

- secure the shock absorber and connect the side steering rod to the knuckle arm;
- install the hub complete with the brake disc on the joint housing extension and install tapered bushing 18;
- screw in a new adjusting nut and adjust the clearances in the wheel hub bearings;
- install the wheel hub cap with mandrel 67.7853-9528;
- put in place the brake caliper and the wheel.

Note. In all cases when the nut has been removed from the extension of the outer joint housing, replace it by a new one or by a used nut removed from another car.

Balancing the Wheels

The wheels should be balanced on special stands in accordance with the stand operating instructions. The unbalance can be eliminated by the use of balance weights held on the wheel rim by special springs.

Removing and Installing the Front Suspension

Install the car on a lift or an inspection pit, apply the parking brake, open the hood and remove the spare wheel.

Put chocks under the rear wheels and remove the front ones.

Using remover tool 67.7824-9516 (Fig. 5-10), drive the pins out of the steering knuckle arms and shift aside the steering rods.

Disconnect sway eliminator bar 6 (Fig. 4-6) from the suspension lower wishbones.

Disconnect tension members 5 from the body brackets and cross member.

Detach the shock absorbers from suspension lower wishbones.

Remove the engine sump protective shield and the splashguard.

On each side of the car remove the front brake caliper without disconnecting the brake hoses and suspend it so that it does not hang on the hoses.

Compress the suspension spring to relieve completely the lower wishbone.

Disconnect the ball joint from the lower wishbone and take off the spring, relieving it gently; repeat the same operations on the other suspension unit.

Disconnect upper wishbone shaft 44 (Fig. 4-1) from suspension cross member bracket 2 and remove upper wishbone 41 complete with the steering knuckle, wheel hub, front brake and outer joint housing.

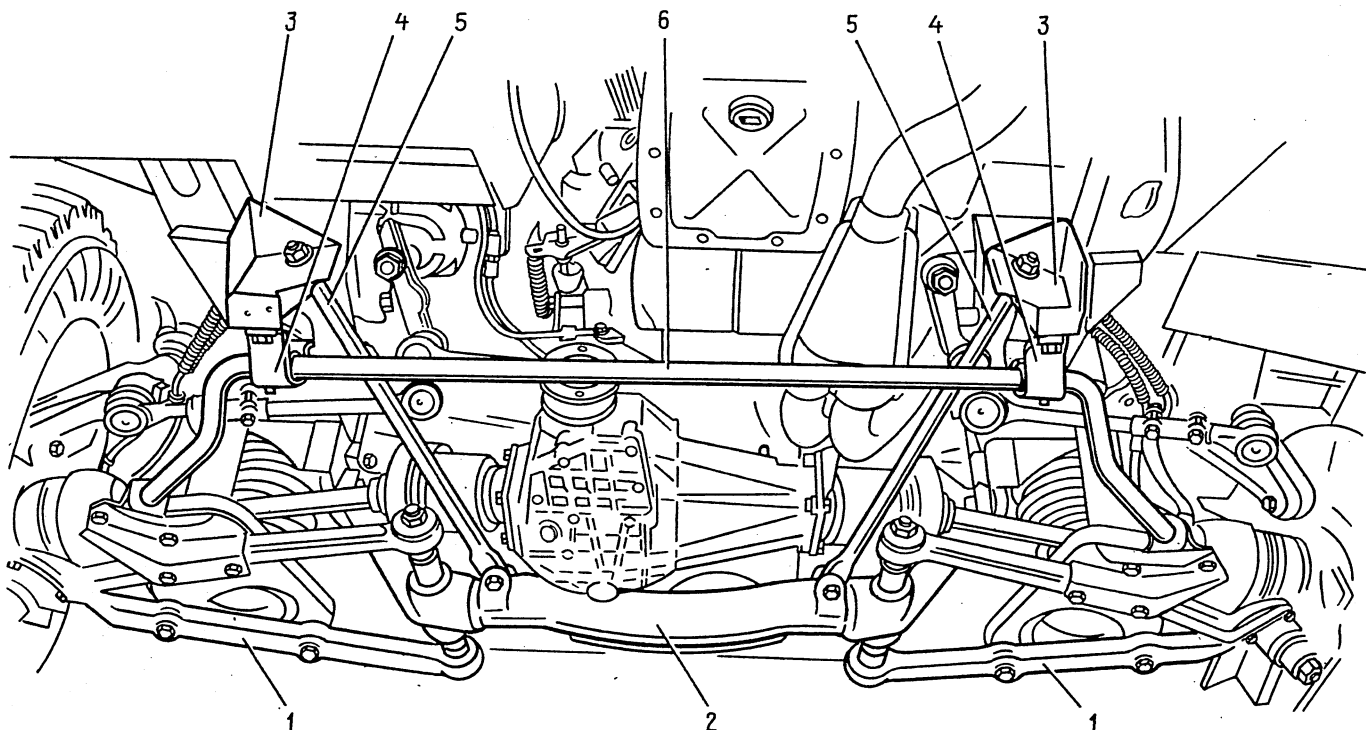


Fig.4-6. Front Suspension Mounted on Car. Rear View:

1 - lower wishbone; 2 - cross member; 3 - tension member bracket; 4 - sway eliminator bar to body bracket; 5 - tension member; 6 - sway eliminator bar

Note. When removing the upper wishbone shaft, take a note of the number and location of the washers between the upper wishbone shaft and the cross member and of the adjusting plates between the cross member and the body side member so as to return the washers and plates to their previous places during reassembly.

Disconnect the engine mounting rubber cushions from the cross member brackets.

Put a hydraulic jack with a fixing device under the suspension cross member and, supporting the engine with cross beam 67.7820-9514 or a hoist, detach the suspension cross member from the body side members, and brackets 42 of the rebound buffers.

Take off cross member 51 complete with lower wishbones 1.

Install the suspension units and parts in the reverse order of removal operations. The suspension springs should belong to the same class (class A - unmarked, class B - black marks on the coil surface). It is also permissible to install class A springs on the front suspension if the rear suspension is provided with class B springs.

Having assembled and installed the suspension, check the wheel alignment angles and the toe-in.

Disassembly and Assembly of Front Suspension Units

Disassembly. If the suspension repairs call for a complete stripping of its units, this should better be begun directly on the car, after removing the sump protective shield and the splashguard.

Proceed as follows:

- unscrew the nut of the pin of upper ball joint 36 (Fig. 4-1) and free the hoses from the clips;
- unbend the tongues of the protective housing, remove the bolts of the caliper guide and shift it aside complete with the caliper;

Caution

To protect the hoses against damage, see that the caliper does not hang on them.

- using remover tool 67.7823-9514, take off the hub cap and unscrew the nut of the wheel hub bearings;
- remove the front wheel hub complete with the brake disc using remover tool 67.7823-9516;
- remove the guard housing of the front brake;
- take down the front shock absorber;
- compress the suspension spring to relieve completely the lower wishbone, easing the wishbone down on a support;

- disconnect the ball joint housings from the suspension lower and upper wishbones and remove the steering knuckle;

- relieve gently and remove the suspension spring;

- using remover tool 67.7823-9515, knock out the shaft and disconnect the lower wishbone from the cross member;

- disconnect the upper wishbone shaft from the cross member and take off the shaft complete with the wishbone;

Note. Before removing the shafts of the upper and lower wishbones, count the number of washers on each end of the lower wishbone shaft and on the bolts of the upper wishbone shaft so as to put them in their own places during reassembly;

- remove the cross member and the rebound buffer bracket as described above;

- using remover tool 67.7824-9516, drive out the ball joint pins from the steering knuckle holes.

The parts of the front suspension are shown in Fig. 4-7.

Assembly of the front suspension units is carried out in the reverse order of disassembly operations. When assembling the wheel hub, put a layer of ЛМТОЛ-24 lubricant into the bearing cages and apply a uniform layer of this lubricant into the steering knuckle space between the bearings, 40 g per knuckle.

When installing the cross member tension members, screw in the inner nut until the clearance between the washer and bracket 3

(Fig. 4-6) is taken up; screw in the outer nut with a torque specified in the Appendix.

To avoid wrong distribution of forces in the silent blocks, screw in the wishbone shaft nuts under a static load of the car equal to 3200 N (320 kgf). Then check and adjust the wheel alignment angles and the toe-in.

Inspection

Ball joints. Make sure that the ball joint boots are intact; they should be free of such defects as fractures, cracks, separation of rubber from metal and leakage of lubricant.

Examine the working surfaces of the ball joints for wear, turning the ball pin by hand. Play or jamming of the pin are impermissible.

The condition of the ball joint can be assessed more accurately by the amount of radial and axial clearances measured with gauge 02.8701-9502. For this purpose install ball joint 1 (Fig. 4-8A) into the gauge socket and clamp it with a screw. Place indicator 2 into the gauge bracket with the gauge spindle bearing

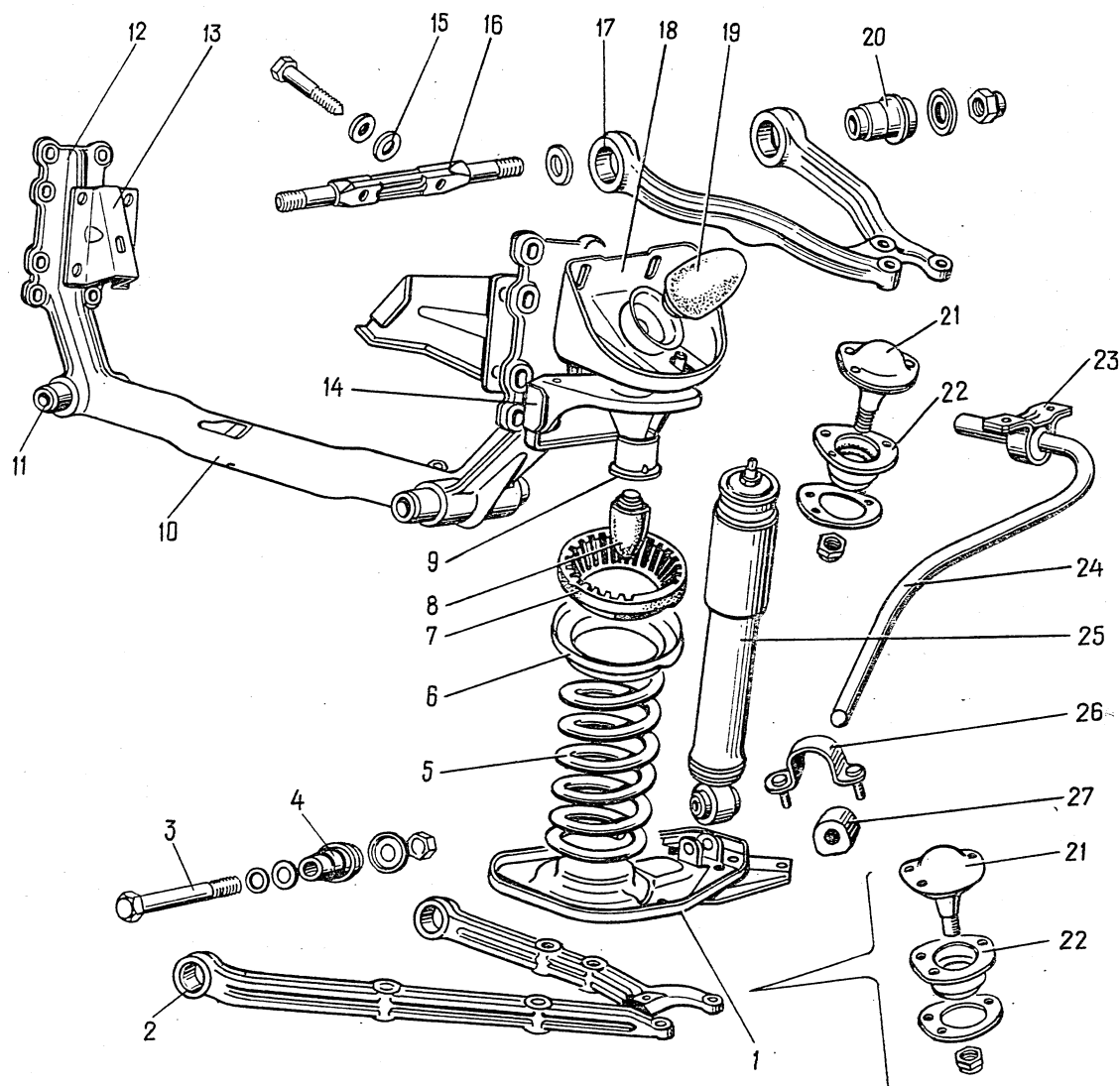


Fig.4-7. Front Suspension Parts:

1 - suspension lower seat; 2 - lower wishbone;
3 - lower wishbone shaft; 4 - lower wishbone silent block; 5 - spring; 6 - upper seat; 7 - spring insulating gasket; 8 - compression stroke buffer; 9 - compression stroke stop; 10 - suspension cross member; 11 - cross member bracket bushing; 12 - cross member bracket; 13 - engine mounting bracket;

14 - spring upper support; 15 - adjusting washer; 16 - upper wishbone shaft; 17 - upper wishbone; 18 - rebound stroke buffer bracket; 19 - rebound stroke buffer; 20 - upper wishbone silent block; 21 - ball joint; 22 - ball pin boot; 23 - bar-to-body bracket; 24 - sway eliminator bar; 25 - shock absorber; 26 - cushion holder; 27 - cushion

against the side surface of the joint housing and with the indicator pointer at the zero division.

Insert torque-indicating wrench 3 into the upper socket of the gauge and, applying a torque of 200 N.m (20 kgf.m) in both directions, read the summary radial clearance in the ball joint on indicator 2. If the clearance is larger than 0.7 mm, replace the ball joint by a new one.

Measure the axial clearance in the ball joint in the same manner, first changing its fastening in the gauge as shown in Fig. 4-8B. The maximum permissible axial clearance in the joint is not over 0.7 mm.

Suspension spring. Examine the springs thoroughly and replace them by new ones if the nature of deformations may render them unfit for further service.

Compress the spring three times until its coils close and check its resilience by the reference points (Fig. 4-9).

Examine the insulating gaskets and replace them, if necessary.

Sway eliminator, wishbones, steering knuckle
Check the sway eliminator bar for distortion and see that its ends are coplanar. Straighten out the bar if distortion is slight or replace it, if heavily damaged.

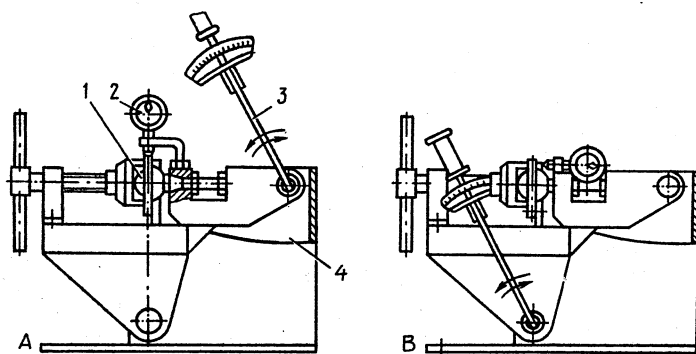


Fig. 4-8. Checking the Ball Joint on Gauge
02.8701.9502:

1 - ball joint; 2 - indicator; 3 - torque-indicating wrench; 4 - gauge 02.8701-9502; A - checking the radial clearance; B - checking the axial clearance

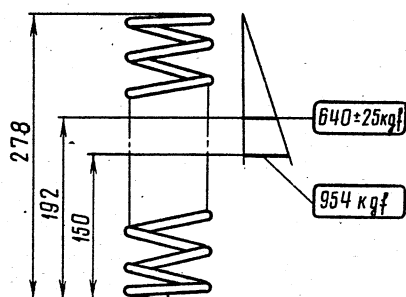


Fig. 4-9. Main Data for Checking the Front Suspension Spring

Make a close examination of the wishbones, cross member and steering knuckles to see that they are neither distorted nor cracked.

Replace any cracked and distorted parts.

Front suspension cross member. Check the geometrical parameters of the cross member with gauging mandrel 67.8732-9501. When the cross member is seriously distorted and the front wheel alignment angles cannot be adjusted by washers though all the other suspension elements are intact, replace the cross member.

Silent blocks. The necessity for replacing the silent blocks is determined in "Inspection of Front Suspension Parts" above.

Replacing the Silent Blocks

Upper wishbone. Install fixture 67.7823-9527 between the wishbone lugs and place the wishbone on mandrel A.47045 (Fig. 4-10). Apply the press punch to wishbone shaft 1 until silent block 3 is driven out of the hole. To drive out the other silent block, turn the wishbone over and repeat the same operation.

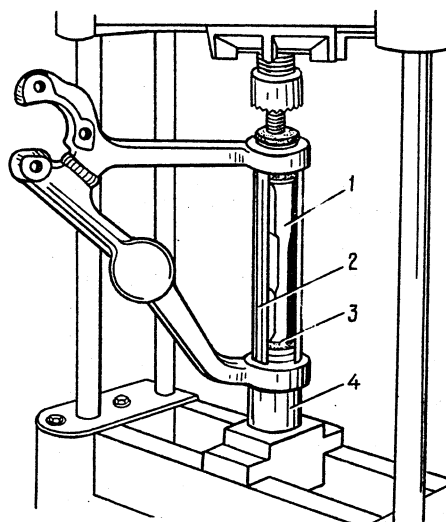


Fig. 4-10. Removing the Upper Wishbone Silent Blocks:
1 - wishbone shaft; 2 - fixture 67.7823-9527;
3 - silent block; 4 - mandrel 47045

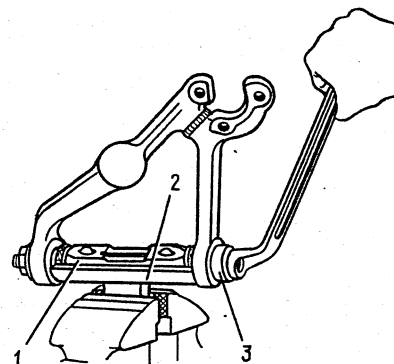


Fig. 4-11. Installing the Upper Wishbone Silent Blocks:

1 - wishbone shaft; 2 - fixture 67.7853-9519;
3 - installation tool A.74177/1

The silent blocks of the upper wishbones are pressed in with the aid of fixture 67.7853-9519 (Fig. 4-11) clamped in a vice. Place the wishbone with shaft 1 on fixture 2, put the silent block on the shaft and drive it into the wishbone socket with installation tool 3 (A.74177/1). Then repeat the same operations for driving in the other silent block on the other side of the wishbone.

Lower wishbone. The silent block can be driven in and out either on a press with the aid of fixture 67.7823-9526 or using fixture 67.7823-9517 (Fig. 4-12) installed on the wishbone with the head of the fixture screw directed inward. Drive out the silent block by turning in the screw.

To press in, insert the silent block into the wishbone socket and install fixture 67.7823-9517 (Fig. 4-13) together with cap 3. Turning in the fixture screw, drive the silent block into the wishbone socket.

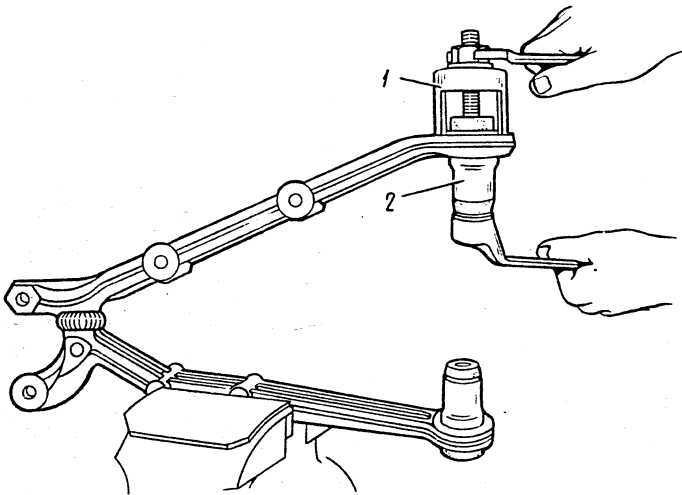


Fig. 4-12. Removing the Lower Wishbone Silent Blocks:
1 - fixture 67.7823-9517; 2 - silent block

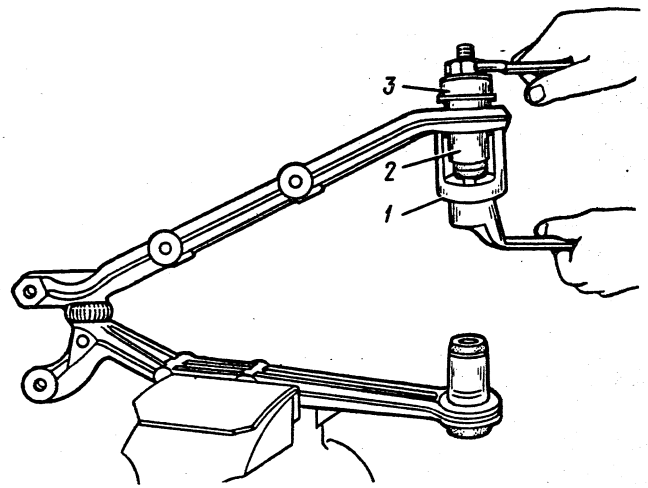


Fig. 4-13. Installing the Lower Wishbone Silent Blocks:
1 - fixture; 2 - silent block; 3 - cap

REAR SUSPENSION

The design of the rear suspension is shown in Fig. 4-14.

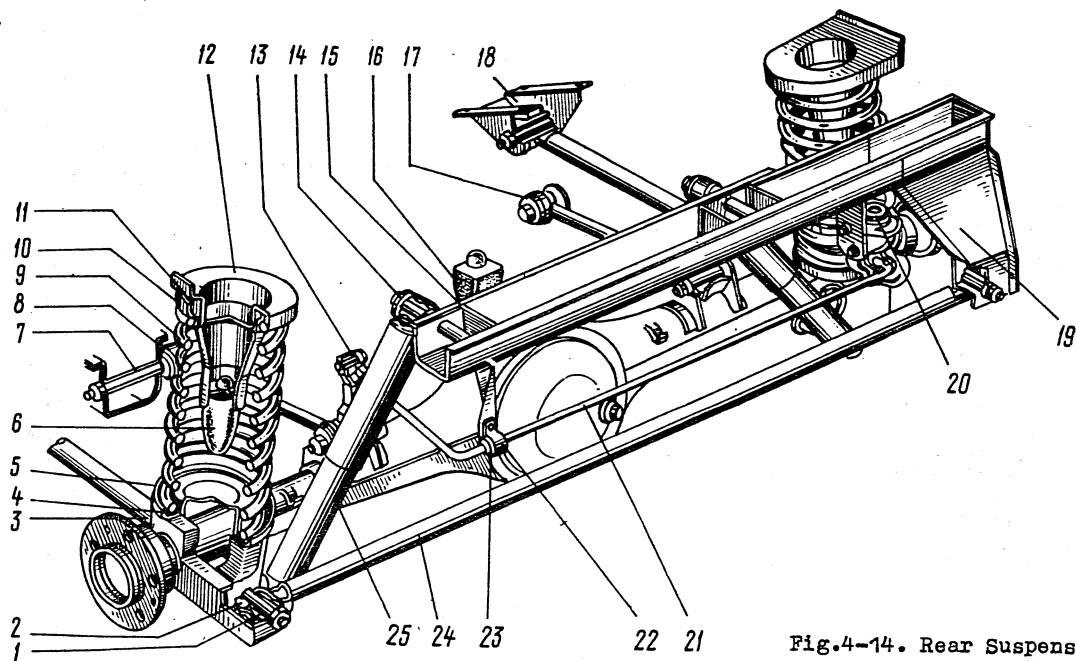


Fig. 4-14. Rear Suspension:

1 - spacer bushing; 2 - rubber bushing; 3 - lower longitudinal radius rod; 4 - lower insulating gasket of rear suspension spring; 5 - spring lower seat; 6 - compression stroke buffer; 7 - upper longitudinal radius rod bolt; 8 - upper longitudinal radius rod bracket; 9 - suspension spring; 10 - suspension spring upper seat; 11 - suspension spring upper insulating gasket; 12 - spring seat; 13 - rod of rear brake pressure regulator operating lever; 14 - shock absorber lug rubber

bushing; 15 - body floor cross member; 16 - compression stroke auxiliary buffer; 17 - upper longitudinal radius rod; 18 - lower longitudinal radius rod bracket; 19 - transverse radius rod to car body bracket; 20 - brake pressure regulator; 21 - pressure regulator operating lever; 22 - lever supporting bushing holder; 23 - lever supporting bushing; 24 - transverse radius rod; 25 - shock absorber

Removal and Installation

Removal. Jack up the rear end of the car and put it on supports. Remove the rear wheels.

Disconnect the propeller shaft from the final drive pinion flange.

Disconnect the hydraulic brake hose from the steel pipe mounted on the axle and take measures to prevent fluid leaks from the brake system.

Disconnect the brackets of the parking brake rear cable from the car body, take off the front cable return spring and, unscrewing the lock nut and the adjusting nut, undo the rear cable. Disconnect operating rod 13 (Fig. 4-14) of the rear brake pressure regulator from the bracket on the axle beam. Disconnect the upper ends of shock absorbers 25.

Put a hydraulic jack under the rear axle beam. Disconnect longitudinal 3, 17 and transverse 24 radius rods from the brackets on the body then lower the jack and take out the rear axle.

Proceed with disassembling the suspension:

- remove the shock absorbers from the brackets on the rear axle beam;
- disconnect the longitudinal and transverse radius rods from the brackets on the rear axle beam.

The parts of the rear suspension are shown in Fig. 4-15.

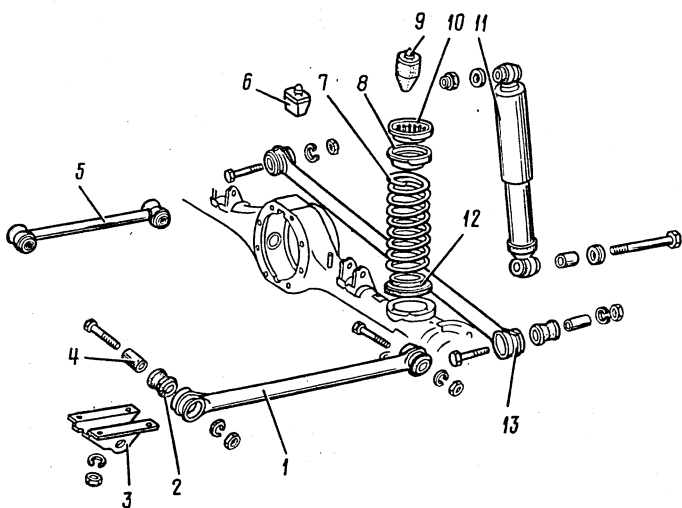


Fig.4-15. Rear Suspension Parts:

- 1 - lower longitudinal radius rod; 2 - rubber bushing; 3 - bracket; 4 - spacer bushing; 5 - upper longitudinal radius rod; 6 - compression stroke auxiliary buffer; 7 - suspension spring; 8 - spring auxiliary buffer; 9 - compression stroke buffer; 10 - spring upper insulating gasket; 11 - shock absorber; 12 - spring lower insulating gasket; 13 - transverse radius rod

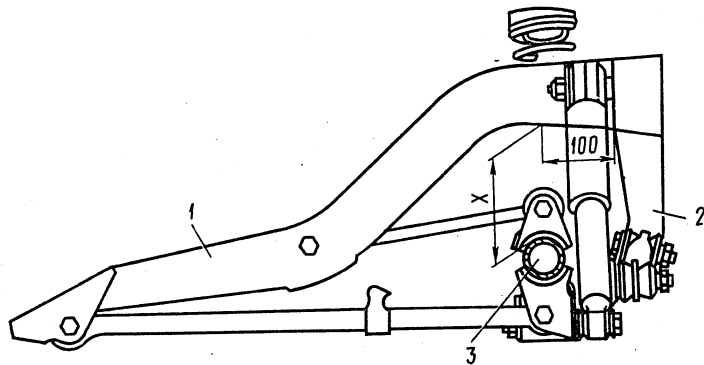


Fig.4-16. Rear Suspension Installation Diagram:
1 - body side member; 2 - transverse radius rod bracket; 3 - rear axle beam; X = 152 mm

Installation. To install the rear suspension, reverse the removal operations.

The springs of the rear suspension should belong to the same class as those used with the front suspension. In exceptional cases, when class A (unmarked) springs are used in the front suspension and such springs are unavailable for the rear suspension, class B springs (marked black) may be used. If the front suspension has class B springs, the rear suspension must have only class B springs too.

To avoid damaging and overtightening the flexible bushings of the radius rod joints and shock absorbers:

- load the rear end of the car so that distance "X" from the axle beam to the body side member measured at a point located 100 mm from the transverse radius rod bracket (Fig. 4-16) is 152 mm;

- using a torque-indicating wrench, tighten the nuts of the bolts of the longitudinal and transverse radius rods, also the nuts of the pins which fasten the shock absorbers to the axle beam and the car body.

Inspection

Before inspection, take care to wash all the parts thoroughly.

Protect the rubber parts, bushings and protective coatings against contact with the solvents in the course of washing.

Springs. Check the resilience of the spring by the reference points (Fig. 4-17) first compressing it until the coils close.

Note. With respect to their length under a load of 3500 N (350 kgf), the springs are divided into class A (longer than 278 mm) and class B (278 mm or shorter).

The springs of class A are unmarked while those of class B are marked black on the external side of the coils.

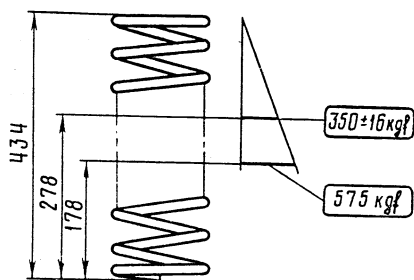


Fig.4-17. Main Data for Checking the Rear Suspension Spring

Check the springs for deformation. Replace the spring if its resilience is other than indicated in Fig. 4-17 or its deformation may interfere with its efficient operation.

Examine the supporting rubber gaskets of the springs and replace them by new ones, if necessary.

Radius rods. Check the following:

- distortion of rods; straighten them, if possible;
- look for cracks on the brackets of the rear axle beam and car body; repair the brackets, if they are cracked;
- examine the flexible bushings of the radius rod joints; replace them by new ones, if necessary, using the set of tools 67.7820-9517.

SHOCK ABSORBERS

The design of the front and rear shock absorbers is shown in Fig. 4-18.

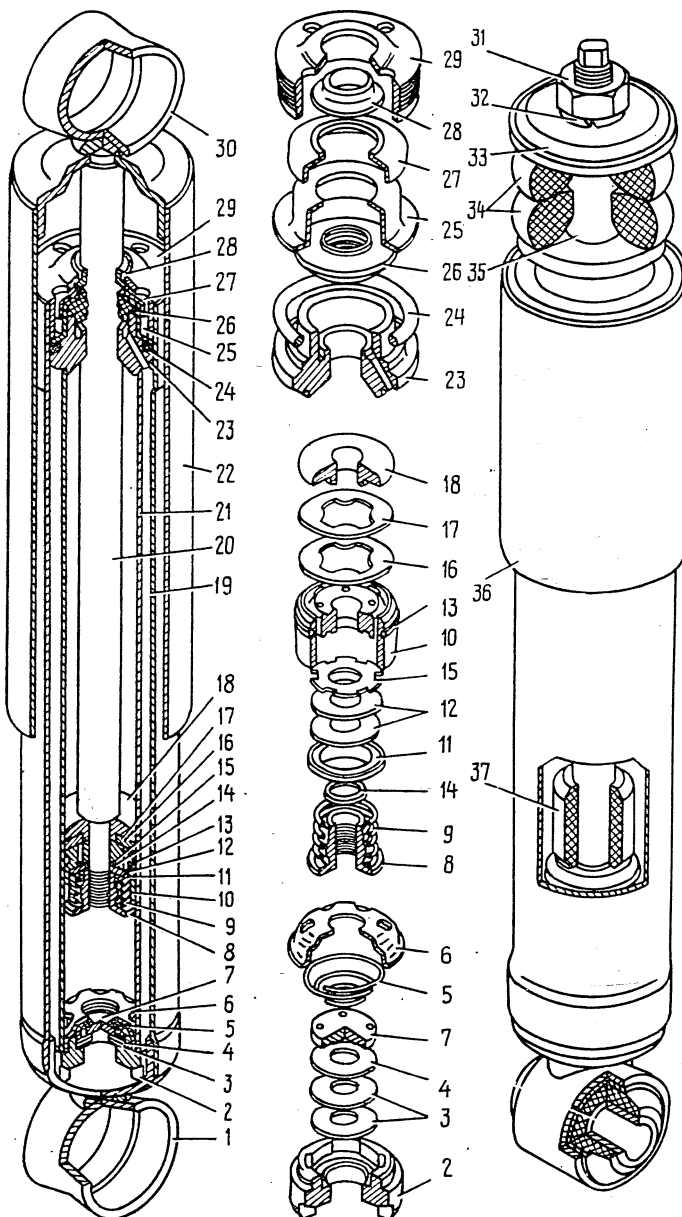
Stand Checks

To assess the serviceability of a shock absorber, check its performance curve on a dynamometer test stand.

Take the performance curves in accordance with the stand operating instructions after at least 5 working cycles at a fluid temperature of $20 \pm 5^\circ\text{C}$, a flywheel speed of 1 s^{-1} (60 rpm) and a rod travel of 80 mm for the front shock absorber and 100 mm for the rear one.

Fig.4-18. Front and Rear Shock Absorbers:

1 - lower lug; 2 - compression valve body; 3 - compression valve discs; 4 - compression valve throttling disc; 5 - compression valve spring; 6 - compression valve holder; 7 - compression valve plate; 8 - rebound valve nut; 9 - rebound valve spring; 10 - shock absorber piston; 11 - rebound valve plate; 12 - rebound valve discs; 13 - piston ring; 14 - rebound valve nut washer; 15 - rebound valve throttling disc; 16 - bypass valve plate; 17 - bypass valve spring; 18 - limiting plate; 19 - reservoir; 20 - rod; 21 - cylinder; 22 - housing; 23 - rod guide bushing; 24 - reservoir sealing ring; 25 - gland holder; 26 - rod gland; 27 - rod protective ring gasket; 28 - rod protective ring; 29 - reservoir nut; 30 - shock absorber upper lug; 31 - front shock absorber upper fastening nut; 32 - spring washer; 33 - shock absorber pad washer; 34 - pad; 35 - spacer bushing; 36 - shock absorber housing; 37 - rod buffer



The curve on the diagram (Fig. 4-19) should be smooth; at the transition points between the rebound and compression strokes there should be no sections parallel to the zero line.

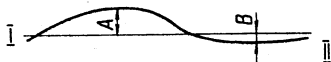


Fig.4-19. Shock Absorber Performance Curve:
I - rebound stroke force; II - compression stroke force

Evaluating the performance curves. The resistance during the rebound and compression strokes is determined by the maximum ordinates of the corresponding curves.

The peak of the rebound stroke curve on a scale of 48 N (4.8 kgf) per 1 mm should lie at the following distances A from the zero line: 25 - 32 mm for the front shock absorbers and 23.5 - 30.5 mm for the rear ones.

The peak of the compression stroke curve on the same scale should lie at the following distances B from the zero line: 3.5 - 6.5 mm for the front shock absorbers and 4.5 - 7.5 mm for the rear ones.

The reference values of the ordinates on the curves for the front and rear shock absorbers are applicable to cold shock absorbers at a fluid temperature of $20 \pm 5^\circ \text{C}$.

After the check, remove the shock absorber from the stand and, if necessary, recondition or replace the faulty parts.

Repeat the check to make sure that the shock absorbers function as they should.

Disassembly and Assembly

Wash the shock absorber on the outside and clamp it in a vice.

Note. For clamping the shock absorber and its parts in a vice, use special soft jaws 67.7824.9513-001.

Pull the shock absorber rod all the way out, unscrew nut 29 (Fig. 4-18) with wrench A.57034/R, take operating cylinder 21 with rod 20 and its parts from the reservoir. Withdraw the reservoir from the vice and drain the fluid.

Using wrench 67.7824.9513-005, remove rod guide bushing 23 from the operating cylinder. Remove piston 10 with the rod from the cylinder and drain the fluid. Drive compression valve body 2 with associated parts gently from the cylinder with a special mandrel.

Clamp the rod with the piston in a vice with special jaws and unscrew rebound valve nut 8. Remove piston 10 with bypass and rebound valves,

guide bushing 23, rod gland 26, gland holder 25 and other parts.

Note. To facilitate inspection of the front shock absorber rod which is covered by the housing, it is good practice to press off this housing too.

Disassemble the compression valve. For this purpose remove holder 6, then take valve spring 5, plate 7 and discs 3 and 4 one after another from body 2.

To assemble the shock absorber, reverse the disassembly procedure, observing the following points:

- having assembled the compression valve, make sure there is free travel of plate 7 and valve discs;
- press-fit holder 6 on body 2 with a special mandrel;
- press-fit the compression valve into the cylinder with a mandrel 67.7824.9513-004;
- to facilitate assembly of the rod-mounted parts, use guide 67.7824.9513-003;
- throttling disc 15 of the front shock absorber has two slots on the outside diameter while that of the rear shock absorber, three;
- tighten the rebound valve nut with a torque of 10 - 15 N.m (1 - 1.5 kgf.m);
- tighten the reservoir nut with wrench 67.7824.9513-002 (tightening torque 70 - 90 N.m or 7 - 9 kgf.m).

Inspection of Parts

Wash all the parts with gasoline or kerosene and leave them to dry.

Check thoroughly to see that the parts meet the following requirements:

- the discs of the compression and rebound valves and the plate of the bypass valve should not be distorted; the plate of bypass valve should be flat, true to 0.05 mm;
 - the working surfaces of the piston, piston ring, rod guide bushing, cylinder and valve parts should be free of scoring and nicks that may affect adversely the normal functioning of the shock absorber;
 - the springs of the rebound and compression valves should be intact and sufficiently resilient;
 - the compression valve discs should be intact and not seriously worn;
 - it is good practice to replace the gland by a new one during repairs.
- Replace all the defective parts and proceed with assembling the shock absorber.

Section V

STEERING

The design of the steering gear is shown in Figs 5-1, 5-2.

The roller of the pitman arm shaft may be installed either on a needle bearing or a ball

bearing. The figures in the text are given for both versions, the asterisk (*) referring to the version with the needle bearing.

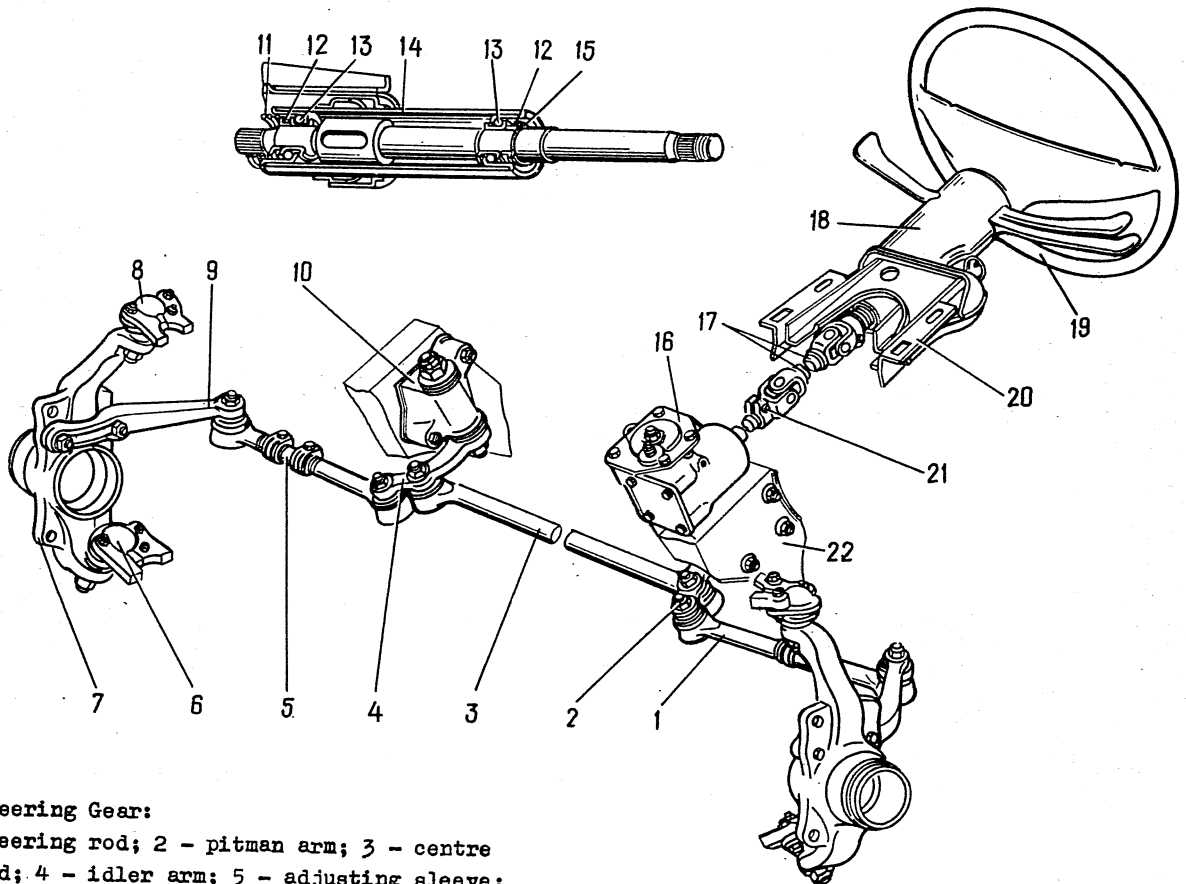


Fig.5-1. Steering Gear:

1 - side steering rod; 2 - pitman arm; 3 - centre steering rod; 4 - idler arm; 5 - adjusting sleeve; 6 - suspension lower ball joint; 7 - R.H. steering knuckle; 8 - suspension upper ball joint; 9 - R.H. knuckle arm; 10 - idler arm bracket. 11 - spring; 12 - expander ring; 13 - bearing; 14 - steering shaft bracket pipe; 15 - lockring; 16 - steering gear case; 17 - intermediate steering shaft; 18 - steering shaft casing; 19 - steering wheel; 20 - steering shaft bracket; 21 - universal joint tie bolt; 22 - car body side member

TROUBLE SHOOTING

Cause of trouble	Remedy
<u>Excessive Steering Wheel Play</u>	
1. Loosening of steering mechanism case bolts	1. Draw up nuts
2. Loosening of steering rod ball pin nuts	2. Examine and tighten nuts
3. Excessive play in steering rod ball joints	3. Replace steering rods or their heads
4. Excessive clearance in front wheel hub bearings	4. Adjust
5. Excessive roller-to-worm mesh	5. Adjust
6. Excessive clearance between idler arm shaft and bushings	6. Replace bushings of bracket assembly
7. Excessive clearance in worm bearings	7. Adjust
8. Loosening of bolts which fasten steering intermediate shaft to worm shaft or upper steering shaft	8. Tighten bolts

<u>Difficult Rotation of Steering Wheel</u>	
1. Deformation of steering linkage parts	1. Replace distorted parts
2. Wrong front wheel alignment angles	2. Check and adjust wheel alignment
3. Wrong roller-to-worm mesh	3. Adjust
4. Overtightening of idler arm shaft adjusting nut	4. Adjust
5. Underinflation of front wheel tyres	5. Inflate to normal pressure
6. Ball joint parts damaged	6. Examine and replace faulty parts
7. No oil in steering gear case	7. Check and top up. Replace gland, if necessary
8. Damaged bearings of upper steering shaft	8. Replace bearings

<u>Knocking in Steering Mechanism</u>	
1. Excessive clearance in front wheel hub bearings	1. Adjust
2. Loosening of steering rod ball pin nuts	2. Check and tighten nuts
3. Excessive clearance between idler arm shaft and bushings	3. Replace bushings or bracket assembly
4. Loosening of idler arm shaft adjusting nut	4. Adjust
5. Wrong clearance in roller-to-worm mesh or in worm bearings	5. Adjust clearance
6. Excessive clearance in steering rod ball joints	6. Replace steering rods or their heads
7. Loose fastening bolts of steering gear case or idler arm bracket	7. Check and tighten bolt nuts
8. Loosening of knuckle arm nuts	8. Tighten nuts
9. Loose bolts of intermediate steering shaft	9. Tighten bolt nuts

<u>Front Wheel Shimmy</u>	
1. Wrong tyre pressure	1. Check and adjust tyre pressure
2. Wrong front wheel alignment angles	2. Check and adjust
3. Excessive clearance in front wheel hub bearings	3. Adjust
4. Wheels out of balance	4. Balance wheels
5. Loosening of steering rod ball pin nuts	5. Check and tighten nuts
6. Loose bolts of steering gear case or idler arm bracket	6. Check and tighten bolt nuts
7. Wrong roller-to-worm backlash	7. Adjust

<u>Car Drifts</u>	
1. Nonuniform tyre pressure	1. Check and adjust tyre pressure
2. Wrong front wheel alignment angles	2. Check and adjust
3. Different deflection of front suspension springs	3. Replace faulty springs
4. Distorted steering knuckles or wishbones	4. Examine knuckles and wishbones and replace faulty parts
5. Incomplete release of one or more wheel brakes	5. Inspect brake system

Cause of trouble	Remedy
<u>Poor Road Stability</u>	
1. Wrong front wheel alignment angles	1. Check and adjust
2. Excessive clearance in front wheel hub bearings	2. Adjust
3. Loosening of steering rod ball pin nuts	3. Check and tighten nuts
4. Excessive clearance in steering rod ball joints	4. Replace steering rods or their heads
5. Loose bolts of steering gear case or idler arm bracket	5. Check and tighten bolt nuts
6. Excessive clearance in roller-to-worm mesh	6. Adjust clearance
7. Distortion of steering knuckles or wishbones	7. Check steering knuckles and wishbones, replace distorted parts
<u>Oil Leaks from Steering Gear Case</u>	
1. Gland of pitman arm shaft or of worm seriously worn	1. Replace gland
2. Loosen bolts of steering gear case covers	2. Tighten bolts
3. Sealing gaskets damaged	3. Replace gaskets

INSPECTIONS, CHECKS AND ADJUSTMENTS

General Inspection

If the steering gear becomes in any way defective (knocking, excessive play or, on the contrary, difficult rotation of the steering wheel, etc.), examine the parts on a trestle or inspection pin in the following order.

Clean the steering linkage and gear case of dirt. Set the wheels to the straight-ahead position.

Turning the steering wheel back and forth, make sure that:

- the steering wheel play is not over 5° (or 18-20 mm measured on the wheel rim); make this check with gauging mandrel 67.8720-9501;
- there is no knocking in the steering linkage, joints and in the steering mechanism;
- the steering gear case and idler arm bracket are reliably fastened (tighten the screw joints, if necessary);
- there is no play in the steering rod ball joints and in the idler arm bracket and no end play of the worm shaft;
- the turning force applied to the steering wheel (with the front wheels resting on a smooth plate) is not over 200 N (20 kgf) (250 N)².

Turning the adjusting sleeves of both side rods, make sure that their clamps are securely tightened.

Examine the ball joints and rubber boots as described below.

Checking the Steering Rod Ball Joints

The first thing is to check the end play of the rod heads along the pin axis. For this purpose the head should be moved parallel to the pin axis with the aid of a lever and a support.

The end play of the rod head relative to the pin should be from 1 to 1.5 mm. This amount of end play indicates that the pin seat is not jammed in the rod head socket and can move together with the pin, compressing the spring. If the seat is jammed, replace the entire ball joint.

Turning the steering wheel back and forth, hand-feel the steering rod joints for play. If the ball joint is felt to be loose, replace the steering rod as a whole, or its head alone.

Examine the boots of the steering rod ball joints.

If the boots are intact and ensure adequate cleanliness inside the joints, the service life of the latter is practically unlimited. Moisture, dust, etc. getting into the joint cause premature wear of its parts.

The boot should be replaced if it is cracked, fractured or when the lubricant oozes outside on squeezing the boot with fingers.

Checking and Adjusting the Steering Worm Bearings

Set the front wheels to the straight-ahead position and, moving the steering wheel back and

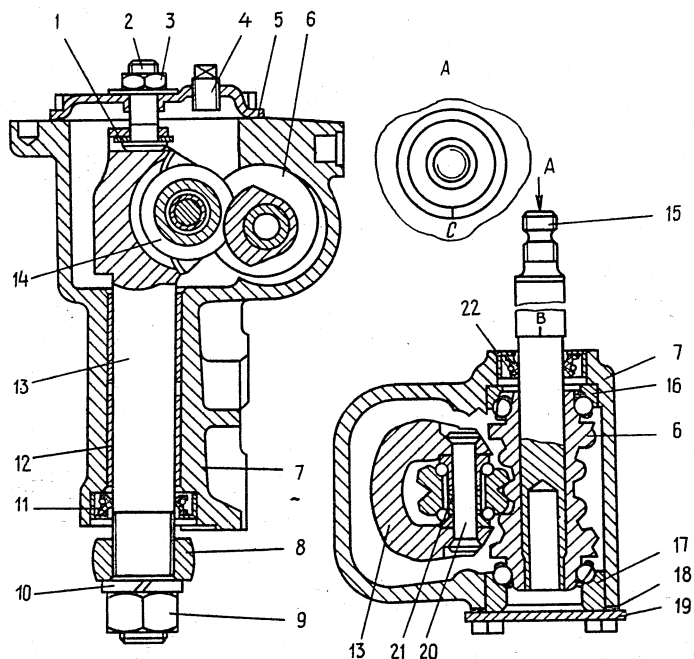


Fig. 5-2. Steering Mechanism, Sectionalized:
 1 - adjusting screw plate; 2 - pitman arm shaft adjusting screw; 3 - adjusting screw nut; 4 - oil filler plug; 5 - cover; 6 - worm; 7 - steering gear case; 8 - pitman arm; 9 - pitman arm-to-shaft nut; 10 - spring washer; 11 - gland; 12 - bronze bushing; 13 - pitman arm shaft; 14 - pitman arm shaft roller; 15 - worm shaft; 16 - upper ball bearing; 17 - lower ball bearing; 18 - adjusting shims; 19 - worm bearing lower cover; 20 - roller shaft; 21 - needle bearing; 22 - worm shaft gland; B, C - marks

forth, check to see that the distance between the face of steering gear case 7 (Fig. 5-2) and mark "B" on the steering worm shaft does not change.

If it does, this is an evidence of play in the worm bearings.

To adjust the clearance in the worm bearings, turn the steering wheel 1 - 1.5 of a revolution to the left, unscrew the bolts of lower cover 19 and drain oil from the steering gear case. Remove the lower cover, take out one of adjusting shims 18 or replace it by a thinner one.

Note. The spare adjusting shims are available in the thicknesses of 0.10 and 0.15 mm.

Secure the lower cover and check again for the axial play of the worm in its bearings. If there is no play, fill the steering gear case with 0.215 l of TAD-I7M transmission oil.

Check the force required for turning the steering wheel, placing the front wheels on a smooth plate. The force should not exceed 200 N (20 kgf) (250 N)*.

Checking and Adjusting the Roller-to-Worm

Mesh

Having ascertained that there is no end play of the worm in the bearings, drive the ball joint pins with remover tool A.47035 from the holes in the pitman arm and disconnect the steering rods from the latter, keeping the front wheels in the straight-ahead position.

Rocking the pitman arm head, check for the clearance in the roller-to-worm mesh. There should be no perceptible free travel of the pitman arm with the steering wheel turned through 30° from the neutral position in either direction.

If, however, the free travel of the pitman arm is noticed, loosen nut 3 (Fig. 5-2) of the adjusting screw, lift the locking washer and turn in adjusting screw 2 until the clearance is taken up. Do not overtighten the adjusting screw. Then, holding the adjusting screw with a screwdriver, tighten nut 3.

Once it has been learned that the pitman arm has no free travel, connect the ball joint pins to it. Check the force required for turning the steering wheel. If it exceeds 200 N (20 kgf) (250 N)*, loosen adjusting screw 2.

STEERING MECHANISM

Removal and Installation

Removal. Disconnect the wires from the storage battery and take off the horn switch, turning off its screws.

Remove the steering wheel. Take off both halves of the steering shaft casing.

Note. If the steering gear case alone has to be removed, unscrew the bolt which fastens the

lower end of the intermediate steering shaft on the worm shaft and the case-to-body-side-member bolts.

Remove the instrument panel and disconnect the terminal blocks of the three-arm lever from their mating receptacles of the wire assembly.

Disconnect the wires from the ignition switch terminals; turn off the fastening screws and, forcing in the lock retainer, remove the ignition

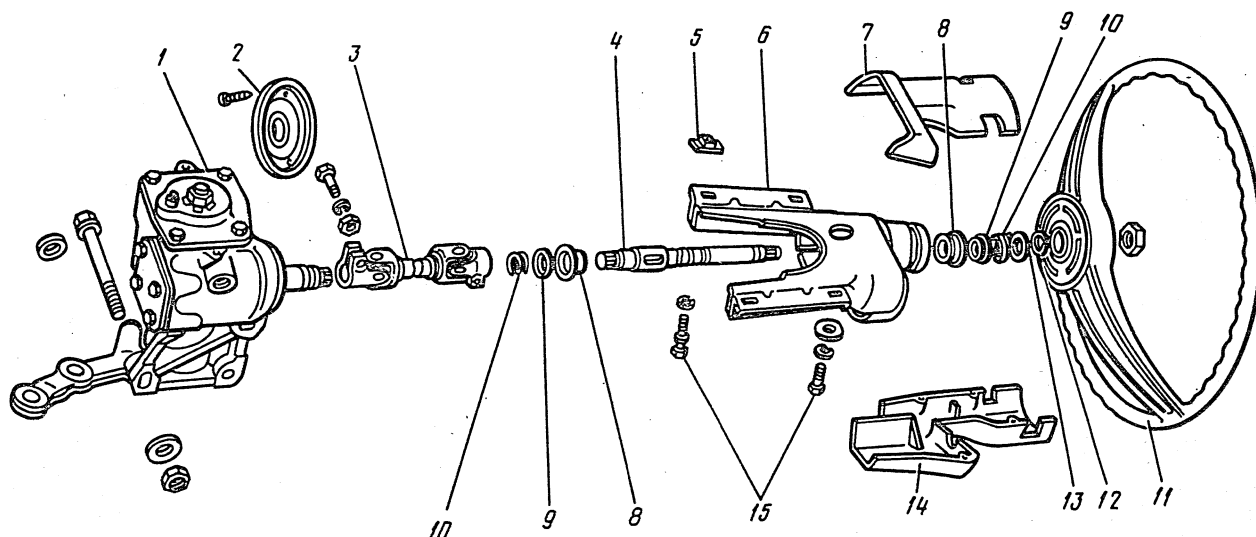


Fig.5-3. Steering Mechanism Parts:

1 - steering gear case; 2 - shaft seal; 3 - intermediate shaft; 4 - upper shaft; 5 - bracket fixing plate; 6 - bracket; 7 - casing upper part; 8 - bearing;

9 - expander ring; 10 - spring; 11 - steering wheel; 12 - locking ring; 13 - washer; 14 - casing lower part; 15 - bracket bolts

switch. Loosen the clamp of the direction indicator, headlamp and windshield wiper switch body and remove the latter.

Unscrew the bolt which holds the lower end of the intermediate shaft to the steering worm shaft.

Unscrew the bolts of bracket 6 (Fig. 5-3) and take off the steering shaft complete with the bracket.

Unscrew the nuts which fasten the ball pins of the side and central steering rods to the pitman arm then, using remover A.47035, drive the ball pins from their holes in the pitman arm.

Take off the steering gear case, first unscrewing the bolts fastening it to the body side member. Turn off the screws of the steering shaft seal and remove it.

Installation. Secure seal 2 (Fig. 5-3) on the dashboard, install the steering gear case on the body side member, without screwing home the nuts of the case bolts.

Using a special device, position the gear case so that angle α (Fig. 5-4) is not over 32° and the clearance between the shaft and the brake pedal is not under 5 mm. Then tighten home the nuts of the steering gear case bolts.

Set the pitman arm to the neutral position by aligning the marks on the gear case and on the worm shaft (Fig. 5-2).

Put the steering wheel temporarily on the shaft with the wheel arms horizontal and in this position connect the universal joint yoke of the intermediate steering shaft to the worm shaft, then fasten the steering shaft bracket to the car body without screwing home the bolts.

Remove the steering wheel and put the direction indicator, headlamp and windshield wiper switch on the steering shaft.

Put the steering wheel in the initial position on the shaft and, pressing the wheel as shown

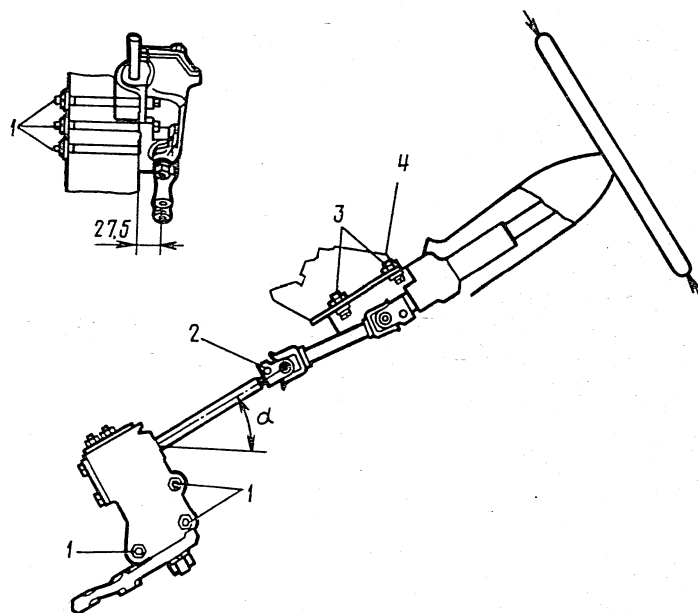


Fig.5-4. Mounting the Steering Mechanism on Car:

1 - steering gear case bolts; 2 - intermediate shaft lower end tie bolt; 3 - bracket bolts; 4 - steering shaft bracket; 27.5 mm - distance from centre of pitman arm hole to steering gear case mounting surface with pitman arm in neutral

by arrows in Fig. 5-4, check for absence of shaft radial play. If such play exists, shift bracket 4 a little upward along the shaft axis until the radial clearance is taken up. If this fails to eliminate the radial clearance, replace the upper steering shaft or its bearings.

Check the steering wheel for smooth and easy rotation in both directions then tighten its nut and lock-punch it at three points. Shift the body of the direction indicator, headlamp and windshield wiper switch all the way towards the steering wheel and tighten the switch clamp.

Connect the wires to the ignition switch terminals and secure the switch with screws on the steering shaft bracket.

Connect the terminal blocks of the direction indicator, headlamp and windshield wiper switch to those of the wire harness.

Put the two halves of the shaft casing on the shaft and fasten them together with screws. Install the horn switch on the steering wheel.

Install the ball pins of the centre and L.H. side steering rods on the pitman arm and secure them with nuts.

Adjust the toe-in of the front wheels and check the force required for turning the steering wheel. With the front wheels placed on a smooth plate this force should not be over 200 N (20 kgf) (250 N)* measured on the wheel rim.

Note. As an alternative, the steering shaft can be assembled separately with the direction indicator, headlamp and windshield wiper switch and with the steering wheel; then the assembled unit as a whole can be installed on the car.

To secure this unit, set the steering wheel arms horizontally and connect the worm shaft with the lower end of the steering intermediate shaft.

Screw in the bracket bolts preliminarily, turn the steering wheel a few times back and forth and tighten home the bracket bolts.

Disassembly and Assembly of Steering Gear Case

Disassembly. Drain oil from the steering gear case.

Fasten the case on bracket A.74076/R with support A.74076/1.

Unscrew the nut of pitman arm 2 (Fig. 5-5), take off the spring washer and, using remover tool A.47043, remove the pitman arm (Fig. 5-6). Turn off the fastening bolts, remove cover 12 (Fig. 5-5) of the steering gear case complete with adjusting screw 8, adjusting plate 9, lock washer 10 and lock nut. Lift pitman arm shaft 7 complete with the roller out of steering gear case 1.

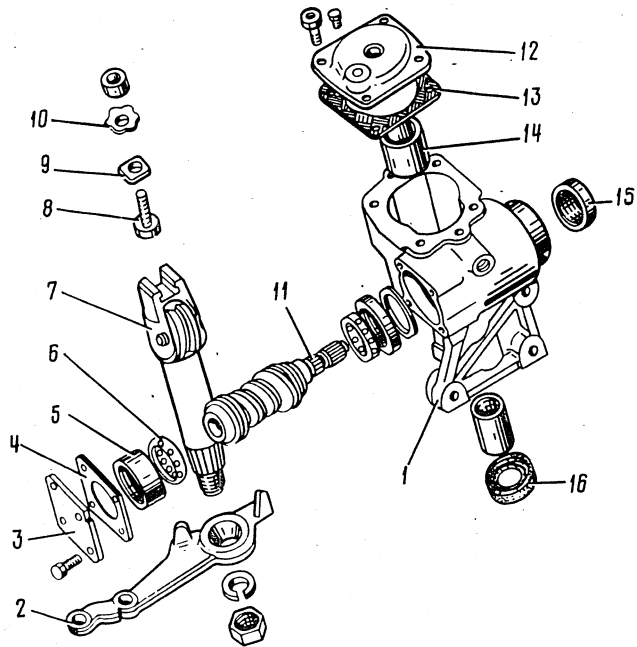


Fig.5-5. Steering Mechanism Parts:

1 - case; 2 - pitman arm; 3 - case lower cover; 4 - adjusting shims; 5 - worm shaft bearing outer race; 6 - bearing cage with balls; 7 - pitman arm shaft; 8 - adjusting screw; 9 - adjusting plate; 10 - lock washer; 11 - worm shaft; 12 - case upper cover; 13 - sealing gasket; 14 - pitman arm shaft bushing; 15 - worm shaft gland; 16 - pitman arm shaft gland

Turn off the fastening bolts, remove cover 3 of the worm shaft thrust bearing complete with adjusting shims 4.

Push bearing outer race 5 by worm shaft 11 out of the case and pull out the shaft complete

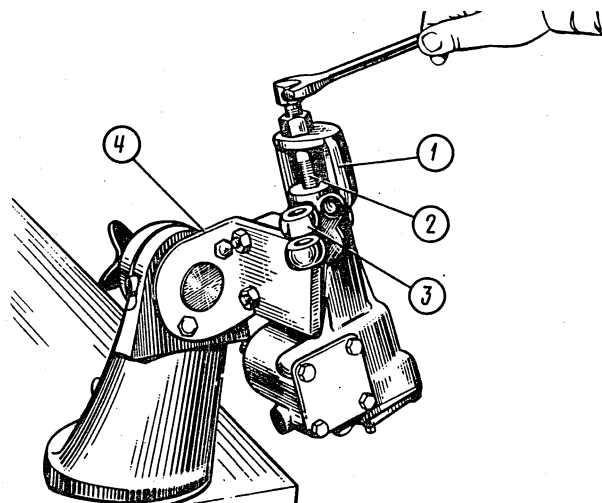


Fig.5-6. Removing the Pitman Arm:

1 - remover tool A.47043; 2 - pitman arm shaft; 3 - pitman arm; 4 - bracket A.74076/R

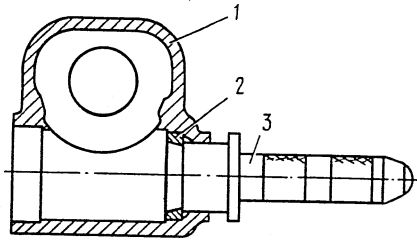


Fig. 5-7. Removing the Worm Upper Bearing Outer Race with Remover Mandrel 67.7853-9541:

1 - steering gear case; 2 - worm upper bearing outer race; 3 - mandrel 67.7853-9541

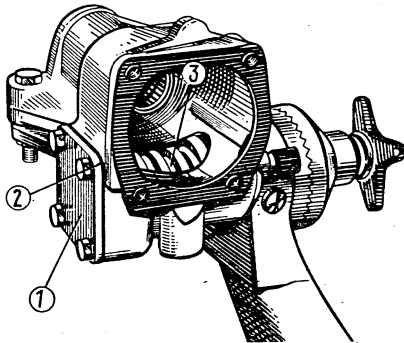


Fig. 5-8. Installing the Steering Worm:

1 - bearing cover; 2 - adjusting shims; 3 - worm

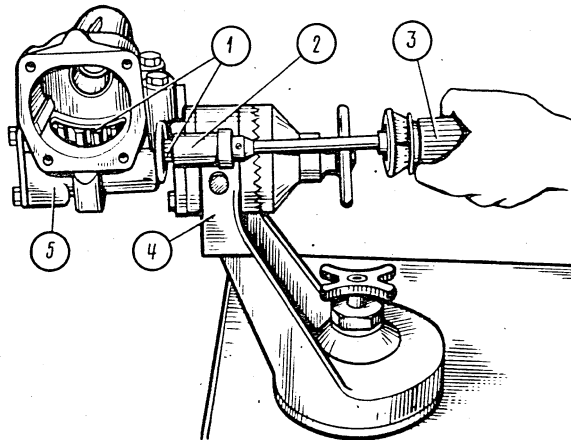


Fig. 5-9. Worm Friction Moment Dynamometer Check:

1 - worm; 2 - head A.95697/5; 3 - dynamometer 02.7812-9501; 4 - repair stand bracket; 5 - steering gear case

with bearing cages 6. Remove glands 15 and 16 of the worm shaft and pitman arm shaft.

Using mandrel 67.7853-9541, take out the outer race of the upper bearing (Fig. 5-7).

Assembly. Assemble the steering mechanism on bracket A.74Q76/R by reversing the disassembly operations.

Press on the outer race of the worm upper bearing with mandrel 67.7853-9541, inverting the

attachment on the mandrel handle.

Having installed the worm into the steering gear case and fastened the lower cover (Fig. 5-8), check the moment of friction of the worm shaft using dynamometer 02.7812.9501 and head A.95697/5 (Fig. 5-9); the moment of friction should range from 20 to 50 N.cm (2 - 5 kgf.cm). If the moment is lower or higher, reduce or increase the thickness of adjusting shims 2 (Fig. 5-8), respectively.

After installation of the pitman arm shaft, check for absence of clearance in the roller-to-worm mesh with the worm shaft turned 30° right and left of the neutral position of the pitman arm. Eliminate the possible clearance by adjusting screw 2 (Fig. 5-2) and tighten lock nut 3.

After adjustment of the roller-to-worm mesh, check the moment of friction of the worm shaft with a dynamometer; on turning the worm shaft 30° left and right from the neutral position it should be 70 to 90 N.cm (7-9 kgf.cm) or 90-120 N.cm^{*} and should diminish smoothly to 50 N.cm (5 kgf.cm) or 70 N.cm^{*} when the shaft is turned from the 30° position all the way to the lock.

On completion of assembly, check the pitman arm turning angles from the neutral position until the pitman arm comes to bear against the bolt heads; these angles should be $32^\circ 10' \pm 1^\circ$ both to the right and left. Then fill the steering gear case with 0.215 l of transmission oil TAD-17И.

Checks and Repairs

Examine the roller and worm carefully for wear, notches or signs of jamming on the working surfaces. Replace any worn and damaged parts.

Measure the clearance between the pitman arm shaft and bushings; it should not be over 0.10 mm; if it is larger, replace the bushings with the aid of driver A.74105.

The internal surface of the pitman arm shaft bushings has spiral grooves which open on one side of the bushings only. While pressing in the bushings, arrange them so that their faces with groove outlets are inside the hole in the case and the outlets are located opposite each other. The bushing faces should sink 1.5 mm into the hole of the steering gear case.

Before press-fitting new bushings, coat them with transmission oil.

The bushings pressed into the case should be finally machined with reamer A.90336 to a diameter of 28.698 - 28.720 mm. The assembly clearance between the pitman arm shaft and bushings should be from 0.008 to 0.051 mm.

Check the pitman arm shaft roller for ease of rotation on the ball (or needle) bearing.

The ball bearings of the steering worm and roller should rotate freely, without binding; the

surfaces of the races and balls must bear no signs of wear and damage.

Check the axial clearance between the head of adjusting screw 8 (Fig. 5-5) and the slot of pitman arm shaft 7. This clearance should not be over 0.05 mm. If it is larger, replace adjusting plate 9 by a thicker one.

Note. The spare adjusting plates are available in eleven sizes, varying in thickness from 1.95 mm to 2.20 mm in steps of 0.025 mm.

Examine fixing plates 5 (Fig. 5-3) and replace them, if distorted.

Disassembly and Assembly of Steering Shaft

Disassembly. Unscrew the tie bolt of the universal joint yoke and disconnect the intermediate and upper steering shafts.

Remove spring 10 (Fig. 5-3) of the lower bearing of upper steering shaft 4, expander ring 9 and take lower bearing 8 from the bracket pipe.

Take off upper bearing locking ring 12, washer and spring, then the expander ring and remove the upper bearing from the pipe.

Remove bracket 6 from upper steering shaft 4.

Assembly. Reverse the disassembly operations. Coat the bearings before installation with lubricant ЛУТОЛ-24 (0.8 - 1.5 g per bearing).

Checks. Examine the bearings and the parts fixing the end of the upper steering shaft; if the bearings or fixing parts are worn or damaged, replace them by new ones.

STEERING RODS AND BALL JOINTS

Removal and Installation

Undo and unscrew the nuts which fasten the ball pins of the side tie rods to the knuckle arms.

Remove the ball pins from the tapered sockets on the arms with remover tool 67.7824-9516 (Fig. 5-10).

Undo and unscrew the nuts which fasten the ball pins of the centre and side tie rods to the pitman arm and idler arm; using remover tool 67.7824-9516, take the ball pins from the arms and remove the rods.

To install the steering rods, reverse the removal operations. All the nuts of the ball pins must be tightened with a torque-indicating wrench and cottered. If the slot of the nut does not coincide with the hole for the cotter pin, screw

in the nut to an angle smaller than 60° to permit cottering.

After installation, adjust the toe-in of the front wheels.

Checks and Repairs

Examine rubber boots 2 (Fig. 5-11) as described above (see "Inspection, Checks and Adjustments"). Replace any damaged boots.

Measure the radial and axial clearance to assess the condition of the steering rod ball joints. If play is felt of pin 1 in body 3, also when dirt or sand get in or the ball pin is corroded and all travel of the ball seat is completely used up, replace the joint complete with the rod head.

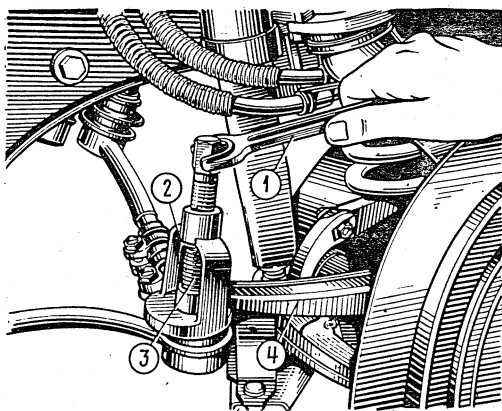


Fig. 5-10. Removing the Steering Rod Ball Pins:
1 - wrench; 2 - remover tool 67.7824-9516; 3 - ball joint; 4 - R.H. knuckle arm

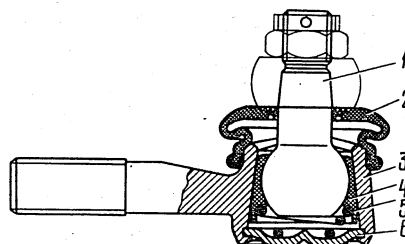


Fig. 5-11. Steering Rod Ball Joint, Sectionalized:
1 - ball pin; 2 - boot; 3 - joint body; 4 - seat;
5 - spring; 6 - plug

IDLER ARM BRACKET

Removal and Disassembly

Detach the idler arm from the ball pins of the centre and R.H. steering rods, first uncottering and unscrewing the nuts and taking the ball pins from the arm with remover tool 67.7824-9516. Then unscrew the bracket-to-side-member bolts and remove the bracket.

Clamp the bracket in a vice, undo and unscrew nut 4 (Fig. 5-12), remove washers 3 and 6 and idler arm 1 complete with shaft 9, washer 10 and self-locking nut 11; remove seals 7 and drive out bushings 8.

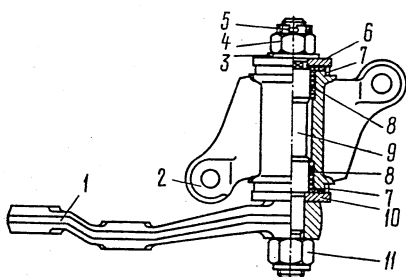


Fig.5-12. Idler Arm Bracket, Sectionalized:
1 - idler arm; 2 - bracket body; 3 - washer;
4 - adjusting nut; 5 - cotter pin; 6 - upper washer; 7 - seal; 8 - bushing; 9 - idler arm shaft;
10 - lower washer; 11 - self-locking nut

Checks

Examine the bushings of the idler arm shaft; if they are out of round or there is an excessive clearance between the shaft and the bushings, the latter must be replaced by new ones.

Examine the shaft for out-of-roundness and damage and replace it with a new one, if necessary. Make sure that the idler arm is not distorted; otherwise replace it by a new one.

Assembly and Installation

Before assembly, coat the bushings of the idler arm shaft and fill the spaces between them with ЛИТОЛ-24 lubricant. Assemble the idler arm bracket by reversing the disassembly operations.

If shaft 9 has been replaced, tighten self-locking nut 11 of the arm with a torque-indicating wrench.

Washer 6 must be installed with the dents facing up.

After tightening nut 4, the idler arm positioned horizontally should not turn under its own weight. It must turn under a force of 10-20 N (1-2 kgf) applied to its end.

If nut 4 proves to be overtightened, unscrew it, lift washer 6 somewhat and tighten again.

Secure the bracket on the side member by bolts with self-locking nuts and plain washers; tighten the nuts with a torque-indicating wrench.

Attach the steering rod ball pins to the idler arm.

Section VI

BRAKES

The layout of the brake system is shown in Fig. 6-1.

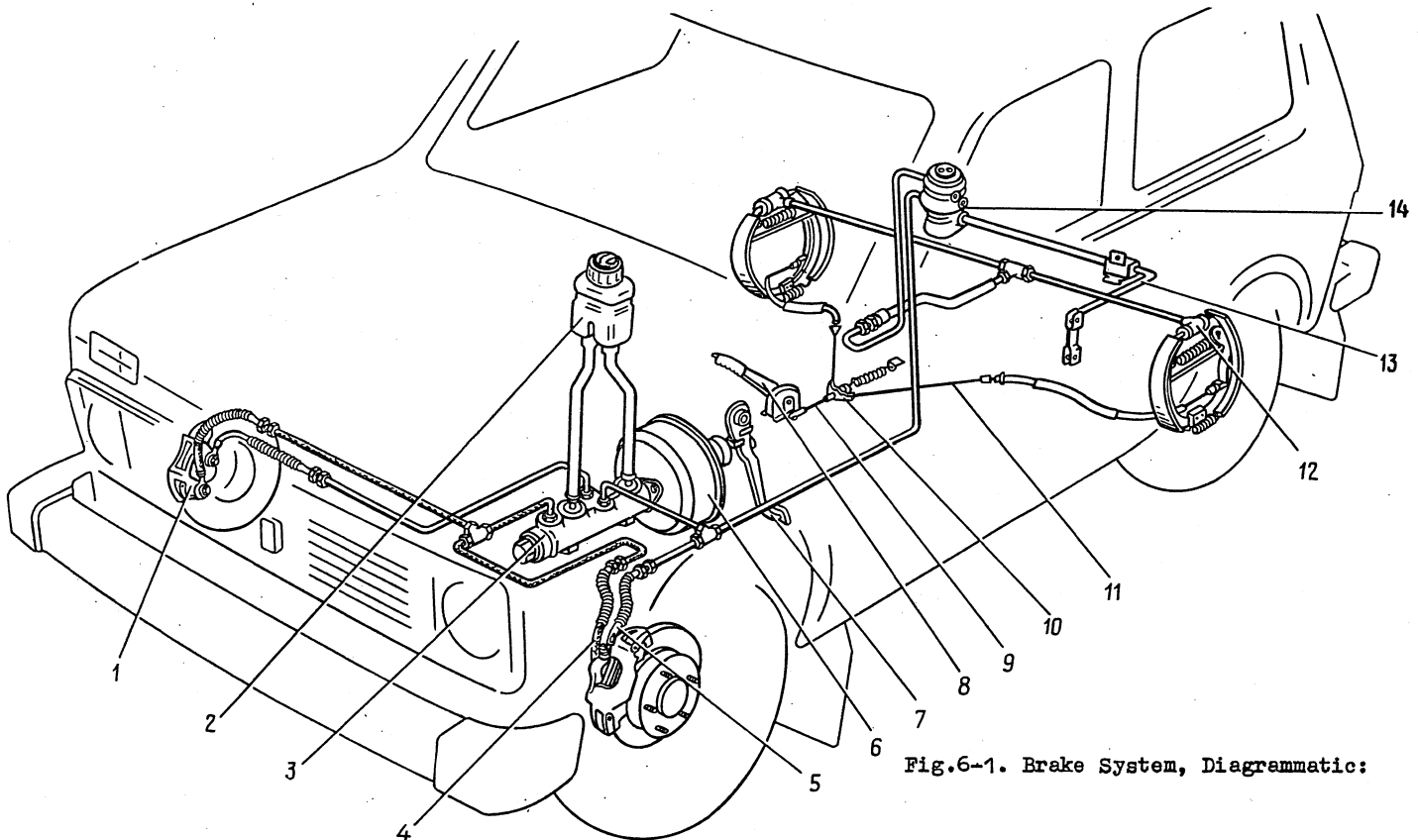


Fig.6-1. Brake System, Diagrammatic:

1 - front brake cylinder block; 2 - brake fluid tank; 3 - brake master cylinder; 4 - primary circuit pipe; 5 - secondary circuit pipe; 6 - vacuum booster; 7 - brake pedal; 8 - parking brake lever;

9 - parking brake front cable; 10 - rear cable guide; 11 - parking brake rear cable; 12 - rear brake wheel cylinder; 13 - pressure regulator operating lever; 14 - pressure regulator

TROUBLE SHOOTING

Cause of trouble	Remedy
Poor Braking Effect	
1. Fluid leaks from wheel cylinders of front or rear brakes	1. Replace faulty parts of wheel cylinders, wash and dry shoes and drums, bleed hydraulic system
2. Air in brake system	2. Bleed system
3. Damaged rubber seals of brake master cylinder	3. Replace seals and bleed system
4. Hydraulic rubber hoses damaged	4. Replace hoses

Cause of trouble	Remedy
<u>Brakes Applied of Themselves with Engine Running</u>	
Wrong position of stop-light switch causes infiltration of air between valve body and boot	Do the following:
(a) cover seal damaged, cocked or improperly fixed due to defective locking parts; wear of seal	(a) replace vacuum booster
(b) insufficient lubrication of cover seal	(b) remove boot and pack seal with lubricant
<u>Incomplete Release of All Wheel Brakes</u>	
1. No free travel of brake pedal due to wrong position of stop light switch	1. Adjust position of switch
2. Protrusion of vacuum booster adjusting bolt from brake master cylinder mounting surface exceeds 1.25-0.2 mm	2. Adjust protrusion of adjusting bolt (See Fig. 6-2)
3. Jamming of vacuum booster valve body caused by swelling of diaphragm or seizure of booster cover seal or boot	3. Replace vacuum booster
4. Clogging of master cylinder compensating hole	4. Clear out hole. Bleed hydraulic system
5. Swelling of master cylinder rubber seals caused by penetration of gasoline, mineral oils, etc. into fluid	5. Wash entire system thoroughly with brake fluid, replace faulty rubber parts, bleed hydraulic system
6. Jamming of brake master cylinder piston	6. Examine master cylinder, replace it, if necessary; bleed hydraulic system
<u>One Wheel Drags with Pedal Released</u>	
1. Rear brake shoe return spring weaken or broken	1. Replace spring
2. Jamming of wheel cylinder piston due to corrosion	2. Disassemble cylinder, clean and wash parts, replace those faulty
3. Swelling of wheel cylinder sealing rings due to penetration of fuel or lubricant into fluid	3. Replace rings, wash brake system with fluid
4. No shoe-to-drum clearance	4. Adjust parking and rear brakes
5. Wrong position of brake caliper relative to brake disc due to loosening of shoe guide-to-steering-knuckle bolts	5. Tighten bolts; if necessary, replace faulty parts
6. Excessive runout of brake disc (over 0.15 mm)	6. Grind disc. Replace, if it is thinner than 9 mm
<u>Car Skids or Pulls Sideways on Braking</u>	
1. Fluid leaks from one of wheel cylinders	1. Replace seals and bleed system
2. Jamming of wheel cylinder piston	2. Eliminate jamming, replace faulty parts, if necessary
3. Clogging of steel pipe due to denting or soiling	3. Replace or clean out pipe. Bleed system
4. Nonuniform tyre pressure	4. Adjust tyre pressure
5. Wrong front wheel alignment angles	5. Adjust
6. Soiling or oiling of discs, drums and shoe linings	6. Clean brake parts
7. Wrong installation of pressure regulator	7. Adjust position of pressure regulator
8. Pressure regulator faulty	8. Repair or replace pressure regulator
<u>Pedal Pressure Too Hard</u>	
1. Clogging of vacuum booster air filter	1. Replace air filter
2. Booster valve body jamming due to swelling of diaphragm or seizure of booster cover seal or boot	2. Replace vacuum booster

Cause of trouble	Remedy
3. Hose between booster and engine inlet manifold damaged or loosely fitted on pipe unions	3. Replace hose or tighten its clamps
4. Brake pedal metal bushings oxidized or run dry (drying of lubricant)	4. Replace worn parts or change lubricant

Brakes Squeak or Squeal

1. Weakening of rear brake shoe return spring	1. Examine return spring and replace, if necessary
2. Rear brake drums out of round	2. Rebore drums
3. Shoe linings smeared with oil	3. Clean linings with wire brush, warm water and detergents. Prevent penetration of fluid or oil to brake shoes
4. Shoe linings worn or fouled with embedded foreign particles	4. Replace shoes
5. Excessive runout or uneven wear of brake disc	5. Grind disc. Replace, if it is thinner than 9 mm

CHECKS AND ADJUSTMENTS

Checking the Piping and Joints

To prevent sudden failure of the brake system, examine closely all pipes:

- the metal pipes should be free from dents, cracks and located sufficiently far from damaging sharp edges;

- the brake hoses should have no penetrating cracks on the external casing and should be out of contact with mineral oil and lubricants that are apt to attack rubber; depress the brake pedal sharply and see that the hoses do not bulge; bulging is indicative of some defect;

- all the pipe clips should be well tightened since their loosening will result in vibration and breakage;

- there should be no fluid leaks from the pipe unions; if necessary, tighten the nuts home, taking care not to distort the pipes.

Replace the parts by new ones if there is even the slightest doubt as to their serviceability.

It is recommended that the flexible hoses, irrespective of their condition, be replaced by new ones after 100 thousand kilometers or five years of service in order to preclude sudden bursting due to ageing.

After five years, it is good practice to fill the brake system with fresh fluid.

Checking the Vacuum Booster

With the engine inoperative, press the brake pedal 5 - 6 times thus building up an equal pressure, close to atmospheric, in spaces A and E (Fig.6-2). At the same time see that valve body 22 is not jammed, judging by the force on the pedal.

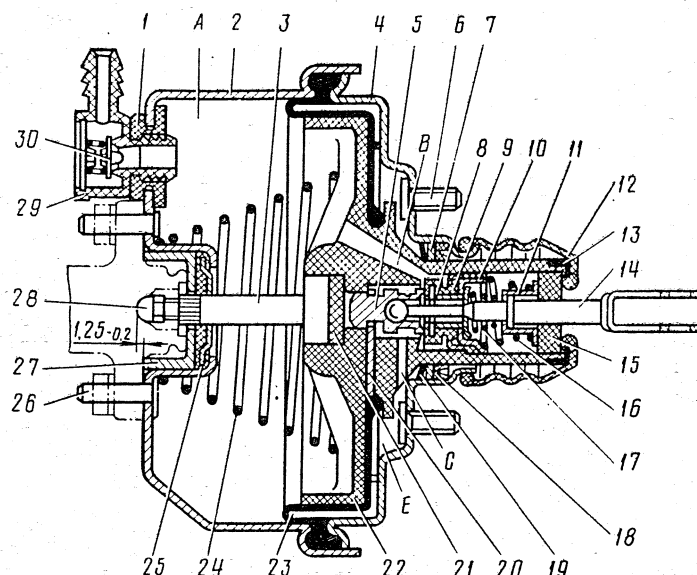


Fig.6-2. Vacuum Brake Booster:

1 - nipple fastening flange; 2 - booster casing; 3 - rod; 4 - cover; 5 - piston; 6 - booster bolt; 7 - spacer ring; 8 - valve spring seat; 9 - valve; 10 - valve supporting cup; 11 - return spring seat; 12 - boot; 13 - boot holder; 14 - pushrod; 15 - air filter; 16 - valve return spring; 17 - valve spring; 18 - casing cover seal; 19 - seal locking ring; 20 - thrust plate; 21 - buffer; 22 - valve body; 23 - diaphragm; 24 - valve body return spring; 25 - rod seal; 26 - master cylinder bolt; 27 - rod seal holder; 28 - adjusting bolt; 29 - hose nipple; 30 - valve
A - vacuum chamber; B - channel from vacuum chamber to inside space of valve; C - channel from inside space of valve to atmospheric pressure space; E - atmospheric pressure space

Stopping the brake pedal midway of its travel, start the engine. If the booster is in order, the brake pedal will sink forward after engine starting.

If, however, the pedal fails to move forward, check the fastening of hose nipple 29, condition and fastening of flange 1, fastening of the hose to the nipple and to the pipe union of the engine inlet manifold because a loosely fastened or damaged hose and flange 1 decreases sharply the vacuum in space A and the efficiency of booster operation.

If the car gets braked of itself, check the vacuum booster for tightness with the engine running, first by releasing the brake pedal, then pressing and holding it so. Sticking of boot 12 to the extension of the valve body and the hissing sound of infiltrating air will symptomize insufficient pressure-tightness of the booster.

Even in absence of boot sticking, seal 18 should be examined as follows:

- remove boot 12 carefully then shift it from the flange of the hole in cover 4;

- with the engine running, rock the protruding extension of the valve body laterally with a force of 30-40 N (3-4 kgf); there should be no characteristic hissing of the air entering the booster through cover seal 18.

If the vacuum booster is found to be leaky, disconnect pushrod 14 from the brake pedal, remove boot 12 and pack 5 g of ЦИАТИМ-221 lubricant between the seal and the flanges of the cover and valve body; then examine air filter 15, replace it, if necessary, and put the boot back in position.

If these measures fail to do away with the infiltration of air, replace the vacuum booster.

Adjusting the Brake Operating Mechanism

The free travel of the brake pedal should be 3-5 mm with the engine inoperative. This travel is ensured by moving stop light switch 6 (Fig.6-3).

If the stop light switch is too close to the pedal, the latter fails to come back to the initial position; as a result, valve 9 (Fig.6-2) bears against body 22 and disconnects spaces A and E which causes incomplete releasing of the wheel brakes when the pedal is released.

To adjust the position of the stop light switch, back off nut 5 (Fig.6-3) and move the switch so that its buffer is in light contact with the brake pedal stop. In this position the free travel of the brake pedal should vary from 3 to 5 mm. After adjustments do not fail to tighten nut 5.

Caution

The free travel of the brake pedal should be adjusted with the engine shut down.

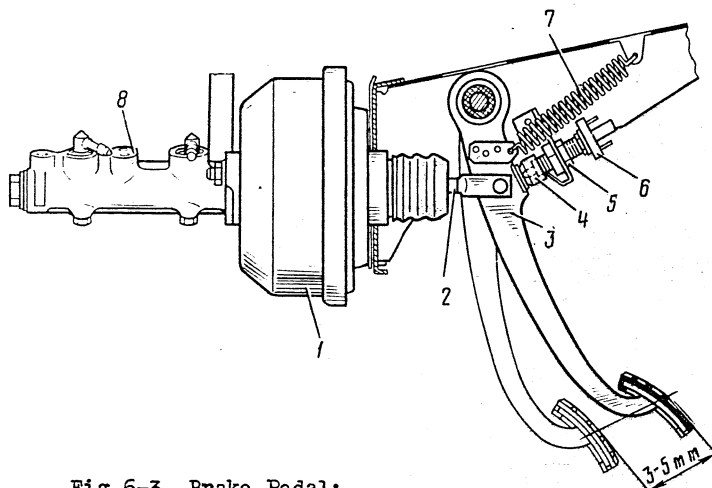


Fig.6-3. Brake Pedal:

- 1 - vacuum booster; 2 - pushrod; 3 - brake pedal;
- 4 - stop light switch buffer; 5 - switch nut;
- 6 - stop light switch; 7 - pedal return spring;
- 8 - master cylinder

If it proves impossible to eliminate incomplete releasing of brakes by moving the stop light switch, disconnect the brake master cylinder from the vacuum booster and check the protrusion of adjusting bolt 28 (Fig.6-2) relative to the mounting surface of the master cylinder flange (1.25_{-0.2} mm). This distance can be set by holding the end of rod 3 with a special wrench and turning adjusting bolt 28 in or out with another wrench.

Adjusting the Parking Brake

If the parking brake fails to hold the car reliably on a 30 % gradient or is applied only after its lever has been shifted more than 4-5 teeth of the ratchet mechanism, adjust the brake as follows:

- jack up the rear end of the car until the wheels are free to rotate and move the lever all the way down;

- loosen lock nut 5 (Fig.6-4) of the tensioning device and keep turning in adjusting nut 6 to tension the cable until the rear wheels are braked and cannot be turned by hand;

Note. If the cables have been replaced by new ones, apply the parking brake 2-3 times, pulling at the lever with a force of about 400 N (40 kgf). This will stretch out the cables.

- unscrewing the adjusting nut, set a 4-5 tooth travel of the lever on the quadrant and tighten the nut.

Apply the brakes a few times to make sure that the lever travel has not changed and the wheels are free to rotate without dragging when the lever is pushed to the downmost position.

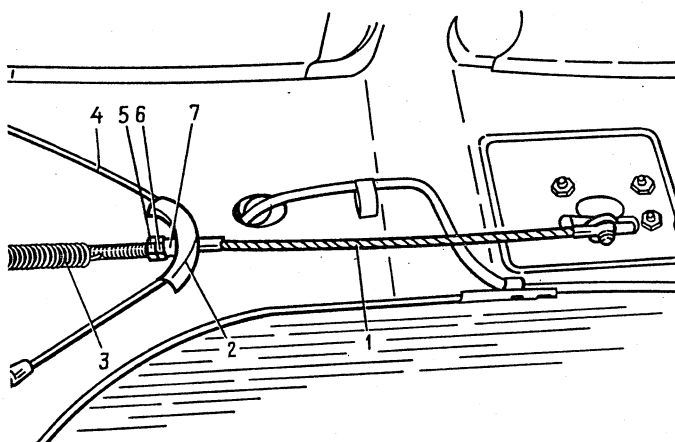


Fig. 6-4. Parking Brake Controls:

1 - front cable; 2 - rear cable guide; 3 - front cable return spring; 4 - rear cable; 5 - locknut; 6 - adjusting nut; 7 - spacer bushing

Checking the Pressure Regulator

Put the car on a lift or an inspection pit and clean the pressure regulator and its protection boot.

Remove the boot carefully, remove any remaining lubricant and clean the torsion-lever-piston joint.

Ask an assistant to press the brake pedal with a force of 700-800 N (70-80 kgf), at the same time watching the protruding part of the regulator piston.

If the piston moves 0.5 - 0.9 mm relative to the regulator body and twists the torsion lever, it means that the pressure regulator is in order. Press the brake pedal again 2 or 3 times to make certain that the pressure regulator is fully serviceable.

If the piston stays still after depression of the brake pedal (this is caused by sticking of the corroded piston to the body), replace the regulator.

On ascertaining that the pressure regulator is fully serviceable and there are no fluid leaks from between the regulator piston and body, apply a thin layer of IT-1 lubricant to the axle and the protruding portion of the piston, pack 5-6 g of the same lubricant into the rubber boot and put the latter back in position.

Adjusting the Shoe-to-Drum Clearance

Proceed as follows:

- press the brake pedal with a force of 100-120 N (10-12 kgf) to bring the shoes in contact with the drum;

- holding the shoes in the position, turn the hexahedral heads of eccentrics A and B (Fig. 6-5)

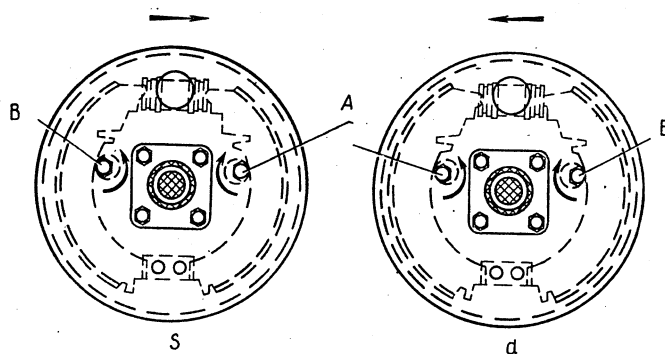


Fig. 6-5. Shoe-to-Drum Clearance Adjustment:

A - front shoe adjusting eccentrics; B - rear shoe adjusting eccentrics. Arrows above show the direction of forward travel; S - L.H. wheel; d - R.H. wheel

in the direction shown by arrows on the figure until they come in contact with the shoes;

- let go of the brake pedal and turn the adjusting eccentrics in the opposite direction through 10° approximately;

- press the brake pedal smartly 3 - 4 times, release it and rotate the jacked-up wheels; the shoes should run clear of the drums.

After adjustments it is good practice to drive the car 5 - 7 km without using the brakes, then to stop and hand-feel the brake drums to make sure they are not heated because of friction against the shoes. If the drums feel hot which should be attributed to friction between the shoes and drums, repeat the adjustments.

If adjustments fail to set the required shoe-to-drum clearance, remove the brake drum, examine the shoes and the drum; if necessary, replace or recondition the worn parts, assemble and adjust once again.

Adjusting the Position of Pressure Regulator

If the regulator fastening bolts become loose, adjust the regulator position first jacking up the rear axle of the car.

Then disconnect lever 4 (Fig. 6-6) from link 8 and attach fixture 67.7820-9519 to the end of the lever. Direct the spindle of the fixture upward to bear against the car body floor (Fig. 6-7). This will set a distance "X" of 150±5 mm between the end of the lever and the body side member (Fig. 6-6).

Lift rubber boot 6 (Fig. 6-6) a little and, turning the pressure regulator on its bolts, establish a light contact between the lever and piston 2.

Holding the regulator in this position, tighten bolts 1 and 7 as far as they will go and apply

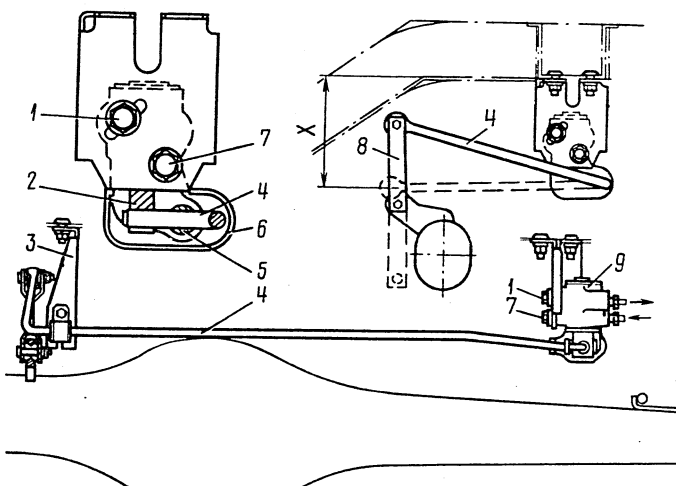


Fig. 6.6. Installation and Adjustment of Rear Brake Pressure Regulator

1, 7 - regulator fastening bolts; 2 - piston; 3 - supporting bushing bracket; 4 - regulator operating lever; 5 - axle; 6 - boot; 8 - link; 9 - pressure regulator; $X = 150 \pm 5$ mm

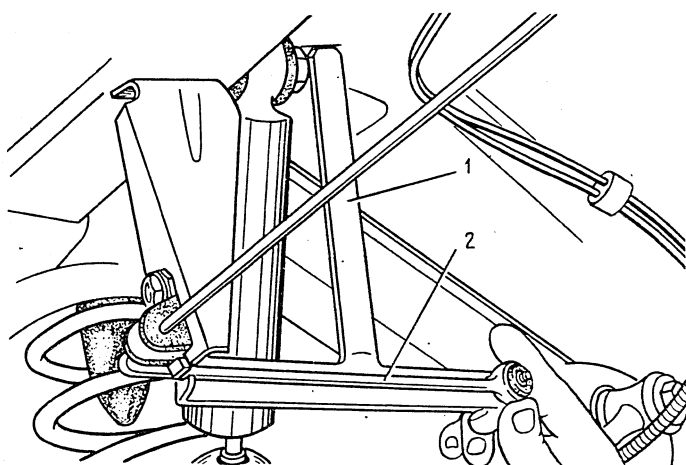


Fig. 6.7. Fixture 67.7820-9519 for Rear Brake Pressure Regulator Adjustment:

1 - fixture 67.7820-9519; 2 - pressure regulator operating lever

a thin coat of MT-1 lubricant to axle 5 and to the protruding part of piston 2. Put 5 - 6 g of the same lubricant into rubber boot 6 and put it back in position.

Remove fixture 67.7820-9519 and connect the end of the lever with link 8.

Bleeding the Hydraulic Brake System

The air getting into the hydraulic brake system during replacement of pipes, hoses, sealing rings or through loose joints increases the free travel of the brake pedal, causes it to feel spongy and impairs the braking effect considerably.

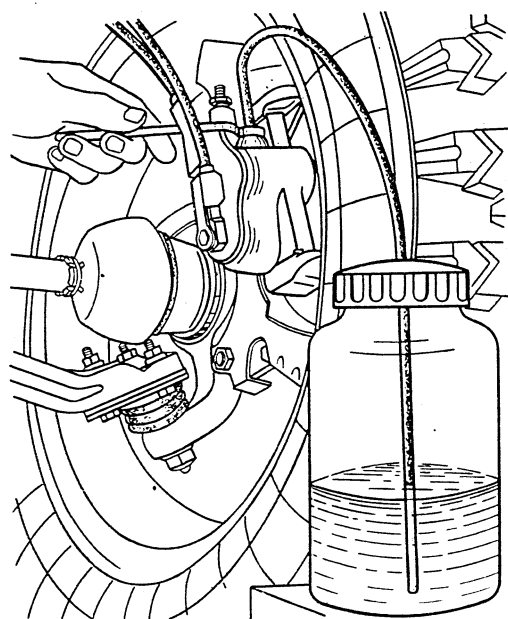


Fig. 6-8. Bleeding the Hydraulic Brake System

Prior to bleeding the system, make sure that all the units of the brake operating mechanism and their joints are pressure-tight, check the amount of fluid in the reservoir and top it up, if necessary, with brake fluid "Heba". Then clean the bleeder unions carefully of dirt and dust and remove the rubber boots from them.

Put a rubber bleeding hose (Fig. 6-8) on the head of the pipe union and dip the other end of the hose into a transparent vessel partly filled with fluid.

Depress the brake pedal sharply 3-5 times with 2-3 s intervals between successive depressions, unscrew the pipe union $1/2 - 3/4$ of a revolution with the pedal depressed, then keep depressing the pedal to remove the fluid with the air from the system through the hose into the vessel. As soon as the pedal reaches its foremost position and the fluid ceases to flow from the hose, screw in the bleeder union all the way. Repeat these operations until the spray of fluid flowing from the hose becomes free of air bubbles. Holding the pedal depressed, screw in the bleeder union all the way and remove the hose. Wipe dry the bleeder union and put in place the rubber boot.

Perform all the above operations first through the upper unions of the rear R.H. wheel which is farthest from the master cylinder, then work in the clockwise direction, i.e. L.H. rear wheel, L.H. and R.H. front wheels. This will expel air from one of the brake circuits. Bleed the other circuit through the lower unions on the cylinder block of the L.H. and R.H. front brakes. Bleeding may be started either from the R.H. or L.H. wheel.

While bleeding the hydraulic brake system take care to maintain a normal fluid level in the brake fluid reservoir. If there is no air in the hydraulic brake system, the brake pedal should move not farther than $1/2 - 2/3$ of its travel.

To exclude the influence of the vacuum booster and pressure regulator on the bleeding operation, do it with the engine shut down and the loaded rear wheels (do not jack up the rear end of the car).

If the hydraulic system has been completely drained, the bleeding operation should be preceded by the following:

- unscrew the bleeder unions 1.5 - 2 revolutions on the brake cylinders of all wheels;

- pressing the brake pedal sharply and releasing it slowly, screw in the unions as the fluid is flowing out. Then bleed the system as described above.

If the air bubbles continue to emerge from the hose even after prolonged bleeding, it means that air penetrates into the system through damaged pipes, leaky joints or faulty master or wheel cylinders.

If the hydraulic system is being bled on the car whose brake system has been operating for a long time, it is recommended that the system be filled with fresh fluid.

The fluid considered fit for reuse should be carefully filtered and settled in a tightly closed vessel.

CLUTCH AND BRAKE PEDAL BRACKET

Removal and installation. To remove the pedal bracket:

- take off the steering shaft bracket as advised under "Steering";
- detach the vacuum booster pushrod from the brake pedal by removing locking shackle 26 (Fig.6-9) and pin 24;
- unscrew the nuts which fasten the vacuum booster and clutch master cylinder to the bracket;
- unscrew the bracket-to-body nuts and remove the bracket, disconnecting the wires from the stop light switch.

To install the bracket, reverse the removal operation, seeing that the pushrod is properly installed in the piston socket of the clutch master cylinder.

Disassembly and assembly. To disassemble, remove clutch pedal servo spring 14, return springs 8 and 17, unscrew nut 2 of bolt 20, take out the bolt and remove the pedals complete with their bushings.

The springs should be removed and installed by the use of tool A.70017.

To assemble, proceed in the reverse sequence of operations. Before assembly, apply Литол-24 lubricant to pedal bushings, to the ends of springs, the joints of the pushrods with the pedals and to the end of the pushrod contacting the piston of the clutch master cylinder.

Checks and repairs. If the pedals move with difficulty, examine the working surfaces of the pedals, bushings and shaft.

If the metal parts are found to be lightly scratched or oxidized, it is enough to dress them with fine abrasive cloth; the outer plastic bushings of the pedals, if worn, should be replaced by new ones.

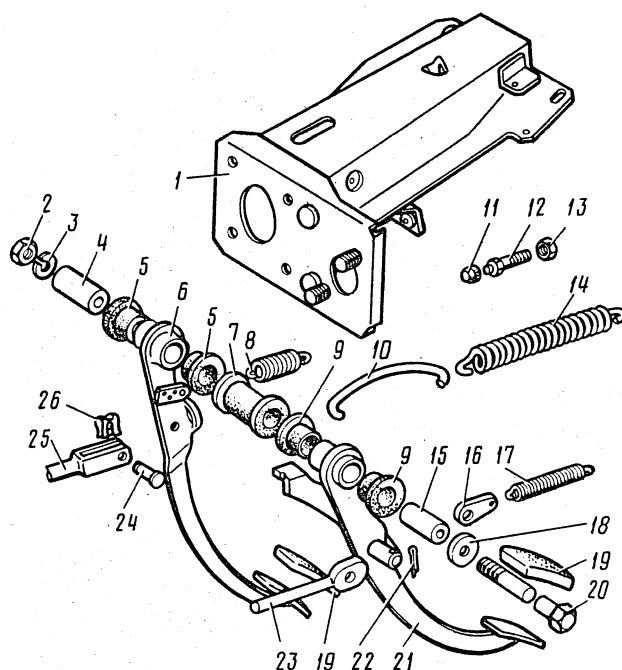


Fig.6-9. Parts of Clutch and Brake Pedal Bracket:
 1 - bracket; 2 - nut; 3 - spring washer; 4 - brake pedal inner bushing; 5 - brake pedal outer bushings; 6 - brake pedal; 7 - spacer bushing; 8 - brake pedal return spring; 9 - clutch pedal outer bushings; 10 - hook; 11 - cap; 12 - clutch pedal limiting screw; 13 - nut; 14 - servo spring; 15 - clutch pedal inner bushing; 16 - plate; 17 - clutch pedal return spring; 18 - washer; 19 - pedal pads; 20 - bolt; 21 - clutch pedal; 22 - cotter pin; 23 - clutch pedal pushrod; 24 - pin; 25 - vacuum booster pushrod; 26 - locking shackle

Check the springs for resilience. The length of the brake pedal return spring should be 80 mm under a force of 13 ± 2 N (1.3 ± 0.2 kgf) and 160 mm under a force of 120 ± 6 N (12 ± 0.6 kgf).

The length of the clutch return spring should

be 130 mm under a force of 33 ± 4 N (3.3 ± 0.4 kgf) and 155 mm under a force of 46 ± 4.5 N (4.6 ± 0.45 kgf). The length of the clutch servo spring should be 120 mm under a force of 204 ± 20 N (20.4 ± 2 kgf) and 152 mm under a force of 599 ± 60 N (59.9 ± 6 kgf).

VACUUM BOOSTER

Removal and Installation

When removing the vacuum booster, leave the brake master cylinder in place to prevent the air from getting into the hydraulic system.

To remove the booster:

- disconnect the booster pushrod from the pedal;
- unscrew the nuts which fasten the master

cylinder to the booster, take the cylinder off the studs and shift it sidewise;

- disconnect the hose from the booster;
- unscrew the nuts which hold the booster to the clutch and brake pedal bracket and take off the booster.

To install the booster, reverse the removal operations.

BRAKE MASTER CYLINDER

The design of the master cylinder is shown in Fig.6-10.

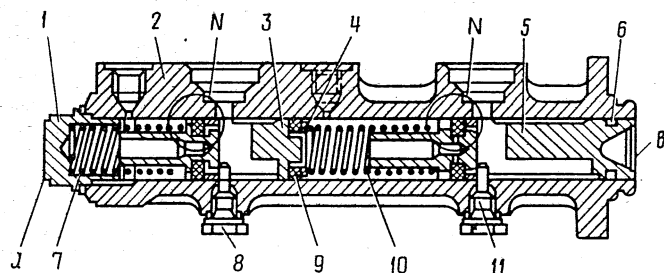
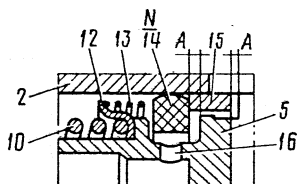


Fig.6-10. Brake Master Cylinder:

1 - plug; 2 - cylinder barrel; 3 - front brake operating piston; 4 - washer; 5 - rear brake operating and front brake auxiliary operating piston; 6 - sealing ring; 7 - piston return springs; 8, 11 - piston locating bolts; 9 - seal; 10 - piston return spring; 12 - spring seat; 13 - seal hold-down spring; 14 - seal; 15 - spacer ring; 16 - inlet hole; A - compensating hole (clearances between seal 14, ring 15 and piston 5).

Removal and Installation

Disconnect the flexible hoses from the master cylinder and stop the holes of the cylinder hoses and pipe unions to keep the fluid in and dust and dirt out.

Disconnect from the master cylinder the steel pipes leading to the wheel cylinders of the front and rear brakes, first unscrewing the pipe nuts.

Remove the master cylinder, unscrewing the nuts which fasten it to the vacuum booster.

To install the master cylinder, reverse the removal procedure. After installation, bleed the brake system.

Disassembly and Assembly

Remove pipe unions 3 (Fig.6-11) with sealing washers 4, take off cap 5, turn off screws 7 and take out all the parts in the order shown in Fig. 6-11.

Assemble the cylinder in the reverse order of steps, using mandrel 67.7853-9543 and lubricating the parts with brake fluid.

Caution

To distinguish the brake master cylinder of the VAZ-2121 car from outwardly identical master cylinders of other car models, the cylinder plug is provided with shoulder "a" (Fig.6-10) and its piston has recess "b".

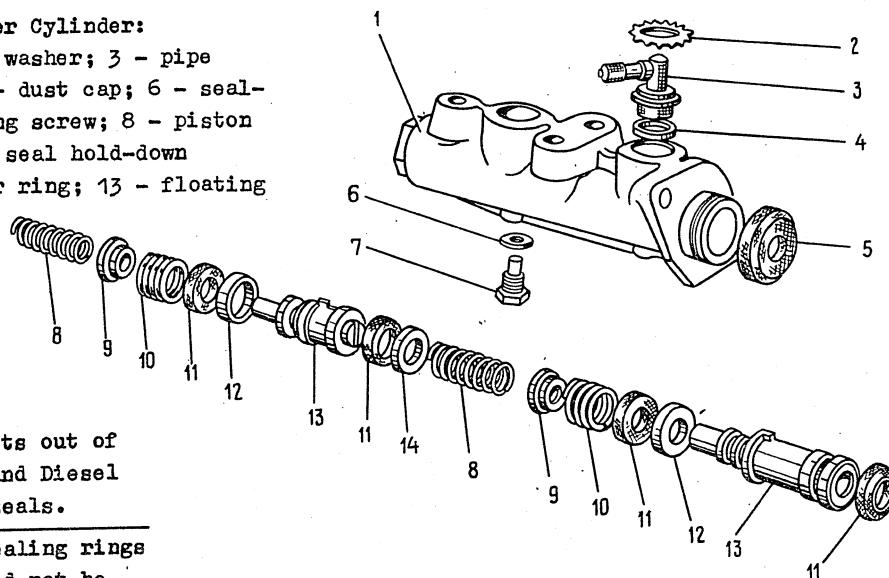
Checking the Master Cylinder

Parts

Before assembly, wash all the parts with isopropyl alcohol, dry them with compressed air or

Fig.6-11. Parts on Brake Master Cylinder:

1 - cylinder barrel; 2 - lock washer; 3 - pipe union; 4 - sealing washer; 5 - dust cap; 6 - sealing washer; 7 - piston locating screw; 8 - piston return spring; 9 - seat; 10 - seal hold-down spring; 11 - seal; 12 - spacer ring; 13 - floating piston; 14 - washer



wipe with clean rags, keeping the parts out of contact with mineral oils, kerosene and Diesel fuel which are apt to attack rubber seals.

Note. The washing time of the sealing rings in isopropyl alcohol should not be over 20 s; then blow the rings with compressed air.

The cylinder face and the working surfaces of the pistons should be perfectly clean and free of rust, notches and other defects. Excessive clearance between the cylinder and pistons is impermissible.

Each time when disassembling the cylinder, take care to replace the seals by new ones even if the old seals appear to be quite serviceable.

Check the piston spring for resilience; its length should be 36 mm under a load of 35^{+7} N ($3.5^{+0.7} \text{ kgf}$), 21 mm under a load of 63.5^{+10} N ($6.35^{+1.0} \text{ kgf}$) and 57.5 mm noncompressed.

Brake Master Cylinder Tightness Check

Mount the master cylinder on a stand and connect it to the latter as shown in Fig.6-12.

Open stand priming valves 1 and, moving the master cylinder pistons a few times through their complete stroke, prime the system. Then close valves 1. Rotating handwheel 5, move the master cylinder pistons slowly until the pressure read by pressure gauges 2 reaches 12.5 MPa (125 kgf/cm^2). In this position lock the master cylinder pushrod. This pressure should stay constant for at least 5 s.

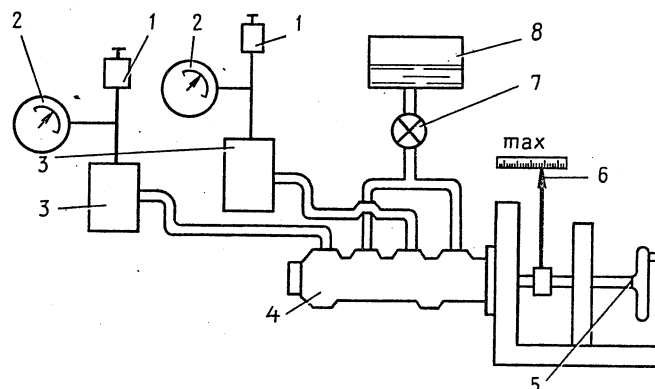


Fig.6-12. Checking the Master Cylinder for Tightness:

1 - stand bleeding valve; 2 - pressure gauge; 3 - receiving cylinder; 4 - master cylinder; 5 - handwheel; 6 - pushrod travel indicator; 7 - cock; 8 - vessel

In case of fluid leaks or when pressure fails to remain constant for 5 s, replace the cylinder piston seals.

FRONT BRAKES

The design of the front brake is illustrated in Fig.6-13.

Cleaning

Prior to repairing the brakes, wash them thoroughly with warm water and a special detergent and dry immediately with compressed air.

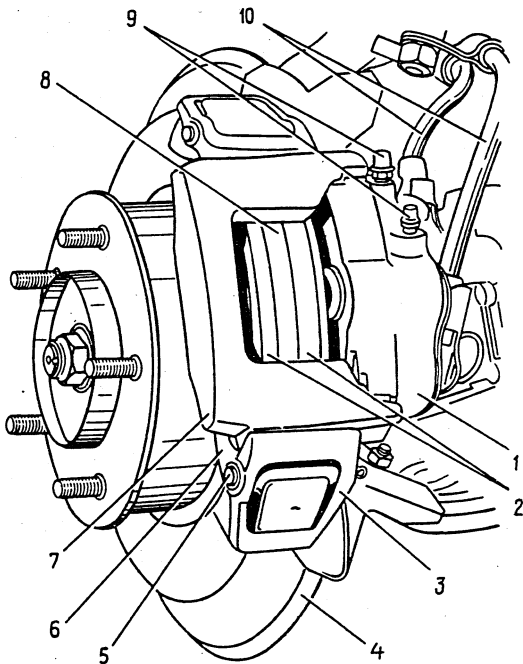


Fig. 6-13. Front Wheel Brake Mechanism:

1 - cylinder block; 2 - brake shoes; 3 - caliper hold-down lever; 4 - guard housing; 5 - hold-down lever axle; 6 - shoe guide; 7 - brake caliper; 8 - brake disc; 9 - bleeder unions; 10 - brake hoses

Caution

Under no circumstances should gasoline, Diesel fuel, trichloroethylene or any other mineral solvents be used for cleaning the brakes since these liquids destroy cylinder seals.

Removal and Installation

Removal. Jack up the front end of the car, put it on supports and remove the wheel.

Take off the guide brackets of the hoses. Unscrew the bypass bolts, detach hoses 10 (Fig. 6-13) from the block of cylinders, keeping dirt from getting into the cylinders. Stop the inlet holes of the cylinder block and hoses.

Unbend the edges of the front brake guard housing, unscrew the brake-to-steering-knuckle bolts (Fig. 6-14); remove the brake as a complete unit.

To install the front brake, proceed in the reverse order of steps.

After installation, restore the fluid level in the reservoir and bleed the brake system.

Disassembly and Assembly

Pull out the cotter pins then axles 5 (Fig. 6-13), holding levers 3 to prevent the springs from getting out.

Remove the hold-down levers and their springs,

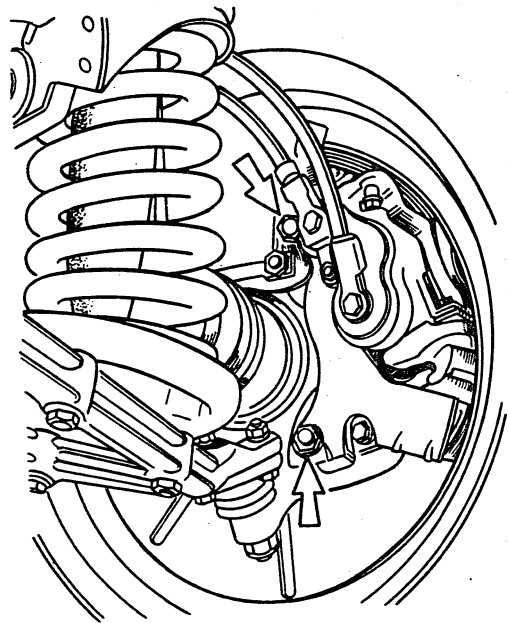


Fig. 6-14. Removing the Front Brake:

Arrows show the bolts to be unscrewed for removing the brake

then caliper 7 complete with cylinder block 1. Remove brake shoes 2.

Take cylinder block 1 from the slots in the caliper, spreading apart the caliper slots to 118.5 mm. Remove piston boots 3 (Fig. 6-15) from the cylinders.

Feeding compressed air through the fluid inlet hole, push pistons 14 out of the cylinder block and remove sealing rings 4.

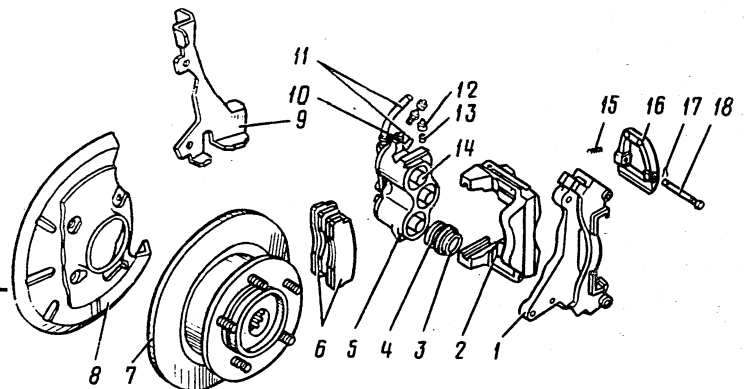


Fig. 6-15. Front Brake Parts:

1 - shoe guide; 2 - brake caliper; 3 - piston boot; 4 - sealing ring; 5 - cylinder block; 6 - brake shoes; 7 - brake disc; 8 - front brake guard housing; 9 - caliper housing; 10 - bleeder union; 11 - brake hoses; 12 - cylinder block retainer; 13 - retainer spring; 14 - piston; 15 - hold-down lever spring; 16 - hold-down lever; 17 - cotter pin; 18 - hold-down lever axle

Assemble the front brake in the reverse sequence, coating the sealing rings, pistons and cylinder faces with brake fluid at assembly; pack the boots with $\Delta T-1$ lubricant.

Checking the Brake Parts

Wash all the parts with lukewarm water and detergent, dry them with compressed air and examine carefully.

If traces of wear or jamming are discovered on the piston or cylinder face, replace the cylinder by a new one, complete with pistons.

Note. In all cases when the piston is removed from the cylinder, it is good practice to replace the sealing ring in the cylinder grooves and the dust cap if satisfactory performance of the system is to be ensured.

Runout Check of Brake Disc

Check the brake disc for face runout without removing it from the car (Fig.6-16). The maximum permissible runout is 0.15 mm shown by an indicator; if it is larger, grind the disc, bearing in mind that the thickness of the disc after grinding should be not under 9.5 mm. If the disc is damaged deeply notched or worn in excess of 1 mm on each side, replace it by a new one.

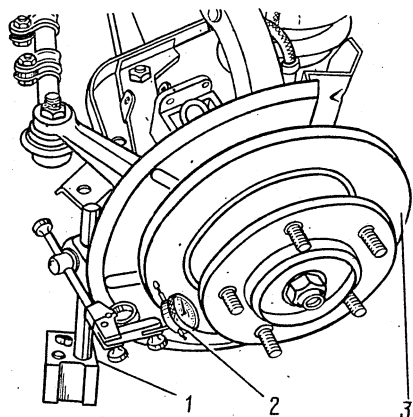


Fig.6-16. Checking the Brake Disc for Face Runout:
1 - magnetic support; 2 - indicator; 3 - brake disc

Replacing the Brake Shoes

The brake shoes must be replaced by new ones if the thickness of the linings has diminished to 1.5 mm.

To replace the shoes:

- uncotter the axle of the upper hold-down lever, take out the axle and remove the lever; take down the caliper assembly and pull the worn shoes from the slots of the guide (Fig.6-17);

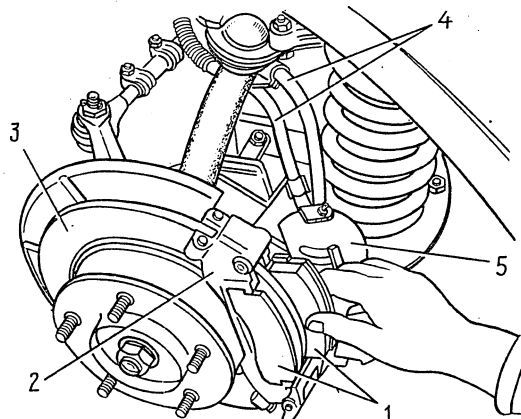


Fig.6-17. Replacing the Brake Shoes:

1 - brake shoes; 2 - shoe guide; 3 - brake disc;
4 - brake hoses; 5 - cylinder block assembled with caliper

- push the pistons gently into the cylinders all the way, taking care that the fluid is not splashed out of the brake reservoir and insert new shoes into the guide slots;

- bringing the lower guide slant of the caliper under the lower hold-down lever, press the caliper against the shoes, insert the lever axle with its head at the wheel side and insert cotter pins.

The brake shoes must be replaced simultaneously on the R.H. and L.H. wheels.

REAR BRAKES

The design of the rear brake is illustrated in Fig.6-18.

removal and Disassembly

Lift the rear end of the car and remove the wheel.

Take measures to prevent fluid leaks from the reservoir.

Using remover tool 67.7823-9519 (Fig.6-19), remove the brake drum.

Disconnect the end of cable 5 (Fig.6-18) from hand-operated shoe control lever 2, pull out the

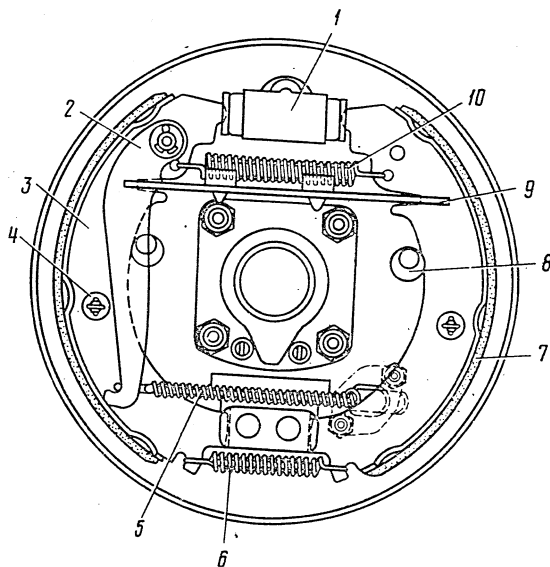


Fig. 6-18. Rear Brake Mechanism:

1 - wheel cylinder; 2 - shoe hand-operating lever; 3 - brake shoe; 4 - shoe cup and support; 5 - parking brake operating cable in casing; 6 - lower pull-back spring; 7 - friction lining; 8 - shoe-to-drum clearance adjusting eccentric; 9 - expander strap; 10 - upper pull-back spring

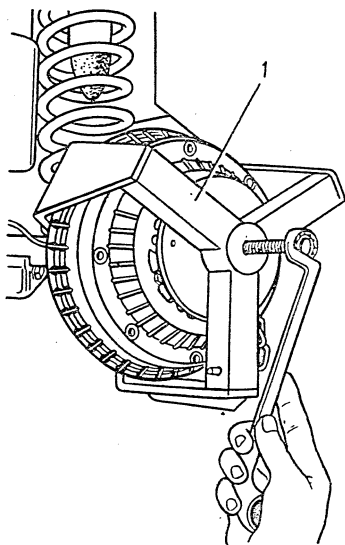


Fig. 6-19. Removing the Brake Drum:

1 - remover tool 67.7823-9519

cotter pin, press the pin and take off lever 2. Disconnect upper 10 and lower 6 pull-back springs. Turn the anchor pin cups and take them out complete with the anchor pins, springs and lower cups; then remove the shoes complete with expander strap 9.

Detach the fluid feed pipe from the wheel cylinder and stop the inlet holes of the cylinder and pipe.

Remove wheel cylinder 1.

When replacing the backing plate, take off the axle shaft as prescribed under "Rear Axle" and disconnect the parking brake control cable, unscrewing two bolts which hold it to the brake backing plate.

Assembly and Installation

Mount and secure the wheel cylinder on the backing plate, connect the fluid inlet pipe to it and tighten home the pipe union nut.

Connect hand-operated lever 2 to the shoe and install the brake shoes with expander strap 9; then install anchor pins with springs and lower cups, install the upper cups and secure them on the anchor pins by turning right or left. Make sure that the ends of the brake shoes fit properly into the sockets of the wheel cylinder and on the backing plate.

Install the shoe pull-back springs and connect the end of shoe hand-operating lever cable 5 to lever 2.

Install the brake drum, first coating the mounting band on the axle shaft and its flange contacting the drum with graphite lubricant or MCH-15 lubricant and tighten the drum bolts securely. The lubricant will facilitate subsequent removal of the brake drum.

If the wheel cylinder has been removed during disassembly, bleed the rear brake hydraulic circuit.

Inspection of Parts

Wheel cylinders. Dismantle the wheel cylinders as follows: take off boots 1 (Fig. 6-20) and pistons 2, take out seals 3, spring seats 5 and spring 7. Then unscrew bleeder union 6. Check the active surfaces of the cylinder and pistons for cleanliness. These surfaces should be perfectly smooth, without roughness so as to rule out fluid leaks and premature wear of the seals and pistons. Eliminate any defects on the cylinder face by lapping or grinding. However, bear in mind that the cylinder bore must not be enlarged.

Replace seals 3 by new ones. Examine boots 1 and replace them, if necessary.

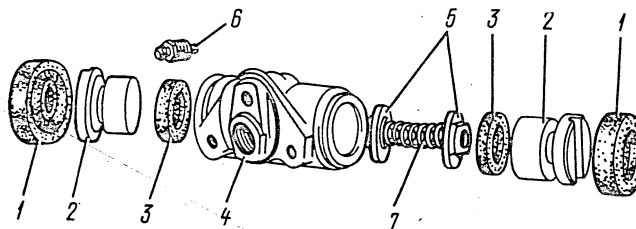


Fig. 6-20. Wheel Cylinder Parts:

1 - boot; 2 - piston; 3 - seal; 4 - barrel; 5 - spring seats; 6 - bleeder union; 7 - spring

Examine spring 7. Its noncompressed length should be 34 mm while under a load of 35 ± 2 N (3.5 ± 0.2 kgf), 17.8 mm. Replace it, if necessary.

Coat all the parts liberally with brake fluid before assembly. Install the parts in the reverse sequence of disassembly. After assembly check the pistons for smooth and free motion.

Shoes. Inspect the shoes carefully for damage and distortion.

Check both the upper and lower return springs for resilience and replace them by new ones, if necessary.

There should be no permanent deformations after the lower and upper springs have been stretched by a force of 350 N (35 kgf) and 420 N (42 kgf), respectively.

Check the linings for cleanness; if dirt or oil is discovered, clean them thoroughly with a wire brush and wash with white spirit; besides, look for leakage of lubricant or oil inside the drum; correct any discovered defects.

Replace the shoes by new ones if the thickness of their linings has diminished below 1.5-2 mm.

Brake drums. Examine the brake drums. If the working surface is deeply scored or excessively out of round, rebore the drums on a lathe.

After re boring, finish the working surface of the drum on a turning lathe with fine-grade abrasive stones. This will extend the service life of the linings and promote the uniformity and efficiency of braking.

The nominal diameter of the drum (250 mm) after re boring and grinding should not be increased by more than 1 mm. This limit should be strictly observed, otherwise the strength of the drum and the braking efficiency will be impaired.

Stand Checks of Rear Brake Wheel

Cylinders

Mount the cylinder on the stand, connect a pipe from the pressure gauges to it (Fig.6-21) and bleed the system.

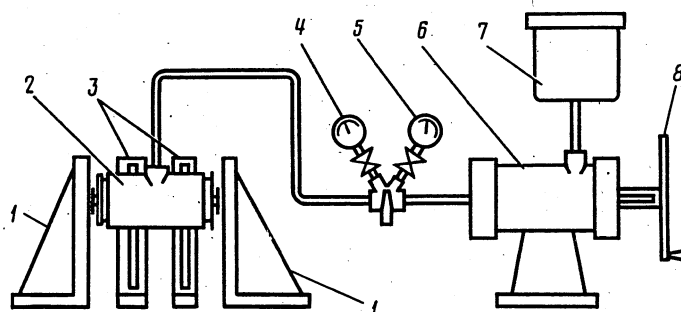


Fig.6-21. Rear Wheel Cylinder Checking Diagram:

1 - piston stops; 2 - cylinder under test; 3 - cylinder bracket; 4 - low pressure gauge; 5 - high pressure gauge; 6 - pressure build-up cylinder; 7 - vessel; 8 - handwheel

Adjust stops 1 so that they bear against the wheel cylinder pistons.

Check for absence of fluid leaks. Connect a low pressure gauge; rotating slowly the handwheel of the stand cylinder, set a fluid pressure of 0.05 MPa (0.5 kgf/cm^2).

Make sure that this pressure remains constant for 5 minutes. Repeat a similar test under a pressure of 0.1, 0.2, 0.3, 0.4, 0.5 MPa (1, 2, 3, 4, 5 kgf/cm^2).

Relieve the pressure and connect a high pressure gauge. Observing the above rules, repeat the tests under a pressure of 5, 10, 15 MPa (50, 100, 150 kgf/cm^2).

There should be no pressure drop caused by fluid leaks through the sealing elements, pipe joints and bleeder unions or through the casting pores.

A slight pressure drop (not over 0.5 MPa or 5 kgf/cm^2 within 5 minutes) is permissible, particularly at high pressures when it is caused by the shrinkage of the seals.

REAR BRAKE PRESSURE REGULATOR

Removal and Installation

Disconnect lever 12 (Fig.6-22) from link 7, then detach holder 18 from bracket 14 and the clips of the pipes leading to the pressure regulator.

Disconnect the muffler mounting parts from the car body and shift aside the pipeline with the mufflers.

Unscrew the regulator-to-bracket and bracket-to-body bolts. Remove the regulator bracket, ease down the regulator and disconnect its pipes.

Remove the regulator and detach its operating lever. Stop the inlet and outlet holes of the pressure regulator and pipes.

To install the pressure regulator, reverse the removal operations. Before tightening the regulator bolts, install fixture 67.7820-9519 (Fig.6-7) on

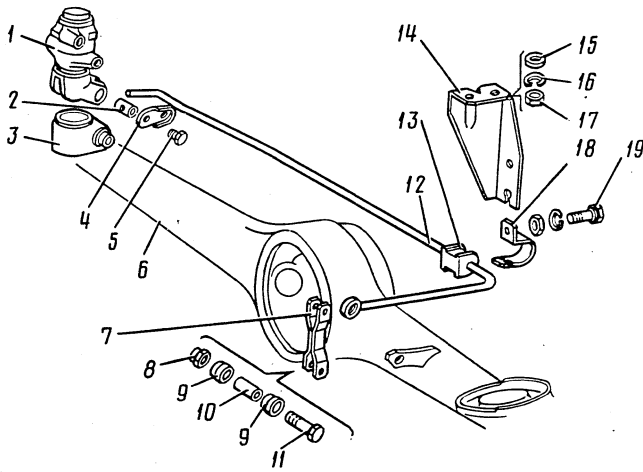


Fig. 6-22. Pressure Regulator Control Linkage:

1 - pressure regulator; 2 - pressure regulator operating lever pin; 3 - boot; 4 - locking plate; 5 - bolt with spring washer; 6 - rear axle beam; 7 - link from pressure regulator lever to rear axle bracket; 8 - nut of bolt 11; 9 - plastic bushing; 10 - spacer bushing; 11 - link bolt; 12 - pressure regulator operating lever; 13 - operating lever supporting bushing; 14 - supporting bushing bracket; 15 - washer; 16 - spring washer; 17 - nut; 18 - supporting bushing holder; 19 - holder to bracket bolt

the end of the regulator operating lever. Direct the fixture spindle upward to bear against the car body. This will set a distance of 150 ± 5 mm (see under "Adjusting the Position of Pressure Regulator") between the end of lever 2 and the body side member.

Lift boot 3 (Fig. 6-22) a little and, turning the regulator on its bolts, bring the end of the lever in light contact with the regulator piston.

Holding the regulator in this position, tighten its fastening bolts all the way, then apply a coat of $\text{M}-1$ lubricant to pin 2 and to the protruding part of the piston. Put rubber boot 3 in position, packing it with 5-6 g of the same lubricant.

Remove fixture 67.7820-9549 and connect the end of the lever with link 7, first applying $\text{M}-1$ lubricant to the bushings of the link-to-lever articulated joint.

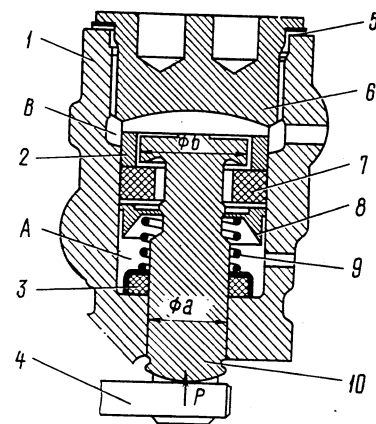


Fig. 6-23. Rear Brake Pressure Regulator (Inactive Position)

A - normal pressure chamber; B - controlled pressure chamber; P - force exerted by regulator lever 4; 1 - regulator body; 2 - spacer bushing; 3 - sealing ring; 4 - regulator lever; 5 - gasket; 6 - plug; 7 - rubber seal; 8 - spring seat; 9 - piston spring; 10 - piston

Fasten the exhaust piping to the car body.
Bleed the brakes to remove any air from the rear brake system.

Disassembly and Assembly

Using wrench A.56424, unscrew the plug, remove gasket 5 (Fig. 6-23), take out piston 10, spacer bushing 2, seal 7, spring seat 8, spring 9, and thrust washer with sealing ring 3.

To assemble, reverse the disassembly operations, lubricating all parts with brake fluid.

Caution

The pressure regulator of the VAZ-2121 car has a recess on the lower part of the piston, to distinguish it from the like regulators of other car models.

Wash the parts with alcohol or brake fluid and inspect them. The surfaces of the parts should be free of scratches and rough spots.

Check the condition and resilience of the spring; its noncompressed length should be 178 mm while under a load of 70^{+8}_{-4} N ($7^{+0.8}_{-0.4}$ kgf), 9 mm.

Replace all damaged parts, the seal and the sealing ring.

PARKING BRAKE

Removal and Installation

Shift the parking brake lever to the downmost position and disconnect the ends of the cables

from the brake shoe operating levers (see "Rear Brakes").

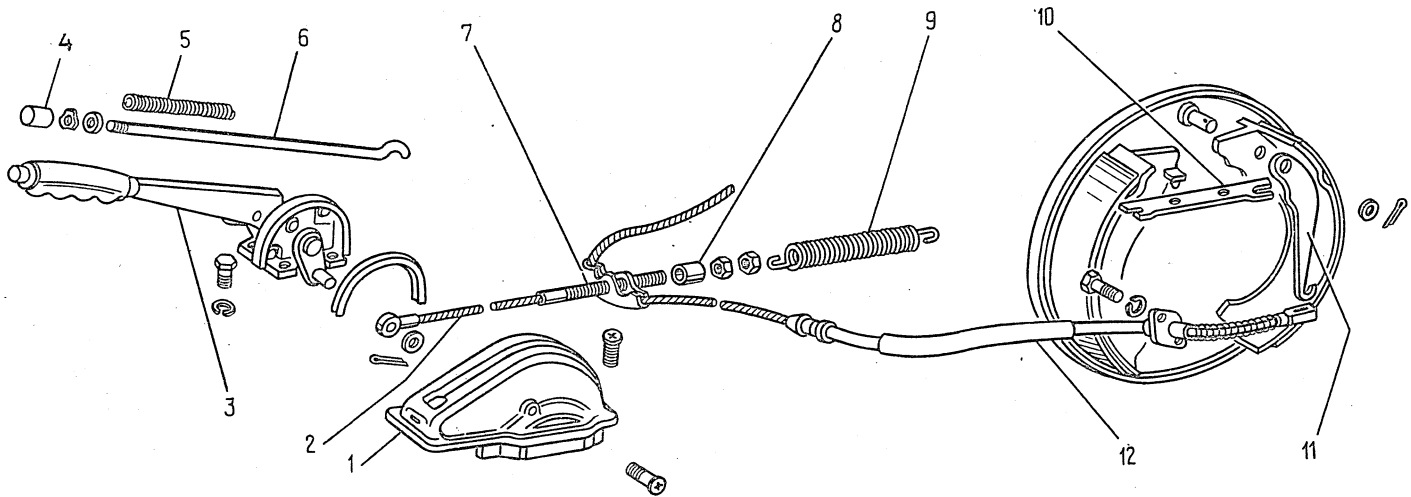


Fig.6-24. Parking Brake Control Linkage:

1 - case; 2 - front cable; 3 - lever; 4 - button;
5 - rod spring; 6 - pawl rod; 7 - rear cable guide;
8 - spacer bushing; 9 - return spring; 10 - expand-
er strap; 11 - shoe hand-operated lever; 12 - rear
cable

Loosen lock nut 5 (Fig.6-4) and adjusting nut 6, remove return spring 9 (Fig.6-24) and unscrew completely the lock nut and the nut.

Take the front end fittings of the rear cable from the body floor brackets and the cable casing out of the brackets on the rear axle beam and remove rear cable 12.

Take off the lever guard casing, the lever assembly and the front cable.

Pull out the cotter pin, take off the thrust washer and disconnect the front cable from the parking brake lever.

To install the parking brake, reverse the removal operations then adjust it (see "Adjusting the Parking Brake"). During installation, apply ЛИТОЛ-24 or ЛЦН-15 grease to the rear cable guide, parking brake lever shaft and front cable end fitting.

Checks and Repairs

Inspect the parking brake parts carefully. Replace the cable if its strands are broken or chafed.

Make sure that the quadrant teeth and the handle latches are intact; replace excessively worn parts.

Check the condition of the spring. It must return the lever reliably to the inactive position.

Examine the casing of the rear cable and the fastening of the end fittings to the casing and make sure that the cable is free to slide inside the casing. Replace the cable if its casing is damaged or the end fittings are loose.

Section VII

ELECTRICAL EQUIPMENT

GENERAL

The electrical equipment is of the single-wire earth-return type with the negative terminals of the power sources and consuming units connected to "ground" which functions as the second wire.

The majority of the circuits are actuated by the ignition switch. The supply circuits of the horns, cigarette lighter, stop light, interior lamps, distress signal switch and inspection lamp socket are constantly energized irrespective of the position of the ignition key.

The electrical equipment of the car is protected by fuses (Fig.7-1) located under the instrument panel, left of the steering column. The battery charging circuit, headlamp lower and upper beam relays, ignition and starting circuits are not protected by fuses. Fuses 11, 13, 14, 15 (Fig. 7-1) installed in the auxiliary fuse block are not used.

If a fuse is blown, first identify and eliminate the cause of the trouble, then replace the fuse. To trace down the faulty spot, refer to the table of fused circuits (Table 7-1) to find out which particular fuse protects the given circuit.

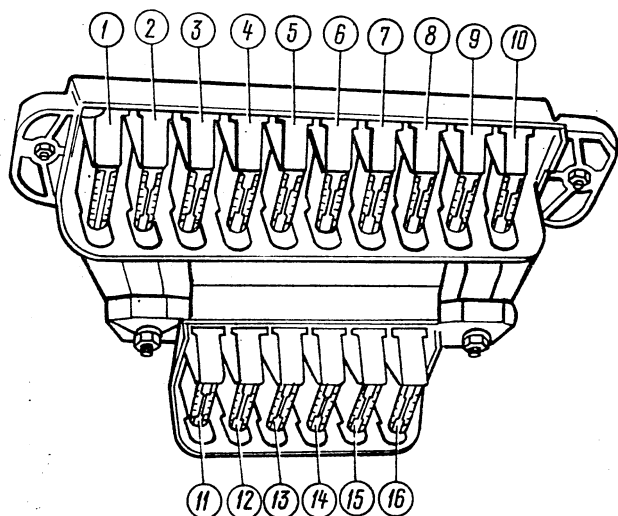


Fig.7-1. Fuses

Table 7-1

Fused Circuits

Fuse No. (Fig.7-1)	Circuit
1(16A)	Interior lamps. Horns. Inspection lamp socket. Cigarette lighter. Stop light lamps
2(8A)	Windshield wiper and its relay. Heater motor. Windshield washer motor. Headlamp wiper and washer relay (with headlamp wiper and washer switch button not pressed in). Headlamp wiper motors in all positions of wiper blade except initial position
3 (8A)	L.H. headlamp (upper beam) and its signal lamp
4 (8A)	R.H. headlamp (upper beam)
5 (8A)	L.H. headlamp (lower beam)
6 (8A)	R.H. headlamp (lower beam)
7 (8A)	L.H. front lamp (marker light). Marker light signal lamp. R.H. tail lamp (marker light). R.H. licence plate lamp
8 (8A)	R.H. front lamp (marker light). L.H. licence plate lamp. Cigarette lighter lamp. L.H. tail lamp (marker light). Instrument lamps
9 (8A)	Oil pressure gauge and signal lamp. Coolant temperature gauge. Fuel level gauge with fuel reserve signal lamp. Parking brake signal lamp. Brake fluid signal lamp. Direction indicators and signal lamp. Carburettor choke signal lamp. Battery no-charge signal lamp. Carburettor shutoff valve. Tachometer. Tail lamps (backing light). Differential lock signal lamp
10 (8A)	Voltage regulator. Generator field winding
12 (8A)	Headlamp wiper and washer (with control button depressed). Headlamp washer

Table 7-1 (continued)

Fuse No. (Fig.7-1)	Circuit
	motor. Headlamp wiper motors at starting and when wiper blades pass through initial position
16 (8A)	Distress signal switch and direction indicators at distress duty

The wiring diagram of the car is shown in Fig.7-2.

In all the diagrams of the "Electrical Equipment" Section the colour of the wires is de-

noted by letters, the first letter standing for the colour of the wire while the second one denotes the colour of the wire tracer (Table 7-2).

Table 7-2

Wire Colour Code

Letter	Colour	Letter	Colour
B	White	O	Amber
T	Blue	P	Pink
X	Yellow	C	Gray
3	Green	Φ	Violet
K	Brown	Υ	Black
Π	Red		

STORAGE BATTERY

Specifications

Type	6CT-55II
Rated voltage, V	12
Rated capacity at 20 h discharge rate and at 25 °C of electrolyte at beginning of discharge, A.h	55
Output current at 20 h discharge rate, A	2.75
Output current at starter duty and at -18 °C of electrolyte, A	255

Commissioning a Dry-Charged Battery

The cars shipped from the Plant are fitted with storage batteries filled with electrolyte and charged.

Spare batteries are delivered in a dry-charged state, without electrolyte. To get the battery ready for use, remove the filler caps and, depending on the battery design, remove the cap seals

Trouble Shooting

Cause of trouble	Remedy
------------------	--------

Rapid Discharge in Service

1. Slipping of generator drive belt	1. Adjust belt tension
2. Generator faulty	2. Check generator
3. Damaged insulation in car electrical system (discharge current higher than 1 mA with electrical loads disconnected)	3. Find leaky point and correct defect
4. Short-circuiting of cell plates	4. Replace battery
5. Connection of new loads by car owner in excess of permissible limits	5. Remove new electrical loads
6. Electrolyte contaminated by foreign matter	6. Drain electrolyte, wash and charge battery
7. Battery surface very dirty	7. Clean battery surface
8. Electrolyte level dropped below upper edge of plates	8. Restore normal electrolyte level

Battery Surface Wetted with Electrolyte

1. Battery overfilled, electrolyte splashes out	1. Adjust normal electrolyte level
2. Electrolyte seeping through cracks in battery case	2. Replace battery
3. Violent gassing of electrolyte caused by excessively high generator voltage	3. Check "ground" connection of voltage regulator body and correct connections of its wires; adjust or replace voltage regulator
4. Gassing of electrolyte and overheating of battery due to sulphation of plates	4. Perform charge-discharge cycle under low current

or cut off the vent projections. Then fill the battery with electrolyte at 15-25 °C.

The specific gravity of poured-in electrolyte (corrected to 25 °C) should be 1.27 - 1.29 g/cm³ for temperate climate and 1.22 - 1.24 g/cm³ for the tropics.

Soak the plates and separators with electrolyte for two hours then check the battery no-load voltage and the specific gravity of electrolyte.

After the electrolyte has been poured in, its specific gravity drops somewhat due to interaction with the active material of the plates. If the specific gravity has dropped by not more than 0.03 g/cm³ and the battery voltage is higher than 12 V, the battery should be considered ready for use. If the voltage is from 10 to 12 V and the specific gravity has dropped by more than 0.03 g/cm³, recharge the battery with a 2-3 A current for 24 hours. If the voltage remains lower than 12 V after recharging, the battery should be discarded.

After the separators and plates have been soaked with electrolyte, the electrolyte level drop inevitably. Therefore, prior to installing the battery on the car, bring the electrolyte level to normal height by adding electrolyte of the same specific gravity as that at the beginning of filling.

In the course of charging check the electrolyte temperature periodically and see that it does not rise above 40 °C. If the temperature reaches 40 °C, reduce the charging current by 50 % or stop charging until the battery cools down to 27 °C.

Stop charging when violent gassing begins in all the cells and when the voltage and specific gravity remain constant in the course of two or three last hours of charging.

Having filled the battery, charge it as a mandatory requirement in the following cases:

- if the battery has been out of use for 24 hours after filling;
- if the initial service conditions are severe (cold weather, frequent applications of the starter, etc.);
- if the battery has been in storage for more than 6 months after the date of manufacture.

Checking the Electrolyte Level

The electrolyte level should be 5-10 mm above the upper edge of the separators or the protective shield and should not rise above the lower edge of indicator 7 (Fig.7-3).

In the course of service the electrolyte level drops gradually due to evaporation of the water component of electrolyte. To restore the normal level, add distilled water only.

If it is known for certain that the electrolyte level has dropped due to splashing out, top up the battery with electrolyte of the same spe-

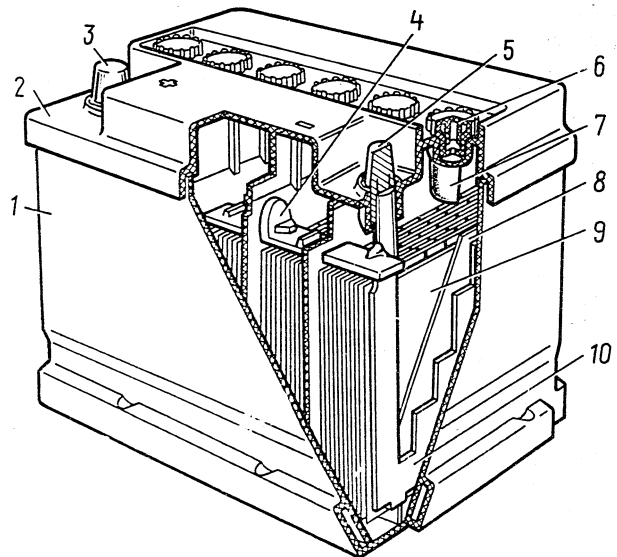


Fig.7-3. Storage Battery, Sectionalized:

1 - battery case; 2 - cover; 3 - positive pole terminal; 4 - cell connector; 5 - negative pole terminal; 6 - plug; 7 - electrolyte level indicator; 8 - separator; 9 - positive plate; 10 - negative plate

cific gravity as that of the electrolyte remaining in the cells.

If the level is higher than necessary, remove the surplus quantity using a rubber bulb with an ebonite nozzle.

Checking the State of Charge

To check the state of charge, measure the specific gravity of electrolyte (Table 7-3) with a hydrometer.

If the battery is discharged to 50 % and over, remove it from the car and have it charged.

When measuring the specific gravity see that the drops of electrolyte do not fall from the pipette on the surface of the battery, car body and other parts; electrolyte contains sulphuric acid which causes corrosion, current leaks, etc.

Table 7-3
State of Battery Discharge vs Specific Gravity of Electrolyte

State of discharge, %	Specific gravity at 25 °C, g/cm ³	
	Temperate climate	Tropical climate
0	1.27±0.01	1.23±0.01
50	1.20	1.15
100	1.13	1.10

The specific gravity of electrolyte depends on its temperature. It drops by 0.01 g/cm³ ap-

proximately per 15 °C. Therefore, if the temperature of electrolyte is higher or lower than 25 °C, make a temperature correction by adding or subtracting the following values from the hydrometer readings:

Electrolyte temperature, °C	+40	+25	+10	-5	-20
Correction	+0.01	0	-0.01	-0.02	-0.03

To avoid errors, do not measure the specific gravity when:

- electrolyte level is other than normal;
- electrolyte is either too hot or too cold; its optimum temperature for measurement is 15-25 °C;
- electrolyte has just been topped up with distilled water; allow the electrolyte to mix up well; with a discharged battery a delay of a few hours may even become necessary;
- the starter has just been operated several times; wait until the specific gravity in the cells becomes equalized;
- electrolyte is gassing; wait until the bubbles in the hydrometer syringe come up to the surface of electrolyte.

If the specific gravity of electrolyte is too low (under 1.22 g/cm³) and the battery is overheated in service (more than 10 °C above the ambient temperature), or else if the specific gravity of

electrolyte in individual battery cells differs by more than 0.2 g/cm³, charge the battery with a 2-3 A current during 24 hours. If the battery voltage is below 12 V after charging, the battery must be discharged.

If the specific gravity of electrolyte is too high (1.3 g/cm³ and higher), bring it to the normal level as described below.

Charging the Battery

Remove the battery from the car, clean it thoroughly, particularly on the top, and check the electrolyte level.

Charge the battery with a 5.5 A current for several hours until the cell voltage and the specific gravity of electrolyte remain constant.

At the end of charge the specific gravity of electrolyte may sometimes be other than normal. If so, adjust it to the required value.

If the specific gravity is too high, remove some electrolyte from the cells, add some distilled water, wait until the electrolyte gets mixed and measure the specific gravity again.

If the specific gravity is lower than normal, remove some electrolyte from the cells and add electrolyte of a higher specific gravity (1.40 g/cm³).

GENERATOR

Specifications

Rated voltage, V 12
 Rotation R.H. (viewed from drive end)
 Maximum output current at 14 V and a rotor speed of 83.3 s⁻¹ (5000 rpm), A 42
 Maximum rotor speed, s⁻¹(rpm) ... 217 (13000)
 Engine-generator speed ratio 1 : 2.04

A sectional view of the generator is shown in Fig.7-4 and its connections, in Fig.7-5.

Caution

1. The "minus" terminal of the storage battery should always be connected to "ground" and its "plus" terminal, to generator terminal "30". An accidental wrong connection of the battery terminals will immediately cause an overcurrent through the generator diodes, thus ruining them.

2. Do not work the generator with the loads disconnected from terminal "30" (particularly with the storage battery disconnected). This causes a

dangerous voltage rise and may damage the diodes and the voltage regulator.

3. Never check the functioning of the generator by "sparking", i.e. by connecting generator terminal "30" with "ground" or "67" terminal even for a short time. This creates a very large current in the diodes and damages them. The generator must be checked only with an ammeter and voltmeter.

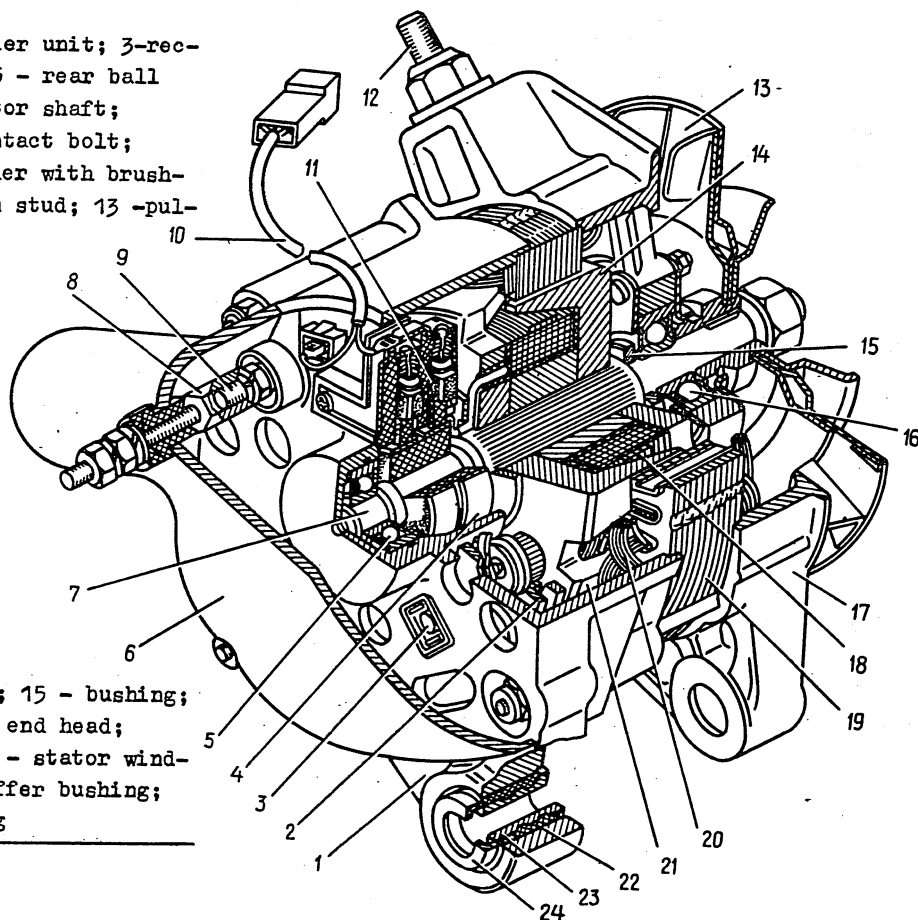
4. Do not check the charging circuits with a megger or a 36 V lamp. If such a check is required, first disconnect the wires from the generator and voltage regulator.

5. The strength of stator insulation should be checked by a high-voltage current only on a test stand, first disconnecting the phase windings from the diodes.

6. Do not confuse the wire connected to generator terminal "67" with the one connected to the plug of the star neutral point (unmarked plug). A wrong connection will blow fuse 10 (Fig.7-1) and damage the voltage regulator contacts.

Fig.7-4. Generator Г-221:

1 - slip ring end head; 2 - rectifier unit; 3-rec-
tifier unit screw; 4 - slip ring; 5 - rear ball
bearing; 6 - guard housing; 7 - rotor shaft;
8 - contact bolt extension; 9 - contact bolt;
10 - wire assembly; 11 - brush holder with brush-
es; 12 - generator to adjusting arm stud; 13 -pul-



ley with fan; 14 - rotor pole piece; 15 - bushing;
16 - front ball bearing; 17 - drive end head;
18 - rotor winding; 19 - stator; 20 - stator wind-
ing; 21 - rotor pole piece; 22 - buffer bushing;
23 - bushing; 24 - hold-down bushing

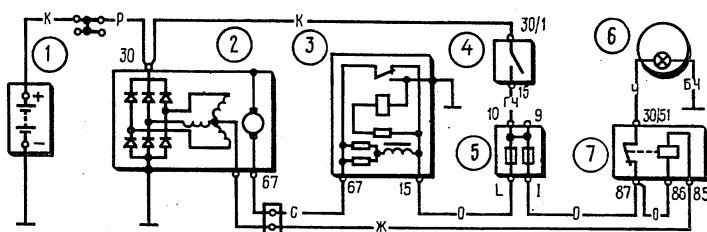


Fig.7-5. Generator Connections:

1 - storage battery; 2 - generator; 3 - voltage
regulator; 4 - ignition switch; 5 - fuse block;
6 - battery no-charge signal lamp; 7 - battery no-
charge signal lamp relay

Trouble Shooting

Cause of trouble	Remedy
<u>No-Charge Signal Lamp Constantly Alight or Flashes Up Periodically on Moving Car</u>	
1. Generator belt slipping	1. Adjust belt tension
2. An open between "85" terminal of no-charge signal lamp relay and centre of generator star	2. Check and restore connection
3. No-charge signal lamp relay damaged or out of adjustment	3. Check, adjust or replace relay
4. An open in field winding supply circuit	4. Restore connection
5. Voltage regulator damaged or maladjusted	5. Clean contacts, adjust or replace regulator
6. Generator brushes worn or jammed; slip rings oxidized	6. Replace brush holder with brushes; wipe rings with gasoline-soaked rag
7. An open or a ground fault of generator field winding	7. Connect winding ends to slip rings or replace rotor
8. One or more positive diodes short-circuited	8. Replace rectifier unit

Cause of trouble	Remedy
9. An open in one or more generator diodes	9. Replace rectifier unit
10. An open between "86" and "87" terminals of no-charge signal lamp relay	10. Restore connection
11. An open or shorted turns in stator winding	11. Replace stator

No-Charge Signal Lamp Fails to Light Up After Turning
on Ignition Switch

- | | |
|--|--|
| 1. Bulb filament burnt out | 1. Replace bulb |
| 2. No-charge lamp relay damaged or maladjusted | 2. Clean contacts, adjust or replace relay |
| 3. An open between "87" terminal of no-charge signal lamp relay and terminal "1" of fuse block | 3. Restore connection |
| 4. Short-circuiting of one or more negative diodes | 4. Replace rectifier unit |
| 5. Ground fault of stator winding | 5. Replace stator |

Generator Working, Battery Undercharged

- | | |
|--|---|
| 1. Generator belt slack: slipping at high speed and under load | 1. Adjust belt tension |
| 2. Wire clamps loose on generator and battery; oxidation of battery terminals; damaged wires | 2. Clean battery terminals of oxides, tighten clamps, replace damaged wires |
| 3. Battery faulty | 3. Replace battery |
| 4. Voltage regulator maladjusted or damaged | 4. Clean contacts, adjust or replace voltage regulator |

Battery Overcharged

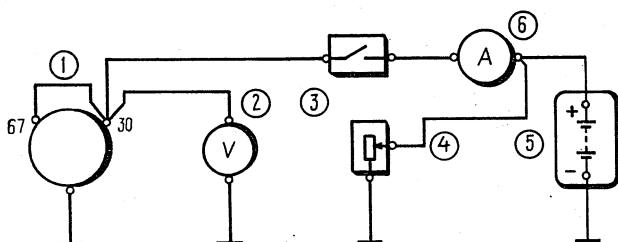
- | | |
|---|--|
| 1. Poor contact between "ground" and voltage regulator body | 1. Restore contact |
| 2. Voltage regulator maladjusted or damaged | 2. Adjust or replace voltage regulator |
| 3. Battery faulty | 3. Replace battery |

Generator Noisy

- | | |
|---|---|
| 1. Loosening of generator pulley nut | 1. Tighten up |
| 2. Generator bearings damaged | 2. Replace bearings |
| 3. Shorted turns of stator winding (humming of generator) | 3. Replace stator |
| 4. Squeaking of brushes | 4. Wipe brushes and slip rings with cotton cloth soaked in gasoline |

7. If some welding work is being performed on the car body, disconnect the wires from all the generator and battery terminals.

8. Under no circumstances should the generator diodes be checked from a 110 or 220 V A.C. source even if there is a signal neon lamp; neither should they be checked with a megger since its voltage is too high for the diodes. In these cases the diode will be disrupted (short-circuited).



Check Tests

On-Car Test

If the battery no-charge signal lamp is alight when the engine is running, the fault of the generator can be identified approximately as follows:

- pull out the carburettor choke knob a little to bring the engine idle speed to 16.6 - 25 s⁻¹ (1000-1500 rpm);
- disconnect the wire from the battery "minus" terminal for a short time. If the engine stalls, this is an indication that the generator

Fig.7-6. Generator Test Stand Hookup:

1 - generator; 2 - voltmeter; 3 - switch; 4-rheostat; 5 - storage battery; 6 - ammeter

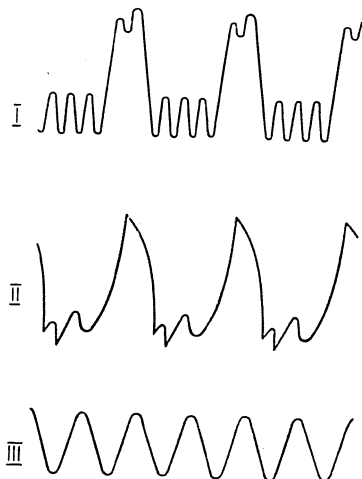


Fig.7-7. Generator Rectified Voltage Curve:
I - generator serviceable; II - diode disrupted;
III - diode circuit open

is faulty and all the loads are supplied from the storage battery.

Stand Test

The stand test is intended to check the condition of the generator and to ascertain whether its performance agrees with the rated characteristics. Guard housing 6 (Fig.7-4) of the generator under test should be removed, the brushes should be well bedded on the slip rings and the rings should be perfectly clean.

Mount the generator on the stand and make connections as shown in Fig.7-6. Start the stand motor, adjust a generator output voltage of 14 V by rheostat 4 and accelerate the rotor to 83.3 s^{-1} (5000 rpm). Work the generator at this speed for at least 2 minutes and measure the output current. In a serviceable generator it should be not under 44 A.

If the output current is smaller, this should be traced to some fault in the stator and rotor windings, to damaged diodes or wear of the slip rings and brushes. In this case the windings and diodes should be carefully checked to identify the faulty spot.

If some fault of the rectifier diodes is suspected, measure the output current on the warm generator. This check helps to discover more accurately the faulty condition of the diodes by a sharp reduction of the output current with the rise of generator temperature. To warm up the machine, work it for at least 15 minutes at a rotor speed of 83.3 s^{-1} (5000 rpm) and at 14 V across the generator output terminals. Then measure the output current. On a warmed-up generator it should be not lower than 42 A.

Oscillograph Test

The oscillograph makes it possible to check the generator accurately and quickly and determine the nature of the trouble by the shape of the rectified voltage curve.

For conducting this test, run the generator rotor at 1500-2000 rpm, supplying the field winding from the storage battery but disconnecting the battery from terminal "30".

If the diodes and the stator winding are in order, the rectified voltage curve will be of a saw-like pattern with uniform teeth (Fig.7-7). If there is an open in the stator winding, an open or a short circuit in the rectifier diodes, the shape of the curve changes radically: the teeth become nonuniform with deep spaces between them (Fig.7-7, II and III).

Rotor Field Winding Test

The condition of the winding and the standard of brush-to-slip-ring contact can be checked on the stand without disassembling the generator, by measuring the resistance between terminal "67" and the generator "ground".

If there are no shorted turns in the winding and the brushes are well seated, the winding resistance should be $4.4^{+0.3}_{-0.2} \Omega$ at 20°C . In the course of the test ensure reliability of contact between the rotor slip rings and the conductors connected thereto.

Stator Test

The stator should be tested separately after disassembling the generator and disconnecting the stator winding terminals from the rectifier diodes.

The first thing to do is to check the stator winding for open circuits and earth faults with an ohmmeter or a test lamp and a storage battery.

The insulation of the winding conductors should bear no signs of overheating caused by a short circuit in the rectifier diodes. Replace the stator if its winding is damaged in this manner.

Finally, check the stator winding for shorted turns with a special flaw detector.

Rectifier Diode Test

A sound diode passes current in one direction only. A faulty diode may either pass no current at all (open circuit) or pass it in both directions (short circuit).

If one of the rectifier diodes is damaged, the entire rectifier unit has to be replaced.

The diodes can be checked for shorts without removing the generator from the car, but first disconnecting the wires from the storage battery and generator. Make the test with an ohmmeter or

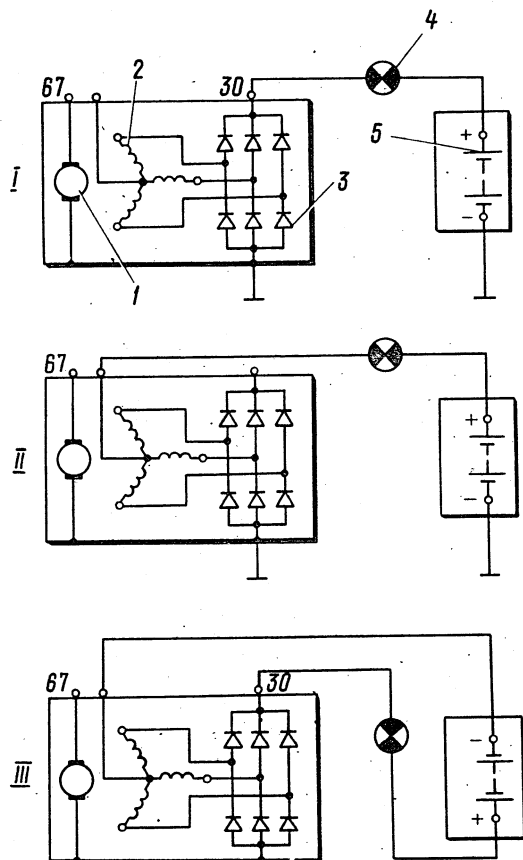


Fig.7-8. Rectifier Diode Test Hookups:
I - simultaneous test of "positive" and "negative" diodes; II - "negative" diode test; III - "positive" diode test; 1 - generator rotor; 2 - stator winding; 3 - rectifier diodes; 4 - signal lamp; 5 - storage battery.

a 25-40 W test lamp and a storage battery as shown in Fig.7-8.

Note. To simplify the fastening of the rectifier parts, three diodes have rectified voltage with the "plus" sign on the body. These are positive diodes which are pressed into one plate of the rectifier unit. The other three diodes are negative and the rectified voltage on their body has the "minus" sign. They are pressed into the other plate of the rectifier unit.

First check for simultaneous shorts in both the positive and negative diodes. For this purpose connect the battery "plus" across a lamp to generator terminal "30" and its "minus", to the generator frame (Fig.7-8, I). If the lamp lights up, it means that both the negative and positive diodes are shorted.

The negative diodes can be tested for shorts by connecting the battery "plus" across a lamp with the terminal of the stator winding neutral

wire and its "minus", with the generator frame (Fig.7-8, II).

If the lamp is alight, this is an evidence of a short circuit in one or more negative diodes.

It should be borne in mind that in this case the lamp may be caused to burn due to shorting of the stator winding turns to the generator frame. However, this fault is by far less frequent than short-circuiting of the diodes.

To check the positive diodes for shorts, connect the battery "plus" across a lamp with generator terminal "30" and its "minus" with the terminal of the stator winding neutral wire (Fig.7-8, III). Lighting up of the lamp will indicate a short circuit in one or more positive diodes.

An open circuit in the diodes can be discovered without disassembling the generator only by an indirect method on a stand, judging by a considerable reduction (by 20 - 30 %) of the output current as compared with the rated value. If the generator windings are in order and the diodes are not short-circuited, the cause of the low current output lies in an open in the diodes.

Generator Repairs

Disassembly

Remove the nuts from contact bolt extension 21 (Fig.7-9), turn off the fastening screws, remove guard housing 19 with the hose. Disconnect wire assembly 22.

Turn off the screws and remove brush holder 2 with brushes.

Unscrew the nuts of through bolts 14 and remove generator drive end head 11 complete with the rotor.

Clamp the rotor in a vice, unscrew the pulley nut and, using remover tool Q2.7823.9504, take the pulley off the rotor shaft. Withdraw the Woodruff key from the shaft slot and remove end head 11.

Turn off the nuts of the screws which connect the diode ends with the stator winding terminals, pull the neutral wire plug from plug connector 4 and withdraw stator 8 from slip ring end head 16.

Turn off the nut of contact bolt 7 and remove rectifier unit 6.

Assembly

To assemble the generator, reverse the disassembly operations. The axial misalignment of the holes in the generator end head lugs should not exceed 0.4 mm. Therefore, insert a special gauge into these holes at assembly.

The convex side of the tapered spring washer of the pulley should be in contact with the nut. Tighten the pulley nut with a torque of 45 - 72 N.m (4.5 - 7.2 kgf.m).

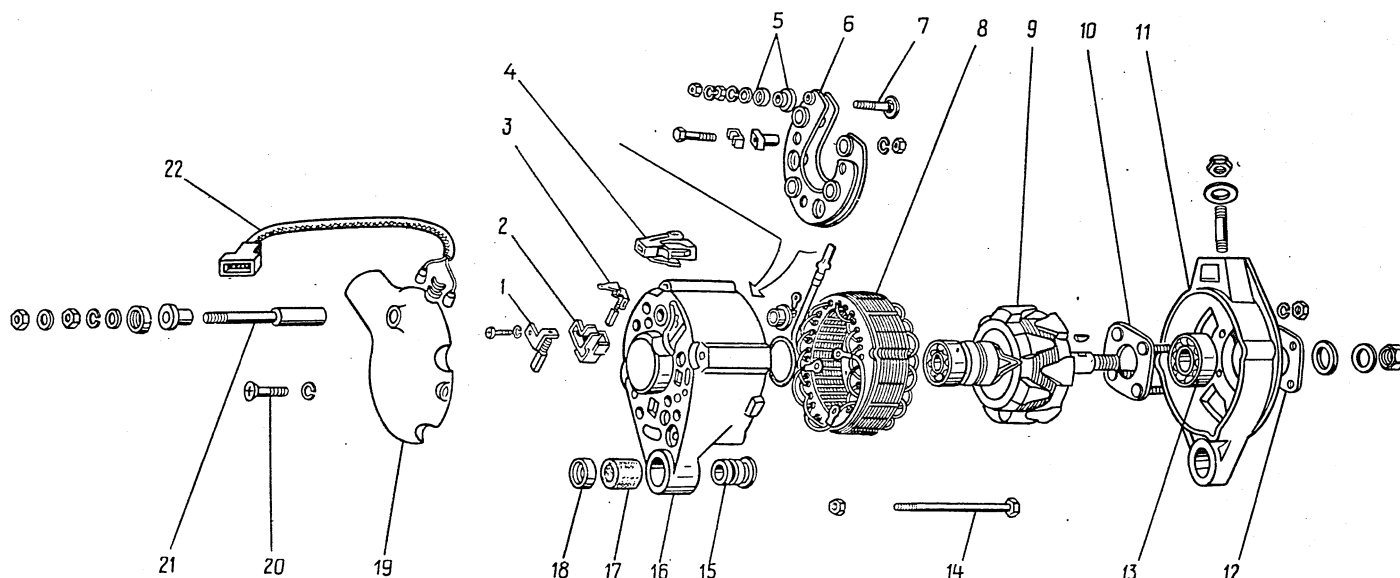


Fig.7-9. Generator Parts:

1 - "negative" brush; 2 - brush holder; 3 - "positive" brush; 4 - neutral wire plug connector; 5 - insulating bushings; 6 - rectifier unit; 7 - contact bolt; 8 - stator; 9 - rotor; 10 - bearing inner fastening washer; 11 - drive end head; 12 - bearing outer fastening washer; 13 - rotor

bearing; 14 - through bolt; 15 - hold-down bushing; 16 - slip ring end head; 17 - buffer bushing; 18 - bushing; 19 - guard housing; 20 - housing assembly; 21 - contact bolt extension; 22 - wire

Replacing the Brush Holder

If the brushes are worn and protrude less than 5 mm from the holder, replace the latter complete with the brushes.

Prior to installing the brush holder, blow out the carbon dust and wipe away the oil mixed with carbon dust.

Replacing the Rotor Bearing in Drive End Head

To remove the faulty bearing from the end head, turn off the nuts of the screws that hold together the bearing washers, remove the washers

with the screws and force out the bearing on a hand-operated press. If the ends of the screws are lock-punched and the nuts refuse to come off, file off the ends of the screws.

A new bearing may be installed into the generator end head only if the bore for it is not distorted. The bore diameter should be 41.967 - 41.992 mm. If it is larger or the bore is distorted, replace the end head by a new one.

Force the bearing into the end head on a press then clamp it between two washers which are held together by screws with nuts. After tightening the nuts, lock-punch the ends of the screws.

VOLTAGE REGULATOR

A general view of the voltage regulator appears in Fig.7-10 and its electrical connections, in Fig.7-11.

Caution

1. Do not confuse the wires connected to terminals "15" and "67". In case of a wrong connection the voltage regulator will become inoperative and the upper contacts will be constantly closed.

The generator output voltage will rise high thus resulting in violent gassing of electrolyte in the storage battery and in damage to the consuming units. Besides, the contacts will get stuck and the voltage regulator will have to be replaced.

2. Do not connect the radio noise suppressor condensers to the circuit between terminals "67" of the regulator and generator. This will disturb normal functioning of the contacts and they will be rapidly ruined.

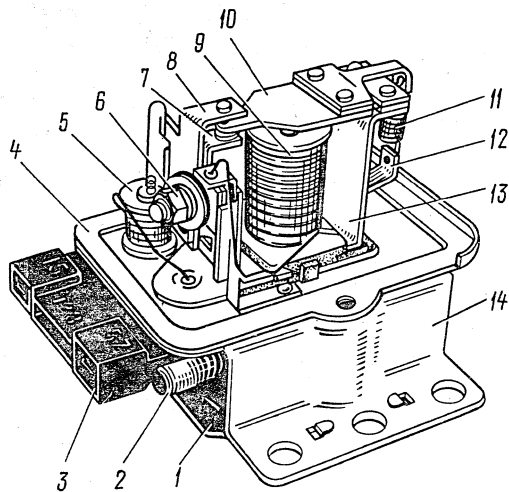


Fig. 7-10. Voltage Regulator PP-380:

1 - protective plate; 2 - additional resistor; 3 - lower gasket with sockets for "15" and "67" plugs; 4 - cover gasket; 5 - choke; 6 - bracket fastening nut; 7 - lower contact bracket; 8 - upper contact bracket; 9 - regulator winding; 10 - armature; 11 - armature spring; 12 - spring bracket; 13 - yoke; 14 - base

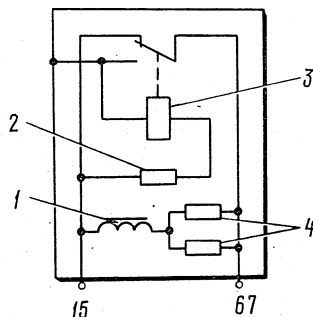


Fig. 7-11. Voltage Regulator Electrical Connections:

1 - choke; 2 - thermal-compensating resistor; 3 - regulator winding; 4 - additional resistors

3. Do not connect additional electric loads to the generator field winding supply circuit as this will raise the generator voltage excessively.

4. Do not check the regulator by shorting its terminals "15" and "67". This will raise the generator voltage and may damage the rectifier.

5. Do not remove the regulator cover unless urgently necessary so as to avoid disturbing the tightness of the seal. Moisture and various foreign particles penetrating under the cover cause soiling, burning of contacts and interfere with the normal functioning of the regulator. For this reason all the materials of which the regulator is made are checked for absence of gassing; when replacing the gasket, see that the new one is made

of polyurethane as prescribed in the regulator design.

6. Keep the regulator always clean and protect it against chance blows that may interfere with its setting.

See that the regulator body and "ground" are reliably connected by the fastening screws since inadequate connection steps up the generator voltage above the specified limit.

Stand Checks and Adjustments

Reference Data

Regulated voltage at regulator and ambient temperature of 50 ± 3 °C, V:

2nd stage 14.2 ± 0.3

1st stage, lower than at the

2nd stage but by not more

than 0.7

Resistance between "15" terminal

and "ground", Ω 27.7 ± 2

Resistance between "15" and "67"

terminals with contacts open, Ω ... 5.65 ± 0.3

Armature-to-core air gap, mm 1.4 ± 0.07

2nd stage contact gap, mm 0.45 ± 0.1

The regulator should be checked and adjusted on a stand which is equipped with a generator, storage battery, thermostat and electric motor capable of varying the rotation speed within a wide range. The regulator with the cover closed should be mounted on the stand with its terminal plugs down.

The diagram of stand hookup is illustrated in Fig. 7-12. Pay particular attention to the reliability of connections seeing that their contact resistance is not higher than that specified in Table 7-4.

Table 7-4

Maximum Ohmic Resistance of Connections

Connections	Resistance, Ω
Generator "30", battery "plus"	0.005
Generator "ground", battery "minus"	0.001
Generator "30", regulator "15"	0.02
Generator "67", regulator "67"	0.02
Generator "ground", regulator "ground"	0.02

The wires leading from switch 3 should be connected directly to generator "30" terminal and regulator "15" terminal and the regulator "ground" should be directly connected to generator "ground". All connecting wires should be as short as possible. If tray wiring used (wires laid in pipes or trays), the trays should be made of a nonmagnetic material.

During trial stand tests do not operate the regulator with the battery disconnected since this may damage the regulator contacts.

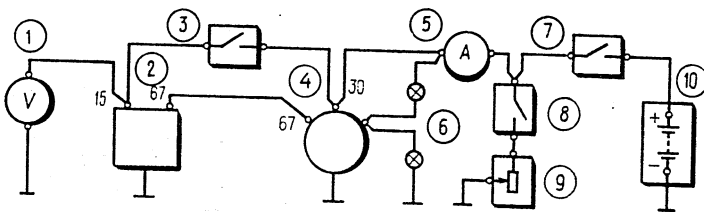


Fig.7-12. Voltage Regulator Test Stand Hookup:

1 - voltmeter, 15 V scale, accuracy class not under 0.5; 2 - voltage regulator; 3 - master switch; 4 - generator; 5 - ammeter, scale graduations up to 50 A; 6 - signal lamps, 3 W, 12 V; 7 - storage battery switch; 8 - rheostat switch; 9 - rheostat 5 - 30 A, 15 V; 10 - storage battery

Signal lamps 6 indicate that the generator is in order; with the generator running the filaments of these lamps should be uniformly lit.

Before the checks, warm the regulator in a thermostat for 15-18 minutes at $50 \pm 3^\circ \text{C}$, delivering a 12-13 V current to the regulator winding. This voltage is set by rheostat 9 with switches 3, 7, 8 turned ON and the generator inoperative.

Carry out the checks and adjustments immediately after warm-up.

2nd stage tests. Run the generator rotor at 83.3 s^{-1} (5000 rpm). Adjust the generator loading current of 2-12 A with rheostat 9. Check the generator voltage which must be $14.2 \pm 0.3 \text{ V}$. If it is different, stop the generator, disconnect the storage battery, remove the regulator cover and, bending bracket 12 (Fig.7-10) weaken spring 11 (if the voltage is too high) or increase its tension (if the voltage is too low). Replace the regulator cover and recheck the 2nd stage voltage.

After adjustments of the 2nd stage, check the 1st stage immediately.

1st stage tests. At a rotor speed of 83.3 s^{-1} (5000 rpm), adjust a loading current of 25-35 A with rheostat 9 (Fig.7-12). The voltage should be not more than 0.7 V below the value obtained during 2nd stage adjustments.

Note. While checking the 1st and 2nd stages see that the adjusted voltage is steady, without sharp fluctuations.

If the voltage fails to fall within these limits, stop the generator, disconnect the storage battery, remove the regulator cover, loosen nut 6 (Fig.7-10) and shift bracket 8 a distance of 0.1-0.2 mm.

If the voltage is high, shift the bracket down and vice versa. Simultaneously shift bracket 7 so as to retain a clearance of $0.45 \pm 0.1 \text{ mm}$ between the 2nd stage contacts. Meanwhile see that the axes of the 1st and 2nd stage contacts are

aligned. The armature contact should not go beyond the outline of the contacts on the brackets.

Tighten nut 6, put the cover in place, recheck the 1st and 2nd stages of the regulator and, if necessary, repeat the adjusting operations.

Upon completion of adjustments clean the regulator cover carefully and install it on the hot regulator to bring the absorption of moisture down to a minimum.

Trouble Shooting

If the storage battery is overcharged systematically on the car, check the regulator, without removing it, under the following conditions:

- the storage battery should be fully charged;
- all the consuming units except the storage battery and ignition system should be disconnected;
- the engine speed should be 2500-3000 rpm.

Measure the voltage across the battery terminals with a voltmeter. If it does not exceed 14.5 V, the regulator may be considered serviceable. If it is higher, connect the regulator body to the car body by a separate conductor and recheck the voltage.

If the voltage in the second case is again too high, the regulator is faulty and must be adjusted or replaced. If the voltage is normal, the cause of battery overcharging lies in poor connection of the regulator body with "ground".

The defects of the voltage regulator can be identified by checking its internal parts.

The causes of defects may be as follows:

1. An open in the thermal-compensating resistor 2 (Fig.7-11) or in the regulator winding; in this case the voltage cannot be regulated and rises excessively. This defect can be discovered by measuring the resistance between "15" terminal and the "ground" (base) with an ohmmeter.

2. An open in the winding of the choke or in additional resistor 4; in this case voltage regulation is unsteady and fluctuates sharply.

This defect can be identified by checking the electric resistance between terminals "15" and "67" with the contacts of both the 1st and 2nd stages open.

3. Soiling, burning or oxidation of 1st and 2nd stage contacts when the regulated voltage is unsteady.

This defect may be caused by oil, gasoline, and water penetrating into the regulator and soiling the contacts, or by a short circuit in the circuit of "67" terminal or else in the generator field winding. Foreign matter may penetrate into the regulator due to wrong installation or damage of the sealing gasket between the regulator cover and base also when the gasket is made of a wrong material and fails to ensure adequate tightness or liberates volatile substances.

If the contacts are found damaged, it is good practice to check the circuits for shorts and correct connections of wires and the condition of the generator.

Repairs

The regulator should be repaired as an exception only; as a rule, it must be replaced. Described below are some of the permitted regulator repair operations:

Replacing the cover and gasket. When installing a new cover see that both the cover and its gasket are perfectly clean and the gasket occupies a proper position. After installation draw up the screws all the way.

If dirt is detected inside the regulator body, clean the regulator contacts and other parts.

Soldering the faulty connections. Solder the connections with a neutral flux and take care not to overheat the insulation. After soldering remove the surplus flux since the remaining flux will evaporate under the effect of heat liberated by the operating regulator, and soil the contacts.

Cleaning the contacts. To clean the contacts, take off the armature spring and, loosening nut 6 (Fig.7-10), lift somewhat 1st stage stationary contact bracket 8.

Using a flat barette file, dress neatly the contacts, removing the burnt matter and oxides throughout the contact surface. The file should be perfectly dry, washed in clean alcohol, gasoline or, even better, in trichloroethylene. The craters on the contacts caused by burning must be dressed with a clean pointed steel tool. Remove the silver chippings from the regulator body, blowing it with dry clean air.

Put the armature spring back in position.

Moving the bracket of the 1st stage stationary contact, adjust the armature-to-core gap to 1.4 ± 0.07 mm, ensuring proper touching of the contacts.

Moving the bracket of the 2nd stage stationary contact, adjust the gap between the 2nd stage contacts to 0.45 ± 0.1 mm, ensuring proper touching of the contacts. Tighten nut 6.

Put in place the gasket and cover then check the regulator on the stand and adjust it, if necessary.

Cleaning the voltage regulator. If some foreign matter gets inside the regulator after the cleaning of the contacts, wash the regulator with alcohol or clean gasoline (solvent) before checks and adjustments, then dry it without the cover in an oven at 120°C for 2 hours. Check the regulator on the stand and adjust it, if necessary.

BATTERY NO-CHARGE SIGNAL LAMP RELAY

The relay, Type PC-702, switches on the signal lamp on the instrument panel when the generator voltage becomes too low for charging the storage battery. The relay is installed in the engine compartment, on the upper part of the R.H. wheel mudguard.

When the generator is in operation, the relay winding is supplied with the rectified phase voltage of the generator. This voltage is approximately a half of the generator voltage. If the voltage between generator terminal "30" and "ground" is 13.8 - 14.5 V, the rectified phase voltage is 5 - 7 V.

The relay contacts close the supply circuit of signal lamp 6 (Fig.7-5). When the ignition switch is turned on but the engine and generator are still inoperative, the relay contacts pass the current

from the storage battery and the lamp is alight.

After engine starting and on the moving car the lamp should go out because the rectified phase voltage should attract the relay armature to the core thus opening the relay contacts.

If the signal lamp fails to go out after engine starting and on the move, this may be caused by some fault in the generator or regulator or in the relay proper (an open in the winding, etc.).

Reference Data

Contact-opening voltage, *V 5.3 ± 0.4
Contact-closing voltage, *V 0.2 - 1.5
Winding resistance at 20°C , Ω 29^{+2}

*At $25 \pm 5^\circ\text{C}$.

STARTER

Specifications

Rated voltage, V 12
Rated power, kW 1.3
Current draw at maximum power, A, max.. 260

Current draw at locked-rotor test, A, max 500
Current draw at no-load duty, A, max... 35

The design of the starter appears in Fig.7-13 and its circuit diagram, in Fig.7-14.

Fig.7-13. Starter CT-221:

- 1 - drive pinion; 2 - overrunning clutch roller;
- 3 - overrunning clutch; 4 - carrier ring; 5 - rubber plug;
- 6 - operating lever; 7 - drive end head;
- 8 - solenoid switch plunger; 9 - solenoid switch winding;
- 10 - contact plate; 11 - solenoid switch cover;
- 12 - contact bolts; 13 - commutator end head;
- 14 - end head brake disc; 15 - armature shaft brake disc;
- 16 - armature; 17 - bearing bush; 18 - stator winding;
- 19 - stator pole; 20 - starter frame;
- 21 - limiting ring;
- 22 - adjusting ring

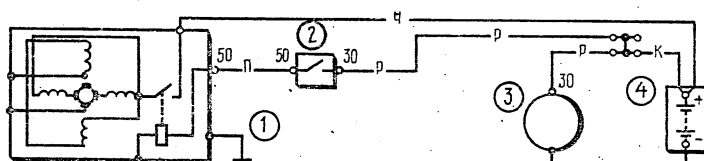
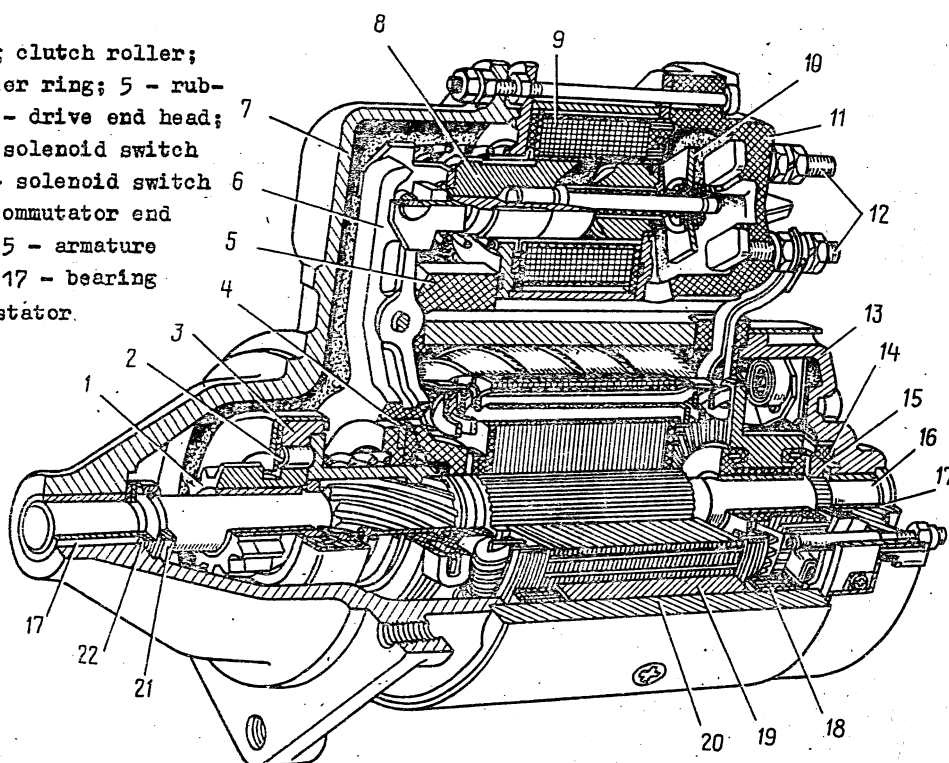


Fig.7-14. Starter Circuit Diagram:

- 1 - starter; 2 - ignition switch; 3 - generator;
- 4 - storage battery

Trouble Shooting

Cause of trouble	Remedy
<u>On Application of Starter its Armature Stands Still.</u>	
<u>Solenoid Switch Inoperative</u>	
1. Storage battery faulty or completely run down	1. Charge or replace battery
2. Heavy oxidation of battery terminals and wire clamps; loosening of wire clamps	2. Clean battery terminals and wire clamps, coat with petrolatum and tighten
3. Shorted turns, earth fault or an open in solenoid switch winding	3. Replace solenoid switch
4. Wire terminal disconnected from solenoid switch terminal "50" or from ignition switch	4. Restore connection
5. Faulty ignition switch contact unit fails to close circuit between contacts "30" and "50"	5. Replace ignition switch contacts
6. Jamming of solenoid switch plunger	6. Remove solenoid switch, check plunger for freedom of movement
<u>On Application of Starter its Armature Rotates Slowly or Not At All. Solenoid Switch Operates</u>	
1. Storage battery faulty or discharged	1. Charge or replace battery
2. Battery terminals and wire clamps oxidized; wire clamps loose	2. Clean battery terminals and wire clamps, coat with petrolatum and tighten securely
3. Solenoid switch contact bolts oxidized	3. Dress contact bolts
4. Wire tag nuts loose on solenoid switch contact bolts	4. Tighten nuts

Cause of trouble	Remedy
5. Burning of commutator, jamming or wear of brushes	5. Dress commutator, replace brushes
6. An open in stator or armature winding	6. Replace stator coils or armature
7. Shorting of commutator bars, turn-to-turn shorts in armature or stator windings, or earth fault	7. Replace faulty parts
8. Earth fault of positive brush holder	8. Eliminate earth fault or replace commutator end head

On Application of Starter its Armature Rotates but Flywheel Stands Still

- | | |
|--|--|
| 1. Overrunning clutch slipping | 1. Check starter on stand, replace clutch |
| 2. Clutch operating lever broken or its shaft fell out | 2. Replace lever or put in place its shaft |
| 3. Breaking of clutch carrier ring or buffer spring | 3. Replace clutch |

Abnormal Noise of Starter during Armature Rotation

- | | |
|--|---|
| 1. Excessive wear of bearing or armature shaft bushes | 1. Replace armature bushes |
| 2. Starter fastenings loose or drive end head broken | 2. Tighten bolts or repair starter |
| 3. Starter fastened out of true | 3. Check starter mounting |
| 4. Loosening of stator pole (armature rubs against pole) | 4. Tighten pole screw |
| 5. Damaged teeth of starter pinion or flywheel ring gear | 5. Replace starter drive or flywheel |
| 6. Pinion fails to disengage from flywheel: | |
| (a) jamming of operating lever | (a) replace lever |
| (b) clutch seized on armature shaft splines | (b) clean splines and coat them with engine oil |
| (c) clutch or solenoid switch springs weak or broken | (c) replace clutch or solenoid switch |
| (d) locking ring came off clutch hub | (d) replace faulty parts |
| (e) solenoid switch plunger seized due to overheating | (e) replace solenoid switch |
| (f) faulty ignition switch contact unit fails to open contacts "30" and "50" | (f) check opening of contacts in various positions of ignition key; replace faulty contact unit |

Stand Tests

The efficiency of the starter can be determined by checking its electrical and mechanical characteristics on a stand.

The hookup for checking the starter on the stand is shown in Fig.7-15. The cross section of the wires leading to the power source, ammeter and to the contact bolt of the starter solenoid switch should be not less than 16 mm².

The starter should be supplied from a fully charged battery 6CT-55 or from a special source of power whose voltage drop curve under load corresponds to that of the 6CT-55 battery.

The temperature during the tests should be 25±5 °C and the brushes must be well seated on the commutator.

Performance Test

Closing switch 5 and using a 12 V power source, apply the starter four times with different brake torques, e.g. 2-2.4, 5.5-6.6, 9-10.8

and 11.5-12.5 N.m (0.2-0.24, 0.55-0.66, 0.9-1.08 and 1.15-1.25 kgf.m). Each time the starter should be applied for not longer than 5 s with at least 5 s intervals between successive applications.

If the starter fails to rotate the stand ring gear or is noisy in operation, disassemble it and examine its parts.

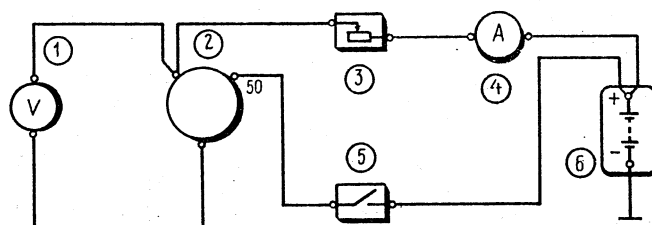


Fig.7-15. Starter Test Stand Hookup:
1 - voltmeter, scale limit not under 15 V; 2 - starter; 3 - rheostat 800 A; 4 - ammeter with 1000 A shunt; 5 - switch; 6 - storage battery

Lock Test

Lock the stand ring gear, switch on the starter and measure the current, voltage and torque which should not be over 500 A and 6.5 V, and not under 1.4 kgf.m, respectively. Apply the starter for not longer than 5 s.

If the torque is lower and the current is higher than the above-specified values, this may be probably caused by shorted turns or earth fault of the stator and armature windings.

If the brake torque and current draw are lower than specified above, the cause may be oxidation and soiling of the commutator, heavy wear of brushes or weakening of their springs, jamming in the holders, loose terminals of the stator winding, oxidation or burning of the solenoid switch contact bolts.

With the pinion locked, the starter armature should not rotate. If it does, the overrunning clutch is at fault.

To remedy the defects, disassemble the starter and replace or repair the damaged parts.

No-Load Test

Disengage the ring gear of the stand from the starter pinion. Switch on the starter and measure the current draw and the armature speed which should be, respectively, not over 35A and $33.3 \pm 8.3s^{-1}$ (5000 ± 500 rpm) at 11 - 11.5 V across the starter terminals.

If the current draw and the armature speed go beyond the above-indicated limits, the causes may be the same as in the previous test.

Solenoid Switch Test

Insert an ammeter into the supply current of the solenoid switch winding, place a gasket 12.8 mm thick between limiting ring 21 (Fig.7-13) and the pinion and energize the solenoid switch. The winding supply current should not exceed 23 A. If it is higher, either the switch winding or the starter drive is faulty.

Mechanical Test

Using a dynamometer, check the brush spring tension which should be 10 ± 1 N (1 ± 0.1 kgf) for new brushes. If the brushes are worn to a length of 12 mm, replace them, first seating them well on the commutator.

The end play of the armature shaft should be from 0.07 to 0.7 mm. If it fails to fall within these limits, disassemble the starter and select the required thickness and number of adjusting washers 20 (Fig.7-16).

The starter drive should move freely along the splined shaft without perceptible jamming and be pulled from the working to the initial position by the return spring of the switch plunger.

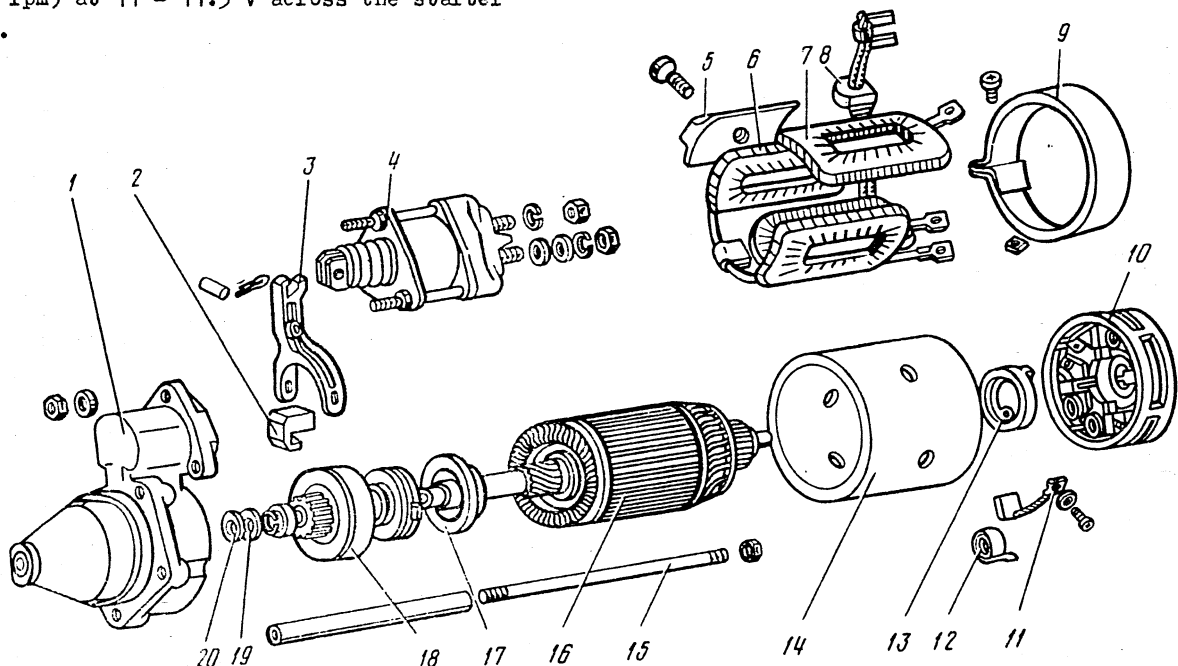


Fig.7-16. Starter Parts:

1 - drive end head; 2 - rubber plug; 3 - operating lever; 4 - solenoid switch; 5 - stator pole; 6 - stator series winding; 7 - stator shunt winding; 8 - rubber plug; 9 - cover band; 10 - commutator end head; 11 - brush; 12 - brush spring;

13 - end head brake disc; 14 - frame; 15 - through bolt; 16 - armature; 17 - pinion stop; 18 - overrunning clutch with drive pinion; 19 - thrust washer; 20 - adjusting washer

When the drive pinion is turned in the normal direction of the armature, the latter should stay still. The torque required for turning the pinion relative to the armature shaft should not exceed 28 N.cm (2.8 kgf.cm).

Repairs

Defects and damage of the starter should be put right by replacing the faulty parts. The only permissible repair operation is turning down the commutator.

Disassembly

Unscrew the nut on the lower contact bolt of the solenoid switch and disconnect the stator winding terminal. Unscrew the solenoid switch fastening nuts and remove the switch.

Loosen the screw of the cover band on commutator end head 10 and remove cover band 9 with its gasket. Remove the brush terminal screws and take off the brushes.

Unscrew the nuts of through bolts 15, screw out the latter and remove drive end head 1 complete with armature 16.

Detach the commutator end head from the frame. Remove rubber plug 2 of the lever from the drive end head, undo and pull out the shaft of starter operating lever 3, take the lever and the armature from the end head.

To remove the starter drive from the armature, take the locking ring from under limiting ring 21 (Fig.7-13). The drive can be disassembled after removing the locking washer from the clutch hub.

After disassembly, blow the parts with compressed air and wipe them clean.

Inspection and Repairs

Armature. Using a megger or a 220 V test lamp, check the armature winding for earth faults.

The voltage is fed through the lamp to the commutator bars and the armature core. If the lamp is alight it means that either the armature winding or the commutator bars are shorted to the ground. When the megger is used, it should read a resistance of not less than 10 kΩ. The armature with an earth fault should be replaced.

Using a special tester, check for short circuits between the armature winding sections or commutator bars and for opens at the points where the ends of the winding sections are soldered to the commutator bars.

Examine the working surface of the commutator and check it for runout relative to the shaft journals (Fig.7-17). If the commutator is soiled or burnt, dress it with fine abrasive cloth. If the surface is heavily damaged or its runout exceeds 0.06 mm, turn down the commutator on a lathe, taking care to remove as little metal as possible. The minimum diameter to which the commutator may

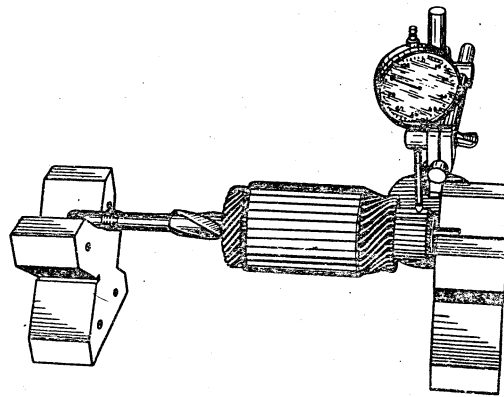


Fig.7-17. Checking the Commutator Runout

be turned is 36 mm. After turning down, grind the commutator with fine abrasive cloth.

Check the core for runout relative to the shaft journals. Replace the armature if the runout exceeds 0.08 mm.

Examine the surfaces of the armature shaft splines and journals. They should be free of scoring, nicks and wear. If the shaft surface bears yellow deposits from the pinion bush, remove them with fine abrasive cloth since they may cause jamming of the pinion on the shaft.

Starter drive. The pinion teeth should be free of considerable wear. If the engaging portion of the teeth is nicked, grind the teeth with a fine small-diameter grinding stone. The pinion should rotate easily relative to the clutch hub but only in the direction of armature rotation at engine starting.

If the parts of the starter drive are damaged or considerably worn, replace the drive by a new one.

Stator. Using a megger or a 220 V test lamp, check the stator winding for earth faults. The voltage is fed through the lamp to the common terminal of the winding and to the starter frame. If the lamp flashes up or the megger reading is under 10 kΩ, also if the winding shows signs of overheating (darkened insulation), replace the winding.

To replace the stator winding coils, take off the pole pieces by removing the pole screws with a power screwdriver. Prior to removing the pole pieces, match-mark both the frame and the poles so as to reassemble them in their previous positions.

It is recommended that the winding be heated to 50 °C approximately before installation so as to make it flexible and facilitate its fitting on the poles. Fasten the poles by tightening their screws as far as they will go in order to retain the initial air gap between the armature and the poles (0.38 mm measured with a feeler gauge).

After assembly, check the inside diameter between the poles; it must be 67.80 - 67.97 mm. Besides, using a plug gauge of 67.66 mm diameter,

check the concentricity of the frame and the poles. Being touched to the inside surface of the frame, the gauge should go in and turn freely between the poles. If this requirement is not satisfied, it means that the starter was improperly assembled and must again be stripped down and reassembled.

Machining of poles is by no means permissible.

End heads. Examine the end heads for cracks. Replace them, if cracked. Inspect the end head bushes. If they are worn, replace either the end head assemblies or the bushes alone. After pressing-in, ream out the new bushes to a diameter of $12.015^{+0.015}_{-0.015}$ mm. Before replacing the bush in the commutator end head, take out the blank plug; having pressed-in the bush, reinstall the blank plug and lock-punch it at three points.

Check to see that the brush holders are reliably secured on the commutator end head. The positive brush holders should have no earth faults. The brushes must be free to move in their holders. The brushes worn down to a length of 12 mm should be replaced by new ones, carefully bedded on the commutator.

Using a dynamometer, check the brush spring pressure; for new brushes it should be 10 ± 1 N (1 ± 0.1 kgf). If necessary, replace the springs by new ones.

Solenoid switch. Check the switch plunger for freedom of movement. Examine the contacts. If they are burnt, dress them with fine abrasive cloth or

a flat barette file. If the contact bolts are seriously damaged at the point where they touch upon the contact plate, turn them through 180° .

Check the resistance of the solenoid switch winding, reliability of its connections with terminal "50" and "ground" and see that it shows no signs of overheating. A faulty solenoid switch should be replaced by a new one.

Assembly

Before assembling the starter, coat the helical splines of the armature shaft and overrunning clutch hub with engine oil M-10TM. Lubricate the bushes of both end heads as well as the pinion with engine oil; coat the carrier ring of the drive with LITOL-24 grease.

Before assembly, check the end play of the armature shaft, first assembling the end heads, frame and armature and tightening the nuts of the through bolts. The armature can be assembled without the drive; end head 1 (Fig.7-16) can be assembled without the lever. The end play of the shaft should be within 0.07-0.7 mm. It can be changed by selecting the required number or thickness of adjusting washers 20.

Having installed the appropriate number of adjusting washers, assemble the starter by reversing the disassembly procedure.

Check the assembled starter on a stand.

IGNITION SYSTEM

The circuit diagram of the ignition system is given in Fig. 7-18.

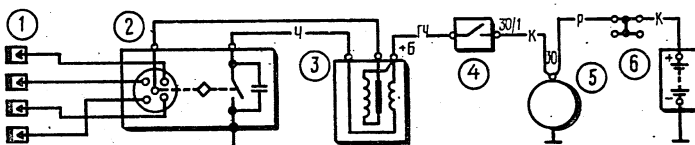


Fig.7-18. Ignition System Circuit Diagram:
1 - spark plugs; 2 - ignition distributor; 3 - ignition coil; 4 - ignition switch; 5 - generator; 6 - storage battery

Trouble Shooting

Cause of trouble	Remedy
Engine Fails to Start	
1. No current across breaker contacts: (a) breaker contacts dirty, oxidized or stuck; bulges and craters on contacts due to erosion; excessively large contact gap or weakening of contact spring	(a) dress contacts and adjust contact gap; replace contact unit if spring is weak

Cause of trouble	Remedy
(b) L.T. wire tags loose or oxidized; wires broken or shorted to "ground"	(b) inspect wires and connections, replace damaged wires
(c) ignition switch faulty; contacts "15" and "30/1" fail to close	(c) examine switch and, if necessary, replace switch or its contact unit
(d) breakdown of condenser (short circuit)	(d) replace condenser
(e) an open in ignition coil primary winding	(e) replace coil
2. Breaker contacts fail to open:	
(a) breaker point gap out of adjustment	(a) adjust
(b) heavy wear of breaker arm rubbing block or bushing	(b) replace contact unit
3. No H.T. supply to spark plugs:	
(a) H.T. wire tags loose, broken or oxidized; wires badly soiled or their insulation damaged	(a) inspect and restore connections, clean or replace wires
(b) central carbon electrode worn, damaged or jammed in distributor cap	(b) inspect distributor cap and replace, if necessary
(c) current leaks through cracks or burnt holes in distributor cap, through carbon deposits or moisture on inside surface of cap	(c) examine cap, remove moisture and carbon deposits; replace cap, if cracked.
(d) current leaks through cracks or burnt holes in distributor rotor	(d) examine rotor and replace, if necessary
(e) burnt resistor in distributor rotor	(e) replace resistor
(f) an open or earth fault in ignition coil secondary winding	(f) replace coil
4. H.T. wires confused in distributor cap sockets	4. Check and connect wires according to engine firing order (1-3-4-2)
5. Wrong spark plug gap or oiling of spark plugs	5. Clean spark plugs and adjust spark gap
6. Spark plugs damaged (cracked insulator)	6. Replace spark plugs by new ones
7. Wrong ignition timing	7. Check and adjust ignition timing

Engine Runs Erratically or Stalls when Idling

- | | |
|--|-------------------------------------|
| 1. Ignition too early | 1. Check and adjust ignition timing |
| 2. Excessively large spark gap | 2. Check and adjust spark gap |
| 3. Breaker contact gap too small | 3. Check and adjust contact gap |
| 4. Burnt resistor in distributor rotor | 4. Replace resistor |

Engine Runs Erratically at High Speeds

- | | |
|---|--|
| 1. Weakening of breaker arm spring | 1. Replace breaker contact unit |
| 2. Breaker contact gap too large | 2. Check and adjust contact gap |
| 3. Weak springs of spark timer flyweights | 3. Replace springs, check centrifugal spark timer on stand |

Engine Missing at All Speeds

- | | |
|---|---|
| 1. Faulty ignition wires. Loose wire fastenings or oxidation of wire tags | 1. Inspect wires and connections. Replace damaged wires |
| 2. Breaker contacts dirty, oxidized, stuck or displaced | 2. Dress contacts and adjust contact gap |
| 3. Reduced capacity or breakdown of condenser | 3. Check condenser and replace, if necessary |
| 4. Wear or damage of central carbon electrode in distributor cap, weakening of its spring | 4. Replace distributor cap |
| 5. Heavy burning of central contact in distributor rotor | 5. Dress central contact |
| 6. Cracks, dirt or burning of distributor rotor or cap | 6. Inspect and replace rotor or cap |
| 7. Excessive runout of distributor shaft, heavy wear of shaft bushing | 7. Replace ignition distributor |

Cause of trouble	Remedy
8. Oiling of spark plug or wear of electrodes; heavy carbonization; cracked spark plug insulator	8. Examine spark plugs, decarbonize them, adjust spark gap, replace faulty spark plug
<u>Lack of Power and Poor Pickup</u>	
1. Wrong ignition timing	1. Check and adjust
2. Jamming of spark timer flyweights or weakening of their springs	2. Inspect and replace damaged parts
3. Heavy wear of breaker arm bushing	3. Check and replace breaker contacts

Ignition Timing

To check ignition timing, there are three marks 1, 2, and 3 (Fig.7-19) on the valve gear cover and mark 4 on the crankshaft pulley; when mark 4 is aligned with mark 3 on the cover this indicates the TDC of the piston in No.1 and No.4 cylinders.

Ignition timing can be checked and adjusted with a stroboscope in the following order:

- set the eccentric of the ignition distributor or octane selector to zero;
- connect stroboscope lamp "+" with ignition coil terminal "+" and connect the "ground" clamp with an unpainted surface of the car body;
- insert an adapter for the stroboscopic lamp between the spark plug of No.1 cylinder and its wire and make a chalk mark to render mark 4 more conspicuous on the crankshaft pulley;
- start the engine and direct the flashing light of the stroboscope at the mark on the pulley; if ignition timing is correct, mark 4 seen on the pulley will be in line with mark 2 on the valve gear cover when the engine is idling.

To adjust ignition timing, stop the engine, loosen the distributor fastening nut and turn the distributor through the required angle. To increase

or decrease the spark advance angle, turn the distributor body counterclockwise or clockwise, respectively. Then recheck the ignition timing.

If a diagnostic stand with an oscilloscope is available, it can also be used for an easy check of ignition timing, following the instructions for the stand.

If the ignition distributor has been removed from the engine, put it back in place as follows:

- remove the distributor cap, check the breaker point gap and adjust it, if necessary.
- turn the crankshaft until a compression stroke begins in No.1 cylinder and, continuing to turn the crankshaft, align mark 4 with mark 2;
- turn the rotor to a position in which its outer contact faces the contact of No.1 cylinder on the distributor cap;
- holding the distributor shaft against turning, insert it into the socket on the cylinder block to engage the drive gear;
- secure the distributor on the cylinder block, install the cap, connect the wires, check and adjust the ignition timing.

Checking and Adjusting the Breaker Point Gap

To check the breaker point gap:

- set the gearshift lever to neutral;
- apply the parking brake;
- turning the engine crankshaft, bring the breaker cam to a position in which the breaker contacts are completely open;
- measure the gap with a feeler gauge. If the gap is not within 0.35 and 0.45 mm limits, loosen screws 21 and 25 (Fig.7-20), insert the blade of a screwdriver into slot 26 and turn the breaker bracket as required. After adjustments tighten screws 21 and 25 all the way home.

Stand Tests of Ignition Units

Ignition Distributor

Caution

From 1980, the car engines fitted with carburettor 2107-1107010-20 may have Type 30.3706-02

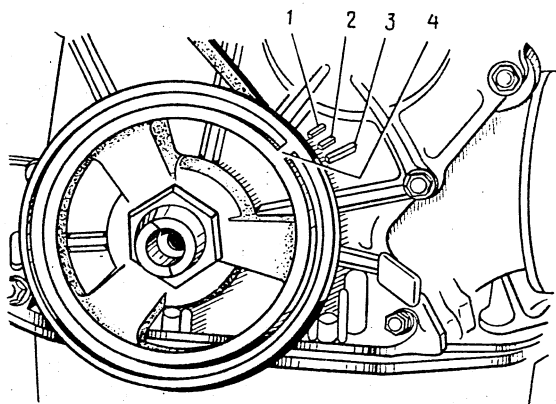


Fig.7-19. Ignition Timing Marks:

1 - 10° spark advance mark; 2 - 5° spark advance mark; 3 - 0° spark advance mark; 4 - TDC mark on crankshaft pulley

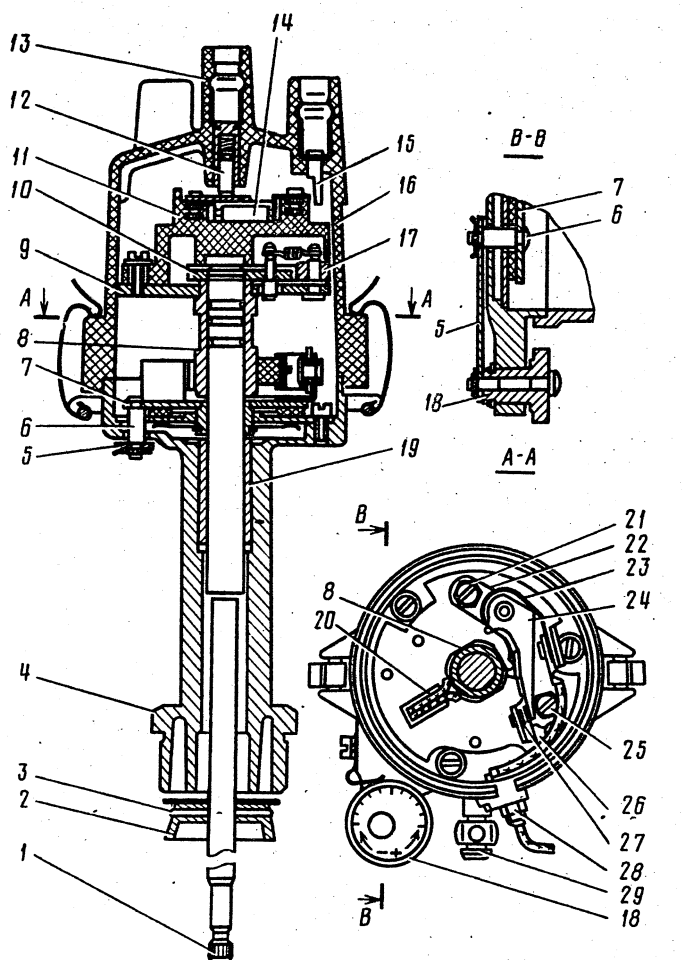


Fig.7-20. Ignition Distributor P-125B:

1 - shaft; 2 - oil-deflecting sleeve; 3 - spiral stud; 4 - body; 5 - link; 6 - axle; 7 - breaker movable plate; 8 - breaker cam; 9 - driven plate; 10 - driving plate; 11 - rotor; 12 - central carbon electrode; 13 - central electrode terminal; 14 - resistor; 15 - side electrode; 16 - cap; 17 - flyweight; 18 - octane selector eccentric; 19 - shaft bushing; 20 - wick; 21, 25 - breaker contact bracket screws; 22 - breaker contact bracket; 23 - arm spring; 24 - breaker arm; 26 - bracket adjusting slot; 27 - breaker contact points; 28 - L.T. wire terminal nut; 29 - shaft oiler

ignition distributor with a vacuum spark timer and with a different characteristic of the centrifugal spark timer. The ignition distributor 30.3706-02 is shown in Fig.7-21.

Prior to mounting the ignition distributor on the stand, examine the breaker contacts, see that the breaker arm is not jammed on its shaft and measure the contact pressure which should be 5-6 N (500-600 gf).

Check the rubbing block of the breaker arm for wear; if it is worn, set the required gap

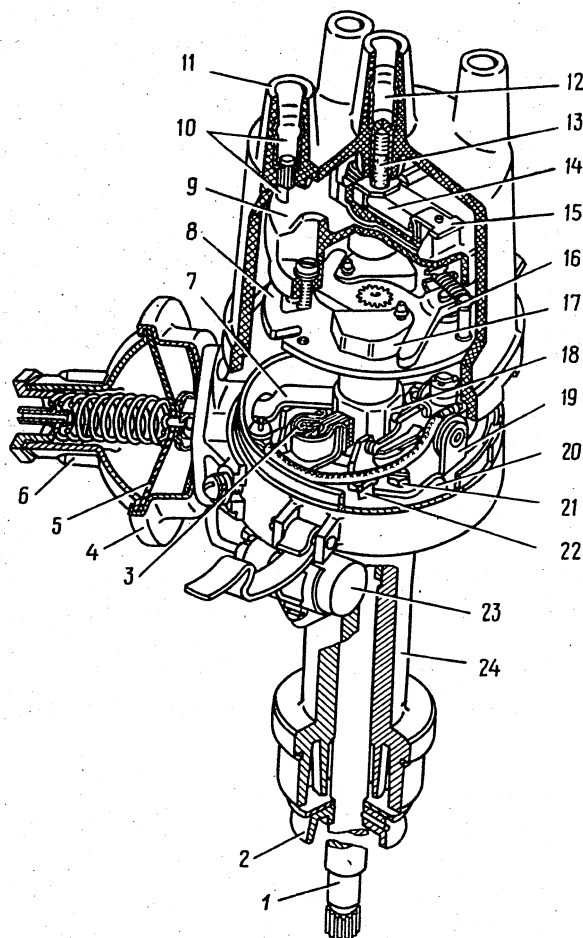


Fig.7-21. Ignition Distributor 30.3706-02:

1 - shaft; 2 - oil deflecting sleeve; 3 - wick; 4 - vacuum spark timer body; 5 - membrane; 6 - vacuum spark timer cover; 7 - vacuum spark timer rod; 8 - centrifugal spark timer supporting plate; 9 - distributor rotor; 10 - side electrode with terminal; 11 - cap; 12 - central electrode with terminal; 13 - central electrode carbon contact; 14 - resistor; 15 - rotor outer contact; 16 - centrifugal spark timer plate; 17 - flyweight; 18 - breaker cap; 19 - contact group; 20 - breaker movable plate; 21 - contact group screw; 22 - slot; 23 - condenser; 24 - ignition distributor body

between the breaker contact points. If the arm is jammed on its shaft or its spring is weak, replace the contact group.

If the breaker contacts are soiled, stuck or eroded, dress them with a barette file. Never use abrasive cloth nor other abrasives for this purpose.

After dressing, wipe the breaker contacts with chamois leather soaked in gasoline. Then pull off the breaker arm to allow gasoline to evaporate and wipe the contacts once more with dry chamois leather. The chamois leather may be substituted by any

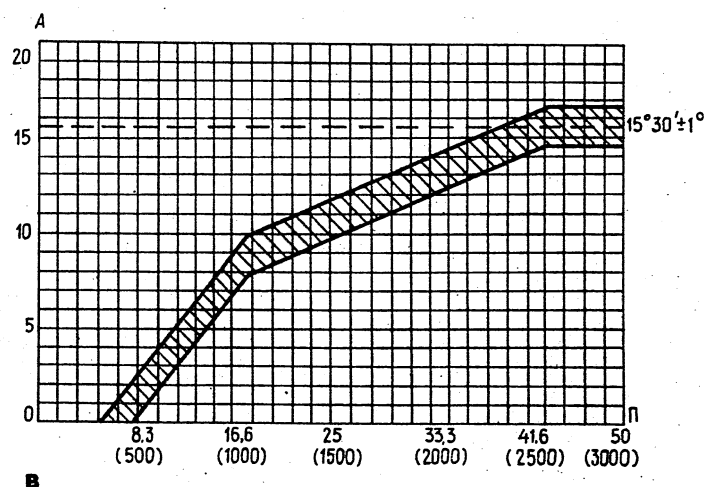
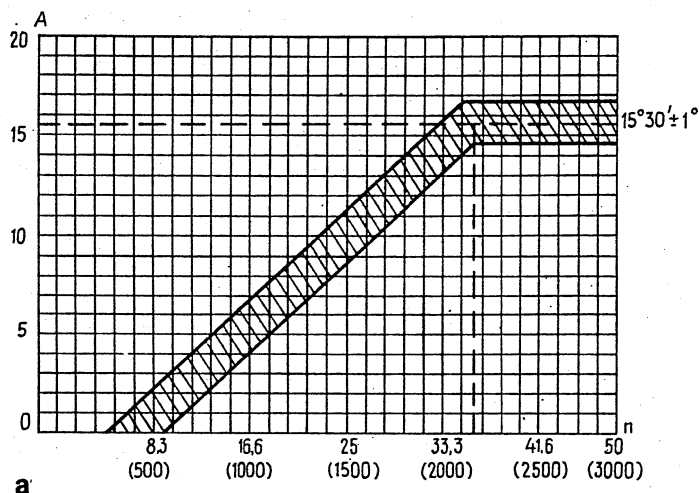


Fig.7-22. Centrifugal Spark Timer Performance Curve:

a - ignition distributor P-125B; b - ignition distributor 30.3706-02; A - spark advance angle, deg.; n - distributor shaft speed, s^{-1} (rpm)

other material which leaves no lints on the contacts.

The contacts should touch each other throughout their surface. If they are not in full contact, adjust the position of the fixed contact by bending the bracket support. It is not permitted to bend the breaker arm.

Wipe the distributor cap to remove any dirt and oil.

Lifting the distributor cap a little, check to see whether the rotor contact faces the electrode of the cap at the moment of opening of the breaker contact points.

Performance check. Mount the distributor on the test stand and connect it to a variable-speed motor.

Make necessary connections with the ignition coil and storage battery; connect four terminals of the distributor cap with four adjustable-gap spark dischargers of the stand.

Set a 5 mm electrode gap in the dischargers, start the stand motor and rotate the distributor shaft a few minutes in the clockwise direction at $33.3 s^{-1}$ (2000 rpm). Then increase the electrode gap to 10 mm and look for internal discharges in the distributor. Internal discharges can be noticed either by sound or by weak and missing sparks in the stand discharger.

The operating distributor should make no noise at any engine speed.

Taking the automatic spark advance diagram. Mount the distributor on the stand and connect it in compliance with the stand instructions.

Start the stand motor and rotate the distributor shaft at $5 - 6.6 s^{-1}$ (300-400 rpm)*. Watching the graduated disc, note the degrees at which one of the four spark occurs.

Increasing the motor speed and taking the readings each time after raising the speed by $3.3 - 5 s^{-1}$ (200-300 rpm), determine the degrees of the spark advance angle relative to the initial setting at various distributor shaft speeds. Compare the obtained diagram with that shown in Fig.7-22.

Checking the closed-contact angle. Mount the distributor on the test stand and remove the distributor cap.

Make the electric connections according to the recommendations of the stand operating instructions.

Turn on the stand motor and accelerate the distributor shaft to $16.6 s^{-1}$ (1000 rpm).

Measure the closed-contact angle on the lighted portions of the scale; the angle should be $55 \pm 3^\circ$.

Having checked the closed-contact angle, check the angles between the contact-opening moments in the cylinders relative to No.1 cylinder (asynchronism); these angles should not differ by more than $\pm 1^\circ$ from the nominal values.

Checking the insulation resistance. The resistance of insulation between various terminals and "ground" should be checked with a megger. Measure the resistance between the breaker L.T. terminal and "ground" with the breaker contacts open.

The insulation resistance at $25 \pm 5^\circ C$ should be higher than 10 M Ω .

Checking the condenser. The condenser capacity measured within a frequency range of 50 - 1000 Hz should be from 0.20 to 0.25 μF .

* $2.5 - 3.3 s^{-1}$ (150-200 rpm) for ignition distributor 30.3706-02.

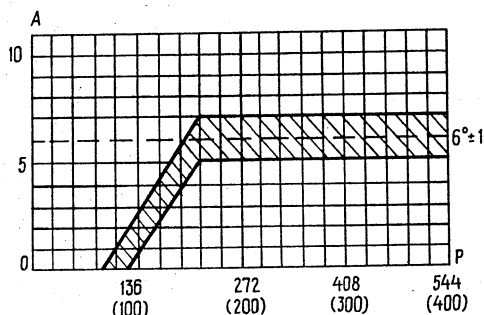


Fig. 7-23. Vacuum Spark Timer Performance Curve 30.3706-02:
A - spark advance angle, deg.; P - vacuum, GPa (mm Hg)

Taking the vacuum spark timer performance curve. Mount the ignition distributor on a stand and make the electrical connections as prescribed in the stand instructions.

Turn on the stand motor and rotate the distributor shaft at a speed of 16.6 s^{-1} (1000 rpm). Watching the graduated disc, set an arbitrary "zero" at which a spark occurs in any cylinder.

Increasing the vacuum gradually, note the number of spark advance degrees every 27.2 GPa (20 mm Hg) comparing it with the initial value. Compare the obtained performance curve with that shown in Fig. 7-23.

Adjust the timer performance curve by selecting the required number of adjusting washers inserted between the timer spring and plug.

See that the breaker movable plate returns readily to the initial position after the vacuum is relieved.

Ignition Coil

To check the ignition coil, make the following tests:

The ohmic resistance of the primary winding at 20°C should be $3.07\text{--}3.5 \Omega$ and that of the secondary winding, $5400\text{--}9200 \Omega$.

Insulation to "ground". The coil should withstand a 1500 V, 50 Hz alternating current in the course of 1 minute between the end of the primary winding and the body without discharges.

The resistance of insulation to "ground" should be equal to, or higher than, $50 \text{ M}\Omega$.

Spark Plugs

If sparks are missing in one or more cylinders, take care to examine the spark plugs.

Before the test, clean the carbonized or fouled spark plugs by sand- and airblasting on a special installation.

If carbon deposits are light-brown in colour, they may be left in place since they may appear in

a sound engine and do not interfere with normal functioning of the ignition system.

After cleaning, examine the spark plugs and adjust the electrode gap. Replace the spark plug, if the insulator is chipped or cracked or the weld of the side electrode is damaged.

The gap between the spark plug electrodes (0.5–0.6 mm) should be checked with a round wire feeler gauge included into the driver's tool kit. Do not check the gap with a flat feeler gauge since this measurement will not include the crater on the side electrode that develops in the course of spark plug operation. Adjust the gap by bending the side electrode only. The central electrode must not be bent as this may damage the ceramic insulator.

Tightness test. Screw the spark plug into the corresponding socket of the stand and build up a pressure of 2 MPa (20 kgf/cm^2) in the stand chamber.

Apply a few drops of oil or kerosene to the spark plug; in case of poor tightness, bubbles will appear, usually between the insulator and the metal body of the spark plug.

Electric test. Adjust the electrode gap to 0.6 mm, screw the spark plug into the stand socket and tighten to a torque of $32\text{--}40 \text{ N}\cdot\text{m}$ ($3.2\text{--}4 \text{ kgf}\cdot\text{m}$) with a torque-indicating wrench; pressure tightness is ensured by an elastic gasket of the socket union. Set a 12 mm gap between the discharge electrodes (which corresponds to a voltage of 18 kV) and build up a pressure of 0.6 MPa (6 kgf/cm^2) with a pump.

Fit the terminal of a H.T. wire on the spark plug and press the switch button.

The following conditions may be observed:

1. A good hot spark jumps across the spark plug electrodes as seen through the stand observation port. In this case the spark plug is considered to be sound.

2. Sparking takes place between the discharger electrodes. If so, relieve the pressure and note its value at which the spark plug starts producing sparks. If this occurs at a pressure of 0.5 MPa (5 kgf/cm^2), the spark plug is considered sound; if it occurs at a pressure of 0.4 MPa (4 kgf/cm^2) and lower, the spark plug is defective and must be discarded.

There may be several sparks on the discharger; if there are no sparks both in the spark plug and discharger, the fault lies probably with a cracked spark plug insulator so that the discharge takes place inside, between "ground" and the electrode. Such a spark plug is considered faulty.

Ignition Switch

The ignition switch should be checked for proper functioning of the antitheft device and for correct closing of contacts in various positions of the key (Table 7-5). The voltage is fed from the battery and generator to contacts "30" and

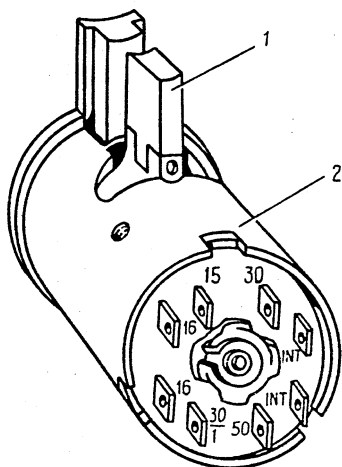


Fig. 7-24. Ignition Switch Contact Group:
1 - locking rod; 2 - wide lug

"30/1". The "16" contacts of the switch are out of use. An additional plug "INT" is intended for connecting a radio receiver.

The locking bar of the antitheft device should extend when the key is turned to the PARKING (СТОЯНКА) position and removed from the lock; it should be retracted when the key is turned from the PARKING (СТОЯНКА) to the OFF (ВЫКЛЮЧЕНО) position.

When installing the contact unit into the switch body, arrange the unit so that terminals "15" and "30" are located at the locking bar side (Fig. 7-24) in which case the wide lug of the contact unit will snap into the wide slot of the switch body.

Checking the Radio Noise Suppressors

The radio noise suppressors include the H.T. wires with a distributed resistance of $2000 \pm 200 \Omega/m$ and a suppressor resistor in the distributor rotor, rated $5000-6000 \Omega$. The condition of these elements can be checked with an ohmmeter.

Table 7-5

Circuits Energized in Various Key Positions

Key position	Energized contacts	Energized circuits
OFF (ВЫКЛЮЧЕНО)	30 and 30/1	-
PARKING (СТОЯНКА)	30-INT	External lighting, windshield wiper, heater
	30/1	-
IGNITION (ЗАЖИГАНИЕ)	30-INT	External lighting, windshield wiper, heater
	30/1 - 15	Ignition system, generator excitation, instruments, direction indicators
STARTER (СТАРТЕР)	30-INT	External lighting, windshield wiper, heater
	30/1 - 15	Ignition system, generator excitation, instruments, direction indicators
	30 - 50	Starter
	30 - 16	-

LIGHTING SYSTEM

The external lighting circuit diagram and the headlamp circuit diagram are shown in Figs 7-25 and 7-26, respectively.

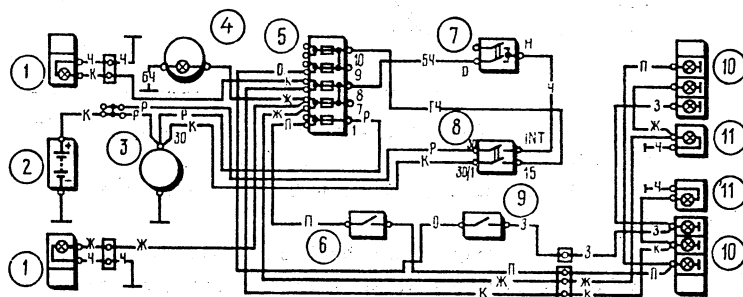


Fig. 7-25. External Lighting Circuit Diagram:
1 - front lamps; 2 - storage battery; 3 - generator; 4 - external lighting signal lamp; 5 - fuse block; 6 - stop light switch; 7 - external lighting switch; 8 - ignition switch; 9 - backing light switch; 10 - tail lamps; 11 - licence plate lamps

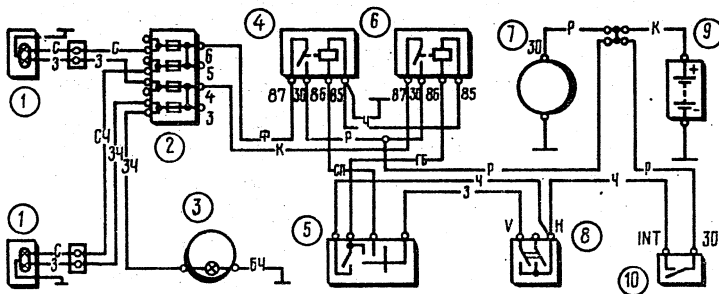


Fig. 7-26. Headlamp Circuit Diagram:

1 - headlamps; 2 - fuse block; 3 - headlamp upper beam signal lamp in speedometer; 4 - headlamp lower beam relay; 5 - headlamp beam changeover switch; 6 - headlamp upper beam relay; 7 - generator; 8 - external lighting switch; 9 - storage battery; 10 - ignition switch

Trouble Shooting

Cause of Trouble	Remedy
<u>Individual Bulbs Inoperative</u>	
1. Fuses blown out	1. Check and replace fuses
2. Bulb filaments burnt out	2. Replace bulbs
3. Wires damaged, their terminals oxidized or connections loosened	3. Inspect, replace damaged wires, clean terminals
<u>Stop Light Inoperative</u>	
Stop light switch faulty	Check with test lamp, replace faulty switch
<u>Headlamp Lower and Upper Beams Cannot be Changed Over</u>	
1. Lower and upper beams relay faulty	1. Adjust or replace relay
2. Oxidation of switch contacts	2. Replace three-lever switch
<u>Direction Indicator and Headlamp Changeover Switch Levers Fail to be Fixed in Position</u>	
1. Lever lock ball has snapped out	1. Replace three-lever switch
2. Damaged sockets of lever locks	2. Replace three-lever switch
<u>Direction Indicators Fail to be Canceled Automatically on Completion of Turn</u>	
1. Direction indicator lever return mechanism jamming	1. Replace three-lever switch
2. Lugs of direction indicator switch carrier ring worn or broken	2. Replace three-lever switch
<u>Direction Indicator and Headlamp Switch Levers Fail to Function</u>	
1. Jamming of lever lock balls	1. Replace three-lever switch
2. Jamming of direction indicator lever return mechanism	2. Replace three-lever switch
<u>Direction Indicator Signal Lamp Inoperative</u>	
1. Bulb filament burnt out	1. Replace bulb
2. Direction indicator and distress signal relay-breaker faulty	2. Replace relay-breaker
<u>After Turning on Direction Indicator Lever the Signal Lamp is Constantly Alight (Fails to Blink)</u>	
1. Bulb of front or rear direction indicator burnt out	1. Replace bulb
2. Direction indicator and distress signal relay-breaker faulty	2. Replace relay-breaker

Headlamps

Replacing the Bulb

To replace the bulb:

- remove decorative facing 4 (Fig. 7-27) on the front end of the body by turning out screws 5;

- loosen headlamp rim screws 3, turn the rim counterclockwise and take it off;

- take out the light unit and replace the bulb.

Put the light unit back in position so that its lugs enter the sockets of the headlamp inner rim.

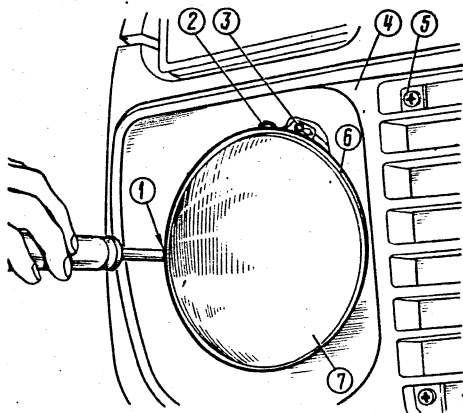


Fig. 7-27. Headlamp Aiming:

1 - horizontal adjusting screw; 2 - vertical adjusting screw; 3 - headlamp rim screw; 4 - decorative facing; 5 - facing screw; 6 - headlamp rim; 7 - light unit

Headlamp Aiming

The headlamps should be aimed so as to ensure efficient illumination of the road ahead without dazzling the drivers of the oncoming vehicles by the lower beam. The headlamps are aimed by rotating screws 1 and 2 which turn the light unit in the vertical and horizontal planes.

The best practice is to aim the headlamps with the aid of portable optical apparatuses. However, if they are not available, this work can be done with the aid of a makeshift screen.

Put the empty car on a level horizontal floor, 5 m away from a smooth wall or some sort of a screen (a sheet of plywood 2x1 m in size approximately) so that the car axis is square to the screen. Before marking off the screen, make sure that the car tyres are properly inflated then swing the car by pushing it from one of its sides to allow the suspension springs to settle.

Mark the screen as shown in Fig. 7-28, drawing an axial vertical line O and vertical lines A and B

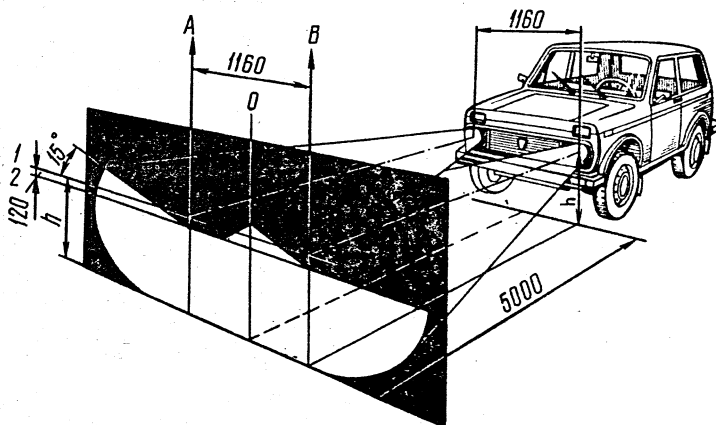


Fig. 7-28. Headlamp Aiming Diagram

passing through the points which correspond to the headlamp centres. These lines should be symmetrical with the fore-and-aft line of the car. Draw line 1 at the height of the headlamp centres above the floor and line 2 of the headlamp hot spots at a distance of 120 mm below line 1.

Turn on the lower beam. Cover first the L.H. then the R.H. headlamp with a piece of cardboard or dark cloth and adjust the light beams with screws 1 and 2 (Fig. 7-27). The upper boundary of the hot spots of well-aimed headlamps should coincide with line 2 (Fig. 7-28) while the points of intersection of the horizontal and inclined portions of the hot spots, with lines A and B.

Headlamp Relay

Reference Data

Relay cutting-in voltage at

23 ± 5 °C, V, maximum 8

Winding resistance at 20 °C, Ω 85 ± 5

The lower and upper beams of the headlamps are turned on by identical relays, Type 111.3747. Together with the headlamp wiper and washer relays they are installed under the instrument panel behind the fuse block.

Three-Lever Switch

The switch is held by a clamp on the steering shaft bracket.

To remove the switch:

- take off the steering wheel;
- remove the two halves of the steering shaft casing;
- take off the instrument panel and disconnect the switch wires from the wire assembly of the car;
- loosen the fastening clamp and take off the switch.

Distress Signal and Direction Indicator

Relay-Breaker

Relay-breaker 10 (Fig. 7-29) provides for the blinking light of direction indicators both when indicating the turns and giving distress signals, also for checking the condition of the direction indicator bulbs. If these bulbs are sound, signal lamp 11 will be blinking too. If the bulbs are faulty (burnt or inoperative because of an open in their supply circuit), the relay-breaker will ensure constant light of the signal lamp.

The relay-breaker is fastened under the instrument panel on a bolt welded to the wall of the air intake box. A defective relay-breaker is not subject to repairs and must be replaced by a new one.

The relay-breaker makes the direction indicator bulbs blink at a frequency of 90 ± 30 cycles per minute under a rated load of 92 W, an ambient tem-

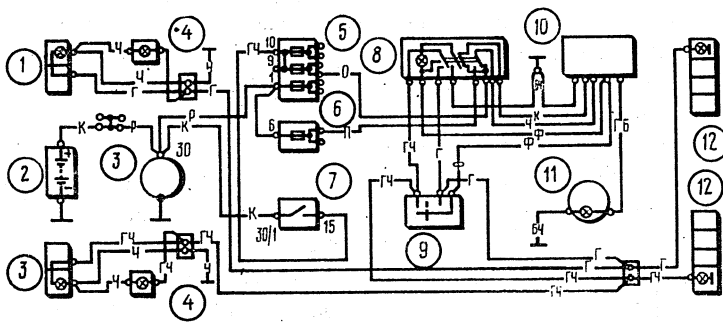


Fig. 7-29. Distress Signal and Direction Indicator Circuit Diagram:

1 - front lamps; 2 - storage battery; 3 - generator; 4 - side direction indicators; 5 - main fuse block; 6 - additional fuse block; 7 - ignition switch; 8 - distress signal switch; 9 - direction indicator changeover switch; 10 - distress signal and direction indicator relay-breaker; 11 - direction indicator signal lamp in speedometer; 12 - tail lamps

perature from -20 to $+50^{\circ}\text{C}$ and a voltage of 10.8 to 15 V.

A circuit diagram of the relay-breaker is illustrated in Fig. 7-30.

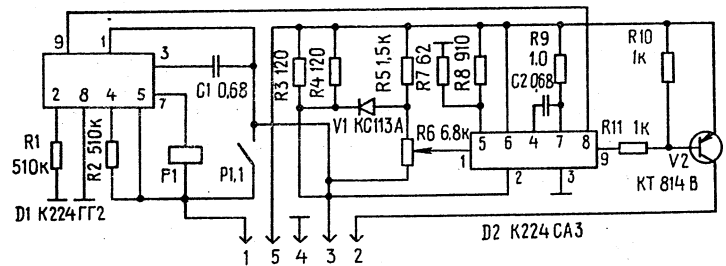


Fig. 7-30. Distress Signal and Direction Indicator Relay Circuit Diagram

HORNS

The car is fitted with two horns (Fig. 7-31), high-tone and low-tone ones. They are bracketed to the radiator L.H. shield in the engine compartment.

The horn connection diagram is shown in Fig. 7-32.

Fig. 7-31. Horn:

1 - membrane; 2 - stationary contact holder; 3 - diffuser; 4 - ring; 5 - movable contact plate; 6 - body; 7 - core; 8 - adjusting screw; 9 - adjusting screw spring; 10 - bridge; 11 - horn fastening plate; 12 - yoke; 13 - armature

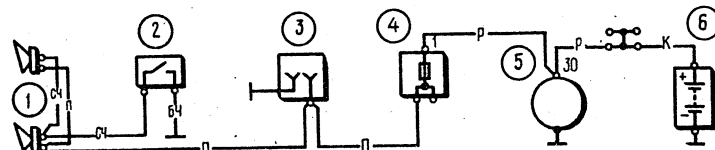
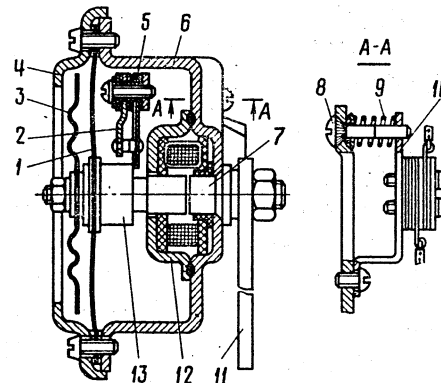


Fig. 7-32. Horn Connection Diagram:

1 - horns; 2 - horn switch; 3 - inspection lamp socket; 4 - fuse block; 5 - generator; 6 - storage battery

Trouble Shooting

Faulty operation of the horns can be caused by a defective or jamming switch and by a defective horn.

To identify the trouble, examine the wire connections and the switch contacts. Clean the contacts, if necessary. The faulty switch or horn should be replaced by new ones.

If the horn becomes weak or hoarse, adjust it

by turning screw 8 in or out (Fig. 7-31) until loud and clear sound is obtained.

If adjustments fail to eliminate hoarseness or the horn produces intermittent sound, disassemble it and clean the breaker contacts.

When assembling the horn, take care to install the previously removed gasket between horn membrane 1 and body 6 so as to retain a clearance of 0.4 ± 0.05 mm between the armature and the core.

WINDSHIELD WIPER

Trouble Shooting

Cause of trouble	Remedy
<u>Wiper Motor Inoperative, Fuse Intact</u>	
1. Damaged motor supply wires, oxidation of wire terminals	1. Inspect wires, replace damaged ones, clean terminals
2. Damaged wiper switch	2. Replace three-lever switch
3. Jamming of motor brushes, heavy oxidation of commutator	3. Inspect, eliminate jamming of brushes or replace faulty parts; dress commutator
4. Breaking of motor leads	4. Inspect and solder up, if necessary
5. Open circuit in motor armature winding	5. Replace armature or motor
<u>Wiper Motor Inoperative, Fuse Blown Out</u>	
1. Short circuit in motor armature	1. Replace motor or armature
2. Wiper arms distorted and brush against car body	2. Inspect, straighten arms or replace wiper
3. Wiper blades frozen to windshield	3. Pull wiper blades off windshield
4. Foreign object in wiper mechanism	4. Inspect, remove foreign object
<u>Wiper Motor Fails to Function at Intermittent Duty</u>	
1. Wiper switch damaged	1. Replace three-lever switch
2. Wiper relay damaged:	
(a) open circuit in relay winding	(a) replace relay
(b) shorted wires on contact bracket	(b) eliminate short circuit
(c) clearance developed between relay breaker contacts	(c) eliminate clearance; replace relay, if necessary
<u>Wiper Motor Fails to Stop at Intermittent Duty</u>	
1. Burnt wiper breaker relay winding	1. Replace breaker relay
2. Cam of motor reduction unit gear fails to force off limit switch spring plate	2. Bend switch plate so that cam can force it off
3. Burning of motor limit switch contacts	3. Dress switch contacts
4. Burning of wiper relay breaker contacts	4. Remedy defect, dress breaker contacts or replace relay
<u>Wiper Motor Stops at Intermittent Duty. Blades Fail to Park in Initial Position</u>	
Oxidation or poor closing of limit switch contacts in motor	Clean switch contacts or bend limit switch plate
<u>Wiper Motor Operating, Blades Stay Still</u>	
1. Broken teeth of motor reduction unit gear	1. Replace gear
2. Loosening of crank on reduction unit gear shaft	2. Inspect, tighten crank nut

Repairs

The circuit diagram of the windshield wiper is given in Fig.7-33.

The repairs of the windshield wiper are confined basically to straightening the distorted components of the leverage or replacing them with new ones. A faulty motor should also be replaced by a new one. The only permissible repair operations on the electric motor are replacing the reduction unit gear, armature and cleaning the commutator.

Removal and Installation

The windshield wiper is removed from the engine compartment as follows:

- remove the blades with the arms;
- disconnect the wires from the storage battery and wiper motor;
- unscrew the nuts of the arm pivots with the locating bushings;
- unscrew the nuts of the motor bracket and take off the motor complete with the leverage.

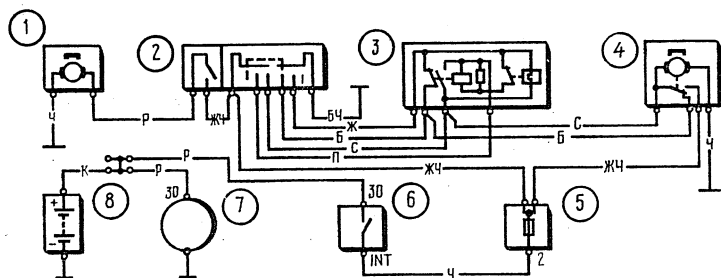


Fig. 7-33. Windshield Wiper and Washer Circuit Diagram:

1 - windshield washer motor; 2 - windshield wiper relay; 3 - windshield wiper and washer switch; 4 - windshield wiper motor; 5 - fuse block; 6 - ignition switch; 7 - generator; 8 - storage battery

Put the motor on a work bench and remove the leverage.

To install, reverse the removal operations.

Disassembly, Assembly and Inspection of Windshield Wiper Motor

Reference Data

Maximum effective torque on reduction unit shaft*, N.m (kgf.m) 2(0.2)
 Current draw* at a torque of 1 N.m (0.1 kgf.m), A, maximum 2.8
 Reduction unit shaft speed* at a torque of 1 N.m (0.1 kgf.m), s⁻¹(rpm), minimum 0.83 (50)
 Starting torque on reduction unit shaft*, N.m (kgf.m), minimum 12 (1.2)

* At 14 V and 25±10 °C in cold state.

The M3-241 motor (Fig. 7-34) is a D.C. machine excited by permanent magnets and made integral with a worm gear reduction unit.

To disassemble the motor, remove the screws of reduction unit cover 1 and take off the cover together with panel 2. Then remove the screws which hold end head 16 to motor frame 7 and detach the end head. Take out motor armature 8.

To remove reduction unit gear 3, unscrew the nut of crank 9, take the locking ring off the shaft and remove the shaft complete with gear and washers from the frame.

After disassembly, blow the motor inside with compressed air to remove accumulations of carbon dust; then examine the brushes and the commutator.

The brushes should be free to move in the holders and the brush springs should be intact and sufficiently resilient. Clean the commutator with fine abrasive cloth then wipe it with a clean rag lightly coated with petrolatum. If the commutator is heavily burnt or worn, the best practice is to replace the armature.

Look for the signs of binding on the armature shaft journals. If necessary, clean them with fine abrasive cloth.

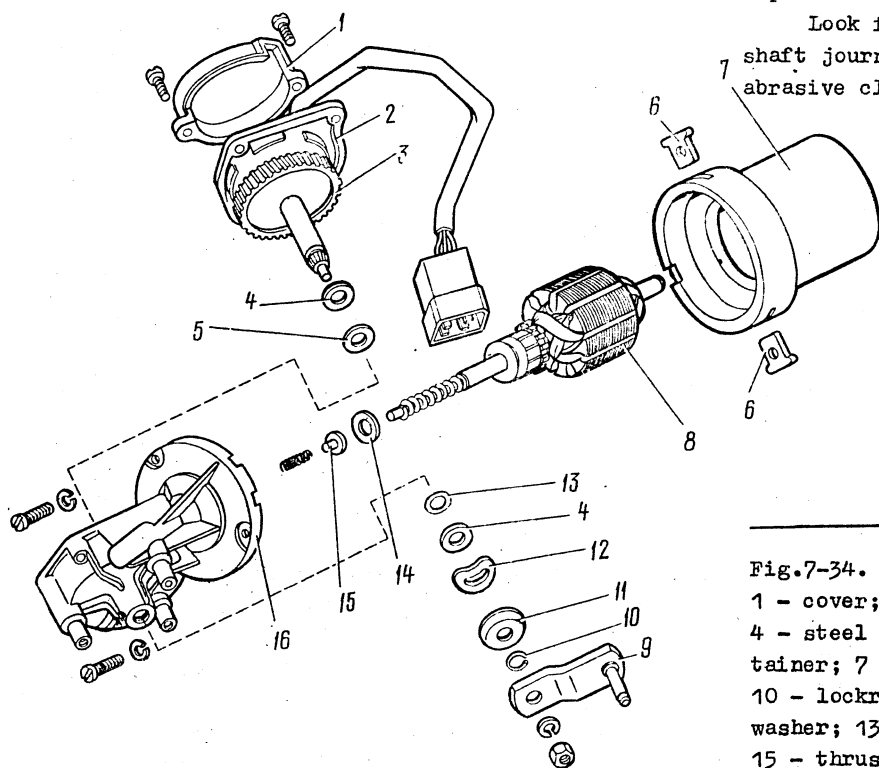


Fig. 7-34. Windshield Wiper Motor Parts:

1 - cover; 2 - panel; 3 - reduction unit gear; 4 - steel washer; 5 - textolite washer; 6 - re- tainer; 7 - frame; 8 - armature; 9 - crank; 10 - locking ring; 11 - protective cap; 12 - spring washer; 13 - sealing ring; 14 - adjusting washer; 15 - thrust bearing; 16 - end head

During assembly, pull the brushes away from the commutator to avoid breaking them and damaging their edges. Insert the armature into the frame with particular care without bumping the armature against the pole pieces so as not to break them.

After assembly, strike the motor frame with a wooden mallet so as to allow the bearings to seek their proper places, then check the motor on a stand.

Windshield Wiper Relay

Reference Data

Number of operations per minute at 10-14 V and a temperature from -20 to +50 °C 9-17

Electromagnet winding resistance, Ω 66 ± 2
Breaker winding resistance, Ω 23 ± 1

The PC-514 relay ensures intermittent operation of the windshield wiper. It is installed under the instrument panel at the left-hand side and is held to the car body by two screws.

At the first moment after switching on the wiper for intermittent operation (while the bimetallic plate of the breaker has not yet become heated) the wiper blades may make up to four double strokes in succession.

HEADLAMP WIPER

The headlamp wiper circuit diagram is shown in Fig.7-35.

The headlamp wiper motor is made integral with the reduction unit in one housing. The motor is non-dismountable and should be discarded, when faulty.

Motor Reference Data

Rated voltage, V 12
Current draw* at a torque of 1 N.m (0.1 kgf.m), A, not over 1.5
Number* of double shaft strokes per minute at a torque of 1 N.m (0.1 kgf.m) 50 ± 5
Swinging angle of output shaft $65^\circ \pm 1^\circ 30'$

* At 12 V and 25 ± 10 °C.

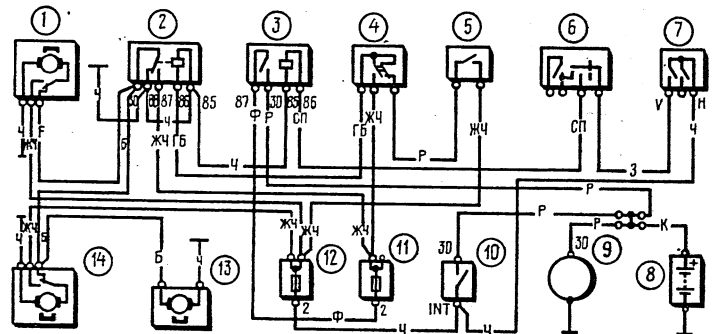


Fig.7-35. Headlamp Wiper and Washer Circuit Diagram:

1 - headlamp wiper R.H. motor; 2 - headlamp wiper and washer relay; 3 - headlamp lower beam relay; 4 - headlamp wiper and washer switch; 5 - windshield washer switch; 6 - headlamp beam changeover switch; 7 - external lighting switch; 8 - storage battery; 9 - generator; 10 - ignition switch; 11 - additional fuse block; 12 - main fuse block; 13 - headlamp washer motor; 14 - headlamp wiper L.H. motor

HEATER MOTOR

Trouble Shooting

Cause of trouble	Remedy
<u>Motor Inoperative</u>	
1. Wires damaged or connections oxidized	1. Inspect and restore connections. Replace damaged wires
2. Heater switch damaged. No voltage on switch output terminals	2. Examine switch. Replace, if necessary
3. Jamming or wear of motor brushes. Open circuit in armature winding or oxidation of commutator	3. Check motor, repair or replace

Cause of trouble	Remedy
4. Earth fault in armature winding. Fuse burns out when motor is turned on	4. Replace motor

Motor Armature Rotates Slowly

1. Commutator soiled or oxidized	1. Clean commutator
2. Shorted turns in armature winding	2. Replace motor
3. Armature shaft jammed in bearings	3. Disassemble motor, clean shaft journals

Repairs

Reference Data

Rated voltage, V	12
Rated power, W	20
Speed of armature shaft with propeller at rated power, s^{-1} (rpm)	50 ± 2.5 (3000 $\pm$ 150)
Current draw at rated power, A, not over	4.5
Low speed of armature shaft with propeller, s^{-1} (rpm)	36.6 ± 2.5 (2200 $\pm$ 150)
Current draw at 36.6 s^{-1} (2200 rpm) of armature shaft, A, not over	2.7

The M3-255 motor is a D.C. machine with permanent-magnet excitation. The heater fan motor connection diagram is given in Fig.7-36.

When series resistor 2 is cut into the motor supply circuit, the armature shaft rotates at a low speed. The resistor is secured by two spring washers in the heater fan shroud. The resistor is rated 1.5 Ω at 20 $^{\circ}\text{C}$.

As a rule, the faulty motor should be replaced. The only permissible repair operation is dressing the commutator.

To disassemble the motor, turn off the screws of end head 6 (Fig.7-37) and remove the latter. Then remove lock washer 1 from the armature shaft and take armature 4 out of the frame. To assemble, reverse the disassembly operations.

Inspection of the heater fan motor is similar to that prescribed for the windshield wiper motor.

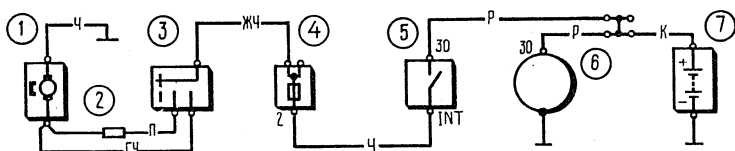


Fig.7-36. Heater Fan Motor Connection Diagram:
1 - heater motor; 2 - series resistor; 3 - heater switch; 4 - fuse block; 5 - ignition switch; 6 - generator; 7 - storage battery

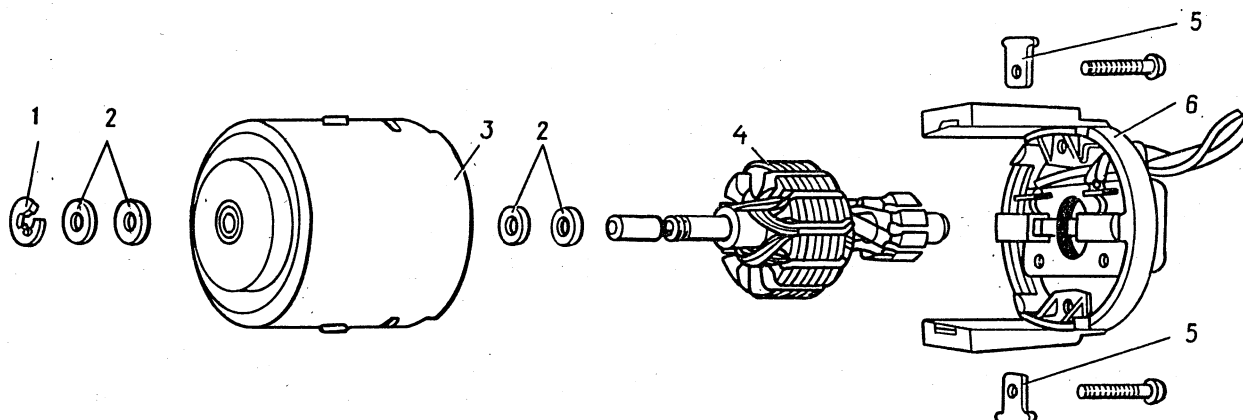


Fig.7-37. Heater Fan Motor Parts:
1 - lock washer; 2 - washer; 3 - frame; 4 - armature; 5 - retainer; 6 - end head

INSTRUMENTS

Trouble Shooting

Cause of trouble	Remedy
<u>Instrument Fuse Repeatedly Blown Out</u>	
Breakdown of instrument-protecting diode	Replace damaged diode
<u>Coolant Temperature Gauge Pointer Constantly at Beginning of Scale</u>	
1. Gauge faulty	1. Replace
2. Transmitter faulty	2. Replace
3. Wires damaged or wire terminals oxidized	3. Examine wires, restore connections
<u>Coolant Temperature Gauge Pointer Stays Constantly in Red Zone</u>	
1. Gauge faulty	1. Replace
2. Transmitter faulty	2. Replace
3. Transmitter wire shorted to "ground"	3. Check, eliminate earth fault
<u>Fuel Level Gauge Pointer Constantly at "O" Division</u>	
1. Gauge faulty	1. Replace
2. Wires damaged or wire terminals oxidized	2. Examine wires, restore connections
3. Transmitter faulty:	
(a) transmitter flexible bus broken off	(a) solder bus or replace transmitter
(b) open circuit in resistor winding	(b) replace transmitter
(c) poor contact of resistor sliding contact	(c) bend contact as required
(d) leaky float	(d) replace float
<u>Fuel Level Gauge Pointer Constantly at 4/4 Division</u>	
1. Gauge faulty	1. Replace
2. Transmitter flexible bus shorted to fuel suction pipe	2. Bend off bus
3. Transmitter wire shorted to "ground"	3. Check, eliminate earth fault
<u>Fuel Level Gauge Pointer Returns to "O" Division when Tank is Full</u>	
Wrong installation of float travel stop (end of resistor winding)	Bend stop 1-2 mm down
<u>Fuel Level Gauge Pointer Jumps and Falls Frequently to "O" Division</u>	
1. Poor contact of transmitter sliding contact	1. Bend contact
2. Open circuit in transmitter resistor winding	2. Replace transmitter
<u>Fuel Reserve Signal Lamp Constantly Alight</u>	
1. Flexible bus touches upon fuel suction pipe	1. Bend off bus
2. Transmitter wire shorted to "ground"	2. Check, eliminate earth fault
<u>Fuel Reserve Signal Lamp Fails to Light Up</u>	
1. Bulb burnt out	1. Replace bulb
2. Transmitter contacts oxidized	2. Clean contacts
3. Transmitter contacts fail to close	3. Bend transmitter sliding contact
4. Broken wire	4. Replace damaged wire
<u>Oil Pressure Signal Lamp Fails to Light Up After Turning On Ignition Switch</u>	
1. Bulb burnt out	1. Replace
2. Transmitter faulty	2. Replace
3. Wires broken or wire terminals oxidized	3. Check, replace damaged wires, clean terminals

Cause of trouble	Remedy
<u>Oil Pressure Signal Lamp Constantly Alight or Goes Off at High Engine Speeds</u>	
1. Transmitter faulty	1. Replace
2. Oil pressure too low	2. See "Engine" chapter
<u>Parking Brake Signal Lamp Fails to Blink (Constantly Alight)</u>	
Open circuit in relay-breaker winding (between "-" and "+" terminals)	Replace relay-breaker
<u>Parking Brake Signal Lamp Fails to Light Up</u>	
1. Bulb burnt out	1. Replace
2. Relay breaker contacts oxidized or open	2. Remove relay-breaker cover, clean contacts and eliminate clearance between them
3. Signal lamp switch faulty	3. Replace switch
<u>Speedometer Inoperative</u>	
1. Loosening of nuts which fasten cable ends to speedometer or its drive	1. Check and tighten nuts
2. Breaking of speedometer drive cable	2. Replace cable
3. Speedometer mechanism damaged	3. Replace speedometer
<u>Speedometer Drive Cable Noisy</u>	
1. Speedometer cable casing distorted (dented, bent, etc.)	1. Replace cable
2. Bending radiuses of speedometer cable smaller than 100 mm	2. Check and correct cable installation

Removing the Instrument Board

To remove the instrument board from the instrument panel for replacing a faulty instrument or a burnt-out bulb, force off clamps 3 (Fig.7-38) with a piercer 4 through special holes in the lower part of the instrument panel, disconnect the plug connectors and detach the cable from the speedometer.

Caution

When removing the instrument board take a note of the manner in which the speedometer cable has been laid; when installing the instrument board position the cable in the previous place to as to avoid excessive bending.

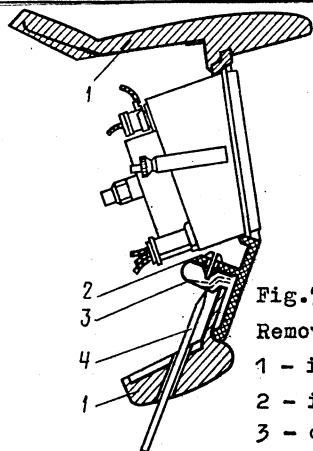


Fig.7-38.

Removing the Instrument, Panel:

- 1 - instrument panel;
- 2 - instrument board;
- 3 - clamp; 4 - piercer

The instrument illuminating and signal lamps are removed from their holders complete with the sockets.

Methods of Trouble Shooting

The instrument circuit diagram is shown in Fig.7-39. The circuit diagrams of the battery no-charge signal lamp, marker light, upper beam signal lamps and direction indicator signal lamp are given earlier in Figs 7-5, 7-25, 7-26 and 7-29.

Coolant Temperature Gauge

If the gauge pointer stays constantly at the beginning of the scale, turn on the ignition switch, disconnect the wire from the gauge transmitter and touch the end of the wire to "ground".

If the pointer deflects, it means that the transmitter is faulty and has to be replaced. If the pointer does not deflect, remove the instrument board, turn on the ignition switch and touch the gauge terminal "V" to "ground". In this case deflection of the pointer will indicate that the instrument is in order, but the wire between the gauge and its transmitter is faulty. If the pointer stays still, replace the instrument.

If the gauge pointer stays constantly in the red zone, turn on the ignition switch and disconnect the wire from the transmitter. If the transmitter is faulty, the pointer will return to division "50".

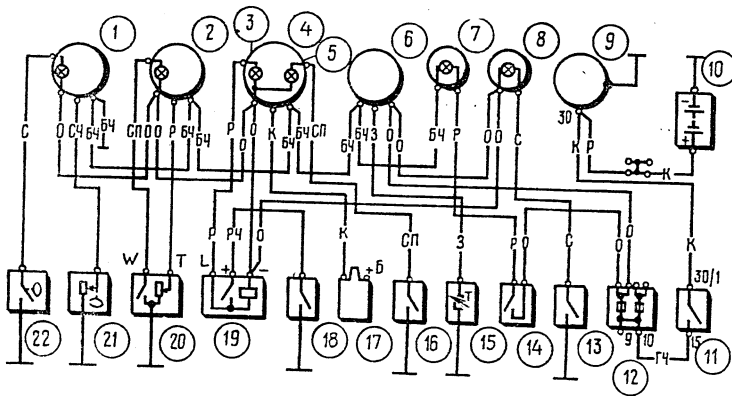


Fig.7-39. Instrument Circuit Diagram:

- 1 - oil pressure gauge with low pressure signal lamp; 2 - fuel level gauge with fuel reserve signal lamp; 3 - parking brake signal lamp; 4 - tachometer; 5 - carburettor choke signal lamp; 6 - coolant temperature gauge; 7 - brake fluid signal lamp; 8 - differential lock signal lamp; 9 - generator; 10 - storage battery; 11 - ignition switch; 12 - fuse block; 13 - differential lock signal lamp switch; 14 - brake fluid low level transmitter; 15 - coolant temperature gauge transmitter; 16 - carburettor choke signal lamp switch; 17 - ignition coil; 18 - parking brake signal lamp switch; 19 - parking brake signal lamp relay-breaker; 20 - fuel level and reserve transmitter; 21 - oil pressure gauge transmitter; 22 - oil pressure signal lamp transmitter

If the pointer stays in the red zone, it means that either the wire is shorted to "ground" or the instrument is damaged. The condition of the gauge can be checked by disconnecting the green wire leading from the gauge to the transmitter. With the ignition switch turned on the pointer should return to "50" division:

Fuel Level Gauge

The checking procedure is the same as described above. It should be borne in mind that terminal "W" of the gauge transmitter is connected with the wire leading to the fuel reserve signal lamp while the wire leading to the gauge proper is connected to terminal "T".

If the gauge pointer stays constantly at the beginning of the scale and does not deflect when the wire disconnected from transmitter terminal "T" is touched to "ground", it is necessary to check the gauge. For this purpose remove the instrument board, turn on the ignition switch and connect the "S" terminal of the gauge to "ground". If the gauge is sound, its pointer will deflect to the end of the scale.

If the gauge pointer is constantly opposite

the 4/4 division, the condition of the gauge can be checked by disconnecting from it the pink wire leading to the "T" terminal of the transmitter. In this case the pointer of the sound gauge should settle opposite division "0" when the ignition switch is turned on.

Oil Pressure Gauge

The checking procedure is the same as described above. When looking for the cause of the trouble, connect the "HN" terminal of the gauge to "ground" or disconnect from it the grey wire with black tracer leading to the transmitter.

Instrument Checks

Coolant Temperature Gauge

The gauge YK-193 functions in conjunction with the transmitter TM-106. With the transmitter resistance ranging from 640 to 1320 Ω the pointer should stay at the beginning of the scale, at a resistance of 77-89 Ω it should be at the beginning of the red zone while at a resistance of 40-50 Ω it should move to the end of the red zone of the scale.

Fuel Level Gauge

The gauge YB-193 is used in conjunction with transmitter EM-168 installed in the fuel tank. This transmitter is also used to light up the fuel reserve signal lamp when 5.3-6.5 l of gasoline remains in the tank.

With the transmitter resistance ranging from 285 to 335 Ω the pointer should settle at the beginning of the scale, at 100-135 Ω it should be in the middle of the scale and at 7-25 Ω , in the end of the scale.

Oil Pressure Gauge

The gauge YK-194 incorporates a critical oil pressure signal lamp turned on by transmitter MM-120.

The gauge works jointly with MM393A transmitter which changes the resistance of the electrical circuit in accordance with the changes of oil pressure in the engine lubricating system. At a transmitter resistance of 285-335 Ω the gauge pointer should be at the beginning of the scale, at 100-135 Ω , in the middle of the scale and at 0-25 Ω , at the end of the scale.

Tachometer

The electronic tachometer TX-193 installed on the car operates by measuring the frequency of voltage pulses in the primary circuit of the engine ignition system.

The tachometer should be checked on a stand simulating the engine ignition system. Connect the tachometer to the stand circuitry in the same manner as on the car, set a voltage of 14 V in the primary

circuit and a 7 mm gap in the stand discharger. Rotate the distributor shaft at a speed at which the tachometer pointer moves to one of the scale divisions. At this instant check to see that the distributor shaft speed is within the limits specified in Table 7-6.

Table 7-6
Tachometer Reference Data

Scale divisions, s^{-1} (rpm)	Distributor shaft speed, s^{-1} (rpm)
16.6 (1000)	7.3-9.6 (440-550)
33.3 (2000)	14.4-17.5 (875-1050)
50 (3000)	22.5-25.4 (1350-1525)
66.6 (4000)	30.8-33.7 (1850-2025)
83.3 (5000)	39.1-41.6 (2350-2500)
100 (6000)	48.3-50 (2900-3000)
116.6 (7000)	55.8-58.3 (3350-3500)
133.3 (8000)	63.3-70 (3800-4200)

Speedometer

The speedometer CH-193 consists of a pointer-type speed indicator showing the road speed in kilometers per hour, an odometer and a trip counter.

The trip counter can be reset to zero by rotating counterclockwise the knob on the instrument board.

To avoid damaging the counter, do not reset it on the moving car.

To check the speedometer, compare its readings with those of a reference speedometer. The speedometer reference data are given in Table 7-7.

Table 7-7
Speedometer Reference Data

Drive cable speed, s^{-1} (rpm)	Speedometer readings, km/h
8.3 (500)	31-35
16.6 (1000)	62-66.5
25 (1500)	93-98
33.3 (2000)	124-130
41.6 (2500)	155-161.5

Checking the Instrument Transmitters

Fuel Level Transmitter

The FM-168 transmitter is fastened by screws in the fuel tank.

The transmitter comprises a variable resistor of nichrome wire. The resistor slide is controlled by a lever with a float. The short end of this lever also carries a movable contact which switches on the fuel reserve signal lamp when 4-6.5 l of gasoline remains in the tank.

With the empty tank the transmitter resistance should be 315 - 345 Ω ; it should be 108-128 Ω with a half-full tank and 7 Ω or less when the tank is full.

Coolant Temperature Transmitter

The TM-106 transmitter is screwed into the cylinder head at the L.H. side of the engine.

The transmitter comprises a thermal resistor whose electric resistance varies with the temperature of coolant. The transmitter reference data are given below in Table 7-8.

Table 7-8
Coolant Temperature Transmitter Reference Data

Temperature, $^{\circ}\text{C}$	Supply voltage, V	Transmitter resistance, Ω
30	8.00	1350-1880
50	7.60	585-820
70	6.85	280-390
90	5.80	155-196
110	4.70	87-109

Oil Pressure Transmitter

The MM393A transmitter converts pressure in the engine lubricating system into electric resistance. It is installed on the L.H. side of the cylinder block. The transmitter reference data are given in Table 7-9.

Table 7-9
Reference Data

Pressure, MPa (kgf/cm ²)	Transmitter resistance, Ω
0 0	290-320
0.4 (4)	103-133
0.6 (6)	55-80
0.8 (8)	0-15

Oil Pressure Signal Lamp Transmitter

The MM-120 transmitter is installed on the L.H. side of the cylinder block.

The transmitter contacts should close and open at a pressure of 20-60 KPa (0.2-0.6 kgf/cm²).

Parking Brake Signal Lamp Relay-Breaker

The PC-492 relay-breaker ensures the blinking light of the parking brake signal lamp. It is suspended from wires behind the instrument board.

The number of closing and opening cycles per minute at a voltage of 10.8-15 V and a temperature from -40 to +40 $^{\circ}\text{C}$ should range from 60 to 120. The resistance of the breaker winding is 26 Ω .

Section VIII

BODY

TROUBLE SHOOTING

Cause of trouble	Remedy
<u>Dark Stains Over Entire Body Surface</u>	
1. Car washed with very hot water (over 80 °C)	1. Eliminate minor defects by polishing; repaint body if heavily damaged
2. Ethylated gasoline and other paint-attacking materials used for removing protective wax coating	2. Polish body or repaint it, if necessary
<u>Pink Stains on Light-Coloured Surfaces</u>	
Coolant spilled on body surfaces	Polish damaged surfaces
<u>Light Stains on Dark-Coloured Surfaces</u>	
Effect of moisture during prolonged storage of car under airtight covers	Polish damaged surfaces or repaint car body, if necessary
<u>Enamel Paint Lost Initial Lustre</u>	
1. Wiping of car with dry rags	1. Polish dull surfaces, repaint body, if necessary
2. Prolonged exposure to sun light	2. Polish, repaint body, if necessary
3. Employment of paint-attacking materials for washing	3. Polish dull surfaces, repaint body, if necessary
<u>Water Penetrates into Car Body</u>	
1. Clogging of water drain holes in windshield weatherseal	1. Remove windshield, clear up holes or replace weatherseal. When installing weatherseal, align its holes with holes in body.
2. Poor tightness of antenna cable seal	2. Replace seal or coat it with nondrying sealing compound
3. Excessively large clearance around door perimeter	3. Adjust position of door and of lock thrust block
4. Crushed metal framework of door weatherstrip	4. Replace weatherstrip
5. Valve for draining water from heater air intake box squeezed by vacuum booster hose	5. Set right vacuum booster hose
<u>Door Opens with Difficulty</u>	
1. Bending of door lock thrust block retainer axle	1. Replace axle
2. Wear of thrust block retainer	2. Replace retainer
3. Wrong door position	3. Adjust door position
<u>Door Lock Cannot be Locked by Button or with Key</u>	
Upper end of outer remote control lever bears against outer handle shoulder	Bend off upper end of lever from handle shoulder to set a clearance of 0.5-2 mm between them
<u>Door Fails to be Opened by Outer Handle</u>	
Excessively large clearance between door outer handle shoulder and upper end of outer lock control lever	Bend upper end of lever to handle shoulder to set a clearance of 0.5 - 2 mm

Cause of trouble	Remedy
<u>Door Fails to be Locked</u>	
1. Breaking or weakening of lock central shaft spring or of outer control lever	1. Replace lock
2. Loose upsetting of outer control lever. Lever tooth fails to engage ratchet due to axial displacement of lever	2. Remove lock and upset axle reliably
3. Outer control lever jamming due to gumming of lubricant and dust	3. Remove lock, wash and lubricate it
<u>Inner Handle Fails to Open Door Completely</u>	
Incomplete travel of inner control lever due to insufficient travel of link	Adjust position of inner lock handle
<u>Hood Lock Cannot be Opened by Handle from Inside the Car</u>	
1. Breaking of lock control cable	1. Replace cable
2. Lock control cable too long	2. Adjust cable length by its fastening loop on lock hook
<u>Hood Fails to be Locked</u>	
1. Lock spring broken	1. Replace spring
2. Lock control cable too short	2. Adjust cable length by its fastening loop on lock hook
3. Lock displaced on car body	3. Adjust position of lock
<u>Roll-Down Window Glass Cannot be Fixed in Desired Position</u>	
Window regulator spring brake broken	Replace window regulator
<u>On Lifting Rake-Adjusting Handle, Front Seat Back Fails to Return from Reclined Position</u>	
Breaking of mechanism spring	Replace spring, check functioning of mechanism
<u>Front Seat Back Fails to be Fixed in Desired Position</u>	
Breaking of back retainer teeth	Replace seat framework
<u>Difficult Adjustment of Front Seat Position</u>	
1. Slides jammed in rail guides due to lack of lubricant	1. Lubricate slides and guides
2. Balls fell out of seat rails over bent edges of slides and guides	2. Disassemble seat rails, insert balls, assemble mechanism and bend guide and slide edges as required. Replace seat rails if necessary
<u>Hot Air Constantly Supplied into Car Interior</u>	
1. Heater cock control mechanism faulty	1. Examine control mechanism, fasten link casing and replace link, if necessary
2. Heater cock fails to shut off coolant flow	2. Replace cock
<u>Only Cold Air Supplied into Car Interior</u>	
1. Heater cock fails to open due to breaking of cock controls	1. Examine control mechanism, fasten link casing, replace link, if necessary
2. Cock faulty	2. Replace cock
<u>Insufficient Air Supply into Body Interior</u>	
Faulty cable control linkage of air intake hatch lid (lid closed)	Examine control linkage, fasten link casing, replace link, if necessary.

BODY SHELL

The design of the body shell and miscellaneous sheet metal parts is shown in Figs 8-1, 8-2, 8-3.

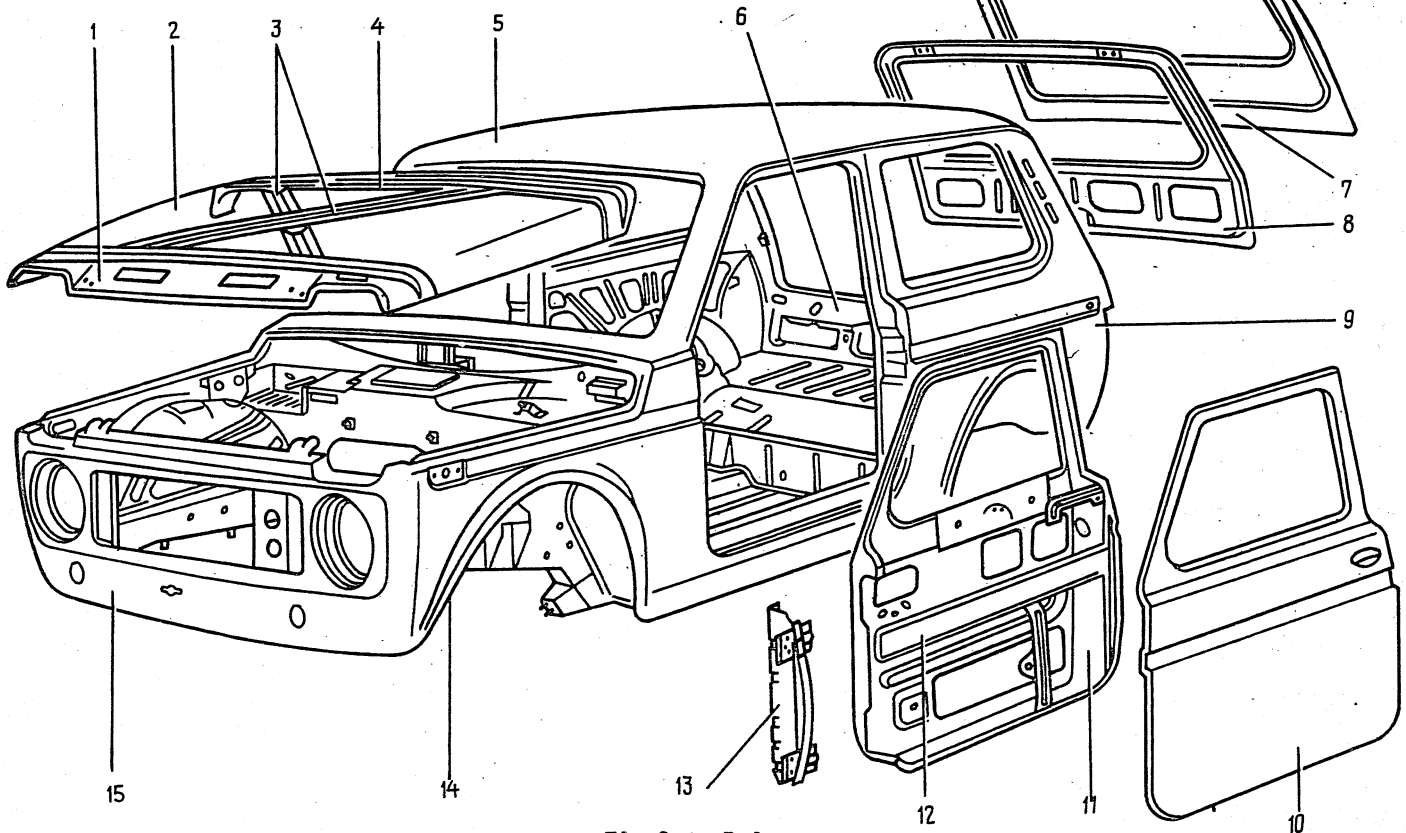


Fig.8-1. Body:

1 - hood front reinforcement; 2 - hood panel;
3 - hood diagonal reinforcements; 4 - hood rear reinforcement; 5 - roof panel; 6 - body rear panel;
7 - tailgate outer panel; 8 - tailgate inner panel;

9 - body side; 10 - front door outer panel;
11 - front door inner panel; 12 - door rail;
13 - front door extension; 14 - front fender;
15 - radiator grille panel

Gauging and Straightening

A considerable proportion of body repairs falls to the crashed cars which in most cases have to be checked for the geometry of the fastening points of the chassis units and mechanisms (Fig.8-4).

The equipment designed for checking the datum points is also used for repairs in combination with the fixtures for straightening the body.

The distorted surfaces are repaired by mechanical or thermal treatment of metal and by filling the dents with quick-hardening plastics or solders.

The distorted surfaces are straightened, as a rule, manually with the aid of special tools (metal, plastic and wooden hammers, mallets and various mandrels) and fixtures.

Hot straightening is resorted to for contracting heavily stretched surfaces of panels. To rule

out sharp bulging and deterioration of mechanical properties, the panels are heated to cherry red colour (600-650 °C).

The heated spot should not be larger than 20-30 mm in diameter.

Contract the surface as follows:

- heat metal with a gas burner from the periphery to the centre of the defective spot and flatten the heated surfaces with a wooden maul and hammer on a flat backing or anvil;

- repeat heating and upsetting operations until the panel surface becomes smooth.

The distorted places on the panels can be smoothed out with polyester putties, thermoplastic cold-setting epoxy mastics and solders.

The polyester putties stick reliably to the panels dressed to bright metal. These are bi-component materials: unsaturated polyester resin and

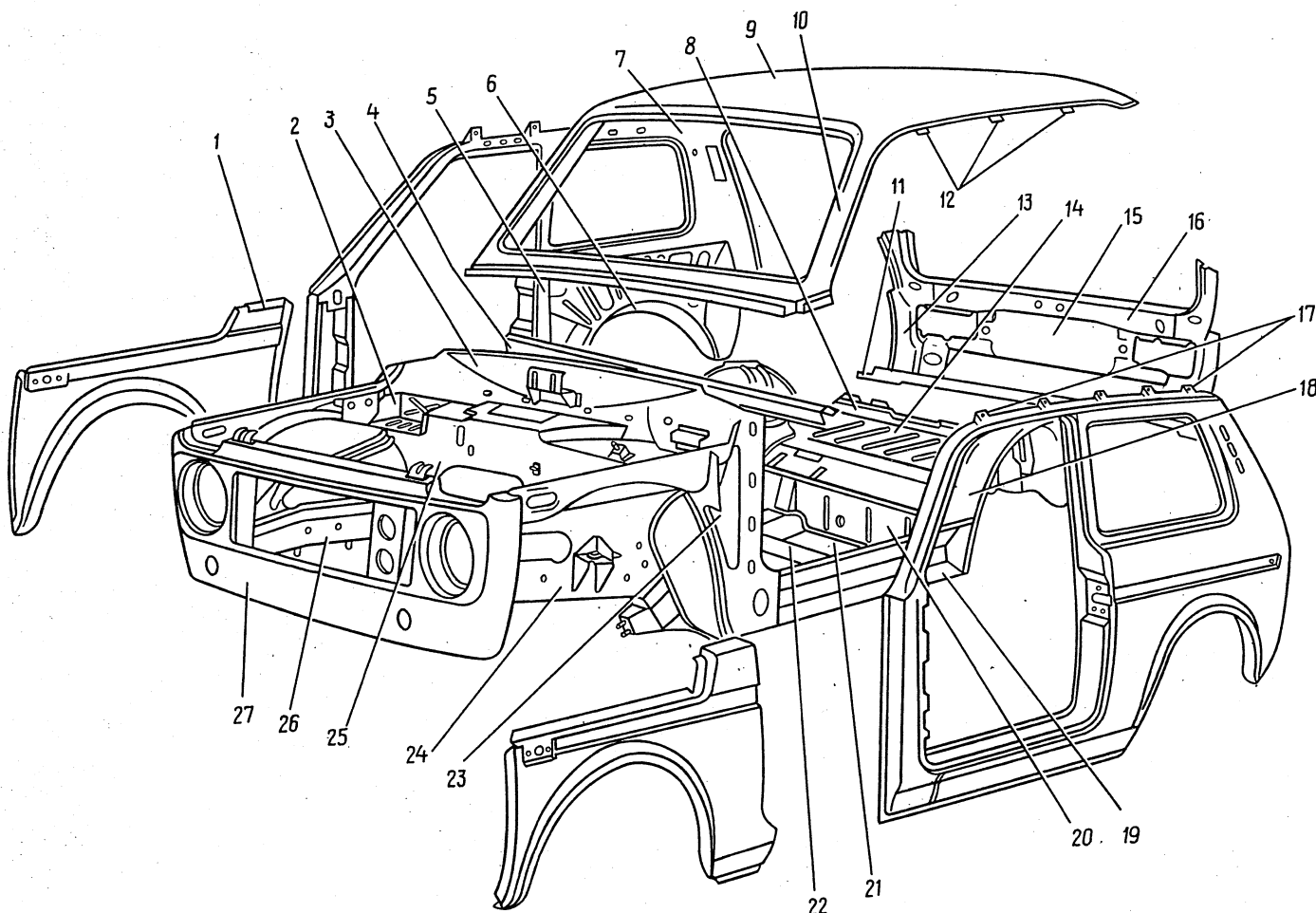


Fig.8-2. Body Parts:

1 - front fender; 2 - storage battery pan; 3 -dash-board upper reinforcement; 4 - instrument panel cross member; 5 - central pillar; 6 - rear wheel outer arch; 7 - body side inner panel; 8 - floor rear cross member; 9 - roof panel; 10 - windshield frame; 11 - wheel splashguard; 12 - roof reinforcements; 13 - rear pillar; 14 - floor rear panel; 15 - tailgate panel; 16 - tailgate upper cross

member; 17 - roof lining bow brackets; 18 - rear wheel inner arch; 19 - floor and body side connector; 20 - floor cross member under rear seat; 21 - floor front panel; 22 - floor cross member under front seat; 23 - body front side panel; 24 - front fender mud guard; 25 - dashboard; 26 - front side member; 27 - radiator grille panel

a curing agent serving as a catalyst for rapid hardening of the mixture, irrespective of the thickness of the putty layer. The drying time is 15-20 minutes at 20 °C. Therefore, there is no necessity in applying several layers of putty and thus the time of its application is reduced.

The corroded surfaces of the body panels can be repaired with cold-setting epoxy cements which feature good adhesion, sufficient strength and are easy to apply to the damaged spots.

The sealing cements are composed of curing agents, plasticizers (to improve plasticity of resin and impact strength of the hardened epoxy compound), fillers (to diminish shrinkage of resin and to bring nearer the coefficients of thermal expansion of resin and metal).

Solders HOC-18 or HOC-20 are used to straighten the spots already filled with solder, to build up the edges of parts and to fill up clearances. To avoid corrosion it is better to use the acid-free method of solder application.

Heavily distorted panels should be replaced by new ones installed with the use of resistance welding and gas-shielded arc welding.

Replacing the Front Fender

If the fender is slightly damaged (shallow dents, scratches, etc.), straighten it out directly on the car and have it painted. After straightening, check the condition of the inner anticorrosion coating and restore it, if necessary.

In case of serious distortions and fractures, replace the fender.

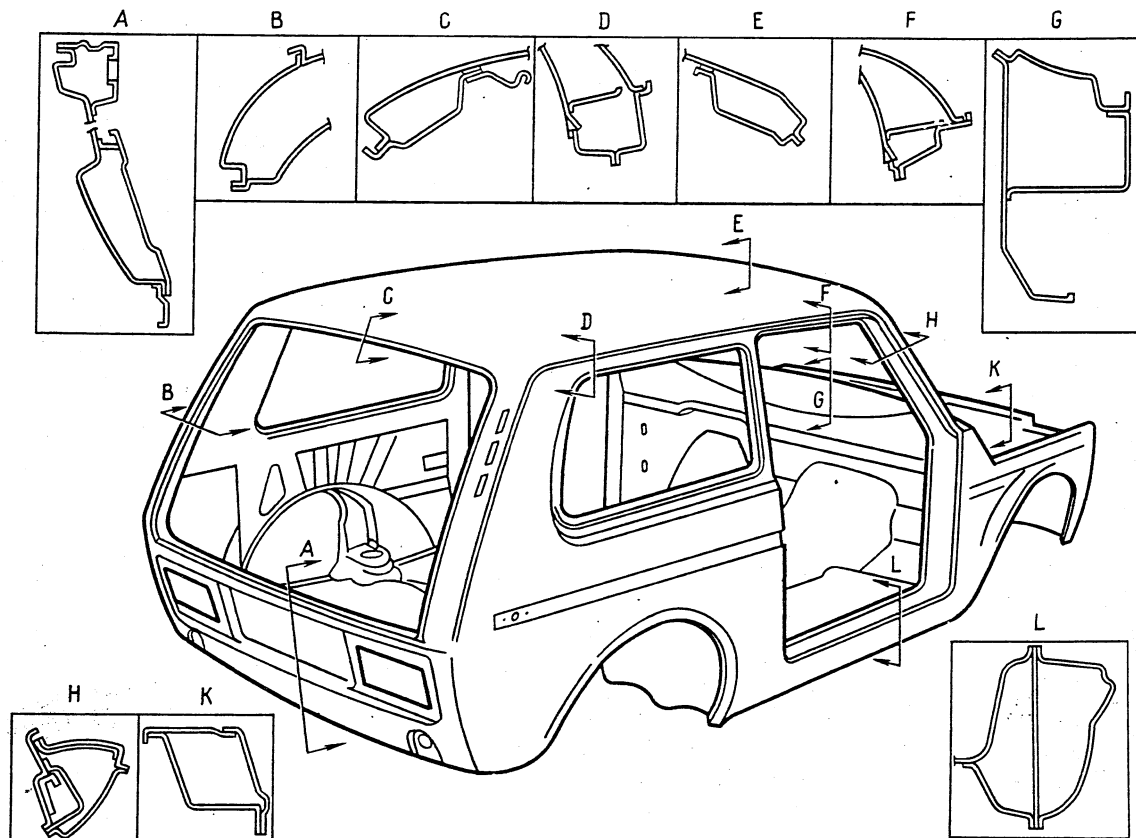


Fig.8-3. Body Main Sections

Remove the bumper, hood and front door.

Using a sharp chisel or a grinder, cut off the fender along the lines shown in Fig.8-5.

Detach the fender, remove the remaining metal strips, straighten out the distorted edges and dress them with an electric or pneumatic grinder.

Install the front door and a new fender and fasten it with quick-detachable clamps.

Gas-weld the fender at points shown by arrows in the Figure. Use solder bars J62, J63 of 2-3 mm diameter as a filler material.

Install the hood and check the position of the fender. It must protrude or sink relative to the door or hood not in excess of 2 mm; the gaps between the fender and the hood and door over the face surface should not exceed 5 ± 2 mm.

Remove the hood and the door.

Weld the fender with resistance welding at a pitch of 40-50 mm to the front pillar, mudguard and dashboard. It is also permissible to use gas welding with brass solder or carbon-dioxide shield-arc welding with intermittent 10 mm welds applied every 50-60 mm. Weld the fender with semiautomatic arc welders using welding wire MCB 08 TIC or MCB 08 I2C, 0.8 mm in diameter.

Gas-weld the fender to the body front panel by flashing off the edges with an intermittent weld.

Replacing the Roof

As a rule, the roof of a crashed car has to be replaced.

Remove the tailgate, drip channel mouldings, windshield, roof lining and accessories.

Place the new roof panel on the body and determine the points where the pillars and roof side panels have to be cut.

Cut off the roof panel along the lines shown in Fig.8-5.

Detach the roof panel, remove the remaining panel strips and straighten the distorted surfaces.

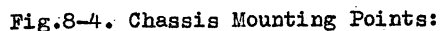
Dress the paint and prime-coat to bright metal on the welded edges of the roof panel, windshield frame, body side panels, roof side panels and reinforcements.

Replace gaskets on the roof reinforcements.

Install the roof panel, fasten it with quick-removable clamps and gas-tack the panel at points shown by arrows in Fig.8-5.

Weld the roof panel by resistance welding at a pitch of 40-50 mm or by gas welding at points spaced 50-60 mm through the previously drilled holes of 5-6 mm diameter. To rule out distortion of parts, work from the middle of the weld to the right and left.

Dress the welds with an electric or pneumatic grinder.



14 - power plant rear mount fastening points;
15 - transfer case fastening points; 16 - hand
brake fastening points; 17 - longitudinal radius
rod front fastening points; 18 - longitudinal
radius rod rear fastening points; 19 - rear shock
absorber fastening points; 20 - transverse radius
rod fastening points; 21 - main muffler front
fastening points; 22 - main muffler tail pipe
fastening points;

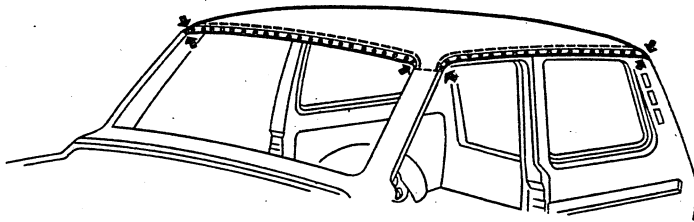
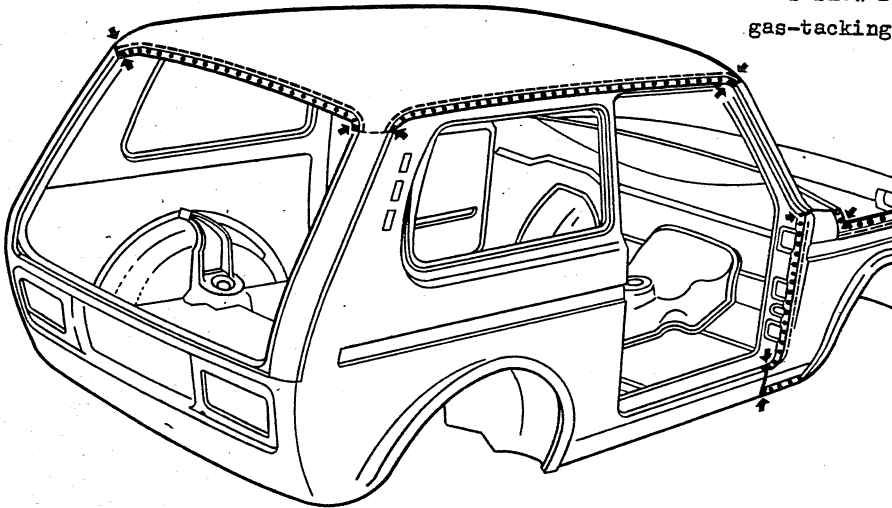


Fig.8-5. Front Fender and Roof Panel Welding Contours

Dots show resistance welding seams . Arrows show gas-tacking points



BODY PAINT

Polishing

If the lustre of the paint is slightly dulled, or there are greasy stains, use car polish BA3-03.

When the paint has lost its lustre but partly, rub the car with polishing paste BA3-2. It produces a smooth glossy surface.

Before polishing, wash the car body carefully and wipe it with a piece of clean flannel.

If the paint lustre is considerably worsened, use polishing paste BA3-1, then paste BA3-2.

The car polish BA3-03, pastes BA3-2 and BA3-1 do not make the flannel wheel oily and mix readily with water.

Take care to mix the polishing paste before application; if it becomes thick, dilute it with water until a paste-like homogeneous mass is obtained.

Apply the polishing pastes in a thin layer and polish the car body in small portions.

Polishing can be done either by hand or mechanically, with flannel or fur wheels.

After polishing, wipe the surfaces with clean flannel.

Repainting with Synthetic Enamels

Wash the body with water and remove the old flaking paint from the defective surfaces with a spatula or a brush.

Wet-rub the surfaces to be painted using grinding cloth 63C8II or 55C4II (GOST 10054). Poorly accessible places should be rubbed by hand. If the surfaces are seriously corroded or the body has previously been painted with nitrocellulose enamel, dress it down to bare metal.

Wash the body with water, airblast it and leave to dry.

Degrease the surfaces to be painted with white spirit (GOST 3134-52) and apply sealing compound "plastisol Д-4А" to the welds and joints. Remove surplus sealant with rags soaked in white spirit.

The surfaces not to be painted should be masked with thick paper and adhesive tape.

Using a paint gun, apply primer IФ-073 to the surfaces dressed down to bright metal.

The viscosity the primer should be 22-24 s at 20 °C, as read by viscometer B3-4. Dilute the primer with xylene.

Using a paint spray gun, apply epoxy primer 3Ф-083 to the surfaces coated with primer IФ-073 and to the replaced body parts and dry them at 90 °C for 60 minutes. Before applying primer 3Ф-083, mix it with 3-4 % of catalyst (by weight). The primer with catalyst is fit for use in the course of 7 hours. The primer viscosity should be 23-25 s at 20 °C as read by viscometer B3-4. The

primer can be diluted with solvent P3-11B, xylene, butyl alcohol and ethylcellosolv.

Cool down the body, wet-rub it with abrasive cloth 63C8II or 55C4II, wash with water, airblast and leave to dry.

Fill, if necessary, the rough surfaces with putty MC-00-6 (GOST 10277-62), applying a layer not thicker than 0.3 mm. If the putty is found to be thickened, dilute it with xylene.

Dry the body for 30 minutes at 18-20 °C. Flatten the surface again with emery cloth 55C4II, wash the body, airblast it and leave to dry.

Mask the non-painted surfaces of the body with thick paper or adhesive tape and place it into the painting chamber.

Degrease the surfaces to be painted with white spirit and dry for 15 minutes at 18-20 °C.

Open the doors, hood and trunk lid and apply two layers of enamel MJ-197 from a paint gun, making an interval of 7-10 minutes between successive applications, to the internal painted surfaces of the car interior, door frames, door edges, engine compartment and trunk.

Apply three layers of MJ-197 enamel to the external surfaces of the body, making 7-10 minute intervals between successive applications.

Dry the paint coating at 90 °C in the course of 1 h and cool it down under natural conditions.

If necessary, remove the surplus sprayed paint with car paste BA3-2.

Before using the enamel, mix it with 3 % of catalyst by weight. The enamel viscosity should be 20 s at 20 °C as read by viscometer B3-4. Dilute the enamel with solvent P-197 (GOST 18187-72) followed by filtering it through screen No.015K (GOST 3584-53).

If the old paint should be removed, use paint remover CH-7. Apply the remover with a brush 2-3 times depending on the thickness of the old paint and primer. The old coating will soften in 30-40 minutes after which it can be scraped off with a brush or a spatula.

Wipe the surface with white spirit to take off the remaining paint remover, wash with water abundantly and dry the body.

Painting the Individual Body Parts

After the replacement of individual body parts (fender, door, hood, etc.), as well as after straightening the distorted parts, paint the part in question over the entire external surface.

Before painting the newly installed parts, coat them all over with epoxy primer 3P-083.

The preparation for painting and for the application of enamel paint should go along the same lines as when repainting the car body.

ANTICORROSIVE TREATMENT OF BODY

The elements most likely to be attacked by corrosion include the load-bearing hollow spaces of the body, bottom, lower parts of the doors and pillars, as well as the joints of body parts including the spot-welded seams.

Corrosion is apt to spread intensively in the boxed spaces and lower parts of the body when they get in contact with moisture, dirt, salts and acids.

This calls for an additional protection of the internal surfaces and boxed spaces of the body by applying special anticorrosive compounds and by filling the joints with sealing cements.

The materials used for anticorrosive treatment are summarized in Table 8-1.

The autopreservative "Movil" is recommended for treating the boxed spaces. A good practice is to treat them every 1 - 1.5 years. This autopreservative can be used for application to the surfaces previously coated with nigroil and other oils and to the rusty surfaces. The required amount is 3 kg.

The protective lubricant HIM-MI is used for treating the boxed spaces. All the new cars are treated with this lubricant.

The protective film coating HT-2IGB is applied to the car parts under the body.

The soundproofing bituminous sealant HIM-1 is used for anticorrosive protection of the body underside and for reducing the noise caused by vibration. The sealant is applied by spraying or by hand in a layer 1.5-2 mm thick.

Plastisol D-11A protects the body underside against corrosion, abrasive wear and ensures soundproofing. The thickness of coating is 1 - 1.5 mm. The best adhesion is achieved at room temperature to primers 3P-083, 4M-093 and BK4 -0207.

Plastisol D-4A is used for sealing the welded joints on the external zones of the body.

The non-drying sealant 51-T-7 seals the body joints.

The internal spaces are sprayed over with anticorrosive materials by air or airless spraying.

Air spraying with compressed air at a pressure of 0.5 - 0.8 MPa is carried out with a spray gun and a reservoir, hoses and spray gun extension nozzles. The best coating is achieved by airless spraying under a pressure of 4 - 12 MPa which makes it possible to spray highly viscous materials.

Table 8-1

Materials for Anticorrosive Treatment of Car Body

Name	Grade	Viscosity, s, at 20 °C read by viscometer B3-4	Name of thinner or solvent	Drying conditions	
				temperature, °C	time, min.
Sill preservative	"Movil"	15-40	White spi- rit, gaso- line	20	20-30
Non-drying protective lubricant	HIM-MI	45	White spirit	20	15
Protective film coating	HF-2I6B	18-22	White spirit, 20 gasoline	20	20
Soundproofing sealant	HIM-1	high- viscosity	Xylene, solvent	100-110 (or 24 h at 18-20 °C)	30
Flexible PVC	Plastisol II-IIA	high- viscosity	-	130	30
Flexible PVC	II-4A	high- viscosity	-	130	30
Non-drying sealant	51-T-7	high- viscosity	-	-	-

Anticorrosive Treatment of Boxed
Spaces

Inasmuch as treatment of boxed spaces calls for the use of sophisticated technological equipment and for high-quality of work, this operation is performed only at service stations.

The procedure is as follows:

1. Place the car on a lift, remove the parts and upholstery that interfere with access to the boxed spaces.

2. Wash the boxed spaces (Table 8-2), body underside, wheel arches with water at 40-50 °C through auxiliary and drain holes until the water flowing out becomes clean. The ventilator glasses should be closed and roll-down window glasses lifted up all the way.

3. Remove any moisture that could have penetrated into the body and trunk, airblast all the boxed spaces and the surfaces to which the anticorrosive compounds will be applied.

4. Take the car to the anticorrosion-treating chamber and put it on a lift. Spray the anticorrosive compound onto the surfaces shown in Figs 8-6, 8-7 and 8-8.

5. Lower the car from the lift, and clean the external surfaces of the body with rags soaked in white spirit.

Restoring the Anticorrosive and Soundproofing
Coatings of Body Underside
and Wheel Arches

In the course of service, the coatings on the body bottom are subjected to the damaging effect of gravel, sand, salt and moisture. As a result, the sealant and primer are damaged and abraded. The bare metal is attacked by corrosion.

With a view to soundproofing and anticorrosive treatment, the lower part of the body base and side members are protected at the autoplant with a layer of PVC plastic "plastisol II-11A" 1 - 1.5 mm thick on top of epoxy primer 3Ф-083.

Fig.8-6. Boxed Spaces (Front View of Body):

1 - body front upper cross member; 2 - headlamp housings; 3 - body front lower cross member; 4 - under front fender; 5 - outer sill; 6 - inner sill

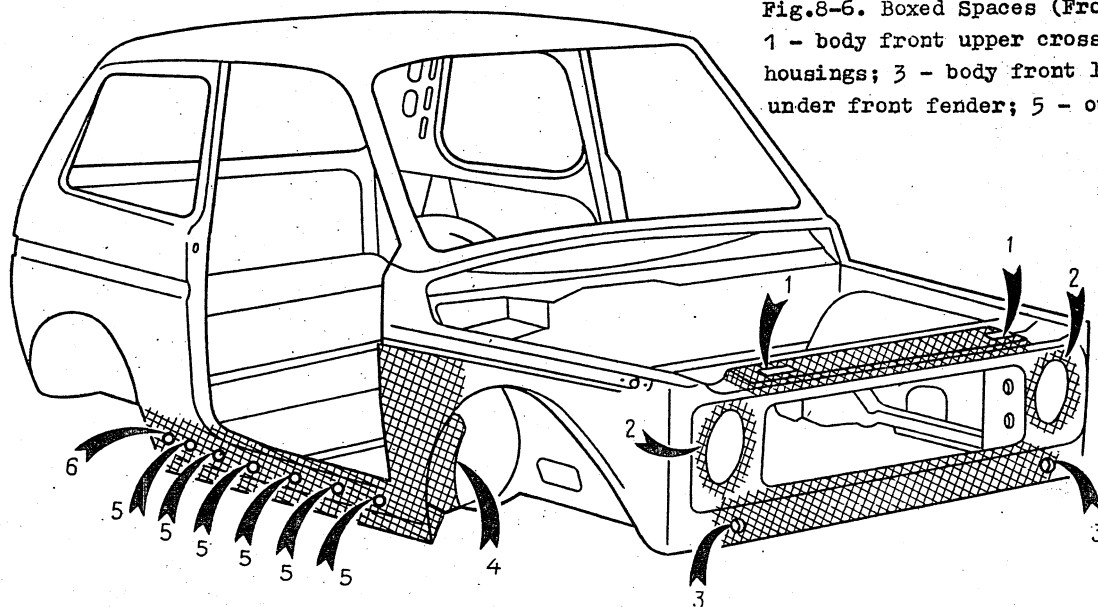


Table 8-2

Boxed Spaces Treated with Anticorrosive Compounds

Name of space	Where injected	Direction of injection	Additional instructions
Body front upper cross member	Through two upper holes	Right and left	Open engine hood
Headlamp housings	In front (from outside)	All over	Remove headlamps
Body front lower cross member	Through two holes for installation of bumper	Right and left	Remove front bumper
Under front fenders	Through opening closed with shield	All over	Remove sealing shield
Door outer sills	Through six side holes	Forward and back	Remove mouldings and fasteners
Door inner sills	Through rear hole in sill end	Along sill	
Front side members	Through bumper installation holes	Along side member	Remove front bumper
Front side member connectors	Through holes on body underside	Right and left	Put car on lift
Middle and rear side members	Through seven holes in body underside	Forward and back	Put car on lift
Middle side member connectors	Through holes in body underside	Right and left	Put car on lift
Rear floor cross member	Through holes in trunk and body underside	Right and left	Remove trunk lining
Body rear lower cross member	Through two holes in body underside	Right and left	Put car on lift
Body rear upper cross member	Through openings under tail lamps	Upward and right, left	Remove tail lamps
Between rear wheel arches and body sides	Into openings in trunk	All over	Remove trunk lining
Door rear pillars	Through hole behind pillar	Downward	Remove lining
Door front pillars	Through two holes from interior side	Downward	Remove lining
Door pockets	Through openings in door inner panel	All over internal surface	Remove door lining

Fig.8-7. Boxed Spaces (Body Rear View):

1 - rear side members; 2 - tailgate upper cross member (in slot with tail lamps removed); 3 - between rear wheel arches and body sides; 4 - rear side members; 5 - rear floor cross-member; 6 -door rear pillars; 7 - door front pillars; 8 - door pocket

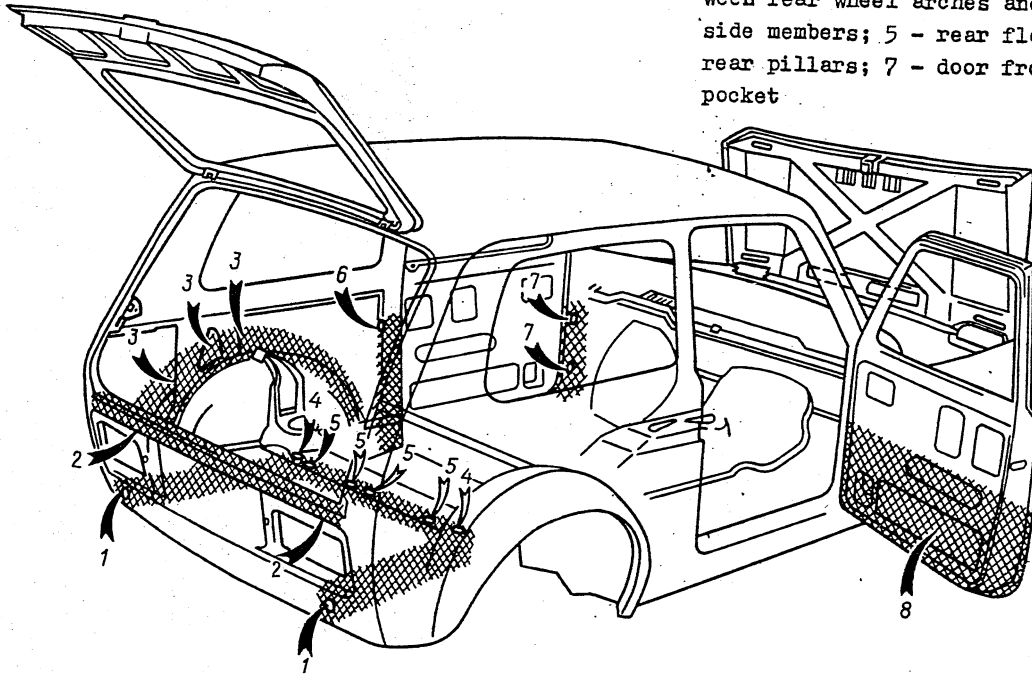
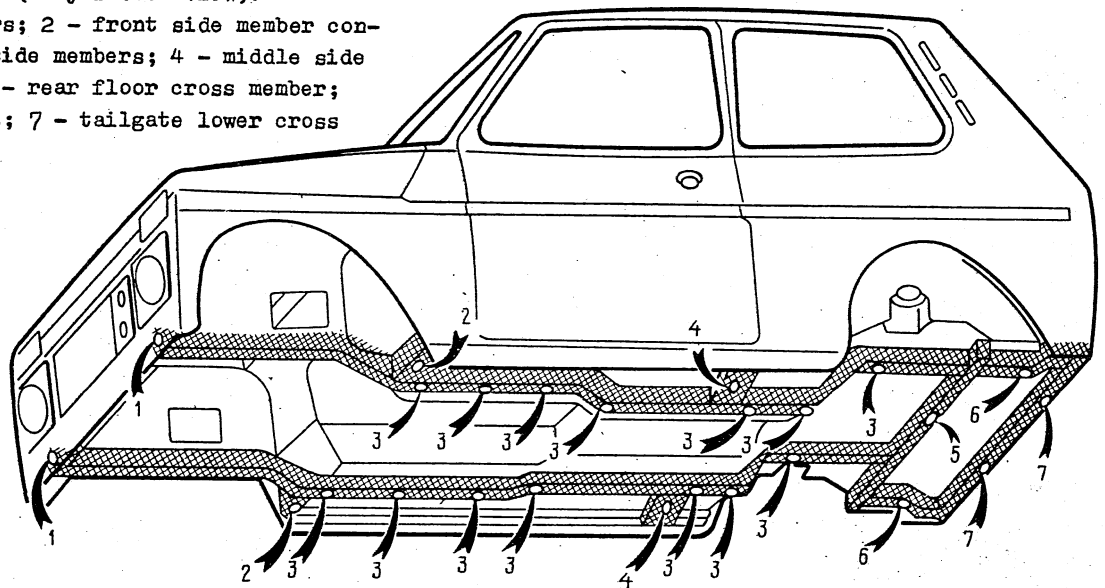


Fig.8-8. Boxed Spaces (Body Bottom View):

1 - front side members; 2 - front side member connectors; 3 - middle side members; 4 - middle side member connectors; 5 - rear floor cross member; 6 - rear side members; 7 - tailgate lower cross member



If the coating of plastisol II-11A is damaged but the layer of primer remains intact, clean the damaged surfaces of dirt and apply plastisol to the dry surface by airless spraying or with a brush. Dry plastisol III-A at 130 °C for 30 minutes.

It is also permissible to apply soundproofing sealant HIM-1 which can be dried under natural conditions.

Before restoring the coating, put the car on a lift, examine the body underside thoroughly and determine the defects of the coating. Clean the body underside of dirt, remove any rust with a spatula, abrasive cloth or rust remover according to the relevant instructions. Airblast the body underside.

Place the car on a lift in the rustproofing chamber and remove the wheels.

Close the brake drums and discs with protective housings, mask the propeller shaft drive, muffler, cables and other surfaces not to be treated, using thick paper and adhesive tape.

Degrease the surfaces dressed to bright metal with rags soaked in white spirit.

Coat the dressed surfaces with primer ПЭ-073 by spraying or with a brush and leave to dry for 5-10 minutes. Then apply a coat of sealant БИМ-1 1 - 1.5 mm thick to the defective surfaces by spraying or manually with a brush or a spatula. The old layer of the coating should be overlapped as little as possible.

In cold season keep the sealant before use in a warm room so that its temperature rises at least to 20 °C. If the sealant is thickened, dilute it with up to 3 % of xylene.

Clean the paint coating of surplus sealant with rags soaked in white spirit. Dry the sealant at 100-110 °C for 30 minutes or at 18-20 °C for at least 24 h.

Sealing the Body with Rubber Weatherstrips and Sealants

The body is sealed by various weatherstrips (Fig.8-9), sealing compounds, rubber plugs installed in auxiliary holes, and by careful fitting of the mating parts.

When removing and installing the weatherstrips, avoid corrugating and crushing their metal reinforcements.

The resistance spot welds joining the stamped parts of the body fail to provide a tight joint. They are subjected to heavy corrosion, particularly at the bends of sheets with small rounding radiuses and at overstrained points.

The welded seams are protected at the Auto-plant against ingress of moisture and dirt with plastisol П-4А.

When replacing individual body parts, after welding and primecoating operations, coat the welds on both sides with plastisol П-4А and apply

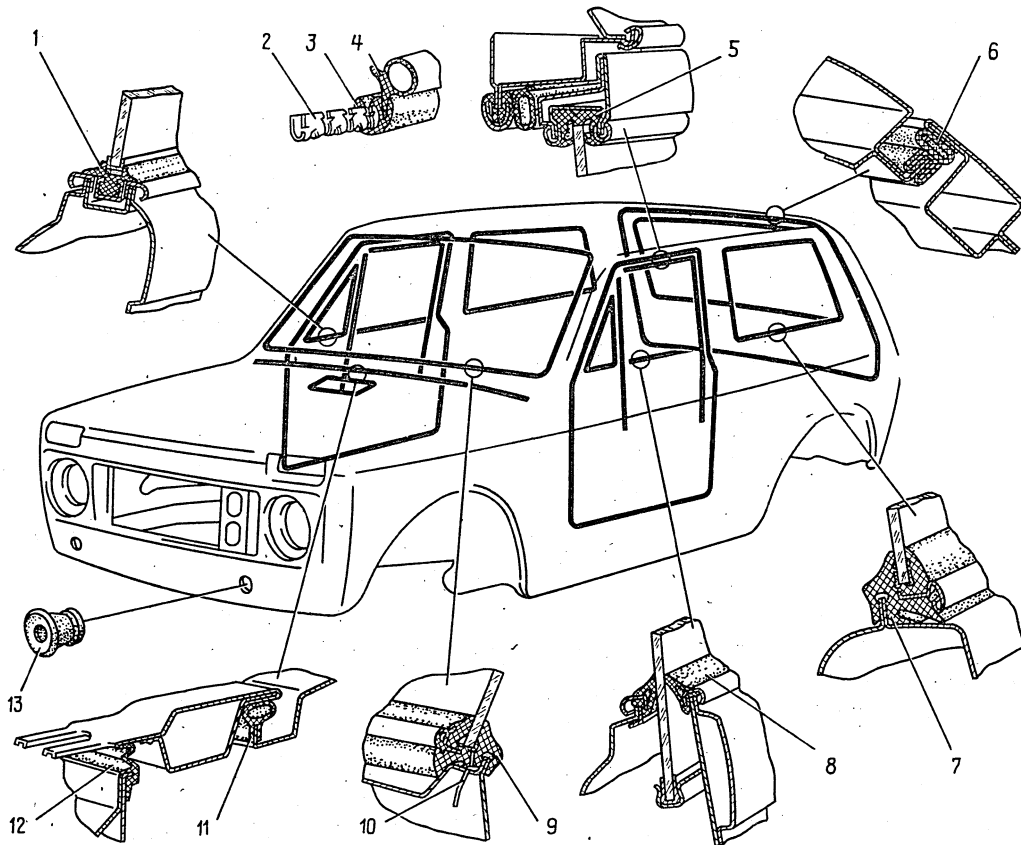


Fig.8-9. Rubber Weatherstrips:

1 - ventilator glass; 2 - front door weatherstrip carcass; 3 - weatherstrip edging; 4 - front door frame weatherstrip; 5 - roll-down glass weatherstrip; 6 - tailgate frame weatherstrip; 7 - side window weatherstrip; 8 - roll-down glass lower

weatherstrip; 9 - windshield weatherstrip; 10 - drain pipe; 11 - hood weatherstrip; 12 - air intake weatherstrip; 13 - front bumper connector bush

Fig.8-10. Points of 51-I-7 Sealant Application
(Front View of Body):

1 - front side member to radiator frame joint;
2 - front side member to dashboard joints; 3 - storage battery pan to dashboard joint (at body interior side); 4 - dashboard to body front strip joints (under the hood)

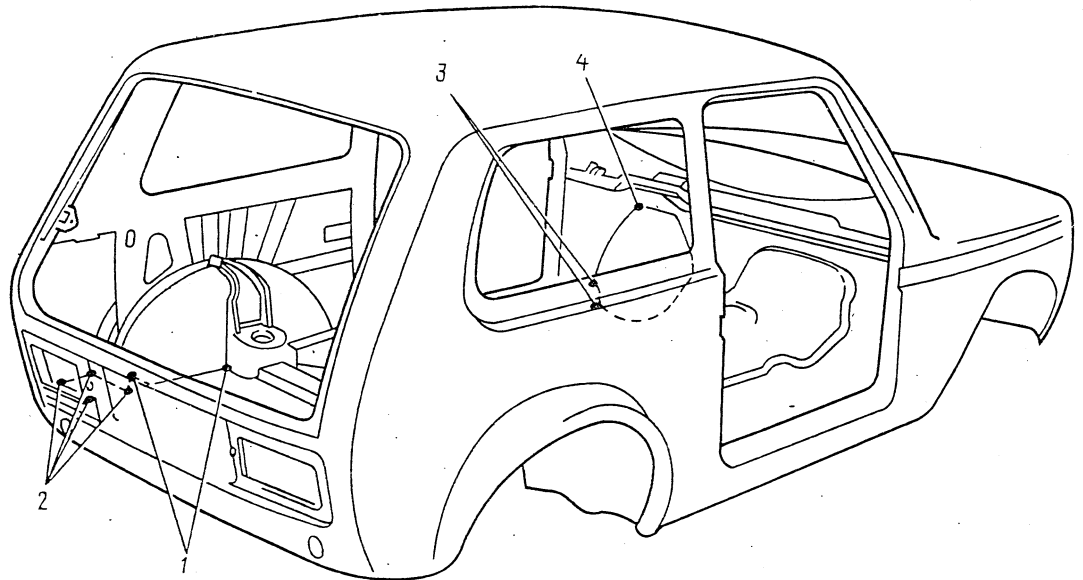
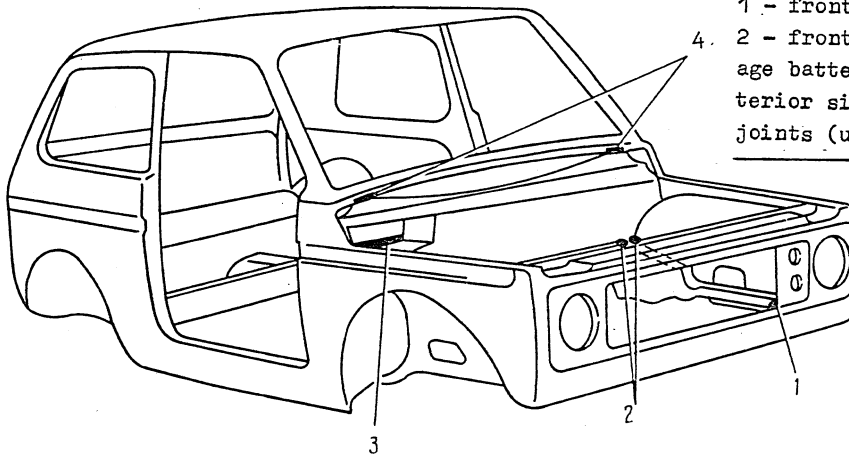


Fig.8-11. Points of 51-I-7 Sealant Application
(Rear View of Body):

1 - rear floor to rear wheel arch joints; 2 - slots in corner joints of rear floor extensions with rear wheel arches, body sides and tailgate panel;
3 - corner joints of dashboard with floor sill;
4 - dashboard corner with body side front pillar panel

the non-drying sealant 51-I-7 (Figs 8-10, 8-11) at the corners, between the following parts:

- door sills and the dashboard (at the body interior side);
- dashboard and the front pillar panel and the storage battery tray;
- front side-member joints with radiator frame and dashboard;
- dashboard joints with body front panel;
- rear floor and its extensions with rear wheel arches, body sides and rear panel.

DOORS

Removing and Installing the Front Door

Open the door all the way and detach the door check, driving out the pin which fastens the check to the body front pillar.

Holding the door open and using power screwdriver 2 (Fig.8-12) remove screws 1 which fasten the door hinges to the body pillar and remove the door.

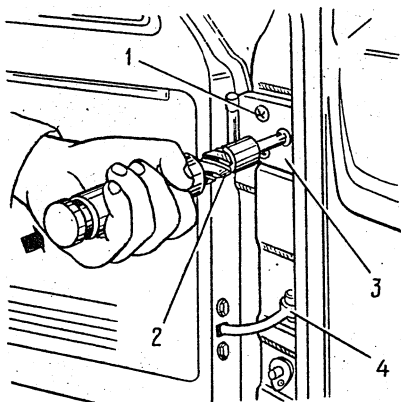


Fig. 8-12. Removing the Front Door:

1 - hinge screw; 2 - impact screwdriver; 3 - hinge;
4 - Restrictor of door opening

Arrow shows direction of blow

To install the door, reverse the removal operations.

Before final tightening of the screws, adjust the gaps between the door and the car body.

Disassembly and Assembly of Front Door

Disassemble the door, if some of its parts and mechanisms have to be repaired or replaced.

Turn off the elbow rest screws, first taking off plastic decorative plug 2 (Fig. 8-13) of the upper screw and remove the elbow rest.

Force off escutcheon 20 (Fig. 8-14), take out circlip 1 with remover tool 2 A.78034 and take off glass regulator handle 22. Take off the facing of the inner lock handle with a screwdriver.

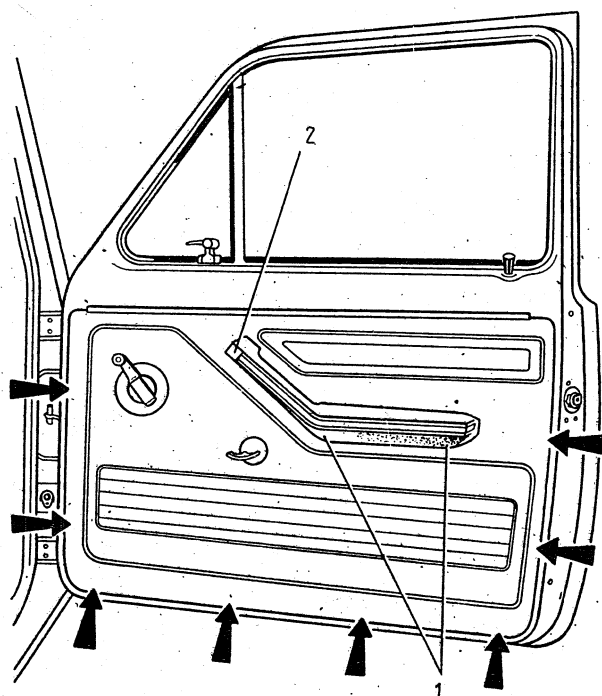


Fig. 8-13. Front Door, Inside View:

1 - elbow rest lower screws; 2 - elbow rest upper screw plug.

Arrows Show Location of Door Upholstery Holders

Override the resistance of the plastic spring holders (shown by arrows in Fig. 8-13) and remove the door upholstery.

Lift the roll-down glass, turn off the fastening screws and remove the front and rear glass guide runs.

Lower the glass, loosen the nut of the window regulator tensioning roller, disconnect the cable from the roll-down glass channel, slip the cable off the rollers and take out the glass through the lower opening of the door. Unscrew the nuts and remove the window regulator mechanism.

Remove the roll-down glass weatherstrip and the ventilator glass assembly by turning off its screws.

Unscrew lock-closing button 6 (Fig. 8-15), remove the screws of bracket 4 of lock inner handle 1, remove screws 3 (Fig. 8-16) of the lock body and take off the lock complete with the rods, first disconnecting link 20 (Fig. 8-15) from the lock release carrier.

Unscrew two nuts and remove the outer handle of the door.

Remove two fastening bolts and take off the door check.

Assemble the front doors in the reverse sequence of disassembly operations.

When installing the window regulator, see that the cable coils are not laid on one another on the drum. Adjust the tension of cable 2 (Fig. 8-17) and smooth functioning of the window regulator by shifting the take-up roller; for this purpose loosen nut 3.

Before installing the door lining examine the plastic lining holders.

Adjusting the Position of Front Door

Before adjustments, mark off the contours of the hinges on the body pillar. Using impact screwdriver 2 (Fig. 8-12), loosen hinge screws 1.

Set the required external clearances by displacing the hinges relative to the marked-off contour and turn in the screws.

Adjusting the Door Locks

To ensure trouble-free operation of the door lock, adjust the position of thrust block body 14 (Fig. 8-15) first loosening its fastening bolts.

Before adjustments, it is practicable to mark off the outline of the thrust block on the body pillar.

If the door closes too tightly, shift the thrust block outward and tighten the bolts.

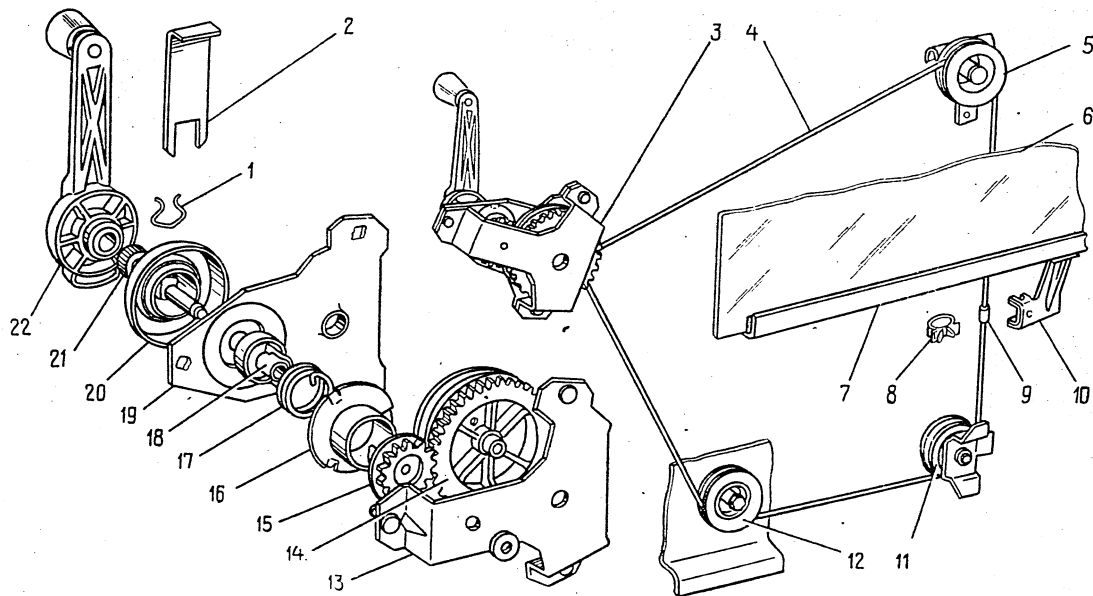


Fig.8-14. Roll-Down Glass Regulator:

1 - circlip; 2 - circlip remover A.78034; 3 - glass regulator mechanism; 4 - cable; 5 - upper roller; 6 - roll-down glass; 7 - roll-down glass channel; 8 - cable holder; 9 - cable coupling; 10 - glass channel bracket; 11 - lower roller; 12 - take-up roller; 13 - glass regulator mechanism body;

14 - drum with driven gear; 15 - drive pinion; 16 - drive shaft support; 17 - brake spring; 18 - spring brake carrier; 19 - body cover; 20 - escutcheon; 21 - drive shaft; 22 - glass regulator handle

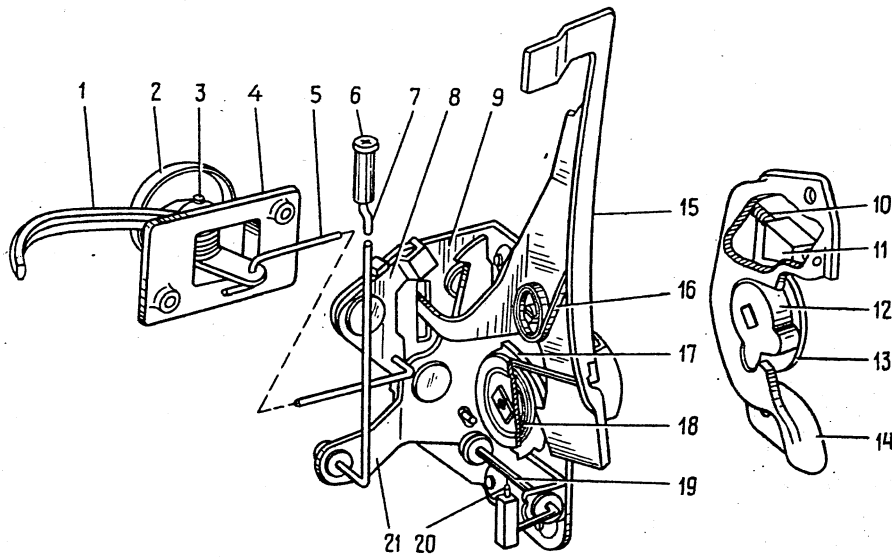


Fig.8-15. L.H. Front Door Lock:

1 - lock inner handle; 2 - inner handle facing; 3 - axle; 4 - inner handle bracket; 5 - inner handle rod; 6 - lock-closing button; 7 - lock-closing button rod; 8 - inner lock release lever; 9 - lock body; 10 - retainer spring; 11 - thrust block retainer; 12 - rotor; 13 - central shaft

support; 14 - thrust block body; 15 - outer lock release lever; 16 - outer lock release lever spring; 17 - ratchet; 18 - ratchet spring; 19 - lock release shaft; 20 - lock release link; 21 - lock closing lever

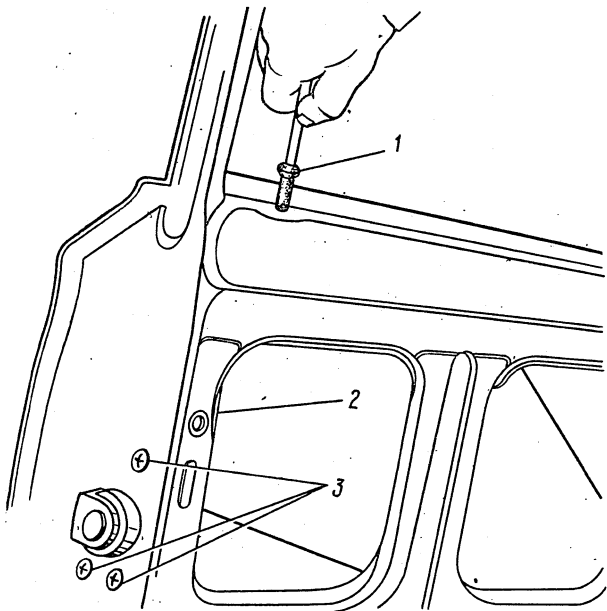


Fig.8-16. Front Door Lock Fastenings:

1 - lock-closing button; 2 - lock-closing button rod; 3 - lock fastening screws

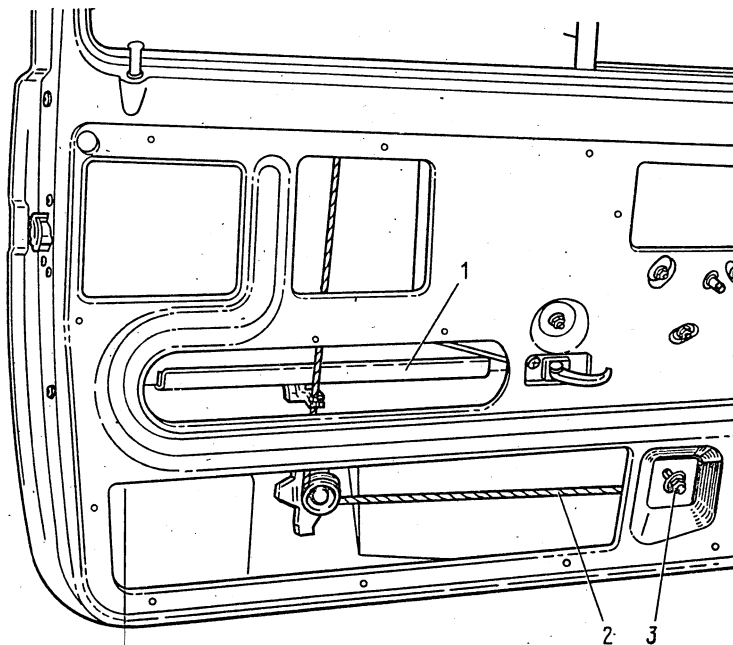


Fig.8-17. Adjusting the Glass Regulator Cable Tension:

1 - roll-down glass channel; 2 - cable; 3 - take-up roller bolt nut

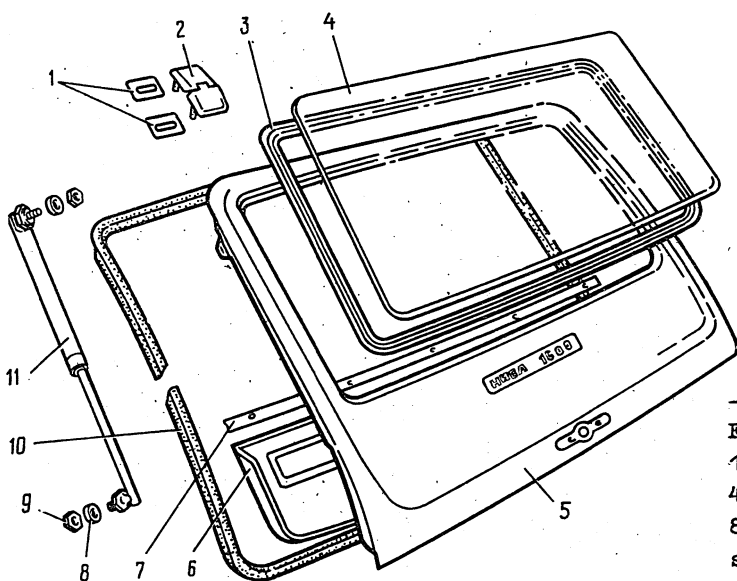
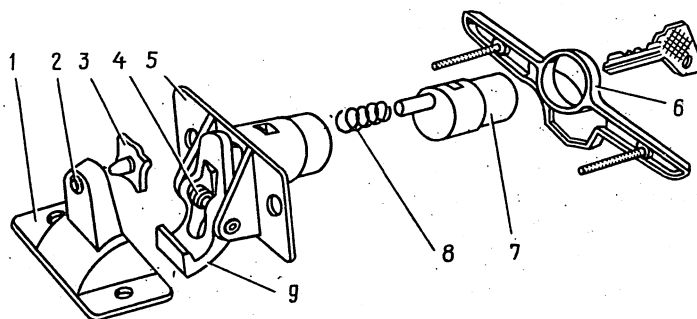


Fig.8-18. Tailgate with Prop:

1 - gasket; 2 - hinge; 3 - glass weatherstrip; 4 - glass; 5 - door; 6 - door lining; 7 - strip; 8 - washer; 9 - prop nut; 10 - body frame weatherstrip; 11 - tailgate gas-filled hydraulic prop

Fig.8-19. Tailgate Lock:

1 - thrust block; 2 - thrust block socket; 3 - lock tenon; 4 - hook spring; 5 - lock body; 6 - tailgate lock handle; 7 - button; 8 - button spring; 9 - hook



If the door closes loosely, shift the thrust block inward.

If the door sags after closing, move the thrust block upward; if it rises after closing (sagging when open), shift the thrust block down.

If it is difficult to open the door by inner handle 1, adjust the handle position. For this purpose, loosen the fastening screws and shift the handle with the bracket as required.

Tighten the fastening screws after adjustments.

Removing, Installing and Adjusting the Tailgate

The tailgate is mounted on the body on two hinges 2 (Fig.8-18) and closed by a lock. When

open, it is held by two nondismountable gas-filled hydraulic props 11.

Detach the props from the tailgate, unscrew the door-to-hinge nuts and remove the tailgate.

When installing, adjust the position of the tailgate in the body opening with the aid of the oval holes for the hinge studs, then tighten the nuts home.

If the door lock closes with difficulty (Fig.8-19), adjust it by shifting its body 5 or thrust block 1 as required.

Replace the gas-filled props by new ones, if they fail to hold the door open.

HOOD, BUMPERS

Removing, Installing and Adjusting the Position of Hood

Open hood 3 (Fig.8-20), uncotter axle 1 of prop 2 and detach the latter from the hood.

Supporting the hood, unscrew bolts 4 of the upper links of hinges 5 and take off the hood.

Install the hood in the reverse order of operations.

Adjust the position of the hood by the use of enlarged holes in the hinges.

Adjusting the Hood Lock

If the lock is not reliable in closing the hood or opens with difficulty, adjust its position (Fig.8-21).

Open the hood, mark off the contours of lock

body 1, loosen the fastening nuts and shift the lock body in the required direction, using the enlarged holes.

Tighten the fastening nuts and check the performance of the lock.

Removal and Installation of Bumpers

The bumpers (Fig.8-22) are made of aluminium shapes whose face wall is provided throughout the length of the bumper with black rubber strip 9 and the ends of the bumpers are fitted with black plastic side covers 6.

Each bumper is held to the body by two bolts; to remove the bumper, these bolts must be unscrewed.

Install the bumpers in the reverse order of operations.

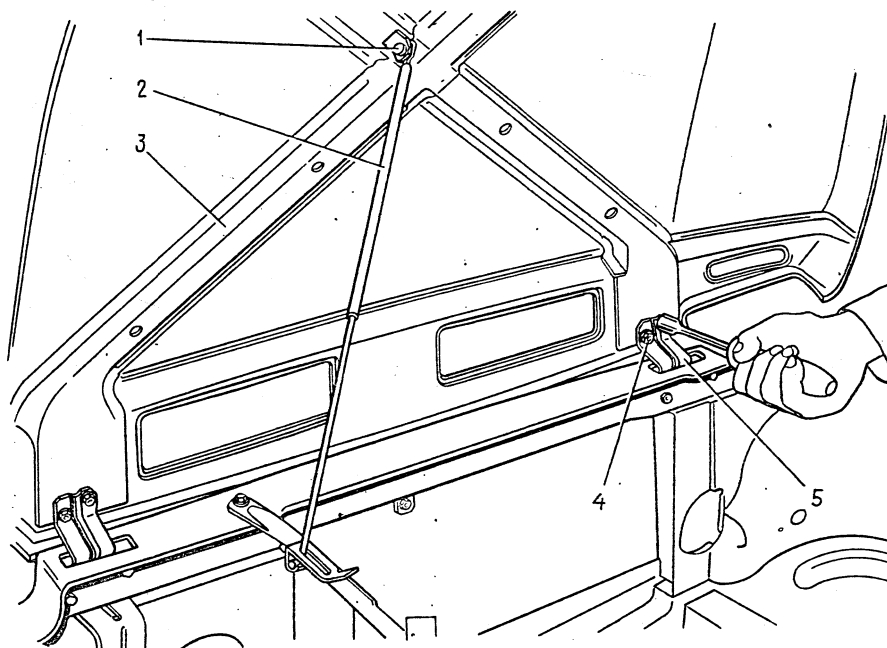


Fig.8-20. Removing the Engine Hood:
1 - prop axle; 2 - prop; 3 - hood;
4 - hood bolt; 5 - hinge

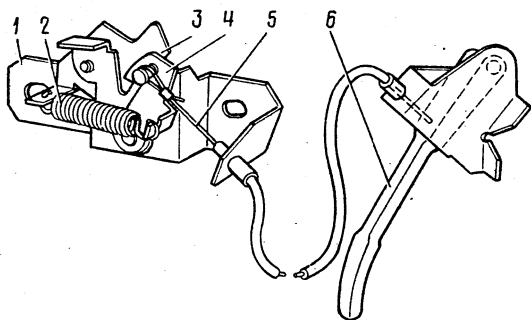


Fig. 8-21. Hood Lock:

1 - lock body; 2 - spring; 3 - ejector; 4 - hook;
5 - control cable; 6 - control handle

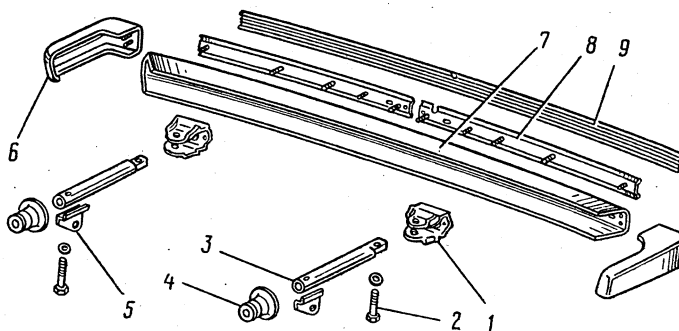


Fig. 8-22. Front Bumper Assembly:

1 - bracket; 2 - fastening bolt; 3 - connector;
4 - rubber bush; 5 - tow lug; 6 - side plastic
cover; 7 - bumper; 8 - rubber strip holder;
9 - rubber strip

WINDOW GLASSES, WINDSHIELD AND HEADLAMP WASHERS

Replacing the Windshield

To take out the damaged glass, remove the wiper arms, weatherstrip edging and, pressing the upper corners of the glass, push it outward. An assistant should support the glass from without (Fig. 8-23)

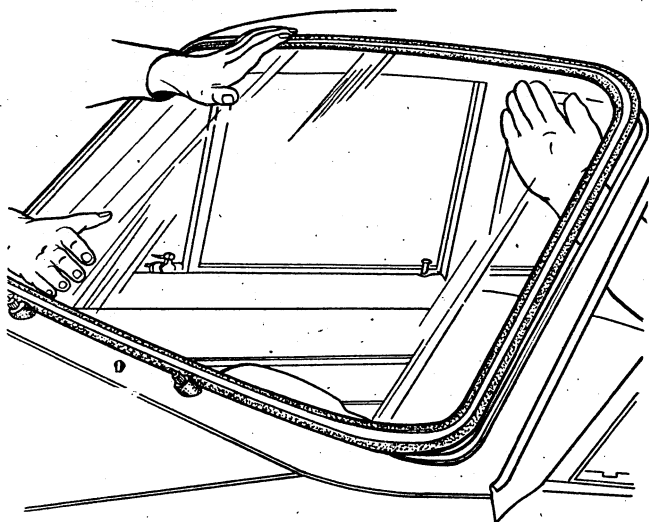


Fig. 8-23. Removing the Windshield

To install the windshield:

- wash the recesses of weatherstrip 9 (Fig. 8-9) with gasoline;
- slip the weatherstrip with the edging on the glass;
- using a screwdriver, insert installation cord 1 (Fig. 8-24) into the recess by which weatherstrip 2 is slipped on the body flange;
- fit the glass into the body opening and pull at the ends of the cord from inside the body until

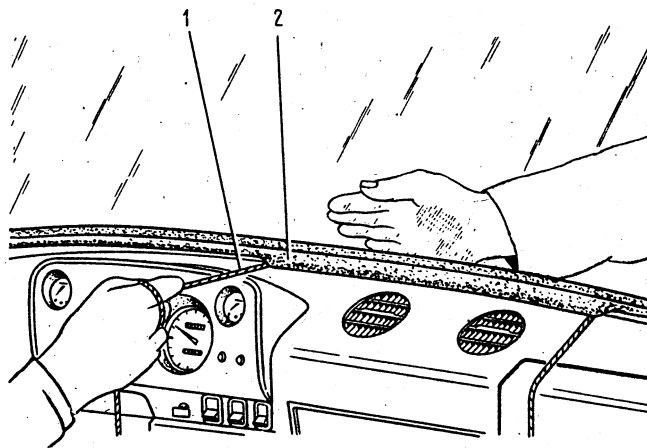


Fig. 8-24. Installing the Windshield:

1 - installation cord; 2 - windshield weatherstrip

the weatherstrip snaps in position. The assistant should press the glass gently from outside.

Replacing the Side and Tailgate Glasses

To remove the glasses, take off the weatherstrip edging and, pressing the lower corners of the glass, push it outward. An assistant should support the glass from without.

Installation of the glasses is similar to that of the windshield.

Windshield and Headlamp Washers

A schematic diagram of the windshield and headlamp washers is shown in Fig. 8-25.

The cars of early manufacture were provided with washers (Fig. 8-26) of a tentative version.

The washers are provided with non-return valves between the pumps and nozzles; they rule out leaks of the fluid after the washer has been stop-

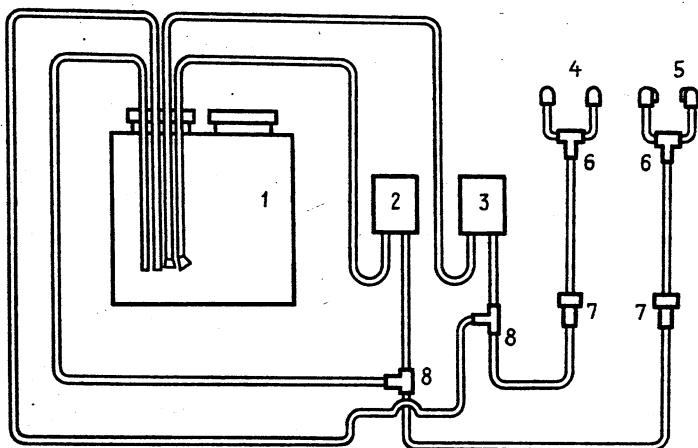


Fig. 8-25. Windshield and Headlamp Washers, Diagrammatic:

1 - fluid tank; 2 - headlamp washer pump; 3 - windshield washer pump; 4 - windshield washer nozzles; 5 - headlamp washer nozzles; 6 - nozzle Tee pipes; 7 - non-return valves; 8 - Tee pipes assembled with flow restrictors

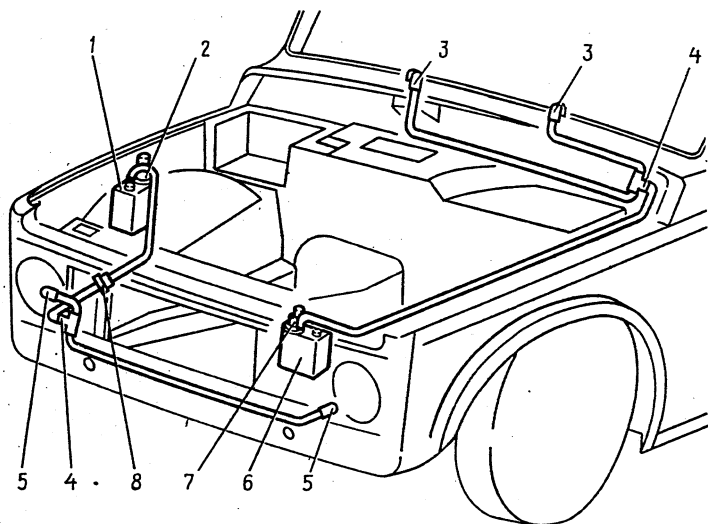


Fig. 8-26. Windshield and Headlamp Washers, Diagrammatic. Tentative Version:

1 - headlamp washer tank; 2 - headlamp washer pump; 3 - windshield washer nozzles; 4 - Tee pipes; 5 - headlamp washer nozzles; 6 - windshield washer tank; 7 - windshield washer pump; 8 - non-return valve

ped; this saves time for filling the tubes when the pump is restarted.

Due to a considerable resistance of the non-return valves the washer pump may fail to draw in the fluid; to counter this contingency, Tee-pipes & (Fig. 8-25) complete with flow restrictors and drain pipes are provided. Flow restrictor 2 (Fig. 8-27) allows free passage of air from the tubes

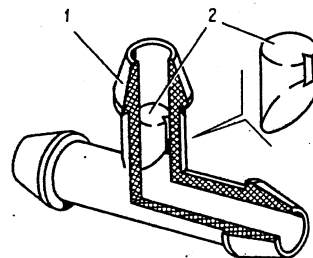


Fig. 8-27. Tee Pipe with Flow Restrictor:
1 - Tee pipe; 2 - flow restrictor

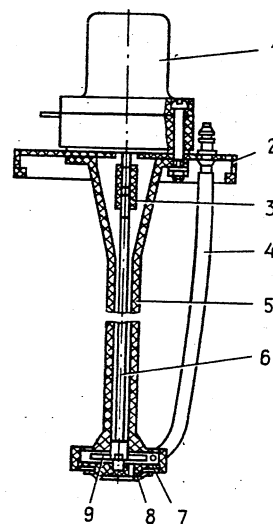


Fig. 8-28. Washer Pump:

1 - electric motor; 2 - tank cover; 3 - coupling; 4 - fluid feed pipe; 5 - pump casing; 6 - rotor shaft; 7 - rotor shaft support; 8 - rim with filter screen; 9 - rotor

and passes but a small amount of fluid delivered by the pump.

Removing and Installing the Washer Pump

Disconnect the electric wires from motor 1 (Fig. 8-28) and take the tube from the pipe union of the washer pump.

Turn cover 2 with the electric motor counter-clockwise and take them off complete with the pump from the tank.

To install, reverse the removal operations.

Disassembly and Assembly of Washer Pump

The pump and electric motor (Fig. 8-28) are fastened by screws and nuts to cover 2.

To disassemble the pump, turn off the screws, remove the motor and cover, detaching fluid feed pipe 4.

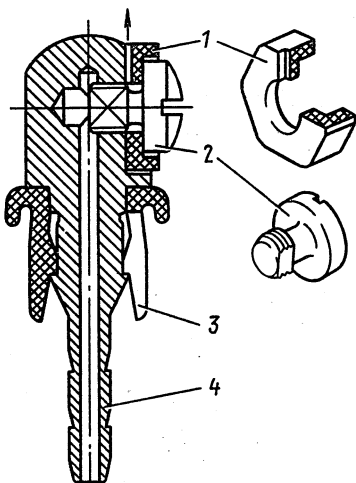


Fig. 8-29. Windshield Washer Nozzle:

1 - atomizer; 2 - screw; 3 - bushing; 4 - nozzle body with pipe union

Insert a pointed tool under the edge of rim 8 and take it off complete with the filter screen.

Remove coupling 3 and, tapping gently shaft 6 of rotor 9, push out support 7 and take out the

shaft with the rotor.

To assemble, proceed in the reverse sequence of operations.

Removing and Installing the Windshield Washer Nozzles

If the nozzles become clogged, remove and disassemble them.

Squeeze lightly plastic bushing 3 (Fig. 8-29) at the side of the air intake box, then hook the bushing from above with a screwdriver and, applying a certain force, take out the nozzle complete with the bushing.

Turn off screw 2, clean all the parts thoroughly and airblast body 4 and atomizer 1.

Insert bushing 3 into the hole in the car body. Then insert smartly the nozzle into the bushing so that the slot of body 4 engages the bushing edges.

Check the functioning of the nozzle.

Adjust the direction of fluid spray by turning the body in the bushing and turning atomizer 1 with screw 2 loosened.

INSTRUMENT PANEL

Removal and Installation

Disconnect the "ground" wire from the storage battery.

Remove the lining of the windshield pillars, the steering column casing and the instrument board (see "Electrical Equipment") and disconnect the plugs and sockets of the wire assembly.

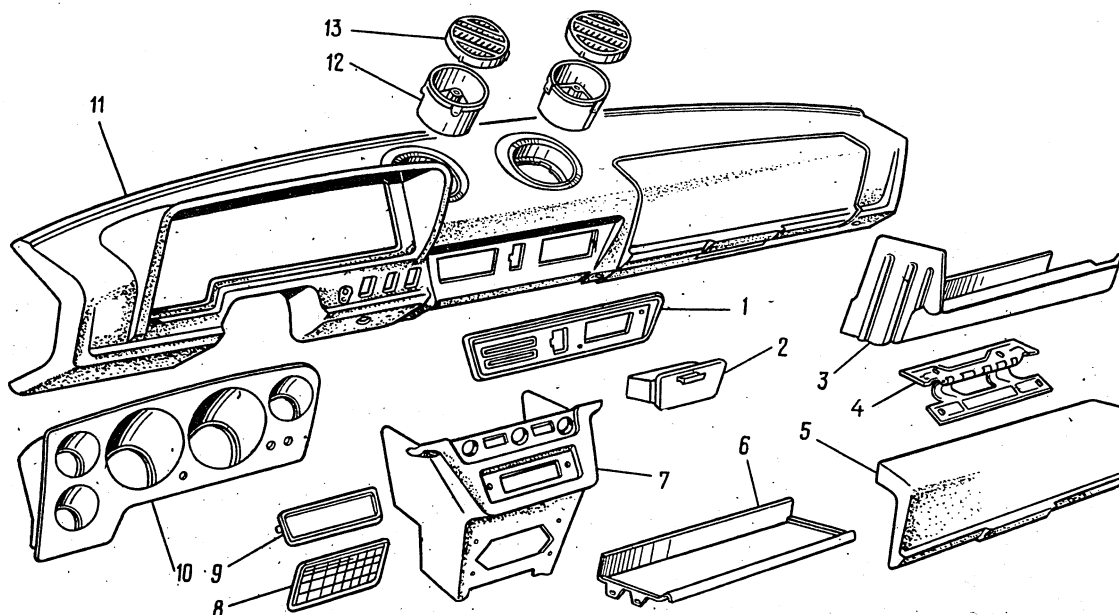


Fig. 8-30. Instrument Panel:

1 - ash tray and heater lever facing; 2 - ash tray; 3 - glove box casing; 4 - glove box lid hinge; 5 - glove box lid; 6 - shelf; 7 - radio set panel; 8 - loudspeaker facing; 9 - radio set panel facing; 10 - instrument board; 11 - instrument panel; 12 - deflector pipe; 13 - deflector

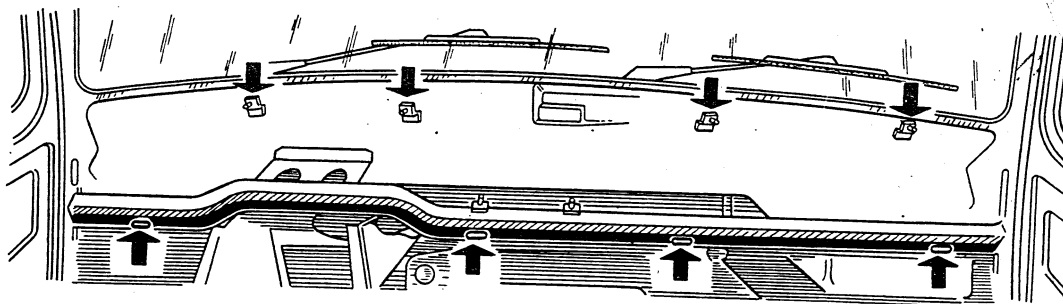


Fig.8-31. Instrument Panel Fastening Points:
(Shows by arrows)

Pull out the knob of the instrument lighting switch, unscrew the nut and take off the switch.

Remove package shelf 6 (Fig.8-30) and radio set panel 7, first turning off their screws; disconnect the wires from the radio set, cigarette lighter, headlamp wiper and washer switch, and from the distress signal switch.

Remove the fastening screws and take out glove box casing 3.

Remove the knobs from the heater control levers; for this purpose bend off the lower part

of the upper knob and the upper part of the lower knob, using a flat sharp tool.

Remove four lower screws (Fig.8-31) that fasten the instrument panel to the body front cross member, then turn off the four upper nuts which hold the panel to the dashboard, reaching through the openings of the glove box, and take off the instrument panel.

To install, reverse the removal operations.

SEATS

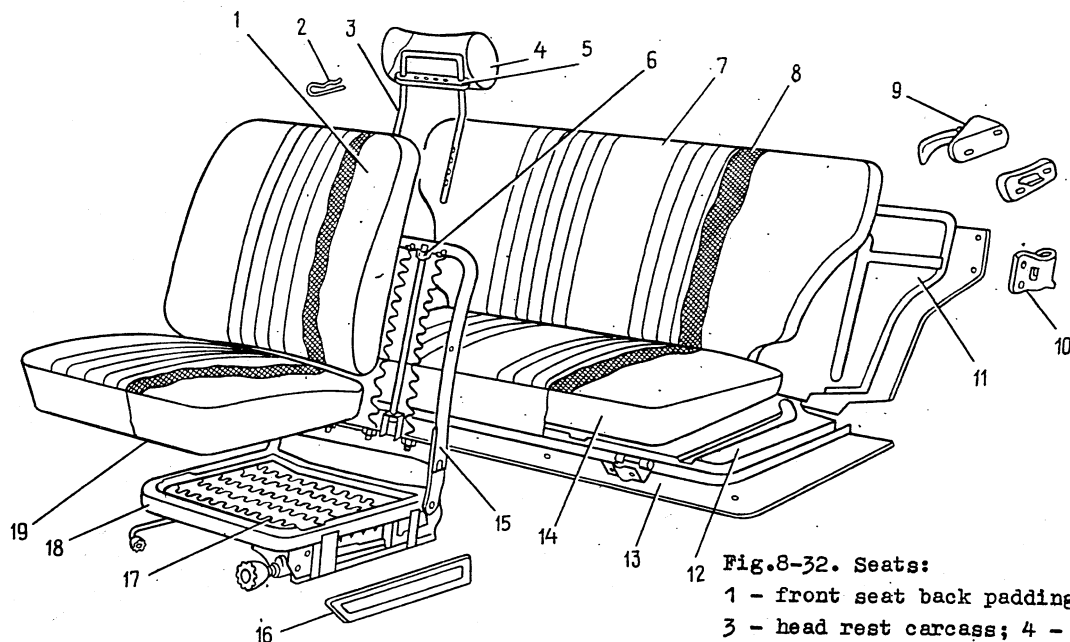


Fig.8-32. Seats:

- 1 - front seat back padding; 2 - head rest lock;
- 3 - head rest carcass; 4 - head rest padding;
- 5 - head rest carcass strip; 6 - guide pipe; 7 - seat upholstery; 8 - seat upholstery backing; 9 - seat back retainer; 10 - rear seat back shackle; 11 - seat back base; 12 - seat cushion base; 13 - mat;
- 14 - rear seat cushion padding; 15 - back frame;
- 16 - front seat facing; 17 - seat cushion spring;
- 18 - rear seat carcass; 19 - front seat cushion padding

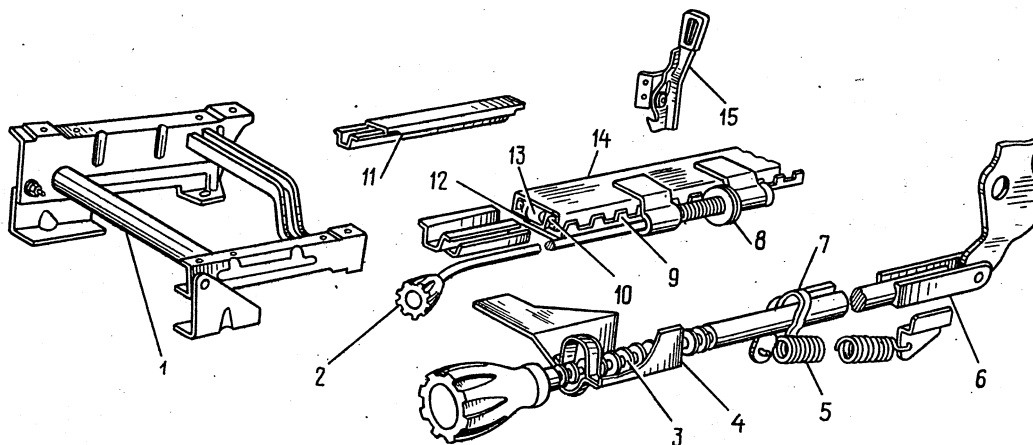


Fig.8-33. Front Seat Adjusters:

1 - front seat framework; 2 - horizontal adjuster handle; 3 - back rake adjuster threaded rod; 4 - back rake adjuster lock; 5 - spring; 6 - rod; 7 - cotter pin; 8 - horizontal adjuster catch;

9 - horizontal adjuster lock; 10 - ball; 11 - seat rails; 12 - rail guide; 13 - roller; 14 - rail slide; 15 - seat catch

Removal and Installation

Front seats. To take out the seat (Fig.8-32), tilt it forward and unscrew the bolts holding it to the framework.

Remove the seat with the adjuster mechanisms.

Install the seat in the reverse order of operations.

Rear seat. Force off seat back retainers 9 (Fig.8-32) and secure the back with the strap located under the cushion. Unscrew the bolts that fasten the cushion hinges to the floor cross member and take out the seat.

Install the seat in the reverse sequence of steps.

Disassembly and Assembly of Front Seat Adjusters

Perform disassembly and assembly work on the removed seats.

Horizontal adjuster. Unbend the edges of rail slides 14 (Fig.8-33) and of rail guides 12, take out all balls 10 and shift the guides over the slides until rollers 13 come out.

To assemble, put the rollers into the slot of the slide and slip on the guide. Then insert the balls and bend the edges.

Seat back rake adjuster. Disconnect spring 5 from the rod, and knock out the pin which connects rod 6 with the seat back reinforcement. Pull out cotter pin 7 and remove the rod from back rake adjuster lock 4.

Assemble the adjuster in the reverse order of steps.

HEATER

Removal and Installation

To remove the body heater:

- shift lever 6 (Fig.8-34) of heater cock 14 all the way to the right and drain the engine cooling system;

- detach the "ground" wire from the storage battery;

- turn off the fastening screws, remove the instrument panel shelf and radio set panel, disconnecting the wires;

- remove internal ventilation air duct 1 by turning off its screws;

- loosen the clamps and disconnect the coolant inlet and outlet rubber hoses from heater pipes 13;

- unscrew two fastening bolts in the engine compartment and take off the seal of the heater radiator pipes;

- loosen the bolt of the flexible link casing clip on the cock and take the link off the cock;

- remove the switch of the heater fan motor and disconnect its wires;

- remove four spring holders and heater fan housing 15 assembly;

- take out the instrument board through a special opening in the instrument panel, loosen

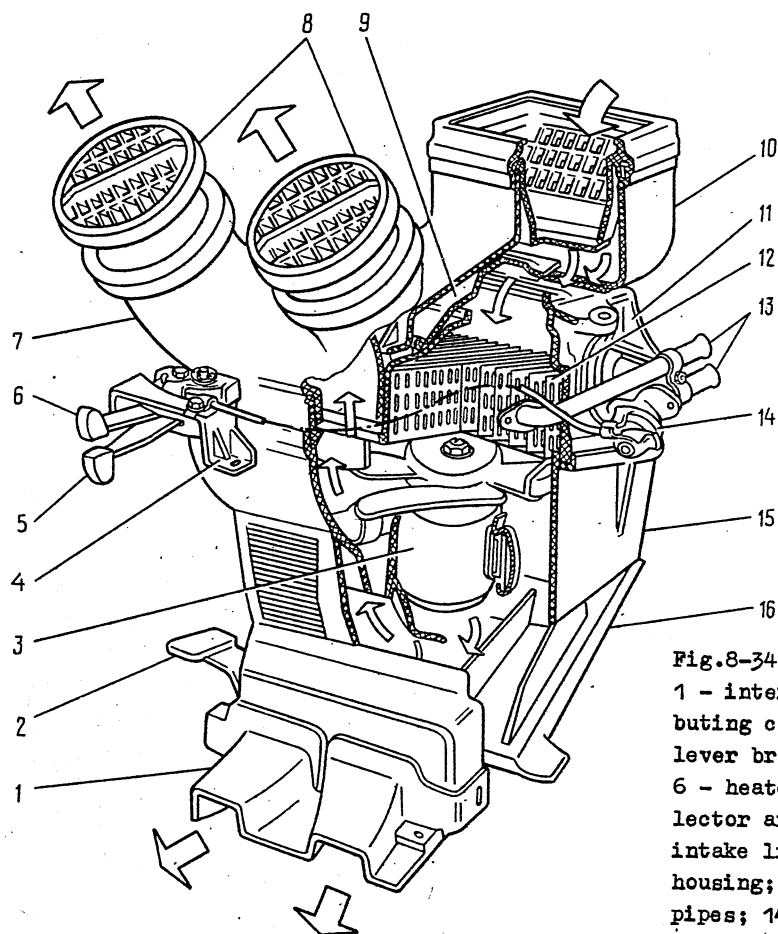
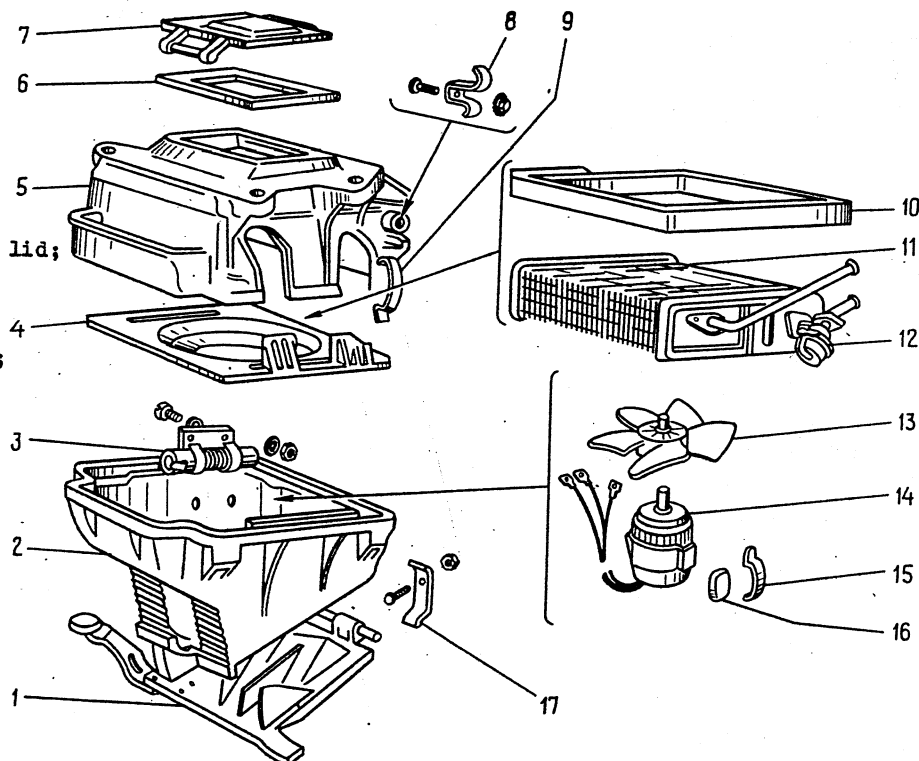


Fig.8-34. Body Heater:

1 - internal ventilation air duct; 2 - air distributing cover lever; 3 - electric fan; 4 - control lever bracket; 5 - air intake lid control lever; 6 - heater cock control lever; 7 - rotatable deflector air duct; 8 - rotatable deflectors; 9 - air intake lid; 10 - air intake box; 11 - radiator housing; 12 - radiator; 13 - fluid inlet and outlet pipes; 14 - cock; 15 - fan housing; 16 - air distributing cover

Fig.8-35. Heater Parts:

1 - air distributing cover; 2 - fan housing; 3 - series resistor; 4 - fan guide housing; 5 - radiator housing; 6 - gasket; 7 - air intake lid; 8 - inlet and outlet pipe clip; 9 - fan housing spring holder; 10 - radiator gasket; 11 - radiator; 12 - cock; 13 - propeller; 14 - electric motor; 15 - spring clip; 16 - electric motor pad; 17 - air distributing cover clip



the screw of the flexible rod of air intake lid 9 and take the rod off the lever;

- unscrew the nuts of housing 11, of radiator 12 and air intake box 10, disconnect the "ground" wire from under one of the nuts, remove the housing and the air intake box;

- if necessary, remove air duct 7 which is connected with deflectors 8 by two rubber seals.

Install the heater in the reverse order of steps. Take a note of the correct position of the sealing gasket between the radiator housing and the car body and see that the hose clamps are properly tightened.

Having installed the heater on the car and connected all the hoses to the engine, fill the cooling system and check the heater connections for leaks.

Disassembly and Assembly

Take off two spring clips 15 (Fig.8-35) and take the electric fan out of housing 2. Unscrew the nut of propeller 13 and take it off electric motor 14.

Unscrew the nut of inlet and outlet pipe clip 8, take off the clip and lift radiator 11 out of housing 5.

Unscrew the clip nuts and take off air intake lid 7.

Unscrew the nuts of clips 17 and remove air-distributing cover 1 of the fan housing.

Assemble the heater in the reverse sequence of operations, taking care to install radiator sealing gasket 10 properly.

APPENDICES

Appendix 1

TIGHTENING TORQUES FOR SCREW JOINTS

Name of Part	Thread	Tightening Torque, N.m (kgf.m)		
		Nominal	Minimum	Maximum
<u>Engine</u>				
Bolt, main bearing cap	M10x1.25	82(8.2)	70(7.0)	86(8.6)
Bolt, oil sump	M6	8(0.8)	5.2(0.52)	8.4(0.84)
Stud, breather cover	M8	20(2)	17(1.7)	21(2.1)
Nut, breather cover	M8	14(1.4)	12(1.2)	15(1.5)
Bolt, cylinder head:	M12x1.25			
preliminary tightening		40(4)	34(3.4)	42(4.2)
final tightening		115(11.5)	98(9.8)	121(12.1)
Bolt, cylinder head	M8	38(3.8)	32(3.2)	40(4)
Nut, inlet and exhaust manifold	M8	25(2.5)	21(2.1)	26(2.6)
Nut, connecting rod cap bolt	M9x1	52(5.2)	44(4.4)	55(5.5)
Bolt, flywheel	M10x1.25	85(8.5)	72(7.2)	89(8.9)
Bolt, chain tensioner shoe	M10x1.25	45(4.5)	38(3.8)	47(4.7)
Nut, camshaft bearing housing	M8	22(2.2)	19(1.9)	23(2.3)
Bolts, camshaft and oil pump drive	M10x1.25	49(4.9)	42(4.2)	51(5.1)
shaft sprockets				
Nut, valve adjusting bolt	M12x1.25	52(5.2)	48(4.8)	56(5.6)
Bushing, valve adjusting bolt	M18x1.5	100(10.0)	85(8.5)	105(10.5)
Spark plug	M14x1.25	38(3.8)	32(3.2)	40(4)
Bolt, coolant pump	M8	26(2.6)	22(2.2)	27(2.7)
Nut, cooling jacket outlet connection	M8	22(2.2)	14(1.4)	23(2.3)
Starting jaw, crankshaft	M20x1.5	122(12.2)	104(10.4)	128(12.8)
Bolt, generator bracket	M10x1.25	53(5.3)	45(4.5)	56(5.6)
Nut, generator adjusting arm	M10x1.25	44(4.4)	29(2.9)	46(4.6)
Nut, generator to bracket bolt	M12x1.25	70(7.0)	46(4.6)	74(7.4)
Nut, adjusting arm to generator	M10x1.25	44(4.4)	29(2.9)	46(4.6)
Nut, support pad to engine bracket	M10x1.25	34(3.4)	22(2.2)	36(3.6)
Nut, front support pad to cross member				
bracket	M10x1.25	33(3.3)	28(2.8)	35(3.5)
Nut, plate to pad	M6	9(0.9)	7.6(0.76)	9.4(0.94)
Nut, engine rear mounting cross member	M8	18(1.8)	15(1.5)	19(1.9)
Nut, rear support to gearbox	M8	28(2.8)	24(2.4)	29(2.9)
Nut, rear support to cross member	M8	25(2.5)	16(1.6)	26(2.6)
<u>Clutch</u>				
Bolt, clutch	M8	30(3)	20(2)	32(3.2)
Nut, clutch and brake pedal bolt	M12x1.25	20(2)	13(1.3)	21(2.1)
Nut, clutch and brake master cylinders	M8	15(1.5)	10(1)	16(1.6)

Name of Part	Thread	Tightening Torque, N.m (kgf.m)		
		Nominal	Minimum	Maximum
Nut, clutch hydraulic pipe, connecting	M12	30(3)	25(2.5)	32(3.2)
Nut, brake hydraulic pipe, connecting	M10	18(1.8)	15(1.5)	19(1.9)
<u>Gearbox</u>				
Switch, backing light	M14x1.5	44(4.4)	29(2.9)	46(4.6)
Bolts, clutch housing to engine	M12x1.25	85(8.5)	55(5.5)	89(8.9)
Nut, clutch housing to gearbox	M10x1.25	50(5)	32(3.2)	52(5.2)
Nut, clutch housing to gearbox	M8	25(2.5)	16(1.6)	26(2.6)
Bolt, shift rail lock cover	M8	25(2.5)	16(1.6)	26(2.6)
Nut, rear cover	M8	25(2.5)	16(1.6)	26(2.6)
Nut, main shaft rear end	M20x1.0	80(8)	68(6.8)	84(8.4)
Bolt, countershaft bearing clamping washer	M12x1.25	95(9.5)	81(8.1)	100(10)
Bolt, fork to shift rail	M6	18(1.8)	12(1.2)	19(1.9)
<u>Transfer Case</u>				
Nut, mounting bracket to pad pivot	M10x1.25	31(3.1)	27(2.7)	33(3.3)
Nut, mounting bracket to body	M8	15(1.5)	10(1)	16(1.6)
Nut, transfer case housing covers, front axle drive housing, speedometer drive housing, control lever bracket	M8	23(2.3)	15(1.5)	25(2.5)
Switch, differential lock	M16x1.5	44(4.4)	29(2.9)	46(4.6)
Bolt, forks to gear and differential lock shift rails	M6	18(1.8)	12(1.2)	19(1.9)
Bolt, driven gear	M10x1.25	80(8.0)	68(6.8)	84(8.4)
Nut, drive shaft rear bearing and countershaft rear bearing	M18x1.5	115(11.5)	98(9.8)	120(12)
Nut, propeller shaft flange to drive shaft and to front and rear axle drive shafts	M16x1.5	115(11.5)	98(9.8)	120(12)
<u>Propeller Shaft Drive</u>				
Nuts, flexible coupling to gearbox and transfer case flange bolts	M12x1.25	69(6.9)	59(5.9)	73(7.3)
Nut, propeller shaft flange to flanges of front and rear axle final drives and of transfer case, bolt	M8	33(3.3)	28(2.8)	35(3.5)
<u>Front Axle</u>				
Nut, front axle to engine	M12	73(7.3)	62(6.2)	77(7.7)
Bolt, front axle to engine	M10x1.25	50(5)	43(4.3)	53(5.3)
Bolt, front axle to engine	M12x1.25	89(8.9)	76(7.6)	94(9.4)
Nut, inner joint housing bearing cover	M8x1.25	23(2.3)	20(2)	25(2.5)
Nut, differential bearing cover	M12x1.25	73(7.3)	63(6.3)	77(7.7)
Bolt, crown wheel	M10x1.25	100(10)	85(8.5)	105(10.5)
<u>Rear Axle</u>				
Bolt, final drive housing to rear axle beam	M8	42(4.2)	36(3.6)	44(4.4)
Bolt, differential bearing cover	M10x1.25	52(5.2)	44(4.4)	55(5.5)
Bolt, crown wheel	M10x1.25	100(10)	85(8.5)	105(10.5)
Nut, drive pinion flange	M16x1.5	see section "Rear Axle"		
Nut, axle shaft bearing and rear brake	M10x1.25	50(5)	43(4.3)	53(5.3)

Continued

Name of Part	Thread	Tightening Torque, N.m (kgf.m)		
		Nominal	Minimum	Maximum
<u>Steering</u>				
Nut, steering gear case bolt	M10x1.25	40(4)	34(3.4)	42(4.2)
Nut, idler arm bracket bolt	M10x1.25	40(4)	34(3.4)	42(4.2)
Nut, steering rod ball pin	M14x1.5	51(5.1)	43(4.3)	54(5.4)
Nut, intermediate steering shaft to upper steering shaft and to worm shaft	M8	27(2.7)	23(2.3)	28(2.8)
Nut, steering wheel	M16x1.5	50(5)	32(3.2)	52(5.2)
Bolt, steering shaft bracket and ignition switch	M8	30(3)	20(2)	32(3.2)
Nut, pitman arm	M20x1.5	240(24)	204(20.4)	252(25.2)
Nut, idler arm shaft	M14x1.5	100(10)	65(6.5)	105(10.5)
<u>Front Suspension</u>				
Nut, cross member lower bolts to body side member	M12x1.25	80(8)	68(6.8)	84(8.4)
Nut, cross member upper bolts to body side member	M12x1.25	80(8)	68(6.8)	84(8.4)
Nut, rebound buffer bracket to cross member bolt	M8	18(1.8)	15(1.5)	19(1.9)
Nut, upper wishbone shaft bolt	M12x1.25	80(8)	68(6.8)	84(8.4)
Nut, shock absorber, upper	M8	15(1.5)	10(1)	16(1.6)
Nut, shock absorber, lower	M10x1.25	60(6)	51(5.1)	63(6.3)
Nut, front wheel hub bearings	M18x1.5	see section "Running Gear"		
Bolt, brake caliper to steering knuckle	M10x1.25	35(3.5)	30(3)	37(3.7)
Nut, sway eliminator bar	M8	18(1.8)	15(1.5)	19(1.9)
Nut, ball pins to steering knuckle	M14x1.5	100(10)	85(8.5)	105(10.5)
Nut, brace to suspension cross member	M12x1.25	80(8)	68(6.8)	84(8.4)
Nut, brace to body	M16x1.5	165(16.5)	107(10.7)	173(17.3)
Nut, lower wishbone shaft	M16x1.5	180(18)	117(11.7)	189(18.9)
Nut, wheel bolt	M12x1.25	75(7.5)	64(6.4)	79(7.9)
Nut, upper wishbone shaft	M14x1.5	100(10)	65(6.5)	105(10.5)
Nut, knuckle arm bolts	M12x1.25	80(8)	68(6.8)	84(8.4)
<u>Rear Suspension</u>				
Nuts, shock absorbers	M12x1.25	60(6)	39(3.9)	63(6.3)
Nuts, transverse and longitudinal radius rod bolts	M12x1.25	80(8)	68(6.8)	84(8.4)

Appendix 2

REPAIR EQUIPMENT*

Continued

Designation	Name	Designation	Name
A.40005	Set of general-purpose remover tools	A.45008	Remover tool, final drive pinion rear bearing inner race
A.40006/1/3	Remover tool, gearbox clutch shaft front bearing	A.45028	Stop for removal of differential pinion cage bearing inner races
A.40009	Stud wrench	A.47035	Remover tool, steering rod ball pins from pitman arm
A.40026	Remover tool, coolant pump impeller	A.47043	Remover tool, pitman arm
		A.47045	Driver, upper wishbone silent block

* The tool sets delivered to the Customer are enumerated in separate lists.

Continued

Designation	Name
A.50088	Wrench, inlet and exhaust manifold nuts
A.50113	Wrench, engine sump drain plug
A.50121	Wrench, crankshaft starting jaw
A.50126	Wrench, cylinder head bolt tightening test (with camshaft installed)
A.55035	Wrench, articulated, gearbox
A.55085	Wrench, pinion cage bearing nuts
A.56124	Wrench, rear brake pressure regulator plug
A.57034/R	Wrench, shock absorber reservoir nut
A.57070	Wrench, front shock absorber
A.60018	Stopper, spark plug well, for valve tightness test
A.60041/2	Holder, valve tightness tester
A.60148	Tester, engine valve tightness
A.60153/R	Mandrel, inlet and exhaust valve guides
A.60308	Driver, piston pin
A.60311/R	Engine valve removal and installation tool
A.60312	Remover, oil filter
A.60326/R	Driver, oil pump and ignition distributor drive gear bushing
A.60330/R	Tool, flywheel fixing
A.60333/1/2	Driver, oil pump drive shaft bushing
A.60334	Tester, cylinder head tightness
A.60335	Plate, cylinder head, for removal and installation of valves
A.60353	Support, cylinder head, for valve seat refacing
A.60430	Installation tool, coolant pump impeller
A.70017	Tool, clutch pedal spring removal and installation
A.70025	Clamp, propeller shaft flexible coupling, removal and installation
A.70081	Aligning mandrel, clutch driven disc
A.70152	Installation driver, final drive pinion rear bearing inner race
A.70157	Installation driver, axle shaft gland
A.70171	Installation driver, final drive pinion rear bearing outer race
A.70172	Gauging flanges (2 pcs), rear axle beam
A.70184	Dummy pinion, for determining shim thickness when adjusting final drive gear backlash

Continued

Designation	Name
A.70185	Installation driver, final drive pinion front bearing outer race
A.70198	Removing driver, final drive pinion bearing outer race
A.74076/1	Repair fixture, steering gear case
A.74076/R	Bracket, steering gear case, accessory to fixture A.74076/1
A.74105	Driver, pitman arm shaft bushing
A.74177/1	Installation tool, upper wishbone silent block (accessory to fixture 67.7853-9519)
A.78034	Remover tool, glass regulator handle circlip
A.86010	Installation driver, crankshaft plug
A.86606	Wrench for M6x1 studs
A.86608	Wrench for M8x1.25 studs
A.86610	Wrench for M10x1.25 studs
A.90310	Reamer set, valve guide
A.90336	Reamer, steering gear case bushing
A.90353	Reamer, oil pump, ignition distributor and fuel pump drive shaft bushing
A.94003	Counterbore for inlet valve seats
A.94016	Spindle, plug socket counterbore
A.94016/10	Counterbore, crankshaft plug socket
A.94031	Counterbore 20°, exhaust valve seat
A.94058	Mandrel, valve seat counterbore
A.94059	Set of pilot spindles, valve seat refacing
A.94069	Mandrel, valve seat grinding wheel
A.94078	Grinding wheel, exhaust valve seat
A.94092	Counterbore, exhaust valve seat
A.94100	Grinding wheel, inlet valve seat
A.94101	Counterbore 20°, inlet and exhaust valve seat
A.95111	Feeler gauge, lever-to-cam clearance
A.95615	Tester, piston pin fit
A.95688/R	Gauge, final drive gear mesh and differential bearing clearance adjusting
A.95690	Thickness gauge, driving pinion adjusting shim
A.95697/5	Head, accessory to 02.7812-9501 dynamometer
02.7812-9500	Articulated socket wrench 13 mm for starter and muffler inlet pipe
02.7812-9501	Dynamometer, rolling moment of bearings

Continued

Designation	Name
02.7823-9504	Remover tool, generator pulley
02.7823-9505	Jig, engine valve installation and removal (alternative of portable tool A.60311/R)
02.7834-9504	Gauge, axle shaft end play
02.7853-9500	Driver, piston pin
02.7854-9500	Set of inserter bushings for standard and oversize pistons
02.8701-9502	Test gauge, front suspension ball joints
41.7811-4014	Wrench, gearbox countershaft nut
41.7816-4013	Socket wrench 21 mm, valve lever adjusting bolt guide
41.7816-4068	Fixing tool, gearbox clutch shaft
41.7816-4069	Installation and remover tool, gearbox main shaft locking ring
41.7820-4003	Aligning tool, oil pump shaft
41.7820-4006	Installation tool, oil pump and ignition distributor driven gear
41.7853-4010	Installation mandrel, camshaft drive cover
41.7853-4011	Installation mandrel, crankshaft gland and holder
41.7853-4016	Installation mandrel, valve guide oil deflecting cap
41.7853-4028	Installation mandrel, gearbox main shaft bearing
41.7853-4032	Installation mandrel, gearbox countershaft bearing
41.7853-4039	Installation mandrel, gearbox main shaft gland
41.8734-4092	Matching gauge, cross bearing lockrings
67.7812-9520	Wrench, front axle final drive adjusting
67.7812-9513	Dynamometer, fan drive belt tension control
67.7812-9514	Spark plug wrench
67.7812-9515	Wrench, spark plug tightening torque control
67.7812-9517	Articulated extension rod L=500 mm
67.7812-9518	Articulated extension rod L=1000 mm
67.7812-9519	Head, spark plug removal and installation
67.7813-9503	Repair tools, clutch driven disc
67.7813-9504	Wrench, steering rod sleeve
67.7820-9514	Cross-beam, engine lifting
67.7820-9517	Tool set for replacement of rear suspension radius rod bushings
67.7820-9519	Installation fixture, rear brake pressure regulator
67.7820-9520	Fixture, nut setting

Continued

Designation	Name
67.7820-9521	Lever, to move front wheel hub for checking bearing clearance
67.7822-9517	Jig, clutch driven disc facing replacement
67.7823-9514	Remover tool, wheel hub cap
67.7823-9515	Remover tool, lower wishbone shaft
67.7823-9516	Remover tool, axle shaft and front wheel hub
67.7823-9517	Fixture, lower wishbone silent block removal and installation
67.7823-9519	Remover tool, brake drum
67.7823-9522	Screw clamp, propeller shaft cross bearing, removing
67.7823-9526	Fixture, lower wishbone silent block installation and removal on press
67.7823-9527	Fixture, upper wishbone silent block, removing
67.7823-9529	Remover tool, axle shaft bearing lockring
67.7823-9530	Installation tool, axle shaft bearing lockring
67.7824-9513	Tool set for shock absorber repairs
67.7824-9516	Remover tool, steering rod and front suspension ball pins
67.7834-9506	Fixture for measuring fuel pump lifter travel
67.7834-9507	Measuring gauge, front wheel hub bearing end play
67.7851-9500	Mandrel, clutch driven disc, riveting
67.7853-9519	Fixture, upper wishbone silent block installation (accessory to tool A.74177/1)
67.7853-9528	Installation mandrel, wheel hub cap
67.7853-9533	Installation mandrel, front wheel drive joint gland ring
67.7853-9534	Removing washer, front wheel hub inner bearing outer race
67.7853-9535	Handles for washers 67.7853-9534
67.7853-9536	Installation mandrel, front wheel hub bearing outer race
67.7853-9537	Installation mandrel, front wheel drive joint boot
67.7853-9540	Removing washer, wheel hub bearing inner race and gland
67.7853-9541	Mandrel, steering worm upper bearing installation and removal
67.7853-9543	Mandrel, for compressing brake master cylinder spring during installation of lock screws

Continued

Designation	Name
67.7853-9558	Installation mandrel, transfer case differential bearings
67.7853-9559	Stop, differential bearing, removing
67.8125-9501	Ring gauge dia 79 mm for zeroing internal gauge
67.8151-9505	Gauge, carburettor fuel level control (instead of A.95129)
67.8701-9508	Bracket with end-piece for gauge A.95688/R for adjusting front axle final drive

Continued

Designation	Name
67.8720-9501	Checking fixture, steering wheel play
67.8732-9501	Gauging mandrel for checking geometrical parameters of front suspension cross member
TCO-3/379	Cross beam, engine lifting and installation
EC -106	Test stand, thermostat

CONTENTS

Introduction	2		
Section I. General Data			
Specifications	3		
Main Adjustment Data	5		
Fuels, Lubricants, Fluids	6		
Section II. Engine			
Trouble Shooting	7		
Engine Removal and Installation	10		
Engine Disassembly	11		
Engine Assembly	13		
Engine Stand Tests	16		
Engine Checkover on Car	16		
Cylinder Block	16		
Pistons and Connecting Rods	18		
Crankshaft and Flywheel	21		
Cylinder Head and Valve Gear	24		
Camshaft and Drive	28		
Cooling System	31		
Lubricating System	33		
Crankcase Breathing System	36		
Fuel System	37		
Exhaust System	50		
Section III. Power Transmission			
Clutch	51		
Gearbox	57		
Transfer Case	66		
Propeller Shaft Drive	73		
Rear Axle	77		
Front Axle	91		
Front Wheel Drive	93		
Section IV. Running Gear			
Trouble Shooting	96		
Front Suspension	99		
Rear Suspension	107		
Shock Absorbers	109		
Section V. Steering			
Trouble Shooting	112		
Inspections, Checks and Adjustments	113		
Steering Mechanism	114		
Steering Rods and Ball Joints	118		
Idle Arm Bracket	119		
		Section VI. Brakes	
		Trouble Shooting	120
		Checks and Adjustments	122
		Clutch and Brake Pedal Bracket	126
		Vacuum Booster	127
		Brake Master Cylinder	127
		Front Brakes	128
		Rear Brakes	130
		Rear Brake Pressure Regulator	132
		Parking Brake	133
		Section VII. Electrical Equipment	
		General	135
		Storage Battery	136
		Generator	138
		Voltage Regulator	143
		Battery No-Charge Signal Lamp Relay	146
		Starter	146
		Ignition System	151
		Lighting System	157
		Horns	160
		Windshield Wiper	161
		Headlamp Wiper	163
		Heater Motor	163
		Instruments	165
		Section VIII. Body	
		Trouble Shooting	169
		Body Shell	171
		Body Paint	175
		Anticorrosive Treatment of Body	176
		Doors	181
		Hood, Bumpers	185
		Window Glasses, Windshield and Headlamp	
		Washers	186
		Instrument Panel	188
		Seats	189
		Heater	190
		Appendices	
		Appendix 1. Tightening Torques for Screw Joints	193
		Appendix 2. Repair Equipment	195

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