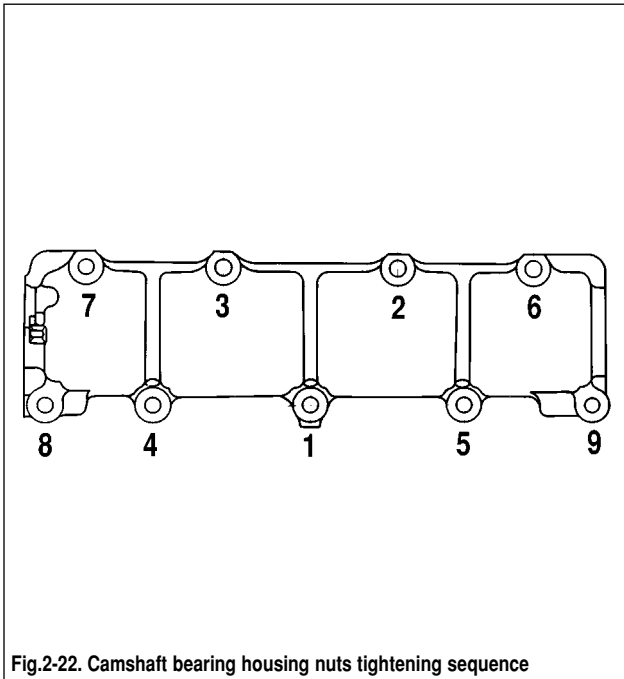


Fig.2-22. Camshaft bearing housing nuts tightening sequence

Adjust the clearance between the camshaft lobes and valve levers.

Refit the camshaft cover (Fig.2-23) complete with the gasket and oil seal to the cylinder block, do not tighten the retaining bolts and nuts fully. Using tool 41.7853.4010 centralize the cover against the crankshaft end, then tighten the retaining nuts and bolts to the torques specified.

Fit the alternator and oil pump pulley, then secure it with the nut.

Fit the oil filter complete with the gasket, manually screw it to the union on the cylinder block. Refit the crankcase vent oil separator, breather cover and secure the oil separator drain pipe with the clip.

Fit oil pump 1(Fig.2-24), then fit the oil sump with the gasket.

Fit the coolant pump, alternator bracket and alternator. Fit the belt around the pulleys and adjust the belt tension.

Fit the heater matrix supply pipe and cooling water jacket outlet pipe to the cylinder block. Secure the heater matrix drain pipe to the coolant pump and outlet pipe.

Fit the instrumentation sensors.

Fit the oil pump / distributor gear, followed by the ignition distributor. Insert the spark plugs, place spanner 67.7812.9515 on the spark plugs and tighten the spark plugs with a torque wrench to the torques specified.

Fit the fuel pump as outlined in section «Fuel system».

Fit the carburettor and reconnect the hoses. Cover the carburettor with a provisional cap.

WARNING. Never secure the carburettor (or tighten its retaining nuts) when it is warm.

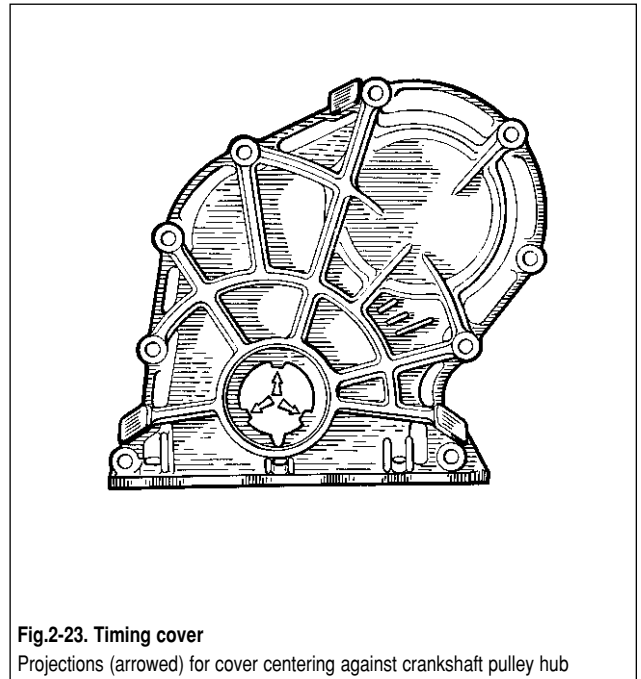


Fig.2-23. Timing cover

Projections (arrowed) for cover centering against crankshaft pulley hub

Fit the valve cover complete with the gasket and fuel piping bracket.

Fit the air cleaner, to do this secure the hoses to the air cleaner housing, fit the filter housing complete with the gasket to the carburettor, then fit the mounting plate and secure the housing with nuts. Locate the filter element and secure the air cleaner cover.

Reconnect the HT leads to the distributor and spark plugs.

Fill the engine with motor oil through the oil filler in the valve cover.

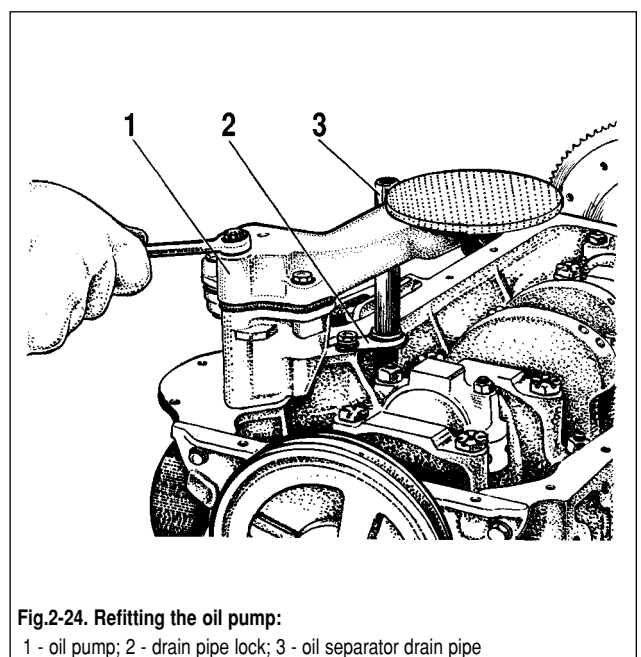


Fig.2-24. Refitting the oil pump:

1 - oil pump; 2 - drain pipe lock; 3 - oil separator drain pipe

Engine run-in after overhaul

After overhaul the engine is bench tested (run-in) at no loads under the following cycle:

750-800 rpm	2 minutes
1000 rpm	3 minutes
1500 rpm	4 minutes
2000 rpm	5 minutes

Locate the engine on the test bench, start the engine and make checks with respect to the following items:

- evidence of coolant or fuel leaks through mating components, pipe connections or gaskets;
- oil pressure and oil leaks through gaskets;
- ignition timing;
- idle speed;
- carburettor / intake pipe tightness;
- abnormal knock.

In case of any malfunctions or unknown rattle, stop the engine, eliminate the faults, then continue the tests.

In case of oil leaks through the gasket between the valve cover and cylinder head or through the gaskets between the oil sump, cylinder block and covers, tighten the securing bolts to the torque specified. If oil leaks persist, check the correct fitting of the gaskets and renew when applicable.

Since the overhauled engine is not fully bed-in and frictions between the working surfaces of renewed parts show significant resistance to the rotation, a certain run-in period is required.

This especially concerns those engines, where the pistons, main / big-end bearing shells have been renewed, or the crankshaft journals have been reground, or the cylinders - honed.

Therefore during run-in after the engine overhaul, never allow the engine to run at maximum loads. When in the vehicle, always run-in the engine at the speeds which are recommended for the run-in periods.

In-vehicle engine inspection after overhaul

Locate the engine in the vehicle, thoroughly check its correct mounting.

Run the engine for a while, then check for:

- coolant or fuel leaks through pipe connections, tighten when necessary;
- full throttle opening and closing by the carburettor cable, adjust accordingly, if necessary;
- alternator drivebelt tension, adjust, when applicable;
- reliable wiring connections and operation of the warning lamps in the instrument cluster.

WARNING. Never check the engine or vehicle on the roller stand without additional rollers for the front wheels.

Cylinder block

General description

The cylinder block basic sizes are shown in Fig.2-25.

The cylinder block is of a low-alloyed cast iron. The cylinder bores are of five classes in steps of 0.01 mm and are designated by the letters A, B, C, D, E. The cylinder class is engraved on the cylinder block bottom face. (Fig.2-26).

The cylinders can be rebored to accommodate the oversize pistons of 0.4 mm and 0.8 mm bigger diameters.

The main bearing caps are machined complete with the cylinder block; therefore they are not interchangeable and feature distinctive notches on the outside surface (Fig.2-13).

Inspection and repair

Inspection. Wash the cylinder block thoroughly and clear the oilways. Blow dry with compressed air and inspect the cylinder block visually. Make sure there are no cracks in the mountings or elsewhere in the cylinder block.

When cooling water is suspected in the crankcase, use a special test bench to examine the cylinder block for leaks. To do this, plug the cylinder block cooling water jacket ports, force in some room temperature water at 0.3 MPa (3 kgf/sq.cm). There should be no evidence of water leaks from the cylinder block within 2 minutes.

When coolant is found contaminated with oil, do not strip the engine completely, rather check the cylinder block for cracks in the area of the oilways. For that, drain the coolant from the cooling system, remove the cylinder head, refill the cylinder block water jacket with water and apply compressed air to the vertical oilway in the cylinder. If there are any bubbles in the water of the cooling water jacket, renew the cylinder block.

Examine the split face between the cylinder block and cylinder head using a straight-edge and feeler blades. Position the straight-edge diagonally and using a feeler gauge measure at the centre, both transversely and longitudinally. The flatness to be within 0.1 mm tolerance.

Cylinder repair. Check the cylinders for wear to be maximum 0.15 mm.

When available, use a dial inside gauge to measure the bore diameter (Fig.2-27) in four lands, both longitudinally and transversely (Fig.2-28). Use tool 67.8125.9502 to set the inside gauge to zero.

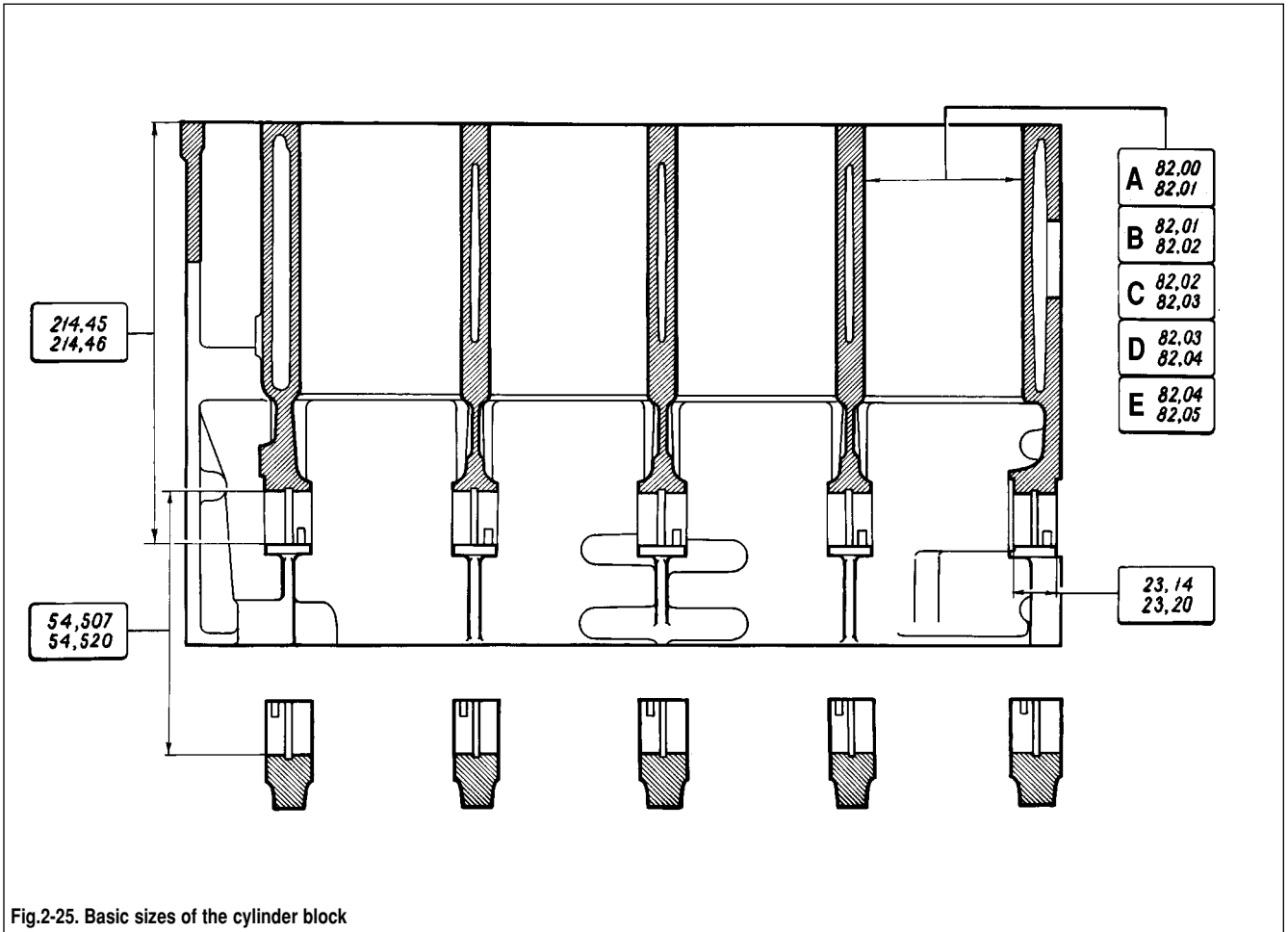


Fig.2-25. Basic sizes of the cylinder block

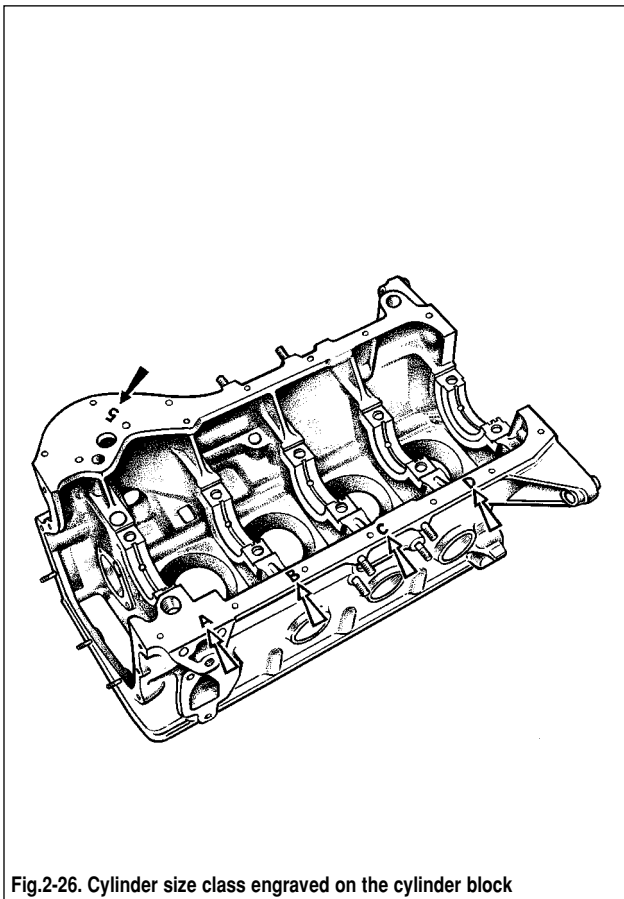


Fig.2-26. Cylinder size class engraved on the cylinder block

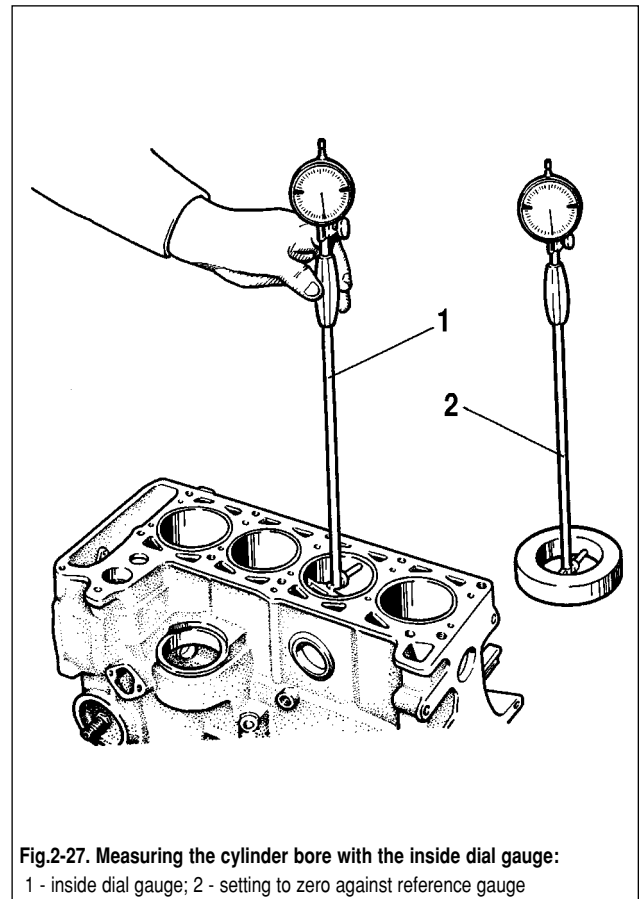


Fig.2-27. Measuring the cylinder bore with the inside dial gauge:
1 - inside dial gauge; 2 - setting to zero against reference gauge

There is practically no wear in the land 1 area of the cylinders. Compare the values measured on the first and other cylinder lands to see the amount of the cylinder wear.

When the maximum wear is over 0.15 mm, rebore the cylinders to the nearest oversize; provide 0.03 mm honing allowance on the diameter.hone the cylinder walls so that the difference between the oversize piston diameter and cylinder bore is 0.025 - 0.045 mm.

Pistons and connecting rods

General Description

The basic sizes of the pistons and connecting rods are shown in Fig.2-29.

Piston is an aluminium casting. The piston weight is precisely maintained during the manufacturing process. Consequently, there is no need to select the matching piston of the same weight class during the engine assembly.

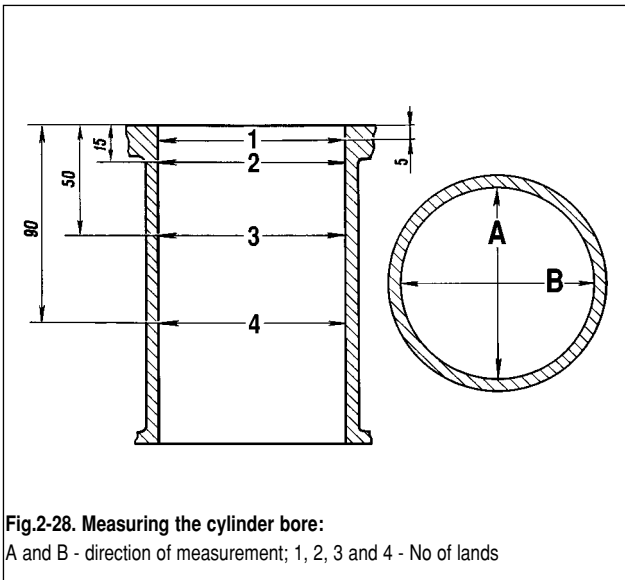


Fig.2-28. Measuring the cylinder bore:
A and B - direction of measurement; 1, 2, 3 and 4 - No of lands

There are five classes (A, B, C, D, E) of the piston according to their major diameter, in steps of 0.01 mm. The piston has a complex outside shape: tapered in height and oval in the cross-section area. Therefore, the piston diameter must be measured in the plane normal to the gudgeon pin at 55 mm from the piston crown.

There are three classes (1, 2, 3) of pistons, as to the hole for the gudgeon pin, in step of 0.004 mm. The classes of piston diameters and holes for the gudgeon pin are stamped on the piston crown (Fig.2-30).

The oversize piston major diameter is 0.4 or 0.8 mm bigger. The 0.4 step is marked in the form of a triangle, while the 0.8 mm step is marked as a square.

Use the arrow on the piston crown for correct piston orientation and fitting within the cylinder. The arrow of the piston must face the timing belt end of the engine.

Gudgeon pin is of steel, hollow, floating-type, i.e. freely operates in the piston bosses and connecting rod bush. The gudgeon pin is secured in the hole with two circlips.

As to the outside diameter the gudgeon pin are of three classes in step of 0.004 mm. The class is paint marked on the gudgeon pin face: 1st class - blue paint, 2nd class - green paint, 3rd class - red paint.

Piston rings are of cast iron. The top compression ring has a chromed barrel face. The bottom compression ring is of the scraper type. The oil control piston ring features chromed working edges and has a coil expander (spreader ring).

The oversize rings are marked as 40 or 80, which corresponds respectively to 0.4 or 0.8 mm step in the major diameter.

Connecting rod is of forged steel. The connecting rod is machined together with the big end cap, therefore they are inter-related. The cylinder number (6 in Fig.2-30) is stamped on the caps and connecting rods to prevent confusion when refitting into the cylinders. During reassembly the figures on the connecting rod and cap should face the same side.

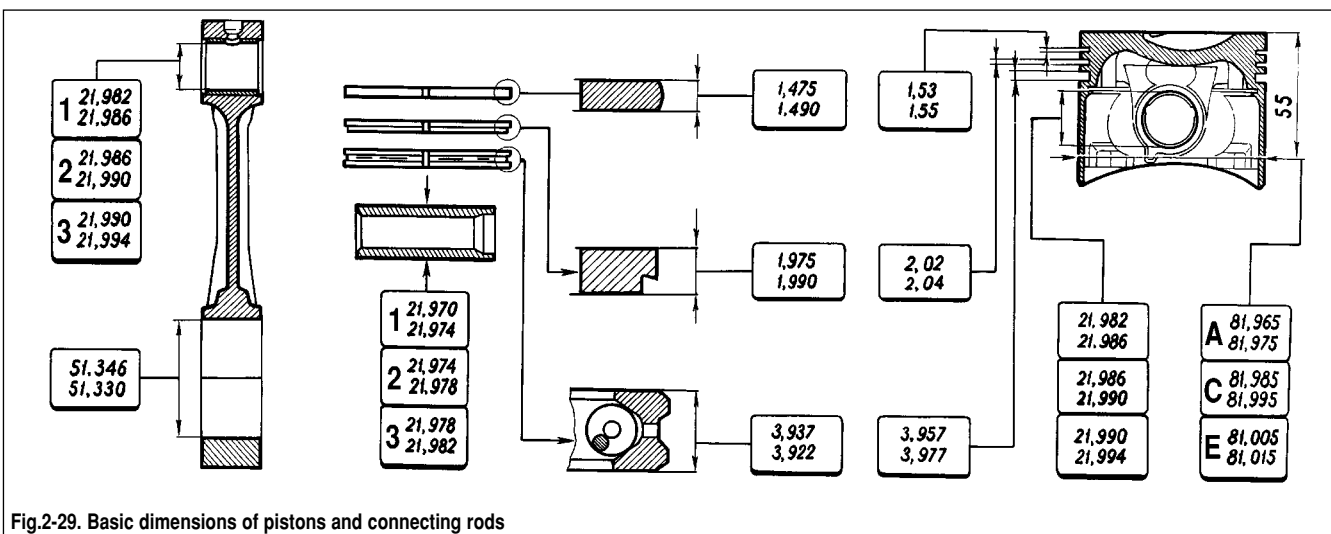


Fig.2-29. Basic dimensions of pistons and connecting rods

The connecting rod small-end features a pressed-in steel-bronze bush. As to the diameter of the bush, the connecting rods are divided into three classes in steps of 0.004 mm (similar to the pistons).

The class number (5 in Fig.2-30) is engraved on the big-end cap.

The connecting rod small-end and big-end are classified weight-wise (Table 2-1) and are paint marked on the connecting

rod. The engine must always be fitted with the connecting rods of the same weight class. The connecting rod weight can be adjusted by removing excess metal from the bosses on the small-end or big-end up to the minimum size of 16.5 mm or 35.5 mm (Fig.2-31).

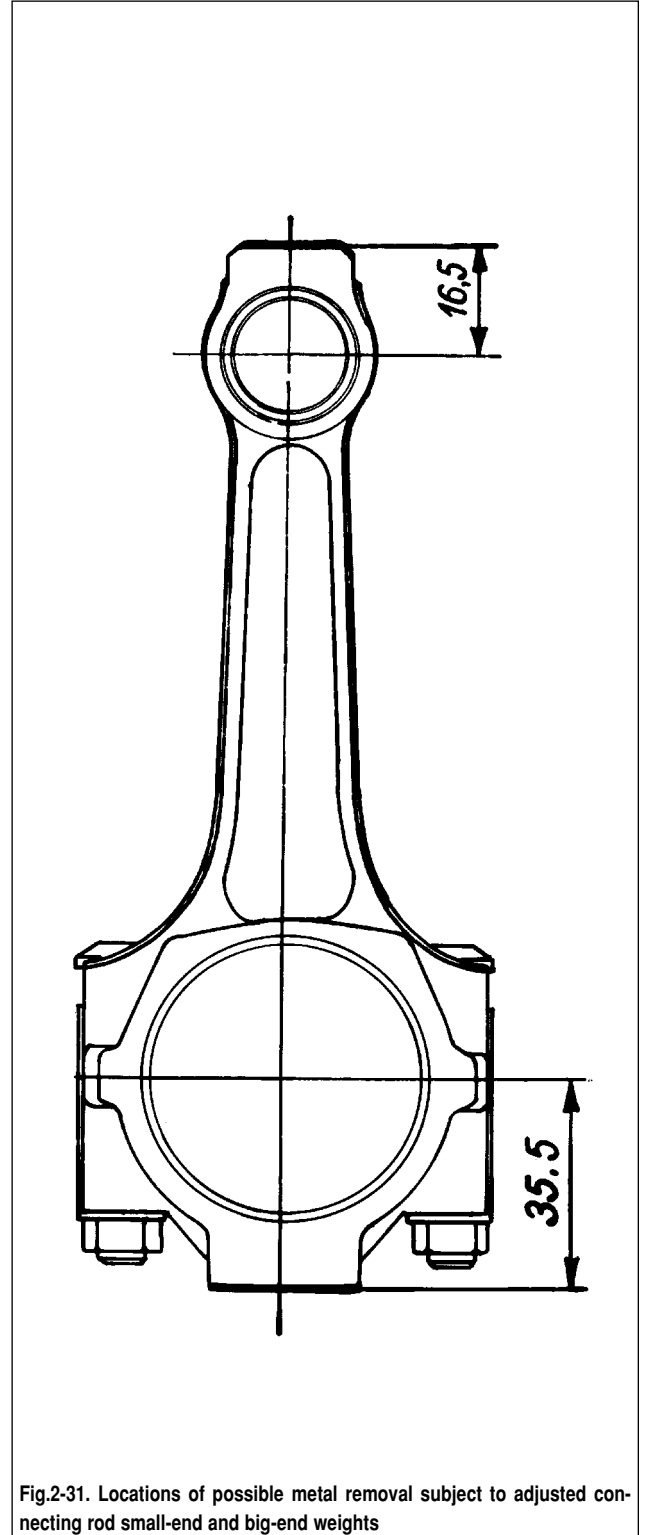
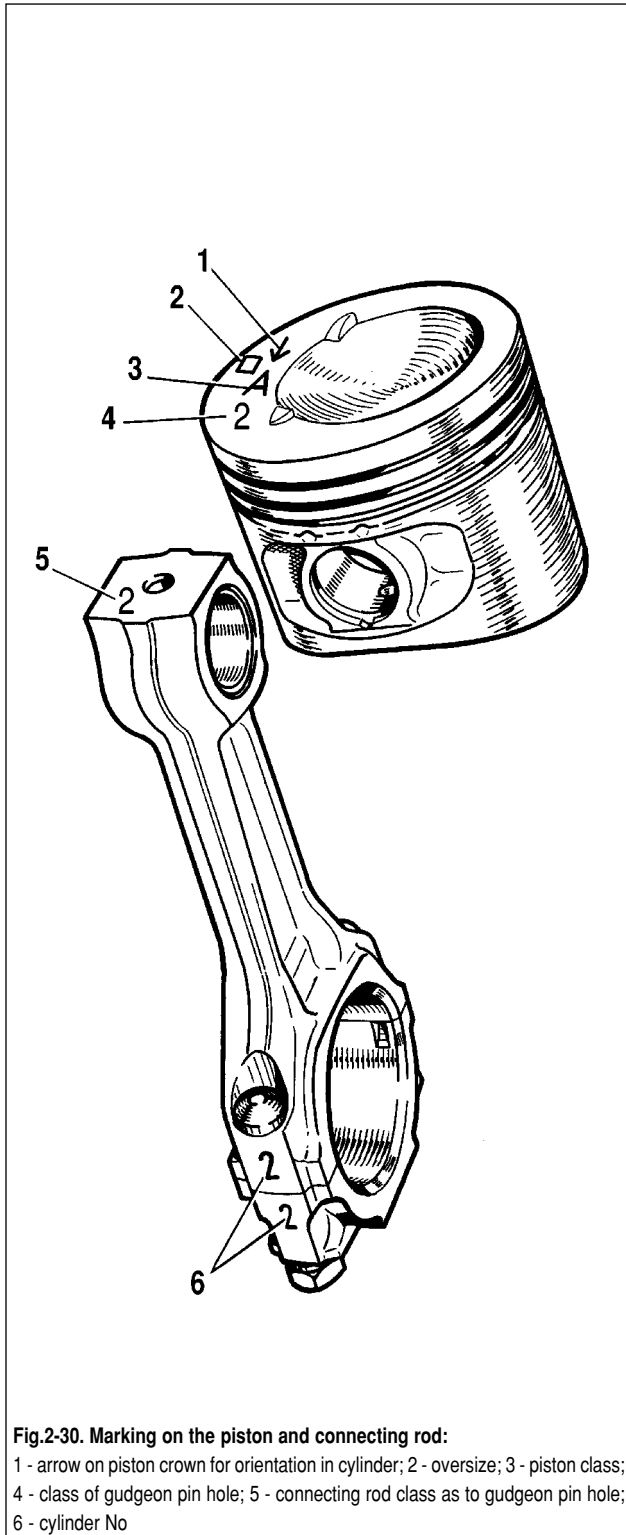


Table 2-1

**Connecting rod classification as to
small-end and big-end weights**

Connecting rod weight, g		Class	Paint mark
small-end	big-end		
186±2	519±3	A	white
	525±3	B	blue
	531±3	C	red
190±2	519±3	D	black
	525±3	E	violet
	531±3	F	green
194±2	519±3	G	yellow
	525±3	H	brown
	531±3	I	orange

Selecting piston to cylinder

The design clearance between the piston and cylinder bore (for new parts) is 0.025 - 0.045. The condition must be ensured through prior measurements of the associated parts and fitting of the pistons which belong to the same class of cylinders. The maximum permissible gap (for worn parts) is 0.15 mm.

When the engine, in the course of operation, shows a clearance of over 0.15 mm, reselect the pistons to the cylinders to have the clearance as close to the design value as possible.

The pistons of classes A, C, E are intended for replacement. These classes can be selected to closely match any cylinder in the event of the engine overhaul, since the pistons and cylinders are classified with small overlapping in the sizes. It means, the piston of class C can match the cylinders of class B and D.

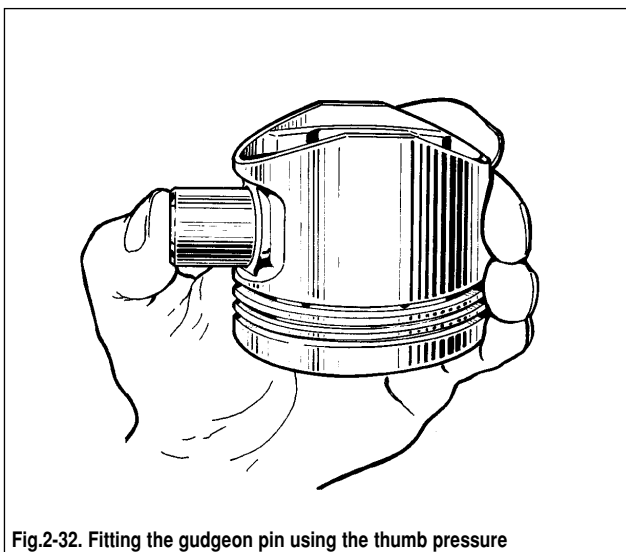


Fig.2-32. Fitting the gudgeon pin using the thumb pressure

Dismantling and reassembly

Dismantling. Prise out the gudgeon pin circlips from the piston, press out the gudgeon pin and detach the connecting rod from the piston. Remove the piston rings.

The bolts are pressed into the connecting rod and must never be pressed out from the connecting rods during the engine or piston/connecting rod dismantling.

When some components of the piston or connecting rod are not damaged or show little wear, they can be re-used. Identify them accordingly during dismantling to facilitate further reassembly with the respective components and to the original cylinder.

Reassembly. Before reassembly, select the gudgeon pin to match the piston and connecting rod. For new components the class of the holes for the gudgeon pin in the connecting rod and pistons must be identical to the class of the gudgeon pin. In case of used components, for perfect mating, the gudgeon pin when oiled should fit the relevant piston hole by force of the hand thumb (Fig.2-32); it should not drop out while held as shown in Fig.2-33.

If the gudgeon pin drops, replace it with a new one of the next class. When the piston is fitted with the gudgeon pin of the third class, renew the piston, gudgeon pin and connecting rod.

The reassembly of the piston and connecting rod is a reversal of dismantling. After reassembly oil the gudgeon pin through the holes in the piston bosses. Refit the piston rings in the order as detailed below.

Oil the piston rings and grooves in the piston. Arrange the piston rings so that the gap of the first compression ring is at a 45° interval to the gudgeon pin; space the gap of the second compression ring at about 180° interval to the first compression gap, afterwards align the gap of the oil ring at about 90° interval to the first compression ring gap.

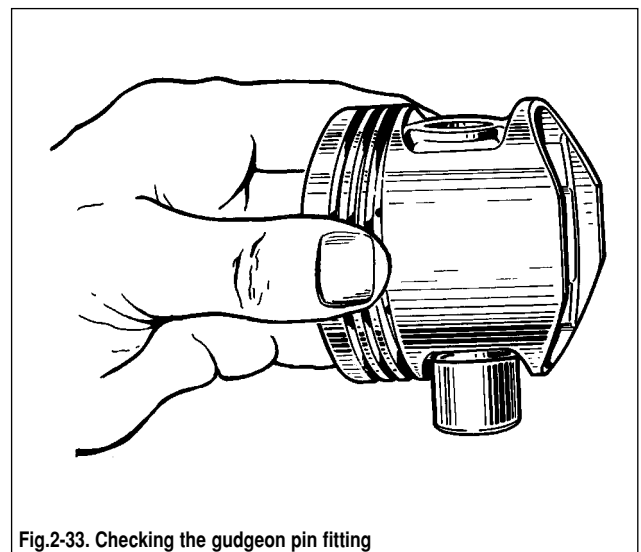


Fig.2-33. Checking the gudgeon pin fitting

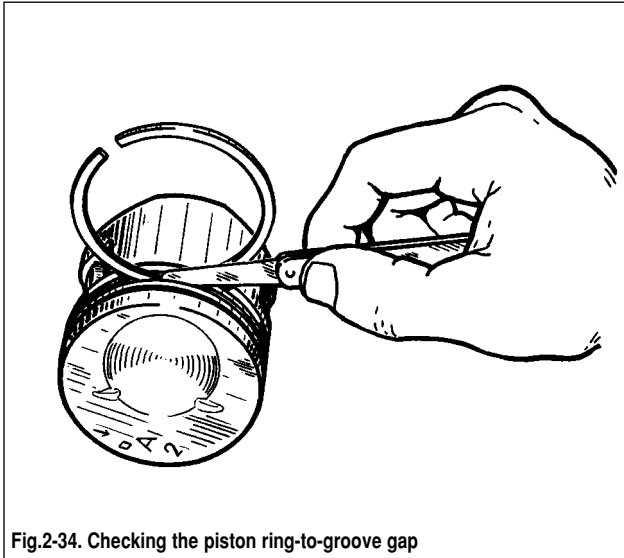


Fig.2-34. Checking the piston ring-to-groove gap

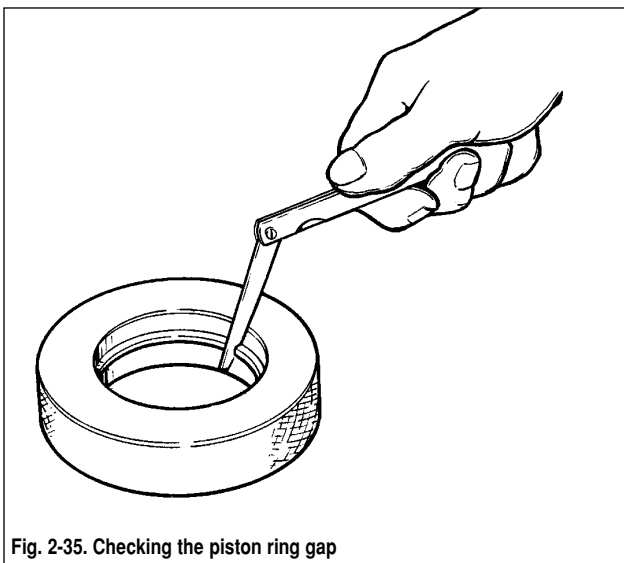


Fig. 2-35. Checking the piston ring gap

Make certain the second compression ring is positioned with the recess facing down (Fig.2-30), while the TOP (or BEPX) mark should face up (the piston crown).

Before refitting the oil ring, check to see the joint of the coil expander (spreader ring) is on the side opposite to the ring gap.

Inspection

Scrape away all traces of carbon from the piston and remove all carbon deposits from the piston/connecting rod oilways.

Thoroughly examine the components. Make sure there are no cracks of any sort on the piston, piston rings, gudgeon pin, connecting rod or big-end cap. Renew the bearing shell if there is obvious scoring or scuffing.

The piston-ring-to-groove wall clearance is checked using feeler blades as shown in Fig.2-34, fitting the ring into the respective groove. For new components the design clearance (rounded off to the nearest 0.01 mm) is 0.04-0.07 mm for the first compression ring; 0.03-0.06 mm for the second compression ring and

0.02-0.05 mm for the oil control ring. When worn, the tolerance must not exceed the specified maximum of 0.15 mm.

The piston ring gap should be checked with a feeler gauge via inserting the rings into the gauge (Fig.2-35), with the bore equal to the piston ring nominal diameter ± 0.003 mm. Use gauge 67.8125.9502 for the normal 82 mm rings.

The gap for all new piston rings should be within 0.25 to 0.45 mm. The maximum permitted gap for worn rings is 1 mm.

Crankshaft and flywheel

Design description

Basic dimensions of the crankshaft are shown in Fig.2-36.

Crankshaft is cast-iron, of five bearings. The crankshaft journals can be reground during the engine overhaul when the diameter is reduced by 0.25 mm, 0.5 mm, 0.75 mm and 1mm.

The crankshaft endfloat is restricted by two thrust washers. The thrust washers are fitted on both sides of the rear main bearing: a sintered one (yellow) at the rear end and a steel-aluminium one at the front end. The thrust washers are of two sizes - standard and 0.127 mm thicker.

Crankshaft bearing shells are thin-walled, aluminium with steel backing. The upper bearing shells of No 1, 2, 4 и 5 bearings have inner oil grooves, whilst the lower bearing shells are plain shells. The upper and lower bearing shells of the centre bearing (No 3) are plain, without an oil groove. The big-end bearing shells (both upper and lower ones) are also plain.

The oversize bearing shells are thicker for the crankshaft journals reduced by 0.25 mm, 0.5 mm, 0.75 mm and 1 mm.

Flywheel is cast iron with the pressed-in steel starter ring. The flywheel centering is ensured by a front input shaft bearing which is pressed into the crankshaft.

A taper recess on the rear face of the flywheel near the ring gear is provided as a positioning mark. Adjust it against cylinder No 4 crankpin.

Inspection and overhaul

Crankshaft. Inspect the crankshaft. Make sure there are no cracks. Examine the faces which mate the oil seal working edges for evident cracking, scoring or scuffing.

Mount the crankshaft on two V-blocks as shown in Fig.2-37 and check the run-out with a dial gauge:

- main bearing journals - maximum 0.03 mm;
- mounting surfaces for the input shaft sprocket and bearing - maximum 0.04 mm;
- surface mating the oil seal - maximum 0.05 mm.

Measure the diameters of the main bearing journals and

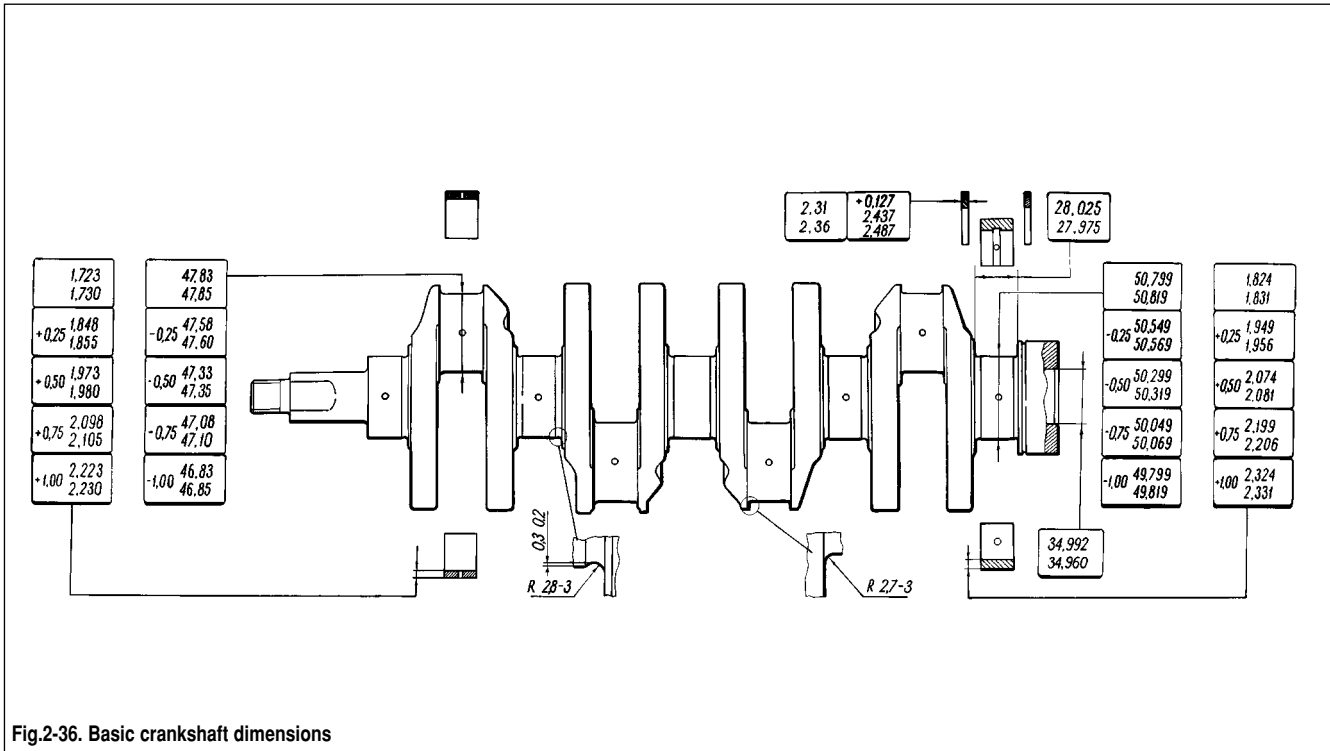


Fig.2-36. Basic crankshaft dimensions

crankpins. Regrind when the wear is in excess of 0.03 mm, ovality is over 0.03 mm, or when scoring and scuffing is obvious.

Regrind the journals and crankpins through reducing the diameter to the nearest undersize (Fig.2-36).

When regrinding, observe the sizes for the crankshaft fillet as shown in Fig.2-36 for the standard-size crankshaft.

The ovality and taper for the main bearing journals and big-end bearing journals after regrinding must not exceed 0.005 mm.

On a reground crankshaft, the vertical offset of the crankpins axes must be 0.35 mm (Fig.2-37). To check this, place the crankshaft on V-blocks and position the crankshaft so that No1 crankpin axis is in the horizontal plane passing through the main bearing journal axes. Using a dial gauge, check the vertical offset of crankpins No 2, No 3 and No 4 against crankpin No 1.

After regrinding the journals and crankpins, polish them using the diamond paste or special grinding pastes.

After regrinding and followed finishing, unplug the oilways, then machine the plug seats with the mill-cutter A.94016/10 and spindle A.94016. Thoroughly wash the crankshaft and oilways to flush abrasive residuals and blow dry with compressed air.

Use tool A.86010 to press in new plugs and punch each plug in three points with a centre-punch.

On crankshaft web No 1 mark the reduced amount (undersize) of the main bearing journals and big-end journals (eg. M 0.25; B 0.50).

Bearing shells. Remember that no adjustment on the bearing shells is allowed. Renew the shells when there are scratches, scoring or flaking.

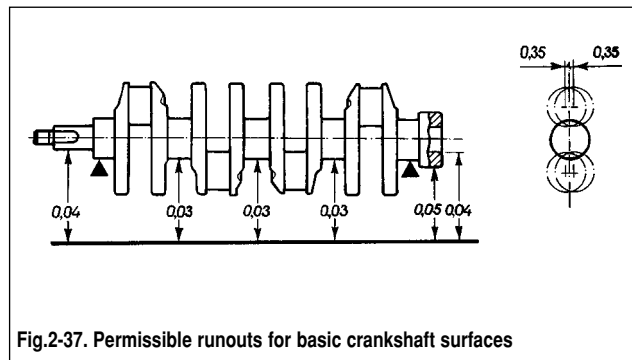


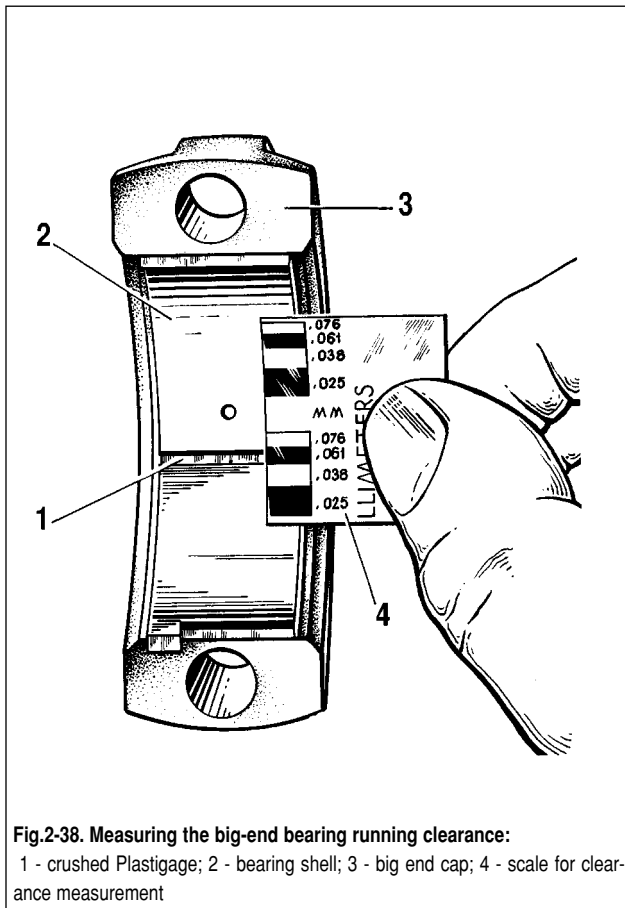
Fig.2-37. Permissible runouts for basic crankshaft surfaces

The main and big-end bearing running clearance is checked by measuring the components. It is convenient to check the clearance with the help of «Plastigage» (which consists of a fine thread of perfectly-round plastic, which is compressed between the bearing cap shell and the crankshaft journal) under the following procedure:

- ensure the journals and bearing shells are clean and dry, cut several pieces of the appropriate-size Plastigage (they should be slightly shorter than the width of the bearings) and place one piece on each crankshaft journal axis;

- with the bearing shells in position in the cages, fit the caps to their original locations (depending on the journal checked). Take care not to disturb the Plastigage. Then tighten the securing nuts and bolts to the specified torque. Tighten the connecting rod bolts to 51 H•M (5.2 kgf•m), while the main bearing cap bolts to 80.4 H•M (8.2 kgf•m);

- remove the bearing cap and check the running clearance by comparing the width of the crushed Plastigage on each journal with the scale printed on the card gauge to obtain the bearing running clearance (Fig.2-38).



The nominal design clearance is 0.02-0.07 mm for the crankpins and 0.026-0.073 mm for the main bearing journal. When the running clearance is below the maximum value (0.1 mm for the big-end bearing journals and 0.15 mm for the main bearing journals), the bearing shells can be re-used.

When the running clearance exceeds the specified maximum, replace the respective bearing shells with new ones.

Where the crankshaft journals are worn and are reground to their undersize, change the bearing shells to those oversize.

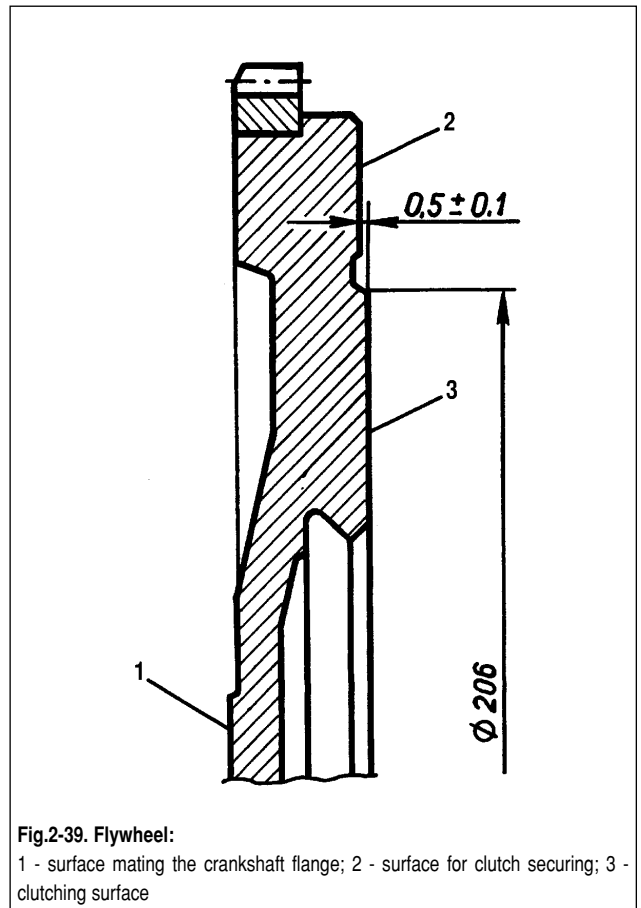
Thrust washers. Similar to the bearing shells, no adjustments are possible on the thrust washers. Always renew the thrust washers when there is scoring, scuffing or flaking.

The thrust washers must be renewed when the crankshaft endfloat exceeds the specified limit of 0.35 mm. Select new thrust washers of the standard size or 0.127 mm thicker to have the endfloat within 0.06 - 0.26 mm.

The crankshaft endfloat is checked with the help of a dial gauge as outlined in Section «Engine reassembly» (Fig.2-14).

The crankshaft endfloat can be also checked on the engine in the vehicle. The axial shift of the crankshaft occurs at depressing and releasing the clutch pedal, the endfloat value is determined by the front crankshaft end displacement.

Flywheel. Inspect the teeth of the flywheel starter ring, should they are found deteriorated, renew the flywheel. If there are temper colours on flywheel face 3 (Fig.2-39), check the



starter ring interference on the flywheel. The starter ring should not rotate when applying 590 H•m (60 kgf•m).

Check to see there are no scratches or scores on flywheel face 1 mating the crankshaft flange or on surface 3 mating the clutch disc.

Remove by lathing all scratches or scores on face 3, provided the overall thickness is reduced maximum by 1 mm. Do not forget to lathe surface 2 maintaining the size (0.5±0.1) mm. Ensure surfaces 2 and 3 are parallel to surface 1. The out-of-parallelism tolerance is 0.1 mm.

Mount the flywheel on the tool, centralize is over the mounting bore against surface 1 and check the run-out of surfaces 2 and 3. The run-out values at the outboard points must not exceed 0.1 mm.

Cylinder head and valve gear

General description

Refer to Fig. 2-40 for basic sizes of the valves, guides and valve seats.

Cylinder head is an aluminium casting with the pressed-in iron valve seats and valve guides.

The top of the valve guides is sealed with metal-rubber oil caps 3 (Fig.2-41).

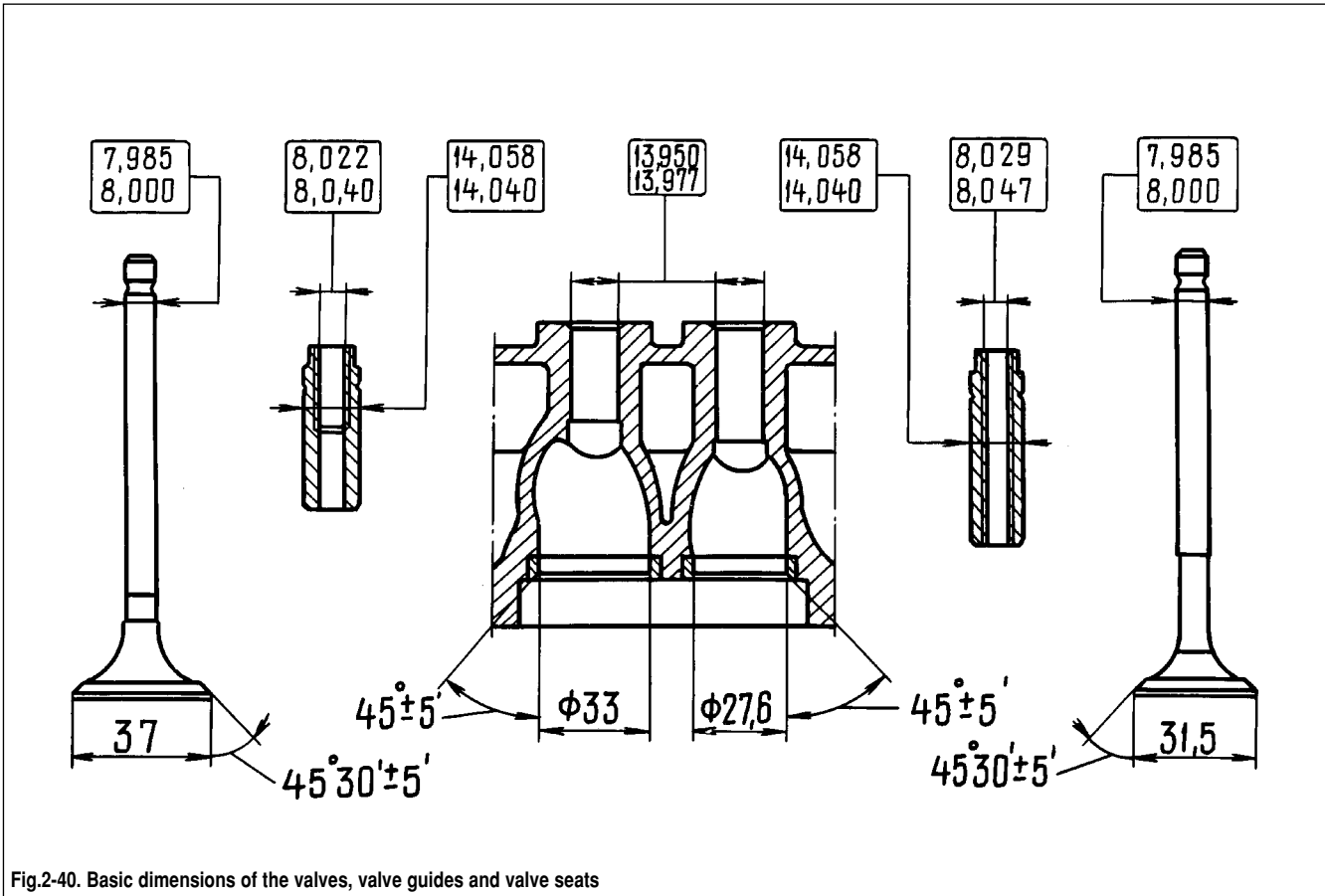


Fig.2-40. Basic dimensions of the valves, valve guides and valve seats

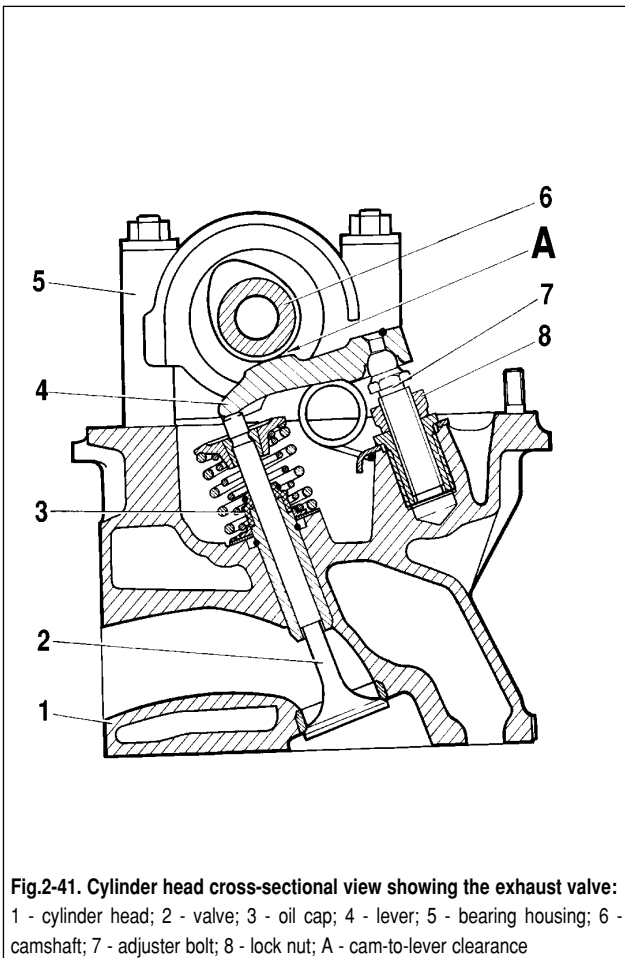


Fig.2-41. Cylinder head cross-sectional view showing the exhaust valve:
1 - cylinder head; 2 - valve; 3 - oil cap; 4 - lever; 5 - bearing housing; 6 - camshaft; 7 - adjuster bolt; 8 - lock nut; A - cam-to-lever clearance

The outer diameter of the replacement guides is 0.2 mm bigger. Bearing housing 5 with camshaft 6 is fitted to the cylinder head.

Valve train. Valves 2 are operated by the cams through levers 4. One end of the lever pushes the valve stem, while the other end rests on the spherical head of adjuster bolt 7 which adjusts the clearance A in the valve gear.

Valve clearance adjustment

The clearances are adjusted on the cold engine by means of the chain adequately tensioned. The adjustment should result in 0.15±0.02 mm clearance for the intake valves and 0.2±0.02 mm clearance for the exhaust valves.

While making adjustments, do not to twist the valve lever, since it may result in a bigger final clearance.

The clearance is adjusted as follows:

- turn the crankshaft clockwise to align the indentation in the camshaft sprocket with the mark on the bearing housing, which corresponds to the end of the compression stroke of the cylinder No4. Now in this position adjust the clearance at the cylinder No4 exhaust valve (No8 cam) and cylinder No3 intake valve (No6 cam);
- slacken the valve lever adjuster bolt nut;
- between the valve lever and cam place a flat feeler blade (A.95111) of 0.15 mm for the intake valve (0.2 mm for the exhaust valve) and using a spanner tighten or slacken the bolt with further

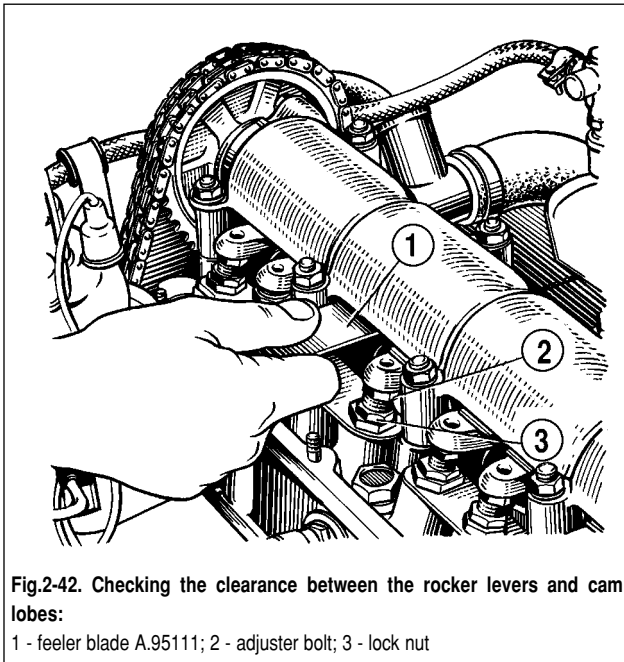


Fig.2-42. Checking the clearance between the rocker levers and cam lobes:
1 - feeler blade A.95111; 2 - adjuster bolt; 3 - lock nut

lock nut tightening, until the blade is a firm sliding fit when the lock nut is tightened (Fig.2-42);

- after the clearance is adjusted at the cylinder No4 exhaust valve and cylinder No3 intake valve, turn the crankshaft progressively to the 180° and adjust the clearances, observing the sequence as shown in Table 2-2.

Table 2-2

Valve clearance adjustment

Crankshaft angle, degrees	Cylinder No (end of compression stroke)	Valve (cam) No
0	4	8 & 6
180	2	4 & 7
360	1	1 & 3
540	3	5 & 2

Cylinder head - removal and refitting

The cylinder head is removed from the engine in the vehicle, when no complete stripping of the engine is required, or when carbon deposits should only be removed from the combustion chamber and valves. To remove the cylinder head, carry out the following operations.

Apply the handbrake, remove the spare wheel and disconnect the battery negative lead.

Remove the air cleaner and protect the carburettor with the provisional plug. Drain the coolant from the radiator and cylinder block.

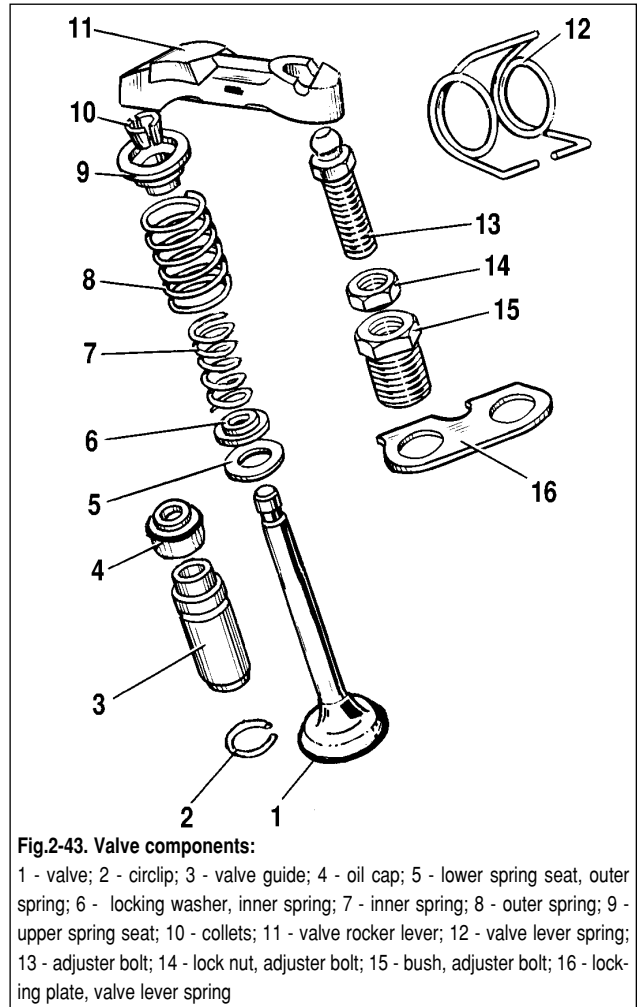


Fig.2-43. Valve components:
1 - valve; 2 - circlip; 3 - valve guide; 4 - oil cap; 5 - lower spring seat, outer spring; 6 - locking washer, inner spring; 7 - inner spring; 8 - outer spring; 9 - upper spring seat; 10 - collets; 11 - valve rocker lever; 12 - valve lever spring; 13 - adjuster bolt; 14 - lock nut, adjuster bolt; 15 - bush, adjuster bolt; 16 - locking plate, valve lever spring

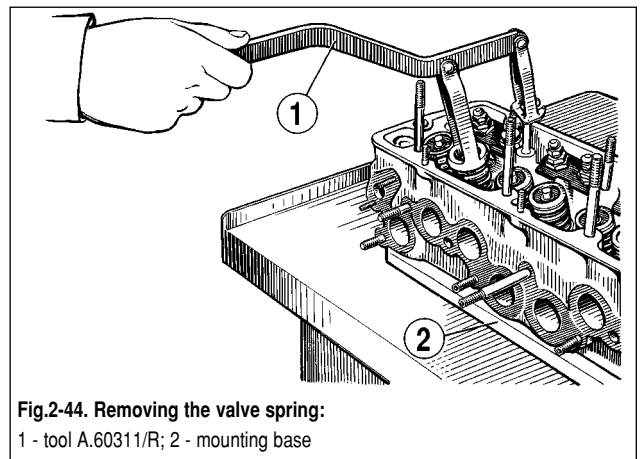


Fig.2-44. Removing the valve spring:
1 - tool A.60311/R; 2 - mounting base

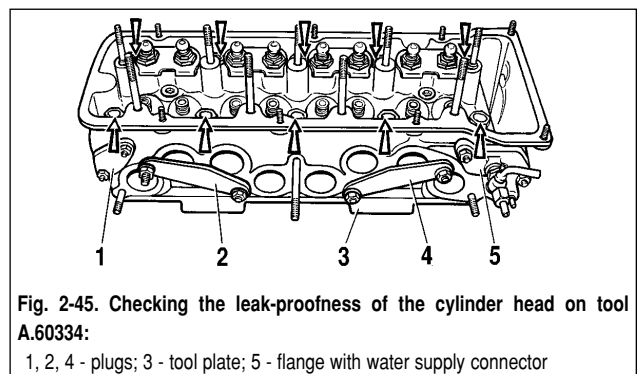


Fig. 2-45. Checking the leak-proofness of the cylinder head on tool A.60334:
1, 2, 4 - plugs; 3 - tool plate; 5 - flange with water supply connector

Disconnect the leads from the spark plugs and coolant temperature sender, from carburettor idle switch and fuel cutoff solenoid.

Disconnect the choke cable; disconnect the throttle linkage from the intermediate lever on the valve cover.

Loosen the clips and disconnect the carburettor supply / return fuel hoses. Secure the hoses in a manner to exclude possible fuel leaks. Detach the vacuum hose from the carburettor.

Disconnect the hoses from the intake pipe, from the outlet pipe of the cooling water jacket and from coolant delivery pipe to the heater. Remove the EGR valve.

Disconnect the starter motor shield from the exhaust manifold, downpipe and detach the bracket securing the coolant pipe (heater return line).

Remove the valve cover complete with the gasket and fuel piping securing bracket.

Turn the crankshaft to align the camshaft sprocket TDC mark against the bearing housing mark (Fig.2-22).

Unbolt the camshaft sprocket. Slacken the chain tensioner cap nut, release the tensioner rod and fix it in position with the cap nut. Remove the camshaft sprocket.

Undo the bolts securing the cylinder head to the cylinder block and remove the cylinder head complete with the gasket.

Refitting of the cylinder head is the reverse order of removal, refer to the procedure described in section «Engine reassembly». Never re-use the gasket between the cylinder head and cylinder block, always replace it with a new one.

While refitting the cylinder head, adjust the timing chain tension and valve clearances. Having refitted the cylinder head, adjust the carburettor linkage and ignition timing.

Cylinder head - dismantling and reassembly

Dismantling. When only a single part is required to be replaced, there is no need to completely dismantle the cylinder head; instead, remove only what is necessary.

Position the cylinder head on the stand, disconnect the hose from the hot air intake, undo the nuts and remove the carburettor complete with the gasket; next withdraw the inlet and exhaust manifolds (the hot air intake is withdrawn at the same time).

Remove the water jacket return pipe and coolant-to-heater return pipe. Unscrew the spark plugs and coolant temperature sender.

Undo the securing nuts and remove the bearing housing complete with the camshaft. Undo the nuts holding the thrust flange to the bearing housing. Remove the flange and lift out the camshaft from the bearing housing.

Release springs 12 and remove valve rocker levers 11 (Fig.2-43). Remove the rocker lever springs.

Slacken lock nuts 14, undo adjuster bolts 13 and bushes 15.

Position tool A.60311/R, as shown in Fig.2-44, compress the valve springs and release the collets. A stationary tool 02.7823.9505 can be used instead of tool A.60311/R.

Remove the valve springs together with lower and upper seats. Turn the cylinder head over and remove the valves from the underneath. Take off the outer caps from the valve guides.

Reassembly. Reassemble the cylinder head in the reverse order. Before assembly begins, always oil the outer caps and valves with engine oil.

Before refitting the camshaft bearing housing, check the centering pins are in the position (Fin.2-21). Tighten the bearing housing securing nuts in the sequence as shown in Fig.2-23. Ensure the centering pins are positioned in the bearing housing recesses without sheering.

The valve clearances are adjusted only after the cylinder head has been refitted to the engine.

Inspection and overhaul

Cylinder head. Thoroughly wash the cylinder head and clean the oilways. Scrape away all carbon from the combustion chambers and from the exhaust valve ports with a wire brush.

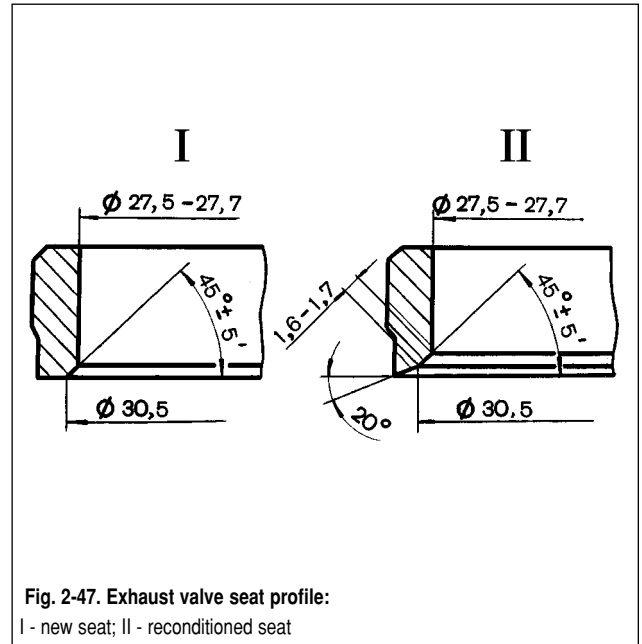
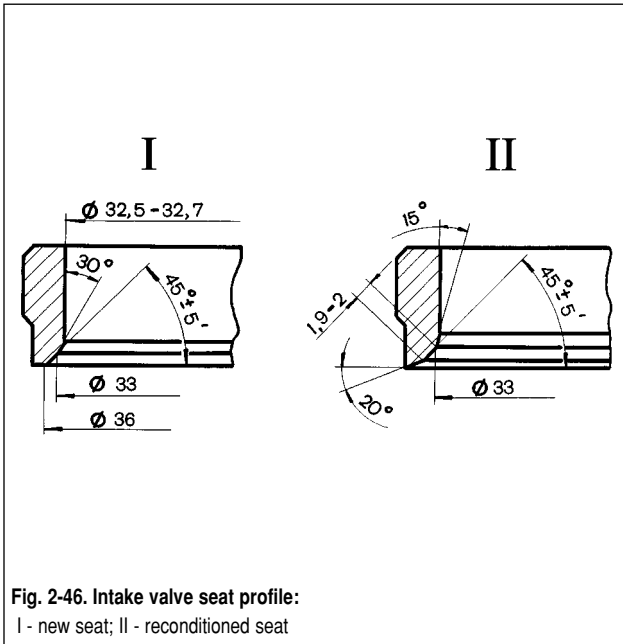
Examine the cylinder head. Look to see there is no cracking in the cylinder head. Check the cylinder head for leakage when suspicious as to possible oil contamination with coolant.

To do this, plug the cooling water jacket holes (using plugs from tool A.60334, Fig.2-45), then pump water into the cylinder head water jacket at 0.5 MPa (5 kgf/cm²). No water leak should be evident within 2 minutes.

The cylinder head tightness can be checked with compressed air. Plug the water jacket holes (using the same plugs from tool A.60334), immerse the cylinder head into the bath with water of 60-80°C for 5 minutes. Next pump the compressed air into the cylinder head at 0.15-0.2 MPa (1.5-2 kgf/cm²). No air bubbles must be seen from the cylinder head within 1-1.5 minutes.

Valve seats. The valve seat chamfer shape is shown in Fig.2-46 and Fig.2-47. Check the working chamfers of the valve seats (valve contact area) for pitting, corrosion or deterioration. Minor irregularities of the seats must be recut. Remove as little metal as possible. Both manual and machine grinding is permitted. Valve regrinding is carried out as follows.

Position the cylinder head on a mounting base. Insert centering tool A.94059 in the valve guide and clean the seat chamfers from carbon using tools A.94031 and A.94092 for the exhaust valves and A.94003 and A.94101 for the inlet valves. Use spindle A.94058 and centering tool A.94059. The centering tools differ in diameters, use tool A.94059/1 for the inlet valve guides and A.94059/2 for the exhaust valve guides.



Put spring A.94069/5 on tool A.94059, fit tapered wheel A.94078 on spindle A.94069 for the exhaust valve seats or wheel A.94100 for the inlet valve seats, secure the spindle in a grinder and recut the valve seat (Fig.2-48).

The grinding wheel must be off at the moment the grinding wheel contacts the valve seat, otherwise vibration ensued will distort the chamfer. Frequent diamond dressing of the wheel is recommended.

The working chamfer width for the exhaust valve seats should be as shown in Fig.2-46 using tools A.94031 (20°) and A.94092 to remove the wear hardening on the minor diameter. The tools should be used with spindle A.94058 and are centered with tool A.94059.

The working chamfer width for the inlet valve seats should be as shown in Fig.2-47, first machine the inner chamfer with tool A.94003 (Fig.2-49) to get the diameter of 33 mm, then machine the 20° chamfer with tool A.94101 to achieve the working chamfer width of 1.9-2 mm.

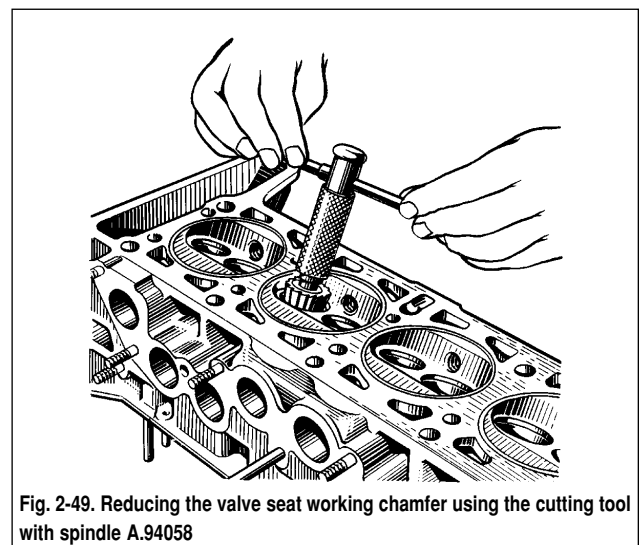
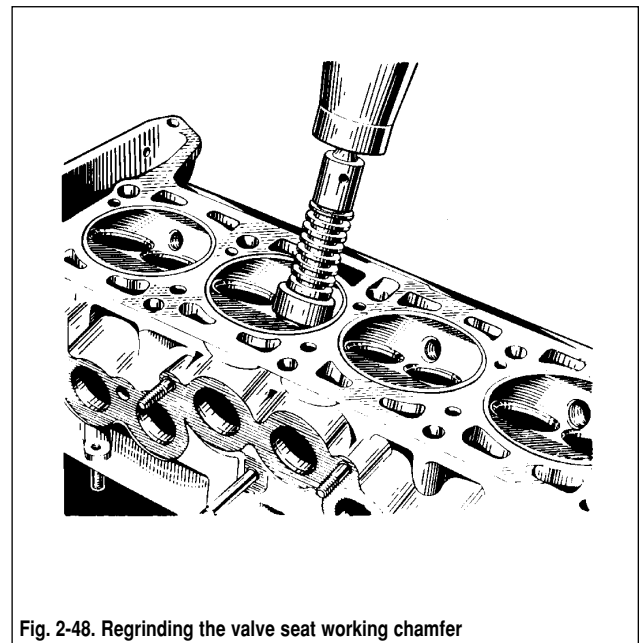
Valves. Scrape away carbon from the valves.

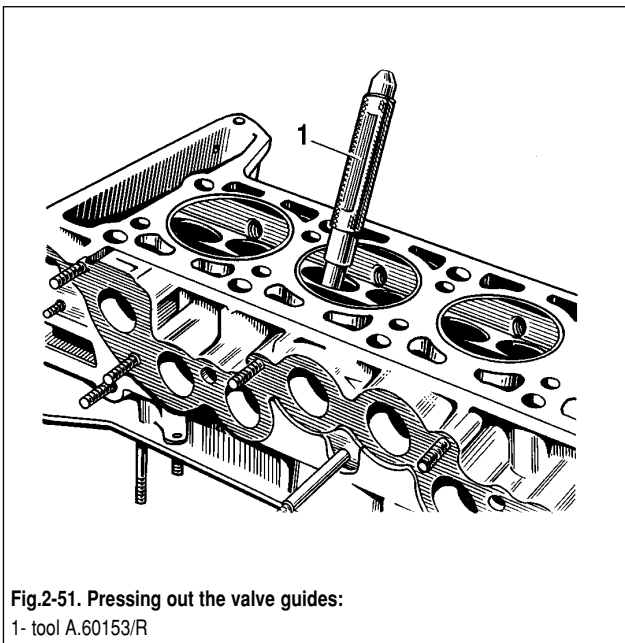
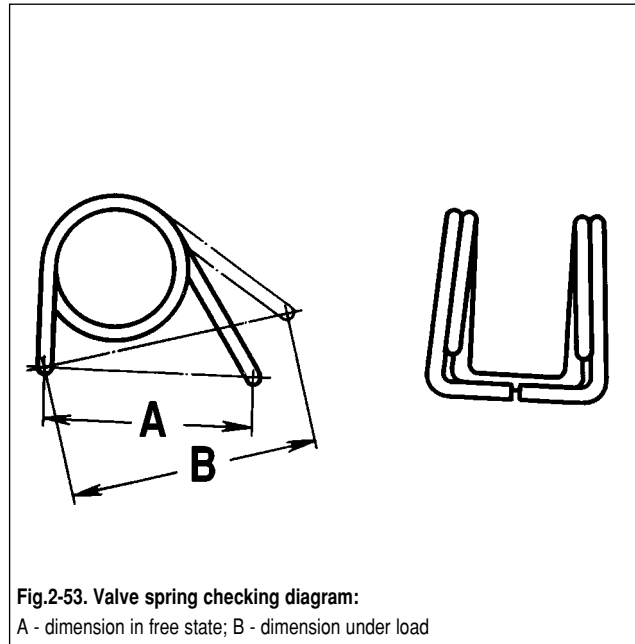
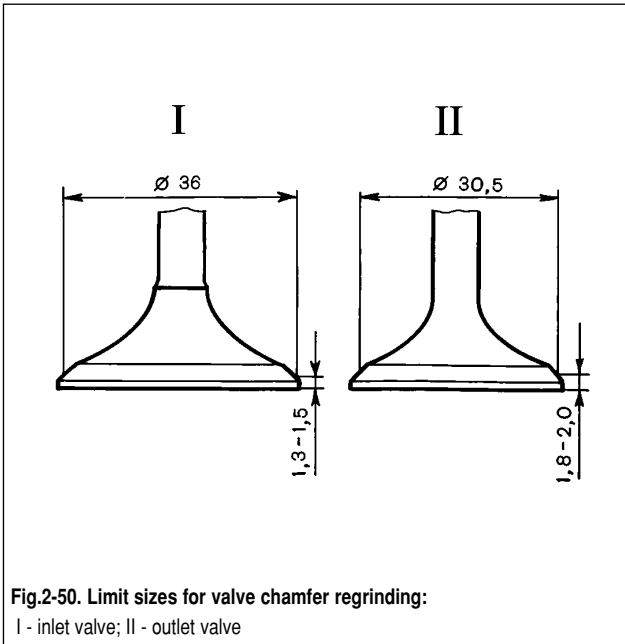
Check the valve stem for deformation; check the valve disc for cracking. Always renew the damaged valve.

Examine the valve working chamfer. Reface the valve in case of minor damages, maintaining the chamfer angle at 45°30' ±5'. Note, that the distance between the bottom valve seat face and base diameter (36 and 30.5) must be as shown in Fig.2-50.

Valve guides. Check the valve guide - to - stem clearance by measuring the valve stem diameter and valve guide bore.

The clearance for new guides is 0.022 - 0.055 mm for the inlet valves and 0.029 - 0.062 mm for the exhaust valves; the maximum permissible clearance (in case of wear) is 0.3 mm provided no excessive noise is produced in the valve train.





When a new valve fails to take up clearance between the valve guide and the valve rim, renew the valve guides using tool A.60153/R (Fig.2-51).

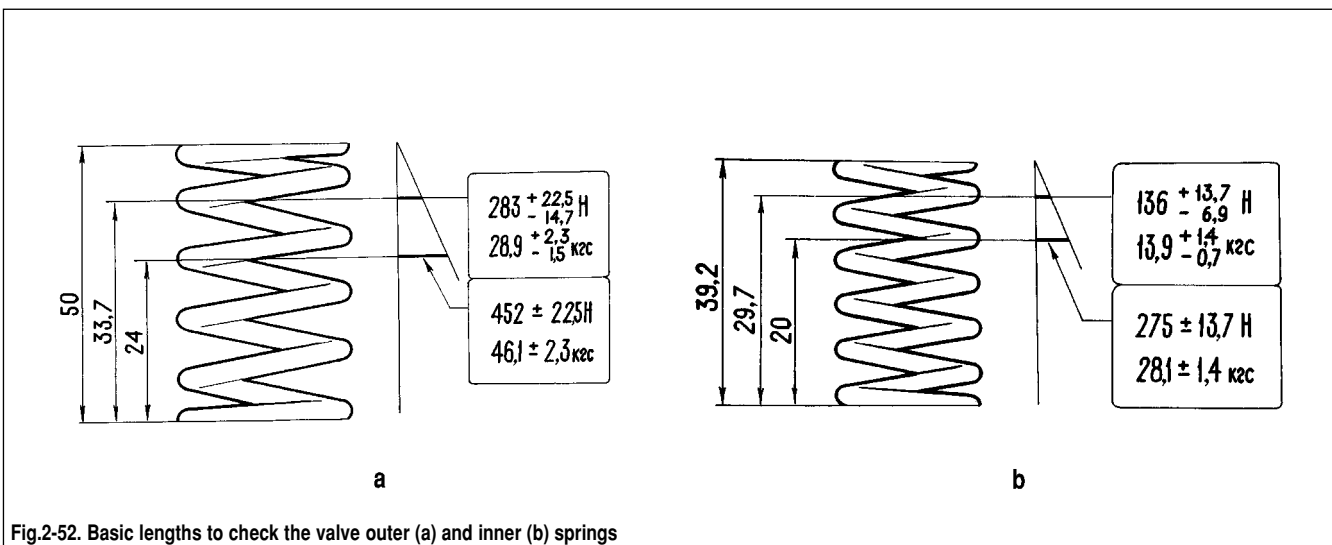
Push in the valve guide complete with the circlip to the cylinder head to their stop.

After the valve is pressed into position, ream the valve guide bores using tool A.90310/1 (for the inlet valve guides) and tool A.90310/2 (for the exhaust valve guides).

Valve stem oil caps must always be renewed during the engine overhaul.

Any damaged oil caps are renewed on the cylinder head removed. Use special tool 41.7853.4016 to push the oil seals on the guide.

Springs. Check the springs are not cracked and are adequately tense; load test the springs to reveal any deformation (Fig.2-52).



For lever springs (Fig.2-53) the size A (spring unloaded) must be 35 mm, whereas the size B (spring loaded 51-73.5 N/ 5.2-7.5 kgf) must be 43 mm.

Cylinder head bolts. Multiple use of the cylinder head bolts results in the bolt elongation. Therefore, check the length of the bolt (L) to be 120 mm (less the bolt head length), otherwise renew the bolt.

When replacing the bolts take care not to fit similar bolts from other VAZ engines of the same type (2101, 21011, 2103, 2107, 2121), but made of different steel.

The 21213 engine bolts have the threaded area of 70 mm (30 mm for other engines); in addition, the 21213 engine bolts do not have a distinctive mark (a 7.5 mm diameter recess for wrench).

Valve rocker levers. Check the condition of the lever operating surfaces which mate the valve stem, cam lobe and adjuster bolt spherical end.

Always renew the rocker arm when its surfaces are chipped, scored or scuffed.

Renew the lever adjuster bolt bush or the bolt itself in case of any deformation or damages found.

Camshaft and timing gear

Design description

Camshaft is cast iron, of five bearings, operates in the aluminium bearing housing fitted to the cylinder head.

Basic dimensions of the camshaft and bearing housing are shown in Fig.2-54. The flanks of the cams are chilled for better wear resistance.

In order to eliminate the camshaft endfloat, the camshaft is supported by the thrust flange held in the front journal groove.

Camshaft is operated through crankshaft sprocket 5 (Fig. 2-55) and double-row roller chain 2. The chain also operates sprocket 4 of the oil pump shaft. The chain drive has semi-automatic tensioner 8 with shoe 7 and chain damper 3 with rubber covers.

In the cylinder bottom there is stop pin 6 to prevent the chain dropping into the crankcase when camshaft sprocket 1 is removed.

Chain tension adjustment

Loosen nut 1 (Fig.2-56) of the tensioner. This releases rod 3 and the chain is tightened by means of shoe 7 (Fig.2-55) which is loaded by spring 7 (Fig.2-56).

Turn the crankshaft 1-1.5 turns progressively. By doing that, the tensioner spring, operating the shoe, automatically adjusts the chain tension.

Tighten tensioner nut 1, this results in rod 3 clamped by collets 8; during engine operation plunger 6 is effected only by spring 4. The spring releases the plunger from rod 3 head, so that the clearance between them is filled with oil that acts as a damper when the chain strikes.

Chain renewal

Apply the handbrake, open the bonnet, remove the spare wheel with the supporting tube and withdraw the battery.

Remove the air cleaner and close the carburettor inlet filler with a provisional cap. Disconnect the throttle and choke cables from the carburettor.

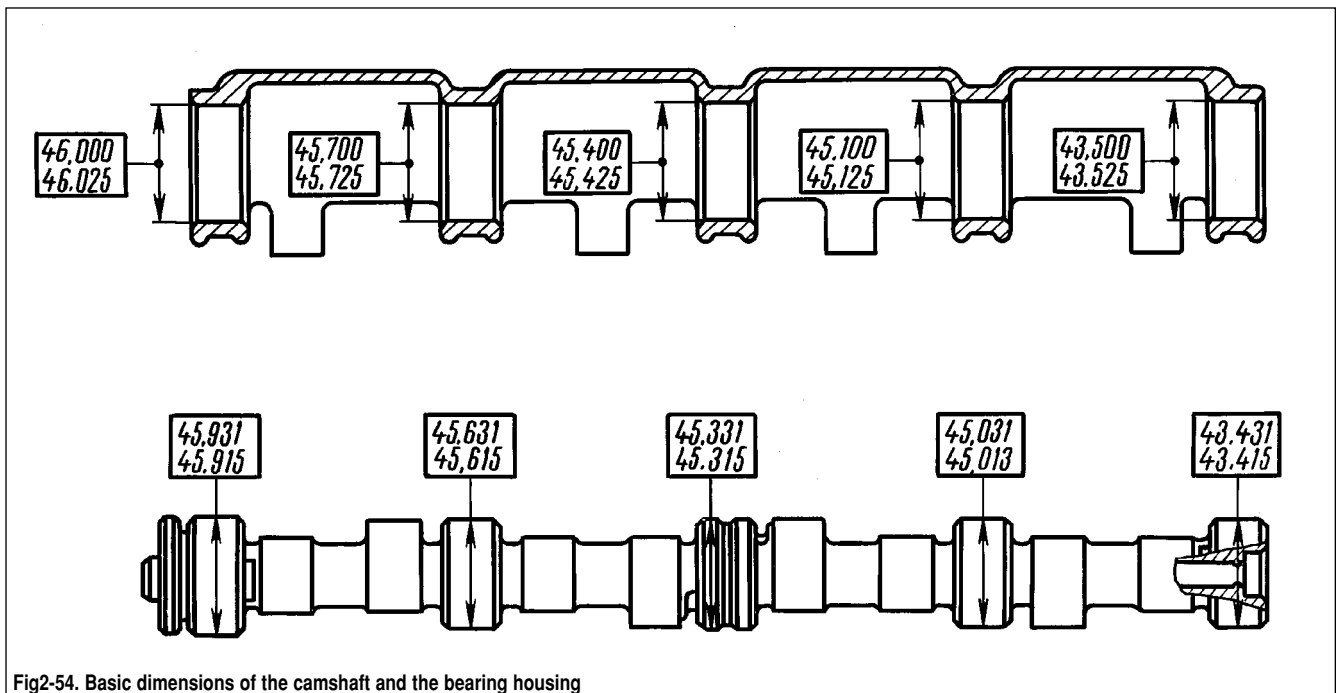
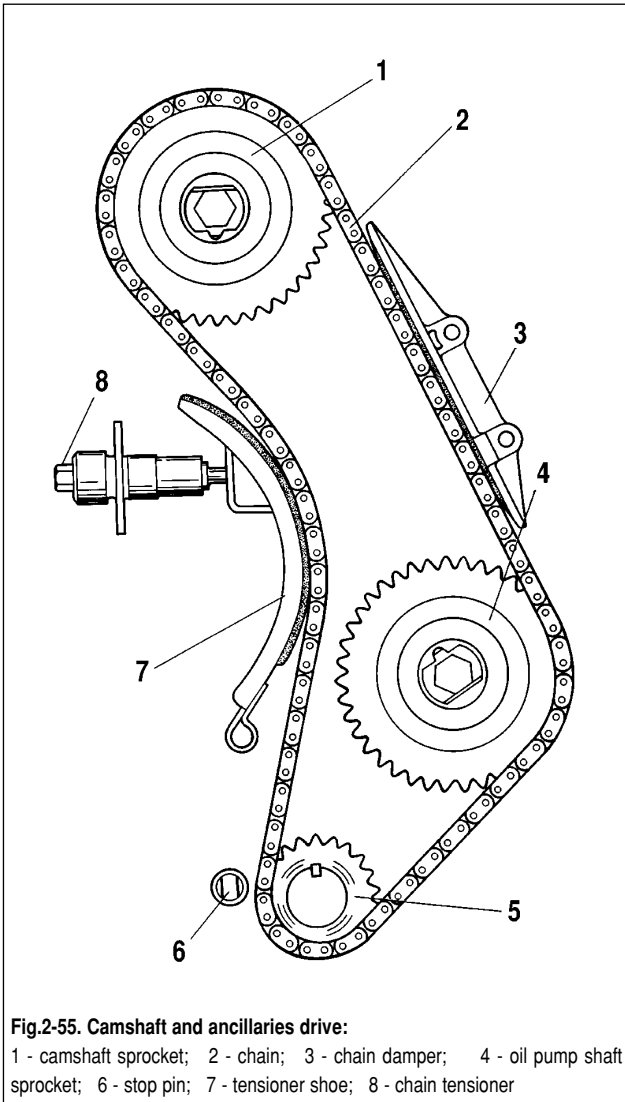


Fig2-54. Basic dimensions of the camshaft and the bearing housing



Drain the cooling water from the radiator and cylinder block, remove the radiator complete with the hoses and thermostat. Undo the retaining nuts and remove the fan.

Remove the valve cover and turn the crankshaft to align the TDC mark in the camshaft sprocket against the timing mark in the bearing housing (Fig.2-21), while the alternator belt pulley marks are aligned against a long mark in the timing cover (Fig.7-18).

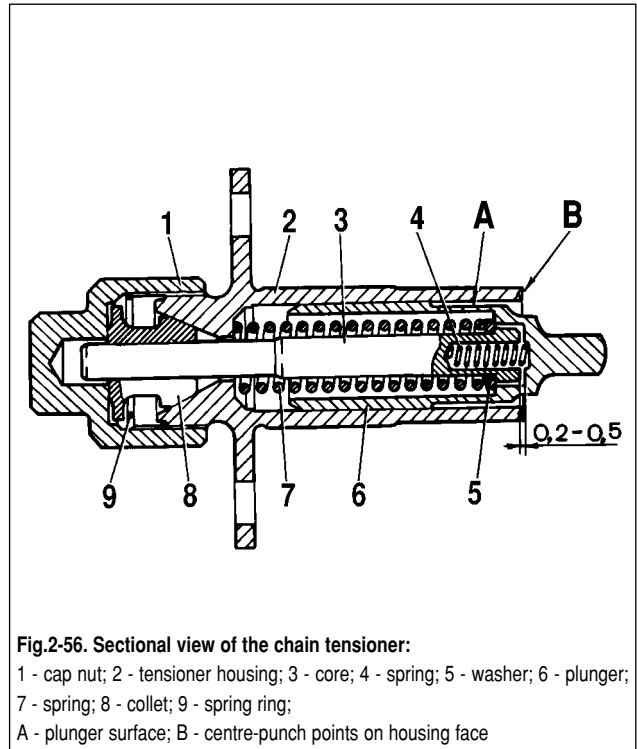
Undo the camshaft sprocket retaining bolt. Slacken the chain tensioner cap nut, release the tensioner rod and fix it in position using the cap nut. Remove the camshaft sprocket.

Slacken the alternator and remove the alternator drivebelt. Apply the 4th gear of the gearbox, undo the nut and withdraw the alternator drivebelt pulley from the crankshaft.

Remove the timing cover complete with the gasket. Undo the nuts holding the cover to the cylinder block; then undo the bolts retaining the oil sump to the cover.

Undo stop pin 6 (Fig.2-55) and withdraw the camshaft timing chain.

The refitting procedure is a reversal of removal, observing the recommendations outlined in section «Engine assembly».



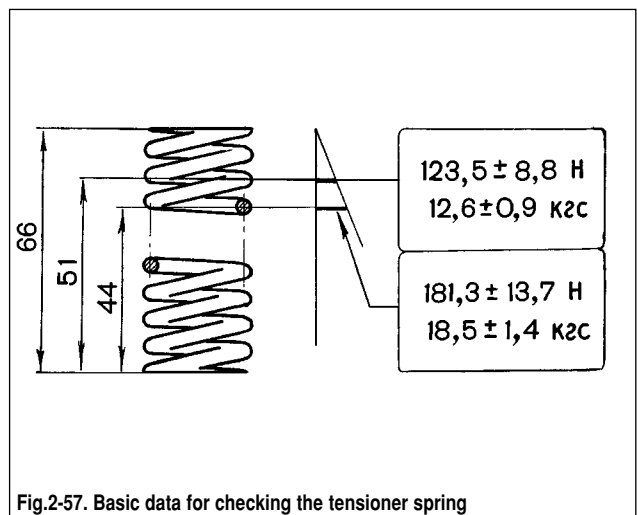
Before refitting, smear the chain with engine oil. Always use new gaskets for the timing cover and valve cover.

The chain refitted, adjust the chain tension and alternator drivebelt tension, adjust the carburettor linkage and ignition timing.

Inspection

Camshaft. The camshaft journals must have no scores, scuffs, scratches or aluminium galling from the bearing housing. The maximum wear of the cam lobe surfaces is 0.5 mm, there should be no evident scoring or cut-type wear of the cams.

Mount the crankshaft on two V-blocks, located on the test plate and using a dial gauge, check the centre camshaft journal endfloat to be 0.04 mm maximum. If the endfloat exceeds the value specified, straighten the camshaft on the straightening press.



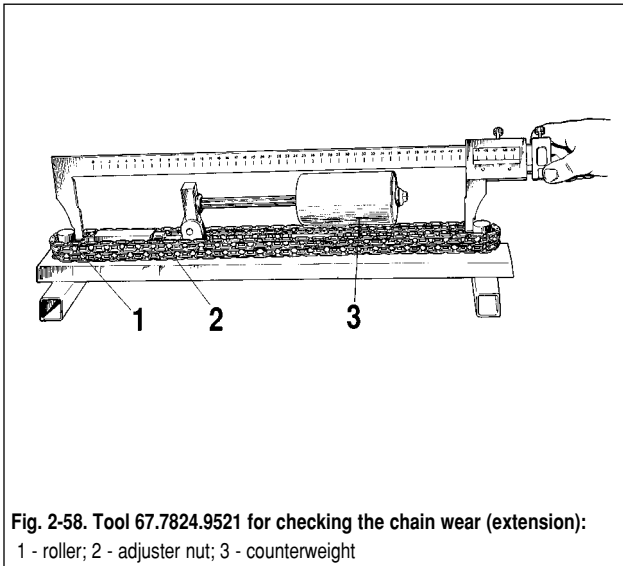


Fig. 2-58. Tool 67.7824.9521 for checking the chain wear (extension):
1 - roller; 2 - adjuster nut; 3 - counterweight

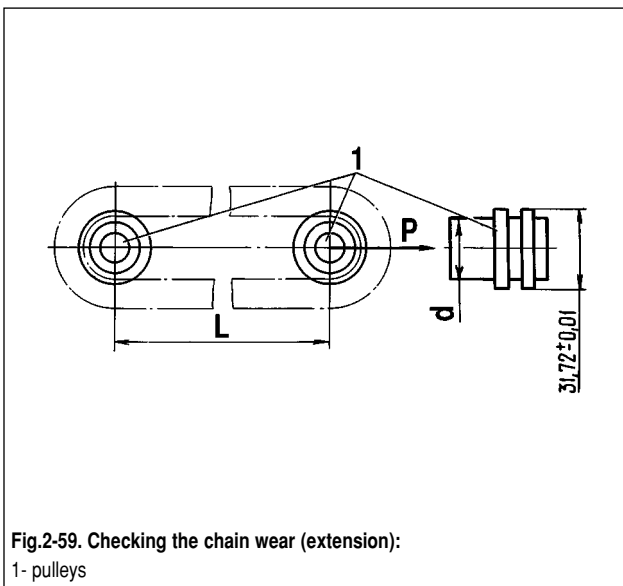


Fig. 2-59. Checking the chain wear (extension):
1 - pulleys

Camshaft bearing housing. Wash and clean the bearing housing, flush clean the oilways.

Check the diameters of the holes in the bearings. When the clearance between the camshaft journals and bearing surfaces exceeds 0.2 mm (wear limit), renew the bearing housing.

The inner bearing surfaces should be smooth, with no scores; renew the bearing housing in case of damages. Check the housing for cracks; if this is the case, renew the bearing housing.

Chain tensioner. When the tensioner plunger is seized in the housing, dismantle the chain tensioner. For that undo cap nut 1 (Fig. 2-56), push plunger 6 full way, then tighten the cap nut. File the housing edges at the points B of centre-punching, withdraw plunger 6 with spring 4. Undo the cap nut and withdraw rod 3 complete with spring 7 and washer 5. Prise free spring ring 9 and take out clamping collet 8 from cap nut 1.

Check collet 8, core 3 and plunger 6 for scores, check the mating surfaces of the tensioner shoe and plunger for deep scores. Always renew any damaged components.

The spring tension should be within the range specified in Fig. 2-57; otherwise renew the spring.

Check to see the shoe and chain damper do not have excess wear; renew them when applicable.

Refitting is a reversal of removal. Once the plunger is refitted, center-punch housing 2 at three points B. Make certain the projections caused by centre-punching do not contact the surface A during the plunger stroke.

Note: The spring ring is used in some vehicles instead of centre-punching.

Camshaft timing chain. Wash the chain in kerosine, examine the chain links. Check to see there are no scores, cracks or other damages.

In the course of the engine operation the chain lengthens. The chain deems operable as long as the tensioner ensures its proper tension, i.e. the chain length is maximum 4 mm longer.

Check the chain length with the help of tool 67.7824. 9521 (Fig. 2-58), having 2 special-type wheels 1 on which the chain is located. Using counterweight 3 the chain is extended through applying force of 294 N (30 kgf) or 147 N (15 kgf). Use adjuster nut 2 to ensure the counterweight axis is parallel to the tool base.

Apply force 294 N (30 kgf) with the counterweight in the extreme right position, then decrease the force by 147 N (15 kgf) moving the counterweight fully to the left. Repeat both operations and determine the chain difference on the length L (Fig. 2-59) between the axis of the wheels. Using vernier calipers, measure the distance between the wheels, then add the diameter d value to get the distance L between the wheels axes.

For a new chain the distance L between the wheels axes is 495.4-495.8 mm. Renew the chain, when its length is 499.5 mm.

Before refitting, smear the chain with engine oil.

Cooling system

Refer to the cooling system layout as shown in Fig. 2-60.

Checking coolant level and density

Check to make certain the coolant level in the expansion tank is adequate. When the engine is cold (15-20°C), the coolant level within the expansion tank must be 3-4 cm above the «MIN» mark.

WARNING. Always check the coolant level on the cold engine, since its volume increases with rise in temperature; the coolant level can be significantly higher with the hot engine.

When necessary, use an areometer to check the coolant density to be 1.078-1.085 g/cu.cm for TOSOL A-40 which is used in VAZ vehicles.

When the level in the expansion tank is below the value specified, while its density is in excess of that required, top up distilled water.

When the density is as recommended, top up the correct coolant of the same grade as that in the cooling system.

When the coolant density is below the value specified, while the vehicle will be used in cold conditions, change the coolant.

Coolant change

Change coolant at the intervals recommended or after the engine overhaul. Fill the cooling system, as described below:

- undo the radiator and expansion tank caps, open the heater tap;

- disconnect the heater hose (top) from the union on the vehicle body;

- pour coolant (10.7 litre) to the radiator (up to the upper filler edge) until it starts flowing from the hose and heater union;

- reconnect the heater hose with the union and refit the radiator cap. Top up the remaining coolant into the expansion tank, refit and tighten the filler cap;

- to remove air pockets, start the engine, run it idle until the coolant temperature reaches the temperature of the thermostat opening (80 ± 2)°C. Check to see the radiator inlet and return pipes are hot.

Leave the engine to cool and check the coolant level. When the level is below that required, while there are no evident system leaks, top up coolant as necessary.

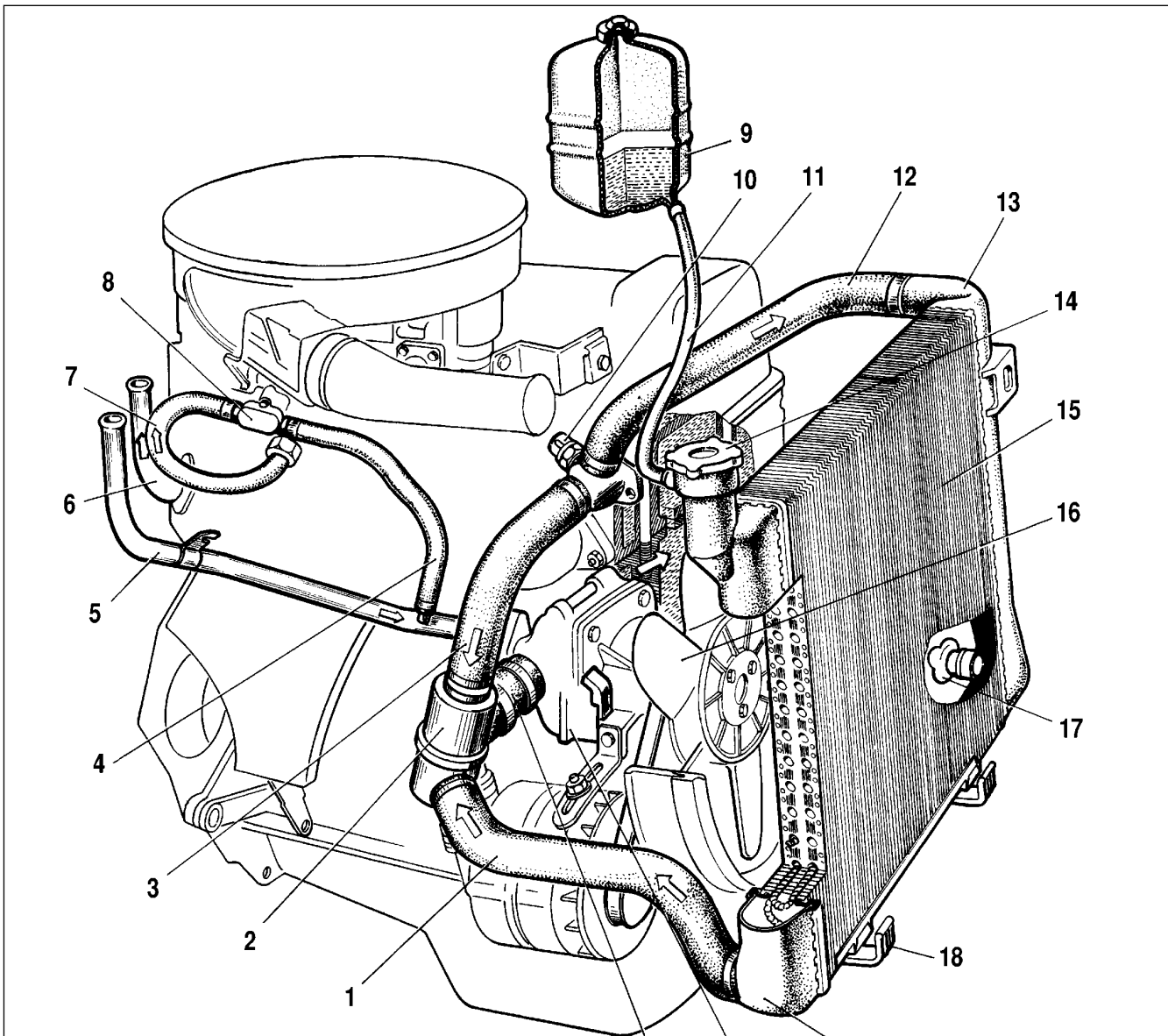
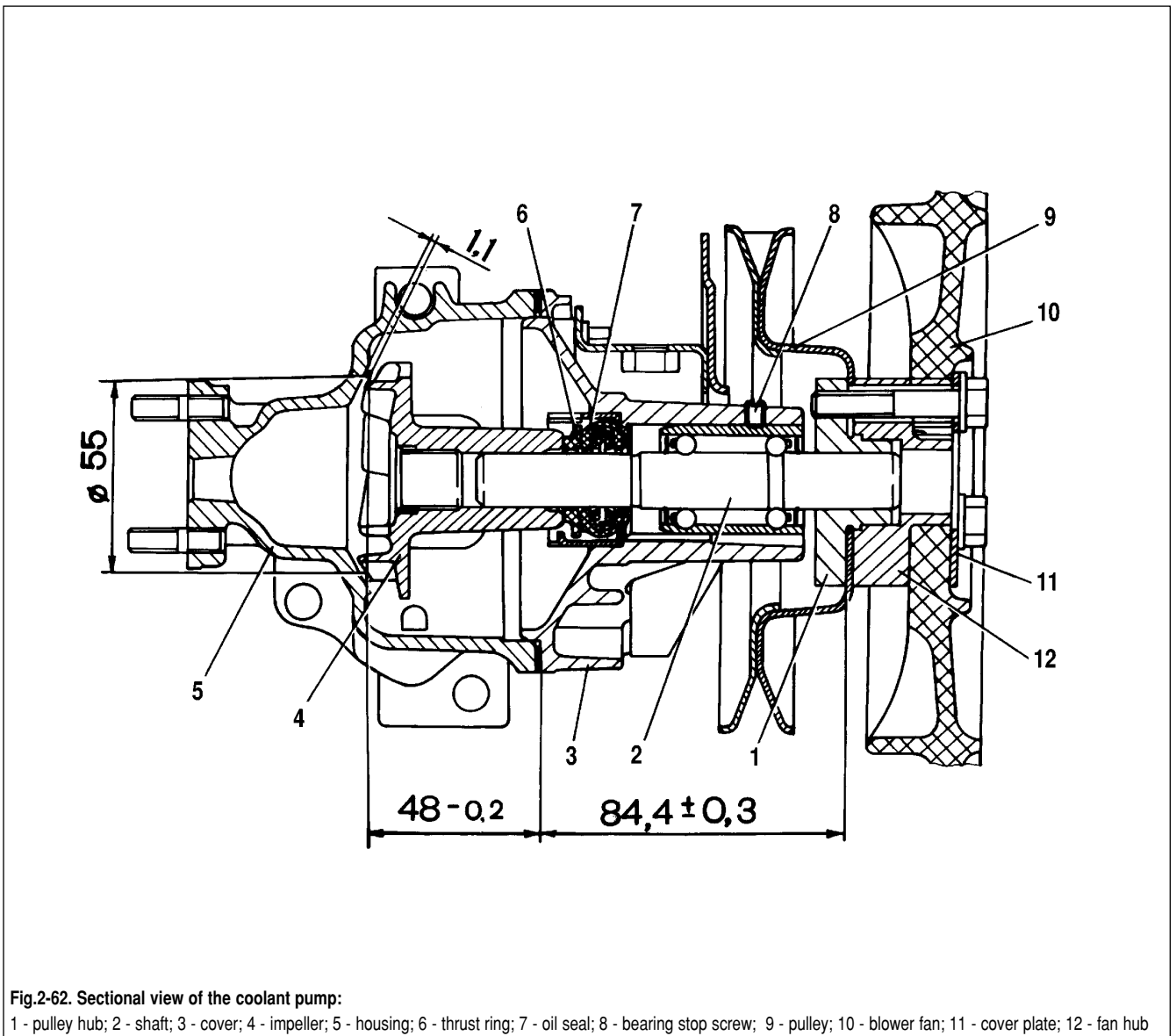
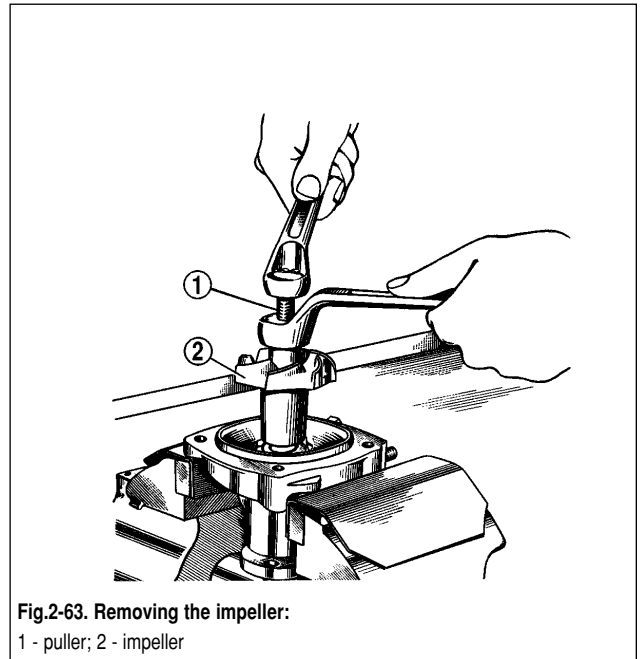
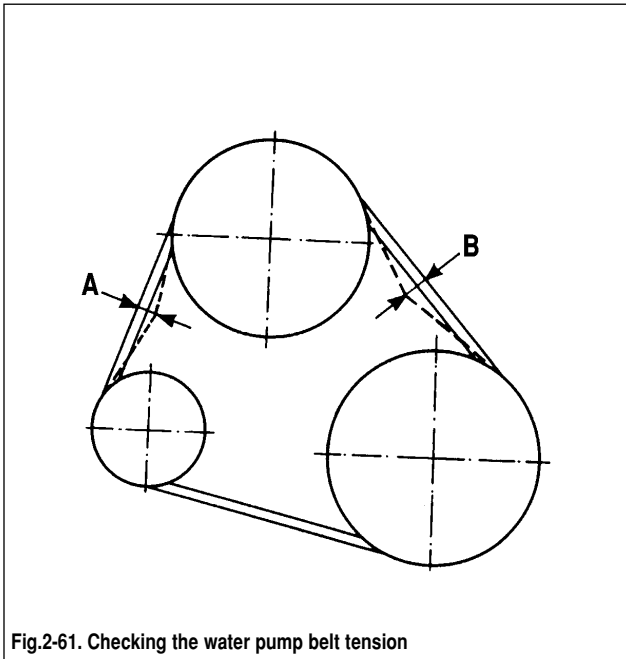


Fig.2-60. Engine cooling system:

1 - radiator return hose; 2 - thermostat; 3 - thermostat hose; 4 - return hose to pump; 5 - return pipe, heater radiator; 6 - delivery pipe, heater radiator; 7 - return hose from intake manifold preheater to part throttle channel heater; 8 - part throttle channel heater; 9 - expansion tank; 10 - coolant temperature sensor; 11 - hose between radiator and expansion tank; 12 - radiator feed hose; 13 - left-hand fluid cooler; 14 - radiator cap; 15 - radiator matrix; 16 - fan ring; 17 - radiator drain tap; 18 - radiator mounting rubber; 19 - right-hand fluid cooler; 20 - water pump; 21 - feed hose to pump



Water pump drivebelt tension adjustment

The belt tension is checked by exerting a hand pressure on the chain between the alternator pulley and pump pulley or between the pump pulley and crankshaft pulley. With proper tension, slack A in the belt (Fig.2-61) at 98 N (10 kgf) must be 10-15 mm, while at the same pressure the deflection B must be within 12-17 mm.

To adjust the belt tension, slacken the alternator retaining nuts, move the alternator off the engine (to increase tension) or towards the engine (to decrease tension), then tighten the nuts. Turn the crankshaft two revolutions clockwise and check the belt tension.

No excess tension of the belt is allowed to prevent hazardous loads to the alternator bearings.

Coolant pump

Dismantling. Carry out the coolant pump dismantling as detailed below:

- disconnect pump housing 5 (Fig.2-62) from cover 3;
- place the cover in vice using protective pads; remove impeller 2 (Fig.2-63) from the shaft using picker A.40026;
- remove hub 2 (Fig.2-64) of the fan pulley from the shaft using puller A.40005/1/5;
- undo lock screw 8 (Fig.2-62) and force out the shaft with the bearing, applying force to the bearing race;
- withdraw oil seal 7 from housing cover 3.

Inspection. Check the bearing axial clearance. This operation is mandatory if the pump is noisy. The clearance must not exceed 0.13 mm at load of 49 N (5 kgf). Renew the bearing complete with the shaft when the clearance is bigger.

Always remember to renew the pump oil seal and pump-to-cylinder block gasket during overhaul.

Check the pump housing and cover for cracks or deformation, which are not permitted.

Reassembly. The assembly is carried out as follows:

- using the appropriate tool, fit the oil seal to the housing cover, look out not to skew;
- press in the bearing and shaft, applying the force to the bearing race so that the holes for the locking screw are matched;
- tighten the bearing lock screw and punch the seat over the contour to prevent its self-loosening;
- using tool A.60430 (Fig.2-65) press the pulley hub onto the shaft, maintaining a size of (84.4 ± 0.3) mm. When the hub is of sintered quality, press in the new hub only.
- using tool A60430, press the impeller onto the shaft, maintaining a size of (48 ± 0.2) mm, as shown in Fig.2-62. This ensures the required clearance between the impeller blades and pump housing;

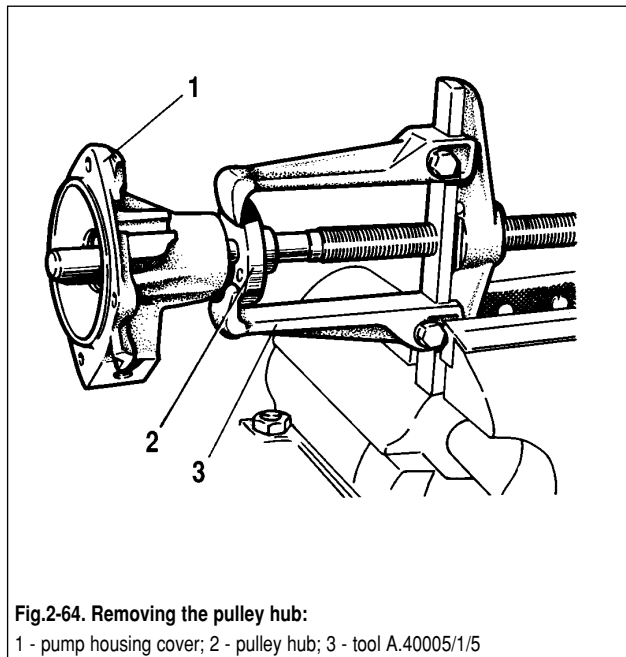


Fig.2-64. Removing the pulley hub:

1 - pump housing cover; 2 - pulley hub; 3 - tool A.40005/1/5

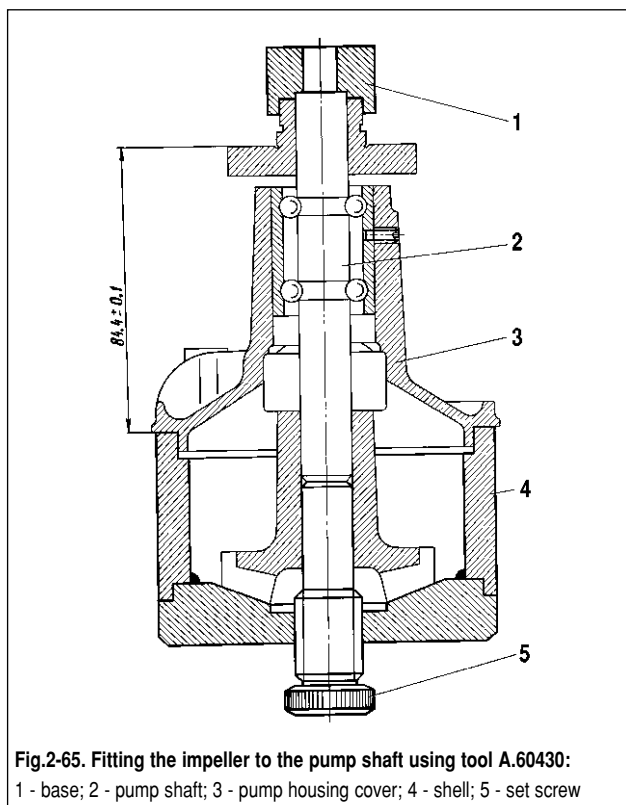


Fig.2-65. Fitting the impeller to the pump shaft using tool A.60430:

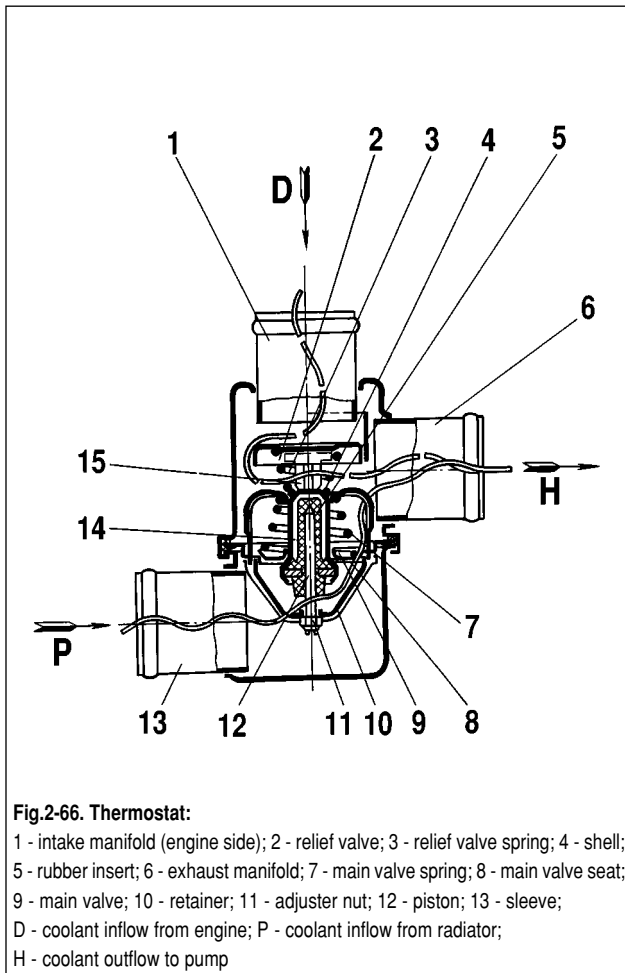
1 - base; 2 - pump shaft; 3 - pump housing cover; 4 - shell; 5 - set screw

- reassemble the pump housing with the cover, having placed the gasket in-between.

Thermostat

To test whether the unit is serviceable, check the temperature of the main valve opening and valve travel.

Using the test bench EC-106-000, suspend the thermostat with a piece of string in a container of water or coolant. Position the bracket arm of the gauge against main valve 9 (Fig.2-66).



Gradually heat the water from the starting 73-75°C in increments of approximately 1°C per minute, at constant agitation to ensure homogeneous heating within the container.

The value, when the valve travel is 0.1 mm, is deemed as the initial temperature of the main valve opening.

The main valve opening temperature is stated on the thermostat face side and is (80±2)°C or (83±2)°C. The thermostat is subject to renewal when its main valve opening temperature differs from the value stated on the thermostat face or when the main valve stroke is below 6.0 mm.

The easiest way to check the thermostat is serviceable, is to touch it directly in the vehicle. The thermostat is good when after the engine cold start, the lower radiator pipe gets warmer as soon as the coolant temperature reaches 80-85°C (the coolant temperature gauge needle is 3-4 mm from the red area of the scale).

Radiator

Removal. Withdraw the radiator from the vehicle in the following order:

- remove the spare wheel and its supporting tube;
- drain the fluid from the radiator and cylinder block through the respective caps in the left-hand fluid cooler and cylinder block; open the heater drain tap and remove the radiator filler cap;

- disconnect the hoses from the radiator;
- separate the fan cowl halves and withdraw the fan cowl;
- undo two bolts holding the radiator to the body, release the upper catch of the radiator cowling upwards, move the radiator top towards the engine and withdraw the radiator from the engine compartment;
- take out the radiator cowling.

Radiator leak test. The radiator tightness is checked in a container full of water.

Plug the radiator pipes, apply air at pressure of 0.2 MPa (2 kgf/cm²) and immerse the radiator into the water for at least 30 seconds. The radiator should show no air bubbles.

Repair or renew the radiator when it is found leaky or damaged.

Radiator repair. In the event the aluminium tubes are damaged, dismantle the radiator, drill the defective tubes from both ends to a depth of 25-30 mm, using a drill of 8.5 mm diameter.

Fit the undersize tubes (flared at one end) of 7.3 mm diameter and 0.5 mm wall thickness into the defective tubes. Then on a special stand push the tubes all the length down using a steel core of 7.5±0.05 mm.

On the respective bench expand each tube from both ends simultaneously.

Assemble the radiator and check it for tightness.

Lubrication system

Refer to Fig.2-67.

Engine oil change

Change oil only when the engine is hot. Allow at least 10 minutes, after the drain plug is removed, for all the oil to drain.

Oil renewal should be accompanied by the oil filter removal; use tool A.60312 (Fig.2-4) to undo the filter. When refitting, screw the filter into position on the engine and tighten the filter by hand only - do not use any tools.

Change oil in the following order:

- stop the engine, drain the oil and without removing the oil filter, pour cleaner oil to the «MIN» mark of the oil dipstick (2.9 litre). Use oil equivalent to grades ВНИИИП-ФД, МСП-1 or МПТ-2М;
- start the engine and run it for 10 minutes at low rpm;
- completely drain the cleaner oil and discard the old oil filter;
- fit a new oil filter and pour oil of respective season grade.

Oil pump

The basic dimensions of the pump components and its linkage are shown in Fig.2-68.

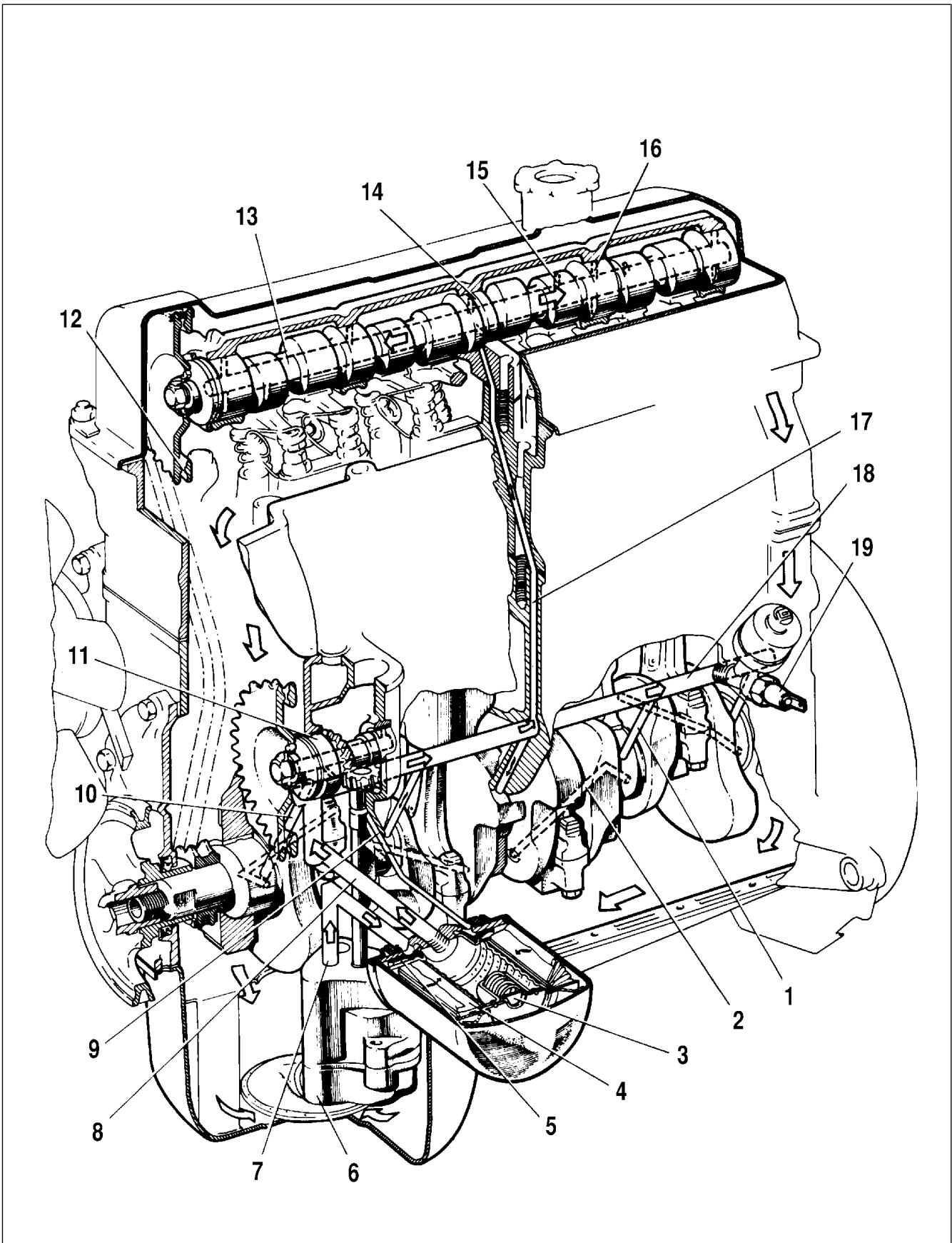


Fig.2-67. Lubrication system:

1 - oil passage to main bearing; 2 - main bearing-to-big-end bearing oil passage; 3 - oil filter relief valve; 4 - paper element; 5 - check valve; 6 - oil pump; 7 - oil pump-to-oil filter oil passage; 8 - oil passage from oil filter to main oil gallery; 9 - oil passage to oil pump gear and ignition distributor; 10 - oilway to oil pump shaft and ignition distributor; 11 - oil pump and ignition distributor shaft; 12 - oilway in outer gear to feed oil to chain; 13 - camshaft; 14 - oil recess, camshaft centre bearing journal; 15 - cam lobe oilway; 16 - oilway, camshaft bearing journal; 17 - cylinder head vertical oil passage to valve timing gear; 18 - oil gallery; 19 - oil pressure warning light sender

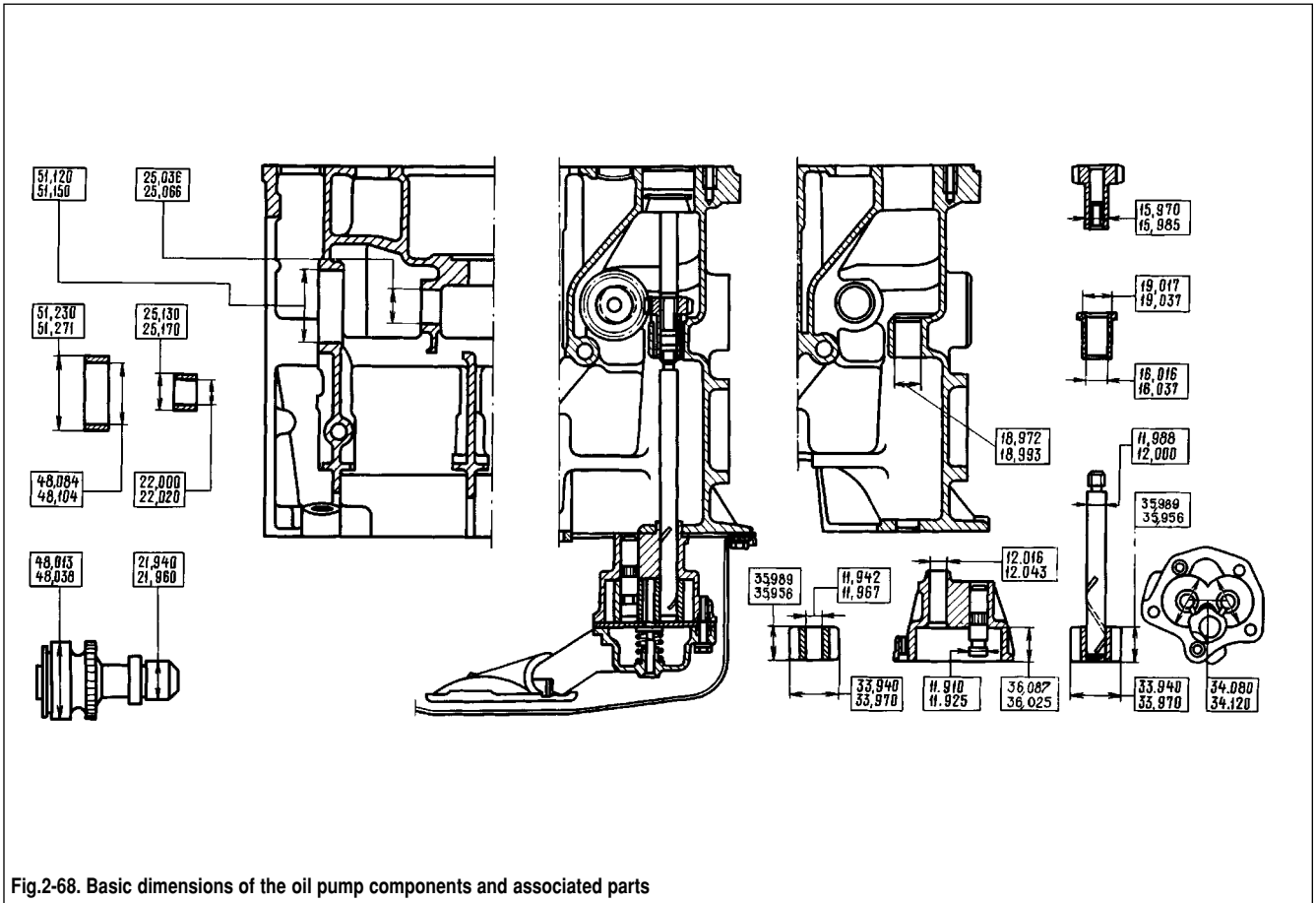


Fig.2-68. Basic dimensions of the oil pump components and associated parts

Removal and refitting. When only the oil pump requires reconditioning, remove it from the vehicle (Refer to section «Engine - removal and refitting»), place it on the turning stand, drain the oil from the sump, turn over the engine and remove the sump. Undo the oil pump bolts and remove the pump complete with the intake manifold assembly.

Refitting is the reversal order of removal.

Dismantling and reassembly. Position the oil pump in vice taking care not to damage the pump housing, then:

- undo the bolts and remove the intake manifold complete with the oil pressure relief valve;
- remove cover 3 (Fig.2-69) and withdraw the pump shaft complete with the inner and outer gears from the housing.

To reassemble the pump, position the pump in vice and carry out the following operations:

- refit the inner gear with the shaft, then the outer gear;
- refit the pump cover, pressure relief valve with the spring and bolt the intake manifold assembly to the pump body.

Note. On completing the pump assembly, turn the inner gear by hand to check the gears are running smoothly, without jerks or seizures.

Inspection. After dismantling, wash all components in kerosene or petrol, blow dry with compressed air, then check the pump

housing and cover for cracks, renew when applicable.

Using feeler blades, check the backlash in the gears and the radial play (Fig.2-70) to be respectively 0.15 mm (maximum permissible value is 0.25 mm) and 0.11-0.18 mm (maximum permissible value is 0.25 mm). If the tolerances are exceeded, then the gears or pump housing should be renewed.

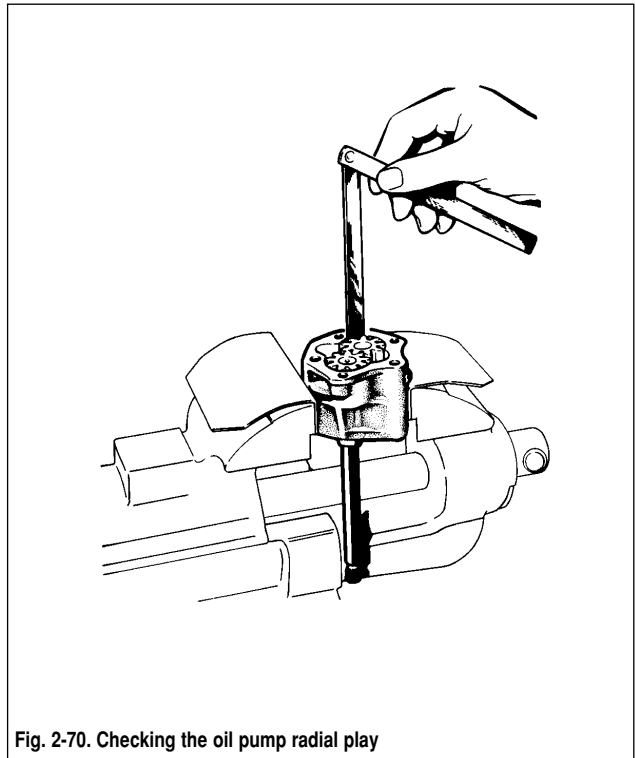
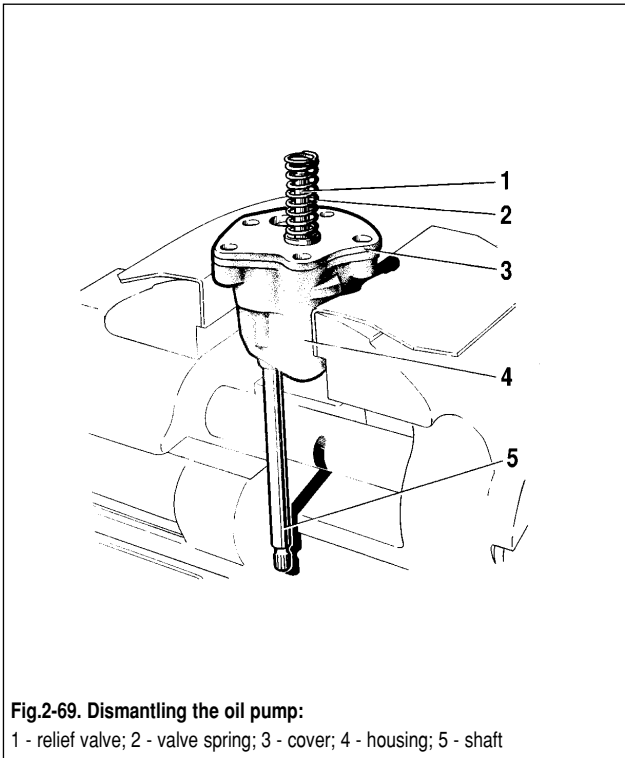
Using a feeler gauge and a straight-edge (Fig. 2-71), check the axial clearance to be 0.066-0.161 mm (maximum permissible value is 0.20 mm). When the clearance is over 0.20 mm, renew the gears or pump housing whichever is worn out.

Having taken the measurements, determine the clearance between the outer gear and its axle to be 0.017-0.057 mm (maximum permissible value is 0.10 mm) and the clearance between the oil pump shaft and the housing bore to be 0.016-0.055 mm (maximum permissible value is 0.10 mm). Renew any worn parts when the tolerances exceed the values specified.

Checking the pressure relief valve. Always inspect the pressure relief valve during the oil pump repair. Draw special attention to the valve surfaces and bores in the intake manifold assembly, since possible contamination or sediments on the mating surfaces can result in the valve seizures.

The mating valve/pump cover surfaces should show no dents or flash to prevent a drop of oil pressure in the lubrication system.

Check the relief valve spring tension against the values as given in Fig.2-72.



Oil pump shaft and drive gears

Check to see there is no denting or scuffing of the shaft bearing journals or eccentric cam surfaces.

No pitting of the oil pump gears or ignition distributor is permitted, if this is the case, renew the gears and shaft.

Oil pump shaft bushes. Check the inner diameter of the bushes, their proper fitting, make certain the oil port in the front bush is aligned against the oilway in the cylinder block (bush turning). The inner surface must be smooth and without scuffs.

Measure the diameter of the shaft and bushes to determine the clearances between the bushes and shaft bearing surfaces. When the clearance is over 0.15 mm (limit wear value), or in case of damaged or loose bushes, renew the bushes.

For removal and refitting use tool A.60333/1/2 (Fig. 2-73), observing the following:

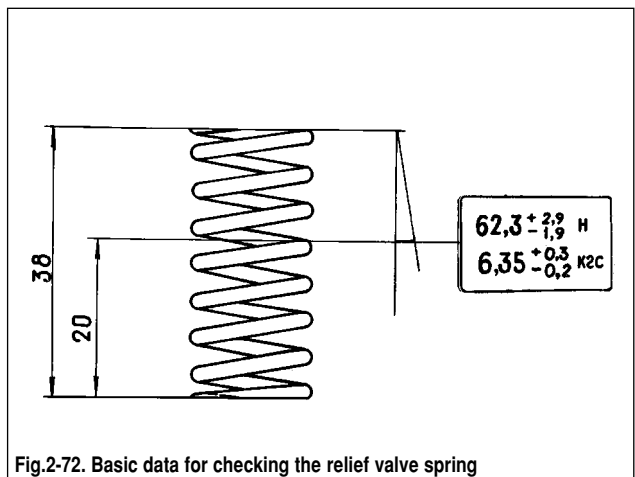
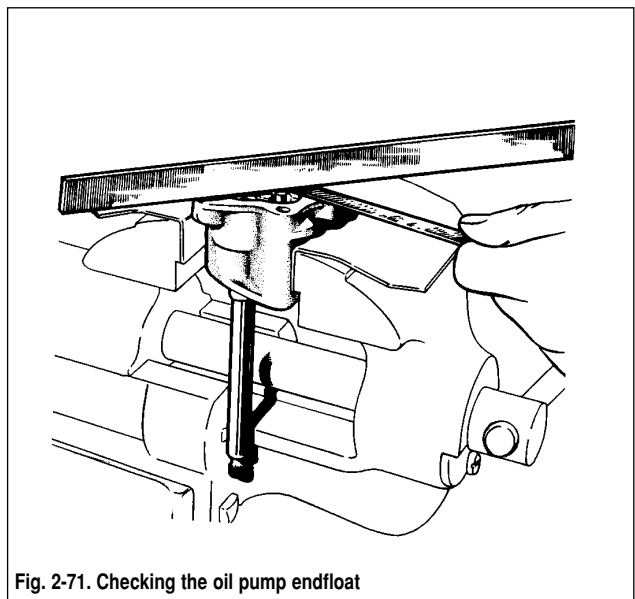
- the bushes must be pressed in place with the oil port in the front bush aligned against the oilway in the cylinder block;

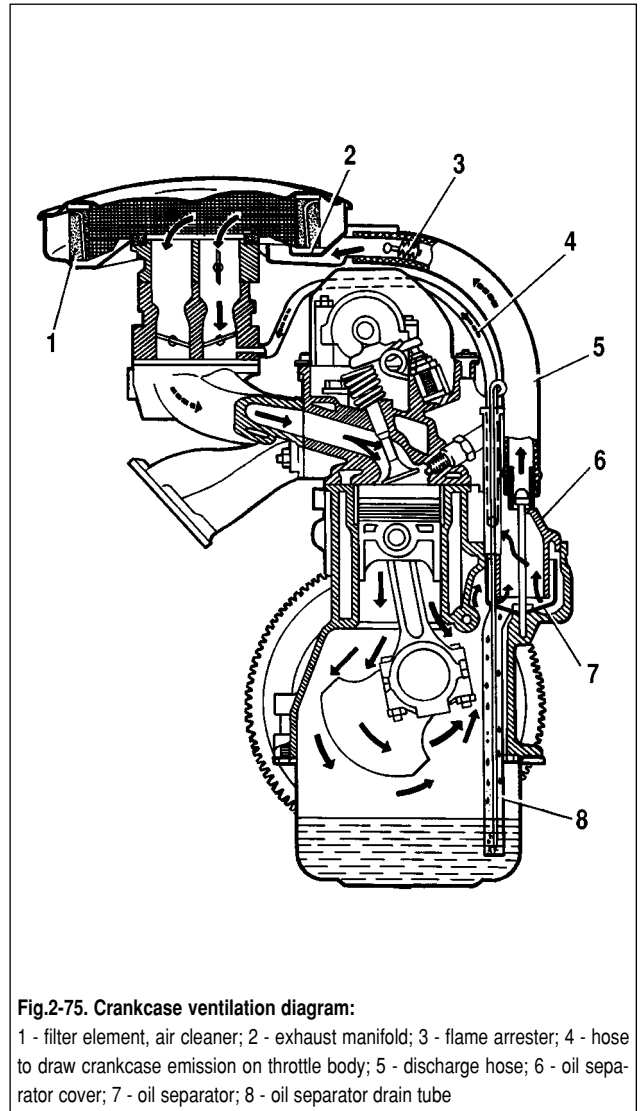
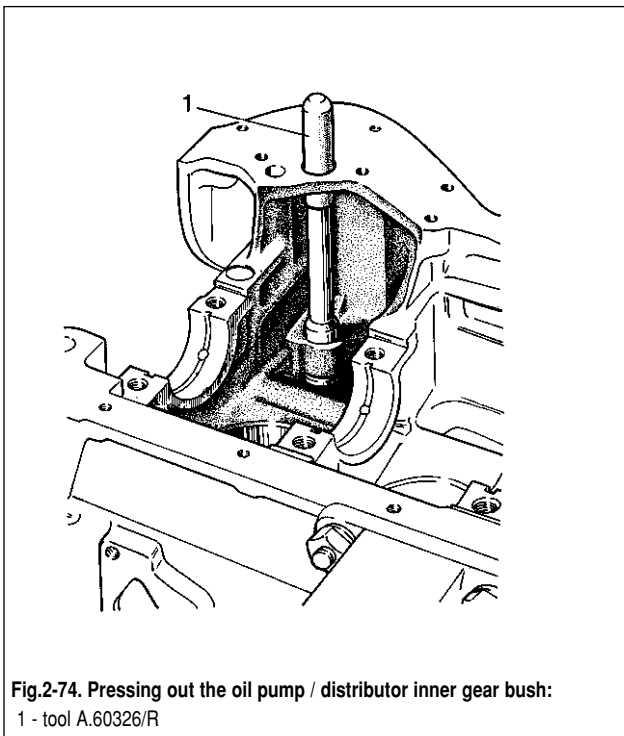
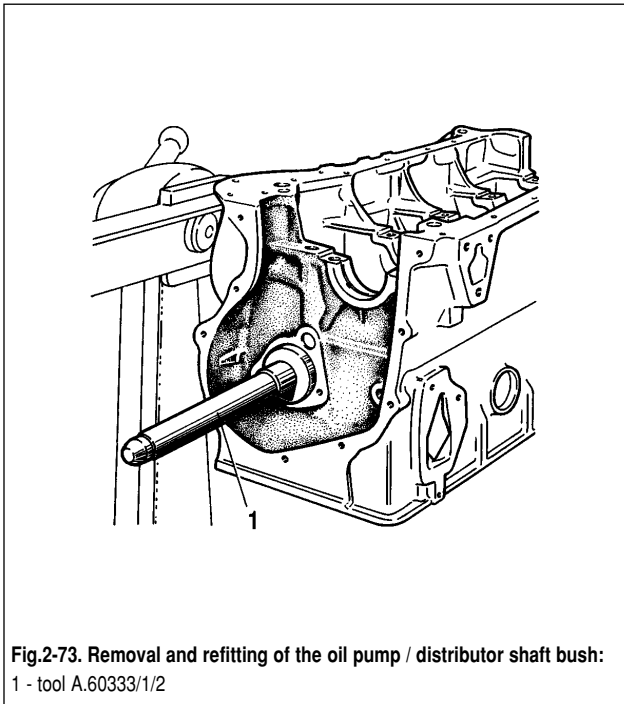
- after pressing in, the bushes are machined to the final inner diameter (Refer to Fig.2-68 for the sizes). For optimum concentricity of the shaft bushes, use the finishing reamer A.90353 for concurrent machining of both bushes.

Oil pump inner gear bush. Check the bush is adequately pressed in. The inner surface should be smooth, with no scuffs, otherwise renew the bush.

Use tool A.60326/R for bush pressing-in or out (Fig.2-74).

After pressing-in, ream the bush to 16.016-16.037 mm.





Crankcase emission ventilation system

Flushing the system. For flushing disconnect vent hoses 4 and 5 (Fig. 2-75) from the manifolds, remove flame arrester 3 from discharge hose 5, remove cover 6 of oil separator 7 and wash them in petrol or kerosine.

Flush and blow dry with compressed air the carburettor manifold to draw crankcase emission on the throttle body (to the side of the air cleaner).

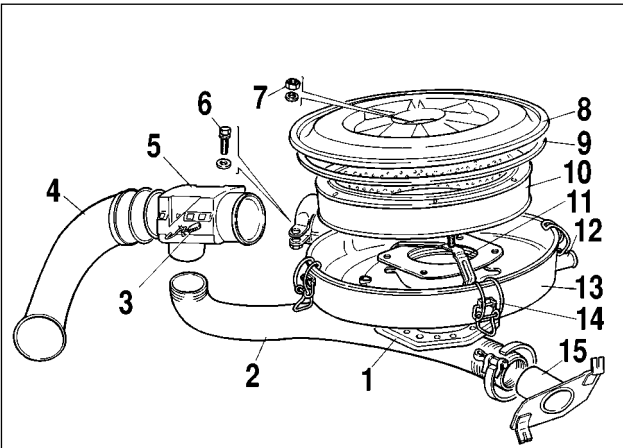


Fig.2-76. Air cleaner and temperature regulator:

1 - gasket; 2 - corrugated hose; 3 - air temperature control flap handle; 4 - cold air intake; 5 - temperature regulator; 6 - clamp bolt; 7 - air cleaner cover securing nut; 8 - air cleaner cover; 9 - air cleaner cover gasket; 10 - filter element; 11 - filter cover mounting bracket; 12 - emission discharge pipe; 13 - air filter housing; 14 - spring retainer; 15 - warm air intake from exhaust manifold

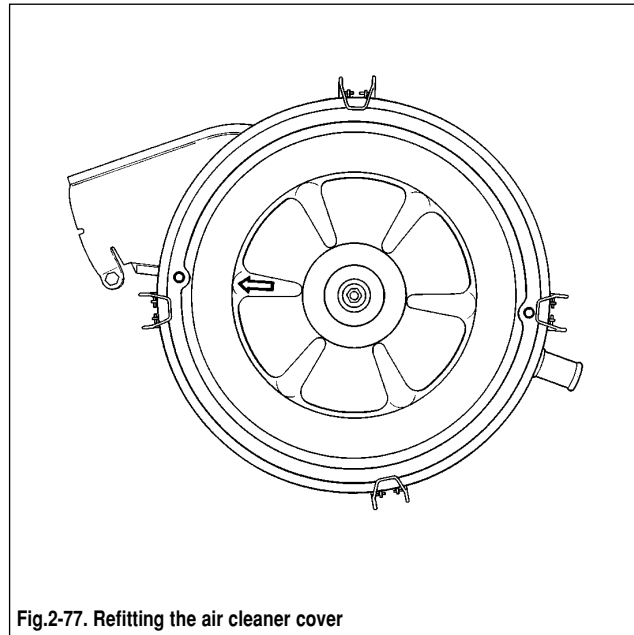


Fig.2-77. Refitting the air cleaner cover

Fuel system

Air cleaner and temperature regulator

Removal and refitting. To remove the air cleaner, release spring retainers 14 (Fig. 2-76) and undo nut 7 securing air cleaner cover 8. Remove the cover and lift out filter element 10.

Undo the nuts holding housing 13 to the carburettor. Disconnect hose 2, then remove the air cleaner and temperature regulator 5.

Loosen clamp bolt 6 and remove temperature regulator 5 complete with cold air intake 4.

When refitting the air cleaner, position the arrow on the filter cover as shown in Fig. 2-77 in order to reduce intake air noise.

Fuel tank

Removal and refitting. Before removing fuel tank 1 (Fig.2-78), disconnect the battery earth lead.

Undo cap 5 of filler pipe 4 and remove as much petrol as possible.

Remove the rear seat, undo screws holding the right-hand and left-hand wheel arch liner, remove the liners.

Unbolt and remove the cover in the floor to expose the fuel tank. Disconnect hoses 9 and wiring from fuel level sender 8, followed by hoses 2 from the fuel vapour separator.

Undo the retaining bolts and withdraw the petrol tank.

The fuel tank refitting is a reversal of removal.

Cleaning and inspection. Remove the fuel level sender. Clean the tank with petrol to remove any contaminants or sediments. Wash the tank with a jet of hot water and steam out any petrol residuals.

Thoroughly examine the fuel tank welding seam for leaks. If leakage is evident, solder the fuel tank.

WARNING. Before soldering, check to see the fuel tank is thoroughly cleaned and steam-treated and there are no fuel vapours which can ignite and explode during soldering.

Fuel pump

Refer to Fig.2-79.

Fuel pump inspection. Insufficient fuel flow to the carburettor can be caused by a faulty fuel pump, clogged or damaged fuel lines or fuel filter.

To find the cause of failure, disconnect the hose from supply manifold 1 and using fuel priming lever 8, check fuel delivery. If there is no fuel, disconnect the hose from intake manifold 4 and check the manifold for vacuum. In case of vacuum, the fuel lines are damaged, if not - the fuel pump is faulty.

The fuel pump can be tested on a stand. By rotating the drive shaft at 2000 ± 40 rpm, check the fuel delivery by the pump to be at least 54 litre/hour at $20 \pm 5^\circ\text{C}$, while the supply pressure at «zero» fuel delivery must be 0.02-0.03 MPa (0.21-0.30 kg/cm²). When found defective, dismantle the fuel pump and examine all its components.

Dismantling, cleaning and inspection. To dismantle, unbolt cover 5, remove the cover and fuel pump filter 2. Next undo the screws holding the housing to the lower cover, separate them, withdraw the diaphragm unit and spring. Wash all components in petrol and blow dry with compressed air.

Examine the state of components. The pump springs must be undamaged. Check the valves are not sticking. The diaphragms must have no fractures, cracks or hard spots.

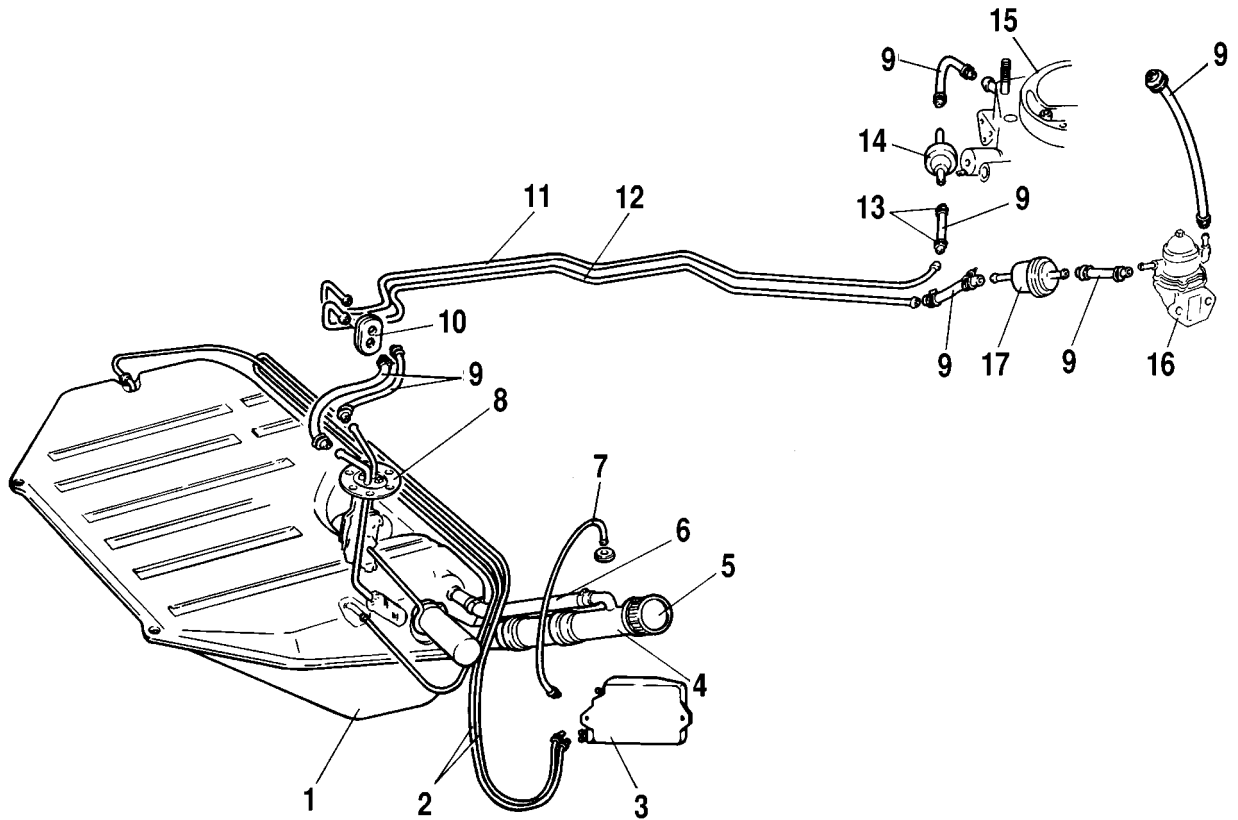


Fig.2-78. Fuel tank and fuel pipeline associated components

1 - fuel tank; 2 - hoses, fuel vapour separator and fuel tank; 3 - fuel vapour separator; 4 - filler pipe; 5 - cap; 6 - hose, fuel tank and filler pipe; 7 - hose, fuel vapour separator and fuel tank cover; 8 - fuel level sender; 9 - connection hoses; 10 - grommet; 11 - return flow line; 12 - fuel line; 13 - hose clips; 14 - non-return valve; 15 - carburettor; 16 - fuel pump; 17 - fine fuel filter

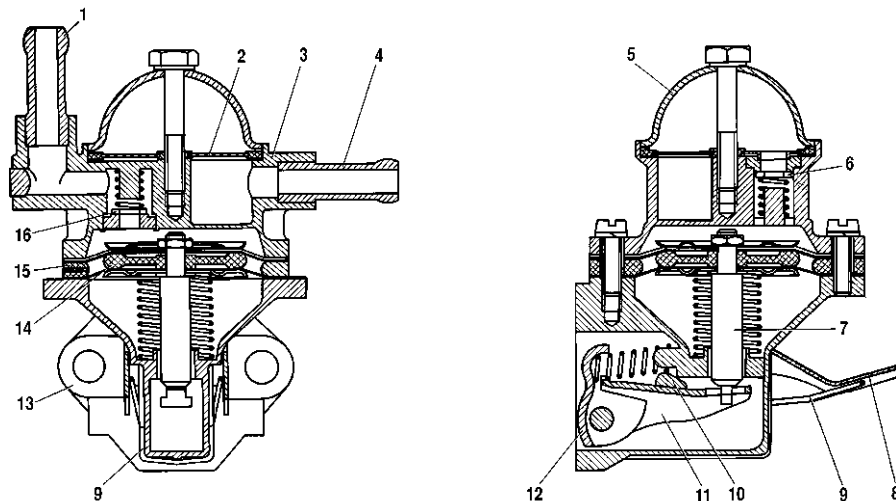


Fig.2-79. Fuel pump:

1 - delivery pipe; 2 - filter; 3 - housing; 4 - suction pipe; 5 - cover; 6 - suction valve; 7 - operating rod; 8 - hand priming lever; 9 - spring; 10 - eccentric; 11 - rocker; 12 - mechanical priming lever; 13 - lower cover; 14 - inner distance gasket; 15 - outer distance gasket; 16 - delivery valve

Check and renew any worn components. Always fit new pump gaskets, remember to lubricate the gaskets with a thin layer of grease before refitting them to the pump.

Refitting pump to engine. For correct fitting, use two out of three gaskets as stated below:

«**A**» gasket of 0.27-0.33 mm;

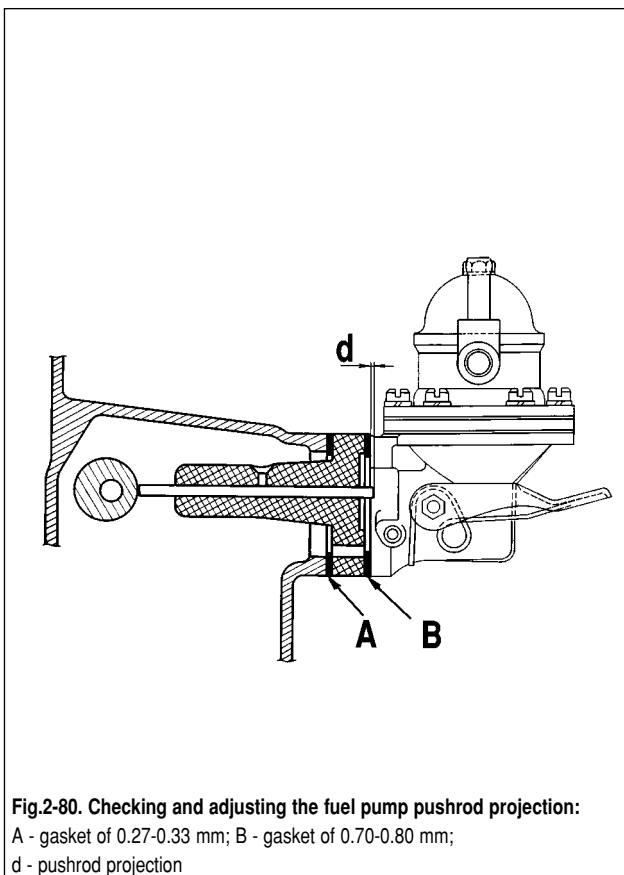
«**B**» gasket of 0.70-0.80 mm

«**C**» gasket of 1.10-1.30 mm.

Refit as shown in Fig.2-80 in the following sequence.

Locate the gasket **A**, then heat screen to the cylinder block, next place the gasket **B** on the face mating the pump. Using tool 67.7834.9506 measure the distance «**d**» (minimum rod protrusion to be set through slow crankshaft rotation). When the size «**d**» is within 0.8-1.3 mm, secure the fuel pump to the engine. When the size «**d**» is below 0.8 mm, replace the gasket **B** with the gasket **A**. When the size «**d**» is over 1.3 mm, replace the gasket **B** with the gasket **C**. Recheck the size «**d**» and secure the pump to the engine.

Make sure the gasket **A** is always fitted between the cylinder block and heat screen.



Carburettor

General description

The engine is fitted with the 21073-1107010 carburettor (Fig.2-81) of emulsion, twin progressive throttle type. The carburettor features a balanced float barrel, a system of drawing crankcase emission on the throttle body, a part throttle channel heater and secondary barrel locking.

The carburettor has two main fuel jet systems for the primary and secondary barrels, a primary barrel idling system with air correction, a secondary barrel air correction system, part throttle enrichment (economizer), full throttle enrichment (econostat), diaphragm-type accelerator pump, semi-automatic choke control unit.

On the overrun an idling overrun control unit is actuated.

Refer to Table 2-2 for carburettor data.

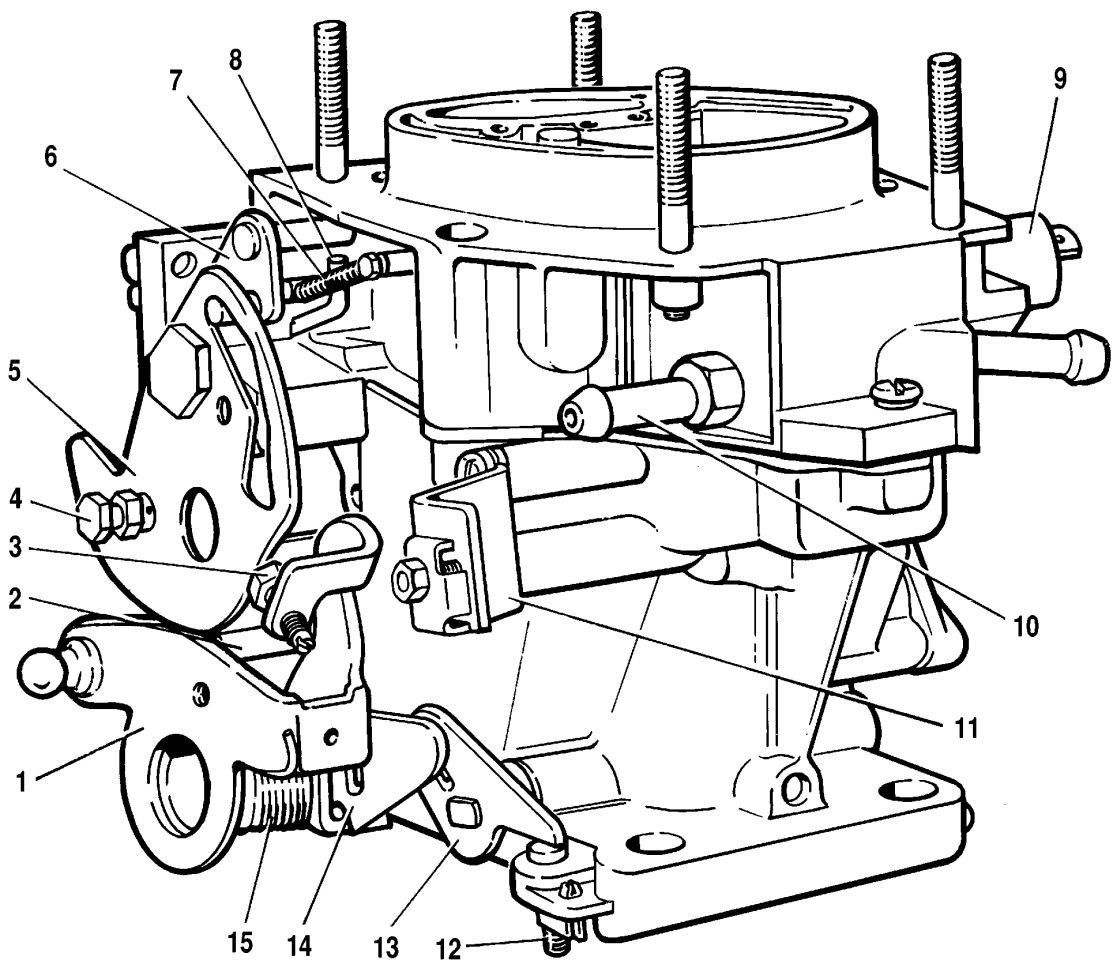


Fig.2-81. Carburettor 21073-1107010:

1 - throttle valve lever; 2 - secondary barrel lock lever pin; 3 - primary throttle valve opening adjustment screw; 4 - screw for choke valve cable end fitting; 5 - choke valve control lever; 6 - choke valve lever; 7 - choke valve return spring; 8 - diaphragm rod, pull-down unit; 9 - fuel shutoff solenoid; 10 - fuel supply manifold; 11 - bracket for choke outer cable end fitting; 12 - secondary barrel adjuster screw; 13 - secondary throttle valve lever; 14 - secondary throttle lever; 15 - primary throttle return spring

21073-1107010 CARBURETTOR

Parameters	Primary barrel	Secondary barrel
Barrel diameter, mm	32	32
Venturi diameter,mm	24	24
Main jet system:		
• fuel jet marking*	107.5	117.5
• air jet marking	150	135
Emulsion tube, type	ZD	ZC
Idling and air correction systems, primary barrel:		
• fuel jet marking	39	–
• conventional flow,** air jet	140	–
Air correction system, secondary barrel:		
• conventional flow, fuel jet	–	70
• conventional flow, air jet	–	140
Full throttle enrichment (econostat):		
• conventional flow, fuel jet	–	70
Part throttle enrichment (economizer):		
• fuel jet marking	40	–
• spring compression (9.5 mm length), N		14.5±15%
Accelerator pump:		
• atomizer marking	45	–
• delivery (10 full strokes), cc	14	–
• cam marking	4	–
Starting clearances***:		
• choke valve (clearance B), mm	3.0	–
• throttle valve (clearance C), mm	1.1	–
Diameters,mm:		
• crankcase vent drilling	1.2	–
• vacuum advance unit orifice		1.2
• needle valve bore		1.8
• fuel return orifice to petrol tank		0.70

* Jet marking is flow-related. Flow rate is measured with a micrometer, calibrated against the reference jets.

** Conventional flow through the jet is determined against the reference jet under a special procedure; in operation no control is required.

***Starting clearances are as shown in Fig.2-86

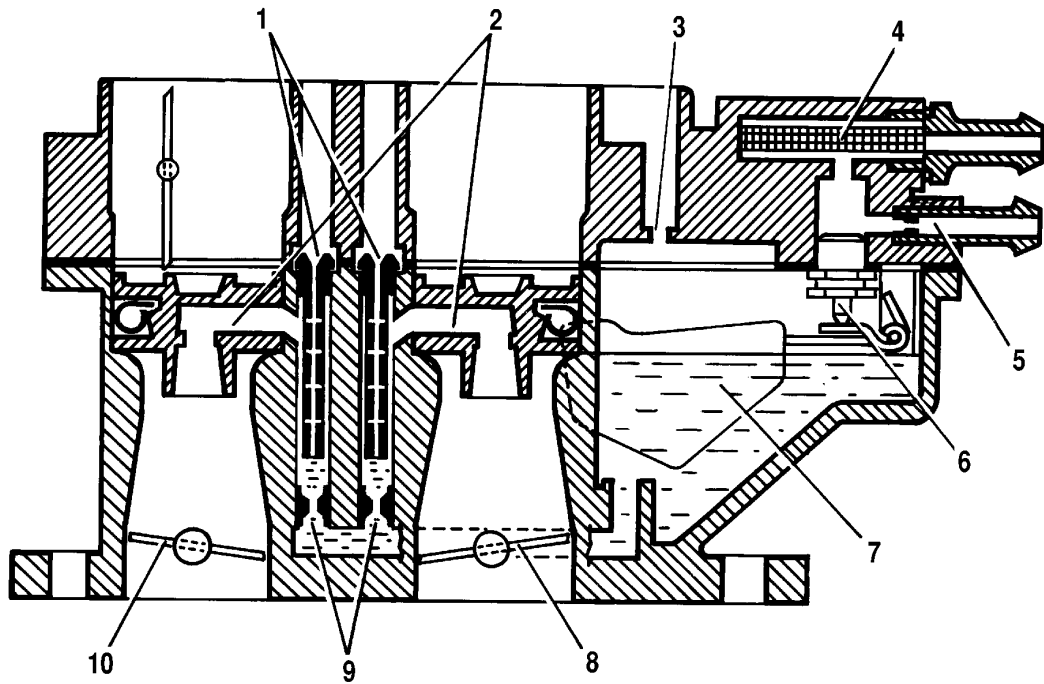


Fig.2-82. Main metering system:

1 - main air jets and emulsion tubes; 2 - atomizers, primary and secondary barrels; 3 - balance orifice; 4 - fuel filter; 5 - return pipe with calibrated orifice to petrol tank; 6 - needle valve; 7 - float; 8 - secondary throttle valve; 9 - main fuel jets; 10 - primary throttle valve

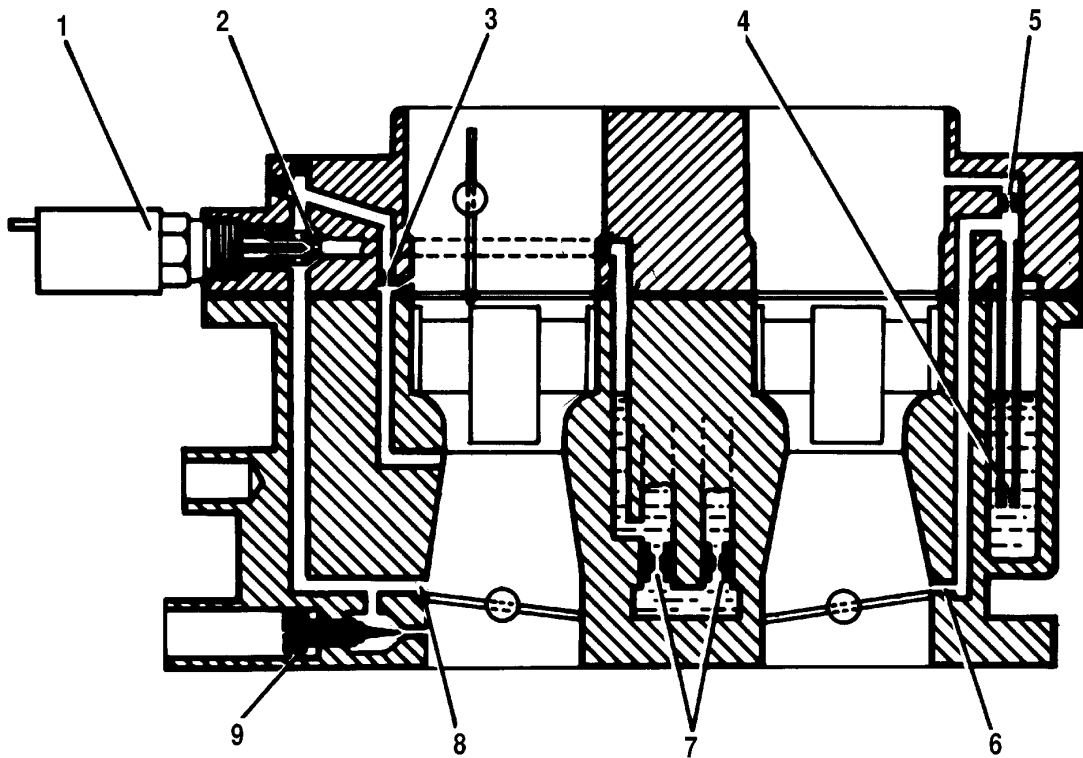


Fig.2-83. Idling and air correction systems:

1 - fuel cut-off solenoid; 2 - idling fuel jet; 3 - idling air jet; 4 - fuel jet and tube, secondary air correction system; 5 - air jet, secondary air correction system; 6 - outlet orifice, secondary air correction system; 7 - main fuel jets; 8 - primary air correction passage; 9 - idle mixture adjustment screw

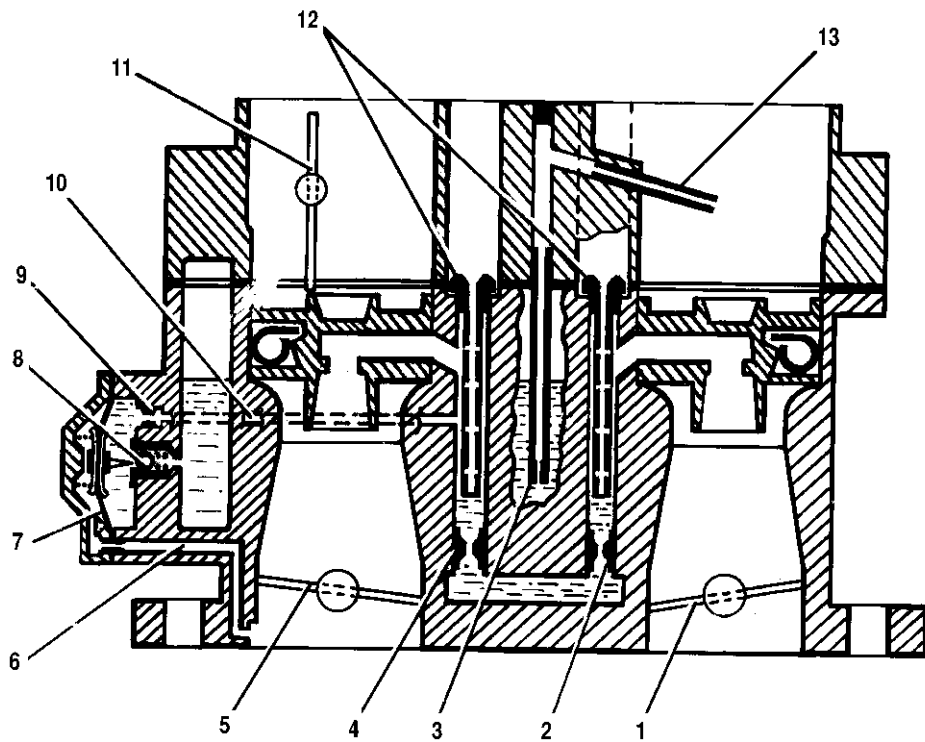


Fig.2-84. Part throttle and full throttle enrichment systems:

1 - secondary throttle valve; 2 - main fuel jet, secondary barrel; 3 - fuel jet and tube, full throttle enrichment; 4 - main fuel jet, primary barrel; 5 - primary throttle valve; 6 - vacuum port; 7 - part throttle diaphragm; 8 - ball valve; 9 - fuel jet, part throttle enrichment; 10 - fuel passage; 11 - choke; 12 - main air jets; 13 - injection tube, full throttle enrichment

Main metering system. Fuel through gauze filter 4 (Fig. 2-82) and needle valve 6 is fed to the float chamber. From the float chamber fuel flows through main fuel jets 9 to the emulsion wells to be mixed with air, escaping from emulsion tubes 1 which are built as one piece with the main air jets. Through atomizers 2 the air-fuel mixture flows to the primary and secondary venturi.

Throttle valves 8 and 10 are connected so that the secondary barrel starts opening when the primary one is 2/3 open.

Idling system runs on fuel from the emulsion well behind fuel jet 7 (Fig.2-83). Fuel is fed to fuel jet 2 which is fitted with fuel cut-off solenoid 1. At the jet outlet the fuel is mixed with the air coming from the port and from a flared part of the venturi (to ensure the carburettor smooth operation at idling). Emulsion goes under the throttle plate through the correcting orifice adjusted by idle mixture adjustment screw 9.

Air correction systems. Following the throttle opening but prior to activation of the main metering system, the air-fuel mixture enters:

- the primary barrel through idling fuel jet 2 and air correction system passage 8, located at the level of the closed throttle plate edge;
- the secondary barrel through outlet orifice 6 being slightly over the edge of the closed throttle plate. Fuel flows from jet 4 through the tube to be further mixed with air from air jet 5 flowing through the idling air passage.

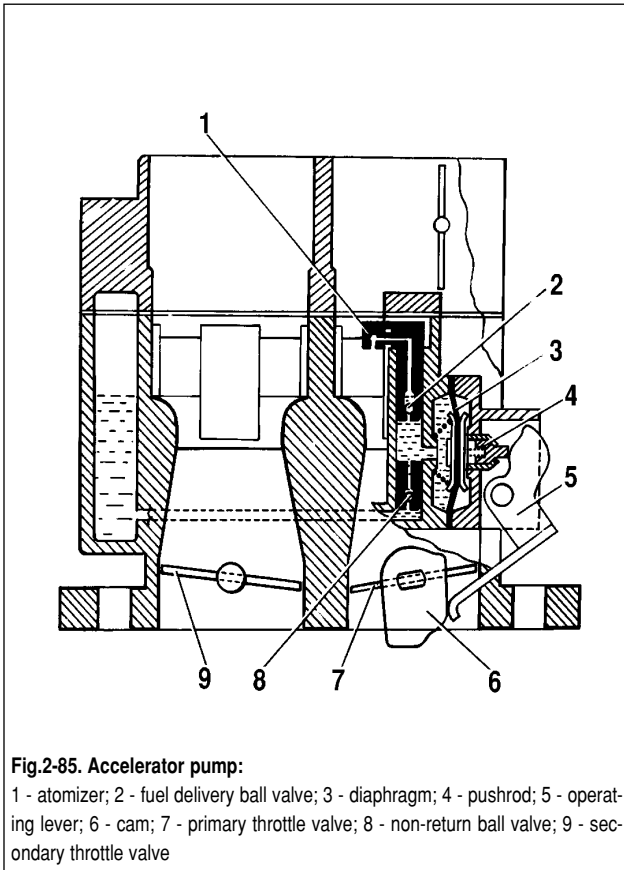
Part throttle enrichment (economizer) operates when certain vacuum level is maintained on throttle body 5 (Fig. 2-84). Fuel is fed from the float chamber through ball valve 8. Valve 8 remains closed as long as the diaphragm is held retracted in the intake pipe by means of the vacuum. With wide open throttle, the vacuum decreases allowing diaphragm 7 spring to open the valve. Petrol which flows through part throttle enrichment jet 9 is added to fuel passing through main fuel jet 4, providing a richer mixture.

Full throttle enrichment (econostat) operates at full engine load, at high, close-to-maximum speeds and wide open throttles. Petrol from the float barrel through jet 3 (Fig.2-84) is delivered to the fuel pipe and further through injection tube 13 into the secondary barrel resulting in a richer mixture.

Accelerator pump is of diaphragm type, mechanically operated by cam 6 (Fig.2-85) on the primary throttle spindle. With the throttle valve closed, the spring retracts diaphragm 3 thus filling the pump with petrol through ball valve 8. As the throttle opens, the cam operates lever 5, whilst diaphragm 3 forces fuel through ball valve 2 and atomizer 1 into the barrels enriching the air-fuel mixture.

The pump capacity is invariable and is determined by the cam profile only.

Choke control unit. Choke lever 4 (Fig.2-86) has three profiles. Its outer edge 4.3 operates throttle lever 11 through adjuster screw 10 to start the engine when cold and to further rise the



engine speed. Inner profiles 4.1 and 4.2 operate choke lever 6 allowing choke opening to a certain amount at intermediate positions of lever 4. Rotation of choke lever 4 anticlockwise causes the wider slot to release choke lever 6 stud; the choke is held in a fully closed position by return spring 7. At the same time the primary throttle is opened by means of lever 4 edge 4.3.

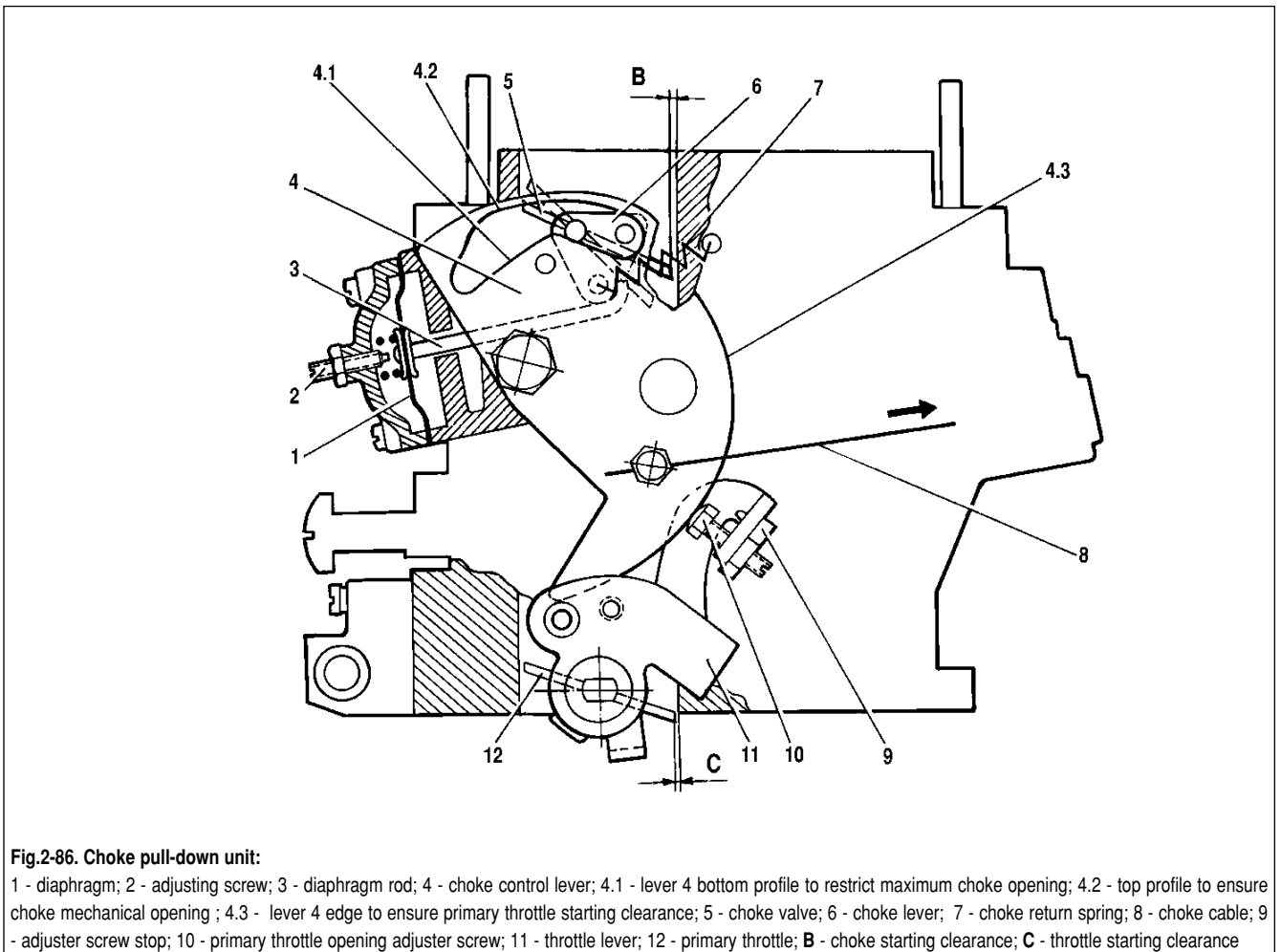
Choke 5 shaft is not centralized, therefore, after the engine is started, the choke is opened by force of air flow, extending spring 7 to result in a leaner air-fuel mixture.

Vacuum from the throttle body operates diaphragm 1 and opens the choke by means of rod 3. Adjuster screw 2 makes possible to control the degree of the choke opening.

The maximum choke opening rate at the engine start-up and warm-up depends on choke lever 4 positions or choke lever slot width.

Idling overrun control unit disables the idling system on the overrun (during engine deceleration, downhill movement or gear shifting) thus improving fuel economy and reducing CO emission to atmosphere.

On the overrun at over 2100 rpm and carburettor idle switch 7 shorted to «ground» (Fig.7-40) (throttle pedal released), fuel cutoff solenoid 4 is deactivated to shut off fuel supply. When the idle switch is not grounded, the solenoid will not be disabled.



When the crankshaft speed goes down as low as 1900 rpm on the overrun, the control unit re-triggers the fuel cutoff solenoid to feed fuel through the idle jet, and the engine gradually shifts to idling.

Secondary barrel locking. The secondary throttle can open only with the open choke when lever 5 edge (Fig.2-81) does not rest against pin 2 of the secondary barrel lock lever.

In this case during throttle opening the lock lever operates lever 13 through lever 14 to open the secondary throttle.

When the choke is closing, lever 5 outer edge operates lock lever pin 2 to disengage lever 14 and lock lever. Now the secondary throttle is locked out and cannot be opened.

Carburettor - removal and refitting

Carburettor removal and refitting is done on the cold engine only. Start with removing the air cleaner. Next disconnect operating rod 15 (Fig. 2-87) from the throttle lever, followed by operating rod 3 and choke outer operating rod. Undo the retaining screw and remove the part throttle channel heater.

Disconnect the idling overrun wiring from the shutoff solenoid and idle switch. Undo the carburettor retaining nuts, remove the carburettor and plug the intake pipe.

Refitting is a reversal of the removal procedure. Before refitting, examine the carburettor heat screen and intake pipe/carburettor mating surfaces. Tighten the carburettor nuts to the torques specified in Attachment 1.

WARNING. Never refit or tighten the retaining nuts on the hot carburettor.

After refitting, adjust the carburettor linkage and engine idle.

The carburettor linkage should operate without seizures.

Carburettor - dismantling

Undo the retaining screws and remove the carburettor cover, taking care not to damage the gasket, float and tubes of the full throttle enrichment and secondary air correction systems.

Dismantle the carburettor cover.

Using a tool, carefully push out spindle 1 (Fig.2-88) of floats 3, providing you do not damage the float tabs, remove the floats.

Remove gasket 4, needle valve 2 seat, fuel supply pipe 11 and fuel filter 13.

Remove the housing of the idling fuel jet with fuel cutoff solenoid 10 and remove jet 9.

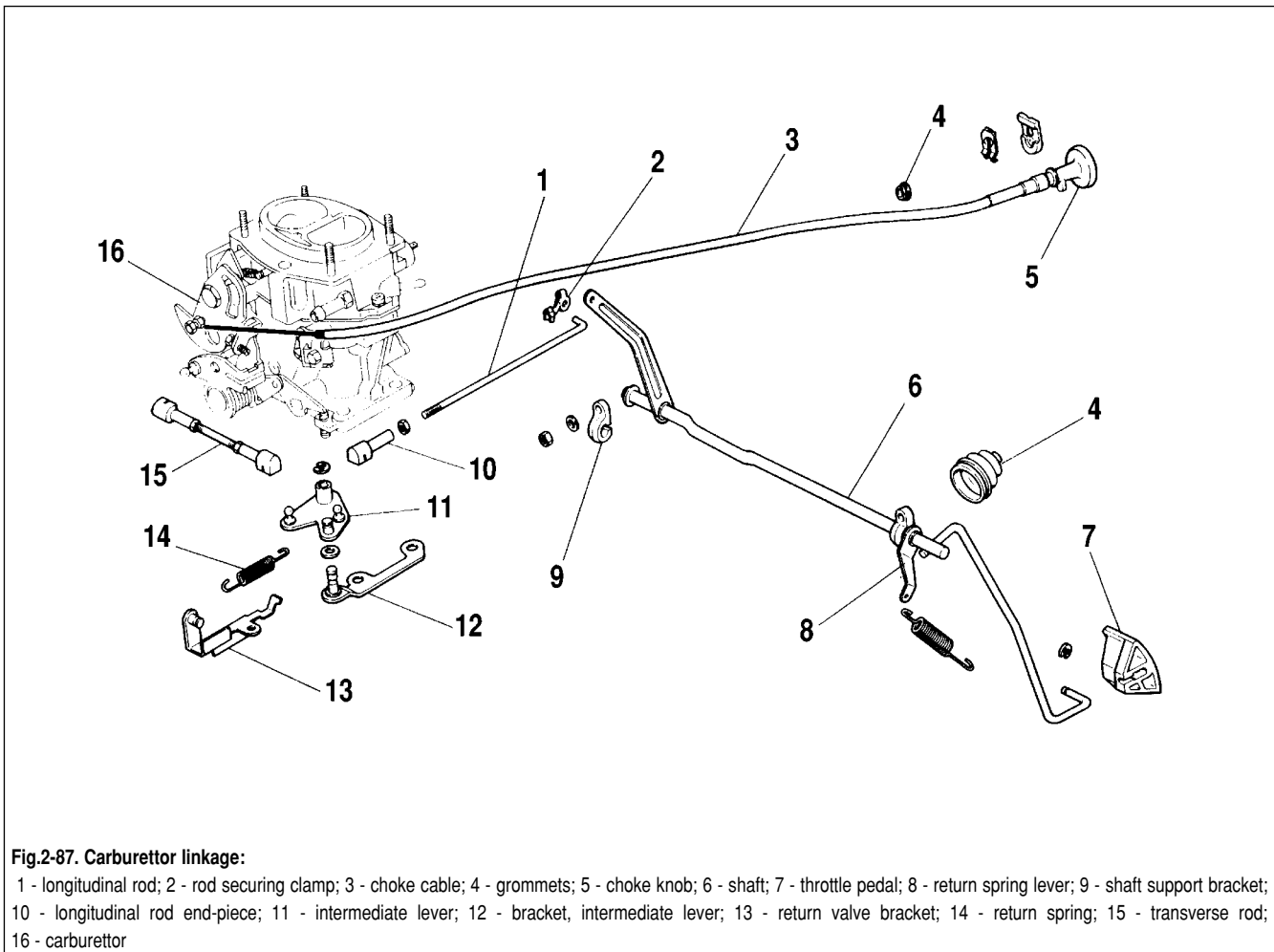


Fig.2-87. Carburettor linkage:

1 - longitudinal rod; 2 - rod securing clamp; 3 - choke cable; 4 - grommets; 5 - choke knob; 6 - shaft; 7 - throttle pedal; 8 - return spring lever; 9 - shaft support bracket; 10 - longitudinal rod end-piece; 11 - intermediate lever; 12 - bracket, intermediate lever; 13 - return valve bracket; 14 - return spring; 15 - transverse rod; 16 - carburettor

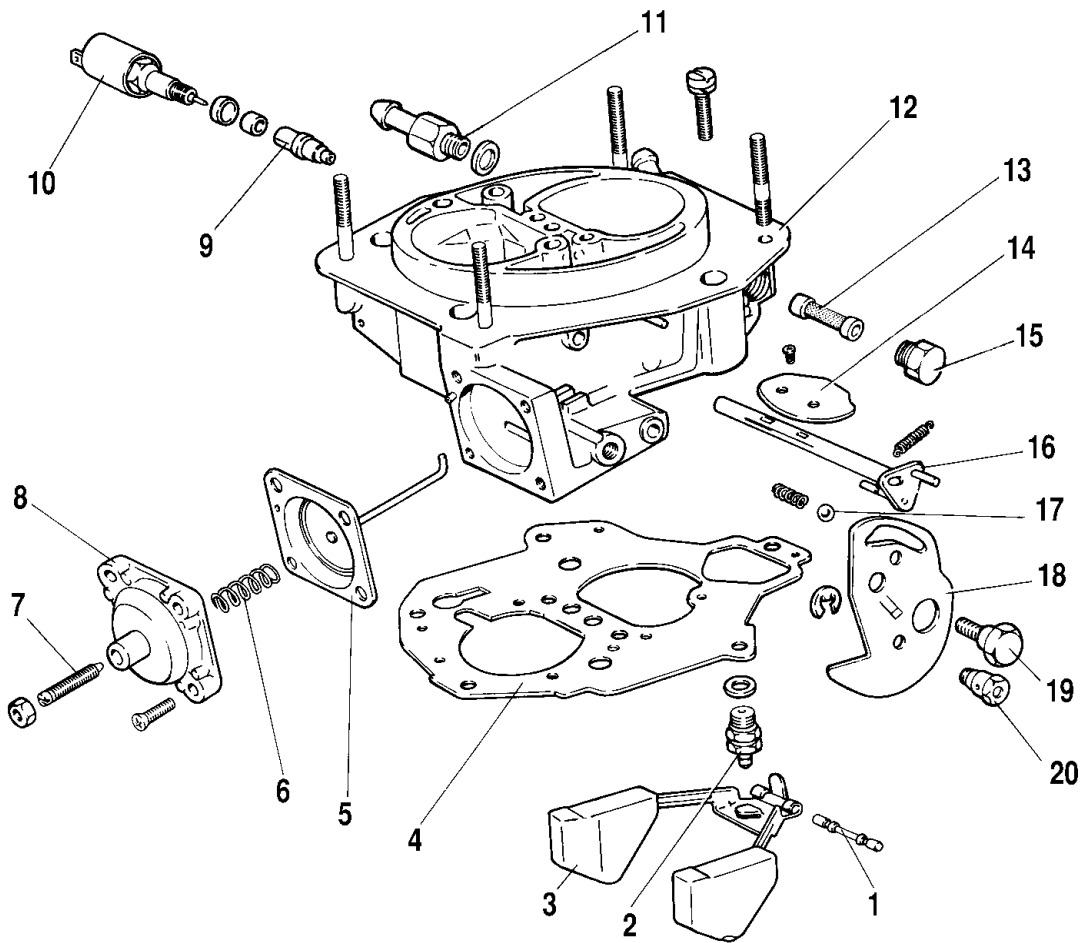


Fig.2-88. Carburettor cover components:

1 - float spindle; 2 - needle valve; 3 - float; 4 - gasket; 5 - diaphragm and rod, choke pull down unit; 6 - spring; 7 - adjusting screw; 8 - cover, choke pull down unit; 9 - idling fuel jet; 10 - fuel cut-off solenoid; 11 - fuel supply pipe; 12 - carburettor cover; 13 - fuel filter; 14 - choke valve; 15 - cap; 16 - spindle, choke valve and lever; 17 - choke control lever securing ball; 18 - choke control lever; 19 - lever spindle; 20 - bush for securing choke cable

Undo shaft 19, extract ball 17 with the spring, remove choke lever 18, detach the choke lever spring. When applicable, undo choke retaining screws, withdraw plate 14 and spindle 16.

Dismantle the diaphragm-type choke control unit, having removed cover 8 complete with adjusting screw 7. Lift out spring 6 and diaphragm 5 with the rod.

Dismantle the carburettor housing (Fig.2-89) as described below.

Remove accelerator pump cover 3 complete with lever 2 and diaphragm 1.

Using a screwdriver, remove accelerator pump atomizer 10, followed by atomizers 11 of the primary and secondary barrels. Grip the housing when removing atomizer 10.

Undo the nut of the primary throttle spindle, remove cam plate 4 of the accelerator pump linkage, then the washer.

Undo the retaining screw, remove wire 30 from throttle stop

screw (CO adjustment screw) 29 and when applicable remove screw 29.

Remove plastic plug 25 and undo idle mixture adjusting screw 27.

Lift out part throttle enrichment cover 5, diaphragm 6 and spring.

Unscrew fuel jet 7 of the part throttle enrichment unit.

Undo main air jets 12 with the emulsion tubes and main fuel jets 13.

Carburettor components - cleaning and inspection

Fuel filter. Wash the filter and blow dry with compressed air. Examine the filter. When the filter or the fuel supply manifold are damaged, renew them.

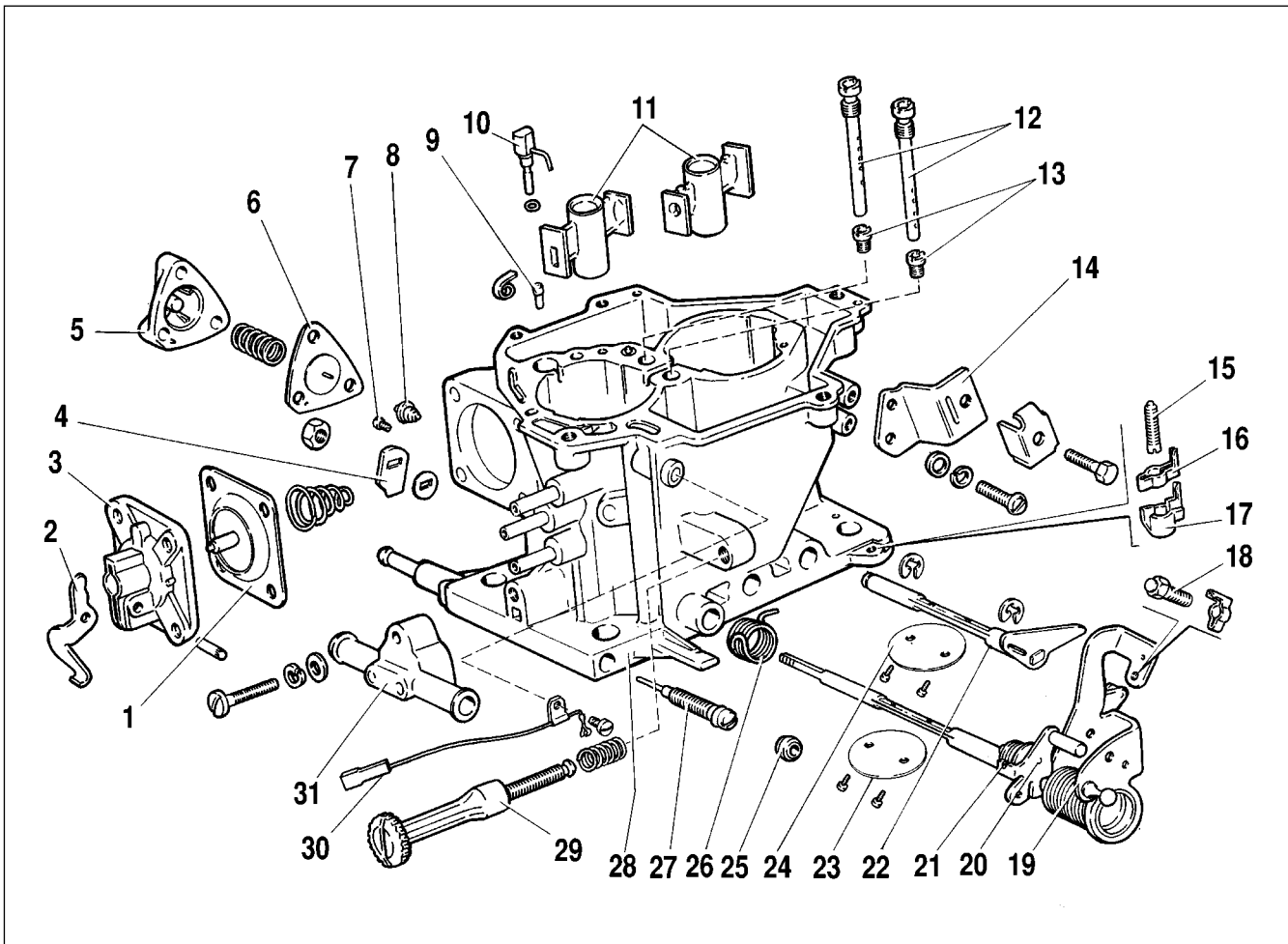


Fig.2-89. Carburettor housing components:

1 - accelerator pump diaphragm; 2 - operating lever, accelerator pump; 3 - cover; 4 - cam, accelerator pump linkage; 5 - cover, part throttle enrichment; 6 - diaphragm, part throttle enrichment; 7 - fuel jet, part throttle enrichment; 8 - valve, part throttle enrichment; 9 - return valve, accelerator pump; 10 - atomizer and fuel feed valve, accelerator pump; 11 - main metering atomizers; 12 - main air jets with emulsion tubes; 13 - main fuel jets; 14 - bracket to secure choke outer cable end; 15 - adjusting screw, secondary barrel; 16 - stop, adjusting screw; 17 - cap, stop; 18 - primary throttle opening adjusting screw; 19 - primary throttle spindle and operating levers; 20 - secondary lock lever; 21 - lock lever spring; 22 - secondary throttle shaft and lever; 23 - primary throttle valve; 24 - secondary throttle valve; 25 - idle mixture adjustment screw cap; 26 - return spring, secondary throttle lever; 27 - idle mixture adjustment screw; 28 - carburettor body; 29 - throttle stop screw (CO adjustment); 30 - idle switch wire; 31 - part throttle channel heater

Float components. Wash the components in petrol and examine them. The floats must have no damages. Check to see there are no damages on the needle valve sealing face and seat which can result in the valve leakage. The valve must easily operate in its socket, the ball should not stick. The float weight should not exceed 6.23 gram. Renew any damaged components.

Carburettor cover. Clean any dirt or oil from the cover, clean all passages and holes. Wash the cover in acetone or petrol, blow dry with compressed air. Examine the cover sealing surfaces. Renew the cover in there are any damages.

Choke control unit. Wash in petrol and blow dry all choke control associated components. Inspect the parts and renew when applicable.

Jets and emulsion tubes. Clean out the jets and emulsion pipes from dirt, gummy substances, wash in acetone or petrol, then blow dry with compressed air.

Do not use any metal tool or wire for cleaning the jets; never

wipe the jets or other carburettor components with cotton wool, cloths or rags, since lint can foul up the fuel-emulsion ducting. When excessively dirty, clear the jets with the help of a soft wooden needle soaked in acetone.

Carburettor housing. Clean the housing from dirt or oil. Wash the passages with acetone or petrol, blow dry with compressed air. Where applicable, use special tools for cleaning the ports and emulsion tubes. Examine the sealing surfaces of the housing; when found damaged or distorted, renew the housing with a new one.

Accelerator pump. Clean out the pump components, wash in petrol and blow dry with compressed air. Check to see the ball in the atomizers and moving parts (lever, diaphragm components) operate smoothly. There must be no seizures or sticking. The diaphragm should be intact and undamaged. Examine all sealing surfaces and gaskets. Always renew any damaged components.

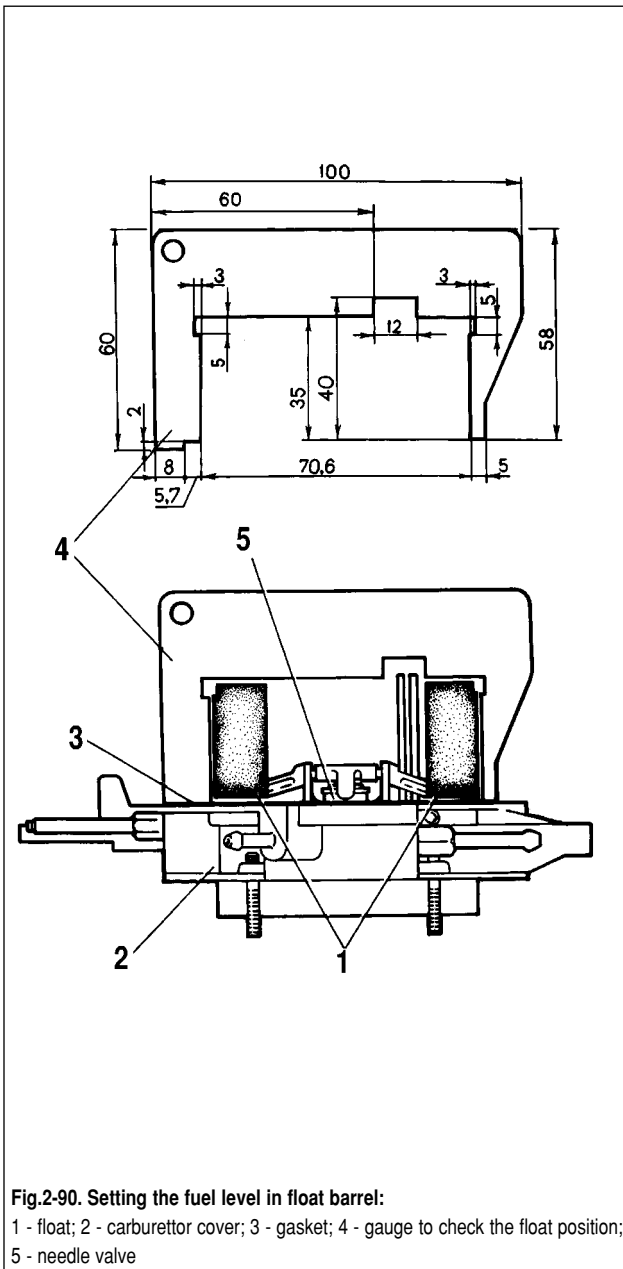


Fig.2-90. Setting the fuel level in float barrel:
 1 - float; 2 - carburettor cover; 3 - gasket; 4 - gauge to check the float position; 5 - needle valve

Part throttle enrichment unit (economizer). The diaphragm must be integral and have no damages. Renew the diaphragm complete with the pushrod when the pushrod length (the head included) is less than 6.0 mm.

Carburettor - reassembly

Reassembly of the carburettor is a reverse of the dismantling procedure. Special attention should be drawn to the following.

The float must freely turn on its pivot pin, there should be no conflict with the barrel walls.

The needle valve must freely operate in its seating, without warping or seizure; the tightening torque for the needle valve seat is 14.7 N•m (1.5 kgf•m).

The tightening torque for the solenoid cutoff valve is 3.68 N•m (0.4 kgf•m).

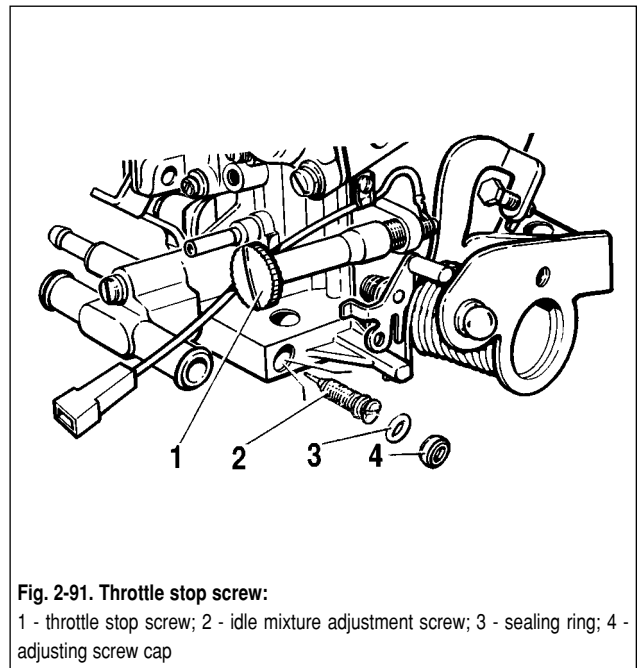


Fig. 2-91. Throttle stop screw:
 1 - throttle stop screw; 2 - idle mixture adjustment screw; 3 - sealing ring; 4 - adjusting screw cap

Check the jet marking and consult Table 2-2 to prevent the jet confusion when refitting.

Before refitting pivot pit 19 (Fig.2-88), apply sealant VF-9 on the pivot end and over 1-1.5 end turns of thread.

To reassemble the accelerator pump, first hand start the cover retaining screws, press the lever full way to stop, tighten the screws and release the lever.

Carburettor - adjustment and checks

Setting fuel level in float chamber. The adequate fuel level for proper carburettor operation is ensured by correct fitting of good cut-off valve components.

Correct fitting of float 1 (Fig.2-90) is checked with gauge 4. To do it, locate it normal to cover 2, which should be held horizontally with the floats up. The clearance between the gauge (over its contour) and floats must be 1 mm as a maximum.

When necessary, adjust by means of bending the float tab or levers. The locating tab face must be normal to needle valve 5 pivot and have no evident dents or cuts.

Choke control unit adjustment. When turning lever 4 (Fig. 2-86) of choke 5 control unit full way anticlockwise, choke must be completely closed by spring 7. If not, remedy the situation.

With the choke fully closed, press choke control rod 3 to its stop. This results in choke 5 opening to 3.0 mm (starting clearance **B**). Adjust the clearance using screw 2.

Primary throttle 12 with the choke fully closed, should be open to 1.1 mm (starting clearance **C**). Using screw 10, adjust the clearance as necessary.

Carburettor linkage adjustment. With fully depressed throttle pedal 7 (Fig.2-87) the primary throttle must be wide open and rod 15 must have no further travel. With pedal 7 released the

throttle must be fully closed. If not, adjust the pedal and throttle by means of end piece 10 at front rod 1 end.

Secure the end of throttle linkage cable 3 so that with knob 5 pulled, the choke is fully closed, while with knob 5 pushed in - fully open.

Engine idle adjustment. This is to be done via idle mixture adjustment screw 2 (Fig.2-91) and throttle stop screw 1. Cap 4 is provided for adjustment screw 2. Remove the cap to access the screw.

Idle adjustment is done on the warm engine (coolant to be at 85-90°C), after the valve gaps and ignition timing are correctly adjusted, the choke should be wide open.

Using throttle stop screw 1, set the crankshaft speed within 750-800 rpm.

Using idle mixture adjustment screw 2, set the content of carbon monoxide (CO) in exhaust emissions at maximum 1.5% with throttle stop screw 1 at the preset position as above (CO level is for 20°C and 101.3 kPa (760 mm Hg)).

Reset the crankshaft speed to 750-800 rpm by means of throttle stop screw 1.

When applicable, restore CO level to the maximum 1.5%.

On completion, sharply depress and release the throttle pedal - check to see the engine speeds up without any gasps and does not stall at lower rpm. Should the engine stops, use throttle stop screw 1 to increase the engine speed to 750-800 rpm.

Refit new plastic cap 4 to idle mixture adjustment screw 2.

Checking the secondary barrel locking linkage. Turn the choke lever anticlockwise to fully close the choke. Next, turn spindle 19 lever (Fig.2-89) to wide open primary throttle 23; secondary throttle 24 must remain closed

Turn the choke lever fully clockwise, turn throttle lever 19 to wide open the throttle. If the secondary throttle fails to open, eliminate the fault. The fault can be caused by seized secondary lock lever 20 or disconnected lock lever spring 21.

Exhaust gas recirculation system

The vehicle is fitted with the exhaust gas recirculation (EGR) system which comprises thermo-vacuum switch 2 (Fig.2-92) and EGR valve 5 with the relevant port and recirculation tube 6 in intake pipe 3.

When coolant is over 40-48°C, the thermo-vacuum switch triggers to build-up vacuum in the EGR valve; the valve opens to reintroduce small amount of exhaust gas from exhaust manifold 4 into the intake pipe and inside the engine.

Checking EGR system operation. Depress the throttle lever and smoothly raise the engine speed to 2500-3000 rpm. At coolant temperature of 30-38°C EGR valve 5 must be closed, while at coolant temperature of 40-48°C it must be open, which can be evident through the EGR valve rod upward travel. If the

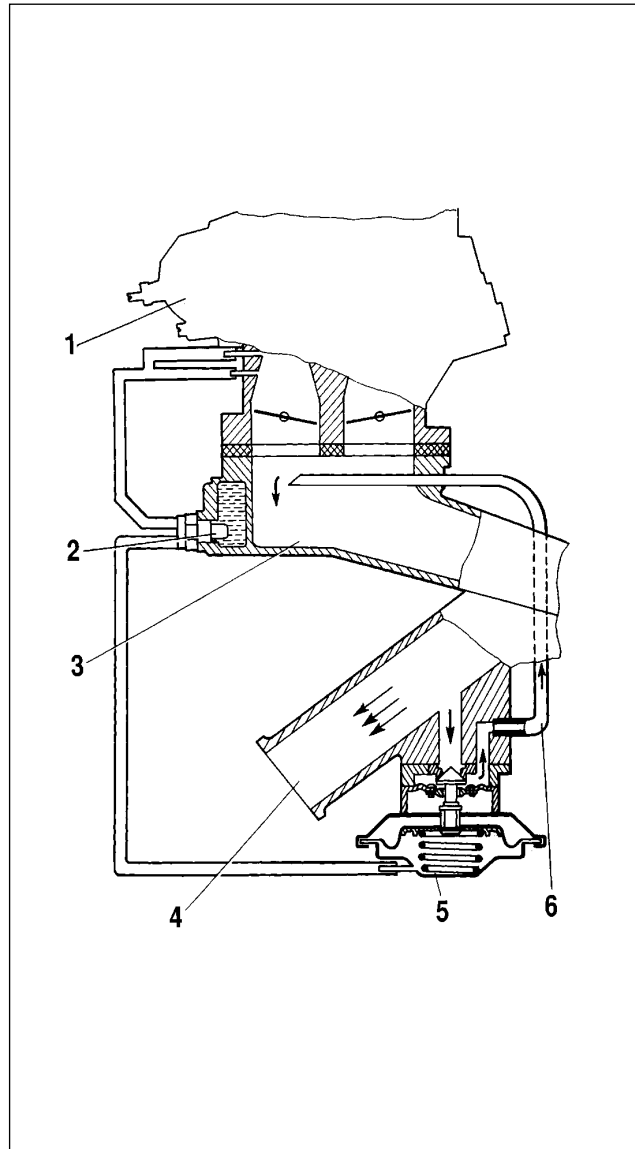


Fig.2-92. Exhaust gas recirculation:

1 - carburettor; 2 - thermo-vacuum switch of EGR valve; 3 - intake pipe; 4 - exhaust manifold; 5 - EGR valve; 6 - recirculation tube

EGR valve does not open, check the proper operation of the EGR valve and thermo-vacuum switch 2.

To check the EGR valve, disconnect the thermo-vacuum switch. Using manual vacuum pump, build up vacuum in the EGR valve diaphragm cavity. The EGR valve must be closed at 9.3 kPa (70-75 mm Hg). With vacuum level over 59.9 kPa (450-455 mm Hg) the EGR valve must be fully open, which is checked through a sharp vacuum removal - the EGR valve closes with a distinct click. In both cases no air leaks are allowed within 5 seconds.

To check thermo-vacuum switch 2, disconnect the hose and EGR valve 5. Using manual vacuum pump, build up vacuum of 13.3 kPa (100±5 mm Hg) to the thermo-vacuum switch. At coolant temperature maximum 30-38°C no vacuum leaks are allowed (thermo-vacuum switch is closed). At coolant temperature below 40-48°C there should be no vacuum (thermo-vacuum switch is open).

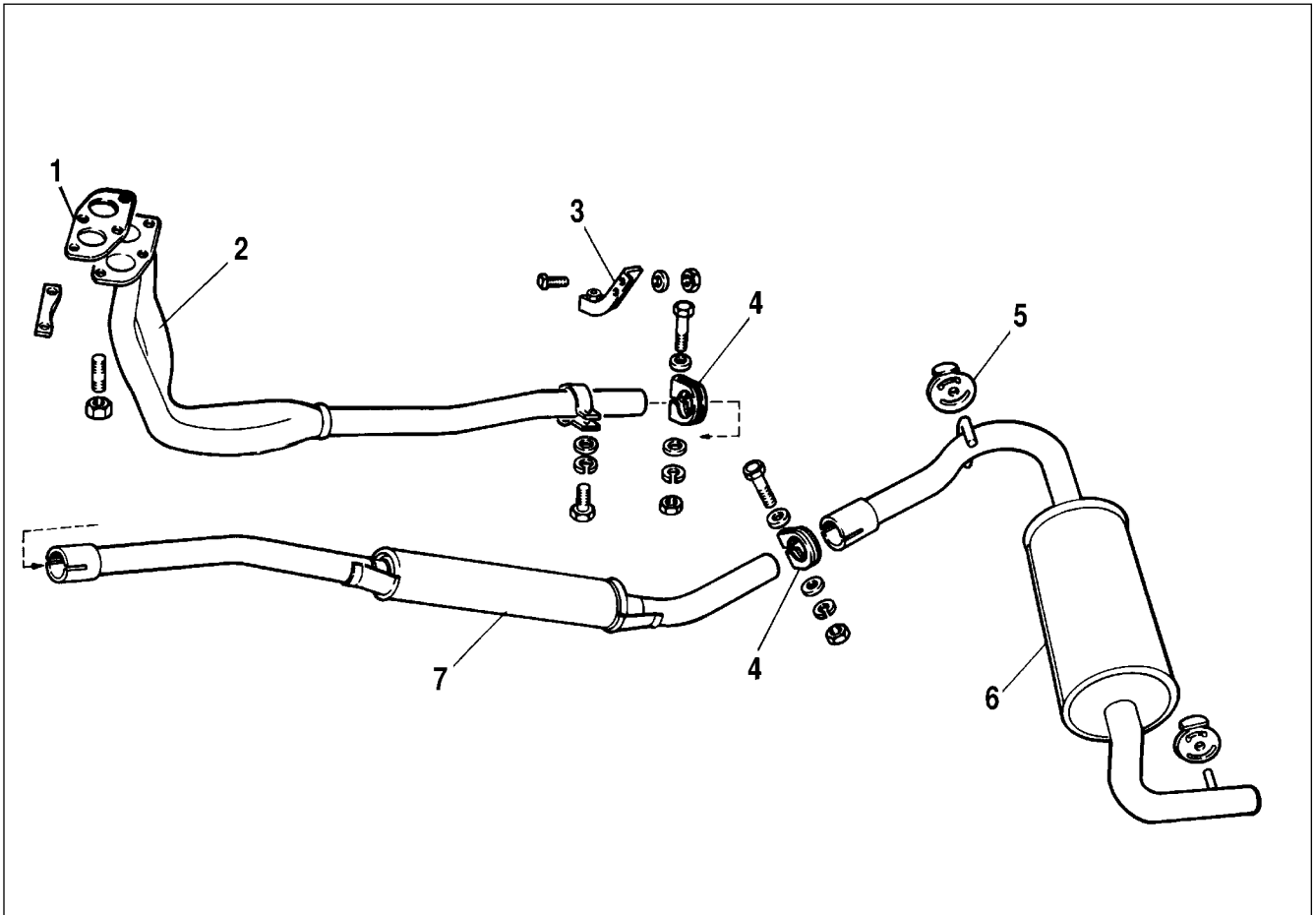


Fig.2-93. Exhaust system:

1 - sealing gasket; 2 - downpipe; 3 - bracket to secure downpipe to transmission; 4 - connection clasp; 5 - suspension ring, main silencer; 6 - main silencer; 7 - front silencer

Exhaust system

Exhaust gases escape from the engine through the exhaust manifold, front exhaust pipe (downpipe) 2 (Fig.2-93), centre (front) silencer 7 and main (rear) silencer 6.

Gasket 1 is fitted between the exhaust manifold and downpipe. The silencer pipes are connected through their flared ends by means of clasps 4 with taper rings.

Downpipe 2 is secured with nuts to the exhaust manifold studs and in addition to bracket 3 mounted on the gearbox cover. The lock plates are used under the manifold retaining nuts. The nuts and gasket 1 are of disposal type. Rear silencer 6 is secured to the underbody with the help of two suspension rings 5.

The silencers and associated pipes are made as a one-piece unit, so in the event of their failure they are renewed as a unit.

Chapter 3. Power train

Clutch

The design of the clutch is shown on fig. 3-1. The clutch release fork 11 (fig. 3-1) can be of two types: with a leaf or wire spring.

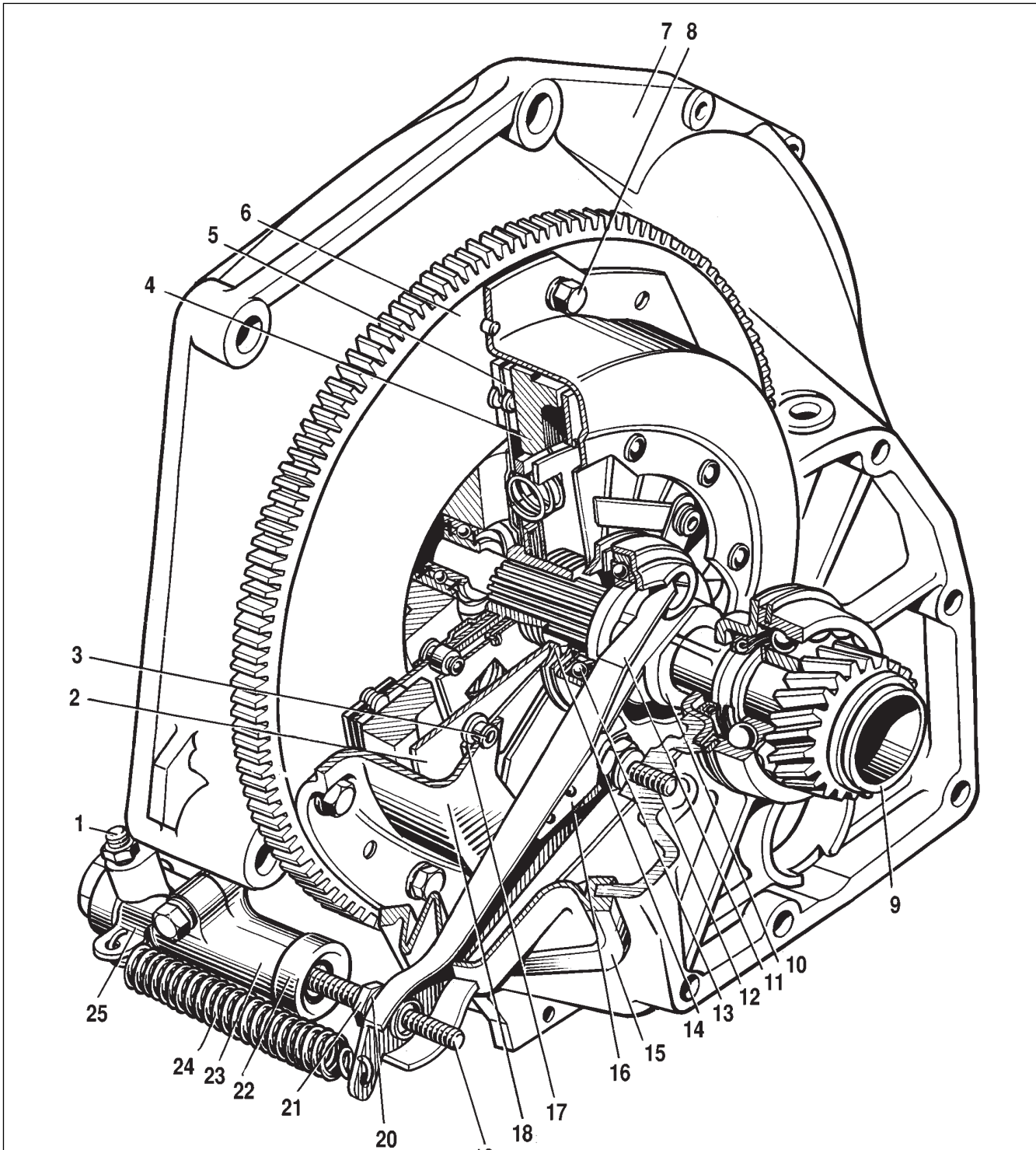


Fig. 3-1. Clutch assembly:

1 - bleeder; 2 - central diaphragm spring; 3 - diaphragm spring rivet; 4 - pressure plate; 5 - clutch disc; 6 - flywheel; 7 - clutch bellhousing; 8 - bellhousing-to-flywheel bolt; 9 - gearbox input shaft; 10 - clutch release bearing assembly; 11 - clutch release fork; 12 - release fork ball socket; 13 - clutch release bearing; 14 - pressure plate thrust flange; 15 - clutch release fork boot; 16 - clutch release fork spring; 17 - pressure plate fulcrum ring; 18 - clutch cover; 19 - clutch release fork pushrod; 20 - adjusting nut; 21 - locknut; 22 - protective cap; 23 - clutch release cylinder (slave cylinder); 24 - fork return spring; 25 - return spring bracket

Fault diagnosis

Diagnosis	Remedy
<i>Incomplete clutch release (clutch spin)</i>	
<ol style="list-style-type: none"> 1. Excessive gaps in clutch release drive 2. Buckling of clutch disc (camming action more than 0.5 mm) 3. Roughness on clutch disc friction linings 4. Jammed rivets or broken clutch disc friction linings 5. Jammed clutch disc hub on primary shaft splines 6. Broken thrust flange-to-clutch cover connecting plates 7. Air in clutch hydraulic drive system 8. Liquid leak from hydraulic drive system through connections or damaged pipelines 9. Leaking master cylinder or clutch release cylinder 10. Plugged opening in reservoir cover, causing underpressure and vacuum leak in cylinder through sealings 11. Vacuum leak due to fouling or wear of front sealing ring in master cylinder 12. Skew or buckling of pressure plate 	<ol style="list-style-type: none"> 1. Adjust clutch release drive 2. Straighten or replace disc 3. Renew linings or clutch disc assembly 4. Renew linings, check disc runout 5. Clean splines, apply grease ЛСЦ-15 or Фиол-1, Фиол-2. In case of badly worn splines causing seizure, renew input shaft or clutch disc 6. Renew clutch cover/pressure plate assembly 7. Bleed system 8. Tighten connections, renew damaged components, bleed system 9. Renew sealing rings, bleed system 10. Clean opening in tank cover, bleed system 11. Clean sealing ring, replace in case of wear 12. Renew clutch cover/pressure plate assembly
<i>Incomplete clutch engagement (clutch slips)</i>	
<ol style="list-style-type: none"> 1. No gaps in clutch release drive 2. Badly worn or burnt clutch disc friction linings 3. Excessive oil on clutch disc friction linings, surfaces of flywheel and pressure plate 4. Plugged compensation port in master cylinder 5. Damaged or jammed clutch release drive 	<ol style="list-style-type: none"> 1. Adjust clutch release drive 2. Renew linings or clutch disc assembly 3. Clean oily surfaces with white-spirit, remedy the situation 4. Wash cylinder and clean port 5. Rectify malfunctions causing jamming
<i>Clutch judder</i>	
<ol style="list-style-type: none"> 1. Jammed clutch disc hub on primary shaft splines 2. Excessive oil on clutch disc friction linings, surfaces of flywheel and pressure plate 3. Jammed clutch release drive mechanism 4. Badly worn clutch disc friction linings 5. Loose rivets on clutch disc friction linings 6. Damaged surface or buckling of pressure plate 	<ol style="list-style-type: none"> 1. Clean splines, apply grease ЛСЦ-15 or Фиол-1, Фиол-2. In case of badly worn splines causing seizure, renew input shaft or clutch disc 2. Clean oily surfaces with white-spirit, remedy the situation 3. Replace damaged parts, rectify malfunctions causing jamming 4. Renew linings, check for damages on disc surfaces 5. Renew damaged rivets and linings, if necessary 6. Renew clutch cover/pressure plate assembly
<i>Excessive noise at clutch release</i>	
<ol style="list-style-type: none"> 1. Worn, damaged or dry clutch release bearing 2. Worn front bearing on gearbox primary shaft 	<ol style="list-style-type: none"> 1. Renew bearing 2. Renew bearing
<i>Excessive noise at clutch engagement</i>	
<ol style="list-style-type: none"> 1. Broken or weak damper spring 2. Broken, weak or detached clutch release fork return spring 3. Broken pressure plate-to-clutch cover connecting plates 	<ol style="list-style-type: none"> 1. Renew clutch disc assembly 2. Renew spring or secure 3. Renew clutch cover/pressure plate assembly

Clutch release drive adjustment

The following adjustments are carried out in the clutch release drive:

- the 0.1-0.5 mm gap between the pushrod and the piston of the master cylinder (see fig. 3-2) is set. This gap, necessary for complete clutch release, is adjusted by the clutch pedal limiter bolt 5. The clearance is determined by the pedal free travel equal to 0.4-2 mm;

- the free travel of the clutch release fork pushrod, equal to 4-5 mm, is adjusted by bolt 5 (fig. 3-3) and fixed by locknut 6. The distance of the pushrod free travel is controlled by a special pattern.

After carrying out the above described adjustments the clutch pedal free travel should make 25-35 mm.

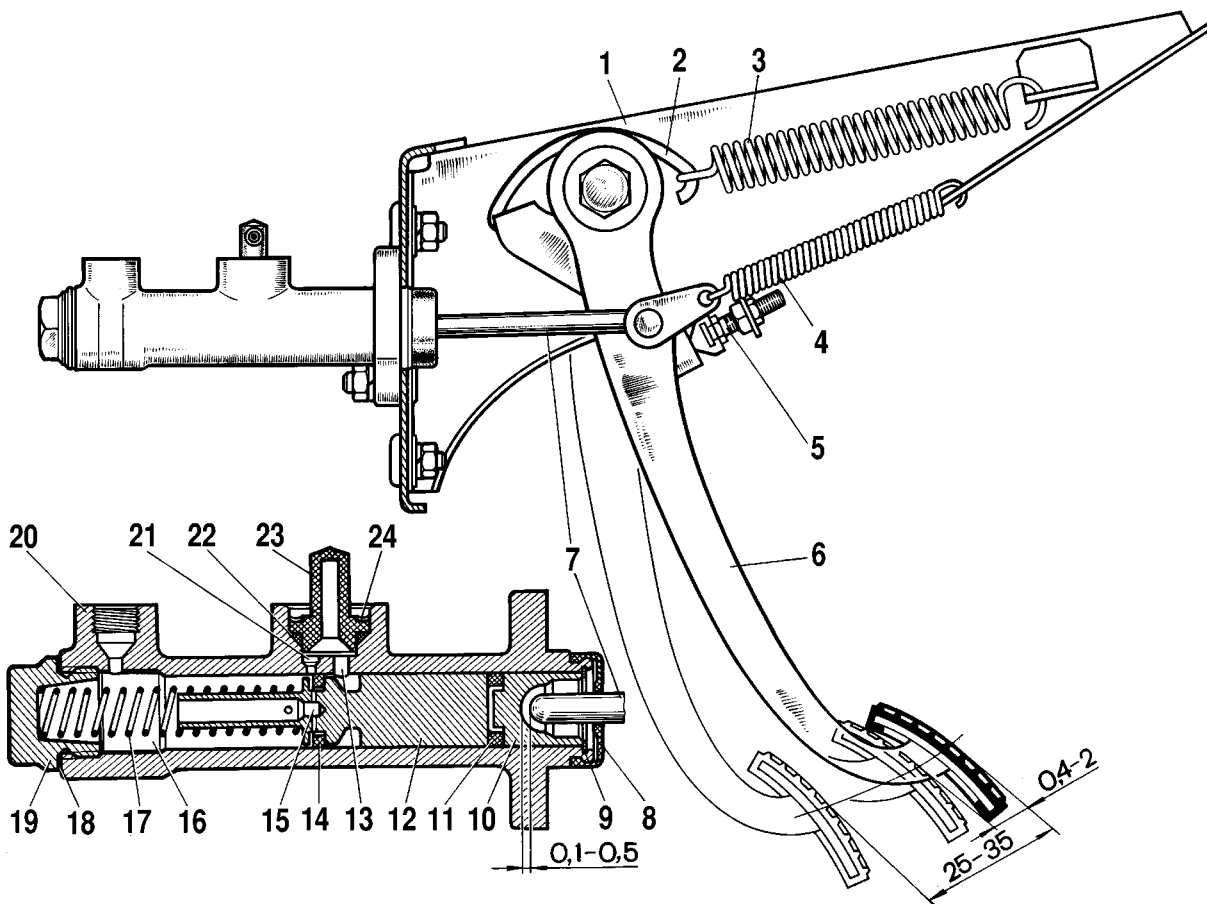


Fig. 3-2. Clutch pedal and master cylinder:

1 - pedal cluster mounting bracket; 2 - clip; 3 - clutch pedal servo spring; 4 - clutch pedal return spring; 5 - clutch pedal limiter bolt; 6 - clutch pedal; 7 - pushrod; 8 - protective cap; 9 - circlip; 10 - pushrod piston; 11 - sealing ring; 12 - master cylinder piston; 13 - inlet port; 14 - sealing ring (ring valve); 15 - piston bypass orifice; 16 - cylinder cavity; 17 - piston return spring; 18 - gasket; 19 - plug; 20 - master cylinder body; 21 - bypass (compensation) port; 22 - gasket; 23 - union; 24 - washer

Bleeding the clutch hydraulic system

Air in the clutch hydraulic system is indicated by incomplete clutch release, and also by "sponginess" and "failure" of clutch pedal.

To expel air from the hydraulic drive:

- clean the tank and the bleeder from dust and dirt;
- check the liquid level in the hydraulic system tank and top up if necessary;
- put a hose on bleeder 9 (see fig. 3-3) of the slave cylinder and place its lower end into a container with hydrodrive liquid (30-50 gr);
- undo bleeder 9 by 1/2-3/4 turn, several times rapidly depress and smoothly release the pedal until there will be no air bubbles coming out from the hose;

- depress the pedal and fully tighten the bleeder. Remove the hose and refit the bleeder cap.

If, despite a continuous bleeding, there are still air bubbles in the hose, check the tightness of connections, find out if there are cracks on tubes or leaks in places of connections. Air inleak is possible through damaged sealing rings of the master or slave cylinders.

During bleeding:

- the liquid level in the reservoir should be higher than the opening of the tube connecting the reservoir with the master cylinder;
- the end of the bleeding hose should be always dipped in liquid;
- after bleeding, top-up liquid in the reservoir to the lower edge of the filler neck.

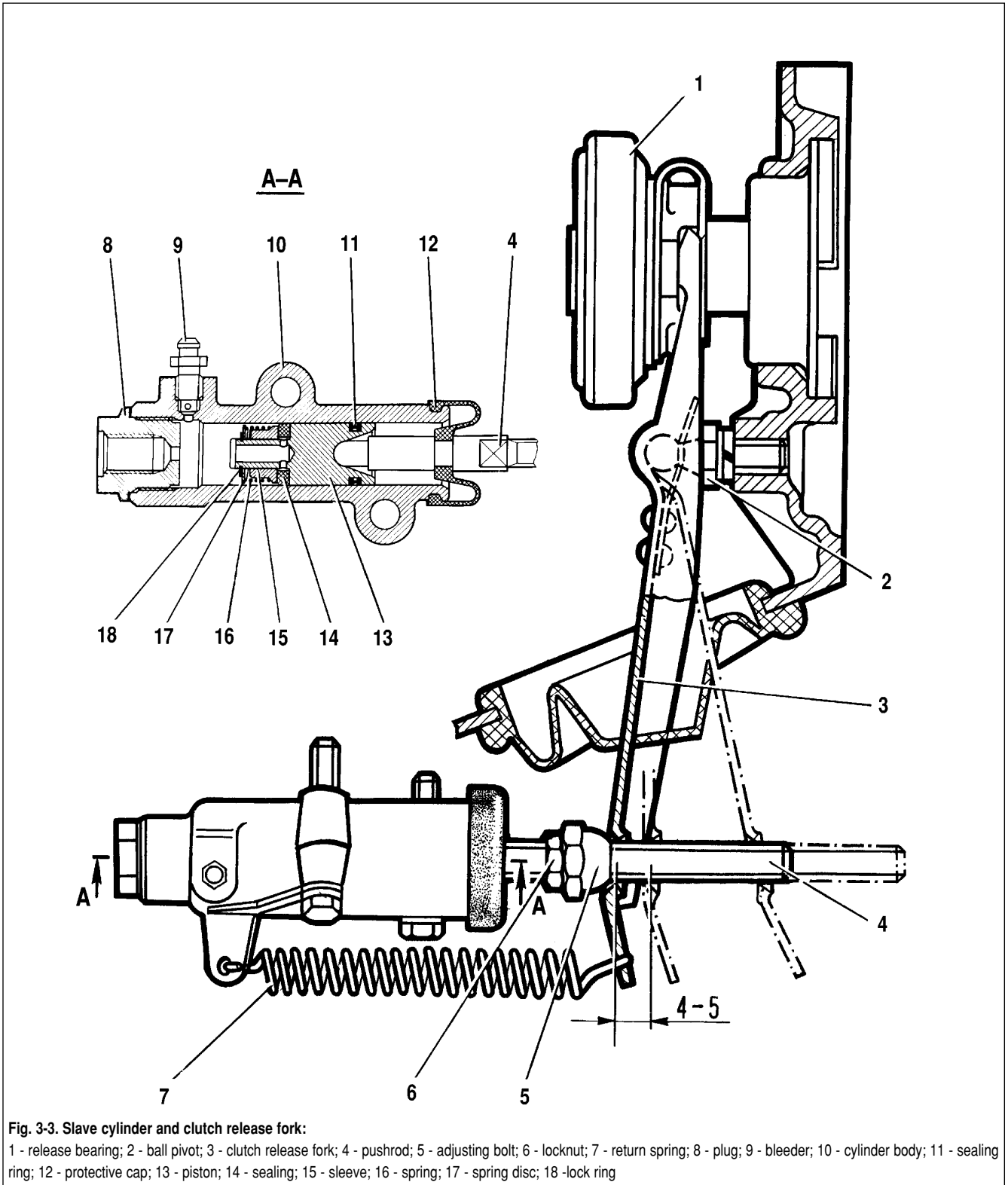


Fig. 3-3. Slave cylinder and clutch release fork:

1 - release bearing; 2 - ball pivot; 3 - clutch release fork; 4 - pushrod; 5 - adjusting bolt; 6 - locknut; 7 - return spring; 8 - plug; 9 - bleeder; 10 - cylinder body; 11 - sealing ring; 12 - protective cap; 13 - piston; 14 - sealing; 15 - sleeve; 16 - spring; 17 - spring disc; 18 - lock ring

Clutch assembly - removal and refitting

Removal. First remove the gearbox (see "Gearbox"). Undo the bolts and remove the clutch cover in assembly with the pressure plate. Do not lift this unit by holding the pressure plate thrust flange.

Refitting is a reversal of removal, providing the following:

- inspect the bearing on the crankshaft end face, if necessary replace the bearing;

- inspect the splines on the clutch disc hub and the gearbox input shaft, clean the splines and grease with a thin layer of greasing ЛСЦ-15 or ФИОЛ-1, ФИОЛ-2;

- refit the clutch disc with the hub protruding part facing the gearbox and centralise the plate against the bearing using tool A.70081, simulating the gearbox input shaft splined end (fig. 3-4).

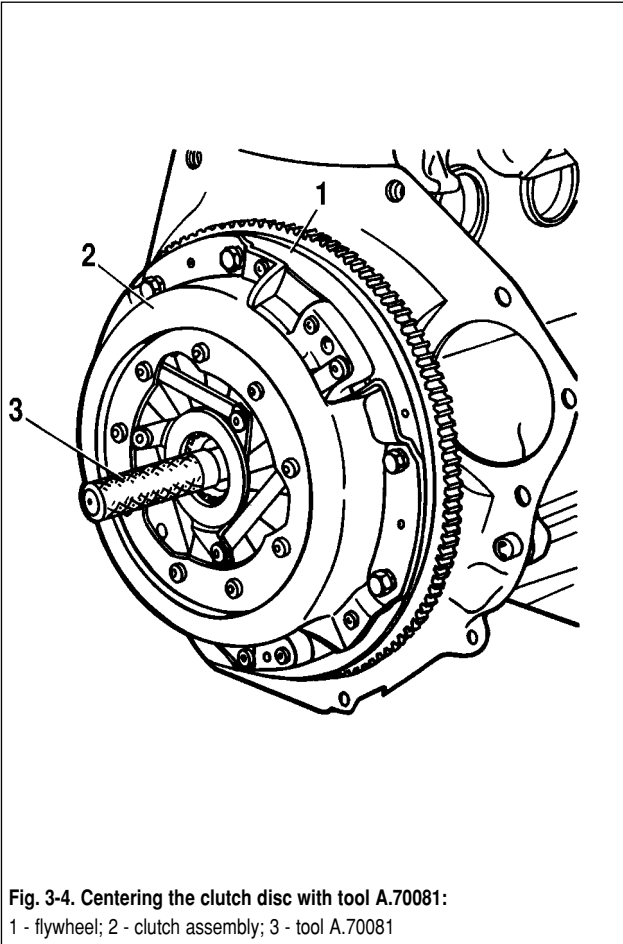


Fig. 3-4. Centering the clutch disc with tool A.70081:
1 - flywheel; 2 - clutch assembly; 3 - tool A.70081

Clutch inspection

The inspection of the clutch is carried out on a bench, which simulates the engine flywheel and has a metal intermediate ring 4 (fig. 3-5) with thickness of 8.2 mm simulating the clutch disc. Having fixed the clutch cover, make four release strokes equal to 8-9 mm. The release stroke of 8 mm should correspond to the travel of the pressure plate within 1.6-1.7 mm (permitted minimum - 1.4 mm).

The distance from the rig base to the working surface of the thrust flange friction washer should be 40-43 mm. During engine operation due to wear of the clutch disc surfaces this size increases. If it will reach 48 mm or the travel of the pressure plate will be less than 1.4 mm, renew the clutch cover in assembly with the pressure plate.

The clutch disc friction linings should be replaced at any signs of cracks, reduction of distance between the rivet and the working surface up to 0.2 mm, and also at one-side scuffings. To repair the clutch disc and replace the friction linings use tool 67.7822.9529 (fig. 3-6).

Flared rivets should have no breaks. The runout of the friction lining working surface should not exceed 0.5 mm. If this value is exceeded, straighten the disc (fig. 3-7) or replace with a new one. Also replace the clutch disc assembly in case of cracks on the clutch disc or the damper springs.

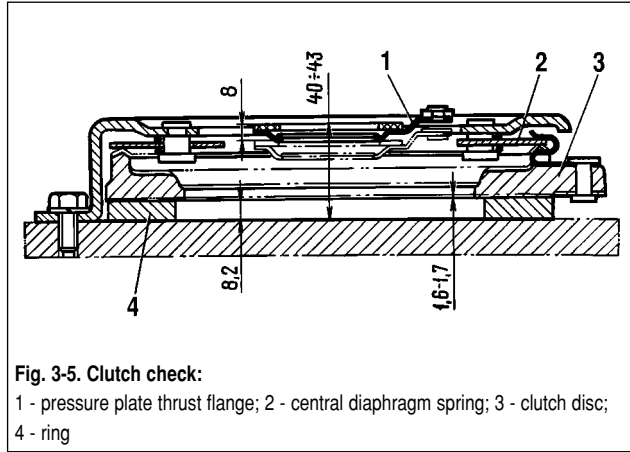


Fig. 3-5. Clutch check:
1 - pressure plate thrust flange; 2 - central diaphragm spring; 3 - clutch disc;
4 - ring

Master and slave cylinders - removal and refitting

First, drain working liquid. To do this, attach one end of the hose to bleeder 9 (see fig. 3-3) on the slave cylinder, and the other end place in a clean reservoir; unscrew bleeder 9 by 1/2-3/4 turn and depress the pedal several times until all liquid will be removed from the hydrosystem, then disconnect the tubes between the master and the slave cylinders, disconnect the return spring 7, remove the pin from the pushrod end, and the slave cylinder, having prior undone two fastening bolts.

To remove the master cylinder undo two nuts, with which it is pinned to the pedal bracket, and disconnect the flexible hose from the reservoir.

To refit the master and slave cylinders the above described operations are executed in reverse order.

After filling with working liquid, bleed the system.

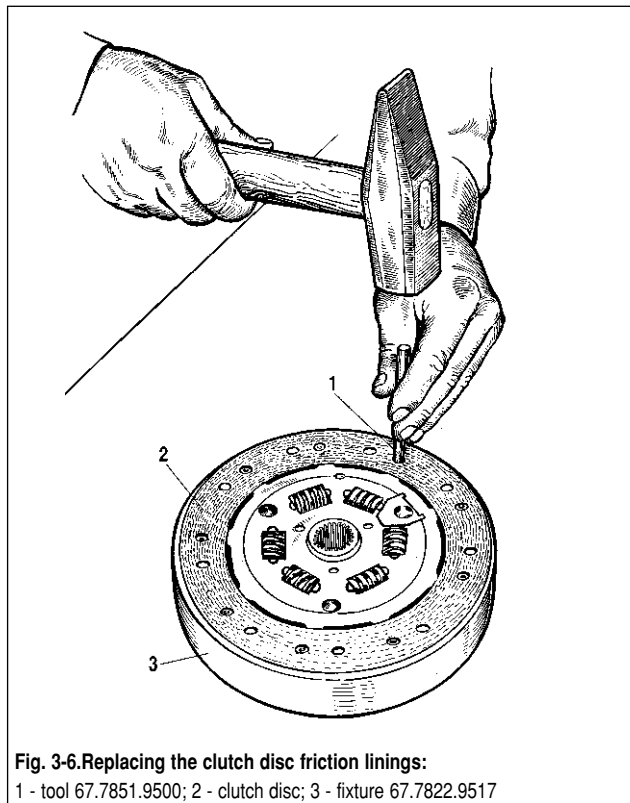


Fig. 3-6. Replacing the clutch disc friction linings:
1 - tool 67.7851.9500; 2 - clutch disc; 3 - fixture 67.7822.9517

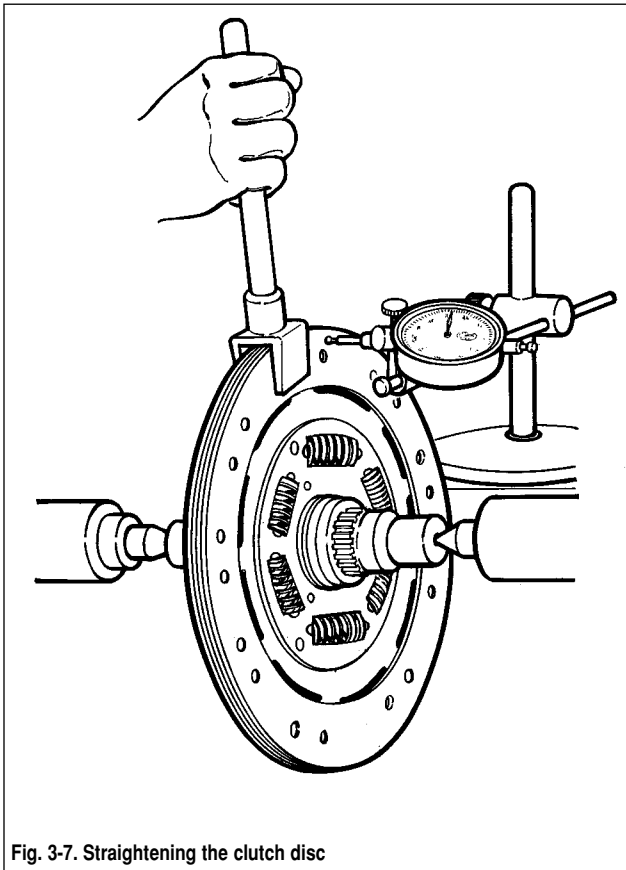


Fig. 3-7. Straightening the clutch disc

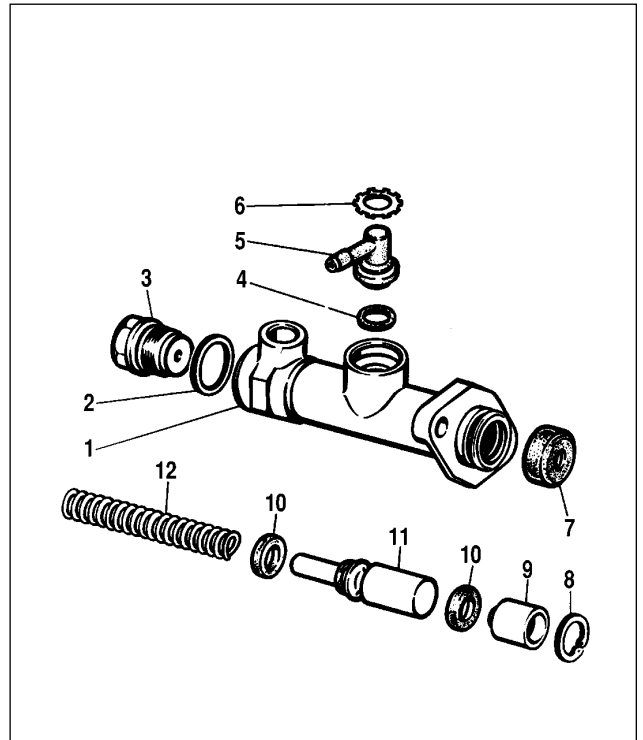


Fig. 3-8. Master cylinder components:
 1 - body; 2 - sealing; 3 - plug; 4 - gasket; 5 - union; 6 - retaining washer; 7 - cap;
 8 - circlip; 9 - pushrod piston; 10 - sealing ring; 11 - master cylinder piston;
 12 - spring

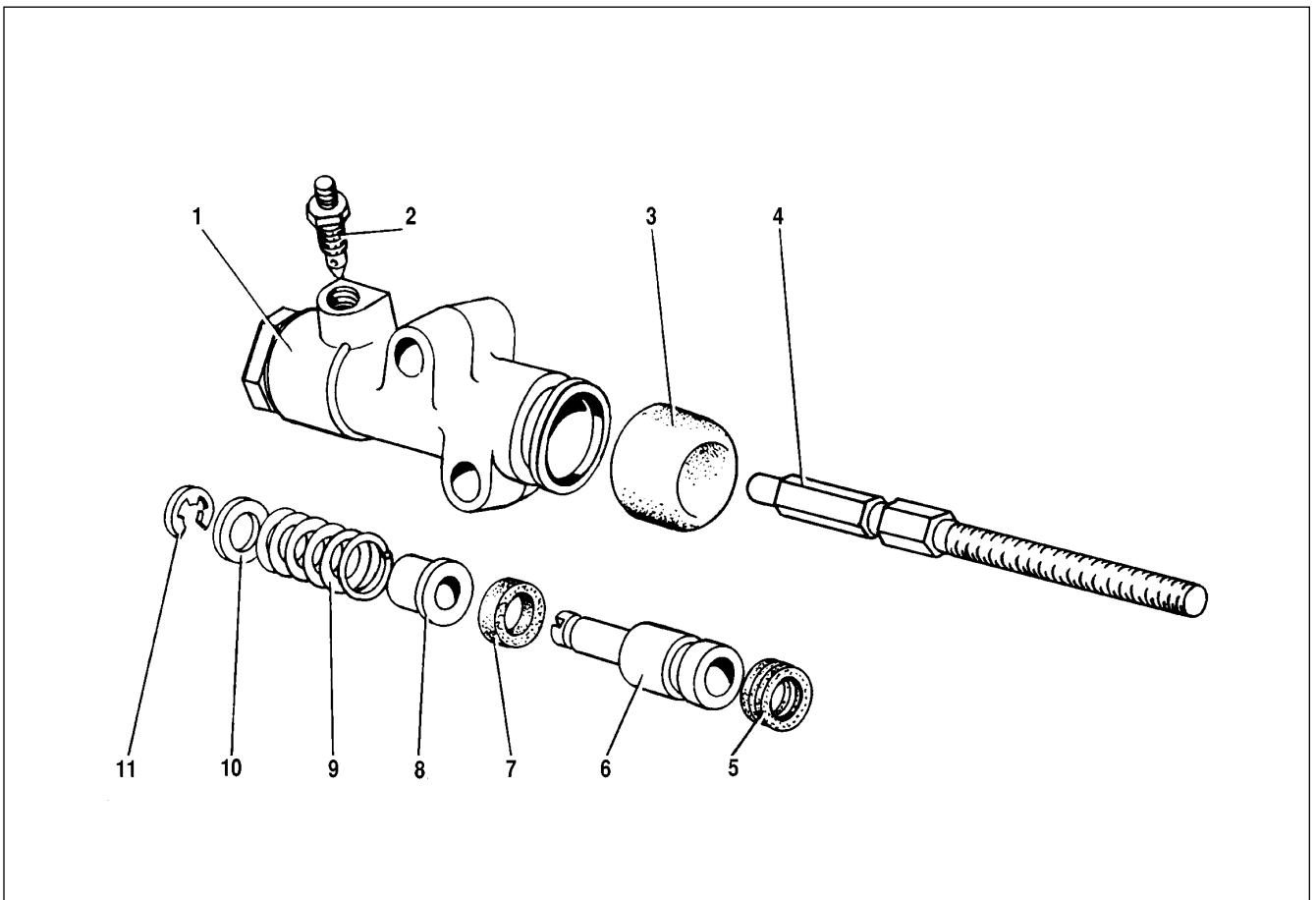


Fig. 3-9. Slave cylinder components:
 1 - body; 2 - bleeder; 3 - cap; 4 - pushrod; 5 - sealing ring; 6 - piston; 7 - sealing ring; 8 - sleeve; 9 - spring; 10 - disc; 11 - lock ring

Master and slave cylinders - dismantling, inspection, repair and reassembly

Master cylinder. Turn out plug 3 (fig. 3-8), remove protective rubber cap 7 and circlip 8. This will allow to withdraw from the cylinder body piston 9, sealing ring 10, floating piston 11 with sealing ring and piston return spring 12.

Cylinder mirror and the outer surface of the piston should have no damages or marks. The inner diameter of the cylinder should be within the limits of 19.035-19.075 mm.

Inspect the piston return spring and replace if it has become weak.

Renew sealing rings. Inspect the protective cap on the rear end of the cylinder and renew in case of damage. Before reassembly, accurately clean and wash all parts in brake liquid. Do not let mineral oil, petrol, kerosine or diesel fuel to get in contact with the parts as this may cause swelling of the rubber sealings.

After inspection, reassemble all parts of the master cylinder in reverse order; grease all components with brake liquid or preservation liquid HF-213.

Slave cylinder. Turn out plug, take off protective rubber cap 3 (fig. 3-9) together with pushrod 4, take out piston and dismantle it, previously having removed lock ring 11.

After dismantle, accurately wash and check all parts, as it is specified for the master cylinder. Do not refit a damaged pushrod.

After inspection, begin to reassemble in reverse order, grease all parts with brake liquid.

Clutch master cylinder - bench-check

Checking the leak-proofness of the rear sealing ring.

Place the master cylinder on the test-bench (see fig. 3-10), and ensure good sealing between the cylinder flange and the surface of the test-bench. Connect reservoir 2 with hydraulic liquid to the cylinder. Open the compressed air vent, with the adjusting screw 6 being open, and then slowly close the adjusting screw until all air will be expelled from reservoir 2.

Control air pressure by the pressure gauge, it should be within 0.05-0.08 MPA (0.5-0.8 kgf/cm²). If pressure is less, replace the rear sealing ring.

Checking the leak-proofness of the front sealing ring.

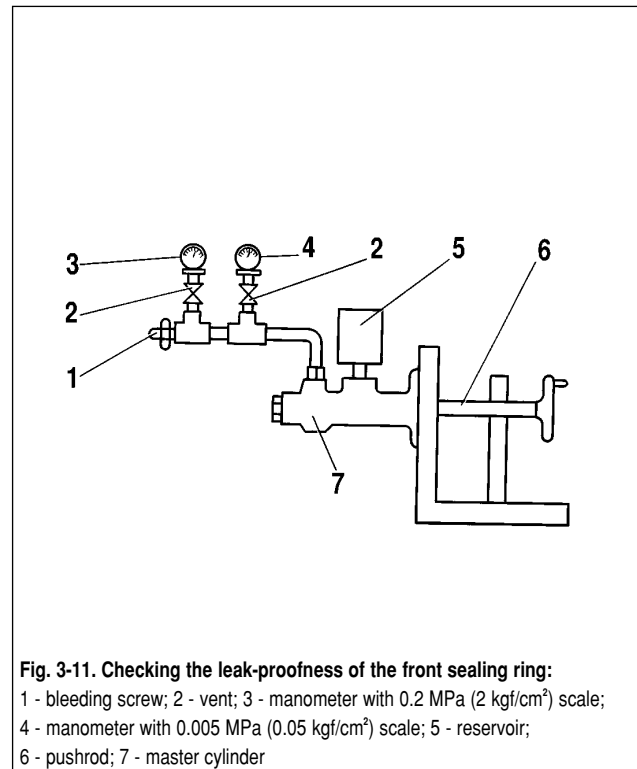
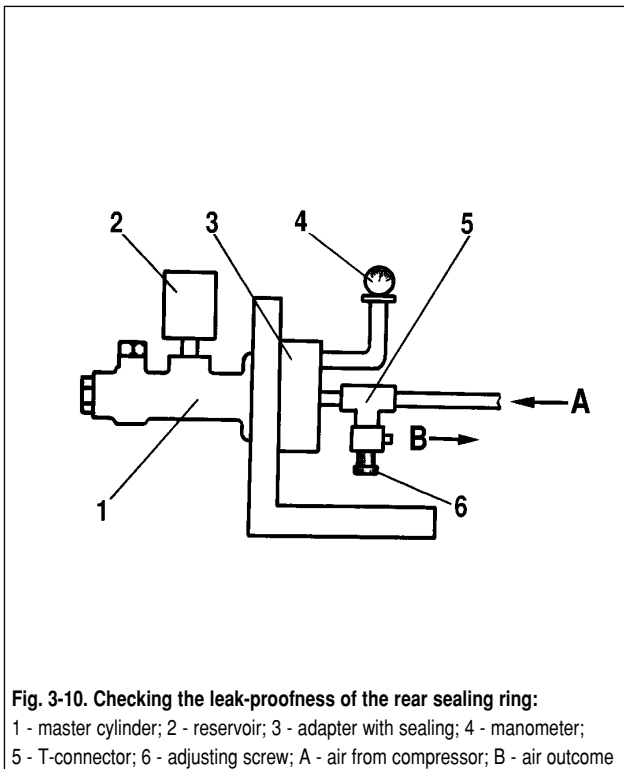
Place the master cylinder on the test-bench and connect it to the reservoir with hydro drive liquid, and with manometers (fig. 3-11).

Close manometer vent 3 and, by moving the master cylinder pushrod, provide constant pressure of 0.2 MPA (2 kgf/cm²).

With a fixed pushrod and no liquid leaks pressure should remain constant during 2 minutes.

Close pressure gauge vent 4 and open pressure gauge vent 3. By moving the pushrod provide constant pressure of 10 MPA (100 kgf/cm²).

With a fixed pushrod and no liquid leaks pressure should remain constant for no less than 2 minutes. Otherwise, replace the front sealing ring.



Gearbox

The design of the gearbox is shown on fig. 3-12, 3-26, 3-34.

Fault diagnosis

Diagnosis	Remedy
-----------	--------

Noise in gearbox

1. Noise in bearings	1. Renew damaged bearings
2. Worn teeth on gears and synchro units	2. Replace worn parts
3. Low oil level in gearbox	3. Top up oil. Rectify cause of oil leak
4. Axial shaft movement	4. Renew bearings or securing components

Difficulty in engaging gears

1. Incomplete clutch release	1. See. subsec. "Clutch"
2. Jammed gearshift lever ball-joint	2. Clean ball contact surfaces
3. Deformed gearshift lever	3. Rectify deformation or renew lever
4. Hard movement of fork rods (burrs, dirty rod sockets, detent seizure)	4. Repair or renew worn components
5. Hard movement of sleeve on hub when splines get dirty	5. Clean components
6. Deformed gearshift forks	6. Straighten forks or renew

Jumps out of gear or incomplete clutch engagement

1. Worn rod balls and sockets, weak detent spring	1. Renew damaged components
2. Worn synchro unit baulk rings	2. Renew baulk ring
3. Broken synchro unit spring	3. Renew spring
4. Worn teeth on synchro unit sleeve or synchro unit crown	4. Renew sleeve or gear
5. Crushed hub short teeth	5. Renew synchro hub

Oil leak

1. Worn oil seals on input and output shafts	1. Replace oil seals
2. Loose fitting of gearbox covers, damaged sealings	2. Tighten nuts (see torque in Appendix) or renew seals
3. Loose fitting of clutch housing to transmission casing	3. Tighten nuts

Removal and refitting

Removal. Place the vehicle over an inspection pit or on a lift, put blocks under front wheels and raise the rear axle from one or two sides. Let off the handbrake and place the gearshift lever in neutral. Disconnect the wires from the battery.

Take out the front floor mat and the gaiters from the transfer- and gearbox levers. Remove the aperture covers and sealings. Unscrew the handles from the transfer box levers.

Push downward lever rod 27 (see fig. 3-12) and with the help of a screwdriver or any other pointed tool take out the retaining sleeve 31 from the groove on the lever rod; remove the rod.

Disconnect the brackets that are fixing pipes and mufflers in the rear part of the vehicle, and then the muffler pipe from the front exhaust pipe. Disconnect the exhaust pipe clip and remove the pipe downward.

Undo the lower bolts of the clutch bellhousing cover plate. Disconnect the "ground" wires from the clutch bellhousing and the wires from the tail light switch.

Unhook the return spring 1 (fig. 3-13) from the clutch release fork 5 and take pin 4 out from pushrod 6. Disconnect the slave cylinder 8 from the clutch bellhousing. Thus, cylinder 8 connected to the master cylinder hose, remains on the vehicle, what excludes losing brake liquid and necessity of the subsequent bleeding of the clutch release hydraulic drive.

Put clip 2 (A.70025) on the flexible coupling 3 (fig. 3-14) and tighten. This will help in subsequent removal and refitting of the flexible coupling. Undo nuts 1 and, by turning the layshaft, remove the bolts that are fastening the flexible coupling 3 to the flange of the gearbox output shaft.

Disconnect the speedometer cable from the speedometer drive unit on the transfer box.

Disconnect the shaft flanges of the front and rear axles drive from the flanges of the transfer box shafts. Lower and move aside the axle drive shafts.

Undo the bolts that are fastening the transfer box brackets to the car body and remove it together with the propeller shaft.

Using a socket spanner 02.7812.9500 undo the bolts fastening the starter motor to the clutch bellhousing and release it. Undo the clutch bellhousing cover plate bolts.

Disconnect the engine rear mounting from the crossmember 4 (fig. 3-14), and then remove the crossmember while supporting the gearbox from below.

Place a jack or other suitable support under the transmission casing. Using a socket spanner A.55035 undo the fastening bolts and remove the gearbox together with the clutch bellhousing by moving it to the rear part of the vehicle so that to take out the gearbox input shaft from the front bearing and from the clutch disc hub.

ATTENTION. So that not to deform the clutch straps, do not rest the end of the input shaft on the clutch diaphragm spring flange when removing or refitting the gearbox.

Refitting the gearbox is a reversal of removal. Before refitting, apply a thin layer of greasing ЛСЦ-15 (ЛИТОЛ-24) on the spline end of the input shaft and centralize the clutch disc using tool A.70081 (see fig. 3-4).

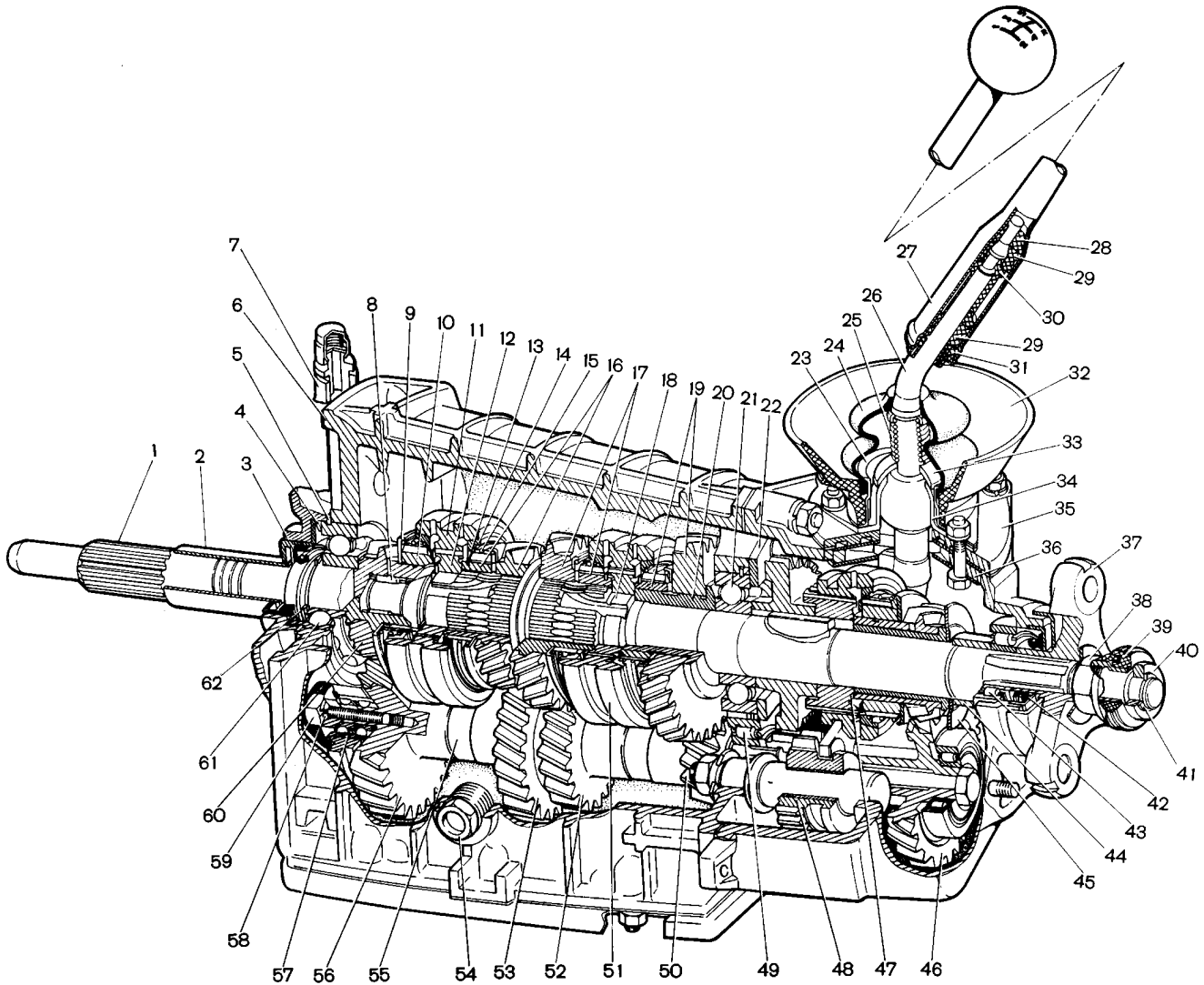


Fig. 3-12. Gearbox:

1 - input shaft; 2 - front cover with guide sleeve; 3 - input shaft oil seal; 4 - spring washer; 5 - bearing set collar; 6 - gearbox housing; 7 - breather; 8 - output shaft needle bearing; 9 - synchro spring thrust washer; 10 - 4th speed synchro unit crown; 11 - 3rd/4th synchro unit sleeve; 12 - 3rd/4th synchro unit hub; 13 - circlip; 14 - baulk ring; 15 - synchro unit spring; 16 - 3rd speed synchro unit crown and gear; 17 - 2nd speed synchro unit crown and gear; 18 - output shaft; 19 - 1st speed synchro unit crown and gear; 20 - 1st gear bush; 21 - output shaft idler bearing; 22 - idler bearing lock plate; 23 - flange; 24 - bellows; 25 - spring; 26 - gear shift lever; 27 - lever rod; 28 - damper rubber pad; 29 - grommet; 30 - distance washer; 31 - retaining sleeve; 32 - collar; 33 - cap washer; 34 - ball socket; 35 - gearshift lever housing; 36 - guide plate; 37 - driveline coupling flange; 38 - nut; 39 - centering ring oil seal; 40 - centering ring; 41 - circlip; 42 - output shaft rear bearing oil seal; 43 - output shaft rear bearing; 44 - distance washer; 45 - oil deflector washer; 46 - 5th/reverse gear unit; 47 - 5th synchro unit hub; 48 - reverse idler gear; 49 - intermediate shaft rear bearing; 50 - intermediate shaft 1st speed gear; 51 - 1st/2nd synchro sleeve; 52 - intermediate shaft 2nd speed gear; 53 - intermediate shaft 3rd speed gear; 54 - filler and check orifice plug; 55 - intermediate shaft; 56 - intermediate shaft constant mesh gear; 57 - intermediate shaft front bearing; 58 - intermediate shaft bearing clamping washer; 59 - clamping washer bolt; 60 - input shaft constant mesh gear; 61 - input shaft rear bearing; 62 - circlip

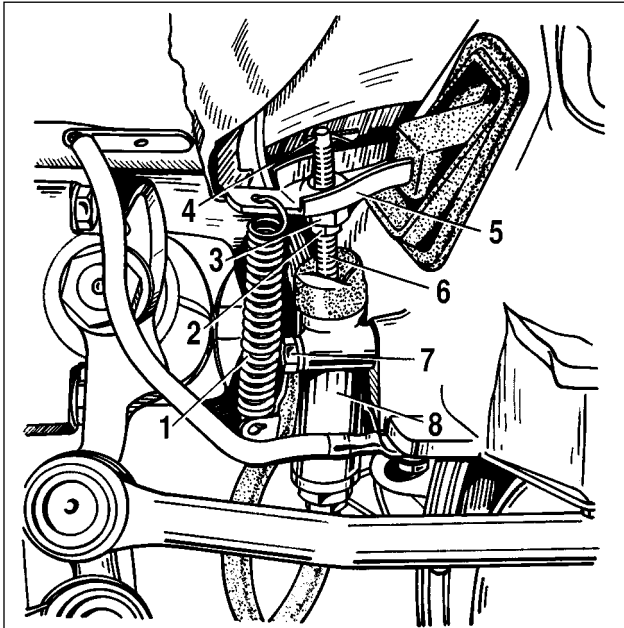


Fig. 3-13. Clutch release drive:

1 - fork return spring; 2 - locknut; 3 - adjusting nut; 4 - cotter pin; 5 - clutch release fork; 6 - pushrod; 7 - slave cylinder fastening bolt; 8 - slave cylinder

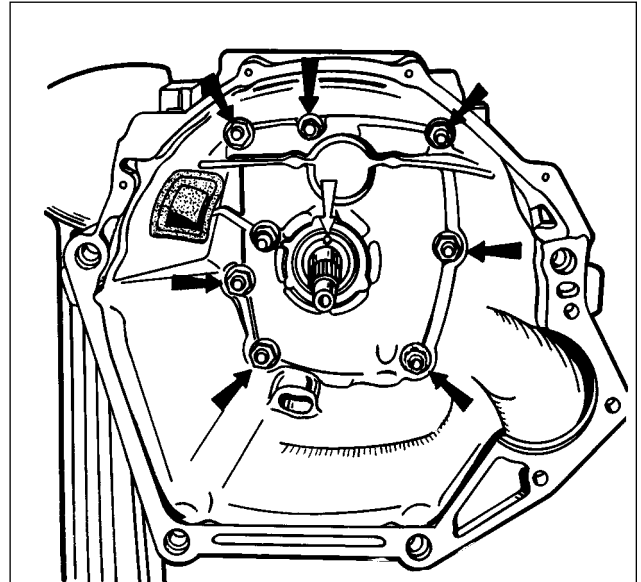


Fig. 3-15. Clutch bellhousing, view from inside.

The black arrows point to the gearbox-to-clutch bellhousing fastening nuts; the white arrow points to the opening in the front cover for oil outflow from the transmission casing to avoid clutch disc contamination.

Dismantling and reassembly

Dismantling. Wash the gearbox and place it on a bench. Drain oil and remove the bottom cover with the lining.

Remove the clutch release fork, and the coupling in assembly with the bearing and the spring from the guide sleeve in the gearbox front cover.

Remove the clutch bellhousing with the lining and the front cover together with the oil seal and spring washer (see fig. 3-15).

Turn out the rear light switch, take care not to deform the housing.

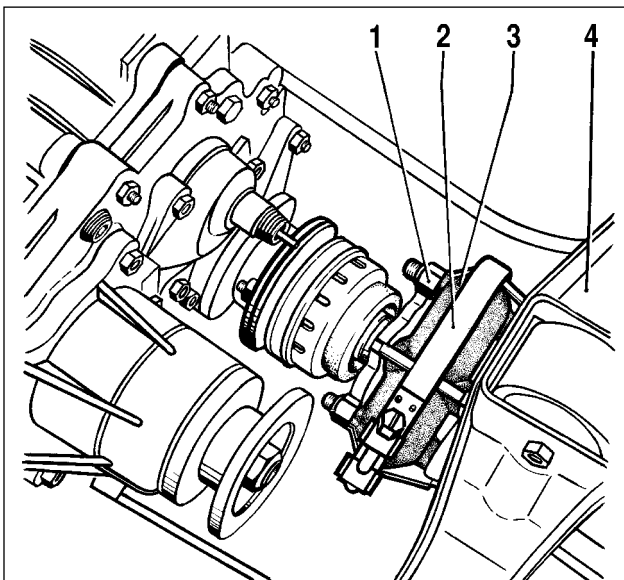


Fig. 3-14. Flexible coupling between the propeller shaft and the gearbox:

1 - propeller shaft flange-to-flexible coupling fastening nuts; 2 - clamp A.70025; 3 - flexible coupling; 4 - rear engine mounting crossmember

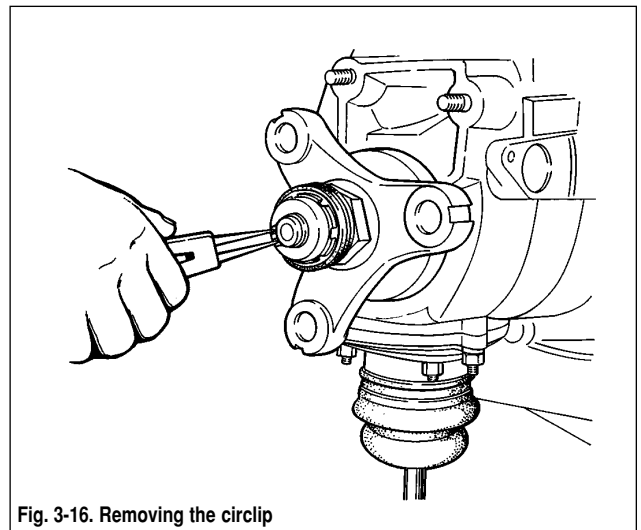


Fig. 3-16. Removing the circlip

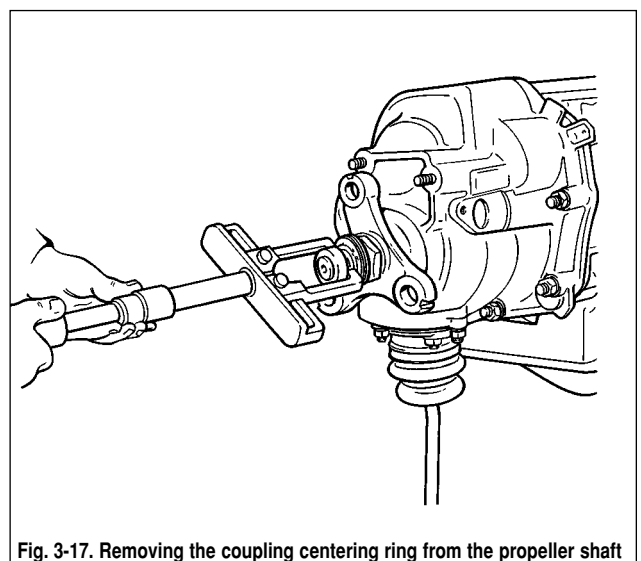


Fig. 3-17. Removing the coupling centering ring from the propeller shaft

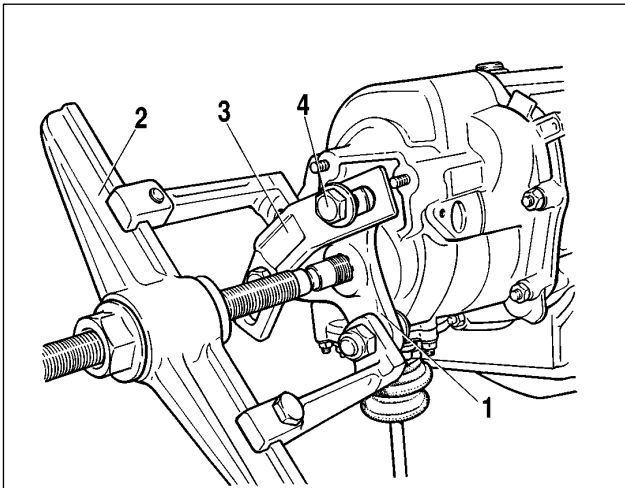


Fig. 3-18. Removing the coupling flange using tool A.40005/3/9B/9C:
 1 - flexible coupling flange; 2 - tool A.40005/3; 3 - tool A.40005/3 strap; 4 - tool-to-flange fastening bolts

Turn out the 3rd/4th gearshift fork fastening bolt. Install lock 41.7816. 4068 on the input shaft or simultaneously engage both gears. This will prevent the turning of the input, output and intermediate shafts and will allow to do the subsequent operations on dismantling.

ATTENTION. Since 1997, on the rear end of the gearbox output shaft the design of the following parts was changed:

- instead of a metal centering ring 26 (see fig. 3-31) and circlip 1, a rubber centering bush is installed;
- instead of sealing 25 with spring 24, a sealing without a spring is installed;
- lock washer 22 is replaced with a spring washer;
- nut 23 is sealed with YF-9 or YF-10.

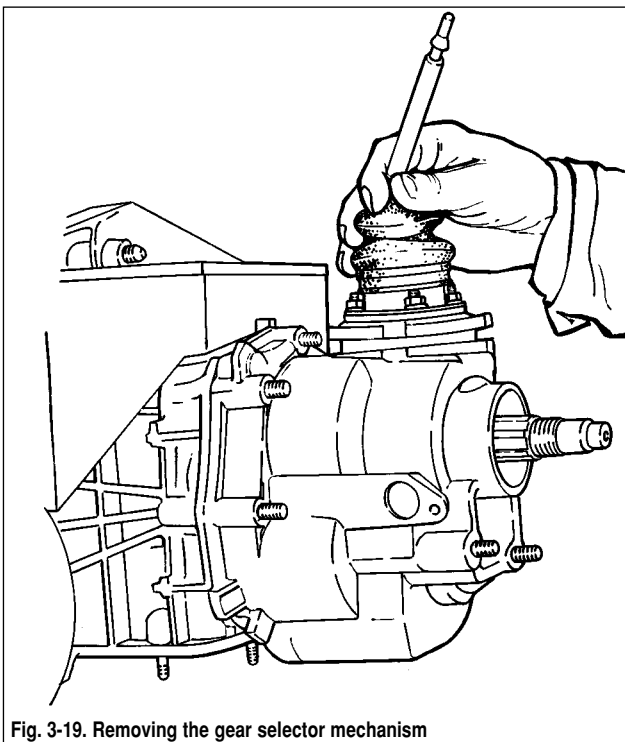


Fig. 3-19. Removing the gear selector mechanism

Remove circlip from the gearbox output shaft end (fig. 3-16).

Unbend the lock washer, undo the nut by several turns to move the coupling centering ring, and again turn in the nut. Using a puller A.40006/1 with tool A.40005/4 remove the flexible coupling centering ring from the output shaft end (fig. 3-17).

Remove the coupling centering ring seal with spring from the output shaft end, undo the nut and using tool A.40005/3/9B/9C remove the flexible coupling flange (fig. 3-18).

Before removing the rear cover, place the gearshift lever in neutral position, undo the gear selector mechanism fastening nuts and remove the gearshift lever (fig. 3-19) in assembly with the selector mechanism. One of the cover fastening nuts is undone from the inside of the transmission casing with the bottom cover being removed. When removing the rear cover it is necessary to move it not only backwards, but also to turn it to exclude hitting the fifth speed/reverse gear unit.

After removing the output shaft rear bearing inner ring 43 (see fig. 3-12) and distance sleeve 44, loosen the cover fastening bolts 5 (fig. 3-20) and undo bolts 2 and 4 that are securing the fifth speed/reverse gear unit. Remove the oil deflector washer 45 (see fig. 3-12), then bush 1 (fig. 3-21) from the fifth speed gear and take out rod 1 (fig. 3-22) from fork 2. Thus, distance bush 3 is removed from the rod. Then remove the gear unit 4 from the intermediate shaft splines.

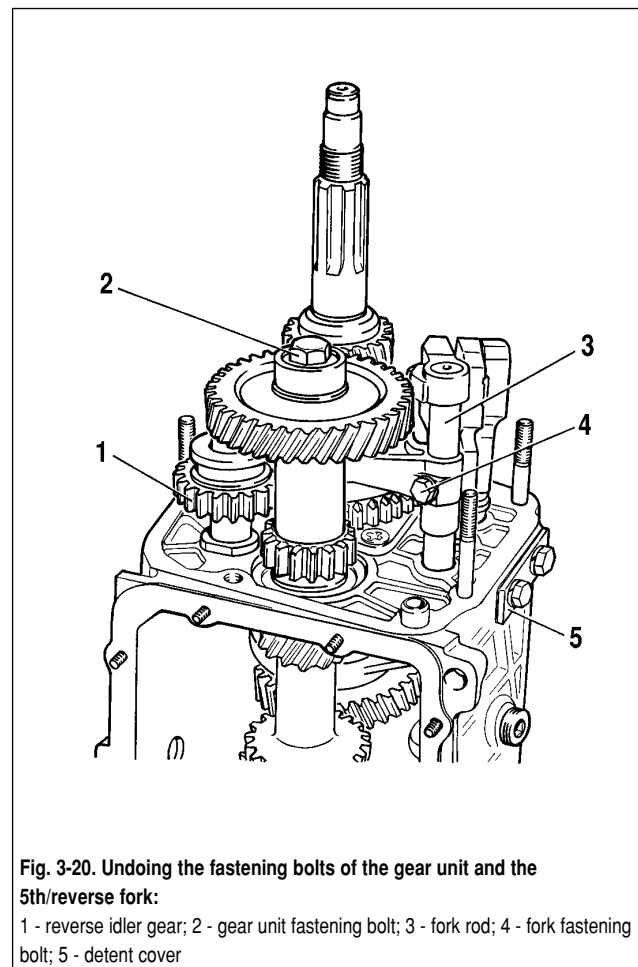
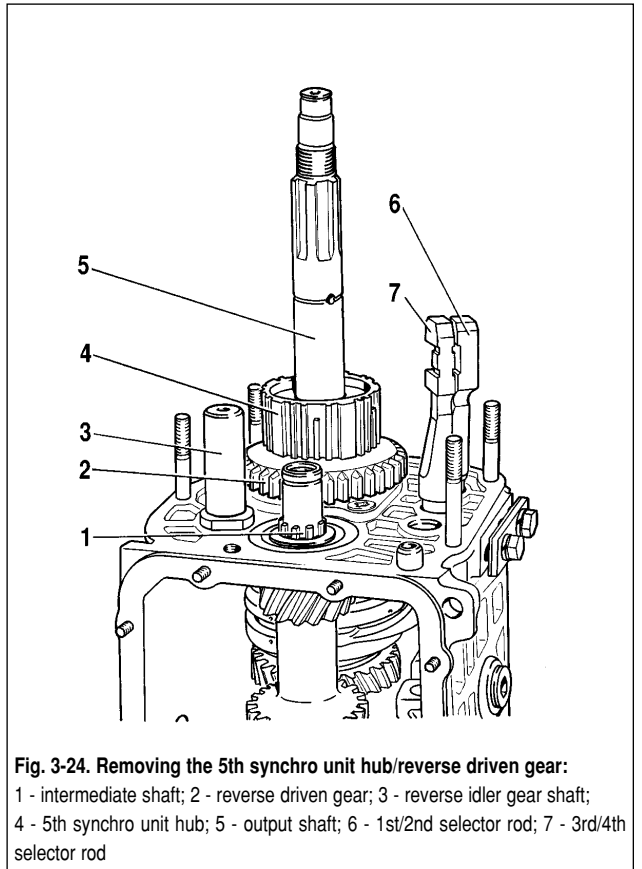
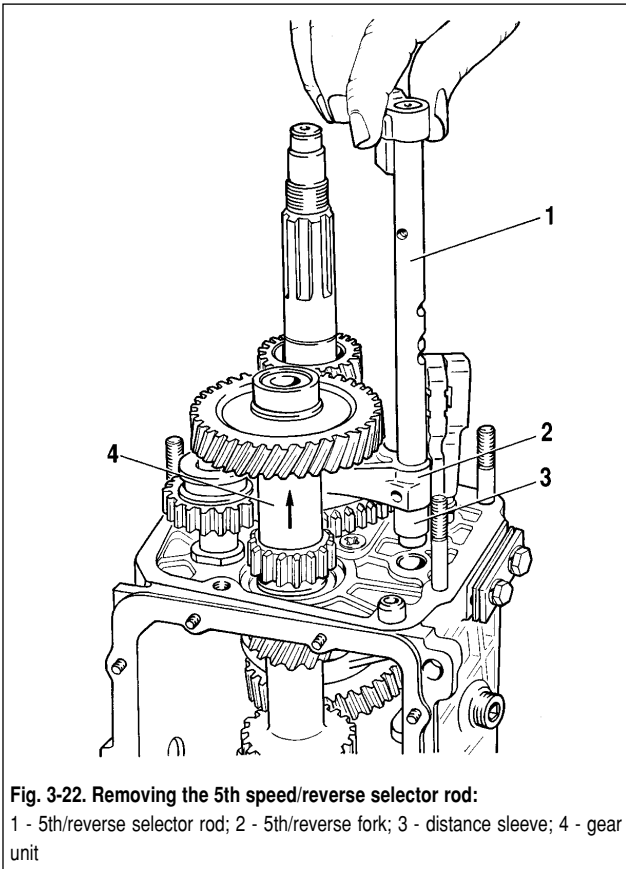
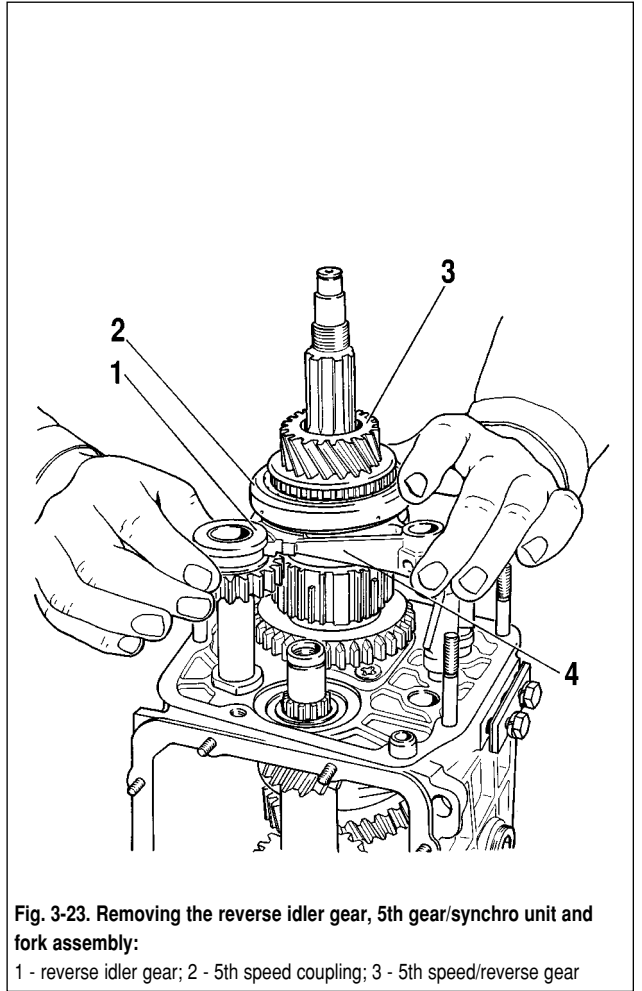
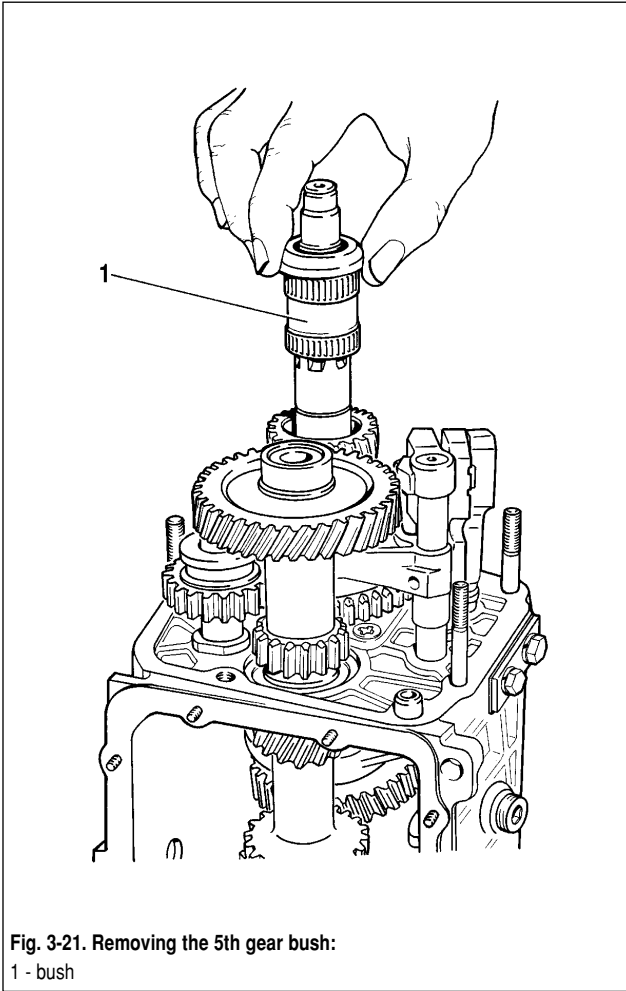
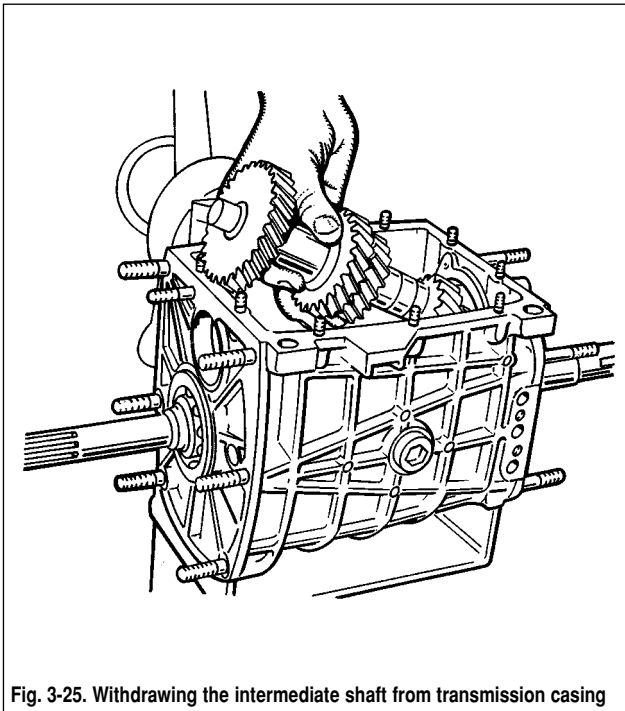


Fig. 3-20. Undoing the fastening bolts of the gear unit and the 5th/reverse fork:

1 - reverse idler gear; 2 - gear unit fastening bolt; 3 - fork rod; 4 - fork fastening bolt; 5 - detent cover





Simultaneously remove the reverse idler gear 1 (fig. 3-23) from the shaft, gear 3 in assembly with the coupling and fork 4 from the output shaft.

With the help of a special mandrel (like a screwdriver) remove the 5th synchro unit hub together with reverse driven gear 2 from key 4 (fig. 3-24).

With the help of a special mandrel (like a screwdriver) and a knock-out tool take out the front and rear bearings of the intermediate shaft from the transmission casing. Make marks on the inner rings of the double-row bearing for further refitting in the bearing outer ring.

Take the intermediate shaft out from the transmission casing, inclining it as shown on fig. 3-25.

Take out from the transmission casing the 1st, 2nd, 3rd and 4th selector rods one by one, previously having undone the securing bolts. Taking out the rods, simultaneously remove three detents 6 (fig. 3-26). Remove the output shaft idler bearing lock plate (fig. 3-27). Undo the fastening nut of the reverse idler gear shaft and remove it.

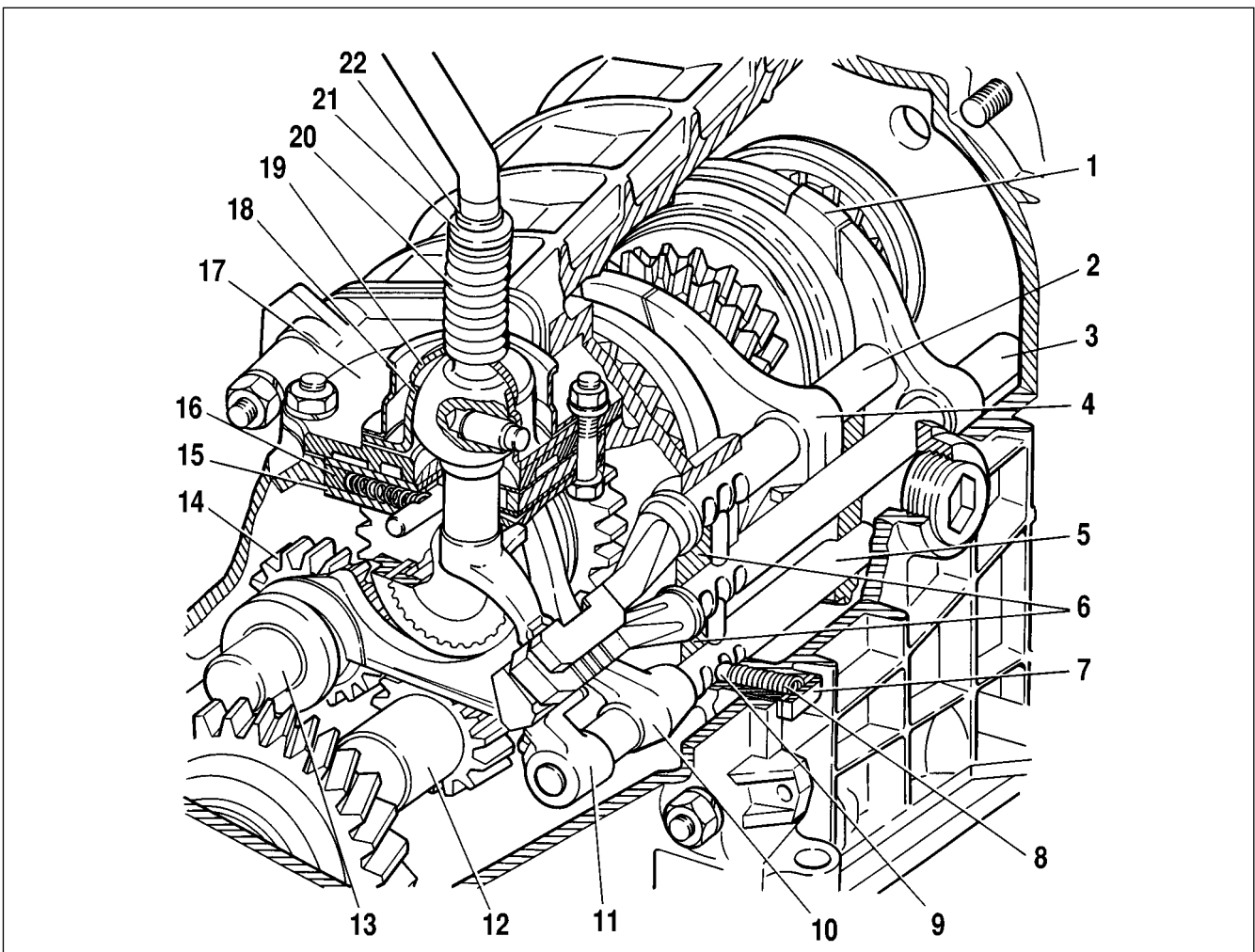
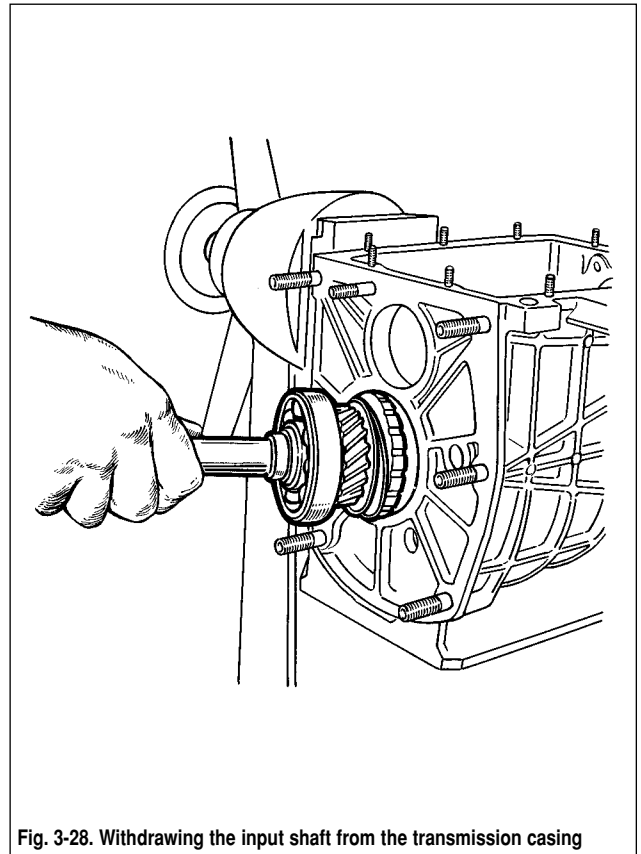
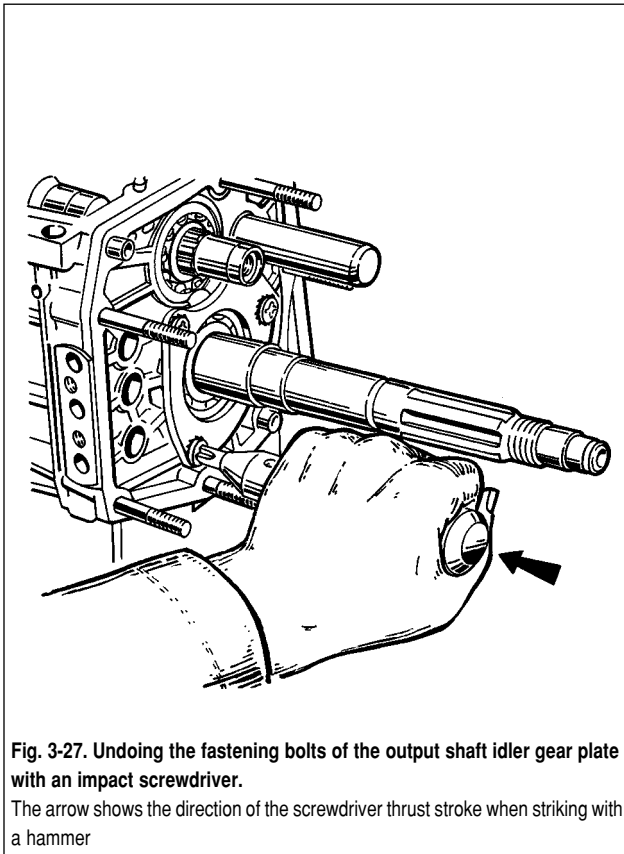


Fig. 3-26. Gear shift mechanism:
 1 - 3rd/4th selector fork; 2 - 1st/2nd selector rod; 3 - 3rd/4th selector rod; 4 - 1st/2nd selector fork; 5 - 5th/reverse selector rod; 6 - detents; 7 - detent cover; 8 - detent spring; 9 - detent ball; 10 - 5th/reverse selector fork; 11 - 5th/reverse fork rod head; 12 - 5th/reverse gear unit; 13 - reverse idler gear shaft; 14 - reverse idler gear; 15 - guide plate washer; 16 - guide plate; 17 - gear shift lever housing; 18 - ball socket; 19 - cap; 20 - spring; 21 - thrust washer; 22 - circlip



With the help of a special mandrel (like a screwdriver) take out the input shaft together with the bearing and the synchro unit ring (fig. 3-28) and remove the needle bearing from the front end of the output shaft.

Punch out the output shaft from the idler bearing, take out the idler bearing and, having inclined as shown on fig. 3-29, take out from the crankcase the output shaft in assembly with gears, couplings and synchro unit rings. Remove the 3rd/4th synchro unit sleeve from the shaft.

Dismantle the input shaft (fig. 3-30):

- remove circlip 7, baulk ring 6 and spring 5;

- place the shaft on a press and, having fixed the spring washer 2 with tool 41.7816.4069, remove circlip 1, and then the spring washer and bearing 3.

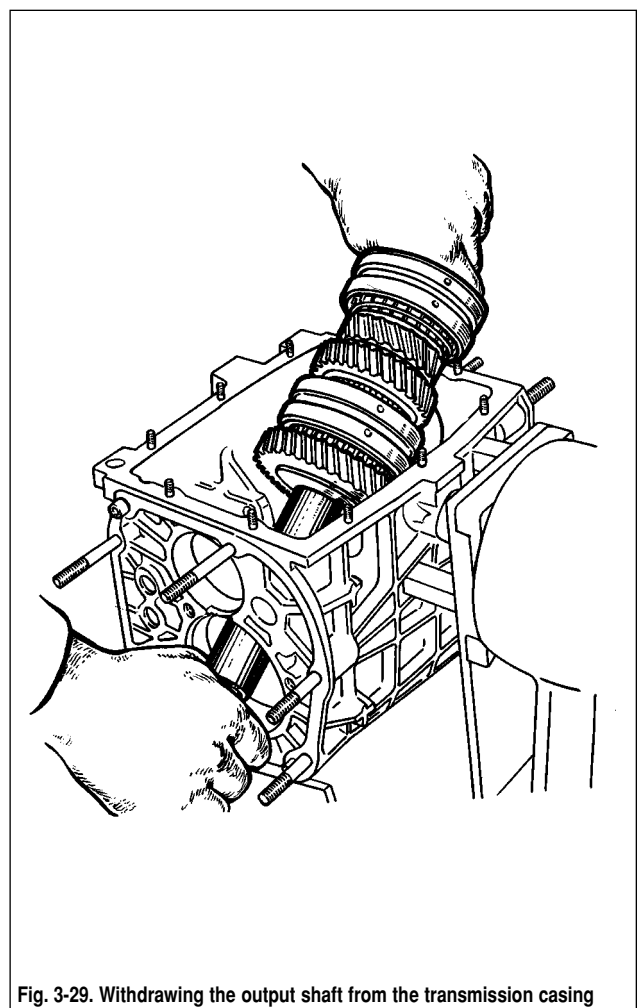
Dismantle the output shaft (fig. 3-31):

- from the rear end of the shaft remove the 1st synchro gear 11 with bush 12, hub 3 with 1st/2nd synchro sleeve 4, 2nd speed gear 10 together with baulk ring 5;

- place the output shaft with tool 41.7816.4069 on a press (fig. 3-32), place two thrust half-rings 3 under 3rd speed gear and by pressing the spring washer with the mandrel, remove the circlip 2, then spring washer 4, 3rd/4th sleeve hub and 3rd speed gear.

If necessary, dismantle the lever and the gear selector mechanism. Proceed as follows:

- take off rubber boot 10 (fig. 3-33), thrust ring 6 and circlip 7, spring 5 and cap 4 from the gearshift lever;



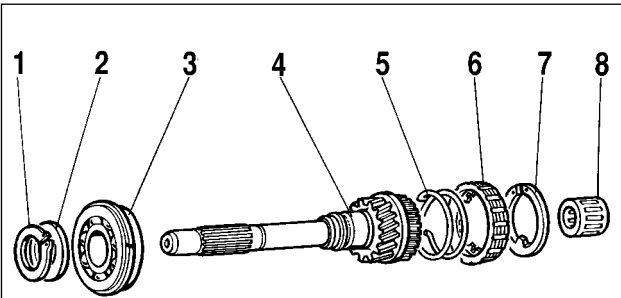


Fig. 3-30. Input shaft components:

1 - circlip; 2 - spring washer; 3 - bearing; 4 - input shaft; 5 - synchro unit spring; 6 - synchro unit baulk ring; 7 - circlip; 8 - bearing

- note visually the location of parts relative to risk A (fig. 3-34), made on the directing plate, so that to reassemble the parts in the same order;

- having undone the nuts from the fastening bolts, separate the parts of the gear selector mechanism and remove lever 9, ball socket 4 and rubber sealing rings 15.

The reassembly of the gearbox is carried out in reverse sequence. Pay attention, that:

- the reverse idler gear shaft is fitted before refitting the shafts in the transmission casing with torque to 78 N•m (7.8 kgf•m);

- before refitting the 5th/reverse fork rod in the crankcase, refit the spacer;

- the inner ring of the bearing is press-fitted on the 5th/reverse gear unit, and the outer one - in the rear cover socket;

- the output shaft rear bearing is press-fitted on the shaft to facilitate the installation of the rear cover;

- the reverse idler gear 1 (see fig. 3-23), gear 3 and fork 4 are installed simultaneously;

- when reassembling the gear switch lever apply grease ЛСЦ-15 or ЛИТОЛ-24 on the ball or the cap of the ball socket;

- the gear unit fastening bolt is tightened with torque to 78 N•m (7.8 kgf•m);

- when refitting the clutch housing with the transmission casing front cover, the opening in the front cover should be located as shown on fig. 3-15;

- grease the oil seals with ЛИТОЛ-24 before refitting;

- use tools 41.7853.4028, 41.7853.4032, 41.7853.4039 to install the sealings and bearings.

Inspection

Cleaning. Before inspection, carefully clean all gearbox components. Brush or scrape all deposits or residues, clean the bores and splines; then wash down to dissolve and remove all traces of oil.

Blow the parts with compressed air and carefully wipe them. Especially carefully blow the bearings, directing the air jet so, that to exclude fast rotation of rings.

Gearbox casing and covers. There should be no cracks on the casing, and no wear or damage should be evident on the bearing housings.

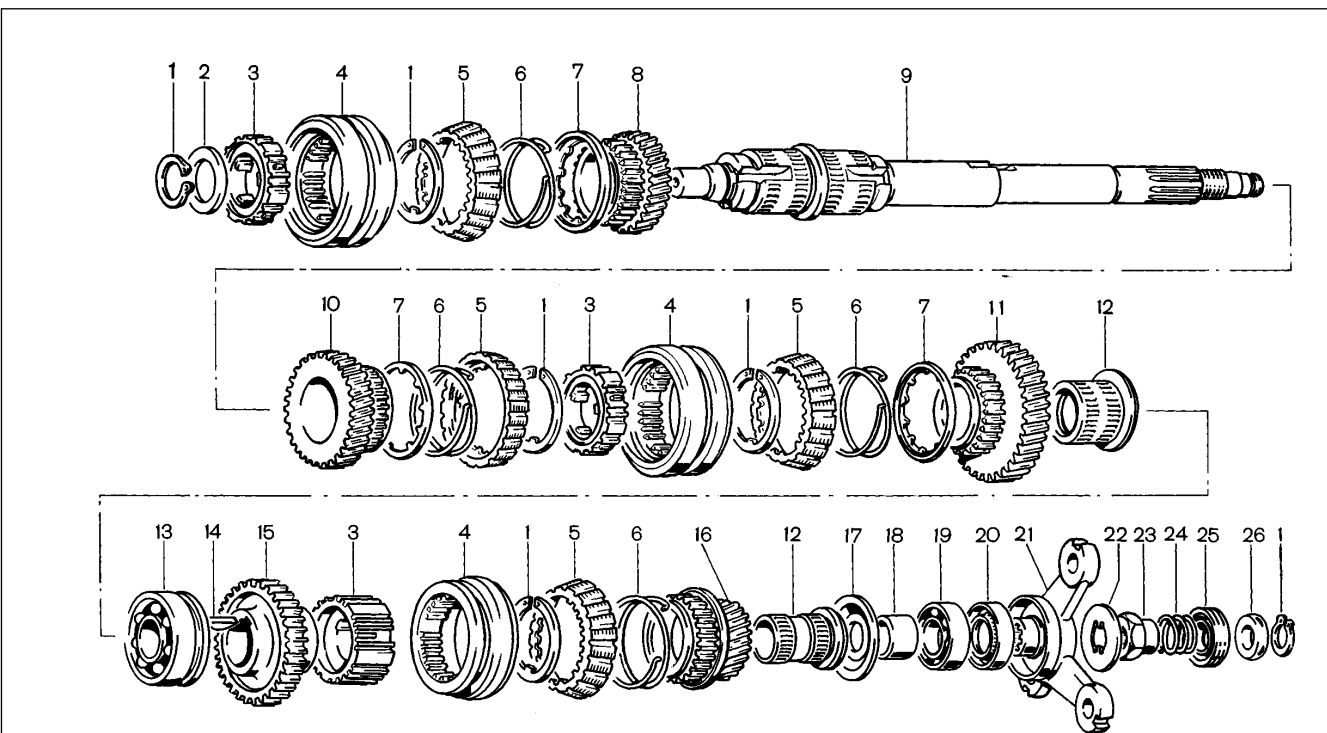


Fig. 3-31. Output shaft, exploded view:

1 - circlip; 2 - spring washer; 3 - synchro unit hub; 4 - synchro unit sleeve; 5 - baulk ring; 6 - spring; 7 - washer; 8 - 3rd speed gear; 9 - output shaft; 10 - 2nd speed gear; 11 - 1st speed gear; 12 - gear bush; 13 - bearing; 14 - key; 15 - reverse gear; 16 - 5th speed gear; 17 - oil deflector washer; 18 - spacer; 19 - output shaft rear bearing; 20 - oil seal; 21 - coupling flange; 22 - lock washer; 23 - nut; 24 - seal spring; 25 - seal; 26 - centering ring

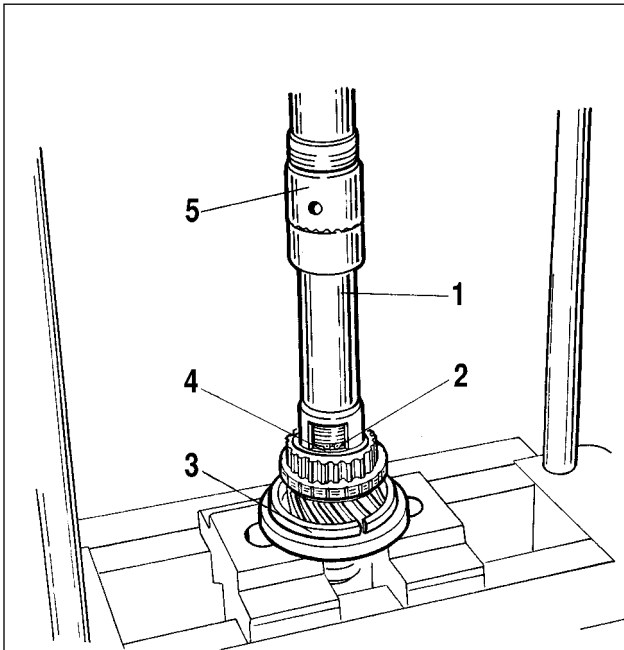


Fig. 3-32. Refitting the circlip on the output shaft:
 1 - tool 41.7816.4069; 2 - circlip; 3 - support half-ring; 4 - spring washer;
 5 - press rod

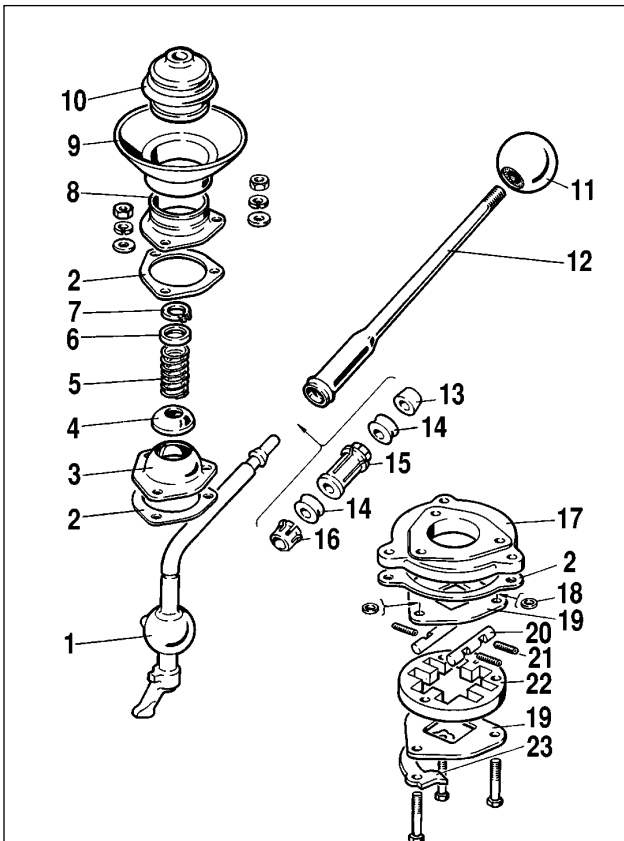


Fig. 3-33. Gear change mechanism and lever:
 1 - gear change lever; 2 - gasket; 3 - ball socket; 4 - cap; 5 - spring; 6 - ring;
 7 - circlip; 8 - flange; 9 - collar; 10 - rubber boot; 11 - lever knob; 12 - lever extension;
 13 - pad; 14 - rubber bush; 15 - spacer; 16 - securing collar; 17 - gear
 change lever housing; 18 - sealing ring; 19 - guide plate washer; 20 - guide bar;
 21 - spring; 22 - guide plate; 23 - reverse lock plate

On surfaces mating with the clutch housing, with the rear and bottom covers there should be no damages that may cause oil leak. Insignificant damages should be smoothed with a file. If parts are badly damaged or worn, renew them.

Check the condition of the front cover and ensure that the input shaft does not touch it when rotating. If the shaft and the cover are not aligned against each other, replace the damaged parts. Ensure, that the oil drain aperture is not fouled (shown by an arrow on fig. 3-15). Clean the oil drain plug.

Seals. Inspect the oil seals and ensure there is no damage, severe wear or roughness on the working edges. The permissible amount of wear of seal working edges is no more than 1 mm. In case of any insignificant defect renew the seals.

Shafts. On the working surfaces and on the splines of the output shaft no damages or excessive wear is allowed. There

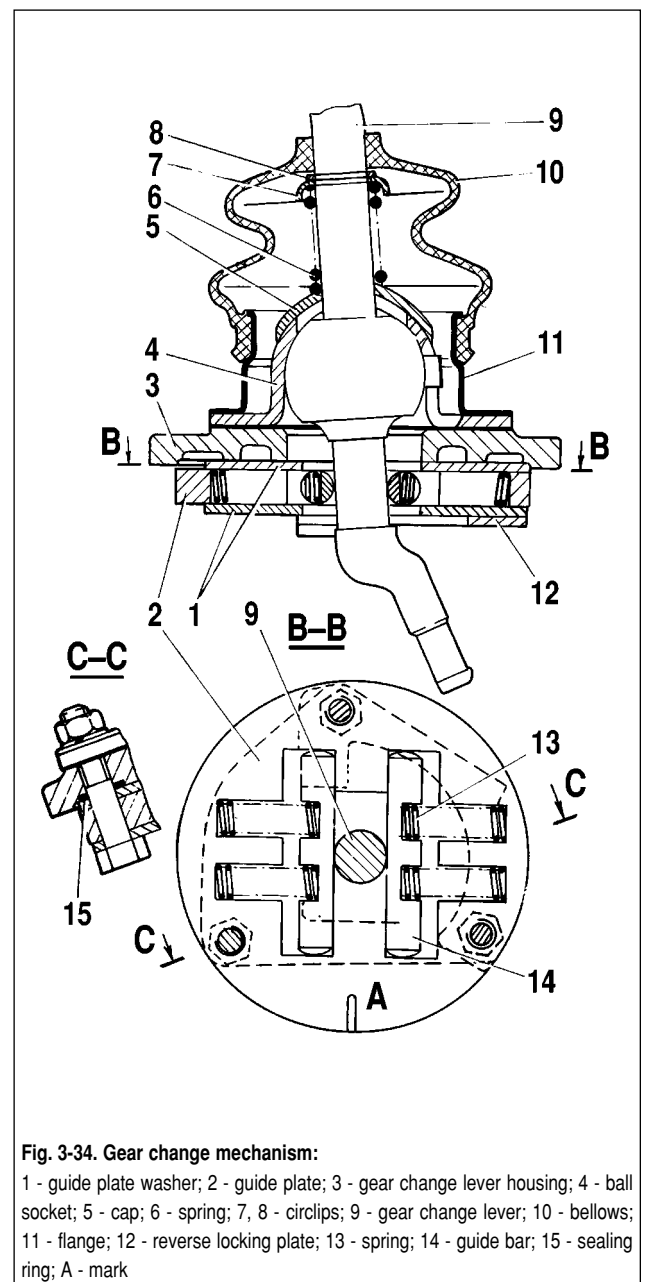


Fig. 3-34. Gear change mechanism:
 1 - guide plate washer; 2 - guide plate; 3 - gear change lever housing; 4 - ball
 socket; 5 - cap; 6 - spring; 7, 8 - circlips; 9 - gear change lever; 10 - bellows;
 11 - flange; 12 - reverse locking plate; 13 - spring; 14 - guide bar; 15 - sealing
 ring; A - mark

should be no roughness or scuffings on the rolling surfaces of the shaft front end.

Check the condition of needle rolling surface in the opening of the primary shaft.

Examine the intermediate shaft, no chipping or excessive wear of teeth is allowed.

The surface of the reverse gear shaft should be absolutely smooth, with no traces of jamming. The mounting gap between the shaft and the bush of the reverse idler gear should be 0.056-0.09 mm, the maximum permissible size is 0.15 mm. The clearance is checked by measuring the shaft diameter and the opening of the gear bush. On new parts the shaft diameter is equal to 19.079-19.094 mm, and the inner diameter of the press-fitted bush is 20.05-20.07 mm.

Insignificant surface roughness can be removed with fine sandpaper. In case of serious damages and deformations renew the shaft.

Gears. There should be no damages or excessive wear of teeth. Special attention should be paid to the condition of the teeth end faces on the synchro unit crown.

The bearing pattern between the gear teeth should cover the complete working area, which should be smooth with no signs of wear. Check the gear mesh clearance, the mounting gap should be 0.10 mm; maximum wear-gap - 0.20 mm.

The mounting gap between the bushes and the 1st/5th gears, and between the output shaft and the 2nd/3rd gears should be 0.05-0.10 mm; maximum wear-gap - 0.15 mm.

If wear exceeds permissible limits, renew the gears.

Bearings. Ball and roller bearings should be in perfect condition. Their radial gap should not exceed 0.05 mm.

Press the inner ring to the outer one with fingers, turn one of them in both directions, the rolling thus should be smooth. On the surface of balls and rollers and the rolling paths of the rings no damage is permissible. Renew damaged bearings. When replacing the input shaft front bearing use pusher A.40006 (see fig. 2-11); it is possible not to remove the flywheel.

Rods and forks. No deformation of gear shift forks is acceptable. The rods should freely slide in the borings without significant gaps.

Check the condition of rod collets, springs and detent balls. Parts having any traces of jamming or wear should be renewed.

Hubs, sleeves and baulk rings. Ensure the hubs have no damage, in particular on the sleeve sliding surface. Draw special attention to the condition of the sleeve spline face.

The synchro rings should show no sign of excessive wear. They should be renewed in case the end face is resting on the synchro unit sleeve. Roughness interfering free sliding, should be removed with a fine-cut file. Badly worn parts should be renewed.

Transfer box

Fault diagnosis

Diagnosis	Remedy
-----------	--------

Vibration of the transfer box and body floor (in the area of front seats) when starting and accelerating to 80 km/h

1. Transfer box not centralised against power unit	1. Centralise transfer box
2. Loose or damaged transfer box mountings, and power unit rear mount	2. Tighten securing nuts and bolts, renew if necessary
3. Hard turning or jamming of front or rear propeller shaft joints	3. Repair U-joints or renew shafts
4. Incomplete handbrake release	4. Adjust handbrake
5. Hard turning of layshaft CV-joint	5. Inspect boot and joint. Renew joint in case of damage

Vibration of the transfer box and body floor (in the area of front seats) at a steady-state movement (most typical at speed of 80-90 km/h)

1. Propeller shafts out-of-balance	1. Renew or repair propeller shafts
2. Interaxial differential out-of-balance	2. Renew or repair differential
3. Jammed propeller shaft U-joints	3. Repair joints or replace shafts
4. Jammed layshaft CV-joint	4. Inspect boot and joint. Renew joint in case of damage
5. Loose engine mounting nuts and bolts or damaged engine supports	5. Tighten mounting nuts and bolts or renew engine mounts
6. Bended bolts and layshaft flexible coupling flange	6. Renew bolts or layshaft

Noise at cornering or wheel slip

1. Hard rotation of differential pinions on shaft	1. Renew worn or damaged parts
2. Jammed axle drive gears in differential housing	2. Renew worn or damaged parts
3. Damaged differential pinion working surface	3. Renew worn or damaged parts
4. Large axial clearance of axle drive gears in differential housing	4. Use shims to adjust clearance to 0-0.10 mm

Hard gear switching or differential lock up

1. Jammed coupling on hub splines or on differential housing splines	1. Rectify burrs, dints, scores, renew bad parts
2. Dents on smaller crown teeth on top or lower gears, on clutch teeth and on splines of front axle drive shaft	2. Rectify burrs, scores, renew bad parts
3. Bended fork or rod	3. Straighten deformed parts
4. Deformed transfer box drive levers	4. Straighten levers, renew if necessary
5. Jammed drive levers on shafts	5. Remove levers, clean shafts and bushes. Renew bad parts

Spontaneous gear or differential lock disengagement

- | | |
|----------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------|
| 1. Worn teeth on gears and couplings | 1. Renew worn parts |
| 2. Weak detent spring or detent component wear | 2. Renew springs or worn parts |
| 3. Incomplete gear engagement and differential lock due to drive system component damage or due to dents on gears, clutches or splines | 3. Straighten deformed parts or renew, clean burrs and scores, replace bad parts |

Oil leak

- | | |
|------------------------------------------------|--------------------------------------------|
| 1. Damaged sealings | 1. Renew gaskets |
| 2. Loose nuts and pins fixing covers to casing | 2. Tighten nuts and pins in places of leak |
| 3. Worn or damaged shaft seals | 3. Renew oil seals |
| 4. Worn transfer drive rod seals | 4. Renew sealing ring |

Transfer box / car body floor vibration trouble-shooting (in the area of front seats)

First of all note, at what speed does the transfer box vibration occur, then start with the diagnosis.

Test 1. Place the transfer- and gearbox levers in neutral position and start the engine. Set engine speed equal to vehicle speed at which vibration occurs.

If vibration still exists on a parked vehicle, it is necessary to check engine mounting and supports, as they are the reason of vibration.

Test 2. If during test 1 vibration was not diagnosed, place the transfer levers in neutral position, start the engine, engage direct gear and set engine speed equal to vehicle speed at which vibration occurs.

If vibration is observed on a parked vehicle at this engine speed, the reason should be looked for in the layshaft (out-of-balance, bended fastening bolts or flexible coupling flange, jammed CV-joint).

Test 3. If no vibrations was diagnosed during tests 1 and 2, go to test 3. Accelerate the vehicle to the speed, at which vibration occurs, and place the transfer- and gearbox levers in neutral position. If vibration persists, the reason should be looked for in the front or rear propeller shaft (out-of-balance, jammed joints) or interaxial differential is not balanced.

Transfer box - removal, refitting and centering

Removal. Place the vehicle over an inspection pit or on a lift. Release the handbrake and place the gear- and transfer-box levers in neutral position. Undo the fastening screws of the gear lever surround and remove it. Remove the handles and gaiters from the levers. Undo the fastening screws and remove the cover cap and the bellows.

Disconnect the speedometer cable from the transfer box and the wires from the differential lock warning lamp sensor. Turn the driveshafts and disconnect the driveshaft flanges from the transfer box shafts, and the layshaft flange from the gearbox output shaft flange.

Unscrew nuts 3 (fig. 3-37) on the transfer box mounting bracket 1 fastening bolts and remove it together with brackets and shims 5, which are placed under the brackets, in assembly with the layshaft. Mark each shim so that to refit them in the same amount.

Refitting and centering the transfer box is done in the following order:

- ensure proper refitting of engine support pads in brackets (the centering washers of the engine front support pads should fit into the appropriate apertures in the side brackets) and perfect fit of transfer box supports to the car body bottom. If necessary, straighten the floor surface under the supports;

- place the transfer box on the vehicle, but do not tighten completely mounting bracket nuts 4 and 5 (fig. 3-38);

- by moving the transfer box in different directions, find such location, at which the flanges of the transfer box input shaft and the layshaft will be on one level, parallel and with minimum clearances between them; the transfer box shafts should be parallel with the car bottom;

- refit the earlier removed shims under the mounting brackets, fully tighten the fastening nuts;

- reconnect the front and rear propeller shafts to the transfer box shafts; attach the speedometer cable, and the wires to the differential lock warning lamp sensor.

When replacing the transfer box, and also at engine rear mount "settle down", resulting in vibration of the transfer box, renew and match shims 5 (see fig. 3-37) with those of proper thickness.

Matching the shim thickness:

- ensure proper refitting of engine support pads (see subsection. "Engine removal and refitting");

- separate the flanges of the transfer box input shaft and the layshaft;

- slacken the nuts that are fixing the transfer box supports to the car body, remove the shims and, and by moving the transfer box in different directions, find such location, at which the separated flanges will be on one level, parallel and with minimum clearances between them; the transfer box shafts should be parallel with the car body bottom;

- the formed gap between the floor and the support should be filled with a sufficient amount of shims;

- align the large centering collars without tensioning the supports of the transfer box and the engine, and while keeping the transfer box in this place, tighten the earlier slackened support nuts;

- refit and tighten the flange fastening bolts on the transfer box and the layshaft; if the bolts fit perfectly in the apertures of the flanges, the centering is carried out correctly, otherwise the flanges should be re-aligned.

Dismantle and reassembly

Dismantle. Wash the transfer box and drain oil.

Place the transfer box on a bench for dismantle and slacken the flange fastening nuts on the input shaft and on the front and rear axle shafts.

Undo the fastening nuts and remove the front axle casing 1 (fig. 3-39) in assembly with cover 2, lever, fork, differential lock

coupling and the front axle shaft. Remove the speedometer drive unit housing 3 in assembly with the speedometer driven gear.

After removing lock washer 8 (see fig. 3-36) take out lever shaft 10 and remove differential locking lever 11. Then remove cover 7 from the front axle drive and take out the detent spring and ball 19. Undo clamping bolt 3 from the differential lock fork, take out rod 6, fork 1 and locking coupling 2.

Remove rear cover 31 (see fig. 3-35) in assembly with the rear axle drive shaft, taking care not to damage the sealing. Then remove flanges 12 from the input shaft and the drive shafts of the front and rear axles.

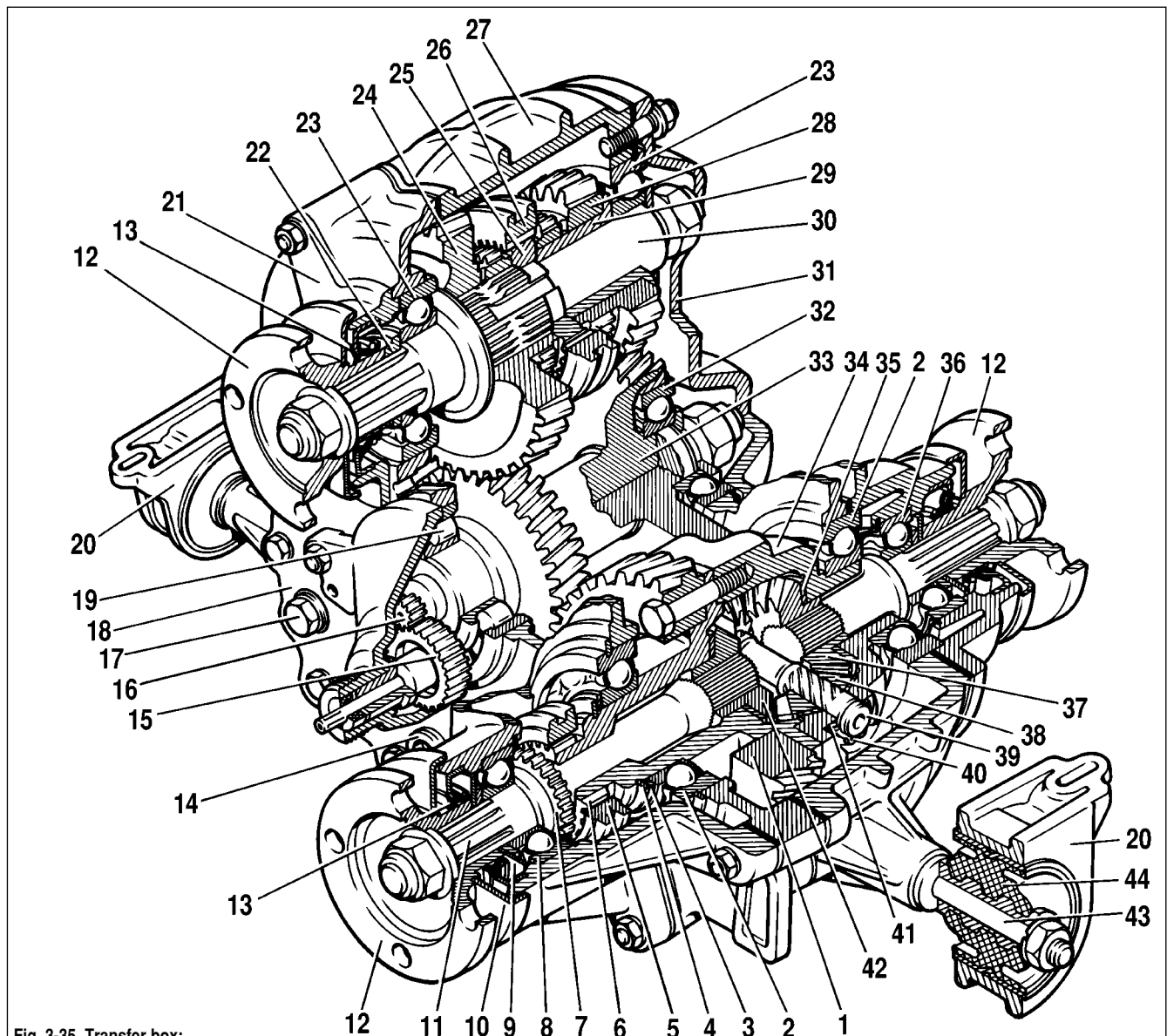


Fig. 3-35. Transfer box:

1 - driven gear; 2 - differential bearing; 3 - spring washer; 4 - circlip; 5 - differential locking coupling; 6 - differential housing crown; 7 - front axle drive shaft crown; 8 - front axle drive shaft bearing; 9 - oil screen; 10 - splash guard; 11 - front axle drive shaft; 12 - flange; 13 - oil seal; 14 - oil drain plug; 15 - speedometer driven gear; 16 - speedometer drive gear; 17 - plug for oil top-up and level check; 18 - transfer box front cover; 19 - layshaft roller bearing; 20 - mounting bracket; 21 - input shaft bearing cover; 22 - bearing thrust ring; 23 - input shaft bearing; 24 - top gear; 25 - gear shift clutch hub; 26 - gear shift clutch; 27 - transfer box casing; 28 - low gear; 29 - low gear bush; 30 - input shaft; 31 - rear cover; 32 - layshaft ball bearing; 33 - layshaft; 34 - differential housing; 35 - rear axle differential gear thrust washer; 36 - rear axle drive shaft bearing; 37 - rear axle differential gear; 38 - pinion; 39 - pinion shaft; 40 - pinion shaft circlip; 41 - spring washer; 42 - front axle differential gear; 43 - transfer box mounting shaft; 44 - mounting bracket rubber pad

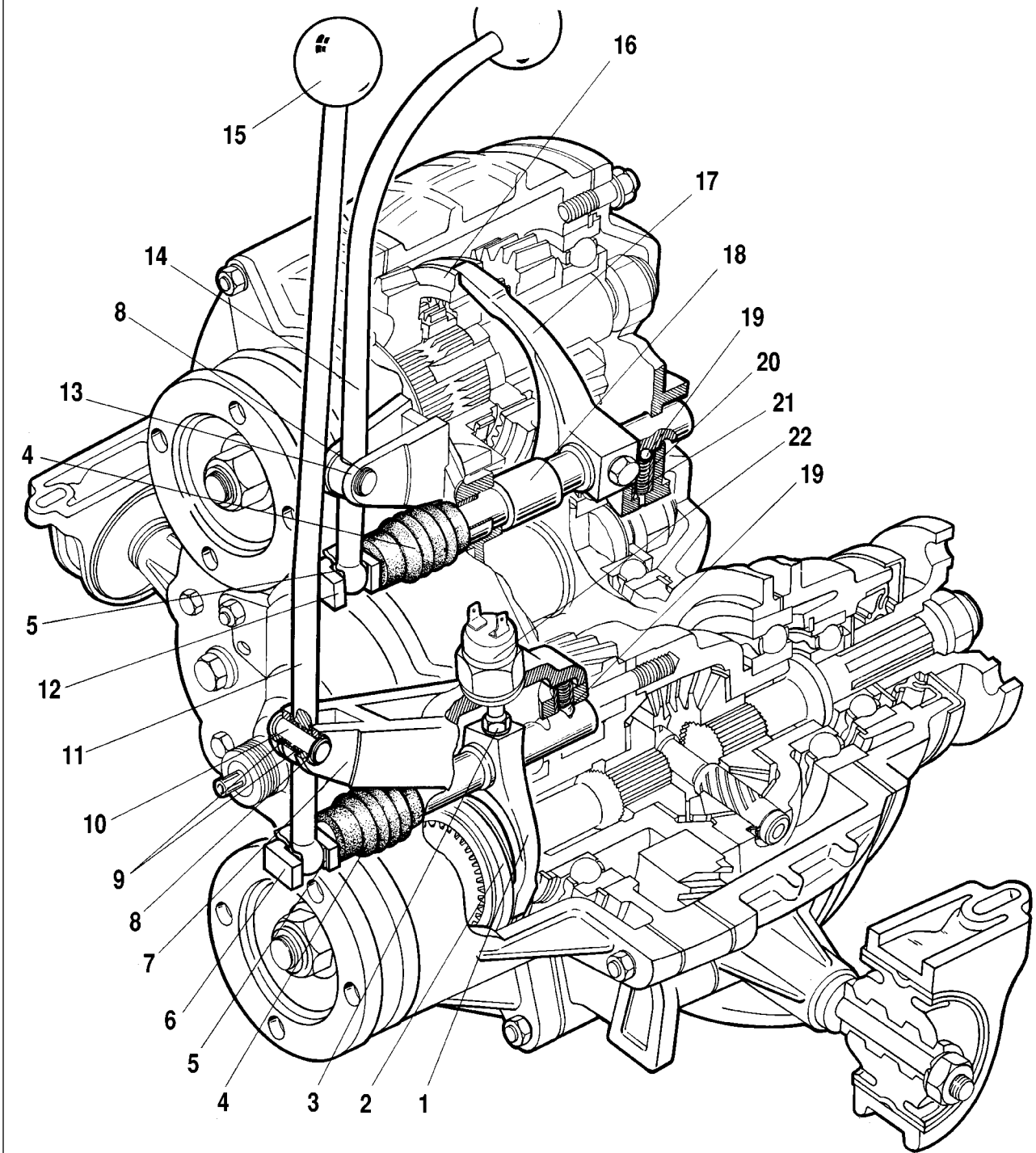


Fig. 3-36. Transfer box operating system:

1 - differential locking clutch yoke; 2 - differential locking clutch; 3 - yoke stop bolt; 4 - boot; 5 - lever spring; 6 - differential locking fork rod; 7 - front axle case cover; 8 - lock washer; 9 - lever shaft bush; 10 - lever shaft; 11 - differential locking lever; 12 - gear shift fork rod; 13 - gearshift lever bracket; 14 - gear shift lever; 15 - knob; 16 - gear shift clutch; 17 - gear shift clutch fork; 18 - distance sleeve; 19 - detent ball; 20 - detent spring bush; 21 - detent spring; 22 - differential lock warning light switch

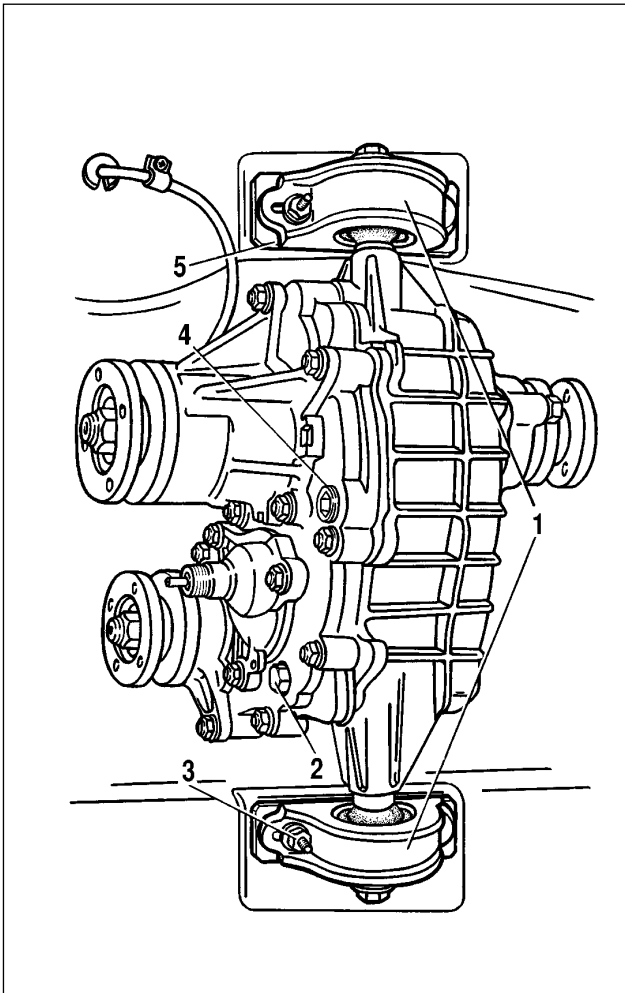


Fig. 3-37. Transfer box mounting on vehicle:
 1 - transfer box mounting bracket; 2 - filler plug; 3 - bracket fastening nut;
 4 - drain orifice plug; 5 - shims

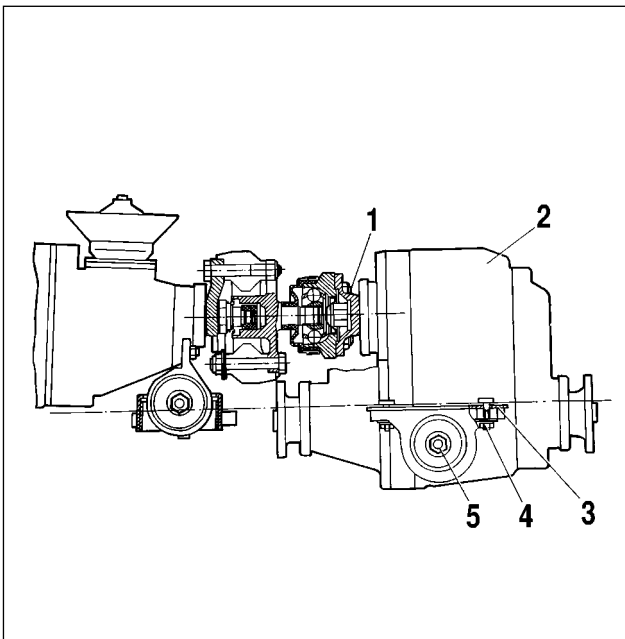


Fig. 3-38. Transfer box installation:
 1 - layshaft and drive shaft flange fastening pin; 2 - transfer box; 3 - shims;
 4 - transfer box-to-car body fastening nuts; 5 - nuts fastening mounting brackets on shafts

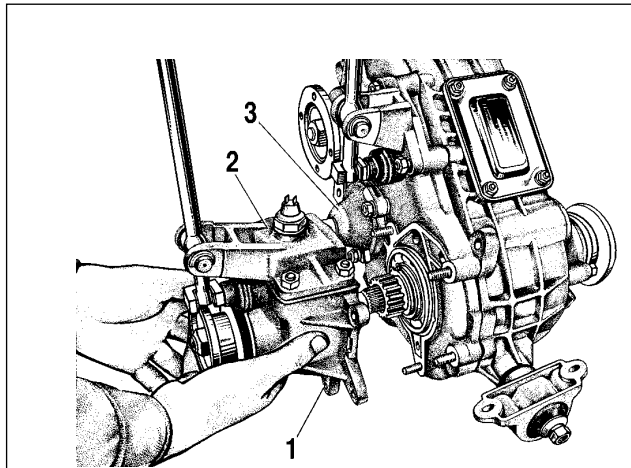


Fig. 3-39. Removing the front axle case:
 1 - front axle case; 2 - case cover; 3 - speedometer drive housing

Remove the bearing setting rings from the front and rear drive shafts. Take the front axle drive shaft 11 (see fig. 3-35) out from the casing together with bearing 8, thrust ring and oil deflector 9. Take the rear axle drive shaft out from the rear cover 31 together with bearing 36, thrust ring and oil deflector.

Remove cover 21 from the input shaft front bearing and the inspection hatch cover.

Remove the gear switch lever bracket 13 (see fig. 3-36) in assembly with the lever. After removing the lock washer, take out the shaft and remove lever 14.

Undo the locking bolt of the gear shift fork 17, close the detent socket with a finger and carefully take out rod 12 and the detent components.

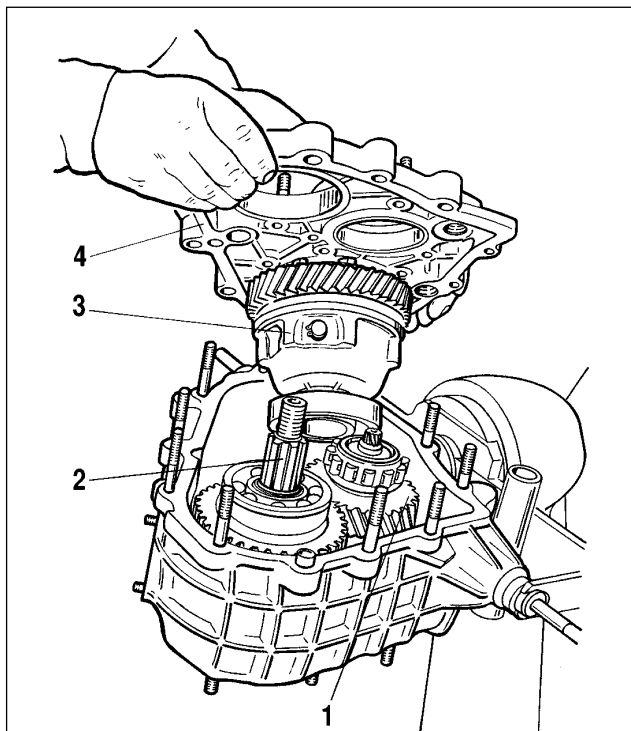


Fig. 3-40. Removing the transfer box front cover:
 1 - layshaft; 2 - drive shaft; 3 - differential; 4 - front cover

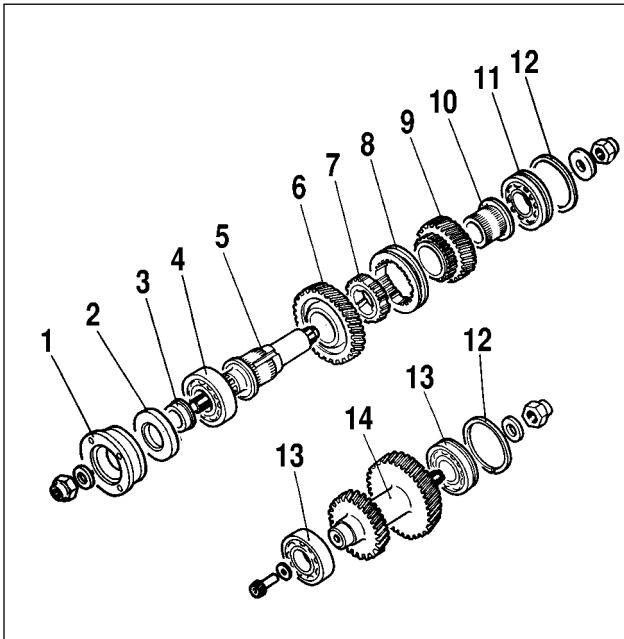


Fig. 3-41. Drive shaft and layshaft components:
 1 - flange; 2 - oil seal; 3 - bearing thrust ring; 4 - front bearing; 5 - drive shaft; 6 - top gear; 7 - hub; 8 - coupling; 9 - low gear; 10 - bush; 11 - rear bearing; 12 - bearing set ring; 13 - layshaft bearing; 14 - layshaft

Remove front cover 4 (fig. 3-40) with the differential, fit the differential bearing setting ring and take out the bearing in assembly with the differential from the front cover.

Remove the setting rings from the bearings of the drive- and intermediate shafts and remove both input- and layshafts from the transfer box casing.

Grip the input shaft in vise and use a universal remover tool to remove the thrust ring and rear bearing 11 (fig. 3-41) . Remove low gear 9 together with bush 10, gear engagement clutch 8, clutch hub 7 and top gear 6 from the input shaft.

Dismantle the differential:

- remove circlip 1 (fig. 3-42) and spring washer 2 from the front bearing;
- remove the rear and front bearings from the differential casing (fig. 3-43) using a universal puller and a rest block 67.7853.9559;
- undo the differential driven gear fastening bolts, make risks on the differential casings to mark their location against to each other and dismantle the casing;
- remove the differential driven gear;

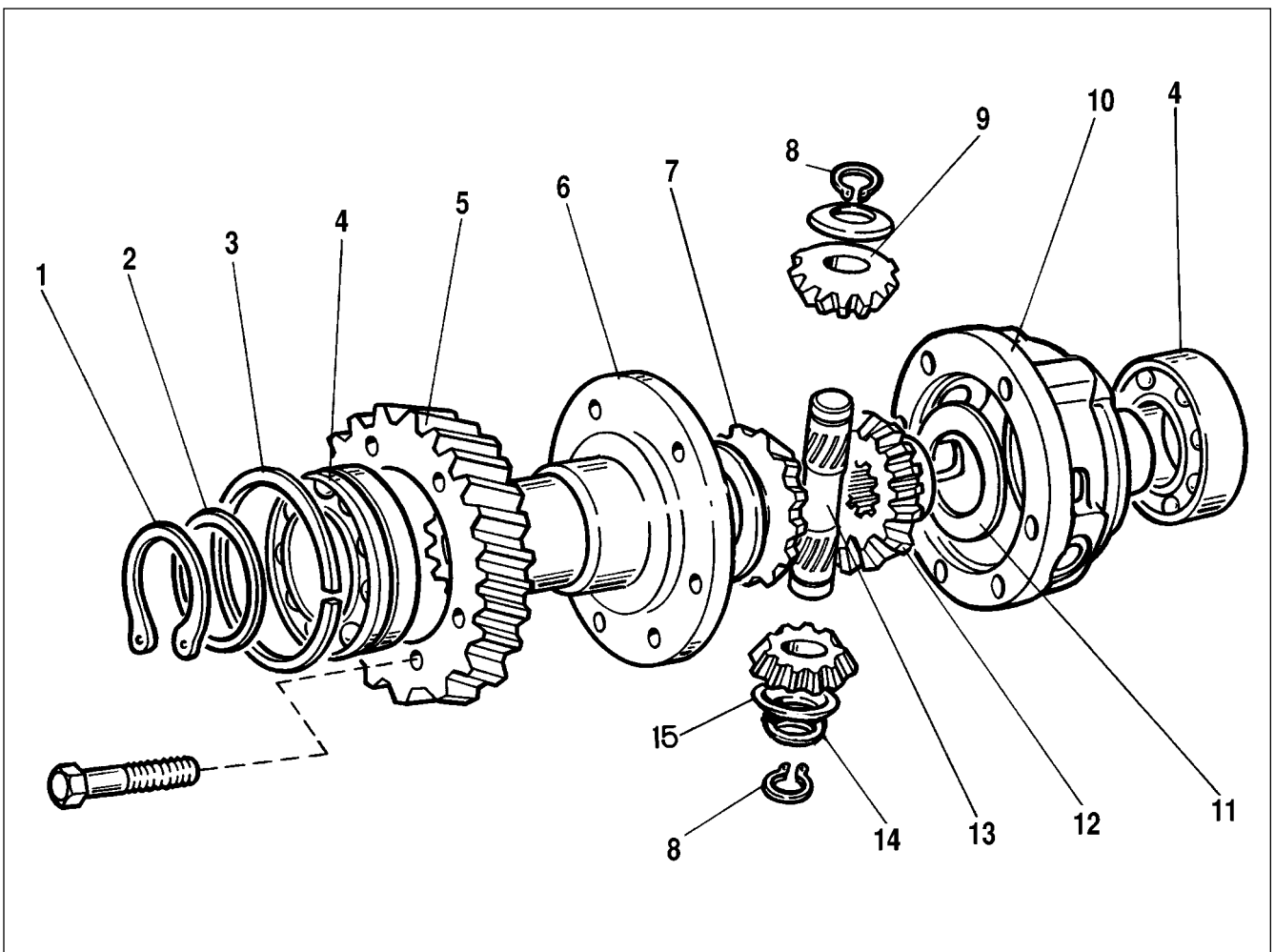
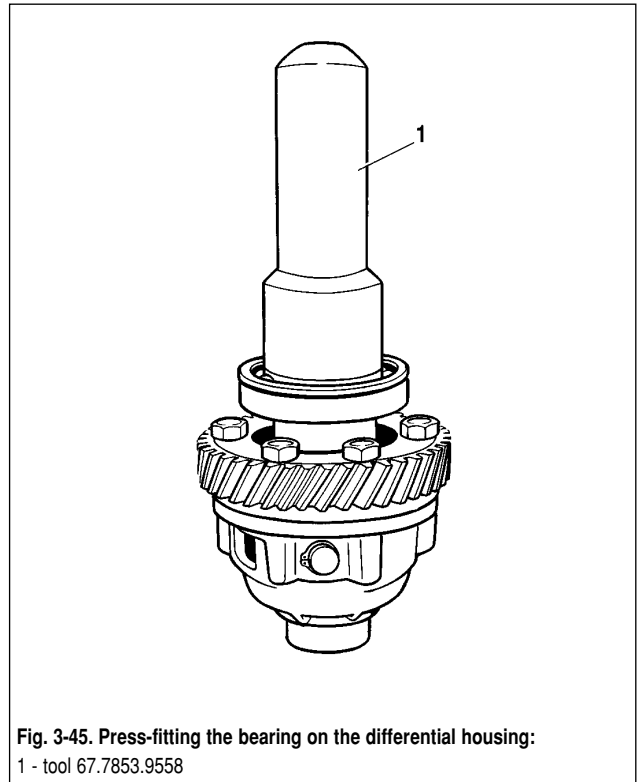
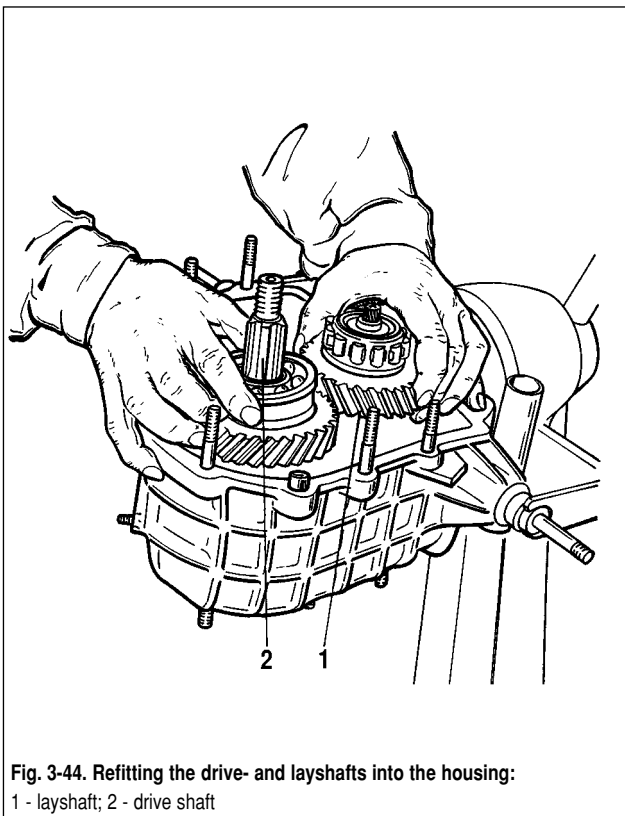
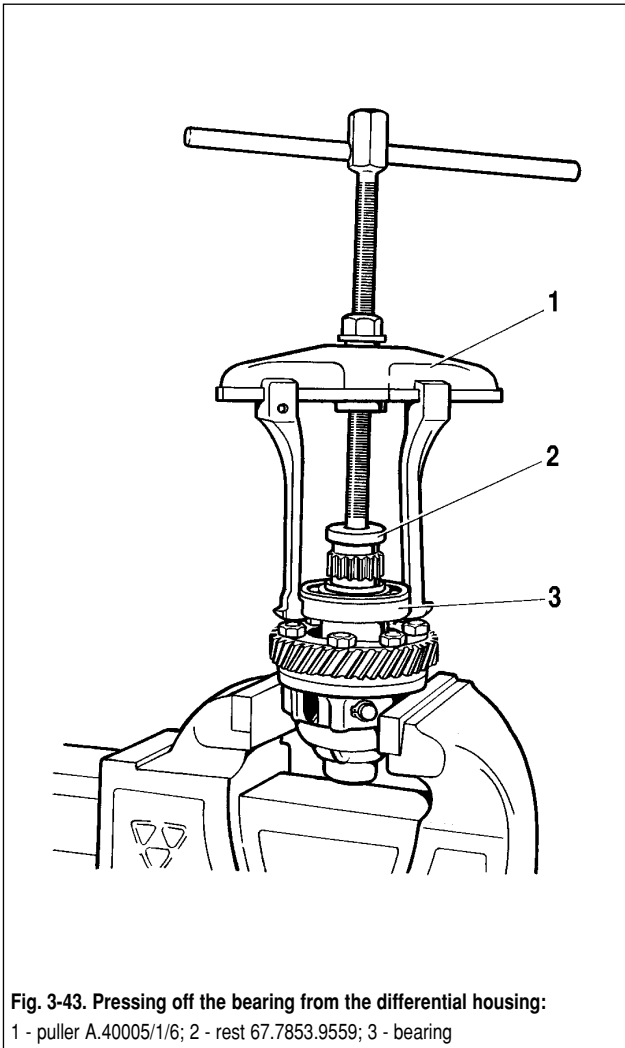


Fig. 3-42. Differential, exploded view:
 1 - circlip; 2 - spring washer; 3 - bearing set ring; 4 - differential housing bearing; 5 - driven gear; 6 - differential front housing; 7 - front axle gear; 8 - pinion shaft circlip; 9 - pinion; 10 - differential rear housing; 11 - washer; 12 - rear axle gear; 13 - pinion shaft; 14 - pinion shaft spring washer; 15 - washer



- remove circlips 8 (see fig. 3-42) and spring washer 14, then press out the differential pinion shaft and remove the differential pinions and the drive shaft gears with support washers.

Press out worn or damaged oil seals from the front axle case, from the front bearing cover and from the rear cover. Undo the nuts from the axle support pad and remove brackets assembly.

The reassembly of the transfer box is carried out in reverse sequence. Pay attention to the following:

- reassemble the interaxial differential, having matched the marks on its cases so that not to disturb the balance of this unit;
- the spring washer on the differential pinion shaft should be placed from the blind hole side on the shaft end face;
- the axial gap of each axle drive gear should be 0-0.10 mm, and the gear moment of resistance to rotation should not exceed 14.7 N•m (1.5 kgf•m). If the gap is greater, renew the support washers with those having bigger thickness; if this will not help to obtain the specified gap, renew the gears because of their excessive wear;
- drive- and layshafts are installed in the transfer box casing simultaneously (see fig. 3-44);
- bearings are press fitted on the differential casing with tool 67.7853.9558 (see fig. 3-45);
- the working surfaces of oil seals are greased with ЛИТОЛ-24 before their refitting in the covers and casings;
- threaded connections are tightened with torque specified in appendix 1;
- use tool 67.7820.9520 to reduce the transfer box shaft nuts (see fig. 3-46).

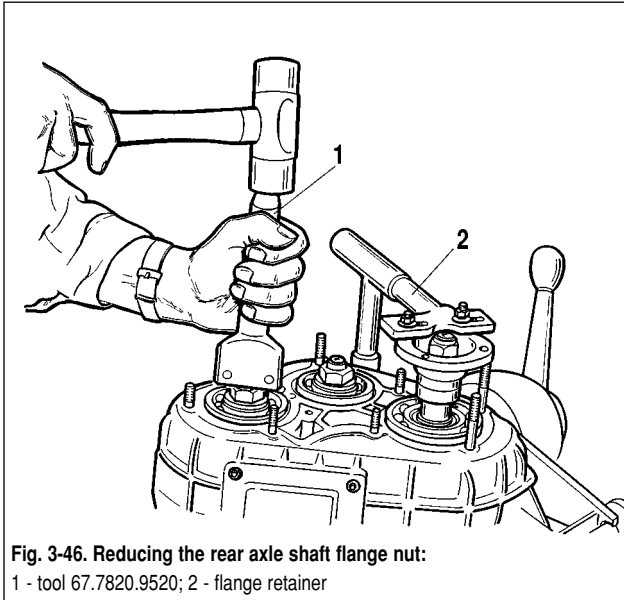


Fig. 3-46. Reducing the rear axle shaft flange nut:
1 - tool 67.7820.9520; 2 - flange retainer

After reassembly, top-up oil in the transfer box to the lower edge of the filler neck.

Inspection

Prior to inspection, all parts of the transfer box should be carefully cleaned with a brush and a scraper, and then washed. Blow the parts with a jet of compressed air. Especially carefully wash and blow the bearings, but do not let them to rotate quickly under the air jet to prevent damage.

Casing and covers. There should be no cracks on the casings and covers, no signs of wear or damage (dents, chipping) is allowed on the surface of bearing housings. Damage on surfaces between casing and covers may result in misalignment of shafts and oil leak. Small damages can be repaired with a file. Renew the parts with significant damage or wear.

Seals. Carefully inspect their condition. Renew in case of even insignificant damages. The wear width of working edges should not exceed 1 mm.

Shafts. On working surfaces, threaded parts and on shaft splines no damages are allowed. To check the runout of the input shaft and the drive shafts of the front and rear axles place them on V-blocks and turn manually. The runout of face ends of bearing thrust shoulders should be no more than 0.01 mm.

When checking the layshaft, pay attention to the condition of the gear unit and the speedometer drive gear. No chipping or excessive wear of teeth is allowed. Renew bad parts.

Gears. When inspecting the gears, check the condition of teeth and landing surfaces. No teeth chipping or excessive wear is allowed. There should be no scuffings or wear on gears landing surfaces that may cause large gaps.

Check the gear mesh clearance; the mounting gap should be 0.10 mm, maximum allowed - 0.20 mm.

The mounting gap between the low gear and bush, and

between the input shaft and top gear should be 0.05-0.10 mm, maximum allowed - 0.15 mm. If wear exceeds the limits, renew the gears.

Bearings. Ball and roller bearings should have no damages on races, cages, rollers or balls, and no cracks and choppings on rings. The bearing radial gap should not exceed 0.05 mm.

When turned, a clean dry bearing should not knock. It should run smooth, without jamming. Renew damaged bearings.

Rods, forks. No deformation of forks and jamming of rods in the casing apertures is allowed. In case of jamming, renew the detent components. Weak springs should be replaced. The spring length under load of 99.15-114.85 N (10.2-11.8 kgf) should be 19 mm, when let free - 23.3 mm.

Ensure there are no traces of jamming on the gear shift clutch hub and especially on the clutch sliding surfaces, and also on the differential housing splines. Scuffings and burrs can be smoothed with a file. Special attention should be paid to the clutch teeth end faces; if their damage interferes with the clutch sliding when shifting the gears, renew the clutch.

Differential. Check the differential pinion shaft surface and the apertures in the differential housing; in case of insignificant damages smooth the surfaces with fine sandpaper, and at major damages - renew.

Check the surfaces of axle drive gear journals and their mounting apertures in differential housings, and also the adjusting washer surfaces and mating end face surfaces on the axle drive gears and housings. The detected damages can be removed by fine sandpaper or velvet file; renew the parts in case of major damages or wear.

With spring washer 15 being removed (see fig. 3-42) ensure there is no radial movement of circlip 8 in shaft grooves 14. Replace circlips in case of free play.

Drive line

Design of propeller shafts is shown on fig. 3-47, 3-48, 3-49.

Fault diagnosis

Diagnosis	Remedy
Knock in shafts at pull away, at hard acceleration or gear switching	
1. Loose fastening bolts and nuts on flexible coupling and U-joint flanges	1. Tighten nuts to torque specified in Appendix
2. Excessive backlash in spline joints of front or rear propeller shafts	2. Check gap on spline middle diameter; if it is more than 0.30 mm - renew worn parts
3. Worn U-joints	3. Repair joints and renew worn parts

Noise and vibration of propeller shafts

1. Deformation of front or rear propeller shaft	1. Rectify under press or renew
2. Propeller shafts out-of-balance	2. Check and balance shafts (see "Shaft balancing")
3. Worn or damaged centering bush on layshaft flexible coupling flange	3. Renew coupling flange bush
4. Worn U-joint	4. Repair joints and renew worn parts
5. Loose grease seal retainer on spline joint of front or rear propeller shaft	5. Tighten grease seal and compress retainer, renew oil seal in case of oil leak
6. Insufficient greasing of spline joints	6. Grease spline joints with Фiol-1 or Фiol-2У using oil cups

Lubrication leak

1. Loose grease seal retainer on spline joint of front or rear propeller shaft	1. Tighten grease seal and compress retainer, renew oil seal
2. Damaged layshaft CV-joint boot	2. Dismantle joint, renew greasing and boot. In case of damage - renew joint assembly

Removal and refitting

Place the vehicle on a lift or over an inspection pit, provide free rotation of front and rear wheels from one or both sides of the vehicle.

Reliably anchor the vehicle, release handbrake and place the gearshift lever in neutral.

Remove the front and rear propeller shafts.

Place fixture A.70025 on the layshaft flexible coupling 3 (see fig. 3-14) and, while turning the shaft, undo the bolt nuts that are fastening the flexible coupling to the gearbox output shaft flange. Remove the transfer box (see subsection. "Transfer box") in assembly with the intermediate shaft. Undo the pin nuts that are fastening the intermediate shaft joint to the transfer box input shaft flange and remove the intermediate shaft.

The refitting of propeller shafts is carried out in reverse order. Before refitting the intermediate shaft in assembly with the transfer box, place the flexible coupling centering ring on the gearbox output shaft. When refitting the layshaft, ensure the alignment of the gearbox and the transfer box shafts (see "Refitting the transfer box").

Before refitting the layshaft, grease the inner surface of the flange centering bush with 2-3 gr of ШПГУС-4.

Inspection without dismantle

After cleaning and washing the propeller shafts, check the shaft U-joints for smooth and easy rotation and absence of significant axial and radial gaps.

Check the layshaft balance on a balance bench, as follows.

It is not recommended to dismantle the propeller shafts, if the yokes are turning smoothly, there is no jamming, the mis-alignment of the drive axle shafts does not exceed 1.716 N•mm (175 grf•mm), the layshaft - 2.16 N•mm(200 grf•mm) and there is no lubricant leak from the spider bearing seals and the layshaft protective shroud.

Dismantling

Rear and front shafts. Make marks (with paint or punch) to note mutual location of mating parts so that to refit them in the same position and avoid misalignment of shafts.

Place the front (rear) shaft in vice with aluminum jaws. Remove the circlips using round-nose pliers.

Press out the bearing housing from the U-joint yoke. Proceed as follows:

- place the propeller shaft so that one of the yokes will be based on rest 1 (fig. 3-50). Move the other yoke (pos.3) with the help of the press rod through special bush 2 down until it will be pressed against the spider;

- turnover the yoke, repeat the described operations, i.e. move the other end of the yoke down to press against the spider. When performing these operations the opposite spider bearing will partially leave the yoke aperture and in the formed gap between the yoke and spider it will be possible to place bush 1 (fig. 3-51) with a side notch for further complete dismantle;

- place bush 1 (see fig. 3-51) on the spider stud, move the U-joint yoke down to press out the bearing;

- using the above specified procedure, press out the other spider bearings.

Layshaft. Disconnect the flexible coupling from flange 5 (see fig. 3-49). Note the amount and location of the coupling and balance washers 17 on the flange, so that to refit them in place.

In case of damage of the protective cover 6 or shroud 14, when it is required to inspect the joints and the quality of greasing, note the location of the U-joint in relation to the flexible coupling flange, and dismantle the U-joint using the procedure described in subsection "Front wheel drive".

Inspection

Eccentricity check. Place the front (rear) propeller shaft between the centers on a special bench and while turning it, check the runout, which should not exceed:

- 0.5 mm in 50 mm from the end weld seams;

- 0.3 mm in the middle part.

If the runout exceeds the specified values, straighten the shaft under a press or renew.

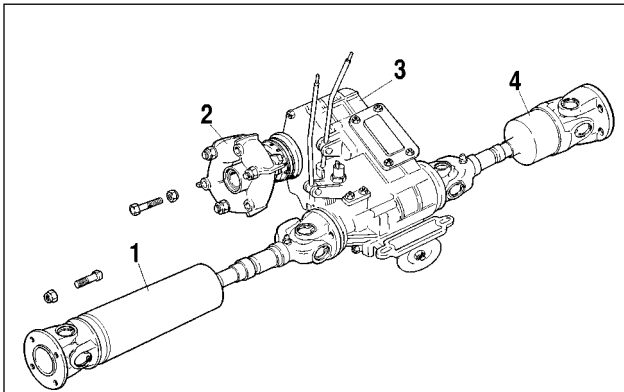


Fig. 3-47. Driveline assembly:

1 - front propeller shaft; 2 - layshaft; 3 - transfer box; 4 - rear propeller shaft

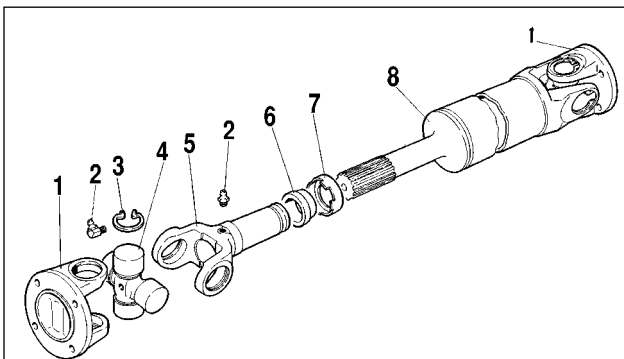


Fig. 3-48. Front propeller shaft, exploded view:

1 - U-joint flange; 2 - grease cup; 3 - circlip; 4 - spider; 5 - sliding yoke; 6 - seal; 7 - seal retainer; 8 - propeller shaft

Spline joint. Check the gap in the spline joint of the sliding yoke of the forward and rear shafts. The maximum allowable backlash on the spline middle diameter is 0.30 mm.

Check for the plug in yoke 5 (fig. 3-48), inspect retainer 7 and seal 6 of the sliding yoke. If necessary, renew the seal, and the retainer if damaged.

U-joint. Inspect the bearing housing, needles and thorns of the spider, seals, end face washers.

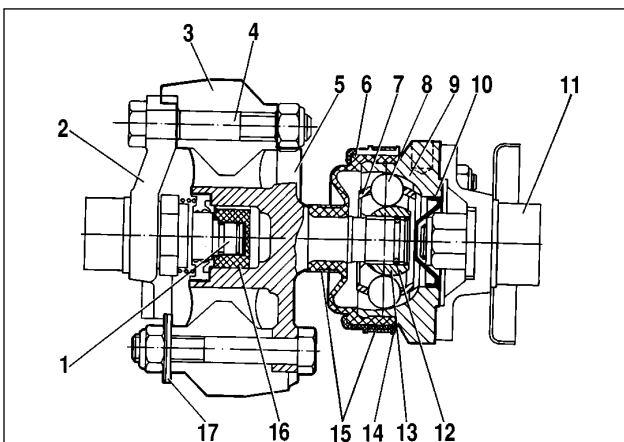


Fig. 3-49. Layshaft:

1 - gear box output shaft; 2 - output shaft flange; 3 - coupling insert; 4 - flange fastening bolt; 5 - coupling flange; 6 - boot; 7 - cage; 8 - ball; 9 - CV-joint housing; 10 - plug; 11 - transfer box input shaft; 12 - circlip; 13 - joint race; 14 - boot cover; 15 - clamp; 16 - centering bush; 17 - balancing washer

If any of the components are damaged, renew the spider in assembly with the bearings.

The diameter of the yoke opening for the needle bearing should not exceed 28.021 mm.

In case of damage or if wear of working surfaces of the layshaft U-joint components exceeds 0.1 mm, renew the U-joint assembly.

Flexible coupling. Inspect the rubber components of the flexible coupling. In case of cracks or peelings of rubber from the metal inserts, renew the flexible coupling.

Flexible coupling flange. Inspect the centering bush on the flexible coupling flange. Renew in case of damage or wear.

Reassembly

The reassembly is a reversal of dismantle, providing the following:

- evenly grease the spline joints with 3-4 gr of ФИОЛ-1 or ФИОЛ-2У;
- match the marks on the dismantled parts;
- after reassembling the spline joint, apply axial load to press the seal by 0.3-0.5 mm and crimp the retainer on the yoke groove.

The reassembly of the U-joint is carried out in the following sequence:

- remove old greasing, lubricate the inner surface of the bearing housing with grease № 158 or ФИОЛ-2У (0.8-1.2 gr on each bearing). Do not grease the spider thorns, to avoid an air plug during reassembly. Mount the spider into fork apertures. Insert a bearing in one of the yoke openings and place circlip1 (fig. 3-52) with thickness of 1.56 mm in the yoke groove. Insert a bearing in the other yoke opening until the opposite bearing will thrust against the circlip end face. The pressing force should not exceed 15000 N (1500 kgf).

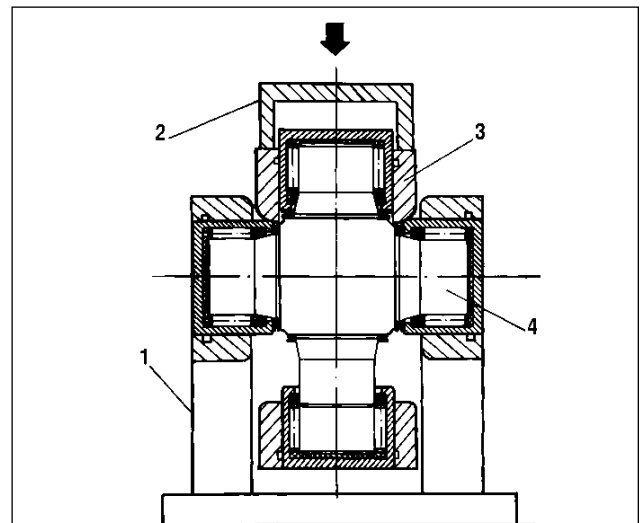
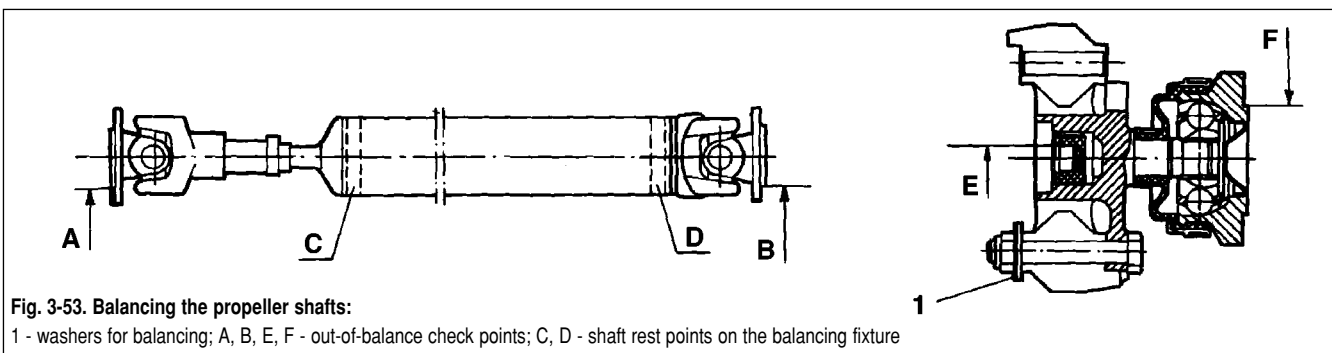
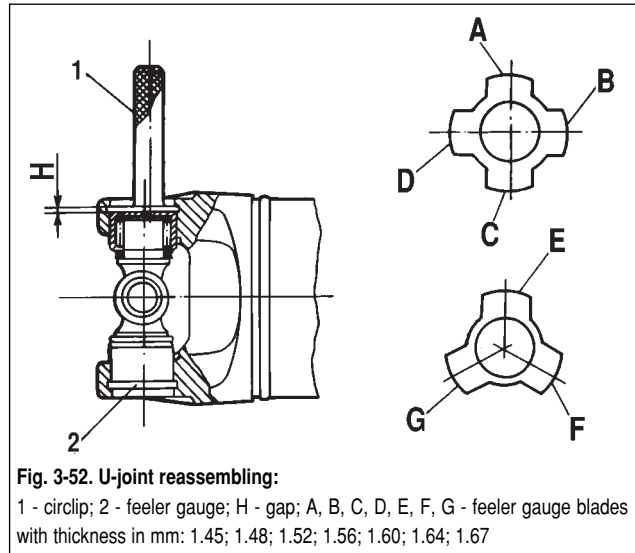
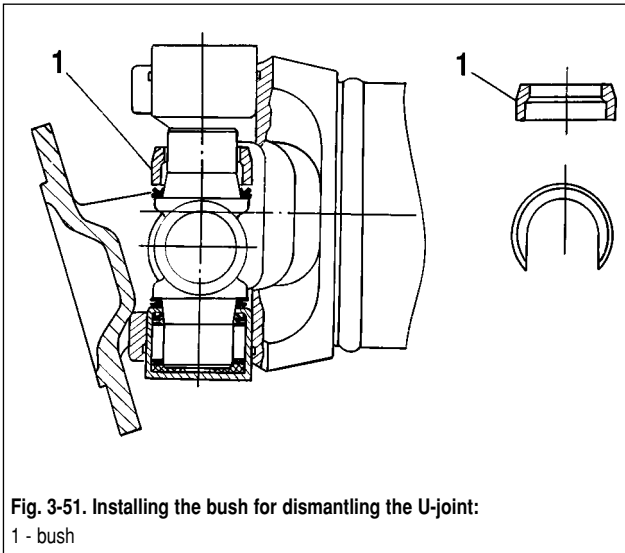


Fig. 3-50. Dismantling the U-joint:

1 - rest; 2 - bush; 3 - joint fork; 4 - spider



Using two feeler gauges 2, with 4 and 3 blades of different thickness accordingly, determine which will tightly fit in the clearance **H** between the base of the bearing and the yoke groove end face, and install a circlip of the same thickness.

Note. One feeler gauge has blades with thickness of 1.45; 1.48; 1.52; 1.56 mm, the other one - 1.60; 1.64; 1.67 mm.

If the blade of the smallest thickness (1.45 mm) does not fit into gap **H**, replace circlip 1 with the one having thickness of 1.4 mm and repeat the procedure.

If the blade of the greatest thickness (1.67 mm) loosely fits into backlash **H**, it is necessary to remove ring 1 and insert in this gap a ring with thickness of 1.67 mm, and repeat all specified operations.

Note. It is recommended to carry out the gap measurement from the side of the pipe. The circlips are provided in eight size sets (according to their thickness), each of them has a certain colour: 1.45 - not painted; 1.48 - yellow; 1.52 - brown; 1.56 - dark blue; 1.60 - black; 1.64; 1.67; 1.40 - colors are not designated and their thickness is determined by measuring.

After inserting the circlips, hit the yoke forks with a hammer with plastic head. After the impact the backlash between the bearing bottom and the circlip will be taken up, and formed between the bearing housing and spider thorn end faces within

0.01-0.04 mm. After reassembly, check for easy rotation of the U-joint yokes and the shaft balance.

To reassemble the layshaft U-joint follow the procedure described in chapter "Front wheel drive". When reassembling, install retainer 7 (see fig. 3-49) with the chamfer facing the transfer box input shaft, and grease the U-joint with 20 cm³ of Longtern-00 from "Dow corning".

Shaft balance

The front and rear propeller shafts are balanced on special machines by welding metal plates.

At speed of 5500 min⁻¹ the shaft misalignment, checked on surfaces **A** and **B** (fig. 3-53), should not exceed 1.72 N•mm (175 grf•mm), and at the balance check - 2.16 N•mm (220 grf•mm).

The layshaft balance is checked at speed of 800 min⁻¹ on surfaces **E** and **F**. Equilibration is provided by balance washers 1 (see fig. 3-53) and drilling the U-joint housing. The out-of-balance condition should not exceed 1.96 N•mm (200 grf•mm).

ATTENTION. If any of the shaft components were replaced during repair, it is necessary to balance the shafts.

After balancing, lubricate the U-joint bearings with grease N158 or ФИОЛ-2У through oilers. Force in the grease until it will start coming out through the sealings.

Rear axle

The design of the rear axle is shown on fig. 3-54.

Fault diagnosis

Diagnosis	Remedy
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Excessive noise from the rear wheels

1. Loose wheel fastening	1. Tighten wheel securing nuts
2. Worn or failed axle shaft ball bearing	2. Inspect axle shaft and replace bearing

Constant excessive noise at rear axle operation

1. Deformed rear axle beam, damaged axle shaft bearings	1. Rectify beam and check dimensions, renew axle shaft bearings
2. Damaged axle shafts and intolerable runout	2. Straighten axle shafts. In case of heavy damages - renew
3. Wrong adjustment, damage or wear of gears or reduction gear bearings	3. Isolate problem and repair reduction gear
4. Wear or wrong adjustment of differential bearings	4. Dismantle reduction gear, repair and adjust

Noise at acceleration and engine deceleration

1. Wrong adjustment of final drive gear mesh during reduction gear repair	1. Adjust gear mesh
2. Damaged axle shaft bearing	2. Renew bearings
3. Insufficient amount of oil	3. Top up oil and check for leaks from seals and rear axle beam
4. Worn gap in final drive gear mesh during reduction gear	4. Adjust clearance
5. Excessive gap in driving gear bearing due to loose flange fastening nut or worn bearing	5. Check moment of resistance to rotation, tighten nut or renew damaged parts

Noise at cornering

1. Damaged axle shaft bearings	1. Renew bearings
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Knock at the beginning of movement

1. Worn opening in differential box for differential pinion shaft	1. Replace differential box
2. Loose rear suspension arm fastening bolt	2. Tighten bolts

Oil leak

1. Worn or damaged driving gear seal	1. Renew oil seal
2. Worn axle shaft seal, determined by excessive oil on braking plates, drums and pads	2. Check axle shaft runout, beam sag. Straighten or replace damaged parts
3. Loose fastening bolts on rear axle reduction gear casing, damaged sealings	3. Tighten bolts, replace gaskets

Rear axle - removal and refitting

The removal and refitting of the rear axle beam is described in subsection "Rear suspension". To remove the rear axle it is enough to disconnect the suspension arm and the shock-absorbers only from the rear axle beam. When refitting the rear axle the bar fastening bolts should be tightened according to the regulations in subsection "Rear suspension". After refitting, bleed the brakes and adjust the main and handbrake systems as directed in section "Brakes". Fill the rear axle with transmission oil through oil fillers.

Rear axle - dismantling and reassembly

Dismantling. Disconnect the pipe ends from the brake cylinders and remove the pipeline with the brake system tee from the axle.

Place the axle on a repair-bench and drain oil.

After removing the brake drum and undoing the braking plate fastening nuts with pusher 67.7823.9516 (fig. 3-55), take out the axle shaft in assembly with the oil screen, the bearing fastening plate, the bearing and a stop ring. Remove the braking plate and the sealing ring. If necessary to renew, take out the sealing ring from the axle beam flange.

Do the same on the other end of the beam, then remove the reduction gear.

The reassembly of the rear axle is carried out in reverse sequence:

- grease the threads of the reduction gear fastening bolts with a sealant, previously having degreased them and the threaded connections in the rear axle beam;

- grease the axle shaft bearing seal with ЛИТОЛ-24 before refitting, and use tool A.70157 to refit the seal in the beam flange;
- grease the landing shoulder of the axle shaft and the drum-mating surface of the flange with graphite or ЛЦЦ-15.

The brake drums are installed after refitting the rear axle on the vehicle and fastening the cable ends to the handbrake linkage levers.

Rear axle beam - inspection

Carefully inspect the beam, especially on a vehicle after collision. A damaged beam can become the reason of noise in the rear axle and quick wear of tyres.

The deformation of the axle beam is checked both horizontally and vertically.

Attach flange A.70172 to each end of the beam, place the beam with the flanges on identical V-blocks located on a surface plate with length no less than 1600 mm so that the abutment surface between the casing and the beam will be vertical.

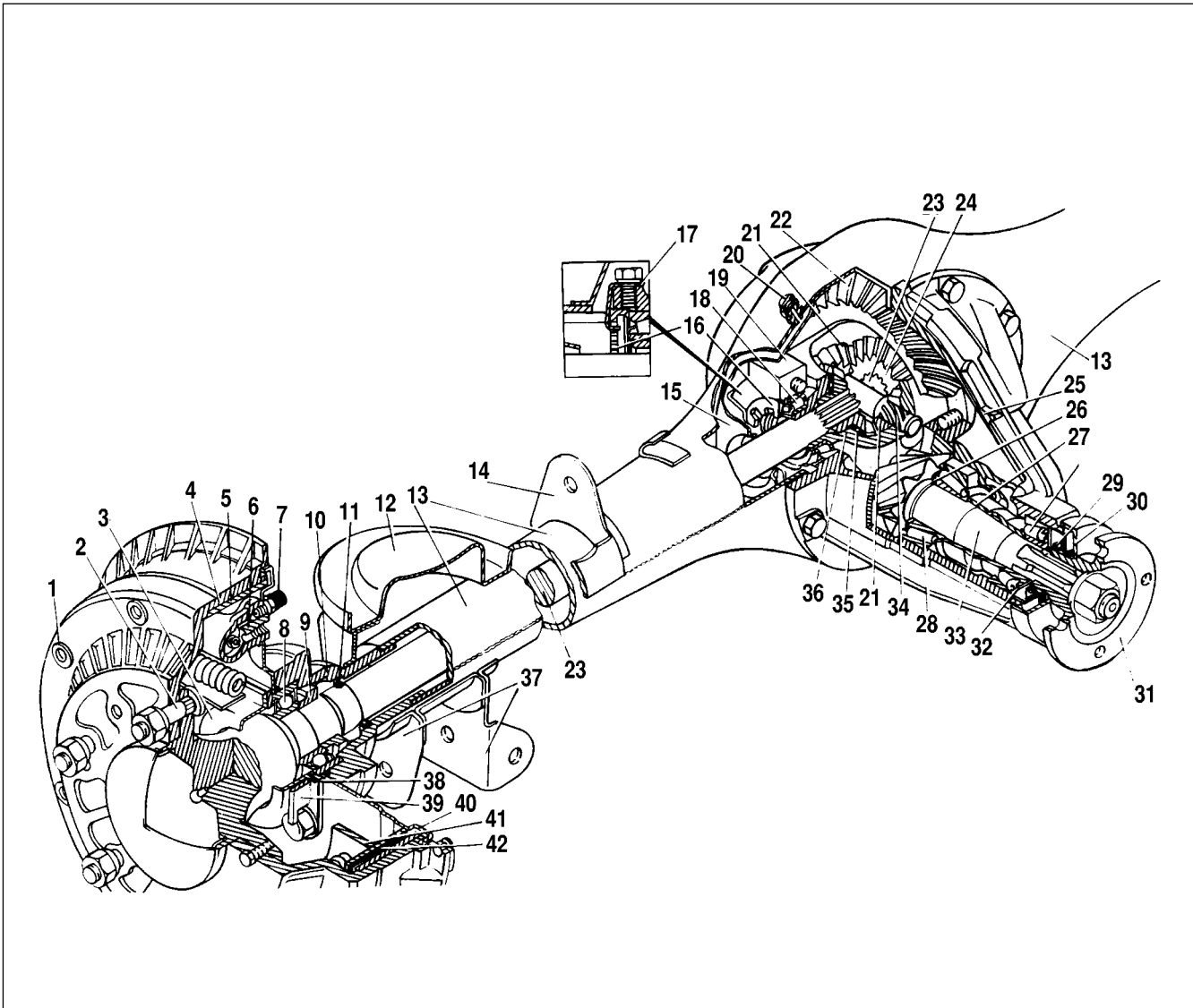


Fig. 3-54. Rear axle:

1 - wheel cap; 2 - brake drum-to-wheel securing bolt; 3 - oil deflector; 4 - brake drum; 5 - brake drum iron ring; 6 - wheel cylinder; 7 - bleeder; 8 - axle shaft bearing; 9 - bearing locking ring; 10 - rear axle beam flange; 11 - oil seal; 12 - suspension spring cup; 13 - rear axle beam; 14 - rear suspension bar mounting bracket; 15 - axle shaft guide; 16 - differential bearing adjusting nut; 17 - nut locking plate; 18 - differential housing bearing; 19 - bearing cover; 20 - breather; 21 - pinion; 22 - driven gear; 23 - axle shaft; 24 - differential side gear; 25 - rear axle reduction gear casing; 26 - shim; 27 - bearing spacer sleeve; 28 - final drive bearing; 29 - grease seal; 30 - splash guard; 31 - flange; 32 - oil screen; 33 - final drive gear; 34 - pinion shaft; 35 - axle shaft gear washer; 36 - differential housing; 37 - suspension mounting bracket; 38 - axle shaft bearing, mounting plate; 39 - plate fastening bolt holder; 40 - rear brake backplate; 41 - rear brake shoe; 42 - shoe pad

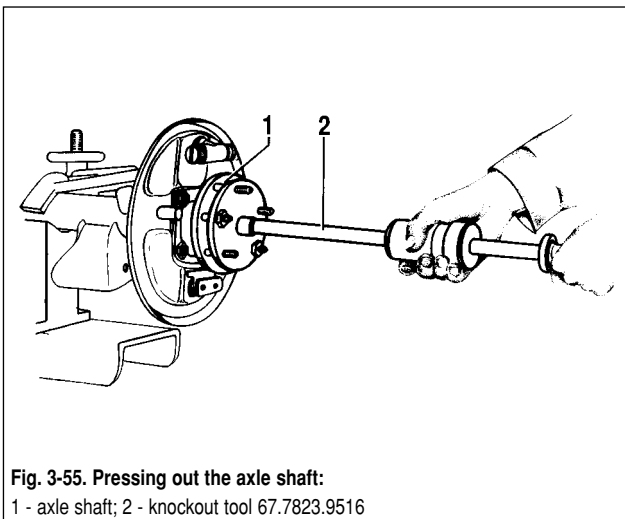


Fig. 3-55. Pressing out the axle shaft:

1 - axle shaft; 2 - knockout tool 67.7823.9516

Check the beam deformation by attaching a try square to the outer (fig. 3-56) and side (fig. 3-57) surfaces of the flange A.70172; if the beam is not deformed, the try square will fit perfectly.

Size of deformation is checked by a probe. If a 0.2 mm gauge passes through on any of the flanges, the beam should be straightened.

Using a try square (fig. 3-58), check the normality of the reduction gear fastening surface vs the seating surface of flange A.70172. The 0.2 mm feeler gauge should not fit.

Make a 90 ° turn of the axle beam and place it on V-blocks. A try square applied to the outer surface of the flange (fig. 3-59) should adjoin with no gaps, otherwise check the size of deformation by a feeler gauge. The 0.2 mm gauge should not fit.

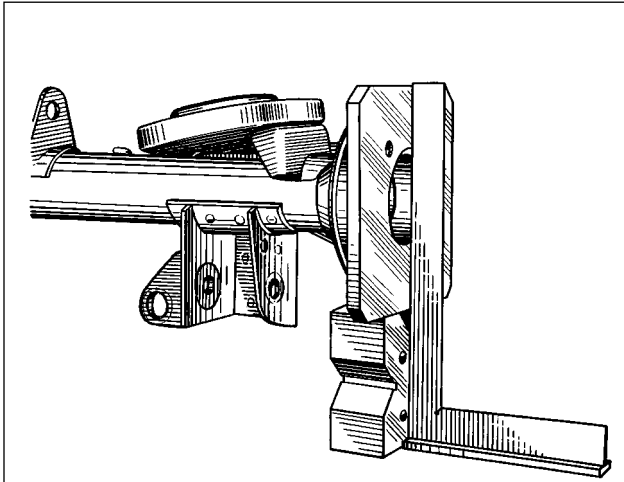


Fig. 3-56. Checking for vertical deformations of the rear axle beam using a try-square on the outside surface of flange A.70172

If deformation exceeds this size, straighten the beam, following the procedure given below.

After straightening, carefully wash the beam, clean the magnetic plug, put it in place and check the following:

- quality of weld seams and leak-proofness of the beam;
- the beam breather and the beam should be clean inside (no burrs, chippings or oil residues).

After that paint the beam to protect from corrosion.

Straightening the rear axle beam

Attach to each end of the beam flanges A.70172 (the set used for straightening and not for checking the beams) and place it on supports of a hydraulic press so that the ends of the clamping crossrail 2 (fig. 3-60) were in the zone of deformation. The most probable location of the zone is in 200-300 mm from the end faces of the beam flange.

Establish rack 7 with the indicator so that the leg of the indicator will rest against the top part of the flange side surface, and

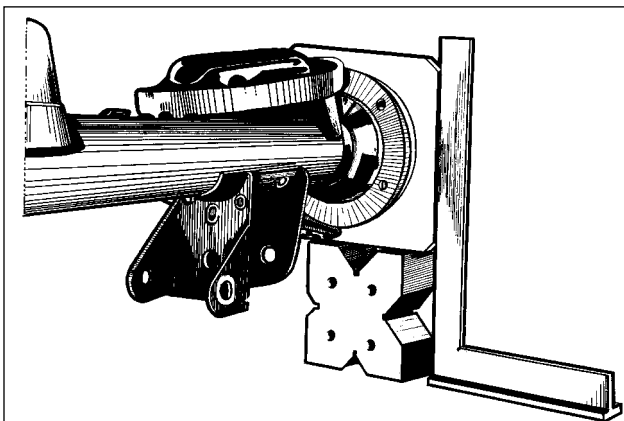


Fig. 3-57. Checking for twisting of the rear axle beam using a try-square on the side surface of flange A.70172

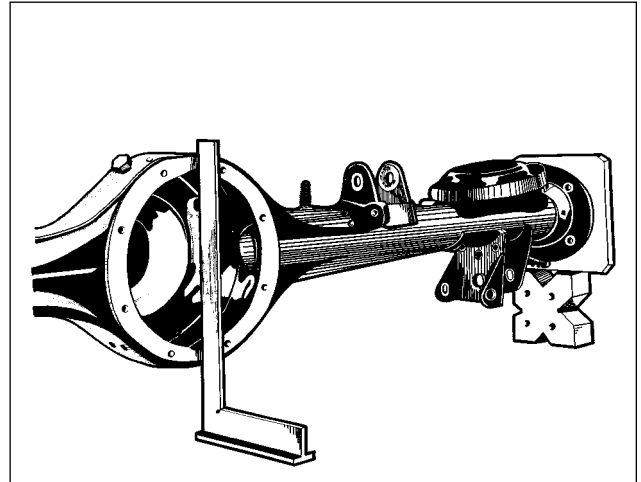


Fig. 3-58. Checking the reduction gear mounting

the arrow of the indicator will point to the division equal to the size of beam deformation measured by a feeler gauge when checking the beam. On the other end of the beam place either a rack with an indicator or a try square 4.

Place rests 6 under the beam (in the zone of deformation), straighten the beam on a hydraulic press first horizontally and then vertically, monitoring the results by an indicator or a feeler gauge with a try square 4.

The maximum pressing force during straightening should not exceed 98 kN (10000 kgf), so that not to affect the housing profile.

Note. If the height of the rest was experimentally correctly adjusted, the beam can be straightened without monitoring by a try square or an indicator.

Remove the beam from the press and check as mentioned above, having replaced flanges A.70172 with "test" ones.

In case there is no necessary equipment available, as an exception, it is possible to straighten the rear axle beam first from one side, then from the other, but with an obligatory deformation check from both sides (see "Rear axle beam check").

Axle shafts

Removal and refitting

Remove the wheel and the brake drum.

After unscrewing the nuts fastening the brake backplate to the axle beam, hold the backplate, and using pusher 67.7823.9516 remove the axle shaft together with the oil screen, bearing fastening plate and bearing stop ring.

Take out the seal from the beam flange if necessary to renew.

The axle shaft refitting is a reversal to removal, paying attention not to damage the working edge of the seal. Before refitting the brake drum, grease the landing shoulder of the axle shaft with

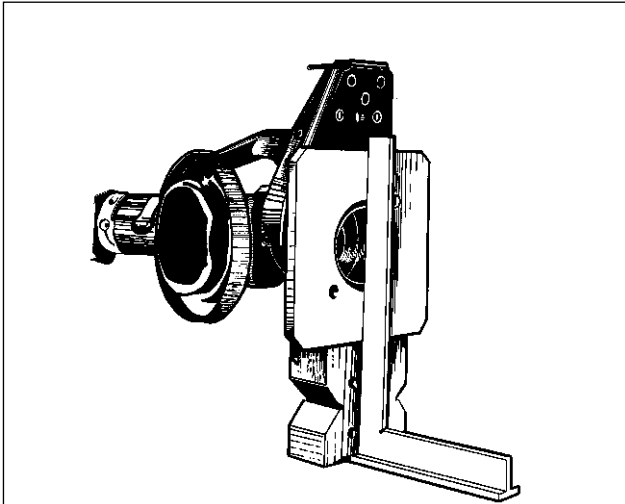


Fig. 3-59. Checking for horizontal deformations of the rear axle beam using a try-square on the outside surface of flange A.70172

graphite greasing or ЛЦЛ-15. After refitting, check the operation of axle shafts during an actual road test.

Inspection

Inspect the parts composing a complete set, and make sure that:

- bearing is not worn and is not damaged; if the axial gap exceeds 0.7 mm, renew the bearing;
- stop ring and bearing are not shifted in relation to the initial position; if the bearing inner ring turns against the axle shaft landing shoulder, renew the stop ring;
- bearing fastening plate and oil screen have no damages;
- axle shaft is not deformed and the landing surfaces are not damaged; the axle shafts runout measured in centers, on the seal journal does not exceed 0.08 mm. Before fitting in the centers, carefully clean the centering apertures on the axle shaft from dirt and rust.

In case of wear or damage of parts fitted on the axle shaft, renew them following the below guidelines and using special tools. An insignificant bending of the axle shaft core can be corrected by straightening. After straightening the runout of the

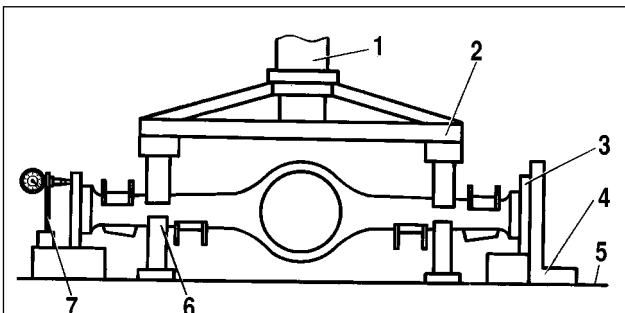


Fig. 3-60. Rear axle beam straightening:
1 - hydraulic cylinder; 2 - clamping bar; 3 - flange A.70172; 4 - try-square;
5 - press table; 6 - rest; 7 - indicator post

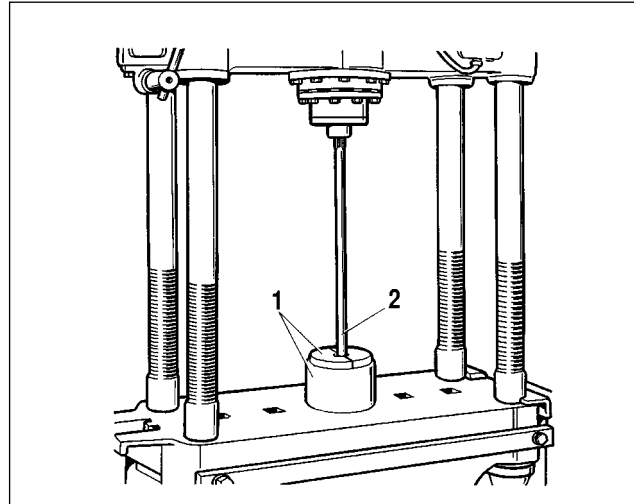


Fig. 3-61. Pressing out the axle shaft bearing stop ring:
1 - fixture; 2 - axle shaft

flange end face measured in the centers, should not exceed 0.05 mm, if the runout is above the specified value, but no more than 0.08 mm, it can be lathed to eliminate runout. The reduction of flange thickness due to turning should be no more than 0.2 mm.

Stop ring removal

The axle shaft bearing stop ring is removed and installed on a hydraulic press.

First, bend out bolt retainers 39 (see fig. 3-54) that are fastening plate 38 with the oil screen and the brake plate, and take out the bolts.

Straddle the bearing with tool 67.7823.9529 and place the axle shaft vertically so that the half-rings are rested on the thrust ring.

Place the axle shaft under the press (fig. 3-61) and apply gradually increasing force to the spline end of the axle shaft until the bearing stop ring will be removed. The bearing stop ring should be renewed.

Ensure that the landing surface of the axle shaft has no marks or damages; renew if necessary.

Axle shaft reassembly

Place the axle shaft vertically and rest the flange on ring 7 (fig. 3-62) of tool 67.7823.9530.

Bolt together the axle shaft bearing oil screen and the bearing fastening plate with a seal, and refit the assembly on the axle shaft; fit the axle shaft ball bearing.

Fit a new stop ring into special retainer 3, place into heater and warm the ring up to approximately 300 °C, so that at the moment of press-fitting its temperature will be 220-240 °C.

The stop ring is press-fitted on the axle shaft with tool 1 on a press with force of 58.8 kN (6000 kgf) so that the bearing inner ring is fixed between the stop ring and the axle shaft collar.

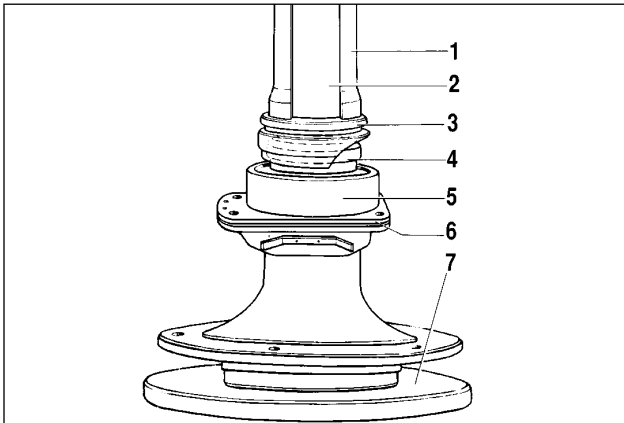


Fig. 3-62. Press-fitting the axle shaft bearing stop ring:
1 - tool; 2 - axle shaft; 3 - race; 4 - stop ring; 5 - bearing; 6 - oil deflector assembly and bearing securing plate; 7 - ring

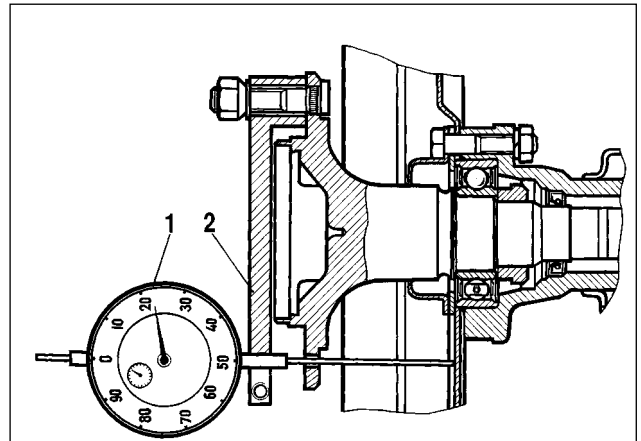


Fig. 3-64. Checking the axle shaft axial play with the wheel and the brake drum removed:
1 - indicator; 2 - fixture

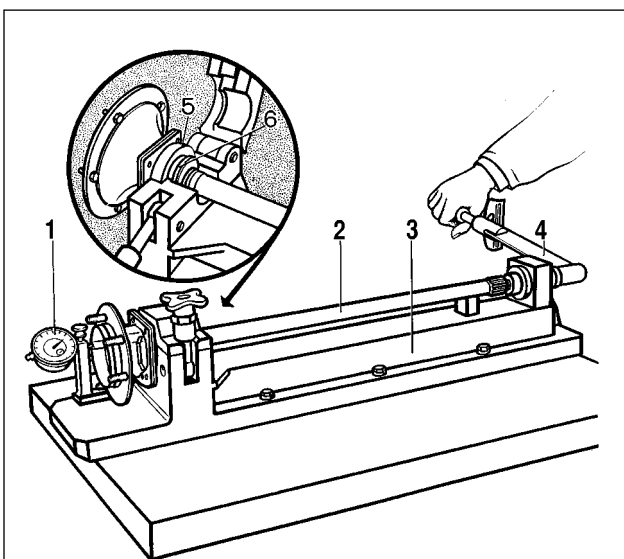


Fig. 3-63. Checking the force of pressing out the axle shaft bearing stop ring:
1 - indicator; 2 - axle shaft; 3 - fixture; 4 - dynamometer; 5 - bearing; 6 - bearing stop ring

After press-fitting, ensure, that the ring does not shift under the axial load of 19.6 kN (2000 kgf). To do this, place the axle shaft assembly on a special fixture (fig. 3-63), and grip the stop ring in special vice.

Attach the leg of indicator 1 with scale interval of 0.01 mm to the axle shaft flange. Set the arrow to "0" and apply the specified axial load, creating with a dynamometer the torque of 78.5-83.3 N•m (8-8.5 kgf•m) on the tool screw. The screw through the ball should be pressed against the axle shaft end face. There should be no, even a slightest, gap between the stop ring and the inner ring of the bearing.

After removing load and when undoing the tool screw, the indicator arrow should return to zero, thus proving there was no shift between the stop ring and the axle shaft. If the indicator arrow does not return to zero, it will mean the stop ring had shifted and the axle shaft assembly should be renewed.

After checking the press fitting of the stop ring, replace the fastening bolts of the plate and oil screen 6 (see fig. 3-62) and fix them in place by bending back the bolt retainers.

On-vehicle measurement of the axle shaft axial play

Slacken the rear wheels fastening nuts. Put blocks under front wheels and raise the rear axle. Release the handbrake and place the gear shift lever in neutral.

Remove wheels and brake drums. Attach tool 02.7834.9504 (fig. 3-64) to the axle shaft, pass through one of the axle shaft openings the indicator 1 leg extension until it will rest against the braking plate or the oil screen and fix the indicator.

Make the measurement with the indicator, applying to the axle shaft flange force of approx. 49 N (5 kgf) in both directions along the rear axle shaft. The free play should not exceed 0.7 mm.

Reduction gear

The rear axle reduction gear assembly is shown on fig. 3-65. It is unified with the reduction gear of VAZ - 2106 and has a label on the housing as figure 6.

Fault diagnosis by noise

Fault diagnosis is carried out in the following sequence.

Test 1. In order to clearly determine the character of noise, drive the vehicle on a highway with speed approximately 20 km/h. Then gradually increase speed up to 90 km/h, listen carefully to various noises and note speed, at which they occur and disappear.

Release the throttle pedal and without applying the brake pedal shift to lower gear.

During deceleration listen how noises change, and note the moment, when noise increases. Usually, noises appear and disappears at same speeds both at acceleration and deceleration.

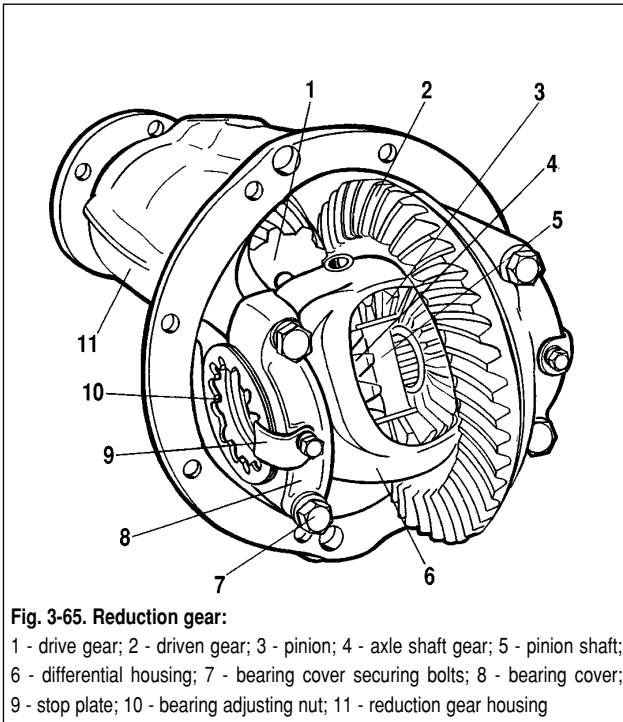


Fig. 3-65. Reduction gear:
 1 - drive gear; 2 - driven gear; 3 - pinion; 4 - axle shaft gear; 5 - pinion shaft;
 6 - differential housing; 7 - bearing cover securing bolts; 8 - bearing cover;
 9 - stop plate; 10 - bearing adjusting nut; 11 - reduction gear housing

Test 2. Accelerate the vehicle approximately up to 100 km/h, place the gear shift lever in neutral, switch off ignition and let the vehicle to roll on to a stop; listen to the noise character at various speeds during deceleration.

ATTENTION. *With the ignition switched off, be attentive and careful. Do not turn the key more than it is necessary, as it may activate the anti-theft system.*

Noise noticed during this test and corresponding to the one noticed at the first test, does not originate from the final drive drive gears, as they do not make any noise without load.

And on the contrary, noise marked during the first test and which was not repeated at the second one, can proceed from the reduction gears or the driving gear bearing or the differential.

Test 3. On a parked vehicle with the handbrake set, switch on the engine and, by gradually increasing the revolutions, compare the arisen noises with those noticed in the previous tests. Noises similar to those indicated in test 1, do not originate from the reduction gear and are likely to be caused by other units.

Test 4. Noise noticed at the first test and which were not repeated at the subsequent, originate from the reduction gear; for confirmation lift the rear wheels, start the engine and engage the fourth gear. Thus, it is possible to ensure, that noise indeed originates from the reduction gear, and not from the other units, for example, suspension or car body.

Reduction gear - removal

If it is necessary to remove only the reduction gear:

- drain oil from the rear axle beam;
- raise the rear part of the vehicle, place it on supports and remove wheels and brake drums;

- undo nuts fastening the braking plate to the beam and pull out the axle shafts so that they come out from the differential box;
- disconnect the propeller shaft from the reduction gear, put a support under the reduction gear casing, turn out the bolts fastening it to the rear axle beam and take out the reduction gear from the beam, pay attention not to damage the sealing.

Reduction gear - refitting

Before refitting the reduction gear, carefully clean the axle beam from oil. Place a sealing on the mating surface, fit the reduction gear into the beam and fix with bolts. Grease the bolt threads with a sealant. Before greasing the bolts and connections in the beam carefully degrease all surfaces. Connect the propeller shaft to the reduction gear. Install the axle shafts and brake drums.

Install a wheel with a tyre and fasten without tightening the wheel nuts. After refitting both wheels, remove the supports and lower the vehicle; then tighten the wheel nuts with a torque wrench.

Fill the axle beam with oil through the filler, previously having cleaned and screwed in the drain plug.

Reduction gear - dismantle

Fix the reduction gear on a bench. Remove lock plates 9 (see fig. 3-65), turn out bolts 7 and remove covers 8 of the differential box bearings, adjusting nuts 10 and outer rings of the roller bearings. Make marks on covers 8 and bearing outer rings, so that to refit them on former places.

Take out from the reduction gear casing 11 the differential box together with the driven gear 2 and bearing inner rings.

To remove gear 1 and its components:

- turn the reduction gear casing with the filler neck upward (fig. 3-66), hold driving gear flange 3 with tool 1, and undo the flange fastening nut with wrench 2;
- remove the flange and take out the driving gear with the adjusting ring, rear bearing inner ring with distance sleeve;
- take out the seal, the oil screen and the front bearing inner ring from the reduction gear casing;
- using tool A.70198 press out the outer rings from the front and rear bearings;
- remove the distance sleeve from the driving gear and with the help of a universal puller A.40005/1/7 and tool A. 45008 (fig. 3-67) take out the inner ring from the rear roller bearing;
- remove the driving gear adjusting ring.

To dismantle the differential:

- remove inner rings 2 (fig. 3-68) from the differential box 3 roller bearings with the help of a universal puller A.40005/1/6 and rest A.45028;
- undo the driven gear fastening bolts and punch out the differential pinion shafts from the differential box;

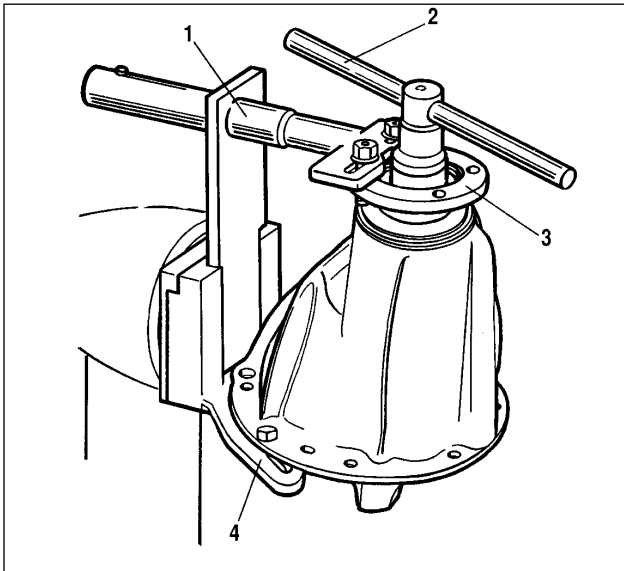


Fig. 3-66. Undoing the drive gear nut:
 1 - tool to fix the drive gear flange; 2 - box wrench; 3 - drive gear flange;
 4 - bracket

- turn the differential side gears and differential pinions so that the last ones will roll out from the differential openings, then take them out;

- remove the differential side gears with support washers.

Inspection of reduction gear components

Before inspection carefully wash all parts. It will help to locate wear and damages.

Check for damages on the final drive gear teeth and for proper location of the bearing pattern between the teeth. In case of inadmissible wear renew the parts; find the reason for wrong teeth mesh.

Note. As spare parts the driving and driven gears are delivered in a complete set matched by noise and mesh, therefore both should be replaced in case of damage.

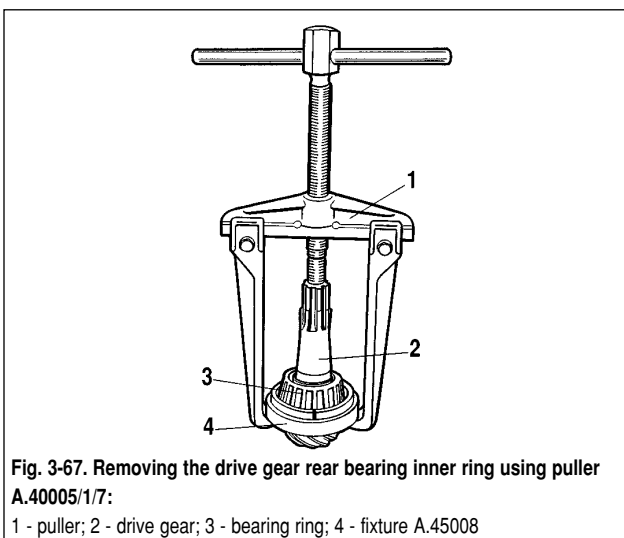


Fig. 3-67. Removing the drive gear rear bearing inner ring using puller A.40005/1/7:
 1 - puller; 2 - drive gear; 3 - bearing ring; 4 - fixture A.45008

Inspect the differential pinion apertures and the shafts; insignificant surface damages smooth with fine sandpaper, and renew in case of serious damages.

Inspect the surfaces of the axle shaft gear journals and their bores in the differential box, check the condition of box apertures for differential pinion shafts. The revealed damages should be eliminated as described above, if necessary, replace worn or damaged parts.

Examine the surfaces of the differential side gear support washers, even insignificant damages should be eliminated. When replacing, match the new washers by thickness.

Examine the roller bearings on the drive gear and the differential boxes; they should have smooth working surfaces and no wear. Replace bearings in slightest doubt in their serviceability, as bad condition of bearings can cause noise and teeth jamming.

Check for deformations or cracks on the casing and on the differential box, renew if necessary.

Reduction gear - reassembly

The reliable operation of the reduction gear is provided by strict observance of following guidelines on reassembly and adjustment.

The reduction gear components are shown on fig. 3-69.

Differential reassembly. Grease the differential side gears with support washers and the differential pinions with transmission oil and establish them through the openings in the differential box. Turn differential pinions and differential side gears so that to align the rotation axis with the opening axis in the box, then insert the differential pinion shaft.

Check the axial gap in each differential side gear: it should be 0-0.10 mm, and the moment of resistance to rotation of the differential gears should not exceed 14.7 N•m (1.5 kgf•m).

In case of an excessive gap resulting from wear of differential parts, replace the support washers of the differential side gears by others of greater thickness. If the specified clearance

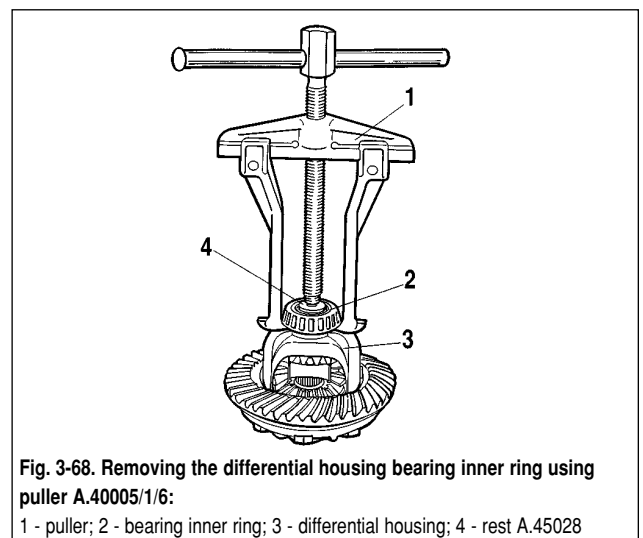


Fig. 3-68. Removing the differential housing bearing inner ring using puller A.40005/1/6:
 1 - puller; 2 - bearing inner ring; 3 - differential housing; 4 - rest A.45028

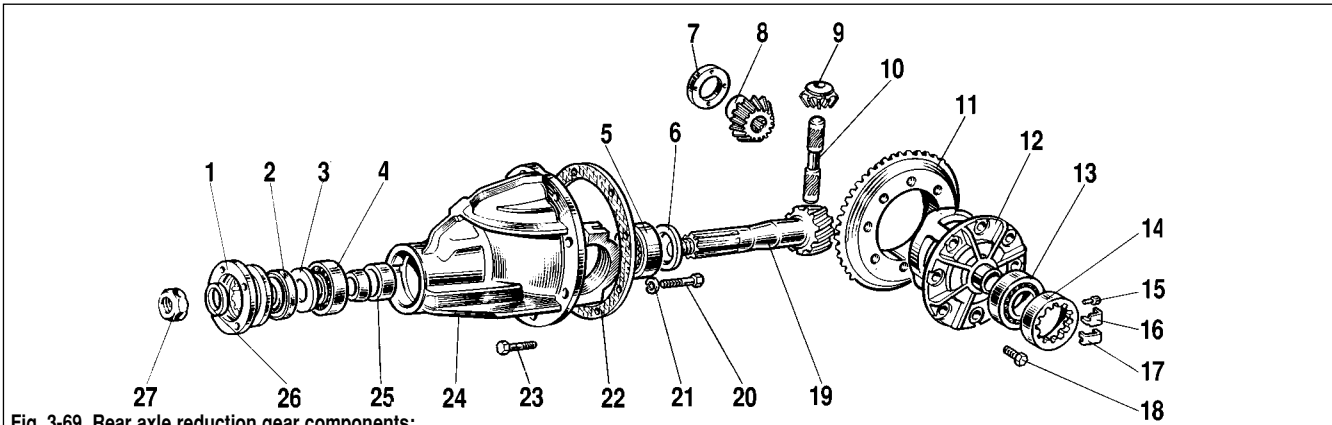


Fig. 3-69. Rear axle reduction gear components:

1 - drive gear flange; 2 - oil seal; 3 - oil deflector; 4 - front bearing; 5 - rear bearing; 6 - drive gear adjusting ring; 7 - axle shaft gear support washer; 8 - axle shaft gear; 9 - pinion; 10 - pinion shaft; 11 - driven gear; 12 - differential housing; 13 - differential housing bearing; 14 - adjusting nut; 15 - stop plate securing nut; 16 - stop plate; 17 - stop plate; 18 - driven gear fastening bolt; 19 - drive gear; 20 - cover securing bolt; 21 - spring washer; 22 - gasket; 23 - reduction gear securing bolt; 24 - reduction gear housing; 25 - distance sleeve; 26 - flat washer; 27 - drive gear flange securing nut

fails to be achieved even by increasing the washer thickness, renew the gears due to their excessive wear.

Fix the gear on the differential box.

Using tool A.70152 press-fit the roller bearing inner rings on the differential box.

Drive gear - refitting and adjustment

The correct location of the drive gear against the driven gear is provided by selecting the thickness of the adjusting ring fitted between the driving gear face and the rear bearing inner ring.

Select the thickness of the adjusting ring with the help of tool A.70184 and tool A.95690 with an indicator. The procedure is carried out in the following sequence.

Fix the reduction gear casing on a bench, use tool A.70185 to press-fit the outer rings of the drive gear front bearing in the casing, and tool A.70171 (fig. 3-70) - for the rear bearing.

On tool A.70184, simulating the driving gear, with the help of tool A.70152, fit the rear bearing inner ring and insert the tool into the reduction gear casing (fig. 3-71).

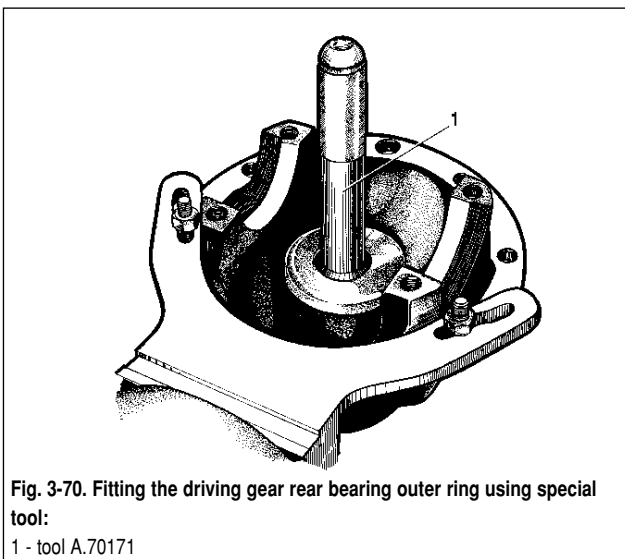


Fig. 3-70. Fitting the driving gear rear bearing outer ring using special tool:

1 - tool A.70171

Fit the front bearing inner ring, the driving gear flange and, while turning the tool to refit the bearing rollers correctly, tighten the nut with torque to 7.85-9.8 N·m (0.8-1 kgf·m).

Fix tool A.95690 on tool face 4 and adjust the indicator with a 0.01 mm scale to zero having established its leg on the same end face of tool A.70184. Then move indicator 1 so that its leg will be on the landing surface of the differential housing bearing.

Turn tool 4 with indicator left and right, and find a position in which the arrow of the indicator will show the minimum reading of "a₁" (fig. 3-72) and record. Repeat this operation on the landing surface of the second bearing and record the reading of "a₂".

Define thickness "S" of the driving gear adjusting ring, which is an algebraic difference between "a" and "b":

$$S = a - b$$

Where:

a - average arithmetic distance from the tool 1 face (fig. 3-64) to the differential bearing journals

$$a = (a_1 + a_2) : 2$$

b - deviation of the driving gear from the nominal position in terms of mm. The size of deviation is marked on the driving gear (fig. 3-73) in hundredth of a millimeter with a plus or minus sign.

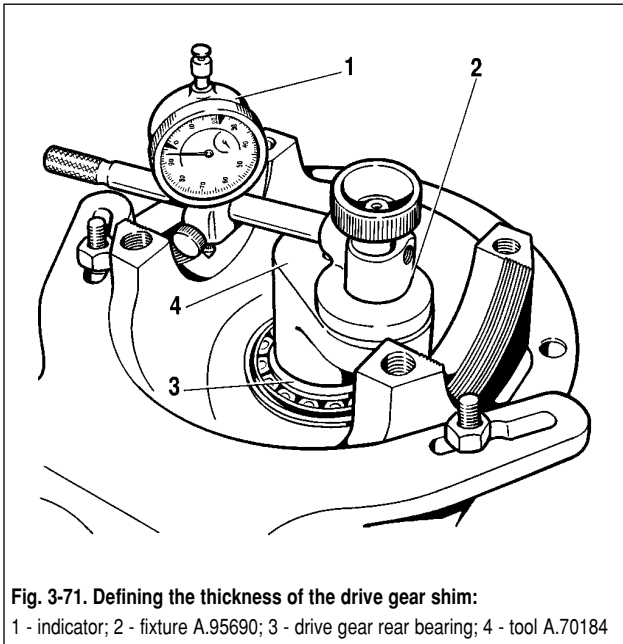
When finding the thickness of the adjusting ring pay attention to the "b" sign and unit of measurement.

Example. We presume, that size "a", determined by the indicator, is equal to 2.91 mm (size "a" is always positive), and on the driving gear after the serial number the deviation of "-14" is shown. To get size "b" in millimeters, we multiply the specified size by 0.01 mm.

$$b = -14 \cdot 0.01 = -0.14 \text{ mm}$$

Determine the thickness of the driving gear adjusting ring in millimeters.

$$S = a - b = 2.91 - (-0.14) = 2.91 + 0.14 = 3.05 \text{ mm}$$



In this case fit an adjusting ring with thickness of 3.05 mm.

Fit an adjusting ring of the necessary thickness on the driving gear and press fit using tool A.70152 (fig. 3-74) the rear bearing inner ring which was taken from tool A.70184. Fit the distance sleeve.

ATTENTION. When repairing the rear axle reduction gear, install a new distance sleeve, if the reduction gear casing, the final drive gears or the driving gear bearings were replaced. If these parts were not changed, the former distance sleeve can be used.

Fit the driving gear into the reduction gear casing and place on it the front bearing inner ring, the oil deflector, sealing, the driving gear flange and washer. Screw a nut on the gear end and, having locked the driving gear flange, tighten it (tightening torque is specified below).

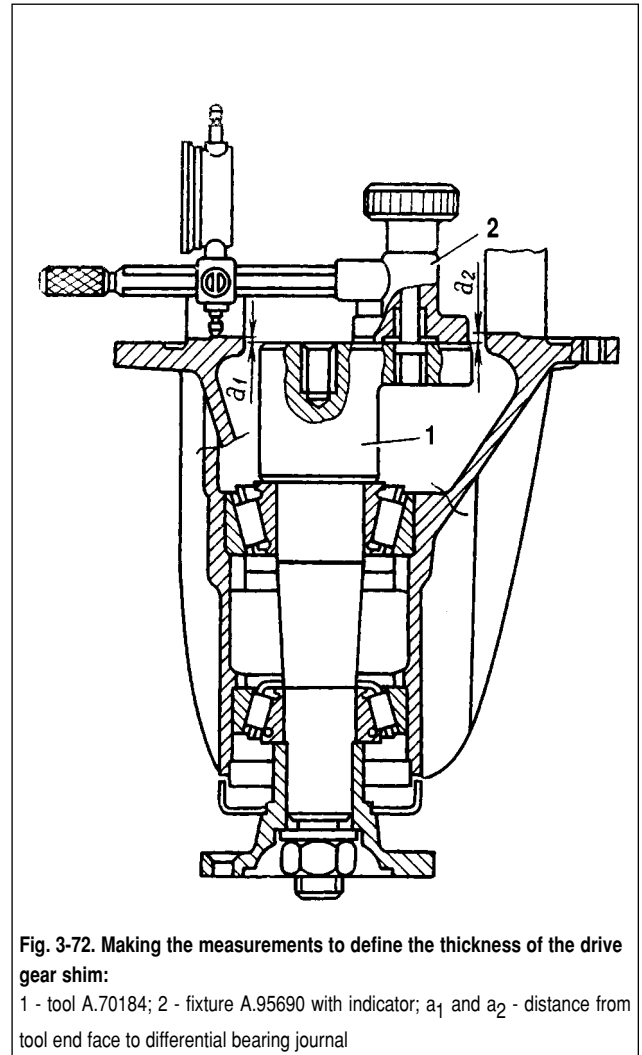
Adjustment of the driving gear bearings

To restrict the axial shifts of the driving gear under working loads, it is very important to create the bearing preload within the given limits. Tension is monitored by a dynamometer 02.7812.9501 (fig. 3-75), which measures the driving gear moment of resistance to rotation.

The moment of resistance to rotation determines the tightness of the bearing. It should be 157 - 196 N•cm (16 - 20 kgf•cm) for new bearings, and 39.2 - 58.8 N•cm (4 - 6 kgf•cm) - for bearings after mileage of 30 km and more.

The flange nut should be tightened to torque 118 - 255 N•m (12 - 26 kgf•m), periodically checking with the dynamometer the bearing's moment of resistance to the rotation of the driving gear.

To check the resistance torque, fix the dynamometer on sleeve 3 (fig. 3-76), place the torque limit indicator 2 (fig. 3-75) on the scale division corresponding to 196 N•cm (20 kgf•cm), and



make a few turns clockwise with handle 4. During rotation of the driving gear the movable indicator 1 should not pass indicator 2 and should show no less than 157 N•cm (16 kgf•cm).

If the moment of resistance to rotation is less than 157 N•cm (16 kgf•cm), and for bearings after 30 km - 39.2 N•cm (4 kgf•cm), tighten the driving gear flange nut (but do not exceed the rated tightening torque) and check again the driving gear moment of resistance to rotation.

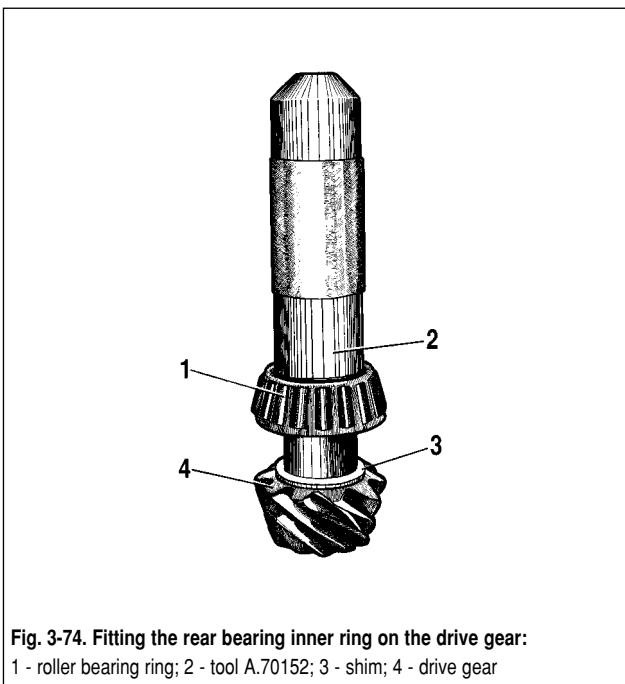
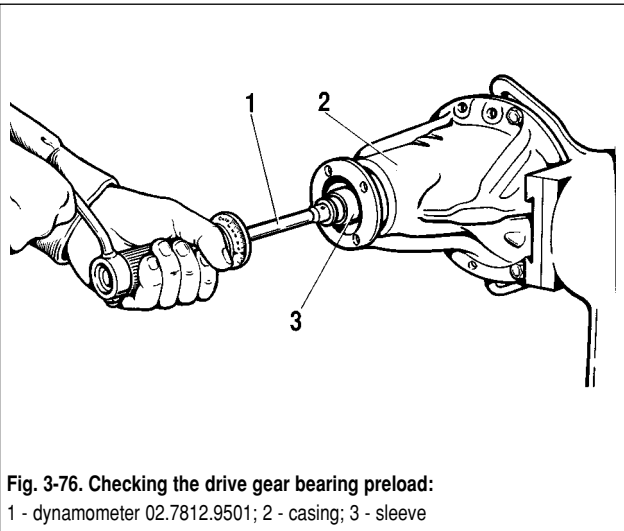
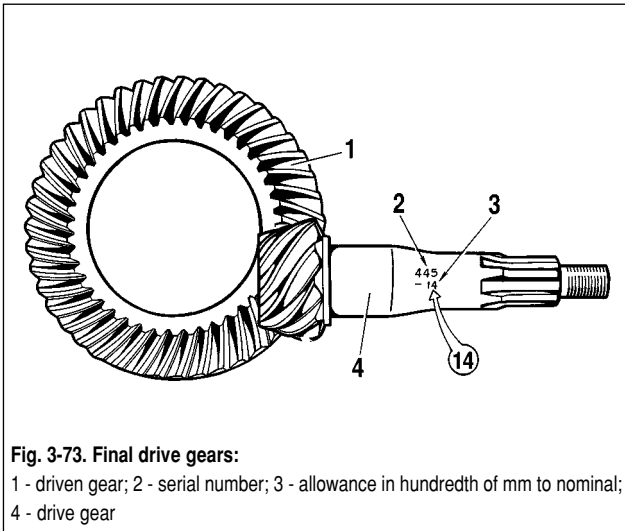
If the moment of resistance to rotation has appeared to be more than 196 N•cm (20 kgf•cm), and for run-in bearings 58.8 N•cm (6 kgf•cm), this will indicate excessive bearing preload. Renew the deformed distance sleeve. After replacing the distance sleeve, re-assemble the unit with the appropriate adjustments and checks.

Refitting the differential housing

Fit in the casing previously assembled differential housing together with the outer bearing rings.

Place two adjusting nuts 4 (fig. 3-77) so that they adjoin the bearing rings.

Fit the bearing covers and tighten the fastening bolts with a torque wrench.



Differential housing bearings preload and adjustment of the side gap in final drive gears mesh

These operations are carried out simultaneously using tool A.95688/R and key A.55085.

Fix the tool on the reduction gear casing (see fig. 3-77) with screws 1 and 6, having screwed them in the bolt apertures for the adjusting nut lock plate.

Move bracket 7 along the tool guide rail until arm 5 will touch the outer side surface of the cover and tighten screw 8.

Loosen screws 1 and 3 (fig. 3-78) and place bracket 4 so that the leg of indicator 2 will be based on the side surface of the driving gear tooth near the tooth edge, then tighten screws 1 and 3.

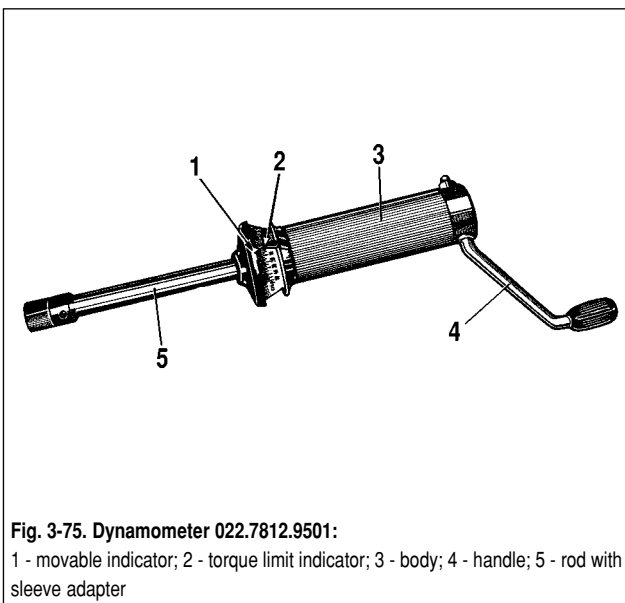
Turn the adjusting nuts and make the preliminary adjustment of the side gap between the teeth of the driving and driven gears within the limits of 0.08 - 0.13 mm. The gap is checked by indicator 2 while rocking gear 6. Bearings should have no preload. The adjusting nuts should be only in contact with bearings, otherwise the accuracy of preload measurement is affected.

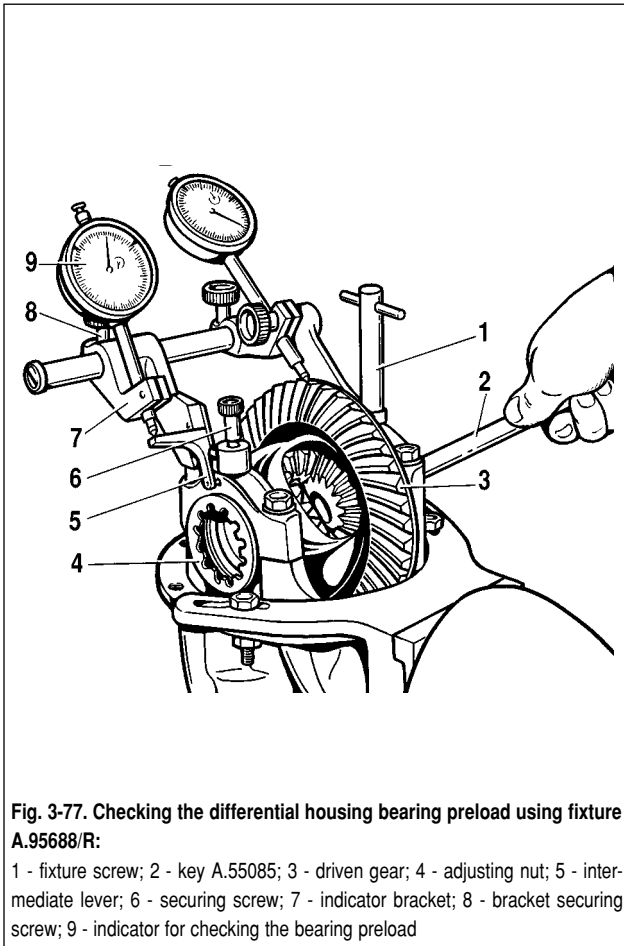
Evenly tighten both adjusting nuts of the bearings, the differential bearings covers will go apart and, hence, distance "D" (fig. 3-79) will increase by 0.14 - 0.18 mm.

Having established the exact preload of the differential housing bearings, finally check the side gap in the final drive gears mesh, which should not change.

If the gears mesh gap is more than 0.08 - 0.13 mm, move the driven gear closer to the driving gear or move it away, if the gap is below this value. To maintain the bearings preload, move the driven gear, tightening one of the bearing adjusting nuts and loosen the other one by the same angle.

To fulfill this procedure correctly, watch the indicator 9 (see fig. 3-77), which shows the size of the previously set bearing preload. After tightening one of the nuts the indication will change, as distance "D" (fig. 3-79) between the covers and the bearings preload increase. Therefore, the other nut should be loosened until the indicator arrow will return to the initial position.





After moving the driven gear, check the side gap by indicator 2 (see fig. 3-78). Repeat the adjustment if the clearance does not correspond to the rated value.

Remove tool A.95688/R, fit the adjusting nut lock plates and fix them by bolts with spring washers. In spare parts the lock plates are delivered of two types: with one or two tabs depending on the location of the nut slot.

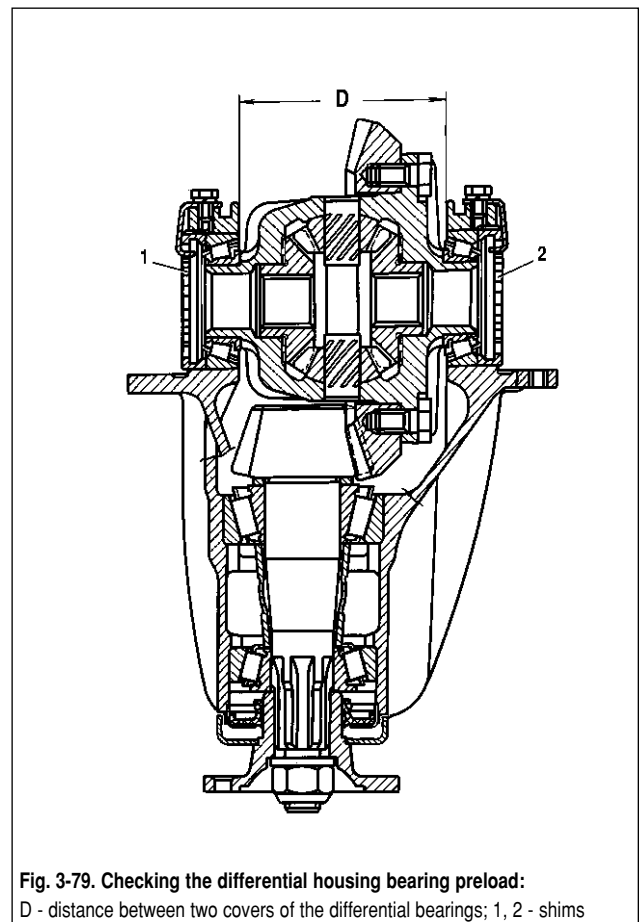
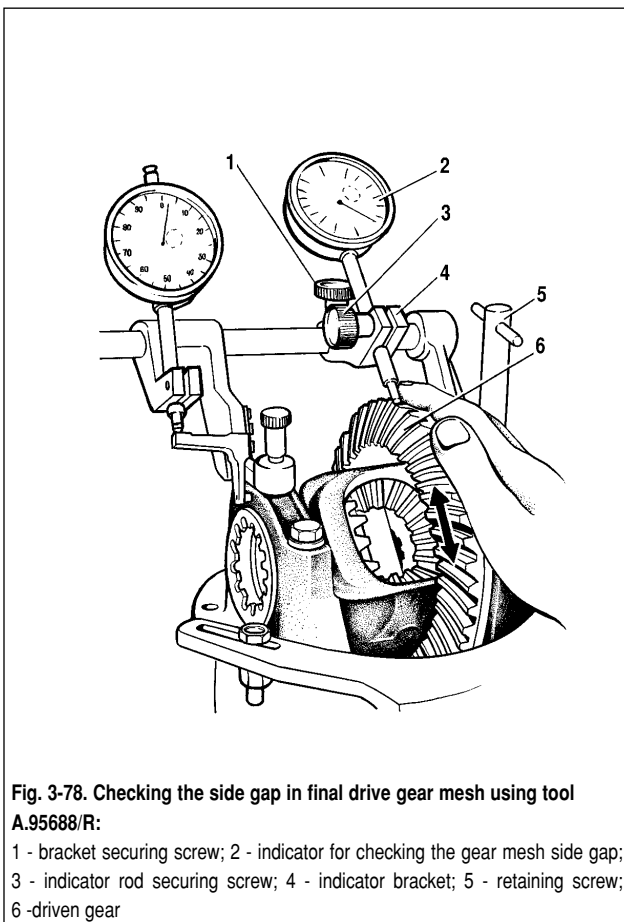
Adjustment and repair of reduction gear components is carried out on a bench, on which it is possible also to test the reduction gear for noise and to check the arrangement and the form of the pattern on teeth working surfaces, as set forth below.

Final drive gear teeth mesh pattern check

To finally check the quality of final drive gear mesh on the test bench:

- after adjustment place the reduction gear on the bench and grease the working surfaces of the driven gear teeth with a thin layer of lead oxide;
- start the bench and decelerate the rotation of the axle shafts, so that under load on the driven gear teeth surfaces there were visible traces of contact with the driving gear teeth;
- change the rotation direction and while decelerating ensure forming the contact patterns on the other side of the driven gear teeth, what will simulate the reverse movement of the vehicle.

The gear mesh is considered to be OK, if on both sides of the



driven gear teeth the contact pattern is located in regular intervals closer to the narrow end of the tooth, occupying two thirds of length and without covering the top and the base of the tooth, as shown on fig. 3-80, e.

The examples of wrong location of contact pattern on the tooth working surface are shown on fig. 3-80 (a, b, c, d).

The unit will have to be dismantled to make the adjustments of the driving gear and replace the adjusting ring.

After reassembly, repeat all operations on the driving gear roller bearings preload, check the moment of resistance to rotation, the preload of the differential housing roller bearings and the adjustment of the final drive mesh side gap.

Replacing the driving gear sealing

The necessity of seal replacement is determined by the drop of oil level in the rear axle casing (due to oil leak through the sealing) to the level which might affect normal operation of the reduction gear.

Misting of the casing filler neck and even oil drops, in the amount not exceeding the below norms, do not indicate oil leak.

In case of heavy drop formation inspect the sealing:

- put the vehicle on the lift or over an inspection pit;
- clean the breather from dirt and inspect;
- undo the control plug, check the oil level in the axle casing; top up if necessary;

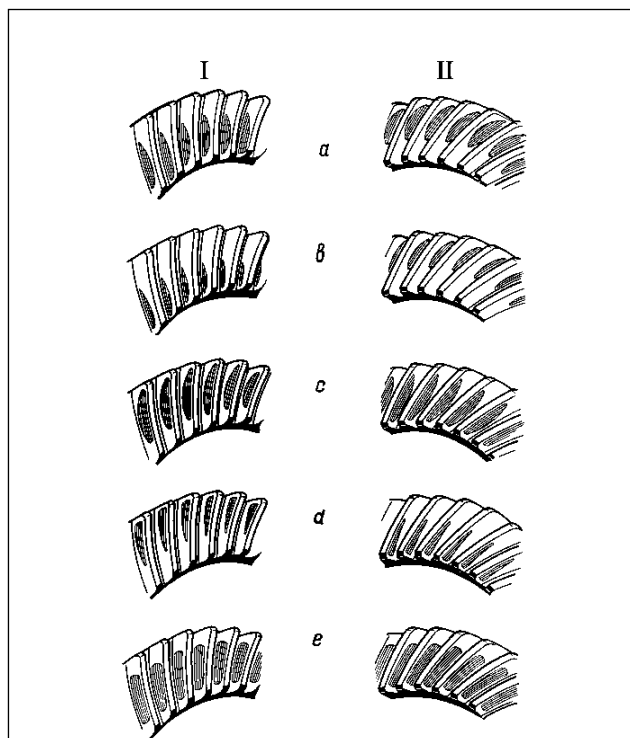


Fig. 3-80. Bearing pattern in final drive gear mesh:

I - front side; II - rear side; «a» and «b» - improper contact in gear mesh: move the drive gear away from the driven gear by reducing the shim thickness; «c» and «d» - improper contact, move the drive gear closer to the driven by increasing the shim thickness; «e» - right contact in gear mesh

- clean the casing filler neck from oil and wipe dry;
- raise the rear axle and put it on supports;
- start the engine, engage the fourth gear and at speed of 90-100 km/h warm oil up to 80-90 °C (approximately during 15 minutes);

-with the fourth gear engaged, at speed of 100 km/h determine the amount of oil leakage during 15 minutes.

Oil leak exceeding 5 drops in 15 minutes will indicate a bad sealing.

Damaged sealing can be replaced without removing the reduction gear from the vehicle, if no replacement of other parts of the reduction gear is required.

The procedure of seal replacement is the following:

- drain oil from the rear axle casing;
- loosen the rear wheels fastening nuts, put blocks under front wheels and raise the rear axle; release the handbrake and place the gear shift lever in neutral;
- take off the wheels and brake drums;
- undo the nuts that are fastening the braking plate to the axle beam and using a pusher remove the axle shafts from the differential box;
- disconnect the propeller shaft from the driving gear flange and move the shaft aside;
- using a dynamometer check the driving gear moment of resistance to rotation and note;
- hold the flange with a special key, undo the driving gear flange fastening nut and remove the flange with the washer;
- remove the driving gear sealing;
- grease the seal working surface with ЛИТОЛ-24 and press fit with a mandrel into the reduction gear casing on depth of 2-0.3 mm between the end face of the reduction gear casing and the sealing outer surface;
- fit the flange with a washer on the driving gear, hold it with a special key and tighten the flange fastening nut, controlling the moment of resistance to rotation by a dynamometer from time to time.

If the initial value of moment of resistance to rotation was 58.8 N•cm (6 kgf•cm) or more, the new one should exceed the initial by 9.8-19.6 N•cm (1-2 kgf•cm). If the initial moment of resistance to rotation was less than 58.8 N•cm (6 kgf•cm), the flange fastening nut should be tightened to 58.8-88.2 N•cm (6-9 kgf•cm).

If the moment of resistance to rotation was exceeded when tightening the nut, dismantle the reduction gear, renew the distance sleeve, then reassemble the reduction gear and adjust as described in chapter "Assembly and adjustment".

The reassembly of the rear axle is carried out in sequence reverse to dismantle.

Front axle

The design of the front axle is shown on fig. 3-81. A number "13" is painted on the reduction gear casing for distinction.

Fault diagnosis

Diagnosis	Remedy
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Constant excessive noise at front axle operation

1. Worn or badly adjusted differential bearings	1. Renew worn components, adjust differential bearings
2. Wrong adjustment, damage or wear of gears or bearings of reduction gear	2. Isolate problem in reduction gear, repair or replace
3. Low oil amount in axle case	3. Top up oil, check for oil leak from front axle casing
4. Worn or destructed inner joint bearing (axle shaft)	4. Replace bearing

Noise at vehicle acceleration and engine braking

1. Incorrectly adjusted final drive gear mesh at reduction gear repair	1. Adjust gear mesh as described in subsec. "Rear axle"
2. Wrong side gap in final drive gear mesh	2. Adjust clearance as described in subsec. "Rear axle"
3. Excessive gap in driving gear bearing due to loose flange fastening nut or worn bearings	3. Adjust clearance (as described in subsec. "Rear axle"), replace bearing if necessary

Knock at the beginning of movement

1. Worn differential pinion shaft opening in differential housing	1. Replace differential housing and pinion shaft if necessary
-------------------------------------------------------------------	---------------------------------------------------------------

Oil leak

1. Worn or damaged oil seal	1. Renew oil seal
2. Worn inner joint casing oil seal	2. Renew oil seal
3. Loose inner joint casing bearing cover fastening or casing covers, damaged sealings	3. Tighten nuts and bolts, replace gaskets

Removal and refitting

Place the vehicle on the lift or over an inspection pit and raise the vehicle front part.

Remove the anti-roll bar, the suspension crossmember tie-rods and the crankcase protective cover. Disconnect the shock-absorbers from the lower suspension control arms, and the input propeller shaft from the front axle reduction driving gear flange.

Compress the suspension spring, disconnect the balljoint from the lower arm and take off the spring, having smoothly unloaded it. Disconnect the steering tie-rods from the steering knuckle arms.

Remove the wheel cap and undo the wheel hub bearing nut.

Do the same on the other end of the suspension.

Loosen the muffler-to-front exhaust pipe clip, disconnect the pipes and muffler brackets in the rear part of the vehicle and on the gearbox.

Using key 02.7812.9500 undo the front exhaust pipe-to-exhaust manifold fastening nuts and remove the pipe downward.

Undo the nuts that are fastening the engine front mounting pads to the suspension crossmember brackets.

Support the front axle and undo the bolt fastening the right bracket 22 (see fig. 3-81) to the engine and two fastening nuts of the front axle from the left side.

Raise the engine by 25-30 mm, remove the front axle in assembly with the front wheel drives.

Refitting of the front axle on the vehicle is carried out in a reverse sequence. When refitting the axle, the fastening nuts and bolts should be tightened with torque specified in the appendix.

Fill the front axle casing with transmission oil through the filler neck, the oil level should reach the lower edge of the opening.

Dismantle

Place and fix the front axle on a bench for repair. Turn out plug 5 and drain oil from the casing, then do the following from both ends of the front axle:

- undo the inner joint casing bearing 7 cover 12 fastening nuts and take out the joint, paying attention not to damage the sealing;
- after removing circlip 11 and spring washer 10, press off bearing 7 from the inner joint casing 9 and remove oil seal 8.

Remove the axle casing stamped cover and sealing. It is not recommended to remove bottom cover 2.

Dismantle the front axle reduction gear, using the procedure described in subsection "Rear axle".

Inspection

Parts are inspected according to the procedure given in subsection "Rear axle", and besides ensure that:

- the ball bearing of the inner joint casing is not worn or damaged (renew the bearing if the radial gap exceeds 0.05 mm);
- the inner joint casing is not deformed and the landing places are not damaged;
- there are no scuffings and dents in the grooves of the inner joint casing;
- there is no wear and cracks on the casing landing places.

Renew worn and damaged parts.

Reassembly

Before reassembly, match the ratio marks on the final drive and the rear axle reduction gears.

Reassemble and adjust the front axle reduction gear, follow-

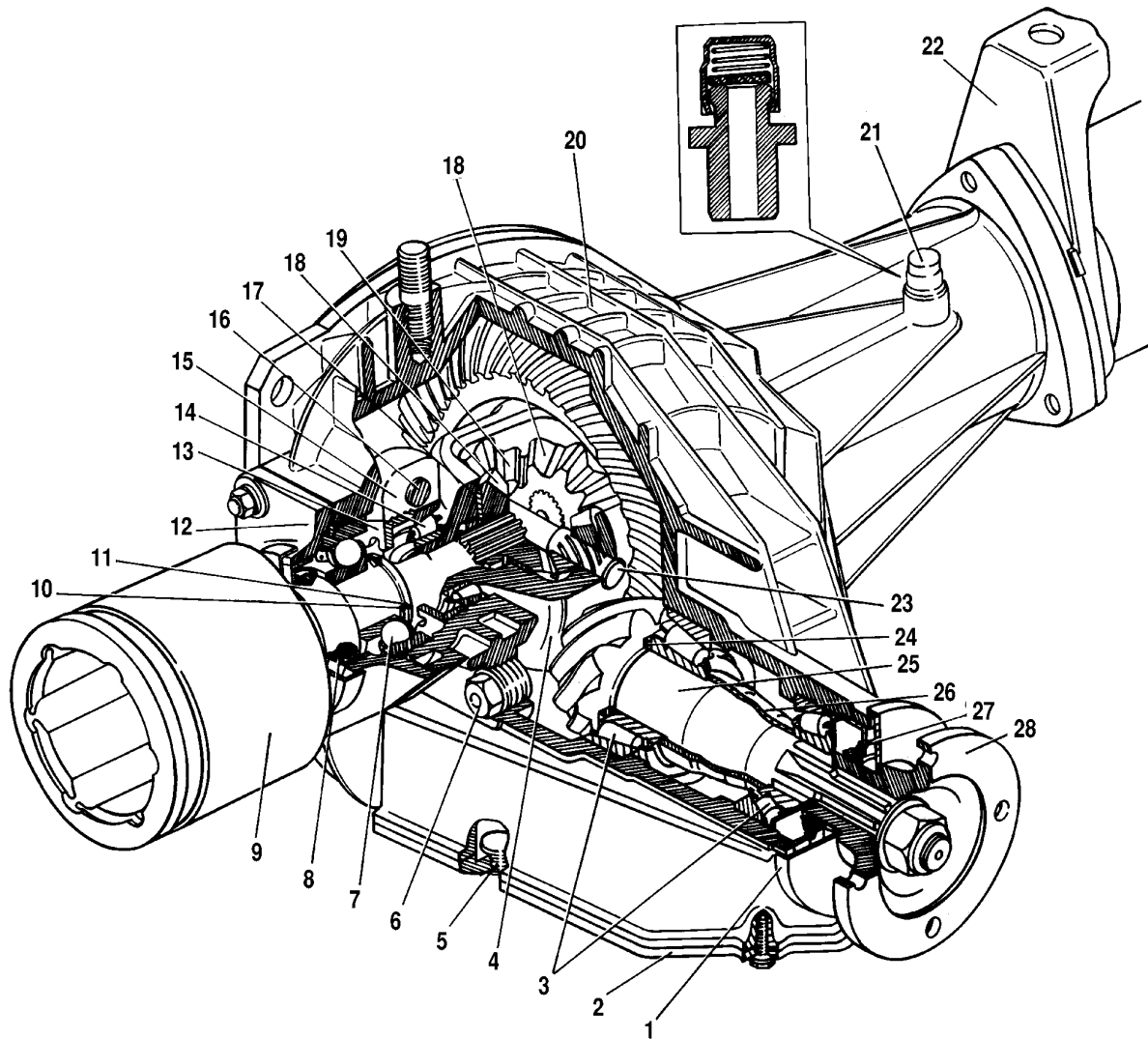


Fig. 3-81. Front axle:

1 - splash guard; 2 - reduction gear casing lower cover; 3 - final drive gear bearing; 4 - differential housing; 5 - drain aperture plug; 6 - check and filler plug; 7 - inner joint housing bearing; 8 - oil seal; 9 - wheel drive inner joint housing; 10 - spring washer; 11 - circlip; 12 - bearing cover; 13 - adjuster nut; 14 - differential housing bearing; 15 - bearing cover; 16 - cover securing bolt; 17 - thrust washer; 18 - axle shaft gear; 19 - pinion; 20 - reduction gear casing; 21 - breather; 22 - front axle mounting bracket; 23 - pinion shaft; 24 - shim; 25 - drive gear; 26 - bearing spacer; 27 - drive gear oil seal; 28 - flange

ing the guidelines given in subsection "Rear axle", distance "D" (see fig. 3-79) should increase by 0.08 - 0.11 mm. For adjustment use bracket 67.8701.9508 with a measuring end piece and key 67.7812.9520.

Place cover 12 with sealing 8 on the inner joint bearing casing 9 (see fig. 3-81), then press fit bearing 7. Refit spring washer 10 and circlip 11.

Note. The left sealing of the inner joint (axle shaft) for distinction has a mark in form of a circular groove on the body.

Fit the front axle mounting bracket 22 with cover on the inner joint right casing.

Place the inner joint assembly in the casing, previously having fit the sealings on the pins. Tighten the fastening nuts of the joint bearing covers.

Front wheel drive

Torque from the front axle is transferred to the front wheels through the right and left drives, each consisting of shaft 4 (fig. 3-82) and two CV-joints.

The joints are mounted on the ends of shaft 4. The outer joint is connected with the front wheel hub; it is of a rigid type with angular degree of freedom. The inner joint is of universal type, with an angular and axial degree of freedom. It is connected with the front axle shaft gear.

The outer joint consists of case 13, race 11, cage 8 with balls 10, lock ring 12 and thrust ring 7. Race 11 is connected with case 13 through balls, which come into race grooves made on the radius, and in the case grooves. The race is fixed on shaft 4 splines against ring 7 and is secured by circlip 12. In compressed

state this ring should pass free through the spline opening in race 11, what allows to connect and to separate the joint and shaft 4.

The joint is protected by boot 6 from dirt and moisture, which in its turn is protected from mechanical damages by shroud 5. On the shaft 4 and on the joint case the shroud is fixed by clamps 9.

The use of straight grooves differs the design of the inner joint from the outer one. The axial movement of components in the case is limited by circlip 2.

The components of the inner joint and separate sets of the outer joints are sorted according to their sizes into different assembly groups, therefore do not replace only part of the joint during repair. The joint should be replaced in assembly. Only shroud 5 and boot 6, clips 9, clamp 3 and circlip 2 can be replaced separately.

Fault diagnosis

Diagnosis	Remedy
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Noise, knock from the front axle at vehicle movement (especially at cornering)

- | | |
|---------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> 1. Worn components in outer or inner joints 2. Deformed wheel drive shafts | <ul style="list-style-type: none"> 1. Replace damaged or worn joints 2. Straighten or replace shafts |
|---------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------|

Oil leak

- | | |
|-----------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> 1. Damaged or broken protective cover of inner or outer joint | <ul style="list-style-type: none"> 1. Renew greasing in joint and boot. In case of wear or damage, replace joint assembly |
|-----------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|

Removal and refitting

Removal. Place the vehicle on a lift or over an inspection pit, set the handbrake and do the following from both sides of the vehicle:

- raise the front part of the vehicle and put it on supports;
- disconnect the shock-absorber from the suspension lower arm;
- remove the suspension spring, and disconnect the balljoint from the lower arm;

- remove the wheel hub cap and undo the wheel hub bearing nut, then unscrew the fastening nut of the inner joint housing bearing cover;

- undo the fastening bolt of the front axle suspension right arm;

- remove the outer and inner joints from the wheel hub and from the front axle.

The refitting of the front wheel drive is carried out in reverse sequence. When tightening the wheel hub bearing nuts, adjust the bearing clearance as specified in subsection "Front suspension".

Dismantle and reassembly

Dismantle is needed in case of damage on boot 6 and shroud 5 with the aim to check the joint components and the quality of greasing.

The order of dismantle is the following:

- undo clip 9 (see fig. 3-82), remove it from boot 6 and move the shroud with the boot on the shaft to provide access to joint race 11;

- using a knock-out and a hammer, beat off race 11 from the shaft;

ATTENTION. To exclude jamming circlip 12, pay attention not to skew the race, be careful in choosing the force and direction of impact.

- remove thrust rings 7, boot 6 and shroud 5 from shaft 4;

- move on the shaft the inner joint shroud and boot and, after taking out lock ring 2, take out from case 1 shaft 4 in assembly with race, cage and balls;

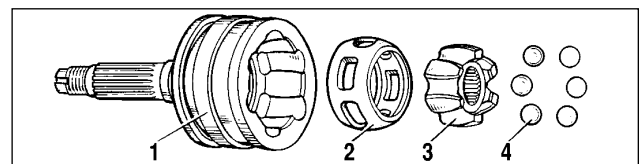


Fig. 3-83. Front wheel drive, outer joint, exploded view:
1 - joint housing; 2 - cage; 3 - race; 4 - ball

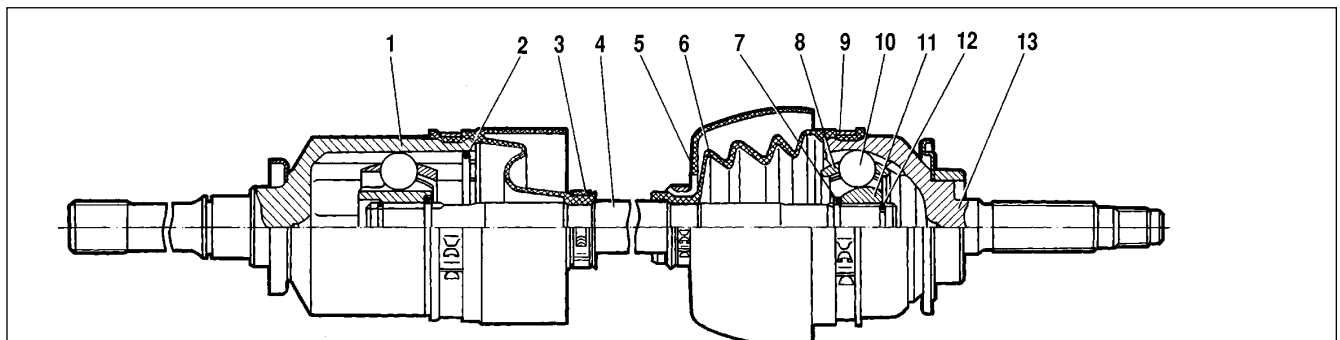


Fig. 3-82. Front wheel drive:

- 1 - inner joint housing; 2 - circlip; 3 - boot clamp; 4 - wheel drive shaft; 5 - shroud; 6 - boot; 7 - race thrust ring; 8 - cage; 9 - clip; 10 - ball; 11 - outer joint holder; 12 - circlip; 13 - outer joint casing

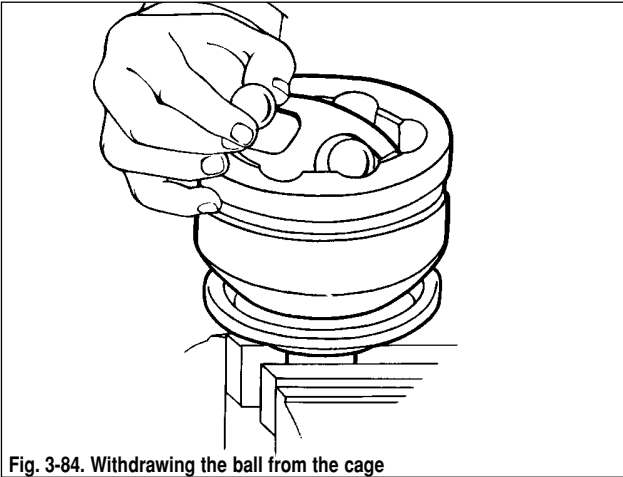


Fig. 3-84. Withdrawing the ball from the cage

- using a knock-out and a hammer, beat the inner joint race from shaft 4;
- after removing the thrust ring, move the shroud from the shaft;
- wash the inner cavities of the joint housings and other components.

The most difficult and crucial are the operations on dismantling and reassembling the outer joint, the components of which are shown on fig. 3-83. The high quality of dismantling-reassembly works is provided with observance of below instructions.

Mark with paint the mutual arrangement of the race, cage and the joint housing. Fix the outer joint in vice, as shown on fig. 3-84. Incline the race and cage so that one ball will go out from the groove in the case of the joint as far as possible. Using a screwdriver made of soft metal, push the ball out from the cage. Then turn all components so that the next ball will occupy the same position, and take it out from the cage. Using the above procedure, take out other balls. The sequence of removing the balls from the cage can be different - every other ball.

Slight tapping on the cage or race with a tool made of soft material is allowed. No excessive effort when turning the cage is admissible, as the balls may be blocked what will complicate the further dismantle.

Place the cage/race unit so that the elongated apertures of the cage are situated against the ledges of the joint case (see fig. 3-85) and take out the cage in assembly with the race.

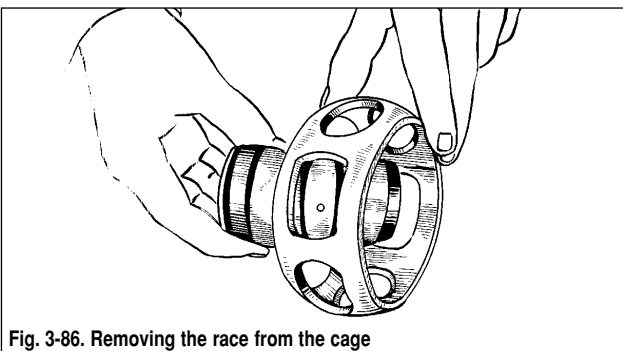


Fig. 3-86. Removing the race from the cage

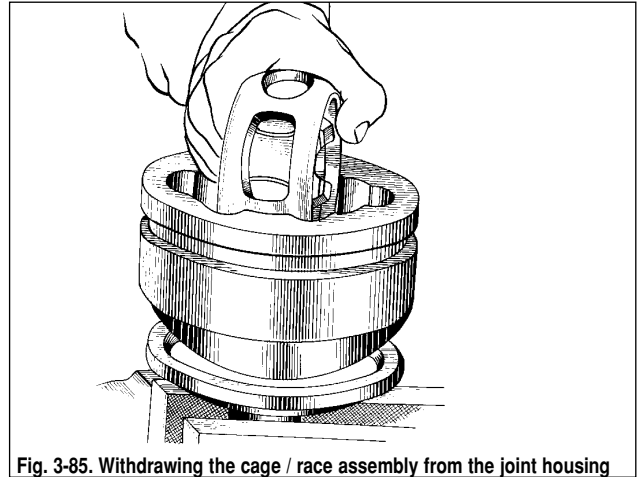


Fig. 3-85. Withdrawing the cage / race assembly from the joint housing

Take the race out from the cage, to do that, place one of the race ledges in the elongated opening of the cage (see fig. 3-86) and then roll out the race in the direction of the straight edge of the aperture. Wash all components and blow with compressed air.

The reassembly of the outer joint is carried out in reverse sequence, paying attention to the following:

- grease all components with ЛПVC-4 before reassembly;
- when refitting the cage/race assembly in the joint casing, ensure the matching of labels made before dismantle, the race should be fitted with the ring groove (for the thrust ring) facing the shaft;
- when refitting the balls in the cage, incline the race approximately by an angle twice bigger, than the cage;
- fill the joint with 60 cm³ of ЛПVC-4;
- before striking the shaft 4 (see fig. 3-82) to connect it with the inner race 11, it is necessary to fit a new circlip 12 strictly in the centre, and then sharply strike downward on the shaft end; the circlip will compress and slip through the race spline opening;
- use tool 67.7853.9533 to press-fit the sealing ring in the joint housing.

After reassembly, the race might be blocking at shaft rolling, when the ball does not rotate. This does not indicate a poor-quality assembly, as such blocking will not appear at the joint rotation during operation.

Using the above mentioned procedure, dismantle completely the inner joint. The race should be taken out in the direction of the larger diameter of the cage.

The reassembly of the inner joint is carried out in reverse sequence. It is necessary to match the labels made before dismantle. The elongated cone part of the cage should be facing shaft 4. When reassembling, fill 150 cm³ of ЛПVC-4 into the joint.

Use tool 67.7853.9537 to refit the joints protective covers.

If there are no knocks and vibrations, the shrouds are in good condition, the dismantle of the front wheels drive is not recommended.

Chapter 4

Wheel suspensions

Fault diagnosis

Diagnosis	Remedy
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Noise and knock in suspension at vehicle movement

<ol style="list-style-type: none"> 1. Faulty shock-absorbers 2. Loose anti-roll bar fastening bolts 3. Worn arm silent blocks 4. Loose shock-absorber fastening or worn shock absorber eye rubber bushes 5. Worn arm balljoints 6. Excessive gap in wheel hub bearings 7. Wheels significantly out of balance 8. Deformed wheel discs 9. Set down or broken springs 10. Worn rear suspension bar rubber bushes 11. Knock in "stiff" suspension due to damaged buffers 12. Rear suspension "stiffness" due to rear axle overload 	<ol style="list-style-type: none"> 1. Replace or repair shock absorbers 2. Tighten securing nuts and bolts; in case of rubber pad wear - replace 3. Renew silent blocks 4. Tighten fastening bolts and nuts, renew bushes in shock absorber eyes 5. Renew ball joints 6. Adjust clearance or replace bearings 7. Balance wheels 8. Replace discs 9. Renew spring 10. Renew rubber bushes 11. Replace damaged buffers 12. Unload vehicle rear part
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Wheel alignment angles can not be adjusted

<ol style="list-style-type: none"> 1. Deformed lower arm shaft or suspension arms 	<ol style="list-style-type: none"> 1. Replace shaft or arm
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Vehicle wandering

<ol style="list-style-type: none"> 1. Different pressure in tyres 2. Misalignment of front wheels 3. Wrong gap in front wheel bearings 4. Deformed suspension arms 5. Unequal tension of suspension springs 6. Incomplete release of wheel brake mechanism 7. Significant difference in tyres wear 8. Front wheels significantly out-of-balance 9. Displacement of rear axle due to deformation of rear suspension bar 	<ol style="list-style-type: none"> 1. Adjust pressure in tyres 2. Align wheels 3. Adjust bearing clearance 4. Replace deformed arms 5. Renew weak spring 6. Rectify fault 7. Replace worn tyres 8. Balance wheels 9. Straighten or replace suspension arms
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Shimmy

<ol style="list-style-type: none"> 1. Insufficient tyres pressure 2. Excessive gap in front wheel hub bearings 3. Shock-absorbers do not work 4. Loose fastening nuts on balljoint pins 5. Misalignment of front wheels 6. Worn arm shaft silent blocks 7. Wheels are significantly out of balance 8. Worn arm balljoints 	<ol style="list-style-type: none"> 1. Adjust pressure in tyres 2. Adjust clearance 3. Renew shock absorbers or repair 4. Tighten nuts 5. Align wheels 6. Renew silent blocks 7. Check and balance wheels 8. Replace joints
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Often "stiffness" in suspension

<ol style="list-style-type: none"> 1. Suspension springs set down 2. Shock-absorbers do not work 3. Deformed front suspension arms 	<ol style="list-style-type: none"> 1. Renew springs 2. Renew shock absorbers or repair 3. Renew deformed arms
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Excessive gap in balljoints

<ol style="list-style-type: none"> 1. Worn balljoint rubbing surfaces as a result of fouling due to leaks in shroud or its damage 	<ol style="list-style-type: none"> 1. Replace ball joint and boot
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Diagnosis	Remedy
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Un-even tyre tread wear

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| <ol style="list-style-type: none"> 1. Excessive speed at cornering 2. Excessive wear of suspension joints and bushes 3. Wheels out of balance (stains in regular intervals on tread outer path and on central path when driving with a disbalanced wheel for a long time) 4. Uneven wheel braking 5. Shock-absorbers do not work 6. Wheel camber misalignment (wear of tread inner path) 7. Low tyre pressure (large wear on tread edge) 8. Excessive tyre pressure (large wear in tread middle part) 9. Low front wheel toe-in (wear of tread inner path) 10. Excessive front wheel toe-in (wear of tread outer path) | <ol style="list-style-type: none"> 1. Low down speed 2. Repair suspension 3. Balance wheels
 4. Adjust braking system 5. Renew shock absorbers or repair 6. Align wheel camber 7. Adjust to normal pressure 8. Adjust to normal pressure 9. Adjust wheel toe-in 10. Adjust wheel toe-in |
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Wheel runout

- | | |
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| <ol style="list-style-type: none"> 1. Wheel out of balance: <ul style="list-style-type: none"> - uneven tread wear - displacement of balance weights and tyres at installation - deformed rim - damaged tyres 2. Excessive gap in wheel hub bearings | <ol style="list-style-type: none"> 1. Do the following: <ul style="list-style-type: none"> - balance or replace wheels - balance wheels - rectify rim or replace, balance wheels - replace tyre and balance wheels 2. Adjust clearance |
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Liquid leak from shock-absorber

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| <ol style="list-style-type: none"> 1. Wear or destruction of rod sealing 2. Foreign particles on sealing surfaces 3. Dent, risks, scuffings on rod, complete wear of chrome coating 4. Loose tank nut 5. Tank damage in zone of sealing ring 6. Shrinkage or damage of tank sealing ring 7. Excessive amount of liquid in shock-absorber | <ol style="list-style-type: none"> 1. Replace oil seal 2. Wash shock absorber components, renew or filter liquid 3. Renew worn or damaged rod and oil seal 4. Tighten nut 5. Renew or repair tank 6. Renew ring 7. Ensure required amount of liquid |
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Insufficient shock-absorber resistance at recoil stroke

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| <ol style="list-style-type: none"> 1. Leaking recoil valve or bypass valve 2. Piston ring broken or stuck in flute 3. Insufficient amount of liquid due to leak 4. Scuffings on piston or cylinder 5. Worn guide bush opening 6. Impurities in liquid 7. Recoil spring set down | <ol style="list-style-type: none"> 1. Renew damaged valve components or repair 2. Renew ring or rectify sticking 3. Renew damaged components and top up liquid 4. Renew damaged components and liquid 5. Replace guide bush 6. Wash all parts, renew liquid 7. Replace spring |
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Insufficient shock-absorber resistance at compression stroke

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|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ol style="list-style-type: none"> 1. Compression valve leak 2. Insufficient amount of liquid due to leak 3. Worn guide bush and rod 4. Impurities in liquid 5. Worn or damaged compression valve discs | <ol style="list-style-type: none"> 1. Renew damaged components or repair 2. Renew damaged components and top up liquid 3. Renew worn parts 4. Wash all parts, renew liquid 5. Renew damaged components |
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Shock-absorber knock and squeak

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|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ol style="list-style-type: none"> 1. Worn rubber bushes in eyes 2. Impact deformation of boot 3. Insufficient amount of liquid due to leak 4. Loose tank and piston fastening nuts 5. Jammed rod due to deformation of cylinder, tank or rod 6. Loose shock-absorber fastening nuts 7. Damaged components of shock-absorbers | <ol style="list-style-type: none"> 1. Renew bushes 2. Renew or repair boot 3. Renew damaged components and top up liquid 4. Tighten nuts 5. Renew damaged components or repair 6. Tighten nuts 7. Renew damaged components |
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Diagnosis	Remedy
Excessive wear of tyre tread	
1. High driving speed 2. Heavy vehicle acceleration 3. Often braking 4. Wrong wheel alignment angles 5. Excessive clearance in front wheel hub bearings 6. Vehicle overload 7. Recommended rearrangement of wheels was not carried out	1. Choose speed according to road conditions 2. Avoid sharp acceleration 3. Use brakes correctly 4. Adjust wheel alignment angles 5. Adjust clearance 6. Avoid vehicle overload 7. Rearrange wheels on vehicle according to service manual
Tyres squeal at cornering	
1. Abnormal tyre pressure 2. Wrong wheel alignment angle 3. Deformed suspension arms, crossmember or body front elements	1. Ensure normal pressure 2. Adjust wheel alignment angles 3. Replace deformed parts, rectify body front elements

Front suspension

The design of the front suspension is shown on fig. 4-1.

Suspension components - inspection

At each maintenance and repair, it is necessary to inspect the protective covers of suspension balljoints, paying special attention to any possible mechanical damages. It is necessary to check the suspension components for traces of hitting the road obstacles or car body, for cracks on the suspension components, deformations of lower arm shaft, crossmember or suspension arms and elements of body front, and also to check the condition of balljoints and silent blocks.

The deformations of lower and upper arm shafts is determined by visual check.

The deformation of the front suspension crossmember is determined by measuring the distance between the outer surface of the crossmember bracket in the zone of the upper arm shaft fastening bolt. This distance should be (736 ± 1.5) mm.

If the crossmember is so badly deformed, that it is impossible to adjust the wheel alignment angles with the help of washers, but at satisfactory condition of all suspension components, renew the crossmember.

The condition of the silent blocks is checked in the following order:

- ensure there are no deformations of the suspension arms, the lower arm shaft, the suspension crossmember;
- raise the vehicle front wheels;
- measure the outer bush 2 radial displacement A (fig. 4-2) in relation to the inner bush 6 and distance B between the thrust washer 5 and the outer end face of the outer bush 2.

The silent blocks of the top and lower arms are subject to replacement in case of:

- breaks and one-sided "buckling" of rubber;
 - undercutting and wear of rubber on the end faces of joints;
 - if the outer bush radial displacement **A** relative to the inner bush exceeds 2.5 mm;
 - if size **B** is not within the limits of 3-7.5 mm.
- If size **B** exceeds the specified limits, check the press fitting of the silent block in the arm socket.
- The gap in the upper balljoints is checked in the following order:
- place the vehicle on an even horizontal platform with hard surface;
 - lift the right (left) front part of the vehicle and take off the wheel;
 - put a 230 mm wooden pad under the lower arm, which is closer to the ball pin, and lower the vehicle on it;
 - ensure, that resin does not come out from the runner channel of the upper ballpin housing, if necessary smooth with a file to avoid errors when measuring;
 - fix tool indicator bracket 4 (fig. 4-3) on the top of stub axle;
 - place the indicator 2 in centre of the pin balljoint housing 3 sphere with small preliminary preload, and then align the zero division of the scale with the arrow;
 - fix a fork lever 5 with length of 0.7 m on the front suspension upper arm;
 - using dynamometer 6 create load of $196 \text{ N}\cdot\text{m}$ ($20 \text{ kgf}\cdot\text{m}$) (on the fork lever end 294 N) in vertical direction, first to press-in, and then to pull out the ball pin from the joint housing;
 - record the maximum deviations of the indicator arrow;
 - calculate the meaning of the clearance in the upper balljoint by summing the values of deviations from zero;
 - the total indicator readings should not exceed 0.8 mm.

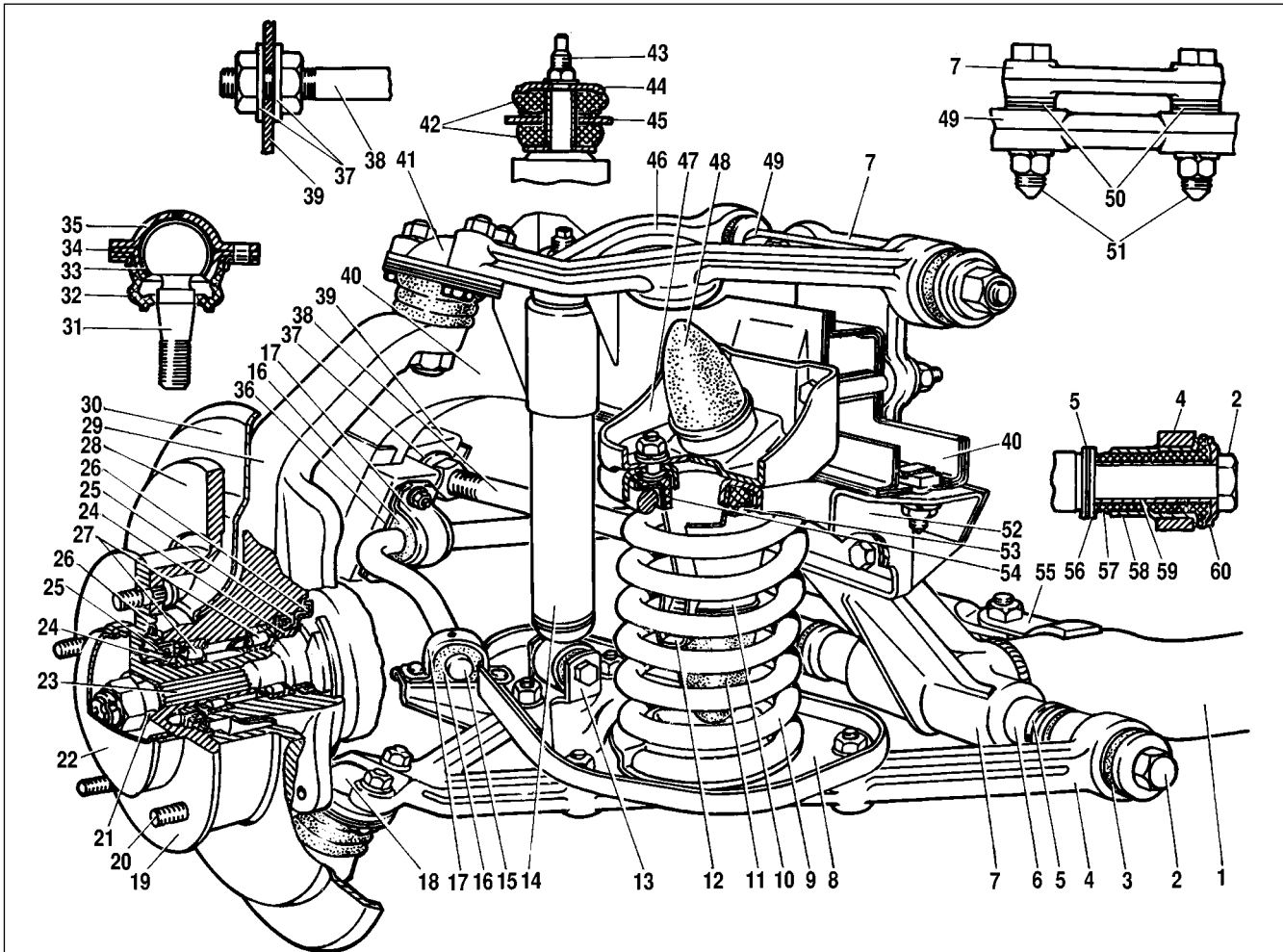


Fig. 4-1. Front suspension:

1 - front suspension crossmember; 2 - lower control arm shaft; 3 - lower arm silent block; 4 - lower control arm; 5 - lower control arm shims; 6 - lower control arm shaft bush; 7 - crossmember bracket; 8 - coil spring lower seat; 9 - coil spring; 10 - compression buffer mounting strut; 11 - compression buffer; 12 - compression restrictor; 13 - shock absorber mounting bracket, lower; 14 - shock absorber; 15 - anti-roll bar; 16 - rubber pad; 17 - anti-roll bar securing clamp; 18 - lower balljoint; 19 - wheel hub; 20 - wheel and brake disc securing bolt; 21 - taper bush; 22 - cap; 23 - outer CV-joint housing tail; 24 - oil seal bush; 25 - oil seal; 26 - splash guard ring; 27 - wheel hub bearings; 28 - wheel disc; 29 - steering knuckle; 30 - front brake splash guard; 31 - ballpin; 32 - boot; 33 - bearing; 34 - ballpin liner race; 35 - ballpin bearing housing; 36 - anti-roll bar securing plate; 37 - washers; 38 - tie-rod; 39 - tie-rod mounting bracket; 40 - body chassis arm; 41 - upper ball joint; 42 - shock absorber rod mounting pad; 43 - shock absorber rod; 44 - washer; 45 - shock absorber mounting bracket; 46 - upper control arm; 47 - recoil buffer bracket; 48 - recoil buffer; 49 - upper arm shaft; 50 - shims; 51 - upper arm shaft securing bolts; 52 - suspension spring mounting, upper; 53 - suspension spring seat, upper; 54 - spring sealing gasket; 55 - crossmember-to-tie-rod securing bracket; 56 - thrust washer; 57 - balljoint rubber bush; 58 - balljoint sleeve, outer; 59 - balljoint sleeve, inner; 60 - balljoint thrust washer

Front wheel alignment angle - checking and adjustment

Table 4-1

Front wheel alignment angle parameters

The check and adjustment of the front wheel alignment angle is carried out on special test-benches according to the instructions.

ATTENTION. It is necessary to check the wheel alignment angle after replacement or repair of suspension components, that could have caused the misalignment of wheel angle.

The check and adjustment of wheel angles is carried out on a vehicle under static load of 3140 N (320 kgf) (four men and 40 kg in boot).

Follow the parameters specified in tab. 4-1 to check and adjust the wheel alignment angles.

Front wheels alignment angle	for vehicle with load 3140 N (320 kgf)	vehicle curb weight
Camber	$0^{\circ}30' \pm 20'$ ($0^{\circ}30' +^{+60'} -^{30'}$) *	$0^{\circ}20' \pm 20'$ ($0^{\circ}20' +^{+60'} -^{30'}$) *
Caster	$3^{\circ}30' \pm 30'$ ($3^{\circ}30' +^{+60'} -^{30'}$) *	$1^{\circ}30' \pm 30'$ ($1^{\circ}30' +^{+60'} -^{30'}$) *
Toe-in	2... 4 mm (1... 7 mm) *	4.5... 6.5 mm (3.5... 9.5 mm) *

* permissible front wheel alignment angle for the elastic elements stabilization time before the first maintenance (2000-3000 km).

Before adjusting the wheel alignment angles check the following:

- pressure in tyres;
- axial gap in front wheel hub bearings;
- serviceability of shock-absorbers (absence of rod jamming);
- radial and axial runout of tyres;
- gap in suspension balljoints;
- free play of steering wheel.

Rectify any detected malfunctions and make necessary adjustments.

After placing the vehicle on a test-bench, immediately prior to inspection, apply 2 or 3 times a downward force of 392-490 N (40-50 kgf) first on the rear bumper and then on the front one.

The wheel alignment angle should be checked and adjusted in the following sequence:

1. Caster angle
2. Camber angle
3. Toe-in

Caster angle. If the check will show that the angle size does not correspond to the above data, it is necessary to change the quantity of adjusting washers 50 (see fig. 4-1) between the upper arm shaft and the crossmember arm (see tab. 4-2).

Table 4-2

Camber and caster angle vs. number of washers in a set

Number of washers added to the set or withdrawn		camber	caster
front bolt	rear bolt		
+1	+1	+ (8' 42")	0
-1	-1	- (8' 42")	0
+1	0	- (7' 30")	+ (20' 24")
-1	0	+ (7' 30")	- (20' 24")
0	+1	+ (15' 18")	- (25' 18")
0	-1	- (15' 18")	+ (25' 18")
-1	+1	+ (27' 30")	- (43' 18")
+1	-1	- (21' 36")	+ (40')

Note. Data are given for washers with thickness of 0.75 mm. Plus - adding a washer, minus - removing a washer.

To adjust the caster angle:

- undo the fastening nuts of the front suspension upper arm shaft and replace the washers from one bolt to the other one until a normal reading of the angle will be obtained. The caster angle increases at rearrangement of washers from the rear bolt to the front one and decreases at reverse swapping;

- tighten the nuts with a torque wrench and check the caster angle.

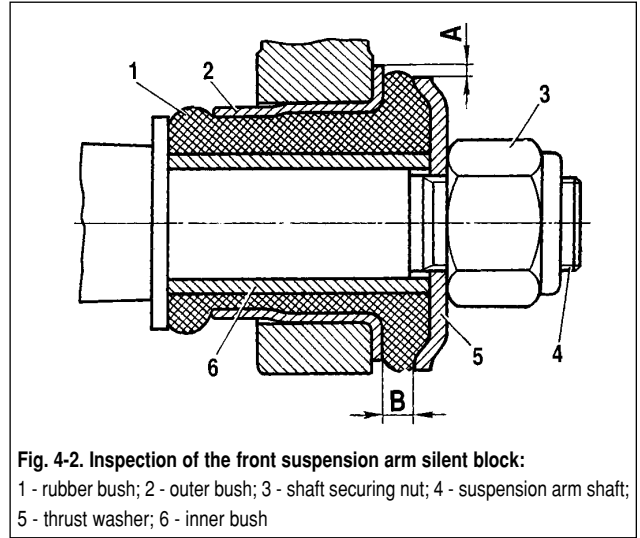


Fig. 4-2. Inspection of the front suspension arm silent block:
1 - rubber bush; 2 - outer bush; 3 - shaft securing nut; 4 - suspension arm shaft; 5 - thrust washer; 6 - inner bush

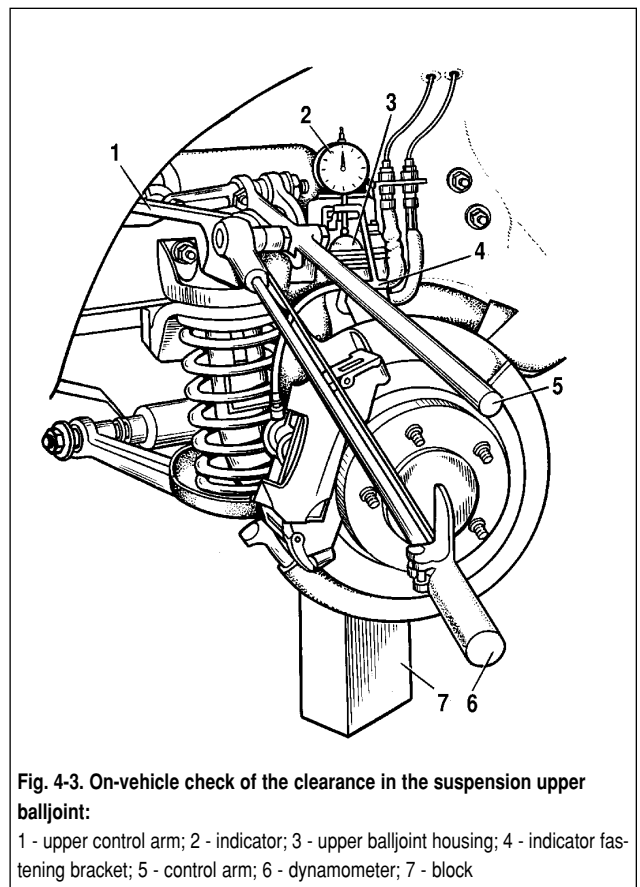


Fig. 4-3. On-vehicle check of the clearance in the suspension upper balljoint:
1 - upper control arm; 2 - indicator; 3 - upper balljoint housing; 4 - indicator fastening bracket; 5 - control arm; 6 - dynamometer; 7 - block

Front wheel camber. If the camber angle differs from normal, it should be adjusted by changing the amount of washers 50 (see fig. 4-1) between the upper arm shaft and crossmember bracket.

To reduce the camber angle remove the same amount of washers from both bolts, and to increase - add.

Front wheel toe-in. If the toe-in differs from normal value, it is necessary to slacken the fastening clamps on the side tie-rods and using tool 67.7813.9504 identically turn both adjuster pins in opposite directions; thus the pins are turned on or off and change the length of side tie-rods.

After adjustment, refit the fastening clamps with the slot facing back with allowable deviation downward by 60° to the horizontal plane of the vehicle. With the nuts tightened the clamp slot edges should not contact.

After toe-in adjustment, ensure that wheels and steering mechanism components do not hit the adjacent components of the suspension and car body. To do this, turn the wheels fully right and left until the steering pitman arm will rest against the steering mechanism housing fastening nuts.

Front wheel hub bearing gap - check and adjustment

To check the gap, remove the cap and slacken the wheel fastening nut, lift the front part of the vehicle, rest it on a support and take off the front wheel.

Remove the front brake caliper with brake pads. Do not allow the caliper to hang on high pressure hoses.

Fix tool 67.7834.9507 with indicator (fig. 4-4) on the steering knuckle so that the indicator leg will rest against the wheel hub as closely as possible to the adjusting nut. Turn the hub in both directions and simultaneously move it with lever 67.7820.9521 along the steering knuckle shaft (forward and backward). Measure the size of shift (gap) by the indicator.

If the gap is more than 0.15 mm, adjust it in the following order:

- undo the adjusting nut from the outer joint housing tail;
- fit a new or used, but on other vehicle, nut and tighten with torque to $19.6 \text{ N}\cdot\text{m}$ ($2 \text{ kgf}\cdot\text{m}$), simultaneously turning the hub in both directions 2-3 times for self-setting the roller bearings;
- slacken the adjusting nut and again tighten with torque to $6.86 \text{ N}\cdot\text{m}$ ($0.7 \text{ kgf}\cdot\text{m}$);
- make a mark **B** on the washer (fig. 4-5), then undo the nut by $20\text{-}25^\circ$ until the first edge will meet the **A** mark;
- fix the nut in this position by pressing the cups on the journal into the grooves on the outer joint race tail end.

After adjustment the bearing clearance should be within the limits of 0.01-0.07 mm.

Front wheel hub bearing - renewing the greasing

To renew the greasing do the following from both sides of the vehicle:

- raise the front part of the vehicle and take off the wheel;
- unbend the edge of the brake front splash guard, undo the fastening bolt of the brake pad carrier and remove the brake caliper from the brake disc by moving it aside. Do not disconnect the brake hoses, to avoid air penetration in the hydraulic system, and do not leave the caliper to hang on the hoses;

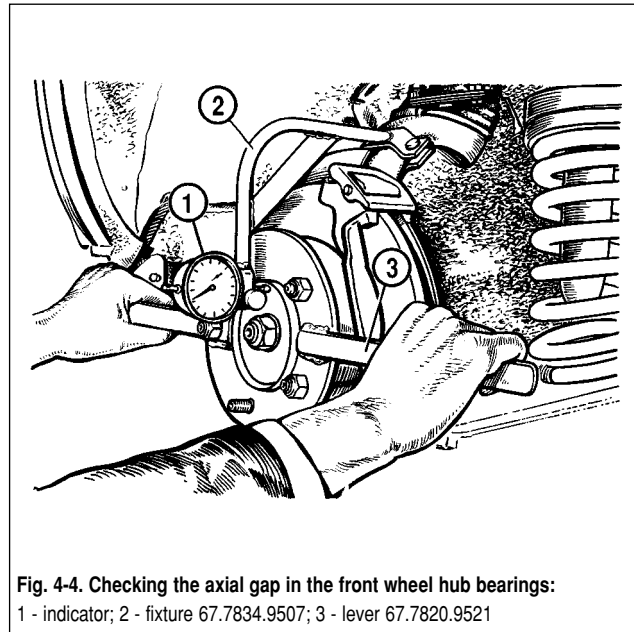


Fig. 4-4. Checking the axial gap in the front wheel hub bearings: 1 - indicator; 2 - fixture 67.7834.9507; 3 - lever 67.7820.9521

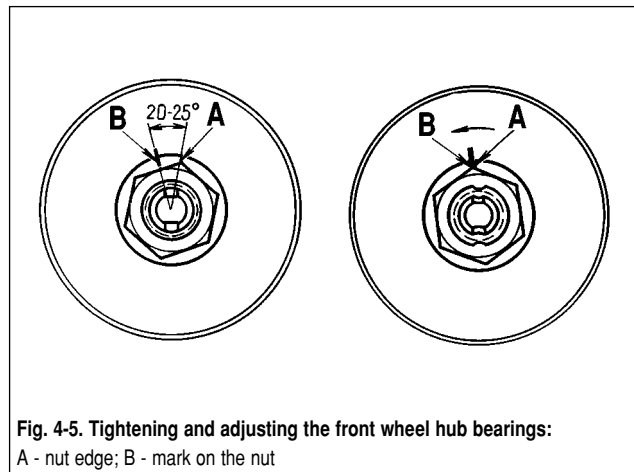
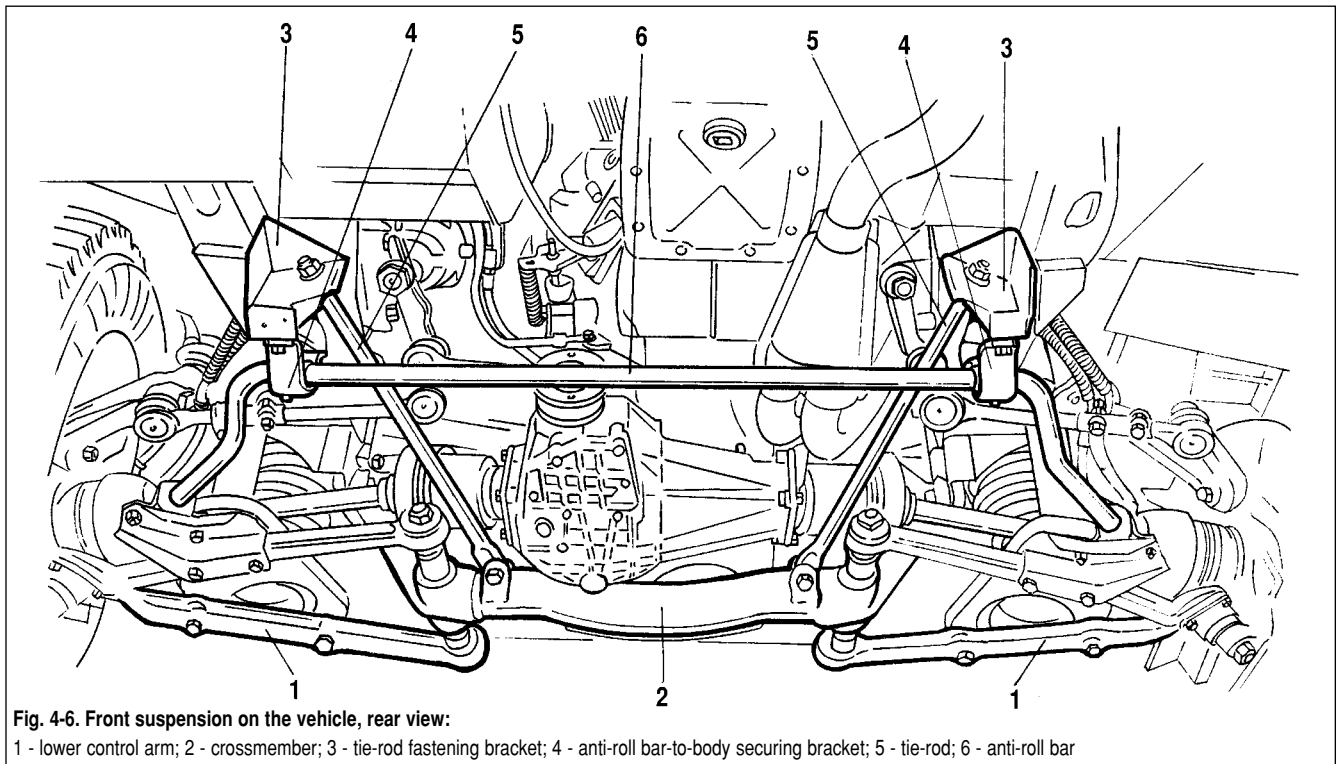


Fig. 4-5. Tightening and adjusting the front wheel hub bearings: A - nut edge; B - mark on the nut

- use tool 67.7823.9514 to remove the wheel hub cap, undo the adjusting nut and remove bush 21 (see fig. 4-1);
- carefully, so that not to damage sealing 25, remove hub 19 in assembly with the brake disc;
- put a support under the suspension lower arm 4 and slightly lower the front part of the vehicle to compress spring 9;
- disconnect the lower balljoint 18 from the suspension arm;
- disconnect the shock-absorber 14 from the lower arm 4 and steering drive side tie-rod from the steering knuckle shaft 29;
- move the front wheel drive shaft fully forward to the front axle;
- by turning the steering knuckle 29 relatively the upper balljoint 41, remove the knuckle from the joint casing tail 23;
- using tool 67.7853.9535 with washer 67.7853.9540 press out from the cavity of the steering knuckle the inner rings of bearings 27 with dismantling rings and seals 25. The bearing outer rings are pressed off using washer 67.7853.9534, and press-fitted with tool 67.7853.9536. Mark the bearing rings so that to put them on former place when reassembling;



- remove old greasing and wash with kerosine the inner cavity of the steering knuckle, the outer and inner cavities of the hub, the CV-joint case tail and bearings;

- fill 40 gr of fresh ЛИТОЛ-24 in bearing cages, spread evenly in the cavity of the steering knuckle between the bearings, grease the splines of the joint casing tail;

- fit the bearing inner rings, the oil seal bush and press fit the sealings;

- fit the steering knuckle on the joint case tail and connect the balljoint to the lower arm;

- fix the shock-absorber and attach the side tie-rod of the steering mechanism to the steering knuckle arm;

- fit the hub in assembly with brake disc on the joint case tail and establish the taper bush 21;

- turn the new adjusting nut and adjust the gaps in wheel hub bearings;

- using tool 67.7853.9528 fit the wheel hub cap;

- replace the brake caliper and the wheel.

Note. In all cases, when the nut is unscrewed from the tail of the outer joint case, renew the nut or use one from another vehicle

Balancing the wheels

The wheels are balanced on special benches according to the instructions attached to the test-bench. The wheel out-of-balance is eliminated by balance weights, which are fastened on the rim with special springs.

Front suspension - removal and refitting

Place the vehicle on the lift or over an inspection pit, set the parking brake, open the hood and take out the spare wheel.

Place supports under rear wheels and take off front wheels.

Using remover 67.7824.9516 (see fig. 5-10) press out pins from the steering knuckle arms and draw aside the steering tie-rods.

Disconnect the anti-roll bar 6 (fig. 4-6) from the suspension lower arms.

Disconnect the tie rods 5 from body brackets and the cross-member.

Disconnect the shock-absorbers from the suspension lower arms.

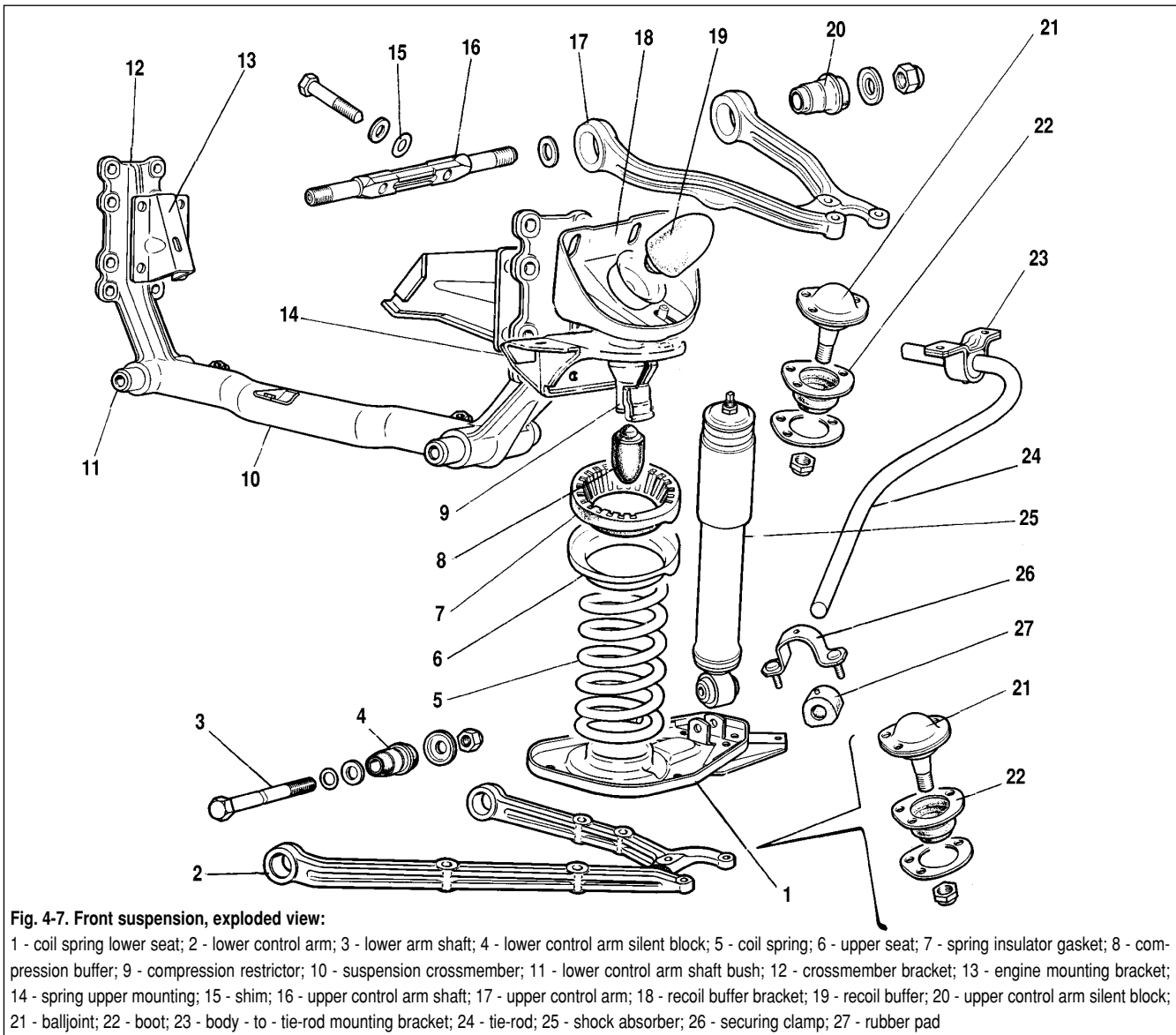
Remove the engine crankcase protective plate and the splash guard.

Remove from each side the front brake caliper without disconnecting the brake hoses, and suspend it so that the caliper will not hang on hoses.

Compress the suspension spring to completely unload the lower arm.

Disconnect from the lower arm the balljoint and take off the spring, having smoothly unloaded it, repeat the procedure for the other unit of the suspension.

Disconnect the upper arm shaft 49 (see fig. 4-1) from suspension crossmember bracket 7 and remove the upper arm 46 in assembly with the steering knuckle, wheel hub, front brake and the outer joint case.



Note. When removing the upper arm shaft, note the amount and arrangement of washers between the upper arm shaft and the crossmember, and also the number of shims between the crossmember and car body chassis arm, so that at refitting all washers and shims will be properly replaced.

Disconnect the engine mounting rubber pads from the crossmember brackets.

Place a hydraulic jack with a fixing tool under the suspension crossmember, support the engine with arm 67.7820.9514 or hoist, disconnect the recoil bumper bracket 47 and the crossmember from the body chassis.

Remove the crossmember 1 in assembly with lower arms 4.

The installation of suspension parts and units is done in reverse order. The springs on the suspension should be installed only of one class (class **A** - not marked or has marks by white paint, class **B** - with black marks on the outer surface of the coils). It is permissible to install springs of A class on the front suspension, if B class springs are fitted on the rear suspension.

After reassembly and suspension refitting, check the wheel alignment angles and toe-in.

Suspension units - dismantle and reassembly

Dismantle. If the suspension repair requires complete dismantle of the units, it is more convenient to begin directly on the vehicle after removing the crankcase protective plate and the splash guard.

Proceed as follows:

- undo the upper balljoint 41 (see fig. 4-1) pin nut and remove the clips from hoses;
- unbend the protective casing blades, turn out the fastening bolt of the caliper carrier and move the whole assembly aside;

ATTENTION. To avoid damaging the hoses do not leave the caliper to hang on hoses.

- using tool 67.7823.9514 remove the hub cap and undo the wheel hub bearing nut;

- remove the front wheel hub in assembly with the brake disc, using pusher 67.7823.9516;
- remove the front brake splash guard;
- remove the front suspension shock-absorber;
- lower the suspension lower arm on a support and compress the suspension spring to fully unload the lower arm;
- disconnect the balljoint housing from the suspension lower and upper control arms and remove the steering knuckle;
- smoothly unload the suspension spring and take it off;
- using pusher 67.7823.9515 knock out the shaft and disconnect the suspension lower arm from the crossmember;
- disconnect the upper arm shaft from the crossmember and remove the shaft in assembly with the control arm;

Note. Before removing the upper and lower arm shafts count the amount of washers on each end of the lower arm shaft and on the fastening bolts of the upper arm shaft, so that to refit them in former places.

- remove the recoil bumper bracket and the crossmember, as described above;
- using puller 67.7824.9516, press out the balljoint pins from the steering knuckle.

The front suspension components are shown on fig. 4-7.

The reassembly of suspension units is carried out in reverse sequence. When reassembling the wheel hub, grease the bearing cages with ЛИТОЛ-24 and put a thin layer in the cavity of the steering knuckle between the bearings in the amount of 40 gr in each knuckle.

When refitting the crossmember tie rods, the inner nut should be tightened until the clearance between the washer and the bracket 3 (see fig. 4-6) will be taken up, and the outer one - with torque specified in the appendix.

To avoid wrong force distribution in silent blocks, the arm shaft nuts should be tightened under vehicle static load of 3140N (320 kgf). Then check and adjust the wheel alignment angles and toe-in.

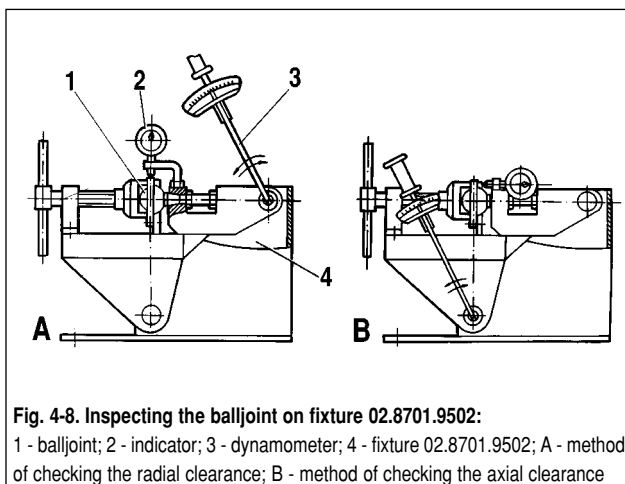


Fig. 4-8. Inspecting the balljoint on fixture 02.8701.9502:
1 - balljoint; 2 - indicator; 3 - dynamometer; 4 - fixture 02.8701.9502; A - method of checking the radial clearance; B - method of checking the axial clearance

Inspection

Balljoint. Ensure the integrity of the balljoint boots; no breaks, cracks, rubber peeling from the metal fixture, traces of grease leaks are permissible.

Check for wear of balljoint working surfaces by manually turning the ballpin. No free play or pin jamming is allowed.

A more profound check of the balljoint radial and axial clearances is carried out on fixture 02.8701.9502. Place the balljoint 1 (fig. 4-8, A) in the fixture bezel and fix with screw. Fit in the fixture bracket indicator 2 so that the indicator leg will rest against the side surface of the balljoint housing, the indicator arrow should point to zero.

Fit the dynamometer 3 in the fixture bezel and apply torque of 196 N•m (20 kgf•m) in both directions, determine by indicator 2 the total radial clearance in the balljoint. If it exceeds 0.7 mm - renew the joint.

Make the similar check of the balljoint axial clearance, previously having changed its fastening in the fixture, as shown on fig. 4-8, B. The axial clearance in the joint should not exceed 0.7 mm.

Suspension springs. Carefully examine the springs. If any deformations affecting the spring efficiency will be found - renew the springs.

To check the spring set down, fully compress it three times. The spring compression is made along the spring axis; the bearing surfaces should meet the vehicle suspension spring seats. Then apply load of 6.276 N (640 kgf). According to the spring length (see fig. 4-9) under the specified load the springs are divided into two classes: class A - length more than 192 mm, and class B - length is equal to or less than 192 mm. The springs of A class can be not marked or have marks with white paint on the external side of coils, spring of B class are marked with black paint.

On the front suspension the springs of the same class, as those on the rear suspension, should be installed. As an exception, when on the rear suspension the springs of B class are installed, and there are no springs of the same class available for

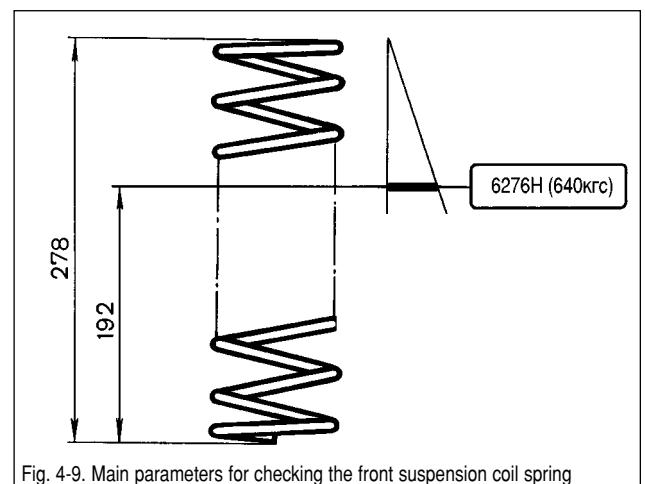


Fig. 4-9. Main parameters for checking the front suspension coil spring

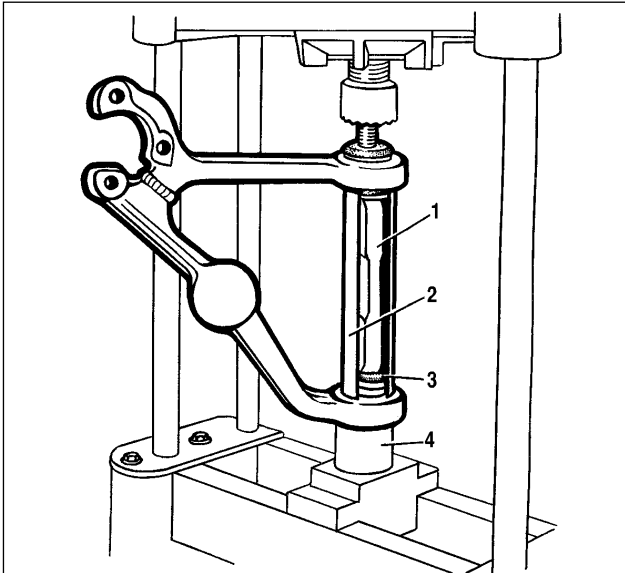


Fig. 4-10. Pressing out the upper control arm balljoint:
1 - control arm shaft; 2 - tool 67.7823.9527; 3 - balljoint; 4 - tool A.47045

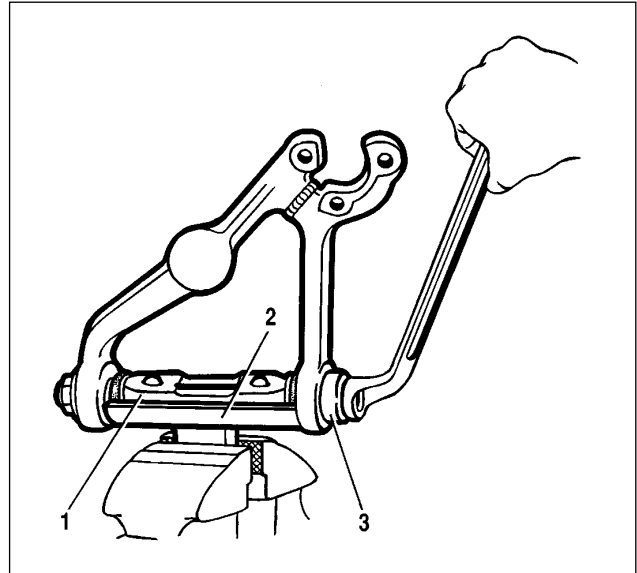


Fig. 4-11. Press-fitting the upper control arm balljoint:
1 - control arm shaft; 2 - tool 67.7853.9519; 3 - fixture A.74177/1

the front suspension, it is permissible to install the A class springs on the front suspension. But you can not install the B class springs on the front suspension, if the A class springs are installed on the rear suspension.

Inspect the gaskets and renew, if they have damages.

Anti-roll bar, suspension arms, steering knuckle. Check the bar for deformations and ensure that the ends lie in one plane; if deformation is insignificant, the bar can be straightened; at significant deformations - renew the bar.

Carefully inspect and ensure that the suspension arms, crossmember and steering knuckles are not deformed and have no cracks. Renew the specified components in case of cracks and deformations.

Suspension crossmember. Use tool 67.8732.9501 to check the geometrical parameters of the crossmember. At significant deformations of the crossmember, when it is impossible to adjust the front wheel alignment angle with washers, and at satisfactory condition of all other elements, renew the crossmember.

Silent blocks. The criteria for renewal are described in chapter "Front suspension - inspection".

Replacement of silent blocks

The upper arm. Between the eyes of the arm establish tool 67.7823.9527 on the shaft and place the arm on tool A.47045 (fig. 4-10). Press the arm shaft 1 with the punch to press out joint 3 from the aperture. To press out the second joint turn over the arm and repeat the procedure.

The press fitting of upper arm joints is done with tool 67.7853.9519 (fig. 4-11), fixed in vice. Fix the arm with shaft 1 in fixture 2, place the joint on the shaft and press fit in the arm bezel with tool 3 (A.74177/1). Then repeat the above described operations to press fit the second joint on the other side of the arm.

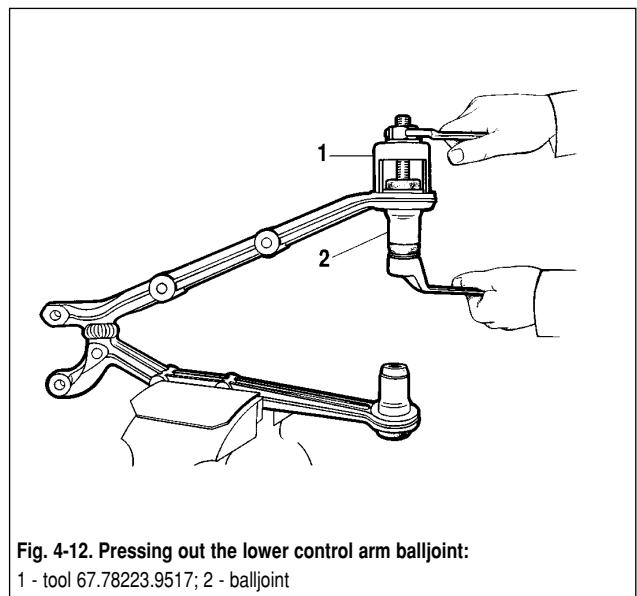


Fig. 4-12. Pressing out the lower control arm balljoint:
1 - tool 67.78223.9517; 2 - balljoint

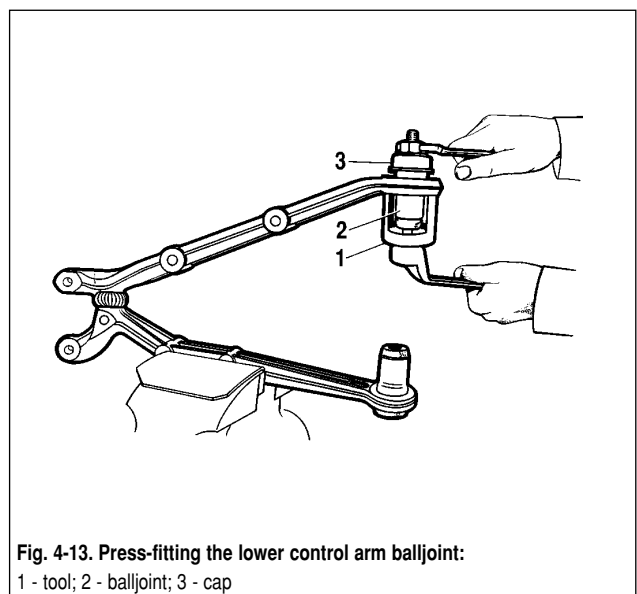


Fig. 4-13. Press-fitting the lower control arm balljoint:
1 - tool; 2 - balljoint; 3 - cap

The lower arm. The pressing-out and press-fitting of the joint can be carried out on a press, using tool 67.7823.9526, and also with tool 67.7823.9517 (fig. 4-12), which is installed on the arm so that the head of the tool screw was directed inside. Tighten the tool screw to press out the joint.

For press fitting, insert the joint into the arm bezel and fit tool 67.7823.9517 (fig. 4-13) complete with cap 3. By tightening the fixture screw, press fit the joint in the arm bezel.

Rear suspension

The design of the rear suspension is shown on fig. 4-14.

Suspension removal and refitting

Removal. Lift the rear part of the vehicle and place it on supports. Take off the rear wheels.

Disconnect the propeller shaft from the final drive gear flange.

Disconnect the hose of the brake hydraulic system from the steel tube on the axle, and make arrangements to prevent liquid leaking from the brake system.

Disconnect the handbrake rear cable brackets from the body, remove the front cable return spring, and after undoing the locknut and the adjusting nut, release the rear cable. Disconnect from the bracket on the axle beam the tie-rod 13 (see fig. 4-14) of the rear brake pressure regulator drive. Disconnect the top ends of shock-absorbers 25.

Put under the rear axle beam a hydraulic jack. Disconnect the longitudinal 3 and 17 and transverse 24 arms from brackets on the body, lower the jack and remove the axle.

Start to dismantle the suspension:

- remove the shock-absorbers from the brackets on the axle beam;

- disconnect the longitudinal and transverse arms from the brackets on the axle beam.

The rear suspension components are shown on fig. 4-15.

The rear suspension refitting is carried out in reverse sequence. On the rear suspension the springs of the same class, as on the front suspension, should be installed. In exceptional cases, if the springs of A class (not marked or with marks by white paint on the external side of coils) are installed on the front suspension, and there are no springs of the same class available

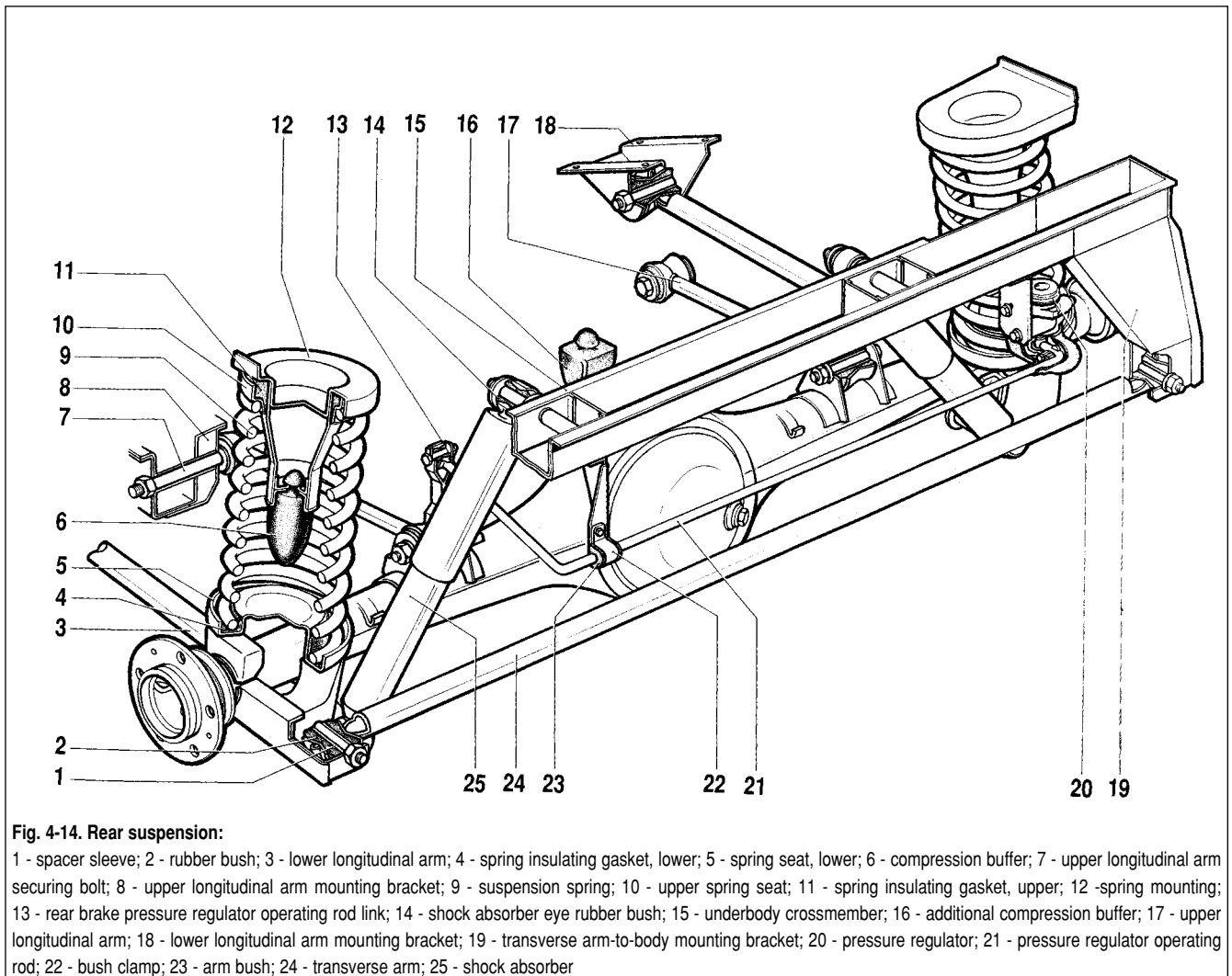


Fig. 4-14. Rear suspension:

1 - spacer sleeve; 2 - rubber bush; 3 - lower longitudinal arm; 4 - spring insulating gasket, lower; 5 - spring seat, lower; 6 - compression buffer; 7 - upper longitudinal arm securing bolt; 8 - upper longitudinal arm mounting bracket; 9 - suspension spring; 10 - upper spring seat; 11 - spring insulating gasket, upper; 12 - spring mounting; 13 - rear brake pressure regulator operating rod link; 14 - shock absorber eye rubber bush; 15 - underbody crossmember; 16 - additional compression buffer; 17 - upper longitudinal arm; 18 - lower longitudinal arm mounting bracket; 19 - transverse arm-to-body mounting bracket; 20 - pressure regulator; 21 - pressure regulator operating rod; 22 - bush clamp; 23 - arm bush; 24 - transverse arm; 25 - shock absorber

for the rear suspension, it is permissible to install the B class springs (with black marking). If on the front suspension the springs of B class are installed, the rear suspension should be fitted with B class springs only.

To avoid damage and excessive tightening of control arm rubber bushes and shock-absorbers:

- load the rear part of the vehicle so that distance **X**, measured from the axle beam to the body chassis arm in 100 mm from the cross bar bracket (fig. 4-16), will make 152 mm; use a dynamometer to tighten the nuts on fastening bolts of the longitudinal and cross bars, and the shock-absorbers fastening pins on the axle beam and car body.

Inspection

Before inspection thoroughly wash all components.

Protect the rubber components, bushes and protective covers from solvents.

Springs. Check the tension characteristic of the spring on control points (fig. 4-17), previously having depressed it to bring the coils in contact.

Note. According to length under load of 3432 N (350 kgf) the springs are divided into two classes: class A - length more than 278 mm, and class B - length equal to or less than 278 mm. The springs of A class can be not marked or have marks with white paint on the external side of coils, and class B - marked with black paint on the external side of the coils.

Check for spring deformation. If the spring tension does not correspond to the data on fig. 4-17 or the deformation can affect spring efficiency, renew it.

Inspect the spring rubber gaskets; if necessary - renew.

Arms. Check for:

- arm deformation; straighten if possible;
- cracks on rear axle beam brackets and body; overhaul the brackets in case of cracks;
- the arm joint rubber bushes; if necessary - renew, using a set of fixtures 67.7820.9517.

Shock-absorbers

The design of shock-absorbers of front and rear suspensions is shown on fig. 4-18.

Shock-absorbers bench-test

To test the efficiency of the shock-absorber, make an operating diagram check on a dynamometer bench.

The working diagram is made according to the instruction attached to the test-bench, after no less than 5 working cycles, at the shock-absorber liquid temperature of $(20 \pm 5) ^\circ\text{C}$, the flywheel

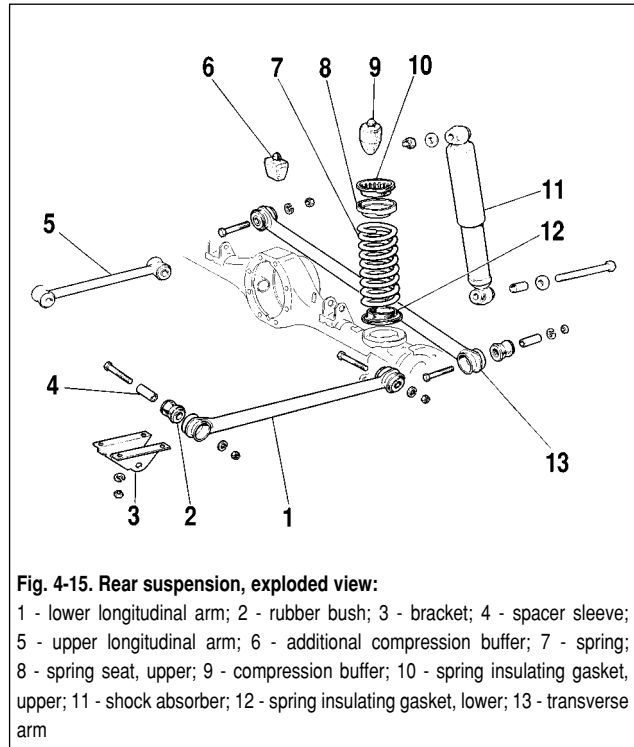


Fig. 4-15. Rear suspension, exploded view:
 1 - lower longitudinal arm; 2 - rubber bush; 3 - bracket; 4 - spacer sleeve; 5 - upper longitudinal arm; 6 - additional compression buffer; 7 - spring; 8 - spring seat, upper; 9 - compression buffer; 10 - spring insulating gasket, lower; 11 - shock absorber; 12 - spring insulating gasket, lower; 13 - transverse arm

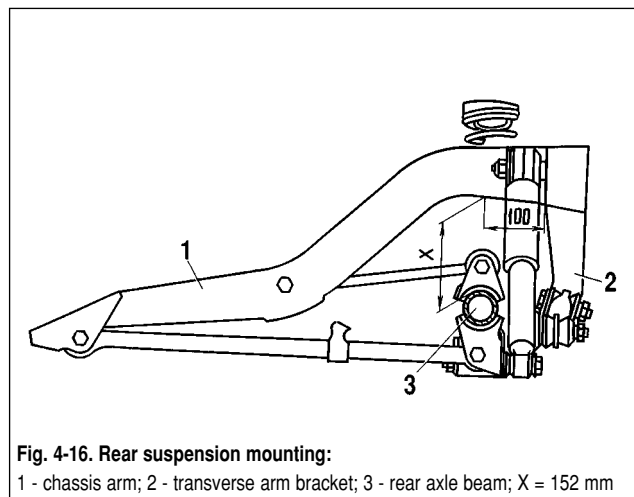


Fig. 4-16. Rear suspension mounting:
 1 - chassis arm; 2 - transverse arm bracket; 3 - rear axle beam; X = 152 mm

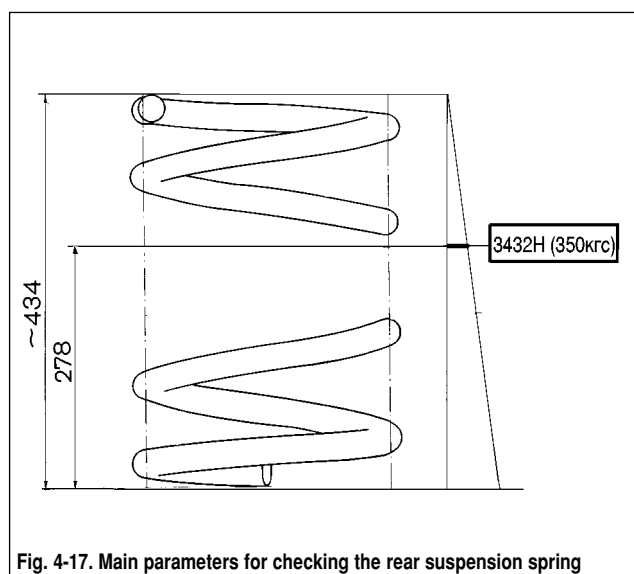


Fig. 4-17. Main parameters for checking the rear suspension spring

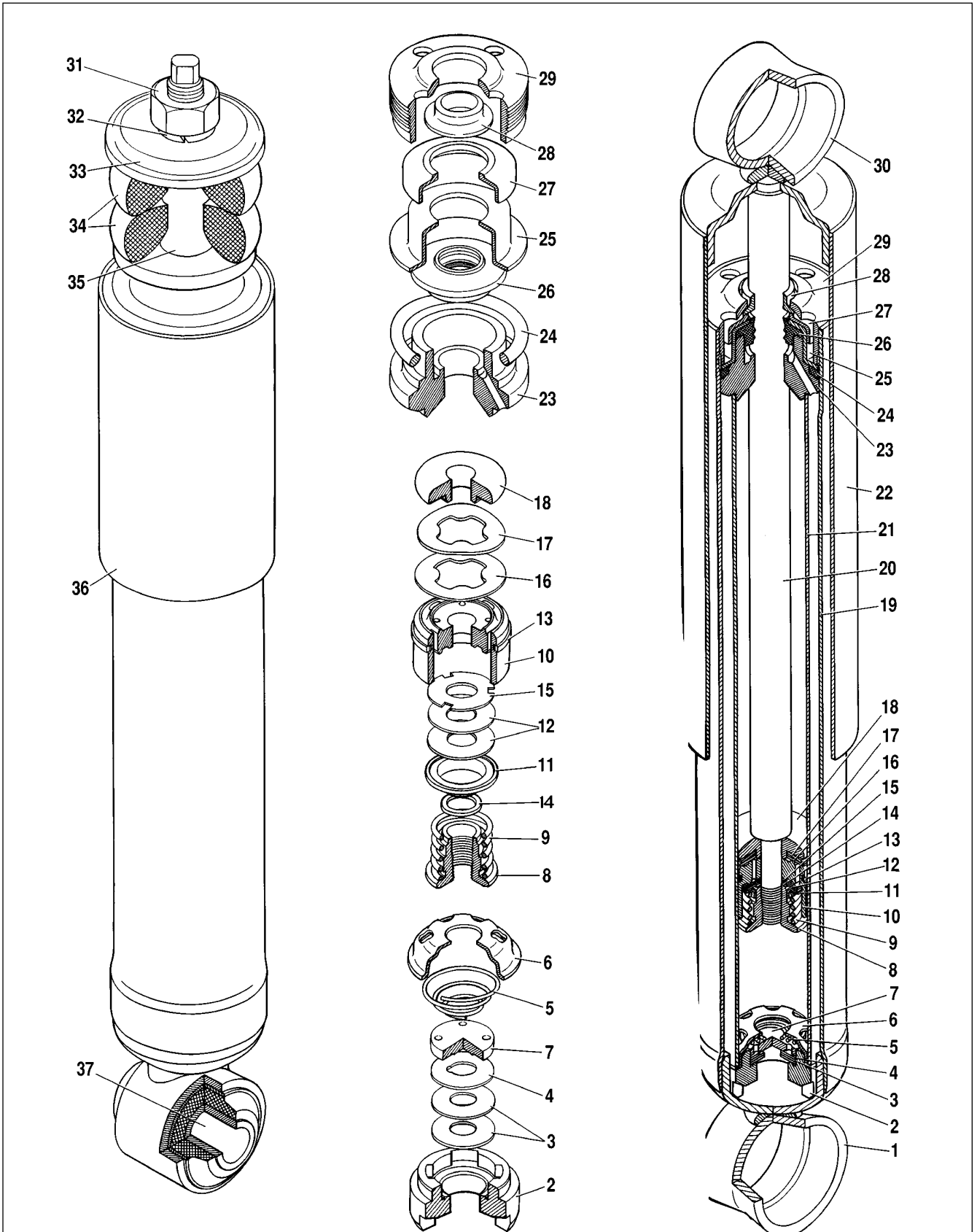
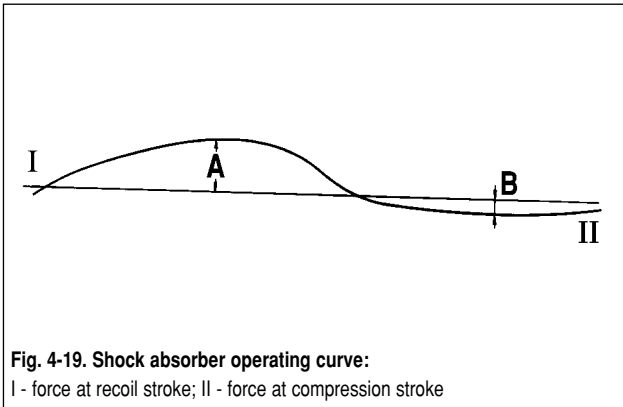


Fig. 4-18. Front and rear suspension shock absorbers:

1 - lower eye; 2 - compression valve body; 3 - compression valve discs; 4 - compression valve throttling disc; 5 - compression valve spring; 6 - compression valve holder; 7 - compression valve cap; 8 - recoil valve nut; 9 - recoil valve spring; 10 - shock absorber piston; 11 - recoil valve cap; 12 - recoil valve discs; 13 - piston ring; 14 - recoil valve nut washer; 15 - recoil valve throttling disc; 16 - by-pass valve cap; 17 - by-pass valve spring; 18 - restricting plate; 19 - tank; 20 - rod; 21 - cylinder; 22 - housing; 23 - rod guide sleeve; 24 - tank sealing ring; 25 - oil seal retainer; 26 - rod oil seal; 27 - gasket; 28 - rod guard ring; 29 - tank nut; 30 - shock absorber eye, upper; 31 - front suspension shock absorber securing nut for top end; 32 - spring washer; 33 - washer; 34 - pad; 35 - distance sleeve; 36 - shock absorber casing; 37 - silent block



speed of 60 min^{-1} , rod stroke length of 80 mm for the front shock-absorber, and 100 mm - for the rear one.

The curve of the diagram (fig. 4-19) should be smooth, and in points of transition (from the recoil stroke to the compression stroke) - without areas parallel to zero line.

Evaluation of diagram results. The resistance of recoil and compression strokes is defined by the peaks of the appropriate diagrams.

The highest point of the recoil stroke curve, with the scale of $1 \text{ mm} = 47 \text{ N}$ (4.8 kgf), should be on the A distance from the zero line, and equal to: 25-32 mm - for front shock-absorbers, 23.5-30.5 mm - for the rear ones.

The highest point of the compression stroke curve, with the same scale, should be on the B distance from the zero line, and equal to 3.5-6.5 mm - for front shock-absorbers, 4.5-7.5 - for the rear ones.

The ordinate control points on the diagrams of front and rear shock-absorbers are given for cold shock-absorbers at shock-absorber liquid temperature $(20 \pm 5) \text{ }^\circ\text{C}$.

After checking, remove the shock-absorber from the test-bench, overhaul or renew the components if necessary.

Repeat the tests to ensure the shock-absorber efficiency.

Shock-absorber - dismantle and reassembly

After washing fix the shock-absorber in vice.

Note. Special grips 67.7824. 9513-001 are used to fasten the shock-absorber and its components in vice.

Fully extend the shock-absorber rod, undo tank nut 29 (see fig. 4-18) with key A.57034/R, take out from the tank the slave cylinder 21 in assembly with the rod and compression valve 2. Remove the tank from vice and drain liquid.

Using key 67.7824.9513-005 take out the rod guide bush 23 from the slave cylinder. Take out from the cylinder rod 20 complete with piston 10 and drain the liquid. Carefully, using a special tool, punch out from the cylinder the compression valve 2 housing in assembly with other components.

Place the rod in assembly with the piston in grips, fix in vice and undo the recoil valve nut 8. Remove piston 10 with valves (bypass and recoil), rod guide bush 23, rod sealing 26, sealing race 25 and other components.

Note. To facilitate the inspection of the rod in the front suspension shock-absorber it might be helpful to press off the cover from the rod.

To dismantle the compression valve, first remove race 6, and then sequentially take out from case 2 spring 5, plate 7 and valve discs 4 and 3.

The reassembly of the shock-absorber is carried out in reverse sequence, paying attention to the following:

- after the reassembly of the compression valve ensure the free play of plate 7 and valve discs;
- race 6 is press fitted on case 2 with special tool;
- the compression valve is press-fitted in the cylinder using tool 67.7824.9513-004;
- to facilitate the reassembly of components located on the rod, use guide 67.7824.9513-003;
- the throttle disc 15 of the front shock-absorber has two grooves on the outer diameter, and the rear shock-absorber throttle disc - three;
- the recoil valve nut is tightened with torque of 11.76-15.68 $\text{N}\cdot\text{m}$ (1.2-1.6 $\text{kgf}\cdot\text{m}$);
- the tank nut is tightened with key 67.7824.9513-002 to torque 68.6-88.2 $\text{N}\cdot\text{m}$ (7-9 $\text{kgf}\cdot\text{m}$).

Inspection of components

Wash the metal components and dry, wipe the rubber components with clean cloth and wash in warm water.

Carefully inspect the components, paying attention to the following:

- the compression and feedback valve discs, and the bypass valve plate should not be deformed; the nonflatness of the bypass valve plate is allowed no more than 0.05 mm;
- the working surfaces of the piston, the piston ring, the rod guide bush, cylinder and the valve components should have no scuffings and dents that might affect normal operation of the shock-absorber;
- the recoil and compression valve springs should be tense enough and not damaged ;
- the compression valve discs should not be damaged and should have no significant wear;
- it is recommended to renew the sealing at repair.

Replace all damaged components and start to reassemble the shock-absorber.

Chapter 5. Steering

The steering mechanism design is shown on fig. 5-1, 5-2.

Since November, 1998, vehicles are fitted with a telescopic intermediate shaft instead of a cylindrical intermediate shaft 17 (see fig. 5-1) and the steering wheel 19 is fastened by a self-locking nut.

There are two variants of fitting the steering pitman arm roller: on needle or on ball bearing. In the text the figures for both variants are given, thus the sign "" refers to the first embodiment (pitman arm roller is established on a needle bearing).

Fault diagnosis

Diagnosis	Remedy
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Excessive free play in the steering wheel

1. Loose steering box fastening bolt	1. Tighten nuts
2. Loose tie-rod ballpin nuts	2. Check and tighten nuts
3. Excessive gap in rod balljoints	3. Renew ball joints or tie rods
4. Excessive clearance in front wheel hub bearings	4. Adjust clearance
5. Excessive clearance in roller-to-worm mesh	5. Adjust clearance
6. Too large clearance between slave arm shaft and bushes	6. Replace bushes or bracket assembly
7. Excessive clearance in worm bearings	7. Adjust clearance
8. Loose bolts fastening intermediate shaft to worm shaft or to upper shaft	8. Tighten bolts

Stiff steering wheel

1. Deformation of steering drive components	1. Renew deformed components
2. Wrong wheel alignment angle	2. Check wheel alignment angle and adjust
3. Wrong roller-to-worm clearance	3. Adjust clearance
4. Excessive torque applied to slave arm shaft adjusting nut	4. Adjust nut tightening
5. Low pressure in front wheel tyres	5. Ensure normal pressure
6. Damaged balljoint components	6. Inspect and renew damaged parts
7. No oil in steering box	7. Check oil level and top up. Renew oil seal if necessary
8. Damaged upper shaft bearings	8. Renew bearing

Noise (rattle) in the steering mechanism

1. Excessive clearance in front wheel hub bearings	1. Adjust clearance
2. Loose nuts on tie-rod ballpins	2. Check and tighten nuts
3. Excessive gap between slave arm shaft and bushes	3. Replace bushes or bracket in assembly
4. Slackened slave arm shaft adjusting nut	4. Adjust nut

Diagnosis	Remedy
5. Wrong clearance in roller-to-worm mesh or in worm bearings	5. Adjust clearance
6. Excessive gap in tie-rod balljoint	6. Renew ball joints or tie rods
7. Loose steering box fastening bolts or slave arm shaft bracket	7. Check and tighten bolt nuts
8. Loose knuckle arm fastening nuts	8. Tighten nuts
9. Loose steering shaft fastening bolts	9. Tighten nuts

Shimmy

1. Improper tyre pressure	1. Check and ensure normal pressure
2. Wrong front wheel alignment angle	2. Check and adjust wheel alignment angle
3. Excessive clearance in front wheel hub bearings	3. Adjust clearance
4. Wheels out-of-balance	4. Balance wheels
5. Loose tie-rod ballpin nuts	5. Check and tighten nuts
6. Loose fastening bolts on steering box or slave arm shaft bracket	6. Check and tighten bolt nuts
7. Wrong roller-to-worm gap	7. Adjust clearance

Vehicle wandering

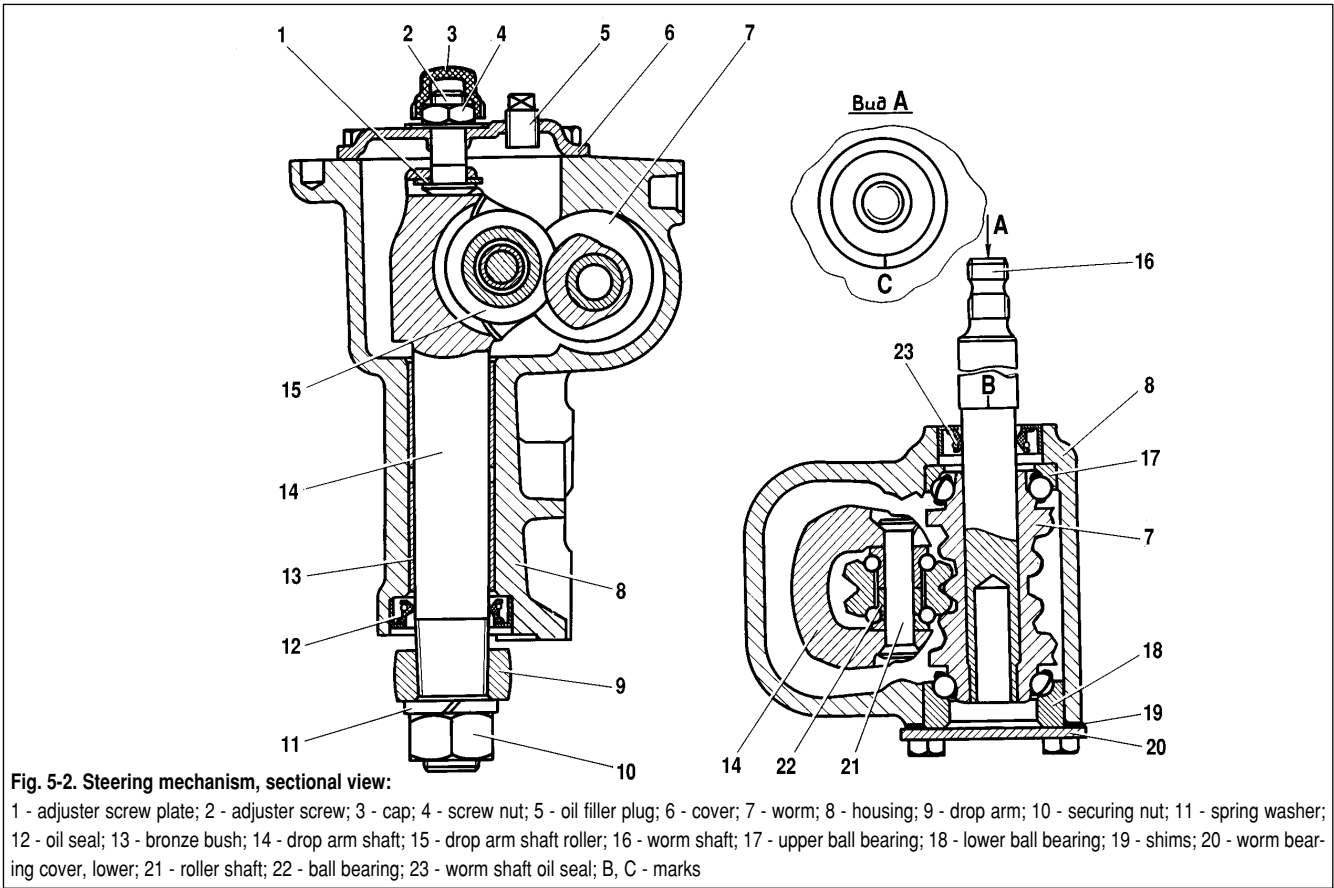
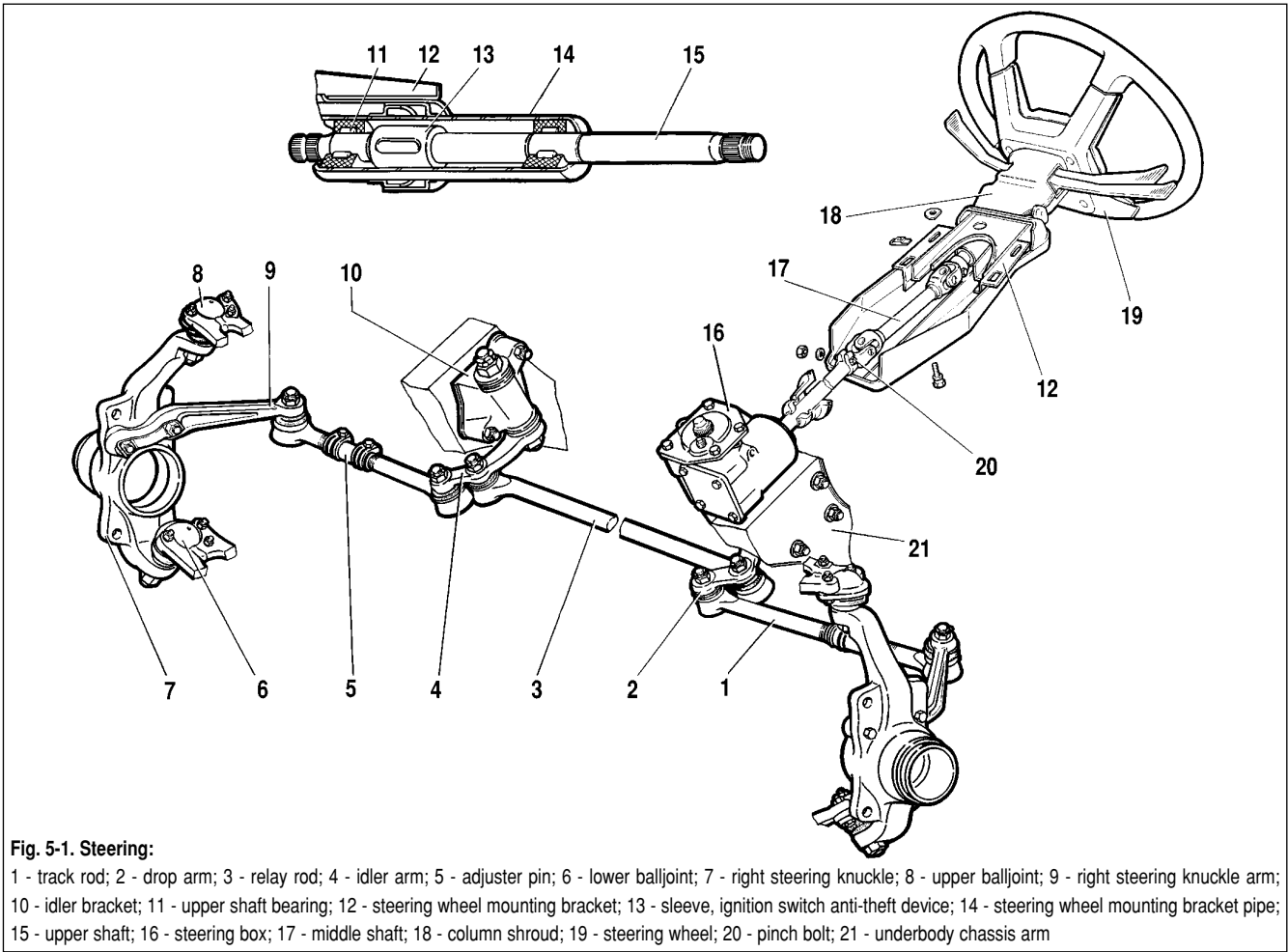
1. Unequal pressure in tyres	1. Check and ensure normal pressure
2. Wrong front wheel alignment angle	2. Check wheel alignment angle and adjust
3. Different tension in front suspension springs	3. Replace bad springs
4. Deformed steering knuckles or suspension arms	4. Inspect knuckles and arms, replaces bad parts
5. Incomplete brake release on one or several wheels	5. Check braking system

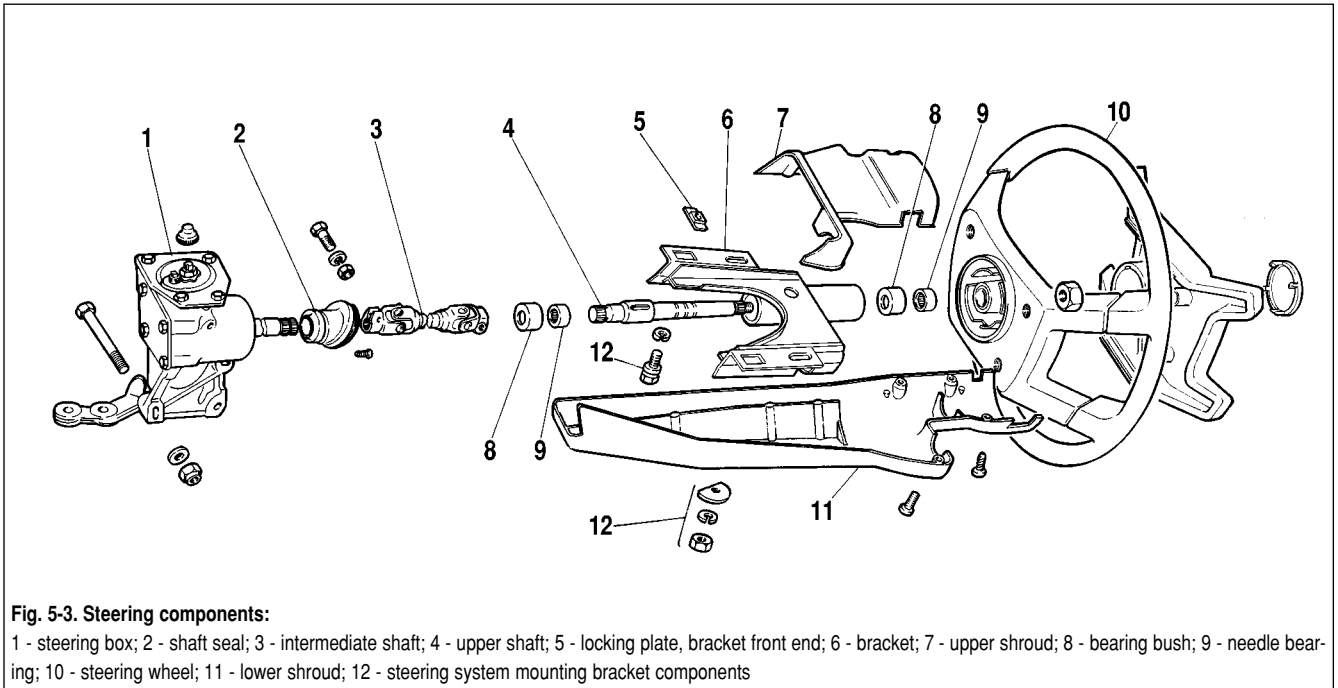
Vehicle unstable

1. Wrong front wheel alignment angle	1. Check wheel alignment angle and adjust
2. Excessive clearance in front wheel bearings	2. Adjust clearance
3. Loose tie-rod ballpin nuts	3. Check and tighten nuts
4. Excessive clearance in tie-rod balljoint	4. Renew tie rod balljoints
5. Loose fastening bolts on steering box or slave arm shaft bracket	5. Check and tighten bolt nuts
6. Excessive roller-to-worm gap	6. Adjust gap
7. The steering knuckles or suspension arms are deformed	7. Inspect knuckles and arms, replaces bad parts

Oil leak from the steering box

1. Worn arm shaft sealing or worm	1. Renew oil seal
2. Loose steering box cover fastening bolts	2. Tighten bolts
3. Damaged sealings	3. Renew sealings





Steering - inspection, check and adjustment

General inspection

The steering system should be examined at any signs of malfunction (rattle, excessive free play of the steering wheel or, on the contrary, its hard rotation, and so on). The inspection is carried out on the trestles or an inspection pit in the following order.

Clean the components of the steering mechanism and the steering box. Place the wheels in position corresponding to straight movement.

- Turn the steering wheel in both directions, and ensure:
 - the steering wheel free play does not exceed 5° (when measured on the wheel rim, no more than 18-20 mm). To perform this operation use tool 67.8720.9501;
 - there is no rattle in joints, connections and steering mechanism;
 - reliable fastening of the steering box and the slave arm bracket (tighten the threaded connections if necessary);
 - there is no free play in the tie-rod balljoint and in the slave arm bracket, and there is no axial displacement of the worm shaft;
 - the steering wheel turns with the effort (with the front wheels standing on smooth surface) not exceeding 196 N (20 kgf), 245* N (25* kgf).

Check the tie-rod adjuster pins, ensure reliable tightening of the clamps.

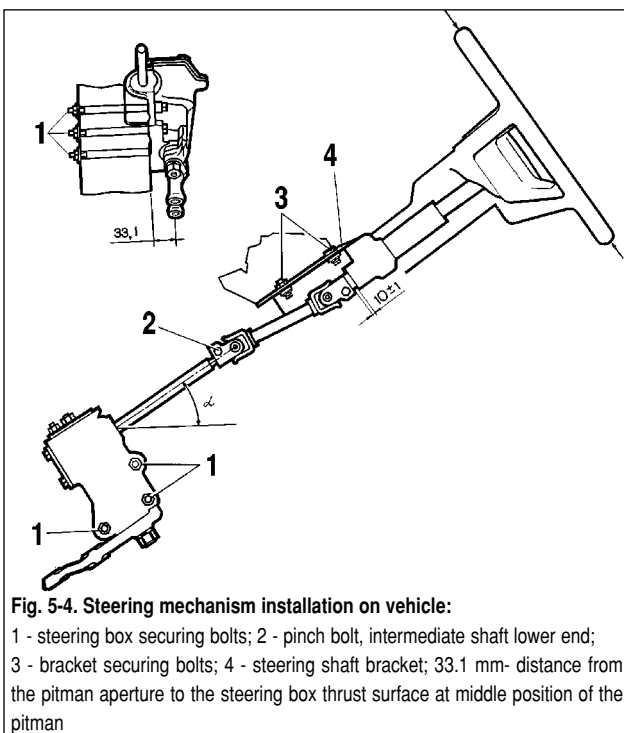
Inspect the balljoint and protective caps, as set forth below.

Inspection of the tie-rod balljoint

First, check the movement of the tie-rod ends along the pins. For this purpose, move the end parallel to the pin, using a lever and a support.

The axial movement of the end in relation to the pin should be 1-1.5 mm. This will prove that the pin insert is not jammed in the tie-rod end and it moves together with the pin, depressing the spring. Replace the joint with a jammed insert.

Rotate the steering wheel in both directions, by touch ensure there is no free play in the tie-rod joints. If the free play in the ball is detected, replace the tie-rod ends or tie-rod assembly.



Inspect the tie-rod balljoint protective caps.

If the protective caps are in good condition and provide inside cleanness, their service life is practically unlimited. Moisture, dust and other foreign particles inside the joint will result in premature wear of components.

The cap should be replaced in case of cracks, breaks and in case greasing is squeezing out when the joint is pressed with fingers.

Checking and adjusting the clearance in the steering mechanism worm bearings

Place the front wheels in position corresponding to straight movement, rotate the steering wheel in both directions, and check if the distance between the steering box 8 end face (fig. 5-2) and mark B made on the steering worm shaft will change. This change will indicate a gap in worm bearings.

To adjust the clearance in worm bearings, make 1-1.5 turns of the steering wheel to the left, undo the fastening bolt from the bottom cover 20 and drain oil from the steering box. Remove the bottom cover, remove one shim or replace it with a thinner one.

Note. Shims are delivered in spare parts with thickness of 0.10 and 0.15 mm.

Fix the bottom cover, again check for axial shift of worm in bearings. If there is no free play, fill the steering box with 0.215 l. of transmission oil.

Check the effort of turning the steering wheel, having placed the front wheels on smooth metal surface. It should not exceed 196 N (20 kgf), 245* N (25* kgf).

Check and adjustment of the roller-to-worm mesh

Having ensured there is no axial movement of the worm in the bearings, use puller A.47035 to press out the balljoint pins from the apertures in the arm and disconnect the tie-rods from the arm, at the same time keeping the front wheels straight.

Move the arm by the head, check for a gap in the roller-to-worm mesh. Within the 30° turn of the steering wheel in each direction from the neutral position there should be no clearance, that is, no evident free play of the arm.

If the free play of the arm can be felt, remove cap 3 (see fig. 5-2), slacken nut 4 on the adjusting screw and, having raised the washer, tighten the adjusting screw 2 to take up the backlash. Do not tighten the adjusting screw too much. Then, hold the adjusting screw with a screwdriver, and tighten nut 4.

Ensure, that the arm does not move, connect the balljoint pins. Check the effort of turning the steering wheel. If it exceeds 196 N (20 kgf), slacken adjusting screw 2 and refit cap 3.

Steering mechanism

Removal and refitting

Removal. Disconnect the wires from the battery and take off the horn push-pad trim. Undo the steering wheel fastening nut, remove the steering wheel, and both halves of the steering column shroud.

Note. If it is necessary to remove only the steering box, undo the bolt that is fastening the intermediate shaft lower U-joint fork on the worm shaft and the bolts fastening the steering box to the body chassis arm.

Remove the instrument cluster and disconnect the connector plugs of the three-lever switch from the harness connectors.

Disconnect the wires from the ignition switch terminals, undo the fastening screws, push down the switch lock and remove the ignition switch. Loosen the fastening clip of the switch housing incorporating the turn lights, headlights and wipers, and remove.

Undo the bolt that is fastening the intermediate shaft lower U-joint fork to the steering worm shaft.

Undo the bracket 6 fastening bolt (fig. 5-3) and remove the steering shaft with the bracket.

Undo the nuts that are fastening the ballpins on the side and middle tie-rods to the arm, and use puller A.47035 to press out the ballpins from the arm apertures.

Remove the steering box, prior having undone the bolts that are fastening it to the body chassis arm. Take out the steering shaft sealing from the opening in the car front.

Refitting. Insert sealing 2 (see fig. 5-3) into the opening in the car front, match the sealing ridges with the grooves in the opening, place the steering box on the chassis arm, but do not tighten completely the nuts on the steering box fastening bolts.

Using a special fixture, situate the steering box so that angle α (fig. 5-4) does not exceed 32°, and the clearance between the shaft and the brake pedal will be no less than 5 mm. Then completely tighten the steering box fastening nuts.

Place the steering pitman arm in middle position. To do this, match the labels on the steering box and on the worm shaft (see fig. 5-2).

Temporarily refit the steering wheel on the shaft so that the spokes are located horizontally and in this position connect the intermediate shaft U-joint with the worm shaft, paying special attention, that the fastening bolts pass through the worm ring groove. Then attach the steering shaft bracket to the body.

Remove the steering wheel and refit the combination switch (turn lights, headlights and wipers) on the column.

Refit the steering wheel on the shaft so that the spokes are located horizontally. The steering wheel should rotate smoothly and easily in both directions, then tighten the steering wheel fas-

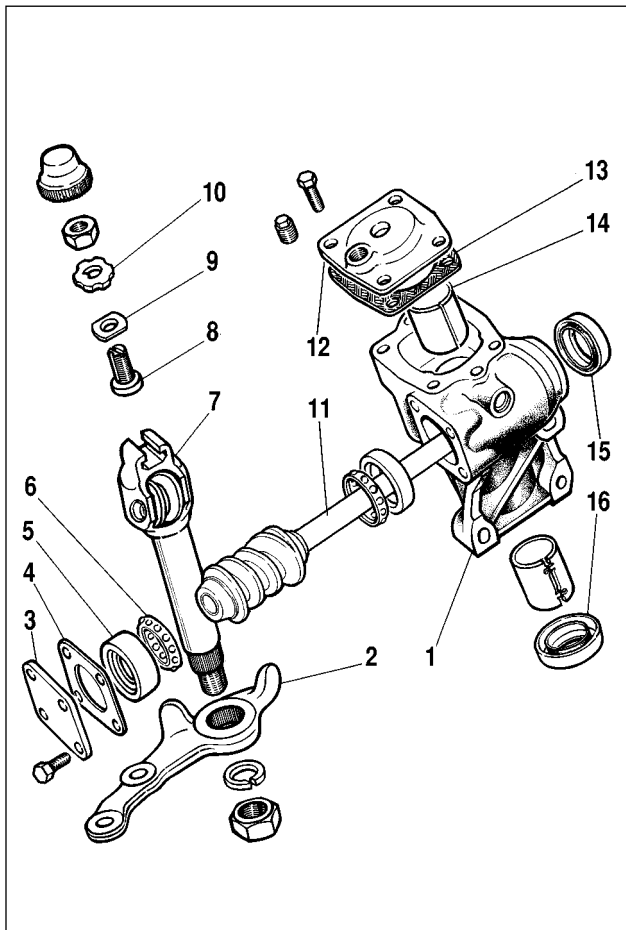


Fig. 5-5. Steering mechanism, exploded view:

1 - steering box; 2 - drop arm; 3 - box cover, lower; 4 - shims; 5 - worm shaft bearing ring, outer; 6 - race with balls; 7 - drop arm shaft; 8 - adjusting screw; 9 - adjusting plate; 10 - lockwasher; 11 - worm shaft; 12 - top cover; 13 - gasket; 14 - pitman shaft bush; 15 - worm shaft oil seal; 16 - pitman shaft oil seal

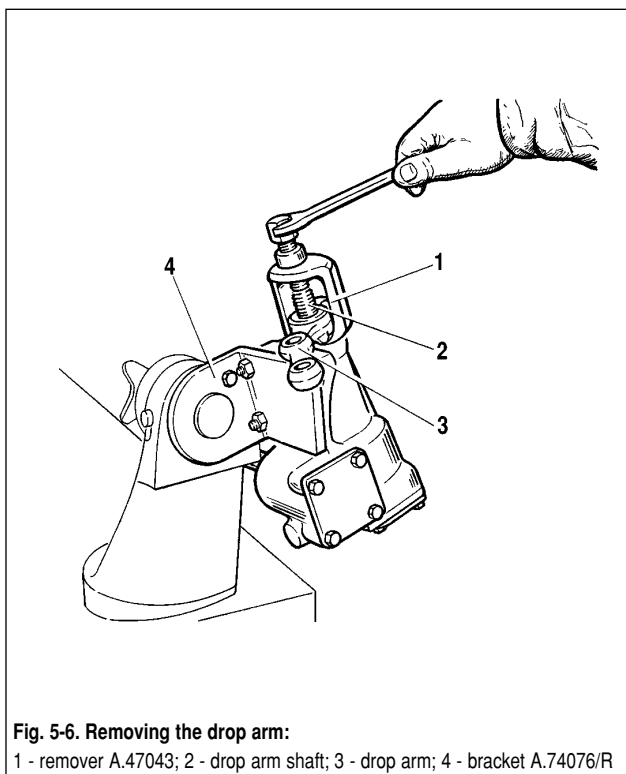


Fig. 5-6. Removing the drop arm:

1 - remover A.47043; 2 - drop arm shaft; 3 - drop arm; 4 - bracket A.74076/R

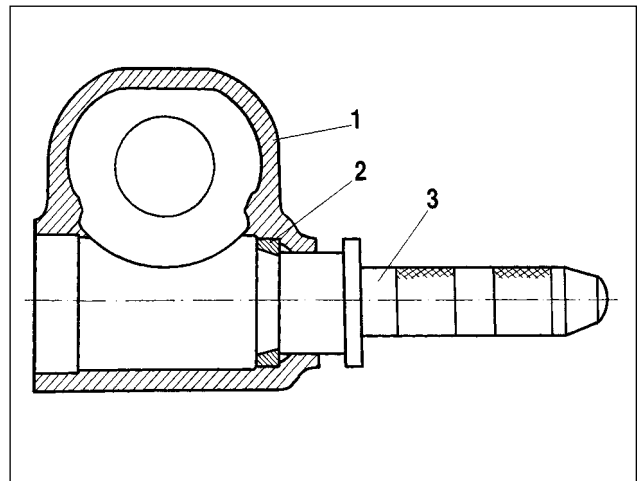


Fig. 5-7. Removing the outer ring of the worm upper bearing using tool 67.7853.9541:

1 - steering box; 2 - worm upper bearing ring, outer; 3 - tool 67.7853.9541

tening nut and fix it in three points. Move the combination switch case fully towards the steering wheel, and tighten the switch fastening clip.

Reconnect the wires of the ignition switch and fix the switch on the steering column bracket with screws.

Reconnect the combination switch plugs to the vehicle harness plugs.

Refit both halves of the shaft shroud and fasten them with screws. Apply a thin layer of greasing on the lower contact ring and refit the horn push-pad trim on the steering wheel.

Refit the ballpins of the middle and left tie-rods on the pitman arm and fix them with nuts.

Adjust the front wheels toe-in and check the effort on the steering wheel, which should not exceed 196 N (20 kgf), 245* N (25* kgf) (measured on the wheel rim) when tested on a smooth metal plate.

Note. It is possible to assemble the steering column (with the combination switch) separately and then to refit the unit on the vehicle.

To fix the unit, establish the steering wheel spokes horizontally and connect the worm shaft to the lower end of the intermediate shaft, paying attention, that the lock bolts pass through a ring groove on the worm shaft and the wheel shaft.

Prior to completely fastening the bracket bolts, rotate the steering wheel in both directions several times and only then tighten the bracket fastening bolts.

Steering mechanism - dismantle and reassembly

Dismantle. Drain oil from the steering box. Fix it on bracket A.74076/R with support A.74076/1.

Undo the pitman arm fastening nut 2 (fig. 5-5), take off the spring washer, and using puller A.47043 remove the arm (fig. 5-

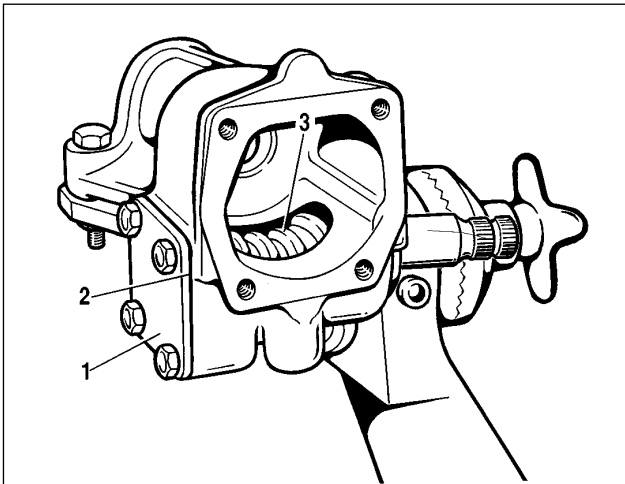


Fig. 5-8. Installing the steering worm
1 - bearing cover; 2 - shim; 3 - worm

6). Undo the fastening bolt, take off cover 12 (see fig. 5-5) of the steering box together with cap, adjusting screw 8, adjusting plate 9, lock washer 10 and jam nut. Take out from the steering box 1 the pitman arm shaft 7 in assembly with the roller.

Undo the fastening bolt, remove cover 3 from the worm shaft thrust bearings together with shims 4.

With the worm shaft 11 push out from the box the bearing outer ring 5 and take out the shaft together with bearing cage 6. Remove worm shaft sealing 15 and the pitman arm sealing 16.

Using tool 67.7853.9541 take out the top bearing outer ring (fig. 5-7).

Reassembly. The reassembly of the steering mechanism is carried out on bracket A.74076/R in sequence, reverse to dismantle.

The outer ring of the worm upper bearing is press-fitted with tool 67.7853.9541, having rearranged the fixture on the tool handle in reverse order.

Refit the worm in the steering box and fasten the bottom cover (fig. 5-8), use dynamometer 02.7812.9501 and head A.95697/5 (fig. 5-9) to check the worm friction moment; it should be within the limits of 19.6-49 N•cm (2-5 kgf•cm). If the moment

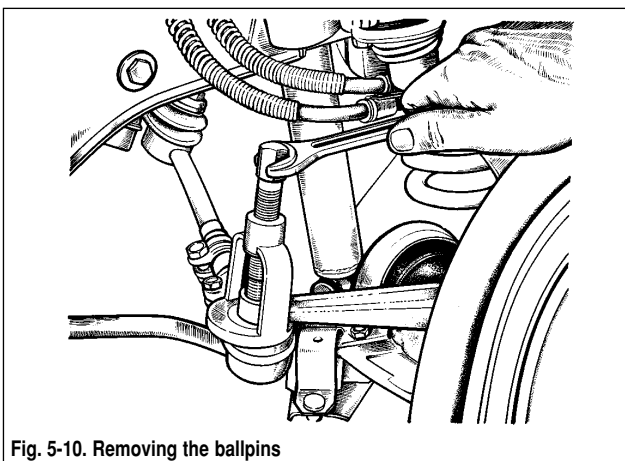


Fig. 5-10. Removing the ballpins

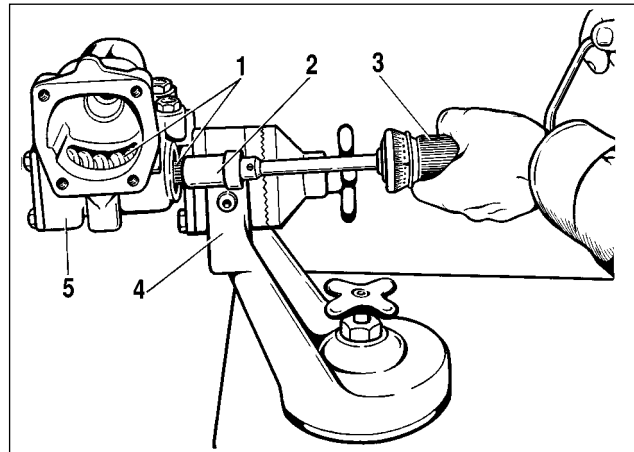


Fig. 5-9. Checking the worm friction moment using a dynamometer:
1 - worm; 2 - head A.95697/5; 3 - dynamometer 02.7812.9501; 4 - test-bench bracket; 5 - steering box

will appear less than specified, reduce the thickness of shim 2 (see fig. 5-8), and if more - increase.

After refitting the pitman arm, ensure there is no clearance in the roller-to-worm mesh in position when the worm shaft is turned right and left by 30° from the pitman arm middle position. Take up any possible clearance by adjusting screw 2 (see fig. 5-2) and tighten jam nut 4.

After adjusting the roller-to-worm mesh gap, use a dynamometer to check the worm friction, which should be equal to 68.7-88.3 N•cm (7-9 kgf•cm) when turning the worm shaft by 30° both to the left and to the right from the middle position and should smoothly reduce to 49 N•cm (5 kgf•cm) when turned from the 30° position further to the stop.

After the reassembly, check the angles of pitman rotation from the neutral position, which should make $32^{\circ}10' \pm 1^{\circ}$ both to the left and to the right until the pitman arm will get pressed against the bolt head; fill the steering box with 0.215 l of transmission oil.

Check and repair

Carefully examine the working surfaces of the roller and the worm for traces of wear, jamming or risks. Renew worn and damaged components.

Check the size of the clearance between the bushes and the pitman arm shaft, which should not exceed 0.10 mm. If the clearance is more than specified, renew the bushes using tool A.74105.

On the inner surfaces of the pitman arm bushes there are spiral flutes, which come out only from one side. When press-fitting, the bushes should be located so that their end faces with the flutes were inside the aperture of the steering box, and the outputs of the flutes were facing each other. The end faces of the bushes should be deep inside the steering box aperture by 1.5 mm.

New bushes should be greased with transmission oil before press-fitting.

After press-fitting in the steering box, finally process the bushes with a reamer A.90336 up to the size of 28.698-28.720 mm. The mounting gap between the pitman arm shaft and the bushes should be within 0.008-0.051 mm.

Check for easy rotation of the pitman arm roller on the ball bearing. The ball bearings on the worm and the roller should rotate freely, without jamming; there should be no signs of wear or damages on the surface of the rings and balls.

Check the axial clearance between the head of the adjusting screw 8 (see fig. 5-5) and the groove in the pitman arm shaft 7. The gap should not exceed 0.05 mm. If more, replace the adjusting plate 9 with a plate of greater thickness.

Note. In the spare parts the adjusting plates are supplied of eleven sizes, with thickness from 1.95 mm up to 2.20 mm, ; the increase in each size makes 0.025 mm.

Inspect locking plates 5 (see fig. 5-3). Renew if they are deformed.

Steering shaft - dismantle and reassembly

Dismantle. Undo the U-joint fork fastening bolt and separate the intermediate and upper shafts of the steering mechanism.

If the upper shaft or its bearings are damaged, flare the places of the bracket pipe punching and take out the pipe from the shaft 15 (see fig. 5-1) in assembly with bearings 11.

If the shaft rotates in the bearings without jamming and there is no radial free play in the bearings (the resilient radial movements of the steering shaft are allowed), it is not recommended to dismantle the upper steering shaft.

Renew the shaft and the bearing in case of wear or damage.

The reassembly is carried out in reverse order, paying attention that the U-joint lock bolt passes through the ring groove on the upper shaft. Then punch the bracket pipe in two points from both sides to fix the shaft bearings.

Tie-rods and balljoints

Removal and refitting. Remove the cotter pins and undo the nuts with which the side tie-rod ballpins are fastened to the arms on the steering knuckles.

Using puller 67.7824.9516 (fig. 5-10) take out the ballpins from the cone apertures on the arms.

Remove the cotter pins and undo the nuts fastening the ballpins of the middle and side tie-rods to the pitman arm and to the idler arm. Using puller 67.7824.9516, take out the pins from the corresponding jacks on the arms and remove the tie-rods.

The tie-rods are refitted in reverse order. All ballpin nuts are tightened with a dynamometer with subsequent splinting. If the nut cut does not match the opening for the pin, the nut should be

screwed in to an angle, smaller than 60° to provide for subsequent splinting.

After refitting adjust the front wheel toe-in.

Check and repair. Inspect the protective caps 3 (fig. 5-11), as described above (see "Inspection, check and adjustment of steering mechanism"). Renew damaged protective caps.

Inspect the condition of the tie-rod balljoints by their radial and axial clearance. If the free play of pin 1 in case 3 is felt, and also in case of dirt or sand penetration, or corrosion on the ballpin, wear of the support insert - renew the joint with the tie-rod end.

Idler arm bracket

Removal and dismantle. Separate the idler arm from ballpins on the middle and side tie-rods, remove the cotter pins, having previously undone the nuts and taken out the ballpins from the arm using puller 67.7824.9516. Then undo the bolt fastening the bracket to the body chassis arm and remove the bracket.

Fix the bracket in vice, remove the cotter pins and undo nut 4 (fig. 5-12), then remove washers 3 and 6 and the idler arm 1 in assembly with shaft 9, washer 10 and self-locking nut 11, remove sealings 7 and press out bushes 8.

Inspection. Inspect the idler arm shaft bushes; in case of out-of-roundness or inadmissible gap between them and the shaft, renew the bushes. Also renew sealings 7.

Check the shaft for out-of-roundness and damages, renew if necessary. Ensure the idler arm has no deformations, otherwise renew.

Assembly and refitting. Before reassembly grease the bushes of the idler arm shaft and fill the space between them with ЛИТОЛ-24. The reassembly order of the idler arm bracket is a reverse to dismantle.

If shaft 9 was replaced, the bracket self-locking nut 11 should be tightened with a dynamometer.

Washer 6 is installed with the extrusions facing upwards.

After tightening nut 4 the arm in horizontal position should not rotate under its own weight. It should turn under force of 9.8-19.6 N (1-2 kgf) applied to its end.

If nut 4 was tightened too much, undo it, raise washer 6 and tighten again.

Fix the bracket on the chassis arm with self-locking nuts and flat washers, tighten them with dynamometer.

Connect the tie-rod ballpins to the idler arm.

Chapter 6

Braking system

The design of the braking system is shown on fig. 6-1.

Fault diagnosis

Diagnosis	Remedy
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Insufficient efficiency of braking

1. Leak of brake liquid from wheel cylinders of front or rear brakes	1. Renew bad components of wheel cylinder, wash and dry shoes and drums, bleed braking mechanism
2. Air in brake system	2. Expel air from system
3. Damaged rubber sealings in master brake cylinder	3. Renew seals and bleed system
4. Damaged hydraulic system rubber hoses	4. Renew hoses

Spontaneous braking at working engine

1. Air inleak in servo unit between valve housing and protective cap	1. Replace servo unit
----------------------------------------------------------------------	-----------------------

Incomplete brake release on all wheels

1. No brake pedal free travel due to wrong position of stop-signal switch	1. Adjust switch position
2. Projection of servo unit adjusting bolt in relation to fastening surface of master cylinder exceeds 1.25 ^{±0.2} mm	2. Adjust bolt position (see fig. 6-2)
3. Jammed servo unit valve housing	3. Replace servo unit
4. Plugged compensation aperture in master cylinder	4. Clean aperture and bleed system
5. Swollen master cylinder rubber sealings due to penetration of petrol, mineral oils and etc in liquid.	5. Carefully wash system with brake liquid, renew damaged rubber parts, bleed system
6. Jammed master cylinder piston	6. Check and replace, if necessary, master cylinder, bleed system

Snubbing of one wheel at released brake pedal

1. Loose or damaged return spring of rare brake shoes	1. Renew spring
2. Jammed piston in wheel cylinder due to corrosion	2. Dismantle cylinder, clean and wash all components, renew damaged parts
3. Swollen wheel cylinder sealing due to penetration of fuels and lubricants in liquid	3. Renew rings, wash system with brake liquid
4. No gap between shoes and drum	4. Adjust parking brake
5. Wrong position of caliper in relation to brake disc due to loose bolts that are fastening carrier to steering knuckle	5. Tighten securing bolts, renew damaged parts if necessary
6. Excessive runout of brake disc (more than 0.15 mm)	6. Grind disc, in case thickness is less than 9 mm - renew

Vehicle wandering or skidding at braking

1. Leak of brake liquid in one of wheel cylinders	1. Renew seals and bleed system
2. Jammed piston in brake wheel cylinder	2. Check and rectify piston sticking in cylinder, renew damaged components if necessary
3. Clogged tube due to dent or contamination	3. Renew or clean tube, bleed system
4. Different pressure in tyres	4. Adjust pressure
5. Wrong wheel alignment angles	5. Adjust angles
6. Dirty or oily discs, drums and linings	6. Clean braking mechanism components
7. Wrong adjustment of pressure regulator	7. Adjust position
8. Faulty pressure regulator	8. Adjust or renew

Excessive pedal effort at braking

1. Plugged air filter	1. Renew air filter
2. Jammed servo unit valve housing	2. Renew servo unit
3. Damaged hose between servo unit and engine inlet pipe, or its loose fastening on connectors	3. Renew hose or tighten clips
4. Oxidation of brake pedal metal bushes or dry greasing in pedal bushes	4. Renew worn parts or greasing

Scratch or squeal of brakes

1. Loose shoe return spring	1. Inspect return spring, replace if necessary
2. Ovality of drums	2. Remachine brake drum
3. Excessive oil on friction linings	3. Clean pads using metal brush with warm water and washing liquid. Eliminate cause of liquid or lubricate ingress
4. Worn linings or trapped detrimental inclusions	4. Renew pads
5. Excessive disc runout or non-uniform wear	5. Grind disc, in case thickness is less than 9 mm - renew

Inspection and adjustment

Pipelines and connections - inspection

To prevent any occasional failure of the braking system carefully inspect all pipelines:

- metal pipelines should have no dents or cracks and should lie far from sharp edges that can damage them;

- brake hoses should have no cracks on the outer surface and should not get in contact with mineral oils and greasings that dissolve rubber; heavily depress the brake pedal and inspect the hoses for bulges that will indicate malfunctions;

- all brake lines should be reliably fastened; loose fastening will result in vibration causing damage;

- liquid leak through pipeline connections is not allowed; if necessary, fully tighten the connections without deforming the pipelines.

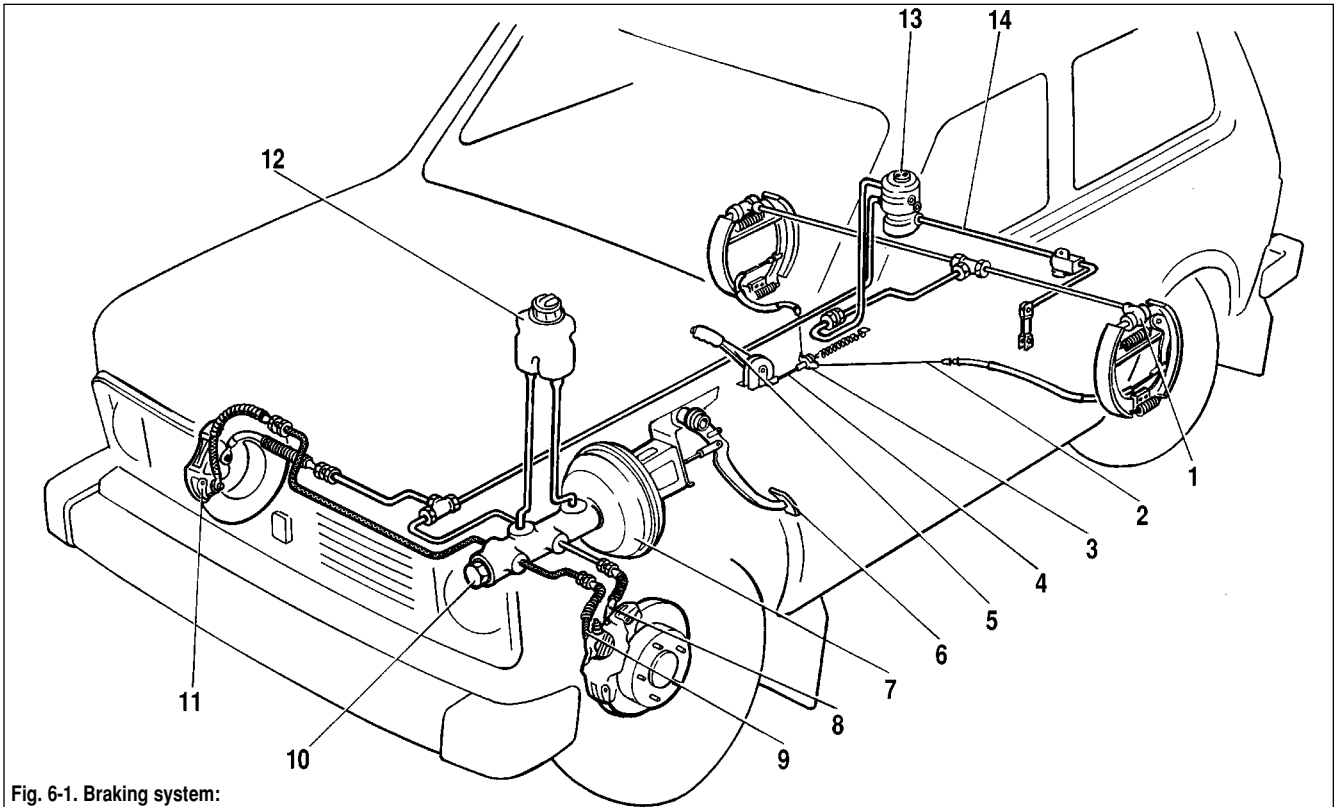


Fig. 6-1. Braking system:

1 - rear brake wheel cylinder; 2 - parking brake rear cable; 3 - rear brake guide; 4 - parking brake front cable; 5 - parking brake lever; 6 - brake pedal; 7 - servo unit; 8 - second circuit pipeline; 9 - primary circuit pipeline; 10 - master cylinder; 11 - wheel cylinder block, front brakes; 12 - master cylinder tank; 13 - pressure regulator; 14 - pressure regulator control arm

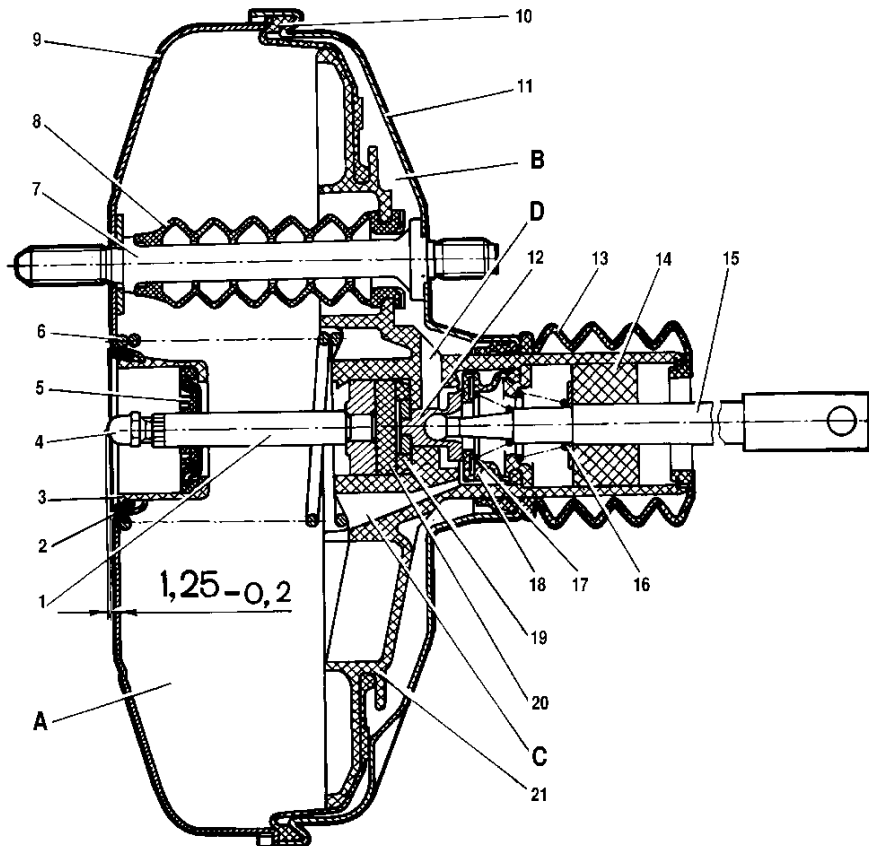


Fig. 6-2. Brake servo unit:

1 - rod; 2 - master cylinder flange sealing ring; 3 - servo housing cup; 4 - adjuster bolt; 5 - rod sealing; 6 - diaphragm return spring; 7 - pin; 8 - sealing boot; 9 - servo unit housing; 10 - diaphragm; 11 - servo unit housing cover; 12 - piston; 13 - valve body boot; 14 - air cleaner; 15 - push rod; 16 - push rod return spring; 17 - valve spring; 18 - valve; 19 - valve body bush; 20 - reaction disc; 21 - valve body; A - vacuum chamber; B - atmospheric chamber; C, D - ports

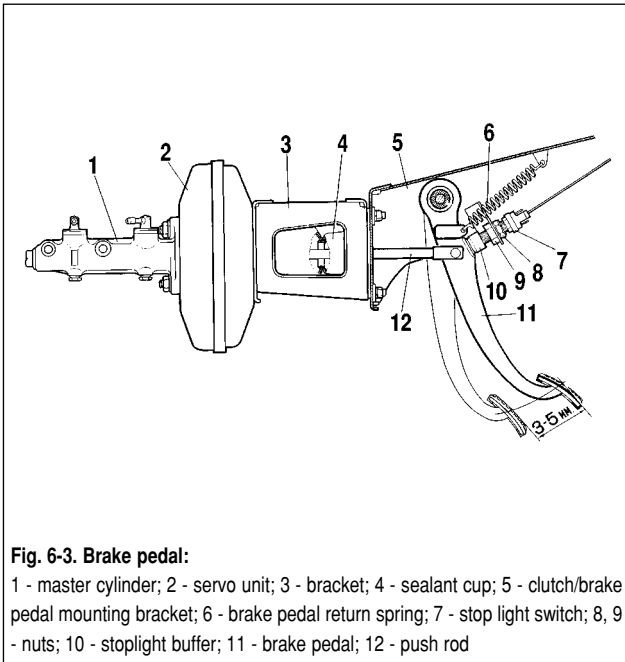


Fig. 6-3. Brake pedal:

1 - master cylinder; 2 - servo unit; 3 - bracket; 4 - sealant cup; 5 - clutch/brake pedal mounting bracket; 6 - brake pedal return spring; 7 - stop light switch; 8, 9 - nuts; 10 - stoplight buffer; 11 - brake pedal; 12 - push rod

Renew the components in the slightest doubt in serviceability.

Flexible hoses, irrespective their condition, should be renewed after 100000 km or after 5 years of vehicle operation to prevent sudden breaks due to aging.

After five years of operation it is recommended to renew the brake liquid.

Servo unit -serviceability check

Press the brake pedal 5-6 times with the engine not working to create in cavities A and B (fig. 6-2) identical pressure close to atmospheric. Simultaneously, by effort applied to the pedal, define, whether the valve housing 21 is jammed.

Stop the brake pedal in the middle of its travel and start the engine. If the servo unit is OK, the brake pedal after engine start should "go forward".

If the pedal does not "go forward", check the fastening of the hose end piece, condition and fastening of the end piece flange in the booster, hose-to-end piece fastening and connection to the engine inlet pipe, because loose fastening or damage will significantly reduce the underpressure in cavity A and performance efficiency of the unit.

In case of vehicle spontaneous braking, check the servo unit for leak-proofness with the engine running, first with a released, and then depressed motionless brake pedal. "Sticking" of the protective cap 13 to the valve housing tail and hissing of inleaking air will indicate insufficient tightness of the servo unit. In these cases the unit should be renewed.

Brake drive adjustment

The free travel of the brake pedal with engine not working should be 3-5 mm. This size is received by adjusting the position of the stoplight switch 7 (fig. 6-3).

If the stoplight switch is too close to the pedal, it does not come back to the initial position, valve 18 (see fig. 6-2), being pressed to housing 21, separates cavities A and B, and it results in incomplete release of wheels when the pedal is let off.

To adjust the stop-light switch position slacken nut 8 and by rotating nut 9 (see fig. 6-3) position the switch so that its buffer will slightly touch the pedal rest, thus the pedal free travel should make 3-5 mm. After adjustment tighten nut 8.

ATTENTION. The brake pedal free travel adjustment is made with the engine not working.

If the adjustment of the stoplight switch fails to remedy the brake mechanism, disconnect the master cylinder from the servo unit and check the protrusion of the adjusting bolt 4 (see fig. 6-2) in relation to the fastening plane of the master cylinder flange (size $1.25^{+0.2}$). This size can be established by holding with a special key the end of rod 3, and with the other key screwing in or undoing bolt 28.

Handbrake adjustment

Note. In the end of year 1995, the design of the handbrake lever quadrant was changed - the first tooth of the sector became double and thus the order of adjustment, marked below in the text with a "*" sign, has changed.

If the handbrake does not hold the vehicle on a slope up to 25 % when moving the lever by 4-7 (2-8) * teeth of the quadrant, adjust the handbrake in following order:

- shift the handbrake lever to the lowest position and then lift by 1-2 teeth of quadrant (this operation is carried out only for the gear sector of the "old" design);
- slacken locknut 5 (fig. 6-4) and by turning the adjusting nut 6 take up cable 1;
- check the full travel of the handbrake lever, which should be 4-5 (2-4)* teeth on the quadrant, then tighten locknut 5.

Apply the brake pedal several times to ensure that the lever travel does not change and wheels rotate without jamming at fully lowered lever.

Note. If the cables were renewed, depress the brake pedal two or three times applying force on the lever of approx. 392 N (40 kgf). Thus the cables will be stretched.

Pressure regulator serviceability check

Position the vehicle on a lift or over an inspection pit, clean the pressure regulator and protective cover from dirt.

Carefully remove the protective cover from the pressure regulator, remove the remains of greasing and clean the "torsion-to-piston" connection.

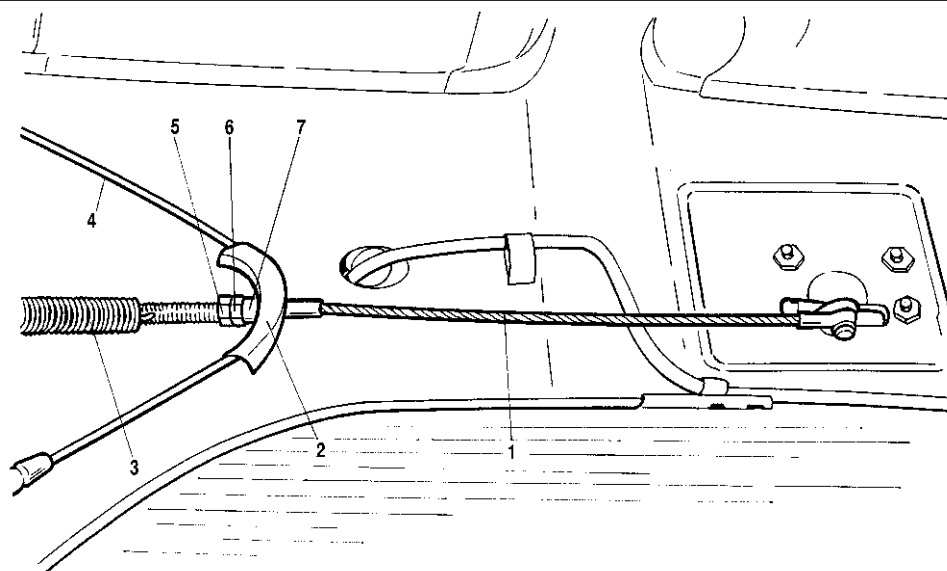


Fig. 6-4. Handbrake linkage:

1 - front cable; 2 - rear cable guide; 3 - front cable return spring; 4 - rear cable; 5 - locknut; 6 - adjusting nut; 7 - spacer

Ask an assistant to press the brake pedal with effort of 686-784 N (70-80 kgf) and simultaneously observe the outcoming part of the pressure regulator piston. If the piston moves by 0.5-0.9 mm in relation to the regulator housing, thus twisting the torsion arm, the pressure regulator is efficient. Repeat the pedal depressing 2-3 times to completely ensure the serviceability of the pressure regulator.

If during pedal depressing the piston remains motionless, this means that the piston became stuck to the housing due to corrosion, and pressure regulator renewal is required.

After ensuring the pressure regulator serviceability and no brake liquid leaks between the piston and the pressure regulator

housing, apply a thin layer of ДТ-1 on the shaft and the acting part of the piston, fill 5-6 gr. of this greasing in the rubber boot and refit the cover.

Pressure regulator position adjustment

The pressure regulator position adjustment is required if the fastening bolts became loose. Raise the vehicle rear axle. Disconnect arm 4 (fig. 6-5) from tie-rod 8 and fix on its end tool 67.7820.9519. Direct the core of the tool upwards until it will get pressed against the car floor (fig. 6-6). This will be distance "X" from the arm end to the body chassis arm (see fig. 6-5), equal to (150 ± 5) mm.

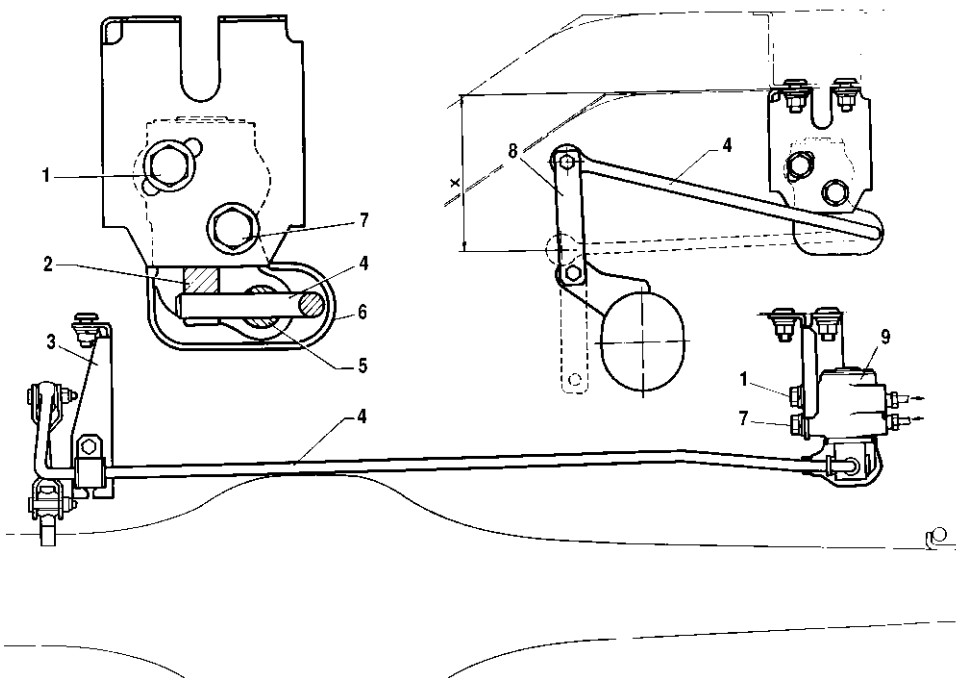


Fig. 6-5. Installation of the rear brake pressure regulator and adjustments:

1, 7 - regulator securing bolts; 2 - piston; 3 - thrust washer bracket; 4 - pressure regulator control arm; 5 - shaft; 6 - cap; 8 - tie rod; 9 - pressure regulator; X = 150 ± 5 mm

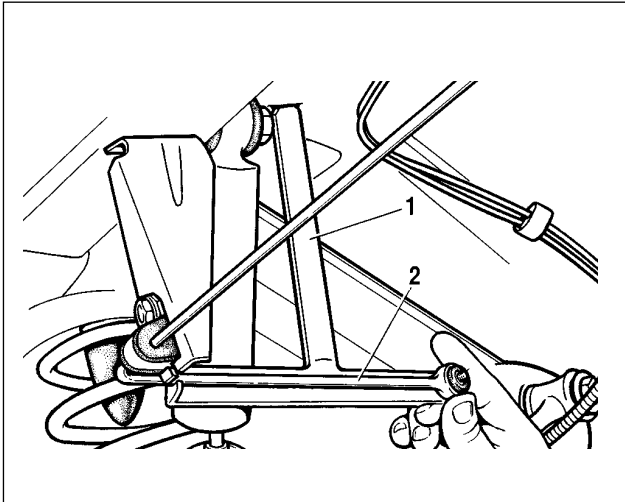


Fig. 6-6. Installing tool 67.7820.9519 to adjust the position of the rear brake pressure regulator:

1 - tool 67.7820.9519; 2 - pressure regulator control arm

Raise the protective rubber cap 6 (see fig. 6-5) and, by turning the pressure regulator on the bolts, get a slight contact between the arm and piston 2.

Keep the regulator in this position, fully tighten bolts 1 and 7, then apply a thin layer of greasing ДТ-1 on shaft 5 and the working part of piston 2. Fill 5-6 gr. of the same greasing in rubber cap 6 and refit.

Remove tool 67.7820.9519 and reconnect the arm end with tie-rod 8.

Hydraulic system bleeding

Air, that got into the brake hydraulic system during replacement of pipelines, hoses, sealing rings or due to system leak, causes increase of brake pedal free travel, its "softness" and considerably reduces braking efficiency.

Before bleeding the brake system ensure the leak-proofness of all system units and their connections, check and if necessary fill the tank with brake liquid up to normal level. Then carefully clean from dirt and dust the bleeding connectors and remove the protective caps.

Fit a rubber hose on the connector (fig. 6-7) for liquid drain, and place its free end in a transparent vessel partially filled with liquid.

Sharply depress the brake pedal 3-5 times, with 2-3 sec. intervals, undo the connector by 1/2-3/4 turn with the pedal depressed. Continue to press the pedal, bleed liquid with air through the hose into the vessel. After the brake pedal will reach the lowest front position and the liquid drain through the hose will be finished, tightly close the bleeding connector. Repeat these operations until all air bubbles will be bled from the hose. Then, keeping the brake pedal in depressed position, tightly close the bleeding connector and take off the hose. Wipe dry the connector and refit the protective cap.

All above operations should be carried out through the upper connectors first on the right rear wheel, the most remote from the master cylinder, then further clockwise: the left rear wheel, left and right front wheels. Thus, air from one circuit will be removed. To bleed the other circuit use the lower connectors on the cylinder block of the left and right front brakes. Bleeding can be started from the right or left wheel.

During bleeding maintain normal liquid level in the hydraulic system tank. If there is no air in the system the brake pedal should go no more than 1/2-3/4 of full travel.

To exclude the influence of the servo unit and the pressure regulator on bleeding the hydraulic system, it should be carried out with the engine not working and rear wheels loaded (do not raise the rear part of the vehicle).

If the brake liquid was completely drained from the system, do the following before bleeding air:

- undo the bleeding connector by 1.5-2 turns on all wheel cylinders;

- sharply depress the brake pedal and smoothly release it, close the connector when liquid will be drained. Then bleed the hydraulic system, as described above.

If, despite continuous bleeding, the air bubbles still come out from the hose into the vessel, it means air penetrates into the system through damaged pipelines, because of insufficient tightness of connections or due to malfunction of the master or wheel cylinders.

When bleeding the vehicle, the braking system of which has worked for a long time, renew the brake liquid.

If the brake liquid is suitable for further use, carefully filter the liquid, and then desilt in a tightly closed vessel.

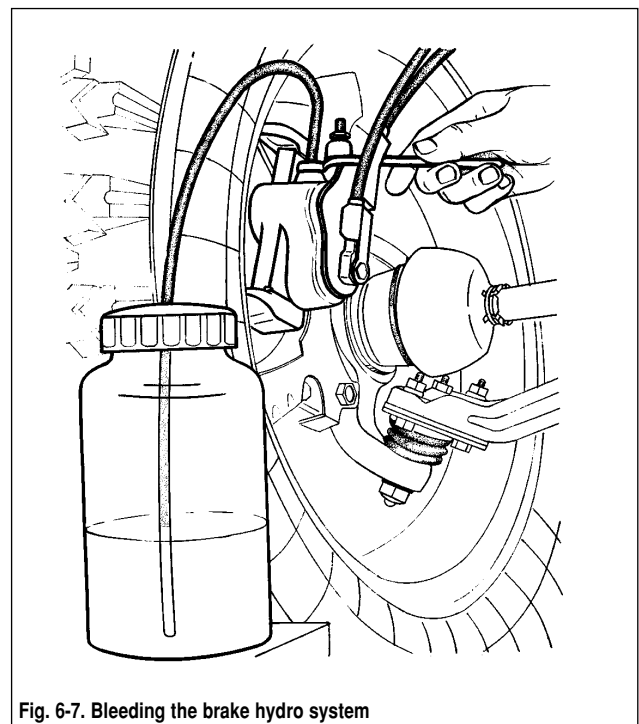


Fig. 6-7. Bleeding the brake hydro system

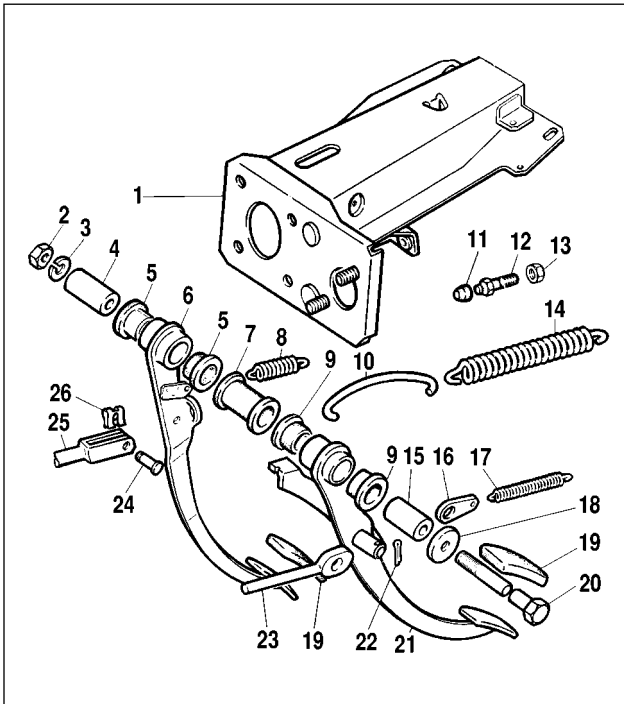


Fig. 6-8. Clutch/brake pedal bracket, exploded view:

1 - bracket; 2 - nut; 3 - spring washer; 4 - brake pedal inner bush; 5 - brake pedal outer bush; 6 - brake pedal; 7 - distance sleeve; 8 - brake pedal return spring; 9 - clutch pedal outer bush; 10 - hook; 11 - cap; 12 - clutch pedal limit screw; 13 - nut; 14 - servo spring; 15 - clutch pedal inner bush; 16 - plate; 17 - clutch pedal return spring; 18 - washer; 19 - pad; 20 - bolt; 21 - clutch pedal; 22 - cotter pin; 23 - clutch pedal push rod; 24 - pin; 25 - push rod; 26 - lock shackle

Clutch and brake pedal bracket

Removal and refitting. To remove the pedal bracket:

- remove the steering shaft bracket, as mentioned in section "Steering";
- disconnect the servo unit push rod from the brake pedal, having removed lock shackle 26 (fig. 6-8) and taken out pin 24;
- disconnect the wires from the stoplight switch;
- undo the nuts that are fixing the brackets of the servo unit and pedals to the body front and remove the bracket in assembly with the servo unit and the master cylinder, and then the clutch and brake pedal bracket.

Refitting is carried out in reverse sequence. Pay attention to correctly refit the push rod in the jack of the clutch master cylinder piston.

Dismantle and reassembly. To dismantle, remove the clutch pedal servo unit spring 14, remove return springs 8 and 17, undo nut 2 of bolt 20, take out the bolt and remove the pedals together with bushes.

To remove and refit the springs use tool A.70017.

Reassembly of the master cylinder is carried out in reverse order. When reassembling, grease with ЛИТОЛ-24 the pedal bushes, spring ends, connection places between the push rods and pedals, and the push rod end adjoining the piston of the clutch master cylinder.

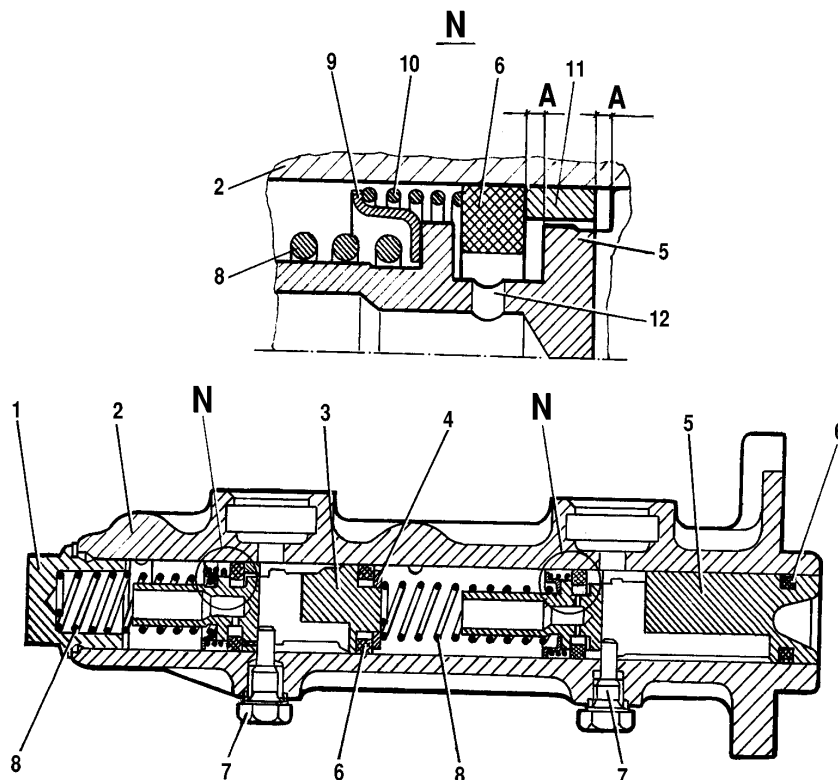


Fig. 6-9. Master cylinder:

1 - plug; 2 - cylinder body; 3 - front brake drive piston; 4 - washer; 5 - rear brake / front additional drive piston; 6 - sealing ring; 7 - stop screws; 8 - piston return springs; 9 - spring cup; 10 - seal holding spring; 11 - spacer ring; 12 - inlet port; A - compensation port (clearances between seal 6, ring 11 and piston 5)

Check and repair. At hard pedal movement examine the working surfaces of pedals, bushes and shaft.

If there will be small risks or traces of oxidation on surfaces of metal parts, grind them slightly with sandpaper; renew worn outer plastic bushes on pedals.

Check the spring tension. The length of the brake pedal spring should be: under load of 12.8 ± 1.96 N (1.3 ± 0.2 kgf) - 80 mm, under load of 117.5 ± 5.88 N (12 ± 0.6 kgf) - 160 mm.

The clutch pedal return spring has the length of 130 mm under load of $36.26 - 30.38$ N ($3.7 - 3.1$ kgf), and 155 mm under load of $49.49 - 42.63$ N ($5.05 - 4.35$ kgf). Length of the clutch servo unit spring under load of $219.52 - 180.32$ N ($22.4 - 18.4$ kgf) should be 120 mm, and under load of $645.82 - 529.22$ N ($65.9 - 53.9$ kgf) - 152 mm.

Servo unit

Removal and refitting. When removing the servo unit, do not disconnect the brake hydrodrive master cylinder from the hydraulic system to avoid air penetration.

The order of removal:

- disconnect the servo unit push rod from the pedal;
- undo the nuts fastening the master cylinder to the unit, remove it from pins and move aside;
- disconnect the hose from the servo unit;

- undo the nuts fastening the servo unit bracket to the body front and remove the unit in assembly with the bracket.

Refitting of the servo unit is carried out in reverse order.

Master cylinder

The design of the master cylinder is shown on fig. 6-9.

Removal and refitting. Disconnect the flexible hoses from the master cylinder and close the openings of hoses and connectors on the cylinder to prevent liquid leak from reservoir and penetration of dust, dirt or foreign matters.

Undo the tube nuts and disconnect from the master cylinder the steel pipelines that are carrying liquid to wheel cylinders of front and rear brakes.

Remove the cylinder, having undone the nuts that are fastening it to the servo unit.

Refitting of the master cylinder is carried out in reverse sequence. After refitting the cylinder, bleed the hydraulic system to expel air.

Dismantle and reassembly. Remove connectors 2 (fig. 6-10) with connecting bushes 3, turn out lock bolts 5 and take out all components in order specified on fig. 6-10.

The reassembly of the cylinder is carried out in reverse sequence. Grease all components with brake liquid. When reassembling, use tool 67.7853.9543.

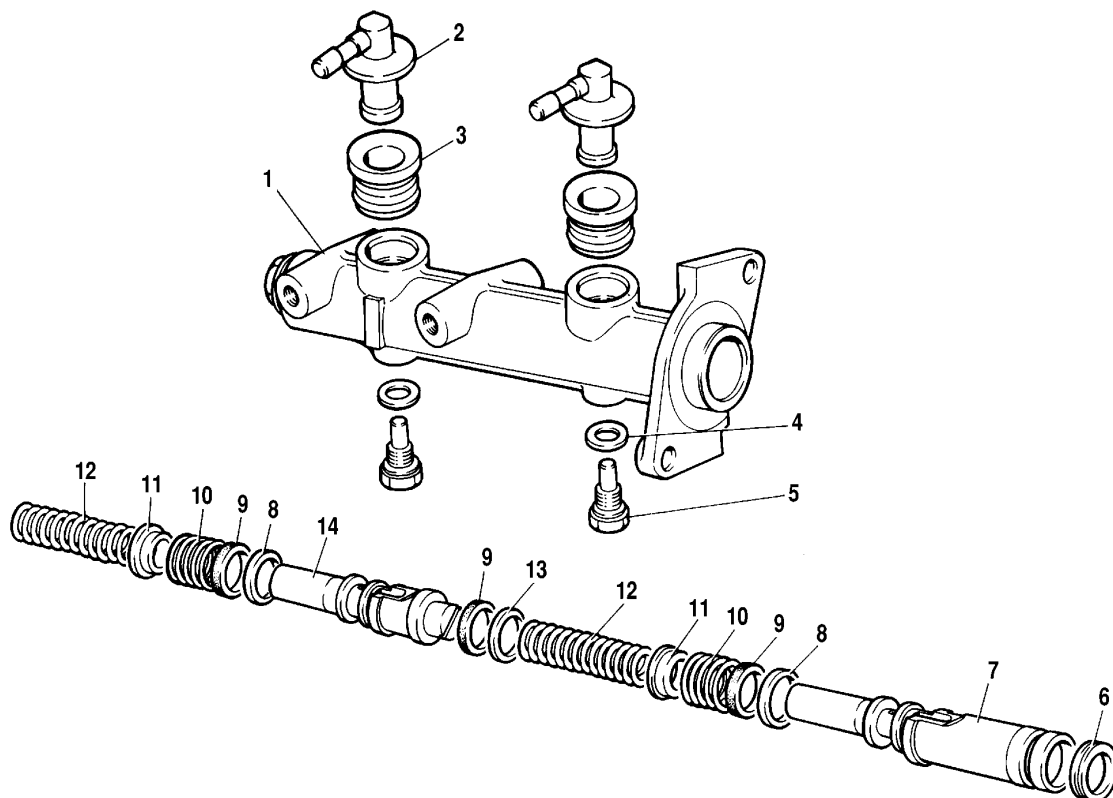


Fig. 6-10. Master cylinder components:

1 - cylinder body; 2 - connector; 3 - connector bush; 4 - sealing washer; 5 - lock bolt; 6, 9 - sealing rings; 7 - rear brake / front additional drive piston; 8 - distance ring; 10 - sealing ring holding spring; 11 - spring cup; 12 - piston return spring; 13 - washer; 14 - front brake drive piston

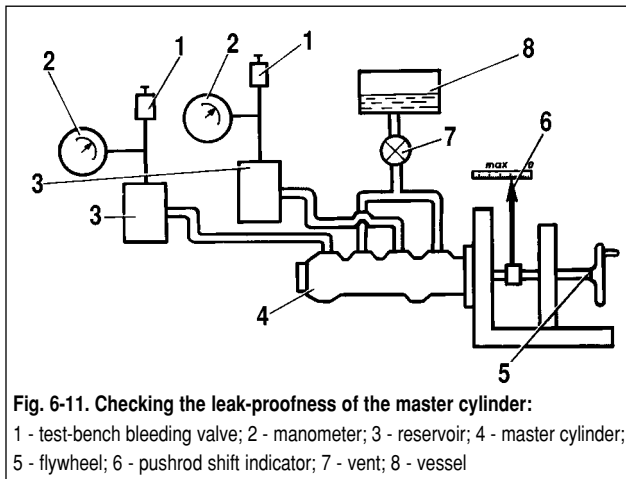


Fig. 6-11. Checking the leak-proofness of the master cylinder:
 1 - test-bench bleeding valve; 2 - manometer; 3 - reservoir; 4 - master cylinder;
 5 - flywheel; 6 - pushrod shift indicator; 7 - vent; 8 - vessel

Inspection of components. Before reassembly, wash all components with isopropyl alcohol; dry by a jet of compressed air or wipe with a clean cloth, but do not allow their contact with mineral oil, kerosine or diesel fuel, which can damage the sealings.

Note. Time of washing the sealing rings in isopropyl alcohol is no more than 20 seconds with subsequent drying by compressed air.

The cylinder mirror and working surfaces of pistons should be completely clean, without rust, marks and other defects. No excessive gap between the cylinder and pistons is allowed.

Every time, when dismantling the cylinder, renew the sealings, even if they are in good condition.

Check the piston spring tension, the length of which should be 41.7 mm under load of 42.18 ± 3.92 N (4.3 ± 0.4 kgf), 21 mm under load of 90.64 ± 8.83 N (9.24 ± 0.9 kgf), in free state - 59.7 mm.

Master cylinder leak-proofness check. Place the master cylinder on a test bench and connect it to the bench elements, as shown on fig. 6-11.

Open the bench bleeding valves 1 and, by moving the master cylinder piston several times by its full stroke, bleed the system. Then close valves 1. Rotate flywheel 5, slowly move the master cylinder pistons until pressure monitored by manometer 2 will reach 12.5 MPA (125 kgf/cm^2). In this position block the master cylinder push rod. Specified pressure should remain constant for no less than 5 seconds.

In case of liquid leaks or drop of established pressure during 5 seconds, renew the cylinder piston sealings.

Front brakes

The design of the front brake is shown on fig. 6-12.

Before repairing the brakes, carefully wash them in warm water with washing liquids and immediately dry with a jet of compressed air.

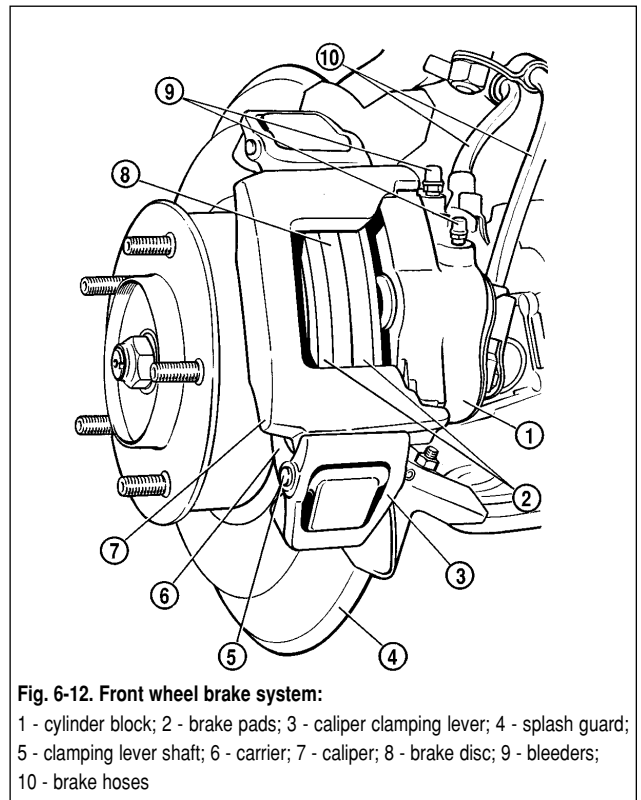


Fig. 6-12. Front wheel brake system:
 1 - cylinder block; 2 - brake pads; 3 - caliper clamping lever; 4 - splash guard;
 5 - clamping lever shaft; 6 - carrier; 7 - caliper; 8 - brake disc; 9 - bleeders;
 10 - brake hoses

ATTENTION. Do not use petrol, diesel fuel, trichloroethylene or any other mineral solvents to clean the brakes, as these materials damage the cylinder sealings.

Removal and refitting

Removal. Lift the front part of the vehicle, place it on supports and remove the wheel.

Remove the hose guide brackets. Undo the bypass bolts, disconnect from the cylinder block hoses 10 (see fig. 6-12), avoid penetration of dirt into the cylinder cavities. Plug the openings of the cylinder block and hoses.

Unbend the edges of the front brake splash guard, undo the bolt fastening the brake to the steering knuckle (fig. 6-13) and remove the brake assembly.

The refitting of the front brake is carried out in sequence reverse to removal.

After refitting, fill the brake liquid in the reservoir and bleed the system to expel air from the hydraulic drive.

Dismantle and reassembly

Take out pins, then shafts 5 (see fig. 6-12), hold the clamping levers 3 so that not to loose the springs. Remove the clamping levers and their springs, and then caliper 7 in assembly with block 1. Remove brake pads 2.

Take out cylinder block 1 from the caliper grooves by moving apart the caliper grooves up to 118.5 mm and pressing on lock 12. Remove the dust caps 3 (fig. 6-14) from cylinders.

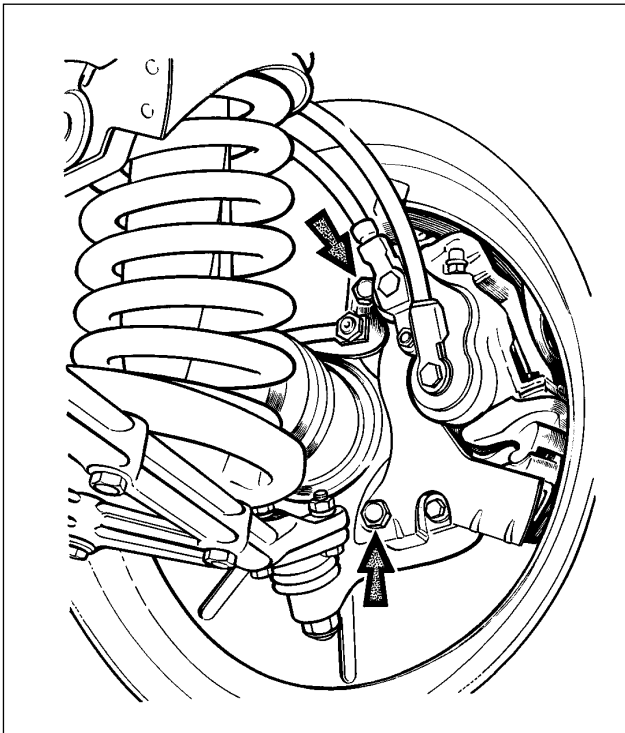


Fig. 6-13. Removing the front brake:
Arrows are pointing to the bolts that should be undone to remove the front brake

Forcing a jet of compressed air through the aperture for brake liquid, push out pistons 14 from the cylinder block and take out sealing rings 4.

The reassembly of the front brake is carried out in sequence reverse to dismantle. When assembling, lubricate the sealing rings, pistons and cylinder mirrors with brake liquid, and grease the protective caps with ДТ-1.

Components inspection

Carefully examine all components, having previously washed them in warm water with washing liquid and dried by a jet of compressed air.

If on pistons and on cylinder mirrors any traces of wear or jamming are found, renew the cylinder block complete with pistons.

Note. In all cases, when the piston is taken out from the cylinder, it is recommended to renew the dust cap and the sealing rings in the cylinder block flutes to ensure satisfactory operation of the system.

Brake disc runout check

Check the axial runout of the brake disc without removing it from the vehicle (fig. 6-15). The maximum allowable runout by the indicator is 0.15 mm; if the runout is greater, it is necessary to grind the disc, but the final thickness of the disc after grinding should be no less than 9.5 mm. In case of damage or very deep risks, and also if wear exceeds 1 mm on each side, renew the disc.

Replacement of brake pads

Renew the pads, if the friction lining thickness has decreased to 1.5 mm.

To replace the pads do the following:

- remove the pins from the shaft of the upper clamping lever, take out the shaft and remove the lever; remove the caliper

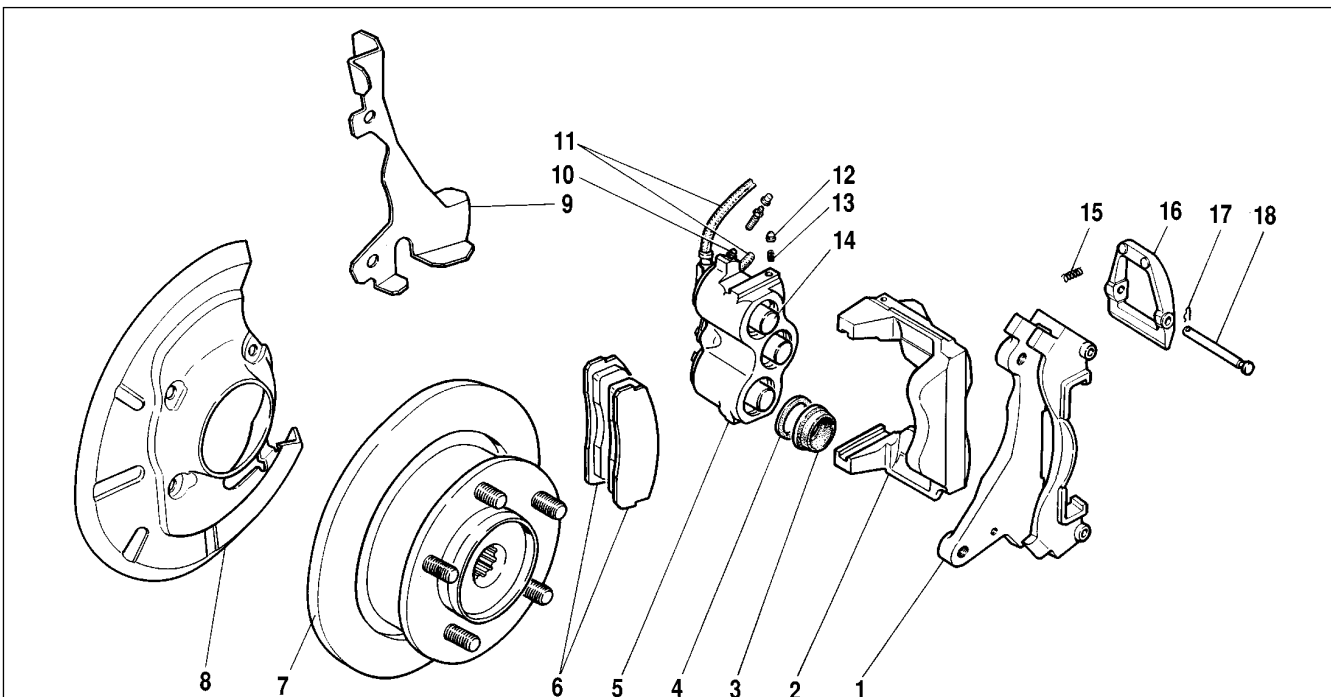


Fig. 6-14. Front brake components:
1 - carrier; 2 - caliper; 3 - piston cap; 4 - sealing ring; 5 - cylinder block; 6 - brake pads; 7 - brake disc; 8 - caliper dust cover; 9 - brake splash guard; 10 - bleeder; 11 - brake hoses; 12 - cylinder block detent; 13 - detent spring; 14 - piston; 15 - clamping lever spring; 16 - clamping lever; 17 - pin; 18 - clamping lever shaft

Rear brakes

The design of the rare brake is shown on fig. 6-17.

Removal and dismantling

Lift the rear part of the vehicle and take off the wheel. Take care of possible liquid spillage from the tank.

Using puller 67.7823.9519 (fig. 6-18) remove the brake drum. Disconnect the cable end piece from the shoe manual lever 18 (see fig. 6-17), remove the cotter pin, press pin 21 and remove the lever. Using flat-nose pliers disconnect the upper 2 and lower 7 return springs.

Turn the cups of the steady post 17, take them off together with posts, springs and bottom cups; remove shoes 8 and 16 and expander strut 20. Disconnect from the wheel cylinder 1 pipeline and plug the openings of the cylinder and pipeline. Remove the wheel cylinder. To replace the brake backplate 4 remove the axle shaft, as specified in chapter "Rear axle", and disconnect the rear cable 13, having turned out two bolts that are fastening it to the brake plate 4.

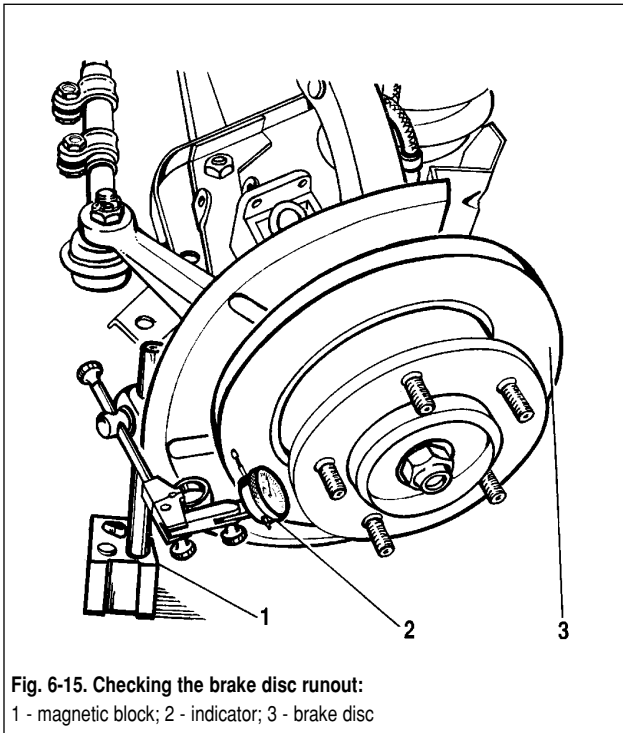


Fig. 6-15. Checking the brake disc runout:
1 - magnetic block; 2 - indicator; 3 - brake disc

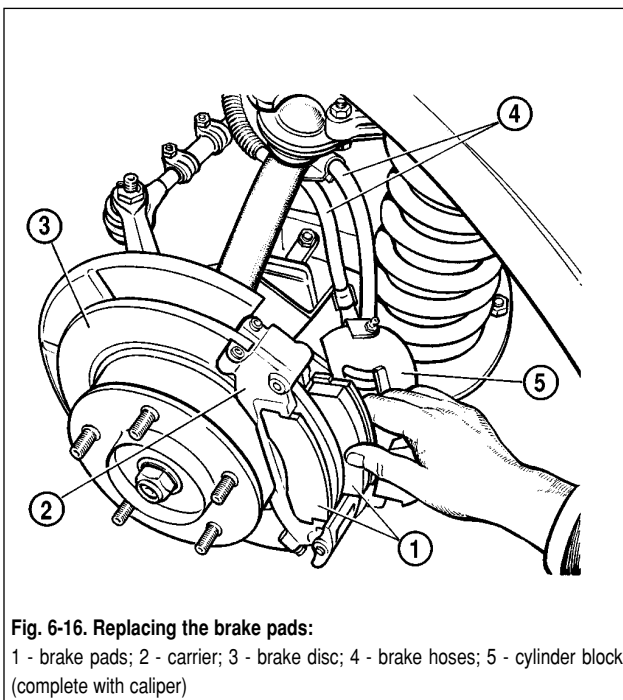


Fig. 6-16. Replacing the brake pads:
1 - brake pads; 2 - carrier; 3 - brake disc; 4 - brake hoses; 5 - cylinder block (complete with caliper)

assembly and take out the worn pads from the carrier grooves (fig. 6-16);

- carefully depress the pistons in cylinders to a stop, paying attention not to splash the liquid from the master cylinder reservoir, and place new brake pads in carrier grooves;

- move the lower directing splay on the caliper under the lower clamping lever, press the caliper to the pads, insert the lever shaft with the head facing the wheel and fix the pins.

The pads should be changed simultaneously on the right and on the left brakes.

Assembly and refitting

Assembly and refitting is carried out as follows.

Fit and fix the wheel cylinder on the brake backplate, attach it to the pipeline and fully tighten the connector nut.

Attach the shoe manual lever 18 (see fig. 6-17) and refit the brake shoes with expander strut 20, then insert posts 17 with springs and bottom cups, put the upper springs and fix them on racks by turning one or other way. Ensure, that the shoe ends have correctly settled down in the support jacks on the wheel cylinder pistons and on the backplate. Attach the rear cable end piece 15 to lever 18.

Fit the brake drum, previously having greased the landing shoulder of the axle shaft with graphite lubricant or greasing ЛСЦ-15 and fully tighten the drum fastening bolts.

Wheel cylinders - dismantle and reassembly

The dismantle and reassembly of the wheel cylinders is carried out as follows.

Remove protective caps 2 (fig. 6-19), then press out from the cylinder body 3 pistons 4 in assembly with the components of the automatic shoe-drum clearance adjuster.

Place the piston in assembly with the automatic adjuster on a special tool so that the ledges of the tool will cover the head of the thrust screw 3 (fig. 6-20). Using a screwdriver and by turning piston 9, turn out thrust screw 3 from the piston. Remove sealing 8 with support cup 7 and retainers 5 from the screw. Separate thrust ring 4 and thrust screw 3.

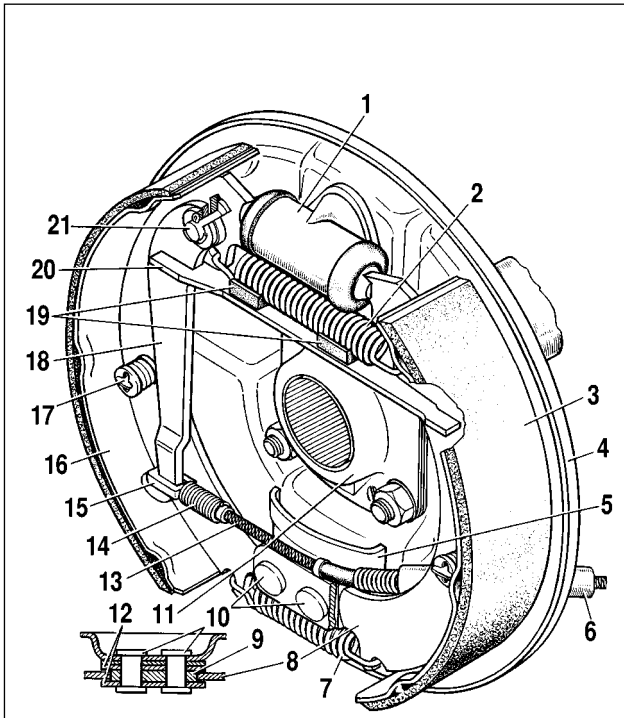


Fig. 6-17. Rear wheel brake mechanism:

1 - wheel cylinder; 2 - upper return spring; 3 - friction lining; 4 - backplate; 5 - inner plate; 6 - rear cable sheath; 7 - lower return spring; 8 - front brake shoe; 9 - thrust plate; 10 - rivet; 11 - oil deflector; 12 - guide plates; 13 - handbrake rear cable; 14 - rear cable spring; 15 - rear cable end; 16 - rear brake shoe; 17 - steady post; 18 - shoe manual control lever; 19 - rubber pads; 20 - expander strut; 21 - shoe manual control lever pin

The reassembly of the automatic adjuster and the wheel cylinder is carried out in reverse sequence, paying attention to the following:

- piston thrust screws are tightened to torque 4-7 N•m (0.4-0.7 kgf•m);

- slot A (see fig. 6-19) on thrust rings should be directed vertically upward; vertical deviation should be no more than 30°. Such position of the slot provides complete air bleeding from the brake mechanism;

- for preliminary compression of thrust rings the pistons are press-fitted in the cylinder body with a special tool having the form of a cylinder with a cone inner aperture;

- the effort of press-fitting the piston in the cylinder should be no less than 350 N (35 kgf); in case effort was less than 350 N (35 kgf) - replace the thrust ring;

- when press-fitting the piston in the cylinder it is necessary to maintain the sizes of 4.5-4.8 mm and 67 mm (maximum) (see fig. 6-19) for free landing of the brake drum;

- before refitting the components in the cylinder body thickly grease them with brake liquid.

After reassembly check the movement of each piston in the cylinder body. They should freely move within the limits of 1.25-1.65 mm. The last established in place is the protective cap 2.

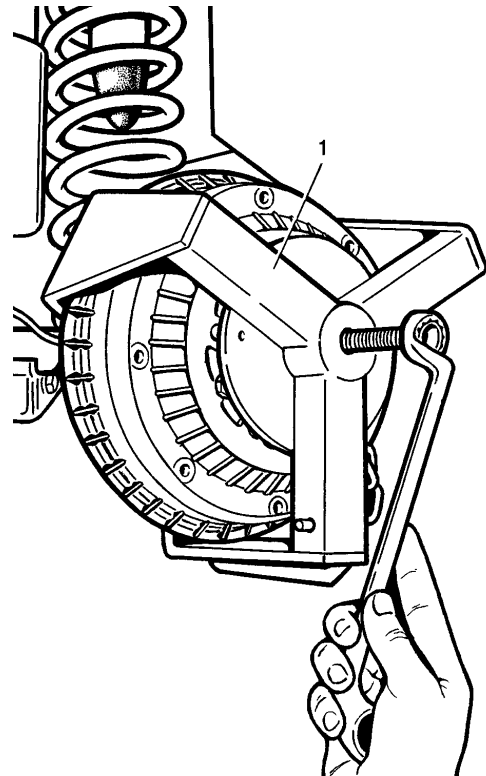


Fig. 6-18. Removing the brake drum:

1 - remover tool 67.7823.9519

Component inspection

Wheel cylinders. Ensure the cleanness of working surfaces of the cylinder, pistons and thrust rings. The surfaces should be absolutely smooth, without roughness, to avoid liquid leak and premature wear of sealings and pistons. The defects on the cylinder mirror can be eliminated by lapping or polishing. However, no increase of the cylinder inner diameter is allowed.

Inspect screw 3 (see fig. 6-20), spring 6, thrust cup 7 and retainers 5. If necessary, renew damaged components.

Renew sealings 8. Inspect protective caps 10 and renew if necessary.

Shoes. Carefully check the shoes for damages or deformations.

Check the tension of the upper and lower return springs; if necessary, renew.

The springs should have no residual deformations when stretched with effort of 350 N (35 kgf) for lower springs and 420 N (42 kgf) - the upper ones.

Check the linings for dirt or traces of greasing, if necessary, carefully clean with metal brush and wash with white-spirit, besides, check for leaks of greasing inside the drum; eliminate malfunctions. Renew shoes, if the friction lining thickness is less than 1.5-2 mm.

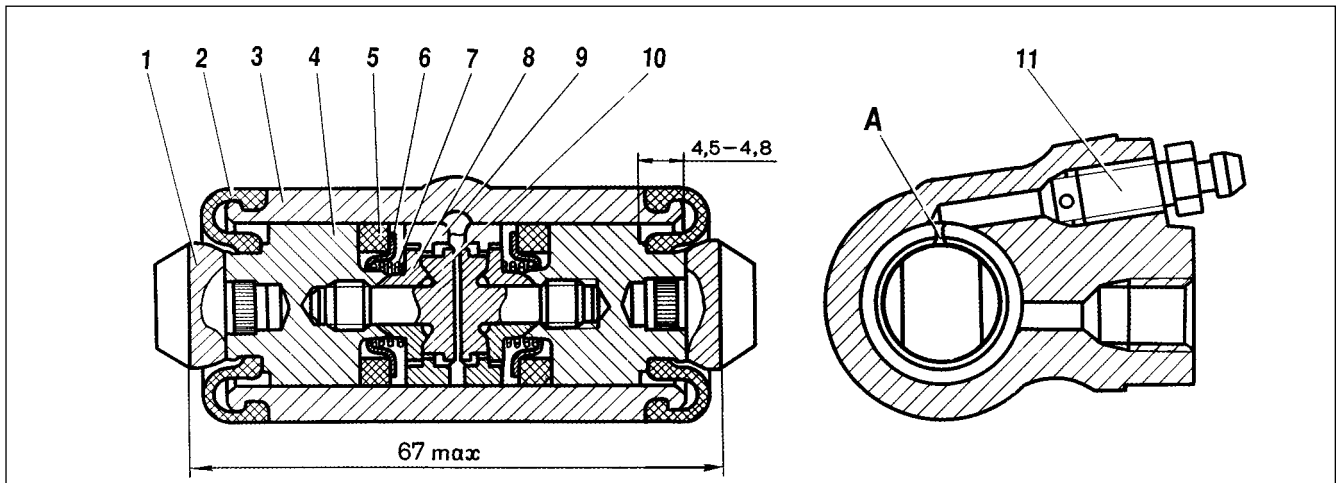


Fig. 6-19. Wheel cylinder:

1 - shoe abutment plate; 2 - cap; 3 - cylinder body; 4 - piston; 5 - seal; 6 - backing cup; 7 - spring; 8 - retainers; 9 - thrust ring; 10 - thrust screw; 11 - bleed screw; A - slot in thrust ring

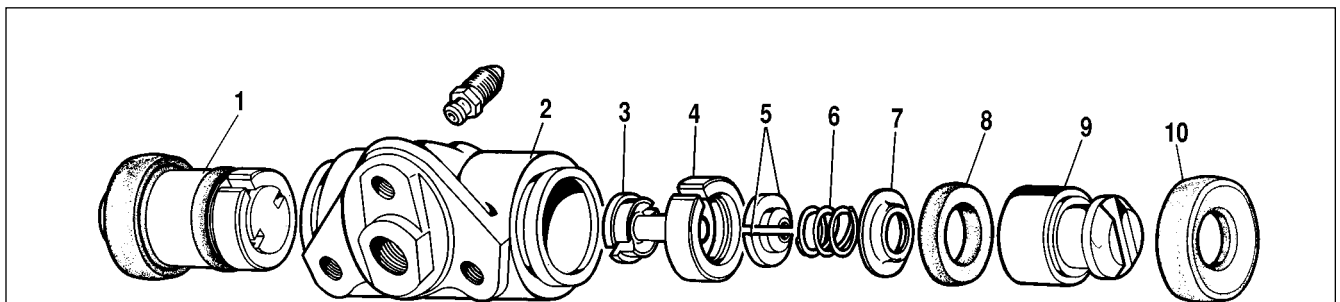


Fig. 6-20. Wheel cylinder components:

1 - piston assembly; 2 - cylinder body; 3 - thrust screw; 4 - thrust ring; 5 - retainers; 6 - spring; 7 - backing cup; 8 - seal; 9 - piston; 10 - cap

Brake drums. Examine the brake drums. If the working surfaces have deep risks or excessive ovality, chisel the drums. Then grind on a machine tool with abrasive fine stones. This will help to increase the lining durability, and improve the uniformity and efficiency of braking.

The maximum allowable increase of drum nominal diameter (250 mm) after turning and polishing is 1 mm. These dimension limits should be strictly observed, otherwise, the durability of the drum, and the efficiency of braking will be decreased due to reduction of drum rigidity.

Rear brake wheel cylinder -test-bench inspection

Position cylinder 2 (fig. 6-21) on the test bench, attach the pipeline from the manometers and bleed the system.

Adjust rests 1 so that the wheel cylinder pistons are rested against them.

Check for liquid leak. Connect a low pressure manometer 4. Slowly rotate flywheel 8 to obtain liquid pressure of 0.05 MPA (0.5 kgf/cm²) as read by the pressure gauge 4.

Ensure that pressure holds steady for 5 minutes. Repeat similar test at liquid pressure of 0.1 - 0.2 - 0.3 - 0.4 - 0.5 MPA (1 - 2 - 3 - 4 - 5 kgf/cm²).

Reduce pressure and connect a high pressure manometer 5. Ensure that pressure holds steady for 5 minutes, repeat similar test at liquid pressure of 5 - 10 - 15 MPA (50 - 100 - 150 kgf/cm²).

There should be no pressure decrease due to liquid leak through sealing elements, pipeline connections, bleeding connectors or through casting pores.

An insignificant reduction of pressure (no more than 0.5 MPA (5 kgf/cm²) during 5 minutes is permissible, especially at high pressure, due to shrinkage of sealings.

Rear brake pressure regulator

Removal and refitting. Disconnect arm 12 (fig. 6-22) from tie-rod 7, and holder 18 from bracket 14 and shackle that is fastening the pipelines going to the pressure regulator.

Disconnect the components of muffler mounting from the body and move the pipeline with the mufflers aside.

Undo the bolts fastening the regulator on the bracket and the bracket on the car body, remove the regulator bracket, and then, having lowered the regulator downward, disconnect the pipelines.

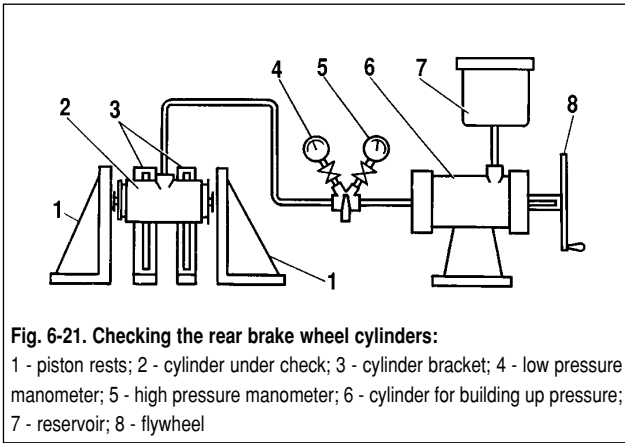


Fig. 6-21. Checking the rear brake wheel cylinders:
 1 - piston rests; 2 - cylinder under check; 3 - cylinder bracket; 4 - low pressure manometer; 5 - high pressure manometer; 6 - cylinder for building up pressure; 7 - reservoir; 8 - flywheel

Remove the regulator and disconnect the arm. Plug all openings of the pressure regulator and pipelines.

Refitting of the pressure regulator is carried out in reverse sequence. Before tightening the regulator fastening bolt place tool 67.7820.9519 (see fig. 6-6) on the end of the regulator arm. Direct the tool bar upwards to the car body. Thus, the distance of (150+5) mm (see "Pressure regulator position adjustment") between the end of arm 2 and underframe side member is obtained.

Raise protective cap 3 (see fig. 6-22) and by turning the regulator on the fastening bolts, obtain a slight contact between the arm end and the regulator piston.

Fix the regulator in this position, fully tighten the fastening bolts, then apply a layer of greasing ДТ-1 or "ДИТОР" on shaft 2 and the protruding part of the piston. Refit rubber cap 3 having applied 5-6 gr of the same greasing.

Remove tool 67.7820.9519 and reconnect the arm end to tie-rod 7, previously having covered the bushes of the rod-to-arm connection with greasing ДТ-1 or ДИТОР.

Attach the gas release system pipelines to the car body.

Bleed the brakes to expel air from the rear brakes.

Dismantle and reassembly. Use key A.56124 to turn out the plug, remove lining 5 (fig. 6-23), take out piston 10, distance sleeve 2, sealing 7, plate 8, spring 9 and thrust washer with sealing ring 3.

When reassembling, which is carried out in reverse sequence, grease all components with brake liquid.

ATTENTION. To differentiate the VAZ-2121 and -21213 pressure regulators from others of similar design, there is a groove on the bottom part of the piston.

Wash the components with isopropyl alcohol or brake liquid and inspect. The components surfaces should have no marks and roughness.

Check the spring tension, length in free condition should be 17.8 mm, and under load of 76.44 - 64.68 N (7.8-6.6 kgf) - 9 mm.

Renew damaged components, sealings and sealing rings.

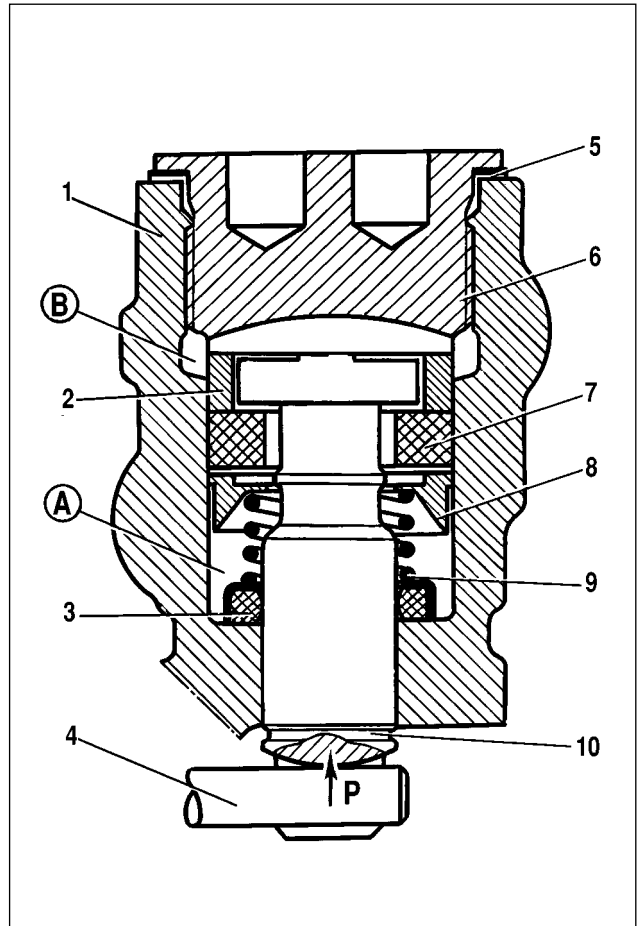


Fig. 6-23. Rear brake pressure regulator, non-operating position:
 A - normal pressure chamber; B - adjustable pressure chamber; P - force from arm 4; 1 - regulator housing; 2 - distance sleeve; 3 - sealing ring; 4 - regulator control arm; 5 - gasket; 6 - plug; 7 - seal; 8 - spring cup; 9 - piston spring; 10 - piston

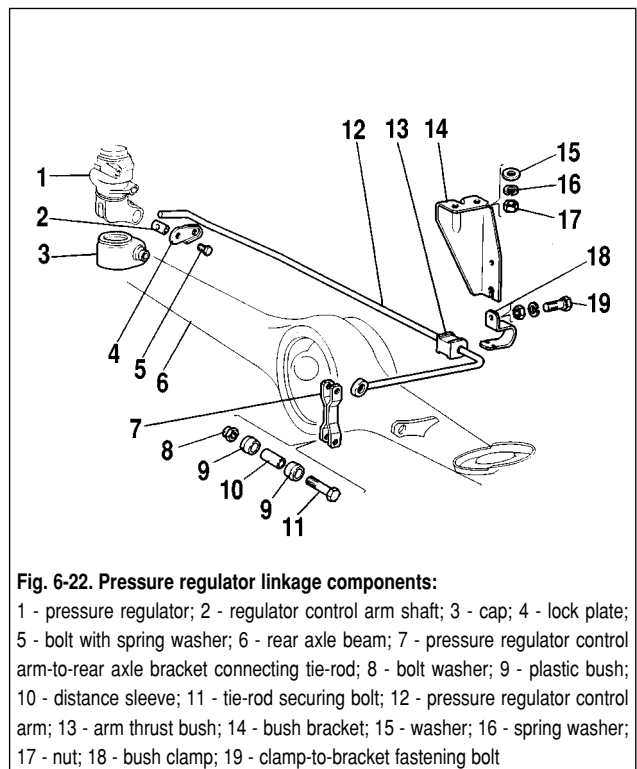
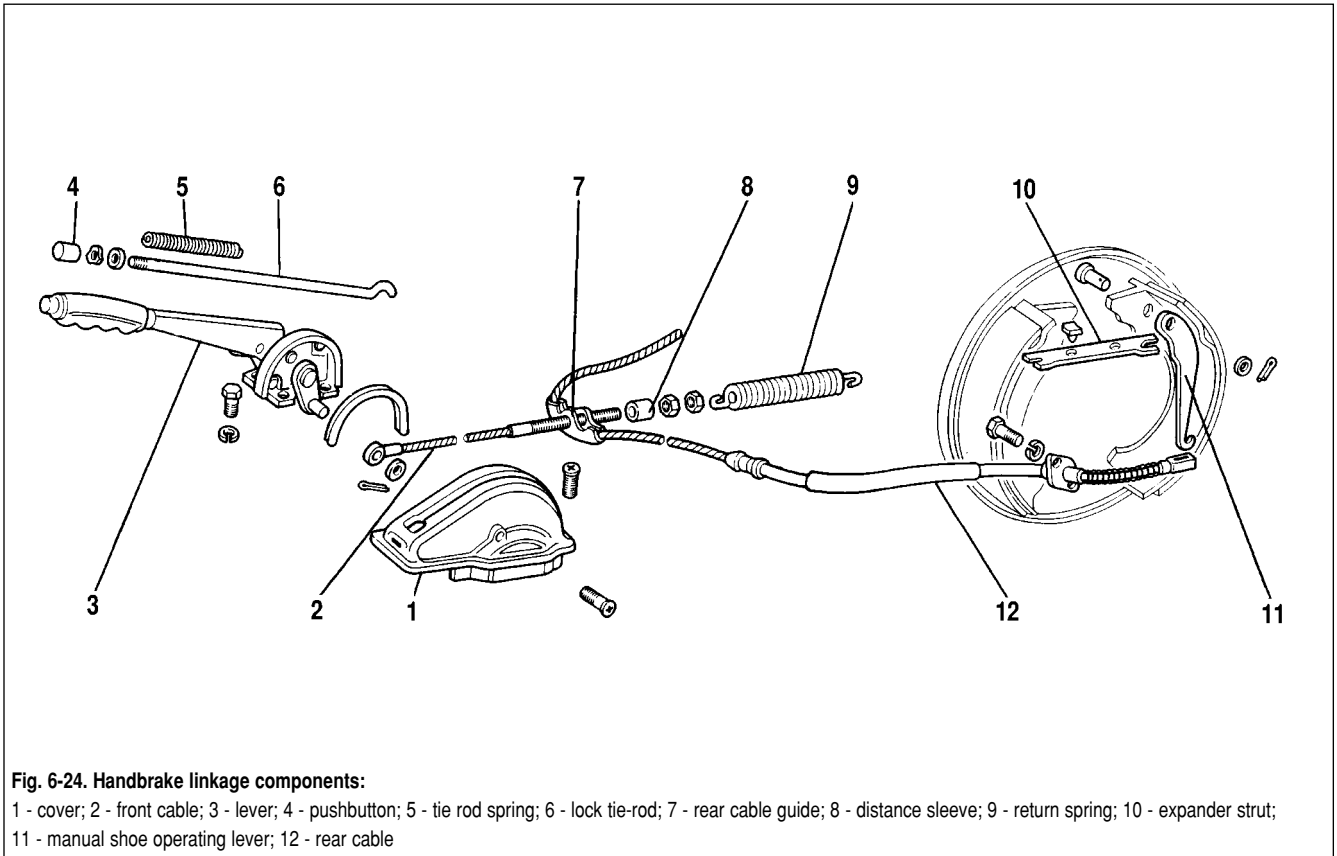


Fig. 6-22. Pressure regulator linkage components:
 1 - pressure regulator; 2 - regulator control arm shaft; 3 - cap; 4 - lock plate; 5 - bolt with spring washer; 6 - rear axle beam; 7 - pressure regulator control arm-to-rear axle beam bracket connecting tie-rod; 8 - bolt washer; 9 - plastic bush; 10 - distance sleeve; 11 - tie-rod securing bolt; 12 - pressure regulator control arm; 13 - arm thrust bush; 14 - bush bracket; 15 - washer; 16 - spring washer; 17 - nut; 18 - bush clamp; 19 - clamp-to-bracket fastening bolt



Handbrake

Removal and refitting. Place the handbrake lever in the lowest position, disconnect the cable ends from the brake shoe levers (see "Rear brake").

Slacken locknut 5 (see fig. 6-4) and adjusting nut 6, remove return spring 9 (fig. 6-24), then completely undo the locknut and nut.

Take out the front end pieces of the rear cable from the brackets on the floor, and the cable sheath from the brackets on the rear axle beam, and remove the rear cable 12.

Remove the lever protective cover and then the lever assembly and the front cable.

Take out the pin and remove the thrust washer, disconnect the front cable from the handbrake linkage lever.

The handbrake is refitted in reverse sequence with subsequent adjustment (see "Handbrake adjustment"). When refitting, grease with ЛИТОЛ-24 or ЛСЦ-15 the rear cable guide, the handbrake lever shaft and the front cable end.

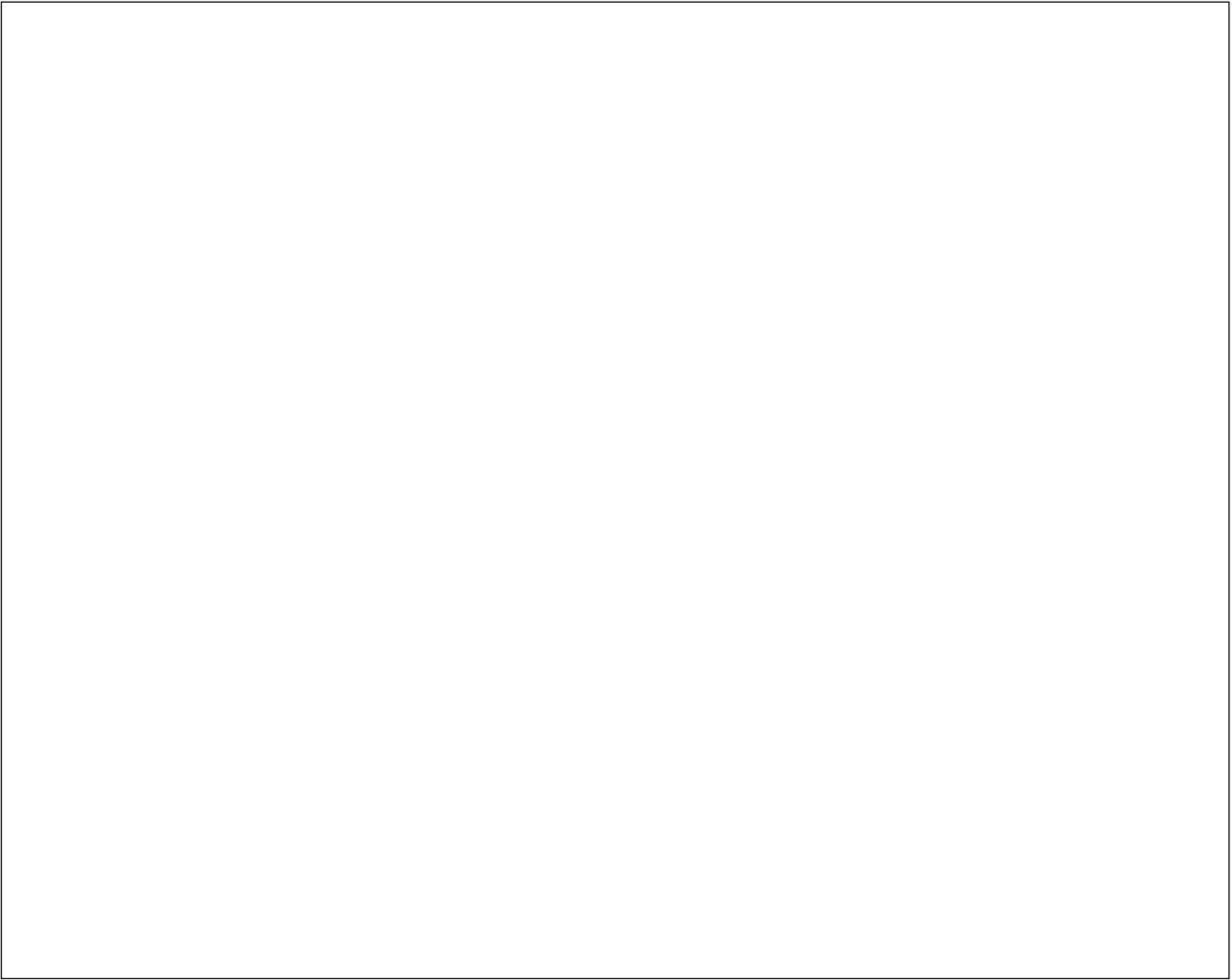
Check and repair. Carefully inspect the components of the handbrake mechanism.

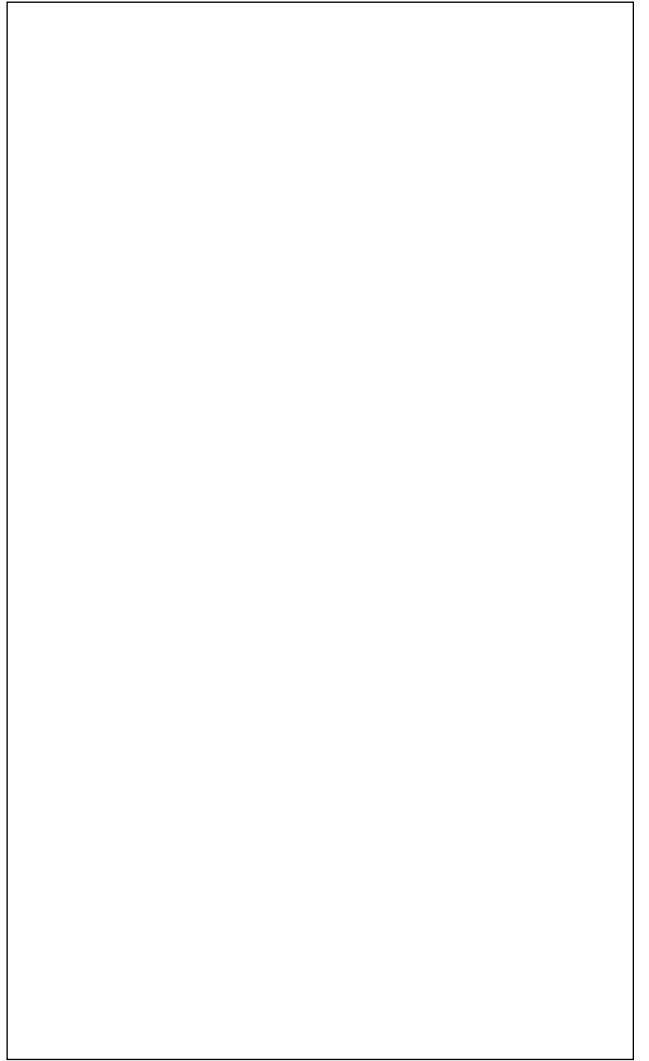
If breakage or wire scuffing is detected, renew the cable.

Make sure, that the quadrant teeth and handle lock are not damaged; worn components should be replaced.

Check the condition of the spring. It should provide the lever return to the released position.

Inspect the rear cable sheath and the fastening of end pieces on the sheath, and ensure, that the cable freely moves inside the sheath. Replace the cable in case of sheath damage and loose end piece fastening.





Chapter 7. Electrical system

Wiring and fuses

The electrical system is of the single-wire negative earth type. The vehicle basic wiring diagram is illustrated in Fig.7-1.

Most electrical circuits are powered when the ignition is switched on. Regardless the ignition switch position, the following functions are available: horn, stoplight, cigarette lighter, interior lamps, inspection lamp, hazard warning flashers, exterior lighting and main beam.

Most of the vehicle electrical circuits are protected by fuses, which are located beneath the facia, at the left-hand side of the steering column (Fig.7-2). There are no fuses for battery charging, ignition and engine start-up (starter and alternator) circuits, main/dipped beam relay. Extra fuses 11, 12, 14, 16 are provided in the additional fusebox to be used for alternative vehicle specifications.

Before renewing a blown fuse, isolate and remedy the cause. Before attempting to diagnose any electrical fault, refer to Table 7-1 to study the relevant wiring diagram protected by a failed fuse.

Table 7-1

Fuse-protected circuits

Fuse No	Circuit protected
1 (16 A)	Heater blower motor Headlight wiper relay (winding) and headlight wiper motors at all wiper positions, except initial Heated tailgate relay (winding) Tailgate wipe/wash motors Windscreen washer motor
2 (8 A)	Windscreen wiper relay and motor Direction indicators and indicators flasher relay (turn indication mode) Direction indicator warning light Tail lights (reversing lamp) Alternator winding (at engine start-up) and low battery warning light* Differential lockup warning light Relay and handbrake-on warning light Low brake fluid warning light Oil pressure warning light Coolant temperature gauge Low fuel gauge and fuel reserve warning light Tachometer
3 (8A)	Left-hand headlight (main beam) Main beam warning light
4 (8 A)	Right-hand headlight (main beam)
5 (8 A)	Left-hand headlight (dipped beam)
6 (8 A)	Right-hand headlight (main beam)

7 (8 A)	Left-hand front lamp (side marker light) Right-hand front lamp (side marker light) Number plate light Side marker warning light
8 (8A)	Right-hand rear lamp (side marker light) Left-hand rear lamp (side marker light) Instrument panel illumination Heater control illumination lamp Cigarette lighter illumination Switch illumination
9 (16A)	Direction indicators and indicators hazard relay (hazard flashers mode) Tailgate heating element and switch-on relay (contacts)
10 (16A)	Horn Inspection lamp socket Interior lamps Tail lights (stop lamp bulbs)
13 (8A)	Tail lights (fog lamps) Headlight wiper motors at start-up and when wiper arms pass initial position Headlight wiper relay (contacts) Headlight washer motor
15 (16A)	Cigarette lighter

* Pre-1996 vehicles were fitted with a voltmeter (protected by fuse No2) instead of the relevant warning light in the instrument cluster.

In all wiring diagrams, covered by chapter «Electrical system», the letters are used to denote the respective colour code: the first letter stays for the wire colour code, while the second letter - for the tracer colour code (Table 7-2).

Table 7-2

Fuse colour codes

Letter	Colour
Б	White
Г	Blue
Ж	Yellow
З	Green
К	Brown
О	Orange
П	Red
Р	Pink
С	Grey
Ч	Black

WARNING. Always disconnect the battery negative lead when making repairs on the vehicles or its electrical system. When replacing fuses or checking wiring, never use fuses other than those specified for a particular vehicle model as it may damage current tracks in the fuse and relay box.

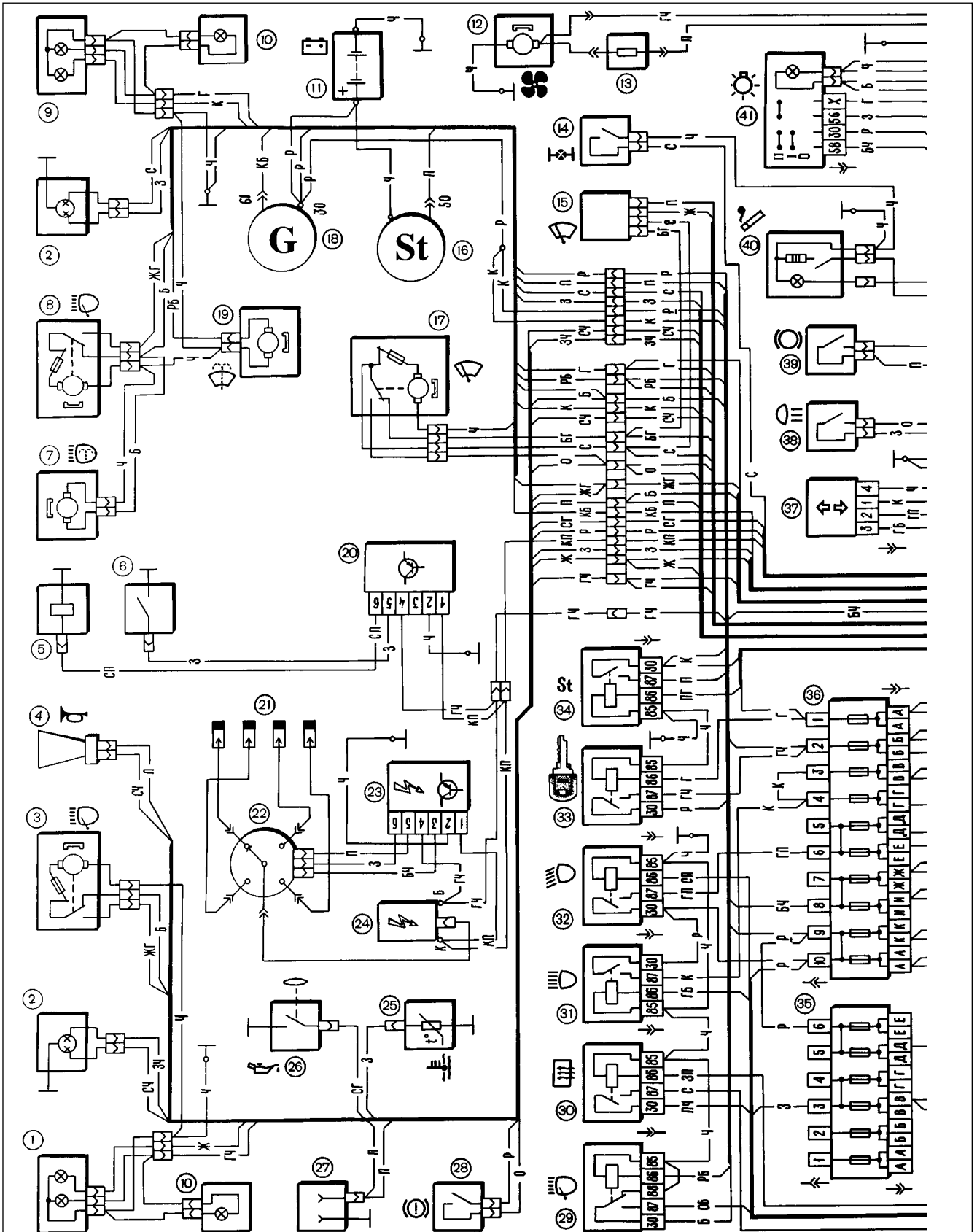
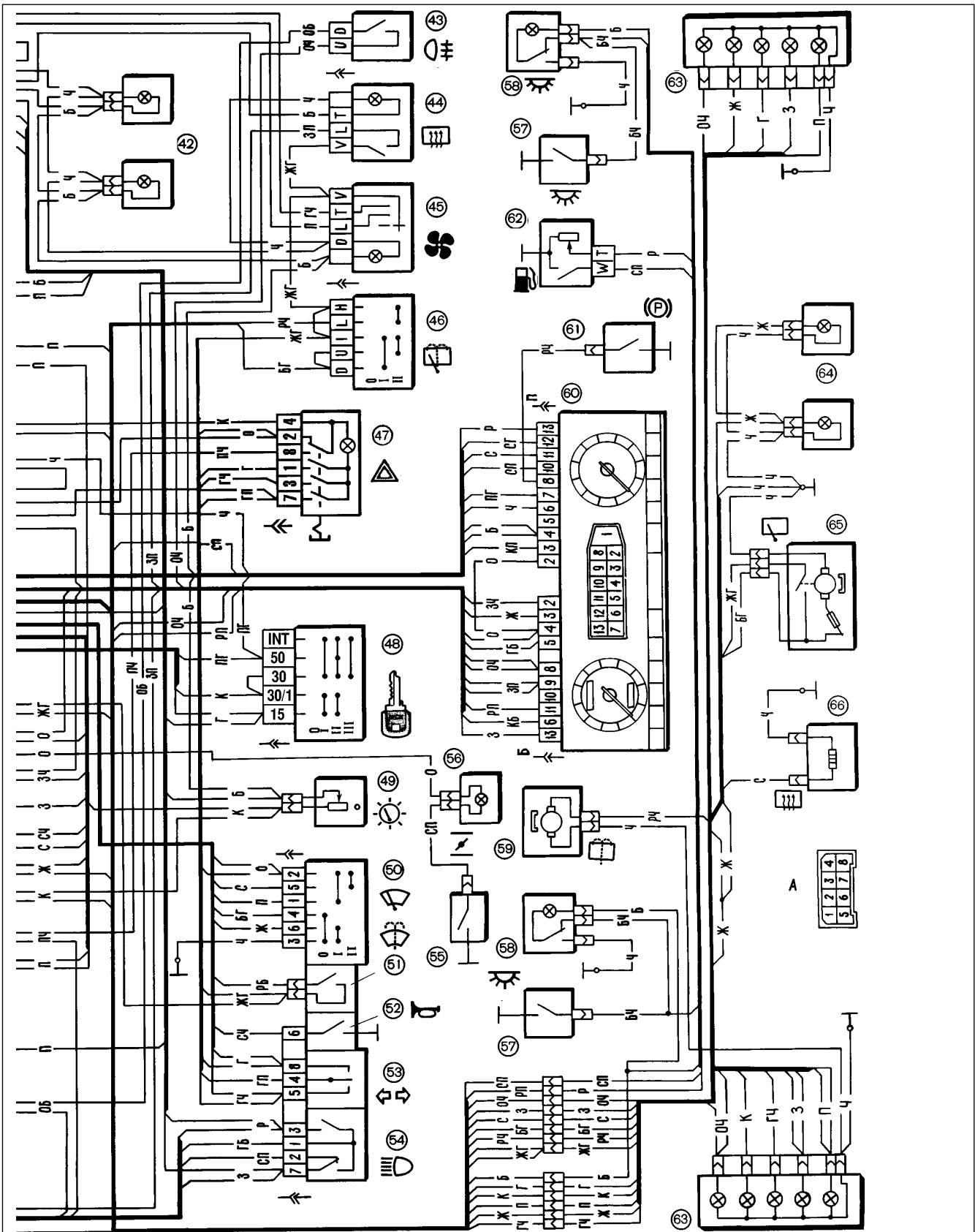


Fig.7-1. Electrical system of VAZ-21213 vehicle:

1 - left-hand front headlamp; 2 - headlights; 3 - left-hand headlamp wiper motor; 4 - horn; 5 - fuel cutoff solenoid; 6 - idle switch; 7 - headlight washer motor; 8 - right-hand headlight wiper motor; 9 - right-hand front headlamp; 10 - side repeaters; 11 - battery; 12 - heater motor; 13 - heater motor complimentary resistor; 14 - differential lockup warning light switch; 15 - windscreen wiper relay; 16 - starter motor; 17 - windscreen wiper motor; 18 - alternator; 19 - windscreen washer motor; 20 - fuel cutoff solenoid control unit; 21 - spark plugs; 22 - ignition distributor; 23 - spark control module; 24 - ignition coil; 25 - temperature gauge sender unit; 26 - oil pressure warning light sender; 27 - inspection lamp socket; 28 - brake fluid level warning light switch; 29 - headlight wipe/wash relay; 30 - rear window heating relay; 31 - main beam relay; 32 - dipped beam relay; 33 - ignition switch relay; 34 - starter motor relay; 35 - complimentary fuse box; 36 - main fuse box; 37 - indicators flasher relay; 38 - reversing light switch; 39



- stop light switch; 40 - cigarette lighter; 41 - exterior light switch; 42 - heater controls illumination; 43 - rear fog light switch; 44 - rear window heating switch; 45 - heater motor switch; 46 - rear window wipe/wash switch; 47 - hazard warning flasher switch; 48 - ignition switch; 49 - instrument lighting switch; 50 - windscreen wiper switch; 51 - switch, windscreen washer & headlamp wipe/wash; 52 - horn switch; 53 - direction indicator switch; 54 - headlight switch; 55 - choke warning light switch; 56 - choke warning light; 57 - door courtesy light switches; 58 - interior lights; 59 - rear window washer motor; 60 - instrument cluster; 61 - handbrake warning light switch; 62 - fuel level and fuel reserve gauge sender unit; 63 - rear lights; 64 - number plate light; 65 - rear window wiper motor; 66 - rear window heating element; A - pin assignment in steering column combination switch connector

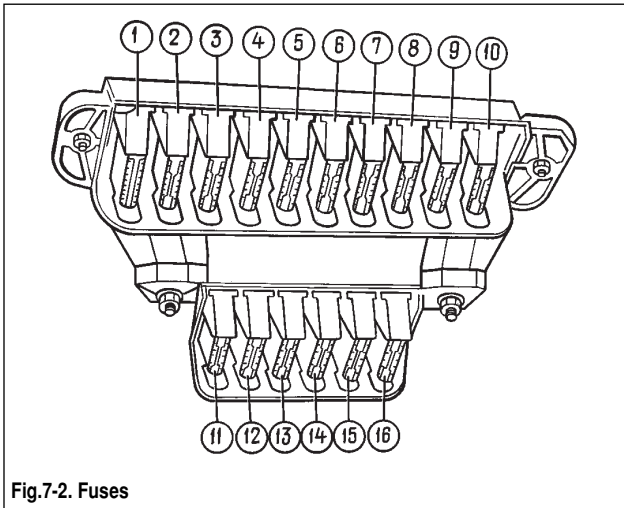


Fig.7-2. Fuses

Battery

Specification

Battery	6CT-55A, maintenance-free
Maximum voltage, volt	12
Maximum capacity (at 20-hour discharge rate and initial electrolyte temperature of $(27\pm 2)^\circ\text{C}$, ampere-hour	55
20-hour discharge amps rate	2.75
Cold start amps rating (with running starter motor and electrolyte temperature of -18°C)	255

Fault diagnosis

Cause	Remedy
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Battery discharge in operation

1. Alternator drivebelt slipping	1. Adjust belt tension
2. Battery surface dirty	2. Clean battery surface
3. Damaged insulation in electrical equipment system (discharge rate exceeds 11 mA with loads disconnected)	3. Locate battery leak and remedy the situation
4. Too many accessories fitted by vehicle owner	4. Disconnect new electrical consumers
5. Alternator faulty	5. Check alternator
6. Electrolyte contaminated	6. Charge battery, drain electrolyte, flush, fill with new electrolyte and recharge battery
7. Short-circuits between plates	7. Renew battery
8. Electrolyte level below top plate edge	8. Restore electrolyte level

Electrolyte on battery cover

1. Too high electrolyte level causing spillage	1. Replenish electrolyte as required
2. Electrolyte leaks through fractures in battery case	2. Replace battery
3. Electrolyte boiling due to excessive alternator voltage	3. Replace alternator
4. Electrolyte boiling through plate sulfation	4. Replace battery

Dry-storage battery - putting into operation

The vehicles are factory-fitted with ready-to-use batteries, i.e. batteries filled with electrolyte and fully charged.

Replacement batteries can be supplied dry, without electrolyte. In order to operate such battery, first remove any provisional plugs or masking tape. Then using a funnel (made of glass or acid-resistant plastic), slowly fill the battery with electrolyte (at 25°C) of 1.28 g/cm^3 for normal climates or 1.23 g/cm^3 for tropics. All procedures required to activate the battery should be performed at the ambient temperature of $(25\pm 10)^\circ\text{C}$.

Allow 20 minutes for the internal plates and separators to saturate well in electrolyte. Then check the battery voltage without loads.

The battery is ready for use when its voltage reading is at least 12.5 volts. At values below 12.5 volts but over 10.5 volts, the battery should be recharged to the output voltage which is specified by the manufacturer. The battery is rejected when the voltage is equal or below 10.5 volts.

The saturation of internal plates and separators normally results in a lower electrolyte level. Therefore, top up the battery with electrolyte of the original specific gravity before refitting it to the vehicle.

Always re-charge the battery after it is filled with electrolyte in the event:

- the battery will be initially operated in heavy duty conditions, in cold weather, at frequent engine starts, etc.;
- the battery has been stored for over 12 months from the date of manufacture.

Electrolyte level - checking

Electrolyte level in all battery cells must be maintained between the «MIN» «MAX» marks on the translucent battery case. Never try to use the battery with the electrolyte level below the «MIN» mark.

In the course of vehicle operation the electrolyte level gradually decreases due to water evaporation. Only distilled water should be used to top up the battery.

If spillage is suspected to be the cause for low electrolyte level, always add electrolyte of the same specific gravity as that remaining in the battery cell. When overfilled, remove excessive electrolyte using an ebony-tipped rubber bulb.

Battery charge level- checking

Always measure the battery charge with a hydrometer (areometer) during servicing or in the event of the battery failed in operation. At the same time measure the temperature in order to account for temperature correlation (Table 7-3) of hydrometer readings.

Table 7-3

Temperature correction values to hydrometer readings for measuring electrolyte density

Electrolyte temperature, °C	Correction value, g/cm ³
-40 to -26	-0.04
-25 to -11	-0.03
-10 to +4	-0.02
+5 to +19	-0.01
+20 to +30	0.00
+31 to +45	+0.01

With electrolyte temperatures over 30°C, the correction value is added to actual hydrometer readings. When electrolyte temperature is below 20°C, the correction value is subtracted. The correction value is not applied when electrolyte temperature is within 20 to 30°C.

Once you have measured the electrolyte specific gravity in each battery cell, determine the state of the battery charge using Table 7-4. Withdraw the battery from the vehicle for re-charging when it is discharged in excess of 25 percent in winter time or 50 percent in summer time.

When measuring electrolyte density, take care not to drip electrolyte on the battery cover, case, body or other parts. Electrolyte contains hazardous sulfuric acid which causes corrosion, current leaks, etc.

Do not measure the electrolyte specific gravity in the following cases to exclude wrong readings:

- when the electrolyte level is not as required;
- when electrolyte is too hot or too cold; the optimum temperature to measure electrolyte specific gravity is 15-27°C;
- immediately after the battery replenishment. Leave the battery for some time to let the electrolyte mix up; it may take up to several hours if the battery has been fully discharged;
- after a number of start-up attempts. It is advisable to wait until electrolyte in the battery cell is homogeneous in terms of density;

- when electrolyte is «boiling». Wait to see bubbles rising to the surface in the electrolyte, sampled with a hydrometer.

Battery charging

Remove the battery from the vehicle and clean it carefully, especially its top. Check the electrolyte level and replenish, if applicable.

The battery is recharged at a rate of 5.5 amperes with the caps undone. Charge the battery until intensive gas escape is observed and consistent voltage and electrolyte specific gravity is achieved within three hours. The electrolyte density of the charged battery at 25°C should be as shown in Table 7-4.

When recharging the battery, frequently check the electrolyte temperature to keep it below 40°C. When 40°C is reached, then either halve the charging current or stop recharging to cool the battery down to 27°C.

Stop charging the battery in case of intensive gas escape from the battery cells and when the last three measurements (taken hourly) show no changes in voltage and specific gravity.

If at the end of the recharging procedure the electrolyte specific gravity (after temperature correlation) differs from that specified, adjust it accordingly. In case of higher specific gravity, remove some electrolyte and top up distilled water, while in case of lower specific gravity - remove some amount of lower specific gravity electrolyte and add some higher specific gravity electrolyte (1.4 g/cm³).

After the electrolyte specific gravity has been duly adjusted, continue to charge the battery further 30 minutes for better electrolyte mixing. Next disconnect the battery and after 30 minutes check the electrolyte level in all cells.

When electrolyte is below the level required, pour in electrolyte of the specific gravity which is recommended for that climate (Refer to Table 7-4). When electrolyte level is above that required, remove excessive amount using a rubber bulb.

Table 7-4

Electrolyte specific gravity at 25°C, g/cm ³				
Climate (average January temperature, °C)	Season	Fully discharged battery	Battery discharged	
			by 25%	by 50%
Very cold (from -50 to -30)	Winter	1.30	1.26	1.22
	Summer	1.28	1.24	1.20
Cold (from -30 to -15)	All seasons	1.28	1.24	1.20
Moderate (from -15 to -8)	All seasons	1.28	1.24	1.20
Warm and damp (from 0 to +4)	All seasons	1.23	1.19	1.15
Hot and dry (from -15 to +4)	All seasons	1.23	1.19	1.15

Alternator

Specification

Maximum current output (at 13 volts and 5000 rpm), amp . . . 55
Adjustable voltage range, volts 14.1±0.5
Maximum rotor speed, rpm 13,000
Engine-to-alternator ratio 1:2.04

General description

The alternator of 37.3701 model is of AC, three-phase, clockwise rotation (when viewed from the drive end), with integral diode plate and voltage regulator.

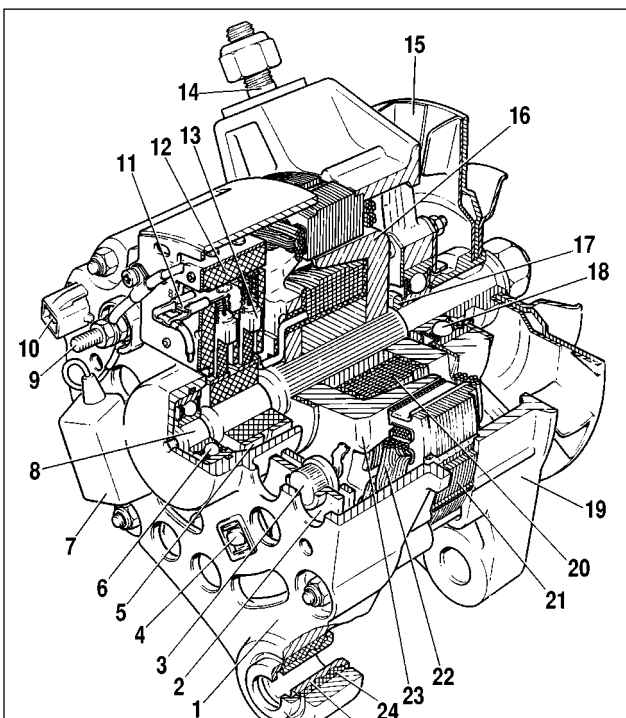


Fig.7-3. Alternator 37.3701:
 1 - slip ring end housing; 2 - diode plate; 3 - diode; 4 - screw; 5 - slip ring; 6 - rear ballbearing; 7 - suppression condenser; 8 - rotor shaft; 9 - alternator terminal «30»; 10 - alternator terminal «61»; 11 - voltage regulator terminal «B»; 12 - voltage regulator; 13 - brush; 14 - alternator-to-belt tensioner lever securing pin; 15 - pulley and fan; 16 - rotor pole end; 17 - spacer; 18 - front ballbearing; 19 - drive-end housing; 20 - rotor winding; 21 - stator; 22 - stator winding; 23 - rotor pole end; 24 - buffer bush; 25 - bush; 26 - hold-down bush

Protective cover 4 is used for slip ring-end housing (Fig.7-11). The protective cover and air intake have several design alternatives.

Four bolts hold together stator 21 (Fig.7-3) and housings 1 and 19. Rotor shaft 8 runs in bearings 6 and 18 located in the housings. The rotor winding (field winding) is powered through the brushes and slip rings 5.

Three-phase alternative current, induced in the stator winding, is converted into direct current in diode plate 2 fitted to housing 1. Electronic voltage regulator 12 is integral with the brush holder and is also attached to housing 1.

The alternator wiring diagram is shown in Fig.7-4. When the ignition is switched on, the voltage for the alternator actuation is applied to the regulator terminal «B» (alternator terminal 61) via warning light 6 in instrument cluster 3. Once the engine is started, the current to the field winding is supplied from three supplementary diodes in the alternator diode plate.

The alternator operation is checked via warning light 6 in the instrument cluster. The light comes on when the ignition is switched on and goes out after the engine has been started, when the alternator is good. Bright or dim light of the warning lamp indicates faults.

Before 1995 an electronic voltmeter in the instrument cluster was used to control voltage in the vehicle electrical system. With correct voltage the voltmeter LED did not light up. In case of overvoltage the LED started flashing, while in case of undervoltage the LED stayed steadily.

Starting from 1996 an alternative voltage regulator and brush holder are used. Now the voltage regulator is located in the metal housing and is riveted to the brush holder (Fig.7-10, a), making a unit. The new voltage regulator has no terminal «B», so voltage is supplied only to terminal «B». Both the earlier and new voltage regulators are similar and are interchangeable as a complete unit with the brush holder.

Some vehicles can be fitted with alternators made in Slovenia, Bulgaria or Germany. These alternators are interchangeable with the alternator of 37.3701 model as to specification and mounting sizes, though are slightly different in design. This chapter describes the alternator of 37.3701 model, preferably used in VAZ-21213 vehicles.

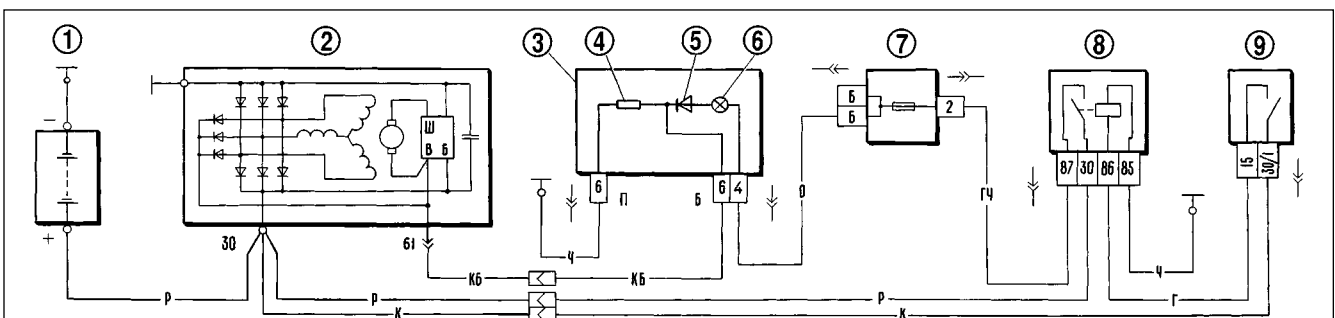


Fig.7-4. Alternator wiring diagram:
 1 - battery; 2 - alternator; 3 - instrument cluster; 4 - resistor 51 Ohm, 5 W; 5 - diode; 6 - low battery charge warning light; 7 - fuse box; 8 - ignition relay; 9 - ignition switch

Fault diagnosis

Cause	Remedy
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Warning light does not light up when ignition is switched on. Instruments inoperative

1. Blown fuse 2 in fuse box	1. Renew fuse
2. Broken supply circuit in instrument cluster: - no voltage between terminal «Б» of main fusebox and instrument cluster; - no voltage between ignition relay and fusebox unit	2. Carry out the following: - check wire «O» and its connections between fuse boxes and instrument cluster; - check wire «ГЧ» and its connections between ignition relay and fusebox
3. Ignition switch or ignition relay faulty: - faulty contact part or ignition relay; - no voltage between ignition switch and ignition relay; - break or no contact in the ignition relay earth wire	3. Carry out the following: - check and renew faulty contact part of ignition switch or ignition relay; - check wire «Г» and its connections between ignition switch and ignition relay; - check wire «Ч» and its connections between ignition relay and earth

Warning light does not light up when ignition is switched on and does not stay on during engine operation. Instruments operate. Battery is discharged.

1. Blown warning light bulb or loose holder-to-PCB contact	1. Renew failed bulb, bend holder contacts or replace bulb holder
2. Broken circuit between instrument cluster and alternator terminal 61	2. Check wire «КБ» and its connections between alternator and instrument cluster
3. Brushes worn or binding, slip ring oxidized	3. Renew brush holder with brushes, clean slip rings with fuel-moistened cloth
4. Voltage regulator damaged (break between «ЛЛ» terminal and earth)	4. Renew voltage regulator
5. Lead from voltage regulator «B» terminal disconnected	5. Reconnect wire
6. Short-circuit in positive diodes	6. Renew diode plate
7. Field winding leads disconnected from slip rings	7. Solder pins or renew alternator rotor
8. No contact between voltage regulator terminals «B» and «ЛЛ» and brush terminals (for pre-1996 alternators)	8. Clean voltage regulator terminals «B», «ЛЛ» and brush output; bend voltage regulator pins

Warning light is bright or half bright with engine running. Battery is non-charged

1. Alternator drivebelt slipping	1. Adjust belt tension
2. Voltage regulator damaged	2. Renew voltage regulator
3. Damaged diodes	3. Renew diode plate
4. Field winding diodes damaged	4. Renew diodes or diode plate
5. Stator winding broken, shorted or earthed	5. Replace alternator stator

Warning light is on with engine running. Battery is overcharged

Voltage regulator damaged (short-circuit between terminal «ЛЛ» and earth)	Renew voltage regulator
---------------------------------------------------------------------------	-------------------------

Alternator is noisy

1. Loose alternator pulley nut	1. Tighten nut
2. Alternator bearings damaged	2. Renew rear bearing or front cover with bearing
3. Stator winding shorted internally or to housing (alternator howl)	3. Renew stator
4. Short-circuit in diode plate	4. Renew diode plate
5. Brush squeak	5. Clean brushes and slip rings with cotton cloth moistened in petrol

WARNING. Always earth the battery negative post to the bodyshell and connect the positive post to the alternator clip 30. If battery connections are erroneously reversed, the alternator diodes will be damaged by resulting high voltage.

Never operate the alternator with the battery disconnected since this causes overvoltage peaks at the alternator terminal 30 and can damage the voltage regulator or other electronic devices of the vehicle electrical system.

Never test the alternator for «spark» by earthing the alternator terminal 30 even for a short time. The diodes can be damaged by considerable current flow. Check the alternator operation using an ammeter or a voltmeter.

Never check the alternator diodes by applying voltage over 12 volts or using a megohmmeter, as its voltage is very high and can damage the diodes (by short-circuit).

Never check the vehicle wiring by a megohmmeter or a lamp powered in excess of 12 volts. If the check is really necessary, disconnect the leads from the alternator first.

Always use the test bench and disconnect the winding from the diodes when performing the high voltage check of alternator stator winding insulation resistance.

When welding the body units or components, remember to disconnect first the leads from all battery and alternator connectors.

Alternator - testing

Using tester

A tester helps determine whether the alternator is faulty or meets the specification. The carbon brushes of the unit tested should slide smoothly on the slip rings, which should always be clean.

Mount the alternator on the tester and connect as shown in Fig.7-5. Start the tester motor, using rheostat 4, set the alternator output voltage at 13 volts and raise the rotor speed to 5000 rpm. Run the alternator at this speed for at least 10 minutes and then measure the alternator output amperage. The reading for a sound alternator should not be below 55 amperes.

When the measured amperage is much lower, this is an indication of some fault in the stator or rotor windings or damaged diodes. If this is the case, very thorough diagnostics will have to be carried out in order to locate the fault.

The output voltage should be measured at rotor speed of 5000 rpm. Set rheostat 4 to test amperage of 15 amps and take the reading of the alternator output voltage to be within 14.1 ± 0.5 volts at the ambient / alternator temperature of $25 \pm 10^\circ\text{C}$.

If the voltage reading falls outside the range specified, replace the complete voltage regulator with a new unit which is proved good. Then repeat the test procedure. Normal voltage indicates that the old regulator is faulty and must be renewed. If the fault persists, check the alternator windings and diodes.

Alternator - oscilloscope test

The oscilloscope offers an accurate and quick way to check the alternator and identify the fault through the output waveform.

To perform the check make the connections as shown in Fig.7-6. Disconnect the output lead common for three supple-

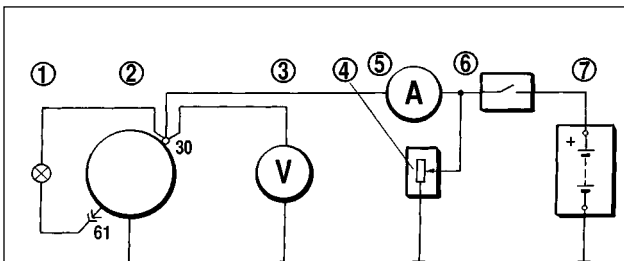


Fig.7-5. Wiring connections for diode plate test:
1 - warning light (12 v, 3 W); 2 - alternator; 3 - voltmeter; 4 - rheostat; 5 - amperemeter; 6 - switch; 7 - battery

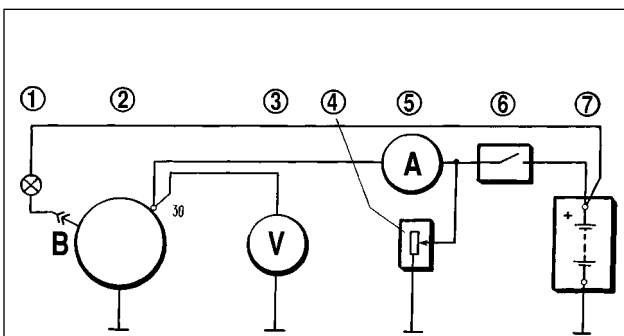


Fig.7-6. Alternator wiring connections for oscilloscope test:
1 - warning light (12 v, 3 W); 2 - alternator; 3 - voltmeter; 4 - rheostat; 5 - amperemeter; 6 - switch; 7 - battery

mentary diodes from the voltage regulator terminal «B» and make sure the lead end does not touch the alternator housing. Connect the battery lead to the regulator terminal «B» via warning light 1. Now the field winding is only battery powered.

Start the tester motor and increase the rotor speed up to 1500-2000 rpm. Using switch 6, cut off the battery from the alternator terminal 30; while using rheostat 4, set the output current at 10 amperes.

Check the voltage across the alternator terminal 30. When the diodes and stator winding are sound, the output waveform is «saw-shaped» with uniform peaks (Refer to Fig.7-7, I). In case of a broken stator winding or shorted diodes, the waveform is quite different - the peaks are no longer uniform and there are very deep troughs (Fig.7-7, II и III).

Check to see the output waveform across the alternator terminal 30 is normal; next check voltage across the alternator terminal 61 or at the end of the lead disconnected from the voltage regulator terminal «B». These points are a common connection for three supplementary diodes (Fig.7-4), supplying current to the field winding during the alternator operation. The output waveform must have the same even saw-shaped pattern. An irregular waveform is an indication of damaged supplementary diodes.

Rotor field winding - testing

The field winding can be tested with the alternator in the vehicle. It is sufficient to remove the housing and voltage regulator/brush holder assembly.

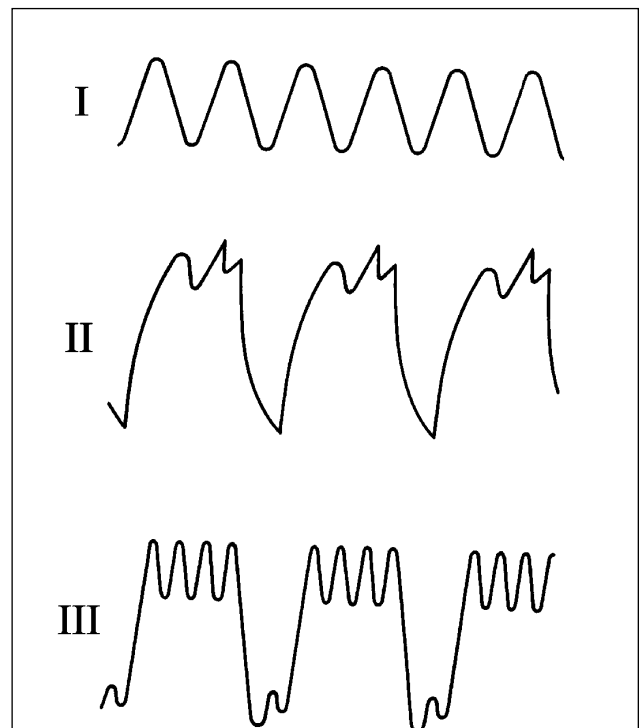


Fig.7-7. Alternator rectified waveform:
I - sound alternator; II - blown diode; III - diode circuit broken (stator winding)

When necessary, sand the slip rings with emery paper, then check the winding for continuity or earthing with an ohmmeter or a test bulb.

Stator - testing

The stator is tested separately after dismantling the alternator and disconnecting the winding from the diodes.

First test the stator winding for continuity or earthing using an ohmmeter or a test bulb and battery. The wire insulation should show no signs of overheating caused by short-circuit in the diode plate. Always renew the stator with a damaged winding.

Finally, using a special growler, check the stator winding for internal short-circuit.

Diodes - testing

A sound diode allows current only in one direction. A faulty diode can either prohibit the current flow (a broken circuit) or allow it in both directions (a short-circuit).

The complete diode plate must be renewed if any diode is found damaged.

The diode plate can be checked for a short-circuit with the alternator in the vehicle. For this disconnect leads from the battery and alternator and remove the slip ring end housing. Also the lead to the voltage regulator terminal «B» should be disconnected. In case of the alternator with an old voltage regulator do not forget to disconnect the voltage regulator terminal «Б» from the alternator terminal 30.

An ohmmeter or a test bulb (1-5 watt, 12 volts) and battery can be used as shown in Fig.7-8.

Note. For easier diode fitting three diodes (marked red) make «positive» rectified voltage. These diodes are «plus» and are pressed within one diode plate connected to the alternator terminal 30. Three other diodes («minus», marked black) have «negative» rectified voltage to the housing. They are press-fitted to the other diode plate connected to earth.

First make sure both positive and negative diodes are not shorted internally. For this connect the battery positive terminal through a test bulb to the alternator terminal 30, whilst the negative terminal - to the alternator housing (Fig.7-8, I). The illuminated bulb indicates shorted positive and negative diodes.

Short-circuit in the negative diodes can be detected by connecting the battery «plus» terminal through a test bulb to one of the diode plate securing bolts, while the «minus» to the alternator housing (Fig.7-8, II). The illuminated bulb is an indication of a short-circuit fault in one or more negative diodes. Note that in the latter case the bulb may come on as a result of stator winding being earthed to the alternator housing. However, this fault is much less frequent than short-circuits in the diodes.

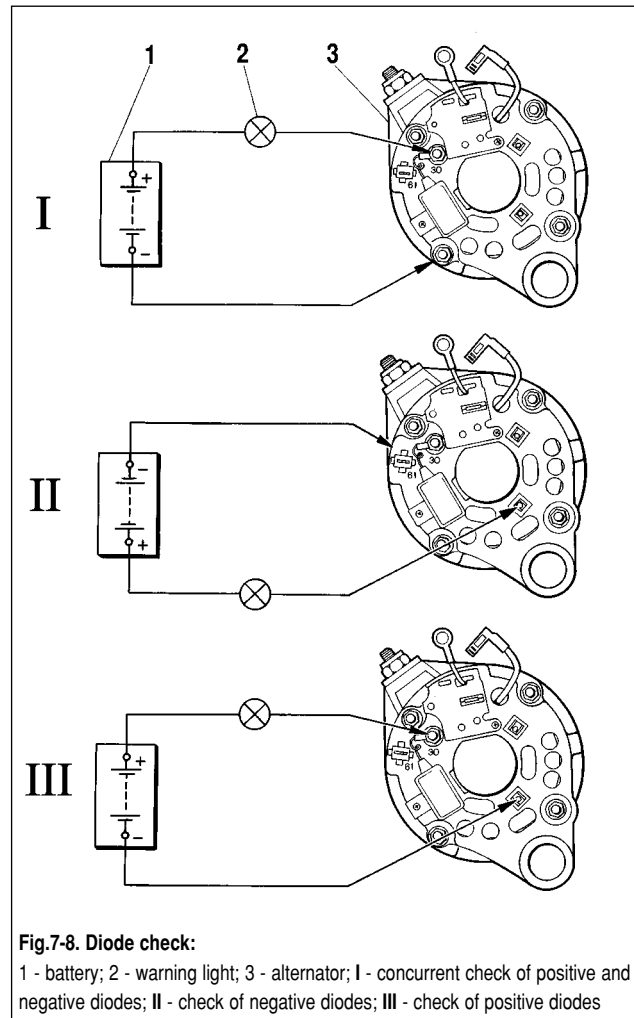


Fig.7-8. Diode check:

1 - battery; 2 - warning light; 3 - alternator; I - concurrent check of positive and negative diodes; II - check of negative diodes; III - check of positive diodes

Short-circuit in the positive diodes can be detected by connecting the battery «plus» terminal through a test bulb to the alternator terminal 30, while «minus» - to one of the diode plate securing bolts (Fig.7-8, III). The illuminated bulb advises about a short-circuit in one or more positive diodes.

Discontinuity in the diodes can be traced without dismantling the alternator either by means of an oscilloscope or a tester through a significant output current drop (20 to 30 percent) against the specification. If the alternator windings, supplementary diodes or voltage regulator are sound, whilst the diodes are not shorted, the cause of the output current drop is discontinuity in the diodes.

Supplementary diodes - testing

To check the supplementary diodes for short-circuit without removing and dismantling the alternator, make connections as shown in Fig.7-9. Similarly to the diode checking, disconnect the battery and alternator leads, remove the alternator housing, disconnect the lead to the voltage regulator terminal «B».

Connect the battery positive post through a test bulb (1-3 watt, 12 volts) to the alternator terminal 61, while the negative post - to one of the diode plate securing bolts.

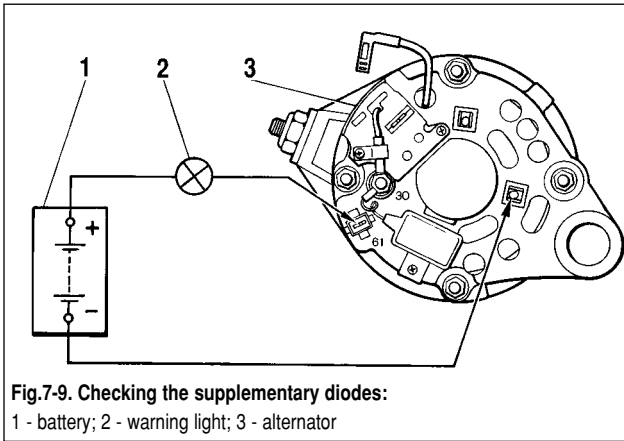


Fig.7-9. Checking the supplementary diodes:
1 - battery; 2 - warning light; 3 - alternator

An illuminated bulb advises about short-circuit in one or more supplementary diodes.

The damaged diode can be identified only after removing the diode plate and checking each diode.

Discontinuity in the supplementary diodes can be detected with an oscilloscope through distortions in the voltage waveform across terminal 61 and also by low voltage (below 14 volts) across terminal 61 at a medium rate of the alternator rotor.

Voltage regulator - testing

The function of the voltage regulator is to continuously adjust the field current flow to the alternator so that the alternator voltage is maintained within the preset range at various speed / load conditions of the alternator operation.

In-vehicle test. For this test you need a DC voltmeter with 15-30 volt scale and accuracy of at least 1.0 class.

Run the engine for 15 minutes at medium speeds with the headlights on, measure the voltage between the alternator terminal 30 and alternator earth. The reading should be within 13.6-14.6 volts.

When battery undercharge or overcharge becomes repetitive, while the adjustable voltage falls outside the specification, the voltage regulator must be renewed.

Off-vehicle test. For testing the voltage regulator, removed from the alternator, make the connections as shown in Fig.7-10. The pre-1996 voltage regulator should be tested complete with the brush holder (Fig.7-10, b), since at the same time you can detect a broken brush connection or a poor contact between the voltage regulator terminals and brush holder.

Connect a test lamp of 1-3 watt, 12 volts across the brush terminals. The terminals «B», «Б» (when available) and earth terminal should be connected first to the power supply of 12 volts and then to that of 15-16 volts.

With the sound voltage regulator, the lamp illuminates in the first case and goes out in the second case. If the lamp illuminates in both cases, there must be a break in the voltage regulator; when the bulb fails to light in both cases, the regulator circuit is broken or brush-to-regulator connection is loose (for pre-1996 alternators).

Capacitor - testing

The suppression capacitor is intended to protect the on-board electronic equipment against voltage surges in the ignition system along with suppression of radio interference.

A damaged capacitor or its loose fitting to the alternator (poor ground) is recognizable through increased radio interference with the engine running.

A simple way of testing the capacitor is to use a megohmmeter or a tester (scaled as 1-10 MOhm). In case of a sound capacitor, when its contacts are closed via the instrument, the needle should first deflect towards a lower resistance values and then gradually return to the initial position. The capacitance measured with a special device should be 2.2 microfarad \pm 20%.

Alternator - overhaul

Alternator - dismantling

Clean the alternator and blow dry with compressed air. Release the clip to disconnect air intake 3 (Fig.7-11) from housing 4. Undo two screws 1 and nut from contact bolt extension 5,

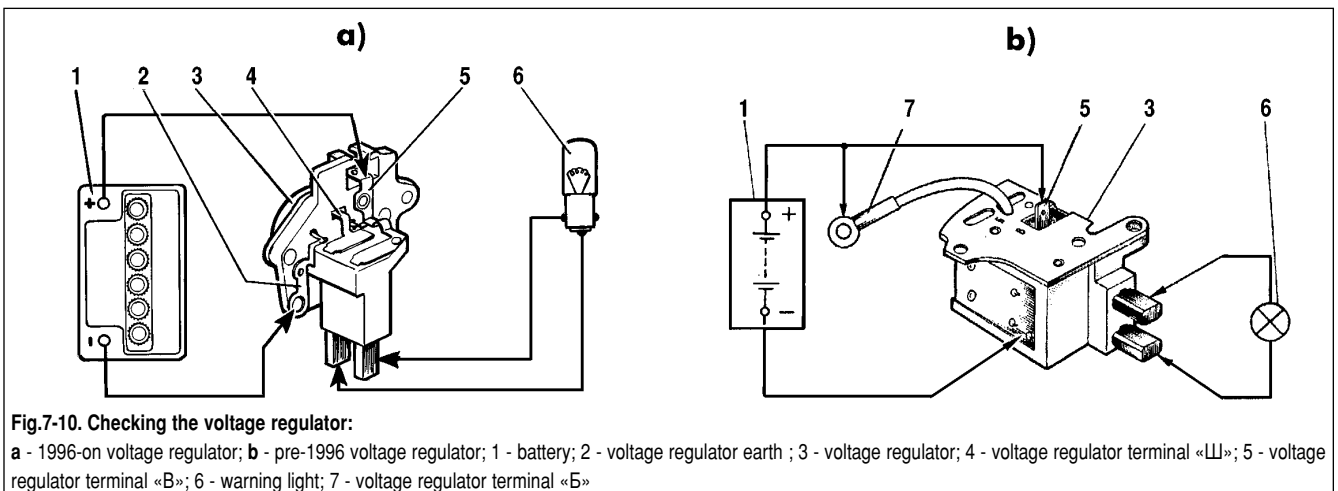


Fig.7-10. Checking the voltage regulator:

a - 1996-on voltage regulator; **b** - pre-1996 voltage regulator; 1 - battery; 2 - voltage regulator earth; 3 - voltage regulator; 4 - voltage regulator terminal «L»; 5 - voltage regulator terminal «B»; 6 - warning light; 7 - voltage regulator terminal «B»

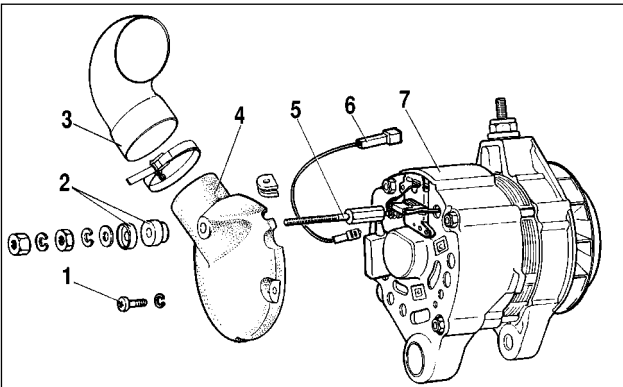


Fig.7-11. Removing the alternator protective case:
 1 - securing screw; 2 - bushes; 3 - air intake; 4 - protective case; 5 - extension, alternator terminal 30; 6 - wire, alternator terminal 61; 7 - alternator

remove housing 4. Disconnect lead 6 from alternator terminal 61 and undo contact bolt extension 5.

Lock the alternator pulley with a tool from kit 67.7823.9504, undo the pulley retaining nut and press the pulley out using a puller.

Remove the pulley key and taper washer.

Tool kit 67.7823.9504 includes an ordinary picker and a grip. The grip consists of two steel half-rings, inserted into the pulley.

The half-rings are of the same cross-section area as the alternator drivebelt. At one end they are connected by means of the joint, at the other end they have levers to be compressed by hand when removing the pulley.

Disconnect the wire from the alternator terminal «B». Disconnect the voltage regulator and capacitor leads from alternator terminal 30, undo regulator 1 retaining screws (Fig.7-12)

and withdraw it. In case of pre-1996 alternators to prevent damages to the brushes when removing the brush holder. Insert a screwdriver between regulator 2 housing and brush holder, then partly pull out the regulator from the alternator, leaving the brush holder in place. Next swing and withdraw the regulator complete with the brush holder from the alternator. Undo the retaining screw and remove suppression capacitor 20.

Undo clamp bolt 14 nuts, remove alternator housing 11 and rotor 8. Undo the bolt nuts, connecting diode ends to stator windings terminals, withdraw stator 7 from alternator housing 17.

Undo contact bolt 6 nut, disconnect the supplementary diode wire terminal from connector 3, remove diode plate 5.

Alternator - reassembly

The reassembly of the alternator is the reverse of the dismantling procedure.

In case of pre-1996 alternators (with detachable regulator / brush holder unit), in order to avoid damage to the brushes, before refitting the regulator complete with the brush holders, do not fully insert the brush holder into the regulator, it should be pushed in place only partly, then insert the assembly as such into the alternator. After the brush holder is refit into the alternator housing, press lightly the regulator into the alternator.

Out-of-concentricity for the holes in the alternator housings must not exceed 0.4 mm. Therefore during reassembly always insert a special gauge into these holes.

The taper spring washer of the pulley must be assembled with the convex side facing the nut. Tighten the pulley securing nut to a torque of 38.4-88 N•m (3.9-9.0 kgf•m)

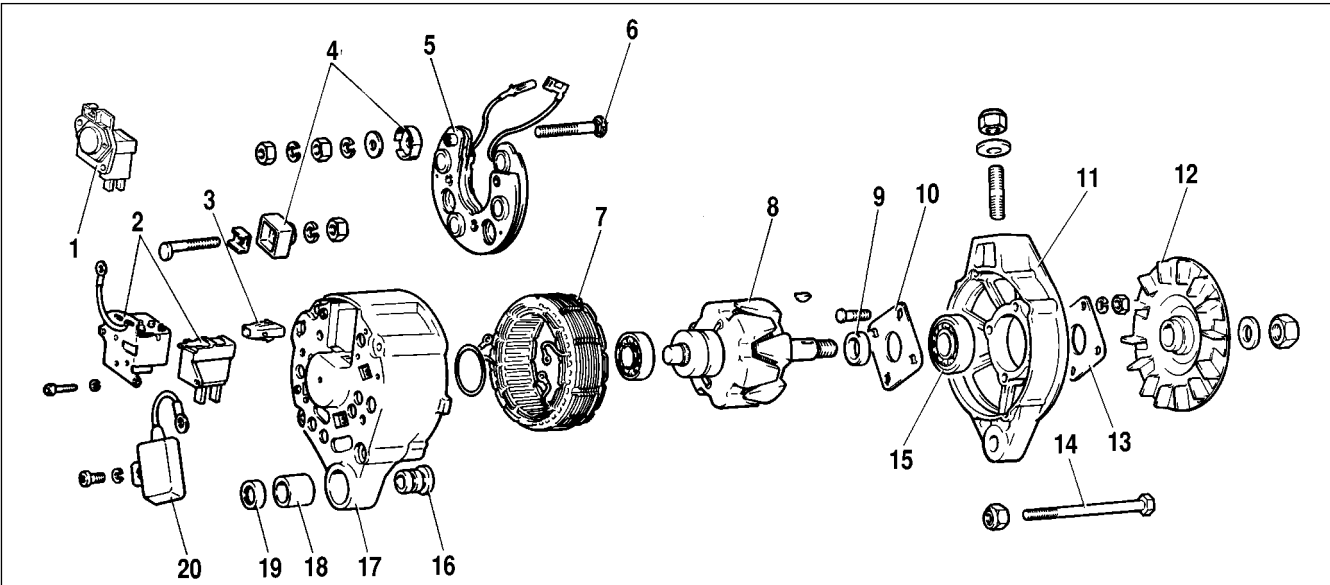


Fig.7-12. Alternator components:
 1 - voltage regulator complete with brush holder, 1996-on alternators; 2 - voltage regulator and brush holder, pre-1996 alternators; 3 - supplementary diode connector; 4 - insulating bushes; 5 - diode plate; 6 - contact bolt; 7 - stator; 8 - rotor; 9 - spacer; 10 - inner washer for bearing attachment; 11 - drive end housing; 12 - pulley; 13 - outer washer for bearing attachment; 14 - clamp bolt; 15 - front rotor ball bearing; 16 - bush; 17 - slip ring end housing; 18 - buffer bush; 19 - hold-down bush; 20 - suppression capacitor

Brush holder - renewal

Always renew the complete unit if the regulator fails or brushes are worn or protrude from the holder to less than 5 mm.

In case of pre-1996 alternators, force the brush holder out of the voltage regulator housing by pressing the terminal «B». Avoid damaging the brushes, so remove and refit the regulator with the brush holder as described earlier in sections «Alternator - dismantling» and «Alternator - reassembly».

In case of 1996-on alternators with one-piece regulator/brush holder unit, renew the complete brush regulator/holder assembly.

Before refitting the voltage regulator with new brush holder, blow its locating place in the alternator clean from carbon dust and wipe off any oil contamination.

Rotor bearings - renewal

To remove a failed bearing from the drive-end housing, undo the nuts of screws holding the bearing retaining washers, remove the washers and screws, then press out the bearing on a hand press. Should the screw nuts fail to undo (the screw ends are bent-up), cut off the screw ends.

Refit the new bearing to the alternator housing only when the bore for the bearing is not deformed and its diameter is not over 42 mm. If the bore is bigger or deformed, renew the housing.

Using a press, drive in the bearing, then compress the bearing between two washers, held by the screws and nuts. Tighten the nuts and bend-up the screw ends. The slip ring rotor bearing is renewed together with the housing, since when the bearing is damaged, the recess in the housing is damaged too. The bearing is removed from the rotor using a puller; use a press tool to drive it into position.

Supplementary diodes - renewal

To replace a damaged diode, unsolder its pins, then carefully take the diode out from the plastic holder, taking care not to hit the diode plate. Clean the holder from epoxy, fit a new diode and solder it.

The colour-coded diode terminal must be re-soldered to the common output wire. After soldering, secure the diode to the holder with epoxy.

Starter motor

Specification

Maximum power, kW	1.3
Amperage at maximum power, not greater	290±10
Amperage at 'brake-on', not greater	550
Amperage at idle without solenoid, not greater	60

General description

The starter motor is of pre-engaged type (35.3708 model), DC, with field coils, incorporating a double-winding solenoid.

Body 17 (Fig.7-13) houses four poles 18 with field windings, three of which are series and one is parallel. Covers 7 and 15 and starter housing 17 are held together by two bolts. The armature features a face-type commutator. The armature shaft runs in sintered shells 14, press fitted to cover 6 and 15.

The starter motor wiring diagram is shown in Fig.7-14. When the starter motor is switched on, the battery voltage is supplied through supplementary relay 4 (113.3747-10 model) to both solenoid windings (plunging winding II and holding winding I). The plunging winding shuts off when the solenoid contacts close.

Fault diagnosis

Cause	Remedy
At starter motor switch-on, armature fails to rotate, solenoid inoperative	
1. Battery defective or fully discharged	1. Charge or renew battery
2. Battery terminal posts and lead ends severely corroded; end loose	2. Clean battery posts and lead ends, tighten and apply a coat of petroleum jelly (Vaseline)
3. Solenoid faulty internally, earthed or broken	3. Renew solenoid
4. Starter motor relay defective	4. Clean relay contacts. Renew faulty relay
5. Starter relay winding power circuit open	5. Check wires and connections between ignition switch terminal 50 and relay terminal 86
6. Ignition switch contacts 30 and 50 fail to close	6. Renew ignition switch contact unit
7. Starter solenoid power leads broken	7. Check leads and connections: battery - starter cut-in relay - starter solenoid terminal 50
8. Stuck starter solenoid	8. Remove solenoid, check armature for smooth slide
No or slow armature rotation, solenoid inoperative	
1. Battery defective or fully discharged	1. Renew or charge battery
2. Battery posts and lead clamps severely corroded; ends loose	2. Clean battery posts and wire ends, tighten and apply a coat of petroleum jelly
3. Loose end of cable from power plant to body or between power plant to battery «minus» post	3. Tighten cable end fasteners
4. Solenoid terminal bolts oxidized or terminal bolt wire end retaining nuts loose	4. Clean terminal bolts, tighten lead retaining nuts
5. Commutator burnt, brushes sticking or worn	5. Clean commutator, renew brushes
6. Stator winding or armature broken or shorted	6. Renew stator or armature
7. Positive brush holder earthed	7. Eliminate shock-circuit or renew commutator end cover

Solenoid repetitive cutting in and out

- | | |
|----------------------------------------------------------------------------------------|-------------------------------------------------------------------------|
| 1. Battery discharged | 1. Recharge battery |
| 2. Excessive voltage drop in solenoid power circuit caused by badly oxidized lead ends | 2. Check leads and connections between battery and solenoid terminal 50 |
| 3. Solenoid holding winding broken or shorted | 3. Renew solenoid |

Starter motor armature rotates, flywheel inoperative

- | | |
|---------------------------------------------------------|---------------------------------------------------|
| 1. Overrun clutch slipping | 1. Bench test starter motor, renew overrun clutch |
| 2. Clutch operating lever broken or pivot shaft dropped | 2. Renew lever or refit pivot shaft |
| 3. One-way clutch guide ring or buffer spring broken | 3. Renew clutch |

Starter motor noisy

- | | |
|--------------------------------------------------------------------|---------------------------------------------------------------------------------------|
| 1. Starter motor retaining nuts loose or drive-end housing broken | 1. Tighten retaining nuts or overhaul starter motor |
| 2. Starter wrongly mounted | 2. Check starter fitting |
| 3. Bearing shells or armature shaft journals excessively worn | 3. Renew starter motor |
| 4. Stator pole loose (armature touches pole) | 4. Tighten pole retaining screw |
| 5. Pinion or ring gear teeth damaged | 5. Renew drive or flywheel |
| 6. Pinion fails to disengage ring gear: | 6. Carry out the following: |
| - operating lever seized; | - renew operating lever; |
| - overrun clutch jams in mesh with armature shaft splines; | - clean and lubricate splines with motor oil; |
| - clutch or solenoid springs loose or broken; | - renew clutch or solenoid; |
| - clutch hub circlip lost; | - renew damaged components; |
| - solenoid armature sticking; | - renew solenoid or eliminate sticking |
| - ignition switch contact part faulty: pins 30 and 50 fail to open | - check correct contact closing at different key positions; renew faulty contact unit |

Starter motor - bench testing

If the starter motor fails to operate effectively, check it using a tester. The wiring connections for the test are shown in Fig.7-15. The cross-sectional area of leads to power source, ammeter and starter solenoid terminal bolt should be at least 16 mm².

The starter motor test temperature should be (25±5)°C. The brushes must slide smoothly on the commutator.

Functional test. By closing switch 5 (Fig.7-15), operate the starter motor three times from a 12 volt source at different braking conditions, eg. at the braking moments of 2; 6 and 10 N•m (0.2; 0.6 and 1 kgf•m). The starter motor should be switched on for no longer than 5 seconds with minimum 5 second intervals in-between.

If the starter motor fails to turn the tester ring gear or produces unusual noise, dismantle the starter motor and examine its components.

Fully locked ring test. Lock the tester ring gear, operate the starter motor and measure the current, voltage and braking moment to be maximum 550 amps, 7.5 volts and at least 13.7 N•m (1.4 kgf•m) respectively. Do not switch on the starter motor for over than 5 seconds.

When the braking moment is below, while the current is over the values specified, the likely reason is an internal short-circuit of the stator or armature winding or earthed winding.

When the braking moment and current are below the values specified, the possible cause is an oxidized or dirty commutator, severely worn brushes or weak springs, sticking brushes, loose stator winding terminals, eroded or burnt solenoid terminal bolts.

At fully locked condition, the starter armature must not turn; when otherwise the one-way clutch is faulty.

Dismantle the starter motor, replace or overhaul damaged components to remedy the situation.

No-load test. Disengage the tester ring gear from the starter motor pinion. Operate the starter motor, measure the current flow and armature shaft speed to be respectively maximum 60 amps and (5000±1000) rpm at 11.5-12 volts across the starter motor terminals.

If the amperage and drive shaft rpm readings differ from the values specified, the possible causes are likely to be the same as those for the test described above.

Solenoid test. Insert a shim of 12.8 mm between stop collar 21 (Fig.7-13) and pinion and operate the solenoid. The solenoid cut-in voltage, with the pinion resting against the shim, should not exceed 9 volts at ambient (20±5)°C. Any higher voltage indicates the solenoid or drive failure.

Starter motor relay. The relay cut-in voltage should not exceed 8 volts at (23±5)°C. When higher, it is an indication of a failed relay or drive.

Starter overhaul

Dismantling

Undo the nut on the lower solenoid terminal bolt and disconnect the stator winding lead. Undo the solenoid retaining nuts and remove the solenoid. Remove the end cap (Fig.7-16) from the pinion-end cover.

Unscrew and remove protective case 8. Recover lock ring 9, undo clamp bolts 12 and separate yoke 11 with housing 5 from housing 1 with armature 13.

Unscrew the brush holders from the stator winding leads, then separate the yoke from the commutator end housing. Extract springs 7 and brushes 6.

Undo the cotter pin and withdraw the lever and armature / actuator assembly, next disconnect the operating lever.

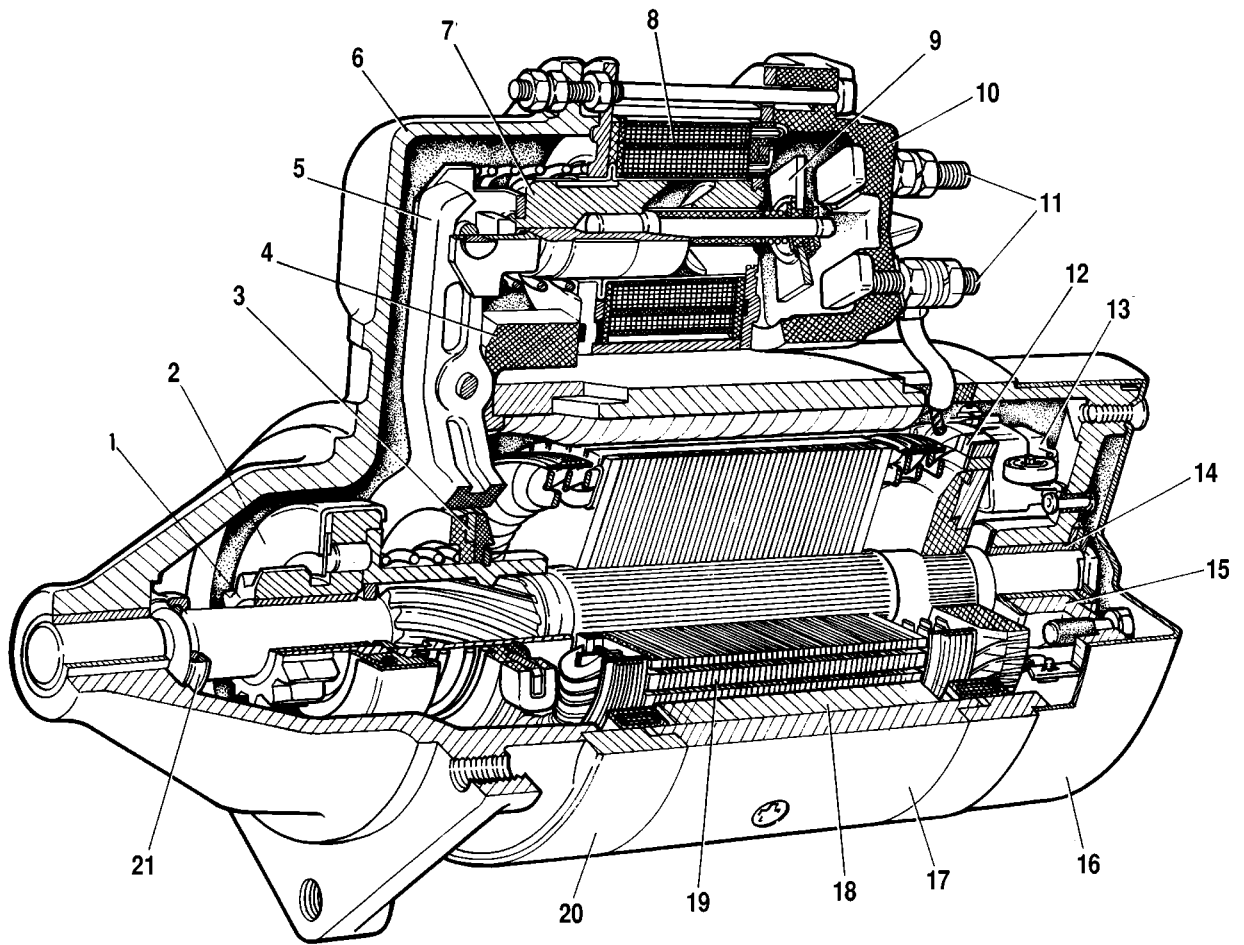


Fig.7-13. Starter motor (35.3708 model):

1 - pinion; 2 - overrun clutch; 3 - guide ring; 4 - rubber plug; 5 - operating lever; 6 - drive-end housing; 7 - relay armature; 8 - relay winding; 9 - contact plate; 10 - relay cover; 11 - terminal bolts; 12 - commutator; 13 - brush; 14 - armature shaft bush; 15 - commutator-end housing; 16 - end cover; 17 - housing; 18 - stator pole; 19 - armature; 20 - intermediate ring; 21 - stop collar

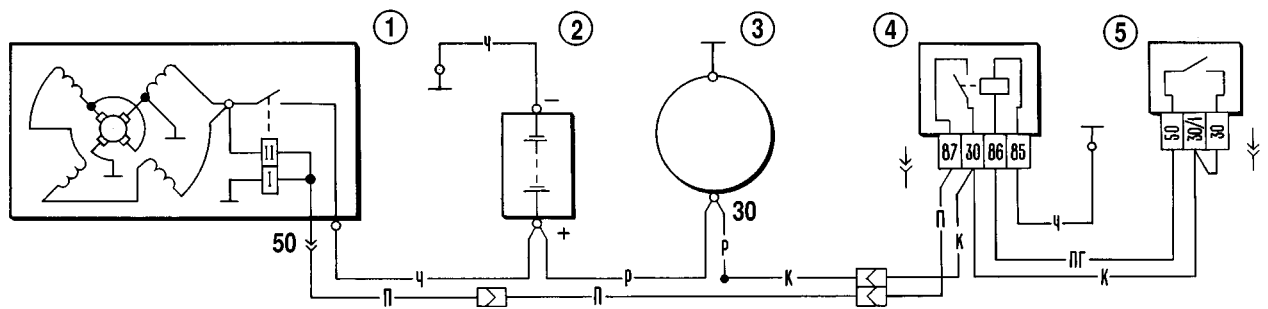
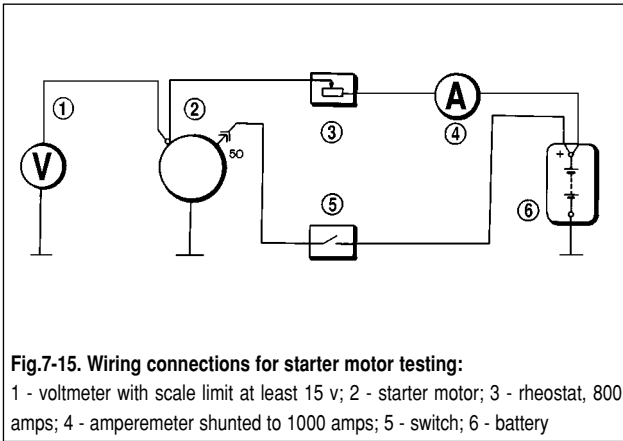


Fig.7-14. Starter wiring connections:

1 - starter motor; 2 - battery; 3 - alternator; 4 - starter cut-in relay; 5 - ignition switch



To withdraw the actuator unit from the armature, retrieve the circlip from under stop collar 16. Dismantle the actuator unit after removing the lockwasher from the clutch hub.

To dismantle the solenoid, undo the clamp bolt nuts and unsolder the winding leads from terminal 50 and from the end which is secured at the bottom solenoid terminal bolt.

Once the starter motor has been dismantled, blow its parts with compressed air and wipe clean.

Components - inspection

Armature. Using a megohmmeter or a 220 v test lamp, check the armature for the earthed winding. The voltage through the test lamp is supplied to the commutator segments and armature core. An illuminated lamp is an indication of a commutator being shorted to earth. When using the megohmmeter, the reading should be at least 10 kOhms. Renew the earthed armature.

Using a specialized device, check for internal faults in the armature winding and commutator segments, check for loose connections where the winding wires are soldered to the commutator.

Inspect the commutator. When dirty or burnt, sand it with fine emery paper. Check the runout between the core and shaft journal. Renew the armature when the runout is over 0.08 mm.

Check the surfaces of splines and armature shaft journals. There should be no scuffs, scores or wear. In the event the shaft surface has yellow marks because of the pinion bush, remove the marks with the help of fine emery paper, since this can possibly cause a pinion jam in the shaft.

Actuator unit. The starter motor actuator unit should operate over the armature shaft smoothly, without jams. The pinion should turn on the armature shaft in the direction of the armature rotation at a maximum torque of 0.27 H•M (2.8 kgf•cm).

The pinion is not supposed to turn in the reverse direction. If the teeth are scored, regrind them with a small-diameter fine abrasive disc.

When the drive-associated components are damaged or badly worn, renew the actuator assembly.

Stator. Using megohmmeter or a 220 v test lamp, check the stator winding is not earthed.

The test lamp voltage is supplied to the common winding terminal and starter housing. When the bulb is lit up or megohmmeter resistance reading is below 10 kOhm, or if the windings have evidence of overheating (blackened insulation), renew the housing complete with the windings.

Housings. Inspect the housings for cracks. If this is the case, replace the housings with new ones.

Examine the bushes. When they are worn, renew the complete housings or only the bushes. When the new bushes are pressed-in, ream them to 12.015+0.03 mm.

Make sure the brush holders are properly secured on the commutator end housing. The «positive» brush holders must not be earthed. The brushes should slide smoothly in the holder slots. Renew the brushes worn to 12 mm in height, but first run them in to the commutator.

Using the dynamometer, check the spring load at the brushes to be 9.8±0.98 N (1±0.1 kgf) for new brushes, renew the spring, when applicable.

Solenoid. Check the solenoid armature for smooth operation. Using ohmmeter, check the closing of the solenoid terminal bolts via a contact plate. When there is no contact, the solenoid should be dismantled and the terminal bolts to be sanded with fine emery paper or a superfine flat file.

You may turn the terminal bolts 180°C in case they are badly damaged at the contact point with the contact plate.

Reassembly

Assemble the starter motor in reversal of the dismantling procedure. Before reassembly lubricate the armature shaft splines and freewheel hub, pinion and housing bushes with motor oil. Lubricate drive guide ring with Litol-24 grease.

Protect the clamp bolt passing under the stator coils with an insulating plastic tube.

Select shim 10 thickness (Fig.7-16) to ensure maximum armature axial play of 0.5 mm. On reassembly, bench test the starter motor.

Ignition system

General description

The ignition system is breakerless. It comprises ignition distributor 5 (Fig.7-17), spark control module 3, ignition coils 4, spark plugs 6, ignition switch 1 with relay 2 (113.3747-10 model) and high-tension (HT) leads. The spark control module monitors the supply circuit of the ignition coil primary winding. Control pulses to the control module are generated by the Hall sensor housed in ignition distributor 6.

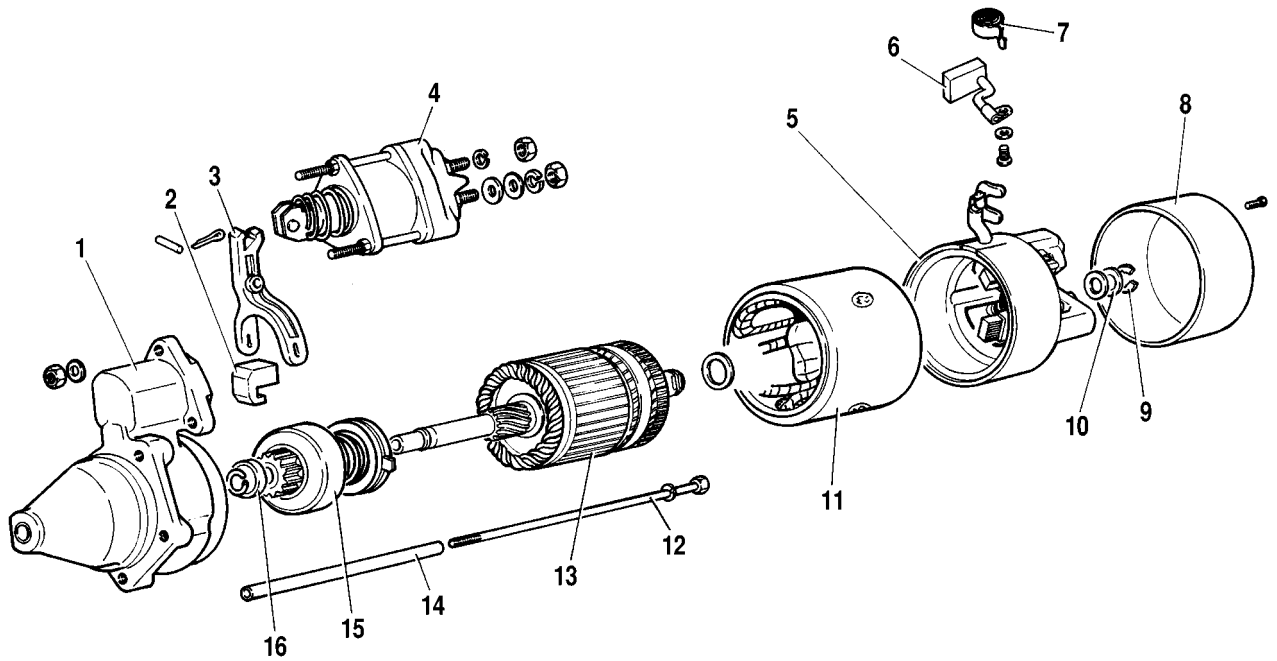


Fig.7-16. Exploded view of starter motor:

1 - drive end housing with intermediate ring; 2 - rubber plug; 3 - operating lever; 4 - solenoid; 5 - commutator end housing; 6 - brush; 7 - brush spring; 8 - protective case; 9 - stop ring; 10 - adjusting shim; 11 - yoke; 12 - clamp bolt; 13 - armature; 14 - insulating pipe; 15 - overrun clutch with pinion; 16 - stop collar

Ignition distributor is of 3810.3706 model, four-event sparking rate, non-shielded, with vacuum and centrifugal advance units, with built-in Hall sender.

Spark control module is of 3620.373 model, or 76.3734, or RT1903, or PZE4022, or K563.3747 model. The module processes the control output pulses from the Hall sender into current pulses for the ignition coil primary winding.

Ignition coil is of 8352.12, or 27.3705, or 027.3705, or 27.3705-01 model, oil-filled, sealed, open-loop magnetic circuit.

Spark plugs are of A17ДВРМ model, or A17ДВРМ1 model with suppressant chokes.

Ignition switch is of 2101-3704000-11 model, theft-deterrent.

Fault diagnosis

Cause	Remedy
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Engine will not start

1. Hall sender pulses fail to reach control module: - broken circuit between sender and control module; - Hall sensor faulty	1. Carry out the following: - check wiring and connections, renew damaged wires; - check Hall sensor using adapter and voltmeter; renew failed sensor
2. No pulses to primary winding: - broken circuit between control module and solenoid or control module and ignition coil;	2. Carry out the following: - check wires and connections; renew damaged wires;

- control module faulty;
- ignition switch or ignition relay failed

3. No HT to spark plugs:

- HT lead ends loose, broken off or oxidized; leads dirty or insulation damaged;
- carbon brush worn or damaged, or has no contact with rotor arm;
- tracking through cracks or burns in distributor cap or rotor, through damp or foul distributor cap inside;
- distributor rotor resistor blown;
- ignition coil damaged

4. Oily spark plugs or wrong electrode gap

5. Spark plug damaged (perished insulation)

6. Wrong HT leads connection to distributor cap terminals

7. Wrong ignition timing

- check control module with oscilloscope; renew faulty control module
- check, renew faulty contact unit of ignition switch or ignition relay

3. Carry out the following:

- check and restore connections, clean or renew leads;

- check and when necessary renew carbon brush;

- check, clean cap from moisture and carbon deposits, renew cap and rotor in case of cracks;

- renew resistor;
- renew ignition coil

4. Clean and regap spark plugs

5. Renew spark plugs

6. Reconnect leads as per firing order 1-3-4-2

7. Check and adjust ignition timing

Engine operates erratically or stalls at idle

1. Ignition timing too advanced	1. Check, adjust ignition timing
2. Electrode gap excessive	2. Check, adjust electrode gap

Engine running unstable or irregular at high crankshaft speeds

Weak weight springs in ignition distributor	Renew springs, run functional bench test of centrifugal unit
---------------------------------------------	--------------------------------------------------------------

Engine gasps at all speeds

- | | |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ol style="list-style-type: none"> 1. Ignition wires damaged, connections loose or lead ends oxidized 2. Electrodes worn or oily spark plugs, strong fouling; cracks in plug insulation 3. Carbon brush in ignition distributor worn or damaged 4. Strong burning of central contact point on distributor rotor arm 5. Cracks, fouling or burnings of rotor arm or distributor cap 6. Control module faulty - wrong waveform of ignition coil primary winding impulses | <ol style="list-style-type: none"> 1. Examine leads and connections. Renew damaged leads 2. Examine plugs, regap spark plugs, renew damaged spark plugs 3. Renew carbon brush 4. Clean central contact 5. Inspect, renew rotor or cap 6. Check spark control module with oscilloscope, renew faulty control module |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

Engine lacking power or sluggish

- | | |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ol style="list-style-type: none"> 1. Incorrect ignition timing 2. Jammed distributor weights, weak weight springs in ignition distributor 3. Spark control module faulty - wrong waveform of ignition coil primary winding pulses | <ol style="list-style-type: none"> 1. Check and adjust ignition timing 2. Examine and renew damaged parts 3. Check spark control module with oscilloscope, renew faulty control module |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

WARNING. The vehicle is fitted with high energy transistorized ignition system with extended application of electronic components. Caution should be exercised to avoid personal injury or damage to electronics. Always observe the following rules.

Do not touch any ignition system parts (spark control module, coil or HT leads) when the engine is running.

Do not start the engine through a spark plug gap and do not check the ignition system through sparking between the ends of the spark plug leads and earth lead.

Do not route LT and HT ignition leads together within one wiring harness.

Always ensure the spark control unit is reliably earthed through the retaining dowels, or its trouble-free operation will be affected.

With ignition switched on, never disconnect the leads from the battery posts and never remove the connector from the spark control unit, since it may result in higher voltage to some components and damaged control module.

Ignition timing - adjustment

Refer to Attachment 3 for the advance angle BTDC at crankshaft speeds of 750-800 rpm.

To check the ignition timing there provided three marks - 1, 2 and 3 (Fig.7-18) on the timing cover and mark 4 in the crankshaft pulley, which corresponds to TDC of pistons No1 and No4 when aligned with mark 1 on the timing cover.

The ignition timing is best checked and adjusted by means of a stroboscopic timing light. Follow the procedure below:

- connect the timing light positive clamp to the battery positive post, earth terminal clamp to the battery negative post, connect the timing light terminal to No1 cylinder HT lead. Highlight in chalk timing mark 4 on the crankshaft pulley;

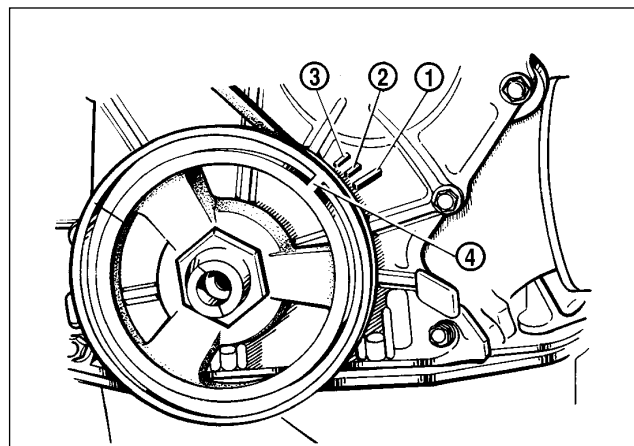


Fig.7-18. Ignition timing marks:
1 - TDC mark; 2 - 5° advance timing mark; 3 - 10° advance timing mark; 4 - TDC mark on crankshaft pulley

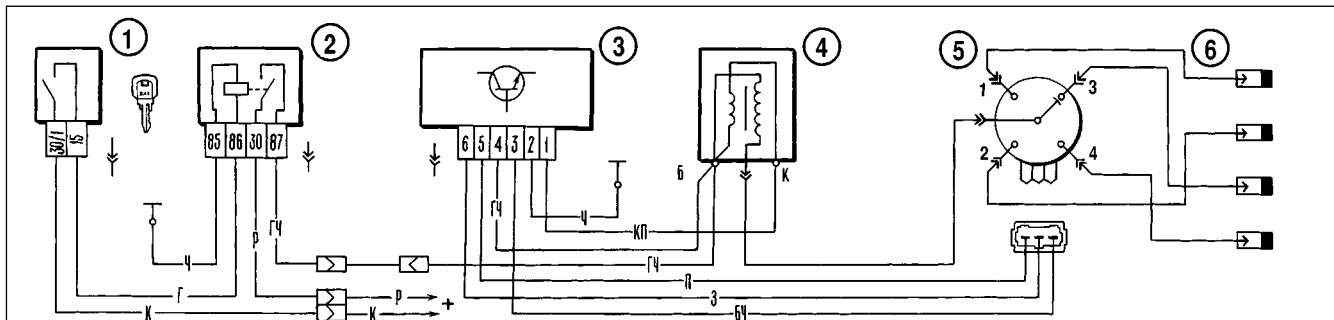


Fig.7 -17. Wiring diagram of ignition system:
1 - ignition switch; 2 - ignition solenoid; 3 - spark control unit; 4 - ignition coil; 5 - ignition distributor; 6 - spark plugs

- start the engine and point the flashing timing light at the timing mark on the pulley; when the ignition is correct, then at idling speed the TDC mark on the flywheel should be as outlined in Attachment 3.

To adjust the ignition timing, switch off the engine, slacken the nuts securing the ignition distributor and turn the latter to the angle desired (clockwise for advance and anticlockwise for retard when viewed from the distributor cap end). Tighten the nuts and recheck the ignition timing.

For easier ignition timing adjustment there provided the respective graduations and (+)/(-) marks on the distributor flange.

A graduation on the distributor flange corresponds to eight degrees (8°) of the crankshaft turn.

Another effective way for checking the ignition timing is to use an oscilloscope analyzer, when this tool is available.

Refit the distributor as following:

- turn the crankshaft to the position of compression beginning at No1 piston; then still turning the crankshaft, align mark 4 with mark 1;

- remove the distributor cap, turn the rotor arm so that its exterior contact faces the No1 piston contact on the distributor cap;

- holding the distributor driveshaft stationary, insert it to the cylinder block so that the axial line through the spring clamps is nearly parallel to the engine axial line;

- locate the distributor to the cylinder block, refit the distributor cap, reconnect the wiring, check and adjust timing ignition.

Ignition components - bench testing

Ignition distributor

The distributor of 3810.3706 model is shown in Fig.7-19.

Functional test. Mount the distributor on the tester intended for checking electrical devices. Connect it to a variable speed motor.

Connect the distributor terminals to the ignition coil, spark control module and battery of the tester similar to the wiring in the vehicle. Connect four terminals of the distributor cap to the spark box with adjustable gaps.

Set the spark gap to 5 mm, switch on the tester motor and operate the distributor driveshaft clockwise for some minutes at 2000 rpm. Increase the gap to 10 mm and check for internal discharges in the distributor. These can be recognized by specific sounds or weak or intermittent sparking in the tester spark box.

No noise should be produced by the ignition distributor at any driveshaft speed.

Automatic ignition advance control. Mount the ignition distributor on the tester and connect it to terminals 3, 5 and 6 of tester control module 1 (Fig.7-20). Connect control module ter-

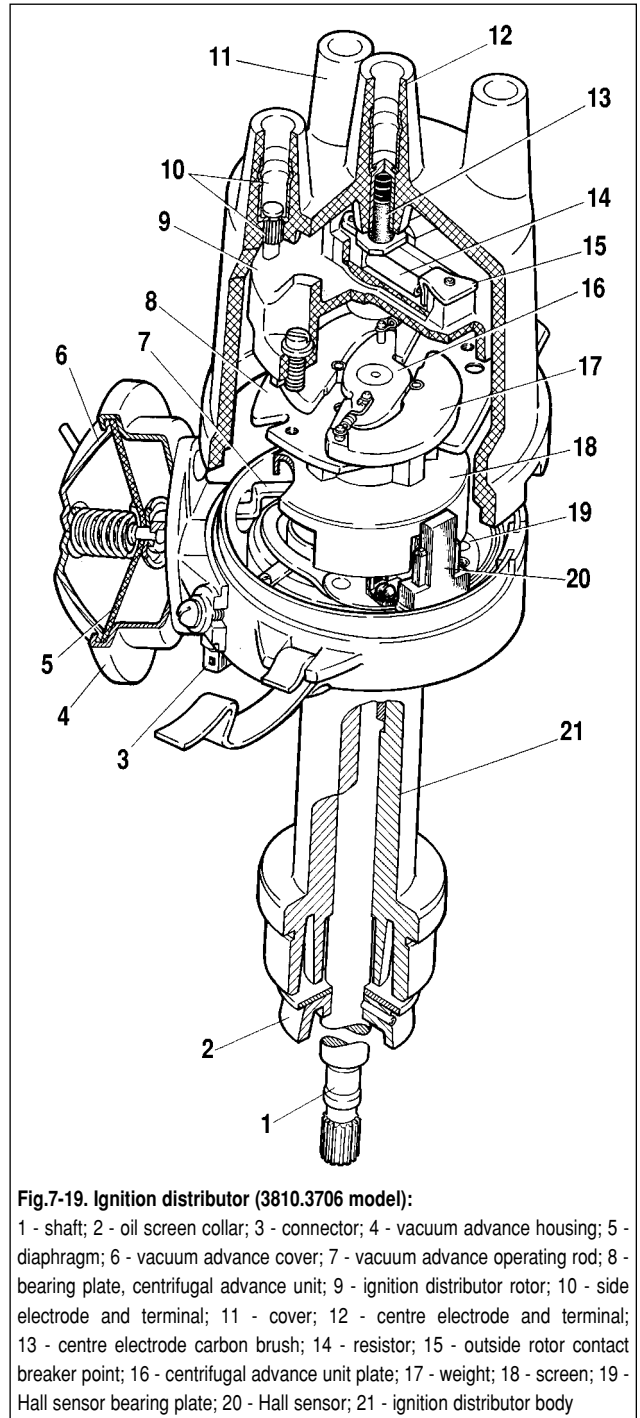


Fig.7-19. Ignition distributor (3810.3706 model):

1 - shaft; 2 - oil screen collar; 3 - connector; 4 - vacuum advance housing; 5 - diaphragm; 6 - vacuum advance cover; 7 - vacuum advance operating rod; 8 - bearing plate, centrifugal advance unit; 9 - ignition distributor rotor; 10 - side electrode and terminal; 11 - cover; 12 - centre electrode and terminal; 13 - centre electrode carbon brush; 14 - resistor; 15 - outside rotor contact breaker point; 16 - centrifugal advance unit plate; 17 - weight; 18 - screen; 19 - Hall sensor bearing plate; 20 - Hall sensor; 21 - ignition distributor body

terminal 4 to the tester «plus», while terminal 1 - to the tester «breaker» terminal. Set the spark gap to 7 mm.

Switch on the tester motor and operate the distributor shaft at 500-600 rpm. On the tester graduated disc note the angle at which one of the four sparkings occurs.

While increasing the speed in steps of 200-300 rpm and watching the disc, determine the advance angle with respect to the distributor shaft speed. Compare the resulting centrifugal advance pattern to that in Fig. 7-21.

When the pattern differs from that shown in Fig.7-21, it can be adjusted by bending the weight spring brackets of the centrifugal advance unit. Bend the thinner spring bracket for speeds

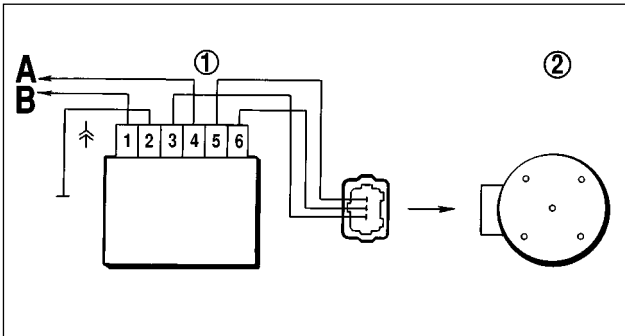


Fig.7-20. Checking the ignition distributor on the test bench:
1 - spark control module; 2 - ignition distributor; A - to test bench «plus» terminal; B - to test bench «breaker» terminal

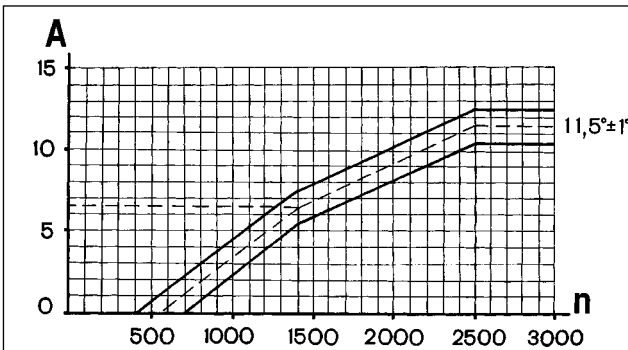


Fig.7-21. Centrifugal advance ignition distributor map:
A - advance timing, degrees; n - ignition distributor shaft speed, rpm

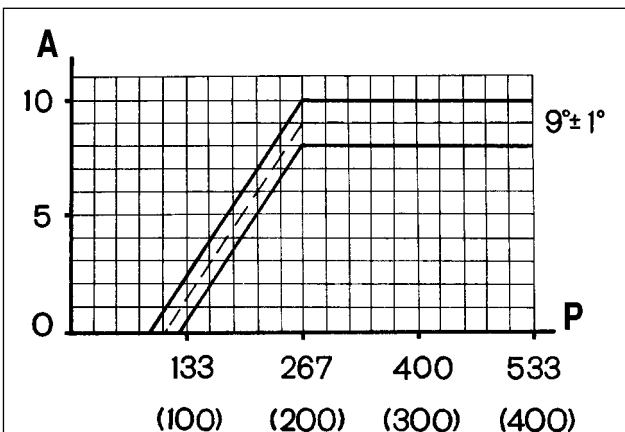


Fig.7-22. Ignition distributor vacuum advance map :
A - advance, degrees; P - vacuum gPa (mm Hg)

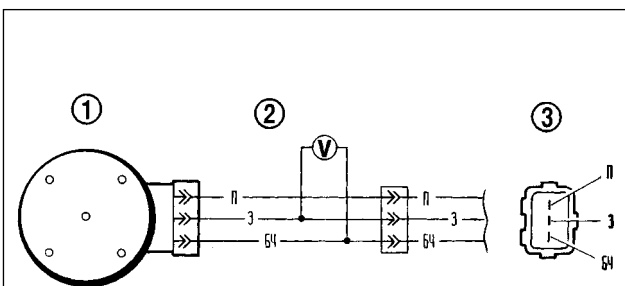


Fig.7-23. Wiring diagram for Hall sensor in-vehicle test:
1 - ignition distributor; 2 - adapter with voltmeter of at least 15 v scale and internal resistance of minimum 100 kOhm; 3 - view on ignition distributor connector

up to 1500 rpm or the thicker spring bracket for speeds over 1500 rpm. Increase the spring tension for a smaller angle (retard) or decrease the spring tension for a bigger angle (advance).

To obtain the vacuum advance pattern, connect the vacuum advance unit to the vacuum pump of the tester.

Operate the tester motor and run the distributor driveshaft at 1000 rpm. Watching the tester graduated disc, note the angle at which one of the four sparking events occurs.

Smoothly increase the vacuum through every 26.7 gPa (20 mm Hg) and make note of the advance angle with respect to the initial value. Compare the resulting advance pattern with that in Fig.7-22.

Note the Hall sensor mounting plate invariably returns to its original position after vacuum has been removed.

Hall sensor. The Hall sensor produces the output voltage if there is a steel vane in the air gap. The output is around zero volts when there is no vane in the gap.

With the distributor removed from the engine, the sensor can be tested as illustrated in Fig.7-24 at supply voltage of 8-14 volts.

While slowly rotating the distributor shaft, measure the output using a voltmeter. The voltage should change sharply between the low level (0.4 volt maximum) and the high level, which must be maximum 3 volts below the supply voltage.

The Hall sensor can be tested in the vehicle as shown in Fig.7-23. Adapter 2 and a voltmeter are connected across the distributor connector and wiring harness connector. Switch on the ignition and measure the sensor output with a voltmeter, while slowly rotating the crankshaft with a special tool. The output voltage readings should meet the specification.

Ignition coil

Check resistance of the winding and insulation.

For the ignition coil of 27.3705 model the resistance at 25°C should be 0.45 ± 0.05 Ohm for the primary winding and 5 ± 0.5 kOhm for the secondary winding. For the ignition coil of 8352.12 model the resistance of the primary winding is 0.42 ± 0.05 Ohm, while that of the secondary winding is 5 ± 1 kOhm.

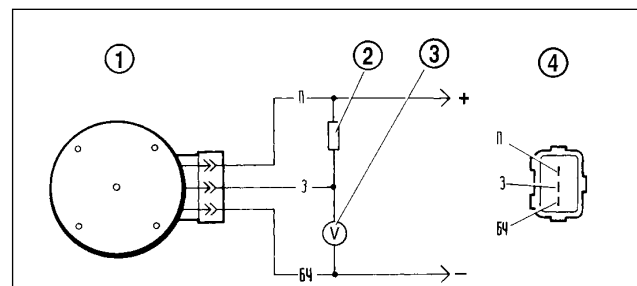


Fig.7-24. Wiring diagram for Hall sensor test on the removed ignition distributor:

1 - ignition distributor; 2 - 2kOhm resistor; 3 - voltmeter of minimum 15 v scale and minimum 100 kOhm internal resistance; 4 - view on the ignition distributor connector

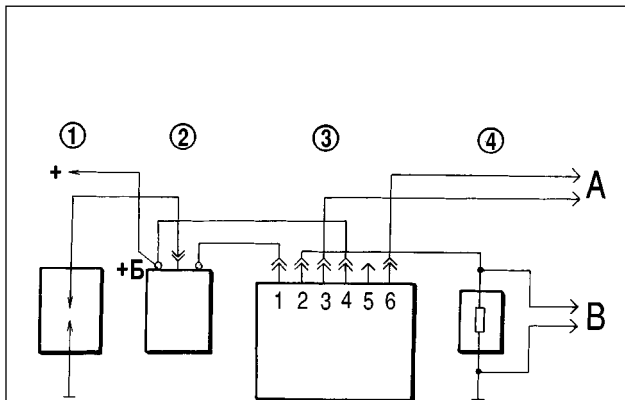


Fig.7-25. Checking the spark control module:

1 - spark gap; 2 - ignition coil; 3 - control module; 4 - 0.01 Ohm resistor (1%, at least 20 W); A - to square wave generator; B - to oscilloscope

Resistance of the insulation to earth should be at least 50 MOhm.

Spark control module

The spark control module can be tested using an oscilloscope and square wave pulse generator connected as shown in Fig.7-25. The pulse generator resistance should be 100-500 Ohm. It is preferable to use a double-channel oscilloscope - the 1st channel is for the generator pulses, while the 2nd channel - for the control module pulses.

Square wave pulses, simulating those of the distributor sensor, are supplied to the module terminals 3 and 6. The pulse frequency should be within 3.33 - 233 Hz, while the duty cycle (period-to-pulse length ratio, $T/T_{и}$) should be set to 3. The maximum voltage (U_{max}) is 10 volts, the minimum voltage (U_{min}) should not exceed 0.4 volts (Fig.7-26, II). A sound control module should generate the pulses as shown in oscillogram I.

For 3620.3734 and 76.3734 modules at the supply voltage 13.5 ± 0.5 volts, the current flow (**B**) should be from 7.5 to 8.5 amps. There is no standard dwell (current saturation) (**A**).

For RT1903 module at the supply voltage of 13.5 ± 0.2 volts and frequency of 25 Hz, the current flow is 7 to 8 amps, while the dwell is 5.5 to 11.5 milliseconds.

For PZE4022 module at the supply voltage of (14 ± 0.3) volts and frequency 25 Hz, the current flow is 7.3-7.7 amps, while the dwell is not specified.

For K563.3747 module at the supply voltage of (13.5 ± 0.5) volts and frequency 33.3 Hz, the current flow is 7.3-7.7 amps, while the dwell is not specified.

Any distortions in the pulse waveform can result in misfires or retarded ignition. The engine will tend to overheating and will not develop maximum power.

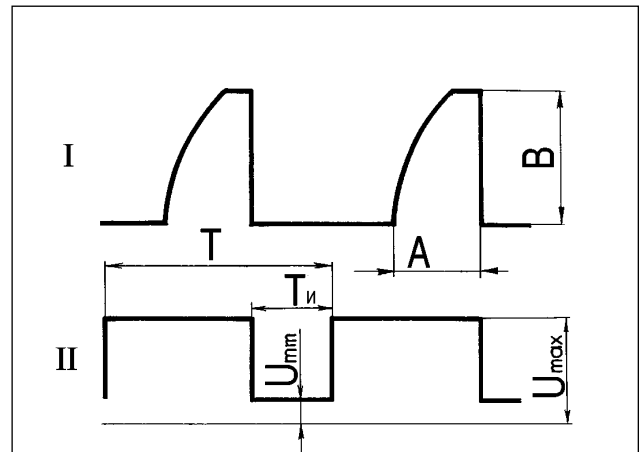


Fig.7-26. Displaying pulse waveform at the oscilloscope:

I - control module pulses; II - alternator pulses; A - dwell (current saturation time); B - maximum current; T - pulse period; $T_{и}$ - pulse width

Spark plugs

If the spark plugs are foul or have deposits, then prior to testing clean them by means of a sand blasting machine and blow with compressed air. When the insulator nose is covered with light tan to greyish brown deposits, there is no need to clean them, as it is indicative that the mixture is correct and the engine is in good condition.

Once the plugs have been cleaned, examine them and set the correct spark gap. If the insulator is chipped, cracked or the side electrode weld is perished, renew the spark plug.

Check the spark plug gap (it is to be 0.7-0.8 mm) with a round wire feeler blade. It is not recommended to use a flat feeler blade since it is cannot account for erosion (cut-out) on the outer electrode which appears in course of operation. Bend, open or close, the outer (side) plug electrode only until the correct gap is achieved.

Leak test. Screw the plug into the seat on the tester and tighten it to a torque of 31.4-39.2 N•m (3.2-4 kgf•m). Build up the pressure of 2 MPa (20 kgf/cm²) in the tester chamber.

Take an oil cup and place a few drops of oil or kerosine on the spark plug; the broken tightness is evident through the air bubbles between the insulator nose and metal plug body.

Electrical test. Insert the spark plug to the seat on the tester and tighten to the torque specified above. Adjust the gap between the spark box electrodes to 12 mm, which corresponds to 18 kvolts; afterwards, using a pump, build the pressure up to 0.6 MPa (6 kgf/cm²).

Fit the end of the HT cable to the plug and apply HT pulses.

The spark plug is sound when a good spark is observed through the tester sight window. When sparking takes place between the spark box electrodes, decrease the pressure in the tester. Next recheck the pressure value when the spark jumps between the spark plug electrodes.

When sparking occurs at the pressure below 0.3 MPa (3 kgf/cm²), the spark plug is defective.

Only a few sparks are allowed in the spark gap; when no sparking is observed either on the spark plug or in the spark gap, it is likely that the insulation is cracked and the central electrode arcs internally to earth. Always discard such spark plugs.

Ignition switch

Check the ignition switch contacts are closing properly at different key positions (Table 7-5) and theft-deterrent device is functional. The battery and alternator voltage is supplied to terminals 30 and 30/1. The vacant terminal «INT» is intended for radio/cassette player connection.

The steering lock pin moves out when the key is turned to position III «parking» and is then removed from the switch. The lock pin moves in after the ignition key is turned from position III «parking» to position 0 «ignition off». The key can only be removed from position III.

When inserting the contact part into the ignition switch housing, locate it so that terminals 15 and 30 are on the lock pin side (Fig.7-27), ensure the wider end of the contact part is well within the wider slot of the ignition switch housing.

Suppression components - testing

The following is used for interference suppression:

- 1 kOhm resistor in the distributor rotor arm;
- resistive HT cables of (2000±200) Ohm/m for red leads (ПВВП-8) or (2550±270) Ohm/m for blue leads (ПВППВ-40);
- 4-10 kOhm resistors in the spark plugs;
- 2.2 microfarad capacitor in the alternator.

The leads and resistors are checked with an ohmmeter. Refer to subsection «Alternator» for the capacitor checking procedure.

Lighting and signalling

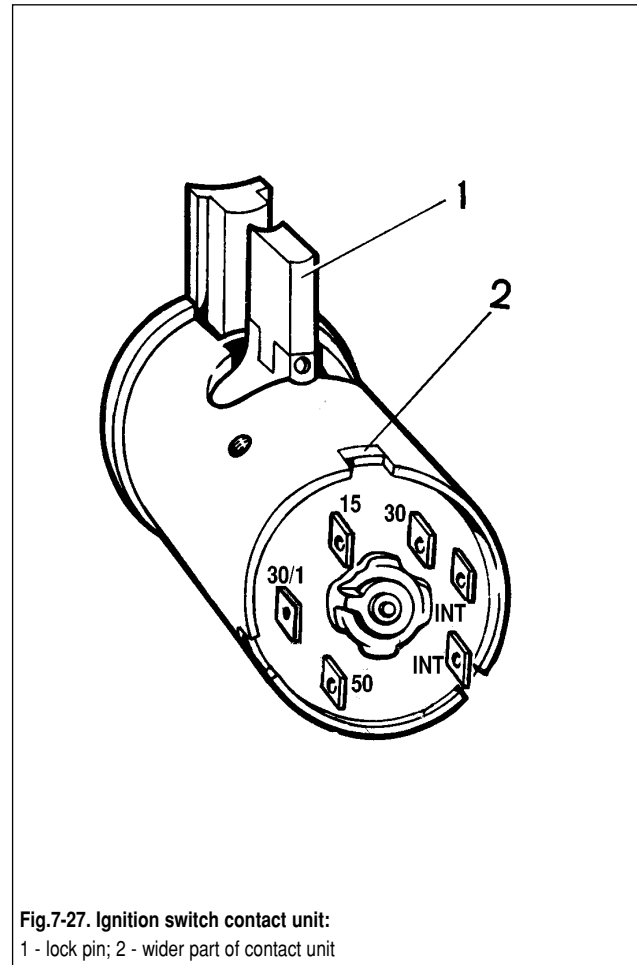


Fig.7-27. Ignition switch contact unit:
1 - lock pin; 2 - wider part of contact unit

Table 7-5

Circuits activated at different ignition switch positions

Position	Live contacts	Circuits activated
0 (Off)	30 and 30/1	—
I (Ignition)	30-INT 30/1-15	— Alternator field winding. Ignition system. Direction indicators. Instruments. Heater unit. Heated rear window. Wipers: windscreen, rear window, headlight .
II (Starter motor)	30-INT 30/1-15	— Refer to position I
III (Parking)	30-50 30-INT	Starter motor

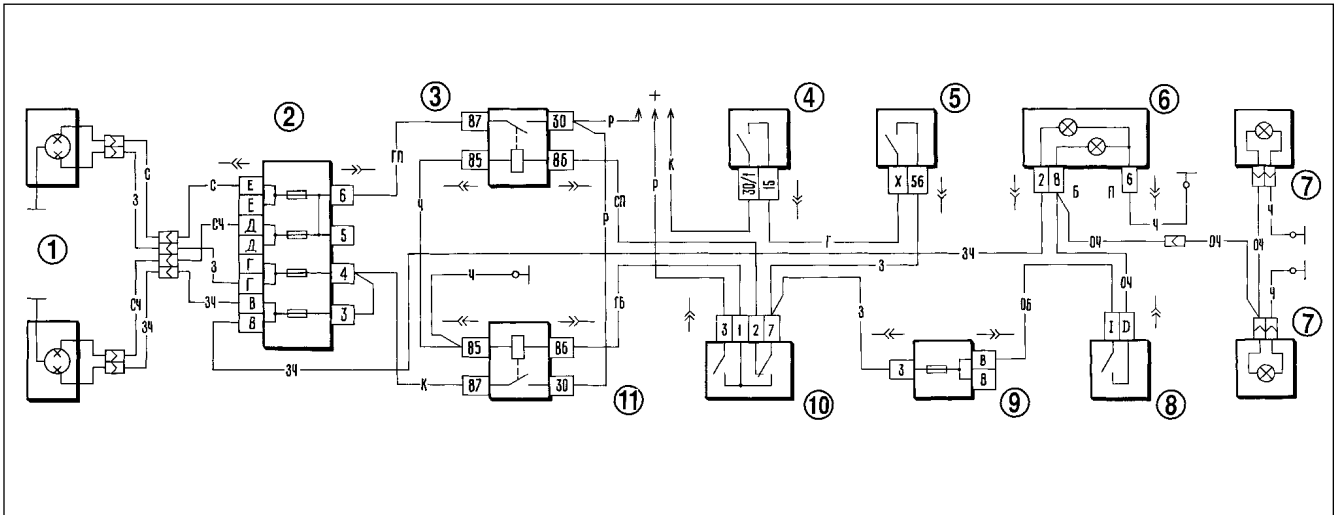


Fig.7-28. Wiring diagram for headlight and foglight:

1 - headlights; 2 - main fusebox; 3 - low beam relay; 4 - ignition switch; 5 - exterior light switch; 6 - warning lights: high beam (left) and fog lamp (right); 7 - rear fog light; 8 - fog light switch; 9 - complementary fusebox; 10 - headlight switch; 11 - high beam relay

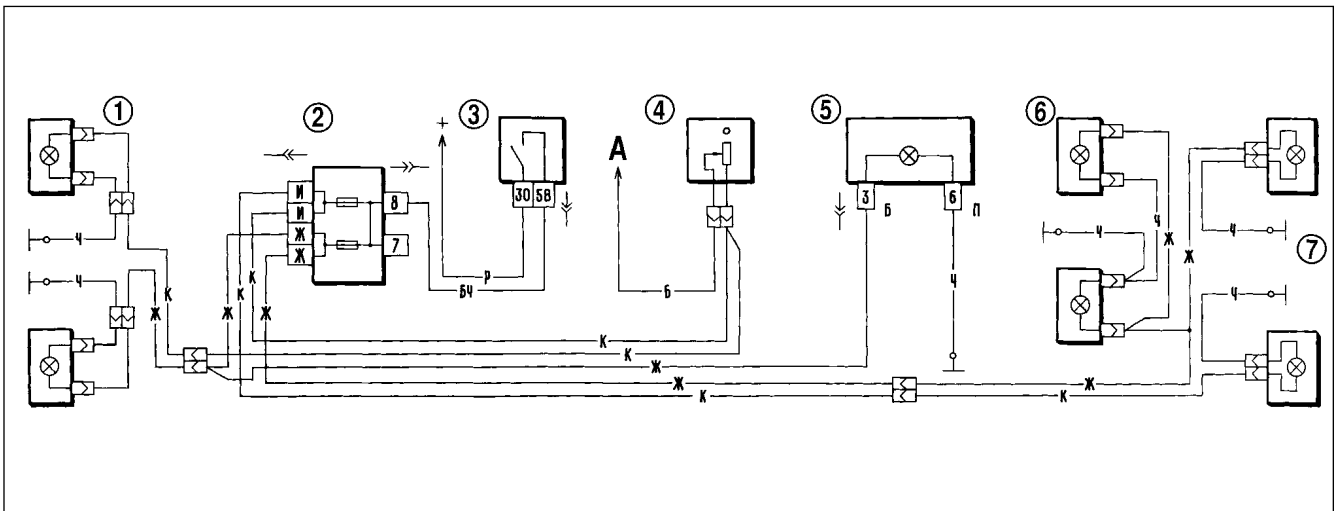


Fig.7-29. Wiring diagram for exterior lighting:

1 - sidelights in headlights; 2 - fusebox; 3 - exterior light switch; 4 - instrument illumination switch; 5 - exterior light warning lamp in instrument cluster; 6 - number plate lamp; 7 - sidelights in rear light units; A - to illumination lamps for instruments, switches and heater controls

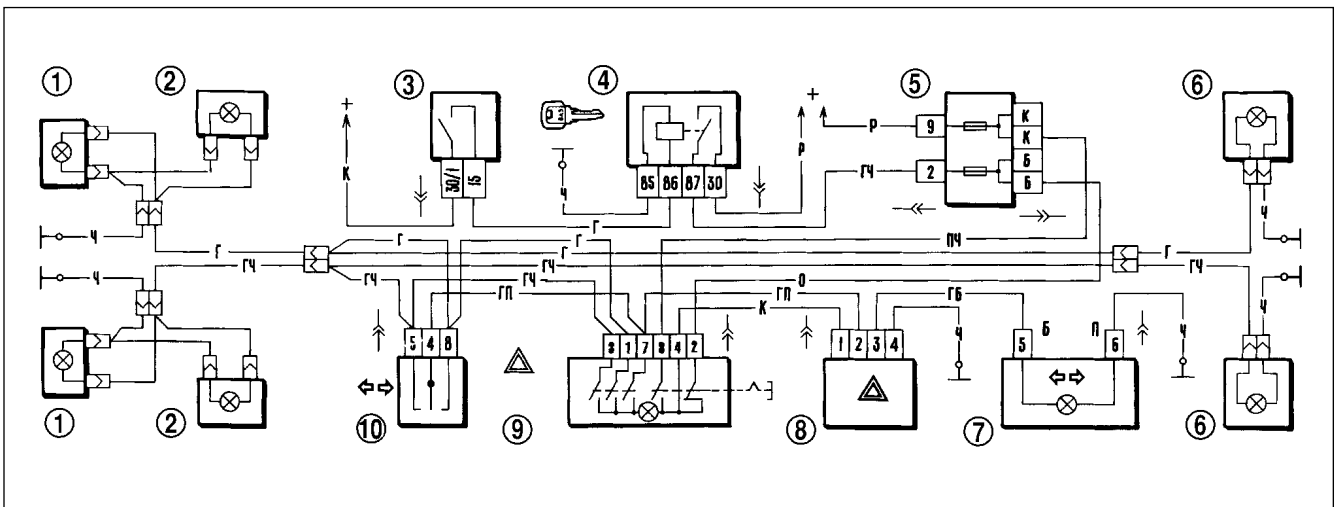


Fig.7-30. Wiring diagram for direction indicators and hazard flashers :

1 - direction indicators in headlights; 2 - side repeat indicators; 3 - ignition switch; 4 - ignition relay; 5 - fusebox; 6 - direction indicators in rear light cluster; 7 - direction indicators warning light in instrument cluster; 8 - indicators flasher relay; 9 - hazard warning flasher switch; 10 - direction indicators switch

General description

The headlight wiring diagram is shown in Fig.7-28.

High and low beam is operated through supplementary relays 3 and 11.

The control voltage to the relay winding is supplied from headlight combination switch 10 when external light push switch 5 is fully depressed.

Regardless the position of push switch 5, the high beam can be briefly switched on by pulling combination switch 10 for light signalling. By doing this, stalk switch 10 terminal is energized directly from the power source bypassing the ignition switch.

Some vehicles are fitted with the hydraulic headlight adjuster to align the headlight beam depending on the vehicle load.

The external light wiring diagram is shown in Fig.7-29.

The sidelights in the front and rear lights are operated by means of exterior light switch 3.

Number plate lamp 6, instruments and switch illumination lamps, sidelight warning lamp 5 are powered at the same time.

The wiring diagram for direction indicators/hazard warning flashers is shown in Fig.7-30.

The left-hand and right-hand direction indicators are operated with the help of steering column combination switch 10.

When operated, hazard flashing switch 9 activates all direction indicators.

Flashing is enabled by relay 8. Fault diagnosis

Cause	Remedy
Lights do not come on	
1. Fuses blown	
2. Bulb filament blown	
3. Switch or relay pins corroded	
4. Damaged leads, corroded ends of leads, loose lead connections	1. Renew fuses 2. Renew bulbs 3. Clean contacts 4. Check, renew damaged leads, clean wire ends
Brake light inoperative	
Brake light switch inoperative	
Failure to switch between low and high beam	
1. Corroded pins of combination switch	Check with a test lamp, renew faulty switch
2. High beam or low beam relay faulty	1. Renew 3- stalk switch 2. Check and renew relay
Steering column levers are inoperative	
1. Lever catch ball dropped	
2. Lever catch recesses damaged	1. Renew 3-stalk switch 2. Detto

Turn signal self-cancelling device inoperative

- | | |
|-----------------------------------------------------------|-------------------------|
| 1. Cancelling mechanism seized | 1. Renew 3-stalk switch |
| 2. Combination switch guide ring shoulders worn or broken | 2. Detto |

Steering column levers fail to switch between the positions

- | | |
|----------------------------------|-------------------------|
| 1. Lever catch balls jammed | 1. Renew 3-stalk switch |
| 2. Self-cancelling device seized | 2. Detto |

Turn signal warning light inoperative

- | | |
|------------------------------------|----------------|
| 1. Bulb filament blown | 1. Renew bulb |
| 2. Indicators flasher relay faulty | 2. Renew relay |

Direction indicator warning light flashes at higher rate

- | | |
|--------------------------------------------------|-----------------------------------|
| 1. Direction indicator bulb blown, front or rear | 1. Renew bulb |
| 2. Indicators flasher relay faulty | 2. Renew indicators flasher relay |

Headlight - adjustment

The headlight beams should be adjusted so that the area in front of the vehicle is properly illuminated and the drivers of the oncoming traffic are not dazzled with the dipped beam.

The headlights are adjusted by means of screws 1 and 7 (Fig.7-31) which allow to alter vertical and horizontal settings of the reflector unit.

Headlight beam alignment is best carried out using optical beam setting equipment. If it is not available, the adjustment can be done using a screen.

A fully laden and equipped vehicle with a load of 735 N (75 kgf) to represent a driver should be positioned on level ground facing a flat wall or screen (plywood board of approx. 2x1 m or similar) at a distance of 5 meters with the vehicle centre line being normal to the screen. Before marking-off the screen, make sure that the tyre pressures are correct; next swing the vehicle to settle the springs and shock absorbers.

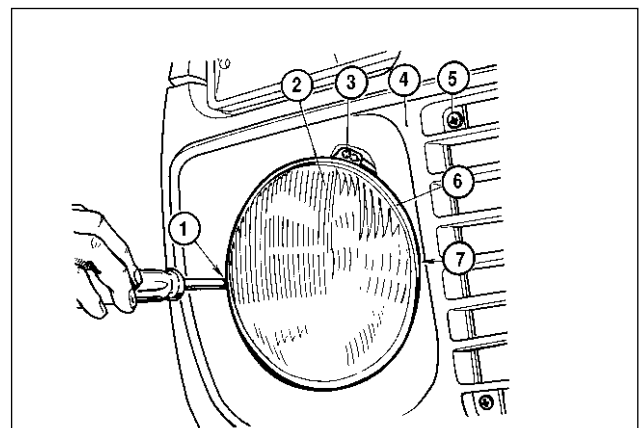


Fig.7-31. Headlight alignment:

1,7 - headlight beam adjustment screws; 2 - optical unit; 3 - retaining screw, optical unit rim; 4 - body front trim; 5 - trim retaining screw; 6 - optical unit rim

Three vertical lines should be drawn on the screen (Fig.7-32): centre line O and lines A and B through the reference points E corresponding to each headlamp center. These lines should run symmetrical to the centre line of the car. Draw line 1 at the height of 600 mm which is the distance to the centres from the ground and 75 mm below draw line 2 passing through the centres of the headlight beam patterns.

Make sure the facia-mounted switch of the headlamp aim adjustment system is in the position corresponding to the load of the driver only.

Switch on the lower beam. Using adjustment screws 1 and 7 (Fig.7-31), align the beams, first on the right-hand headlamp (while the other is covered with a piece of cardboard or dark cloth) and then on the left-hand headlamp (with the right-hand one screened).

To adjust the headlight beam in the vertical plane, turn screws 1 and 7 simultaneously in the same direction and to the same number of turns. The difference in turns between the screws (with the other screw intact) should not exceed 3 turns.

Horizontally the headlights are adjusted by means of screws 1 and 7, turned in opposite directions. If one screw is turned one turn clockwise, the other should be turned one turn anticlockwise.

Some vehicles can be fitted with the headlights without the hydraulic beam adjuster and have an alternatively mounted adjuster screws, when the horizontal adjuster screw is on the left, while that for vertical adjustment is fitted at the top.

If the headlights are correctly aligned, a cut-off at the top of the beam patterns must be at line 2 (Fig.7-32), while the intersection points of horizontal and angled lines should coincide with reference points E.

Bulb replacement

Headlight units. To replace a bulb:

- undo securing screws 5 and remove trim 4 (Fig.7-31);
- slacken screws 3 securing the headlight optical unit rim, turn the rim anti-clockwise to remove it;
- withdraw the headlight optical unit and renew a failed bulb;
- refit the optical unit so that the retaining lugs enter the recesses of the headlight inner rim.

Front lights. Undo two screws and remove the lens, then slightly depress the bulb and turn it anticlockwise to remove.

Direction indicator side repeater. To renew a failed bulb, first remove the holder complete with the bulb, working from the engine bay.

Interior lamp. To renew a blown bulb, gently pull the lens up. The lamp is held in the recess in the door centre pillar by two spring clips.

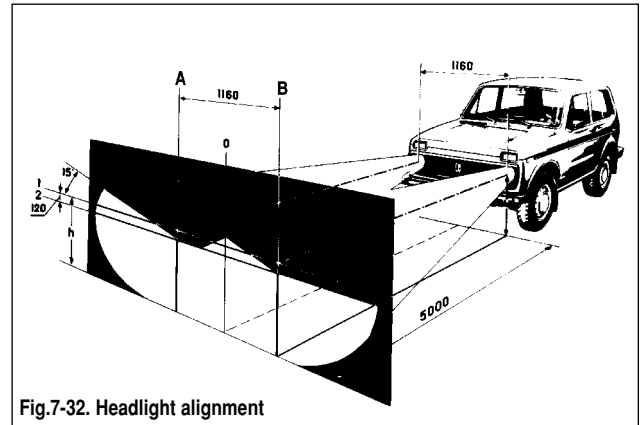


Fig.7-32. Headlight alignment

Rear light unit. To replace a failed bulb in the rear light unit, remove a plastic cap from the inside of the luggage compartment, disconnect the terminal connector, squeeze the retaining lugs and withdraw the base complete with the bulbs. Next depress the bulb, turn it anticlockwise and withdraw.

Number plate light. Undo the retaining screws, remove the light unit, detach the reflector lens and renew a blown bulb.

Hydraulic headlight adjuster

The hydraulic headlight adjuster system consists of the master cylinder, fitted to the instrument panel, working cylinders on the headlamps and connecting pipes. The cylinders and pipes are filled with non-freezing hydraulic fluid. The hydraulic adjuster is not serviceable and has to be renewed as a complete unit, together with the cylinders and pipes, in the event of a failure.

When the beam setting is disturbed and alignment by means of the adjustment screws on the headlight has failed, check the cylinders and pipes for leaks. Remove the working cylinders and check the rod travel to be (7 ± 0.5) mm.

To replace a faulty headlamp adjuster, detach the pipe clips from the wiring clamps, remove the control knob from the master cylinder and undo the mounting nut. Detach the working cylinders from the headlight units and push them together with seals into the passenger compartment. Refit a new headlamp adjuster using the reversal of the removal procedure.

Steering column combination switch

The steering column switch is secured to the steering column support bracket with the help of the retaining strap.

Observe the following procedure when removing the steering column combination switch:

- remove the steering wheel;
- remove both steering column shrouds;
- remove the instrument cluster and disconnect the steering column switch wiring;
- release the retaining strap and withdraw the steering column switch.

Indicators flasher relay

Relay 8 (Fig.7-30) (231.3747 model) is intended for intermittent light signals both for direction indication and hazard flashing. It also allows to identify a failed bulb in the direction indicator. With good bulbs in the direction indication mode, the relay ensures flashing warning light 7. With a failed bulb in the direction indicators (blown bulb or broken bulb circuit), the direction indicator and relevant facia warning light start flashing faster.

The relay is secured under the facia by the bolt welded to the air intake wall. A faulty relay is not repairable and must be always replaced with a new relay.

The relay should ensure the direction indicators flashing at a rate of 90 ± 30 cycles per minutes at 92 watt, ambient temperature of -20 to $+50^\circ\text{C}$ and supply voltage between 10.8 and 15 volts.

Headlamp-on relay

The headlights are switched by means of relay 3 and 11 (Fig.7-28), model 113.3747-10, fitted below the instrument panel on the left. Similar relays are used to switch the rear window heating, headlight wipe/wash.

The relay cut-in voltage at $(23 \pm 5)^\circ\text{C}$ must not exceed 8 volts, the winding resistance should be (85 ± 8.5) Ohms.

Horn

The vehicle is fitted with a horn of model 20.3721. The horn is located in the engine compartment behind the radiator grill.

The horn wiring diagram is shown in Fig.7-33.

When the volume is low or the horn emits harsh sound, adjust it using the adjustment screw on the horn body unit until a satisfactory sound is achieved.

In the event of the horn failure, inspect all connections and condition of the switch contacts.

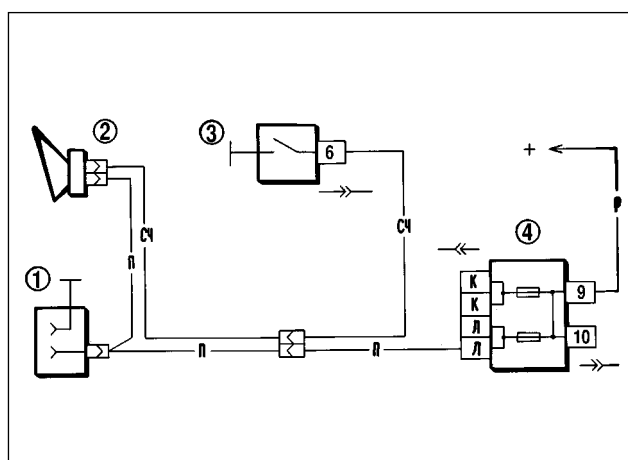


Fig.7-33. Horn wiring diagram:

1 - inspection lamp socket; 2 - horn; 3 - horn switch; 4 - fusebox

Windscreen wiper/washer

General description

The windscreen wipe/wash comprises motor, linkage and blades. The windscreen wipe/wash wiring diagram is shown in Fig.7-34.

There are two operating modes of the windscreen wiper: continuous operation and intermittent operation, ensured by a relay of PC-514 model.

A thermal bimetal fuse is provided to protect against the motor overheating in the event of the blades binding to the glass or resistance to sweep.

The washer pump is combined with the motor and is fitted to the washer fluid container in the engine compartment. The pump motor is operated by pulling up the right-hand lever of the steering column combination switch.

Fault diagnosis

Cause	Remedy
-------	--------

Inoperative wiper motor and bimetal fuse, non-blown fuse 2 in fuse and relay box

1. Motor supply wires damaged, ends of wires in connectors corroded	1. Inspect and renew leads when found damaged. Clean wire ends
2. Wiper switch faulty	2. Renew 3-stalk switch
3. Motor brushes sticking, foul or burnt commutator	3. Inspect, eliminate wiper blades sticking or renew damaged components, clean commutator
4. Broken wires between motor brushes and connector	4. Check and when necessary solder wires
5. Bimetal thermal fuse damaged	5. Clean thermo-bimetal fuse contacts or renew it.
6. Motor armature winding lead broken	6. Renew armature or motor

Wiper motor inoperative, bimetal thermal fuse operative or fuse 2 in fuse box blown

1. Wiper arms bent or conflict with bodywork	1. Examine, straighten wiper arms or renew windscreen wiper
2. Wiper blades stuck because of ice or snow	2. Detach blades from glass, taking care not to damage rubber
3. Foreign object in wiper mechanism	3. Check and remove foreign object if any
4. Short-circuit in motor armature winding	4. Renew motor or motor armature winding

Wiper motor fails to operate intermittently

1. Wiper switch faulty	1. Renew 3-stalk switch
2. Wiper relay damaged:	2. Carry out the following:
- break in relay winding;	- renew relay;
- shorted wires in contact part;	- remedy short-circuit;
- clearance between relay breaker contacts	- eliminate clearance, renew relay when applicable

Continuous operation of wiper blades in intermittent mode

- | | |
|--------------------------------------------------------------|-----------------------------------------------|
| 1. Wiper relay breaker winding blown | 1. Renew wiper relay |
| 2. Motor gear cam does not operate limit switch spring plate | 2. Bend switch plate so cam can operate plate |
| 3. Foul motor limit switch contacts | 3. Clean limit switch contacts |
| 4. Foul wiper relay breaker contacts | 4. Clean breaker contacts or renew relay |

Wiper stops in intermittent mode. Blades do not stop at park position

- | | |
|------------------------------------------------------------|--------------------------------------------------|
| Motor limit switch contacts corroded or close incompletely | Clean switch contacts or bend limit switch plate |
|------------------------------------------------------------|--------------------------------------------------|

Blades inoperative with motor running

- | | |
|--------------------------------------------|-----------------------------------------------------------|
| 1. Motor gear teeth broken | 1. Renew gear |
| 2. Loose crank fitting to motor gear shaft | 2. Check, tighten crank retaining nut in its end position |

Windscreen wiper - removal and refitting

The repair of the wiper is basically restricted to straightening the deformed arms and rods or their renewal. A failed motor must be renewed. The overhaul of the motor is restricted to replacement of gears, cleaning of commutator and adjustment of limit switch. To remove the windscreen wiper:

- withdraw the blades complete with the arms, open the bonnet and disconnect the leads from the battery and wiper motor;
- undo the connector nuts and remove them together with washers and shims;
- undo the motor bracket retaining nut, withdraw the wiper.

When necessary, take the motor off the bracket and dismantle the linkage on the work bench.

Refitting is a reversal of the removal procedure.

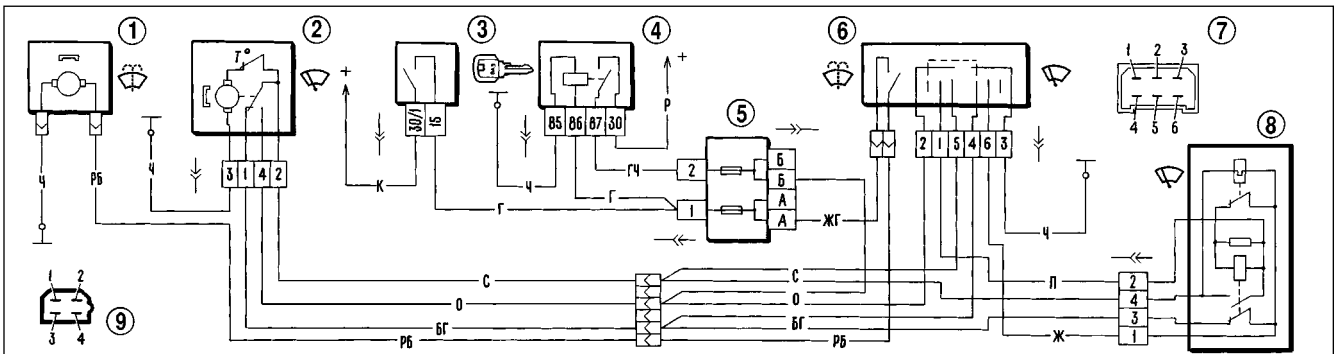


Fig.7-34. Wiring diagram for windscreen wiper/wash :

- 1 - windscreen washer motor; 2 - windscreen wiper motor; 3 - ignition switch; 4 - ignition relay; 5 - fusebox; 6 - windscreen wiper/wash switch; 7 - pin assignment of switch connector; 8 - windscreen wiper relay; 9 - pin assignment of wiper relay and motor connectors

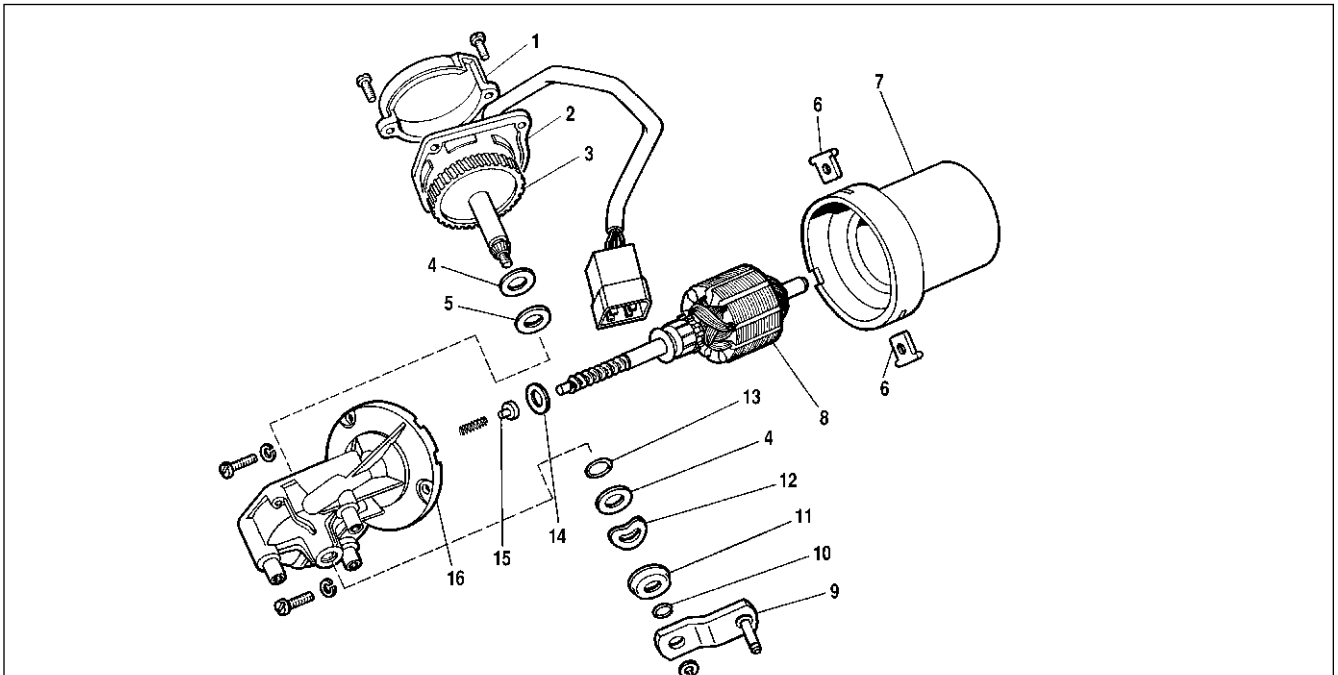


Fig.7-35. Windscreen wiper motor components:

- 1 - cover; 2 - panel; 3 - drive gear; 4 - steel washer; 5 - tekstolite washer; 6 - retainer; 7 - housing; 8 - armature; 9 - crank; 10 - circlip; 11 - protective cap; 12 - spring washer; 13 - sealing ring; 14 - shim; 15 - thrust washer; 16 - motor cover

Wiper motor - dismantling, reassembly and inspection

Commence to dismantle the motor by undoing cover 1 (Fig.7-35) retaining screws.

Remove the cover complete with plate 2. Next unscrew cover 16 from motor housing 7 and separate them. Extract armature 8 from the motor housing.

To remove motor gear 3, undo crank 9 retaining nut, retrieve the circlip from the spindle and withdraw the spindle complete with the gear and washers.

On completion blow the inside of the dismantled motor with compressed air to remove any carbon deposits; always inspect the brushes and commutator.

The brushes should slide freely without sticking in the brush holders, the springs should be good and sufficiently tense.

The commutator should be sanded with fine emery paper, then wiped with a cloth moistened in petroleum jelly.

If the commutator is badly burnt or worn, it is advisable to renew a complete motor.

Inspect the armature shaft ends for any traces of jamming. Sand them with fine emery paper, if applicable.

When reassembling, make sure the brushes are well clear off the commutator to prevent possible edge chipping or damage. Refit the armature into the motor housing with a particular care, avoiding hitting the magnets.

On completion, align the bearings by tapping the motor housing with a wooden mallet, then check the motor on the tester.

Wiper motor specification

Maximum operative drive spindle torque*, N•m (kgf•m) 2 (0.2)

Consumption current*
at 1 N•m (0.1 kgf•m), not greater, amps 2.8

Motor drive spindle speed*
at 1 N•m (0.1 kgf•m), at least, rpm 50

Starting torque of motor drive spindle*,
at least, N•m (kgf•m) 12 (1.2)

* At 14 volts and ambient temperature of (25±10)°C, on a cold engine

Windscreen wiper relay

The relay of PC-514 model is used for intermittent operation of the windscreen wiper. The relay is located beneath the instrument panel on the left-hand side and is attached to the body by means of two screws.

The relay must ensure 9 to 17 wiper cycles per minute at supply voltage of 10 volts and ambient temperatures of -20 to +50°C. The resistance of the electromagnet winding is (66±2) Ohm, while the breaker winding resistance is (23±1) Ohm.

When the wiper is activated for an intermittent operation (while the breaker bimetal plate is not warm enough), the wiper blades can make up to 4 continuous double sweeps.

Headlight wipe/wash

The headlight wipe/wash includes two (right-hand and left-hand) motors, arms and blades. The wiper arms and blades park at the bottom position. The motor unit is fitted with a thermal bimetal fuse for overload protection or 8 amps fuse in the motor yellow-black wire.

The headlight wipe motor unit is built as a complete unit, therefore it is not serviceable and is subject to renewal in case of failure.

The headlight washer pump motor is the same as that for the windscreen washer.

The wiring diagram for wipe/wash operation is shown in Fig.7-36. The headlight wipe/wash system is operated only with the headlights on by steering column lever 7, i.e. simultaneously with activation of the windscreen wipe/wash. Voltage is supplied to supplementary relay 3 winding, activating the relay. When the terminal «30» is powered through the exterior light switch (i.e. the headlights are on), voltage is supplied through the closed relay contacts to headlamp wipers 1 and to headlamp washer motor 2.

The headlamp wiper should operate at 45-60 rpm (double sweeps) at a load of 0.49 N•m (0.05 kgf•m), supply voltage of 12 volts, ambient temperature of (25±10)°C and maximum consumption current of 1.5 amperes.

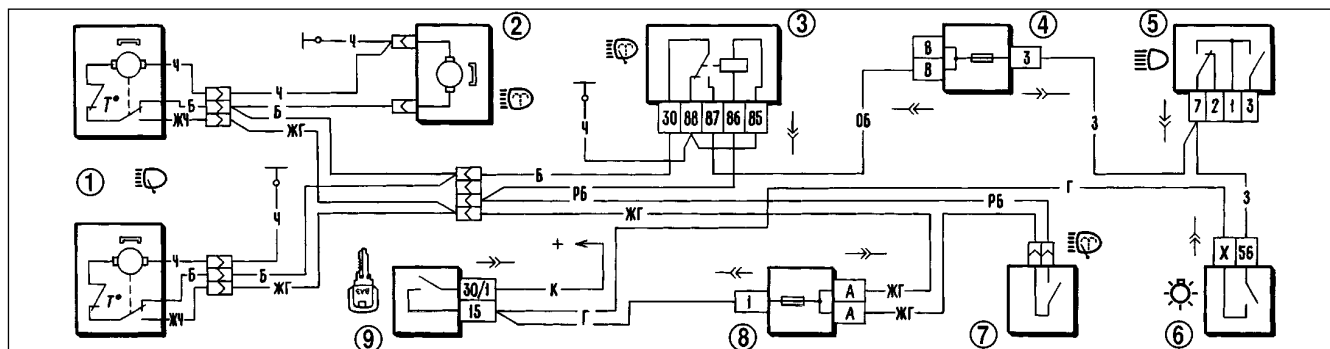


Fig.7-36. Wiring diagram for headlight wipe/wash:
1 - headlight wipers; 2 - headlight washer motor; 3 - headlight wipe/wash relay; 4 - complementary fusebox; 5 - headlight beam switch; 6 - external light switch; 7 - windscreen washer and headlight wipe/wash switch; 8 - fusebox; 9 - ignition switch

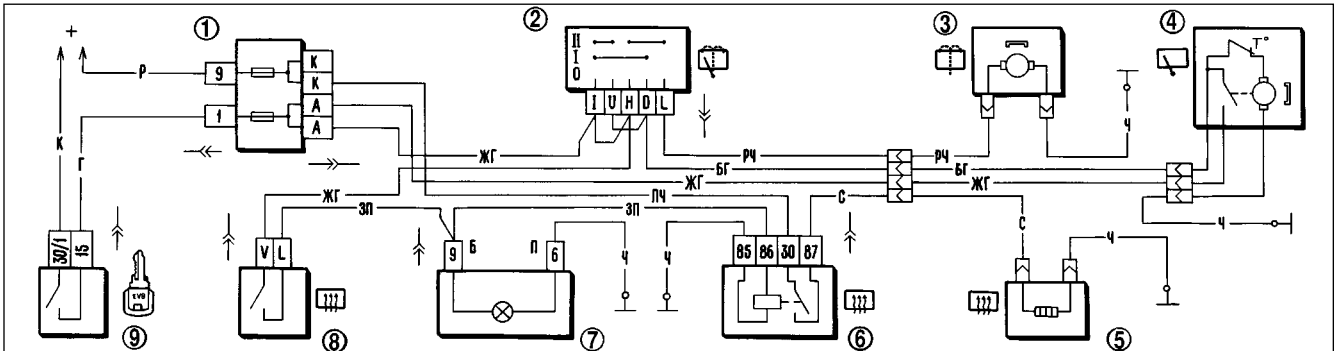


Fig.7-37. Wiring diagram for rear window wipe/wash and heating:

1 - fusebox; 2 - rear window wipe/wash switch; 3 - rear window washer motor; 4 - rear window wiper motor; 5 - rear window heating element; 6 - rear window heating relay; 7 - warning light of heated rear window; 8 - rear window heating switch; 9 - ignition switch

Rear window wipe/wash and heating, cigarette lighter

The rear window wiper includes a motor of 471.3730 model, arm and blade. The wiper arm and blade have a right-hand park position as viewed with the vehicle in forward motion. The motor has a thermal bimetal fuse for overload protection.

The washer motor integral with the pump is secured on the bracket to the left-hand bodyside panel.

The wiring diagram for rear window wipe/wash is shown in Fig.7-37. The wiper is activated by push-button 2 located at the left-hand side of the instrument panel. At the push-button middle position only the wiper is activated, while at a fully depressed push-button the rear window washer is operated too.

The motor design allows its dismantling to eliminate minor faults (commutator cleaning, etc.). Dismantling and reassembly methods are similar to those described earlier for the windscreen wiper motor.

The rear window wiper should operate at (50 ± 5) rpm (double sweeps) at a load of $0.49 \text{ N}\cdot\text{m}$ ($0.05 \text{ kgf}\cdot\text{m}$), supply voltage of 14 volts, ambient temperature of $(25 \pm 10)^\circ\text{C}$ and maximum consumption current of 2 amperes.

The rear window heating is activated by switch 8 through supplementary relay 6 (113.3747-10 model), fitted at the left-hand side of the instrument panel. Refer to «Lighting and signalling» for details.

The cigarette lighter (11.3725 model) is provided with protection against extended operation (over 30 seconds) of the heating element by means of a fusible washer secured on the insulator at the rear of the cigarette lighter. When overheated the washer melts and closes the central lighter contact to earth. This results in a blown fuse No5 in the supplementary fuse box and disconnected cigarette lighter.

To restore the cigarette lighter operation, eliminate the cause of its lengthy operation, dismantle the cigarette lighter, remove the melted washer and fit a new safety washer.

Heater blower motor

It is a motor of MЭ-255 model, DC, on permanent magnets. The motor wiring diagram is shown in Fig.7-38.

For slower speeds there is supplemental resistor 4. The resistor is retained by two spring washers in the heater blower fan cowl. The resistance value is 1.5 Ohms at 20°C .

Always renew a faulty motor with a new one. The only repair possible is the commutator cleaning.

To dismantle the motor, undo the retaining screws to remove the cover. Then retrieve the lock washer from the armature shaft and withdraw the armature from the housing. The reassembly is carried out in the reverse order to the dismantling.

Inspect the motor in the way similar to that for the windscreen wiper motor.

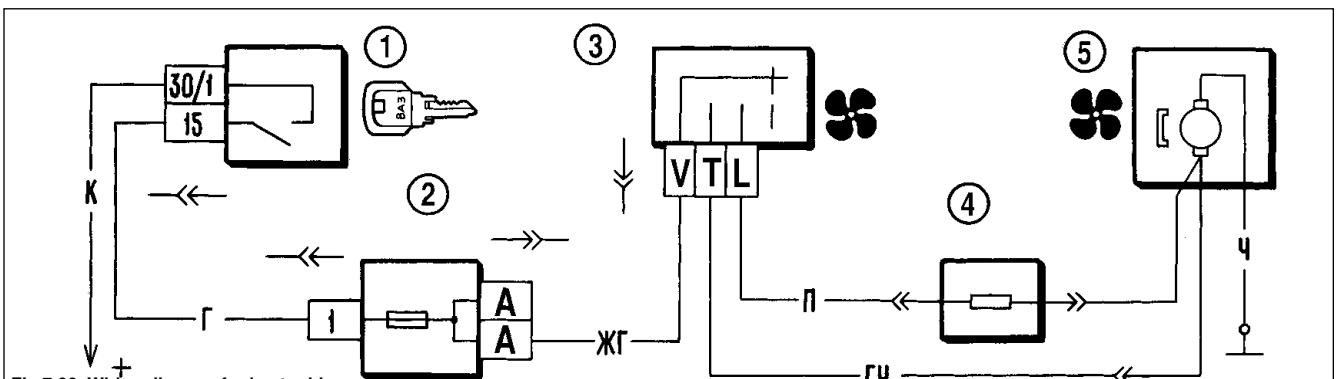


Fig.7-38. Wiring diagram for heater blower motor:

1 - ignition switch; 2 - fusebox; 3 - heater blower switch; 4 - supplemental resistor; 5 - heater blower motor

Blower motor specification

Shaft speed (with fan impeller load)

at 12 v and (25±10)°C, rpm 3000±150

Consumption current at the load and

rpm as above, ampere, not greater 4.5

Fault diagnosis

Cause	Remedy
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Motor does not operate

1. Wires damaged or wire connections corroded	1. Check and restore connections. Renew damaged wiring
2. Blown fuse 1 (in fuse and relay box unit)	2. Renew blown fuse
3. Heater switch damaged - no voltage across switch terminals	3. Check switch, renew when applicable
4. Motor brushes stuck or worn, armature winding broken or commutator foul	4. Check motor, overhaul or renew as applicable
5. Armature winding shorted to earth - fuse blows at motor cut-in	5. Renew motor

Motor is restricted to one speed

1. Wires damaged or wire connections corroded	1. Renew damaged wires, clean wire ends
2. Heater switch damaged	2. Renew switch
3. Supplemental resistor blown	3. Renew resistor

Slower motor armature rotation

1. Dirty or corroded commutator, brushes worn	1. Clean commutator, renew brushes
2. Internal earthing in armature winding	2. Renew motor
3. Armature shaft seized in bearings	3. Dismantle motor, clean shaft journals

Instruments

General description

All gauges and warning lights are grouped within the instrument cluster. The instrument cluster includes a speedometer with trip counter, coolant temperature gauge, fuel gauge, tachometer, voltmeter with LED and 12 warning lights. In 1996 the voltmeter was replaced with the low battery warning light.

The instrument cluster is held to the dashboard by two nuts. The connections for instrument cluster are through the printed circuit board which is fitted to the back of the housing. The wiring diagram for the instrument cluster is shown in Fig.7-39 (pre-1996) and Fig.7-40 (1996-on).

The speedometer incorporates two trip recorders: total mileage odometer and trip counter. The trip counter can be reset

to zero by pushing the reset knob in the instrument cluster. Reset the trip counter only on a stationary vehicle turning the knob clockwise.

WARNING. To avoid damage to the instrument cluster glass, never use solvents for its cleaning.

Fault diagnosis

Cause	Remedy
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Temperature gauge or fuel gauge inoperative

1. Gauge faulty	1. Renew gauge or instrument cluster
2. Sender unit faulty	2. Renew sender unit
3. Wires damaged or wire ends corroded	3. Check wiring, restore connections

Fuel gauge at zero with full tank

Float stop set incorrectly (beyond resistor winding)	Bend stop 1-2 mm down
------------------------------------------------------	-----------------------

Fuel gauge needle moves erratically and frequently drops to zero

1. Poor contact between sender resistance and current collector	1. Bend current collector
2. Sender resistor winding broken	2. Renew sender

Fuel reserve warning lamp stays on

Sender lead earthed	Check, eliminate earthing
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Warning light failure

1. Bulb blown	1. Renew bulb
2. Warning light switch faulty	2. Renew switch
3. Wires broken, wire ends corroded	3. Renew damaged wires, clean wire ends
4. Poor bulb holder contact with PCB	4. Bend bulb holder contacts or renew bulb holder

Speedometer inoperative

1. Loose speedometer cable ends retaining nuts	1. Check, tighten nuts
2. Cable broken	2. Renew cable
3. Speedometer mechanism damaged	3. Renew speedometer

Noise from speedometer cable

1. Outer cable broken (dents, twists, etc.)	1. Renew cable
2. Cable routed with bending radius less than 100 mm	2. Route cable correctly

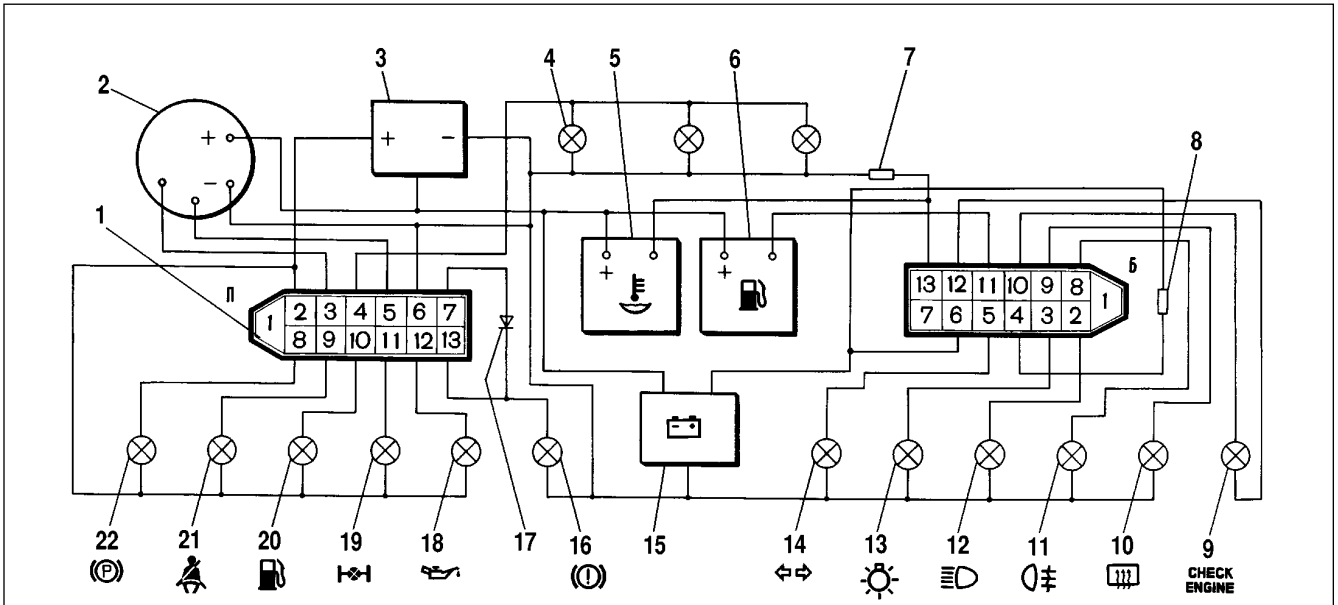


Fig.7-39. Wiring diagram for pre-1996 instrument cluster (rear view):

1 - wiring connector and pin assignment; 2 - tachometer; 3 - voltage stabilizer; 4 - instrument illumination lamp; 5 - coolant temperature gauge; 6 - fuel gauge; 7 - resistor, 470 Ohm, 0.25 W; 8 - resistor, 36 Ohm, 5 W; 9 - warning light, exhaust emission system; 10 - heated rear window warning light; 11 - foglamp warning light; 12 - high beam warning light; 13 - external light warning lamp; 14 - direction indicator warning light; 15 - voltmeter; 16 - low brake fluid warning light; 17 - diode IN4002; 18 - oil pressure warning light; 19 - differential lockup warning light; 20 - fuel reserve warning light; 21 - seat belt reminder; 22 - handbrake-on warning light

Instrument cluster - removal and refitting

The instrument cluster is removed as follows:

- disconnect the battery negative lead;
- undo the screws holding the fascia, pull the bottom edge of the fascia and release the top catches;
- undo the two securing nuts and withdraw the instrument cluster from the fascia;

- disconnect the wiring and speedometer drive cable.

Refitting is the reversal of the removal procedure.

Take precautions not to loop or twist the cable which can result in the outer cable permanent set.

No sharp bends of the drive cable should be evident after refitting. The permitted drive cable bending radius is 100 mm as a maximum.

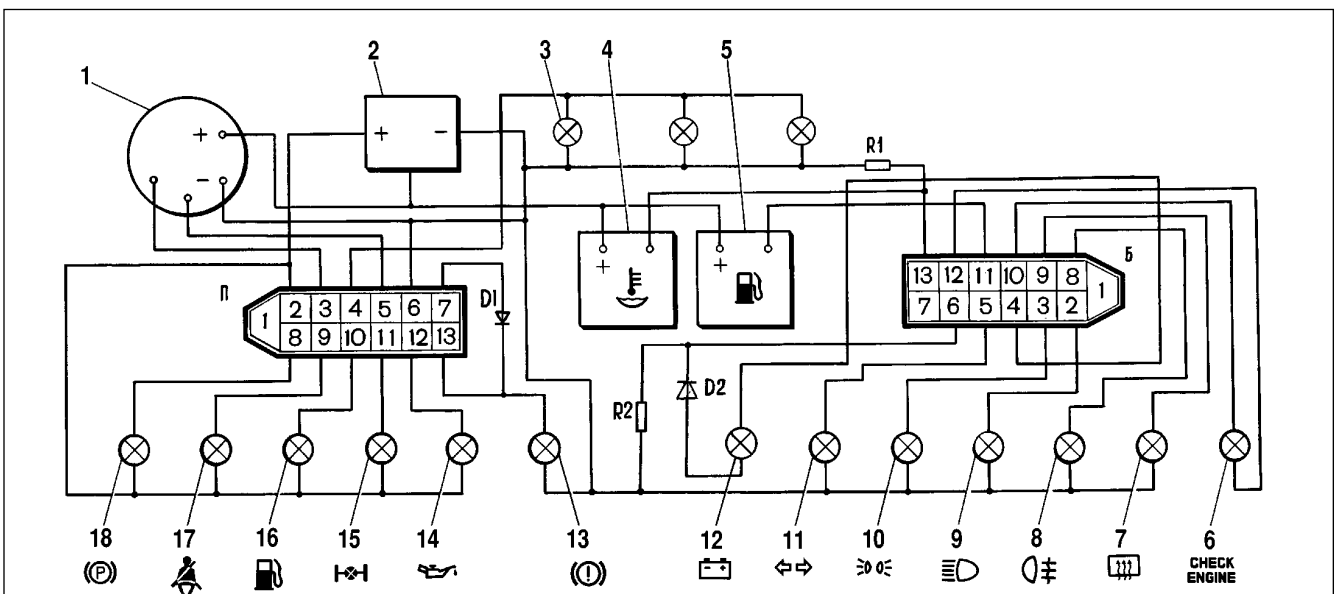


Fig.7-40. Wiring diagram for 1996-on instrument cluster (rear view):

1 - tachometer; 2 - voltage stabilizer; 3 - instrument illumination bulb; 4 - coolant temperature gauge; 5 - fuel gauge; 6 - warning light, exhaust emission system; 7 - heated rear window warning light; 8 - foglight warning lamp; 9 - high beam warning light; 10 - external light warning lamp; 11 - direction indicators warning light; 12 - voltmeter; 13 - low brake fluid warning light; 14 - low oil pressure warning light; 15 - differential lockup warning light; 16 - fuel reserve warning light; 17 - seat belt reminder; 18 - handbrake-on warning light; D1, D2 - diodes IN4002; R1 - resistor, 470 Ohm, 0.25 W; R2 - resistor, 51 Ohm, 5 W

Instrument cluster - dismantling and reassembly

Undo the trip counter knob by pulling it outward, then remove the surround and glass, having first released its bottom edge from the retaining spring wire. Undo the nuts holding the instruments to the PCB and withdraw the instruments.

Reassembly is the reverse of the dismantling procedure.

Instruments - fault diagnosis

Coolant temperature gauge

If the gauge needle constantly stays at the low end of scale, switch on the ignition, disconnect the lead from the gauge and connect its end to earth through a resistor of 20 - 50 Ohm.

If the needle swings, the gauge is faulty and must be renewed. If the needle does not move, remove the instrument cluster, and without disconnecting its wiring, pull out the red connector, then with the ignition switched on, earth terminal 13 (Fig.7-39) of the instrument cluster white connector through the 20-50 Ohm resistor. The needle swings if the gauge is sound but the wire between the sender and the instrument cluster is damaged. When the needle does not swing, renew the coolant temperature gauge or the complete instrument cluster.

When the needle stays in the red area, then with the ignition switched on, disconnect the sender wire. The sender is faulty if the needle returns to the low end of scale. If the needle remains in the red area, then either the lead is earthed or the gauge is damaged. The gauge can be checked through disconnecting the white terminal connector from the instrument cluster. With the ignition switched off, the needle should be at the low end of the scale.

Fuel gauge

The checking procedure for the fuel gauge is similar to the one described earlier.

If the needle stays at the low end of the scale and does not move when the pink wire is disconnected from the gauge and earthed, check the fuel gauge. To do this, remove the instrument cluster, disconnect the white wiring connector, then with the ignition switched on, earth terminal 11 of the instrument cluster white connector through a resistor of 20-50 Ohm. If the gauge is sound, the needle moves.

If the needle always stays at the high end of scale, check the gauge through disconnecting the instrument cluster white connector. If the gauge is sound, the needle returns to the low end of scale with the ignition switched on.

Instruments - checking

Coolant temperature gauge. The gauge is associated with a sender in the cylinder head. At 700 Ohm the needle should be

at the low end of the scale, while at 77-89 Ohm it should stay at the beginning of the red area of scale.

Fuel gauge. The gauge is coupled with a sender in the fuel tank. The sender is used to operate the fuel reserve warning light when only 4 to 6 litres of petrol are left in the fuel tank.

The sender resistance of 238-262 Ohm corresponds to the «empty» reading, 59-71 Ohm - to the half filled tank reading (needle is in the middle of the scale), while 7-23 Ohm - to the «full» reading (mark 1).

Speedometer. Check the speedometer by rotating its drive shaft at various speeds. The speedometer specification is shown in Table 7-6.

Table 7-6

Speedometer checking data

Drive shaft speed, rpm	Speedometer reading, km/h
500	31-35
1000	62-66.5
1500	93-98
2000	124-130
2500	155-161.5

Tachometer. The tachometer measures the frequency of voltage pulses in the ignition primary circuit.

Check the speedometer on a tester unit which simulates the vehicle ignition system. Connect the tachometer to the tester circuitry as it done in the vehicle, set the primary circuit voltage to 14 volts and the spark gap in the tester to 7 mm. Turn the distributor shaft so that the tachometer needle reaches one of the main graduations of the scale. At this moment check the distributor shaft speed variation is within +250 to -70 rpm.

Voltmeter. The voltmeter was fitted to the vehicles before 1996, then it was replaced by the low battery warning light; refer to Fig.7-4 for the relevant wiring diagram.

Check the voltmeter by applying a known voltage. At voltage below (11.3±0.35) volts the voltmeter LED should light steadily. When the voltage is between (11.3±0.35) volts and (16±0.35) volts, the LED should not light. When the voltage is above (16±0.35) volts, the LED should flash. The voltmeter operates with a 5 second delay.

Switches and senders

Coolant temperature sender. The sender has an integrated thermal resistor which resistance alters depending on the coolant temperature. The sender specification is shown in Table 7-7.

Table 7-7

Coolant temperature sender specification

Temperature, °C	Supply voltage, volts	Resistance, Ohm
30	8	1350-1880
50	7.6	585-820
70	6.85	280-390
90	5.8	155-196
110	4.7	87-109

Low oil pressure warning light switch. The switch is fitted to the cylinder head. The switch contacts should close and open at 20-60 kPa (0.2-0.6 kgf/cm²).

Fuel gauge sender. The sender unit is located in the fuel tank and is secured by nuts. The sender has an alternating Ni-Cr wire resistor. The resistor slide contact is operated by the float lever. Another slide contact, fitted to the shorter end of the lever, triggers the fuel reserve warning lamp, when only 4 to 4.6 litres of petrol are left in the tank.

The sender resistance should be (250±12) Ohm for an empty tank, (66±6) Ohm for a half filled tank and (20±3) Ohm for a full tank.

Handbrake-on warning lamp relay. The relay of PC-492 model is intended for intermittent light of the handbrake «on» warning lamp. It is fitted to the wires on the left-hand side beneath the instrument panel.

The number of the relay ons/offs per minute should be in the range of 60-120 at 10.8 to 15 volts within -40 to +40°C. The winding resistance is 26 Ohm.

The relay of PC-492 model is out of use starting from 1995, therefore when the handbrake is applied, the warning lamp lights steadily.

**Carburettor solenoid - control
Electronic control unit - testing**

Sound electronic control unit 4 (Fig.7-41) should cut off solenoid 5 when the engine speed reaches 2100 rpm and operate it when the engine slows down to 1900 rpm, if the idle switch is earthed.

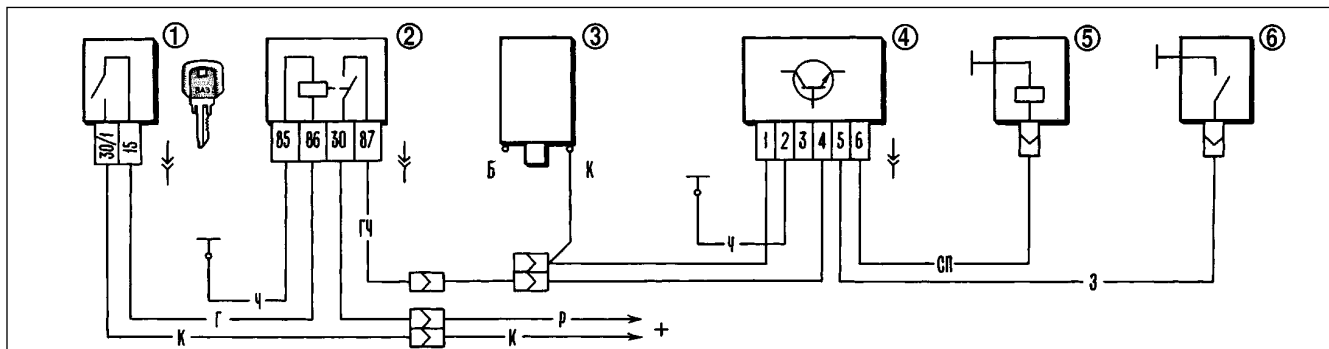


Fig.7-41. Fuel cutoff solenoid control system wiring diagram:
1 - ignition switch; 2 - ignition solenoid; 3 - ignition coil; 4 - control unit; 5 - fuel cutoff solenoid; 6 - idle switch

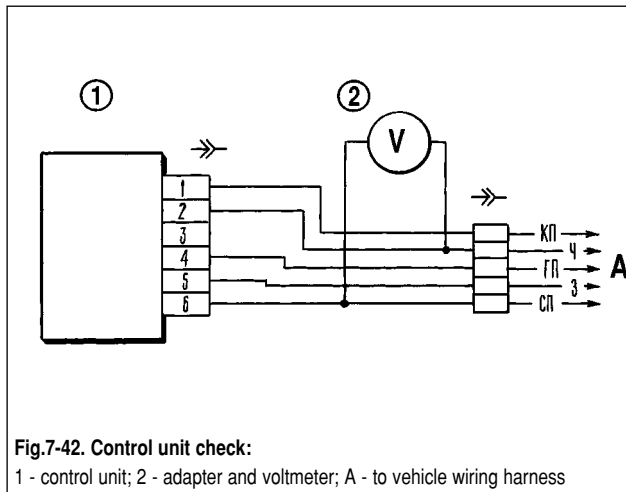


Fig.7-42. Control unit check:
1 - control unit; 2 - adapter and voltmeter; A - to vehicle wiring harness

Start testing the control unit with checking its correct wiring.

Check the control unit operation using a voltmeter (ranged 0-15 volts) in the following sequence:

- disconnect the green wire from the idle switch and earth the wire end;
- connect the voltmeter to the control unit using special connector 2 (Fig.7-42);
- start the engine and let it running, gradually increase the speed while observing the voltmeter readings: after start-up the voltmeter should read at least 10 volts with an instantaneous drop as low as 0.5 volts at the moment the solenoid shuts off;
- once the solenoid is shut off, gradually decrease the engine speed until the solenoid cuts in again - there should be an instant surge in voltage to 10 volts at least;
- run the engine at 2200-2300 rpm, disconnect the carburettor idle switch earth lead and then reconnect it. The solenoid should cut in when the earth wire is disconnected and cut off when the wire is reconnected to earth.

Note. The control unit can be checked without a voltmeter by audible clicks the solenoid produces at cut-in or cut-off.

Chapter 8. Bodywork

Fault diagnosis

Cause	Remedy
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Dark spots over bodywork

1. Hot water was used for washing (above 80°C)	1. Remove minor blemishes through buffing, respray body in case of major deterioration
2. Leaded petrol or other aggressive agents were used for dewaxing	2. Respray body

Pink spots over light painted surfaces

Deterioration by coolant	Polish affected areas
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Lighter spots over dark painted surfaces

Deterioration by moisture due to prolonged vehicle storage under an air-tight cover	Buff affected areas, respray body, if applicable
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Dull shine

1. Dry cloths were used for cleaning	1. Buff affected areas, respray body, if applicable
2. Extended exposure to the sun	2. Buff affected areas, respray body, if applicable
3. Aggressive cleaners were used for bodywork washing	3. Buff affected areas, respray body, if applicable

Water penetration into passenger compartment

1. Excessive or irregular clearance over door aperture	1. Centralize door and adjust door lock striker position, adjust door aperture flange
2. Crumpled metal structure of door seal	2. Renew seal
3. Windscreen seal leaking	3. Put 51-F-7 sealant under outer seal lug
4. Heater air box drain valve is squeezed by vacuum servo unit hose	4. Properly route servo unit hose

Excessive efforts to open door

1. Door lock striker retainer pivot shaft bent	1. Renew pivot
2. Striker retainer worn	2. Renew retainer
3. Door position incorrect	3. Adjust door position

Failure to lock door by key or locking knob

Top end of lock outer control lever butts against exterior handle shoulder	Bend lever top end away of handle shoulder to have 0.5-2.0 mm clearance
----------------------------------------------------------------------------	-------------------------------------------------------------------------

Failure to unlock door with exterior handle

Excessive clearance between exterior handle shoulder and top end of lock exterior linkage	Bend lever top end to handle shoulder to have 0.5-2.0 mm clearance
-------------------------------------------------------------------------------------------	--------------------------------------------------------------------

Failure to lock door

1. Broken or weak spring of lock central shaft or external control lever	1. Renew lock
2. Loose riveting of external operating lever shaft. On closing the lever lug fails to engage ratchet due to lever misalignment	2. Remove lock and ensure reliable riveting
3. Seized exterior control lever due to dust or grease coking	3. Remove lock, wash and lubricate friction parts with grease Litol 24

Failure to unlock door with interior handle

Insufficient travel of inner control lever due to insufficient operating link travel	Adjust lock inner control lever
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Failure to unlock bonnet from passenger compartment

1. Lock operating link broken	1. Renew operating link
2. Excessive operating link length	2. Adjust operating link length through loop on lock hook

Cause	Remedy
Failure to lock bonnet	
<ul style="list-style-type: none"> 1. Lock spring broken or loose 2. Shorter lock operating link 3. Incorrect position of lock 	<ul style="list-style-type: none"> 1. Renew spring 2. Adjust operating link length through loop on lock hook 3. Adjust lock position
Failure to secure sliding glass in position	
Spring brake of window lifter broken	Renew window lifter
Excessive efforts or failure to recline front seat back forward or rearward	
<ul style="list-style-type: none"> 1. Excessive friction in seat reclining mechanism 2. Worn components of seat reclining mechanism 3. Damaged welding joints of front seat frame components 	<ul style="list-style-type: none"> 1. Lubricate friction components of seat reclining mechanism and front seat rails with grease Фиол-1 2. Renew worn components, lubricate new ones 3. Renew front seat frame
Failure to fix front seat back in reclined position	
<ul style="list-style-type: none"> 1. Disconnected control cable of front seat rake adjuster 2. Broken control cable or fractured outer cable of seat back rake adjuster 	<ul style="list-style-type: none"> 1. Secure control cable on seat recliner hook, check for proper operation 2. Renew faulty recliner mechanism components, check for proper operation
Failure to adjust front seat back rake	
<ul style="list-style-type: none"> 1. Faulty retainer of front seat back rake adjuster knob 2. Faulty front seat back rake adjuster 	<ul style="list-style-type: none"> 1. Renew front seat back rake adjuster knob retainer, check operation of mechanism 2. Renew front seat back frame
Front seat position is difficult to adjust	
<ul style="list-style-type: none"> 1. Seized runners in tracks due to poor lubrication 2. Misaligned front seat tracks and runners 	<ul style="list-style-type: none"> 1. Lubricate runners with grease Фиол-1 2. Adjust front seat runner using adjusting shims under securing bolts
Hot air flow to interior compartment	
<ul style="list-style-type: none"> 1. Faulty heater tap linkage 2. Heater tap fails to shut off water flow 	<ul style="list-style-type: none"> 1. Check cable operation, secure outer cable, renew cable, if applicable 2. Renew tap
Air to interior compartment is not heated	
<ul style="list-style-type: none"> 1. Heater tap inoperative due to faulty tap cable drive 2. Faulty heater tap 	<ul style="list-style-type: none"> 1. Check cable operation, secure outer cable, renew cable, if applicable 2. Renew tap
Insufficient air inflow to interior	
Inoperative air intake cover cable drive (cover closed)	Check cable operation, secure outer cable, renew cable, when applicable

Bodywork - repair

Refer to Fig.8-1, Fig.8-2 and Fig.8-3 for body frame design and relevant cross-sections.

Bodywork damages - repair

Most repair on vehicles, especially after road accidents, falls on bodywork. In the large part repair involves geometry inspection of attachment points of diverse vehicle units and ancillaries. The main reference sizes for inspection are shown in Fig.8-4.

The bodywork damages can vary greatly thus demanding specific remedial actions in each particular case. Maximum use of panel ding and dent is recommended. Where applicable, avoid heat treatment of metal to preserve the factory welding and bodywork rustproof protection. The exposed body panel should be lifted off only when it is absolutely necessary in order to locate the damaged area, to straighten or align the bodywork.

In the event of major body damage it is advisable to remove all interior trim to facilitate measurement, examination or fitting of hydraulic and screw jacks to rectify any crosslays or damages.

All projections of exposed panels or detachable parts against the adjoining panels must be properly realigned and readjusted.

Deformed surfaces - repair

The repair of any damaged body parts is carried out by means of stretching, ding and dent, straightening, cutting out of irreparable areas, making of maintenance patches from the body rejects or metal sheets by shaping them into a suitable part.

Deformed panels are restored, as a rule, manually with the help of specialized tools (metal hammers, plastic or wooden mallets, various mandrels) and accessories.

Heating up is recommended to contract (settle down) heavily stretched panel surfaces. Heat up to 600-650°C (cherry-red colour) to prevent a sharp belling-out of the panel or degrading of physical properties. The heated area should not exceed 20 to 30 mm.

Contracting of surfaces is carried out as described below:

- using a carbon electrode of a semi-automatic welder or a gas burner, heat up the metal sheet starting from outside to centre of the damaged area and restore the original shape by hammering out the heated sections with a wooden mallet or a hammer and facilitating the job with a flat block and anvil;

- proceed with alternative heating and settling until you achieve the desired quality of the panel surface.

Panel irregularities can be rectified by means of polyester fillers, thermosetting plastics, cold set epoxy resins or soldering.

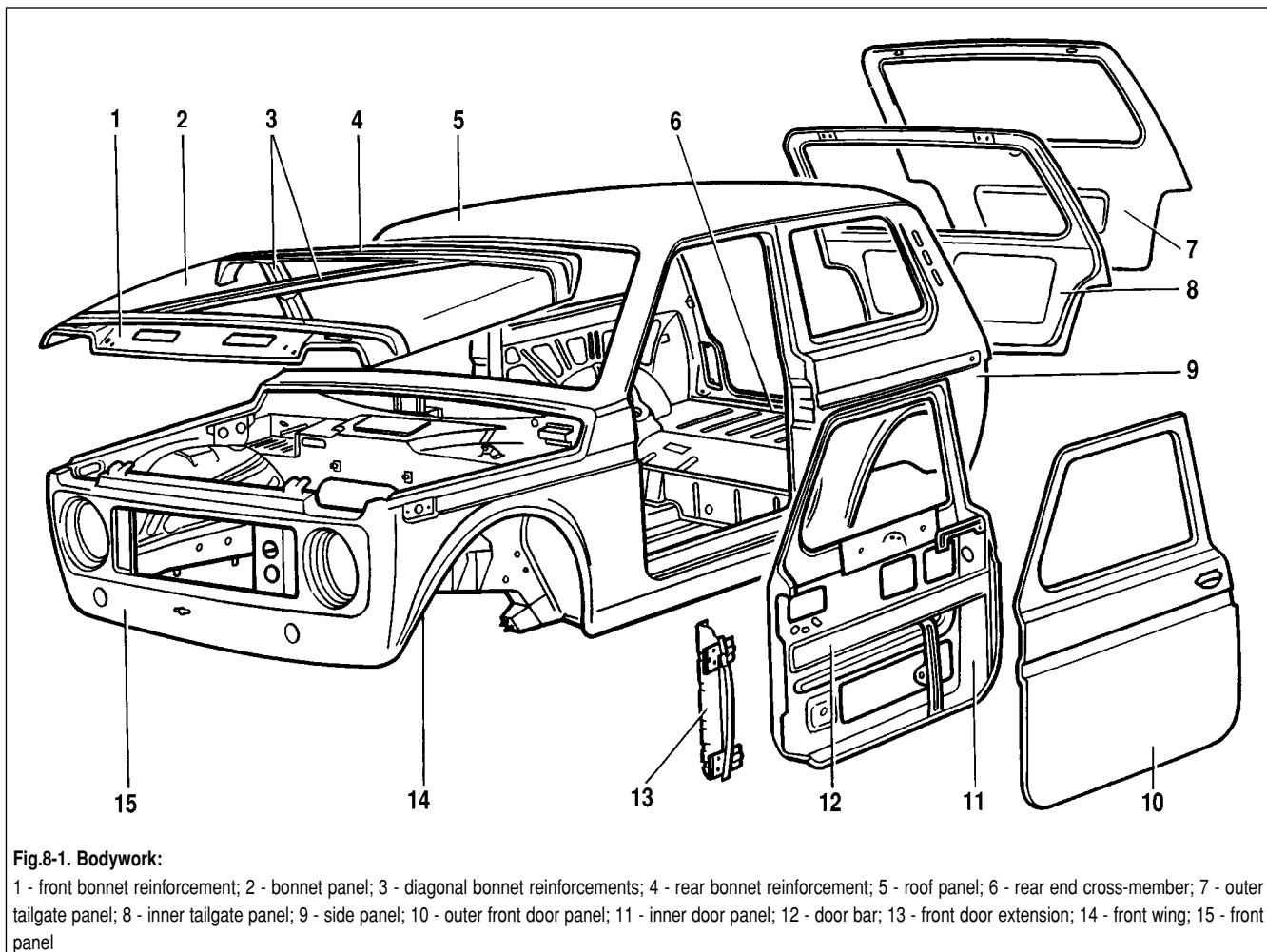


Fig.8-1. Bodywork:

1 - front bonnet reinforcement; 2 - bonnet panel; 3 - diagonal bonnet reinforcements; 4 - rear bonnet reinforcement; 5 - roof panel; 6 - rear end cross-member; 7 - outer tailgate panel; 8 - inner tailgate panel; 9 - side panel; 10 - outer front door panel; 11 - inner door panel; 12 - door bar; 13 - front door extension; 14 - front wing; 15 - front panel

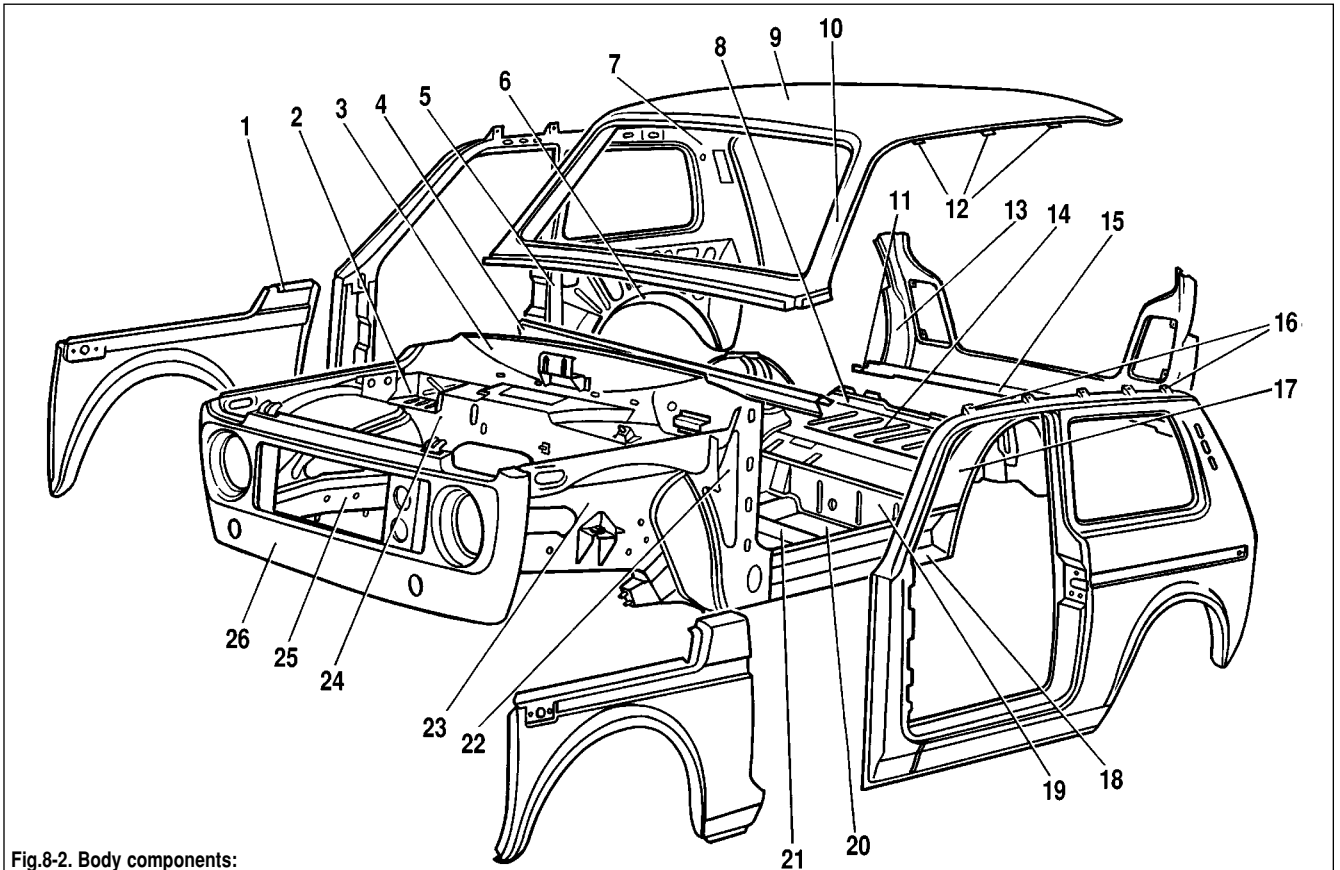


Fig.8-2. Body components:

1 - front wing; 2 - battery tray; 3 - top bulkhead reinforcement; 4 - instrument panel crossbar; 5 - centre pillar; 6 - outer rear wheel arch; 7 - inner bodyside panel; 8 - rear floor cross-member; 9 - roof panel; 10 - windscreen frame; 11 - bracket for wheel mudflap; 12 - roof reinforcements; 13 - rear pillar; 14 - rear floor panel; 15 - rear cross-piece; 16 - brackets of door trim bow; 17 - inner arch, rear wheel; 18 - floor-to-bodyside panel connection; 19 - floor cross-member under rear seat; 20 - floor front panel; 21 - floor cross-member under front seat; 22 - side panel, front end; 23 - splash guard, front wing; 24 - bulkhead; 25 - front chassis arm; 26 - front panel

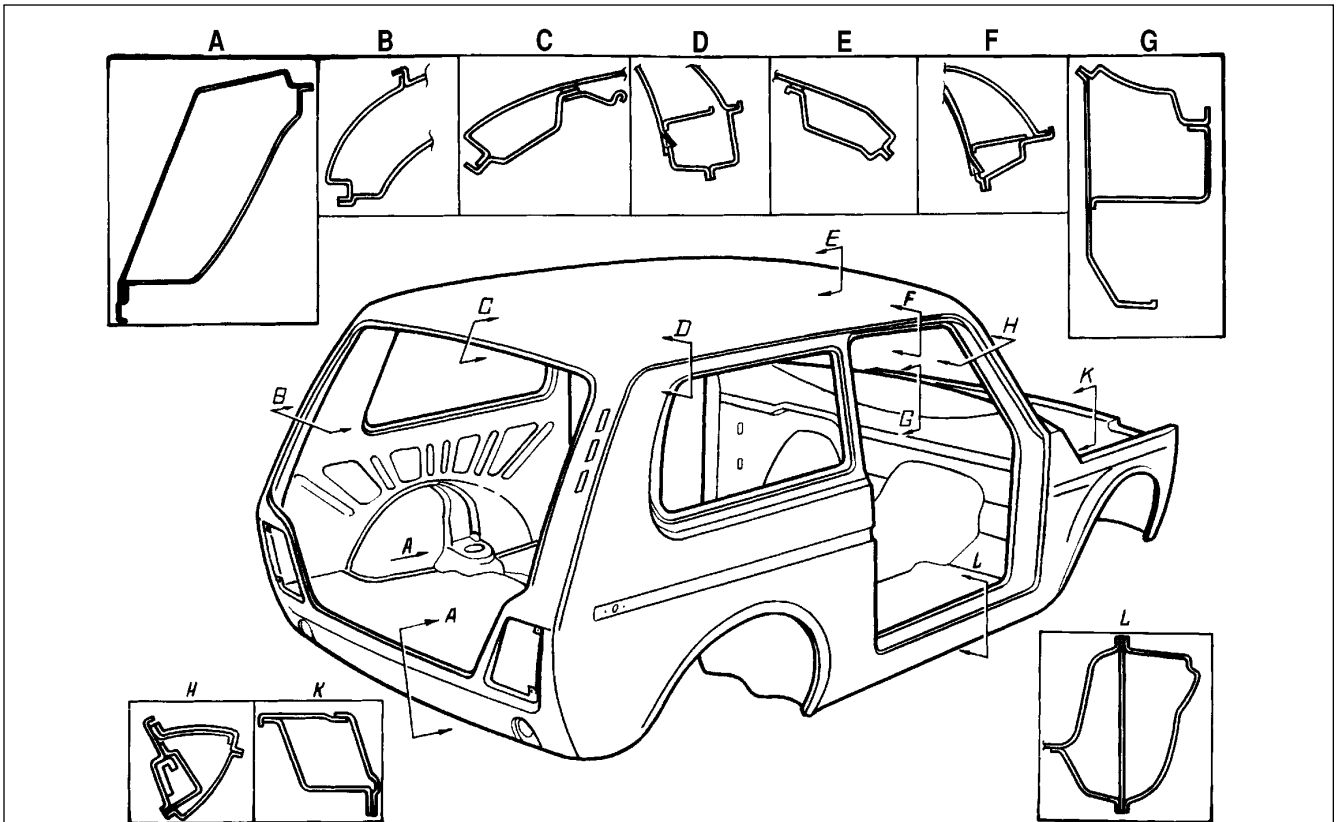


Fig.8-3. Main bodywork cross-sections

Polyester fillers of «Хемпрон-П» or ПЭ-0085 type offer a reliable adhesion with the panels stripped to the bare metal. They consists of two components: unsaturated polyester resin and a hardener serving as a fast curing catalyst. The ambient temperature in the workshop should not be below 18°C. The mixture of polyester filler must be used within ten minutes since it usually takes sixty minutes for the filler to harden well through. The thickness of the filler layer should be a maximum of 2 mm.

Thermosetting plastic is produced as a powder. Its elastic properties, required for application on a metal panel, develop at 150-160°C. The surface to be treated must be thoroughly cleaned of rust, scale, loose paint and other impurities. Thermoplastic adheres better to rough metal surfaces. Before applying thermoplastic, heat up the affected area to 170-180°C and apply a first layer of powder which is to be smoothed down by a metal roller. Then apply a second layer and further ones until all surface imperfections are fully covered. Each layer is rolled down to achieve a

monolithic layer of plastic mass. Use your usual treating methods when the layer is hardened well through.

Use solders of ПОССу 18-2 type or ПОССу 25-2 type to straighten the areas which were earlier filled with solder, to build-up edges and to eliminate undesirable gaps.

Severely damaged panels are replaced with new ones using electric inert gas welding.

Front wing - removal and refitting

With minor damages (small dent, scratches, etc.), straighten and paint the wing without removing it from the vehicle. Inspect the condition of inner anti-corrosion coating, restore it when necessary.

Always renew the wing in case of major damages or splits.

Remove the bumper, bonnet and front door.

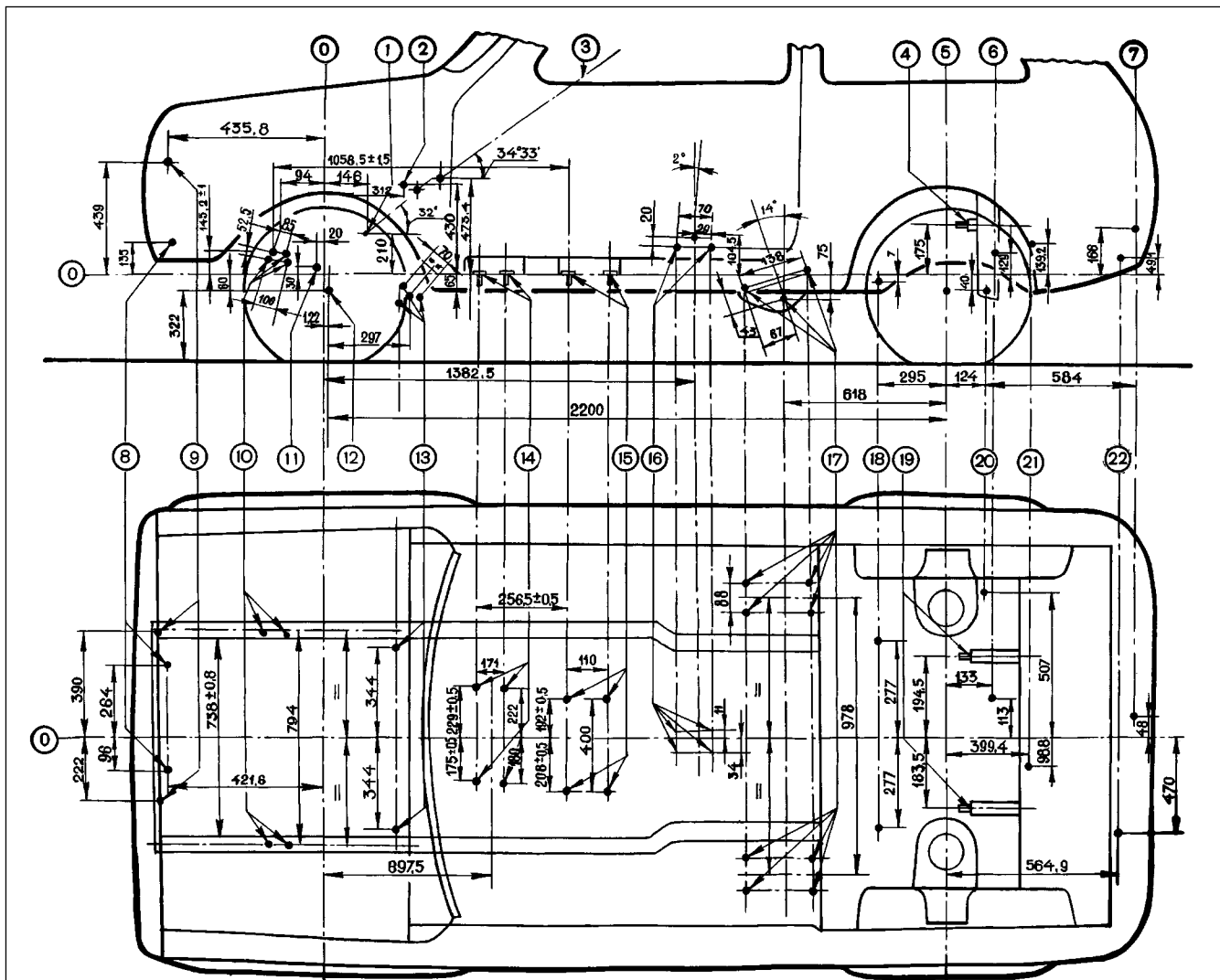


Fig.8-4. Anchorages of vehicle units and assemblies:

0 - datum lines; 1 - centre of steering mechanism; 2 - brake and clutch pedal axis; 3 - steering wheel shaft axis; 4 - attachment of rear suspension shock-absorbers; 5 - rear wheel axis; 6 - attachment of front pipe, main silencer; 7 - rear attachment of main silencer; 8 - bottom radiator attachment; 9 - top radiator attachment; 10 - front suspension cross-member attachment; 11 - differential centre; 12 - wheel centre; 13 - front anti-roll bar attachment; 14 - rear power unit mounting attachment; 15 - transfer case attachment; 16 - attachment of handbrake lever bracket; 17 - front attachment of rear suspension trailing arms; 18 - rear attachment of rear suspension trailing arms; 19 - rear suspension shock-absorber attachment; 20 - attachment of rear suspension trailing arms; 21 - front attachment of main silencer; 22 - attachment of exhaust pipe

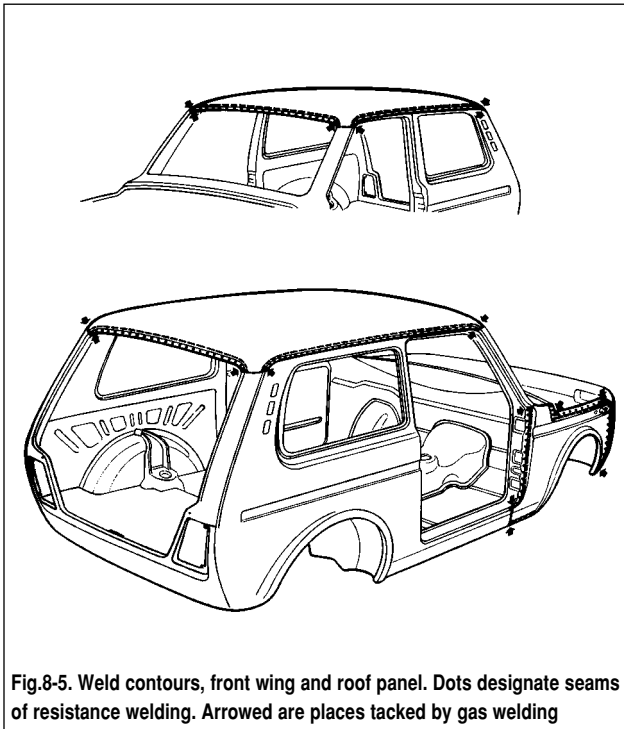


Fig.8-5. Weld contours, front wing and roof panel. Dots designate seams of resistance welding. Arrowed are places tacked by gas welding

Chip off the wing with a sharp thin chisel or cut with a grinding tool over the lines as shown in Fig.8-5.

Detach the wing, remove the remainders of the wing, straighten the deformed edges and smooth them with an electric or pneumatic grinding tool.

Refit the front door and new wing, secure the wing using quick detachable grips.

Weld the wing in the locations as arrowed in the figure by means of CO₂ arc welding. Soldering is allowed too. Use soldering bars of Л62, Л63 type (2-3 mm in diameter).

Refit the bonnet and check the wing position. A maximum 2 mm inward or outward misalignment of the wing against the door or bonnet is allowed; the wing clearances with the bonnet or door over the outer surface should be (5±2) mm.

Withdraw the bonnet and door.

Use resistance welding with step of 40-50 mm to weld the wing to the front bodyside panel pillar, splash guard and bulkhead. Gas welding with tin solder is possible or electric CO₂ arc welding with a broken seam of 7 to 10 mm with a 50-60 mm step. Use an electric semi-automatic welder and 0.8 mm dia. wire of СВ.08Г1С or СВ.08Г2С type.

Weld the wing to the front by melting the welding flange edges using a broken seam of 5 to 7 mm with a 40-70 mm step.

Roof - removal

In most cases a damaged roof requires renewal.

Remove the tailgate, waterchannel trim, windscreen, headliner and roof accessories. Make a layout and cut off the roof panel over the lines as shown in Fig.8-5.

Detach the roof panel, remove the panel remainder and straighten any areas deformed. Remove loose colour paint and base paint up to bare metal on the roof panel edges, windscreen frame, roof side panels and reinforcements.

Renew the gaskets on reinforcements.

Fit the roof panel, secure it with quick detachable grips, tack the panel by gas welding in the locations arrowed in Fig.8-5.

Weld the roof panel by resistance welding with a step of 40-50 mm and by electric CO₂ arc welding or gas welding with a step of 50-60 mm over the earlier drilled holes of 5-6 mm diameter. To avoid deformation, start welding from the middle of the seam rightward and leftward.

Finish the seams with an electric or pneumatic grinding tool.

Paintwork

Polishing

To preserve paintwork and maintain it as long as possible, select the polishers to suit the condition of the paintwork. Strictly adhere to recommendations for application.

The basic maintenance routine for the bodywork within the first two or three months is just regular washing with cold water. Over further three years move to non-abrasive polishers for new coatings to restore the brilliance of shine.

After three to five years of vehicle operation, use the automotive polishers intended for weather affected paintwork which contain a small amount of abrasive. After five years of intensive use, select the polishers for aged paintwork.

To prevent the polisher drying off, work on small areas buffing them manually with a clean flannel cloth.

To rectify minor paintwork defects, it is recommended to use polishing pastes of ПМА-1 or ПМА-2 type. Hand pads or power tools, with lambskin discs or flannel discs, can be used for polishing.

Prior to use, thoroughly mix the paste, dilute it with water when thick. After polishing, wipe the surface clean with flannel.

Respraying with acrylic paints

Using plenty of water and a putty knife or a brush, rub down any loose paint from the affected areas.

Use abrasive paper (68C 8-П or 55C 4-П) for wet sanding of the surfaces to be painted. In case of a thin coating and no evidence of mechanical damages, sand the repair area down to the factory primer layer. In the event of severe corrosion or earlier applied nitric paints, strip down the areas to the bare metal.

Wash the body with water, blow dry with compressed air.

Degrease the painted surfaces with white spirit or petrol-solvent (EP-1) and apply bodystopper paste like «Plastisol Д-4А»

over the weld seams and on the joints of the replaced parts. Remove the stopper surplus with a cleaning cloth moistened in white spirit.

Ensure the surrounding area is protected against overspray (use genuine masking tape or several thickness of newspaper).

With the aid of a spray gun, apply primer like ГФ-073 or ВЛ-023 over the areas rubbed down to the bare metal. Allow five minutes. The primer viscosity should be 22-24 cs at 20°C when measured with the viscosimeter ВЗ-4. Use ksyol for thinning.

Using a spray gun, apply primer (ЭП-0228) over the surfaces coated with the base coat (ГФ-073 or ВЛ-023) and over the renewed body parts. Dry off at 90°C within 60 minutes. Prior to spraying, to primer (ЭП-0228) add НФ-1-type siccative of 6-8 % or МТТ-75-type catalyst of 3-4 % of the primer weight. The ready mixture with catalyst should be consumed within 7 hours. The primer viscosity should be 23-25 cs by the viscosimeter ВЗ-4. Thin the primer with thinner РЭ-11В or ksyol.

Allow the bodywork cool down, proceed with wet sanding using the abrasive paper of 55С 4-П type, flush with water, blow with compressed air and allow to dry.

Any irregularities remained can now be filled carefully applying filler paste, dry the body and smooth down the areas with the abrasive paper of 55С 4-П type. Wash the body and blow dry with compressed air. Mask off the surrounding areas from overspray with thick paper and masking tape, then place the vehicle body into the paint booth. Degrease the surfaces to be painted with white spirit.

Using a spray gun, apply two coats of paint (МЛ-197 or МЛ-1195 type) at 7-10 minute interval on inner surfaces of the passenger compartment, door apertures, engine bay, luggage compartment.

Apply three colour paint coats on the outside body surfaces at 7 to 10 minute intervals.

Allow to dry at 90°C within an hour and cool down at ambient environment.

Before application, add 10% catalyst of ДГУ-70 type into the paint. For paints of МЛ-197 type it is permitted to use 20% maleic anhydride in ethylacetate. The paint viscosity should be 20 cs when measured by the viscosimeter ВЗ-4. It is advisable to thin paint with thinner of P-197 type.

It is recommended to use СП-7-type paint remover. For old multilayer paint, apply it with brush two or three times depending on the paint thickness.

Usually, 30-40 minutes are required to soften the old paint which is then removed with a wire brush or putty knife.

Use white spirit to wipe off the remainder of the paint, rinse with water, allow to dry.

Respraying separate parts

Paint any separately replaced parts (wings, doors, bonnets,

etc.) all over outer surfaces. The same recommendations are applied to the parts restored after ding and dent.

Before respraying the parts remember to sand and apply primer on the reassembled parts .

When performing the job, follow the methods adopted for body respraying.

Bodywork corrosion protection

Corrosion mostly attacks inner cavities of the body, floorpan, lower parts and struts along with anchorages and spot welding areas.

Hard-to-reach cavities and underbody parts are most susceptible to corrosion caused by moisture, mud, salts and acids.

All this necessitates further protection for body inner surfaces and box sections through application of specific rust inhibiting paints or sealants for joints. The products used to resist rust formation are shown in Table 8-1.

It is advisable to use corrosion inhibitors «Мовиль» or «Мовиль-2» for box sections. Box sections should be treated every 1 to 1.5 years. The corrosion inhibitor is also applicable for the surfaces earlier treated with nygrol or other oils as well as for rusty surfaces.

Protective grease of НГМ-МЛ type is used for inner cavities. New vehicles have all inner cavities already coated with it.

Use a protective skin of НГ-216Б type on the underbody.

Bitumen-type sound-proof sealant (БПМ-1) offers corrosion protection and noise reduction for the underbody. The thickness of the protective layer to be 1.0-1.5 mm.

Plastisol Д-11А helps protect the vehicle underbody against corrosion, abrasive wear and contributes to better sound-deadening. The layer thickness should be 1.0-1.2 mm. All new vehicles have the underbody coated with Д-11А-type plastisol.

Plastisol Д-4А is applied on weld seams. Use the wet-type sealant (51-Г-7) on body joints.

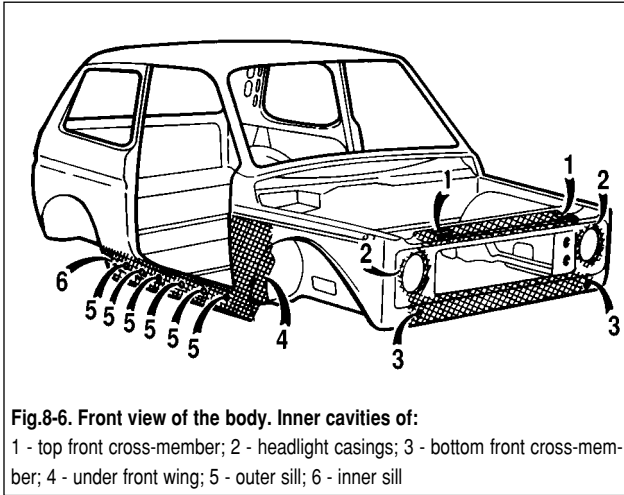
Both air and airless rust-inhibitor spraying is recommended for hard-to-reach or hollow cavities.

For air spray method you need compressed air supplied at 0.5-0.8 MPa (5-8 kgf/sq.cm) and a spray gun with a tank, hoses and extensions for the gun. The optimum coating is achieved with airless spraying at 4-12 MPa (40-120 kgf/cm²), where higher viscosity paints can be successfully used.

Box sections - preparations and corrosion treatment

Inner cavities require specialist equipment. Entrust the job to the skilled personnel in workshops.

Follow the procedure below when treating inner cavities against corrosion:



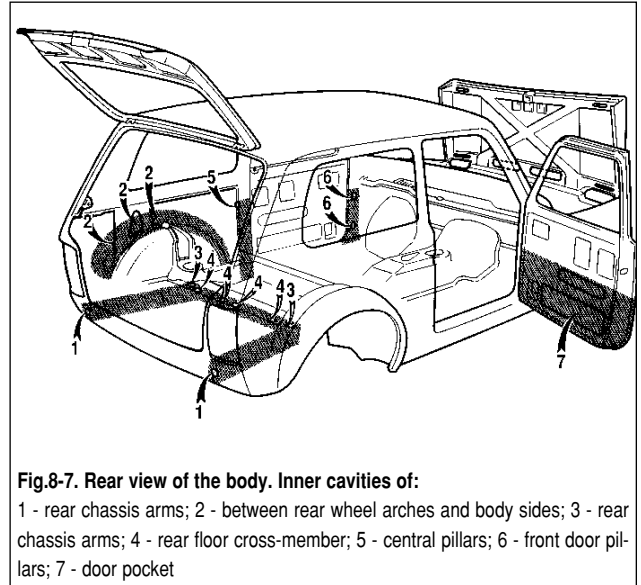
- position the vehicle on a lift, dismantle all relevant components and trims which may obstruct access to box sections;

- through provisional or drain holes flush inner cavities and the underbody with warm (40-50°C) water (Table 8-2) until the drained water is clean. Do not forget to fully close the windows;

- remove any water penetrated into the passenger or luggage compartments; blow dry with compressed air the areas where rust inhibitors are going to be applied;

- drive the vehicle into a corrosion treatment booth and position it on a lift; spray the relevant rust inhibitor onto the areas shown in Fig.8-6, Fig.8-7 and Fig.8-8;

- lower the vehicle, wipe off any dirt from the outside body surfaces with a cloth moistened in white spirit.



Restoring corrosion-proof and sound-proof coating on underbody and wheel arches

When in service, the vehicle underbody is deteriorated by loose gravel, sand salt and water.

As a result, undersealant and primer can be damaged and worn thus encouraging rust.

For the purposes of noise reduction, corrosion protection and wear resistance, the underbody and chassis arms are factory treated with PVC plasticate - Plastisol Д-11А»- of 1-1.5 mm thickness over epoxy ЭФ-083 primer.

Таблица 8-1

Corrosion inhibitors for bodywork protection

Description	Grade	Viscosity, sec at 20 °C as per B3-4	Solvent, thinner	Drying conditions	
				Temperature, °C	Time, min
Automotive sill rust inhibitor	Мовиль				
	Мовиль-2	15 - 40	white-spirit, petrol	20	20 - 30
Protective non-drying grease	НГМ-МЛ	45	white-spirit	20	15
Protective skin	НГ-216Б	18 - 22	white-spirit, petrol	20	20
Bitumen-type sound-proof sealant	БМП-1	high viscosity	ksylol, solvent	100-110	30
PVC plasticate	Plastisol Д-11А	Detto	—	130	30
Plasticate	Plastisol Д-4А	Detto	—	130	30
Non-drying sealant	51-Г-7	Detto	—	—	—

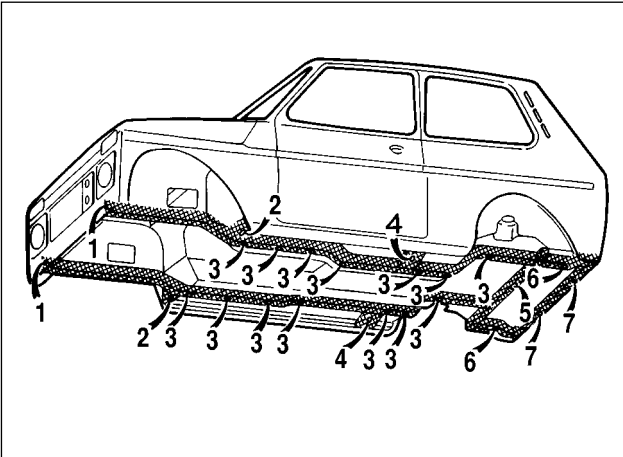


Fig.8-8. Underneath view of the body. Inner cavities of:
 1 - front chassis arms; 2 - front chassis arms connections; 3 - middle chassis arms; 4 - middle chassis arms connectors; 5 - rear floor cross-member; 6 - rear chassis arms; 7 - rear end cross-member

When only the Д-11А plastisol coating is affected, while the primer is intact, scour any dirt from the relevant areas, then on a dry surface apply БПМ-1-type plastisol by means of a brush or airless spray (1.5 mm thick). Allow to dry at ambient temperature within a day or at 90°C within 30 minutes.

In the event of major damages of protective layers and damaged primer, clean of dirt and rust the area affected to the bare metal, then apply ГФ-073-type primer on a dry degreased surface. Using a brush, apply БПМ-1-type sealant on the areas prepared.

When the vehicle is in use no longer than 1-1.5 years, it is recommended to have a minimum overlapping of a new sealant

over an old layer. In the event of a longer field service with this underbody protection, apply the sealant over the entire underbody and wheel arches surfaces.

In cold weather before use, store sealant paste in a warm room to warm it up to at least 20°C. When thick, thin sealant with ksyolol to 3% as a maximum. Clean the paintwork of excessive sealant using a cleaning cloth moistened in white spirit.

Body - sealing and tightness

The body tightness is ensured by use of rubber seals (Fig.8-9), pastes, bodyfillers, sealants, rubber plugs in provisional holes and thorough levelling of adjoining parts.

When removing or refitting seals with metal reinforcement, take care not to crumple the metal frame or seal.

Weld seams do not offer an absolute tightness between the parts, so corrosion is encouraged when water or moisture gets in between the welded parts. Use Д-4А-type plastisol on weld seams to guard off moisture and dirt; apply the 51-Г-7 wet-type sealant (Fig.8-10 and Fig.8-11) on angle joints and clearances:

- between the sidesills and bulkhead (passenger compartment side);
- between the bulkhead and front pillar panel and battery tray;
- between the front chassis arms and radiator support / bulkhead;
- between the bulkhead and front cover plate;
- between the rear floor / rear floor extensions and rear wheel arches, bodysides and rear end cross-member.

Table 8-2

Box sections to be corrosion treated

Cavity	Injection location	Injection direction	Notes
Front top cross-member	Through two top holes	Rightward and leftward	Open bonnet
Headlight casings	Front (from outside)	Over entire surface	Remove headlights
Front bottom cross-member	Through two holes for bumper fitting	Rightward and leftward	Remove front bumper
Under front wings	Through shielded opening	All directions	Remove sealing shield
External door sills	Through six side holes	Forward and backwards	Remove moldings
Internal door sills	Through hole at the back of sill end	Along sills	
Front chassis arms	Through holes for bumper fitting	Along chassis arms	Remove front bumper
Front chassis arm connections	Through holes underneath body	Rightward and leftward	Lift vehicle by hoist
Middle and rear chassis arms	Through seven holes underneath body	Forward and backward	Lift vehicle by hoist
Middle chassis arms connections	Through holes underneath body	Rightward and leftward	Lift vehicle by hoist
Rear floor cross-member	Through holes in luggage compartment and underneath the body	Rightward and leftward	Remove trim in luggage compartment
Rear end cross-member	Through holes underneath the body	Rightward and leftward	Lift vehicle by hoist
Between rear wheel arches and body sides	Into cavity openings in luggage compartment	Over all surface	Remove trim in luggage compartment
Central pillars	Into hole behind pillar	Downward	Remove pillar trim
Front pillars	Through 2 holes from interior compartment side	Downward	Remove pillar trim
Door pockets	Through openings in inner door panel	Over all bottom inner surface	Remove pillar trim

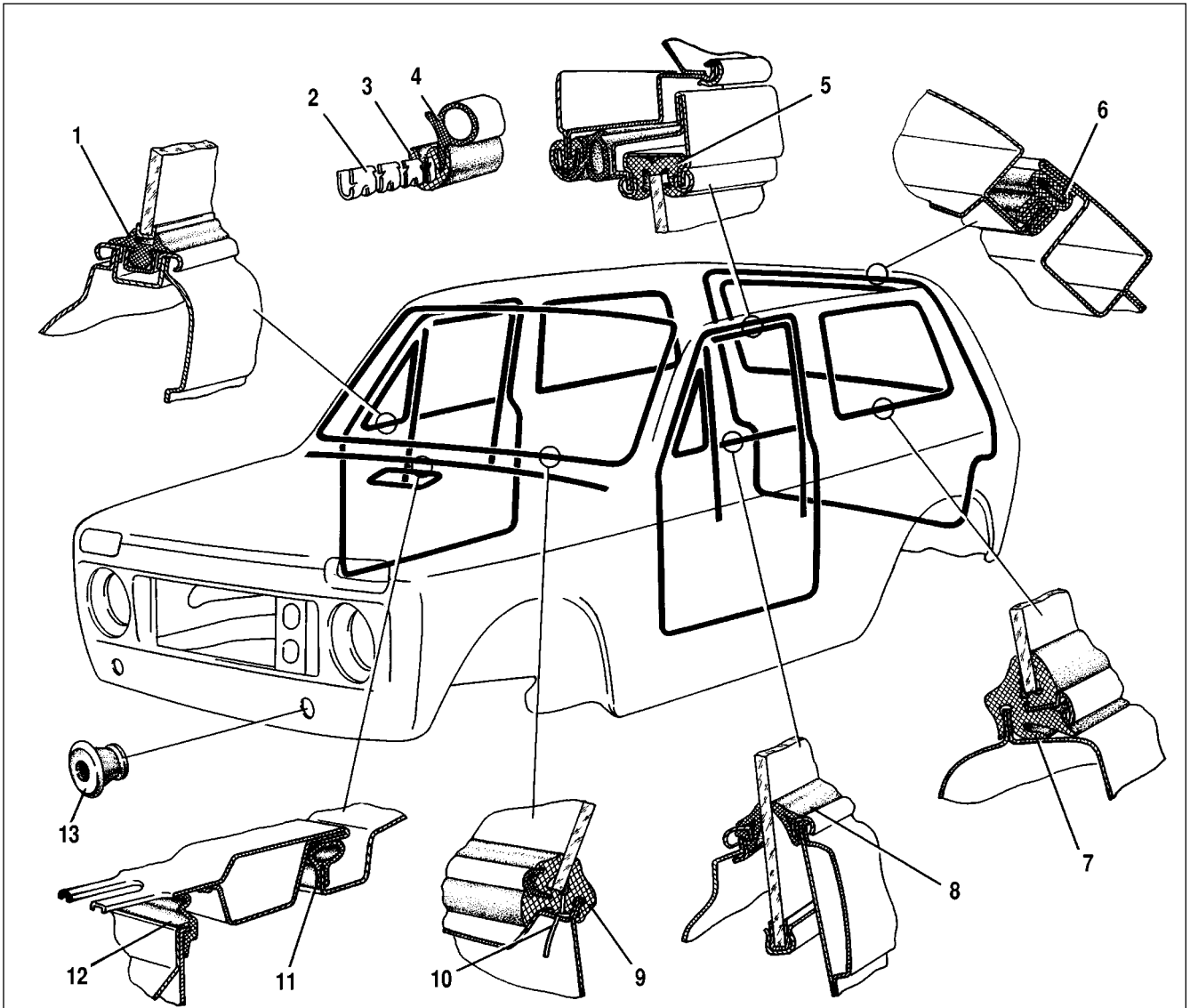


Fig.8-9. Rubber seals:

1 - of swivel glass; 2 - front door seal frame; 3 - seal molding; 4 - front door seal; 5 - of sliding glass; 6 - of tailgate aperture; 7 - of side window; 8 - lower seal of sliding window; 9 - of windscreen; 10 - drain pipe; 11 - bonnet seal; 12 - of air intake; 13 - of front bumper connection

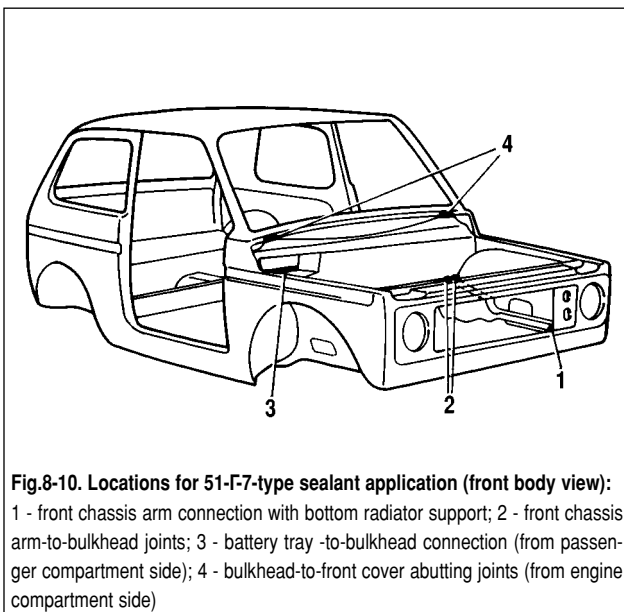


Fig.8-10. Locations for 51-F-7-type sealant application (front body view):

1 - front chassis arm connection with bottom radiator support; 2 - front chassis arm-to-bulkhead joints; 3 - battery tray -to-bulkhead connection (from passenger compartment side); 4 - bulkhead-to-front cover abutting joints (from engine compartment side)

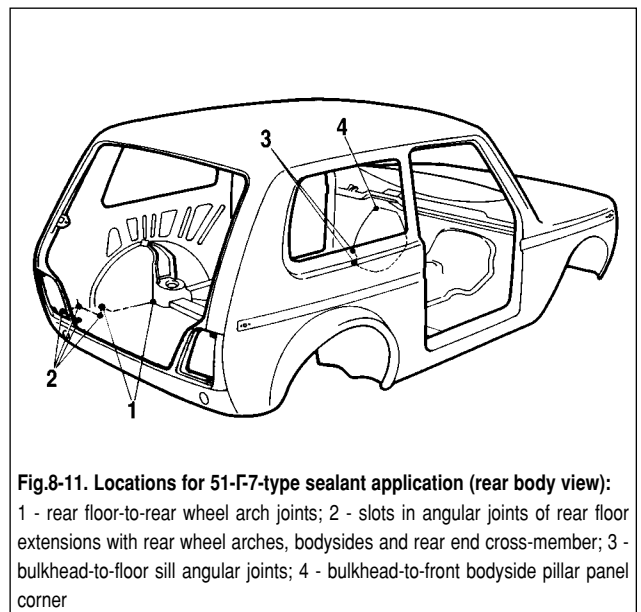


Fig.8-11. Locations for 51-F-7-type sealant application (rear body view):

1 - rear floor-to-rear wheel arch joints; 2 - slots in angular joints of rear floor extensions with rear wheel arches, bodysides and rear end cross-member; 3 - bulkhead-to-floor sill angular joints; 4 - bulkhead-to-front bodyside pillar panel corner

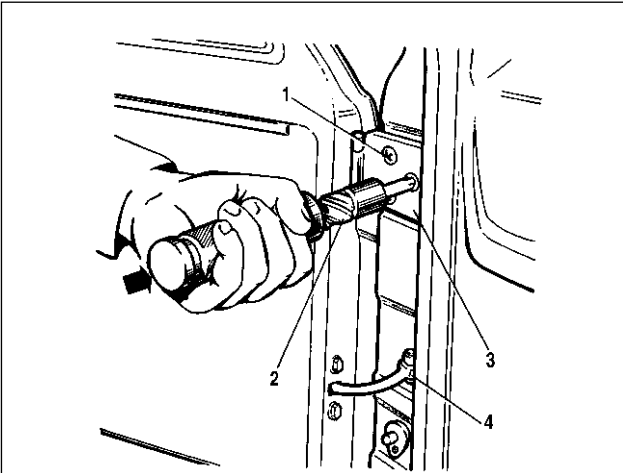


Fig.8-12. Removing the front door:
 1 - hinge screw; 2 - impact screwdriver; 3 - hinge; 4 - check strap.
 Arrowed is the direction to hit the impact screwdriver

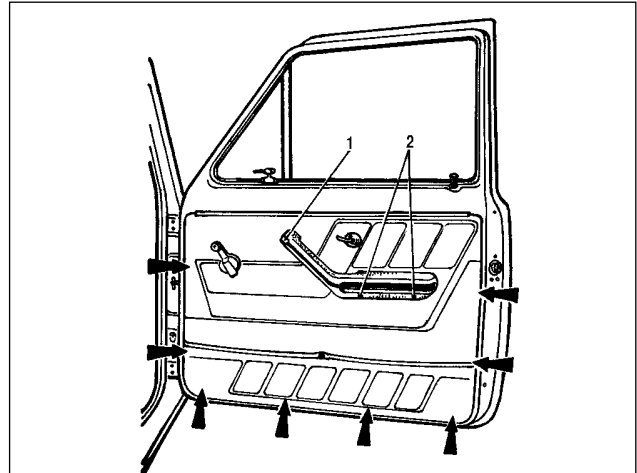


Fig.8-13. Front door inner view:
 1 - top armrest screw clip; 2 - bottom armrest securing screws
 Arrowed is the location for door trim securing clips

Door

Front door - removal and refitting

Fully open the door, push out the finger holding the check strap to the front pillar and disconnect the check strap.

Hold the door open and using impact screwdriver 2 (Fig.8-12), undo screws 1 securing the door hinges to the pillar. Withdraw the door.

Refitting is the reversal of removal. Prior to finally tighten screws 1, adequately line up the door with the aperture in the body.

Front door - dismantling and reassembly

Dismantle the door when you have to repair the door or renew its units and mechanisms.

Remove upper screw plastic clip 1 (Fig.8-13), undo the screws that secure the armrest door pull and remove the armrest door pull.

Prise out surround 20 (Fig.8-14), trim 1 and remove window lifter handle 2. Using a screwdriver, remove the trim of the inner door lock handle.

Remove the door trim overcoming the resistance of the spring-type plastic retaining clips (arrowed in Fig.8-13).

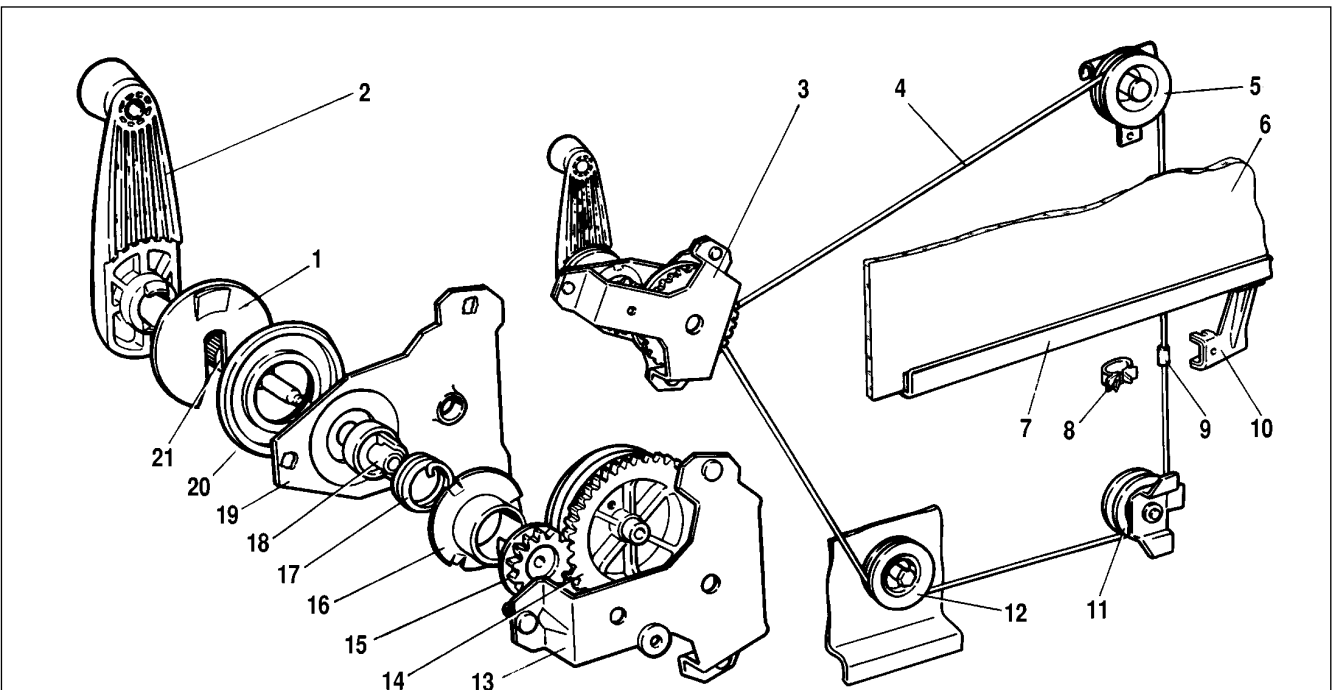


Fig. 8-14. Sliding glass actuation:
 1 - escutcheon; 2 - window lifter handle; 3 - window lifter mechanism; 4 - cable; 5 - top roller; 6 - sliding glass; 7 - sliding glass holder; 8 - cable retainer; 9 - cable sleeve; 10 - glass holder bracket; 11 - bottom roller; 12 - tensioner; 13 - window lifter housing; 14 - barrel and driven gear; 15 - pinion; 16 - support; 17 - brake spring; 18 - spring brake drive link; 19 - housing cover; 20 - surround; 21 - shaft

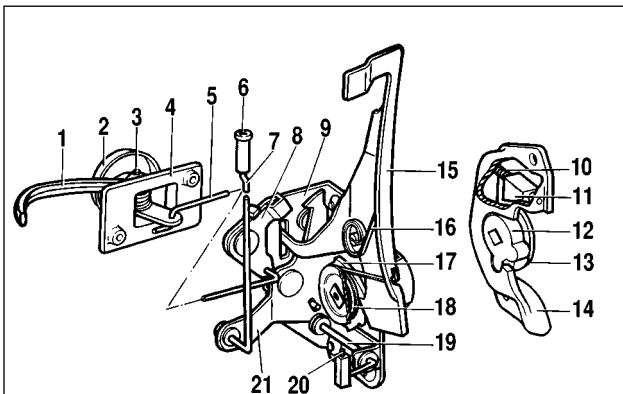


Fig.8-15. Front left door lock:

1 - inner door handle; 2 - escutcheon; 3 - pivot shaft; 4 - inner door bracket; 5 - inner door operating link; 6 - door locking knob; 7 - locking knob rod; 8 - inner control lever; 9 - lock body; 10 - spring; 11 - thrust block; 12 - rotor; 13 - central shaft support; 14 - striker housing; 15 - exterior drive lever; 16 - exterior drive lever spring; 17 - ratchet; 18 - ratchet spring; 19 - lock release shaft; 20 - lock release link; 21 - lock operating lever

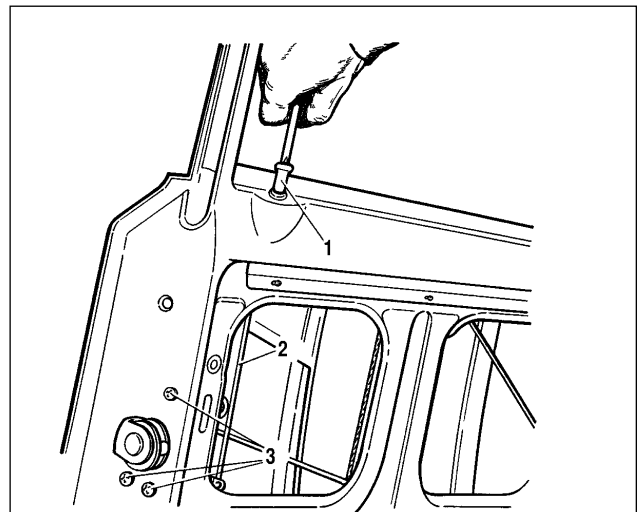


Fig.8-16. Front door lock attachment:

1 - door locking knob; 2 - locking knob rod; 3 - lock securing screws

With the sliding glass fully up, undo the retaining screws and remove the front and rear glass guide channel.

Slide the window down and slacken the window lifter tension roller. Detach the cable from the sliding glass holder and remove it from the rollers. Holding the cable taut, undo the retaining nuts and withdraw the window regulator. Clamp the cable at the barrel output with a wire clip. Withdraw the window glass through the lower door aperture.

Undo the retaining screws to remove the swivel glass complete with the sliding glass weatherstrips.

Undo door locking knob 6 (Fig.8-15), undo the screws that retain inner door handle 1 bracket 4. Undo lock securing screws 3 (Fig.8-16) and remove the lock complete with the links, having first detached lock release link 20 (Fig.8-15) from the lock driver.

Undo the two securing nuts and remove the external door handle.

Undo the two retaining bolts and remove the check strap.

Reassembly is a straightforward reversal of dismantling.

When refitting the window lifter, watch there is no overlapping of the cable on the drum. Adequately adjust the tension of cable 2 (Fig.8-17) and ensure smooth operation of the window lifter by means of the tension roller, having slackened nut 3.

Before refitting the door trim, inspect the plastic clips.

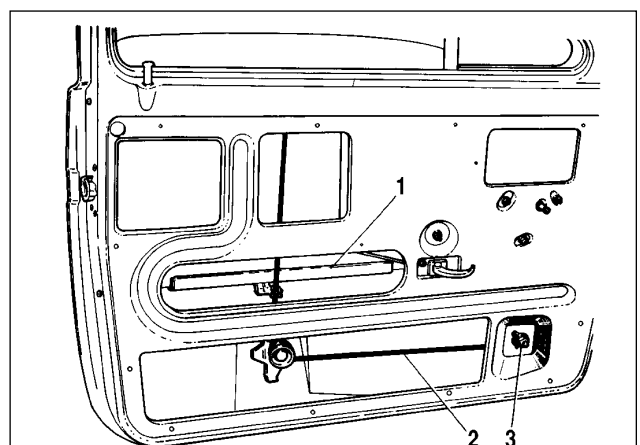


Fig.8-17. Adjusting the window lifter cable tension:

1 - sliding glass holder; 2 - cable; 3 - nut, tensioner bolt

Front door - alignment

Start the alignment by marking the contours of hinges on the body pillar. Using impact screwdriver 2 (Fig.8-12), slacken hinge retaining screws 1.

Align the door with the aperture in the body to the clearances required, shifting the hinges within the contour marked. On completion, tighten the screws.

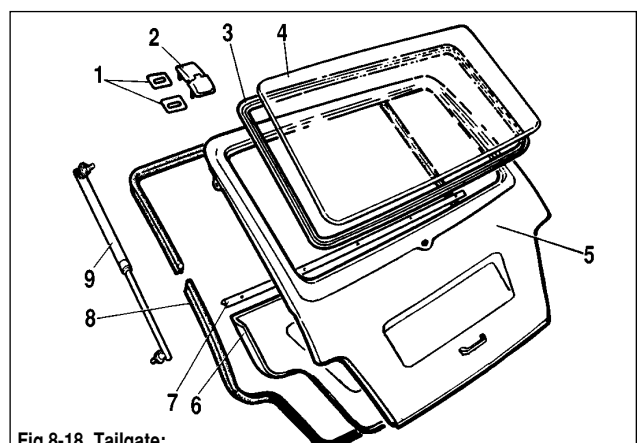


Fig.8-18. Tailgate:

1 - gaskets; 2 - hinge; 3 - window seal; 4 - glass; 5 - tailgate; 6 - door trim; 7 - cover; 8 - door aperture seal; 9 - gas-filled strut

Front door lock - adjustment

To ensure a trouble-free operation of the lock, slacken the securing bolts and align the position of door striker housing 14 (Fig.8-15).

It is a good practice to mark the door striker contour on the body pillar before making any alignments.

If the door fits too tight, slacken the door striker securing screws, move the striker outward and tighten the screws. If the door fails to close firmly, move the striker inward. Check to see the door is not seized and lines up within the body aperture.

Lower down the striker if the door goes up when closing (door sagging in the open position).

When the door is difficult to open with inner handle 1, adjust the handle position accordingly. To do this, slacken the securing screws and move the handle and bracket to the optimum position.

On completion, tighten the securing screws.

Tailgate - removal, refitting and alignment

The tailgate is hinged to the body (two hinges 2, Fig.8-18) and is locked. In the open the tailgate is held by two solid gas-filled struts 9.

Disconnect the struts from the door by removing the pins from the welded nuts.

Disconnect the wiper wiring and washer tube, undo the nuts holding the door to the hinges and withdraw the door.

When refitting the door make appropriate alignments within the body aperture via the oval holes for the hinge studs, then finally tighten the nuts.

When the door lock (Fig.8-19) is difficult in operation, adjust the lock by moving housing 4 or striker plate 5 as appropriate.

The gas-filled struts must be renewed if they fail to hold the door open.

Bonnet, bumpers

Bonnet - removal, refitting and adjustment

Open bonnet 3 (Fig.8-20), undo the pin from pivot 1 of bonnet stay 2 and detach the stay from the bonnet.

Holding the bonnet, undo bolts 4 of upper hinge 5 links to withdraw the bonnet.

Refitting is a reversal of removal. Align the bonnet as applicable via the slotted holes in the hinges.

Bonnet lock adjustment. Adjust the lock position when locking is not reliable or when unlocking requires excessive efforts (Fig.8-21).

Open the bonnet, mark the contour of lock housing 1, slacken the retaining nuts and move the lock housing as appropriate within the slotted hole.

Tighten the nuts and check the lock for satisfactory operation.

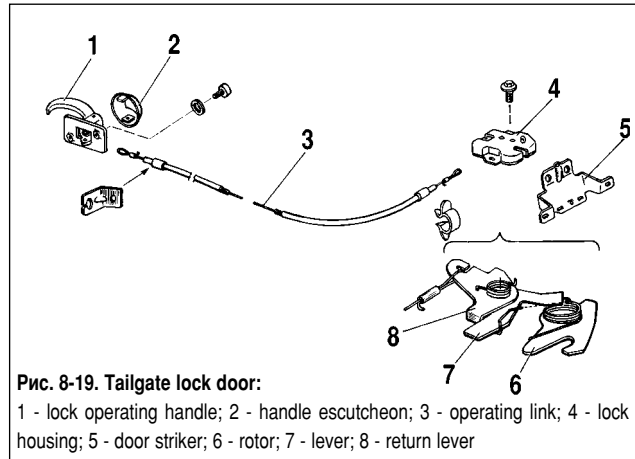


Fig. 8-19. Tailgate lock door:
1 - lock operating handle; 2 - handle escutcheon; 3 - operating link; 4 - lock housing; 5 - door striker; 6 - rotor; 7 - lever; 8 - return lever

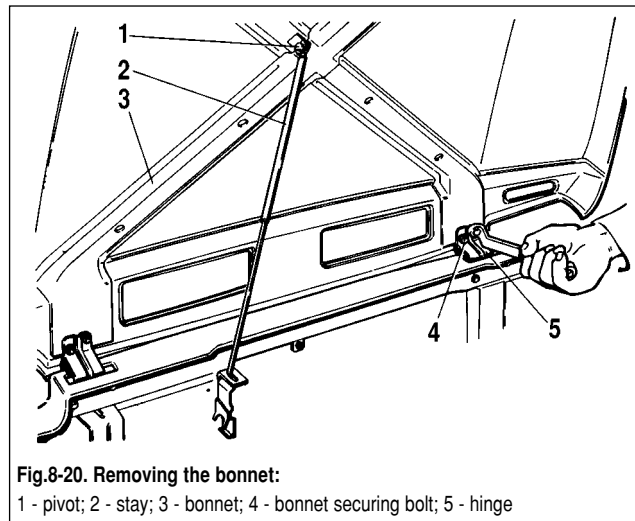


Fig.8-20. Removing the bonnet:
1 - pivot; 2 - stay; 3 - bonnet; 4 - bonnet securing bolt; 5 - hinge

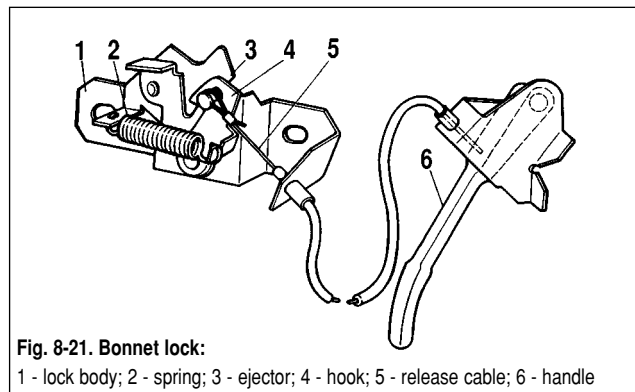


Fig. 8-21. Bonnet lock:
1 - lock body; 2 - spring; 3 - ejector; 4 - hook; 5 - release cable; 6 - handle

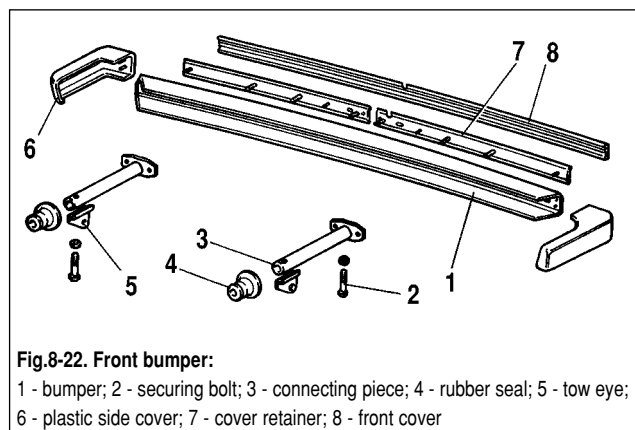


Fig.8-22. Front bumper:
1 - bumper; 2 - securing bolt; 3 - connecting piece; 4 - rubber seal; 5 - tow eye; 6 - plastic side cover; 7 - cover retainer; 8 - front cover

Bumpers - removal and refitting

The bumpers (Fig.8-22) are made from aluminium profile, with the face lined lengthwise with black rubber strip 8. The bumper ends are fitted with plastic black cover plates 6.

Both bumpers are secured to the body with two bolts to be undone when removing the bumpers.

Refitting is reversal to removal.

Bodywork glazing and windscreen washers

Windscreen - renewal

To replace a damaged windscreen, remove the windscreen wiper arms and moulding. Then applying pressure to the top windscreen corners, force the windscreen out. Ask your assistant to support the windscreen from the outside (Fig.8-23).

Remove the windscreen seal.

Refitting is carried out in the following sequence:

- rinse seal 9 grooves (Fig.8-9) with water, then blow dry with compressed air;

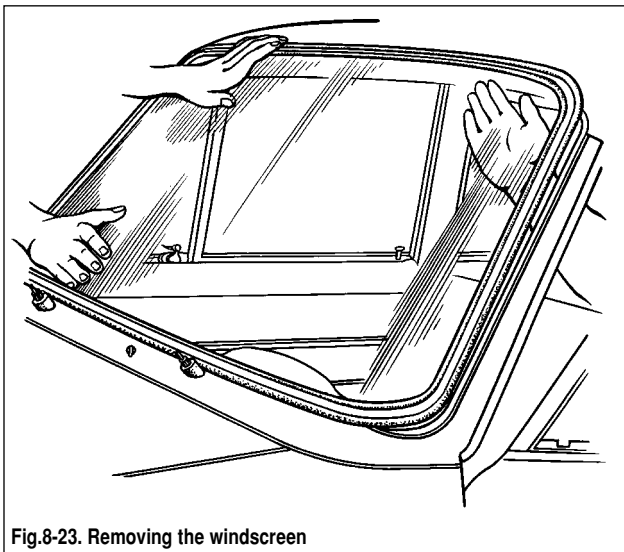


Fig.8-23. Removing the windscreen

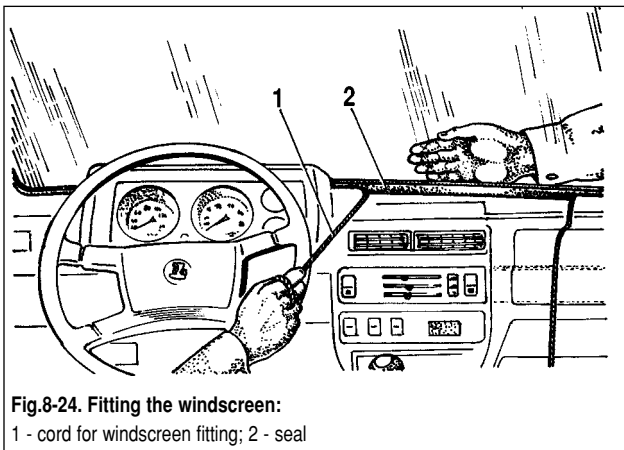


Fig.8-24. Fitting the windscreen:

1 - cord for windscreen fitting; 2 - seal

- refit the seal to the windscreen;
- using glycerine or soapy water, wet seal 2 groove (Fig.8-24) which is used for attaching it to the body flange;
- using a screwdriver, place cord 1 into the groove;
- refit the windscreen to the aperture, then tighten cord 1 ends inside the body to have the glass with seal 2 fitted snugly to place. Ask your assistant to stand outside and slightly press the windscreen inward. Should you experience any difficulties to fit it, check the aperture size, using the windscreen without the seal. Rectify any deviations in the aperture size as applicable.

Side and rear window glasses - replacement

To withdraw the glasses, remove the molding, then depress at the bottom glass corners and force the glass out. Ask your assistant to support the glass from falling outside.

Refitting of the side and rear window glasses is similar to that of the windscreen.

Washer system

The washer system is shown in Fig.8-25.

A separate washer container for the tailgate washer is provided in the luggage compartment.

Removal and refitting of windscreen / headlamp washer pump. Detach the wiring from motor 1 (Fig. 8-26) and remove the tube from the washer pump connection unit.

Turn cover 2 with motor anticlockwise and withdraw the pump from the fluid container.

Refitting is a reversal of the removal sequence.

Dismantling and reassembly of windscreen / headlamp washer pump. The pump and motor (Fig.8-26) are secured with the screws and nuts to cover 2.

To dismantle the pump, undo the screws, remove the motor and cover, detach pick-up tube 4. Pick rim 8 edge to prise it out

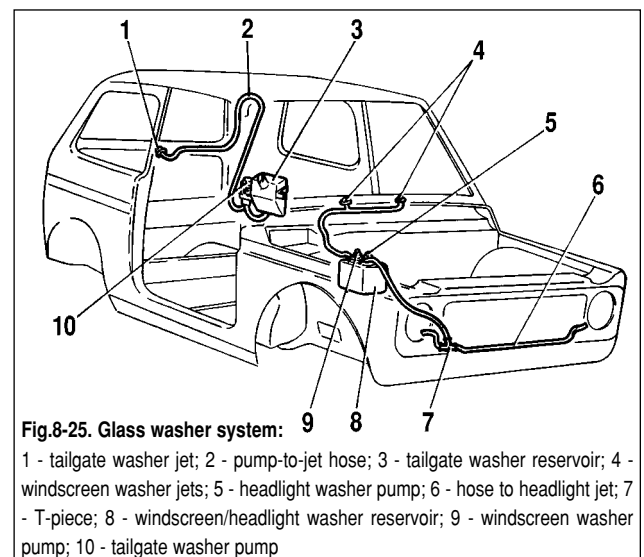


Fig.8-25. Glass washer system:

1 - tailgate washer jet; 2 - pump-to-jet hose; 3 - tailgate washer reservoir; 4 - windscreen washer jets; 5 - headlight washer pump; 6 - hose to headlight jet; 7 - T-piece; 8 - windscreen/headlight washer reservoir; 9 - windscreen washer pump; 10 - tailgate washer pump

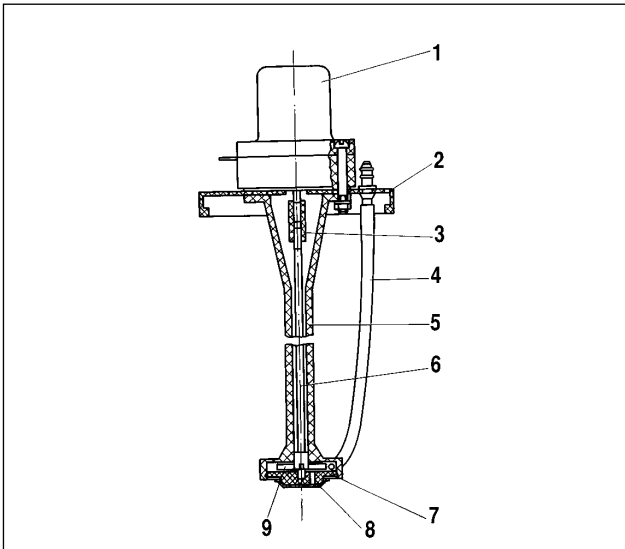


Fig.8-26. Washer pump:

1 - motor; 2 - reservoir cover; 3 - sleeve; 4 - pick-up tube; 5 - pump housing; 6 - rotor shaft; 7 - rotor shaft support; 8 - rim and filter gauze; 9 - rotor

together with the filter gauze. Extract sleeve 3, then carefully tapping rotor 9 shaft 6, push support 7 out and withdraw the shaft and rotor.

Reassembly is a reversal of dismantling.

Removal and refitting of washer jets. Working from the engine bay, slightly squeeze the holders of plastic housing 1 (Fig.8-27), next pick its top with a screwdriver and force the jet complete with the atomizer. Detach the tube and blow atomizer 2 and housing with compressed air. Refit the jet pushing its housing strongly into the bore in the body.

Adjust the fluid jet through altering the atomizer position within the socket in the housing. For that insert a needle into the atomizer hole and carefully swivel the atomizer to direct the fluid jet where desired.

Instrument panel, seats

Instrument panel - removal and refitting

Disconnect the battery negative lead.

Remove the windscreen pillar trim, steering column shroud, instrument panel surround 14 (Fig.8-28), instrument cluster (Refer to section «Electrical equipment»), disconnect the wiring connectors and wiring plugs.

Remove the instrument lighting switch knob, undo the retaining nut and push the switch down, behind the instrument panel.

Undo the retaining screws, remove front parcel shelf 9 and radio support panel 13; disconnect the wiring from the radio, cigarette lighter, headlight wipe/wash switch, hazard warning flasher switch.

Undo the retaining screws and withdraw glovebox housing 4.

Remove the knobs of the heater control levers. To do this, at the knob / lever connection point prise out the lower part of the top knob with some flat and sharp tool, while for the middle and lower knobs - prise out the upper part.

Undo the four screws (arrowed in Fig.8-29) holding lower instrument panel 3 (Fig.8-28) to the front cross-member, then working through the apertures of the glovebox and instrument panel binnacle, undo four nuts holding the top panel to the front end, next remove the instrument panel.

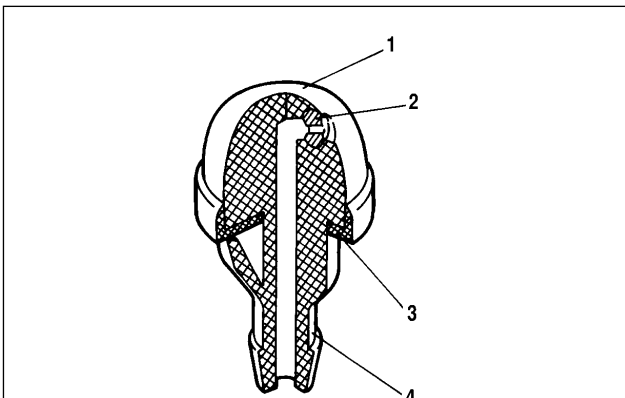


Fig.8-27. Windscreen and tailgate washer jets:

1 - jet housing; 2 - atomizer; 3 - gasket; 4 - pipe union

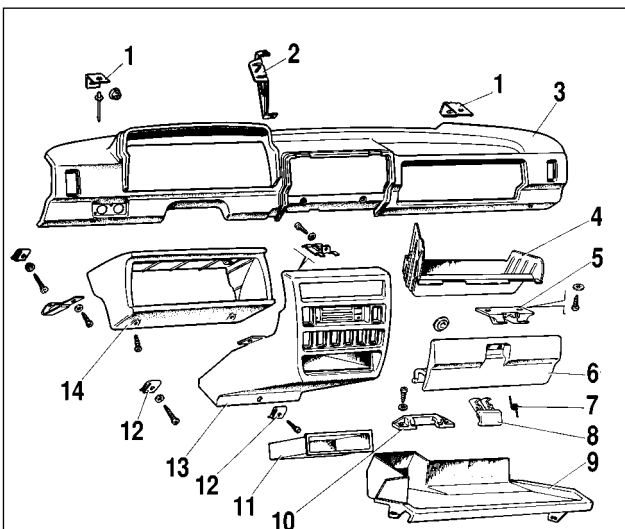


Fig.8-28. Instrument panel components:

1 - bracket; 2 - reinforcement; 3 - instrument panel; 4 - glovebox housing; 5 - lid catch; 6 - glovebox lid; 7 - spring; 8 - lid latch; 9 - shelf; 10 - lid hinge link; 11 - trinket tray; 12 - retaining clips; 13 - radio support panel; 14 - instrument panel surround

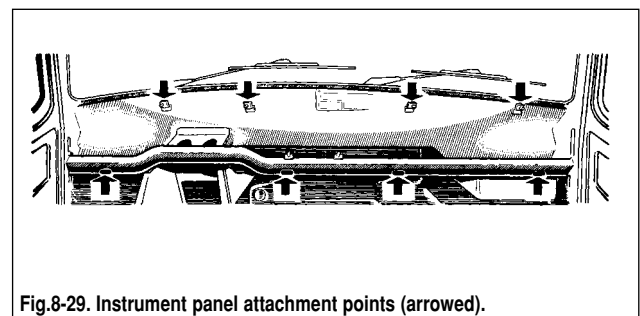
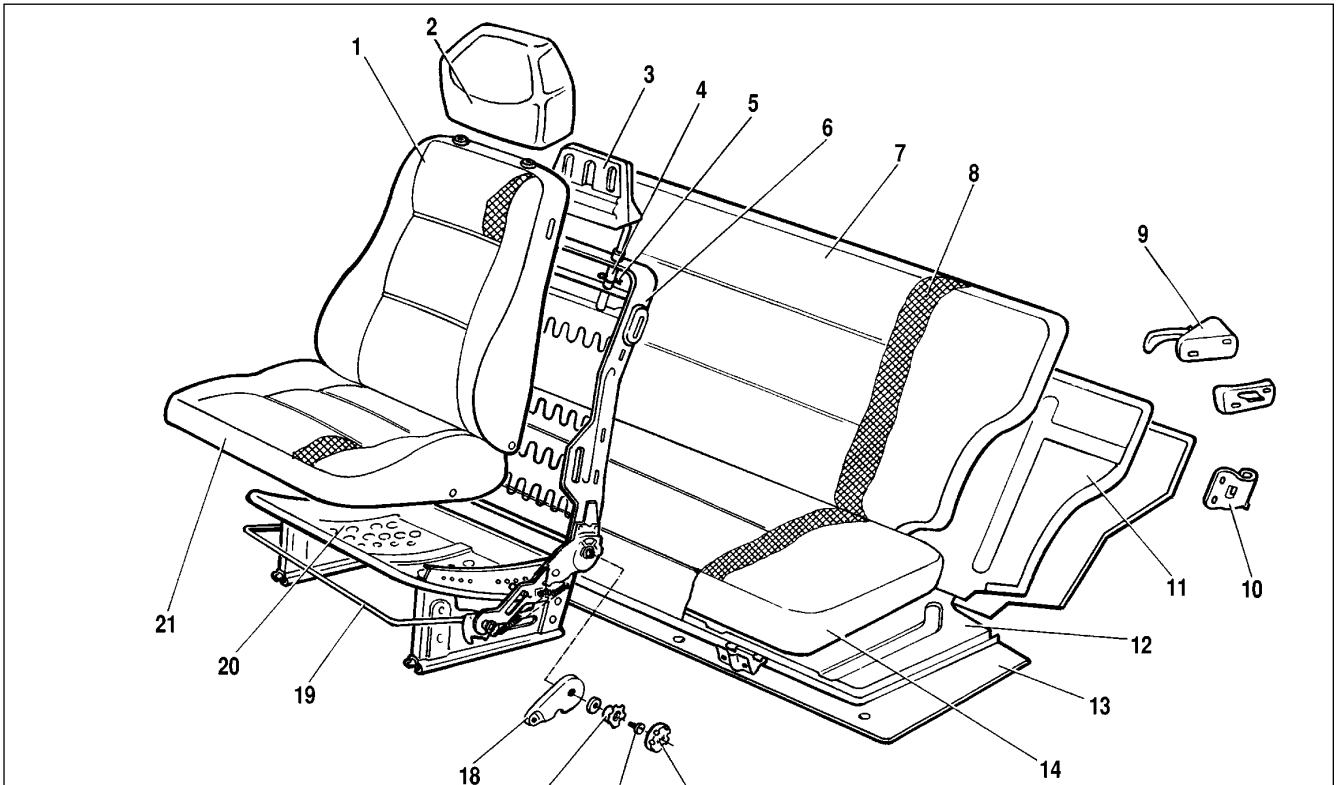


Fig.8-29. Instrument panel attachment points (arrowed).



8Fig.8-30. Seats:

1 - seat back; 2 - headrest; 3 - headrest frame; 4 - headrest guide; 5 - cotter pin; 6 - front seat back frame; 7 - rear seat back trim; 8 - trim backing; 9 - seat back catch; 10 - seat back clamp; 11 - seat back base; 12 - cushion base; 13 - carpet; 14 - rear seat cushion padding; 15 - seat back rake adjuster knob; 16 - retainer securing bolt; 17 - seat back reclining mechanism handle retainer; 18 - trim, seat back reclining mechanism; 19 - seat sliding mechanism grab handle; 20 - front seat cushion frame; 21 - front seat cushion

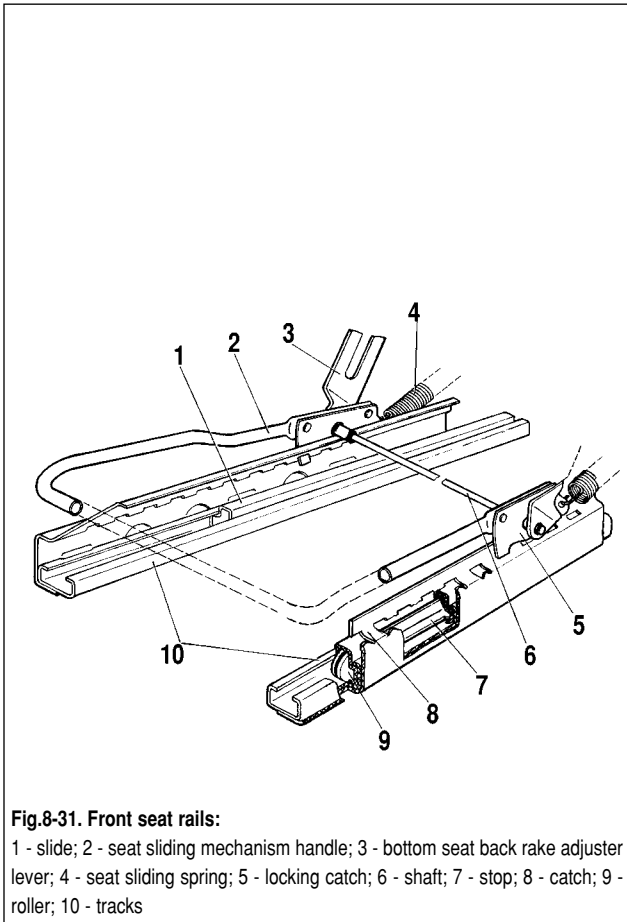


Fig.8-31. Front seat rails:

1 - slide; 2 - seat sliding mechanism handle; 3 - bottom seat back rake adjuster lever; 4 - seat sliding spring; 5 - locking catch; 6 - shaft; 7 - stop; 8 - catch; 9 - roller; 10 - tracks

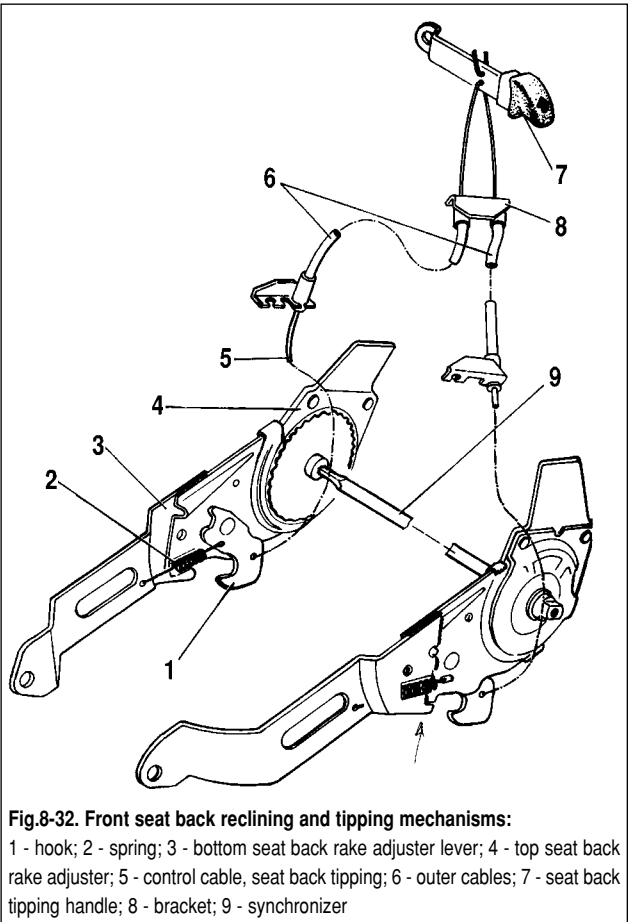


Fig.8-32. Front seat back reclining and tipping mechanisms:

1 - hook; 2 - spring; 3 - bottom seat back rake adjuster lever; 4 - top seat back rake adjuster; 5 - control cable, seat back tipping; 6 - outer cables; 7 - seat back tipping handle; 8 - bracket; 9 - synchronizer

When necessary, remove the centre facia and side facia vent nozzles together with the associated air ducts.

Refitting is a reversal of removal.

Seats - removal and refitting

The front seats design is shown in Fig.8-30, Fig.8-31 and Fig.8-32.

Front seats. To remove the seat, move it fully forward, undo the rear bolts securing the rails to the floor.

Move the seat fully rearward, undo the front bolts securing the rails and withdraw the seat complete with the adjuster mechanisms.

Refitting is a reversal of removal.

Rear seat. Release catches 9 (Fig.8-30) holding the seat back, undo the bolts securing the seat cushion straps to the floor cross-member, then withdraw the seat.

Refitting is a reversal of removal.

Front seat rails - dismantling and reassembly

For dismantling, remove the seats from the vehicle.

Raise handle 2 (Fig.8-31) up, move tracks 10 forward, remove the front rest on the tracks, move the tracks rearward until rollers 9 go out of end stop 7, withdraw the tracks.

To reassemble, relocate the rollers with the stop into the slider groove, force the track fully forward and restore the rests mechanically. Lower down handle 2 and check the slides for smooth operation.

Heater unit

Removal and refitting

To remove the heater unit perform the following operations:

- fully shift rightward knob 6 (Fig.8-33) of heater tap 17 and drain coolant from the engine cooling system;
- disconnect the battery negative lead;
- undo the securing screws, remove the facia shelf and radio panel, disconnect the relevant wiring;
- slacken the clips and detach the rubber hoses from heater supply / return tubes 16;
- working from the engine bay side, undo the two retaining bolts and remove the heater radiator pipe grommet;
- loosen the bolt of tap outer cable retaining clamp, then remove the cable from the tap;
- remove the heater blower motor switch and disconnect its wiring;
- remove four spring holders and fan blower cowl 18 complete with the blower;

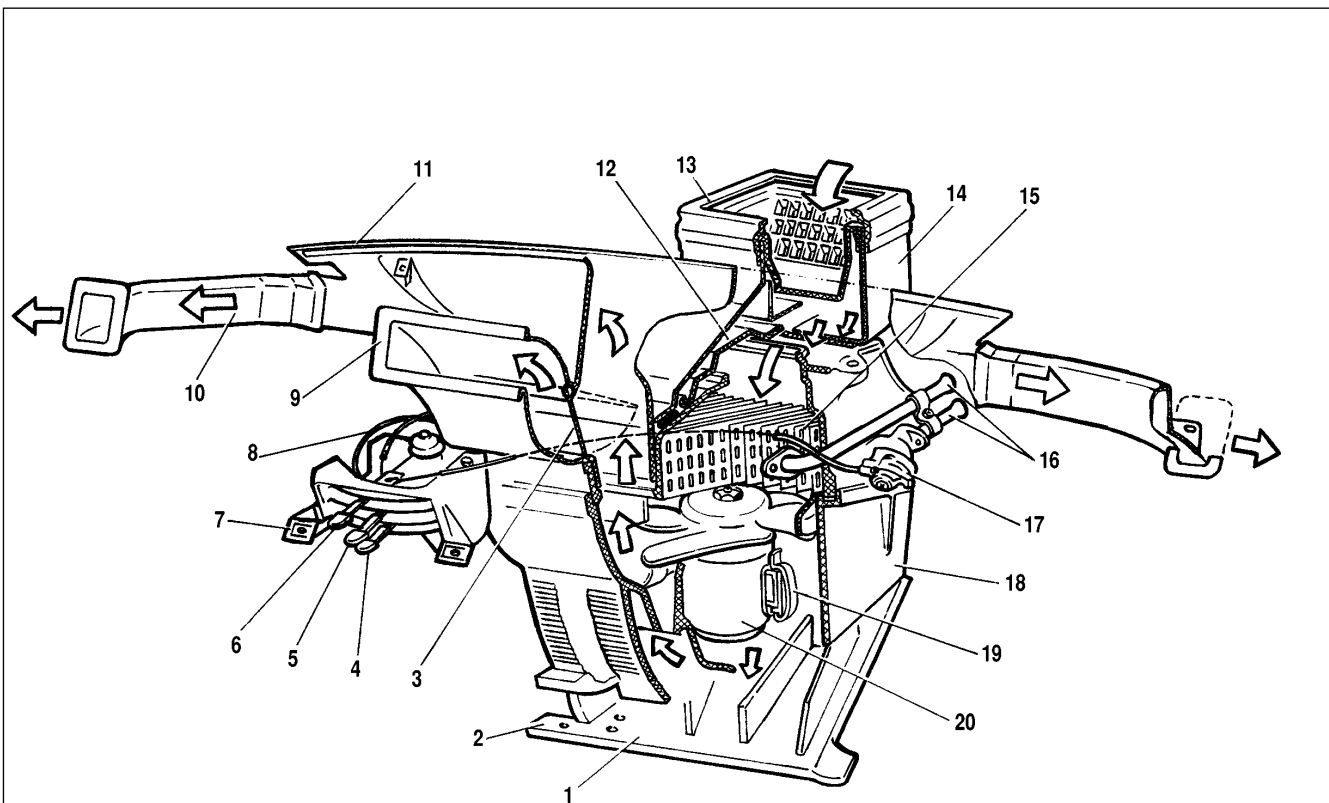


Fig.8-33. Heater unit:

1 - air distribution cover; 2 - lever; 3 - windscreen demister airduct flap; 4 - windscreen heating flap control knob; 5 - air intake cover control knob; 6 - tap control knob; 7 - control levers bracket; 8 - control cable; 9 - interior ventilation airduct; 10 - side demister airduct; 11 - windscreen demister airduct; 12 - air intake cover; 13 - air intake grommet; 14 - air intake; 15 - heater matrix; 16 - delivery and return pipes; 17 - tap; 18 - fan cowl; 19 - spring clip; 20 - fan motor

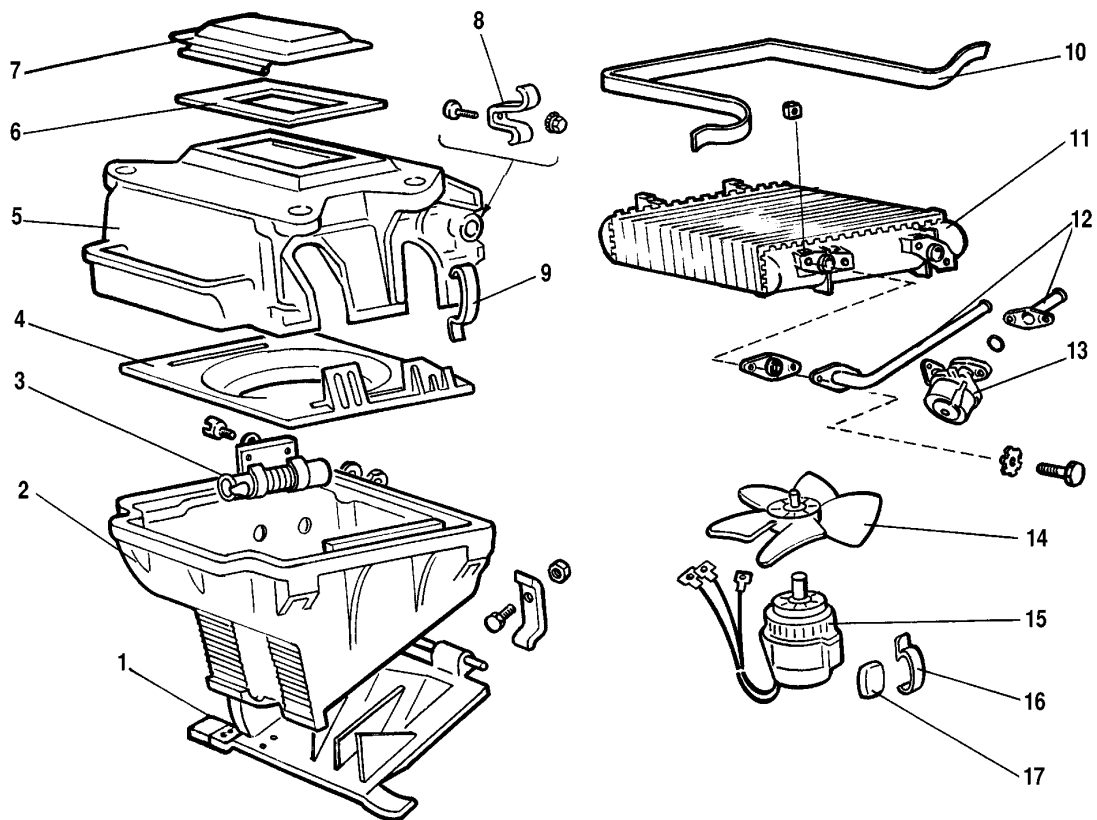


Fig.8-34. Heater components:

1 - air distribution cover; 2 - fan shroud; 3 - resistor; 4 - guide cowl; 5 - heater matrix housing; 6 - air intake cover gasket; 7 - air intake cover; 8 - spring clips, delivery and return pipes; 9 - spring clip; 10 - gasket; 11 - heater matrix; 12 - delivery and return pipes; 13 - heater tap; 14 - fan impeller; 15 - fan motor; 16 - spring clip; 17 - mounting pad

- remove the instrument panel surround, through this aperture, working on bracket 7, loosen the screws of air intake cover 12 cable clips and windscreen heating duct shutter 3. Remove the rods from the control levers;

- undo the nuts holding heater matrix 15 housing to air intake 14, disconnect the negative lead secured under one of the nuts, remove the housing and air intake unit.

Refitting of the heater is a reversal of removal.

Check the position of the sealing grommet between the radiator cowl and body, ensure the rubber hoses securing straps are reliably tightened.

After the hoses have been refitted and reconnected, fill the engine cooling system with coolant and check the connections for leaks.

Heater unit - dismantling and reassembly

To dismantle the heater unit, remove two spring clips 16 (Fig.8-34) and remove the electric blower fan from shroud 4. Undo impeller securing nut 14 and detach it from motor 15.

Undo clasp 8 nut holding the supply and return pipes, remove the clasp and detach heater matrix 11 from housing 5.

Undo the clip retaining nuts and lift off air intake cover 7.

Undo the clip retaining nuts and remove air distributor cover 1 of the blower shroud.

The reassembly is a reversal of removal.

Chapter 9. VAZ-21213 vehicle modifications, alternative and additional equipment

VAZ-21214 vehicle

The VAZ-21214 vehicle is fitted with 1.7-L engine, Central Fuel Injection (CFI). Instead of the carburettor, a single injector is used for injecting fuel into the central injection unit. Here fuel is mixed with air, the resulting combustion mixture is fed to the intake manifold and further to the engine cylinders.

The fuel injection system and catalytic converter in the exhaust system help reduce exhaust emission and improve vehicle performance.

This chapter provides a brief description of design features, operation and diagnostics of fuel injection system, removal and refitting procedures and methods for engine repair. Refer to Repair Manual for Central Fuel Injection System for a more detailed description of the system design, repair and diagnostics with the help of specialized tools and diagnostic charts.

Engine repair - description

Engine - removal and refitting

Before removing the engine, depressurize the fuel system. To do this, detach the fuel pump wiring plug from the injection wiring connector, start the engine, run it for a while, then stop the engine and operate the starter motor for 3 seconds to equalize the pressure in the line.

Disconnect the battery negative lead.

Slacken the nuts holding the air cleaner to the central injection unit and to the pin in the valve cover, detach the relevant hoses and remove the air cleaner. Detach the injector wiring; then temporarily plug the filler neck of the central injection unit.

Disconnect the fuel supply/return hoses from the pipes on the engine. Plug the open ends of the hoses and pipes to prevent dirt ingress or fuel leaking.

Disconnect the throttle cable from the central injection unit and from the bracket on the intake manifold.

On the central injection unit disconnect all vacuum hoses to the charcoal canister and MAP sensor, detach the crankcase vent hose. Disconnect the wiring from all injection-related units fitted to the engine.

Further steps for removing the engine are in accordance with the established procedure.

Refitting is the reverse order of removal. On completion adjust

the accelerator cable and check the operation of fuel injection system, as recommended in Repair Manual for Central Fuel Injection.

Engine - dismantling and reassembly

Remove bracket 3 (Fig.9-1) with ignition module 4, then plug 2 with gasket and detent 1 with the sealing ring.

Disconnect and remove the supply/return pipes from the central injection unit and from the bracket on the valve cover.

Undo the retaining pins and remove the central injection unit, withdraw the gasket from the intake pipe surface.

Remove intake manifold 2 (Fig.9-2) with preheater 1. When applicable, on a work bench, detach the preheater complete with the gasket and sealing ring from the intake manifold.

Unscrew the crankshaft position sensor, mounted on the timing cover.

Further dismantling of the engine is carried out in the usual order as outlined in section 2.

Reassembly is the reversal of dismantling. There is a disposal gasket under the central injection unit, always remember to renew it during reassembly.

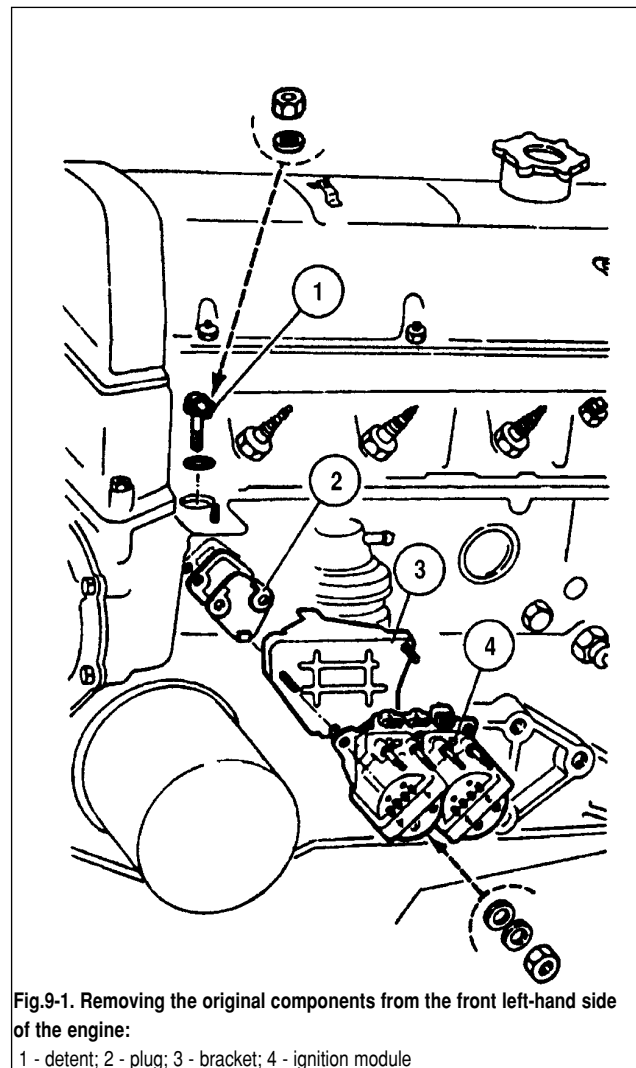


Fig.9-1. Removing the original components from the front left-hand side of the engine:

1 - detent; 2 - plug; 3 - bracket; 4 - ignition module

Central Injection Unit

Removal and refitting

Select the neutral position of the gearchange lever and apply the handbrake.

Since, after the engine is stalled, fuel remains under pressure, always depressurize the fuel system. To do this, disconnect the fuel pump wiring plug from the injection wiring harness. Start the engine and run it until it cuts off. Operate the starter motor for three seconds to equalize pressure in the pipework. Reconnect the fuel pump wiring plug to the injection wiring harness. Disconnect the battery negative lead.

Remove the air cleaner and disconnect the throttle cable from the central injection unit.

Detach the fuel pipes from the central injection unit and plug the pipe ends to prevent fuel leakage.

Disconnect the wiring plug (Fig.9-3) of throttle position sensor 4, injector 2 and idle air control valve 9.

On the central injection unit detach the vacuum hoses to the canister and MAP sender, along with the crankcase vent hose. Make certain everything is reconnected properly.

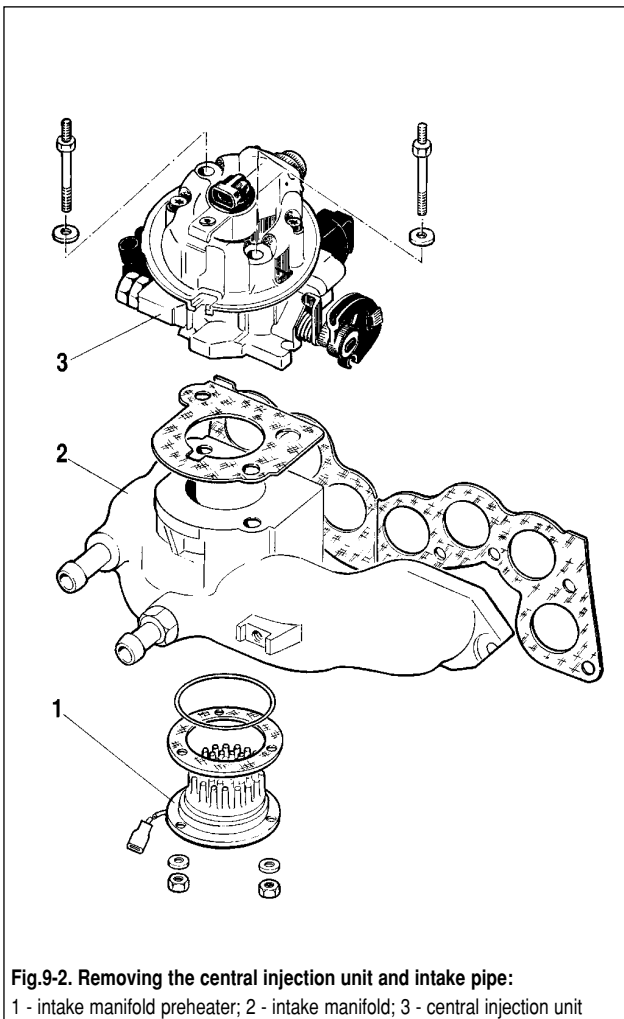


Fig.9-2. Removing the central injection unit and intake pipe:

1 - intake manifold preheater; 2 - intake manifold; 3 - central injection unit

Undo the retaining pins and remove the central injection unit from the intake pipe complete with the gasket. Plug the intake pipe end to prevent entry of extraneous matter.

Refitting is the reverse order of removing. Pay attention to the condition of the seals and gaskets, renew if applicable.

On completion, check the fuel pressure as described below.

WARNING. Never re-use the gasket mounted under the central injection unit and sealing rings of fuel pipes.

Dismantling and reassembly.

Undo the retaining screws and remove throttle position (TP) sensor 10 (Fig. 9-4), injector 6, fuel pressure regulator, vacuum hose manifold housing 13 and idle air control valve 14.

Undo two retaining screws and disconnect the fuel supply part from the throttle housing.

Reassembly is a reverse of dismantling. Examine the seals, renew if applicable. When refitting the TP sensor, align the throttle shaft flats with the TP sensor pickup lever.

Examination and repair

Injector is a one-piece unit. When removing the injector, take care not to damage the wiring plug or atomizer head.

WARNING. Never clean or wash the injector with petrol or other cleaners.

Renew the injector seals. In the event of deposits on the injector filters (the major diameter filter is a purge filter, while the minor diameter filter is an intake filter), blow the filters with compressed air, then flush the fuel tank and fuel pipes.

Apply sealant on the retainer screw thread when refitting the injector.

Fuel pressure regulator. Remember that the spring under the regulator cover is compressed, so exercise care when unscrewing the cover.

When the regulator is removed, examine the valve seats, use a magnifying glass if necessary. The seat must not show any pitting, dents or surface irregularities, otherwise renew the fuel supply housing of the central injection unit.

It is recommended to renew the valve diaphragm after each dismantling. Always smear the thread of the regulator cover securing screw with sealant.

WARNING. When refitting the fuel pressure regulator check to see the diaphragm sits correctly without skewing.

Fuel supply housing of central injection unit. During reassembly of the central injection unit always renew the gasket between the fuel supply housings and throttle plate. Cut-outs in the gasket should be aligned with the bores in the throttle plate.

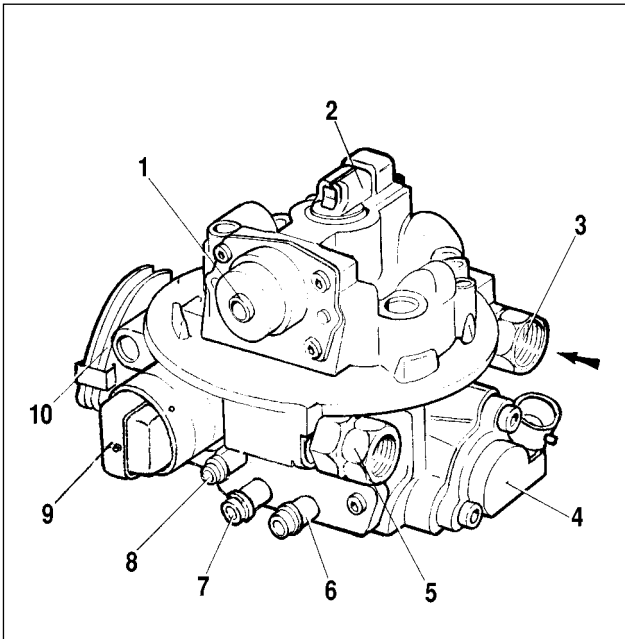


Fig.9-3. Central injection unit:

1 - fuel pressure gauge; 2 - injector; 3 - connection for fuel delivery pipe; 4 - throttle position sensor; 5 - connection for fuel return hose to tank; 6 - pipe union for canister purge hose; 7 - pipe union for crankcase vent hose; 8 - pipe union for MAP sensor hose; 9 - idle air control valve; 10 - quadrant for throttle actuation from pedal in the passenger compartment

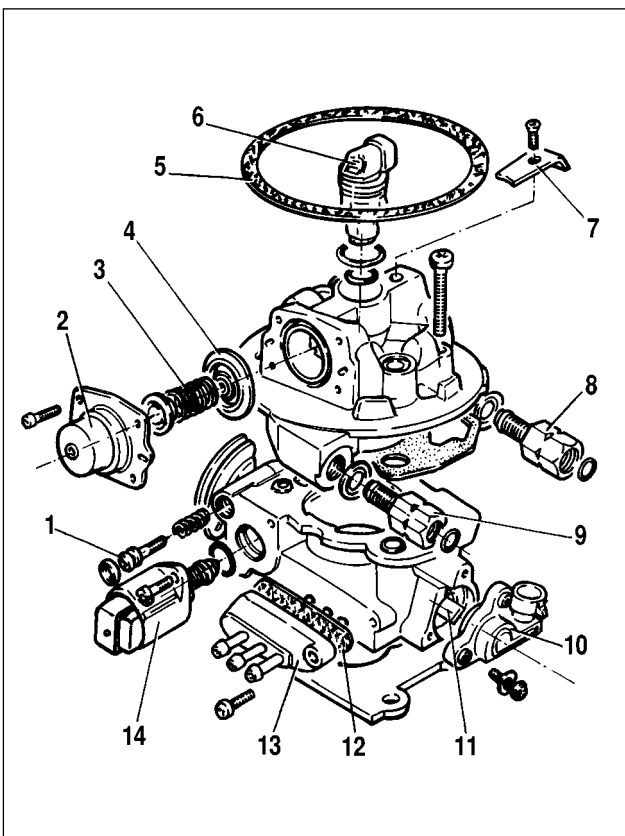


Fig.9-4. Components and assemblies of central injection unit:

1 - throttle stop screw (preset at the factory); 2 - fuel pressure regulator cover; 3 - spring; 4 - diaphragm; 5 - air cleaner gasket; 6 - injector; 7 - holder; 8 - fuel delivery pipe union; 9 - fuel return pipe union; 10 - throttle position sensor; 11 - throttle shaft; 12 - grommet; 13 - vacuum pipes housing; 14 - idle air control valve

Apply sealant on the thread of the housing securing screws.

Throttle position sensor. Before fitting the TP sensor, fully close the throttle, then turning the sensor anticlockwise, align the flats of the shaft with the sensor pickup lever.

Tighten the securing screws.

WARNING. Never clean or wash the TP sensor or idle air control valve with petrol or other cleaners.

Idle air control valve. Replace the sealing washers with new ones. The idle air control valve is of a taper shape, 10 mm diameter. Always replace it with a new valve of the respective model.

Before fitting the idle air control valve to the throttle housing, check the distance between the mounting flange and valve end. Remember, an excess protrusion of the valve can cause damages.

The distance should be less than 23 mm. When with a new idle air control valve it is in excess of 23 mm, sway the valve with your hand, pushing it in.

To avoid damage, do not hand push the valve which was in use. For this purpose it is recommended to use a diagnostic tool or specialized monitor.

After having refitted the idle air control valve and central injection unit, reconnect a diagnostic tool to the diagnostic plug and command the ECM to reset the parameters of the idle air control valve.

Throttle housing. When reassembling the central injection unit, it is a good practice to renew the sealing gasket of the fuel supply housing.

Scrape the gasket from the throttle housing and vacuum housing, fit a new gasket.

Fuel supply pressure - checking

Carry out the following checks: inspect the fuel delivery lines for leaks, check the fuel pressure regulator and electric fuel pump for satisfactory operation.

Relief the pressure in the fuel line, as described earlier for removal of the central injection unit.

Reconnect the wiring plug to the fuel pump.

Disconnect the fuel pipe from the fuel supply pipe union of the central injection unit, then using a T-piece connect a pressure gauge between the pipe union and fuel pipe.

Turn the ignition key to the position «Ignition».

Check the pressure gauge is functional, check its connection shows no leaks. The pressure should be within 190-210 kPa. When there is no pressure, listen to hear the fuel pump cuts in when the ignition key is turned to the position «Ignition» (the pump operation and its relay clicks can be distinctly heard in the passenger compartment).

Should the fuel pump fails to operate, check the pump circuit.

After two seconds of operation the fuel pump shuts off, as no

crankshaft position pulses are fed to the ECU when the engine is not running. To re-activate the fuel pump, switch off the ignition for ten seconds, then switch it on again.

After the fuel pump is shut off, the fuel pressure can slightly go down and then stabilizes; or it can go up, if the engine is warm. When the fuel pressure fails to stabilize and instead, goes down, operate the fuel pump and immediately after its stop, pinch the hose that supplies fuel to the central injection unit.

If no pressure drop is evident, check the fuel line for leaks between the fuel tank and central injection unit, check the gauze filter for tightness, then re-check pressure in the fuel delivery system.

A lower pressure (below 190 kPa) can be caused by a faulty fuel pressure regulator or by a restricted flow in the fuel delivery system.

The fuel delivery system capacity can be checked by return flow. When necessary, renew the gauze filter.

The fuel pressure regulator can be checked by a pressure gauge; for that disconnect the return hose and immerse it into a container. Operate the electric fuel pump, pinch the return hose and check the pump pressure by the pressure gauge. Release the hose. The pressure gauge reading is the pressure of the fuel pressure regulator valve actuation. Renew the fuel pressure regulator when applicable.

A higher pressure in the fuel supply system (in excess of 210 kPa) can be caused by a faulty fuel pressure regulator or a higher resistance to fuel return to the fuel tank. To check this, connect a pressure gauge to the system; then working in the engine bay, disconnect the return hose and immerse it to the container. Switch off the electric fuel pump and read the pressure gauge to check the pressure.

Should the pressure exceeds the normal value, renew the fuel pressure regulator, otherwise, identify and eliminate the cause of higher resistance to fuel return.

Electric fuel pump

Removal and refitting. Disconnect the wiring and depressurize the fuel delivery system as described in the procedure for removing the central injection unit.

Disconnect the fuel pipes from the fuel pump and undo the nuts holding it to the fuel tank. Withdraw the fuel pump unit from the fuel tank.

Refitting is a reversal of the removal procedure.

The electric pump cannot be dismantled or repaired. In case of failure, always replace it with a new one.

Evaporative emission control system

Examine the hoses and charcoal canister. If the housing is found cracked or damaged, renew the charcoal canister.

If leakage is evident, check the hose connections for tightness. Renew a leaking canister.

Electrical equipment

Refer to Fig.9-5 for electric wiring diagram that is complemented with the injection wiring harness routed between the injection electronic control unit (ECU) and various sensors and injection system actuators.

Through a separate connector, three wires of the injection wiring harness are linked to the low tension (LT) input of the tachometer in the instrument cluster, to the «CHECK ENGINE» lamp and terminal «15» of the ignition switch.

There are five fuses in the injection wiring harness.

Fuse 16 (50 amperes) is housed separately. It protects the intake manifold preheater. The remaining four fuses (15 amperes each) are located in a separate fusebox 17, on the left-hand side, under the facia console.

Refer to Table 9-1 for detailed information on the circuits fused.

Table 9-1

Injection system protective fuses

Fuse	Circuits protected
1-2	Fuel pump «on» relay (contacts) Electric fuel pump. Fuel injector.
3-4	Oxygen sensor. Vehicle speed sender. Canister valve. Intake manifold preheater relay (winding).
5-6	ECU. Ignition control module.
7-8	Reserve

In addition to fuses, there is «a fusible link» at the end of the red wire connected to the battery. This fusible link represents a length of black wire of 1mm² cross-section, whereas the main red wire is of 6 mm² cross-section.

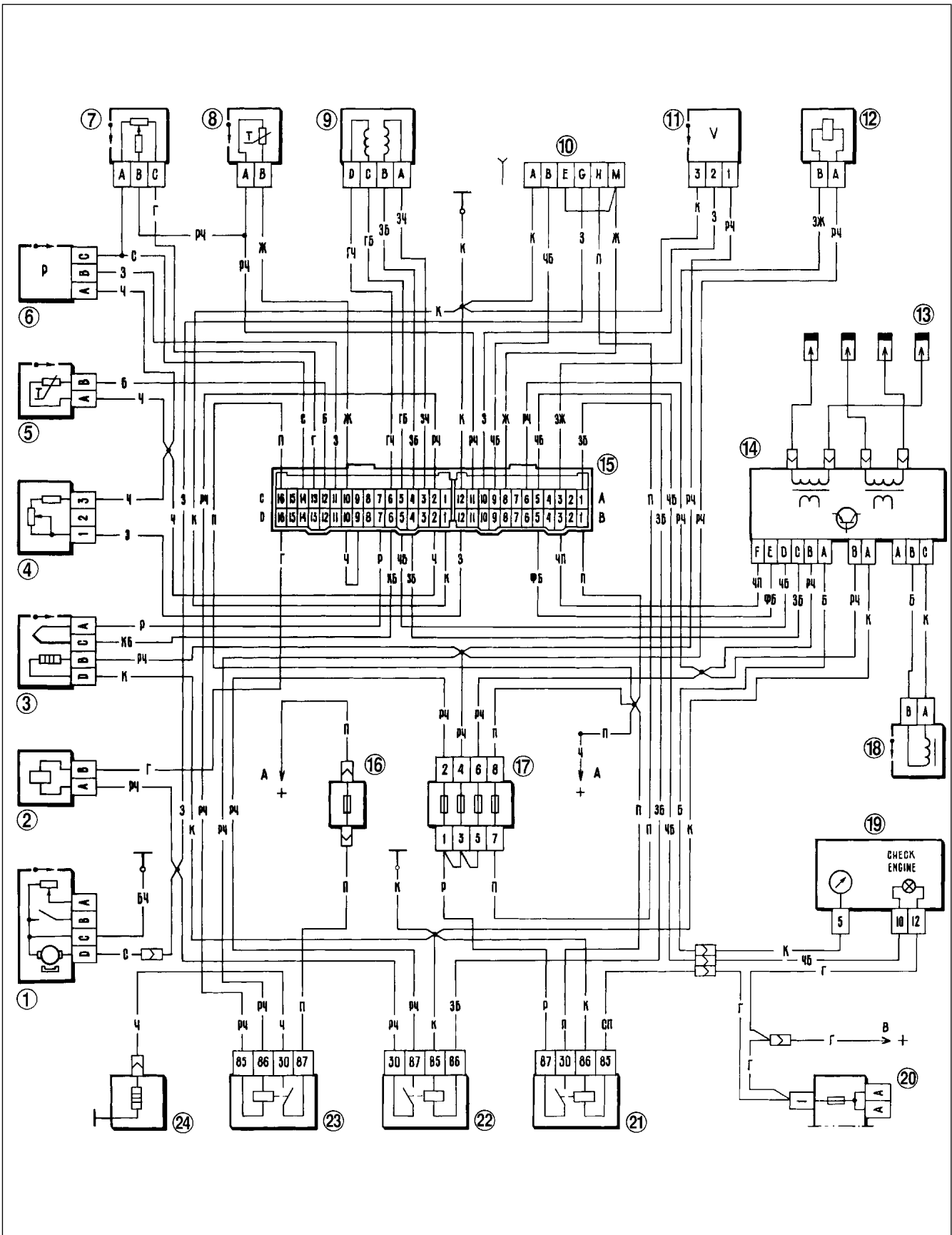


Fig.9-5. Wiring diagram for VAZ-21214 vehicle, CFI:

1 - electric fuel pump and fuel level sender; 2 - injector; 3 - oxygen sensor; 4 - octane potentiometer; 5 - air temperature sensor; 6 - MAP sensor; 7 - throttle position sensor; 8 - coolant temperature sensor; 9 - idle air control valve; 10 - diagnostic plug; 11 - speed sender; 12 - canister purge valve; 13 - spark plugs; 14 - ignition module; 15 - electronic control unit plug; 16 - intake manifold preheater fuse; 17 - fusebox, injection system; 18 - crankshaft position sensor; 19 - instrument cluster with tachometer and «CHECK ENGINE» light; 20 - main fusebox; 21 - ignition relay; 22 - fuel pump cut-in relay; 23 - intake manifold preheater relay; 24 - intake manifold preheater; A - to battery «+» terminal; B - to ignition switch terminal «15»

VAZ-21214-20 vehicle

The VAZ-21214-20 vehicle is fitted with a 1.7-L engine, Sequential Fuel Injection.

Engine 21214-10

The engine 21214-10 is four-stroke, four-cylinder, in-line, SOHC, with Sequential Fuel Injection System.

The 21214-10 engine is based on the 21213 engine. Both engines have similar housing components, piston / connection rod mechanism and power unit mounting. The differences include the sequential ignition system used instead of the carburettor, the hydraulic valve lifters and hydraulic chain tensioner in the valve timing gear. All this results in different engine dismantling and reassembly, with respect to removal and refitting of air supply units, fuel metering system and lubrication system.

Power unit - removal and refitting

Before removing the power unit, depressurize the fuel supply system. For that disconnect the fuel pump wiring plug from the injection wiring harness, operate the engine, let it run until it stops, then operate the starter for three seconds to equalize pressure in the fuel lines.

Disconnect the battery negative lead.

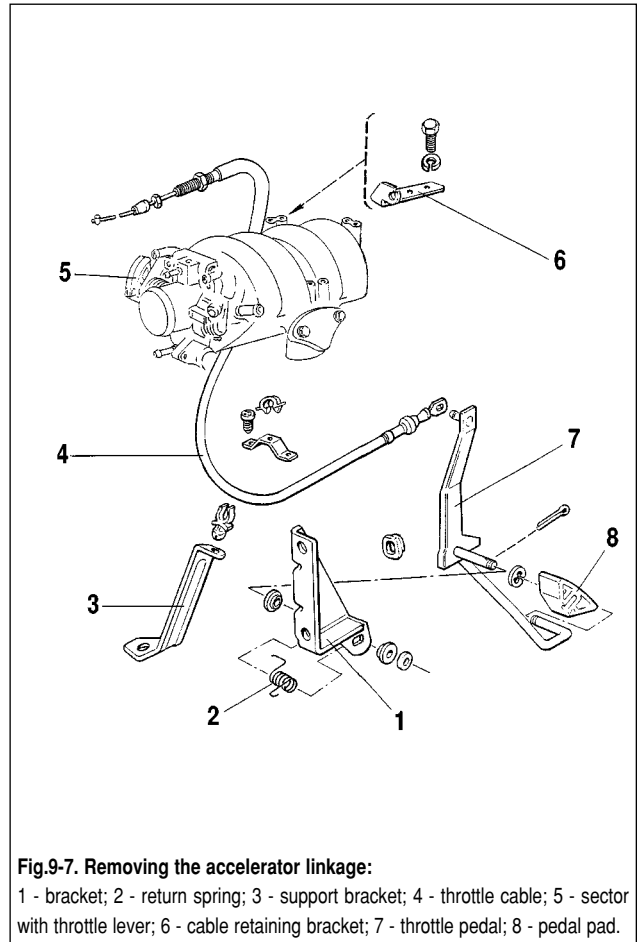


Fig.9-7. Removing the accelerator linkage:
1 - bracket; 2 - return spring; 3 - support bracket; 4 - throttle cable; 5 - sector with throttle lever; 6 - cable retaining bracket; 7 - throttle pedal; 8 - pedal pad.

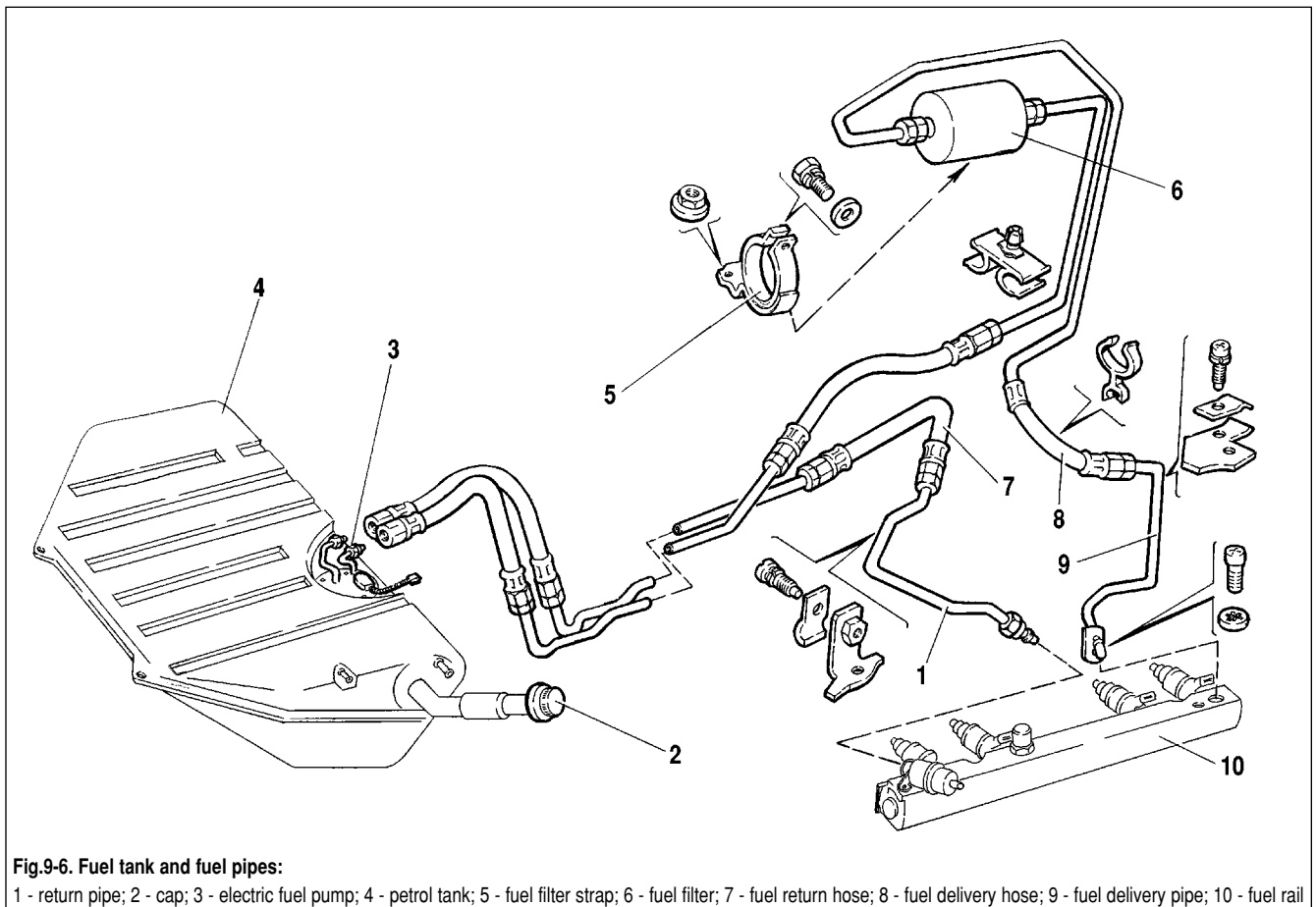


Fig.9-6. Fuel tank and fuel pipes:
1 - return pipe; 2 - cap; 3 - electric fuel pump; 4 - petrol tank; 5 - fuel filter strap; 6 - fuel filter; 7 - fuel return hose; 8 - fuel delivery hose; 9 - fuel delivery pipe; 10 - fuel rail

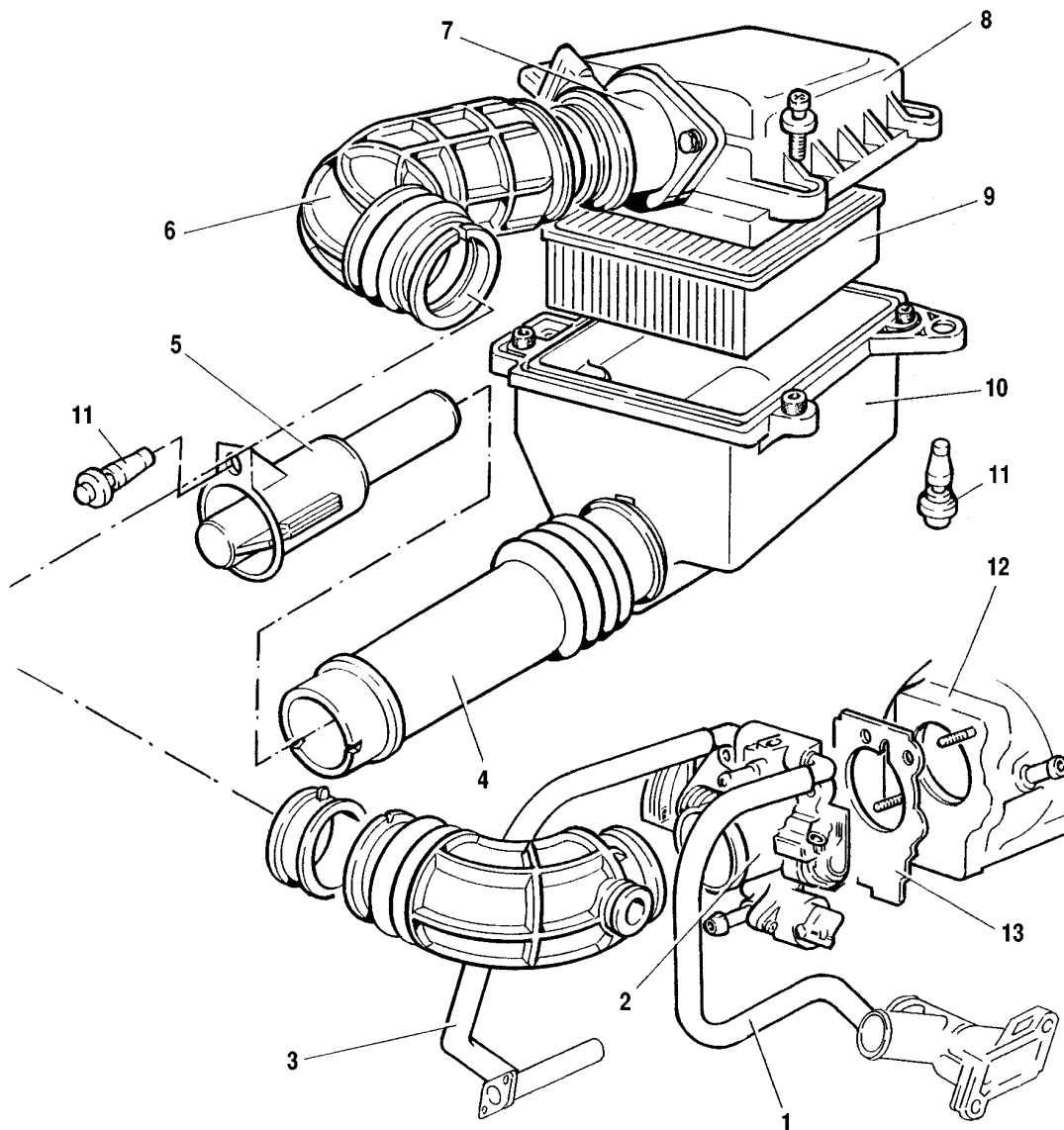


Fig.9-8. Removing the components and units of air intake system:

1 - part throttle channel heater hose; 2 - throttle body; 3 - return hose from throttle body; 4 - air intake; 5 - air intake end piece; 6 - intake manifold hose; 7 - MAF sensor; 8 - air cleaner cover; 9 - filtering element; 10 - air filter housing; 11 - filter mounting; 12 - receiver unit; 13 - gasket

Disconnect hoses 7 and 8 (supply and return) (Fig.9-6) from pipes 1 and 9. Plug the hose / pipe ends to prevent dirt ingress.

Disconnect accelerator cable 4 (Fig.9-7) from sector 6 on the throttle housing, bracket 5 on the receiver unit and from bracket 3 on valve cover.

Disconnect the crankcase evap hose from hose 6 (Fig.9-8) connection, loosen two clips and remove hose 6 of the intake manifold. Cut off three rubber mountings 11 holding the air cleaner to the body and one mounting that retains the cold air intake end to the radiator, remove the air cleaner complete with mass air flow meter 7.

From the receiver unit disconnect the vacuum hose to the fuel pressure regulator and to the brake servo unit.

Disconnect the canister purge hose from the throttle housing (when the vehicle is fitted with the evaporative emission control system).

Disconnect the wiring from the throttle manifold, ignition module, injector wiring harness, all relevant sensors on the power unit and from reversing light switch on the transmission.

Next proceed with the usual removal procedure as described in chapter 2.

Refitting is the reverse order of removal. The rubber mountings of the air cleaner are disposal, so new mountings must be fitted when refitting the air cleaner.

After refitting the power unit, adjust the accelerator drive. At fully released accelerator pedal 7 (Fig. 9-7), the throttle should be fully closed. The cable should be taut. The cable deflection by hand force should be 10 mm as a maximum. When necessary, adjust the cable tension using the adjuster nuts at the cable end.

At fully depressed accelerator pedal, the throttle should be wide open, throttle sector 6 should have no further movement.

Check the injection system for satisfactory operation, as outlined in Repair Manual for Fuel Sequential Injection System.

Engine - dismantling and reassembly

The main differences on dismantling and reassembly are related to alternative design of the air supply system.

Mount the engine on the test bench, drain oil from the oil pan, dismantle the engine in the order described below.

Disconnect supply 1/return 3 coolant hoses (Fig.9-8) and idle crankcase vent hose from throttle manifold 2. Undo the nuts holding the throttle housing to receiver unit 12 and withdraw the throttle housing with gasket 13.

Disconnect and remove supply 9/return 1 fuel pipes (Fig.9-6) from fuel rail 10, fuel pressure regulator and from the bracket on the receiver unit. Detach and remove vacuum hose 6 (Fig.9-9) from receiver unit 8 and fuel pressure regulator 5.

Undo five nuts holding the receiver unit to intake pipe 1 and withdraw the receiver unit complete with gasket 7.

Disconnect the wiring from the injectors, withdraw fuel rail 4 with pressure regulator 5, having undone two bolts 3 holding it to the intake pipe. Undo retaining nuts and bolts, withdraw the brackets, followed by the intake pipe with the shield. Detach the ignition module and knock sensor from the left-hand side of the engine.

Further engine dismantling is as described in chapter 2 of this Manual. The engine reassembly is reverse of the dismantling procedure. Before refitting the fuel rail, lubricate the injector sealing rings with motor oil.

Valve mechanism - design description

Valves 2 (Fig.9-10) are operated by the cams through rocker arms 3. One end of the lever presses down the valve, while the other end rests on the spherical head of the hydraulic lifter. The hydraulic lifters automatically eliminate the clearance in the valve train, so during technical service you do not need to check or adjust the valve clearances.

Lubricating oil through pipe 3 (Fig.9-11) flows to the tensioner cavity «E» (Fig. 9-12), through the bore «Д» and valve unit 2 into the working cavity «B» pushing down plunger 5. Tensioner housing 1 has a 1 mm bore to release air in the cavity «E».

The diameter clearance between housing 1 and plunger 5 should be 0.018-0.024 mm and is measured as a difference between the maximum measured diameter of plunger 5 and minimum measured diameter of housing 1.

The tensioner housing and plunger make a unit, where no replacement of either part is allowed once the clearance has been selected. Plunger 5 should easily stroke within housing 1 up to 16 mm.

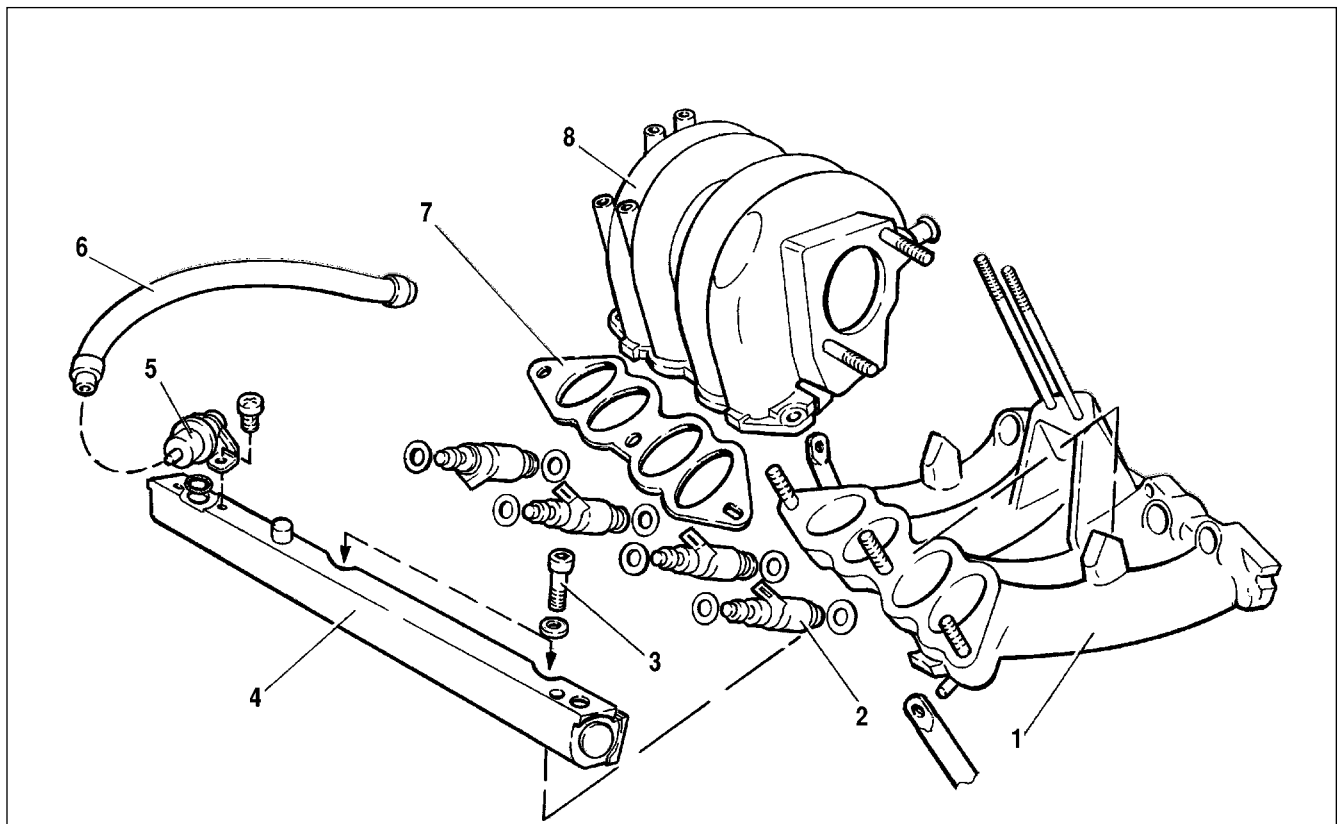


Fig.9-9. Removing the fuel system components:

1 - intake manifold; 2 - injector; 3 - bolt; 4 - fuel rail; 5 - fuel pressure regulator; 6 - vacuum hose; 7 - gasket; 8 - receiver unit

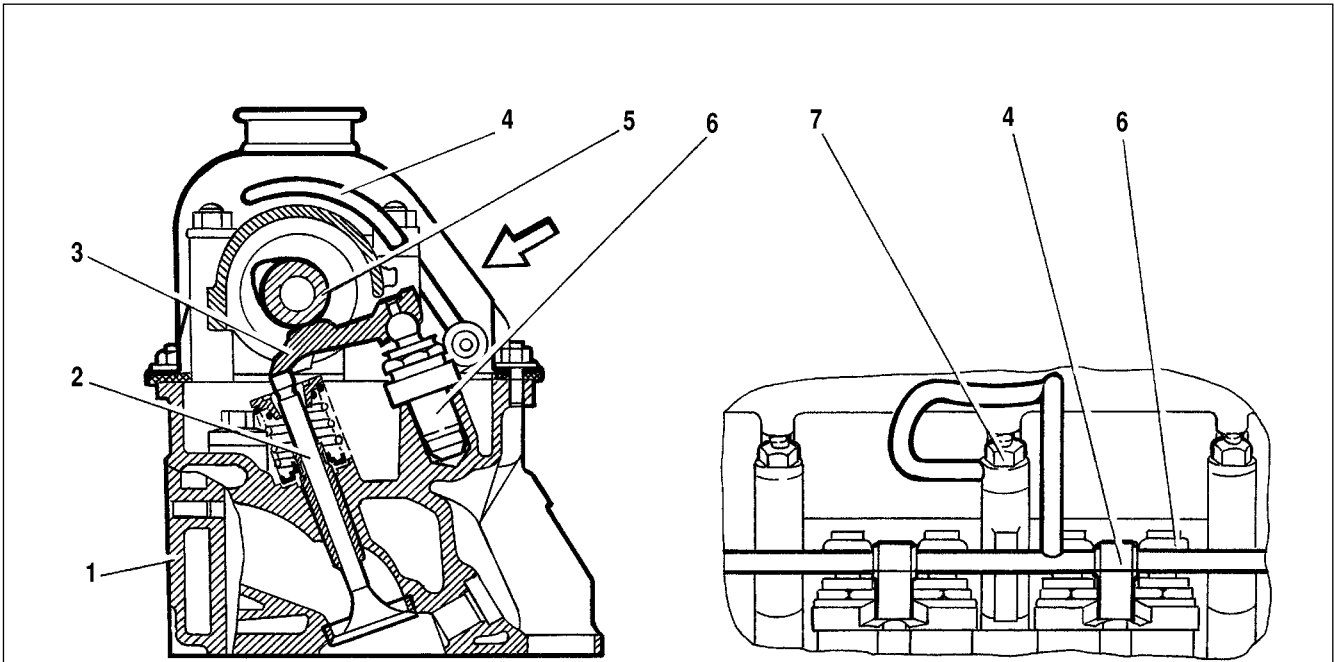


Fig.9-10. Valve actuation:

1 - cylinder head; 2 - valve; 3 - valve lever; 4 - rail, hydraulic valve lifter; 5 - camshaft; 6 - hydraulic valve lifter; 7 - nut

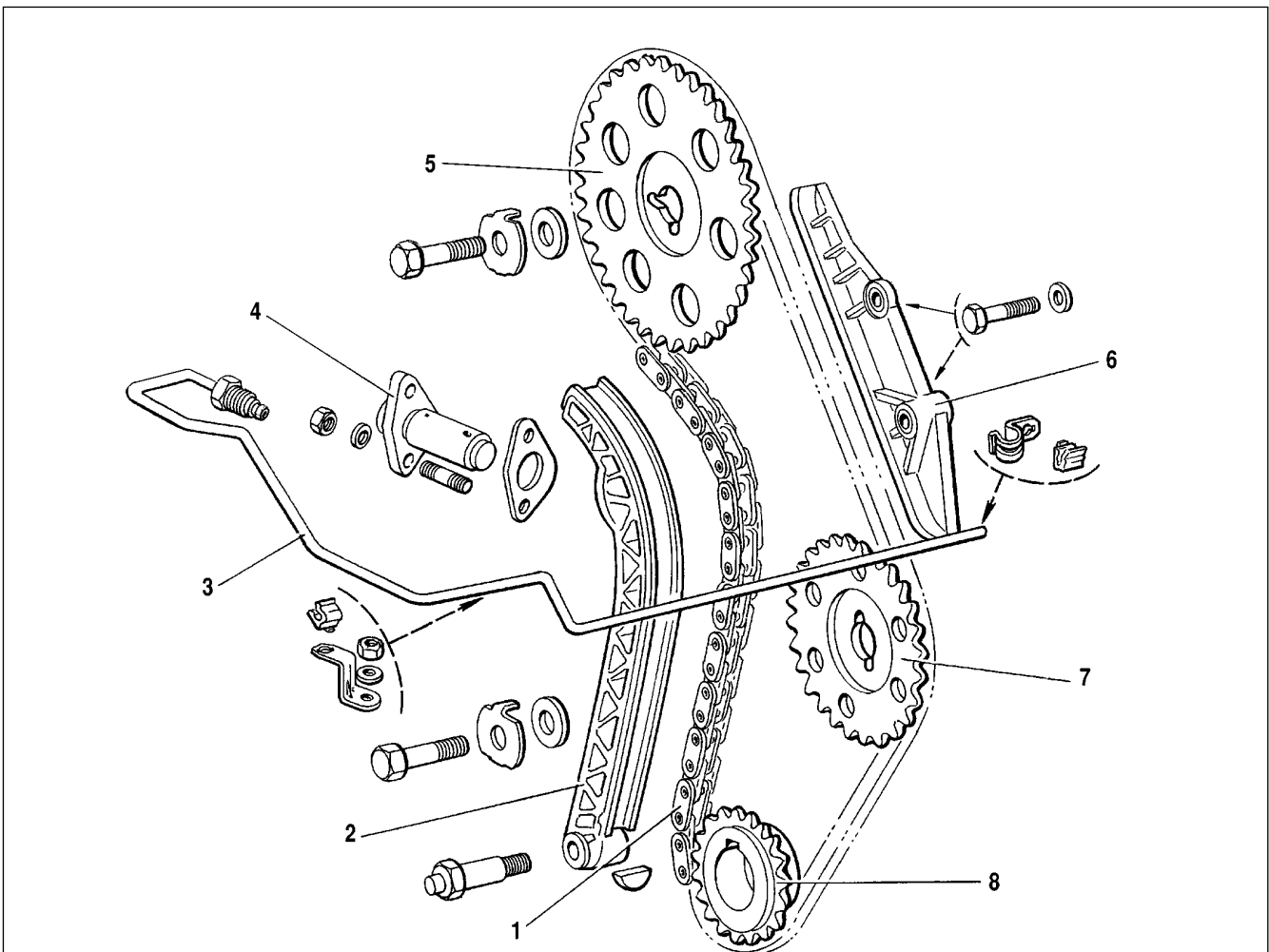


Fig.9-11. Exploded view of chain tensioner:

1 - chain; 2 - tensioner shoe; 3 - oil delivery pipe to tensioner; 4 - chain tensioner; 5 - camshaft sprocket; 6 - chain damper; 7 - oil pump shaft sprocket; 8 - crankshaft sprocket

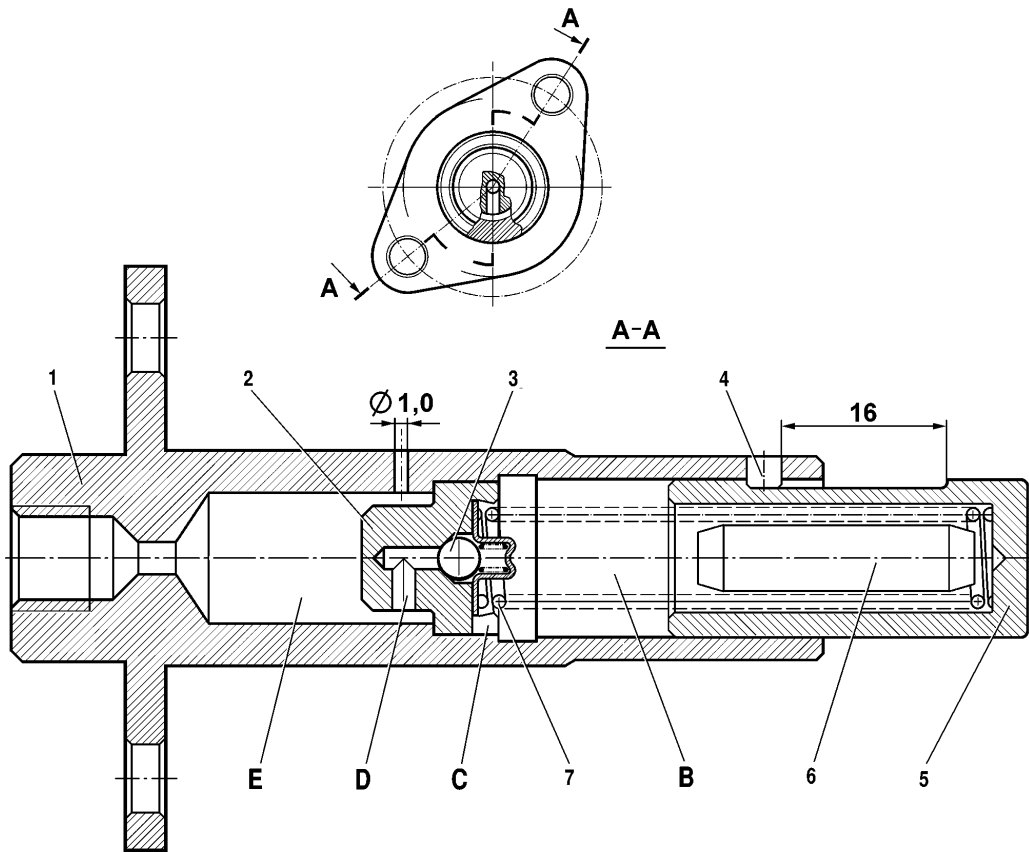


Fig.9-12. Hydraulic chain tensioner:

1 - tensioner housing; 2 - valve unit; 3 - ball, non-return valve; 4 - stop pin; 5 - plunger; 6 - volume restrictor; 7 - spring;
 B - working cavity; C - locating slot; D - hole; E - reserve cavity

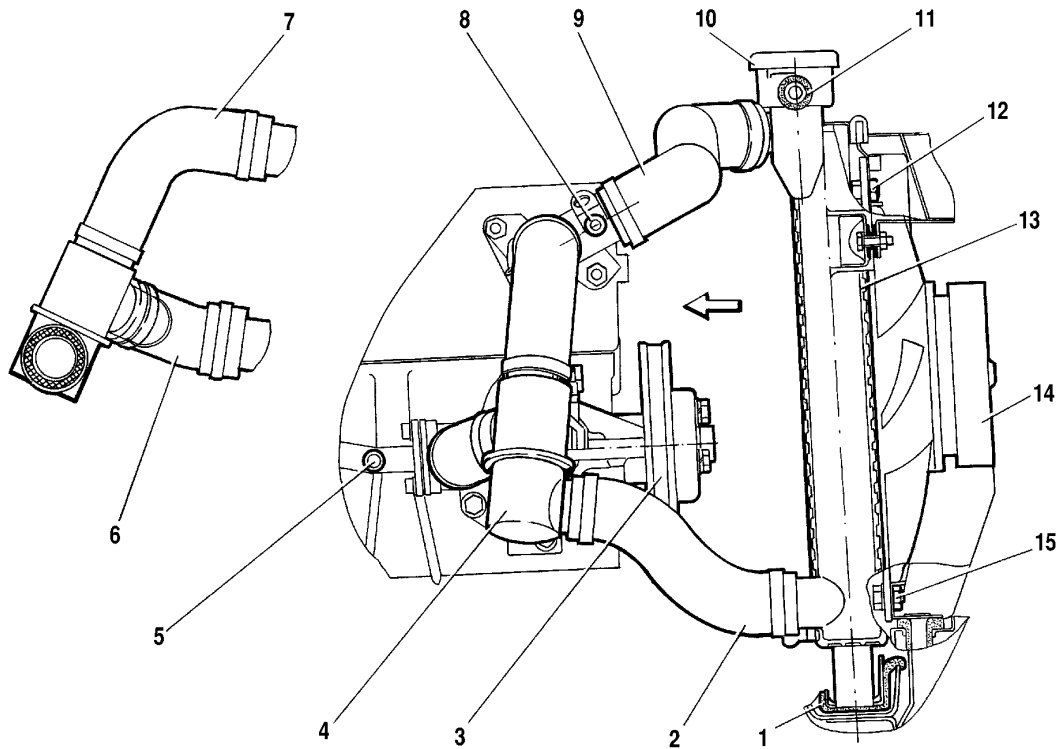


Fig.9-13. Cooling system:

1 - radiator pad; 2 - radiator return hose; 3 - water pump pulley; 4 - thermostat; 5 - drain pipe from throttle housing; 6 - coolant delivery hose to pump; 7 - transfer hose, thermostat; 8 - coolant delivery pipe for part throttle channel preheating; 9 - radiator delivery hose; 10 - radiator cap; 11 - hose between radiator and expansion tank; 12 - top fan cowl securing nut; 13 - radiator; 14 - electric fan; 15 - bottom fan cowl securing nut

When refitting to the engine, the tensioner should be free from oil, dowel 4 should not protrude from the housing.

Cooling system

The cooling system features two electric fans 14 (Fig.9-13). The fan cowl is mounted in front of the radiator and is held by two top 12 and two bottom 15 nuts.

The introduction of the throttle housing in the cooling system has necessitated its heating-up by delivery of coolant via hose 8 from the cylinder head return pipe. The coolant is returned through hose 5 which connects the throttle housing to the heater matrix return pipe.

The cooling fan motor is operated by the electronic control unit, so there is no fan blower «cut-in» sensor.

Fuel system

The fuel system is within the Engine Management System (EMS) which is described in detail in a separate Repair and Service Manual for EMS, Sequential Fuel Injection, therefore this section describes only removal, refitting and replacement of the air cleaner filter element.

The air filter is mounted at the front right-hand side of the engine bay on three rubber mountings 11 (Fig.9-8).

Fresh air through air intake 5 and pipe 4 is drawn into air

cleaner housing 10. The air then flows through paper filter element 9, MAF sensor 7, hose 6 and throttle housing 2. From the throttle housing the warm air is directed to receiver unit 12 and intake pipe and further to the cylinder head and cylinders.

Filter element - renewal

1. Undo four retaining bolts, remove air cleaner cover 8 complete with MAF sensor 7 and intake pipe hose 6.
2. Renew filter element 9 so that its corrugation is parallel to the vehicle axial line.
3. Refit and secure the air cleaner cover.

Crankcase ventilation system

Draught ventilation is provided to expel crankcase gases and fuel vapours into the engine intake pipe.

Crankcase gases are drawn through hose 1 (Fig.9-14) into the intake pipe hose and further via the throttle housing and receiver unit into the intake pipe.

At low rpm and closed throttle, most of crankcase gases are drawn along hose 2 to the throttle housing.

Flushing. To flush the system disconnect vent hoses 1 and 2 from the intake pipe hose and throttle housing 3. Remove oil separator 8 cover 5 and wash both units with petrol or kerosine. Flush and blow with compressed air all hoses and connectors.

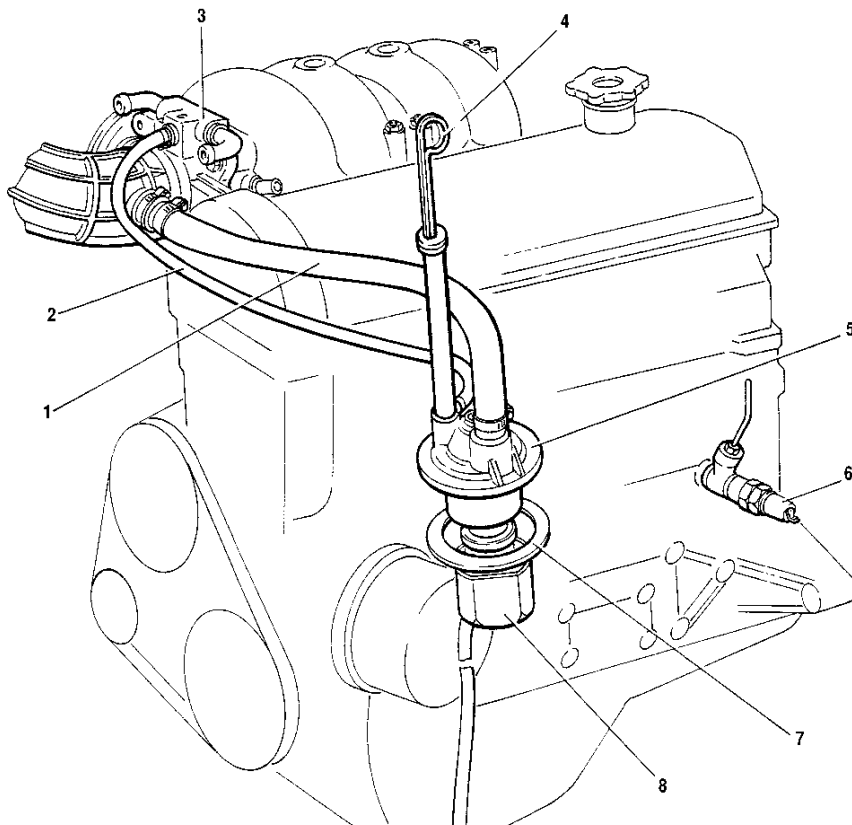


Fig.9-14. Crankcase ventilation system:

1 - discharge hose; 2 - vent hose; 3 - throttle housing; 4 - oil dipstick; 5 - oil separator cover; 6 - oil pressure gauge; 7 - gasket; 8 - oil separator

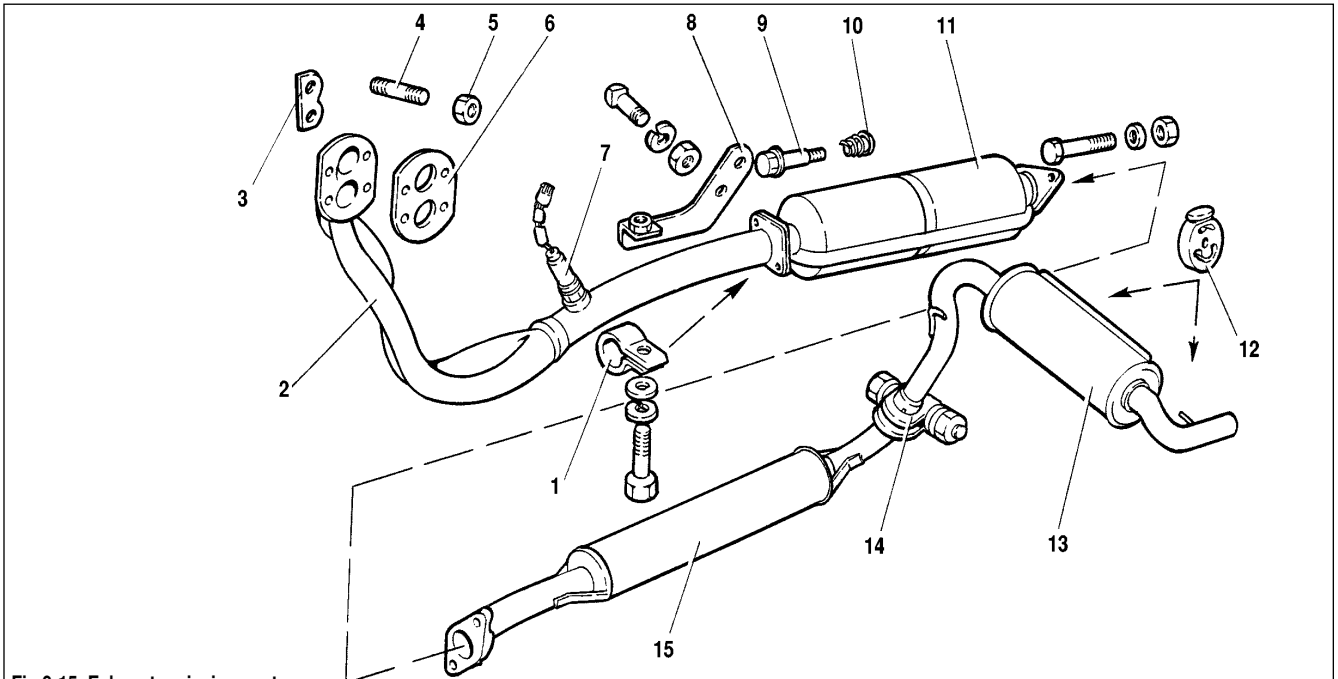


Fig.9-15. Exhaust emission system:
 1 - clasp; 2 - front exhaust pipe; 3 - lock plate; 4 - pin; 5 - nut; 6 - gasket; 7 - oxygen sensor; 8 - bracket; 9 - bolt; 10 - conical string; 11 - catalytic converter; 12 - suspension loop; 13 - main silencer; 14 - clip; 15 - front silencer

Exhaust emission system

Exhaust gases are drawn from the engine through the exhaust manifold, front exhaust pipe 2 (Fig.9-15), catalytic converter 11, front silencer 15 and main silencer 13.

The downpipe is connected to the catalytic converter flange by means of a movable joint. Between the flanges there is a metal-graphite ring with a spherical surface.

Downpipe 2 is secured with nuts 5 onto exhaust manifold studs 4, gasket 6 is fitted between them. Lock plates 3 are placed under the nuts. The other end of the downpipe by means of clasp 1 is secured to bracket 8, fitted to the transmission cover.

Main silencer 13 is attached to the underbody by two suspension loops 12.

The silencers complete with pipes represent single units and should be renewed as such during repair.

Electrical system

An EMS wiring harness is added to the vehicle electrical system (Fig.9-16) to connect the ECU with EMS sensors and actuators. No headlamp wipe/wash is fitted to VAZ 21214-20 vehicle.

Three wires of the EMS wiring harness through a separate plug are connected to the tachometer LT input in the instrument cluster, to «CHECK ENGINE» lamp and to ignition switch terminal «15».

There are four fuses in the EMS wiring harness. They are located in a separate fusebox 26, underneath the left-hand end trim cover. Refer to Table 9-2 for details.

Table 9-2

Injection system fuses

Fuse	Circuits protected
1-2	Electric fuel pump relay (contacts). Electric fuel pump.
3-4	ECU.
5-6	Main relay (contacts). Oxygen sensor. Vehicle speed sender. Canister purge solenoid. Electric fuel pump relay (winding). Electrical fan blower relay (winding). ECM. MAF meter. Injection wiring harness.
7-8	Electric fan blower relay (contacts). Electric fans.

Besides the fuses there is «a fusible link» at the end of red wire, which is connected to the battery «+» terminal. The «fusible link» represents a length of black wire of 1 mm² cross-section, whereas the main red wire is 6 mm² cross-section.

Cooling fan motors. The cooling fans are operated by two dc motors (MP 8015 model) on permanent magnets.

The motors are triggered by EMS ECU via a relay. With the engine running the relay cuts in when the coolant temperature exceeds 105°C or cuts off when the coolant temperature goes below 101°C.

The motors are maintenance-free and must be renewed in case of failure.

Motor specification

Nominal shaft speed with impeller load, rpm2000 - 2200
Current consumption at speeds and loads as specified, amperes, not greater15

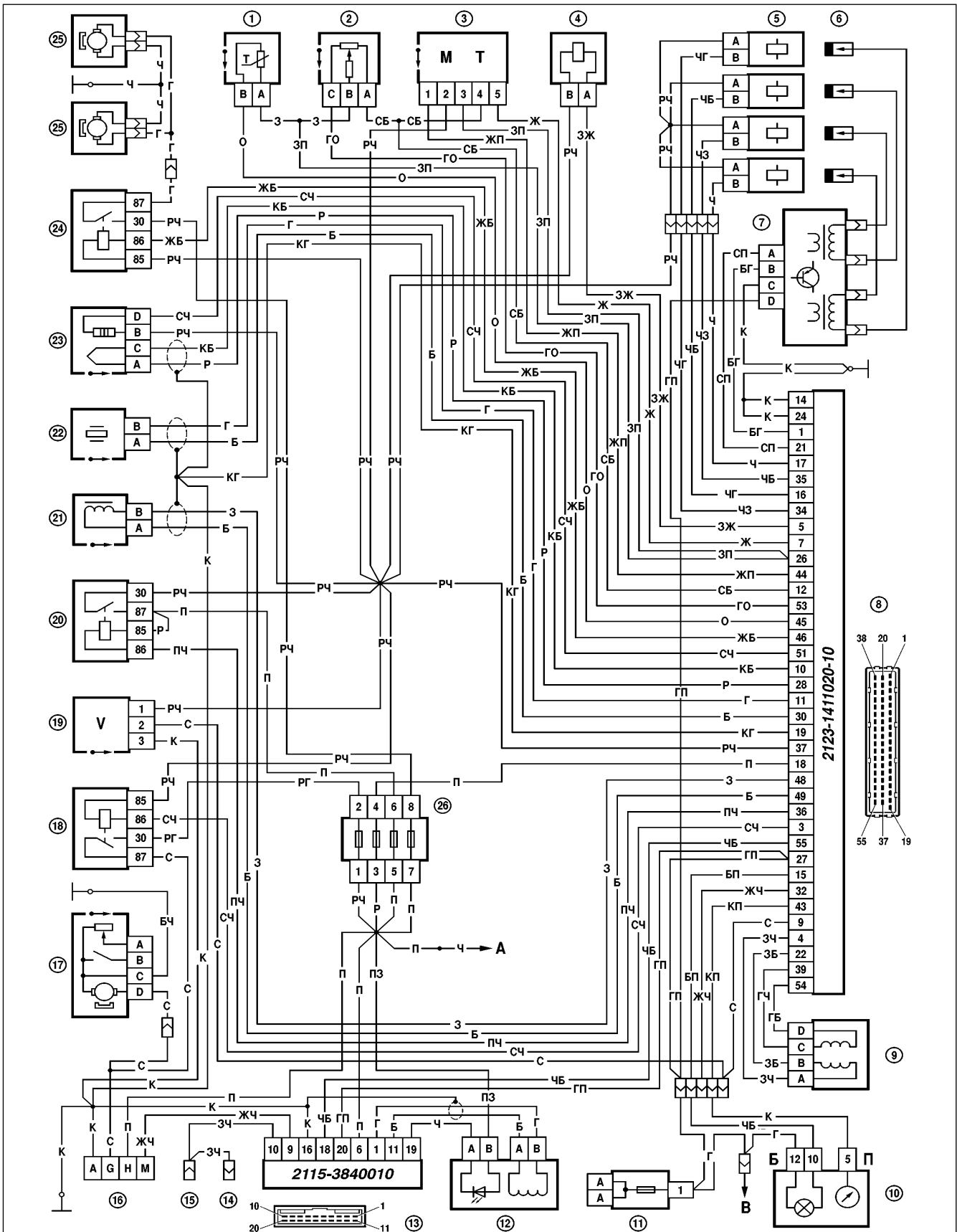


Fig.9-16. EMS wiring diagram (Sequential Fuel Injection), VAZ-2114-20 vehicle:

1 - coolant temperature sensor; 2 - throttle position sensor; 3 - mass airflow meter; 4 - canister purge solenoid; 5 - injectors; 6 - spark plugs; 7 - ignition module; 8 - electronic control unit; 9 - idle air control valve; 10 - instrument cluster with tachometer and CHECK ENGINE light; 11 - main fusebox; 12 - LED, antitheft system; 13 - control module, antitheft system; 14 - to door courtesy light switch; 15 - to interior light switch; 16 - diagnostic plug; 17 - electric fuel pump and fuel level sender; 18 - fuel pump relay; 19 - speed sender; 20 - main relay; 21 - crankshaft position sender; 22 - knock sensor; 23 - oxygen sensor; 24 - fan relay; 25 - electric fans; 26 - injection system fusebox; A - to power supply

VAZ-21215-10 vehicle

The VAZ-21215-10 vehicle is fitted with the diesel engine DHW (XUD-9SD).

The section gives a brief description of diagnostic procedures for fuel and electrical systems, engine removal and refitting, repair procedures for engine systems.

For detailed design, repair and diagnostic procedures with respect to all engine systems using specialized tools and diagnostic charts, refer to PEUGEOT Repair Manual for Diesel Engine.

The diesel engine operation depends much on the sound fuel injection system, this is why this section focuses on the fuel supply units and components.

In the event the injection system has failed, do not blame the high pressure pump, first check the following:

- fuel tank and fuel level;
- delivery and return fuel lines;
- fuel filter;
- injectors;
- glow plugs;
- engine stop solenoid resistance.

Examine the engine, since higher flash-point temperature depends on compression, valve and piston ring condition.

Inspect the air cleaner, battery, starter motor, check the oil level.

Major faults and remedial actions

1. Engine does not start, emitting no smoke:

- check fuel level in fuel tank;
- set engine manual stop device to normal position;
- check fuel delivery pipes; in case of leaks, tighten connections or replace pipes;
- check engine stop solenoid for resistance, wiring conductivity and fuel inflow.

If engine still fails to start after all these checks and remedial actions, remove high pressure pump and test it using specialized equipment.

2. Engine does not start, emitting black smoke:

- when engine speed is below 150 rpm, check condition and fitting of battery terminals and starter motor, battery charge, oil grade and oil level;
- when engine speed is over 150 rpm, start engine without using air cleaner; when no smoke is evident, renew filter element, check proper mounting of air cleaner housing;
- check injection timing is correct, check fuel injectors are sound;
- check valve adjustment and compression in cylinders.

Should smoke persists despite all remedial actions, remove and test pump using specialized equipment.

3. Engine does not start, emitting white smoke (cold engine):

Check the following items:

- glow plugs;
- secondary warming-up system;
- cylinder head gasket;
- injection timing.

If smoke persists after repair work, remove pump for inspection.

4. Difficult cold engine start with black smoke:

Check the following items:

- glow plugs;
- fast idle thermostat;
- injection timing;
- injectors;
- hydraulic lifters and valve clearances;
- compression.

Should smoke persists after repair, remove and test pump using specialist equipment.

5. Engine starts and stalls:

Check the following items:

- idle adjustment;
- oil grade and oil level;
- ventilation system;
- fuel feed system;
- solenoid;
- secondary warming-up system;
- air cleaner;
- non-return valve on LUCAS pump.

Should engine stalls despite repair performed, remove fuel pump.

6. Unstable idle:

Check the following items:

- settings of engine stop prevention system and idle (for LUCAS);
- settings for idle and fuel remainder return (for BOSCH);
- accelerator lever spring;
- fuel feed system;
- injectors;
- valve clearances;
- cam belt tension.

In case of failure to adjust idle speed, remove and examine pump on a specialist test bench.

Engine - removal and refitting

Place the vehicle on the lift or over an inspection pit, chock the front wheels and raise the rear axle from one or both sides.

Withdraw the bonnet, disconnect wiring from the battery and electrical units fitted to the vehicle. Remove the battery and underbonnet lamp.

Drain fluid from the cooling system and heater; to do this unplug the expansion tank, undo the drain plugs on the radiator (underneath, left-hand side) and on the cylinder block (left-hand side).

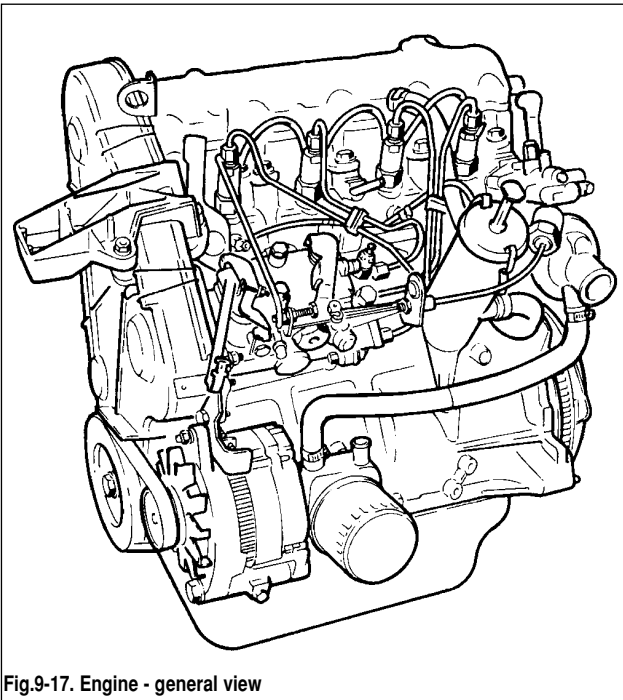


Fig.9-17. Engine - general view

From the engine (Fig.9-17) disconnect the coolant supply and return hoses, remove the radiator complete with the grille and fan cowl. Disconnect the cooling hoses from the thermostat. Disconnect the hoses between the engine and heater.

From the air cleaner (Fig.9-18) disconnect the crankcase vent hose, undo three securing nuts, remove the air cleaner cover complete with the gasket; extract the filter element. Undo four nuts which hold the air cleaner housing to the intake pipe and withdraw the air cleaner housing and gasket.

Disconnect the fuel delivery and return hoses from the high pressure fuel pump.

Using a box spanner, undo the nuts retaining the front exhaust pipe to the exhaust manifold.

Using a flat screwdriver, release the ball end and disconnect the fuel delivery operating cable from the high pressure pump.

Undo the retaining screw and release the end piece, then disconnect the cable from the timing advance lever.

Remove the transmission, working as described in section «Gearbox» in the Repair Manual.

Hoist the cross-piece TCO-3/379 and lock the engine on the right-hand side at the clamp, fitted to the front exhaust manifold securing stud, while on the left-hand side - at the hole for clutch housing fastening. Slightly tighten the hoist chain, undo the nuts securing engine mounting rubbers 2 (Fig.9-19) to the front suspension cross-member and lift the engine out.

Remove the heat shield of the starter motor and withdraw the starter motor. Undo the clutch retaining bolts and withdraw the clutch.

Refitting the engine is carried out as follows:

- refit the cooling hoses, connectors and clamps;
- check the radiator for deposits, leaks, damages;
- check the radiator cooling fan operation;
- check the radiator cap seal and valve;
- fit a new air cleaner and fuel filter elements;
- refill the engine with oil;
- adjust the controls;
- eliminate air pockets and refill the cooling system;
- start and warm-up the engine;
- adjust idle speed;
- check the lubricating and cooling systems for leaks.

Draw special attention to the engine / transmission connection: the input shaft must fully engage the splines of the clutch disc.

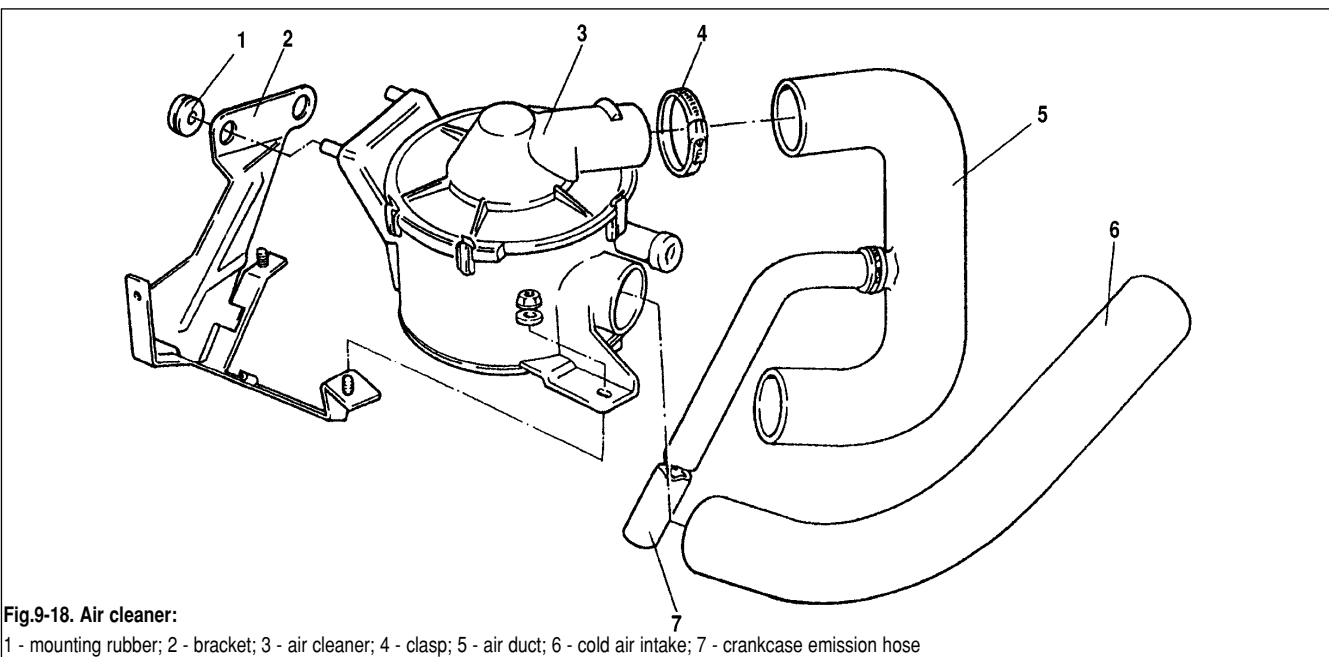


Fig.9-18. Air cleaner:

1 - mounting rubber; 2 - bracket; 3 - air cleaner; 4 - clasp; 5 - air duct; 6 - cold air intake; 7 - crankcase emission hose

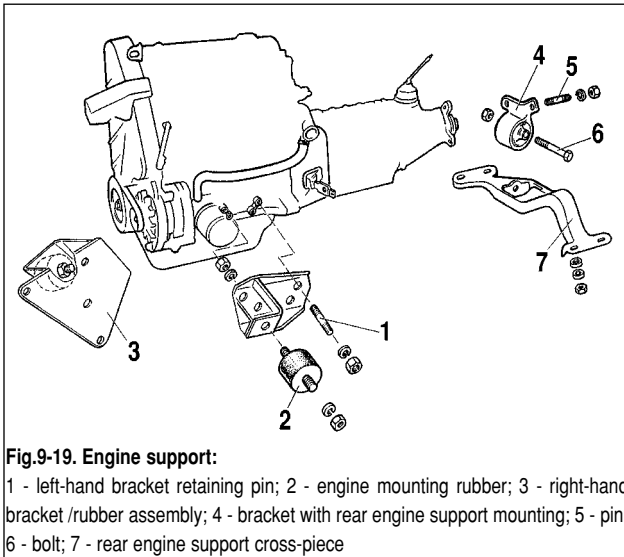


Fig.9-19. Engine support:

1 - left-hand bracket retaining pin; 2 - engine mounting rubber; 3 - right-hand bracket / rubber assembly; 4 - bracket with rear engine support mounting; 5 - pin; 6 - bolt; 7 - rear engine support cross-piece

Cooling system

Design description

The cooling system is of closed-, pressurized type, with expansion tank (Fig.9-20).

The coolant pump is of centrifugal type, driven by a V-belt from the crankshaft pulley.

The cooling system includes radiator 7 with expansion tank 5, thermostat 13, coolant temperature gauge, water jacket and connecting hoses.

During engine operation, water, warmed up in the water jacket, through the drain pipe flows to the radiator or thermostat, depending on the thermostat valve position. Then water is sucked by the pump and returned to the water jacket.

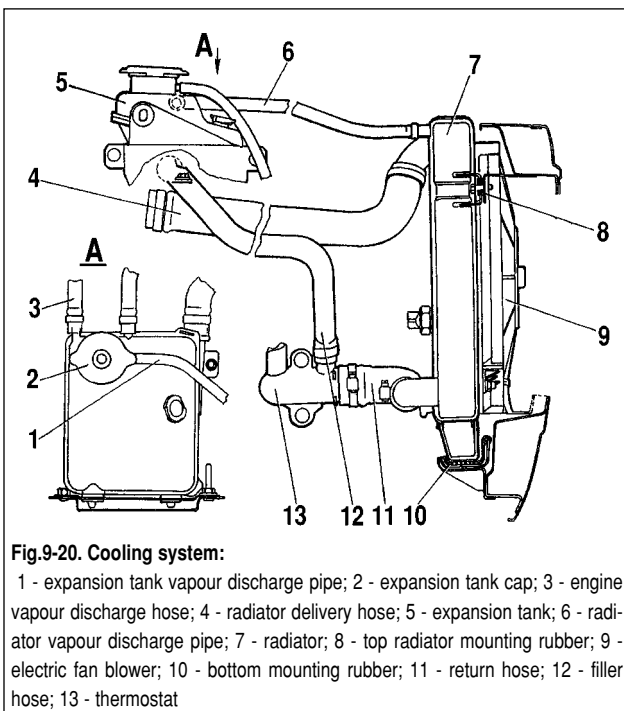


Fig.9-20. Cooling system:

1 - expansion tank vapour discharge pipe; 2 - expansion tank cap; 3 - engine vapour discharge hose; 4 - radiator delivery hose; 5 - expansion tank; 6 - radiator vapour discharge pipe; 7 - radiator; 8 - top radiator mounting rubber; 9 - electric fan blower; 10 - bottom mounting rubber; 11 - return hose; 12 - filler hose; 13 - thermostat

The cooling system is fitted with a built-in double-acting thermostat, the valve opening temperature is 83°C.

Coolant - level and density check

With the cold engine (15-20°C) the level of water in the expansion tank must be 25-30 mm above the «MIN» mark.

WARNING. It is recommended to check the water level on the cold engine, since on heating up water expands, so the fluid level can rise significantly on the warm engine.

When necessary, use areometer to check the coolant density to be 1.078-1.085 g/cm³ for Tosol A-40.

When the level in the expansion tank is below the norm, while the density exceeds the value required, add distilled water. In case of normal density top up the coolant of the same grade as the coolant in the cooling system.

Coolant change

Observe the following procedure when changing coolant:

- set the heater controls in the position «heating»;
 - undo the caps in the bottom radiator cooler and cylinder block, remove the expansion tank cap and drain coolant through two drain holes. Detach the expansion tank and lift it over the radiator, then remove the coolant remainder from the expansion tank;
 - to flush the cooling system, fill the system with clean water, start the engine and run it until the radiator bottom cooler is warm. With engine idling, drain water through the drain holes, stop the engine and let it cool;
 - repeat flushing steps as described above;
 - after flushing refit the caps and fill the system with new coolant 25-30 mm above the «MIN» mark on the expansion tank;
- Fill coolant through the filler neck of the expansion tank. Refit the cap, start the engine and allow it to idle for 1.5-2 minutes. Stop the engine and when necessary top up coolant.

Cambelt - removal and refitting

The cam removal procedure is as follows (Fig.9-21):

- remove covers 3, 5 и 6 of valve timing mechanism;
- fix the flywheel using tool OUT0000049;
- loosen the crankshaft pulley retaining bolts;
- remove the crankshaft pulley;
- fix the flywheel with tool OUT0000015;
- secure the camshaft and fuel pump pulleys with retaining bolts (the bolts should be hand tightened only);
- loosen nut 2 and bolt 4 (Fig.9-22);

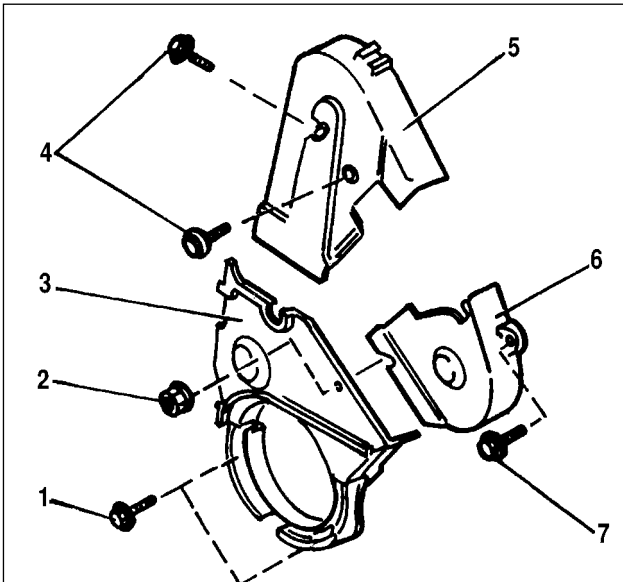


Fig.9-21. Removing and refitting the timing covers:

1 - securing bolts, bottom cover; 2 - nut; 3 - bottom cover; 4 - securing bolts, left-hand cover; 5 - left-hand cover; 6 - right-hand cover; 7 - bolt

- use special wrench (of 10 mm square size) for 5 mm square hole and turn the bracket clockwise to remove spring 6;

- tighten bolt 4;

- remove the cambelt.

Refitting is the reversal of the removal procedure:

- make sure the camshaft and fuel pump pulleys are in the position required and secured, idler pulley 7 (Fig.9-22) and tensioner 3 rotate freely, while plunger 1 and spring 6 are free within the tensioner housing;

- refit the belt providing it is taut;

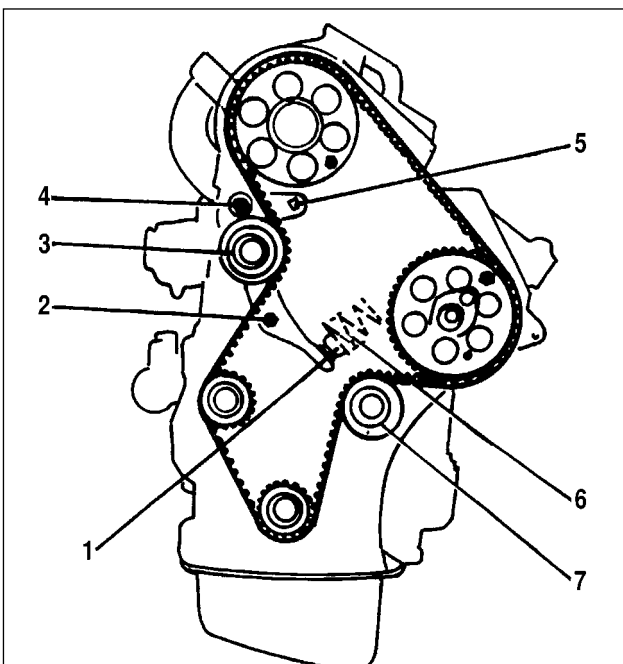


Fig.9-22. Removing and refitting the cambelt:

1 - plunger; 2 - nut; 3 - tensioner roller; 4 - bolt; 5 - square-type hole; 6 - spring; 7 - idler pulley

- refit the timing belt over the pulleys in the following order: crankshaft pulley, idler pulley 7, fuel pump pulley, camshaft pulley, tensioner pulley, water pump;

- slacken bolt 4 to release the tensioner;

- remove the retaining bolts and flywheel retainer;

- tighten bolt 4 and nut 2;

- rotate the crankshaft two turns clockwise.

Tension - checking:

- tighten the retaining bolts and refit the flywheel retainer;

- loosen bolt 4 and nut 2 to spread tension over the belt;

- tighten bolt 4 and nut 2 to 18 N•m;

- refit the crankshaft pulley;

- coat bolt 20 with Loctite 243;

- fix the flywheel with tool OUT0000049;

- refit the pulley retaining bolt, torque to 40 N•m, turn to further 60°;

- refit bottom cover 3 (Fig.9-21), tighten bolts 1 to 15 N•m;

- refit cover 5, tighten bolts 4 to 15 N•m;

- tighten right-hand cover 6 bolt 7 to 10 N•m.

Note. When you fail to refit any securing bolt or a retainer, repeat the complete procedure for the cambelt refitting.

Alternator - removal and refitting

Removal. Loosen tensioner 2 bolt and bolt 9 (Fig.9-23). Tighten bolt 8 until it comes against the limiter. Remove the belt.

CHECK to see pulley 4 rotates easily without seizures.

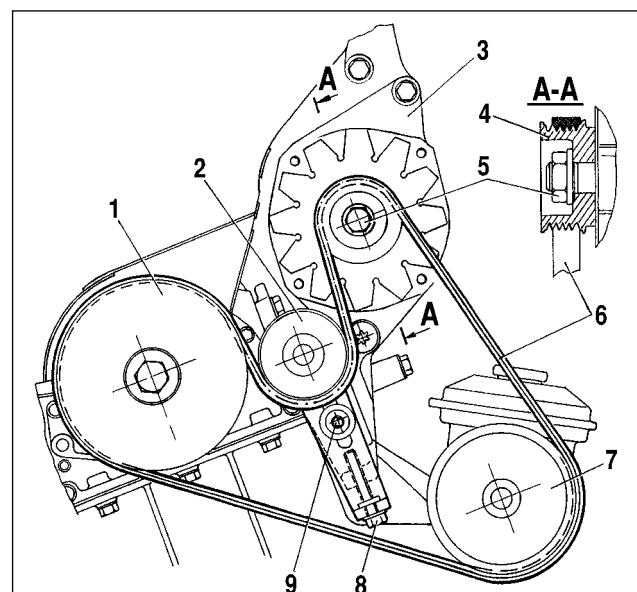


Fig.9-23. Removing and refitting the alternator drive belt:

1 - crankshaft pulley; 2 - tensioner pulley; 3 - alternator; 4 - alternator pulley; 5 - nut; 6 - alternator drivebelt; 7 - vacuum pump pulley; 8 - tensioner bolt; 9 - tensioner fixing bolt

Refitting. Refit the belt over the pulleys and ensure the belt is located properly within the groove of each pulley.

Belt tensioning is carried out in the following sequence:

- tighten the belt through loosening bolt 8;
- locate tool OUT0000016;
- use bolt 8 to tighten the belt until the tool reads 115 ± 10 SEEM;
- remove the tool, tighten the tensioner bolt and bolt 9;
- turn the crankshaft clockwise four turns;
- locate tool OUT0000016, check the tension and adjust it as applicable;
- remove the tool, tighten bolts to 22 N•m.

Lubrication system

Design description

The lubrication system is of mixed type. The crankshaft and camshaft bearings, oil pump shaft and inner gear are pressure lubricated, while pistons, piston rings, gudgeon pins and cylinder walls are fling lubricated.

Oil change

Change oil on a warm engine only. Allow at least 10 minutes after opening the drain plug to completely drain oil.

Oil change should be accompanied by the oil filter renewal; use tool A.60312 to undo the filter. When refitting the filter into position, tighten the filter by hand only - do not use any tools.

Renew oil in the following sequence:

- stop the engine and drain oil; without removing the oil filter, pour in cleaning oil to the «MIN» mark of the oil dipstick. Use cleaning oils of ВНИИИП-ФД, МСП-1 or МПТ-2М type;
- start the engine and run it at low rpm for 10 minutes;
- fully drain the cleaning oil and discard the old oil filter;
- fit a new filter and pour oil of required season grade.

Fuel system

Design description

Fuel system consists of a fuel tank, a fuel filter, a high pressure fuel pump, injectors, an air cleaner, an intake pipe and high / low pressure fuel pipes.

High pressure fuel pump is maintenance-free. To exclude air leaks resulting in higher fuel consumption, remember to check the pipes are properly tightened.

Injectors. In case of difficult engine start or black smoke from the silencer, remove, check and if necessary, renew the injectors.

When refitting the injectors always renew both copper and steel washers.

Fuel filter is one-stage with a replaceable filter element, a built-in water separator and a sludge discharge cap. Undo the central bolt, remove the housing and clean it in diesel fuel. Renew the filter element and oil seals.

Air cleaner has a replaceable filter element made of special cardboard and a gauge strainer from synthetic cotton.

WARNING. Fuel accessories (high pressure fuel pump, fuel injectors, fuel filter) must be repaired at specialist maker's workshops. This manual does not cover the relevant dismantling, repair and reassembly procedures.

Idle adjustment

No adjustments of maximum fuel supply and speed are possible. The adjustments can only be done by specialist dealers.

Idle speed can be adjusted. Any changes in adjustments can result in rapid engine wear and ensued loss of guarantee.

Fast idle - setting. With the cold engine, lever 10 (Fig.9-24) should touch limiter 9; when necessary, tighten cable 7 by tensioner 11. The cable movement should be more than 6 mm.

Accelerator - setting. Fully depress the accelerator pedal, lever 4 should touch limiter 5. Make sure that at idle lever 4 rests on limiter 9.

Warm up the engine, the electric fan blower must cut in.

Engine stall prevention system. Fit 4 mm gasket 8 between lever 4 and limiter. Depress stop lever 2.

Insert 3 mm pin 3 in lever 10. Set the crankshaft speed at 900 ± 100 rpm by turning limiter 9.

Remove gasket 8 and locating pin 3.

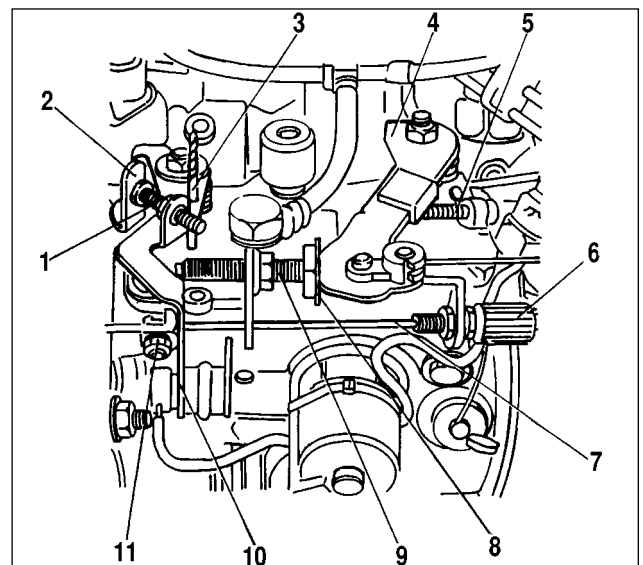
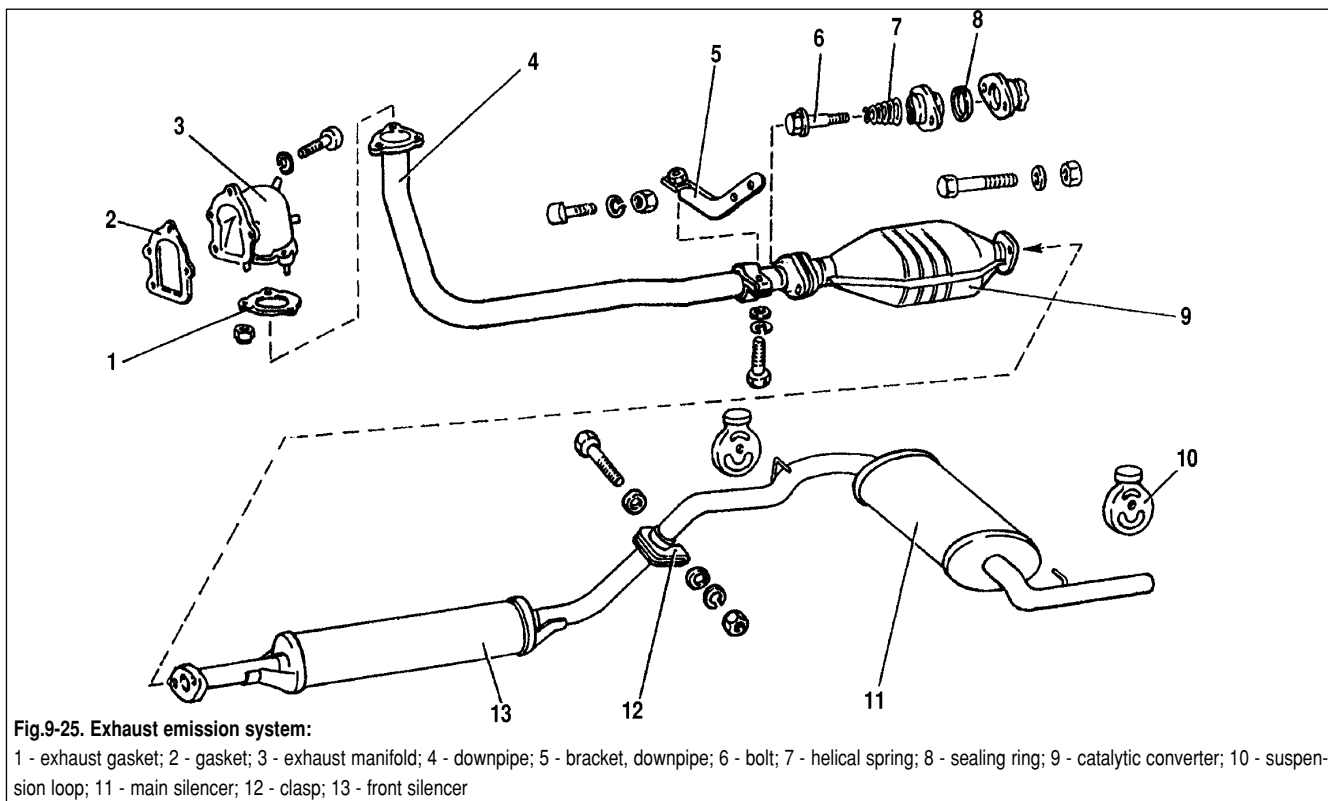


Fig.9-24. Idle control:

1 - throttle stop (CO adjustment) screw; 2 - stop lever; 3 - locating pin; 4 - load lever; 5 - limiter; 6 - outer cable tensioner; 7 - accelerator cable; 8 - gasket; 9 - limiter; 10 - fast idle lever; 11 - cable tensioner



Adjust idle with the help of screw 1. The idle speed should be 800-850 rpm.

Engine rundown - checking. Using load lever 4 set the engine speed at 3000 rpm. Release the load lever, the engine rundown should be 2.5 - 3.5 seconds.

After returning to idle, the speed difference should not exceed 50 rpm.

WARNING. The adjustment screws for maximum fuel feed and speed are sealed at the factory.

Exhaust emission system

Exhaust gases escape from the engine through exhaust manifold 3 (Fig.9-25), front exhaust pipe (downpipe) 4, catalytic converter 9, intermediate silencer 13 and front silencer 11.

There is a steel heat shield over the catalytic converter. Exhaust gasket 1 is fitted between the downpipe flange and exhaust manifold 1.

The downpipe is connected to the catalytic converter flange through a moving joint. Metal/graphite ring 8 with a spherical surface is placed between the flanges, an inner spherical surface is provided in the flange of the downpipe.

The silencer pipes are held together by means of clasp 12. Downpipe 4 is attached by three nuts to the exhaust manifold and in addition to bracket 5.

No dismantling or repair of the silencers or pipes is possible, have them always replaced with new ones.

Electrical system

Alternator. The Valeo alternator is supplied together with the engine. The wiring diagram for alternator is shown in Fig.9-26.

When the ignition is switched on, the alternator «B» terminal is powered through warning light 6. After the engine start current is not supplied through the warning light and it does not illuminate. The alternator «W» terminal is used for voltage supply to electronic tachometer 4.

Starter motor. The Valeo starter motor is supplied together with the engine. The wiring diagram for starter motor is shown in Fig.9-27.

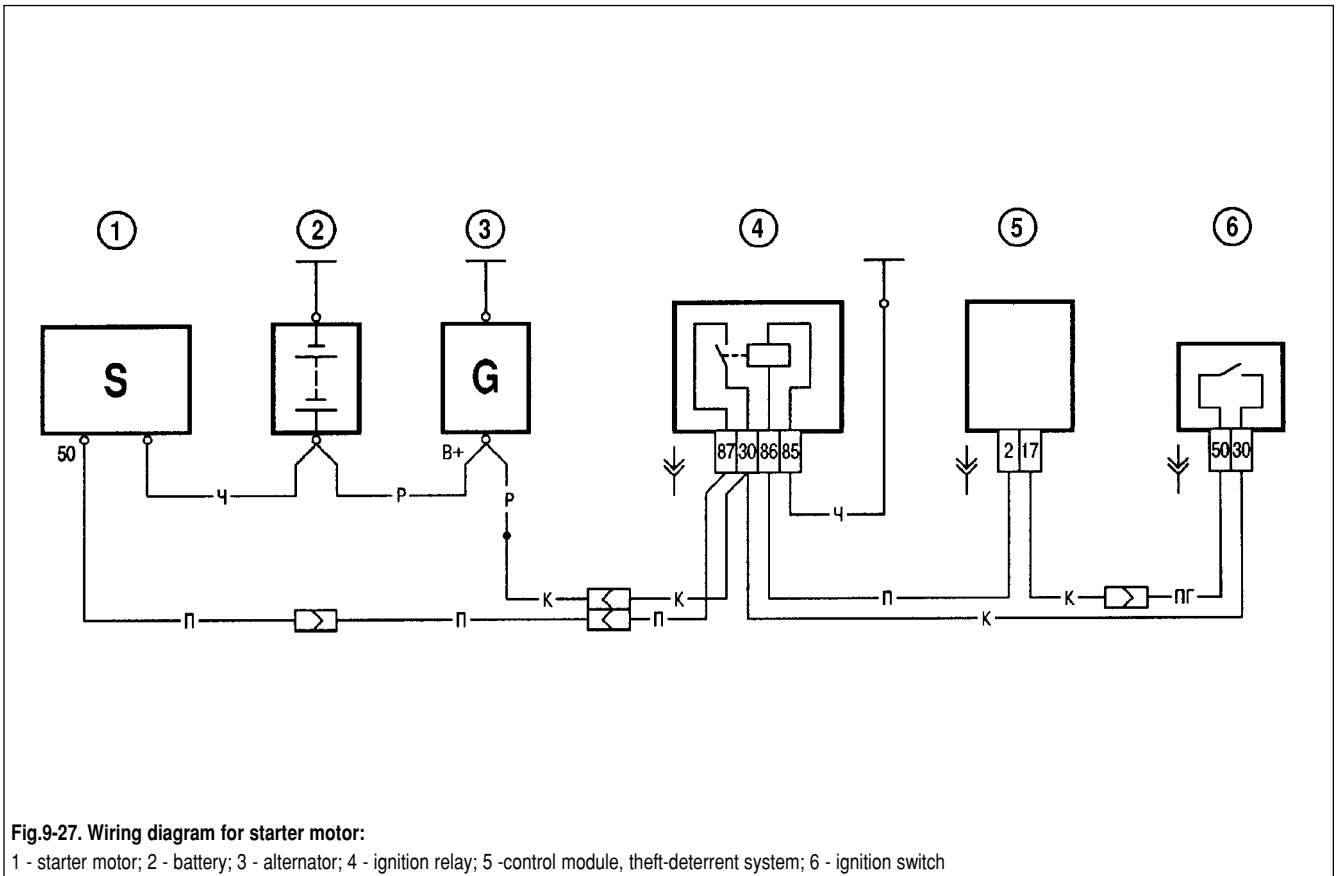
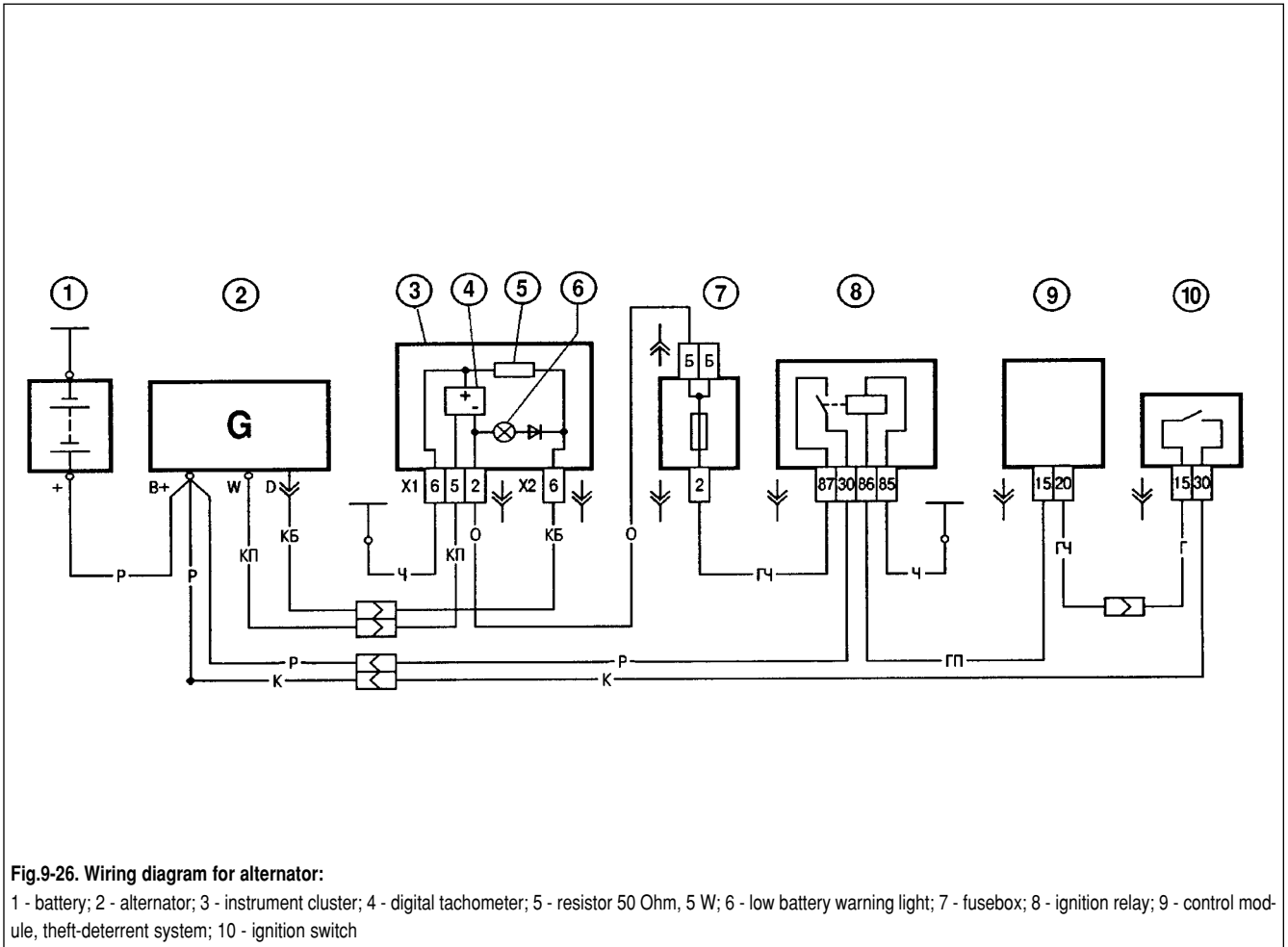
Engine management system (EMS). The wiring diagram for the engine management system is shown in Fig.9-28.

The system design, operation and diagnostics are detailed in a separate «Peugeot» Manual for Diesel Engine Diagnostics.

Vehicle antitheft system. The vehicle VAZ-21215-10 is fitted with an antitheft system of relay type (АПС-2P).

The antitheft system includes control module 1 (Fig.9-29), system state indication LED 2 and code key fobs 3. The theft-deterrent system represents an electronic control module, which allows in case of unauthorized use to inhibit the engine start through disconnecting the relevant electrical circuits.

Refer to Fig.9-30 for the wiring diagram of theft-deterrent system. The installation of the antitheft system brought alterations in operation of direction indicators and hazard flashers (Fig.9-31), windscreen wipe/wash (Fig.9-32), rear window wipe/wash and heating (Fig.9-33).



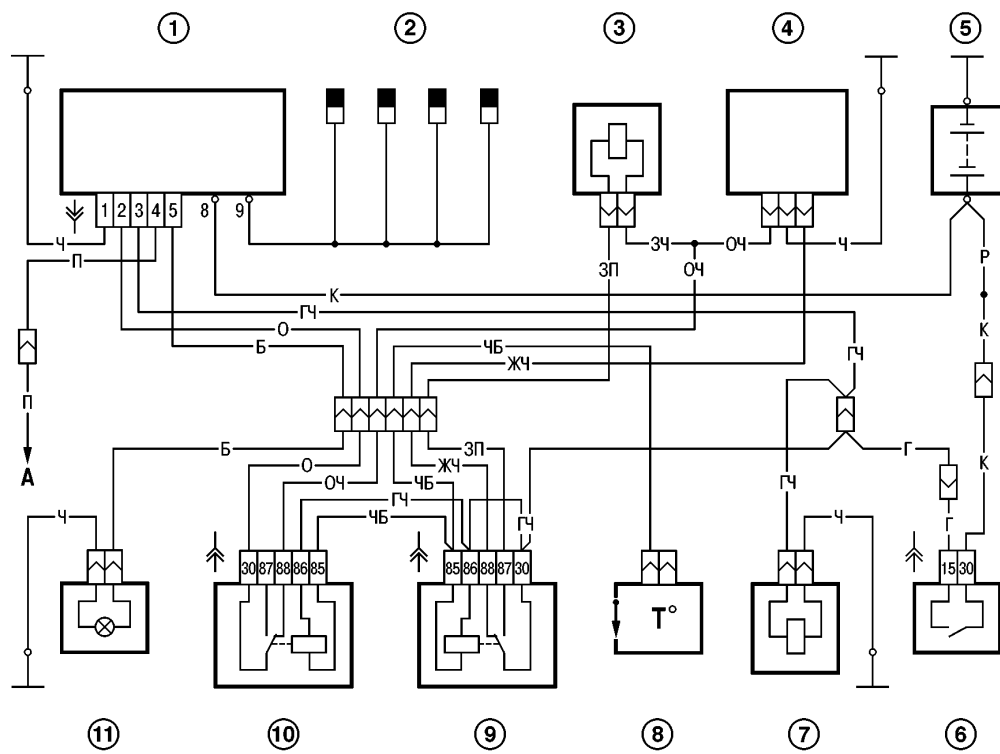


Fig.9-28. Wiring diagram for Engine Management System:

1 - glow plug control module; 2 - glow plugs; 3 - EGR valve; 4 - fuel pump; 5 - battery; 6 - ignition switch; 7 - breaker; 8 - thermoswitch; 9 - relay, EGR valve; 10 - relay, thermoswitch; 11 - glow plug warning light

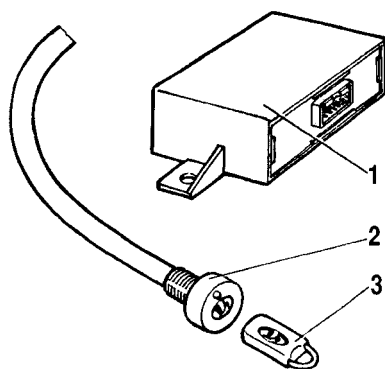


Fig.9-29. Automotive theft-deterrent system:

1 - control module; 2 - LED for system state indication; 3 - key fob

Headlight wipe/wash. The vehicle VAZ-21215-10 is not fitted with the headlight wipe/wash.

Cooling fan motor. Two dc motors powered from constant magnets of MP 8019/37 type are provided to operate the engine cooling fan blower. The wiring diagram for cooling fan motor is shown in Fig.9-34.

The motors are triggered by sensor 1 through complementary relay 3. The sensor is fitted to the right-hand radiator cooler. The sensor contacts close at $(99 \pm 3)^\circ\text{C}$ and open at $(94 \pm 3)^\circ\text{C}$. The relay is housed in the engine bay and is bolted to the top bulk-head reinforcement.

The motors are maintenance-free and must always be renewed in case of failure.

Motor specification

Nominal motor shaft speed with impeller	
load, rpm600-2800
Current consumption at speed and	
load as specified, ampere, not greater14

Instrument cluster. The instrument cluster includes: speedometer with trip counter, coolant temperature gauge, fuel gauge, tachometer, 13 warning lights (Fig.9-35). The wiring diagram for instrument cluster is shown in Fig.9-36. The instrument panel pin assignment is shown in Table 9-3.

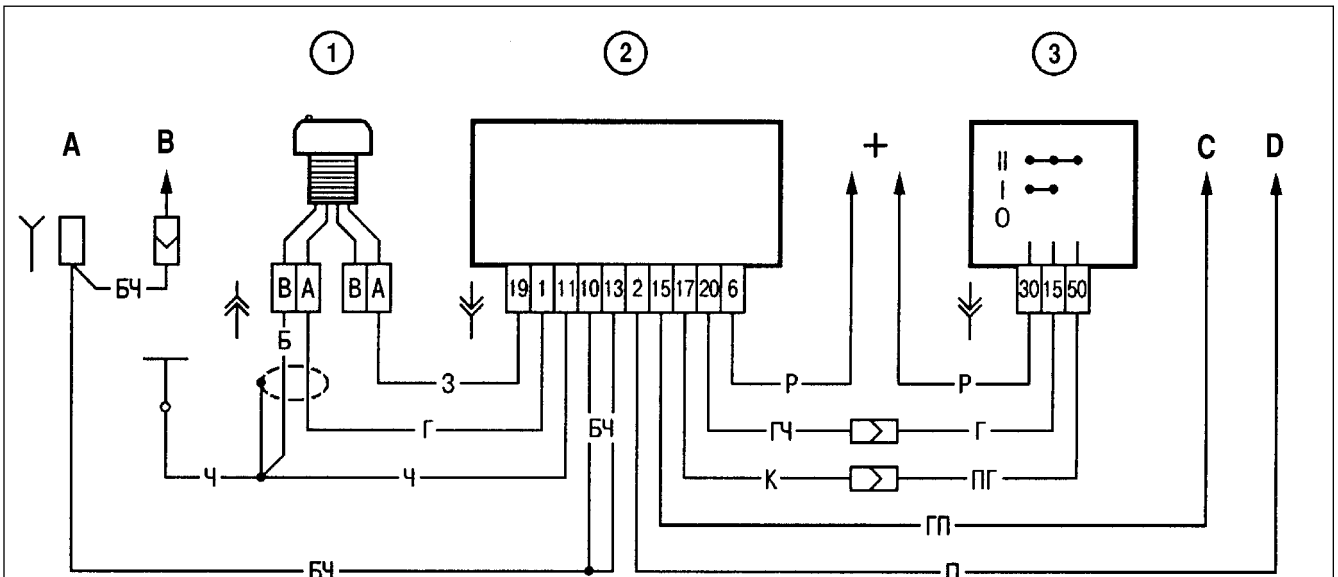


Fig.9-30. Wiring diagram for theft-deterrent system:

1 - LED for system state indication; 2 - control module; 3 - ignition switch;

A - to interior light switch; B - to interior light; C - to ignition relay terminal 86; D - to starter relay terminal 86

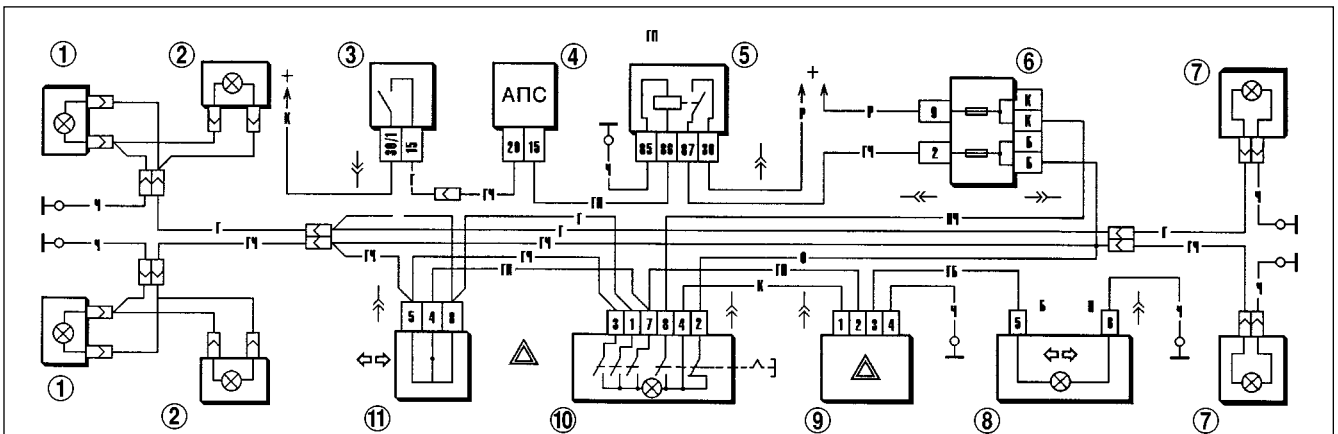


Fig.9-31. Wiring diagram for direction indicators and hazard warning flashers:

1 - direction indicators, front lights; 2 - side repeat indicators; 3 - ignition switch; 4 - control module, theft-deterrent system; 5 - ignition relay; 6 - fuse and relay box; 7 - direction indicators, rear lights; 8 - direction indicator warning light in instrument cluster; 9 - indicators flasher relay; 10 - hazard warning flasher switch; 11 - direction indicator switch

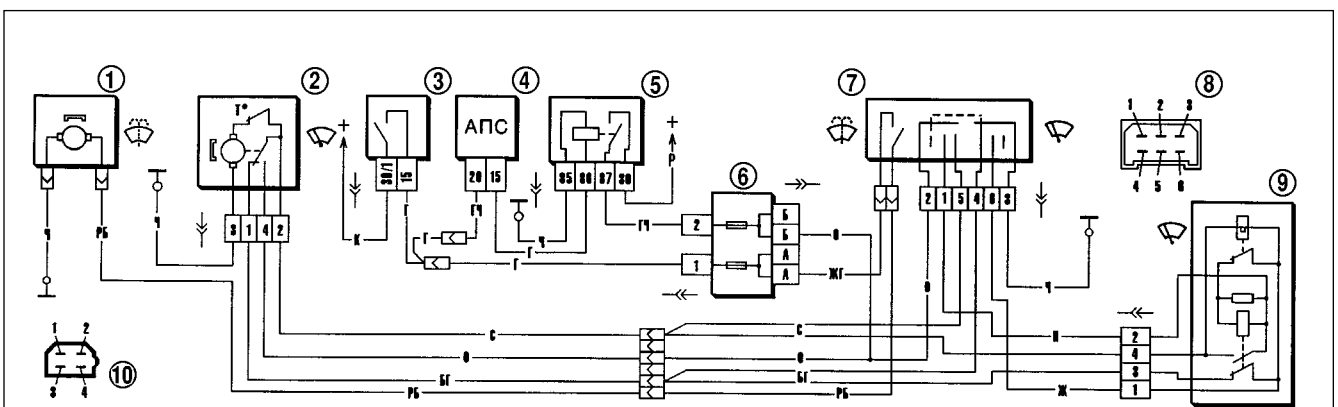


Fig.9-32. Wiring diagram for windscreen wipe/wash:

1 - windscreen washer motor; 2 - windscreen wiper motor; 3 - ignition switch; 4 - control module, anti-theft system; 5 - ignition relay; 6 - fusebox; 7 - windscreen wipe/wash switch; 8 - pin assignment in switch connector; 9 - windscreen wiper relay; 10 - pin assignment in windscreen wiper relay and motor connectors.

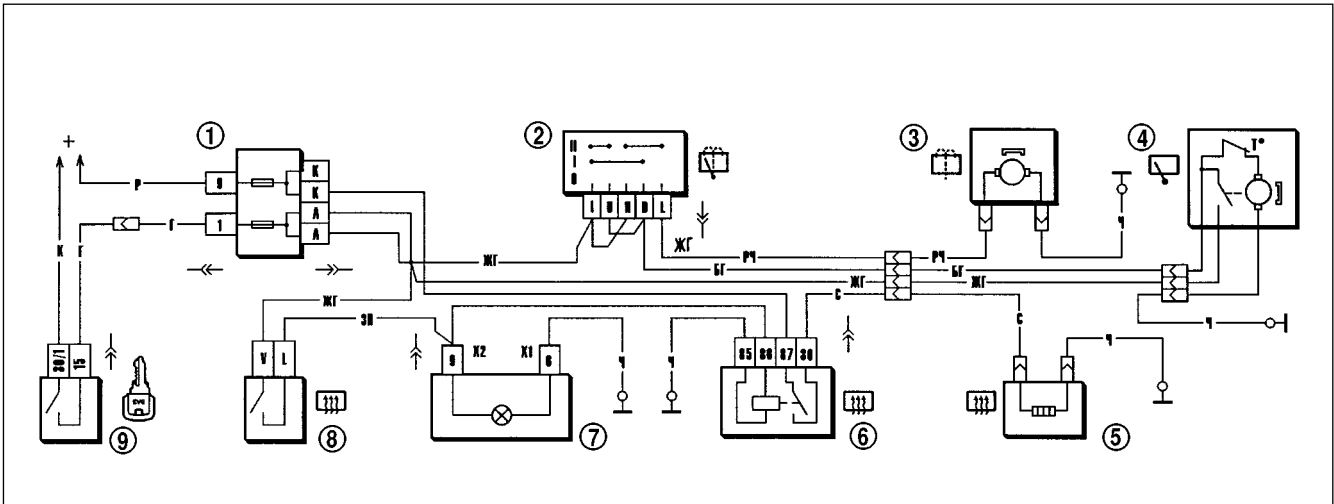


Fig.9-33. Wiring diagram for tailgate wipe/wash and heating element:
 1 - fusebox; 2 - wipe/wash switch; 3 - rear window washer motor; 4 - rear window wiper motor; 5 - rear window heating element; 6 - heated rear window relay; 7 - heated rear window warning light; 8 - heated rear window switch; 9 - ignition switch

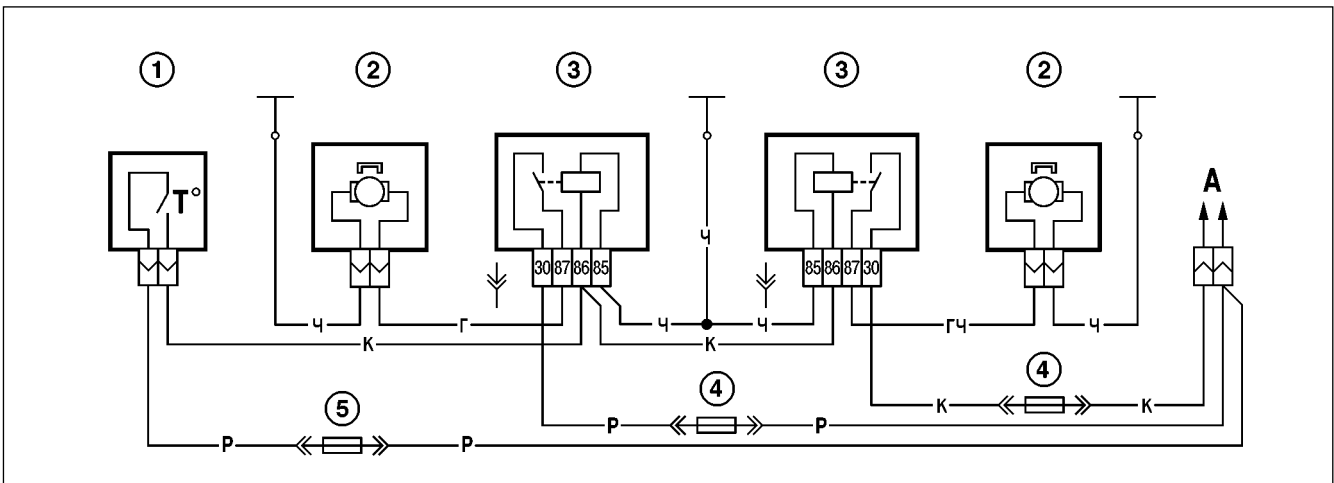


Fig.9-34. Wiring diagram for cooling fan motors:
 1 - motor-on sensor; 2 - fan blower motor; 3 - fan motor cut-in relay; 4 - fuse (8 amperes) 5 - fuse (16 amperes)

Table 9-3.

Instrument cluster pin assignment

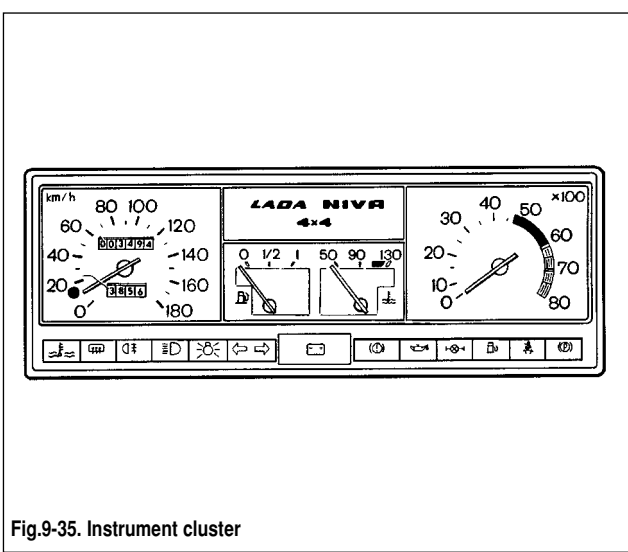
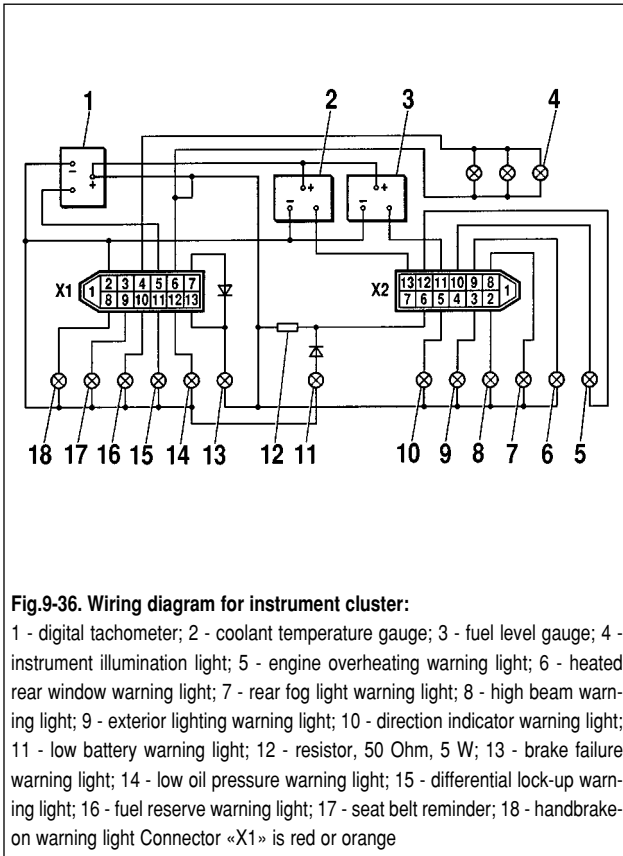


Fig.9-35. Instrument cluster

Pin No	Pin assignment
	Connector X1 (red or amber)
1	-
2	To ignition switch terminal «15»
3	Spare
4	To instrument cluster lighting switch
5	To alternator terminal «W»
6	To housing
7	To ignition switch terminal «50»
8	To handbrake warning light switch
9	To seat belt relay
10	To fuel gauge terminal «W»
11	To differential lockup sensor
12	To low oil pressure sensor
13	To brake fluid level sensor



Connector X2 (any colour, except red and amber)

- 1 -
- 2 To high beam relay
- 3 To exterior lighting switch
- 4 -
- 5 To indicators flasher relay
- 6 To alternator terminal «B»
- 7 -
- 8 To rear foglight switch
- 9 To heated rear window switch
- 10 To ignition switch terminal «15»
- 11 To fuel level sensor terminal «T»
- 12 To coolant temperature sender
- 13 To coolant temperature sender

Coolant temperature gauge - checking. The coolant temperature gauge is associated with the relevant sender in the cylinder head. At the sensor resistance of 640-1320 Ohm the needle should be at the low end of scale, at 77-89 Ohm it should rest at the front of the red area, at resistance of 40-50 Ohm the needle should go to the end of the red area.

Fuel level gauge - checking. The fuel gauge is associated with the relevant sensor in the petrol tank. The same sensor operates the fuel reserve warning light, when 4 to 6 litres are left in the petrol tank. At the sensor resistance of 200-238 Ohm the needle should be at the low end of scale, at 59-71 Ohm - at the middle scale, while at 17-23 Ohm the needle should go to the high end of scale (mark 1).

Speedometer - checking. Check the speedometer turning its drive shaft at various speeds. The data required for checking is shown in Fig.9-4.

Table 9-4

Speedometer specification	
Speedometer readings, km/h	Drive shaft speed, rpm
30	433 - 500
40	600 - 667
50	766 - 833
60	933 - 1000
80	1250 - 1333
100	1567 - 1667
120	1883 - 2000
140	2200 - 2333
160	2517 - 2667

Tachometer - checking. The tachometer operates on the principle of measuring the voltage pulse frequency in the alternator field winding.

The tachometer is checked on a test bench simulating the vehicle ignition system. Connect the tachometer as applicable, apply 14 volts to the primary circuit and set the spark gap at 7 mm. Turn the ignition distributor shaft at such a speed to bring the tachometer needle to one of main scale divisions. At this moment the ignition distributor shaft speed should be within the permissible limits (Refer to Table 9-5).

Table 9-5

Tachometer specification	
Tachometer reading, rpm	Ignition distributor shaft speed, rpm
1000	900 - 1100
2000	1900 - 2250
3000	2950 - 3300
4000	3950 - 4300

Fuel level sender - checking. With an empty tank the sensor resistance should be (250±10) Ohm, with a half-filled tank - (66±6) Ohm, with a full tank - (20±2) Ohm.

Steering with BREED «SRS-40» driver's airbag in the steering wheel

Design description

The SRS-40 system is housed in the steering wheel, being an additional protection to the seat belt, the system is intended to prevent serious chest and head injuries to the driver.

The system is activated at the frontal impact and at 30° impact leftward and rightward to the vehicle centre line. The system is not activated during:

- impacts at more than 30° to the vehicle centre line;
- side impacts;
- rear impacts;
- rollover;
- minor frontal impacts.

The SRS-40 system consists of the following main components:

- gas generator (inflator) with a built-in impact sensor;
- airbag module;
- special steering wheel with fixtures.

The system is activated by inertial impact force via triggering a mechanical sensor (opposite to electrical pulse), which operates the gas generator, thus making redundant wiring and power supply. Since the system is mechanical, there is no need in the warning light or diagnostic unit. The system is always ready to operate, it is maintenance-free, though after seven years in field the gas generator is subject to mandatory replacement.

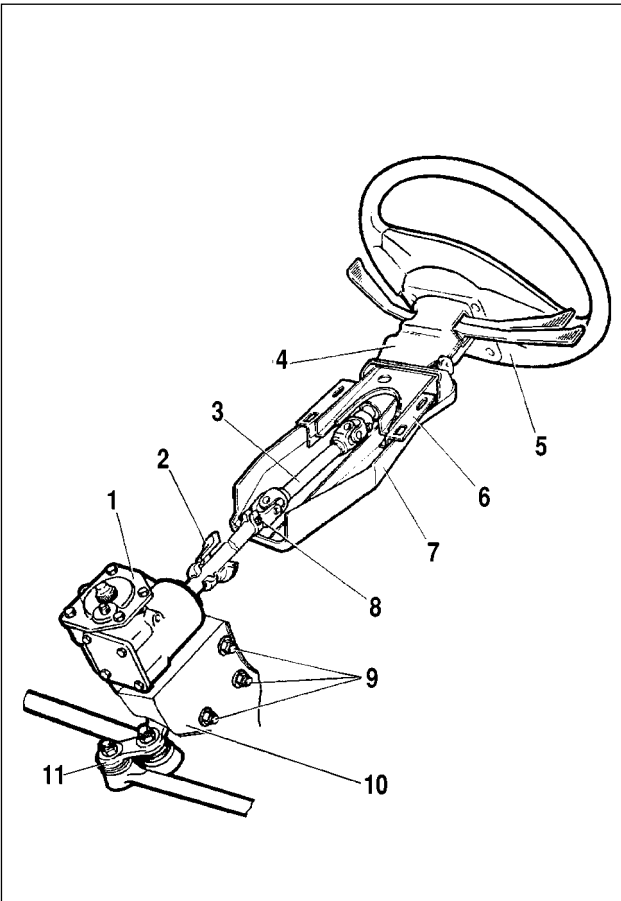


Fig.9-37. Steering components:

1 - steering mechanism; 2 - seal; 3 - middle shaft; 4 - upper steering column shroud; 5 - steering wheel; 6 - bracket; 7 - lower steering column shroud; 8 - clamp bolt, universal joint; 9 - securing bolts, steering mechanism; 10 - chassis arm; 11 - drop arm

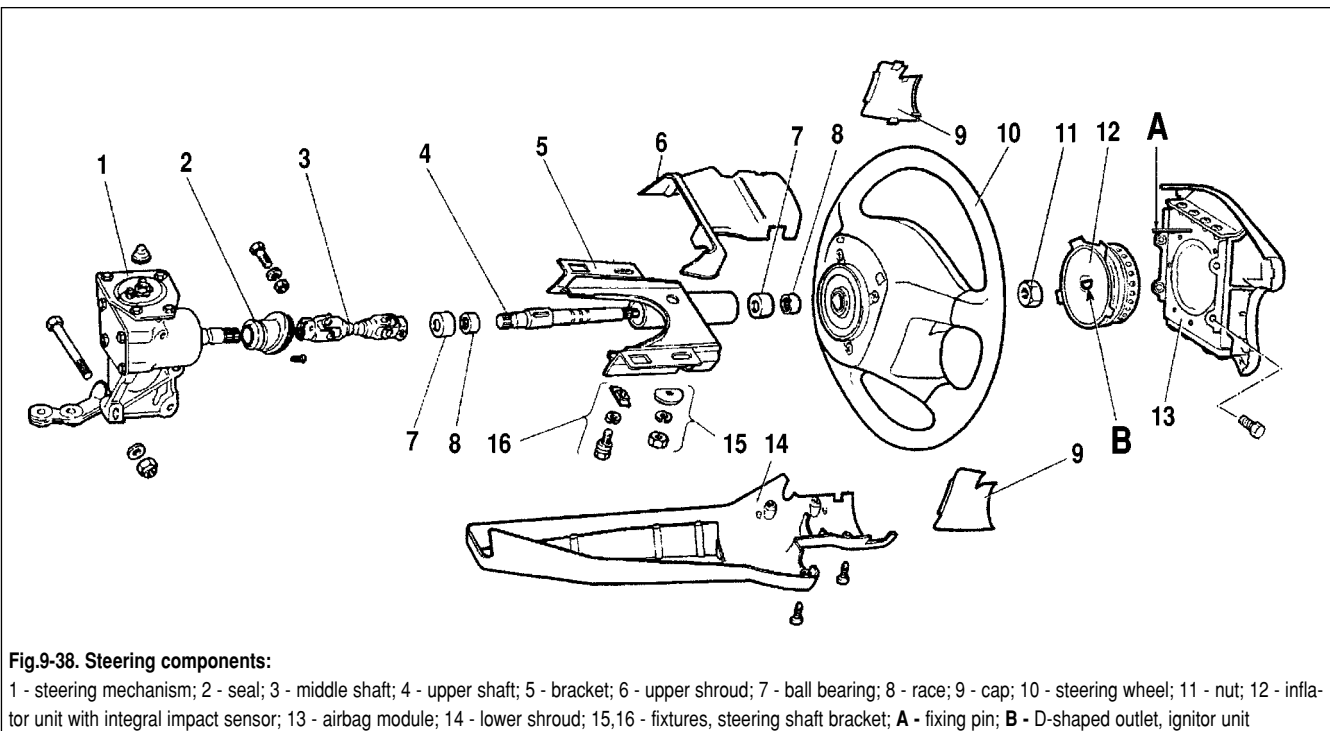


Fig.9-38. Steering components:

1 - steering mechanism; 2 - seal; 3 - middle shaft; 4 - upper shaft; 5 - bracket; 6 - upper shroud; 7 - ball bearing; 8 - race; 9 - cap; 10 - steering wheel; 11 - nut; 12 - inflator unit with integral impact sensor; 13 - airbag module; 14 - lower shroud; 15, 16 - fixtures, steering shaft bracket; A - fixing pin; B - D-shaped outlet, ignitor unit

WARNING. Never fit the steering wheel SRS-40 to other vehicle models, since the impact sensor in the gas generator is tailored to parameters and characteristics of VAZ-21213 vehicle and its versions.

Due to variations in parameters and characteristics among vehicle models and within similar models of different production years, NEVER use the SRS-40 components for other vehicles. In the event the adjustments are lost or a component is damaged in an accident or during dismantling, do not reuse the SRS-40 components.

In case of an accident the impact sensor inside the inflator module receives an impact force pulse and at the preset pulse level activates the system, releasing gas (nitrogen) through the holes in the housing, filling the airbag that is folded inside the module. During the airbag filling, it breaks through the central seam on the steering wheel trim pad, which halves go open up and down respectively. The airbag of 40 litre capacity is deployed in front of the steering wheel.

The protective function of the steering wheel with the SRS-40 airbag is intended for one application only, therefore after the accident renew the steering wheel complete with the inflator, airbag module and other steering-related parts damaged.

The steering fitted with an airbag features a different, original steering wheel, which houses the gas generator and airbag module unit, there is also an original bracket to secure the steering column. Refer to chapter 5 for design description and repair instructions with respect to other steering-associated units and components.

Removal and refitting

WARNING

1. Always use eye protection and wear gloves when working with the gas generator or airbag module.
2. Always keep on the lateral side of the steering wheel when working with the gas generator or airbag module. Never place anything on the steering wheel or between the steering wheel and a worker.
3. Never use the gas generator unit when it happened to fall from over 1 meter height or has evident damages.
4. Do not store the gas generator at temperatures above 52°C.
5. When handling the gas generator, always keep the holes outward; on any surfaces position the holes upward; never put anything on the gas generator.

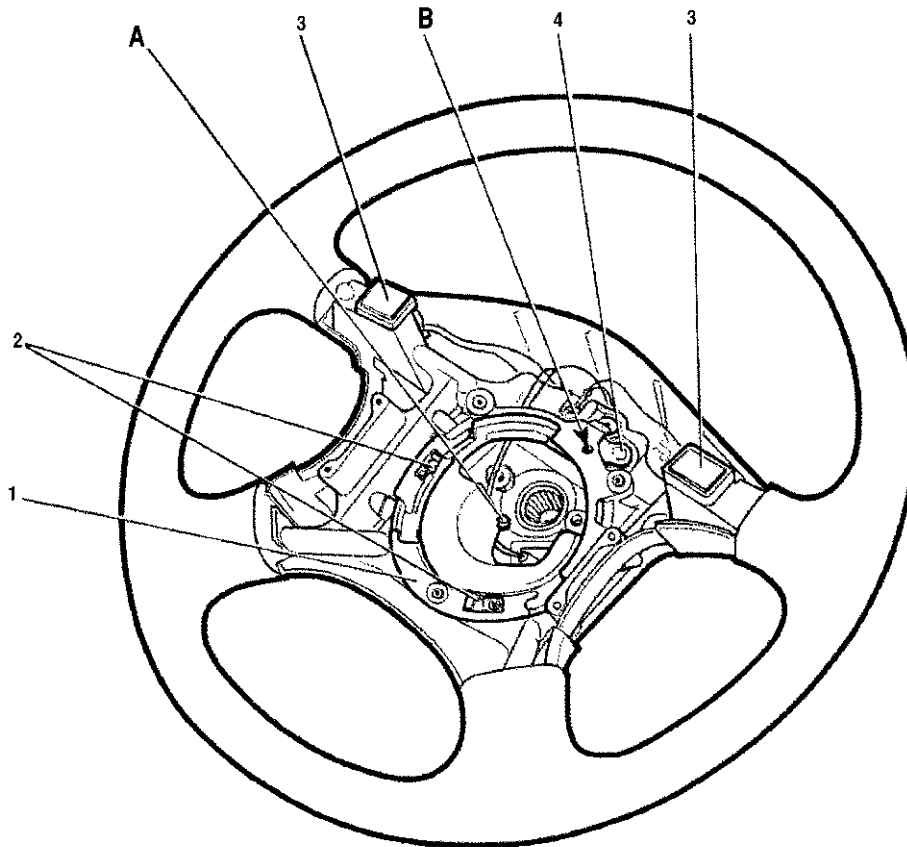


Fig.9-39. Steering wheel:

1 - adapter (for inflator unit fitting); 2 - lock spring; 3 - horn button; 4 - locking tab;
A - device for setting system to ready position - D-shaped lug; B - hole in adapter

6. Always check the steering wheel is reliably secured before fitting the gas generator, never pierce or rotate the ignitor unit through the D-shaped hole in the housing.

7. Store the gas generator in a box, while the airbag module in a plastic bag. Do not dismantle; protect the gas generator from damages, since inside its sealed housing there are solid chemicals being poisonous, inflammable and potentially health hazardous.

8. To exclude any misuse of the SRS-40 system, do not employ impact tools on steering elements.

Removal. Open the bonnet and disconnect the battery negative lead. Position the front wheels in the straight-ahead position so that steering wheel 5 top elements (Fig.9-37) are horizontal. Next carry out the following:

- remove two caps 9 (Fig.9-38) from the steering wheel side trim;

- working from the side of the steering wheel, unscrew four bolts securing airbag module 13; carefully withdraw the airbag module from the steering wheel;

- using a screwdriver, retract spring-type locking tab 4 (Fig.9-39), then turn inflator unit 12 (Fig.9-38) anticlockwise to align its base with recesses in steering wheel adapter 1 (Fig.9-39);

WARNING. Never apply excessive force to the inflator unit when dismantling. If the inflator unit doesn't turn, make certain the locking tab is fully retracted.

- exercise care and withdraw the gas generator from the steering wheel adapter;

- undo nut 11 (Fig.9-38) and remove the steering wheel. Refer to chapter 5 of Repair Manual for further dismantling of steering-associated parts and units.

Refitting of the steering is a reversal of the removal procedure observing the following:

- before refitting the steering wheel, make sure the unit «A» (Fig.9-39) for putting the system in the ready-to-work position (D-shaped projection in the centre of the steering wheel adapter) is not bent or broken, otherwise renew the steering wheel;

- refit the steering wheel to the steering shaft so that the top elements of the steering wheel are horizontal. Torque the steering wheel nut to 31.4-51 N•m (3.2-5.2 kgf•m) and bend it up at one point;

- before refitting the gas generator, make certain there are no knocks or sticking, check the steering wheel rotates smoothly lock-to-lock; swing the steering wheel to see there is no radial or axial steering wheel play; eliminate all defects found;

- fit the gas generator to the steering wheel adapter with your right hand. Position the gas generator in the adapter recesses and turn clockwise about 40° to the full lock. A click should be heard, the hole in locking tab 4 (Fig.9-39) should coincide with the

hole «B» in the steering wheel adapter. In this position the gas generator is set to working order. During installation turn the gas generator by hand only. The gas generator should never be forced into the position;

- working from the outside of the vehicle, place the airbag module to the gas generator unit, while matching the «A» fixture (Fig.9-38) on the module with the hole «B» (Fig.9-39) in the steering wheel adapter;

- tighten airbag module 13 securing bolts (Fig.9-38) to 7-11 N•m;

- do not cut, drill or pierce any part of the SRS-40 system under any circumstances.

ATTACHMENTS

Attachment 1

TORQUE WRENCH SETTINGS *

Part	Thread	Tightening torque, N·m (kgf·m)
ENGINE		
Main bearing cap bolt	M10x1.25	68.31-84.38 (6.97-8.61)
Oil pump bolt	M6	5.10-8.20 (0.52-0.85)
Breather cover retaining stud	M8	12.7-20.6 (1.3-2.1)
Breather cover nut	M8	12.7-20.6 (1.3-2.1)
Cylinder head bolt	M12x1.25	Refer to chapter «Engine»
Cylinder head bolt	M8	31.36-39.1 (3.2-3.99)
Nut, inlet and exhaust pipe securing stud	M8	20.87-25.77 (2.13-2.63)
Nut, big end cap bolt	M9x1	43.32-53.51 (4.42-5.46)
Flywheel securing bolt	M10x1.25	60.96-87.42 (6.22-8.92)
Chain tensioner shoe bolt	M10x1.25	41.2-5.0 (4.2-5.2)
Valve cover bolt	M6	1.96-4.60 (0.20-0.47)
Camshaft bearing housing retaining nut	M8	18.33-22.64 (1.87-2.3)
Oil pump shaft sprocket bolt	M10x1.25	41.2-51.0 (4.2-5.2)
Camshaft sprocket bolt	M10x1.25	41.2-51.0 (4.2-5.2)
Nut, valve adjuster bolt	M12x1.25	43.3-53.5 (4.42-5.46)
Valve adjuster bolt sleeve	M18x.5	83.3-102.9 (8.5-10.5)
Spark plug	M14x1.25	30.67-39 (3.13-3.99)
Coolant pump retaining bolt	M8	21.66-26.75 (2.21-2.73)
Nut, water jacket exhaust manifold	M8	15.97-22.64 (1.63-2.31)
Crankshaft ratchet	M20x1.5	101.3-125.64 (10.34-12.8)
Alternator bracket bolt	M10x1.25	44.1-64.7 (4.5-6.6)
Nut, alternator mounting plate	M10x1.25	28.03-45.27 (2.86-4.62)
Nut, alternator-to-bracket securing bolt	M12x1.25	58.3-72.0 (5.95-7.35)
Mounting plate-to-alternator retaining nut	M10x1.25	28.03-45.27 (2.86-4.62)
Retaining nut, engine front mounting bracket	M8	10.4-24.2 (1.1-2.5)
Retaining nut, front mounting rubber-to-crosspiece bracket	M10x1.25	27.4-34.0 (2.8-3.46)
Retaining nut, rear engine mounting crosspiece	M8	15.0-18.6 (1.53-1.9)
Retaining nut, rear engine mounting / transmission	M8	28.3-28.8 (2.38-2.94)
Retaining nut, rear engine mounting / crosspiece	M8	15.9-25.7 (1.62-2.62)
CLUTCH		
Clutch securing bolt	M8	19.1-30.9 (1.95-3.15)
Nut, clutch / brake pedals bolt	M12x1.25	12.7-20.6 (1.3-2.1)
Retaining nut, clutch / brake master cylinders and pedal bracket	M8	9.8-15.7 (1.0-1.6)
Nut, clutch hydraulic drive connection pipes	M12	24.5-31.4 (2.5-3.2)
Nut, brake hydraulic drive connection pipes	M10	14.7-18.6 (1.5-1.9)

TRANSMISSION

Reversing light switch	M14x1.5	28.4-45.1 (2.9-4.6)
Clutch housing-to-engine bolts	M12x1.25	53.9-87.2 (5.5-8.9)
Clutch housing-to-transmission retaining nut	M10x1.25	31.8-51.4 (3.25-5.25)
Clutch housing-to-transmission retaining nut	M8	15.7-25.5 (1.6-2.6)
Shift rod detent cover bolt	M8	15.7-25.5 (1.6-2.6)
End cover retaining nut	M8	15.7-25.5 (1.6-2.6)
Output shaft rear end nut	M20x1.0	66.6-82.3 (6.8-8.4)
Intermediate shaft bearing clamping washer bolt	M12x1.25	79.4-98 (8.1-10.0)
Fork-to-shift rod retaining bolt	M6	11.7-18.6 (1.2-1.9)

TRANSFER BOX

Mounting bracket-to-rubber shaft retaining nut	M10x1.25	26.5-32.3 (2.7-3.3)
Mounting bracket-to-body retaining nut	M8	15.0-18.6 (1.53-1.9)
Nut holding covers of transfer box casing, front axle drive casing, speedometer drive unit housing, control lever bracket	M8	14.7-24.5 (1.5-2.5)
Differential lockup switch	M16x1.5	28.4-45 (2.9-4.6)
Fork-to-selector rod retaining bolt	M6	11.8-18.6 (1.2-1.9)
Fork-to-differential lockup rod retaining bolt	M12x1.25	11.7-18.6 (1.2-1.9)
Driven gear retaining bolt	M10x1.25	66.6-82.3 (6.8-8.4)
Retaining bolt, driving shaft rear bearing and intermediate shaft rear bearing	M18x1.5	96-117.6 (9.8-12.0)
Nut holding propeller shaft flange to driving shaft and to front / rear axle driveshafts	M16x1.5	96-117.6 (9.8-12.0)

DRIVE LINE

Nut, bolts holding flexible coupling to gearbox and transfer box flanges	M12x1.25	57.8-71.5 (5.9-7.3)
Nut, bolt holding propeller shaft flange to flanges of front/rear axles reduction gear and transfer case	M8	27.4-34.3 (2.8-3.5)

FRONT AXLE

Front axle-to-engine retaining bolt	M12x1.25	74.5-92 (7.6-9.4)
Front axle-to-engine retaining nut	M12	60.8-75 (6.2-7.66)
Front axle-to-engine retaining bolt	M10x1.25	42.1-52 (4.3-5.3)
Inner joint housing bearing cover retaining nut	M8x1.25	19.6-24.5 (2.0-2.5)
Differential bearing cover retaining nut	M12x1.25	62.7-75.4 (6.3-7.7)
Retaining bolt, lockplate-to-spring washer	M6x1	3.8-6.2 (0.39-0.63)
Driven gear securing bolt	M10x1.25	83.3-102.9 (8.5-10.5)

REAR AXLE

Bolt holding reduction gear casing to rear axle beam	M8	35-43.2 (3.57-4.41)
Differential bearing cover bolt	M10x1.25	43.3-53.5 (4.42-5.46)
Driven gear bolt	M10x1.25	83.3-102.9 (8.5-10.5)
Flange-to-drive gear nut	M16x1.5	Refer to section «Rear axle»
Retaining nut, axleshaft bearing and rear brake	M10x1.25	41.6-51.4 (4.25-5.25)

FRONT SUSPENSION

Nut, lower bolts holding cross-member to chassis arms	M12x1.25	66.6-82.3 (6.8-8.4)
Nut, upper bolts holding cross-member to chassis arms	M12x1.25	66.6-82.3 (6.8-8.4)

Nut, bolt holding recoil block bracket to cross-member	M8	15.1-18.6 (1.53-1.9)
Nut, upper control arm shaft bolt	M12x1.25	66.6-82.3 (6.8-8.4)
Shock-absorber upper end retaining nut	M10x1.25	27.4-34 (2.8-3.46)
Shock-absorber lower end retaining nut	M10x1.25	50-61.7 (5.1-6.3)
Nut, front wheel hub bearing	M18x1.5	Refer to «Running gear»
Brake caliper-to-steering knuckle retaining bolt	M10x1.25	29.1-36 (2.97-3.67)
Anti-roll bar retaining nut	M8	15-18.6 (1.53-1.9)
Balljoint-to-steering knuckle retaining nut	M14x1.5	83.3-102.9 (8.5-10.5)
Radius rod-to-suspension crosspiece nut	M12x1.25	66.6-82,3 (6.8-8.4)
Radius rod-to-body retaining nut	M16x1.5	104.9-169.5 (10.7-17.3)
Lower arm shaft-to-crosspiece connecting nut	M16x1.5	114.7-185.2 (11.7-18.9)
Balljoint-to-suspension arm retaining nut	M8	20.6-25.75 (2.1-2.63)
Nut, wheel retaining bolt	M12x1.25	62.4-77.1 (6.37-7.87)
Suspension upper arm shaft nut	M14x1.5	63.7-102.9 (6.5-10.5)
Nut, swing arm retaining bolt	M12x1.25	66.6-82.3 (6.8-8.4)

REAR SUSPENSION

Shock-absorber retaining nut	M12x1.25	38.2-61.7 (3.9-6.3)
Nut, Panhard rod and trailing arms retaining bolts	M12x1.25	66.6-82.3 (6.8-8.4)

STEERING

Nut, steering box retaining bolt	M10x1.25	33.3-41.2 (3.4-4.2)
Nut, idler arm bracket retaining bolt	M10x1.25	33.3-41.2 (3.4-4.2)
Nut, steering rod ballpin **	M14x1.5	42.1-53 (4.3-5.4)
Middle shaft-to-upper shaft and worm shaft retaining nut	M8	22.5-27.4 (2.3-2.8)
Steering wheel retaining nut	M16x1.5	31.4-51 (3.2-5.2)
Steering shaft bracket and ignition switch retaining nut	M8	15-18.6 (1.53-1.9)
Drop arm nut	M20x1.5	199.9-247 (20.4-25.2)
Idler arm shaft nut	M14x1.5	63.7-102.9 (6.5-10.5)

* It is allowed to round tightening torques for nuts and bolts to the tenth of kgf-m within the tolerance.

** With the nut recess mismatching the cotter pin hole, tighten to further torque (less than 60°) to ensure a reliable locking

SPECIAL TOOLS FOR MAINTENANCE AND REPAIR *

Designation	Description
ENGINE	
A.40005	Universal pickers kit
A.40026	Removal tool, coolant pump impeller
A.50088	Spanner, intake / exhaust pipe nuts
A.50113	Allen key, crankcase oil drain plug
A.50121	Spanner, crankshaft pulley bolt
A.50126	Spanner for checking cylinder head bolt tightening torques (with camshaft in situ)
A.60153/R	Mandrel for pressing in/out inlet/exhaust valve guide
A.60311/R	Tool, removal / installation of engine valves
A.60312	Removal tool, oil filter
A.60326/R	Tool to press out ignition distributor / oil pump drive gear bush from the cylinder block
A.60330/R	Flywheel fixing arm for fitting flywheel to crankshaft
A.60333/1/2	Tool to press in/out oil pump drive shaft bushes
A.60334	Tool for checking cylinder head tightness
A.60430	Installation tool, coolant pump impeller
A.86010	Tool for pressing in crankshaft plugs
A.90310	Set of reamers, valve guide bore machining
A.90353	Reamer for bushes of oil pump drive shaft, ignition distributor and fuel pump
A.94003	Core drill (75°), inlet valve seat machining
A.94016	Core drill spindle, plug machining
A.94016/10	Core drill, crankshaft plug socket machining
A.94031	Core drill (20°), exhaust valve seat machining
A.94058	Core drill spindle, valve seat machining
A.94059	Set of guides, valve seat machining
A.94069	Grinding wheel spindle, valve seat machining
A.94078	Grinding wheel, exhaust valve seat machining
A.94092	Core drill, exhaust valve seat machining
A.94100	Grinding wheel, inlet valve seat machining
A.94101	Core drill (20°), inlet/exhaust valve seat machining
A.95111	Blade for checking camshaft valve lever/cam lobe clearance
02.7812.9500	Socket spanner (13 mm), removal and refitting of starter motor and downpipe
02.7823.9505	Tool, valve removal and installation (can be used in place of A.60311/R)
41.7816.4013	Socket spanner (21 mm) for tightening valve lever adjuster bolt guides
41.7853.4010	Installation tool, camshaft cover to engine
41.7853.4011	Installation tool, oil seal + retainer to crankshaft
41.7853.4016	Installation tool, valve guide oil caps
67.7812.9513	Dynamometer for checking fan blower belt tension
67.7812.9514	Spark plug spanner
67.7812.9515	Spanner for checking spark plug tightening torque
67.7812.9519	Socket, spark plug removal/installation
67.7824.9521	Tool for checking wear (extension) of camshaft drive chain
67.7834.9506	Tool for checking fuel pump pushrod protrusion
67.7854.9519	Adjuster bush for fitting normal and oversize pistons of 82 mm dia.
67.8125.9502	Ring gauge (82 mm dia.) for setting inside gauge to zero
67.8151.9505	Gauge for checking fuel level in carburettor
TCO-3/379	Crosspiece, engine removal and installation
EC-106	Thermostat inspection rig

CLUTCH

A.70017	Tool, clutch pedal spring removal and installation
A.70081	Mandrel, clutch disc centering
67.7813.9503	Tooling, clutch disc repair
67.7822.9517	Jig, clutch disc lining renewal
67.7851.9500	Mandrel, clutch disc lining rivetting

TRANSMISSION

A.40006	Puller, front input shaft bearing
A.55035	Jointed box spanner, gearbox removal and installation
41.7816.4068	Input shaft fixing arm
41.7816.4069	Tool for fitting (removing) circlip to (from) output shaft
41.7853.4028	Mandrel for fitting output shaft bearing
41.7853.4032	Mandrel, installation of intermediate shaft bearing
41.7853.4039	Mandrel, installation of output shaft oil seal
67.7853.9558	Mandrel for driving on transfer case differential bearing

DRIVE LINE

A.70025	Clasp, removal and installation of flexible coupling
41.8734.4092	Gauge for selection of propeller shaft universal joint bearing circlips
67.7823.9522	Cramp, renewal of universal joint spider
67.7853.9533	Tool for pressing in front wheel CV joint oil seal ring
67.7853.9537	Installation tool, front wheel CV joint rubber boot

DRIVE AXLES

A.45008	Removal tool, driving pinion rear bearing inner race
A.45028	Rest, removal of differential box bearing inner race
A.55085	Spanner, differential bearing nuts
A.70152	Tool for pressing rear bearing inner race to driving pinion
A.70157	Installation tool, axleshaft oil seal
A.70171	Tool for pressing in driving pinion rear bearing outer race
A.70172	Pair of flanges to be fitted to rear axle beam ends during its inspection (truing)
A.70184	Tool to determine shim thickness to adjust clearance in final drive gear meshing
A.70185	Tool for pressing in driving pinion front bearing outer race
A.70198	Tool for pressing out driving pinion bearing outer race
67.7823.9530	Installation tool, axleshaft lockring
67.7823.9529	Removal tool, lockring from axleshaft
A.95601/R	Tool for checking reliable pressing of lockring onto axleshaft
A.95688/R	Tool for adjusting clearance in drive gear/crown wheel meshing and differential bearing tightening
A.95690	Tool for selecting drive pinion shim thickness
A.95697/5	Socket, dynamometer 02.7812.9501
02.7812.9501	Dynamometer for checking rotational resistance moment of drive axle pinion and steering worm shaft
67.7812.9520	Spanner, front axle pinion adjustment
02.7834.9504	Measuring tool, free axial play of axleshaft
67.7823.9516	Removal tool for axleshaft, rear axle
67.7853.9559	Rest, differential bearing removal
67.8701.9508	Bracket with endpiece to tool A.95688/R for adjusting front axle pinion

FRONT SUSPENSION

A.47045	Tool for pressing out silent blocks of suspension upper arms
A.57034/R	Wrench, shock-absorber cartridge nut

A.57070	Spanner, front shock-absorber removal and installation
A.74177/1	Tool for fitting silent blocks to front suspension upper control arm (to be used with tool 67.7853.9519)
02.8701.9502	Tool for checking front suspension balljoints
67.7820.9514	Cross-member for engine lifting
67.7820.9520	Mandrel, nut reduction
67.7820.9521	Lever for moving front wheel hub to check clearance in bearings
67.7823.9514	Removal tool, wheel hub cap
67.7823.9515	Removal tool, lower control arm shaft
67.7823.9517	Tool for pressing out/in lower control arm silent blocks
67.7823.9526	Tool for pressing in/out lower control arm silent blocks on press
67.7823.9527	Tool for pressing out upper control arm silent block
67.7824.9513	Repair tool kit, shock absorber
67.7834.9507	Tool for measuring clearance in front wheel hub bearing
67.7853.9519	Tool for pressing in upper control arm silent block (to be used with tool A.74177/1)
67.7853.9528	Tool for fitting wheel hub cap
67.7853.9534	Washer for pressing out front wheel hub inner bearing outer race
67.7853.9535	Handle to washers for pressing out wheel hub inner bearing outer race
67.7853.9536	Tool for pressing in front wheel hub bearing outer race
67.7853.9540	Washer for pressing out wheel hub bearing inner race / oil seal
67.8732.9501	Tool for checking geometry of front suspension cross-member

REAR SUSPENSION

67.7820.9517	Tool kit, replacement of rear suspension rod silent blocks
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STEERING

A.47035	Separator tool for pressing out steering joints from drop arm and idler arm
A.47043	Removal tool, drop arm
A.74076/1	Repair tool, steering box
A.74076/R	Bracket for securing steering box, to be attached to tool A.74076/1
A.74105	Tool for pressing in/out drop arm shaft bush
A.74186	Tool for pressing out worm shaft bearing outer race
A.90336	Reamer, steering box bushes
67.7813.9504	Wrench, steering rod coupling
67.7824.9516	Puller, steering link balljoints
67.7853.9541	Tool for pressing out/in worm upper bearing outer race
67.8720.9501	Tool for checking steering wheel free play

BRAKING SYSTEM

A.56124	Spanner, brake pressure regulator cover plug
67.7820.9519	Installation tool, rear brake pressure regulator
67.7823.9519	Puller, brake drum

ELECTRICAL SYSTEM

02.7823.9504	Removal tool, alternator pulley
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BODYWORK

A.78034	Removal tool, window lifter handle locking clip
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** Tool kit to be supplied to the customer is defined separately*

Adjustment and checking DATA

Valve clearances, cold engine (18-20°C), mm:	
inlet valves	0.15
exhaust valves	0.20
Coolant temperature, warm engine, at ambient air of 20-30°C, full load and 80 km/h, not greater, °C	
	95
Minimum idle rpm	750-800
Oil pressure in engine lubrication system, oil temperature of 85°C and crankshaft speed of 5400 rpm, MPa (kgf/cm ²)	
	0.35-0.45 (3.5-4.5)
Coolant level in expansion tank, cold engine	3-4 cm above «MIN» mark
Alternator drivebelt deflection at 98 N (10 kgf), mm	10-15
Electrode gap, mm:	
carburettor engine	0.7-0.8
injection engine	1.00-1.13
Initial ignition timing BTDC, degrees:	
91 RON fuel	1±1
93 RON, 95 RON fuel	3±1
Clutch pedal free play, mm	25-35
Brake pedal free play, engine stalled, mm	3-5
Steering wheel play, vehicle in straight-ahead position, not greater, degrees (mm)	5 (18-20)
Front wheel toe-in, run-in vehicle, at 3140 N (320 kgf), mm	2-4
Front wheel camber, run-in wheel, at 3140 N (320 kgf), degrees (mm)	0°30'±20' (1-5)
Castor, run-in vehicle, at 3140 N (320 kgf), degrees	3°30'±30'
Tyre pressure, MPa (kgf/cm ²):	
front wheels	0.21 (2.1)
rear wheels	0.19 (1.9)
Backlash, front wheel hub bearings, mm:	
field adjustment	0.02-0.07
	0.02-0.15
Minimum permissible lining thickness, front pads and rear shoes, mm	1.5
Fluid level, brake /clutch fluid reservoirs	up to lower filler neck edge
Maximum gradient on dry hard ground where laden vehicle is retained unlimited time with handbrake applied, %	
	25
Handbrake lever travel, notch on the ratchet:	
adjustment	4-5 (2-4)*
operation	4-7 (2-8)*

* For vehicles with double tooth pawl

Fuel, lubricants and fluids

Location	Capacity, litres	Description
Fuel tank, VAZ-21213, VAZ-21214, VAZ-21214-20 vehicles	42	Automotive petrol, at least 95 RON as per EN 228
Fuel tank, VAZ-21215-10 vehicle	45	Diesel fuel as per EN 590
Engine cooling system, including heating and ventilation system, VAZ-21213, VAZ-21214,VAZ-21214-20 vehicles	10.7	Ethylene glycol-based coolant meeting ASTM D 3306-86 b
Engine cooling system, including heating and ventilation system, VAZ-21215-10 vehicle	11	Coolants: «PROCOR 3000», «ACO 800», «NAPGEL C 2400», «REVCO CEL 107»
Engine lubrication system, including oil filter, VAZ-21213, VAZ-21214, VAZ-21214-20 vehicles	3.75	Motor oils: SAE: 5W-40 (-30 to +30°C) 10W-40 (-25 to +35°C) 15W-40 (-20 to +45°C) API: SG/SH/CD ACEA: A2-96
Engine lubrication system, including oil filter, VAZ-21215-10 vehicle	6	Motor oils: SAE: 15W-40 (-12 to +40°C) 10W-30 (-20 to +30°C) 5W-30 (-25 to +30°C) 10W-40 (-20 to +40°C) API: SG/CF ACEA: B2 96 mini CCMC: PD2
Gearbox	1.35	Transmission oils:
Rear axle casing	1.3	SAE: 75W-90(-40 to +25°C)
Steering box	0.18	80W-90 (-26 to +35°C)
Transfer case	0.75	85W-90 (-12 to +45°C)
Front axle casing	1.15	API: GL5
Clutch hydraulic release system	0.2	Brake fluids: FM VSS : 571 116 DOT 4
Brake hydraulic system	0.66	SAE: J 1713
Windscreen/headlight washer container	5.0	Any alcohol-based glass cleaners
Rear door washer reservoir	2.0	
Front wheel bearings		
Starter motor guide ring	–	Automotive multipurpose lithium grease: NLGI: class 2
Bearings, universal joints	–	Automotive multipurpose lithium grease: NLGI: class 2 c MOS2
Propeller shafts spline joint		
Seat rails		
Door locks	–	Automotive multipurpose lithium grease: NLGI: class 1
Front suspension ballpins, steering joints	–	KB-521 (<i>Fiat Lubrificanti</i>) grease
Front wheel CV joints	–	VN 2461C (<i>Molikot</i>) grease
Transmission / transfer case drive joint	–	Longtern-00 (<i>Dow Corning</i>) grease
Battery terminals and clamps	–	Hydrocarbon grease: NLGI: class 1 or 2
Door key holes		
Rear brake pressure regulator	–	Castrol S 058 grease

Автомобили ВАЗ-21213, ВАЗ-21214, ВАЗ-21214-20, ВАЗ-21215
Руководство по ремонту автомобилей
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