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US ARMY FOREIGN SCIENCE AND TECHNOLOGY CENTER

THE ZIL MOTOR VEHICLES

Maintenance and Repair of the ZIL-157K, ZIL-130, ZIL-131 and Their Modifications. Part II

By

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13. ABSTRACT

Chapters 11 through 19 of this report and 12 appendixes described the maintenance and repair procedures of the ZIL157K, ZIL130, ZIL131 motor vehicles; also included are the engineering specifications of the various parts of the vehicles and their modifications.

Details of illustrations in
this document may be better
studied on microfiche

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Motor Vehicle Maintenance						
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Dump Truck						
Servicing Technique						
(U) ZIL157K Cargo Truck						
(U) ZIL130 Cargo Truck						
(U) ZIL131 Cargo Truck						
Revision						
Unarmored Vehicle Specification						
Tractor						
Motor Vehicle Suspension System						
Special Purpose Truck						
Automotive Maintenance Equipment						
Motor Vehicle Brake						
Motor Vehicle Steering System						
Power Train						
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NOTICE

Chapter 11. Frame and Towing Assembly

Chassis, Steering and Brake

Design

ZIL truck frames are riveted and have stamped side members varying in cross section connected by stamped cross members. The frame of the long-based ZIL-130G truck has side members with reenforcements at the most heavily loaded part of the frame (from the rear bracket of the front leaf spring to the rear bracket of the rear leaf spring).

The brackets for the engine mount, front and rear leaf springs, steering assembly and cab are also riveted. The brackets for the fenders, fuel tanks and batteries of ZIL-130 and ZIL-131 are bolted to the frame parts. All truck frames have front bumpers which are also bolted into place. Only the 3-axle ZIL-157K and ZIL-131 trucks have rear bumpers.

The front part of the frame is equipped with towing hooks and an engine shield which protects the under-hood area from roads dirt.

Towing assembly. The rear part of the ZIL-157K truck frame has a towing assembly with a sprung shock absorber, and the ZIL-130 and ZIL-131 truck frames have towing assemblies with rubber shock absorbers.

Dump truck and tractor frames have no towing assembly, but all frames have provision for their installation. From the middle of 1967, some dump truck frames (ZIL-130D2) were produced with towing assemblies. Frames which do not have towing assemblies are equipped with rings intended for short towing, but not for operation with a trailer.

The frame width (Figure 11-1) of the ZIL-130 and its modifications is 865 mm from front to rear.

The frame of the ZIL-157K truck (Figure 11-2) is equipped with removal side member extendors 1 for winch installation. When the extendors are installed the front bumper 30 is replaced with bumper 29. The bumper of a truck with a winch has a winch cable roller.

Figure 11-3 shows the frame of the ZIL-131 and ZIL-131A trucks, and Figure 11-4 shows the frame of the ZIL-131V tractor, which differs only slightly from the frame of the ZIL-131 truck, but is somewhat less in overall length.

The frame of the ZIL-131V truck is equipped with a fifth wheel instead of a bed, and towing ring 14 instead of a towing assembly.

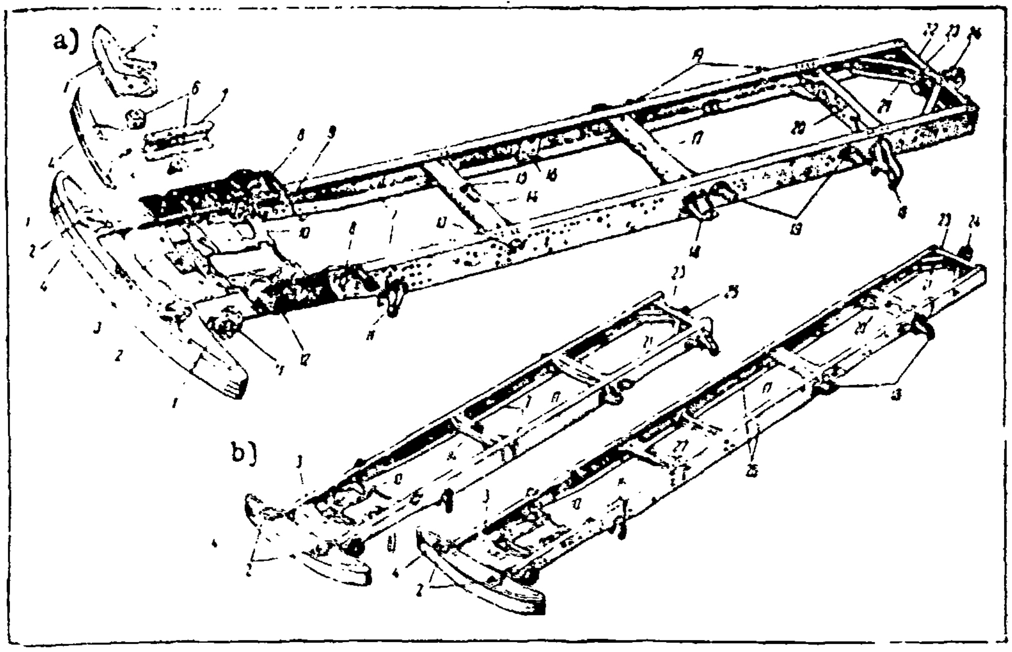


Figure 11-1. Truck Frame:
a, ZIL-130, b, ZIL-MMZ-55 and ZIL-130V, c, ZIL-130G;
1, 10 and 12, splash guards, 2, towing hooks, 3, first cross member, 4, front bumper, 5, bumper mount, 6, front towing hook reenforcement, 7 and 26, side members, 8, shock absorber bracket, 9, rear engine mount bracket, 11, front leaf spring bracket, 13, platform bracket, 14, second cross member, 15, cab bracket, 16, spare wheel mount re-enforcement, 17, third cross member, 18, rear leaf spring mounting bracket, 19, helper spring support bracket, 20, fourth cross member, 21, angle brace, 22, towing cleet, 23, fifth cross member, 24, towing assembly, 25, towing ring, 27, additional cross member.

Wenches are installed on ZIL-131 and ZIL-131A truck frames without extendors. When a winch is installed the front bumper is attached to the frame with gusset plates.

The towing assembly of the ZIL-157K frame is shown in Figure 11-5, and Figure 11-6 shows that of the ZIL-130 and ZIL-131.

The towing ring is shown in Figure 11-7.

Assembly and Dissembly

The riveted connection of the frame must insure reliable rigid connection of the parts. Connections are checked by tapping the rivets with a hammer. Tightening weakened rivets is ineffective. Weakened rivets should be replaced. A bed rivet may be replaced by a bolt with a nut and lock washer. When rivets have worked out, joint parts have separated, or if their holes have different sized openings (one opening enlarged and the other not), the holes should be enlarged and a bigger rivet installed. If the rivet holes have become greatly enlarged (more than 15% of nominal diameter) the opening may be welded and redrilled. All hoies should be strengthened by driving a cylindrical punch into them.

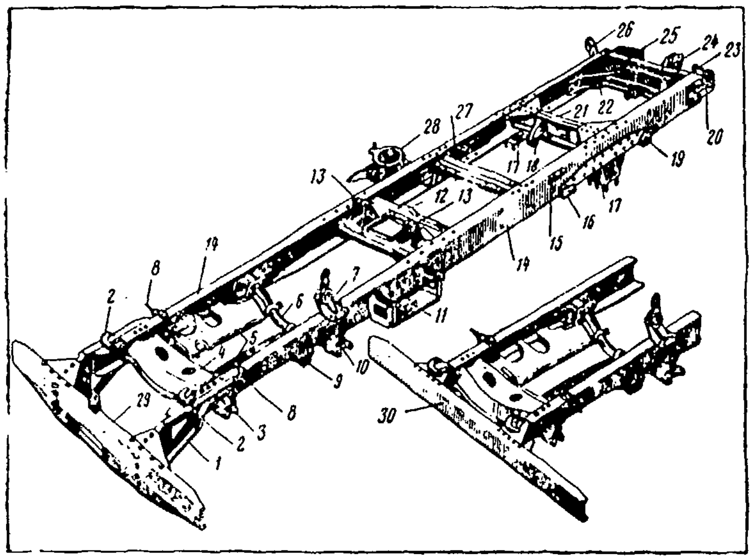


Figure 11-2. ZIL-157K Truck Frame:
1, frame extendor, 2, towing hooks, 3 and 10, front spring brackets, 4, first cross member, 5, splash guards, 6, additional frame cross member, 7, steering assembly bracket, 8, shock absorber bracket, 9, 16 and 19, rubber pads, 11, battery mounting bracket, 12, second cross member, 13, cab bracket, 14, side members, 15, platform bracket, 17, balance suspension brackets, 18, torsion bar bracket, 20 and 26, tail light brackets, 21, fourth cross member, 22, angle brace, 23, rear bumpers, 24, towing assembly, 25, fifth cross member, 27, third cross member, 28, spare wheel bracket, 29, front bumper (when wench is installed), 30, front bumper (without wench).

The rivet must fit the hole tightly. The joint frame parts in front of the rivet must be joined together tightly, because a space will allow the shank of a new rivet to expand into this area, forming a so-called "blind washer." When trouble is encountered, the space should be eliminated by using neighboring holes in the joint parts, pulling them together with a nut and bolt or clamp and then riveting.

Hot riveting may be used in the field, i.e. heating the rivet in an electric or other heating oven. The heated rivet will pull the joined parts together even tighter after cooling. In repair shops, cold hydraulic riveting should be performed. In order not to disturb the position of the parts, rivets should be replaced in sequence, i.e. remove one rivet, replace it, and then remove the next and so forth.

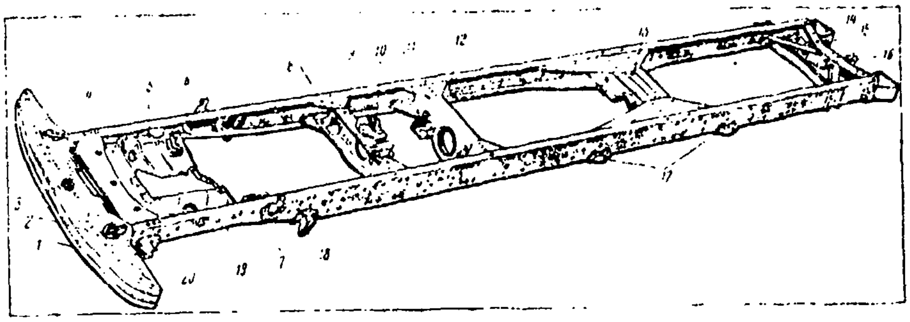


Figure 11-3. ZIL-131 and ZIL-131A Truck Frames:
1, front bumper, 2, front towing hook, 3, bracket for engine hand crank, 4, first cross member, 5, splash guard, 6, rear engine mount bracket, 7, shock absorber bracket, 8, electro pneumatic transmission drive bracket, 9, second cross member, 10, rear cab mount bracket, 11, transmission mount bracket, 12, 13 and 14, third, fourth and fifth frame cross member, 15, rear bumper, 16, towing assembly, 17, shock absorber bracket, 18 and 20, front spring bracket, 19, side member.

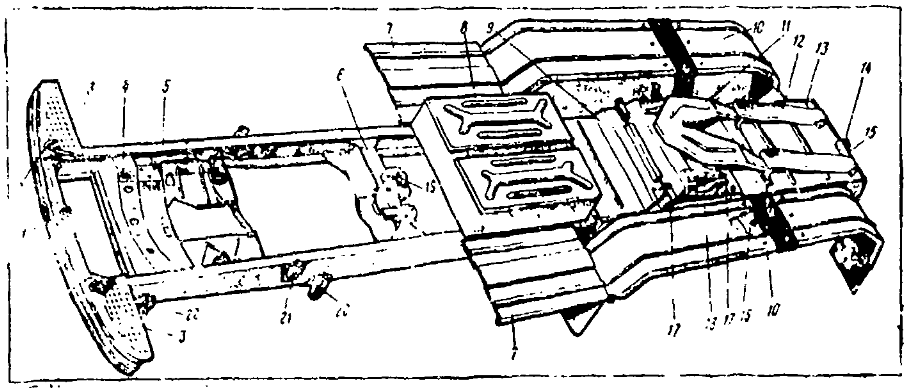


Figure 11-4. ZIL-131V Tractor Frame:
1, front bumper, 2, front towing hook, 3, splash guards, 4 and 6, first and second frame cross members, 5, side member, 7, running boards, 8, tool boxes, 9 and 13, shields, 10, rear fenders, 11, fifth-wheel plate, 12, sliders, 14, towing ring, 15, towing assembly cross member, 16, fender bracket, 17, steps, 18, wood blocks, 19, rear cab mount brackets, 20 and 22, front spring mounts, 21, shock absorber bracket.

After riveting, the rivet heads should be located symmetrically relative to the rivet axis, completely drifted, and have the proper geometric form without gaps, leads and cracks. The diameter of the new rivet head must not be less than 1.5 d (shaft diameter).

The quality of the rivet joint may be checked with a feeler gauge. A 0.5 mm gauge should not fit between two attached parts at a distance equal to 2 diameters of a rivet shaft. A 0.6 mm gauge should not fit in intervals between rivets of up to 60 mm, and a 1.2 mm gauge should not fit at greater distances between rivets. There must be no space beneath rivet heads.

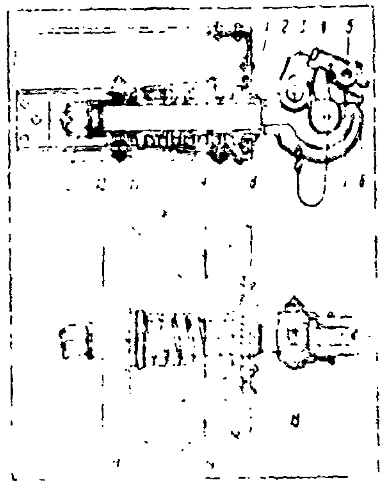


Figure 11-5. ZIL-157K Towing Assembly:
1, sleeve, 2, hook, 3 and 5, pins, 4, dog, 6, catch, 7, dog spring, 8 and 10, spring guide sleeves, 9, hook spring, 11, auxilliary cross member, 12 and 13, nuts, 14, angle braces, 15, rear cross member.

Frames are checked for bending and twisting by visual examination as well as by using straight edges and templates. Bending of the side member in the plane of the vertical wall must not exceed 2 mm per 1,000 mm of length for 5 mm for the whole length of the member.

Bent frame parts are straightened cold.

There must be no more than 3 mm shift of the side members causing the cross members to be nonperpendicular relative to the side members. Longitudinal shifting of the side members may be checked by measuring the distance between the two opposite engine suspension bolt holes. A bent frame should be repaired by placing the bent parts.

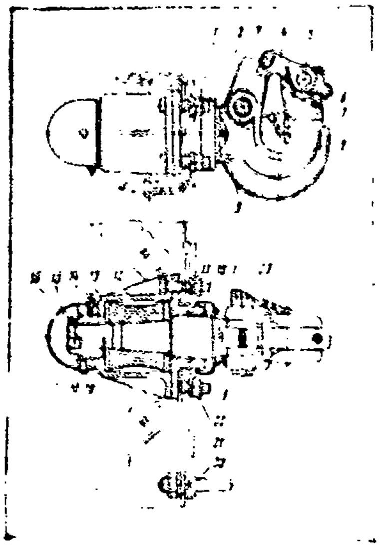


Figure 11-6. ZIL-130 and ZIL-131 Towing Assembly:
1, cover, 2, deflector, 3 and 5, pins, 4, dog, 6, dog spring, 7, latch, 8, hook, 9 and 14, grease fittings, 10 and 18, bolts, 11 and 13, support washers, 12, housing, 15, cover, 16, pin, 17, hook nut, 19, rubber bushing, 20, ring, 21, cross member, 22 and 23, nuts.

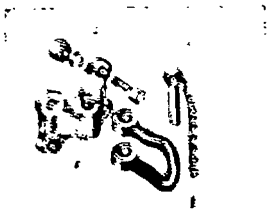


Figure 11-7. ZIL-MMZ-555 Dump Truck and ZIL-130V and ZIL-131V Towing Ring Assembly:
1, nut, 2, washer, 3, pin, 4, chain with cotter pin, 5, ring, 6, bracket.

Cracks and their repair. When cracks are found in spring or shock absorber brackets, the parts should be replaced.

The side members crack only as a result of regular overloading or as a result of driving a loaded truck at excessive speeds over bad roads. When cracks are discovered in the side members of the frame, the boundary of each crack must be determined. For this, the crack should be cleaned down to bear metal, washed with kerosene, dried and tapped with a mallet. The end of the crack will be revealed by escaping kerosene. A mark should be made with a punch at the end of the crack and a 5 mm hole drilled through the member. Prepare the area for welding using a chisel or grinder at an angle of 90° alone the crack, extending 3 mm along both sides. Weld the hole from both sides, beginning from the drilled hole up to the end of the crack. Preparation for welding may also be done by cutting through the frame part with a hack saw along the wholo length of the track.

The frame side members are made of number 30 titanium steel, which makes welding more difficult. Therefore, electric welding with high quality electrodes or semiautomatic welding in a protective medium must be done. For welding cracks on frame parts, NIIAT recommends using OZS-6 VN-48 and UONI-13/55 electrodes.

The weld bead must not extend more than 2 mm above the surface of the parts. The fatigue strength of the metal is reduced because of welding heat at a distance of 3-4 mm from the bead. This area may be strengthened by cold hardening with a pneumatic or metal working hammer.

Any cracks on the side members or cross members except those noted simultaneously on 2 members opposite each other may be welded by installing box or rectangular reenforcements (Figure 11-8).

The reenforcement must fit the parts being repaired perfectly. Only longitudinal horizontal beads should be used to weld the reenforcements in place, leaving the vertical edges unwelded. When reenforces are installed care must be taken not to create excessive rigidity in the area surrounding the crack, since this causes the appearance of new cracks at the end of the reenforcers, which are made of St. 3, 08, or 20 steel 5 mm thick.

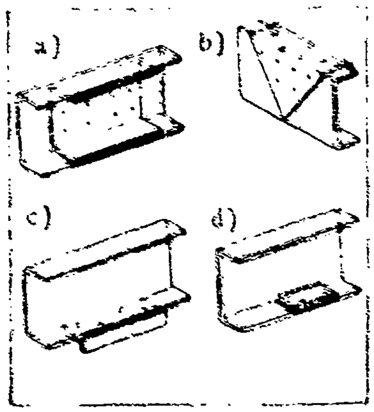


Figure 11-8. Reenforcements:
a, box section, b and c, triangular, d, rectangular.

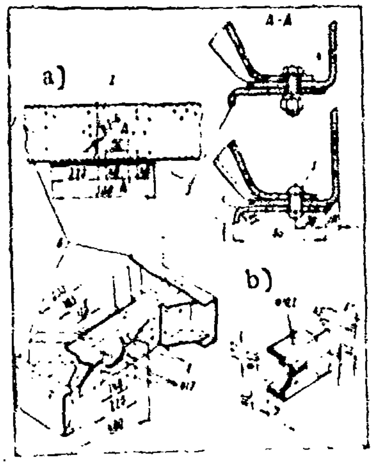


Figure 11-9. Reenforcements for the Side Members and Fourth Cross Member of a Dump Truck Frame:
a, side member reenforcement, b, fourth cross member reenforcement; 1, crack in side member, 2, hole drilled at end of crack, 3, side member reenforcement, 4, attaching the second cross member with bolts, 5, attaching second cross member with rivets, 6, side members, 7, fourth cross member, 8, fourth cross member reenforcement.

Additional holes must not be drilled in the horizontal surfaces of the side members.

Figure 11-9 shows the method recommended by ZIL for repairing dump truck frames. Frequent overloading of vehicles results in the appearance of cracks on the lower surface of the side members of the frames of these trucks around the second and fourth cross members where the angle braces are attached. The following must be done to repair cracks:

make a side member reenforcement (Figure 11-9a) and a fourth cross member reenforcement, first drilling the ends of the crack and preparing the area for welding;

drill out the rivets which attach the second cross member to the roller surface of the side member and the rivets which attach the angle brace to the side members;

rivet the second cross member and reenforcement to the lower surface of the side member and angle brace with reenforcing pieces to the fourth cross member. Bolts are used where rivets cannot be. The bolt holes are corrected by drilling. If the holes are severely damaged, larger M14 bolts are used;

weld the reenforcing pieces to the lower surface of the side member and to the fourth cross member using only longitudinal beads. The beads should stop short of the ends of the reenforcing piece by approximately 20-30 mm. The quality of the weld beads is checked by visual inspection.

ZIL-157K towing assembly. If the towing assembly requires repair (deterioration of the hook, guide sleeves and other parts), it must be removed from the frame and taken apart. When dismantling a towing assembly with a shock absorbing spring it is necessary to remove the cotter pin and unscrew nut 13 (see Figure 11-5) of the hook, remove the support washer and extract towing hook 2 along with its lock. Loosen nuts 12 and remove auxilliary cross member 11 of the towing assembly. Remove guide sleeves 8 and 10 and spring 9. To remove latch 6 from the towing hook it is necessary to remove the cotter pin, unscrew the nut and drive pin 3 out. To remove dog 4 from the latch it is necessary to remove the stopper bolt and drive out pin 5.

The towing assembly with a shock absorbing spring is re-assembled in reverse order from its dissembly.

ZIL-130 and ZIL-131 towing assemblies. The following operations must be carried out when dissembling a towing assembly with a rubber bushing.

Remove bolt 18 (see Figure 11-6) of cover 15 and remove it. Release the nut, removing cotter pin 16. Unfasten hook shank 8 fastening nut 17 and remove the hook along with its lock. Remove nut 22 which fastens cover 1 and housing 12 to frame cross member 21, remove bolts 10 and extract the parts of the towing assembly, taking them apart separately (rubber bushing 19, support washers 11 and 13, housing 12 and cover 1). If the rubber bushing support washers are worn, they should be switched in position.

To remove latch 7 from the towing hook it is necessary to remove the cotter pin, unscrew nut 23 and drive out pin 3.

To remove dog 4 from the latch it is necessary to unscrew the stopper bolt and drive out pin 5.

The towing assembly with a rubber bushing is re-assembled in reverse order from dissembly.

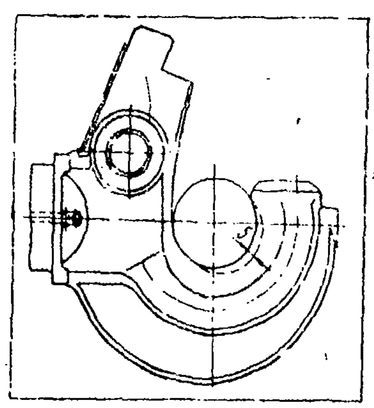


Figure 11-10. Towing Apparatus Hook.

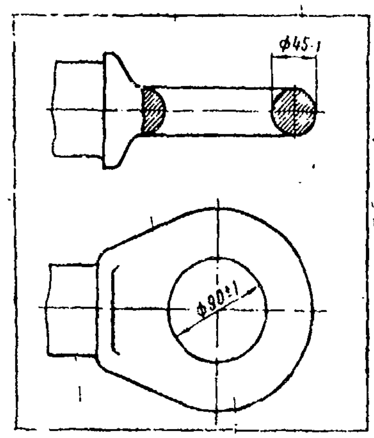


Figure 11-11. Trailer Towing Ring.

A bent hook shank is repaired by straightening. The hook should be replaced if it is cracked or more than 2 turns of the screw are damaged. Admissible wear of the hook opening without repair is no greater than 5 mm (Figure 11-10). The diameter of the sleeve of a towing assembly with a shock absorbing spring without repair may not be less than 45.6 mm. If the rear sleeve is more heavily worn it is recommended to trade places of the sleeves (the dimensions of the front and rear sleeves are identical).

The admissible diameter of the towing assembly latch pins without repair is 24.0 mm.

Damaged or cracked parts of towing assemblies should be replaced.

If the dogs or latches become jammed they should be cleaned.

The basic parameters of the parts and materials of frames and towing assemblies are shown in Tables 11-1, 11-2 and 11-3.

If the parts of towing loops and hooks show cracks or excessive wear they should be replaced. No more than 2 turns of any threaded device may be damaged. If towing hooks are bent they should be straightened.

If trucks are being used for pulling trailers it is necessary to be sure that the trailer towing loops (Figure 11-11) are designed in accordance with GOST 2349-54.

It must be kept in mind that using trailer towing loops with a smaller cross section will lead to increased wear and reduce the service life of the towing assembly as well as the rear cross member of the truck frame.

Trailer hooks with an improper geometrical form (out of round, scratched, poorly welded) should not be used. The use of such rings will cause them to catch in the towing hooks when making turns and bending of the towing hook, and when the trailer is backed is shaft will strike the frame of the truck, crushing the end of the frame and bending the shaft.

TABLE 11-1.

FRAME PART MATERIALS

Part	ZIL-130	ZIL-157K	ZIL-131
Side member	Steel 30 with titanium, sheet thickness 6.35 mm	(spans)	
First cross member	Steel 20, sheet thickness 5.5 mm (GOST 4041-48)	Steel 08, sheet thickness 6 mm (GOST 4041-48)	
Supplementary cross member 6 (see Figure 11-2)		Steel 20, tubing 63.5 mm in diameter (GOST 8732-58 and GOST 8731-58)	
Second cross member	Steel 08, sheet thickness 5 mm (GOST 4041-48)	(spans)	Steel 20, sheet thickness 6 mm (GOST 4041-48)
Third cross member	Same	(spans)	Steel 20, sheet thickness 6 mm (GOST 4041-48)
Supplementary cross member 27 (see Figure 11-1)	Steel 08, sheet thickness 5 mm (GOST 4041-48)		
Fourth cross member	Steel 20, sheet thickness 5.5 mm (GOST 4041-48)	Steel 14G2, sheet thickness 5 mm (GOST 5058-57 and GOST 404k-48)	Steel 20, sheet thickness 6 mm (GOST 4041-48)
Fifth cross member	Same	Same	Same
Towing assembly angle brace cross member		Same	
Towing assembly angle brace	Steel 20, sheet thickness 5.5 mm (GOST 4041-48)	Same	Steel 20, sheet thickness 5.5 mm (GOST 4041-48)
Side member extendor		Steel 30 with titanium, sheet thickness 6.35 mm (TUS 11-46 MMP)	
Front bumper	Steel 20, sheet thickness 4 mm (GOST 3680-57 and GOST 914-56)	Steel 25, sheet thickness 6 mm (GOST 4041-48)	Steel 20, sheet thickness 5.5 mm (GOST 4041-48)
Rear bumper		Steel 55SG, sheet thickness 8 mm (GOST 4555-48), hardness NV 415-369	Steel 55S2 (GOST 2052-53), strip dimension 150 × 9 mm (GOST 7419-55)

TABLE 11-2.

PARAMETERS OF TOWING ASSEMBLY PARTS.

Parts	ZIL-157K	ZIL-130 and ZIL-131
Towing assembly hook	Stamped, made of steel 50 (GOST 1050-60). Hook opening tempered. Tempering depth 6 mm. Hardness HRC 50 (no less) at a depth of 1.0 mm. Dimension of opening 50-52 mm. Sleeve diameter 44.50-44.83 mm, admissible without remont -- 44.0 mm. Threading 2M36×2, cl. 2.	Stamped, made of steel 50 (GOST 1050-60) Hook opening tempered. Depth of tempering 6mm. Hardness HRC 50 (no less) at a depth of 1.0 mm. Dimension of opening 52-53.9 mm. Diameter of hook neck inside towing assembly body 59.805-59.905 mm, admissible without repair 59.3 mm. Thread 2M36×2, cl. 2.
Towing assembly spring	Steel 70G rectangular dimension 15.5-16.5 mm (GOST 1050-60). Hardness HRC 38-45. Total number of turns 7.5. Working number of turns -- 5.5. Length of spring under no load 178-190 mm. Under a load of 800-1,200 kG spring length is 150 mm.	
Towing assembly bushing		Rubber No 2462. Length in free state 81.5-82.5 mm. Length under 1,500 kG load (no less) -- 56 mm. Diameter of opening with hook 37.70-38.50 mm.
Towing assembly housing		Iron KCh 35-10 (GOST 1215-59). Diameter of hook neck 60.00-60.06 mm, admissible without repair 60.5 mm.
Towing assembly housing cover		Iron KCh 35-10 (GOST 1215-59). Diameter of cover opening for hook neck 60.00-60.06 mm, admissible without repair 60.5 mm.
Spring insert	Iron KCh 35-10 (GOST 1215-59(. Nominal diameter: external 59.6-60.6 mm, internal 45.00-45.17 mm.	
Towing assembly latch pin	Steel 45 (GOST 1050-60). Nominal pin diameter 24.58-24.72 mm. Thread 1M20×1.5, cl 2.	
Towing assembly latch	Iron KCh 35-10 (GOST 1215-59)	
Towing hook latch dog	Iron KCh 35-10 (GOST 1215-59)	
Latch dog pin	Steel 45, diameter 21.86-22.00 mm (GOST 1051-59 and GOST 7417-57)	
Latch dog spring	Steel 65G, sheet thickness 0.8 mm (GOST 3680-57 and GOST 1542-54), hardness HRC 40-45	

PARAMETERS OF TOWING EYES AND HOOKS TABLE 11-3.

Part Name	Truck Model ZIL-MMZ-555, ZIL-130V and ZIL-131V
Towing eye	Steel 35 (GOST 1050-60), O 20 mm (GOST 2550-57). Hardness HV 207-241. Diameter of opening under facing 23.0-23.28 mm, admissible without repair 24.5 mm.
Eye facing	Steel 35 (GOST 1050-60), O 28 mm (GOST 2590-57). Hardness HV 207-241. Face diameter 21.48-22.00 mm; admissible without repair 20.5 mm.
Towing eye bracket	Iron KCh 35-10 (GOST 1215-59). Facing opening diameter 22.12-22.14 mm, admissible without repair 22.8 mm.
Front towing hook	Steel 35 (GOST 1050-60), hardness HV 241-285

Chapter 12. Suspension

Assembly

The suspension of all ZIL trucks is designed for four longitudinal semi-elliptical springs installed in pairs on the front and rear bridges. The front suspensions also have two telescopic shock absorbers.

The front springs of the ZIL-157K truck (Figure 12-1) are uncushioned. Both ends of the spring are equipped with rubber cushions 14.

The front springs of the ZIL-130 and ZIL-131 trucks (Figures 12-2, 12-13) have removable forged rings 1 (see Figure 12-3) which hold fingers 26, which attach spring 4 to frame brackets 3. Sleeve 25 is pressed into the removable ring. The rear end of the front springs slide. The top of the rear ends of the springs have a facing which slides along removable steel support bearing 11. The ends of the springs are supported from below by support bushing 15 of bracket 10.

The rear springs of the ZIL-130 truck (Figure 12-4), just as the front springs, have removable rod ring 5 with its pressed bushing 24 on the front end. The rear ends of the springs slide, just as the rear ends of the front springs, and are equipped with a replaceable facing and heat treated support 15. The auxilliary spring 12 is uncushioned and has sliding ends.

The rear suspension of the ZIL-157K and ZIL-131 three axle trucks (Figures 12-5, 12-6) is of the balance type. Shaft 8 (see Figure 12-6) of the balance assembly is pressed into bracket 20, which are attached to frame brackets 22. Hubs 2 with inserts 12 are attached to the ends of shaft 8. Spring 29 is attached at the middle to hub 2 by two u bolts, and its ends move in the eyes of brackets 28, which are welded to the beams of the middle 32 and rear 27 bridges.

Acceleration and braking forces are transmitted from the bridges to the truck frame through 6 six torsion bars 18 and 30. One end of the bars is attached by bearing fingers 17 to the bridge brackets, and the other end is attached to the axle brackets of the balance suspension. An exception are the upper torsion bars of the ZIL-157K truck suspension, which have one end attached to the bridge brackets, and the other to special brackets fastened to the frame cross member.

Shock absorbers. The front suspension of all ZIL trucks have two telescopic hydraulic shock absorbers (Figure 12-7) to absorb vertical oscillations which arise during travel over uneven roads.

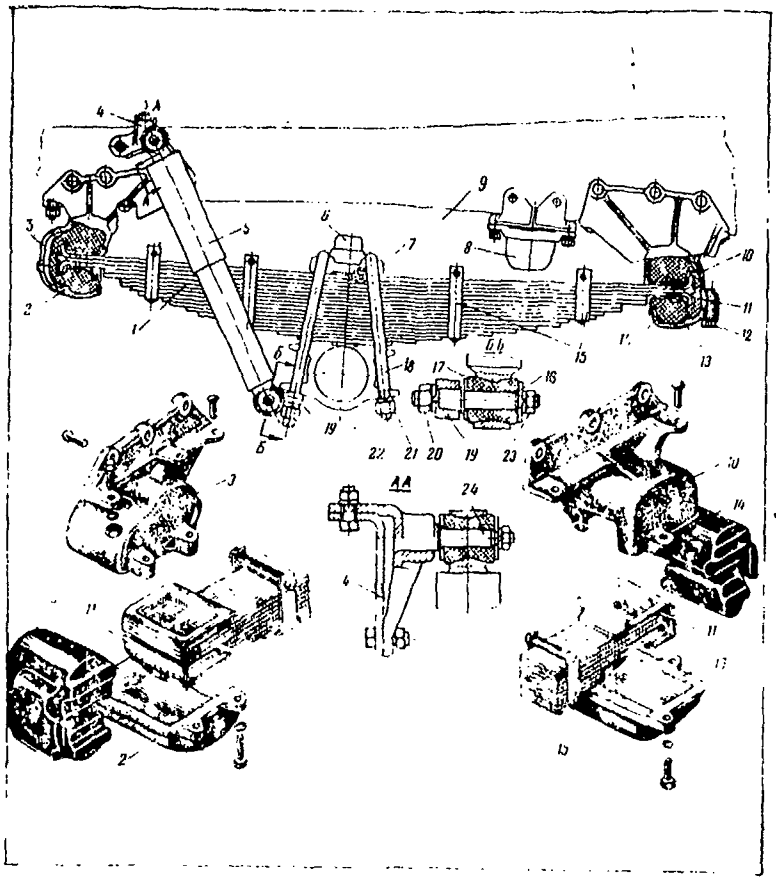


Figure 12-1. Front Suspension of the ZIL-157K Truck:
1, spring, 2 and 13, covers, 3 and 10, suspension bracket, 4 and 19, shock absorber bracket, 5, shock absorber, 6 and 8, bumpers, 7, facing, 9, frame side member, 11, catches, 12, bolt, 14, rubber support bushings, 15, clips, 16 and 24, fingers, 17, rubber inserts, 18, u bolt, 20, 21 and 23, nuts, 22, front bridge beam.

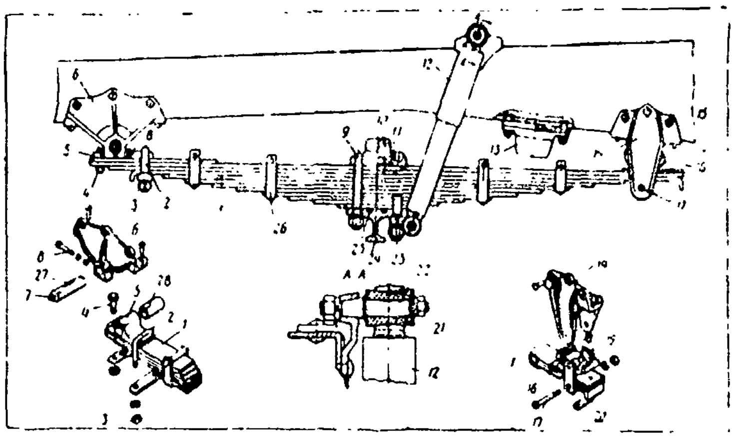


Figure 12-2. Front Suspension of the ZIL-130 Truck:
1, spring, 2 and 9, u bolts, 3 and 23, nuts, 4, 8 and 17, bolts, 5, spring eye, 6 and 14, suspension brackets, 7, grease fitting, 10 and 13, bumpers, 11, facing, 12, shock absorber, 15, frame side member, 16, support, 18, 22 and 27, fingers, 19, inserts, 20, 21 and 28, sleeves, 24, beam, 25, fixing projection, 26, clip.

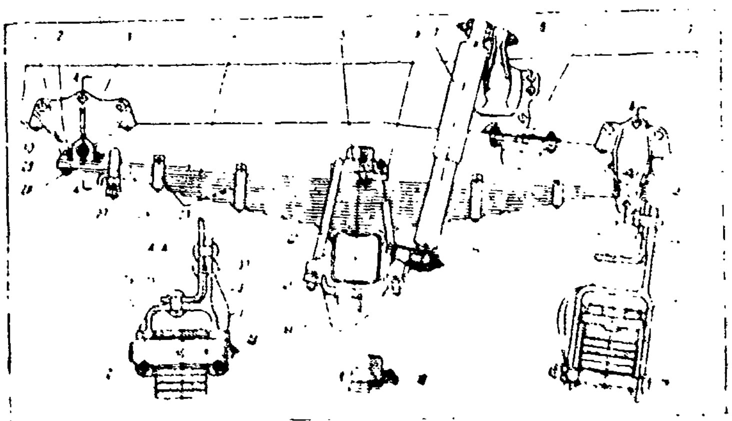


Figure 12-3. Front Suspension of the ZIL-131 Truck:
1, spring eye, 2, tie bolt, 3 and 10, brackets, 4, spring, 5, padded facing, 6, spring stamp (for truck without winch), 7, shock absorber, 8, shock absorber bracket, 9, bumper, 11, support pad, 12, pad finger, 13, insert, 14, 21, 27 and 28, nuts, 15, spacer, 16, rubber insert, 17, shock absorber pin, 18, spring support (for truck with winch), 19, u bolt support, 20, grease fitting, 22, spring u bolt, 23, clips, 24, eye u bolt, 25, eye insert, 26, spring eye pin, 29, lock washer, 30, frame side member.

The shock absorbers are hinge jointed to the beam of the front axle and the frame side members by pins on which the upper and lower eyes of the shock absorber are seated on rubber inserts and fastened with nuts.

The shock operates in the following manner. Piston 14, attached to shaft 19, moves in operating cylinder 18 (Figure 12-8), which is filled with shock absorbing liquid. The piston has 20 openings evenly distributed about 2 different diameters (10 openings in each circle). Openings 6, located on the larger circle, are closed from above by by-pass belt 5. Openings 15, located on the smaller circle, are covered from below by the disk of relief belt 7. The valve disk is held against the piston from below by spring 8, supported by a nut.

The shaft moves in guides 20 (see Figure 12-7) and is packed in special rubber gasket 3 and gaskets 24. Gasket 3 is located in ring 23 and is held in place by spring 22. To reduce wear of the gasket and guide the surface of the shaft is cleaned and highly polished. For the same reason, the rubber gasket is relieved of the operating pressure of the liquid in the plane of the cylinder, for which opening A is provided through which part of the liquid seeping through the opening between the shaft and its guide flows into space P of the reservoir, as a result of which the pressure of the liquid on the shaft is reduced.

Gasket 24 is an auxilliary provision to keep dirt and dust from reaching the shaft gasket. Ring gasket 4, which fills the reservoir space, is installed between the shaft guide and the shaft gasket ring.

The shaft and ring gaskets are tightened with nut 2, which has 4 wrench holes.

Compression valve unit 10 is pressed into the lower part of the operating cylinder. This unit consists of a housing, by-pass valve 9 and a valve tensioned by spring 11, which is fastened by nut 12. The housing of the compression valve contains by-pass valve 13 opening.

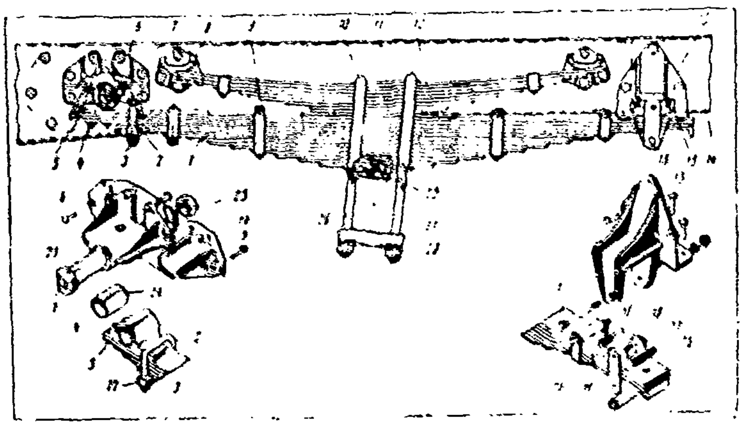


Figure 12-4. Rear Suspension of the ZIL-130 Truck:
1, leaf spring, 2 and 10, u bolt, 3, 20 and 25, nuts, 4 and 16, bolts, 5, spring eye, 6, 8 and 13, brackets, 7, grease fitting, 9, clips, 11, 21 and 27, facings, 12, helper spring, 14, frame side member, 15, support, 17 and 23, pins, 18, insert, 19 and 24, sleeves, 22, centering pad, 26, rear bridge beam.

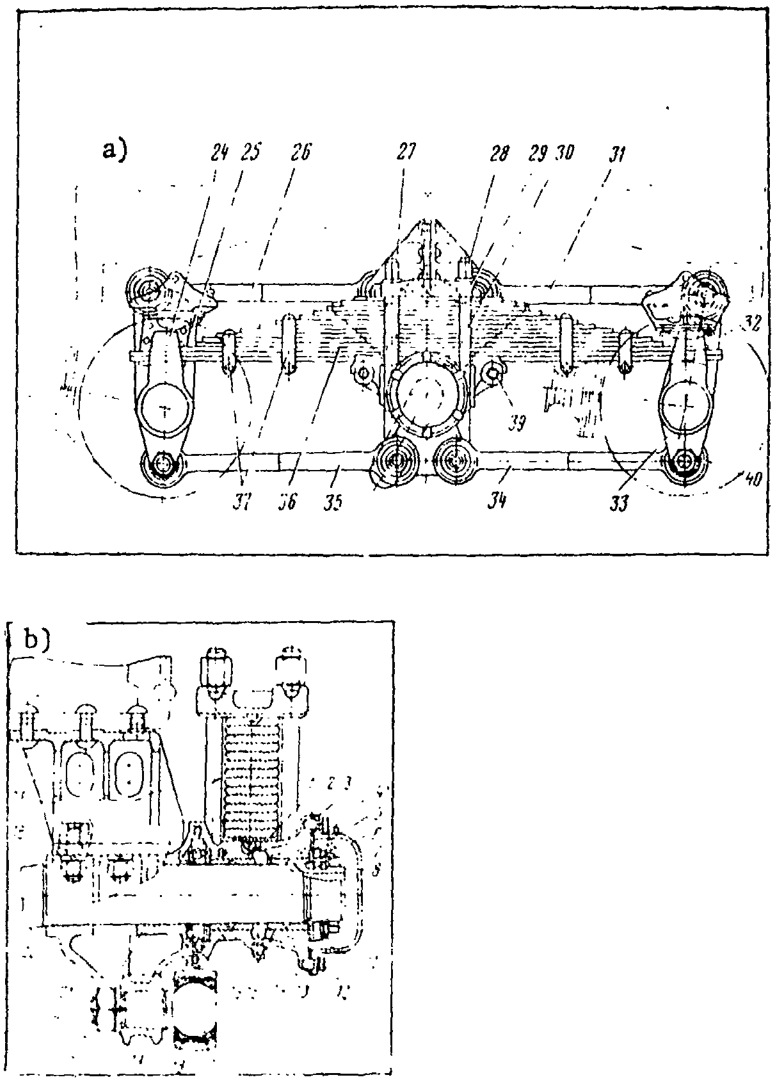
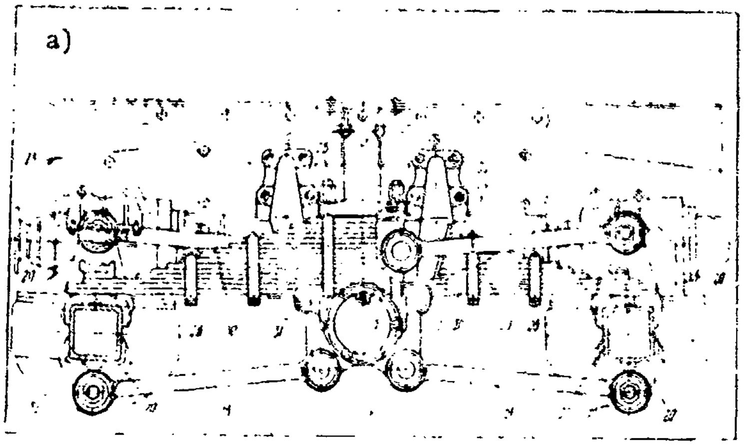


Figure 12-5. Rear Suspension of the ZIL-157K Truck:
a, side view, b, cross section;
1 and 29, facings, 2, hub, 3, pad, 4 and 14, plug, 5, pins, 6, support washer, 7, lock washer, 8, outside nut, 9, cover, 10, lock ring, 11, inside nut, 12, bolt, 13, channel, 15, sleeves, 16, gasket, 17, hinge pin, 18, insert, 19, ring, 20, packing ring, 21, 23 and 27, brackets, 22, balance suspension axle, 24, support bracket, 25, 32 and 33, torsion bars, 26, 31, 34 and 35, torsion shafts, 28 and 38, nut, 30, u bolt, 36, spring, 37, clips, 39, tie bolt, 40, hinge pin fastening nut.



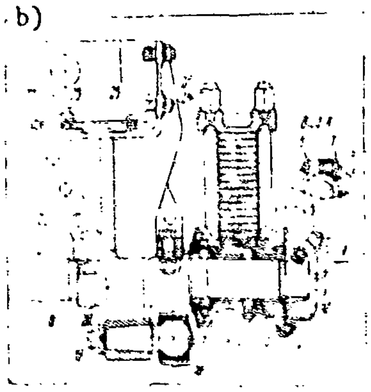


Figure 12-6. Rear Suspension of the ZIL-131 Truck:
a, side view, b, cross section;
1, facing, 2, suspension axle hub, 3, pad, 4, cover, 5 and 13, plug, 6, 19, 21, 24 and 26, nuts, 7, tie bolt, 8, balance suspension axle, 9, slotted bolt, 10 and 14, support washers, 11 and 25, bolts, 12, sleeves, 15, gaskets, 16, eye inserts, 17, hinge joint, 18 and 30, torsion shaft, 20, torsion shaft bracket, 22, bracket fastening suspension to frame, 23, frame, 27, rear bridge beam, 28, spring hinge brackets, 29, rear spring, 31, tension spindle, 32, middle bridge beam.

When the truck is driven along a fairly even road, when the oscillating speed of the suspension is insignificant, the resistance created by the shock absorber is also small. In this case the liquid flows into the shock absorber spaces primarily through the openings in the butterfly disk of the relief valve and the compression valve.

When the truck is driven on a bad road the oscillation rate increases. In this case the shock absorber provides great resistance against bouncing of the sprung portion of the truck. As a result of an increase in the rate of piston travel the liquid pressure increases in the shock absorber, and consequently the force of the shock absorber increases until the liquid pressure opens the by-pass or compression valve sufficiently thus relieving the shock absorber.

The rate of shock absorber resistance increase is determined by the number and dimensions of the opening in the disks of the by-pass valve and compression valve, and the greatest resistance developed by the shock absorber depends upon the pressure of the springs of the compression and by-pass valve.

The greatest resistance created by the shock absorber occurs when it stretches ("rebound" mode), when the sprung portion of the truck moves away from the unsprung part of the truck. When the shock absorber stretches ("rebound" mode) the piston moves upwards (Figure 12-8a) and the liquid above piston 14 undergoes compression.

By-pass rebound valve 5, which is located to the side of the space above the piston, closes and the liquid passes through the inside row of openings 15 of the piston to rebound valve 7 and opens it. The rigidity of the valve disks and pressure of spring 8 creates the necessary resistance of the shock absorber, thus reducing the rate of oscillating movement of the truck suspension.

At the same time, by-pass valve 9 is open and part of the liquid equal in volume to the part of shaft 19 which is pulling out of the operating cylinder at a given moment passes freely through opening 13 from space P of the reservoir into the operating cylinder 18.

When the suspension compresses, when the sprung part nears the unsprung part of the truck ("compression" mode), the shock absorber piston moves downward (Figure 12-8b), by-pass valve 5 opens and liquid freely passes through the outside row of hole 6 of the piston into the space above the piston. Here an amount of liquid equal in volume to the inward moving part of the rod is pushed into the reservoir after overcoming the resistance of spring 11 of compression valve 10 (by-pass compression valve 9 is closed as a result of liquid pressure). The force of the compression valve spring creates the necessary shock absorber resistance in the compression mode and, just as in the rebound mode, slows the rate of oscillation of the truck suspension. Shock absorbers are adjusted at the factory such that the force necessary to stretch it is several times greater than the force required for compression.

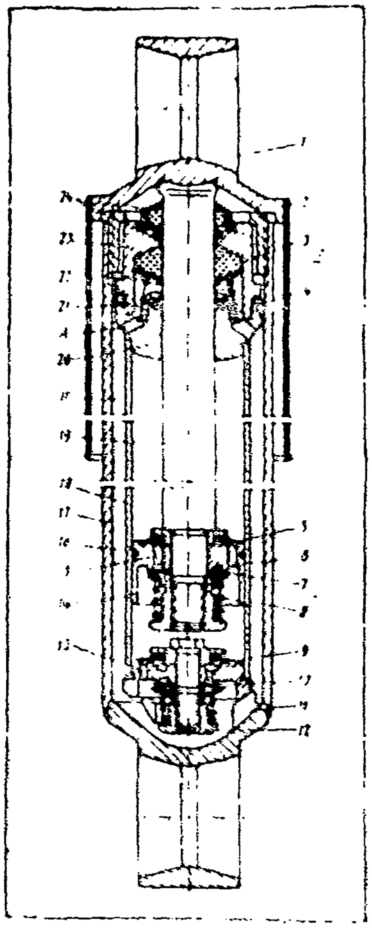


Figure 12-7. Telescopic Shock Absorber:
A, opening for filling reservoir with liquid;
P, reservoir space;
1, eyes, 2, reservoir nut, 3, shaft gasket, 4, band gasket, 5, by-pass valve, 6, outer row of holes, 7, rebound valve, 8, 11 and 22, spring, 9, compression by-pass valve, 10, compression valve, 12, nut, 13, by-pass valve opening, 14, piston, 15, inside circle of holes, 16, piston ring, 17, reservoir housing, 18, operating cylinder, 19, piston rod, 20, rod guide, 21, guide bushing, 23, gasket ring, 24, felt rod gaskets.

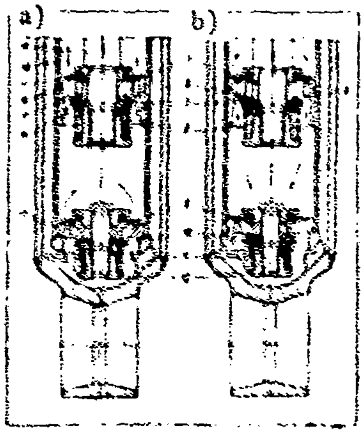


Figure 12-8. Operation of Telescopic Shock Absorber:
a, "rebound" mode, b, "compression" mode.
(for designation of parts see Figure 12-7).

In order to lighten the springs and distribute stresses more evenly along the leaves, front springs with leaves of different lengths have been installed on the ZIL-157K truck with and without winches since December, 1962.

The following changes have been made on the ZIL-130 truck to increase the longevity of the rear springs since December, 1964:

a longer intermediate leaf 9 × 65 × 410 mm has replaced the 6 × 70 × 150 mm leaf;

the 16 mm u bolt which fastens the eye of the rear spring has been replaced with 1 20 mm in diameter. Two lock washers have replaced the lock plate under each u bolt nut. Beginning in December, 1965 this change was also made in the front springs (the nuts of the u bolt fastening the eyes of the rear springs must be tightened until the lock washers compress, after the lock washers are fully compressed it is not recommended to tighten the nuts any further);

to prevent the spring u bolts from sliding passed the weld seam of the rear bridge beam and to increase strength, a u bolt pad of different configuration and distance between u bolt holes (140 instead of 130 mm) has been installed since April, 1964. The old and new pads are interchangeable.

In connection with the increased load capacity of the ZIL-130 truck (from 4 to 5 t) 16-leaf rear springs with longer u bolts have been installed instead of 13-leaf springs since August, 1966. Sixteen-leaf springs have been installed on the ZIL-MMZ-555 dump trucks since they were first put into production.

To increase the fatigue strength of the spring leaves, they undergo middle-shot treatment during manufacture.

Surfacing

During DI the suspension units are cleaned and examined. When the trucks are operated on dusty or dirty roads the pins of the front and rear springs are greased.

During TO-1 the front spring u bolt fasteners are tightened (moment 25-30 kGm). Here the two front nuts should be tightened first, then the two rear nuts.

If the ends of the springs are enclosed in rubber cushions (ZIL-157K truck) the spring requires no service in this area.

Where the front end of a spring is equipped with a removable eye (ZIL-130 and ZIL-131 trucks), the u bolt fasteners of the removable eye must be tightened periodically. The nuts must be tightened until the lock washers are fully compressed.

The load on the front springs and their service life depend both upon the quality of the spring and the condition of the shock absorbers.

The pins and inserts of the front and rear springs of the ZIL-130 truck must be inspected and greased. The tightness of the u bolts of the rear springs on the ZIL-130 trucks must be examined more carefully, since the stamped insert may become seated, which leads to shifting of the bridge beam.

The balance suspension of 3-axle trucks requires periodic changing of the grease in the fittings of the balance suspension and adjustment of its axle openings, as well as a check on the condition and tightening of the torsion shafts. The grease is changed after TO-2.

Shock absorbers require no special adjustment. Shock absorbers should be checked periodically for tightness and condition.

When traces of leaking fluid are detected on a shock absorber, the reservoir nut should be tightened, for which it is necessary to remove the shock absorber from the truck. If leakage appears which cannot be eliminated by tightening the reservoir nut, the shaft packing must be changed. When chaning the shaft packing it should be kept in mind that the packing has a mark Niz, which indicates the correction position of the packing when installing it. In this position, proper operation of the oil seal channels of the shaft is ensured.

Fluid should be changed every 25,000-30,000 km, but no less than once a year.

Before installing fresh fluid, shock absorbers must be cleaned with benzene or kerosene. The shock absorber must be removed from the truck and dissembled for cleaning.

Fluid is changed in the shock absorber after removing it from the truck. Before pouring in the new fluid the shock absorber must be stood on end, clamping eye 3 (see Figure 12-9); pull rod 6 into its upper position, remove reservoir nut 5 and remove rod 6 with piston 4.

Measure out 0.4 1 of shock absorber fluid for ZIL-157K trucks, 0.45 1 for ZIL-131 trucks, 0.355 1 for the ZIL-130 trucks and fill the operating cylinder to the top, pouring the remaining fluid into the shock absorber reservoir. Then re-assemble the shock absorber and install it on the truck.

During refilling it must be ensured that no dirt or sand get into shock absorbers, for this will lead to rapid wear of parts and breakdown of shock absorbers.

The spring pins of the ZIL-130 and ZIL-131 trucks are greased with a grease gun through the grease fittings until grease leaks out under pressure. If grease does not leak out under pressure when greasing the spring pins, load should be removed from the spring by jacking up the truck by the frame. Oil should be poured into the plug of the balance suspension up to the level indicated on the dip stick.

Spring leaves should be greased during overhaul, for which it is necessary to remove the old grease and dirt, as well as traces of corrosion, after which the contact surfaces of the springs are greased with a special graphite grease.

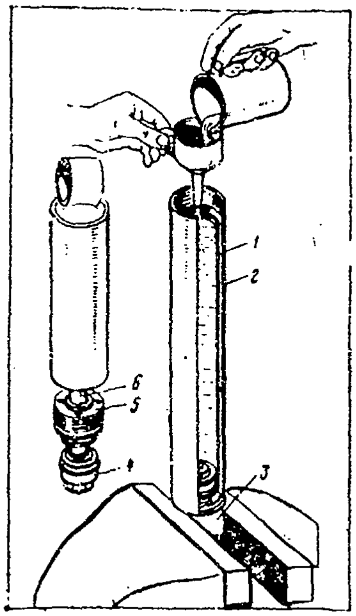


Figure 12-9. Installing Fluid in the Shock Absorber:
1, operating cylinder, 2, reservoir, 3, lower eye, 4, piston, 5, reservoir nut, 6, rod.

Dissembly and Re-assembly

When removing the front suspension from 2 axle and 3 axle trucks they should be parked on a flat area or over a grease pit. Raise the unsprung part of the truck on a stand or lift each side in turn using jacks. Remove all tubing and other parts indicated in Chapter 10 when dissembling the front bridges. Free the fastenings of the front and rear ends of both springs. Remove both shock absorbers from the frame brackets and from the u bolt fastenings and remove them. Hoist the truck and pull out the bridge. Free the middle part of the spring from the u bolt holding it to the axle beam or bridge and remove the spring from the beam.

When removing shock absorbers it is necessary to remove the nuts holding the upper and lower eyes, remove the washers, take out 1 rubber insert and remove the shock absorber. Then remove the other rubber inserts and washers from the pin. To remove the rear suspension, from 2 axle trucks it is necessary to lift the rear part of the truck using a jack to remove load from the springs. Disconnect the tubing and other parts indicated in Chapter 10 when dissembling the rear bridges.

Free the fastenings of the front and rear ends of the springs, pull out the bridge, free the middle part of the springs from the u bolts and remove the springs from the bridge beam. When dissembling springs which have a removable eye, it is necessary to loosen the nut of the u bolt holding the removable eye and remove the u bolt, remove the nut holding the eye to the spring leaves and remove the eye. When necessary, press the bushings out of the spring eyes using a mandrel. After removing the eye fasten the spring in the press (Figure 12-10), remove the nut holding the clips, remove the bolts with the spreader sleeves and take apart the leaves of the spring. Other springs are dissembled in the same way.

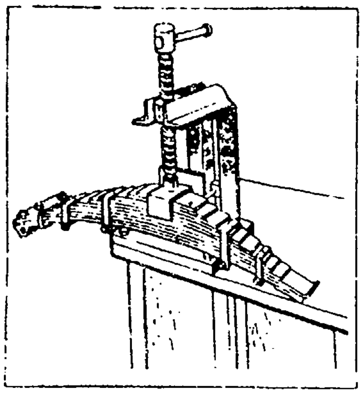


Figure 12-10. Press for Overhauling Springs.

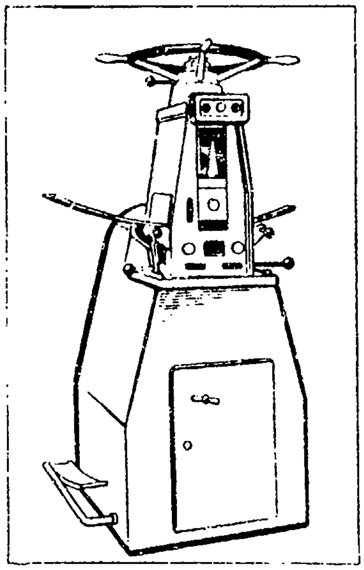


Figure 12-11. Model 2470 Press for Straightening Spring Leaves.

Inspecting and repairing spring leaves. Leaves are inspected with the help of a magnifying glass or using the method of magnetic defectoscopy. Springs which are broken or cracked are discarded.

In case of bending, loss of elasticity and deformation of leaves, they are fixed and heat treated to a hardness of HV 363-444. Spring leaves are also repaired by straightening. A model 2470 press (Figure 12-11) made by the Kochubeyev GARO plant may be used for this.

Worn spring leaves are restored by rolling them through the guide beams of the press. Here the spring leaves are bent under the action of the press beam. Necessary curvature of the leaf is achieved by adjusting the height of the position of the press beam.

Shock absorber dissembly. Before dissembly it is necessary to clean dirt from the shock absorber, wash it with a degreasing solution and blow it dry with compressed air.

For dissembly, the shock absorber should be fastened in a vice by the lower eye. Pull the shock absorber rod out as far as possible and unscrew the reservoir nut (Figure 12-12).

Lift hole 23 (see Figure 12-7) together with rubber rod bushing 3 and hole bushing 4 30-40 mm using a wrench or metal rod with a sharpened end. Remove rod 19 together with piston 14 and reservoir housing from operating cylinder 18. Remove cylinder 18 together with compression valve 10 from reservoir housing 17. Pour the fluid from the cylinder and reservoir of the shock absorber into a clean vessel. Wash the parts of the shock absorber in clean benzene or kerosene. Use a mandrel to remove the compression valve as a unit from the cylinder (Figure 12-13).

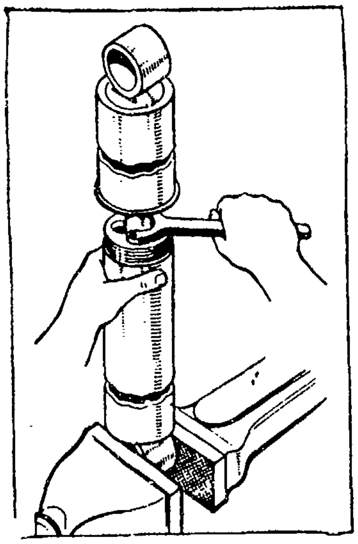


Figure 12-12. Using Special Wrench to Loosen Reservoir Nut.

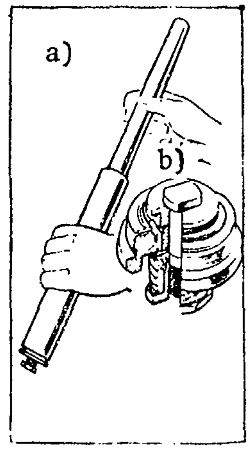


Figure 12-13. Driving Out Compression Valve: a, removal, b, intact compression valve.

To dissemble the compression valve it is necessary to clamp the valve housing in a vice with nonmarring faces, use a wrench to remove the pin from nut 12 (see Figure 12-7) of the valve and take apart the parts of the compression valve.

When dissembling piston 14, rod 19 should be held in a vice by eye 1. Use a wrench to remove the nut holding the rebound valve and remove it along with the adjustment washer. Remove the parts of the rebound valve, piston and parts of the by-pass valve from the end of the rod. Remove guide 20 from rod packing 21, reservoir packing 4, packing spring 22, rubber bushing 3 of the rod, packing eye 23, felt packing 24 of the rod and nut 2 of the reservoir. If the rod, piston or cylinder are worn or damaged the entire shock absorber must be replaced.

If the brackets or fastening pins of the shock absorbers are cracked they should be replaced. No more than two threads of a screw may be damaged.

Spring assembly. Spring leaves must be lubricated with USsA graphite grease. Springs are re-assembled in the press (see Figure 12-10). Assemble the spring leaves so that the stamped protrusions of the springs fit into the depression of each leaf of the spring. Compress the assembled spring leaves in the press using the screw and fasten them using the clips. The leaves of the re-assembled spring may be out of line relative to the first leaf by no more than 2.5 mm.

Clamps should be fastened to the ends of the rear springs of the ZIL-157K truck.

The removable eyes must be installed and fastened with u bolt nuts and bolt nuts on the front ends of the front springs of the ZIL-130 and ZIL-131 trucks, and also on the rear spring of the ZIL-130 truck. Two lock washers must be placed under the nuts of the u bolt holding the removable eye. The nuts of the bolts fastening the eye to the spring must be fastened with a lock washer. Tightening tension of the u bolts of the eyes of the front springs must be within the limits 7-10 kGm.

Spring inspection. After re-assembling all springs must be seated 3 times under a maximum pressure of R_{pr}.

The spring is loaded with control load R_k and a first measurement is made of amount of bend of H_k, then an additional load of 300-500 kG is added and immediately removed, returning to control load R_k, and second measurement is made of H_k. From the two values obtained for the amount of bending H_k an arithmetic mean is obtained, which must not be less than the values shown in Table 12-1. To obtain the correct load magnitude the front spring of the ZIL-157K truck should be seated and tested on two movable supports according to the diagrams shown in Figure 12-14a. Seating and testing of the front and rear springs of the ZIL-130 truck and the front springs of the ZIL-131 truck should be done with one movable and one fixed support (Figure 12-14b). For the rear springs of 3 axle trucks and for auxilliary springs of 2 axle trucks both supports must be stationary (Figure 12-14c). After three seatings the springs are checked for correspondence to the assigned amount of bend H_k under control load R_k. For the magnitude of R see Table 12-1.

Shock absorber re-assembly. The parts of the shock absorber should be cleaned in clean kerosene or benzene. The shock absorber must be re-assembled in the following sequence. Clamp eye 1 (see Figure 12-7) in a vice, with rod 19 pointing upward. Put reservoir nut 2, self-packing 24, packing eye 23, and rod packing 3 on rod 19 using a guide as shown in Figure 12-15. Install it with the side marked Niz toward the fluid. Put packing spring 22 (Figure 12-7) and rod guide 20 on the rod.

In re-assembling the piston, by pass valve and rebound valve, place the plate with the parts of by pass valve 5 on the rod. Install piston 14 with the parts of rebound valve 7. Insert spring 8 and tighten the unit with a nut, putting in an adjusting washer under it.

In re-assembling the compression valve it is necessary to place the plate along with the parts of by pass valve 9 on the rod. Install the housing with the parts of compression valve 10. Install spring 11 and fasten the compression valve unit with nut 12, putting in an adjustment washer under it.

When pressing the compression valve into the cylinder place the cylinder on a plate or flat place on a workbench, insert the body of the compression valve into the cylinder and press it into place using a mandrel and mallet.

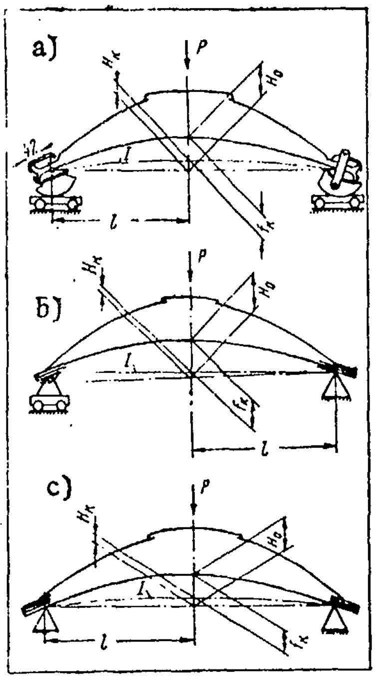


Figure 12-14. Spring Testing:
a, front spring of ZIL-157K truck, b, front spring of ZIL-130 and ZIL-131 trucks, rear main springs of ZIL-130 truck, c, auxilliary springs of rear suspension of two axle trucks and rear springs of three axle trucks, for front spring, 1 = 675 mm, for rear spring -- 695 mm.

When placing the cylinder in the reservoir clamp the lower eye of the latter in a vice, and insert the cylinder along with the compression valve into the reservoir and fill it with shock absorber fluid (see Figure 12-9), observing maximum cleanliness.

After pouring fluid into the shock absorber, insert the rod along with the housing and piston into the cylinder, installing the rod guide in the cylinder. Sit the reservoir packing, pull the parts on the rod to extreme position, pull the reservoir nut as tight as possible using a wrench and push the rod with the piston into the lower position of the cylinder.

Installing the front suspension of two axle and three axle trucks. Install the assembled springs and attach them to the beams of the front axle or front bridge with u bolts. Raise the front part of the frame using a jack and slide the front axle beam or front bridge together with the springs under the frame. Fasten the front and rear ends of the springs to the brackets. Fasten the ends of the shock absorbers to the frame brackets and to the u bolt holders. Lower the frame onto the suspension. Attach all tubing and other parts shown in Chapter 10 in the description of installing front bridges.

Installing the rear suspension of the ZIL-130 truck. Install the assembled springs on the beam of the rear bridge and attach them to it using u bolts. Use a jack to lift the rear part of the frame and slide the rear bridge together with the springs under it. Install the front and rear ends of the springs in the brackets and fasten them. Lower the frame onto the suspension.

Attach tubing and other parts shown in Chapter 10 in the descr'ption of installing rear bridges.

Removing the balance suspension of the ZIL-157K and ZIL-131 trucks. The balance suspensions of the ZIL-157K and ZIL-131 trucks are analogous in design. To remove the rear balance suspension of three axle trucks it is necessary to detach the cardan shafts of the middle and rear bridges, disconnect the placeable brake lines and air hoses. Free the balance axle from the fastening holding it to the frame brackets. On the ZIL-157K truck disconnect the upper torsion rods from the frame cross member.

Raise the rear part of the truck with a jack and slide the guide bridges along with the balance suspension from under the frame (Figure 12-16).

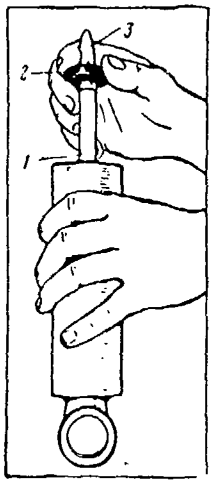


Figure 12-15. Using a Mandrel to Install Rubber Rod Bushing of Shock Absorber: 1, rod, 2, bushing, 3, mandrel.

To disconnect the balance suspension and guide bridges it is necessary to disconnect the ends of the torsion rods from the bridge brackets. For this it is necessary to loosen the nuts fastening the bearing pins and pound them out using a mandrel and hammer. Use a jack to raise the balance suspension such that the ends of the springs pull out of the bracket opening, and put it on a workbench for further dissembly.

In dissembling the balance suspension it is necessary to empty oil from the opening, removing the plug. Disconnect the torsion rods along with the pins, removing the nuts and pressing out the bearing pins from the brackets of the bridges and balance suspension.

In removing the springs from the hubs of the balance suspension, to avoid damaging the threads of the u bolts it is necessary to compress the spring using clamps or an appropriate tool, and then, removing the u bolt nuts, remove the u bolts and pull the spring and plate from the suspension hub.

To remove the hub from the axle of the balance suspension of the ZIL-131 truck it is necessary to remove the bolts fastening the cover and remove it along with its pad; remove the nut of the spacer bolt and pull out the bolt, remove the slotted nut and remove the support washer, and pull the hub from the axle along with its bushings. In removing the hub of the balance suspension of the ZIL-157K truck it is necessary to remove the external nut with the lock washer loosened, remove the lock ring along with the washer, remove the interior nut and pull the hub from the axle.

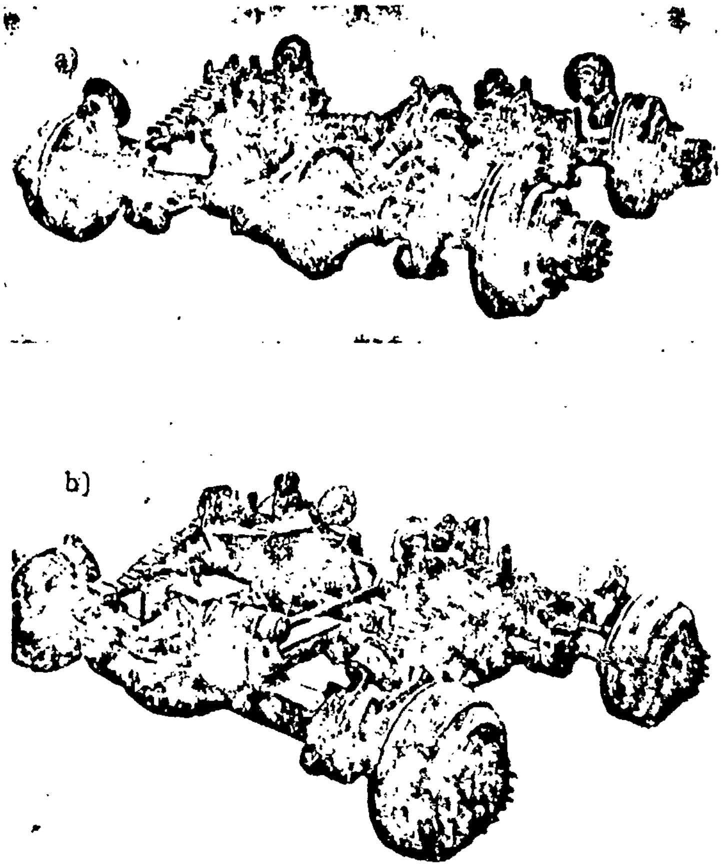


Figure 12-16. Balance Suspension and Bridges:
a, ZIL-157K, b, ZIL-131.

It should be kept in mind that since May, 1964 ZIL-157K trucks have been equipped with torsion rod hinges with sleeves and rings of a new design (in the form of a can). The new inserts are filled in an improved manner (under a vacuum) using special equipment after the hinge joint is assembled. The new joints, just as the old ones, require no service or lubrication in operation. If a hinge fails the pin and ring must be pressed out, the ring cut, and the insert and ring replaced. In order to use the pin taken from the truck, use ring 121-2919032 and insert 121-2919034 of the old design. The new inserts and rings are not available as spare parts, since they cannot be put together with the pin and lubricated outside the factory.

The assembled pin and the insert with the ring are interchangeable.

A bent balance suspension torsion rod should be straightened.

No more than 2 threads of the balance suspension axle or torsion rod pins may be damaged.

If bushings 2 (Figure 12-17) of balance suspension axle hub 1 are worn, they should be replaced with replacement bushings 157-2918074-RP.

The worn journal of the balance suspension axle should be reground to the point where there is no trace of wear along the polished area of the journal (Figure 12-18), leaving unpolished the surface of the journal 18-20 mm for the ZIL-157K and 14-16 mm for the ZIL-131 under the packing rings. The diameter of the journal after polishing must be no less than 62.0 mm.

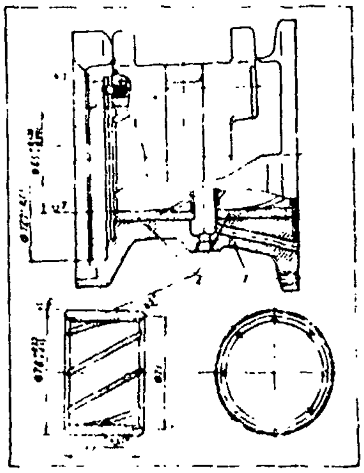


Figure 12-17. Balance Suspension Axle Hub of ZIL-157K and ZIL-131 Trucks: 1, hub body, 2, bushings, 3, pin.

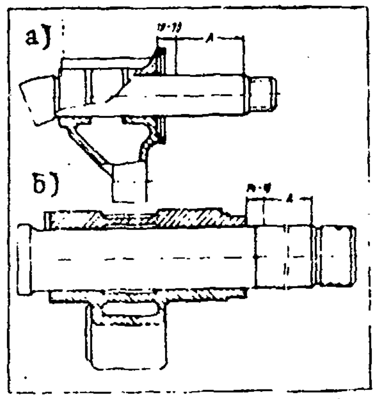


Figure 12-18. Balance Suspension Axle Assembled with Bracket: a, ZIL-157K truck, b, ZIL-131 truck, A, polished area.

Press the replacement sleeve into the hub with a clearance of 0.09-0.23 mm and bore them out to the diameter of the reground axle journal, observing a gap between the bushing and journal equal to 0.095-0.255 mm.

In boring out the sleeves the surfaces of the latter must be concentric relative to the surface for pressing the bushing into the hub.

Assembly of three axle truck balance suspension. In assembling the suspension of the ZIL-131 truck the assembled bushing and the ring with the packing ring must be pressed into hub 2 (see Figure 12-6), first coating it with oil. Install the hub assembled on a stand or press. Lay the lower plate of the spring on the hub such that its guide pins fit into the openings of the hub. Install the assembled spring on the hub such that the stamped protrusions of the spring fit into the guide holes of the lower plate. Install the upper plate of the spring on the upper spring leaf. Insert u bolts into the openings of the hub and openings of the spring plate. Put spring washers on the u bolts and screw nuts on for 2 or 3 turns. Compress the spring using a pneumatic stand or press and tighten the u bolt nut (nut tension 25-30 kGm. Place the support ring along with the sealing ring on axle 8 of the balance suspension. Install the balance suspension axle along with the bracket on special supports so that it is supported on brackets. Install the hubs along with the springs on both ends of the axle and fasten them. Install the support washer, joining it with the pivet, turn slotted nut 9 onto the axle until tight, and then back off by 1/4th-1/6th-turn. Tighten the spacer bolt until tight. Its nut is self-tightening. After this the hub along with the spring must be able to be turned by hand without any noticeable play in the axle. After adjusting the axle gap place the cover on the hub and fasten it with bolts. The same operations must be performed for the second hub. Tighten the nuts of the spring spacer pins. Nut tension is 35-40 kGm.

Remove upper plug 5, insert lower plug 13 and fill the hub with transmission fluid. Insert upper plug 5. The balance suspension of the ZIL-157K truck is assembled and filled in the same manner as that of the ZIL-131.

In assembling the balance suspension of the ZIL-157K truck it is necessary to adjust the axle opening of the tie bearings, for which it is necessary to place the hub on the axle, install a support washer, putting it on pin 5 (see Figure 12-5), place inside nut 11 on the axle and tighten it, then backing off by 1/6th-1/4th turn; install lock ring pin, placing its opening on the nut pin and its protrusion into the key channel of the axle; place lock washer 7 on the axle, tighten outside bolt 8 until tight and bend the lock washer over one of the faces of the nut. The hub should be able to be turned on the axle by hand with no perceptible axle play.

Joining torsion rod pins and ring. To join the pins and ring it is necessary to have a new fiber insert, ring and device (Figure 12-19). Torsion rod pins must be assembled in three stages in the following order.

The ring is placed in the device with one end rolled. A conical mandrel is placed in the device from above on the unrolled end of the ring. Then a fiber insert 200 mm in length is placed in this mandrel, and a bearing pin is placed in the insert, after which both the pin and the insert are pressed into the ring.

The conical mandrel is removed from the device and another mandrel is put in to roll the upper end of the ring. Bearing pin 5 along with ring 4 is shown in Figure 12-20.

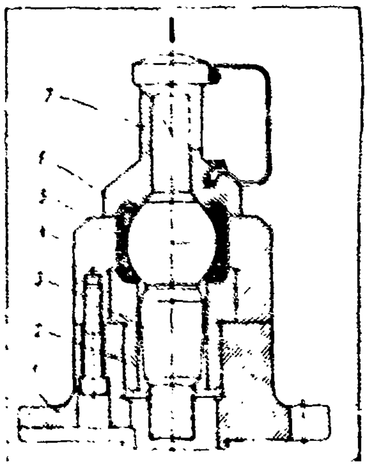


Figure 12-19. Assembling a Bearing Pin Using Special Tool:
1, support, 2, matrix, 3, bearing pin, 4, ring guide, 5, bushing ring, 6, bushing, 7, dye.

Having assembled the bearing pin with the ring, they are placed in the opening of the torsion rod which is 71.0-71.12 mm in diameter and pressed into place using a press with a clearance of 0.18-0.40 mm for the calibrated ring. The force of the press must be 2.5-3.0 T at the end of its stroke.

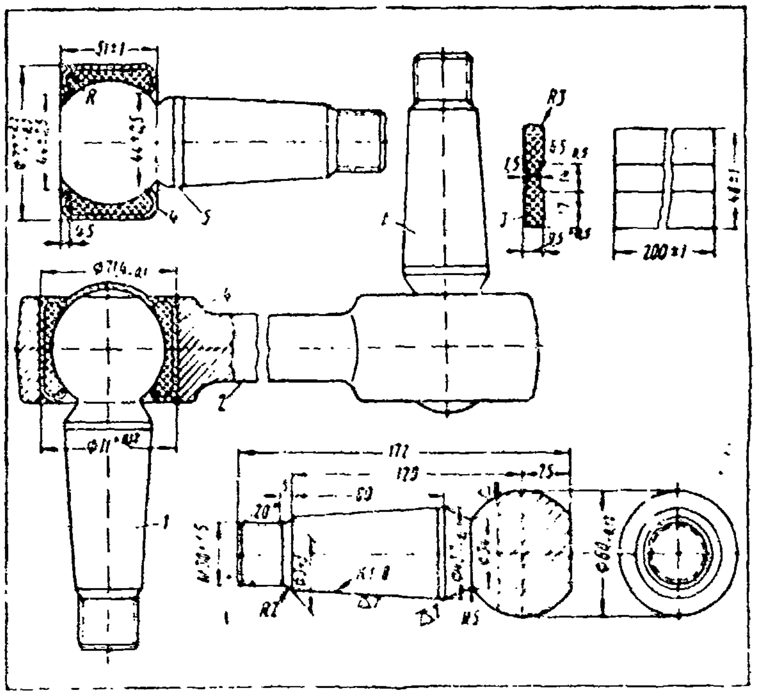


Figure 12-20. ZIL-131 Truck Torsion Rods with Bearing Pins: 1, bearing pins, 2, torsion rod, 3, fiber insert, 4, insert ring, 5, bearing pin assembled with ring (for repair).

In case of loss of clearance after pressing the torsion rod hinges it is recommended to punch them at 8 points on both sides. The assembled torsion rods are installed on the rear balance suspension of the truck.

Replacing the bearing coupling of the torsion rod during repair. If the bearing pin and insert of the torsion rod are worn it is necessary to remove the rod assembly from the truck, press out the ring and pin together, check the diameter of the rod opening, which must be 51.00-71.12 mm in two perpendicular directions, and press in a new bearing pin 5 (see Figure 12-20), which is available as a spare part assembled with ring 4. If the size of the opening is greater it should be modified to match the dimension indicated in the drying by depositing metal on the rod head. Rods which cannot be made to fit the size of the opening should be discarded.

When pressing new ring 4 together with bearing pin 5 into the opening of the torsion rod the force of the press must be no less than 2.5 T at the end of the press stroke. The assembly must be seated with a clearance of 0.18-0.40 mm for the calibrated ring.

The assembled torsion rods are installed on the balance suspension. For this, the bearing pins of the torsion rods are placed in the openings of the balance suspension brackets, spring washers are installed and nuts tightened into place (tension 35-40 kGm).

Installing rear balance suspension on truck. Place the assembled balance suspension on a support. Raise the middle bridge as a unit with a jack and place the openings of the bridge support brackets on the ends of the springs. Leaving the bridge suspended, install the bearing pins in the openings of the upper and lower torsion levers of the bridge (for the ZIL-157K truck, in the openings of the lower bracket), place spring washers on the pins and tighten the nuts. After this, remove the jack. The rear bridge is attached to the balance suspension in the same manner. After both bridges have been attached to the balance suspension, tighten the nuts which fasten the bearing pins (tension 35-45 kGm).

Jack up the rear part of the truck, and slide the bridges together with the balance suspension under the truck. Lower the truck frame onto the suspension such that the openings in the frame and bracket fastening the rear suspension coincide. Insert bolts, put on spring washers and tighten nuts (tension not less than 30 kGm). Attach the cardan shafts to the flanges of the pinion gears of the middle and rear bridges. Attach flexible lines to the bridge chambers and air hoses. Remove special tools.

For the ZIL-157K truck, lowering the truck frame to the suspension, guide the frame bracket prongs into the openings of the balance suspension axle brackets. Place nuts on the bracket prongs and tighten them (tension 25-30 kGm).

Install bearing pins of the upper torsion rods in the frame brackets, put nuts in place and tighten them (tension 20-25 kGm).

PART DIMENSIONS

TABLE 12-1.

LOAD MAGNITUDE DURING FEEDING AND EXTERNAL SPRING CHARACTERISTICS.

a	b	c	d	e	f	g
h	ZIL-157K with winch	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	without winch	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	ZIL-130	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	ZIL-131 with winch	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	without winch	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
i	ZIL-130	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	ZIL-157K	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	ZIL-131	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
j	ZIL-130	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Key: a, spring, b, truck, c, seating load R_{pr}, kg, d, bend camber in free state H_0, mm, e, bend under control load f_k, mm, f, bend camber under control load H_k, mm, g, control load R_k, kg, h, front, i, rear, j, auxiliary,

TABLE 12-2.

BASIC SHOCK ABSORBER DIMENSIONS (MEASUREMENT DIAGRAM SHOWN IN FIGURE 12-21).

Parameters	ZIL-130	ZIL-157K	ZIL-131
Maximal length of A in compressed state, mm	376	406	445
Internal diameter B of operating cylinder, mm	40.0-40.05	40.00-40.05	40.00-40.05
Diameter C of piston, mm	39.90-39.92	39.90-39.92	39.90-39.92
Travel L of piston, mm	210 (no less)	240 (no less)	260
Diameter D of eye opening, mm	35.0-35.62	35.0-35.62	35.00-35.88
Outside diameter E of shock absorber housing, mm	64.5	64.5	70
Fluid volume, cm^3	355	400	450

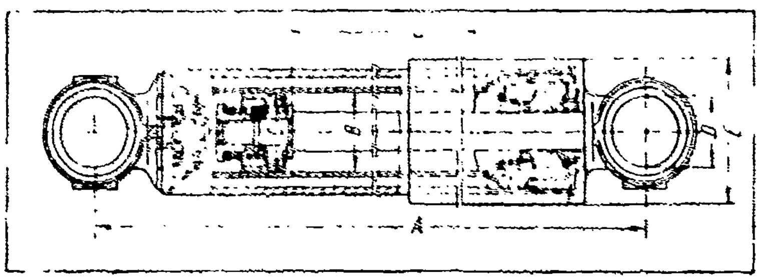


Figure 12-21. Measurement Diagram of Basic Dimensions of Telescopic Shock Absorber.

TABLE 12-3.

BASIC SPRING PARAMETERS

Part	ZIL-130 and ZIL-131	ZIL-157K
Front spring leaves	Steel 60S2, sheet type A (GOST 7419-55 and GOST 2052-53). Sheet width 64.3-65.7 mm. Sheet thickness for ZIL-130- 8.75-9.20 mm and for ZIL-131- 7.75-8.20 mm. Hardness HV 363-444. Number of leaves: ZIL-130- 11, ZIL-131 with winch- 17, ZIL-131 without winch- 15.	Steel 55S2, sheet ty A (GOST 7419-55 and GOST 2052-53). Sheet width 62.3-63.7 mm. Sheet thickness 6.3-6.65 mm. Hardness HB 363-444. Number of leaves: on truck wit winch- 18. on truck without winch- 16.

TABLE 12-4.

LENGTH AND CURVATURE OF LEAVES OF FRONT AND REAR SPRINGS OF ZIL-130 TRUCK, MM

1	2				3				4			
	5	6	7	8	5	6	7	8	5	6	7	8
1	1518	65	3510	а	1400	68	3650	а	1150	63	2190	а
2	1461	79	2890	г	1435	101	2400	г	1060	69	2030	в
3	1258	81	2450	д	1350	115	1985	д	940	58	1890	а
4	1100	62	2450	а	1225	94	1985	в	820	44	1890	в
5	970	48	2450	е	1135	81	1985	в	700	32	1890	в
6	840	36	2450	в	1045	69	1985	и	580	22	1890	в
7	710	26	2450	а	955	57	1985	в	460	14	1890	а
8	580	17	2450	в	865	47	1985	а	340	8	1890	в
9	450	10	2450	к	775	38	1985	к	220	3	1970	в
10	320	5	2450	в	690	30	1985	и	—	—	—	—
11	200	2	2650	а	605	23	1985	в	—	—	—	—
12	—	—	—	—	520	17	1985	в	—	—	—	—
13	—	—	—	—	435	12	1985	к	—	—	—	—
14	—	—	—	—	350	8	1985	в	—	—	—	—
15	—	—	—	—	265	4	2140	в	—	—	—	—
16	—	—	—	—	180	2	2140	в	—	—	—	—

Key: 1, Number of leaves, 2, front springs, 3, rear springs, 4, auxilliary springs, 5, length L in flat state, 6, bend camber h, 7, radius of curvature R, 8, designation on Figure 12-22.

TABLE 12.5

LENGTH AND CURVATURE OF LEAVES OF FRONT AND REAR SPRINGS OF ZIL-157K TRUCK, MM

1	2								3			
	9				10				11			
	5	6	7	8	5	6	7	8	5	6	7	8
1	1184	62	2420	а	1181	62	2420	а	1260	61	3230	в
2	1165	83	1820	к	1165	83	1820	к	1260	61	3230	в
3	1184	83	1820	б	1181	83	1820	б	1260	61	3230	и
4	1010	86	1480	к	1010	86	1480	к	960	49	2860	и
5	1010	86	1480	к	945	89	1250	к	860	32	2860	в
6	945	89	1250	в	880	78	1250	в	760	25	2860	в
7	945	89	1250	л	815	67	1250	к	660	19	2860	в
8	880	78	1250	к	728	56	1250	в	560	14	2860	в
9	815	67	1250	и	663	44	1250	в	460	9	2860	в
10	728	56	1250	в	597	36	1250	и	360	5	3000	к
11	663	14	1250	в	531	28	1250	а	260	2.5	3230	а
12	597	36	1250	н	465	22	1250	в	—	—	—	—
13	531	28	1250	а	400	16	1250	к	—	—	—	—
14	465	22	1250	и	312	10	1250	а	—	—	—	—
15	400	16	1250	в	246	6	1250	в	—	—	—	—
16	312	10	1250	к	180	3	1400	в	—	—	—	—
17	246	6	1250	в	—	—	—	—	—	—	—	—
	180	3	1400	в	—	—	—	—	—	—	—	—

Key: 1, number of leaves, 2, front springs, 3, rear springs, 4, auxilliary springs, 5, length L in flat state, 6, bend camber h, 7, radius of curvature R, 8, designation on Figure 12-22, 9, on trucks with winch, 10, on trucks without winch, 11, on trucks with or without winch.

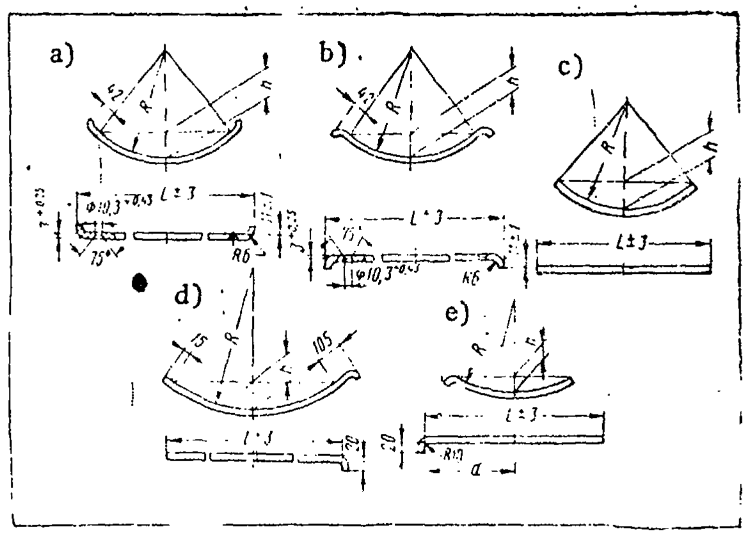


Figure 12-22. Measurement Diagram of ZIL-130 and ZIL-157K Truck Spring Leaves: a, first leaf of spring of ZIL-157K truck, b, third leaf of front spring of ZIL-157K truck, c, leaves: of first front, rear and auxilliary springs, second auxilliary spring, fourth, fifth, sixth, seventh, eighth, ninth, front, rear and auxilliary springs, tenth, eleventh, front and rear springs, twelfth, thirteenth, fourteenth, fifteenth, sixteenth, rear spring of ZIL-130 trucks, leafs of first rear spring, second front and rear springs, third rear spring, fourth, fifth, sixth, seventh, eighth, ninth, tenth, eleventh front and rear springs, twelfth, thirteenth, fourteenth, fifteenth, sixteenth front spring, seventeenth, eighteenth front spring with win.. of ZIL-157K truck, d, second leaf of front and rear springs of ZIL-130 truck, e, measurement of third leaf of front and rear springs of ZIL-130 truck.

TABLE 12-6.

LENGTH AND CURVATURE OF LEAVES OF FRONT AND REAR SPRINGS OF ZIL-131 TRUCK, MM.

1 № листа	2 Передние рессоры								3 Задние рессоры			
	9 На автомобилях с лебедкой				10 На автомобилях без лебедки				11 На автомобилях с лебедкой и без лебедки			
	5 длина в расправленном состоянии L	6 стрела выгиба h	7 радиус кривизны R	8 обозначения на рис. 12-23	5 длина в расправленном состоянии L	6 стрела выгиба h	7 радиус кривизны R	8 обозначения на рис. 12-23	5 длина в расправленном состоянии L	6 стрела выгиба h	7 радиус кривизны R	8 обозначения на рис. 12-23
1	1518	75	3040	а	1518	75	3040	а	1390	57	4250	д
2	1456	90	2520	б	1456	90	2520	б	1390	57	4250	д
3	1258	90	2210	в	1258	90	2210	в	1310	64	3860	д
4	1120	71	2210	г	1120	71	2210	г	1065	51	2775	д
5	1050	62	2210	г	1035	77	1740	г	990	44	2775	д
6	970	53	2210	г	950	65	1740	г	920	38	2775	д
7	900	46	2210	г	865	54	1740	г	850	33	2775	д
8	830	39	2210	г	780	44	1740	г	765	26	2775	д
9	760	33	2210	г	695	35	1740	г	695	22	2775	д
10	690	27	2210	г	610	27	1740	г	625	18	2775	д
11	620	22	2210	г	525	20	1740	г	555	14	2775	д
12	550	17	2210	г	440	14,5	1740	г	470	10	2775	д
13	470	12,5	2210	г	355	9	1740	г	400	7	2775	д
14	400	9	2210	г	270	4	2375	д	330	5	2775	д
15	330	6	2210	г	190	2	2375	г	260	3	3140	д
16	260	3,5	2375	г	—	—	—	—	—	—	—	—
17	190	2	2375	г	—	—	—	—	—	—	—	—

Key: 1, number of leaves, 2, front springs, 3, rear springs, 4, auxilliary springs, 5, length L in flat state, 6, bend camber h, 7, radius of curvature R, 8, designation on Figure 12-22, 9, on trucks with winch, 10, on trucks without winch, 11, on trucks with or without winch.

TABLE 12-7.

PARAMETERS OF SHOCK ABSORBER FASTENING PARTS

Part	ZIL-130 and ZIL-131	ZIL-157K
Lower shock absorber bracket	Steel 35 (GOST 1050-60). Diameter of conical opening under pin 17.0 mm, ratio 1:8. Noncoincidence of ends of part end and gauge ±0.25 mm. Area of contact must be 75% of cone surface. For ZIL-131 truck -- steel 35L (GOST 977-65). Diameter of conical opening under pin 19 mm, ratio 1:8. Noncoincidence of part end and gauge ±0.3 mm.	
Upper shock absorber bracket	Iron KCh 35-10 (GOST 1215-59). Diameter of conical opening under pin 17.0 mm (for ZIL-131 truck-19.0 mm). Ratio 1:8. Noncoincidence of ends of part end and gauge ±0.25 mm (for ZIL-131 truck-±0.3 mm). Area of contact must be 75% of cone surface.	Iron KCh 35-10 (GOST 1215-59). Diameter of opening under pin 25,000-25,045 mm.
Lower shock absorber fastening pin	Steel 35 (GOST 1050-60). Hardness HV 255-285. Threading from side of cone and head M16×15, cl. 2 (for ZIL-131 truck threading from side of head M12×1.75, cl. 2). Pin diameter 17.4 mm (for ZIL-131- 19.5 mm). Noncoincidence of ends of parts and gauge ±0.25 mm. Area of contact must be 75% of cone surface.	

TABLE 12-7 (Continued)

PARAMETERS OF SHOCK ABSORBER FASTENING PARTS

Part	ZIL 130 and ZIL-131	ZIL-157K
Upper shock absorber fastening pin	Steel 35 (GOST 1050-60). Hardness HV 255-285. Threading from side of cone and head M16×1.5, cl. 2. (on ZIL-131 truck threading from side of head M12×1.75, cl. 2). Diameter of pin 17.4 mm (for ZIL-131 truck- 19.5 mm), ratio 1:8. Noncoincidence of ends of parts and gauge ±0.25 mm. Area of contact must be 75% of cone surface.	Steel 35 (GOST 1050-60). Hardness HV 255-285. Diameter of pin under opening in upper bracket 25,100-25,145 mm. Threading M12×1.75, cl. 2.

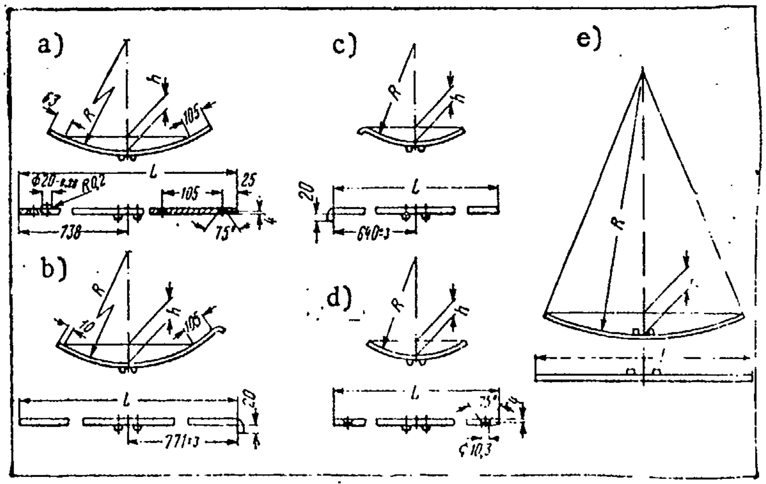


Figure 12-23. Measurement Diagram of ZIL-131 Truck Front Spring Leaf:
a, first leaf of front spring, b, second leaf of front spring, c, third leaf of front spring, d, remaining leaves of front spring, e, leaves of rear spring.

PARAMETERS OF BALANCE SUSPENSION PARTS

TABLE 12-8.

Part	ZIL-157K	ZIL-131
Balance suspension axle	Steel 45 (GOST 1050-60), round 72 mm (GOST 2590-57). Depth of tempered layer 2.5-6 mm and hardness HRC 56-62. Threading M60×1.5, cl. 2. Diameter of axle under sleeve 65.0-65.06 mm. Admissible diameter of axle journal under sleeve without repair not greater 64.90 mm.	Steel 45RP, steel 45G may be used, round 72 mm (GOST 2590-57). Depth of tempered layer 5-10 mm and hardness HRC 54-60. Threading M60×2, cl. 2. Axle diameter under sleeve 64.94-65.00 mm. Admissible diameter of axle journal under sleeve without repair not greater 64.80 mm.
Balance suspension hub	Wrought iron KCh 35-10, GOST 1215-59. Diameter of opening under hub sleeve 78.0-78.1 mm, for ZIL-131 truck diameter 78.00-78.06 mm.	
Balance suspension hub sleeve	TsAM alloy 10-5 (TU OGM No 90-161-59). Outside sleeve diameter 78.15-78.23 mm. Inside diameter of sleeve 65,095-65,195 mm. Admissible diameter of sleeve under axle without repair not greater than 65.30 mm.	
Rear suspension fastening bracket	Steel 35L-1, cast (GOST 977-58).	Iron KCh 35-10 (GOST 1215-59). Diameter of opening under bearing pin 34 mm, ratio 1:8. Noncoincidence of part ends and gauge ±0.5 mm. Area of contact in opening must be no less than 75% of cone surface.
Rear suspension torsion rod fastening bracket	Steel 35L-1, cast (GOST 977-58). Diameter of opening under bearing pin 37.5 mm, ratio 1:8. Noncoincidence of part ends and gauge ±0.5 mm. Area of contact must be no less than 75% of cone surface.	
Rear suspension balance axle bracket	Steel 35L-1, cast (GOST 977-58). Diameter of opening under axle 66.00-66.08 mm. Diameter of opening under bearing pin 37.5 mm, ratio 1:8. Noncoincidence of part ends and gauge ±0.5 mm. Area of contact must be no less than 75% of cone surface.	Iron KCh 35-10 (GOST 1215-59). Diameter of openings under axle 66.00-66.06 mm. Diameter of openings under bearing pin 34 mm, ratio 1:8. Noncoincidence of part ends and gauge ±0.5 mm. Area of contact in opening must be no less than 75% of cone surface.
Upper torsion lever	The same as for rear suspension balance axle bracket.	Steel 35LP (GOST 977-65). Diameter of opening under bearing pin 34 mm, ratio 1:8. Noncoincidence of part ends and gauge ±0.5 mm. Area of contact in opening must be no less than 75% of cone surface.

PARAMETERS OF BALANCE SUSPENSION PARTS

TABLE 12-8 (Continued)

Part	ZIL-157K	ZIL-131
Lower torsion lever	Steel 40LK-P, cast (GOST 977-53), depth of tempered layer 5-10 mm, and 2-7 mm on side surfaces. Hardness of tempered layer HRC 45-62. Diameter of opening under torsion rod pin 37.5 mm, ratio 1:8. Noncoincidence of part ends and gauge ±0.5 mm. Area of contact must be no less than 75% of cone surface.	The same as for upper torsion lever.
Torsion bar	Steel 30 (GOST 1050-60). Diameter of opening under insert ring 71.0-71.12 mm. Threading in head of torsion rod 4M68×1.5, cl. 2.	Steel 30 (GOST 1050-60). Diameter of opening under insert ring 71.0-71.12 mm.
Torsion bar pin	Steel 40Kh (GOST 4543-61). Hardness HV 255-285. Threading 2M30 1.5, cl. 2. Diameter of pin 38.0 mm, ratio 1:8. Noncoincidence of part ends and gauge ±0.5 mm. Area of contact must be no less than 75% of cone surface.	Steel 40Kh (GOST 4543-61). Depth of tempered layer 2-4 mm. Hardness of tempered layer HRC 56-62. Threading M30××1.5, cl. 2. Diameter of pin 34.5 mm, ratio 1:8. Noncoincidence of part ends and gauge ±0.5 mm. Area of contact on ring cone must be no less than 75% of the area of the cone.

Chapter 13. Front Bridge

Design

Beam 1 (Figure 13-1) of the front bridge of the ZIL-130 truck is a stamped I-beam. The ends of the beam have openings to connect them with turning pivets 25 by means of king pins 40. The turning pivets are of the forged type. King pins 40 are fastened to the beams by means of keys with nuts. The beam of the front bridge is connected to the springs, and the latter are connected to the truck frame.

The angles of the turning wheels of the ZIL-130 truck are the following:

Transfer king pin inclination, deg	8
Longitudinal king pin inclination:	
under 4,000 kG load	2°30'
under 5,500 kG lcad	2°50'
no load	1°15'
Wheel camber angle, deg	1
Maximum turning angle of wheels (internal), deg:	
right	34
left	36
Toe in (difference in the distances between the back and front of the wheel rims at the center of the wheel), mm	5-8

Servicing

During all caps DI the beams of the front axle are cleaned and inspected.

During each TO-1 and TO-2 it is necessary to grease the turning arm king pins through the pressure fittings.

During TO-2 the condition of the front bridge beam and amount of toe in should be checked. When necessary wheel toe in is adjusted. When tires are badly worn check the amount of wheel camber, amount of transfer and longitudinal inclination of king pins as well as wheel turning angles.

Toe in of the front wheels is adjusted by changing the length of the crosswise tie bar. To check wheel toe in it is necessary to park the truck over a grease pit or on a flat horizontal area, point the front wheels straight ahead, check the tire pressure and normalize it.

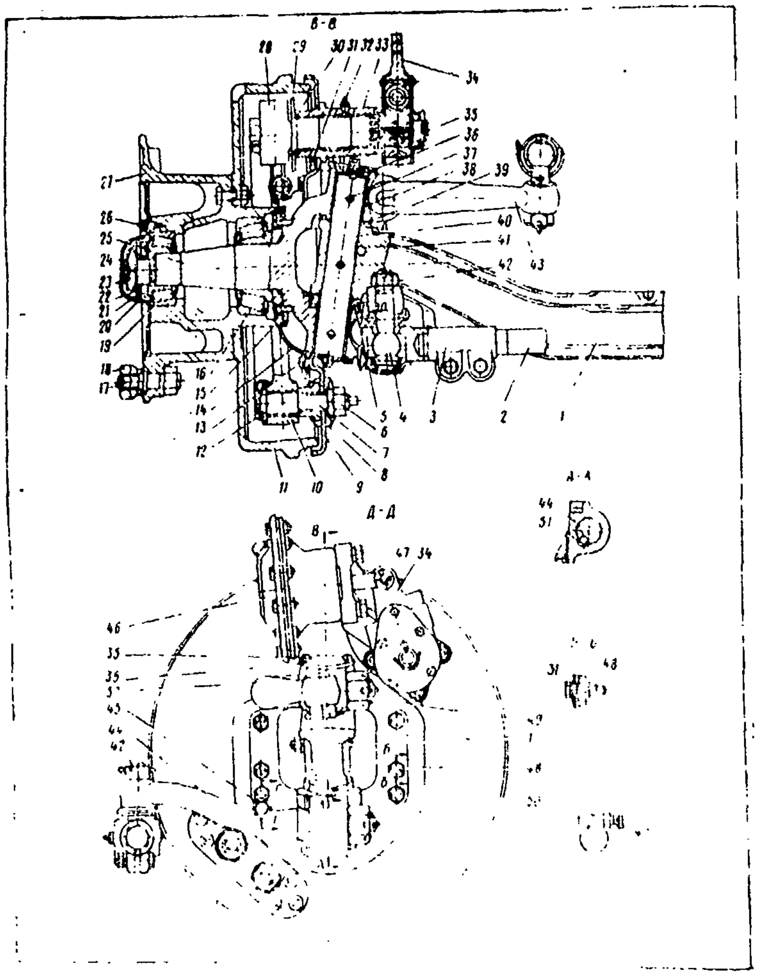


Figure 13-1. Front Bridge of the ZIL-130 Truck:
1, beam, 2, steering push rod, 3, rod fitting, 4, bearing pin, 5, support bearing, 6, 18, 42, 48, 49 and 50, nuts, 7, brake shoe pin, 8, brake shoe pin bracket, 9, brake disk, 10, brake shoe, 11, brake drum, 12, shoe pin, 13, 26, 31, 35, 45, 47, bolts, 14, oil deflector, 15, gasket, 16 and 19, bearings, 17, cotter pin, 20, inside nut, 21, lock ring, 22, lock washer, 23, lock nut, 24, cover, 25, turning arm, 27, wheel hub, 28, release cam, 29, support journal, 30, packing, 32 and 37, grease fitting, 33, release cam pin bracket, 34, adjustment lever, 36, king pin cover, 38, sleeve, 39, adjusting shims, 40, king pin, 41, king pin key, 43, 44 and 45, turning levers, 46, brake chamber, 51, key.

Adjustment of wheel toe in (Figure 13-2) is checked on the truck with a telescopic rule. The rule is placed in front of the front bridge between the wheel rims horizontally at a height corresponding to the length of the plumb lines attached to it. The place of measurement is marked on the wheel rims with chalk, then the truck is rolled forward and the rule placed behind the front bridge at the same height. Under spring loading, the sliding pipe moves and the indicator (see position II) indicates the amount of toe in on the scale.

To adjust toe in it is necessary to loosen the bolts of adapters 3 (see Figure 13-1) of steering tie bar 2 and, turning the tie bar, establish normal wheel toe in. After adjusting toe in, tighten the adapter bolts.

Front truck wheel angles: wheel camber, transverse and longitudinal king pin inclination and wheel turning angles are checked with a model 2183 GARO instrument (Figure 13-3).

The device consists of an aluminum shill which contains 2 adjustment levels (without scales) and 2 levels for measuring (with scales). The instrument is attached to a bracket which is installed on the truck wheel.

All scales are graduated in degrees: positive angles are designated by a + sign and negative angles by a - sign on the camber and king pin longitudinal inclination scales.

Two boxes 7 with scales 1 on the bottom and indicators 3 with extensions 4 are used to measure the wheel turning angles.

The boxes serve for holding the tool during storage and shipment.

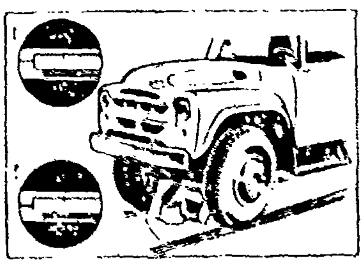


Figure 13-2. Checking Toe In of Front Truck Wheels.

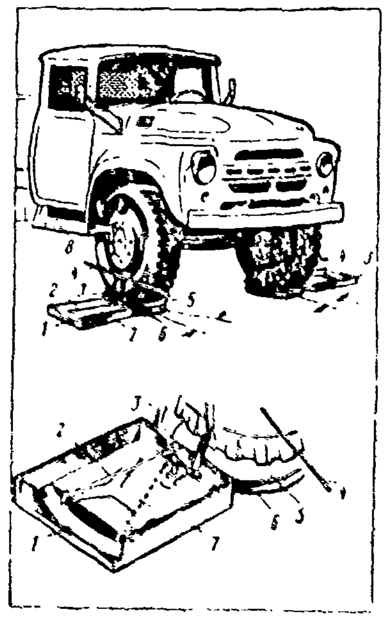


Figure 13-3. Checking Truck Wheel Turning Angles.

The set contains 2 flat 5 and 2 round 6 disks to facilitate turning the wheels of the truck under inspection.

Checking wheel camber. To check wheel camber the truck is parked on a flat horizontal area and the front wheels pointed straight ahead. The wheel hub bearings must be adjusted and the air pressure in the tires must be normal.

The body of the instrument 8 is attached with a clamp to one of the wheel lug nuts with the bottom surface facing up. The instrument is adjusted to horizontal using the bubbles in the 2 adjustment levels. After this the wheel is turned 180° so that the bubbles of the transverse inclination scale level read zero and the angle of camber is determined from the scale (Figure 13-4).

Wheel camber angles are not adjusted.

Checking and adjusting maximum turning angles. To measure the maximum turning angles the front wheels are placed on turning disks (see Figure 13-3), and extendors 4 are connected to the clamp rod of turning box indicators 3. Boxes 7 are placed by each wheel such that the indicator extendors lie across the tires below the hub, and pointer 2 of the indicators point to zero on the scales. The wheels must be turned straight ahead and braked. After this the wheels are turned from stop to stop and the angle of turn is determined. When necessary the angles are adjusted by means of the support screws (inserted in the lower turning levers), which rest on their heads in the lugs of the front bridge beam.

For adjustment the lock nut is removed and the correct turning angle is established by turning the bolt. The same should be done for the other truck wheel. When adjustment is finished, the lock nut is tightened and the plates removed from under the wheels.

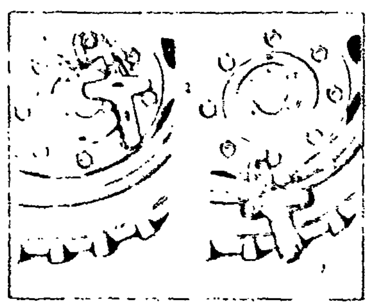


Figure 13-4. Installing Gauge for Measuring Truck Wheel Camber Angle:
1, gauge for measuring wheel camber angle, 2, adjustment levels, 3, king pin longitudinal inclination measurement scale, 4, camber angle measurement scale, 5, wheel camber measurement scale.

King pin longitudinal and transverse inclination angles are measured at the same time as the maximum wheel turning angles. The wheels are turned 20° to the right according to the indicator scale of the left wheel, then the wheels are turned 20° to the left from the zero position of the scale, each time adjusting the bubbles of the instrument levels 1 (see Figure 13-4) to zero, and the king pin angle of each wheel is determined according to the appropriate scale.

After checking the angles of one wheel the instrument is attached to the other wheel and the same operations are carried out.

King pin transverse and longitudinal angles are not adjusted.

Checking the condition of king pin parts. The king pins and turning arm inserts wear out faster than any other parts of the front bridge. Special care must be taken in ensuring timely greasing of these parts, and when necessary they should be replaced, since excessive wear of these parts will make it possible for a shock load to occur which will cause premature damage to the front wheel bearings, openings in the beam under the king pins and to lead to breaking of the turning arm.

Wear of the king pin and its inserts are easily disclosed by shaking the wheel. For this it is necessary to use a jack to raise the front bridge and, grasping the tire from above and below, shake the wheel. Proper tightening of the hub bearings should be checked first.

NIIAT designed an instrument (Figure 13-5) which is produced by the GARO plants for checking the condition of king pin parts.

A truck is considered fit for operation if the radial play in the unit does not exceed 0.75 mm, and the axle play does not exceed 1.5 mm. The condition of king pin parts should be checked in the following order.

Raise the front wheel with a jack. Clean the lower part of the brake disk, which must hold the measuring rod of the indicator.

Fasten the instrument to the beam of the front bridge of the truck, for which screws 1 and 2 and nut 4 should be loosened, place clamps 3 with the jaws on the lower side of the beam, compress the clamps by hand until they touch the beam, tighten stopper screw 1 and finally fasten the instrument with clamp screw 2.

Changing the position of slider 5, collar 6, rod 7 and clip 8, adjust the indicator so that the indicator face is horizontal and touches the lower part of the brake disk under some pressure. The arrow of the small scale of indicator 9 must point division 4 or 5 mm. Tighten all nuts and screws, turning the main scale of the indicator, setting its zero reading opposite the end of the pointer. Slowly lowering the truck wheel to the floor, watch the movement of the arrow of the main scale of the indicator. The scale division opposite which the indicator pointer stops shows the radial play, which is divided by 2 because the measurement is made on a large radius. If the radial play exceeds the maximum magnitude of 0.75 mm, the king pin sleeves should be replaced.

Axle play should be checked with a feeler gauge without raising the wheel. The gauge is placed between the lug of the front bridge beam and the eye of the turning arm. If the axle play exceeds the maximum value of 1.5 mm, it is necessary to adjust this play by changing the support bearing of the king pin or changing the number of adjusting shims.

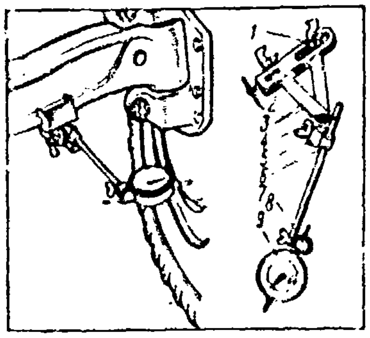


Figure 13-5. NIIAT Instrument for Measuring Radial Play in the King Pin Joint of the Front Bridge.

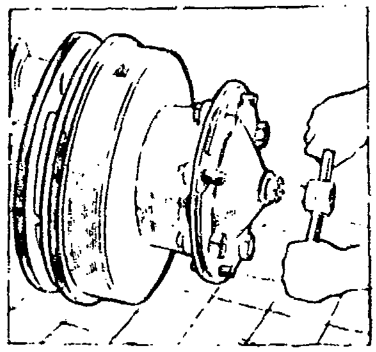


Figure 13-6. Removing the Hub and Brake Drum Using a Puller.

Assembly and Dissembly

To remove the front bridge from the truck it is necessary to jack up the front part of the frame and release the front springs from the frame or from the front bridge beam. Detach the shock absorbers from the front bridge beam and the end of the tie rod from the pitman arm or from the bearing pin on the turning arm lever. Detach the brake lines. Pull the front bridge from under the frame. Support the frame on stands.

Place the front bridge of the truck on a model 2173 stand. Remove the 4 bolts holding cover 24 (Figure 13-1) of the hub and remove it along with its lining. Remove lock washer 22, loosen lock nut 23, remove the lock washer and lock ring 21. Remove inside nut 20 and pull hub 27 and brake drum 11 together using a puller (Figure 13-6). A model 2478 puller (Figure 13-7) may be used for this. Outside bearing 19 (see Figure 13-1) is pressed out as well as the outside ring of inside bearing 16. Press out inside bearing 16. Remove gasket ring 15 from the turning arm.

Unfasten the brake chamber rod pin, remove the washer and pin. Unscrew the 2 bolts 47 which fasten the brake chamber to the bracket and remove brake chamber 46. Remove the 2 keys 12 and rod washers from the shoe rods. Remove the shoe spacer washer, then remove brake shoes 10.

Remove the key which fastens the adjustment lever 34 to the shaft of release cam 28, remove the outside washer, remove adjustment lever 34 from the shaft groove of the release cam, remove the inside washer, remove release cam 28 from the hole in bracket 33 and remove support washer 29 from the release cam.

Loosen the nuts of bolts 31 which fasten bracket 33 of the release cam and brake chamber, remove the spring washers, disconnect and remove the bracket, and pull out the bolts. Remove bolts 13 which fasten oil deflector 14 and remove it and its lining.

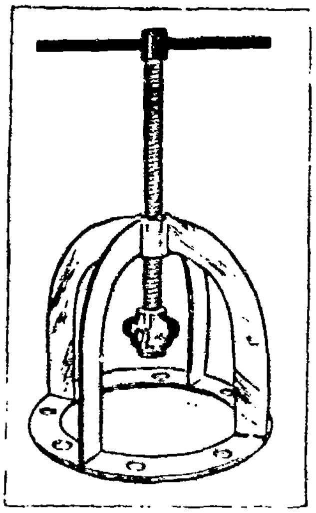


Figure 13-7. Model 2478 Front Wheel Hub Puller.

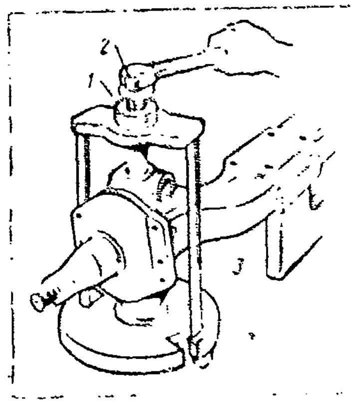


Figure 13-8. Removing Turning Arm King Pin:
1, threaded sleeve, 2, bolt, 3, clamp, 4, support plate.

Remove nut 6 which fasten brake shoe pin 7, remove the spring washers, pound out the shoe pins from the bracket hole using a mandrel and mallet.

Remove nuts 48 which fasten brake disk 9, remove the spring washers and pull out the bolts. Unfasten the transverse and longitudinal pitman arms.

To remove turning arm 25 it is necessary to unpin and loosen the nuts and press out the turning levers, remove bolt 35 holding the king pin covers, remove the upper and lower covers along with their linings. Remove the nut of chalk 41 which fastens the king pin, pound out the chalk using a hammer and copper mandrel. To remove the steering arm the king pin must be pressed out. A special tool (Figure 13-8) should be used for this. Placing the tool so that the axes of screw 2 and the king pin coincide, press out the king pin by turning the screw, remove turning arm 25 (see Figure 13-1), remove adjustment shims 39 and support bearing 5.

The king pin can also removed using a model 2504 press (Figure 13-9).

The front bridge beam (Figure 13-10) must be checked for bending and twisting. For this, a device (Figure 13-11) should be used which is placed on the spring seat and centered by the adjustment holes which fit the seating pins of the springs. Prism 3 of device 4 is adjusted by the opening of indicator clamp 2, which is placed into the king pin hole of beam 1.

Scales are used to determine bending and twisting of the beam as well as the angle of inclination of the king pin hole. To check the opposite side of the beam the device is installed on the second spring seat.

The beam is cold straightened using hydraulic press or on a special model 115 press. After straightening the angle of the king pin hole axis to the vertical should be within the limits 7°45'-8°15'. If bending or twisting is found which cannot be repaired, the beam must be replaced.

The front beam and other parts of the front bridge may not be cracked. The ends of the front axle beam lugs may not be more than 0.25 mm from perpendicular relative to the surface of the king pin hole.

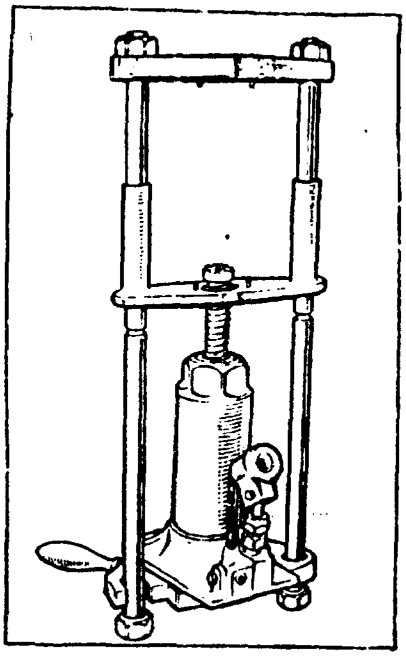


Figure 13-9. Model 2504 Press for Removing Turning Arm King Pins.

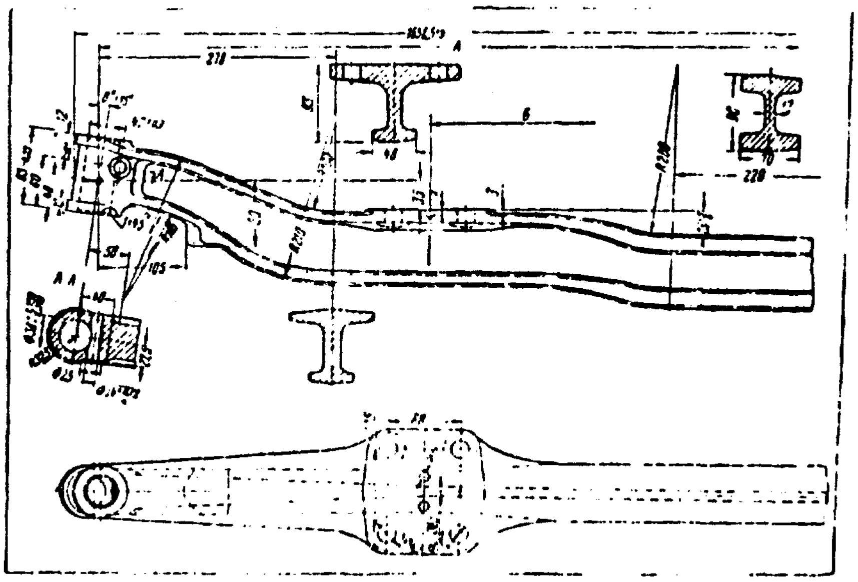


Figure 13-10. ZIL-130 Front Bridge Beam.

Turning arms. If the openings of the turning arms (Figure 13-12) is worn excessively (over 111.75 mm) where it fits the front bridge beam it is recommended to prepare the worn surfaces and install compensating washers during re-assembly. If the opening is worn to a diameter of over 113.25 mm the turning arm should be replaced.

All turning arms produced before December, 1962 had M30×1.5 mm threading, and after December, 1962 -- M36×2 mm.

ZIL-130 trucks produced after January, 1966 have turning arms with larger pitman arm openings (35 mm). Turning arms having lever openings which are different in diameter may not be installed. The use of ZIL-164A truck turning arms on ZIL-130 trucks is not recommended.

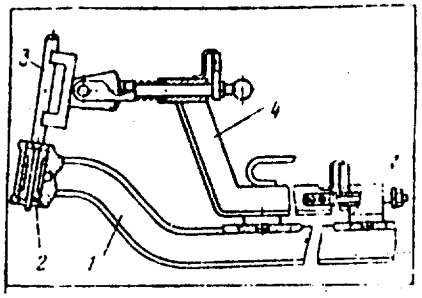


Figure 13-11. Checking the Front Bridge Beam for Bending and Twisting.

Turning arms with worn hub bearing journals and worn turning lever holes should be discarded. Turning arms which are cracked should be replaced.

No more than 2 turns of the threading in the arms and turning levers may be damaged.

Worn sleeves in the king pin holes should be pressed out and replaced.

The support washer and support ring of the turning arm bearing should be replaced if they are worn beyond the admissible dimensions. The basic dimensions of the support washer and bearing support ring are shown in Figure 13-13.

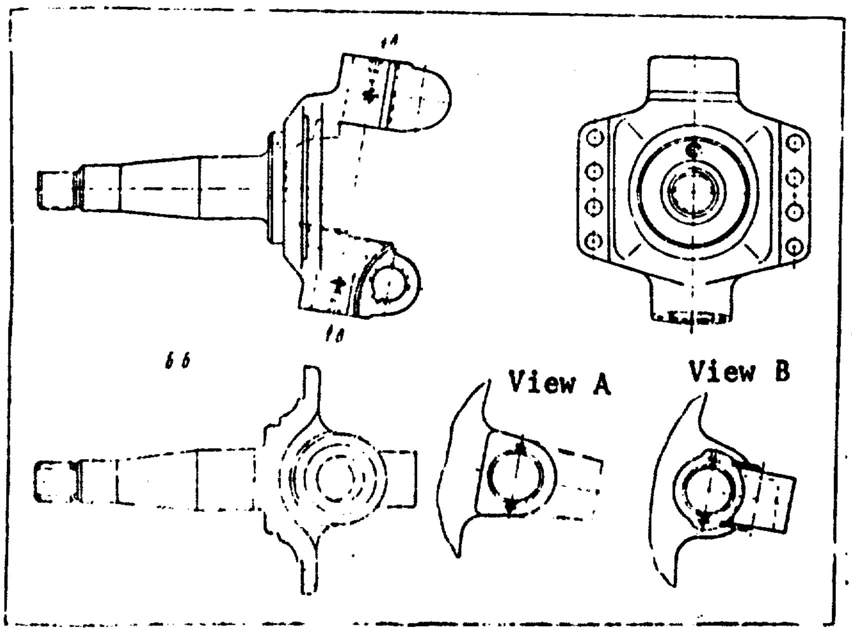


Figure 13-12. Turning Arm.

Turning arm levers and king pins. There are three turning levers on the front bridge: 2 on the left turning arm and 1 on the right.

Until January, 1966 the levers had a smaller cross section with a journal diameter of 29.7 mm. Since January, 1966 the plant has used only reenforced levers with a journal diameter of 35.7 mm for ZIL-130 trucks. The threading of the levers was changed at the same time from 24 mm to 27 mm. Segmented keys 8 × 10 mm are being used to fasten the levers instead of prismatic keys.

Levers and king pins which are cracked or excessively worn must be replaced with new ones.

To increase service life, an additional (second) adjustment washer has been used since January, 1965. In repairing the front bridge it is recommended to rotate the king pin by 90° relative to its old position so that the king pin key fixes the king pin in position on a new bearing surface.

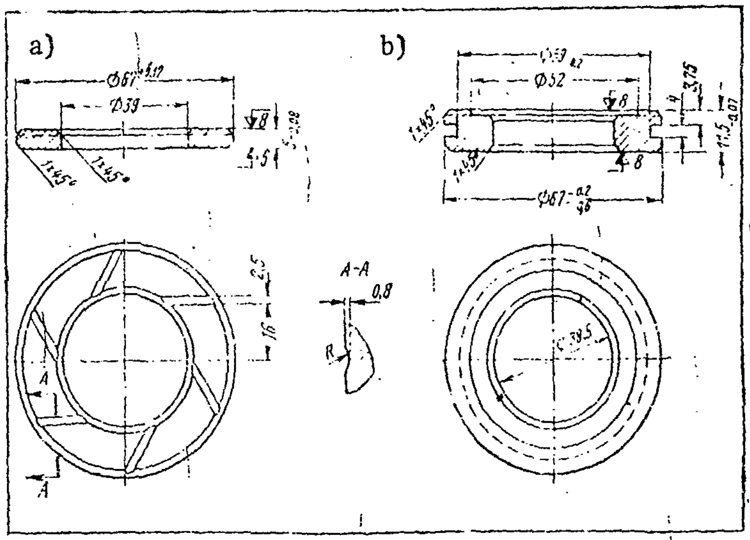


Figure 13-13. Parts of the Turning Arm Support Bearing: a, support washer, b, support ring.

Front bridge assembly. Press king pin sleeves into turning arm holes (clearance 0.100-0.175 mm). Drill holes in the sleeves, guiding the drill through the grease fitting hole. Remount the sleeves to a diameter of 38.025-38.060 mm, observing strict coaxial alignment.

Install keys in the slots of the conical hole of the turning arm, insert the turning levers, fasten the levers with nuts and pin them (nut tension 30-35 kGm). Place support bolts with lock nuts in the lower levers.

Place the front bridge beam on a stand. Put a washer and support bearing 5 in the lower hole of the turning arm (see Figure 13-1) along with the packing ring, and place adjustment shims 39 in the upper opening. Install turning arms

25 and connect them to the beam, placing king pins 40 through the arm in beam holes. Check the clearance between the upper support of the turning arm and the upper surface of the beam support. Clearance must be 0.25 mm. When necessary, adjust the clearance with shims 39. Fasten the king pins with key 41, and place a nut and washer on the king pin. Install king pin covers 36 with linings. Screw grease fittings into the holes in the turning arms.

Assemble the tie rod and install it on the turning levers, fasten the pins with nuts and fix the latter with cotter pins.

If a special gauge is available check the turning angle of the arms to determine the toe in of the front wheels. The angle must be 20'±3' (Figure 13-14), which will constitute 5-8 mm front wheel toe in in linear units. Turning angle is established by adjusting the tie rod.

At the same time it is necessary to check the maximum turning angle of the front wheels and make adjustments when necessary using the support bolts. For the ZIL-130 the turning angle must be: for the right wheel turned to the right -- 34°±30', for the left wheel turned to the left -- 36°±30'.

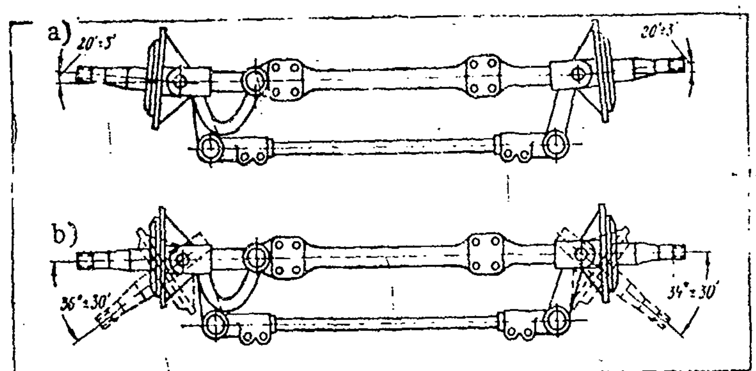


Figure 13-14. Toe In and Turning Angles of ZIL-130 Front Wheels: a, toe in angles, b, turning angle.

Assemble the pitman arm and put it in place, fasten the pin with a nut and insert a cotter pin. See Chapter 16 for assembly and installation of front brakes.

Press the inside bearing into the arm using a mandrel, seeing that the mandrel is held in the inside opening of the bearing. Grease the bearing. Bearings are seated with a gap of 0.032 mm to a clearance of 0.003 mm.

It should be kept in mind that there are 2 standard domestic bearings, 7608U and 7608K, which may be used as an outside bearing for the front wheel hub. While both of these bearings can be used for the ZIL-164A, only the bearing 7608K should be used for the ZIL-130.

Insert the support washer in the hub and press the gasket into place. Liberally grease the inside bearing, install the hub and brake drum together on the turning arm. Then install the outside bearing on the arm journal using a mandrel, seeing that the mandrel is held in the inside opening of the bearing. Bearing seating is from a gap of 0.027 mm to a clearance of 0.002 mm.

Grease the outside bearing, screw on inside nut 20 (see Figure 13-1) and tighten it with a wrench until bearings 16 and 19 start to tighten. Turn the wheel hub several times in both directions so that the bearing rollers become seated properly. Make sure that the brake shoes are not in contact with the drums. Loosen the inside nut by approximately 1/5th turn until the nearest opening coincides with the lock ring pin, noting that the hub turns freely and does not catch. Install lock ring 21 and lock washer 22 on the arm, install lock nut 23, tighten it with a wrench using a 400 mm extension until snug and bend the lock washer over a face of the nut. Install the cover and lining and fasten it to the hub using bolts, putting spring washers until the bolt heads.

Jack up the front part of the frame and slide the front bridge into place. Lower the frame gently onto the suspension. Fasten the front bridge to the truck frame (see Chapter 12). Lower the front of the truck and remove the jack.

PART DIMENSIONS

TABLE 13-1.
BASIC DIMENSIONS OF FRONT BRIDGE PARTS OF ZIL-130 TRUCK, MM (SEE FIGURE 13-1, 13-10)

Dimension	Nominal	Admissible Without Repair
Front Bridge Beam		
Steel 45 (GOST 1050-60) Hardness HV 241-285		
Beam length between king pin hole centers (dimension A)	1593.7-1596.3	-
Distance between axes of spring seat opening (dimension B)	840	
Diameter of king pin hole	38.010-38.035	38.06
Diameter of king pin key hole	14.00-14.12	14.25
Height of king pin lug	92.77-93.00	92.50
Turning Arms		
Steel 40Kh (GOST 4543-61), Hardness HV 241-285		
Diameter of outside wheel hub bearing journal	39.973-39.990	39.95
Diameter of inside wheel hub bearing journal	54.968-54.988	54.94
Diameter of king pin sleeve hole	41.000-41.050	-
Diameter of hub packing ring journal	98.09-98.19	-

TABLE 13-1 (Continued)

BASIC DIMENSIONS OF FRONT BRIDGE PARTS OF ZIL-130 TRUCK, MM (SEE FIGURE 13-1, 13-10).

Dimension	Nominal	Admissible without Repair
Diameter of turning lever hole:		
before 1966	29.0	-
after January, 1966	35.0	-
Conicity of turning lever hole	1:8	-
Gauge play relative to conical opening	±0.3	1.5
Width of front bridge beam opening	111.04-111.50	111.75
Diameter of arm threading	M36×2, cl. 2	-
Diameter of (small) conical journal	35.7	-
Diameter of small bearing pin hole	21.0	-
Nut threading diameter:		
before 1966	2M24×1.5, cl. 2	-
after January, 1966	M27×1.5, cl. 2	-
Conicity of bearing journal and bearing pin holes	1:8	-
Gauge play relative to conical opening	±0.3	-
Turning Arm King Pin Steel 18KhGT (GOST 4543-61); depth of case hardened layer 1.0-1.4 mm; hardness of surface layer HRC 56-62		
King pin diameter	37.983-38.000	37.97
King Pin Sleeve (T<MTU 511-41) Semihard Copper Zinc Alloy		
Outside sleeve diameter (using ring gauge)	41.175	-
Sleeve inside diameter	38.025-38.060	38.08
Turning Arm Bearing Support Journal UN-347 Graphite Bronze		
Outside journal diameter	67.0-67.12	-
Journal thickness	4.92-5.00	4.7
Inside journal diameter	39.0	-
Turning Arm Bearing Support Ring Steel 35 (GOST 1050-60); thickness of cyanided layer 0.3-0.5 mm		
Outside diameter	66.4-66.8	-
Ring thickness	11.43-11.5	11.2
Inside ring diameter	38.5	-

CHAPTER FOURTEEN: STEERING CONTROL

Construction

A steering mechanism without a power booster (Figure 14-1) is used on the ZIL-157K and its modifications. When the steering wheel *16* is turned, the driver's force is transmitted through the steering mechanism to the Pitman arm *20*, which is connected to the steering control drive. The force is then transmitted to the steering wheels of the vehicle.

Power steering (Figure 14-2) is used on the ZIL-130, the ZIL-131, and their modifications. An oil cooler is included in the power steering system of the ZIL-131 to cool the oil. There is no oil cooler on the ZIL-130.

The presence of a power booster in the steering control system, in addition to making the driver's work easier, increases safety in motion and allows the driver to hold the vehicle on the road in the event of a front wheel blowout at high speed.

The steering control operational scheme is shown in Figure 14-3.

Steering mechanism. The steering mechanism (Figure 14-4) is fastened to the frame and connected with the steering wheel shaft by means of a shaft having two universal joints.

The parts of the steering mechanism are located in a cast-iron housing *4*. The housing is simultaneously the cylinder of the power booster in which the piston-rod *5* with a toothed segment *31* is moved by the screw *7* and its adjacent ball nut *8*. The teeth of the rod and of the Pitman arm shaft segment have a thickness with varies with length [along the tooth]. This permits the engagement clearance to be adjusted by means of the axial displacement of the arm shaft.

The Pitman arm shaft turns in bronze bushings *33*, which are pressed into the housing, and in an opening *25* in the side cover of the housing. The axial position of the arm shaft is determined by the adjusting screw *30*, the head of which enters the steering arm shaft opening and rests against the thrust washer *27*. Axial movement of the adjusting screw in the arm shaft -- held to 0.02-0.08 mm during assembly -- is limited by the adjusting washer and stop ring *28*. Ball nut *8* is located in the piston-rod and is secured by the set screw *42* which is center-punched after assembly. The nut is assembled with the screw *7* in such a manner that thirty one balls *10*, upon which the screw *7* turns with insignificant resistance, are located in the channel and screw contour.

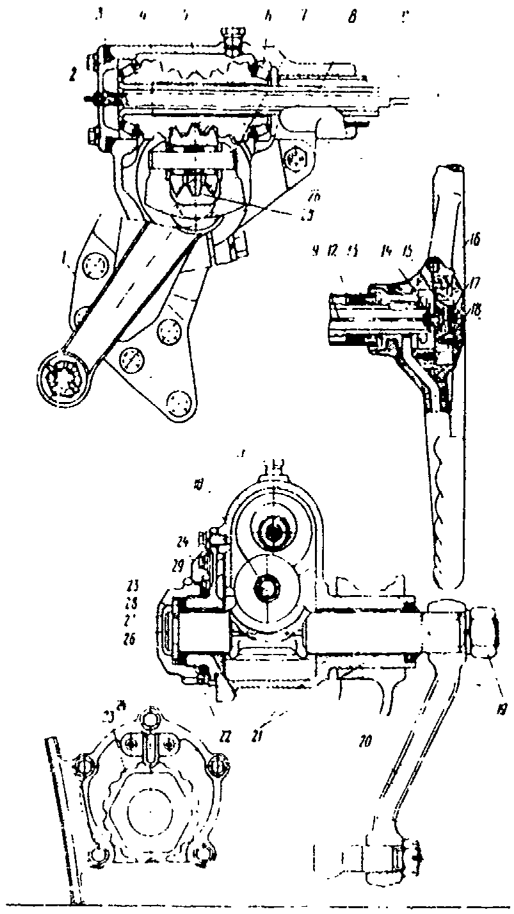


Figure 14-1: The ZIL-157K steering mechanism

1 -- bracket; 2 and 22 -- covers; 3 and 28 -- adjusting gaskets; 4 -- housing; 5 -- worm gear; 6, 10, and 13 -- bearings; 7 -- roller axis; 8 -- steering wheel shaft; 9 -- wire; 11 -- plug; 12 -- steering column tube; 14 and 19 -- nuts; 15 -- contact plate; 16 -- steering wheel; 17 -- cap; 18 -- button; 20 -- Pitman arm; 21 -- shaft bushings; 23 -- adjusting nut; 24 -- stop; 25 -- roller; 26 -- Pitman arm shaft; 27 -- thrust washer; 29 -- sealing rings

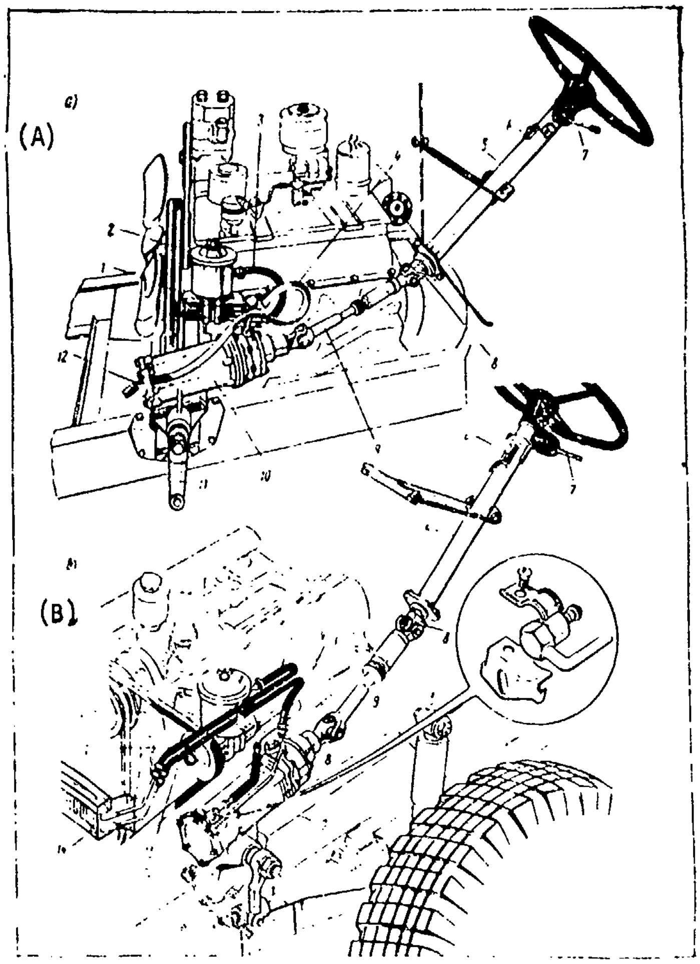


Figure 14-2: Overall view of the steering control for (A) a ZIL-130 and (B) a ZIL-131

1 -- power steering pump; 2 -- pump reservoir; 3 and 13 -- low pressure hoses; 4 and 12 -- high pressure hoses; 5 -- steering column; 6 -- horn contact unit; 7 -- turn indicator switch; 8 -- key for securing the articulated shaft; 9 -- articulated shaft; 10 -- steering mechanism; 11 -- Pitman arm; 14 -- oil cooler

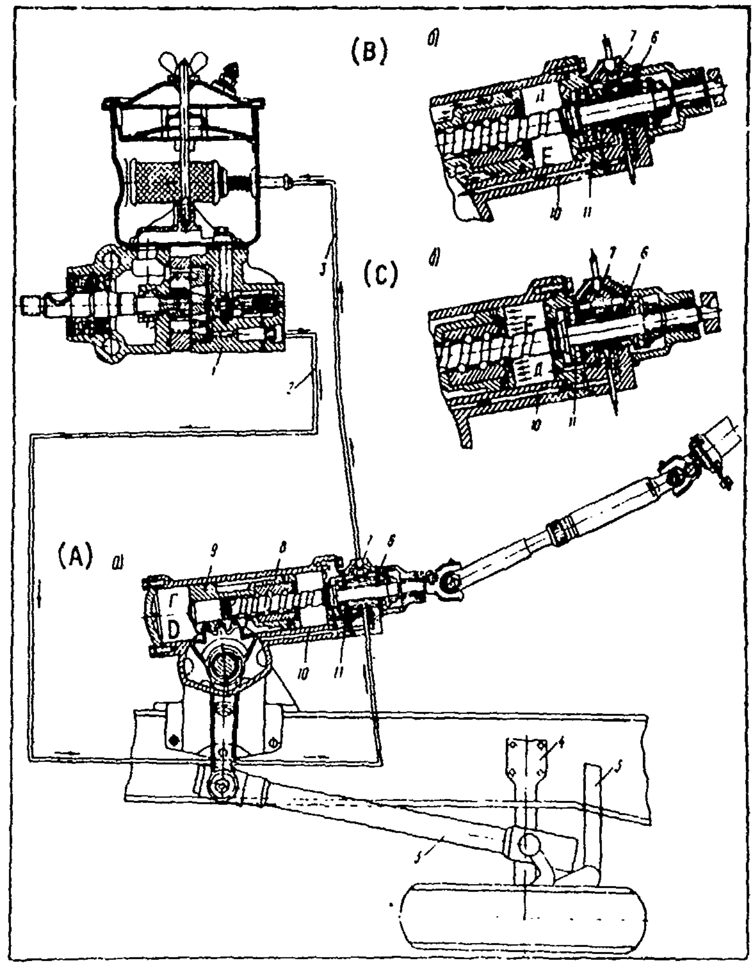


Figure 14-3: Operating scheme of a steering control with power booster -- position of the steering mechanism and the slide valve when the vehicle is moving: (A) straight ahead; (B) left turn; (C) right turn. (D) -- exterior chamber of the steering mechanism housing; (E) -- interior chamber of the steering mechanism housing;

1 -- pump; 2 -- high pressure hose; 3 -- low pressure hose; 4 -- front axle beam; 5 -- steering rods; 6 -- slide valve; 7 -- return valve; 8 -- steering mechanism housing; 9 -- piston-rod; 10 -- exterior chamber oil supply line; 11 -- interior chamber oil supply line; 12 -- steering wheel

EQUIPMENT CHARACTERISTICS OF THE ZIL-157K STEERING CONTROL

Steering mechanism	consists of a globoidal worm gear and crank with a three-ridge roller
Oil used for the steering mechanism	special oil for gearboxes and steering control boxes (GOST 4002-53)
Steering ratio	23.5
Dry weight of the steering mechanism (with column)	31 Kg
Steering column	with horn switch
Steering control drive	consists of tie rods and trailing links and steering arms; cap and ball steering arm joints with self-adjusting bushings

EQUIPMENT CHARACTERISTICS OF THE ZIL-130 AND ZIL-131 STEERING CONTROL

Steering mechanism	consists of a screw and nut with recirculating balls and a rod engaged by a toothed segment
Power steering	consists of a vane-type pump, double acting, turned by a V-belt [which is in turn driven by] the motor crankshaft pulley. The pressure developed by the pump acts on the piston which simultaneously fulfills the role of a rod installed in the steering mechanism housing
Power steering operating fluid	all-season type "R" oil or alternates: turbine oil (winter) or spindle oil (summer)
Steering ratio	20.0
Dry weight of the steering mechanism	26.5 Kg
Power steering pump	vane-type, double acting

(Equipment characteristics of the ZIL-130 and ZIL-131 steering control, continued)

Pump efficiency	9.5 liters/minute at 600 pump shaft rpm, 55 Kg/cm^2 back pressure; 16.5 liters/minute at 2,000 pump shaft rpm, 55 Kg/cm^2 back pressure
Maximum pressure developed by the pump	70 Kg/cm^2
Dry weight of the pump	7.3 Kg
Power steering hoses:	
-- high pressure:	rubber, oil-resistant, with two cotton casings and reinforced ends; exterior hose diameter -- 21.5-22.5 mm; internal hose diameter -- 9.5-10.5 mm
-- low pressure:	rubber, oil-resistant, single cotton casing; exterior hose diameter -- 17-18.5 mm; interior diameter 9.5-10.5 mm
Radiator for cooling the operating fluid	installed only on the ZIL-131 on the low pressure line
Steering control articulated shaft	two universal joints, crosses inset in ceramic bushings. An articulated shaft with needle bearings instead of ceramic bushings may be installed
Steering column	with turn indicator switch and horn button switch assembly
Steering control drive	consists of tie rods and trailing links and steering arms. Cap and ball steering rod joints with self-adjusting bushings

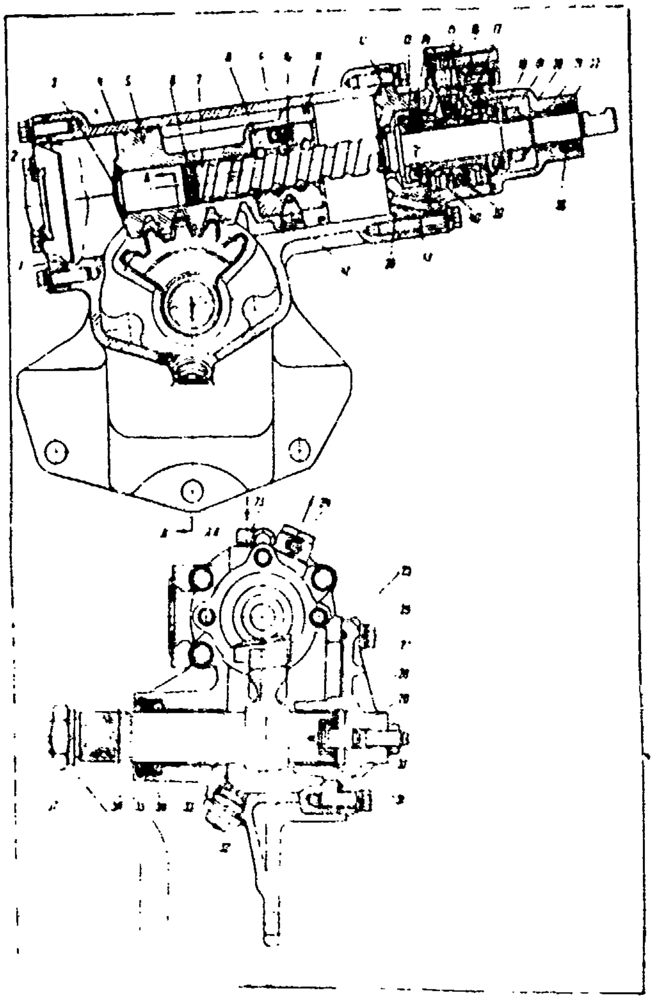


Figure 14-4: ZIL-130 and ZIL-131 steering mechanism

1 -- lower cover; 2, 14, 26 and 29 -- sealing rings; 3 -- cap; 4 -- steering mechanism housing; 5 -- piston-rod; 6 -- split sealing ring; 7 -- steering mechanism screw; 8 -- ball nut; 9 -- channel; 10 -- ball; 11 -- piston ring; 12 -- intermediate cover; 13 -- front thrust bearing; 15 -- ball valve; 16 -- slide valve; 17 -- control valve housing; 18 -- spring washer; 19 -- adjusting nut; 20 -- upper cover; 21 -- needle bearing; 22 and 35 -- oil seal thrust rings; 23 -- connection; 24 -- elbow for removing oil from the system; 25 -- side cover; 27 -- thrust washer; 28 -- stop rings; 30 -- adjusting screw; 31 -- Pitman arm shaft; 32 -- plug; 33 -- Pitman arm shaft bushing; 34 and 38 -- oil seals; 36 -- lock ring; 37 -- Pitman arm shaft nut; 39 -- spring; 40 -- reaction piston; 41 -- channel; 42 -- set screw

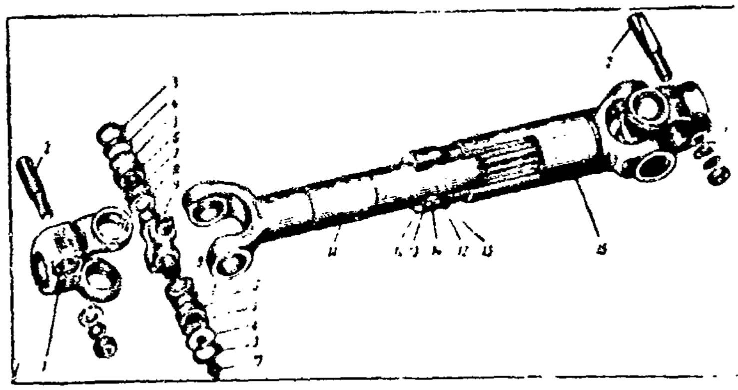


Figure 14-5: Steering control articulated shaft

1 -- fork; 2 -- key; 3 -- stop rings; 4 -- bushing covers; 5 and 7 -- sealing rings; 6 -- cross bushings; 8 -- sealing ring holders; 9 -- cross; 10 -- grease fitting; 11 -- splined fork; 12 -- split washers; 13 -- rubber oil seal ring; 14 -- felt ring; 15 -- nut; 16 -- slotted bushing with fork

Two stamped channels *9*, which form a tube along which the balls, when ejected during the rotation of the screw from one end of the nut, are returned to the other end, are set into the slot of the ball nut which is connected by two openings with the screw channel. Screw *7* passes through the intermediate cover *12* to which the steering control housing *17* is fastened. Two thrust ball bearings *13* in which the screw turns are installed on the screw. The steering control slide valve *16* is installed on the screw between the bearings. The large bearing rings face the slide valve. The ball bearings and the slide valve are fastened by nut *19*, the tapered collar of which is pressed into the slot in the screw. A conical spring washer *18*, which provides for the even compression of the thrust ball bearings, is placed under the nut. The washer is installed with the concave side toward the ball bearing.

The end of the screw *7* is supported by the needle bearing *21*, which is positioned in the upper steering mechanism cover *20*.

The length of the slide valve is greater than the length of its opening in the control valve housing. As a consequence of this, the slide valve and the screw may move axially by 1 mm in each direction from the middle position. They return to the middle position because of the six springs *39* and the reaction piston *40* which are pressurized by the oil in the supply line from the pump.

When the screw *7* is turned in one direction or another (see Figure 14-4), as a consequence of the resistance which arises when the wheels are turned, a force which attempts to move the screw in an axial direction, in a corresponding direction, is created. If this force exceeds the preliminary compression force of the springs *39*, the screw is moved and it displaces the slide valve *16*. Here one chamber of the steering mechanism housing cylinder is connected with the pressure line and the other chamber is connected with the vent line. The oil which enters the cylinder from the pump presses upon the piston-rod, creating an additional force on the Pitman arm shaft sector and facilitates the turning of the wheels.

The pressure in the operating chamber of the cylinder increases with an increase in the resistance of the wheels to turning. Simultaneously, the pressure of the reaction piston *40* is also increased. The screw and the slide valve attempt to return to the middle position, because of the springs *39* and the reaction piston *40*.

The greater the resistance of the wheels to turning and the higher the pressure in the operating chamber of the cylinder, the greater the force with which the slide valve attempts to return to the middle position and place the thrust ball bearings and the screw in the middle position, and also the greater the force on the steering wheel. When the force on the steering wheel increases with an increase in the resistance of the wheels to turning, the driver gets the "feel of the road."

The force on the steering wheel rim which corresponds to the beginning of the operation of the power steering is approximately 2 Kg, and the greatest force is approximately 10 Kg.

When the steering wheel stops turning, the oil which is entering the cylinder acts upon the screw-threaded piston-rod, moves the slide valve to the middle position, which causes a decrease in the pressure in the cylinder relative to that pressure which is necessary to retain the wheels in their turned position, and halts the movement of the piston, and, consequently, the turning of the wheels as well.

In the control valve housing there is a ball valve *15*, which, when the pump is not working, connects the high pressure and vent lines. In this case the valve provides for the operation of the steering mechanism as a standard steering mechanism without a power booster.

The chamber in which the thrust ball bearings are located is connected with the vent opening and is sealed by round rubber sealing rings *14*. The remaining non-moving connections are sealed by similar rings *2* and *26*.

The Pitman arm shaft *31* is sealed by a rubber oil seal *34* which has a thrust ring *33* which prevents its coming out under pressure.

The external rubber seal prevents mud and dirt from getting at the shaft. The piston-rod is sealed by two resilient cast iron split rings.

The steering mechanism screw *7* has two seals in the intermediate cover and in the piston-rod. Sealing is accomplished by resilient cast iron split rings *6*. The screw in the upper cover *20* is sealed by a rubber oil seal *38* with a thrust ring *22* and an external seal, and the adjusting screw *30* is sealed by a round rubber ring *29*.

When the screw *7* is turned in one direction or another away from the middle position, there occurs an increase in the free play in the steering mechanism. This obtains because of the fact that the thickness of the middle tooth of the sector of the Pitman arm shaft *31* is greater in comparison with the remaining teeth, and the screw *7* has a barrel shape with an insignificant decrease in the diameter of the screw channel toward its ends.

In the steering mechanism housing there is a plug *32* with a magnetic plate which catches steel and cast iron particles from the oil. The steering mechanism screw *7* is connected with the steering wheel shaft by an articulated shaft.

The steering control articulated shaft (Figure 14-5) has two universal joints, each of which consists of a fork *1* with metallic-ceramic bushings *6* and crosses *9* installed in the fork. The bushings are secured by stop rings *3*.

Lubrication of the universal joints is accomplished by injection through the grease fitting *10* and through the opening in the cross. Sealing rings *5* prevent dirt from getting into the universal joint.

The articulated shaft has a sliding spline connection which provides for possible changes in the distance between the universal joints when the cabin flexes in relation to the frame.

A felt ring *14* and a rubber ring *13* are installed to retain the lubricant and to prevent the connection from becoming dirty.

The universal joint forks are fastened to the steering mechanism screw and to the steering shaft by keys *2*.

The steering column (Figure 14-6) is fastened at its lower end to the floor of the cabin and at its upper end to a plate and to the dash by means of braces.

The steering shaft *5* turns in ball bearings *4* and *17* which are located in the steering column tube *6*.

The turn indicator switch *21* and the horn button assembly are installed on the upper portion of the steering column.

The power steering pump and reservoir (Figure 14-7) are mounted on the motor and are activated through a pulley by means of a V-belt from the crankshaft pulley.

The pump pulley is fastened to the shaft *6* by a conical expansion bushing *30*, a key, and a nut.

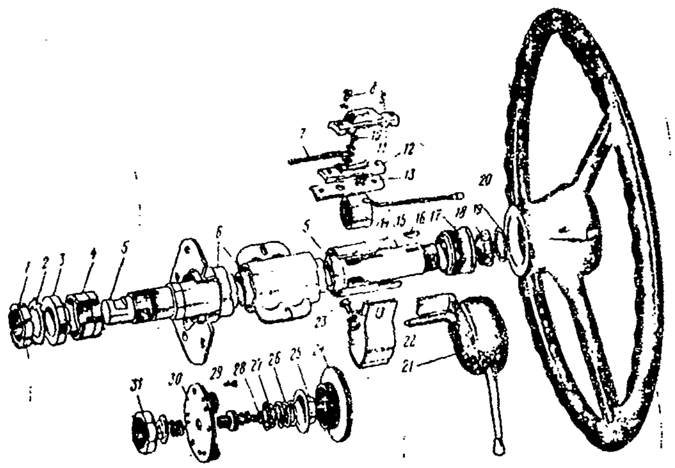


Figure 14-6: Steering column

1 -- adjusting nut; 2 -- stop washer; 3 -- oil seal holder; 4 and 17 -- bearings; 5 -- steering shaft; 6 -- steering column tube; 7 and 15 -- electric wires; 8, 10, 28 and 29 -- screws; 9 -- contact assembly cover; 11 -- contact pressure plate; 12 -- contact insulator; 13 -- contact; 14 -- current pick-up ring; 16 -- key; 18 -- thrust washer; 19 -- stop ring; 20 -- steering wheel; 21 -- turn indicator switch; 22 -- bracket; 23 -- bolt; 24 -- horn button; 25 -- contact cap; 26 -- spring; 27 -- spring retainer; 30 -- contact plate; 31 -- nut

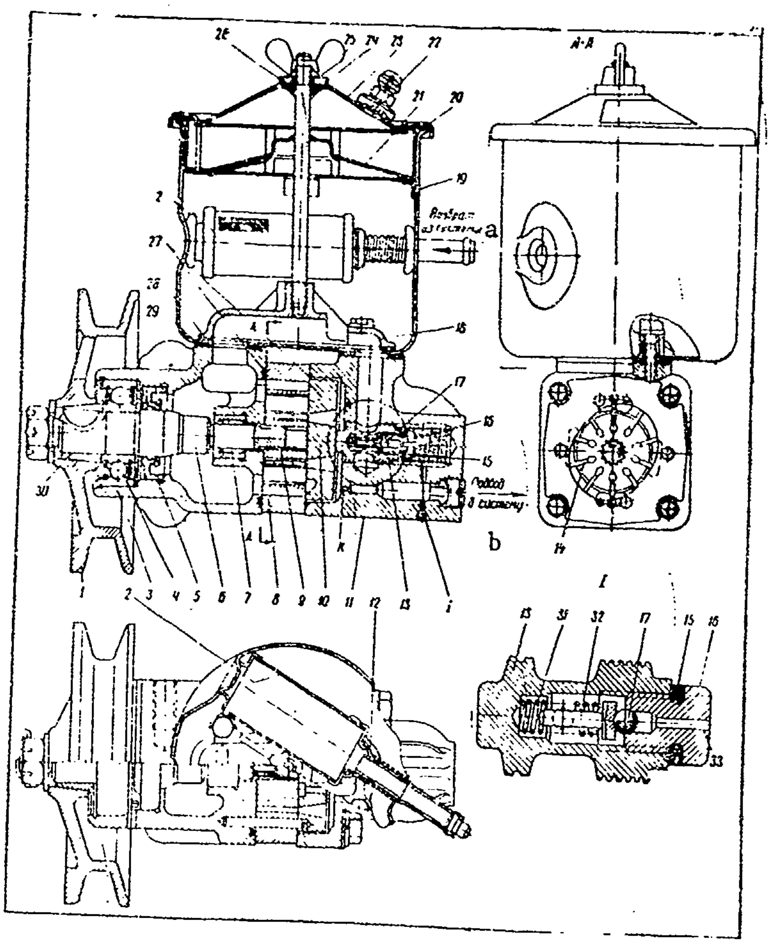


Figure 14-7: ZIL-130 and ZIL-131 power steering pump

1 -- pulley; 2 and 21 -- mesh filters; 3 -- pump housing; 4 -- front bearing; 5 -- oil seal; 6 -- shaft; 7 -- rear bearing; 8 -- stator; 9 -- rotor; 10 -- distributor disk; 11 -- pump cover; 12 -- filter by-pass valve; 13 -- pump by-pass valve; 14 -- vane; 15 -- adjusting gaskets; 16 -- safety valve seat; 17 -- safety valve; 18 -- collector; 19 -- reservoir; 20 -- gasket; 22 -- breather; 23 -- reservoir cover; 24 -- washer; 25 -- nut; 26 and 27 -- sealing rings; 28 and 29 -- collector gaskets; 30 -- conical bushing; 31 -- safety valve spring; 32 -- spring guide rod; 33 -- opening for supplying oil to the safety valve; *K* -- calibrated opening; (a) -- return from the system; (b) -- supply to the system

The pump is a double-acting, vane-type pump (for 1 revolution of the pump shaft, 2 complete cycles of intake and 2 of injection are accomplished). The pump rotor *9* has slots in which the vanes *14* are located. The rotor is installed on the pump shaft *6* on splines and is loosely fitted.

The position of the stator *8* relative to the pump housing *3* must be such that the direction of the arrow on the stator coincindes with the direction of rotation of the pump shaft, if one looks at the shaft from the pulley.

The pump vanes must move in the rotor slots without binding. When the pump shaft rotates the vanes are pressed against the curved surface of the stator because of centrifugal force and the pressure of the oil.

In the intake chambers the oil moves into the spaces between the vanes and then, as the rotor turns, the oil is forced into the injection chambers.

The faces of the housing and distributor disk are carefully polished. The presence either here or on the rotor, stator, or vanes of nicks and burrs is not permissible.

A reservoir *19* for oil and a cover *23* with a nut *25* are installed on the pump. A washer *24* and a rubber sealing ring *26*, which together with the rubber gasket *20* seal the internal chamber of the reservoir, are located under the nut. A breather *22* to limit the pressure within the reservoir is screwed into the reservoir cover.

All of the oil which returns from the power steering to the pump passes through the mesh filter *2*, which is located within the reservoir. In the event that the filter becomes contaminated, the by-pass valve *12* is provided. Besides that, a mesh filter *21*, which filters the oil when it is poured in, is installed within the reservoir.

The pump has two valves which are located in the pump cover *11*. The safety valve *17* located inside the by-pass valve *13* limits the pressure of the oil in the system. The safety valve opens at a pressure of 65-70 Kg/cm^2. The by-pass valve limits the amount of oil which is supplied by the pump to the power steering when the engine crankshaft rpm is increased.

The by-pass valve works in the following manner: the valve seat is connected by one opening with the pump injection chamber and by another opening with the power steering injection line; this second line is in its own turn connected with the pump injection chamber by the calibrated opening *K*. With an increase in the supply of oil to the power steering system (as a result of increasing the engine crankshaft rpm), the difference in pressures in the pump injection chamber and the system injection line is increased and, consequently, the difference in pressure at the ends of the by-pass valve increases. At a specific pressure difference the force which attempts to move the valve to the right increases sufficiently so that the spring is compressed and the valve, moving, connects the injection chamber with the reservoir. Thus, further supply of oil to the system almost ceases.

To preclude noisy operation and increased pump wear at high engine crankshaft rpm's, the oil which passes through valve *13* is compulsorily directed back into the pump housing chamber and into the intake channels. The collector *18*, the interior channel of which is connected with the by-pass valve chamber and which has a small cross-section, serves this purpose. This results in a sharp increase in the speed with which oil is delivered to the intake chamber of the housing. It also facilitates the inflow of that amount of oil which returns from the steering mechanism.

Steering control drive. The steering control drive structural schematics for ZIL vehicles with and without power steering are mostly identical. It should be kept in mind that the trailing links of two- and three-axle vehicles have an identical ball coupling, although the ZIL-157K bushings are different, design-wise, from the bushings of the ZIL-130 and the ZIL-131. The length of the arms and their configuration also varies.

Tie rods (Figure 14-8) of the ZIL-130 and the ZIL-131 also have an identical ball coupling.

The ZIL-157K tie rod has cylindrical pins with bushings for its couplings.

Equipment Servicing

Steering control assembly lubrication and the equipment servicing intervals are given in Chapter Two.

Steering Control Without Power Steering

Checking the free play of the steering wheel. The free play of the steering wheel with the wheels mounted and the direction of travel straight ahead should not exceed 15° (1/24 turn).

The steering wheel free play is determined by means an NIIAT (*Gosudarstvennyy nauchno-issledovatel'skiy institut avtomobil'nogo transporta*; State Vehicular Transport Scientific-Research Institute) device which is installed on the steering column (Figure 14-9). If the steering wheel free play is greater than 15°, the steering control must be adjusted.

Prior to setting about adjusting the steering mechanism it is necessary to check and tighten the attachment of the steering mechanism housing to the bracket, the attachment of the Pitman arm to the shaft, and also to eliminate increased clearances in the trailing link joints, in the hub bearings, and in the kingpin turn journal bushings.

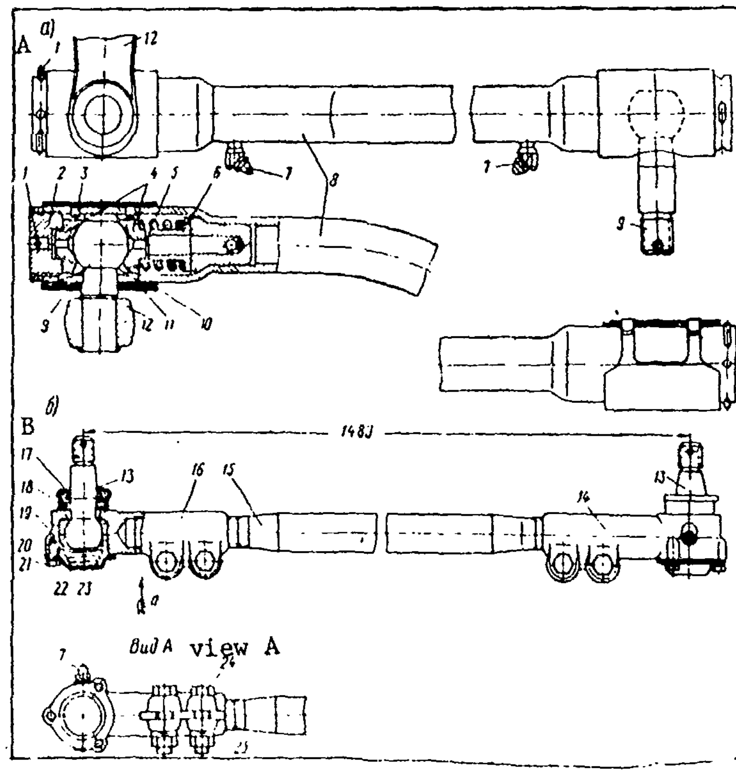


Figure 14-8: ZIL-130 and ZIL-131 trailing links and tie rods

A -- trailing link; B -- tie rod; 1 -- lockpin; 2 -- adjusting plug; 3 -- pin; 4 and 19 -- bushings; 5 and 22 -- springs; 6 -- stop; 7 -- grease fitting; 8 -- trailing link; 9 and 13 -- ball pins; 10 and 20 -- sealing gasket; 11 -- cover; 12 -- Pitman arm; 14 and 16 -- end pieces; 15 -- tie rod; 17 and 23 -- covers; 18 -- oil seal; 21 and 24 -- bolts; 25 -- nut

In order to eliminate any loosening in the trailing link ball joints it is necessary to remove the cotter pin from the adjusting plug *2* (see Figure 14-8) and turn the plug by means of an offset screwdriver until it stops, and then to back off by approximately 1/4 turn, following which the cotter pin should be inserted in the plug.

Adjustment of the steering mechanism worm gear bearing. In order to adjust the bearings (see Figure 14-1) it is necessary to separate the trailing link from the Pitman arm *20* and to remove the Pitman arm. Undo the side cover *22* attachment bolts, remove the cover and disengage the roller *25* from the worm gear *5*. Undo the lower cover *2* bolts of the housing and the steering mechanism and remove the cover along with the adjusting gaskets *3*. Set up the lower cover (see Figure 14-9B) and, pressing it with your hand, measure with a set of feeler gauges the clearance between the cover and the end of the housing. Pick up a set of thick and thin gaskets for the lower cover. This set should be equal in thickness to the measured clearance (the thin gaskets on hand should be left in the set). Place the set of gaskets under the cover and secure the cover with the bolts, turning the steering wheel slightly.

By means of a spring dynamometer fastened to the rim of the steering wheel check the force necessary to turn the worm gear in the bearings. The force must be within the limits of 0.3-0.8 Kg on the steering wheel rim. If the force is less than that which is permissible, the extra adjusting gaskets (the thicker ones, preferably) should be removed. If the force is greater than that which is permissible, add gaskets.

Adjusting the engagement of the steering mechanism roller and worm gear. In order to adjust the engagement, the Pitman arm shaft *26* should be placed in the middle position, having turned the steering wheel by 2.75-3 turns from either extreme position. This should be done with the trailing links disconnected, the Pitman arm *20* (see Figure 14-1) removed, with the adjusting nut *23* along with the thrust washer *27* and the adjusting gaskets *28* removed, but with the side cover *22* attached.

Place thrust washer *27* into the circular Pitman arm shaft *26* groove and, pressing the Pitman arm shaft with your hand from the direction of the cover until the roller touches the worm gear, measure the clearance *H* (see Figure 14-9C) between the ends of the thrust washer and the side cover of the steering mechanism housing in several places in this position.

Pick up the thick and thin adjusting washers (see Figure 14-9C and 14-9D), the thickness of which must be equal to the measured clearance (as many of the existing thin gaskets as possible should be left in the set).

Place the set of adjusting gaskets *28* and the thrust washer *27*

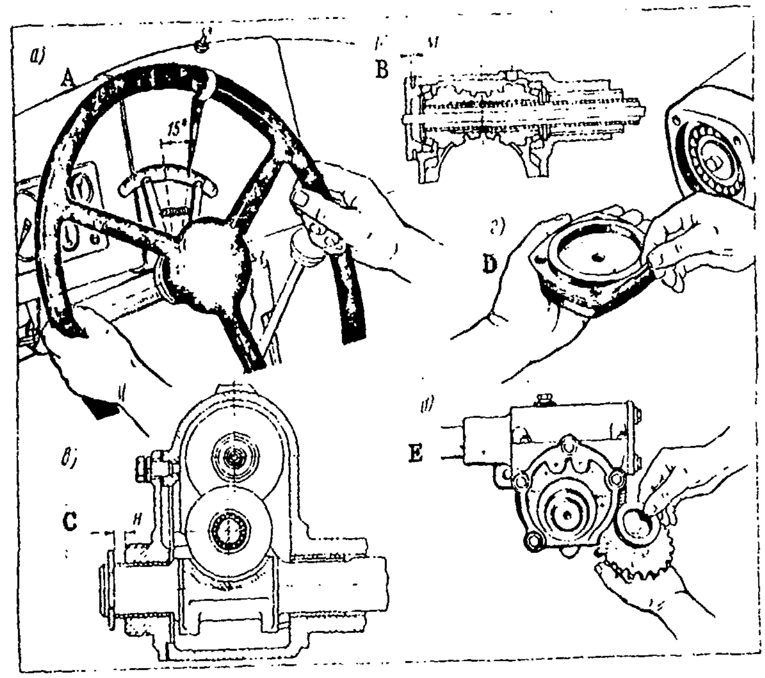


Figure 14-9: Checking the steering wheel free play and adjusting the steering mechanism

A -- checking the steering wheel free play;
B -- adjusting the worm gear bearings;
C -- adjusting the engagement of the roller and worm gear;
D and E -- selection of the adjusting gaskets;
M and H -- adjusting gasket clearances

on the Pitman arm shaft *26* (see Figure 14-1) and place the rubber sealing rings *29* on the collar of the side cover. The rubber rings are installed in such a number as to provide normal sealing between the adjusting nut *23* and the housing cover *22*. Following this, tighten the housing cover nut and, having installed the Pitman arm *20*, secure the Pitman arm with the nut *19*.

Check the Pitman arm turn angle in either direction from the middle position to the point where it stops. The Pitman arm turn angle from the middle position to the point where the arm stops must not be less than 42°. Check the inclination of the Pitman arm; the inclination of the end of the Pitman arm must be equal to 0 mm or not more than 0.2 mm.

After adjusting the engagement of the roller with the worm gear, check the force required to turn the steering wheel at the rim of the steering wheel by means of a spring dynamometer. The force must be within the limits of 1.5-2.5 Kg. If the force is less than that which is permitted, but the inclination of the Pitman arm is greater than that which is permitted, then some of the adjusting bushings *28* (see Figure 14-1), preferably the thicker ones, should be removed. If the force is greater than that which is permissible, add gaskets. Having finished the adjustment, the adjusting nut *23* of the side cover *22* should be checked by the stop *24* and the trailing link should be connected to the Pitman arm.

After adjusting the steering mechanism it is necessary to again check the free play of the steering wheel, which should not exceed 15°.

For the sake of convenience it is recommended that the steering mechanism be removed from the vehicle together with the steering column and adjusted at a mechanic's bench.

Changing oil. Before changing and adding oil, the steering mechanism housing should be cleaned of dirt and dust.

After removing the used oil it is necessary to add fresh oil up to the level of the control plug.

Steering Mechanism With Power Steering

Checking and adjusting the steering mechanism. Before checking and adjusting the steering mechanism, it is necessary to check the air pressure in the tires, the presence of lubricant in the steering control assemblies and wheel hubs, the adjustment of the wheel bearings, the adjustment of the steering control drive arms and the correctness of their position, the proper operation of the shock absorbers, and the correctness of the installation of the front wheel connections, since all of this influences the operation of the steering control. The level of the oil in the pump reservoir and the tightness of the pump belt, and the pressure developed by the pump should also be checked; the absence of air in the power steering system and the absence of oil leaks in the connecting lines should also be checked.

It is necessary to check the adjustment of the steering mechanism in the following order: straighten the front wheels so that the steering wheel is in the middle position, disconnect the trailing link of the steering control from the Pitman arm, and, by means of a spring dynamometer fastened to the steering wheel rim, measure the force in the following three positions:

1. with the steering wheel turned more than 2 turns from the middle position. The force on the steering wheel rim should be equal to 0.55-1.35 Kg.

2. turn the steering wheel 3/4-1 turn from the middle position and measure the force at the rim.

3. the steering wheel passes through the middle position. The force on the rim of the steering wheel must be 0.8-1.25 Kg greater than the force obtained during the measurement in the second position, but should not exceed 2.8 Kg.

If the force in these three positions does not correspond to the magnitudes indicated, the steering mechanism should be adjusted.

The adjustment of the steering mechanism should be begun by determining the magnitude of the force in the thirds position by means of moving the Pitman arm shaft in an axial direction. The movement of the Pitman arm shaft *31* (see Figure 14-4) is accomplished by turning the adjusting screw *30*. If the screw is turned to the right the force will be increased. If the screw is turned to the left, it will be decreased.

A discerpancy in the forces at the steering wheel rim in the second position is caused by the incorrect preliminary tightening of the steering mechanism ball nut, because of the wear on the rolling surfaces of the ball nut or of the steering mechanism screw, or as a result of the bearings jamming. A discrepancy in the forces in the first position is caused for the very same reasons, as well as by the incorrect preliminary tightening of the thrust ball bearings of the steering mechanism screw.

In order to check and adjust the forces in the first and second positions, the steering mechanism should be removed from the vehicle and disassembled; those parts which are touching one another should be checked, worn parts replaced, the steering mechanism assembled and again checked (see the section entitled "Assembly of the Steering Mechanism With Power Steering").

Having finished checking and adjusting the steering control, the Pitman arm must be connected to the trailing link and the steering wheel free play must be checked with a play gauge [see Figure 14-9A].

Checking the steering wheel free play is accomplished with the engine at idle and the turn signal indicator removed by turning the steering wheel in both directions until the steering wheels [i.e., the front wheels of the vehicle] begin to turn. The steering wheel free play should not exceed 15°.

In order to check the free play of the steering wheel, the vehicle must be placed on a flat area and the front wheels [of the vehicle] must be straight. If the steering wheel free play is greater than the amount allowed, it is necessary to determine which coupling is causing the increased free play. In order to do this it is necessary to check the steering control drive arm adjustment situation, the adjustment of the steering control mechanism, the clearances in the steering control universal joints, and the tightness of the universal joint securing keys. It is also necessary to check the tightness of the steering wheel shaft bearings.

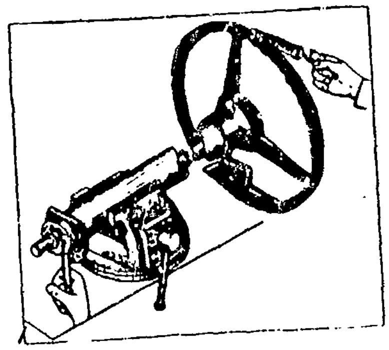


Figure 14-10: Adjusting and checking the tightness of the steering wheel shaft bearings

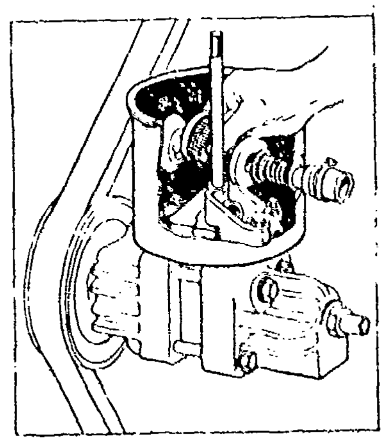


Figure 14-11: Installation of the mesh filter in the pump reservoir

If the adjustment of the steering control mechanism or the drive arms is destroyed, the necessary adjustment should be made. If there are large gaps in the universal joints of the articulated shaft, the universal joints should be replaced or repaired.

Having convinced oneself of the satisfactory condition of the enumerated connections, one should check the tightness of the steering wheel shaft thrust bearings. In order to do this, the articulated shaft should be disconnected and the force required to turn the steering sheel shaft in its bearings (Figure 14-10) measured. The turning moment must be 3-8 Kg·cm, which will correspond to a force of 0.125-0.333 Kg.

If there is a discrepancy in the indicated turning moment, the tightness of the bearings must be adjusted by turning the adjusting nut with a wrench. It should be kept in mind that it is not permissible to over-tighten the nut and then loosen it, since the increased tightening moment may damage the steering shaft bearing races.

All points of attachment should be systematically checked and tightened, the condition of the tie rod and trailing link ball joints should be checked, and the clearance in the joints should be adjusted and the joints should be lubricated as necessary.

Cleaning the mesh filters of the power steering pump. For the break-in period of a new vehicle or a new steering mechanism and power steering pump an additional batiste filter is installed at the plant over the mesh filter of the pump. This additional filter is fastened to the mesh filter with spring rings.

After the vehicle has been run-in for approximately 1,000 Km the batiste filter and the springs must be removed, using all precautionary measures here to prevent dirt from getting in [the system]. The filter is then installed (Figure 14-11).

At each TO-2 equipment inspection the mesh filter which is used when adding fresh oil and the main mesh filter should be washed in gasoline. In the event that the filters are significantly contaminated by tarry deposits, they should be additionally washed in Solvent 646.

Changing the Pitman arm shaft oil seal. As the vehicle is being used a flow of oil through the Pitman arm shaft oil seal may appear. The replacement of an incorrectly operating oil seal may be done without removing the steering mechanism from the vehicle. An oil pressure of 5-10 Kg/cm^2 in the power steering system is used to eject the oil seal. A device is used here (Figure 14-12) which consists of a sleeve 1, a sealing ring 2, and a coupling nut 3 with handles 4. The sleeve is placed on the Pitman arm shaft, and the nut is screwed onto the threading of the same shaft, clamping the sleeve to the oil seal.

In order to change the oil seal it is necessary that the front wheels be turned all the way to the left.

Unscrew the nut and remove the Pitman arm from the shaft. Remove the lock ring 36 (see Figure 14-4) from the oil seal seat by means of round pliers. If possible, remove the seal clamping ring from the seat and the seal with the rubber gasket. Place the sleeve of the device on the Pitman arm shaft, screw the clamping nut onto the threading of the Pitman arm shaft, lightly pressing the sleeve against the oil seal. Place a clean dish under the steering mechanism to catch the oil.

Start the engine and run the power steering system pressure up to 5-10 Kg/cm^2, then, while turning the clamping nut by its handle, gradually unscrew it (Figure 14-13), pressing the oil seal out of its seat. After pressing out the oil seal, remove the oil from the hydraulic system of the steering control and stop the engine.

The installation of the new oil seal should be done with a mandril 3 (Figure 14-14) which protects the oil seal from damage, with the help of the device (see Figure 14-12). During the installation, lubricate the sealing edges of the oil seal and the shaft collar with oil, place the oil seal on the shaft and move it to the seat of the housing. Remove the protective mandril.

Place the sleeve of the device on the Pitman arm shaft and turn the clamping nut onto the threading of the shaft.

While tightening down the clamping nut (see Figure 14-13), press the oil seal into the seat of the housing.

Remove the device, install the sealing rings, and secure the oil seal with the lock ring.

Place the Pitman arm on the shaft, secure the arm with the nut, and turn the vehicle wheels to the straight ahead position.

Then add fresh oil to the power steering system.

Adding or changing oil in the power steering system. When checking the level of the oil in the power steering system, the front wheels of the vehicle must be in the straight ahead position.

Oil must be added when the engine is operating at idle until the oil appears under the input filter mesh.

The adding must be done so as to exclude [the possibility of] any dirt or dust getting in [the system] along with the oil. It is recommended

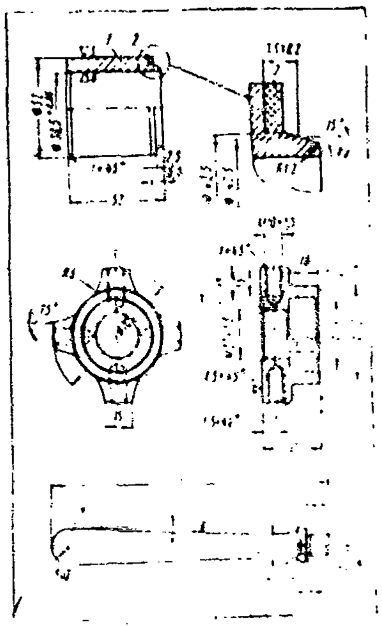


Figure 14-12: A device for changing the Pitman arm shaft oil seal on the ZIL-130 (ZIL-131)

that oil be added through a clean funnel with a double mesh and through the input filter which is installed in the power steering pump reservoir 1 (see Figure 14-15). The level of the oil must coincide with that of the input filter.

Before removing the reservoir cover to check the level of the oil or to add oil, the cover must be carefully cleaned of dirt and washed with gasoline.

When Type "R" oil is used, a seasonal oil change is not necessary. When alternate oils are used, the oil must be changed twice yearly (spring and fall).

When completely changing the oil in the power steering system, it is necessary to raise the front wheels of the vehicle on a jack, turn the steering wheel all the way to the left, open the power steering pump reservoir cover, uncover the drail hole, having unscrewed the plug 2, and drain the oil.

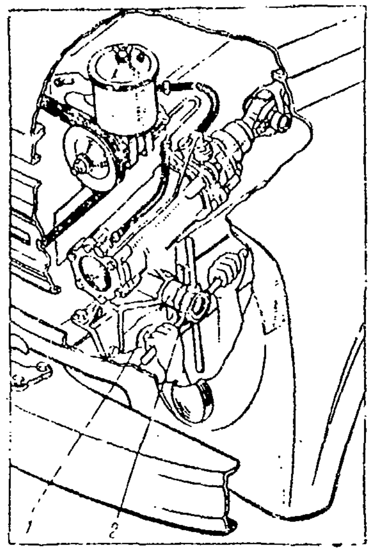


Figure 14-13: The method of changing the Pitman arm shaft without removing the steering mechanism from the vehicle

1 -- sleeve; 2 -- nut with handle

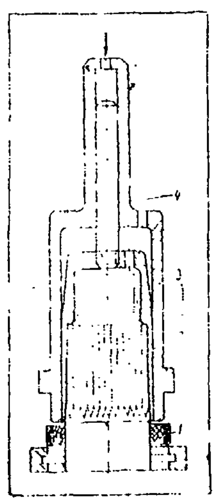


Figure 14-14: A mandril for pressing in the arm shaft oil seal

1 -- oil seal; 2 -- arm shaft; 3 -- protective mandril; 4 -- mandril for pressing in the oil seal

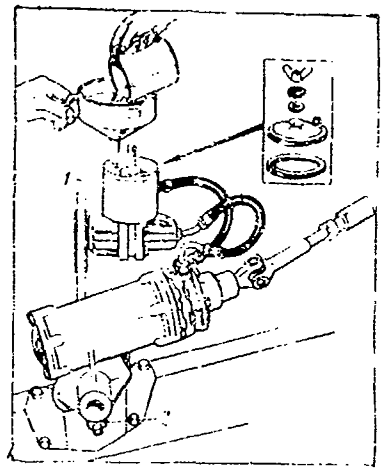


Figure 14-15: Changing the oil in the power steering system

After draining the oil, it is necessary to flush the power steering system, for which it is necessary to: remove all dirty oil from the pump reservoir and wipe out the reservoir; wash the washer, the pump cover rubber sealing ring and the drain plug 2, having cleaned the dirty oil off of them; remove and clean the pump filter meshes and install them; add 1 liter of fresh oil to the reservoir through a funnel with a double mesh, and wait until the oil flows out of the drain opening of the power steering housing, turning the steering wheel here from one extreme position to the other.

Fresh oil must be added to the power steering system in the following order:

Screw the plug with its sealing washer into the drain opening of the housing. With the steering wheel turned to the extreme left position, add fresh oil into the pump reservoir until the oil appears above the mesh of the intake filter; turn the steering wheel from one extreme position to the other and add oil until at least 2.5 liters of oil have been added to the system. Then add still more oil and while the engine is running at idle, turn the steering wheel from one extreme position to the other, holding the steering wheel briefly in these positions for two to three seconds with a force of approximately 10 Kg and adding as much oil as possible.

The addition of oil to the power steering system is considered finished when the output of air bubbles from the oil in the reservoir ceases.

Here the level of oil must be up to the mark on the reservoir or until the oil appears above the mesh of the input filter.

Install the reservoir cover with the sealing gasket, the rubber sealing ring and nut, and secure it with the nut.

Tighten the nut by hand only. In the event that oil leaks out from under the cover, replace the cover gasket. Lower the wheels of the vehicle.

Adjusting the steering control drive. The joints of the trailing link should be extended as far as possible and then backed off to the first possible position for inserting the lockpins by approximately 1/4 turn and the lockpins should be inserted.

The tie rod joints do not require adjustment.

The steering control joints are lubricated in accordance with the lubrication chart. Prior to lubricating the steering control and the turn journal kingpin it is necessary to clean the lubrication points of dirt and mud. Lubrication is through the grease fittings until clean lubricant appears.

Disassembly and Assembly

Steering Control Without Power Steering

Removal of the steering mechanism from the vehicle is accomplished in the following sequence: disconnect the horn wire from the current source and remove the horn button assembly. In order to remove the button, press lightly upon it with your palm, turn it to the left, remove the button, remove the contact dish, the spring cap, the contact cap; remove the three contact plate attachment screws and remove the plate together with the horn wire. With an offset box wrench unscrew the steering wheel attachment nut and remove the steering wheel from the shaft by means of a 20P-7972 extractor (Figure 14-16).

Having removed the steering wheel, remove the key from the shaft slot and remove the spacer spring. Unscrew the Pitman arm attachment nut and by means of a model 2496 extractor (Figure 14-17) remove the Pitman arm from the splines of the shaft (Figure 14-18), tapping lightly with a hammer about the arm. Unscrew the bolts which attach the steering column to the bracket in the cabin and the bolts which attach the steering mechanism housing to the frame bracket. Remove the upper half of the bracket. Unscrew the bolt which attaches the steering column to the plate and remove the plate. Remove the steering mechanism together with the steering wheel shaft as a unit.

It is recommended that the steering mechanism be disassembled on a stand (Figure 14-19). Clean the housing of dirt and pour out the oil.

Removing the Pitman arm shaft. Loosen the bolt which attaches the lower cover *2* (see Figure 14-1) and pour out the oil. Unscrew the two attachment bolts of the stopper *24* of adjusting nut *23*, and remove the stopper. Undo with a wrench adjusting nut *23* and remove thrust washer *27*, adjusting gasket *28*, and rubber sealing ring *29*. With a socket wrench undo the bolts which secure the housing cover *22* and remove the cover from the gasket.

Extract from the housing the Pitman arm shaft *26* together with the roller *25* as a unit, tapping lightly with a hammer against a brass mandril which is set against the end of the shaft. The Pitman arm shaft roller is subject to being dismantled in those cases when it is damaged or greatly worn. During disassembly it is necessary to cut away the roller shaft weld and to remove the roller and shaft.

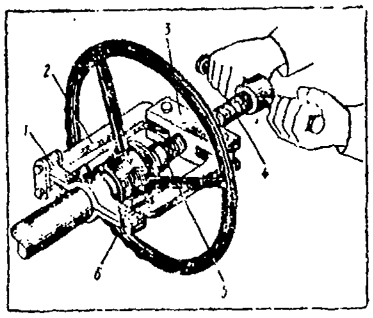


Figure 14-16: Removal of the steering wheel

1 -- clamp; 2 -- arm; 3 -- cross piece;
4 -- screw; 5 -- end piece; 6 -- clip ring

Removal of the steering shaft and disassembly of the steering column. Unscrew the bolts securing the lower cover *2*, remove the cover and the adjusting gasket *3*. Press out the steering wheel shaft *8* by means of a wooden hammer together with the worm gear *5* and the exterior ring of the lower bearing, tapping lightly with a hammer on the face of the shaft (it is not recommended that the

Figure 14-17: Model 2496 extractor

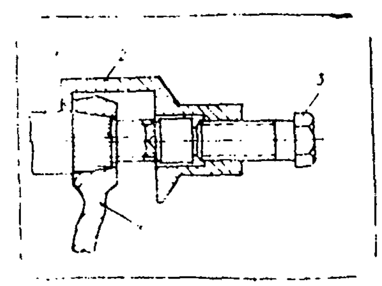


Figure 14-18: Removal of the Pitman arm from the shaft with a model 2496 extractor

1 -- Pitman arm shaft: 2 -- extractor housing; 3 -- screw; 4 -- Pitman arm

worm gear be removed from the steering wheel shaft). Remove the roller bearings *6* from the worm gear. It is recommended that the external ring of the upper worm gear bearing be removed only if necessary.

In order to remove the external upper bearing ring when it is damaged, it is necessary to insert a long mandril into the steering column shaft and extract the ring. If there is significant wear, press the bushings out of the cover and the steering mechanism housing. While pressing the bushings out, simultaneously press out the Pitman arm shaft oil seal.

A bend in the steering column tube may be eliminated by straightening the tube.

Not more than 0.1 mm of eccentricity in the face of the housing at the lower cover is permitted. The face at the side cover may not be other than flat by more than 0.08 mm.

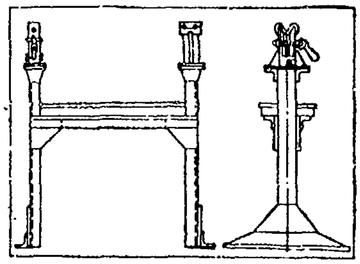


Figure 14-19: A stand for dismantling and assembling the steering mechanism

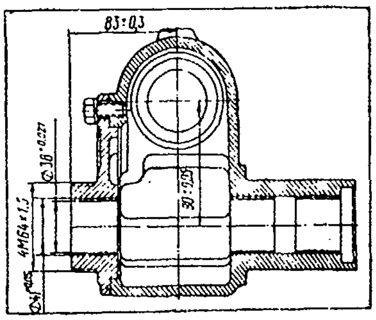


Figure 14-20: The housing of the steering mechanism assembled with cover and bushings, ZIL-157K

If the horn wire tube which is installed in the steering mechanism outer cover is bent, the tube must either be straightened or replaced, but if the rolling of the tube is damaged, it must either be re-rolled or welded.

Step-by-step work on the spiral and the conical surfaces of the worm gear is not permitted. The steering wheel shaft is an integral unit with the worm gear; therefore if the shaft or the worm gear ceases to function, the entire unit must be replaced as a whole.

Wear on a piece of the Pitman arm shaft roller is permissible if it does not exceed 8 mm in thickness, measured at a height ot 2.775 mm. If there is a lot of wear, replace the Pitman arm shaft roller or the Pitman arm shaft with the roller as a unit.

The clearance between the roller and the washer must be not greater than 0.04 mm. If the gap is greater than that, replace the washer. The radial play of the roller must not exceed 0.15 mm.

Assembly and adjustment of the steering mechanism. The parts of the steering control mechanism which are ready for assembly must be clean.

Before assembling the steering control mechanism it is necessary to press the Pitman arm shaft bushings into the housing and the cover of the steering mechanism housing (the tightness is 0.021-0.087 mm) and to ream out the internal diameter of the bushings to the diameter of the Pitman arm shaft with a clearance of 0.025-0.077 mm.

All three bushings must be reamed in a line. Here the cover must be secured by the bolts to the steering mechanism housing (Figure 14-20). After reaming out the bushings, press the Pitman arm shaft oil seal into the housing.

In those cases where the roller unit has been dismantled it is necessary to insert the roller into the eye of the Pitman arm shaft, insert the shaft, and weld the shaft to the arm shaft.

Check the radial and axial clearances of the roller. If the roller has a radial clearance of more than 0.15 mm, the needle bearing should be replaced. If the axial clearance between the roller and the thrust washer is greater than 0.04 mm, the washer should be replaced. The overall assembly of the steering mechanism is accomplished in the following sequence: install the upper exterior roller bearing *6* ring (see Figure 14-1) with a fit varying from a tightness of 0.000 mm to a clearance of 0.093 mm into the housing of the steering mechanism together with the steering column tube as a unit.

Lubricate the upper ball bearing with grease and insert it together with the oil seal as a unit into the steering column tube (the fit of the bearing is to be loose).

Install the upper roller bearing on the steering wheel shaft, having lubricated the bearing with a lubricant grease. Install the worm gear together with the shaft as a unit in the steering mechanism housing. Place the bearing spacer ring on the steering wheel shaft, insert the key in the shaft slot, and mount the steering wheel, having secured the steering wheel temporarily with a nut to turn the shaft during the assembly and adjustment of the steering mechanism.

Install the lower roller bearing on the worm gear cone and insert the exterior ring of the bearing into the housing (the fit should be from a tightness of 0.000 mm to a clearance of 0.093 mm). Install the lower cover *2*, and, pressing against the cover with your hand, measure the clearance *M* (see Figure 14-9B) between the face of the cover and the housing. Select a packet of thick and thin gaskets equal in thickness to this clearance. Install the gasket packet on the lower cover and secure the lower cover to the spring washers with the bolts. When tightening the bolts, slightly turn the shaft by the steering wheel.

Check the correctness of the tightness of the roller bearings of the worm gear by means of a dynamometer. The tightness of the bearings is considered normal if the force required to turn the worm gear, as applied at a radius equal to that of the steering wheel (240 mm), is equal to 0.3-0.8 Kg. Adjustment of the bearing tightness is accomplished by changing the number of adjusting gaskets *3* (see Figure 14-1) at the lower cover *2*. If the force is less than that which is permitted, the extra gaskets should be removed (preferably the thicker ones); if the force is greater than that which is permissible, add gaskets.

Install the Pitman arm shaft together with the roller as a unit in the housing so that the roller *25* is in the middle position relative to the worm gear *5*. Place the cover *22* on the Pitman arm shaft and secure the cover to the gasket with bolts, having placed spring washers under the heads of the bolts.

Insert the thrust washer *27* into the circular slot of the Pitman arm shaft and compress the arm shaft with your hand so that the roller comes into contact with the worm gear. In this position, measure the clearance *H* (see Figure 14-9C) between the faces of the side cover and the thrust washer in several places around the circumference. Then remove the thrust washer, place the set of adjusting gaskets, which is equal in thickness to the measured clearance *H*, onto the Pitman arm shaft and again insert the thrust washer *27* (see Figure 14-1) into the arm shaft slot. There should be no less than six thin gaskets (3 each gaskets 0.05 mm and 0.1 mm in thickness) in the set, and the remaining gaskets should be thick gaskets. Install the rubber sealing ring *29* on the cover *22* and tighten the adjusting nut *23*, turning it with a wrench until it will turn no more.

Check the correctness of the assembly and adjustment of the roller-worm gear engagement. Between the roller and the worm gear there should be a clearance of not more than 0.05 mm, which will correspond to the movement of the lower end of the Pitman arm, which is mounted on the shaft, by not greater than 0.2 mm when the Pitman arm moves. Here the force necessary to turn the worm gear, as applied at a radius equal to that of the steering wheel (240 mm), must be within the limits of 1.5-2.5 Kg. If the force is less than the indicated magnitudes and the movement at the lower end of the arm is greather than 0.2 mm, then the nut *23* should be unscrewed, thrust washer *27* removed from the shaft slot, and the thickness of the adjusting gasket set *28* should be reduced by 0.05 mm. If the force is greater than that which is permissible, but the movement of the Pitman arm is less than 0.2 mm, the thickness of the adjusting gasket set should be increased by 0.05 mm. Thus one may obtain precise adjustment. Before checking, it is necessary to lubricate the worm gear and the roller with a liquid oil through the service opening. Having finished the adjustment, one must install the stop *24* and secure it with the bolts. In the same manner one must insert a lockpin in the adjusting nut *23*.

Install the Pitman arm on the shaft and check the extreme position of the Pitman arm relative to the middle position of the worm gear. The Pitman arm turn angle in either direction to the point where it stops should not be less than 42°. When installing the Pitman arm, the marks which are located at the end of the shaft and on the Pitman arm must be aligned. Having removed the housing plug *11*, pour 1 liter of oil (for gearboxes) into the steering mechanism housing.

Installation of the steering mechanism on the vehicle. Install the steering mechanism, secure it both to the frame and inside the cabin of the vehicle, and close the steering column plate.

Install the parts of the horn button in the steering column seat and secure them. Connect the horn wire to the electrical system.

Install the Pitman arm and secure it. Connect the trailing link with the arm.

Steering Control With Power Steering

Removing the steering mechanism from the vehicle. Undo the nut which secures the Pitman arm and remove the arm from the shaft with a model 2496 extractor (see Figure 14-17). By removing the arm without an extractor it is possible to put the steering mechanism or its parts out of order.

Disconnect the turn signal and horn switch lines. Unscrew the plug *32* (see Figure 14-4), drain the oil from the steering control system, turning the steering two to three times from one extreme position to the other. In order to completely drain the oil from the system, disconnect the hoses and drain the oil remaining in the pump.

Remove the nuts of the keys *8* (see Figure 14-2) and knock out the keys with a mandril made of soft metal. Remove the steering control universal-joint shaft. Undo the bolts which secure the steering mechanism to the frame and remove the steering mechanism as a unit. For ease in lifting, one may use a KZ-0352 device (see Figure 14-21). Turn the steering mechanism until its connecting pipes point down and drain the remaining oil from the slide valve housing. Here one should turn the steering mechanism screw from one extreme position to the other.

Loosen the nut which secures the power steering pump to the engine cylinder head, remove the drive belt from the pulley, loosen the nut, and remove the pump. Undo the bolts which fasten the steering column to the inclined floor and to the forward wall of the cabin, and remove the column together with the steering wheel as a unit.

Disassembly of the steering mechanism should be accomplished only in a case of clear necessity. Only a qualified mechanic must perform this operation under completely clean conditions. Before the disassembly it is necessary to clean the exterior surface of oil and dirt. Small parts should be placed in a box divided into separate sections. The following sequence for dismantling the steering mechanism is recommended:

Clamp the steering mechanism in a vise. Place the steering mechanism screw in the middle position. Unscrew the bolts which secure the side cover *25* (see Figure 14-4) and remove the cover together with the Pitman arm shaft *31*, being careful here not to damage the oil seal with the splined end of the shaft. Remove the sealing ring *26*. Unscrew the lock nut of the adjusting screw *30*. Extract the adjusting screw from the cover and remove the cover from the Pitman arm shaft.

In order to extract the adjusting screw, it is necessary to extract the stop ring *28* and the adjusting screw along with the thrust washer *27*

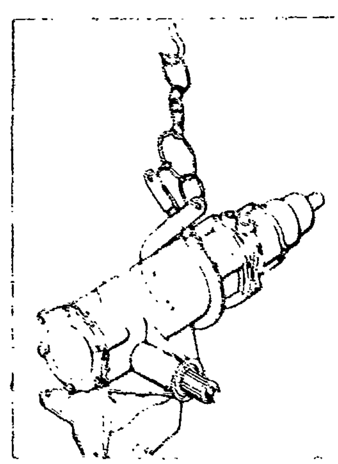


Figure 14-21: Removing the steering mechanism from the vehicle with the help of a KZ-0352 device

by means of circular pliers. When necessary, i.e., when it is worn, press the bronze bushing *33* out of the cover seat.

Unscrew the upper cover attachment bolts *20*; remove the cover together with the needle bearing *21* and the oil seal *38* as a unit. Remove the sealing ring. If necessary, press the oil seal *38* out of the seat, having removed the stop ring. Remove the needle bearing *21*.

Unlock the nut *19*, unscrew it, and remove the spring washer *18* and the thrust bearing *13*. Remove the bolts which secure the steering valve housing *17* and remove the housing from the screw *7*.

Remove the second thrust bearing *13* and extract the sealing ring *14* from the intermediate cover *12* slot.

The steering valve housing parts are individually selected at the plant; therefore during the disassembly one must not destroy the manner in which they fit together.

Remove the twelve reaction pistons *40*, the six reaction springs *39* from the valve housing seat (from both sides), and remove the housing of the slide valve *16*. If necessary, unscrew the coupling for the oil supply line *23* and the elbow *24*, through which oil is removed, from the housing. Also remove the return valve *15* from its seat.

Unscrew the intermediate cover *12* attachment bolts.

Remove the screw *7* together with the intermediate cover and the piston-rod as a unit from the cylinder, while protecting the piston rings *11* from being damaged, and remove the sealing ring *26*.

If necessary, remove the lower cover *1*, having unscrewed the attachment bolts, and removed the sealing ring *2*. Press out the oil seal *34*, together with the thrust ring *35* and the seal, and if necessary the bushing *33*, having preliminarily extracted the lock ring *36*.

For disassembly, clamp the piston-rod together with the screw as a unit in a mechanic's vise with soft jaws (Figure 14-22). Eliminate the center-punch marks from the set screws which secure the piston-rod to the ball nut. Remove the set screws. Remove the steering mechanism screw from the piston chamber together with the ball nut as a unit. Remove the ball nut from the screw, having taken out the channels and unscrewing the nut from the screw and simultaneously taking the balls out of the screw channel. The ball nut and screw assembly is individually selected; therefore it should only be disassembled in the case of extreme necessity. Remove the intermediate cover from the steering control screw. If necessary, remove the sealing rings from the screw and the piston rings from the piston-rod.

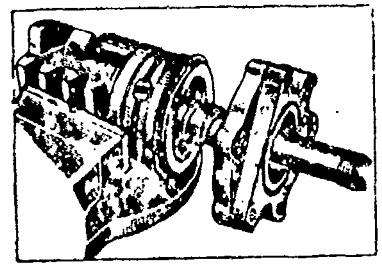


Figure 14-22: Clamping the piston-rod in a vise for dismantling

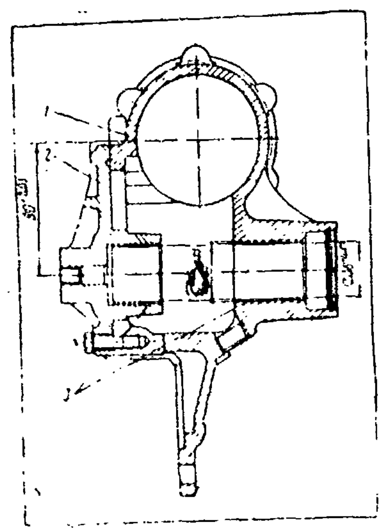


Figure 14-23: Steering mechanism housing together with the side cover, ZIL-130

1 -- housing; 2 -- cover; 3 -- bushings

Examine and check the steering mechanism parts. Cracks or nicks of any sort on the steering mechanism parts are not permitted. Not more than two threads of the screw may be damaged against the housing or the body of the control valve.

When the sliding surfaces of the steering mechanism parts are worn by more than the permissible amounts, the worn parts are to be replaced.

Twisting and bending of the Pitman arm shaft is not permitted.

If there are nicks or damages to the teeth of the Pitman arm shaft sector and the piston-rod, the indicated parts should be replaced.

Play of not more than 0.06 mm is permitted in the surfaces of the piston-rod openings at the ball nut and the steering control screw, but not more than 0.03 mm of play is permitted in the lower face of the ball nut. Not more than 0.02 mm of play is permitted in the screw surface of the steering control screw and not more than 0.03 mm of play in the surface of the screw at the point where it touches the slide valve is permitted.

The housing, slide valve, and piston of the control valve are individually selected at the plant. When one of these parts breaks down, the valve must be replaced as a unit. Residual deformation of the valve spring is not permitted. Non-perpendicularity of the faces of the spring relative to the axis of the spring greater than 0.03 mm is not permitted.

Non-perpendicularity of the faces of the valve piston relative to the surface of the external diameter greater than 0.05 mm is not permitted.

Assembly and adjustment of the steering mechanism. Assembly of the steering mechanism must be done under conditions of special cleanliness. Prior to assembly, all parts must carefully washed and dried. The parts of the steering mechanism should be wiped with a rag, leaving no threads or fibers which could contaminate the oil channels when the mechanism is operating. During assembly the parts should be lubricated with power steering oil. All rubber sealing parts must be examined and replaced with new parts if necessary.

If the Pitman arm shaft bushings *33* (see Figure 14-4) were pressed out, they must again be pressed into the housing *4* and the side cover *25* (tightness is 0.075-0.175 mm). After being pressed in, both bushings are to be reamed out in a line (Figure 14-23) for which the side cover *25* (see Figure 14-4) should be installed and secured on the housing. The clearance between the bushing and the Pitman arm shaft should be 0.025-0.077 mm.

If the sealing rings were removed from the screw *7*, place the rings on the screw. Place the intermediate cover *12* and the ball nut *5* on the shaft.

Place the ball nut on the lower end of the shaft. Align one of the openings of the nut, in which the ball nut channel *9* is installed, with the contour channel of the screw *7* for the balls *10*. Insert 23 balls *10* into the opening of the ball nut *8*, turning the screw to the left. The balls may be inserted manually (Figure 14-24A) or by means of a special device (Figure 14-24B). The remaining 8 balls are to be inserted in the channel *9* (see Figure 14-4) and the channel outlets are

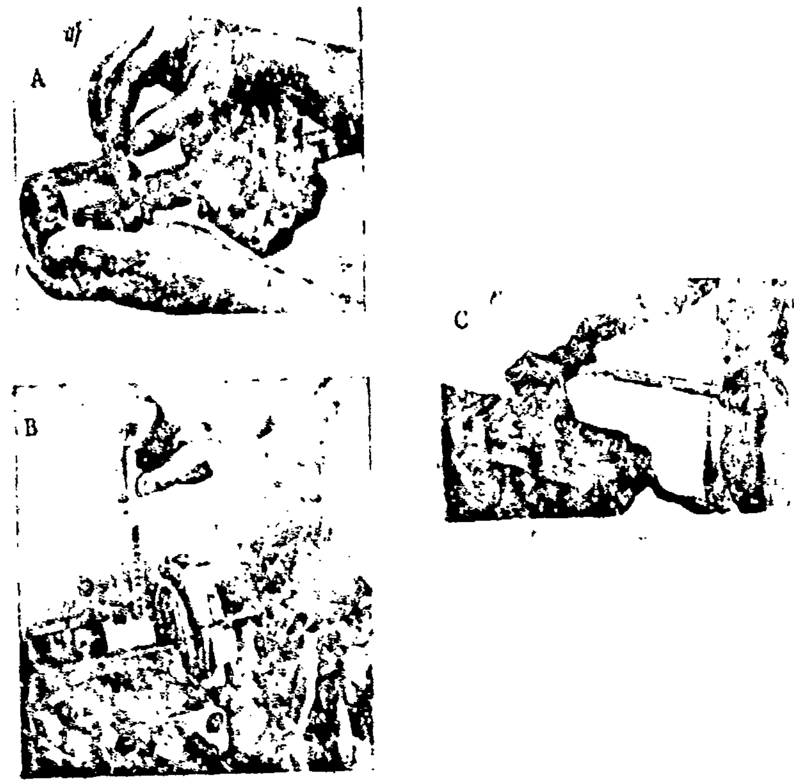


Figure 14-24: Installation of the balls in the screw shaft of the ball nut and steering screw

A -- manually; B -- by using a device;
C -- checking the turning of the ball nut on the steering screw

to be lubricated with lubricant grease UN (technical petroleum jelly) to prevent the balls from falling out. Install the channel with the balls in the nut 8, turning the screw 7 if necessary. It is necessary to place a metal spring ring on the nut so that the channel and balls will not fall out of the nut, and it is necessary to check the turning moment of the nut at the middle section of the steering screw by means of a dynamometer. For this the end of the steering screw should be clamped in a vise with jaws made of soft metal, a thin metal string wound on the ball nut, a dynamometer attached to the end of the string, and the turning moment of the nut measured.

With correctly selected balls *10*, the turning moment of the nut *8* should be 3-8 Kg·cm in the middle section of the screw, which will correspond to a force on the dynamometer of 0.93-2.50 Kg. At the end portions of the screw *7* the nut *8* should turn freely, without any force (a loose fit).

In the event that the ball nut *8* either fits too tightly or turns too easily on the screw *7*, it is necessary to exchange the balls *10* for balls of another specific diameter. The plant sorts balls *10* into 14 groups at intervals of 2 microns according to their diameter.

Select a piston-rod *5* for the cylinder of the housing *4*, having checked the clearance between the cylinder wall and the piston-rod. The clearance should be 0.04-0.11 mm. Remove the piston-rod from the cylinder. Install it on the ball nut *8*, having aligned the screw opening of the piston with the seat of the nut. Screw in the set screws *42* and secure the piston-rod with the set screws. The tightening moment of the set screws is 2.75-3.50 Kg·m. Punch each screw *42* in two places opposite the grooves in the piston-rod *5*. In the event that the piston-rod groove ligns up with the set screw slot, replace the screw. After punching the screw it is necessary to clean up the superfluously protruding metal projections so as to prevent the cylinder of the housing *4* from being gouged.

Select the piston rings *11* according to the cylinder or by caliber. The clearance in the ring gaps must be 0.15-0.40 mm. Place the rings on the piston-rod manually or with a device. Place the gaps in the rings *11* around the piston grooves at angles of 90°. The piston rings must move freely in the piston-rod grooves. The clearance in the piston groove in terms of the height of the ring is 0.025-0.105 mm.

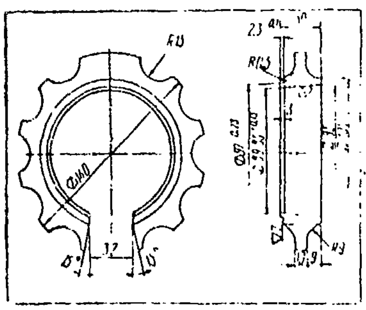


Figure 14-25: A model 2493 device for compressing piston rings when installing a piston-rod in the cylinder of the housing

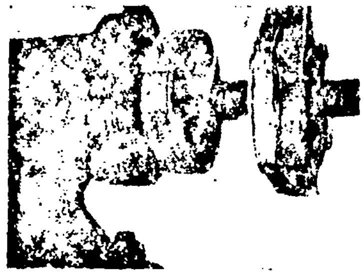


Figure 14-26: Installation of the piston-rod in the steering mechanism housing cylinder

Install the model 2493 (Figure 14-24, 14-26) device on the piston-rod and, having compressed the piston rings, insert the piston-rod into the cylinder of the housing up to its middle position.

The ring gaps must not be positioned opposite the side cover opening.

Remove the device, turn the screw *7* (see Figure 14-4) out of the out of the piston-rod by two turns and install the intermediate cover *12* on the housing. Secure the cover with one bolt.

In the event that the control valve was dismantled, it is necessary that the slide valve *16* and the reaction pistons *40* in the housing *17* of the valve move freely, without catching or binding.

The pistons must be installed bevel side out. The interior recess of the slide valve must be turned back, in the direction of the rear thrust bearing. The return valve *15* must move freely in its seat. The connection *23* for supplying oil and the elbow *24* for removing oil must have correctly operating threading.

Install the front thrust bearing *13* on the screw *7*, insert the sealing rings *14* and *26* into the slots of the intermediate cover *12*. Install the housing *17* of the control valve as a unit on the screw *7*, install the rear thrust bearing and the spring washer, having placed the washer concave side toward the bearing, and place the projection of the washer into the screw slot. Screw down the screw *7* so that the housing *17* of the control valve is aligned with the intermediate cover *12* at its end surface and centering hole. Partially tighten the adjusting nut *19*. This operation provides for centering the housing of the control valve relative to the steering mechanism screw *7*. After preliminarily centering the screw *7*, it is necessary to turn the screw back by one to one and a half turns and remove at this point the valve housing from the intermediate cover *12*. Tighten the adjusting nut *19*, keeping the screw *7* from turning [by holding] the exposed part with a wrench. Check the turning moment of the control valve housing *17* with a dynamometer (Figure 14-27).

Figure 14-27: Checking the tightness of the thrust bearings of the steering mechanism screw

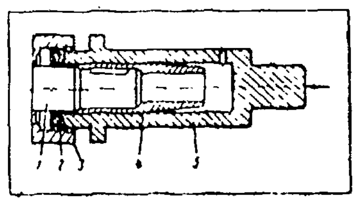


Figure 14-28: A means of pressing in the oil seal of the upper steering mechanism cover

1 -- steering mechanism screw; 2 -- oil seal; 3 -- cover; 4 -- protective mandril; 5 -- mandril for pressing in the oil seal

The turning mome:t necessary to turn the control valve housing relative to the steering control screw must be 6.0-8.5 Kg·cm, which will correspond to a force of 1.07-1.51 Kg. Having completed the adjustment of tightening the bearings, lock the adjusting nut *19* (see Figure 14-4) by pressing its edge into the slot of the steering control screw. Move the intermediate cover *12* alor- the screw *7* to the point where it lies along and is centered on the valve control housing, paying attention to the correct positioning of the rubber sealing rings and the metal sealing ring. Turning the screw, move the aligned intermediate cover and valve housing until they are adjacent to the end of the steering mechanism cylinder housing, paying attention to the correct positioning of the two rubber sealing rings. Screw in and tighten the valve housing and intermediate cover bolts, having placed spring washers under the heads of the bolts (the moment is 3.5-4.2 Kg·m).

Press the needle bearing *21* into the upper cover *20* seat. The seating of the bearing must be accomplished with a clearance of 0.006 mm to a tight fit of 0.017 mm. The rollers of the impressed bearing must turn freely. Press the oil seal *38* into the cover *20*. To prevent the oil seal from being damaged, place the protective mandril *4* (Figure 14-28) on the end of the screw *7*. Install the oil seal on the mandril and, having moved it to the housing of the cover *3*, press the seal into the seat of the cover with the mandril *5*. Place the thrust ring *22* (see Figure 14-4), the rubber seal, and the clamping ring into the seat, and secure this assembly with the stop ring, having installed it in the circular slot of the cover.

Insert the sealing ring in the circular slot of the split surface and install the cover *20* together with the oil seal as a unit on the screw *7*. Secure the cover with the bolts, having placed spring washers under the heads of the bolts. The tightening moment of the bolts is 2.1-2.8 Kg·m. Check the turning of the turning mechanism screw. After the screw is turned by more than two turns to either side from the middle position of the screw should be equal to 15-25 Kg·cm.

Insert the sealing ring *2* into the circular slot of the lower cover *1*, having installed the cover on the end split surface of the steering mechanism housing cylinder. Screw in the bolts with the spring washers, having placed the auxiliary hose bracket under the two bolts, and secure the cover and the bracket with the bolts. The tightening moment of the bolts should be 3.5-4.2 Kg·m.

Insert the lower thrust washer *27*, the adjusting screw *30*, and the upper thrust washer into the seat of the Pitman arm shaft *31*, and secure the assembly with the stop ring *28*, having inserted the stop ring in the circular slot of the shaft. The axial movement of the adjusting screw relative to the arm shaft (the clearance between thrust washers) must bet within the limits of 0.02-0.08 mm. The clearance is regulated by the selection of thrust washers.

Disconnect the side cover *25* from the housing and connect the arm shaft with the cover, having screwed the adjusting screw *30* into the threaded opening of the cover. Here the arm shaft must turn freely by hand in the cover bushing, but the adjusting screw must be immobile. Screw the lock nut, which must be tightened after adjusting the tooth engagement of the sector and of the piston-rod, onto the adjusting screw. Place the steering mechanism screw *7* in the neutral position, turning it by the exposed part with a wrench. For this the steering control screw should initially be turned to the extreme forward position, and then turned [back] by 2.5 turns (the full travel of the screw is five turns).

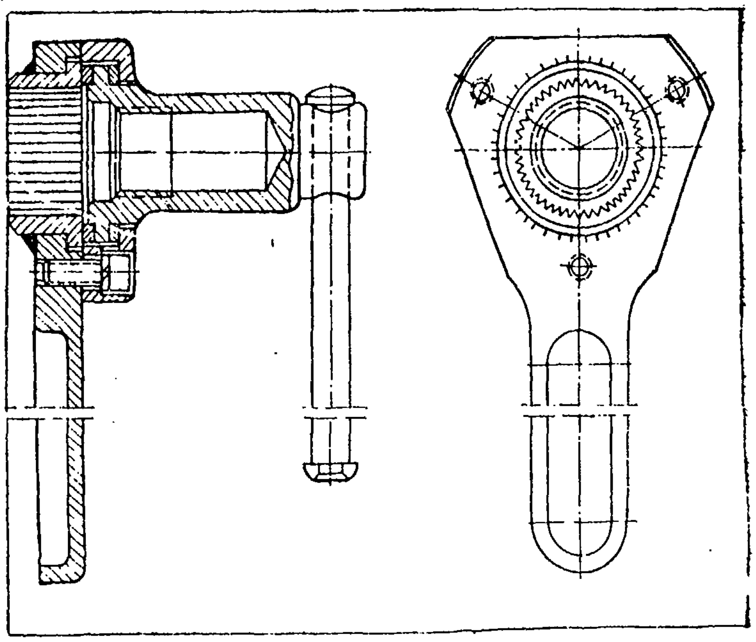


Figure 14-29: A lever-type wrench for turning the Pitman arm shaft during the adjustment and assembly of the steering mechanism

Install the Pitman arm shaft *31* in the housing, guiding its splined end through the bushing. Here the teeth of the shaft sector must engage the teeth of the piston-rod *5* so that the middle tooth of the sector is located in the second recess from the forward end of the piston-rod.

Check to see that there is a sealing ring on the side cover *25* and secure the cover with the bolts, having placed spring washers under the bolt heads. The tightening moment of the bolts should be 3.5-4.2 Kg·m.

Press the Pitman arm shaft oil seal *34* into its seat. When installing the oil seal, it is necessary to place the protective mandril *3* on the shaft of the Pitman arm (see Figure 14-4) and, having moved the oil seal *1* along the mandril to the oil seal seat, press in the oil seal with the mandril *4*. Remove the mandrils from the shaft. Place the internal thrust ring *35* (see Figure 14-4) and the external thrust ring on the oil seal, and secure this assembly with the lock ring *36*, having placed the lock ring in the circular slot.

Check the turn angle of the Pitman arm shaft with the help of the lever-type wrench (Figure 14-29) which is affixed to the splined end of the shaft. The full turn angle must not be less than 90°. The Pitman arm shaft *31* (see Figure 14-4) must turn freely, without binding, from one extreme position to the other when a moment of not greater than 10 Kg·m is applied to the shaft. Check the assembly of the mechanism, turning the steering mechanism screw *7*. When turning the screw as it passes through the middle position with an assured clearance (without rubbing) where the teeth engage, the turning moment of the screw should be 20-40 Kg·cm.

Adjustment the engagement of the sector and the piston-rod *5*. For this it is necessary to move the Pitman arm shaft *31* in an axial direction by means of the adjusting screw *30*, which must be turned with a screwdriver so that the clearance in the sector where the teeth engage is within the limits of one-half turn of the steering mechanism screw *7* (a turn in both directions). Having completed the adjustment of the engagement of the teeth, secure the adjusting screw *30* with the lock nut (the tightening moment is 4.0-4.5 Kg·m).

The quality of the assembly and the adjustment of the steering mechanism must be checked by turning the steering mechanism screw *7*.

After adjusting the clearance in the sector where the teeth engage when [the screw] passes through the middle position, the turning moment of the screw must be 10-15 Kg·cm greater than when checking with an assured clearance in the sector where the teeth engage, but must not be greater than 50 Kg·cm.

When the screw *7* is turned until it stops in both directions, the centering reaction springs *39* must provide for an accurate return of the screw. Here the axial movement of the screw must be 0.9-1.1 mm in each direction.

The assembled and adjusted steering mechanism must be tested to see if it is hermetically sealed in the two extreme positions of the piston-rod at an oil pressure of 80 Kg/cm^2 over the course of not less than 5 minutes. During testing the same oil with which the same oil works should be used. The temperature of the oil should be 40-50°C. A tube-type radiator which is intended to cool the oil in the steering control power steering system is installed on the ZIL-131.

The radiator is installed over the radiator of the engine lubricating system. The oil from the steering mechanism is supplied through rubber hoses from the steering mechanism to the radiator and from the radiator to the power steering pump.

In the event that it is not working properly, the power steering radiator must be removed and washed with a degreasing solution and hot water. An observed leak should be eliminated by soldering the tubes with soft solder. Insignificant damages to the radiator housing should be eliminated by welding and subsequent cleaning.

It is recommended that the hermetical seal of the radiator be checked with air supplied under a pressure of 15 Kg/cm^2 in a water bath. Incorrectly operating rubber hoses should be replaced with new hoses.

Dismantling the steering control articulated shaft. Secure the articulated shaft in a mechanic's vise, remove the fork *1* (see Figure 14-5) from the circular slot, remove the stop rings *3* by means of circular pliers, move the cross *9* to one side of the fork, remove the cover *4* of the bushings with the sealing rings *5*, press out the bushings *6* and disconnect the fork *1* from the cross *9*. The same operations must be done when disconnecting the splined fork *11* from the cross *9*. In order to dismantle the universal joint which connects the steering shaft, it is necessary to carry out the same operations which were done to dismantle the universal joint connecting the steering mechanism screw. In order to dismantle the splined connection, unscrew the nut *15* and remove the splined fork *11* from the slotted bushing *16*. Remove the oil seal, which consists of a felt ring *14*, a rubber ring *13*, and two split washers, from the splined fork.

If the splined connection and the parts of the articulated shaft are worn more than is permissible without repair, they should be replaced.

Cracks and nicks of any sort on the parts of the articulated shaft are not permissible.

No twisting of the splined rod of the articulated shaft is permissible. If the splined fork is bent or the tines of the fork are bent, it is recommended that they be straightened in a press.

If the openings in the fork at the cross bushings are worn and if the bushings are worn by more than is permissible without repair, the bushings should be replaced.

Assembling the articulated shaft of the steering control. The parts intended to be assembled must be clean and checked.

In order to assemble the universal joint the splined fork *11* (see Figure 14-5) must be clamped in a vise. Press one bushing *6* partially into the opening of the splined fork. Place the sealing rings *7* with the retainers *8* on the two arms of the cross *9*. Insert one arm of the cross into the bushing, having directed the other arm into the opposite opening of the splined fork. Press in the second bushing *6* and finish pressing in the first bushing (the fit should be from a clearance of 0.015 mm to a tightness of 0.025 mm). Then install the bushing covers *4* and secure the covers with the stop rings *3*. The grease fitting *10* should be screwed into one of the covers.

When assembling the articulated shaft, be sure that the openings in the fork for the securing keys are located in parallel planes, and that the axes of the openings of both forks at the bushings lie in the same plane.

The other two arms of the cross must be connected with the fork in the very same manner. When assembling the universal joint the crosses are to be lubricated with gearbox oil.

To assemble the other universal joing, carry out the same operations which were done during the assembly of the first universal joint.

To assemble the splined connection, place the nut *15*, the split washer *12*, the rubber oil seal *13* ring and the felt ring *14* on the splined fork *11*. Insert the splined fork into the slotted bushing *16* and, having tightened the clamping nut, secure the seal as a unit. During the assembly lubricate the splined connection with lubricant grease in accordance with the lubrication chart.

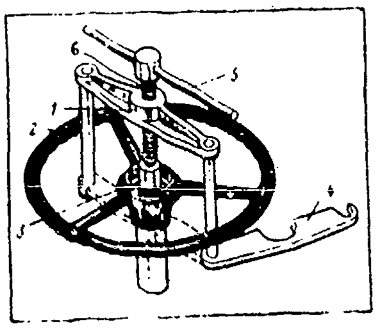


Figure 14-30: Removing the steering wheel with a model 2495 extractor

1 -- cross piece; 2 -- arm; 3 -- end piece; 4 -- clamp; 5 -- handle; 6 -- screw

Figure 14-31: Removing the stop ring from the steering shaft

The installation of the articulated shaft is to be done in such a manner that the fork with the slotted bushing faces the steering wheel.

Dismantling the steering column. The steering column should be dismantled on a mechanic's bench. In order to remove the horn signal button *24* (see Figure 14-6), press on the button with your hand, and, having turned it to the left, remove the clamps from under the holder and remove the hub of the steering wheel *20* from its seat. Remove the contact cap *25* and the spring *26* along with the retainer *27*. Unscrew the screws *28* and remove the contact insulating bushing. Unscrew the screws *29*, remove the contact plate *30* and the spring along with the retainer.

In order to remove the horn button current pick-up unit, unscrew the screws *8*, remove the cover *9*, and the current pick-up assembly together with the insulator *12*, the clamping plate *11* and the contact *13* as a unit, keeping it from falling apart.

In order to remove the turn signal switch *21*, unscrew the bolt *23*, open the bracket *22*, and remove the switch from the column together with the bracket. The steering wheel is removed with a model 2495 extractor (Figure 14-30). The sequence of operations is as follows:

undo the nut *31* (see Figure 14-6), mount the extractor on the column, having removed the clamp *4* (Figure 14-30) from the arm *2* and having guided the end piece *3* into the end of the steering shaft. Place the clamp *4* on the arm so that it it located below the hub of the steering wheel, and, turning the handle *5*, press off the steering wheel and remove the key from the shaft slot.

In order to remove the steering shaft *5* (see Figure 14-6) and the steering column tube *6*, it is necessary to remove the stop ring *19* and the thrust washer *18* from the shaft and to remove the upper bearing *17* from the tube seat. Bend back the tab of the stop washer *2*, unscrew the adjusting nut *1*, holding it by the exposed part to prevent its penetrating anything, and remove the stop ring (Figure 14-31). Remove the oil seal together with the retainer *3* as a unit (see Figure 14-6). Press out the lower bearing *4* from the seat of the tube *6* along with the shaft *5* by means of a mandril (the mandril is installed on the upper end of the shaft).

Remove the lower bearing *4* from the steering shaft.

If the steering shaft is twisted or bent, and also if it has cracks of any nature, it should be replaced. Not more than two threads of the screw at the ends of the shaft may be damaged.

Steering column tube bends are eliminated by straightening [the tube]. The non-linearity of the surface of the tube along its generatrix is permitted if this does not exceed 1.0 mm.

The presence of small cracks in the plastic coating of the steering wheel need not be considered a flaw. Chips in the plastic steering wheel coating are not permitted.

Assembly of the steering column. The parts intended for assembly must be clean and checked.

When installing the bearings, they should be lubricated with a lubricant grease or with technical petroleum jelly.

It is recommended that the assembly be done in the following sequence of operations: insert the shaft *5* (see Figure 14-6) in the tube *6* of the column, place the lower bearing *4* on the steering shaft and press it into the seat until the collar rests in the seat (the fit is from a clearance of 0.10 mm to a tightness of 0.15 mm), install the seal together with the oil seal *3* as a unit, install the stop washer *2*, having guided the internal projection into the key slot of the shaft, and tighten the adjusting nut *1* onto the shaft by hand. Place the bearing *17* on the steering shaft and press it into the seat until the bearing rests against the collar. Install the thrust washer *18* and secure the bearing with the stop ring *19*.

Insert the key in the shaft slot, install the steering wheel [illegible] on the shaft, and, having tightened the nut *31*, seat it in place.

Assemble the horn button components in an order opposite to that in which they were disassembled.

Fasten the current pick-up assembly and the turn signal switch to the steering column.

Adjustment. Clamp the steering column in a vise and tighten with a little bit of force the adjusting nut *1* until the axial clearance of the steering shaft is eliminated. When adjusting the tightness of the bearings, it is necessary to check the turning of the steering shaft in the bearings, having tightened the adjusting nut. The turning moment of the steering wheel must be 3-8 Kg·cm, which will correspond to a force of 0.12-0.33 Kg as applied at a steering wheel radius of 240 mm.

Having completed the adjustment, it is necessary to lock the nut *1*, having bent one tab of the stop washer *2* into the slot of the nut.

Dismantling of the power steering pump must be done in the case of clear necessity (when the parts are worn and they cease to operate). During the dismantling the pump should be clamped in a vise. Unscrew the nut *25* (see Figure 14-7), remove the cover *23* along with the gasket *20*, the input mesh filter *21* along with the seals, the mesh filter *2* along with the thrust dish and the valve *12*. Unscrew the bolts which secure the reservoir to the collector *18* and remove them along with the sealing gaskets *28* and *29*.

Set up the pump vertically, with the pulley down.

Unscrew the bolts which secure the cover and remove the cover together with the sealing ring *37* and the by-pass valve *13*. In order to dismantle the by-pass valve, the valve should be clamped in a vise having jaws made of soft metal. Unscrew the seat *16* with the adjusting gaskets *15*, extract the safety valve *17* and the guide rod *32* together with the spring *31*. Having examined the valve, set the parts in place and screw in the seat with its set of adjusting gaskets.

It should be kept in mind that the cover and the by-pass valve are individually selected at the plant; therefore the manner in which they fit together should not be disturbed.

Note the position of the stator relative to the pump housing and remove the stator from the pins. Remove the sealing ring from the housing slot. Manually remove the rotor from the splines of the shaft, keeping the vanes from falling out of the slots, having wrapped the rotor with a rag. It should be kept in mind that the stator, rotor, and vanes of the pump are selected in groups at the plant; therefore the manner in which they fit together should not be disturbed.

In order to remove the pump pulley *1*, it is necessary to remove the lockpin and unscrew the nut which keeps the pulley from turning. Press the pulley off the shaft, remove the conical bushing *30* and extract the key from the shaft slot.

Remove the stop ring of the bearing *4* with circular pliers and press the front ball bearing together with the shaft as a unit out of the pump housing, utilizing for this purpose a mandril or extractor (Figure 14-32). Press the bearing off of the shaft and remove the thrust washer.

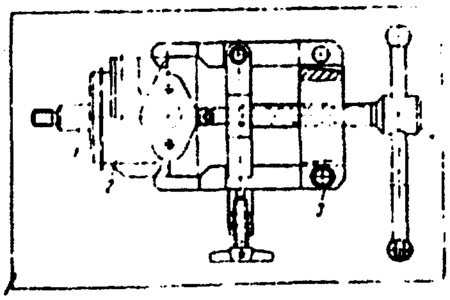


Figure 14-32: Pressing out the pump shaft with an extractor

1 -- shaft; 2 -- housing; 3 -- extractor;
4 -- screw

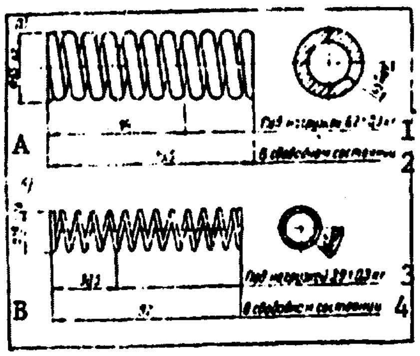


Figure 14-33: Pump springs: A -- safety valve spring;
B -- by-pass valve spring;
1 -- under a load of 6.2 $\pm$ 0.3 Kg;
2 -- in a free state;
3 -- under a load of 3.9 $\pm$ 0.3 Kg;
4 -- in a free state

Figure 14-34: Installation of the stator on the pump housing

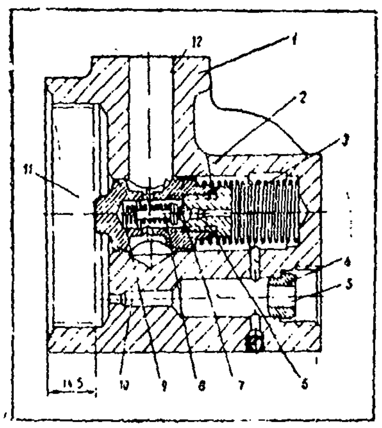


Figure 14-35: Pump cover with by-pass valve, assembled

1 -- cover housing; 2 -- by-pass valve;
3 and 9 -- springs; 4 -- sealing seat;
5, 10 and 12 -- openings; 6 -- safety valve
seat; 7 -- safety valve ball; 8 -- spring guide
rod; 11 -- chamber

Remove the insert and the oil seal from the seat of the pump housing. Press out the needle bearing 7 (see Figure 14-7).

In the event that the sliding surfaces of the pump parts are worn more than the allowable amount, the worn parts should be replaced. Cracks or nicks on the pump parts are not permitted.

The rotor, the vane, the stator, and the by-pass valve of the power steering pump are selected by groups at the plant; therefore in the event that one of these parts does not function, it is necessary to change also those parts which are adjacent to the malfunctioning part.

Non-flatness of the surface of the pump housing which comes in contact with the rotor is permitted only in the form of bumps which do not exceed 0.005 mm.

An oval state and a conical state of the opening of the pump cover at the by-pass valve is permitted if it does not exceed 0.005 mm.

The surfaces of the pump rotor slot may not be other than parallel by more than 0.01 mm.

The facing surfaces of the pump rotor and stator may not be other than parallel by more than 0.004 mm.

The play in the supporting collars of the shaft may not be more than 0.02 mm.

The by-pass valve spring (Figure 14-33) and the pump safety valve spring may not have any residual deformation.

The ends of the springs relative to the axis may not be other than perpendicular by other than 0.025 mm.

Assembly of the power steering pump. All parts must be clean and checked. The internal channels and openings of the parts should be carefully cleaned and blown out with dry compressed air. Wiping the parts with rags is not permitted, so as to avoid contaminating the channels.

During the assembly all touching surfaces of the pump parts must be lubricated with power steering oil.

To assemble the pump shaft with the bearing it is necessary to place the thrust washer on the shaft and press the ball bearing onto the collar of the shaft (the tightness is 0.002-0.018 mm).

Place the pump housing vertically and press the needle bearing into the seat by means of a mandril (the fit is from a clearance of

0.025 mm to a tightness of 0.07 mm).

Press the oil seal into the seat of the housing, utilizing for this purpose a mandril. Install the insert in the seat and press the exterior ring of the ball bearing in place (the fit is from a clearance of 0.023 to a tightness of 0.01 mm). The pressing in of the bearing may be accomplished with the help of a mandril and hammer or press. Secure the bearing with the stop ring, which is installed with circular pliers.

Clamp the pump housing in a vise. Place the rotor on the splines of the shaft. The vanes of the rotor must move freely in the slots.

The rotor may be installed on the splies of the shaft together with the vanes as a unit.

Insert the guide pins in the pump housing openings and install the stator according to the marks which were made during the dismantling. The position on the stator of the arrows which indicate the direction of rotation must be as it is shown in Figure 14-34.

Place the distributor disk on the stator, having guided its openings down over the protruding pin ends.

Assemble the by-pass valve, having installed the springs *31* (see Figure 14-7), the guide rod *32*, and the ball safety valve *17* in the valve housing. Place the set of adjusting gaskets *15* on the housing of the seat *16*. Screw in the seat of the safety valve into the housing and tighten it (the moment is 1.5-2 Kg·m).

Check the operation of the safety valve *17*, which when oil is supplied to the opening *33* must open at a pressure of 65-70 Kg/cm^2 and pass a continuous stream of oil. Adjustment of the pressure is accomplished by the selection of a specific number of adjusting gaskets *15*.

Install the spring *3* (see Figure 14-35) on the housing of the by-pass valve *2*, having guided the six-sided attachment of the seat *6* into the spring. Insert the by-pass valve as a unit into the seat of the housing *1* of the pump cover. Here 14.5 mm must be retained between the valve and the end of the split surface of the cover.

Check the by-pass valve together with the cover as a unit. The valve *2* must move in the seat of the housing *1* of the cover freely in both directions. When oil having a temperature of 2-25°C and a pressure of 60 Kg/cm^2 is supplied into the chamber *11* and the opening *5* is plugged, the flow of oil through the opening *12* must be not more than 150 cm^3/minute. When the opening *10* is plugged and the opening *5* is open and oil is being supplied into the chamber *11*, the by-pass valve *2* must open at a pressure of 1.2-1.8 Kg/cm^2.

Install the cover with the by-pass valve as a unit on the pump housing, holding the valve with your hand.

Secure the cover with the bolts, having placed spring washers under the heads of the bolts. The tightening moment of the bolts must be 3.5-4.2 Kg·m.

Insert the key in the slot of the shaft *6* (see Figure 14-7), place the conical split bushing *30* on the shaft, and place the pulley *1* on the bushing. Tighten the nut, having placed a flat washer under it, and secure the pulley, keeping it from turning. The turning moment of the nut which secures the pulley must be 4.5-5.0 Kg·m. When the pump shaft is turned by the pulley, it must turn freely by hand without binding.

Install the reservoir *19* with the gasket *29* on the housing. Install the collector *18* with the sealing gasket *28* in the reservoir. Tighten the bolts, having placed flat washers under the heads of the bolts. Secure the reservoir together with the collector. The tightening moment of the bolts is 0.6-0.8 Kg·m.

Install the filter *2* with the spring and cap washer in the reservoir. Install the mesh input filter *21*. Cover the reservoir with the cover *23* with the sealing gasket *20*. Secure the cover by hand with the nut, having placed a flat washer under the nut.

Checking the pump. The hermetical seal of the pump and the pressure developed by the pump are checked by means of a manometer which has a valve and a T-joint. The checking may be accomplished on an individual installation equipped with control instruments or on the vehicle by including the manometer with the valve and T-joint (Figure 14-36) in the power steering system.

The T-joint of the manometer *2* is connected with the pump *1* and the high pressure hose *5*. The manometer *3* must have a scale for measuring pressure up to 80 Kg/cm^2.

The valve *4* which is connected to the manometer serves as a shut-off for the oil in the main line.

In order to check the pump it is necessary to add oil to the pump reservoir until the edges of the input filter are covered, and open the valve. Turn the wheels of the vehicle in either direction until they stop and hold them at the stop for not more than 15 seconds.

The pressure of the oil at low engine crankshaft rpm's must not be less than 60 Kg/cm^2. If the pressure of the oil is less than 60 Kg/cm^2 then it is necessary, while turning handle of the valve, to follow the increase in pressure on the manometer.

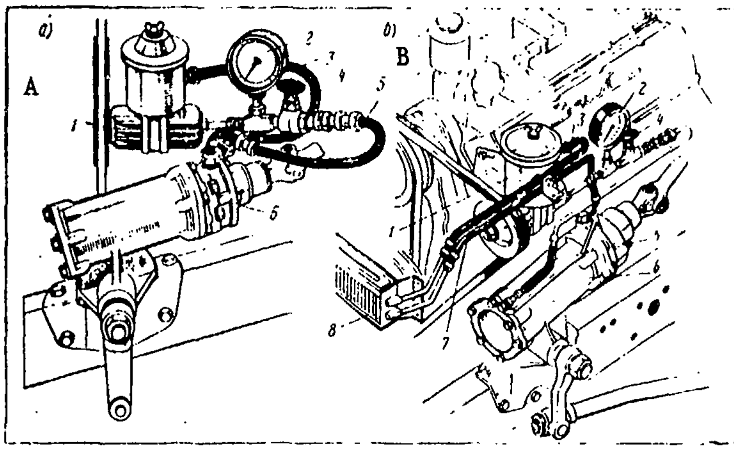


Figure 14-36: Schematic for checking the power steering pump

A -- on the ZIL-130; B -- on the ZIL-131;
1 -- pump; 2 -- manometer; 3 -- low pressure hose;
4 -- valve; 5 -- high pressure hose; 6 -- steering
mechanism; 7 -- hose supplying oil to the radiator;
8 -- radiator

Here the valve may not be held closed for more than 15 seconds. If, when the valve is turned, the pressure in the system does not increase, this bears witness to the incorrect operation of the pump, which must be removed in order to eliminate the malfunction.

It is necessary to check the pump when the temperature of the oil in the reservoir is 65-75°C. The oil may be heated by turning the wheels from stop to stop and holding the wheels against the stops for not more than 15 seconds each time.

Installation of the steering mechanism on the vehicle. Install the steering mechanism with power steering on the frame of the vehicle by means of a KZ-0352 (see Figure 14-21) device and secure the steering mechanism with the bolts.

Install the power steering pump on the engine cylinder head and preliminarily secure it on the dowels with the nuts, having placed the drive belt on the pulley.

After tightening the belt, secure the pump pulley.

Connect the high and low pressure hoses to the pump and to the control valve housing connections.

Install the steering column as a unit and secure its lower end to the wall of the cabin and its upper end to the cabin bracket.

Install the articulated shaft and connect one fork with the steering mechanism fork and the other fork with the steering shaft. Insert the keys in the openings, having aligned them with the slots and, having tightened down the nuts, secure the articulated shaft.

Removal of the steering drive from the vehicle. The Pitman arm should be removed with the help of a model 2496 (see Figure 14-17) extractor.

To remove the trailing link it is necessary to remove the lockpins which secure the ball pins, unscrew the nut, and knock the pins out of the conical openings in the arm, using a brass mandril. It is possible, having removed the lockpins from the adjusting plug and having unscrewed the adjusting plug, and without pressing the pins from the arm, to disconnect the end of the trailing link from the arm.

Until the end of 1967 the Pitman arm of the ZIL-130 and ZIL-131 was assembled with welded pins (Figure 14-37B); therefore in order to disconnect the end of the trailing link from the Pitman arm it is necessary to extract the lockpin and unscrew the adjusting plug.

Since 1968 ball pins (Figure 14-37A), which on the ZIL-130 and ZIL-131 are secured to the Pitman arm by means of a ball nut with a spring washer, have begun to be installed on the vehicles. After it is installed, the nut is punched in three places. The tightening moment of the nut is 23-27 Kg·m.

The removal of the tie rods from the turn arms of the ZIL-130 is accomplished in the same manner as removing the read end of the trailing link. On the ZIL-157K and the ZIL-131 the connection of the tie rod with the arm of the turn journal housing is accomplished in the manner shown in Figure 14-38.

If there are cracks or nicks on the steering control drive parts, the parts should be replaced.

Not more than two threads of the threading may be damaged.

Installation of the steering drive on the vehicle. The assembly and adjustment of the ball connections is accomplished at the same time as the installation of the drive on the vehicle. During the

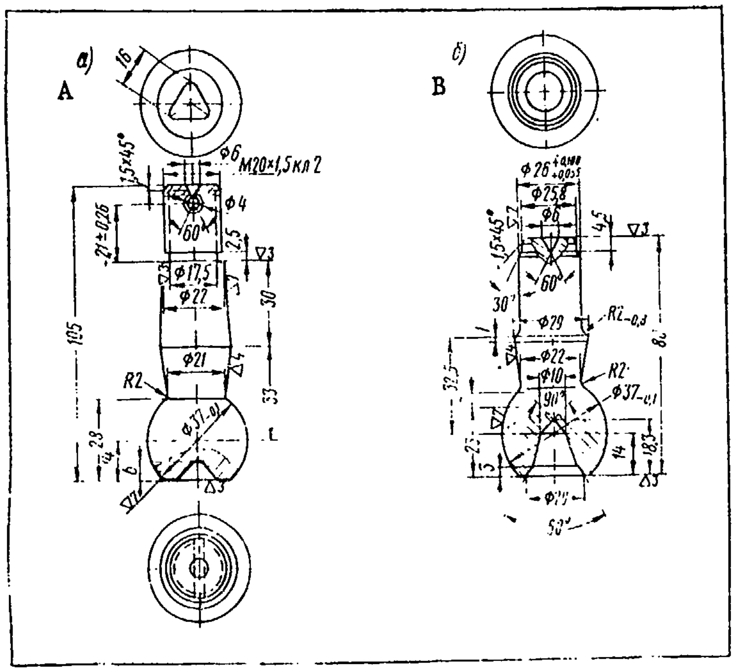


Figure 14-37: Pitman arm ball pins and the pin fastening connection: A -- ZIL-157K pin; B -- ZIL-130 and ZIL-131 pin

assembly of the trailing link, the adjusting plug is tightened until it cannot be tightened any more, then it is loosened by approximately 1/4 turn, following which a lockpin is inserted.

Table 14-1: Incorrect Operation of the Steering Control and Corrective Action

Problem	Reasons, signs of incorrect operation	Corrective action
Vehicle does not "hold the road"	Increased steering wheel free play	check the free play of the vehicle's steering wheel, adjust if necessary

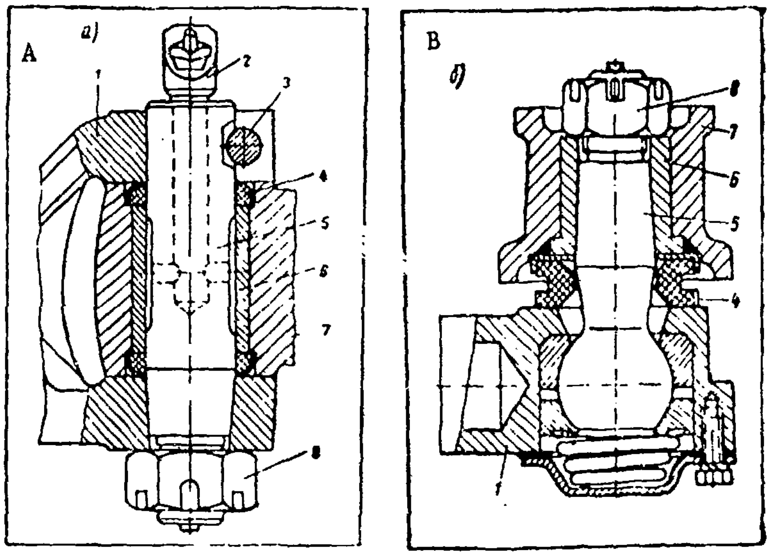


Figure 14-38: Tie rod and turn arm connection assembly

A -- ZIL-157K; B -- ZIL-131;
1 -- tie rod end piece; 2 -- grease fitting;
3 -- coupling bolt; 4 -- oil seal; 5 -- pin;
6 -- pin bushing; 7 -- turn arm; 8 -- nut

(Table 14-1 continued)

Problem	Reasons, signs of incorrect operation	Corrective action
The power steering gives insufficient or uneven pressure	insufficient tightening of the pump drive belt; insufficient oil level in the pump reservoir	tighten the belt; add oil up to the [necessary] level
	air present in the system (froth in the reservoir, the oil is not transparent, the oil is cloudy)	eliminate the air. If the air will not be eliminated, check the tightness of all connections, remove and clean the mesh filter, check the intactness of the gasket under the collector.

(Table 14-1 continued)

Problem	Reasons, signs of incorrect operation	Corrective action
[as above]	[as above]	Check the tightness of the 4 bolts which secure the collector, and if this is all checked and the malfunction is not eliminate, replace the oil seal of the pump shaft
	the tooth engagement of the steering mechanism is too tight	adjust with the steering mechanism screw *30* (see Fig. 14-4)
	pump malfunction	check the condition of the pump
	increased oil leakage in the steering mechanism as a consequence of wear or damage to the sealing rings	dismantle the steering mechanism and replace the sealing rings
	periodic sticking of the pump by-pass valve as a consequence of becoming dirty	dismantle the pump, check the free movement of the by-pass valve
	a loosening of the tightness of the thrust bearing nut of the steering mechanism screw	remove the upper cover *20* (see Fig. 14-4) and check the tightness of the nut *19*
The power steering does not give any boost at various engine crankshaft rpm's	unscrewing of the seat of the safety valve or jamming of the pump by-pass valve	dismantle the pump, tighten the safety valve seat and check the by-pass valve
	wear on the pump rotor	replace the pump rotor as a unit

(Table 14-1 continued)

Problem	Reasons, signs of incorrect operation	Corrective action
Increased noise during pump operation	insufficient oil level in the pump reservoir	add oil to the [required] level
	pump drive belt too loose	tighten belt
	contamination and incorrect installation of filter, presence of air in the system (froth in the reservoir, cloudy oil, non-transparent oil)	wash the filter and flush the power steering system with oil
	the collector *18* (see Fig. 14-7) is buckled	eliminate the non-flat condition
	the gasket under the collector is destroyed	change the gasket
Knock in the steering mechanism	increased clearance in the tooth engagement of the steering mechanism	adjust the steering mechanism with the screw *30* (Fig. 14-4)
Oil being ejected through the pump breather	oil level above the mark	reduce oil level to normal
	mesh filter is contaminated	wash filter
	collector gasket damaged	change gasket
	collector *18* (see Fig. 14-7) is buckled	eliminate the non-flat condition
Oil leak	oil leaking out from under the oil seal of the Pitman arm shaft	replace the oil seal
	oil leaking out from under the steering mechanism cover	replace the sealing ring

Table 14-2: Parts Dimensions: the Principal Dimensions of the Parts of a Steering Control Without Power Steering, mm

Dimension	Nominal	Permissible without repair
I. STEERING MECHANISM HOUSING: Cast Iron KCh 35-10 (GOST 1215-59)		
diameter of the opening under the Pitman arm shaft bushing	41.000-41.050	-
internal diameter of the pressed in bushing:		
nominal:	38.000-38.027	38.057
1st repair:	38.000-37.827	37.857
2nd repair:	37.600-37.627	37.657
diameter of the opening at the worm gear roller bearing ring	72.000-72.046	72.07
diameter of the collar at the bracked securing the housing to the vehicle frame	64.94-65.00	64.5
threading for the cover nut	4M64X1.5, class 2	-
II. STEERING SHAFT: Steel 20 (tube 29X5.5 mm, GOST 8734-58 and 8733-48); number of splines -- 25		
diameter of the shaft collar for the ball bearing	27.955-28.000	27.92
diameter of the conical collar for the steering wheel hub	27.955-28.000 (conical ratio 1:12)	caliber shift not greater than 1 mm

(Table 14-2 continued)

Dimension	Nominal	Permissible without repair
diameter of the threading for the nut	M24X1.5, class 2	-
width of the key slot	19.00-20.5	-

III. STEERING SHAFT WORM GEAR: Steel 40 Kh (GOST 4543-61); depth of the case-hardened layer -- 0.3-0.5 mm, surface layer hardness -- HRC 48-52. For better running-in the worm gear is copper-plated (the copper plating layer is 0.2-0.3 mm)

Dimension	Nominal	Permissible without repair
length of the worm gear between thrust ends of the roller bearings	107.75-108.25	-

IV. PITMAN ARM SHAFT: 40 Kh (GOST 4543-61); hardness HB 241-285; number of splines -- 36

Dimension	Nominal	Permissible without repair
diameter of the Pitman arm shaft collar at the bushings:		
nominal:	37.950-37.975	37.92
1st repair:	37.750-37.775	37.72
2nd repair:	37.550-37.575	37.52
conical ratio of the splined portion of the shaft at the Pitman arm	1:16	caliber shift not greater than 1.5 mm
diameter of the threading for the Pitman arm attachment nut	2M27X1.5, class 2	-

(Table 14-2 continued)

Dimension	Nominal	Permissible without repair
diameter of the opening at the roller axis:		
larger:	18.000-18.019	18.03
lesser:	17.952-17.978	17.94
V. PITMAN ARM SHAFT ROLLER: Steel 18KhGT; depth of the case-hardened layer: 1.0-1.4 mm; surface layer hardness is HRC 56-62		
diameter of the opening at the needle bearing	24.02-24.05	24.07
roller length	44.973-44.990	-
VI. ROLLER AXIS: Steel 15Kh (GOST 4543-61); depth of the case-hardened layer -- 0.8-1.2 mm; surface layer hardness is HRC 56-62		
diameter of the roller shaft at the needle bearing	17.982-18.000	17.97
VII. PITMAN ARM: Steel 40Kh (GOST 4543-61); hardness -- HB 241-285		
conical ratio of the slotted opening at the Pitman arm shaft	1:16	caliber shift relative to the faces not greater than 1.5 mm
conical ratio of the opening at the ball pin	1:8	the same

(Table 14-2 continued)

Dimension	Nominal	Permissible without repair
VIII. STEERING COLUMN TUBE: Steel 20 (tube: 45 $\pm$ 0.5X2.5 mm, GOST 1753-53)		
diameter of the tube at the point where it connects with the steering control mechanism housing	44.075-44.125	44.05

[Table 14-3 begins on the following page]

Table 14-3: Principal Dimensions of the Parts of a Steering Control with Power Steering, mm

Dimension	Nominal	Permissible without repair
I. STEERING MECHANISM HOUSING: Cast Iron KCh 35-10 (GOST 1215-59)		
Diameter of the cylinder at the piston-rod	90.000-90.035	90.060
Diameter of the opening at the bushing	41.00-41.05	-
External diameter of the bushing	41.125-41.175	-
Internal diameter of the bushing	38.000-38.027	38.050
Diameter of the threading in the openings at the cover attachment bolts	M10, class 2	-
II. EXTERNAL HOUSING COVER: Aluminum Alloy AL4 (GOST 2685-63)		
Diameter of the opening at the needle bearing	27.983-28.006	28.02
III. SIDE HOUSING COVER: Aluminum Alloy AL4 (GOST 2685-63)		
Diameter of the opening at the bushing	41.00-41.05	-
Internal bushing diameter	38.00-38.027	38.050
Diameter of the threading of the opening at the adjusting screw	M27X1.5, class 2	-

IV. PITMAN ARM SHAFT: Steel 20Kh2N4A (GOST 4543-61); depth of the case-hardened layer is 1.0-1.4 mm; surface layer hardness HRC 56-62; midsection hardness HRC 28-45; number of splines -- 36; the splined end of the shaft is not subjected to case-hardening; number of teeth of the sector -- 5

(Table 14-3 continued)

Dimension	Nominal	Permissible without repair
Shaft diameter:		
nominal	37.950-37.975	37.93
1st repair	37.750-37.775	37.73
2nd repair	37.550-37.575	37.53
Conical ratio of the splined portion of the shaft	1:16	-
Thickness of a tooth of the sector (height of measurement = 6.45 mm)	12.54	12.30
Length of a tooth of the sector	30.0	-
Diameter of the threading at the Pitman arm attachment nut	M27X1.5, class 2	-
V. STEERING MECHANISM PISTON-ROD (Figure 14.39):	Steel 18KhGT (GOST 4543-61); depth of the case-hardened layer is 1.0-1.4 mm; hardness of the surface layer is HRC 56-62; mid-section hardness is HRC 30-40	
Piston diameter	89.925-89.960	89.90
Diameter of the opening at the ball nut	64.977-65.008	65.03
Diameter of the opening at the steering control screw	30.000-30.033	30.05
Channel width at the piston ring	4.025-4.065	4.08
Width of the 1st, 3rd, and 4th tooth depressions	12.76	13.0
Width of the 2nd tooth depression	12.562	12.8
Diameter of the threading at the opening at the adjusting screw	M16X1.5, class 2	

(Table 14-3 continued)

Dimension	Nominal	Permissible without repair
VI. STEERING MECHANISM BALL NUT: Steel 25KhGT (ChMTU TsNIIChM 561-61); thickness of the case-hardened layer is 1.0-1.4 mm; hardness of the surface layer is HRC 58-62; midsection hardness is HRC 28-45		
External nut diameter	64.97-65.00	-
Screw channel pitch	18.795-18.805	-
Diameter of the ball nut openings (between the opposite control balls 7.144 mm in diameter)	22.508-22.555	-
Diameter of a ball	7.130-7.158 mm (sorted by groups every 0.002 mm)	-
VII. STEERING MECHANISM SCREW: Steel 25KhGT (ChMTU TsNIIChM 561-61); case-hardened layer thickness is 1.0-1.4 mm; surface layer hardness is HRC 58-62; midsection hardness 28-45		
Diameter of the screw at the needle bearing	21.967-21.980	21.95
Diameter of the steering control screw (in terms of an external control ball diameter of 7.144 mm)	36.796-36.844	-
Diameter of the threading at the adjusting nut	M25X1.5, class 2	-
VIII. STEERING CONTROL HOUSING: Gray Iron (casting No. 3 UK-15)		
Diameter of the opening at the slide valve	38.000-38.024 (sorted into 4 groups in 0.006 mm increments)	-
Length of the valve housing	47.975-48.000	47.95

(Table 14-3 continued)

Dimension	Nominal	Permissible without repair
Diameter of the threading at the connecting hose	M20X1.5, class 2	-
Diameter of the threading at the ball valve	M12X1.25, class 2	-
VIII. STEERING CONTROL SLIDE VALVE: Steel 15Kh (GOST 4543-61); depth of the case-hardened layer is 0.5-0.7 mm; surface layer hardness is HRC 56-62		
External slide valve diameter	37.986-38.010 (sorted into 4 groups at 0.006 mm intervals)	-
Width of the ring protrusion of the slide valve	7.310-7.700	-
Length of the slide of the valve	47.975-48.000	47.95
IX. CONTROL VALVE SPRING: Spring Wire, Class 1, Diameter 2.2 mm (GOST 8389-60); 4 working turns		
External spring diameter	10.5	-
Full number of turns	6.25	-
Length of the spring in the free state	19.8	-
Length of the spring under a load of 22 $\pm$ 2.5 Kg	18.0	-
X. CONTROL VALVE REACTION PISTON: Steel 15Kh (GOST 4543-61); depth of the case-hardened layer is 0.6-1.0 mm; hardness of the surface layer is HRC 56-62		
Piston diameter	10.992-11.000	-
Length	14.76-15.00	-

(Table 14.3 continued)

Dimension	Nominal	Permissible without repair
XI. PISTON-ROD RING: Gray Iron (casting No. 6 UK-15); hardness HRB 98-106; not more than 4 units of hardness variation in the ring		
Ring diameter	90.00-90.03	-
Ring height	1.98-2.0	1.96
Clearance in the ring gap when installed in a circular gauge 90.02 mm in diameter	0.15-0.40	-
Elasticity of the ring when compressed by a flexible tape to a clearance of 0.15-0.40 mm, Kg	1.5	-

Table 14-4: Dimensions of the Balls of the Nut by Groups, mm

Group	Ball diameter	Group	Ball diameter
1	7.158-7.156	8	7.144-7.142
2	7.156-7.154	9	7.142-7.140
3	7.154-7.152	10	7.140-7.138
4	7.152-7.150	11	7.138-7.136
5	7.150-7.148	12	7.136-7.134
6	7.148-7.146	13	7.134-7.132
7	7.146-7.144	14	7.132-7.130

Table 14-5: Principal Dimensions of the Steering Control Articulated Shaft, mm

Dimension	Nominal	Permissible without repair

I. THE UNIVERSAL JOINT FORK TOGETHER WITH THE SPLINED ROD AS A UNIT: Steel 45 (GOST 1050-60); depth of the tempered layer of the splined end of the rod is 1.5-4.0 mm; hardness of the surface layer is

(Table 14-5 continued)

Dimension	Nominal	Permissible without repair
HRC 42-56, midsection hardness and hardness of non-tempered surfaces is HB 207-241		
Diameter of the fork opening at the bushing	20.000-20.023	20.03
Diameter of the rod at the sealing ring	24.87-24.94	24.80
Thickness of a tooth at the splined section of the rod	4.435-4.479	4.35
II. THE FORK WITH THE SLOTTED BUSHING AS A UNIT: Fork material -- Steel 35 (GOST 1050-60); hardness HB 207-241; slotted bushing material -- Steel 45 (GOST 1050-60); hardness HB 255-285		
Diameter of the opening at the bushing	20.000-20.021	20.03
Width of the depression of the slotted portion of the bushing	4.500-4.545	4.60
III. ARTICULATED SHAFT CROSS: Copper-graphite metallic-ceramic (UN-247)		
External diameter of the bushing at the fork opening	20.008-20.029	19.99
Internal diameter of the bushing at the cross dowels	11.03-11.06	11.08

Table 14-6: Principal Dimensions of the Parts of the Steering Column, mm

Dimension	Nominal	Permissible without repair

I. STEERING SHAFT: Steel 35 (tube 30X5.5 mm, GOST 8734-58 and GOST

(Table 14-6 continued)

Dimension	Nominal	Permissible without repair
8733-58); depth of the tempered layer of the shaft at the place where the key is installed -- 1.5-4 mm; hardness of the surface layer -- not less than HRC 50.		
Diameter of the collars of the shaft at the bearings	27.995-28.000	27.92
Conical ratio of the collar at the steering wheel hub	1:12	Non-alignment of the part ends and of the bore by ± 0.5 mm
Diameter of the threading at the nut	M24X1.5, class 2	-
II. STEERING COLUMN TUBE: Steel 20 (tube 45.5X2, GOST 1753-53)		
Diameter of the opening at the bearing	42.00-42.1	42.15
III. ASSEMBLED STEERING WHEEL: Hub Material -- Steel 25LK (GOST 977-53); steering wheel material -- plastic		
Conical ratio of the steering wheel hub	1:12	Non-alignment of the part ends and of the bore by ± 0.5 mm

Table 14-7: Dimensions of the Pump Parts by Group, mm

Group	Length of pump parts		
	Stator	Rotor	Vanes
1	22.013-22.017	21.996-22.000	21.992-21.996
2	22.009-22.013	21.992-21.996	21.988-21.992
3	22.005-22.009	21.988-21.992	21.984-21.988
4	22.001-22.005	21.984-21.988	21.980-21.984
5	21.997-22.001	21.980-21.984	21.976-21.980

Table 14-8: Principal Dimensions of the Power Steering Pump Parts, mm

Dimension	Nominal	Permissible without repair
I. PUMP HOUSING: Special Cast Iron UK-15; hardness HB 201-241		
Diameter of the opening at the ball bearing	51.990-52.020	52.04
Diameter of the opening at the roller bearing	21.993-22.016	22.03
Diameter of the opening at the oil seal	45.89-46.06	46.09
Diameter of the opening at the set pins	5.011-5.044	5.05
II. PUMP COVER: Cast Iron SCh 15-32 (GOST 1412-54)		
Diameter of the opening at the safety valve	20.000-20.015 (sorted into 3 groups at 0.005 mm increments)	-
Diameter of the calibrated opening of the output valve	4.100-4.148	4.16
Diameter of the opening of the output valve at the sealing seat	10.00-10.03	-
III. PUMP ROTOR: Steel 12KhN3A (GOST 4543-61); thickness of the tempered layer -- 0.4-0.6 mm; surface layer hardness -- HRC 58-62		
Rotor length	21.980-22.000 (sorted into 5 groups at 0.004 mm intervals)	-
Rotor slot width (number of slots -- 10)	2.008-2.028	2.04
Length of the depression of the slotted part of the rotor	1.257	1.30

(Table 14-8 continued)

Dimension	Nominal	Permissible without repair
IV. PUMP VANE: Steel R18 (GOST 5952-51); hardness HRC 62-65		
Vane length	21.976-21.996	-
Vane thickness	1.991-1.997 (sorted into 5 groups)	-
V. PUMP STATOR: Steel ShKh15 (GOST 801-60); hardness HRC 60-64		
Stator length	21.997-22.017 (sorted into 5 groups at 0.004 mm intervals)	-
Diameter of the set openings	5.011-5.065	5.07
VI. PUMP SHAFT: Steel 30KhGT (GOST 4543-61); thickness of the case-hardened layer -- 0.8-1.2 mm; hardness of the surface layer -- HRC 60-65; number of splines -- 14		
Diameter of the shaft collar at the roller bearing	11.988-12.000	11.97
Diameter of the shaft collar at the ball bearing	20.002-20.017	19.99
Diameter of the shaft at the oil seal	23.995-24.000	23.93
Thickness of a tooth of the splined portion of the shaft	1.212	1.10
Diameter of the threading at the pulley-fastening nut	M16X1.5, class 2	-

(Table 14-8 continued)

Dimension	Nominal	Permissible without repair
VII. PUMP BY-PASS VALVE HOUSING: Steel 45 (GOST 1050-60); thickness of the tempered layer -- 0.6-2.5 mm; hardness -- HRC 56-62		
External housing diameter	19.977-19.992 (sorted into 3 groups at 0.005 mm intervals)	-
Diameter of the threading for the seat of the pump safety valve	M10X1., class 2	-
VIII. PUMP DISTRIBUTOR DISK: Special Cast Iron UK-15; hardness HB 201-241		
Diameter of the opening at the set pins	5.100-5.148	5.16
IX. SAFETY VALVE SEAT: Steel 40Kh (GOST 4543-61); six-sided, 12 mm (GOST 8560-57); hardness HB 255-302		
Diameter of the opening at the pump safety valve	3.300-3.348	-
Diameter of seat threading	M10X1., class 2	-
X. SAFETY VALVE SPRING: Spring Wire (class 1, diameter 1.1 mm, GOST 9389-60); full number of turns -- 11.5; number of working turns -- 9.5		
Length in the free state	19.5	-
Length under a load of 5.9-6.5 Kg	14	-
Spring turn diameter	6.5	-
XI. BY-PASS VALVE SPRING: Spring Wire (class 1, diameter 1.4 mm, GOST 9389-60); full number of turns -- 13; number of operating turns -- 11		
Length of the spring in the free state	82	-

(Table 14-8 continued)

Dimension	Nominal	Permissible without repair
Length of the spring under a load of 3.6-4.2 Kg	30.5	-
Diameter of the spring turn	28.72-19.00	-

Table 14-9: Principal Dimensions of the Steering Drive Parts, mm

Dimension	Nominal	Permissible without repair
I. PITMAN ARM: Steel 40Kh (GOST 4543-61); hardness HB 241-285		
Diameter of the opening at the vehicle ball pin:		
ZIL-157K	21 (conical ratio 1:8)	-
ZIL-130 and ZIL-131	26.000-26.033	-
Diameter of the cone of the slotted opening at the initial circumference at the vehicle Pitman arm shaft:		
ZIL-157K	38.18 (conical ratio 1:16)	-
ZIL-130	36.63-36.68 (conical ratio 1:16)	-
Non-alignment of the Pitman arm and bore faces	± 0.3	1.5
II. PITMAN ARM BALL PIN: Steel 12KhN3A (GOST 4543-61); thickness of the case-hardened layer of the ball surface -- 1.0-1.4 mm; hardness HRC 56-62		
Pin ball diameter	36.9-37.0	-

(Table 14-9 continued)

Dimension	Nominal	Permissible without repair
Diameter of the ZIL-157K pin collar cone	22 (conical ratio 1:8)	-
Diameter of the collar at the opening in the Pitman arm for the:		
ZIL-130 and ZIL-131	26.055-26.100	-
Pin threading diameter	M20X1.5, class 2	-
III. ZIL-130 TURN LEVER:	Steel 40Kh (GOST 4543-61);	hardness HB 241-285
Diameter (lesser) of the conical opening at the tie rod end-piece pin	21 (conical ratio 1:8)	-
Diameter (lesser) of the conical collar of the arm of ZIL-130 vehicles produced:		
Before Jan. 1966:	26.6 (conical ratio 1:8)	-
Since Jan. 1966:	35.7 (conical ratio 1:8)	-
Non-alignment of bore and arm faces	± 0.3	-
Diameter of the threading for ZIL-130 vehicles produced:		
Before Jan. 1966:	M24X1.5, class 2	-
Since Jan. 1966:	M27X1.5, class 2	-
Diameter of the threading of the ZIL-130 thrust adjusting bolt	M12X1.25, class 2	-

(Table 14-9 continued)

Dimension	Nominal	Permissible without repair
IV. TRAILING LINK: Steel 20 (tube diameter 35X6 mm, GOST 8734-58 and GOST 8733-58)		
Internal diameter of the head at the inserts	37.37-37.54	-
Diameter of the opening at the ball pin:		
greater:	37.17-37.50	-
lesser:	27	-
Threading at the adjusting plug	M39X1.5, class 2	-
V. ZIL-130 and ZIL-131 TRAILING LINK BUSHING (Figure 14-40A): Steel 20, GOST 1050-60; thickness of case-hardened layer -- 0.8-1.2 mm; hardness HRC 56-62		
Bushing diameter	37.03-37.20	-
Ball surface diameter	37.00-37.17	-
VI. ZIL-130 and ZIL-131 TIE ROD: Steel 20 (tube 35X5 mm, GOST 8734-58 and GOST 8733-58)		
Diameter of arm end threading at threaded opening for arm end-piece	2M30X1.5	-
VII. BALL PIN: Steel 12KhN3A (GOST 4543-61); thickness of the case-hardened ball surface layer -- 1.0-1.4 mm; hardness HRC 56-62		
Diameter of the ball pin	36.9-37.0	-
Cone diameter (lesser)	22 (conical ratio 1:8)	-
Pin threading diameter	M20X1.5, class 2	-

(Table 14-9 continued)

Dimension	Nominal	Permissible without repair
VIII. ZIL-157K TIE ROD: Steel 40Kh (GOST 4543-61)		
Arm (rod) diameter	36.0	-
Diameter of threading at the end-piece	M33X1.5, class 3	-
IX. ARM END-PIECE: Steel 45 (GOST 1050-60)		
Diameter of the cylindrical opening at the end-piece pin	25.350-25.434	-
Diameter of the (lesser) cone at the end-piece	22.25	-
Conical ratio of the opening	1:8	-
Threading diameter for the arm	2M33X1.5	-
X. ZIL-131 TURN JOURNAL CONE: Cast Iron KCh 35-10 (GOST 1215-59)		
Diameter of the (lesser) cone at the tie rod pin	21	-
Conical ratio of the opening	1:8	-
Non-alignment of bore and part faces	$\pm$ 0.3	-
XI. ZIL-157K TURN JOURNAL HOUSING: Cast Iron KCh 35-10 (GOST 1215-59)		
Diameter of the opening in the arm at the pin bushing	31.00-31.05	32.0

(Table 14-9 continued)

Dimension	Nominal	Permissible without repair
XII. TURN JOURNAL HOUSING BUSHING AT THE END-PIECE:	(GOST 1050-60)	Steel 20
External diameter	31.06-31.11	-
Internal diameter	25.06-25.13	-
XIII. TIE ROD END-PIECE PIN:	Steel 20 (GOST 1050-60)	
Diameter of the pin at the bushing	24.945-25.000	24.92
Diameter (lesser) of the cone	22.5	-
Conical ratio of the pin end	1:8	-
Non-alignment of the face of the pin cone with the bore	$\pm$ 0.3	1.5
Pin end threading diameter	M20X1.5, class 2	-
XIV. ZIL-130 and ZIL-131 TIE	ROD END-PIECE BUSHINGS (See Figure 14-40B): Steel 15 (GOST 1050-60); thickness of the case-hardened layer of the upper bushing -- 0.8-1.2 mm; thickness of the case-hardened layer of the lower bushing -- 0.15-0.30 mm; hardness HRC 56-62	
Diameter of bushing sphere	37.08-37.25	-
External diameter of the lower bushing	47.53-47.70	-
External diameter of the upper bushing	47.90-48.00	-
XV. ZIL-130 and ZIL-131 TIE	ROD END-PIECE: Steel 45 (GOST 1050-60)	
Diameter of the threading for the coupling with the tie rod	M30X1.5	-
Internal diameter of the end-piece at the bushing	48.0-48.1	-

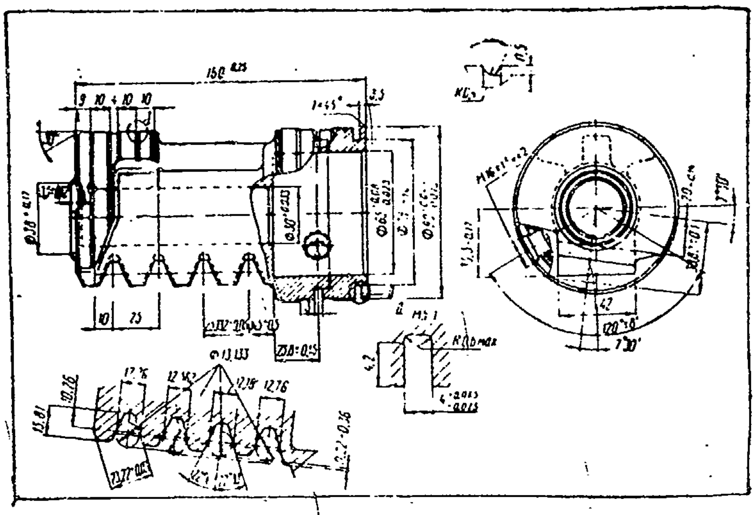


Figure 14-39: Steering mechanism piston-rod

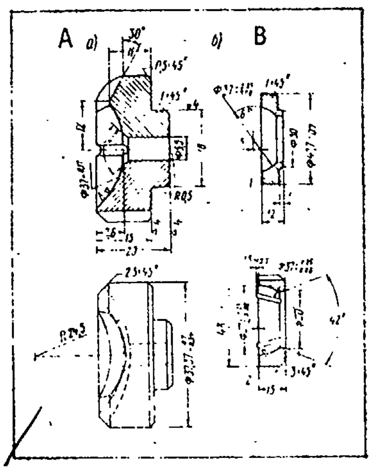


Figure 14-40: ZIL-130 and ZIL-131 steering arm bushings
A -- trailing link bushings; B -- tie rod bushings

1 -- lower bushing; 2 -- upper bushing

CHAPTER FIFTEEN: WHEELS AND TIRES

Construction

ZIL-130 wheels and tires. The wheels (Figure 15-1) are steel, disk, and have split lock rings and one-piece side rings. The tires are pneumatic tube-type. The wheel hubs are cast from wrought iron.

Technical Characteristics of the Wheels and Tires of the ZIL-130

Type of wheel	disk with conical flanges
Wheel specifications	7.0X20
Ring diameter, inches	20
Method of attaching the tire casing	two side lock rings are installed at one side of the wheel: one is a split ring, the other is a one-piece ring
Attachment of the wheel to the hub	lugs (8), the right wheels have right-hand threading, the left wheels have left-hand threading
Diameter of the lug opening	32.0-32.8 mm
Permissible wheel play in an axial and radial direction	up to 3 mm
Permissible face play	up to 0.8 mm
Tire dimensions	260X20
Number of plies	12
Type of tire tread	universal
Permissible load per tire	1,800 Kg
Air pressure in the tires	front wheels: 3.5 Kg/cm^2 real wheels: 5.3 Kg/cm^2

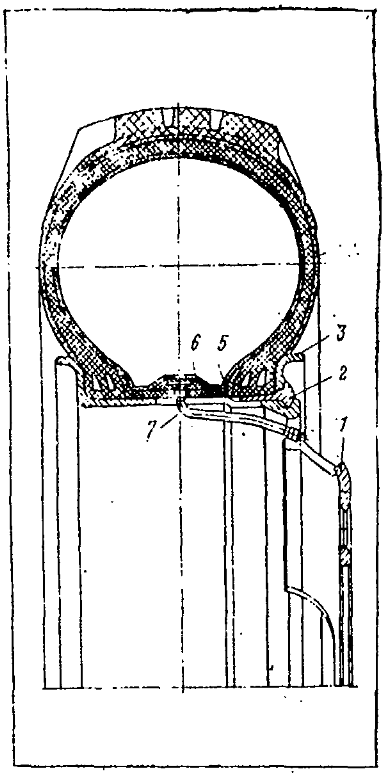


Figure 15-1: ZIL-130 wheel (assembled)

1 -- disk with wheel rim; 2 -- lock ring; 3 -- side ring; 4 -- tire casing; 5 -- rim band; 6 -- inner tube; 7 -- valve

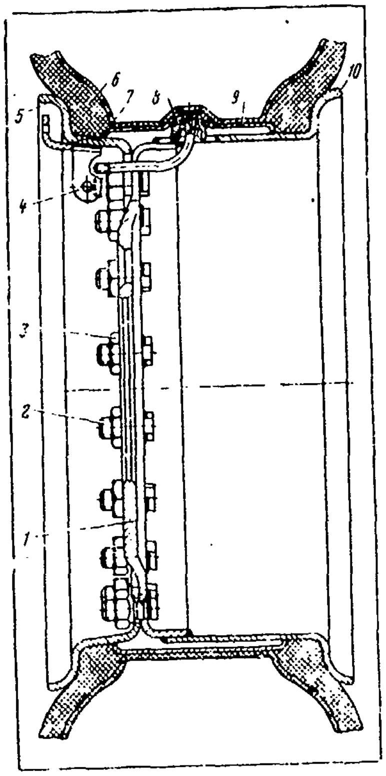


Figure 15-2: ZIL-157K rim (assembled)

1 -- wheel disk; 2 -- bolt; 3 -- nut; 4 -- plate for securing the protective cover; 5 -- external wheel rim; 6 -- tire casing; 7 -- inner tube; 8 -- inner tube valve guide; 9 -- spacer ring; 10 -- internal wheel rim

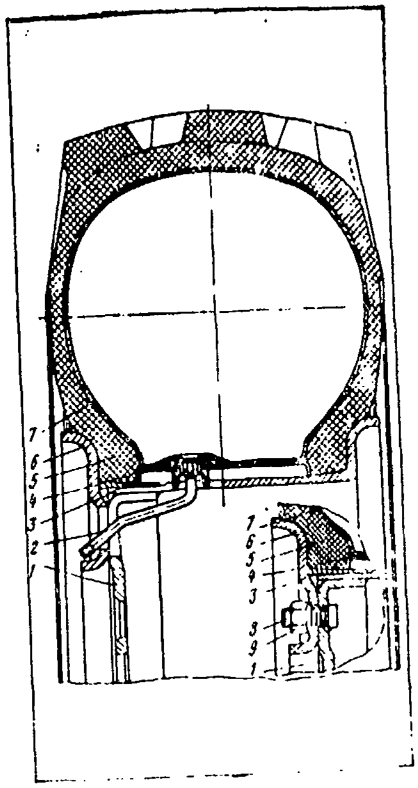


Figure 15-3: ZIL-131 wheel (assembled)

1 -- disk with wheel rim; 2 -- inner tube valve; 3 -- seating ring; 4 -- spacer ring; 5 -- tire casing; 6 -- side ring; 7 -- inner tube; 8 -- bolt; 9 -- nut

ZIL-157K and ZIL-131 wheels and tires are identical in terms of their construction. The wheels (Figure 15-2, 15-3) are steel disk wheels.

Because the tires use regulated air pressure, the wheels have a split rim and a spacer ring. The rim of the wheels is joined to the side ring with seventeen bolts and nuts.

The tires have various pressures. At low pressure the tires are held on the rim by the sides of the tire casing which are pressed between the side of the wheel and the spacer ring.

The vehicles are equipped with a spare wheel which is located under the bed on the right side on the ZIL-157K, and in a wheel mount behind the cabin on the ZIL-131.

Technical Characteristics of Wheels and Tires

Specification	ZIL-157K	ZIL-131
Wheel specification	9.0X18	9.0RG X 20
Securing to the hub (right wheel lugs have right-hand threading, left wheel lugs have left-hand threading)	6 lugs	8 lugs
Permissible wheel play in an axial and radial direction	not more than 3 mm	not more than 3 mm
Permissible face play	not more than 0.8	
Type of tire	variable pressure	
Tire dimension	12.00X18	12.00X20
Number of plies	8	8
Load per tire	1,850 Kg	2,200 Kg
Air pressure in front and rear tires	3.5-0.5 Kg/cm^2, depending on road conditions	4.2-0.5 Kg/cm^2, depending on road conditions
Type of tread pattern	all-terrain	

A centralized system for regulating the air pressure in the tires. The ZIL-157K and ZIL-131 are equipped with a centralized system of regulating the air pressure in the tires (Figure 15-4, 15-5, Table 15-1). The presence of this system permits:

Passage over difficult road sectors;

Continuation in the event of a puncture;

Observation of the air pressure in the tires.

On the ZIL-157K the air is supplied to the tires through the journal hole and the circular journal bushing gap, and on the ZIL-131 air is supplied to the tires through the journal hole and the axle channel.

On the ZIL-157K the air pressure control slide valve *4* (see Figure 15-4) is installed under the dash and is an independent device which is connected with the limiter valve *24* by a line. Air is directed from the valve to the tires through the tire valve unit *22* and the lines.

On the ZIL-131 the pressure control slide valve *5* (see Figure 15-5) is also installed under the dash. It is a combination unit, but it is connected with the limiter valve. There is no tire valve unit in the system. Air is sent from the valve to the tires directly through the T-joints and lines.

Table 15-1: Technical Characteristics of the Devices of the System for Regulating Air Pressure in the Tires

Devices	ZIL-157K	ZIL-131
Pressure control valve	slide valve, separated from the limiter valve	slide valve, connected with the limiter valve
Pressure limiting valve	diaphragm type with by-pass valve separated from the diaphragm	diaphragm type with by-pass valve installed in the middle of the diaphragm
Tire valve unit	with valve for each wheel	---
Air supply attachment	dismantlable, mounted on the end of the external surface of the journal	non-dismantlable, mounted within the journal

(Table 15-1 continued)

Device	ZIL-157K	ZIL-131
Tire valve	plug type, installed on the inner tube valve	plug type, installed in the seat of the half-axle flange

When using the vehicle the following rules for using the system of regulating the air pressure in the tires must be observed.

When travelling on roads with a hard surface, maintain an air pressure in the tires of 3.5 Kg/cm^2 for the ZIL-157K when it is loaded to 4,500 Kg; for the ZIL-131 maintain 4.2 Kg/cm^2 when it is loaded to 5,000 Kg. Maintaining the indicated pressure will provide for increased service life for the tires.

The air pressure in the tires should be lowered only on soft ground when there is a load on the bed of the vehicle not in excess of 2,500 Kg. The pressure may not be lowered if the load exceeds 2,500 Kg. When using the air pressure regulation system, the driver must know that during movement the valves of the valve unit and the tire valves must be completely open. When standing for long periods, in order to avoid air leaks, the tire valves should be closed, and on the ZIL-157K the valve unit valves should also be closed.

In order to determine the air pressure in the tires by the manometer on the ZIL-157K, the pressure control valve arm must be placed in the neutral position and all of the valve unit valves and tire valves must be open. If it is necessary to determine the pressure in an individual tire, the valve of all remaining tires must be closed. There is no valve unit on the ZIL-131; therefore the indicated requirements do not apply. The system of regulating the air pressure in the tires makes it possible to continue the movement of the vehicle in the event that the tires are damaged under conditions such that the output of the compressor can replace the air leakage from the damaged inner tube and can supply pressure to the pneumatic brake system.

On the ZIL-157K the scale of the manometer which measures the air pressure in the tires is calibrated up to 4 Kg/cm^2, but the pressure in the air tank reaches 7.2 Kg/cm^2, and in exceptional circumstances may rise to 9 Kg/cm^2; therefore the pressure control valve arm may not be placed in the extreme right position *inflate* (when the valve unit valves are closed or when any of the tire valves are closed), since the air pressure may damage the manometer.

So as to avoid damaging the tire air pressure control manometer, when supplying air to the system which regulates the air pressure, the pressure control valve lever may be moved to the *inflate* position (the right position) only when the valve unit valves and the tire valves are fully open. In order to prevent a sharp increase in pressure, movement of the control valve lever to the *inflate* position must occur smoothly.

Swampy places are handled by using second gear (gearbox) and first gear (transfer gearbox), having preliminarily reduced the pressure in the tires to 0.75-0.5 Kg/cm^2. The movement speed must not be greater than 10 Km/hour.

Sandy sectors should also be traversed with reduced tire pressure (1.0-0.75 Kg/cm^2), depending on the density of the sand and the conditions of movement.

The vehicle will traverse snow up to 300 mm deep well without reducing the pressure in the tires. Turns on fresh snow must be made in the same manner as when driving through a swampy meadow.

When the snow cover is very deep, and hinders the movement of the vehicle, the pressure in the tires should be reduced to 0.75-0.5 Kg/cm^2, depending on the density of the snow.

Table 15-2: Air Pressure Norms in Tires and Vehicle Movement Speeds for Various Types of Ground

Road conditions	Permissible internal tire pressure, Kg/cm^2	Maximum permissible speed, Km/hour
Fresh snow, swampy ground	0.5-0.75	10
Loose sand, soft ground, soggy meadowland	0.75-1.0	20
Roads of all types over the period of inflating the tires up to their norm after traversing a roadless section	1.0-3.0	30

When traversing difficult sectors with soft ground, the pressure in the tires should be set in accordance with the nature of the ground. The pressure should not be lowered by more than is necessary, according to road conditions. It is also necessary to remember that mileage is limited at reduced pressure; therefore a reduction in pressure should be used only in the case of necessity.

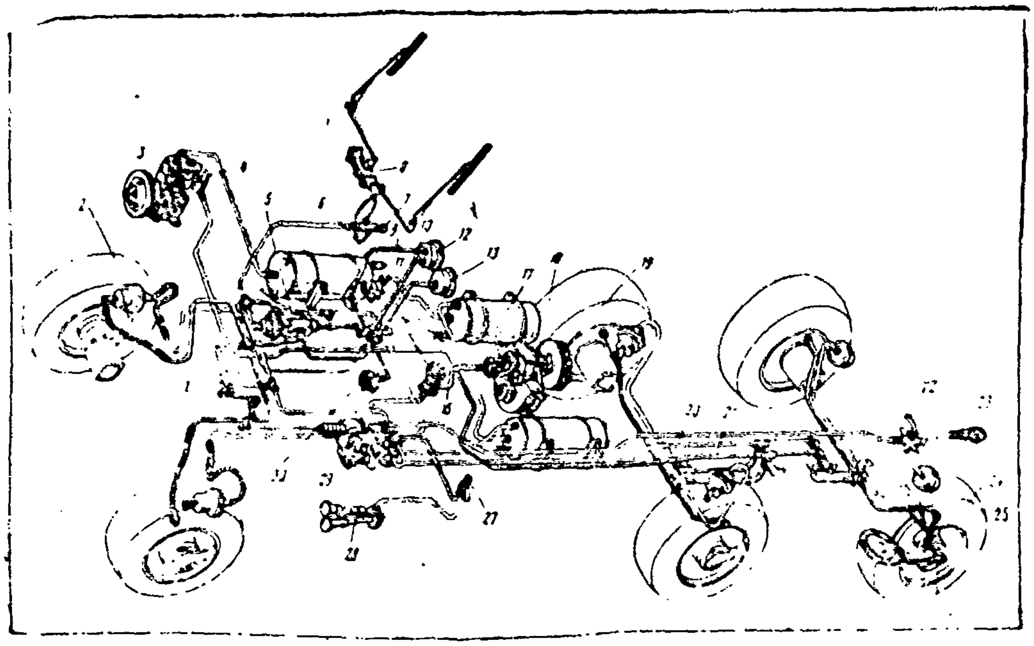


Figure 15-5: The ZIL-131 tire air pressure regulating system

1 -- brake pedal; 2 -- brake chamber; 3 -- compressor; 4 -- pressure regulator; 5 -- combined pressure control valve; 6 -- safety valve; 7 -- windshield wiper switch; 8 -- windshield wiper; 9 -- hose to the manometer for controlling the pressure in the brake chambers; 10 -- hose to the manometer for controlling the air pressure in the pneumatic system; 11 -- air release valve; 12 -- manometer for controlling the pressure in the brake chambers; 13 -- manometer for controlling the pressure of the air in the tires; 14 -- electric air valve for switching on the front axle drive; 15 -- dump valve; 16 -- hose for controlling the switching-on of the front axle; 17 -- air tank; 18 -- transfer gearbox; 19 -- hand brake; 20 -- brake system lines; 21 -- tire air pressure regulating system lines; 22 -- release valve; 23 -- coupling attachment; 24 -- attachment for supplying air to the tires through the half-axle; 25 -- air supply valve; 26 -- tire valve; 27 -- air horn switch; 28 -- horns; 29 -- combined brake valve; 30 -- brake signal switch

Travelling on hard-surface roads with reduced tire pressures in order to increase the smoothness and softness of the ride is forbidden.

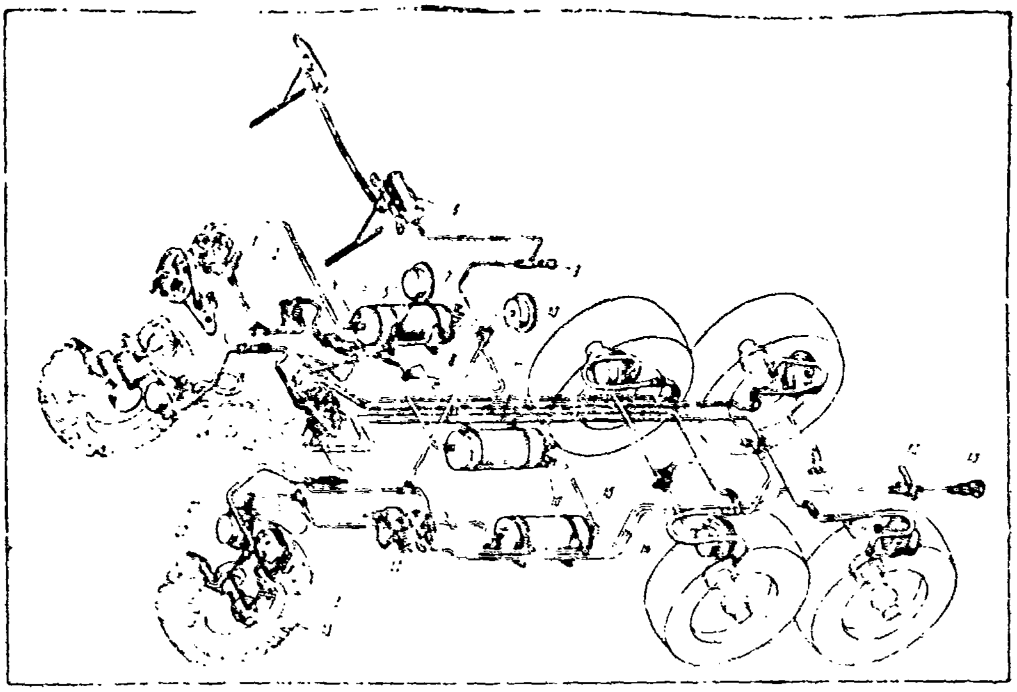


Figure 15-4: The ZIL-157K tire air pressure regulating system

1 -- compressor; 2 -- pressure regulator; 3 -- safety valve; 4 -- pressure control valve; 5 -- manometer for controlling tire air pressure; 6 -- windshield wiper; 7 -- air release valve; 8 -- pressure control valve level; 9 -- windshield wiper switch; 10 -- manometer for controlling air pressure in the brake lines; 11 -- tire air pressure regulating system lines; 12 -- release valve; 13 -- coupling attachment; 14 -- brake system lines; 15 -- air tanks; 16 -- dump valve; 17 -- combined brake valve; 18 -- stopcock; 19 -- air supply attachment; 20 -- channel for supplying air to the tire through the journal; 21 -- brake chamber; 22 -- tire valve unit; 23 -- air release tube; 24 -- tire air pressure drop limiter valve

When going from a difficult [terrain] sector to a hard road, it is necessary to stop and increase the pressure in the tires to at least 1.0 Kg/cm^2. A further in crease in the pressure up to the normal amount may be accomplished in motion at a speed of 30 Km/hour.

Table 15-2 presents the tire air pressure norms. When travelling with reduced pressure in the tires it is necessary to follow carefully the indications of the tire air pressure manometer. When a vehicle travels for a long time at high speed the temperature of the air in the tires increases. This increase in temperature causes an increase in the pressure in the tires. This pressure may not be reduced.

Equipment Servicing

At each daily vehicle servicing, prior to leaving [the motor pool], it is necessary to check the tightness of the lug nuts. The lug nuts are tightened in a star pattern, which provides for an even contact between the wheel disk and the hub flange.

On the ZIL-130 the inner tube valves must always be checked and must have caps on each wheel.

The pressure of the air in the tires must be checked periodically. One must keep gasoline, kerosine, and oil from getting on the tires.

If these liquids get on the tires, the tires should be wiped dry.

If the tire casings show uneven wear, the tires should be rotated according to the diagram shown in Figure 15-6 and 15-7.

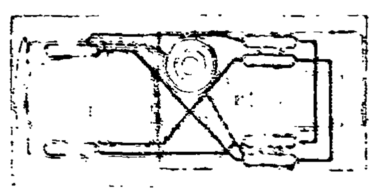


Figure 15-6: ZIL-130 tire rotation plan

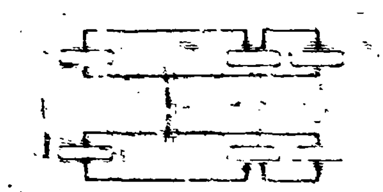


Figure 15-7: ZIL-157K and ZIL-131 tire rotation plan

On the ZIL-157K and ZIL-131 the tire casings with a directional (high efficiency) tread should be mounted so that the sharp projection (when looking at the tire casing from above) faces forward as the vehicle travels.

When the vehicles stand for a long time or are transported by rail, the central pressure control valve and the tire valves on the wheels must be closed. The adjustment of the hub bearings of the front and rear wheels should be checked every other #2 Equipment Inspection.

To adjust the conical wheel hub bearings of two-axle and three-axle vehicles, it is necessary to tighten the bearing attachment nut until the hub begins to drag, turning the hub here in both directions so that the rollers are correctly positioned about the conical wheel surfaces. Then back off the nut by approximately 1/5 turn until the pin in the nut lines up with the closest opening in the lock washer. At the end of the adjustment, the lock nut must be tightened with a wrench until it will turn no more.

Every other #2 Equipment Inspection it is necessary to repack the wheel hubs. Before lubricating the bearings, clean the wheels of dust and dirt and flush out the hub chambers with any low-viscosity oil. When inserting fresh lubricant it is necessary to lubricate the bearings thoroughly.

On two-axle vehicles in addition to packing lubricant directly into the bearings, it is necessary additionally to pack lubricant into the hub chambers in accordance with the lubrication chart.

On the ZIL-157K, besides lubricating the bearings, lubricant should be added to the external seal of the oil seal of the air supply attachment of the tire air pressure regulating system. The reliable operation of the air supply attachment in many ways depends on the presence and condition of the lubricant on the sliding surfaces of the oil seal sealing ring and covers.

When removing the air supply attachment and when installing it on the journal, carefully lubricate the internal surface of the oil seal sealing ring and the covers, as well as the journal end surface.

After installing the air supply attachment it is necessary to fill the space between the attachment and the hub bearing adjustment nut, as well as the space between the attachment and the journal oil holder, with lubricant.

In order not to disrupt the running-in of the sliding surfaces when assembling the air supply attachment, all parts should be placed in their previous position.

Every 35,000-50,000 Km on the ZIL-131 the journals are removed and the air supply attachment seals are checked and the lubricant in them is renewed.

The balancing of the wheels of the ZIL-130 is done when changing a tire or in the event that the tire is worn unevenly. In order to eliminate wheel vibrations which arise as a result of an unbalanced wheel condition, the plant has balanced the wheels together with the tires as a unit. Temporarily, in connection with the significant labor requirement of these operations, only the front wheels and spare wheel of the vehicles are being balanced.

The unbalanced state may be eliminated with balancing weights *4* (Figure 15-8) attached to the side ring *2* with a flexible spring clip *3*, the end of which passes under the edge of the tire casing *1*.

The weights are attached after the tires are inflated with air.

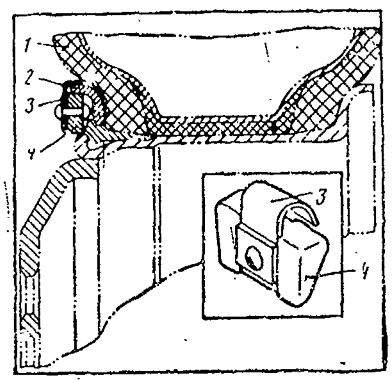


Figure 15-8: Attaching the balancing weight to the front wheel

1 -- tire casing; 2 -- side ring; 3 -- flexible spring clip; 4 -- weight

Figure 15-9 shows a foreign firm's device for balancing wheels without removing them from the vehicle.

In order to balance the wheels, the device *1* is positioned near the wheel being balanced *3*. The forward portion of the vehicle is raised 100 mm on two jackstands *6*. The jackstand placed near the wheel being balanced is equipped with a spring device.

The device is equipped with a vibration sensor *5* which is attached to the front axle beam, and a strobe light *2*, which is connected to the vibration sensor. The friction roller *4* of the device turns the wheel to the right and to the left at a rotational speed which corresponds to a vehicle movement speed of 130 Km/hour. Flashes of the strobe

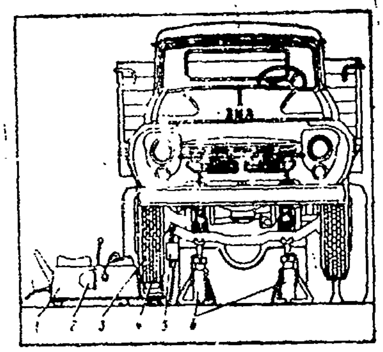


Figure 15-9: Balancing the front wheel of a ZIL-130

1 -- balancing device; 2 -- strobe light; 3 -- wheel being balanced; 4 -- friction roller; 5 -- vibration sensor; 6 -- jackstand

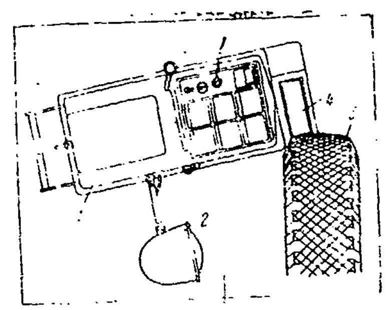


Figure 15-10: Contact between the friction roller and the tire

1 -- device; 2 -- strobe light; 3 -- wheel; 4 -- friction roller

light (Figure 15-10), when the wheel is turning in both directions, permits two lines (marks *1* and *2* on Figure 15-11) to be made on the wheel. The middle line *3* between these lines indicates the place where the weights are to be attached. The balancing of the rear axle wheels is accomplished with the half-axle pulled.

In the absence of a device, the wheel may be balanced on its hub in the following order:

Unscrew the lug nuts, remove the wheel from the hub and carefully clean the wheel of dirt and wash the wheel.

Remove the hub cover, unscrew the bearing attachment nut, remove the hub from the brake drum along with the exterior bearing from the turn journal and clean off the dirt. Completely remove the lubricant from the bearing hub and wash the hub. The presence of dirt and oil may influence the correct balance of the wheel.

Press the oil seal out of the hub without damaging it.

Set the hub, together with the brake drum, in its previous location, and adjust the bearing so that the hub turns freely, but has no axial clearance.

Install the wheel on the hub and secure the wheel.

Check the balance of the wheel together with the tire as a unit, turning the wheel to various positions around the axis.

In order to eliminate the unbalanced state, make a chalk mark on the lighter part of the wheel, i.e., that part which remains higher after the wheel has been spun freely.

Attach a balancing weight to the wheel rim at the marked place.

Turn the wheel 90° sequentially in each direction so that the weight is on a horizontal axis. If the wheel will not remain in either position and returns to the initial position (with the weight at the top), then a second weight should be attached next to the first weight, following which the operation indicated during the installation of the first weight should be followed.

As the wheel balancing continues, all subsequent weights are to be attached symmetrically on both sides of the first weight (see Figure 15-12A). The balancing must be continued until wheel equilibrium is attained.

If after the installation of one of the weights the wheel does not return to the position with the weight up, but turns with the weight down, remove the weight which was installed and consider the wheel balanced. In the event that there is a significant imbalance and there is no possibility of eliminating it with five weights, it is recommended that such a wheel be removed from the front axle and be replaced with the spare or another wheel from a rear axle.

After eliminating the imbalance, the weights must be correctly affixed to the rim in those places at which they were attached during the balancing.

The seating of the weights in place is accomplished by pressing with your hand or by a wooden object (the handle of a screwdriver or hammer), having preliminarily pressed the side of the tire casing away from the side ring with the mounting claw (Figure 15-12B).

It is not recommended that the weights be beaten into place with the blows of a hammer or other hard instrument. This may damage the spring clip which attaches the weight and destroy the reliability with which the weight is attached.

The use of damaged weights on the wheels is not permitted, since as the vehicle is travelling, the damaged or incorrectly installed weight, which will fly off the wheel, may cause an unfortunate occurrence.

For this very same reason, *homemade spring securing the weight should not be made and mounted.*

In order to remove a weight from the rim, it is necessary to press the side of the tire casing away from the rim with the mounting claw and to remove the weight with a screwdriver so that the force removing the weight is directed away from the wheel to the side (see Figure 15-12C).

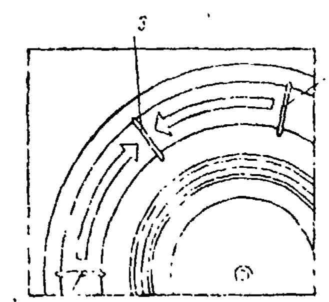


Figure 15-11: The position of the imbalance marks on the wheel (while it is being balanced)

1 and 2 -- initial marks; 3 -- balance point mark

After balancing the wheel and installing the weights on it, note with a piece of chalk the position of the wheel on the hub, remove the wheel and the hub together with the brake drum from the turn journal. Press the oil seal into the hub, insert lubricant, mount the hub, install the wheel in its previous position, observing the correct assembly and adjustment of the bearings.

The other front wheel is balanced in the same manner as indicated above.

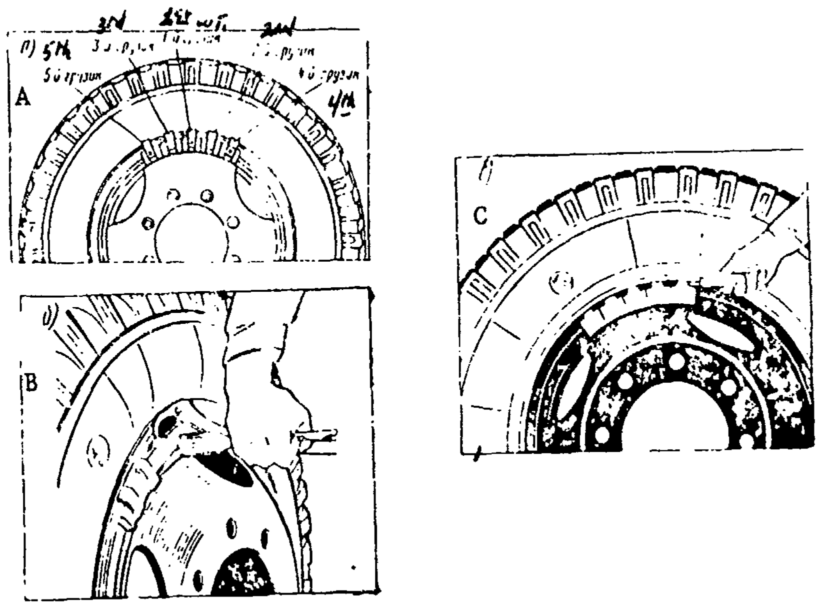


Figure 15-12: Wheel balancing

A -- order of installing the weights;
B -- installation of the weights;
C -- removing the weights

Figure 15-13 presents a plan for an easily manufactured special device which permits a wheel to be balanced together with its hub as a unit, or the wheel without the hub to be balanced, but in this case the device must be equipped ahead of time with a hub together with a brake drum as a unit, which has been balanced ahead of time on the device, and on which the wheel will be mounted.

Balancing the ZIL-157K wheels is accomplished in the same manner as balancing front wheels of two-axle vehicles, with only the slight difference that when balancing the wheel on the hub, the hub must be freed from the half-axle so that there will be no hindering of the free turning of the hub on its bearings. Remove the protective cover of the air supply line and the air line itself, having disconnected it from the connection and the stopcock.

The imbalance of the wheel is eliminated by weights weighing 225 gm and 700 gm, which are mounted on the coupling bolts which

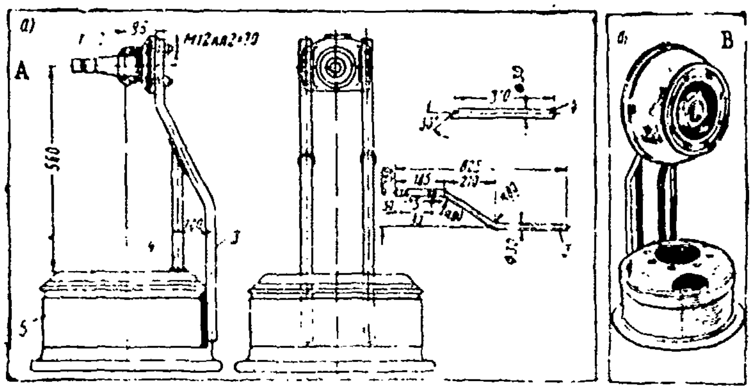


Figure 15-13: A device for balancing a wheel

A -- together with the hub as a unit;
B -- without the hub;
1 -- turn journal; 2 -- bearing;
3 and 4 -- welded braces; 5 -- base

connect the internal and external rims at the nuts *2* (Figure 15-14A).

The dimensions and weights of the weights are shown in Figure 15-14B. Not more than four balancing weights in their various combinations by weight may be installed on one wheel.

Balancing the ZIL-131 wheels. The ZIL-131 wheels together with the tires as a unit are balanced at the plant. The permissible imbalance is 4 Kg·cm. As the tires wear in use, and for several other reasons (when the tires are remounted), the initial balance is disturbed, and therefore a vibration, especially of the front wheels, arises when the vehicle is in motion.

Imbalance causes accelerated wear on the tire tread and the steering control and suspension parts. It also makes control of the vehicle difficult.

In order to eliminate the vibration, it is recommended that the wheel be balanced together with the tire as a unit on a device (see Figure 15-13).

The imbalance is eliminated by means of weights mounted on the coupling bolts at the nuts (Figure 15-15).

The wheel which is being balanced, together with the tire as a unit, is mounted on the device and is balanced to the point of equilibrium with the help of some kind of additional weight (modeling clay, clay, or some other material). This material is affixed to the protruding end of one of the coupling bolts or is affixed directly to the tire. The tire weight is suspended and the magnitude of the actual imbalance is determined by multiplying the weight of the tire weight by the leverage arm at which it was placed.

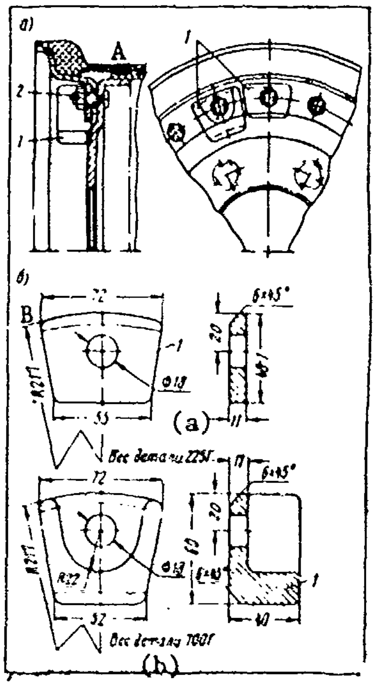


Figure 15-14: Installation of balancing weights on a ZIL-157K wheel

A -- position of the weights on the wheel; B -- weight dimensions; (a) -- part weight 225 gms, (b) -- part weight 700 gms; 1 -- weights; 2 -- nut

Specific balancing weights are selected in accordance with Table 15-3 and are installed on the bolts in the area where the equilibrium-generating weight was affixed. Not more than two large or six small balancing weights in various combinations may be mounted

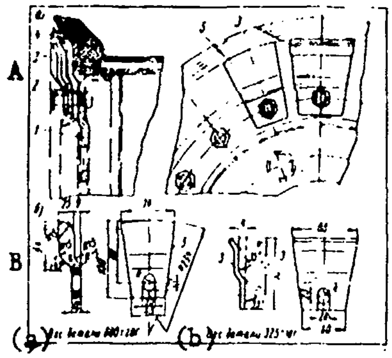


Figure 15-15: Installation of balancing weights on a ZIL-131 wheel

A -- position of the weights on the wheel;
B -- small and large weight dimensions;
(a) -- part weight 800 ± 20 gms;
(b) -- part weight 325 ∓ 10 gms;
1 -- wheel rim; 2 -- nut; 3 and 5 -- weights;
4 -- wheel side ring

on one wheel. If the imbalance is great and is not eliminated by this number of weights, the wheel must be demounted and the tire casing must be rotated until the least imbalance is obtained, following which the balancing should again be done.

Table 15-3: Selection of Balancing Weights

Imbalance of the wheel together with the tire as a unit, Kg·cm	Total number of balancing weights	
	small	large
4-12	1 (see Fig. 15-15, item 3)	---
12-20	2	---
20-27.7	3	---

(Table 15-3 continued)

Imbalance	small weights	large weights
27.7-35.7	4	---
35-7-43.5	---	2 (see Fig. 15-15, item 5)
43.5-50	6	---
50-58	2	2

When balancing the wheel together with the tire as a unit on the device, it is necessary to take into account the imbalance created by the hose which supplies air to the tire and by the protective cover of the hose (equal approximately to 6.4 Kg·cm). This imbalance may be compensated for, having placed a weight of 300 gms near the valve opening at the radius of the coupling bolts.

In the event that there is no device, the wheel may be balanced directly on the vehicle axle journal in the following order:

With a jackstand raise the axle from the side of the wheel being balanced. Remove the protective cover and the air supply hose. Remove the wheel. Remove the half-axle flange (front axle) or the half-axle (middle and rear axles); remove the hub with the bearing and the internal oil seal and remove the external oil seal.

Press out the internal oil seal from the hub, taking special care not to damage it. Remove the lubricant from the hub and bearing and wash [the hub].

Install the hub with the bearing on the axle journal (without oil seals or lubricant) and turn down and tighten the bearing securing nut so that there is no noticeable axial play; the hub must turn freely here.

Place the wheel together with the tire as a unit on the lugs and balance the wheel as indicated above.

In the event that the tire is removed from the wheel in order to change the tube or to clean the wheel of corrosion and paint, the wheels need not be balanced if the tire casing, the balancing weights, and the other parts are installed in the same places they occupied prior to the dismantling.

Inasmuch as the balance of the wheels is destroyed by using [the vehicle], it is necessary to check the magnitude of the imbalance every 12,000-15,000 Km (every second or third #2 Equipment Inspection).

The spare wheel must always be balanced.

Equipment servicing for the tire air pressure regulating system. In servicing the equipment, special attention should be paid to the hermetic connections of the lines and flexible hoses.

Places where there are large air leaks may be determined by ear, and places where there are small leaks may be determined with the help of a soapy solution with which the location of the supposed leak should be wetted.

An air leak through a line connection is eliminated by tightening or replacing the connecting element. The tightening moment for threaded connections must be 0.4 Kg·m.

In a correctly operating pneumatic system the drop in the air pressure in the tires with the pressure control valve closed, the valve unit valves open, and the tire valves open should be not greater than 0.5 Kg/cm^2 over a six-hour period for the ZIL-157K. It should be kept in mind here that the checking of the hermetic state must take place after the tires have cooled to the temperature of the surrounding medium.

When there is significant damage to the devices of the air pressure regulating system, the tire valves may be removed and slide valves may be inserted in the tube valves. The operation of the air supply attachment, which in many ways depends on the presence and quality of the lubricant on the sliding surfaces of the seals of the oil seals and covers, should be periodically checked; therefore, for the ZIL-157K the lubricant in the wheel hub must be changed at intervals stipulated by the lubrication chart. For the ZIL-131 the lubricant should be changed each time the hub is removed.

It is not permissible to disturb the running-in of the sliding surfaces when dismantling the air supply attachment. When installing the attachment on the journal, the interior surface of the seal edges and the surface of the journal should be lubricated with the lubricant used for wheel hubs.

In order to keep the ends of the bolts from catching on the bearing adjusting nuts, the nuts of the bolts with which the attachment is coupled must protrude in the direction of the half-axle flange (ZIL-157K).

All of the lines and hoses of the system for regulating the pressure of the air in the tires should be periodically carefully blown out prior to changing the lubricant in the hub and journal. For this, it is necessary to free the upper end of the line leading from the hub to the stopcock, having preliminarily closed the stopcock plug; remove the condensate from the air tanks; start the engine and bring the pressure of the air in the pneumatic brake lines up to maximum, sequentially opening the valve unit valves on the ZIL-157K, and blow out each branch of the lines. On the ZIL-131, when blowing out each branch, the tire valve of each wheel should be opened in sequence with the hose disconnected and a slide valve inserted in the tube valve.

At the daily inspection following the end of vehicle work, it is necessary to drain the condensate from the pneumatic system's air tanks.

The operation of the pressure control valve line should be checked periodically and, if necessary, adjusted according to the method presented below.

Disassembly and Assembly

ZIL-130

To remove the front wheels it is necessary to loosen the lug nuts, raise the vehicle, fully undo the nuts, and remove the wheels.

When removing the double rear wheels, first undo the nuts which secure the outer wheel and remove the outer wheel. Then undo the cap nut which secures the inner wheel and remove the inner wheel.

To unscrew and screw down the nuts use a model 2460M nut wrench manufactured by the GARO (*Trest po proizvodstvu garazhnogo oborudivaniya*/ Garage Equipment Manufacturing Trust)(Figure 15-16).

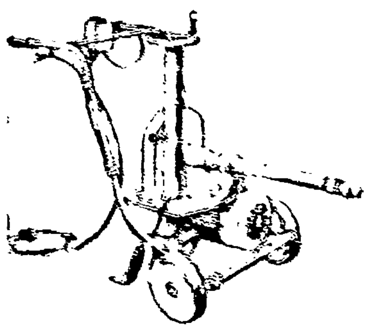


Figure 15-16: The model 2460M nut wrench

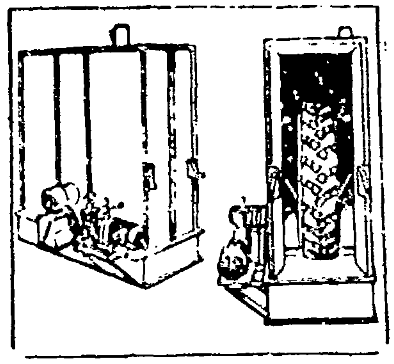


Figure 15-17: A tire casing washing machine

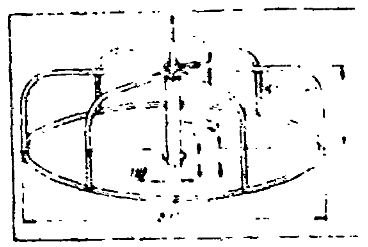


Figure 15-18: A removable safety device

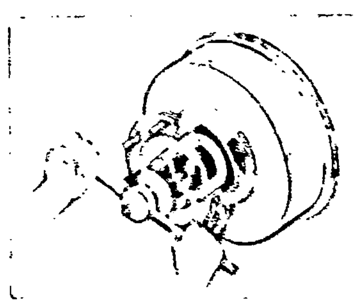


Figure 15-19: Pressing out the external ring of the front wheel bearing of a ZIL-130

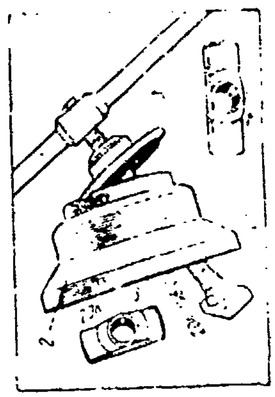


Figure 15-20: An extractor for demounting the external rings of the external and internal bearings of the front and rear wheel hubs of a ZIL-130

1 -- clamps; 2 -- housing; 3 -- disk

For tire changing operations the vehicles are equipped with tire irons. One tire iron has a flat end and the other — which simultaneously serves as the jack lever — has an end with a curved claw. When dismantling the wheel the air should be let completely out of the tube and, using the indicated instrument, the lock and side rings, and the tire casing should be removed. Remove the rim band and the tube from the tire casing.

Assembly of the wheels is accomplished in the reverse sequence. Before assembling the wheels it is necessary to check the suitability of the wheel rim and of the side and lock rings. Bent rims and rings must be straightened, cleaned of rust, and painted.

Prior to repair and assembly, the tire casings must be cleaned of mud and dirt, and washed in warm water at a temperature of 45-50°C. It is recommended that the tire casings be washed in a machine (Figure 15-17).

The assembly of the wheels must be done in the following manner: lightly dust the interior portion of the tire casing and the tube with talcum powder; insert the tube into the tire casing and install the rim band; mount the tire casing on the rim, and mount the side ring and insert the lock ring. Ascertain that the tire casing has gone behind the lock ring all around the circumference, and then add air to the tube up to the normal pressure.

When inflating tires with air, it is necessary to shield the wheel with protective devices (Figure 15-18).

Removal and disassembly of the front wheel hub. Undo the hub cover attachment bolts and remove the cover along with the gasket. Bend the stop washer aside and with a wrench unscrew the journal lock nut. Remove the stop washer and lock ring. With a wrench unscrew the hub bearing attachment nut and remove the hub together with the brake drum as a unit with an extractor (see Figure 13-6, Chapter 13). When removing the brake drum, the internal oil seal of the hub should be kept from being damaged. It should be kept in mind that the brake drums are processed together with the hubs as a unit and that they should be disassembled only in the case of extreme necessity. When removing the hub, simultaneously press out the internal bearing which will then be removed from the hub.

If the threading of the lug nuts is damaged, remove the lug nuts with an offset box wrench and press out the bad lugs, and press in new lugs in their place.

The internal rings of the front wheel bearings are pressed out of the hub with a 20P-7974 extractor (Figure 15-19).

The extractor is composed of three clamps: the 20K-108-1 clamp for pressing out the internal ring of the external and internal rear wheel hub bearing of two-axle vehicles (Figure 15-20); the 20K-108-2 clamp for pressing out the external ring of the internal front wheel hub bearing of a two-axle vehicle; the 20K-108-3 clamp for pressing out the external ring of the external front wheel hub bearing of a two-axle vehicle.

Each time the internal ring of the internal bearing is removed, it is recommended that the turn journal be checked to see that it has no cracks.

Removal and disassembly of the rear wheel hubs. Remove the nuts which secure the half-axle flange to the hub and remove the half-axle by means of the removable bolts. Unscrew the hub bearing attachment locknut with a wrench, remove the lock washer and oil seal. Unscrew the hub bearing attachment nut, attach the model 2478 extractor to the drum lugs and remove the hub together with the brake drum as a unit (Figure 15-21), tapping lightly with a hammer around the drum. The external wheel hub bearing is removed simultaneously here. Remove the internal wheel hub bearing and the ring with the oil seal.

When disassembling the rear wheel hubs it is necessary to remove the oil deflector with the seal. The brake drum is manufactured along with the hub as a unit; they should be disassembled only in the case of extreme necessity (when changing lugs). If the bearings are worn, press the external bearings out of the hub with a 20P-7974 extractor.

Assembly and installation of the front wheel hub (Figure 15-22). Press the internal bearing onto the turn journal with the help of a mandril and hammer (the fit to be from a clearance of 0.032 mm to a tightness of 0.003 mm). The mandril must rest against the internal ring of the bearing. The bearing must be lubricated with lubricant grease. In the event the hub bearings are worn, they are replaced.

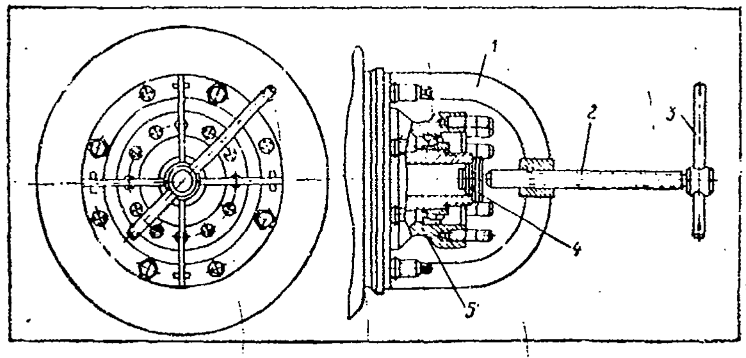


Figure 15-21: Removing the rear wheel hub of a ZIL-130

1 -- supporting bracket; 2 -- working screw; 3 -- handle; 4 -- adapter; 5 -- wheel hub

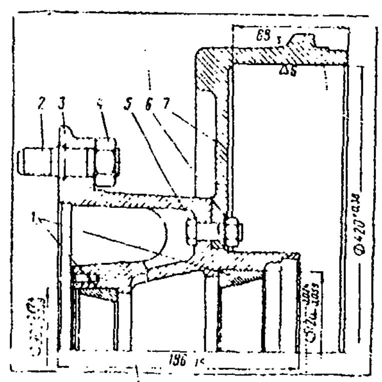


Figure 15-22: ZIL-130 front wheel hub

1 -- external bearing rings; 2 -- lug; 3 -- hub; 4 and 6 -- nut; 5 -- bolt; 7 -- brake drum;

The bearing rings are pressed into the hub with an internal and external bearing tightness of 0.009-0.059 mm. Place the thrust ring into the wheel hub and press in the oil seal. Place the lubricant in the wheel hub, install the wheel together with the brake drum *7* as a unit on the turn journal. Install the internal ring of the external bearing with the help of a mandril and hammer. Here the mandril must rest against the end of the internal bearing ring. The fit of the bearing is from a clearance of 0.027 mm to a tightness of 0.002 mm.

Place some lubricant grease in the bearing, screw on the hub bearing attachment nut and tighten it manually with a wrench until the hub begins to drag against the bearing. Following this, turn the wheel several times in both directions so that the bearing rollers will be correctly set. The brake drum need not bind against the lining the the brake shoes. Back off the bearing attachment nut by approximately 1/5 turn until the closest opening lines up with the lock ring pin. Here the hub must turn freely and have no noticeable axial movement. Install the lock ring and stop washer on the turn journal, screw down the lock nut and tighten it with a wrench 500 mm long until it will turn no more and bend the lock washer onto the edge of the nut. Mount the hub cover together with the gasket and secure the cover on the hub with the bolts, having placed spring washers under the heads of the bolts.

Since October 1965 the external bearing 7608U has been replaced by the bearing 7608K on the ZIL-130 and its modifications. The changed bearing has a greater thickness of the small collar of the internal ring with a corresponding reduction in the length of the roller. The external bearing ring has a barrel shape approximately several microns thick on the working surface.

The 7608K bearings must be used in all cases when the ZIL-130 external front axle hub bearings are changed. A # 130-001060-B washer-nut, which has an increased external diameter, and by which the external hub bearing is secured, must be used.

Assembly and installation of the rear wheels. Press the external ring *1* (Figure 15-23) of the external and internal wheel hub bearings into the hub (tightness is 0.010-0.068 mm). Press on the oil seal ring (tightness is 0.025-0.005 mm). Press on the internal ring of the internal bearing with the rollers until it stops. The seating of the rings is accomplished with a clearance of 0.015-0.060 mm. During the pressing the mandril must rest against the end of the internal ring of the bearing. Lubricate the bearing with lubricant grease, mount the hub along with the brake drum on the rear axle half-axle tube. Preserve the oil seal during the installation.

Press on the internal ring of the external bearing together with the rollers as a unit until they stop (clearance 0.015-0.060 mm).

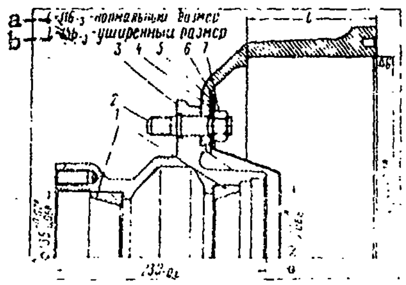


Figure 15-23: ZIL-130 rear wheel hub

1 -- external bearing ring; 2 -- lug; 3 -- hub; 4 -- brake drum; 5 -- seal; 6 -- oil deflector; 7 -- nut; (a) -- nominal dimension; (b) -- expanded dimension

During the pressing the mandril must rest against the end of the internal bearing ring. Using a wrench, tighten the bearing adjusting nut into the bearing until it stops.

To obtain the necessary adjustment of the conical roller bearings of the hub, tighten the nut with a wrench, the leverage arm of which is 500 mm long, until the nut will turn no more, turning the hub in both directions here so that the rollers will be correctly positioned around the conical surfaces of the rings. The nut is tightened so that the hub is braked by the bearings and turns stiffly. Then the nut is backed off by 1/5 turn.

Install the external oil seal, set the lock washer in place, and turn down the lock nut and tighten it until it will turn no more with a wrench, the leverage arm of which is 500 mm long.

ZIL-157K and ZIL-131 Vehicles

Dismantling and assembling the wheels. Prior to removing the wheels it is necessary to remove the protective covers and tire valves together with the lines as a unit. Loosen the lug nuts. Raise the driving axle and unscrew the nuts with the help of a nut wrench and remove the wheel. It is recommended that the dismantling of the wheel be done in the following sequence of operations:

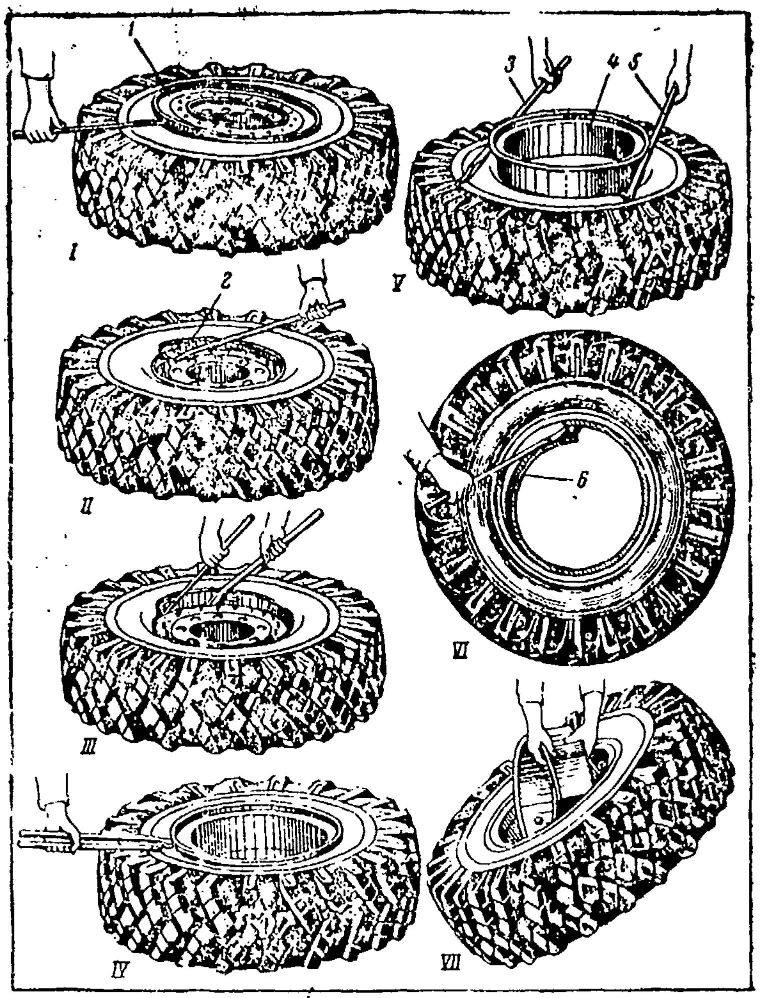


Figure 15-24: Dismantling a ZIL-131 wheel

1 -- side ring; 2 -- seating ring; 3 -- tire iron with flat end; 4 -- rim with disk; 5 -- tire iron with claw end; 6 -- spacer ring; I - VII -- sequence of wheel dismantling

Let the air completely out of the tube. Loosen the four nuts which are placed diametrically opposite one another. One after the other, loosen and remove the remaining nuts in order. Finally, remove the four nuts which were previously loosened.

Remove the side ring *1* (Figure 15-24) with the flat end of the straight tire iron (see I). To remove the seating ring *2* it is necessary to insert the tire iron with the claw end into the slot located next to the break in the seating ring from the inside and press the claw end down (see II). Repeat this application several times until the ends of the seating ring, in which the slots are located, is free.

Insert the straight end of the straight tire iron between the end of the rim and the free part of the seating ring and set this position. Also place the bent end of the tire iron with the curved claw between the rim face and the seating ring and press down on the tire iron (III). Working in this manner, completely remove the seating ring *2*.

To remove the wheel rim from the tire casing it is necessary to turn the wheel, and to insert the straight tire iron all the way into the rim between the rim flange and the side of the tire casing and press down on the tire iron. Insert the tire iron with the curved claw into the space which is formed between the tire casing and the rim. Press down on both tire irons *3* and *5* when they are so engaged (see IV). Repeat the preceding operation around entire circumference until the side of the tire casing is completely separated from the conical flange of the rim. If the wheel rim cannot be removed by hand, it must be extracted from the tire by the tire irons *3* and *5* (V).

To remove the spacer ring *6* it is necessary to stand the tire vertically and push the valve stem into the tire cavity through the valve guide opening in the spacer ring. Release the spacer ring lock using the tire iron (VI). Then rotate the ring within the tire by 90° and completely remove the ring (VII). Remove the tube from the tire casing cavity. The spacer ring with locked and unlocked lock is shown in Figure 15-25.

A 20P-7977 device may be utilized to remove a ZIL-157K tire from the wheel rim. In order to remove the tire, it is necessary to let the air out of the tire, unscrew the external wheel rim attachment nuts, remove the rim from the rim disk bolts, and install the device as is shown in Figure 15-26. Fasten the cleat *7* to the wheel disk with two wheel nuts *8*. Set up the two cross pieces *1* with the braces *5* and the shoes *6* so that the braces rest against the tire casing and the cross pieces are set in place by the guides *9*.

The head of the screw, which has projections, should be inserted in the base of the cleat *7*, which has been turned up against the wheel disk. Turn the screw 90°. This will cause the cleat *7* to engage the screw *3*.

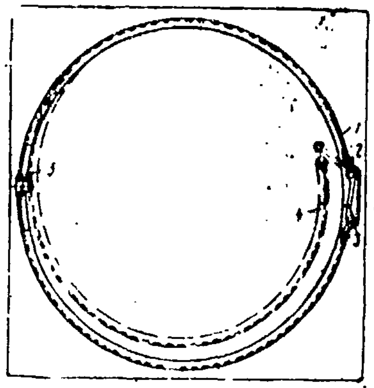


Figure 15-25: ZIL-131 wheel spacer ring

1 -- spacer ring in the operating position; 2 -- rivet; 3 -- lock; 4 -- spacer ring in the position for mounting in the tire; 5 -- valve stem guide bushing

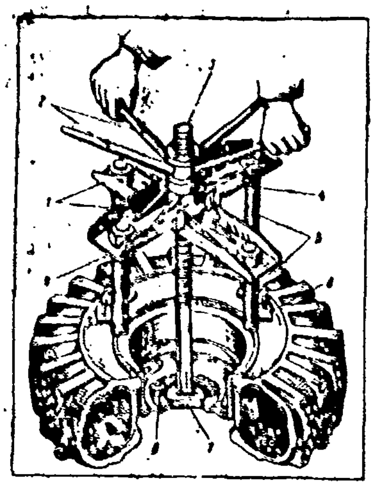


Figure 15-26: Removing the tire from the wheel rim of a ZIL-157K with the help of a device

1 -- cross peices; 2 -- handles; 3 -- screw; 4 -- hub; 5 -- braces; 6 -- shoes; 7 -- cleat; 8 -- wheel nuts; 9 -- cross piece guides

When the hub *4* with the nut screwed up inside it is turned, the screw *3* will rise along with the screwed-in cleat, drawing the internal wheel rim out of the tire.

To remove the spacer ring from the tire it is necessary to stand the tire vertically, open the lock, turn the ring 90° inside the tire, and remove the ring from the tire (see positions VI, VII in Figure 15-24). The ZIL-157K wheel spacer ring is similar in design to the wheel spacer ring of the ZIL-131 (see Figure 15-25).

Removal and disassembly of the hub. It should be kept in mind that the dimensions of the internal and external wheel hub bearing rings of the ZIL-157K and ZIL-131 are identical; therefore the dismantling of the hub, as well as that of its assembly, is accomplished with the same devices. To remove the front wheel hub it is necessary to unscrew the nuts which secure the slotted flange and remove the flange by means of the two removable bolts, screwing them into the threaded openings of the flange when the lock nut is loosened. Remove the flange gaskets and remove the deflector from the ZIL-157K. (The ZIL-131 has no deflector) from the circular hole of the journal (at the middle and rear axles and half-axle is removed instead of the slotted flange).

Unscrew the air supply connection from the attachment and remove it from the seat of the hub cover of the ZIL-157K (on the ZIL-131 the connection is screwed into the brake support disk).

Unscrew the screws which attach the hub cover of the ZIL-157K and remove the cover from the hub, while tapping lightly with a hammer. There is no hub cover on the ZIL-131. Remove the air supply attachment from the journal on the ZIL-157K. On the ZIL-131 the air supply attachment is located inside the journal (at the rear).

Unscrew the lock nut which secures the bearing with the help of a special wrench and remove the lock washer. Unscrew the nut which secures the bearing with the help of a special wrench, fasten the model 2478 extractor to the drum lugs and, tapping lightly with a hammer, remove the hub together with the brake drum and the external bearing as a unit. Remove the internal ring of the internal bearing together with the rollers as a unit from the journal.

It is recommended that the 20P-7976 special extractor be used when changing the worn external rings of the external bearings of the wheel hub of a three-axle vehicle. A method of pressing out the external ring of the external bearing of the hub of the front or rear wheel of a three-axle vehicle is shown in Figure 15-27. A 20P-7975 extractor for pressing out the external rings of the internal bearings of the hubs of the front and rear wheels is shown in Figure 15-28.

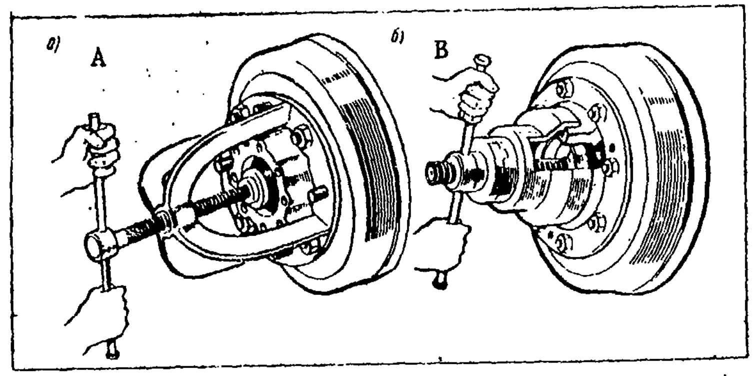


Figure 15-27: Removal of the hub (A) and pressing out (B) the external bearing ring

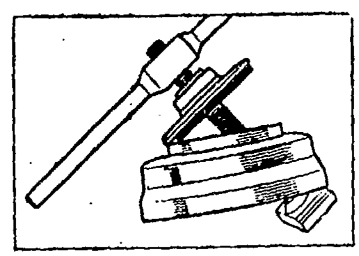


Figure 15-28: An extractor for the external rings of the internal bearings of the hubs of the front and rear wheels of three-axle vehicles

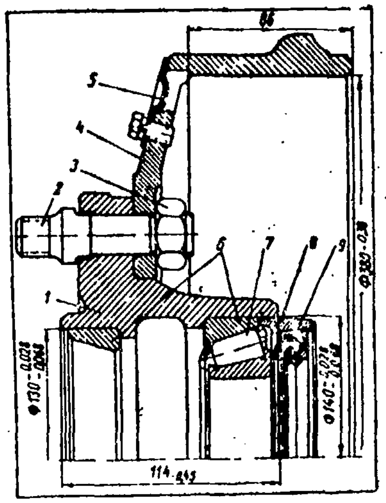


Figure 15-29: The ZIL-157K wheel hub assembled

1 -- hub; 2 -- lug; 3 -- nut; 4 -- brake drum;
5 -- hole cover; 6 -- external bearing rings;
7 -- bearing roller; 8 -- oil seal ring;
9 -- oil seal

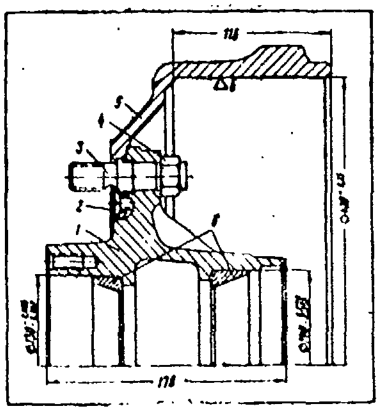


Figure 15-30: The ZIL-131 wheel hub assembled

1 -- hub; 2 -- screw; 3 -- lug; 4 -- nut;
5 -- brake drum; 6 -- external hub bearing rings

Assembly and Installation of the hubs. The seating of the internal and external bearing rings in the wheel hub housing (Figure 15-29, 15-30) of the ZIL-157K and the ZIL-131 is accomplished with a tightness of 0.010-0.068 mm.

When installing the hub on the journal it is necessary to place lubricant grease in the cavity of the hub and in the bearings, and to install the internal ring of the internal bearing together with the rollers as a unit on the journal (the fit of the ring is with a clearance of 0.015-0.060 mm). Install the hub together with the brake drum as a unit on the journal, place the internal ring of the external bearing together with the rollers as a unit on the journal, place lubricant in this bearing and move it onto its own journal seating collar, and install the external ring of the hub bearing with the help of a mandril which presses against the end of the ring (the fit of the internal ring on the journal is with a clearance of 0.015-0.060 mm).

Screw the bearing nut down onto the journal and tighten it until the wheel hub begins to drag, turning the hub here by hand so that the bearing rollers will be correctly positioned on the bearing rings. Back off the bearing nut by approximately 1/5 turn until the stop pin of the nut is aligned with the closest groove in the lock washer. Then install the lock washer on the journal so that the key enters the groove on the journal and the stop pin of the nut enters the groove of the lock washer.

Place the bearing lock nut on the journal and tighten the lock nut until it will turn no more. Here the length of the handle of the wrench must be approximately 450 mm.

Turn the brake drum together with the hub as a unit by hand in both directions. The hub must turn freely on the bearings without axial movement.

While assembling the hub unit, and also the journal unit, it should be kept in mind that air is supplied to the tire on the ZIL-157K through the circular opening in the journal bushing and through the air supply attachment (which is installed from within at the end of the journal). The air then goes to the tire valve. On the ZIL-131 the air is supplied to the tire through the air supply attachment, which is installed inside the journal, and through the half-axle channel to the tire valve.

Before installing the air supply attachment on the ZIL-157K, it is necessary to wipe the journal collars and the air supply attachment with a clean rag and it is necessary to lubricate with lubricant grease the journal collars, the working surfaces of the rubber seals, and the surfaces of the air supply attachment cover opening. There must be no lubricant in the internal chamber of the attachment here.

On the ZIL-157K the air supply attachment is to be installed on the journal collar so that the heads of the screws face the lock nut which secures the bearings. Fill the space between the head and the lock nut with lubricant. Place the sealing ring in the circular hub groove. Install the cover on the wheel hub so that the openings in the cover coincide with the wheel lugs, with the openings in the hub for securing the cover to the hub, and with the openings in the air supply attachment. Screw the screws which attach the cover to the hub into the aligned openings and tighten them until they will turn no more. Insert the sealing ring into the groove of the connecting pipe, install the connecting pipe together with the sealing ring as a unit in the hub cover opening and screw it into the threaded air supply attachment housing opening until it will turn no more. After installing the attachment, it is necessary to cover the protruding end of the journal with a thick layer of lubricant grease.

When installing the half-axle on the ZIL-131, blow out the air supply channel with compressed air and wipe the half-axle collar, which touches the rubber seal of the air supply attachment, with a clean rag.

On the ZIL-131 the air supply coupling is screwed into the channel prior to the installation of the hub and the brake drum on the journal. Place the gasket on the hub cover (for the ZIL-157K) or on the end of the hub (for the ZIL-131). Install the slotted flange of the half-axle of the front axle (for the middle and rear axles insert the half-axle) on the splines of the external half-axle of the joint and on the hub cover pins (for the ZIL-157K) or on the hub pins (for the ZIL-131).

Place spring washers on the pins, screw the nuts onto the pins and tighten the nuts (the moment is 3.5-5.0 Kg·m).

Screw the removable bolts into the threaded openings of the half-axle flange and secure the bolts with lock nuts.

The assembly of the ZIL-131 wheel and tire is accomplished in the following order: open the spacer ring lock (see Figure 15-25) with the help of a bar or manually; here the hands should be kept away from the lock a distance of 150-200 mm.

Insert the spacer ring into the tire, guiding it into the tire at its smallest diameter.

Guide the valve stem of the inner tube into the opening of its guide in the spacer ring and close the lock with a tire iron. The tube must be placed so that the valve stem is to the side of the side ring. The spacer ring should also be installed so that it is shifted under the valve stem.

Place the tire on its side so that the valve stem points down;

de-center the spacer ring relative to the sides of the tire with light taps from a hammer handle.

Without changing the position of the tire, insert the rim into the tire so that the valve guide on the spacer ring lines up with the valve slot in the rim.

Turn the tire with the rim so that the bolts are up and insert the seating ring between the rim and the side of the tire so that the demounting slots which are located in the seating ring turn out to be in the space between the bolts on the rim.

Install the side ring so that it is possible to turn down the nuts and tighten them until the side ring touches the disk.

Compress the sides of the tire with the with the nuts on the bolts with the help of the side ring. The side ring attachment bolts should be tightened evenly, tightening opposite nuts in order. It should be kept in mind that the nuts and the side ring attachment bolts have right-hand threading on all wheels.

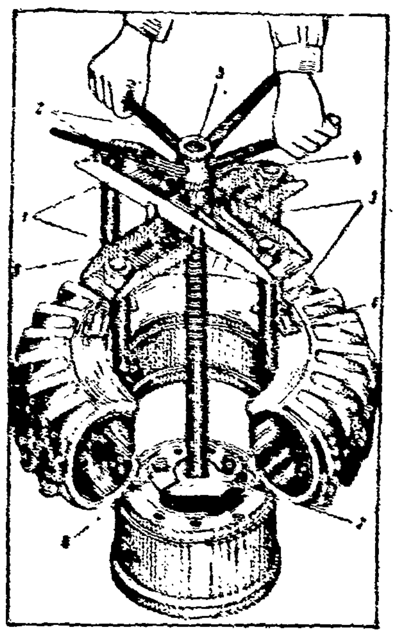


Figure 15-31: Installation of a tire on the rim of a wheel of three-axle vehicle with a device (see Fig. 15-26 for key)

Having assembled the wheel, it is necesary to preliminarily inflate the tire with air to a pressure of 3 Kg/cm^2. The tire must be turned so that the bolts are down here. The tire should be fully inflated on the vehicle.

In the case where the tire casing fits tightly on the wheel rim, a device should be used and the tire casing should be installed as is shown in Figure 15-31, following which the nut, which is fastened inside the hub 4, should be tightened, simultaneously mounting the tire on the wheel rim. Having mounted the tire on the internal wheel rim, it is necessary to remove the device, mount the external rim on the bolts and secure the rim with the nuts. Partially inflate the tire with air. The tire should be fully inflated with air on the vehicle.

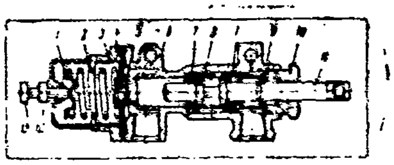


Figure 15-32: The ZiL-131 air pressure control valve with limiter valve

1 -- thrust washer; 2 -- limiter valve spring; 3 -- guide sleeve; 4 -- valve cover; 5 -- diaphragm; 6 -- housing; 7 -- oil seal; 8 -- spacer bushing; 9 -- thrust washer; 10 -- slide valve guide nut 11 -- slide valve; 12 -- lock nut; 13 -- adjusting bolt

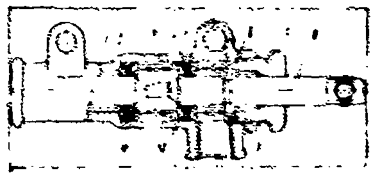


Figure 15-33: The ZIL-157K air pressure control valve

1 -- housing; 2 -- oil seal spacer rings; 3 and 6 -- spacer bushings; 4 and 11 -- oil seals; 5 -- thrust ring; 7 -- slide valve guide; 8 -- slide valve; 9 -- lock ring

Installation of the wheel on the vehicle. Raise the axle on a jack from the side of the wheel which is being mounted. Install the wheel on the hub lugs, turn down the nuts onto the lugs, lower the axle and tighten the nuts with a tire wrench or a nut wrench until they will turn no more.

Install and connect the tire valves and [illegible] them. Install and secure the protective valve covers on the [illegible]-131.

Start the engine and inflate the tires to the necessary pressure with air.

Dismantling the pressure control valve (Figure 15-32, 15-33). The method of dismantling the valves is identical. For the ZIL-131 valve, the operation of disconnecting the limiter valve, which is attached to the valve by bolts, is a supplementary operation.

To dismantle the valve, the stop screw which attaches the guide nut *10* of the slide valve *11* (see Figure 15-32) should be unscrewed with a screwdriver. Unscrew the slide valve guide with a wrench and remove the slide valve from the housing. Remove the two spacer bushings and the two oil seals with spacer rings from the chamber of the housing.

Assemble the valve after checking and replacing the oil seal parts.

The hermetic state of the oil seals is checked in the assembled valve. It is recommended that the auxiliary valve working plan shown in Figure 15-34 be used when checking the hermetic state.

For checking purposes the slide valve is placed in the neutral position. Compressed air at a pressure of not less than 7 Kg/cm^2 is supplied to the opening *2*. The valve is then lowered into water. No air leak is permitted through the input opening *7* and the output opening *6* here. In the event that there is an air leak, which appears as air bubbles, the oil seals *1* and *3* should be compressed, having turned the slide valve guide *4*. Here the slide valve must move freely.

Dismantling and assembling the air pressure drop limiter valve. For dismantling, it is necessary to undo the bolts which secure the cover *5* (Figure 15-35) to the housing *10*, disconnect and remove the cover *5*, remove the guide sleeve *6* with the diaphragm *8* and with the valve *12* from the cover chamber, and then remove the spring *4* and the thruse washer *3*.

To dismantle the diaphragm-by-pass valve assembly, it is necessary the clamp the diaphragm assembly in a vise, unscrew the nut *7*, which secures the assembly, and disconnect the by-pass valve *12* from the diaphragm *8* and the guide sleeve *6*. It is not necessary to disassemble the assembly when changing the seal *13*. In this case it is necessary to remove the seal from the by-pass valve seat and install another seal.

When disassembling the ZIL-131 limiter valve, it is necessary to loosen the bolts which attach the cover *4* (see Figure 15-32) to the valve housing *6* and disconnect the valve. Here the diaphragm *5* with the by-pass valve is easily taken off and the guide sleeve *3*, the spring *2*, and the thruse washer *1* are removed from the chamber of the cover *4*.

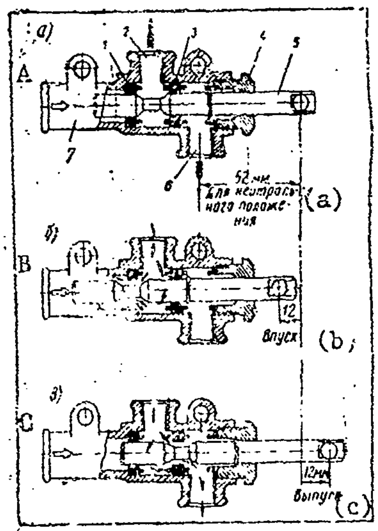


Figure 15-34: Air pressure control valve operational scheme

A -- neutral valve position; B -- valve position when inflating the tires; C -- valve position when releasing air into the atmosphere;

(a) -- for the neutral position; (b) -- input; (c) -- output; 1 and 3 -- oil seals; 2 -- opening for supplying air to the tires; 4 -- slide valve guide; 5 -- slide valve; 6 -- opening for releasing air into the atmosphere; 7 -- input opening, which supplies compressed air from the vehicle tanks

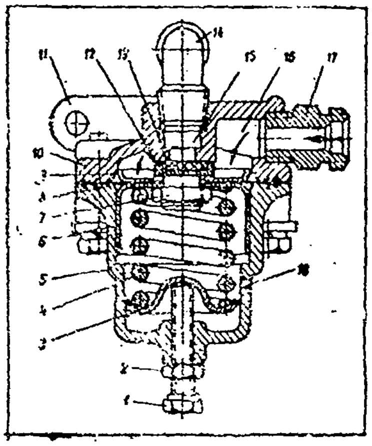


Figure 15-35: The ZIL-157K tire air pressure drop limiter valve

1 -- adjusting bolt; 2 -- lock nut; 3 -- thrust washer; 4 -- spring; 5 -- cover; 6 -- sleeve; 7 -- nut; 8 -- diaphragm; 9 -- holder; 10 -- housing; 11 -- bracket; 12 -- by-pass valve; 13 -- seal; 14 -- elbow; 15 -- chamber over the valve; 16 -- chamber over the diaphragm; 17 -- connection; 18 -- opening

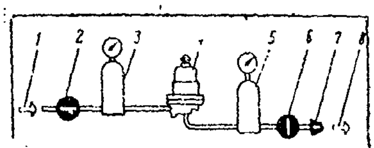


Figure 15-36: Scheme for adjusting the limiter valve

1 -- air supply from the air tank; 2 and 6 -- valves; 3 and 5 -- reservoirs; 4 -- limiter valve; 7 -- calibrated opening; 8 -- output of air into the atmosphere

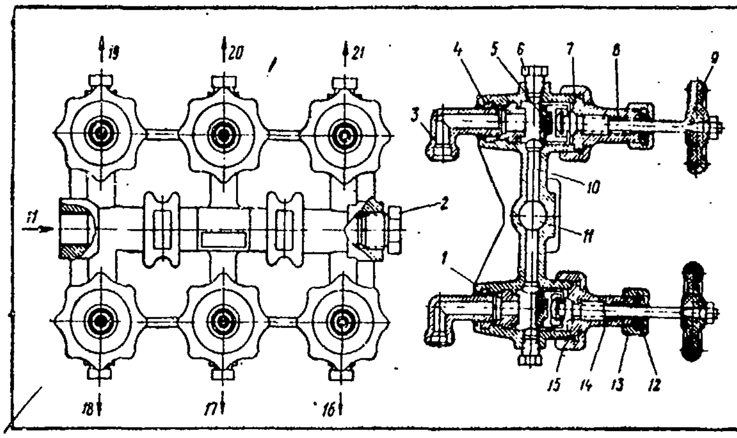


Figure 15-37: Tire valve unit

1 -- housing; 2 and 6 -- plugs; 3 -- elbows; 4 -- bushings; 5 -- valve; 7 -- gasket; 8 -- rod; 9 -- handle; 10 -- lateral valve; 11 -- valve connecting with the pressure control valve; 12 -- oil seal; 13 and 15 -- coupling nuts; 14 -- rod guide; 16, 17 and 18 -- air line to the tires of the rear, middle, and front wheels of the left side; 19, 20 and 21 -- air line to the tires of the front, middle, and rear wheels of the right side

When assembling the ZIL-157K limiter valve, it is necessary to assemble the unit containing the diaphragm *8* (see Figure 15-35) and the by-pass valve *12* and install the unit on the housing *10*. Install the spring *4* in the guide sleeve *6* and install the thrust washer *3* on the spring. Cover the diaphragm unit with the cover *5* and secure the cover to the housing with the bolts, having place spring washers under the heads of the bolts.

The assembled limiter valve is checked and its air pressure is adjusted by means of the adjusting bolt *1* or bolt *13* (see Figure 15-32). When the bolt is tightened, the operating pressure of the valve is increased; when the bolt is loosened, the operating pressure is decreased.

To adjust the limiter valve it is necessary to connect the reservoirs *3* and *5* (Figure 15-36), which have a capacity of 1 liter each, and which are equipped with manometers, to the elbow *14* (see Figure 15-35) and to the connection *17*. Having opened the valve *2*, supply compressed air to the reservoir *3* under a pressure of 9 Kg/cm^2. Here the valve *6* must be closed. An air leak through the limiter valve connection is not permitted.

Close the valve *2*, and open valve *6*. At the same time, connect the reservoir *5* with the atmosphere through the calibrated opening *7*, which has a diameter of 1.5 mm. Adjust by means of the adjusting bolt the pressure of the limiter valve spring so that the pressure drop in the tank *5* reaches zero, and in the tank *3* there remains a pressure equal to 4.5 Kg/cm^2 for the ZIL-157K limiter valve and 5.3-5.6 Kg/cm^2 for the ZIL-131. Having adjusted the pressure, secure the adjusting bolt with a lock nut.

The tire valve unit (Figure 15-37) which is installed on the ZIL-157K (on recently manufactured vehicles the tire valve unit is not installed) should be disassembled only if there is leakage of air through the valve. In this case the coupling nut *15* should be unscrewed and the guide *14* should be removed from the seat along with the rod *8* and the valve *5*. Having replaced the worn parts, it is necessary to set the unit in place and secure it with a coupling nut.

The assembled tire valve unit has its hermetic state checked with compressed air at a pressure of 7 Kg/cm^2. When checking the hermetic state, the air is supplied to the opening *11* from the pressure control valve. The check is made in two positions: the first position -- the unit valves are open, but the openings which supply air to the tires are closed; the second position -- the unit valves are closed, but the openings which supply air to the tires are open. No air leak is permitted in either circumstance. The valves should be easily closed by hand, without the use of a tool.

The air supply attachment (Figure 15-38) is disassembled only when the rubber seals are worn. For this, the screws *5* should be unscrewed, the covers *4* removed, and the rubber seals *1* removed. The use of crudely manufactured (non-plant) seals does not give the [required] effect. Having replaced the seals, the seals should be covered with the covers, and the covers secured by the screws.

[text continued following page]

The tire valve is disassembled only when there is an air leak through its connections (Figure 15-39). In this event, the coupling nuts *2* are unscrewed and the sealing rings *6* and *13*, the oil seal *5*, and the plug are checked.

Adjustment of the air pressure control valve drive (Figure 15-40) is necessary after it is repaired. The methods of adjusting the valve drives of the ZIL-157K and the ZIL-131 are identical.

When the pressure control valve drive is being adjusted the normal travel of the slide valve which connects via a ball with the lever of the handle *6* is established, as is the normal position of the handle which is set in the slots of the bracket *5* which is mounted in the cabin.

If the wheel tire valves on the vehicle are open, when the handle *6* is moved to the extreme right *inflate* position the slide of the valve moves forward as the vehicle travels, connects the air supply channel to the tires, and air, at a pressure of greater than 4.5 Kg/cm^2 for the ZIL-157K and greater than 5.3 Kg/cm^2 for the ZIL-131, will go from the pressure drop limiter-valve through the valve to the tires. Here the end of the slide valve (the connecting opening of the pin) will move forward 12 mm from the neutral position (input travel).

When the pressure control valve handle is moved to the extreme left *deflate* position, the slide of the valve will move back (see Figure 15-34C) and connect the channel with the atmosphere. Air from the tires will come out into the atmosphere (under the hood). Here the end of the slide valve at the pin will move back 12 mm from the neutral position (output travel).

When the pressure control valve is moved to the neutral position (see Figure 15-34A), the slide valve will be in a position preventing air from the pneumatic brake system from getting into the air pressure regulating system. Here the end of the slide valve will be positioned a distance of 52 mm from the axis of the output opening of the valve.

If the pressure control valve slide valve travel does not correspond to the given magnitudes, it is necessary to adjust the valve drive by turning the arm *3* (see Figure 15-40) or the fork of the arm when the lock nut *7* is loosened. The adjustment and checking of the action of the valve must be done for all three positions of the handle *6*, which must be set in the slots of the bracket *5*. The positions of the handle must correspond to the travel of the slide valve during inflation, exhaust, and in the neutral position.

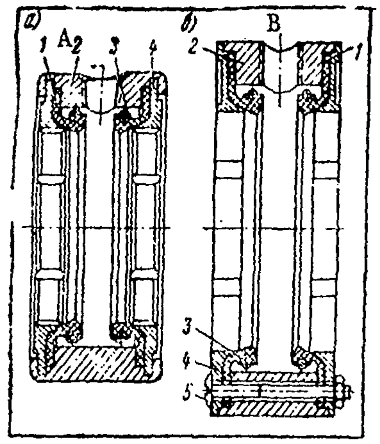


Figure 15-38: Air supply attachment

A -- ZIL-131; B -- ZIL-157K; 1 -- rubber seal;
2 -- housing; 3 -- seal spring; 4 -- cover;
5 -- screw

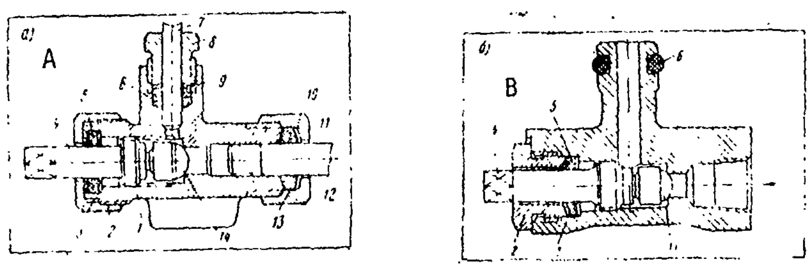


Figure 15-39: Tire valve

A -- ZIL-157K; B -- ZIL-131; 1 -- housing;
2 and 11 -- coupling nuts; 3, 9 and 10 -- washers;
4 -- plug; 5 -- oil seal; 6 and 13 -- sealing
rings; 7 -- connecting tube; 8 -- connecting nut;
12 -- chamber valve; 14 -- ball

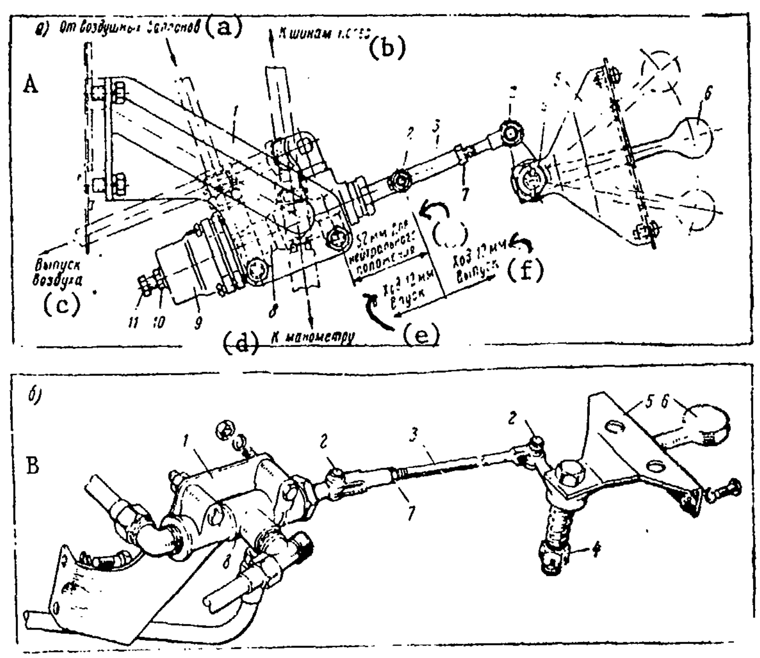


Figure 15-40: Pressure control valve drive

A -- ZIL-131; B -- ZIL-157K;
1 and 5 -- brackets; 2 -- arm pins; 3 -- arms;
4 -- nut; 6 -- valve control handle; 7 and 10 -- lock nuts; 8 -- valve; 9 -- limiter-valve;
11 -- adjusting bolt; (a) -- from air tanks;
(b) -- to tires; (c) -- air output; (d) -- to manometer; (e) -- input travel 12 mm; (f) -- output travel 12 mm; (g) -- 52 mm for the neutral position

Table 15-4: Dimensions of Wheel Hub Parts, ZIL-130, mm

Dimension	Nominal	Permissible without repair
I. FRONT WHEEL HUBS: Cast Iron KCh 35-10 (GOST 1215-59); hardness HB 163		
Diameter of the openings for the external ring of the internal bearing	119.941-119.976	119.99
Diameter of the opening for the external ring of the external bearing	89.941-89.976	89.99
II. REAR WHEEL HUBS: Cast Iron KCh 35-10 (GOST 1215-59); hardness HB 163		
Diameter of the openings for the external ring of the internal bearing	149.932-149.972	149.99
Diameter of the opening for the external ring of the internal bearing	134.932-134.972	134.99
Diameter of the opening in the hub at the wheel lugs	20.000-20.045	-
Diameter of the threading of the half-axle securing pins	M16, class 2	
III. WHEEL LUGS: Steel 35 (GOST 1050-60); hardness HB 207-241		
Lug threading diameter	M20X1.5, class 2	-

Note: to indicate left-hand threading a circular cut is made around the edge angles on the nuts and on the end of the lugs

Table 15-5: Dimensions of Wheel Hub Parts, ZIL-157K and ZIL-131, mm

Dimension	Nominal	Permissible without repair
I. WHEEL HUBS: Cast Iron KCh 35-10 (GOST 1215-59); hardness HB 163		
Diameter of the opening for the external ring of the internal bearing	139.932-139.972	139.99
Diameter of the opening for the external ring of the internal bearing	129.932-129.972	129.99
Diameter of the wheel lug openings	20.000-20.045	-
Diameter of the half-axle securing pins (for the middle and rear axle hubs)	M12X1.75, G1	
II. WHEEL LUGS: Steel 35 (GOST 1050-60); hardness HB 187-247		
Threading diameter	M20X1.5	-

CHAPTER 16. BRAKES

Structure

ZIL motor vehicles (Figure 16-1, 16-2) are equipped with two independently operating brake systems: a pneumatic foot brake acting on all wheels of the vehicle and a mechanical hand brake acting on the transmission.

The parts of the brakes for two and three axle vehicles are standardized and partially interchangeable.

Basic data on the brakes are presented in Table 16-1. The stopping distance of the vehicles has been determined on a dry, horizontal road with asphalt-concrete paving with a load at a speed of 30 km/hr to a full stop, m:

ZIL-130, ZIL-130G and dump truck on ZIL-130D1 chassis	10.5
ZIL-130-66, ZIL-130G-66 and ZIL-130D1-66	11
ZIL-130V1 tractor with semitrailer	12
ZIL-157K, ZIL-157KG and ZIL-157KE	12
ZIL-131 and ZIL-131A	12
ZIL-131V saddle tractor	13

Table 16.1

TECHNICAL CHARACTERISTICS OF BRAKES

Units	Vehicles	Brief Characteristics
Wheel brakes	All vehicles	Drum type, acting on all wheels, pneumatic drive
Number of brake drums in front brakes	All vehicles	2

Table 16.1 Continued

Units	Vehicles	Brief Characteristics
Number of brake drums of rear brakes	Two axle vehicles Three axle vehicles	2 4
Hand brakes	All vehicles	Drum type, with internal drums, central, acting on transmission, mechanical drive
Compressor	ZIL-157K	ZIL-164 (up to July 1964) ZIL-130 (since July 1964)
	ZIL-130 and ZIL-131	ZIL-130
Brake valves:		
single	ZIL-131	Designed for operation without trailer
combined	ZIL-157K, ZIL-130, ZIL-131 and its modifications	Acts on brakes of tractor and trailer
Brake cylinders	All vehicles	Diaphragm type
Outer diameter of cylinders, mm:		
front	All vehicles	180
rear	Two axle vehicles	206
	Three axle vehicles	180
Air cylinders	All vehicles	Interchangeable, 20 l volume
Number of cylinders	Two axle vehicles	2 (total volume 40 l)
	Three axle vehicles	3 (total volume 60 l)
	All vehicles except ZIL-130D1	
Pneumatic line to control trailer brakes		

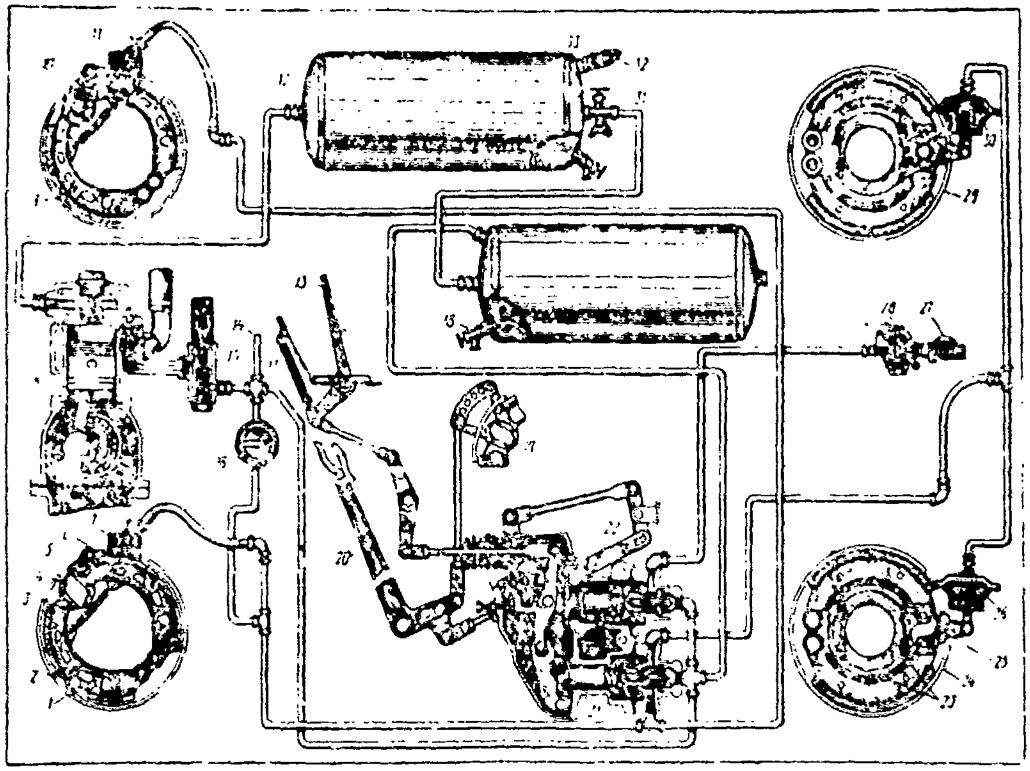


Figure 16-1. Diagram of Brakes of ZIL-130:

1, 9, 24 and 29, brake drums; 2, brake shoes; 3 and 23, tension springs; 4 and 25, spreader cams; 5, adjustment levers; 6, shaft; 7, 11, 26 and 30, brake cylinders; 8, compressor; 10, worm; 12, air cylinders; 13, brake pedal; 14, line tapping air to windshield washer; 15, pressure regulator; 16, manometer; 17, return spring; 18, release valves; 19, hand brake spreader cam; 20, hand brake lever; 21, motor vehicle brake valve cross section; 22, cross section of trailer brake valve; 27, connecting head; 28, disconnecting valve; 31, air tap valve; 32, safety valve

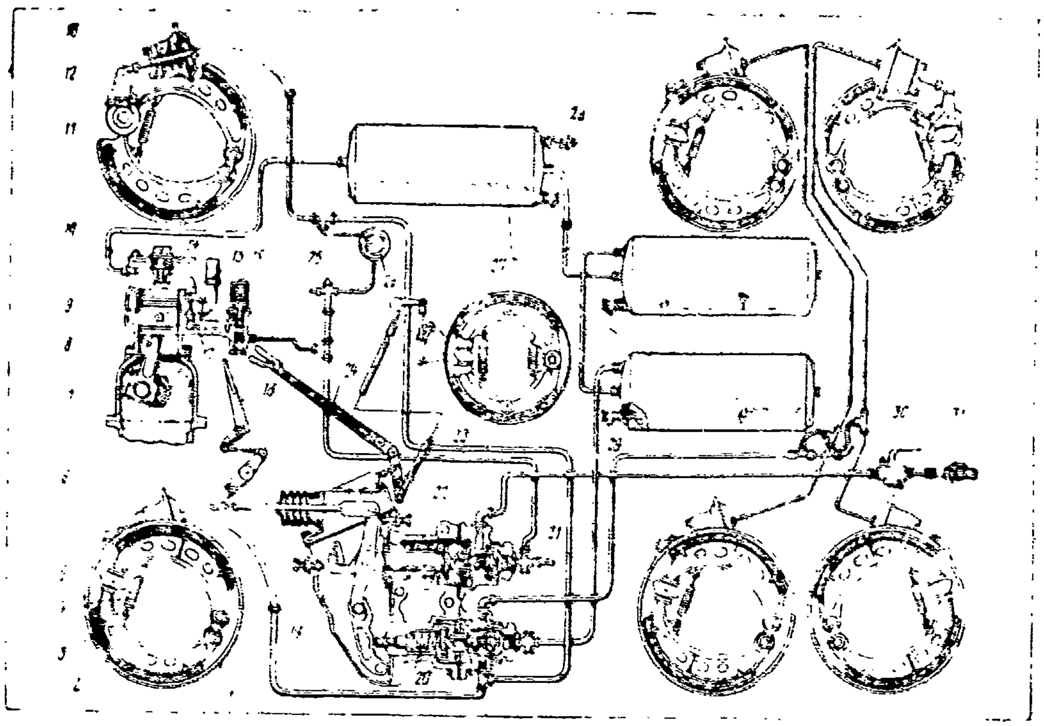


Figure 16-2. Diagram of Brakes of ZIL-131:

1, brake drum; 2, brake shoe lining; 3, brake shoes; 4, shoe retracting springs; 5, spreader cam; 6, brake cylinder; 7, compressor crank; 8, compressor; 9, piston; 10, compressor head; 11, adjusting lever worm; 12, adjusting lever; 13, brake cylinder shaft; 14, exhaust valve; 15, exhaust valve; 16, pressure regulator; 17, unloading device; 18, brake pedal; 19, brake valve; 20, cross section of vehicle brake valve; 21, line to air-powered audible signal; 22, cross section of trailer brake valve; 23, hand brake mechanism; 24, hand brake lever; 25, line to windshield washer; 26, manometer; 27, air cylinders; 28, safety valve; 29, safety valve; 30, separating valve; 31, connecting head

The wheel brakes of all ZIL motor vehicles consist of a pair of brake shoes mounted inside a brake drum, rotating together with the hub of each wheel. The brake shoes are mounted on their axes, which are fastened to the brake discs, or to a support on the rear wheels of the ZIL-130.

Friction liners are attached to the outer surfaces of the shoes. The shoes are pulled together by springs, and spread apart by spreader cams. The spreader cams are rotated by an adjusting lever, on which the shaft of the brake cylinder acts.

Since 1967, power rear brakes with broader drums (140 mm in place of 100 mm) have been installed on the ZIL-130, significantly increasing the effectiveness of the wheels brakes. Therefore, the details of the rear brake differ from the details of the front brake of the ZIL-130 and the brakes (front and rear) of the other ZIL vehicles (Figure 16-3, 16-4, 16-5 and 16-6).

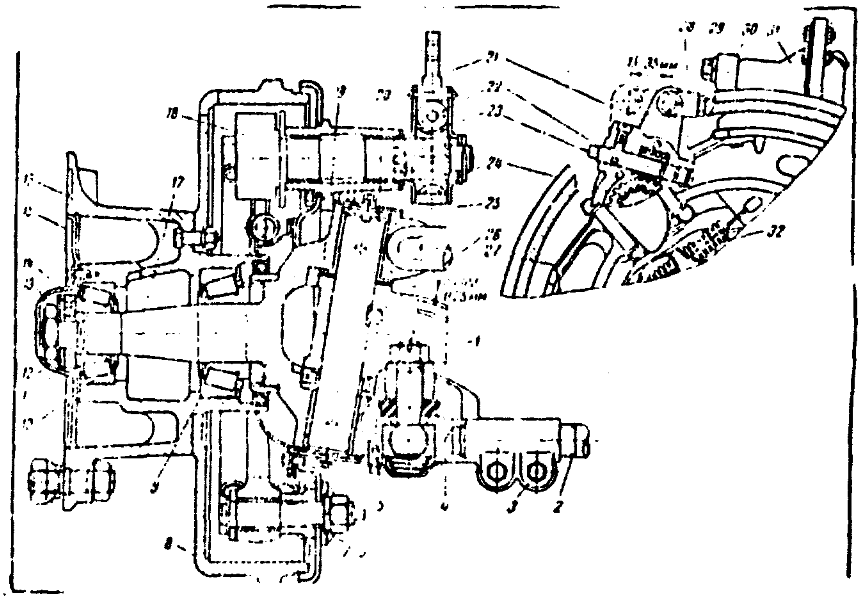


Figure 16.3. Brake Mechanism of Front Wheels of ZIL-130: 1, front axle; 2, transverse steering link; 3, bolt; 4, tip; 5, journal bearing; 6, nut; 7, brake drum axis; 8, brake drum; 9 and 10, hub bearings; 11, locking ring; 12, lock washer; 13, counter nut; 14, washer nut; 15 and 25, caps; 16, hub; 17, rotating pin; 18, spreader cam; 19, adjusting shim; 20, king pin; 21, adjusting lever; 22, worm axis; 23, worm; 24, gear, 26, pin; 27, brake shoe; 28, fork pin; 29, counter nut; 30, shaft; 31, brake cylinder; 32, brake shoe retracting spring

A drum type hand brake is installed on the ZIL-157K, ZIL-130 and ZIL-131 motor vehicles. On two axle vehicles, the brake drum is mounted on a flange of the driven shaft of the transmission (Figure 16-7) while on three axle vehicles it is mounted on a flange on the driven shaft of the transfer box. The nonrotating portion of the brake on two axle vehicles is fastened on the bearing cover of the driven shaft of the transmission, on the ZIL-157K -- on the bearing cover of the driven shaft of the transfer box, and on three axle ZIL-131 vehicles -- on the side cover of the transfer box. The hand brake drive is made in a single unit with the combined brake valve.

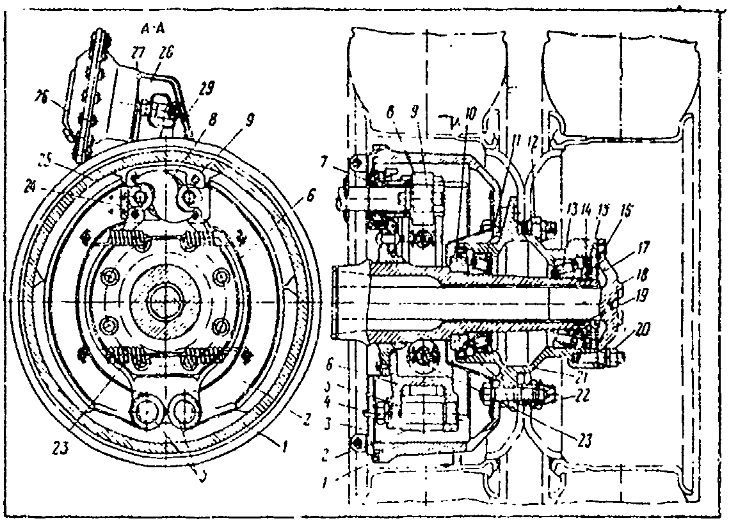


Figure 16-4. Brake Mechanism of Rear Wheel of ZIL-130 Motor Vehicle: 1, brake drum; 2, brake shoe; 3, shield; 4 and 20, nuts; 5, shoe axes; 6, support; 7 and 28, spreader cam brackets; 8, spreader cam; 9, roller; 10 and 14, glands; 11 and 13, bearings; 12, cap nut; 15, adjusting nut; 16, locking ring; 17, counter nut; 18, half axle; 19, half axle cover; 21, hub; 22, internal nut; 23, retracting spring; 24, roller support; 25, roller shaft; 26, brake cylinder; 27, shaft; 29, adjusting lever

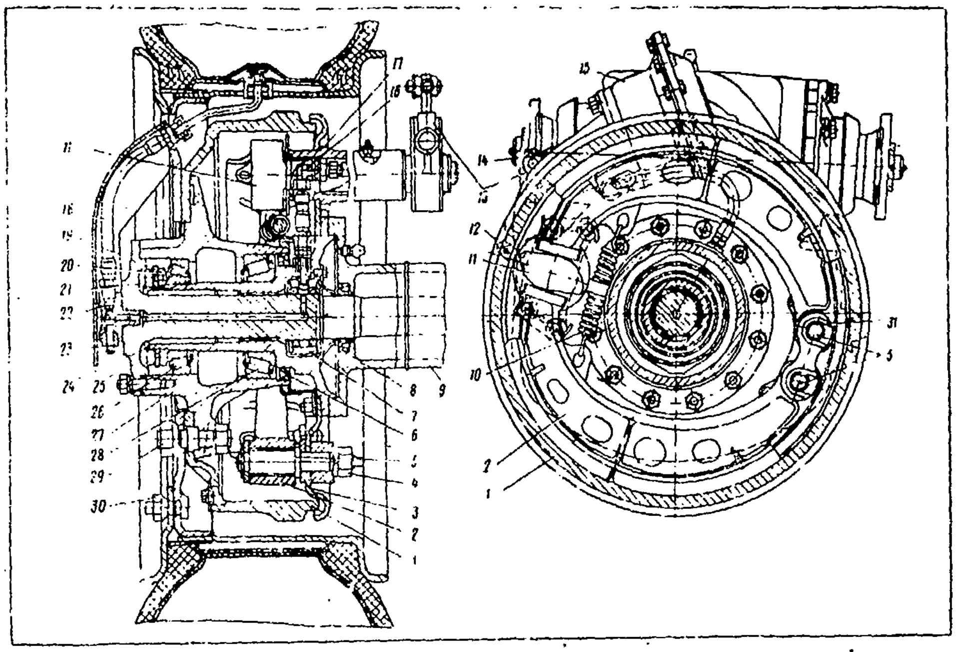


Figure 16-5. Brake Mechanism of Middle Axle Wheels of ZiL-131: 1, brake drum; 2, brake shoe; 3, brake disc; 4, 29 and 30, nuts; 5, shoe axis; 6 and 8, glands; 7, air feed head; 9, axle case; 10, shoe retracting spring; 11, spreader cam; 12, control lever worm; 13, control lever; 14, shaft; 15, brake cylinder; 16, air supply fitting; 17, spreader cam bracket; 18, air line; 19, lock washer; 20, bearing adjusting nut; 21, counter nut; 22, tire valve; 23, protecting cover; 24, pin; 25, half axle; 26 and 28, bearings; 27, wheel hub; 31, cotter pin

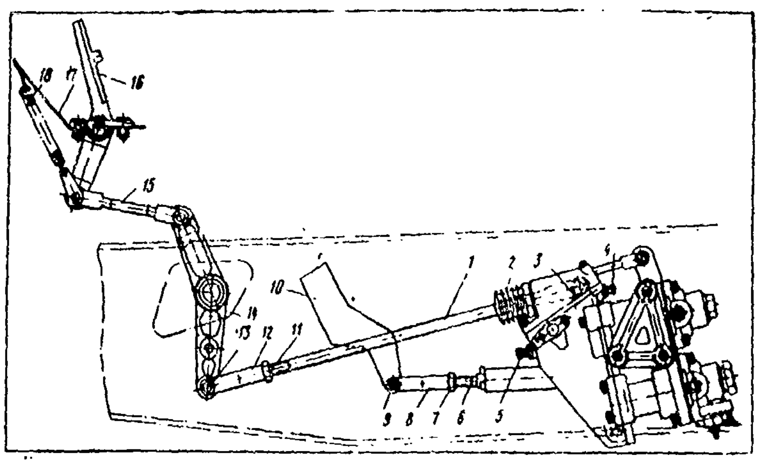


Figure 16-6. ZIL-130 Brake Valve Drive System: 1, tension member of brake pedal; 2, boot; 3, lever; 4 and 5, adjusting screw; 6, manual valve drive tension member for trailer; 7 and 11, counter nuts; 8 and 12, forks; 9 and 13, pins; 10, hand brake drive lever; 14, intermediate lever; 15, pedal arm; 16, brake pedal; 17, cabin floor; 18, return spring

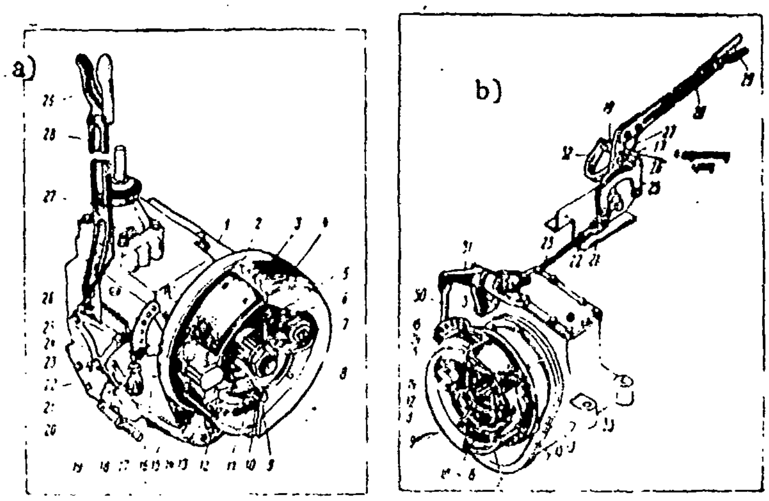


Figure 16-7. Drum Type Hand Brake: a, ZIL-130 motor vehicle; b, ZIL-131 motor vehicle; 1, transmission; 2, lining; 3, drum; 4, bracket; 5, gland; 6 and 12, springs; 7, axle; 8 and 24, nuts; 9, flange; 10, bolt; 11, washer; 13, drum; 14, spreader cam; 15, brake disc; 16, adjusting lever; 17 and 23, arms; 18 and 22, counter nuts; 19 and 22, forks; 20 and 32, drive lug; 25, geared section; 26, detent; 27, detent arm; 28, lever; 29, handle; 30, shaft; 31, angle lever; 33, transfer box

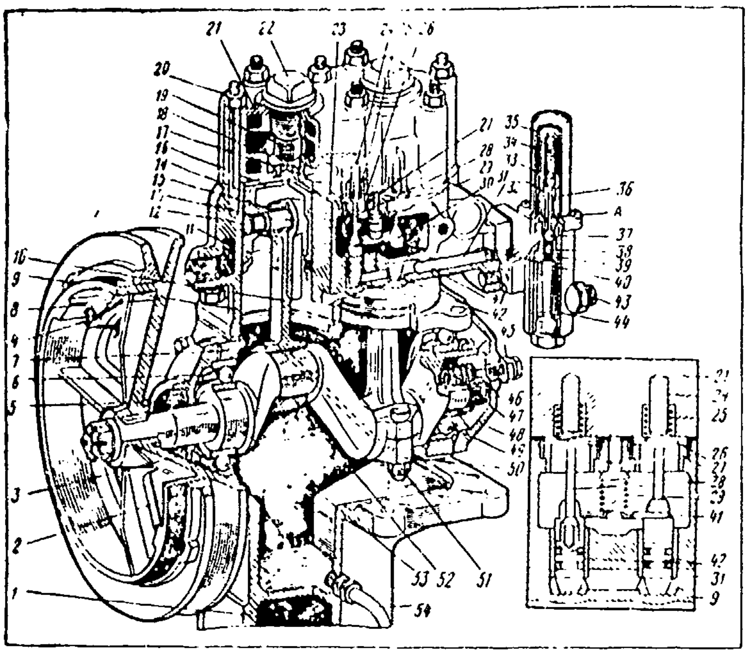


Figure 16-8. Compressor: A, channel connecting relief device to the atmosphere; 1, bracket cover; 2, adjusting clutch; 3 and 48, covers; 4, stop screw; 5, gland; 6 and 49, bearings; 7, case; 8, pulley; 9, cylinder block; 10, crankshaft; 11, oil wiper ring; 12, cap; 13, wrist pin; 14, compression ring; 15, bushing; 16, piston; 17, 27, 32 and 39, valve seats; 18, intake valve; 19, exhaust valve spring; 20 and 51, nuts; 21, cylinder head; 22, valve seat plug; 23, intake channel; 24, valve limiter; 25, intake valve spring; 26, intake valve; 28, shaft; 29, beam spring; 30, relief device and air feed chamber; 31, channel; 33, regulating cap; 34, ball spring; 35, regulator cover; 36, ball shaft; 37, regulator exhaust valve; 38, regulator intake valve; 40, filter; 41, beam; 42, relief plungers; 43, nipple for air input tube from cylinder; 44, pressure regulator; 45, nipple; 46, seal; 47, seal spring; 50, crankshaft cover; 52, crankshaft bushing; 53, crankshaft; 54, oil delivery tube

Table 16-2

TECHNICAL CHARACTERISTICS OF COMPRESSOR

Parameters	Brief Characteristics
Type	Indirect, piston, with relief device in cylinder block
Number of cylinders	2
Cylinder diameter, mm	60
Piston stroke, mm	38
Pistons	Cast iron*
Piston rings	3 (2 compression and 1 oil)
Wrist pins	Floating type, plugged with caps
Connecting rods	Steel with thin-wall bushings
Crankshaft	Steel, necks heat treated; crank radius 18.9-19.1 mm
Shaft neck diameters, mm:	
main	35.003-35.020
cons rod	28.479-28.500
Intake valves	Plated
Exhaust valves	Plated with pneumatic drive
Relief valves	Plated with pneumatic drive
Air pressure limited by regulator, kg/cm^2	7.0-7.4
Air pressure limited by safety valve, kg/cm^2	9.0-9.5

* Since March 1967, compressor pistons are cast of aluminum alloy.

Table 16-2 Continued

Parameters	Brief Characteristics
Relief device	Pneumatic with two plated valves, with plungers and shafts
Pressure at which relief device comes on, kg/cm^2	7.0-7.4
Pressure at which relief device goes off, kg/cm^2	5.65-6.00
Lubrication of compressor	Forced, connected to engine oil system
Pressure regulator	AR11 (pneumatic with ball valves)
Cooling of compressor	Liquid, connected to engine cooling system
Delivery of compressor at 2500 rpm, counter pressure 7 kg/cm^2	250
Compressor drive	By crankshaft pulley through fan belt
Transfer ratio	1.23-1.43
Belt tension adjustment	By changing distance between sides of pulley

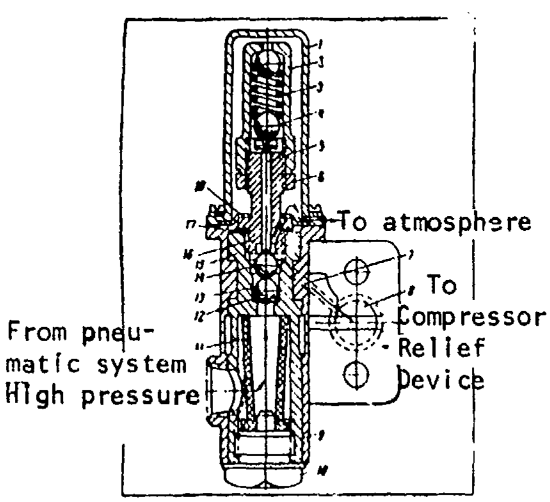


Figure 16-9. Pressure Regulator: 1, case; 2, adjusting cap; 3 and 12, springs; 4, support ball; 5, shaft; 6, counter nut; 7, channel; 8 and 11, filters; 9, regulator body; 10, filter plug; 13, intake valve; 14, exhaust valve; 15, intake valve seat; 16, exhaust valve seat; 17, adjusting inserts; 18, stop washer

The hand brake of the vehicle operates the trailer or semitrailer brake.

The operating principle of the hand brake is the same as that of the foot brake.

Compressors. The ZIL-157K vehicles produced up to July 1964 carried compressors with cooling of the head alone, while since July of 1964, all ZIL motor vehicles carry a compressor (Figure 16-8, Table 16-2) with both head and cylinder block cooled.

Since November of 1969, a one piece drive pulley has been mounted on this compressor without an adjusting clutch and with an improved lower crankcase cover, with three longitudinal slots for movement of the compressor.

The compressor on the ZIL-130 and ZIL-131 vehicles is installed with a new design bracket and fastened to the bracket by nuts on three threaded pins.

The compressor drive belt tension is adjusted by moving the compressor itself on the pins, requiring that the compressor crankcase mounting nuts be loosened and the belt tension adjusted with the regulating bolt. The compressor mounting nut are then tightened and the regulating bolt is set.

The AR11 pressure regulator (Figure 16-9) is mounted on the cylinder block of the ZIL-130 compressor installed in ZIL motor vehicles since July of 1964.

The AR11 regulator, with two ball valves, automatically maintains the necessary compressed air pressure in the brake pneumatic system by intake or exhaust of air in the compressor relief system. The pressure regulator comes on when the pressure in the pneumatic system rises to 7.0-7.4 kg/cm^2, the compressur is turned off and air feed to the brake system is halted.

The pressure regulator turns off when the pressure in the pneumatic system drops to 5.6-6.0 kg/cm^2 in which case the compressor turns on and begins to feed air into the brake system.

The safety valve (Figure 16-10) is designed to protect the brake system from extreme increases in pressure in case of a failure of the automatic pressure regulator. The valve is installed on one of the air cylinders of the vehicle. The safety valve in body 2 has a ball 3 pressed into seat 1 by spring 4, the force of which is adjusted to an air pressure of 9.0-9.5 kg/cm^2.

The combined brake valve (Figure 16-11) consists of two sections -- an upper and lower section, carrying mechanisms. The lower section mechanism is used to control the brakes of the tractor, the upper section -- to control the brakes of the trailer or semitrailer.

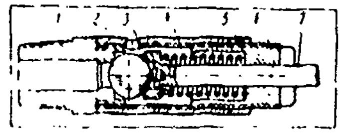


Figure 16-10. Safety Valve: 1, seat; 2, body; 3, ball; 4, spring; 5, counter nut; 6, adjusting screw; 7, rod

There is also a lever mechanism enclosed in a cover and two valve mechanisms enclosed in the covers of the trailer valve and tractor valve. The tractor valve cover on the bottom also includes the stop signal switch. On the latest models of the ZIL-157K and all models of the ZIL-131, the stop signal switch is shifted from the brake valve to the front wall of the cabin in order to protect it from water sprayed during fording.

Vehicles operating without trailers carry a single brake valve (Figure 16-12) which is identical in the design of its mechanisms to the mechanism of the lower section of the combined brake valve.

The brake cylinders (Figure 16-13) are designed to operate the wheel brakes of the vehicle. The brake cylinders (front and rear) consist of steel body 1, containing shaft 3 with return spring 7 and diaphragm 2 of rubberized fabric. The top of the cylinder is closed with cap 4, into which a nipple with hose 5 is screwed for input of compressed air.

The separating valve (Figure 16-14) is designed for connection of the compressed air feed to the main line of the trailer and disconnection when the trailer is removed.

The connecting head (Figure 16-15) is designed to connect the compressed air feed lines to the main air line of the trailer.

Maintenance

Driving safety of the vehicle depends on reliable operation of pneumatic drive, mechanisms and brake units. Their reliability is provided by timely checking and maintenance of the system.

The list of technical maintenance operations for the brakes is presented in Chapter 2. We present below data on checking and adjustment of the basic units and devices of the brakes.

Adjustment of wheel brakes should be performed during TO-2 technical maintenance. During TO-1, the rear brakes of two-axle vehicles should be checked and adjusted if necessary.

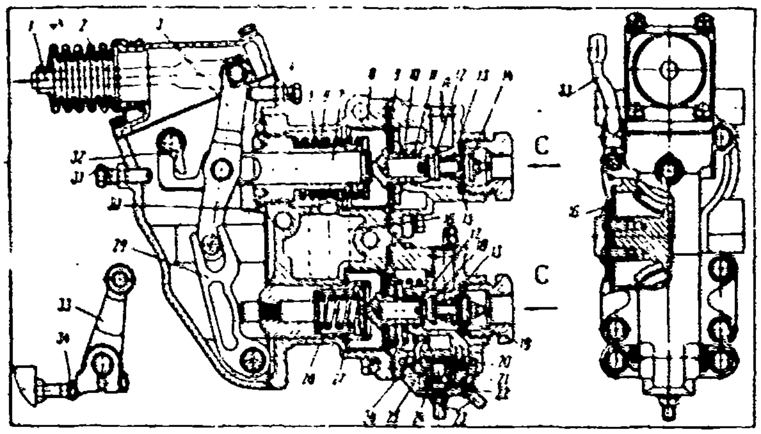


Figure 16-11. Combined Brake Valve. 1, tension member; 2, protective cover; 3, 29 and 43, levers; 4, 31 and 34, adjusting bolts; 5 and 27, balancing springs; 6, guide shaft; 7, trailer valve section shaft; 8, valve body; 9, diaphragm; 10 and 17, exhaust valve seats; 11, sealer; 12 and 18, exhaust valves; 13, adjusting inserts; 14 and 19, intake valves; 15, intake valve seat; 16, exhaust valve to atmosphere; 20, stop signal diaphragm; 21, connector; 22, contact spring; 23, terminal; 24, contacts; 25, switch body; 26, channel; 28, vehicle valve section cup; 30, guide shaft counter nut; 32, trailer brake manual drive shaft cam; A, inlet to brailer brakes; B, air inlet to tractor brakes; C, air feed from air cylinders

Adjustment of the wheel brakes may be complete or partial. Before adjustment, the wheel hub bearing tension must be checked; the brakes should be cold.

Full adjustment of the brakes is presented in the section on "dissembly and assembly" of this chapter.

Partial adjustment is performed to decrease the space between the shoes and drums, which increases due to wear of the shoes.

Large gaps, requiring partial adjustment, can be detected by an increase in travel of the brake cylinder shafts, which should not exceed 35 mm for the front brakes of two-axle vehicles and all brakes of three-axle vehicles, or 40 mm for the rear brakes of two-axle vehicles.

Partial adjustment is performed only by rotating the axis of the adjusting lever gear. During partial adjustment, the shoe axis nuts should not be loosened or their setting changed, since this might cause partial loss of contact between shoes and drum during braking. If the setting of these axes is changed, complete adjustment must be performed.

During adjustment, the least brake cylinder shaft travel must be set; for the front cylinders on two-axle vehicles and all cylinders on three-axle vehicles -- 15 mm, for the rear cylinders on two-axle vehicles -- 20 mm.

In order to produce identical braking effectiveness of right and left wheels, one should make sure that the shaft travels of right and left cylinders on the front and rear axles differ little from each other.

Adjustment of the hand brake. During TO-1, it is recommended that the action of the hand brake be tested and adjusted if necessary. Adjustment of the hand brake is performed to decrease the clearance between the shoes and drum, with increases due to wear of the shoes. The presence of excessive clearance can be determined by increased hand brake lever travel. Adjustment should be performed with the brakes cold in the order set forth in the section on "dissembly and assembly" of this chapter.

Testing the compressor. During TO-2, the mounting of the compressor on the engine, mounting of the pulley, tension of drive belt and tightness of head mounting nuts must be tested. The nuts should be tightened evenly in two phases. The final tightening torque should be 1.2-1.7 kgm.

Valves which do not eal tightly should be turned into their seats, or if strongly worn or damaged, replaced with new valves, which should be turned into the seats until a continuous contact ring is produced in the paint test.

When the compressor head is removed, the condition of the plungers and sealing rings of the plungers in the relief device must be checked.

The compressor is equipped with thin-wall inserts. The bearing separation surface should not be ground. Compressor connecting rod bolts should be tightened to 1.5-1.7 kgm.

Testing of the condition of plunger sealing rings in the relief device and their replacement can be performed without removing the compressor head.

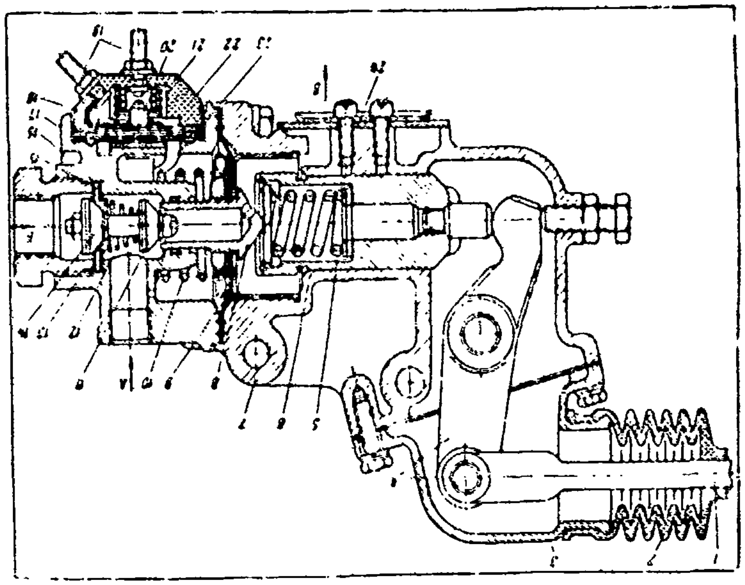


Figure 16-12. Individual Brake Valve: A, compressed air input to brake cylinders of tractor; B, compressed air input from air cylinders; C, air exhaust to atmosphere; 1, arm; 2, protective boot; 3, lever cover; 4, lever; 5, balancing spring; 6, balancing spring cup; 7, valve body; 8, exhaust valve seat; 9, diaphragm; 10, diaphragm return spring; 11, exhaust valve; 12, valve return spring; 13, brake valve cap; 14, intake valve; 15, adjusting inserts; 16, intake valve seat; 17, stop signal switch diaphragm; 18, cross piece; 19, terminal; 20, moving contact; 21, contact spring; 22, switch body; 23, channel for compressed air feed to switch diaphragm; 24, exhaust window valve

When the sealing rings of the plungers are removed, the following sequence should be followed:

Start motor and bring pressure in pneumatic system up to .0-7.4 kg/cm^2;

Stop motor;

Remove rubber hose connecting engine air filter to compressor. If the relief device is leaky, a characteristic air hiss will be heard in the compressor air inlet, and a pressure drop will be noted on the pneumatic system pressure gauge;

Reduce air pressure in pneumatic system to 5.6-6.0 kg/cm^2, and plunger will drop;

Remove air feed line, retract spring and arm. Lift shaft seat and remove it together with shaft, after which remove plunger from its seat with a wire hook, placing it into the 5 mm diameter aperture in the end of the plunger or feed compressed air into the horizontal channel of the relief device of the cylinder block;

Replace worn sealing rings on plungers. Before installing plunger and sealer rings, lubricate with oil used for engine.

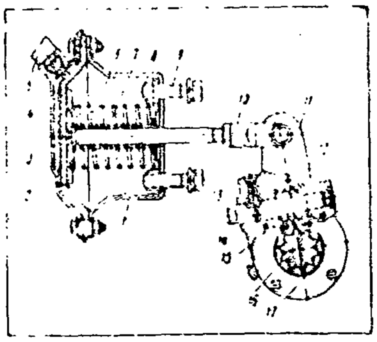


Figure 16-13. Brake Cylinder; 1, cylinder body; 2, diaphragm; 3, shaft; 4, cover; 5, flexible hose; 6 and 7, springs; 8, sealing ring; 9, cylinder mounting bolts; 10, shaft fork; 11, adjusting lever body; 12, worm; 13, positioning ball; 14, worm axis; 15, gear; 16, spreader cam shaft; 17, cap

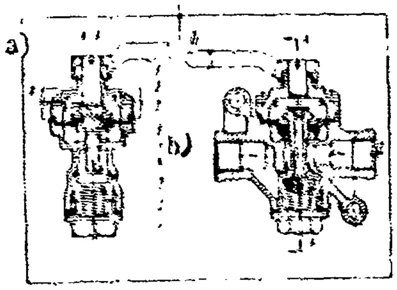


Figure 16-14. Disconnecting Valve: a, valve closed; b, valve opened; 1, plug; 2, body; 3, valve spring; 4, valve unit; 5, return spring; 6, shaft and diaphragm; 7, cap; 8, pusher; 9, valve lever

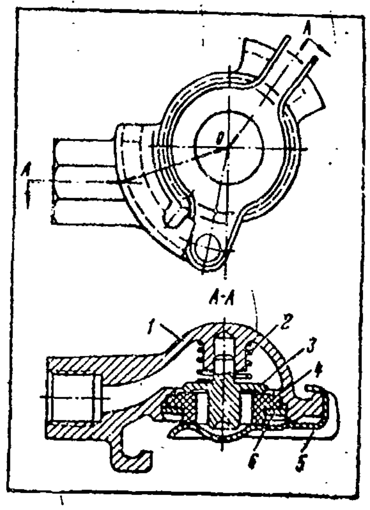


Figure 16-15. Connecting Head: 1, body; 2, spring; 3, back valve; 4, sealing insert; 5, cover; 6, ring nut

Adjustment of pressure regulator. If the pressure regulator does not maintain the air pressure within fixed limits, it should be dissembled, the parts washed in gasoline and defective parts replaced. Adjustment of the regulator is performed in the sequence outlined in the "dissembly and assembly" section of this chapter.

Testing and adjustment of the safety valve. During TO-1, it is necessary to check the seal using a soap emulsion and check the correctness of operation of the safety valve. In order to fix air leaks, the valve should be dissembled, carefully washed in kerosene and dried. The working band of the seat and ball should have no scratches or other surface damages. In testing the safety valve, its rod should be pulled; if this causes the valve to pass air, it is correctly operating. Then the rod should be released; if the air flow then stops, the valve is operating normally. For adjustment of the safety valve, see the section on "dissembly and assembly" of this chapter.

Testing single brake valve. During TO-2, the brake valve drive should be checked. Leakage through the exhaust aperture with the valve in the released position indicates a leak in the intake valve, while air passage with the valve in the braking position indicates a leak in the exhaust valve. In order to check the valve, the brakes should be applied two to three times; if the air leak continues after this, the plug should be removed from the valve cap and the valve should be withdrawn. In case of damage or wear to the rubber cones of the valve, it should be replaced and the cap plug should be replaced and tightened.

Testing combined brake valve. Air leak through the exhaust aperture in the released position indicates a leakage in the exhaust valve of the section controlling the trailer brakes or the intake valve of the section controlling the tractor brakes. During full braking, air should flow through the exhaust aperture from the trailer line. If air continues to flow 1-2 seconds after the pedal is pressed, this indicates a leak in the intake valve of the section controlling the trailer brake for the exhaust valve of the section controlling the tractor brake. If the air flow continues following two to three applications of the brake, these valves must be withdrawn and inspected, then replaced.

In the winter and spring during TO-2, the brake valve should be removed, dissembled, the friction surfaces washed with pure kerosene, dried with a soft rag and lubricated with TSIATIM-201 lubricant. Then the brake valve should be reassembled, after first checking the ease of travel of the diaphragm guiding cups, shaft, balancing spring cups and levers.

The order of dissembly, assembly and adjustment of the brake valve are given in the section on "dissembly and assembly" of this chapter.

Testing correctness of brake drive. Before driving the trucks, one should be sure that the pressure in the system is at least 4.5 kg/cm^2.

During driving, the pressure in the air brake system should remain at 5.6-7-4 kg/cm^2. Only a brief drop in this pressure in case of frequent repeated braking can be allowed.

In order to avoid completely exhausting the air with frequent braking, it is categorically forbidden to switch off the motor during long downhill stretches.

Increases in pressure above 7.4 kg/cm^2 indicate a defective pressure regulator or relief device; increased pressure above 10 kg/cm^2 also indicates a defect in the safety valve. In these cases, the defect must be immediately repaired.

When the pedal is pressed down sharply (with the motor switched off), the pressure in the system should drop slightly, the pressure in the brake cylinder should become equal to the pressure in the air cylinders. After this, the pressure gauge needle should not move noticeably as pedal pressure is retained. A further drop in pressure indicates a leak in the air lines, brake valve or brake cylinders.

The time of pressure drop (according to the gauge needle) in the brake cylinders following release of the pedal should not exceed 2 sec.

A rapid pressure drop in the pneumatic system when the engine is stopped also indicates leakage in the lines, compressor, brake valve, separating valve or connector head.

The location of a large air leak can be determined by its sound. Slight leaks can be found using a soap emulsion, which is used to wet areas of possible leaks. Air leaks at joints are eliminated by tightening.

The position of the hoses of the front brake cylinders should be periodically tested with the wheels turned full left and right.

Normal operation of the brakes requires that the exhaust valves in the air cylinders be opened during TO-1 and TO-2 in order to drain condensate.

The quantity of condensate depends on the technical condition of the compressor and the relative humidity of the surrounding air; therefore, condensate must sometimes be drained more frequently. Large accummulations of condensate in the cylinder should not be allowed, since this can cause liquid to enter the working units of the braking system. We should recall that condensate can be drained from the cylinders only when there is compressed air in the system. In winter, one should be particularly careful to drain the condensate from the air cylinders in order to avoid freezing in the system of pneumatic brake lines.

In case condensate does freeze, the cylinder should not be heated with an open flame (torch, soldering flame, etc.).

Lubrication of spreader cam shafts and worm couples of adjusting levers in wheel brakes. For lubrication, the places to be lubricated must be cleaned of dust and dirt and protective shields of power brakes must be removed.

Spreader cam shafts must be lubricated with a sprayer through the pressure oiling port. It should be kept in mind that the quantity of lubricant must be moderate, since excess lubricant may reach the braking mechanism.

Lubrication of the worm couple of the adjusting levers requires that the plug be removed, the pressure oiler inserted and lubricant added to the adjusting levers.

Dissembly and Assembly

Removal of brake shoes. Remove the retracting springs, using pliers 20 k-107 (Figure 16-16 a).

After the springs are removed, remove the brake shoes from their axes. The springs are reinstalled using a lever (Figure 16-16 b).

The brake shoe spring of the ZIL-157K should be removed and installed using a hook (Figure 16-16 c).

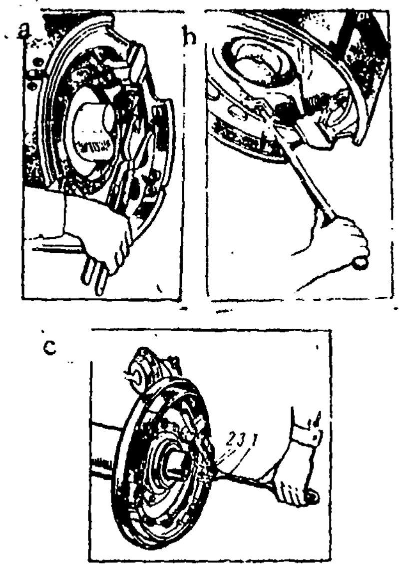


Figure 16-16. Removal and Installation of Brake Shoe Springs: a, removal of spring from front wheel brake of ZIL-130 using pliers: b, installation of spring in front wheel brake of ZIL-130; c, method of removal or installation of spring of wheel brake of ZIL-157K; 1, hook; 2, brake shoe finger; 3, end of spring

In order to remove the spring, hook 1 should be set with its notch on finger 2 and placed beneath the end of the retracting spring. The spring is then removed by lifting the hook upward.

When the spring is returned, the operation should be performed in the reverse sequence; by tilting the hook downward, the end of the spring is guided onto finger 2. Springs can be removed and installed using special pliers (Figure 16-17). On the ZIL-131, the brake shoe springs are removed and installed as on the ZIL-130.

When the adjusting lever and spreader cam are removed, the pin must be removed, plus the flat washer and lever 21 (see Figure 16-3), then spreader cam 18 is withdrawn and the sealing washer is removed from the shaft.

In order to remove the shoe axes, two nuts 6 are removed, the washers are removed and the axes 7 are withdrawn from the holes in the brackets, by pushing them through toward the brake drum.

The brake drums must be turned together with the hub (centered to outer bearing circle, pressed into hub). Beating of the finished brake drum surface should not exceed 0.25 mm for two-axle and 0.15 mm for three-axle vehicles. Nonparallelism of the generating surface relative to the axis of the internal surfaces of the outer bearing circles must not exceed 0.06 mm.

Cracks and scratches on foot brake parts are not permitted.

If brake parts wear beyond the established dimensions, the worn parts must be replaced.

Damage to threads must not exceed two lines, and wear of brake liners must not go beyond the level of the rivet heads. If the wear of the brake drum exceeds 0.5 mm in diameter, the drum must be turned to the next larger standard diameter.

Brake linings must be replaced all at once, both left and right brakes. Shoes with friction liners are assembled in pairs and worked to the proper outside diameter in correspondence to the inside diameter of the brake drum.

When there are scratches on the working surface of the brake drum, they must be removed by turning the drum. When this is done, the lining must be replaced, the lining turned together with the brake shoes to the new diameter of the brake drum.

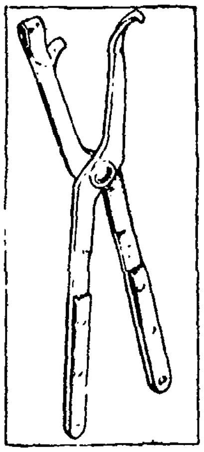


Figure 16-17. Pliers for Brake Shoe Springs

Bent brake mounting discs must be straightened. If strongly bent, the discs must be replaced.

If the mounting of the adjusting lever body is weakened, new rivets must be inserted.

Spreader cams with noticeable twisting should be replaced.

Assembly of wheel brakes must be performed in the sequence opposite to dissembly. During assembly, the mounting surfaces of bushings and axes are lubricated with a thin layer of lubricant. See Chapter 15 for assembly of hubs.

Adjustment of wheel brakes. Full adjustment of the brakes of the vehicles is performed in the following sequence.

On the front axle of the vehicle: loosen nut 6 (see Figure 16-3) which holds axis 7 of the shoe and bring the shaft eccentric together by rotating the shafts until the marks are toward each other. Loosen the nuts on the bolts holding the spreader cam bracket to the disc mounting brake. On the rear axle: also loosen nuts 4 (see Figure 16-4), turn the axles until the marks point toward each other and loosen the bolts holding brackets 7 and 28 of the spreader cam to the disc mounting brake and axle housing (spreader cam should be in neutral position, not spreading shoes).

Feed air into brake cylinder 31 (see Figure 16-3) at a pressure of 1-1.5 kg/cm^2. With no compressed air, withdraw the finger of shaft 30 of the brake cylinder and, pressing on adjusting lever 21 in the direction of shaft travel of the brake cylinder during braking, press shoes 27 against brake drum 8. Rotate the eccentrics of axles 7 in both directions, centering the shoes, providing for tight contact against the brake drum. The contact must be tested by a feeler through the hole in the brake drum at a distance of 20-30 mm from the ends of the shoes. A 0.1 mm feeler should not pass through the width of the shoes.

Continuing to feed compressed air into the brake cylinder, and without compressed air, without lowering the lever and holding the shoe axles so that they cannot rotate, the nuts on all axles must be tightened and the nuts holding down the spreader cam brackets to the brake disc must be tightened.

Stop the compressed air feed or lower the adjusting lever and attach the brake cylinder shaft.

Rotate adjusting lever 21 so that spreader cam 18 occupies its initial position, but without spreading the brake shoes 27. Test the travel of the brake cylinder shaft, which should be 15-25 mm for the front wheels, 20-30 mm for the back wheels.

After completing adjustment, be sure that when the air pressure is turned on and off, the brake cylinder shafts move rapidly, without seizing.

Check to see that in the released position, the drums rotate freely and do not contact the shoes, and that the shoes are suspended.

During adjustment, clearances must be set between the working surface of the brake drum and the linings of the shoes: at the spreader cam, at least 0.4 mm, at the shoe axes about 0.2 mm.

On the rear brakes, placement of the shoes can be more conveniently checked from the side of the reducing gear with protecting shields 3 removed (see Figure 16-4). A feeler gauge 0.1 mm thick should not pass through the entire width of the lining.

On the ZIL-130, the brake mechanism is installed on support sticks, which replaces the brake disc.

The brake mechanisms of the ZIL-157K and ZIL-131 are also adjusted. The brake cylinder shaft travel should be as follows: for the ZIL-157K -- 15-35 mm, for the ZIL-131 -- 15-25 mm.

Adjustment of pneumatic brake drive. The drive of the brake valve should be adjusted so that the end of the pedal 16 (see Figure 16-6) of the brake, when fully depressed, stops short of cabin floor 17 by 10-30 mm. The position of the brake pedal is adjusted with arm 1, by rotating fork 12, after loosening counter nut 11. The fork must be disconnected from lever 14 by removing pin 13. After adjustment, the arm is connected to the intermediate lever, the counter nut is tightened, the pin is replaced and keyed.

With a properly adjusted drive system and proper position of the brake valve levers, the free travel of the end of the brake pedal should be 40-60 mm with the combined brake valve and 10-25 mm with the single brake valve.

Adjustment of the manual drive system for the trailer valve is performed with arm 6 and fork 8 (see description of adjustment of hand brake).

Testing and adjustment of the air pressure in the pneumatic system of the vehicle are performed in the following order. Connect the manometer to the connecting head of the pneumatic lead and open the disconnecting valve.

Start the motor (with brake pedal up) and increase the air pressure in the pneumatic system at low motor speed to 7.0-7.4 kg/cm^2 according to the indications on the top scale of the pressure gauge on the dashboard (pressure in air tanks). The indications on the lower scale of the pressure gauge should remain at zero (pressure in brake cylinders), while the indications of a manometer connected to the pressure head should be between 4.8 and 5.3 kg/cm^2 (pressure in trailer brake line). When the pedal is depressed with the force of 20-30 kg, the air pressure in the brake cylinders should equal the pressure in the air tanks, and the needles on both scales should show identical pressure.

When a force of 10-12 kg is applied to the end of the brake pedal, the pressure in the brake cylinder should become equal to the pressure in the air tanks.

If the indications of the manometer at the connecting head are not normal, the valve section controlling the trailer brakes must be adjusted.

During adjustment, the body of the valve levers must be removed, counter nut 30 loosened (see Figure 16-11) and, rotating guide 6 of shaft 7 with a wrench, the pressure fed into the brake line of the trailer must be adjusted to 4.8-5.3 kg/cm^2. After completing adjustment, guide 6 must be retained with counter nut 30 and the lever body replaced.

With smooth pressure on the brake pedal, the pressure in the brake cylinders of the truck should increase smoothly, the pressure in the trailer line should decrease smoothly, and the arrow on the upper scale of the pressure gauge should not change its position. When a pressure of 4.5-5.0 kg/cm^2 is reached in the brake cylinders (lower scale indication), the pressure in the brake line to the trailer should drop to zero (indication of manometer at collecting head). When the brake pedal is fully depressed (to the stop), the pressure in the air tanks and brake cylinders of the tractor should be equal.

When the brake pedal is pressed sharply (with the motor not operating), the pressure in the air tanks should drop slightly, the pressure in the brake cylinder should become equal to the pressure in the air tanks. After this, there should be no noticeable movement in the needles on the upper and lower scales of the pressure gauge as long as the brake pedal is in the operating position. When the pedal is released quickly, the time required for the pressure to drop in the brake cylinders should not exceed 2 sec.

In a brake system which is operating properly and correctly adjusted, with the brake pedal in the free position (with the motor off) the drop in air pressure in the system (according to the upper scale of the pressure gauge) should not exceed 0.5 kg/cm^2 in fifteen minutes.

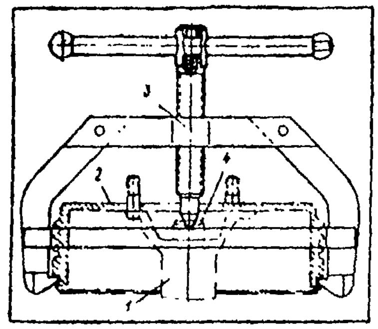


Figure 16-18. Removal of Brake Drum From Driven Shaft of Transmission: 1, flange; 2, brake drum; 3, puller; 4, driven shaft of transmission

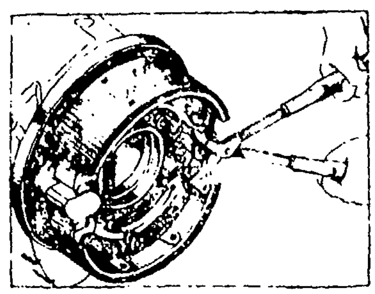


Figure 16-19. Removal of Springs From Hand Brake Shoes

If the pressure drop is too rapid, the reason for the air leak must be located and repaired. The location of the leak can be determined by ear or using a soap solution and the leak can be eliminated by tightening connecting nipples on the air line or replacing individual elements. Threaded connections of air brake equipment can be coated with resin in order to eliminate leaks.

If the vehicle has an individual brake valve, the pneumatic system of the brakes is checked and adjusted just as with the combined brake valve, but without the pressure gauge for the pneumatic connection.

Adjustment of the pneumatic drive of the brakes on three-axle ZIL-157K and ZIL-131 trucks is performed just as on the two-axle trucks with pneumatic leads for trailers. During adjustment of the pneumatic drive, the pneumatic system for adjustment of air pressure in the tires should be disconnected.

Removal and dissembly of the hand brake requires that the drive shaft flange be disconnected from flange 9 (see Figure 16-7). The hand brake drive is disconnected by withdrawing the finger from the hole in the arm and fork 21. When it is necessary to remove the drive lever:

Remove nut 8 fastening flange 9 of the brake drum to the driven shaft of the gear box and remove the drum with puller 3 (Figure 16-18).

Remove retracting springs 6 and 12 (see Figure 16-7) from the brake shoes using a removing tool (Figure 16-19). Remove the pin from the slot in shaft 7 (see Figure 16-7) retaining the shoes with a hammer and awl. Remove the flat washers from the shoe axes.

Remove the two bolts fastening the shoes to the bracket and brake disc. Withdraw the bolts with two spacing (spreader) bushings and two flat washers. Remove the brake shoes.

Remove the bolts mounting the bracket with braking disc on the transmission casing. Removing bolts and washers.

Remove the hand brake brackets together with brake disc 15, spreader cam 14, adjusting lever 16 and rubber-bodied gland 5.

Assembly and installation of hand brake. Assemble brake disc 15 (Figure 16-7) with brake bracket 4, connecting them manually and tightening the bolts. Press gland 5 into its seat, using an awl and hammer, place spreader cam 14 in its position, replace adjusting lever 16 with its arm and fork and fasten them.

Install the assembled brake disc with bracket on the transmission case and fasten with bolts.

Fasten axes 7 of the brake shoes. Stretch both springs 6 and 12 onto the brake shoes and place the shoes onto the axes, followed by the support washers; replace pins to retain shoes on axes.

Install with spacers the two bolts with simple washers in the oval holes in the shoes and fasten them to the brake disc.

Connect the brake drum to the flange of the driven shaft of the gear box and fasten with screws.

Install flange 9 with brake drum 3 onto the splines of the driven shaft, seat the flat washer and, tightening the nut, fasten it with an open end angle wrench (torch 30 kgm). Punch the nut with a blunt chisel and hammer, pressing the thin edge of the nut into the slot in the shaft.

Install the hand brake drive lever 28 onto the transmission case and fasten the lever bracket and shaft down with bolts.

Connect arm 23 of adjusting lever to lever of brake drive, inserting finger and retaining with key.

The hand brake on three-axle vehicles is assembled and installed just like the hand brake on two-axle vehicles, but the brake is installed on the transfer case, the drive lever -- on the transmission.

Adjustment of hand brake drive is performed in the following sequence. Loosen counter nut 22, remove threaded fork 21 from the lower portion of lever 28, withdraw hand brake drive lever to the extreme forward position to the stop, changing the length of arm 23 by turning threaded fork 21 until a position is reached such that after the arm is connected to the lever, braking occurs when the lever with pawl 26 is pulled back by not over 4-6 teeth on sector 25, but when the lever is moved to its extreme forward position, the brake drum rotates freely, without contacting the brake shoe. If the arm still does not provide proper braking with movement of the lever by 4-6 clicks when turned to its extreme position, move the finger of arm 23 to the next hole in adjusting lever 16. This is done by removing the key and loosening nut 24, moving the finger, tightening the nut and reinserting the key. Arter moving the finger, the brakes should be adjusted as described above.

The hand brake drive is combined with the section of the combined brake valve controlling the trailer brakes. Adjustment of the hand brake drive in the combined brake valve for the trailer is performed by rotating threaded fork 15 on arm 17 with the counter nut backed off, after which the counter nut is retightened.

After adjusting the brake, the drive shaft must be connected to the flange of the driven shaft of the gear box and held in place with the bolts.

When the compressor is removed from the truck, the line taking compressed air from the compressor, the line from the pressure regulator, the lines feeding and draining lubricant must be disconnected. Disconnect the hose feeding air to the compressor and the cooling system hoses.

Loosen the compressor mounting nuts. Remove the belt from the compressor pulley. Remove the compressor mounting nuts and remove the compressor from the motor.

Dissembly of ZIL-130 compressor. The compressor must be dissembled in the following sequence.

Remove the keys and remove the pulley mounting nut, remove the flat washer. Withdraw the pulley using type 20P-7968 or 20P-7967 puller.

Remove the lower bracket-cover 1 (see Figure 16-8) of the compressor, by loosening the bolts. Remove the cover gasket, carefully separating it from the case. Remove the air feed hose with its gasket, after loosening its two mounting bolts.

Figure 16-20. Pressing out Intake Valve Seat

Remove mounting nuts and remove cylinder head. In order to make removal easier, the head should be gently tapped with a hammer. Remove head gasket, separating it carefully from the block, remove intake valve spring 25 and intake valves 26. Remove the cover of the chamber of the relief device.

In order to remove the pressure regulator, the bolts mounting the regulator to the block must be removed with a box and wrench, then the regulator is removed together with its gasket.

Unscrew spring 29 and bracket 41 of the relief device. Withdraw two shafts 28 of the intake valve manually or with pliers. Withdraw two plungers 42 of the relief device from their seats using the support, placing it in air channel 31, taking the plunger in the hand and forcing it from its seat. Remove the sealing rings from both plungers (remove only when they are to be replaced).

Remove the two input valve guides from their seats and press out both seats 27 of the intake valves with a removing tool (Figure 16-20 and 16-21).

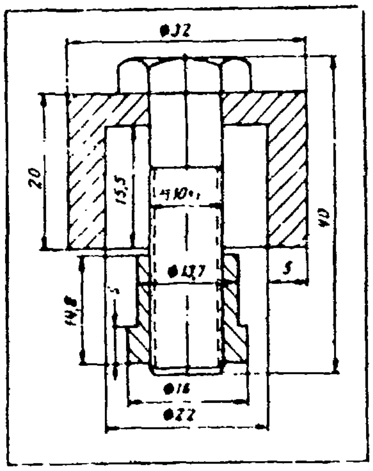


Figure 16-21. Intake Valve Seat Removing Tool

Remove the bolts fastening on the center cover, remove cover 3 (see Figure 16-8), protecting the gasket and gland from damage, remove the gasket and gland 5. Remove the bolts only on the rear cover 48 and remove the cover with its gasket. Remove sealer 46 and sealer spring 47 from their positions on the crankshaft. If the thread is worn, remove the oil supply nipple from the cover.

Set the compressor upside down. Mark the caps and connecting rods. Remove the key from nut 51 on the con rod bolts with pliers and remove the nuts with open end wrenches. Remove both covers of the lower head of the connecting rod together with their bushings, by lightly tapping on the cover with a hammer; the connecting rod bolts can be knocked (seated) slightly downward.

Rotate the crankshaft so that the piston reaches top dead center. Withdraw the piston and connecting rod through the cylinder, by tapping with a hammer handle or copper awl on the end of the lower connecting rod head. Set the cap and bushings down together, twist the nuts onto the bolts. Remove the second piston and connecting rod together from the cylinder in the same manner.

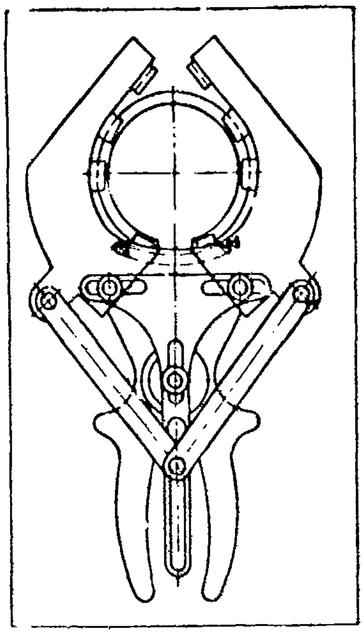


Figure 16-22. Compressor Piston Ring Remover

Clamp the connecting rod in a vise. Remove the two compression and one oil rings from the piston, using a model 2479 ring remover (Figure 16-22). Remove the connecting rod and piston from the vise.

Place the piston on a wood support with a hole in it, press out the wrist pin using a brass awl and separate the piston and rod. Remove the two inserts from the wrist pin hole. When necessary, press out the bronze bushings from the upper head of the connecting rods using a brass awl and hammer, clamping the rods in a vise.

The cylinder head should be dissembled only when necessary. For dissembly, the head should be fastened in a vise and the cooling fluid tap plug withdrawn, along with the compressed air nipple and threaded cap (when the water cavity of the head is to be cleaned).

Withdraw the intake valve plugs, using a cylinder wrench and tap wrench, remove the plug gaskets, remove the valve springs and exhaust valves 18 from their seats (see Figure 16-8), remofe both seats 17 of the valves with a square wrench. The valves are turned into their seats, and it is not recommended that they be dissembled.

Remove the nuts fastening the block to the crankcase, remove the spring washers, block and block gasket. When necessary, remove the pins from the crankcase with a pin remover or two wrenches, by screwing a nut and counter nut onto the pins.

In order to clean the block cooling jacket, remove the plug (nipple) for cooling fluid input, remove the plug and knock out the three blanks. When necessary, remove the lugs from the block.

Set the cylinder block case into a press on the rear end of the case and press out the crankshaft and bearings (Figure 16-23). To do this, place a brass support on the front end of the crankshaft, in order to avoid damaging the thread. Withdraw the lugs from the case when necessary.

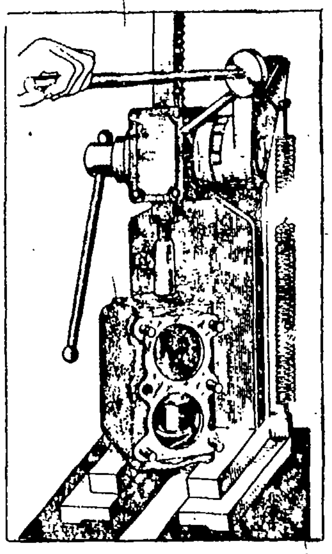


Figure 16-23. Pressing out the Compressor Crankshaft

Remove the pins from the nut holding on the rear bearing, twisting out the stop washer. Place the crankshaft vertically on the press and press out first one, then the other bearing (Figure 16-24).

The compressor crankcase. During the process of operation, cracks or scratches may appear on the compressor crankcase, as well as stripped threads.

When there are cracks in the walls of the crankcase, it should be replaced. Small cracks on the flange fastening the crankcase to the engine, contacting not over one of the holes for the bolts mounting the crankcase to the engine, can be welded or surfaced. Damage to over two turns of threads is not permitted.

Compressor cylinder block. Testing of the geometric dimensions of the cylinders in the compressor block should be performed using a 50-75 mm indicator. The cylinder should be measured in two mutually perpendicular directions along the axis of the crankshaft and perpendicular to it, as well as in two bands, in the upper and lower portions of the cylinder.

The maximum permissible cylinder wear is 0.3 mm.

The cylinders are repaired by turning out and subsequent honing to one (of two) oversized diameter. Deviation from cylindrical shape of the repaired cylinders must not exceed 0.03 mm.

The seal of the cylinder block is tested with compressed air (15 kg/cm^2) in a water bath. The appearance of bubbles indicates a leak in the block.

The separation lines of the block should not be scratched. Nonplanarity is not permissible over 0.04 mm. A 0.05 mm feeler gauge should not pass beneath a flat edge placed on the plane of the block.

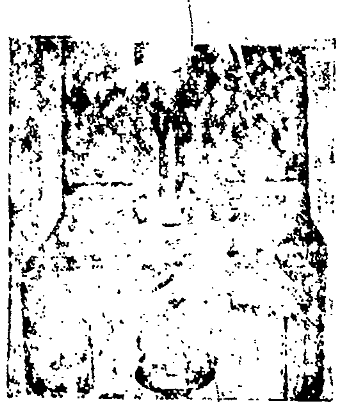


Figure 16-24. Pressing out Front Bearing of Compressor Crankshaft

Pistons. In order to distinguish oversize pistons, the figures +0.4 or +0.8 are engraved on the skirts, indicating which of the oversized dimensions the pistons fit. No mark is placed on nominal size pistons.

Pistons are selected to fit the cylinders with a clearance of 0.03-0.09 mm. A piston placed in a cylinder together with a 0.03 mm feeler gauge should move when pressed with the thumb, but should wedge tightly when placed in the cylinder with a 0.09 mm feeler.

Piston rings are selected according to elasticity and clearance in the seat. The elasticity of the rings (when compressed to a clearance in the seat of 0.2-0.4 mm) for all rings should be 2.0-4.0 kg. The method of testing piston rings for elasticity for the compressor is similar to testing of piston rings for elasticity for the motor.

In order to determine the clearance assembled, the piston ring must be placed in the cylinder at a distance of 10-15 mm from the upper edge of the cylinder and the clearance between the ends of the ring must be tested with a feeler gauge similarly to the testing for motor piston rings. The clearance should be 0.2-0.4 mm.

During selection of piston rings, their adjustment to the walls of the cylinder is tested simultaneously. There should be no gap between the cylinder walls and the ring over an arc located 30° from the ends of the joint. Local clearance of up to 0.03 mm over a total arc up to 90° is permitted.

Piston rings are selected for the ring seats in which the rings should move freely without wedging. The clearance between a seat and compression ring should be 0.035-0.072 mm in height, for an oil ring -- 0.035-0.080 mm for all compressors.

In order to distinguish oversize rings, the numbers +0.4 or +0.8 are engraved on the ends of the ring, determining the size of the ring. No marks are made on rings of nominal size.

All rings are installed on the pistons with the turned step upward.

Piston wrist pins. Wrist pins are selected in correspondence with the apertures in the piston to provide a fit with a clearance of 0.009 mm to an interference of 0.015 mm. In order to facilitate selection of wrist pins, the piston apertures and wrist pins are sorted into four groups at intervals of 0.003 mm and marked with paint of different colors.

Deviation from cylindrical shape of wrist pins must not exceed 0.003 mm.

Crankshaft. In case of wear of ball bearings, they should be removed and replaced with new ones. Crankshaft necks are tested for wear with a micrometer (25-50 mm). In case of wear of con rod necks (noncylindricity) of over 0.05 mm, the necks must be reground to a new standard diameter or the crankshaft must be replaced.

Two standard repair sizes have been established for compressor crankshafts. During repair, the oil channel of the crankshaft must be cleaned and blown out with compressed air.

Connecting rods. In case of excessive wear of the upper bushing of the connecting rod, it should be replaced. The fit of the bushing into the rod aperture should be with an interference of 0.062-0.115 mm. After the bushings are pressed in, a lubricating aperture must be drilled. The wrist pin aperture in the bushing is adjusted to the diameter of the wrist pin so as to provide a clearance of 0.004-0.010 mm between pin and bushing. The wrist pin should slip into the aperture in the upper end of the connecting rod under finger pressure.

Upper connecting rod heads are divided into four groups of bushing diameters at intervals of 0.003 mm and marked with paint.

Connecting rods and wrist pins should be selected from a single group. Wrist pins of the next group can be installed if necessary.

Repair of lower head of compressor connecting rod. The lower head of the ZIL-130 compressor connecting rod contains thin-wall bushings, cast of SOS-6-6 antifriction alloy. Marking of reduced diameter bushings to be used following turning of necks of 0.3 mm or 0.6 mm size is performed on the steel surfaces of the bushings. Bushings of nominal dimensions are not marked.

The connecting rod must be tested for bending and twisting in a tester. The method of testing the compressor connecting rod is similar to the method of testing motor connecting rods.

Deviation from parallel axes of upper and lower heads must not exceed 0.07 mm over a length of 100 mm. When necessary, the rods must be straightened.

When rods are replaced, their weight must be checked. The weight difference for one set of rods should not exceed 15 g.

The cylinder head must be checked for tightness of seal and warping. The seal in the air cavity is tested with air under a pressure of 15 kg/cm^2, the cooling jacket is tested under a pressure of 4 kg/cm^2. The head should be placed in their water bath for this test. The appearance of bubbles indicates a leak in the head.

The split surface of the head should have no scratches or warping. Nonplanarity must not exceed 0.05 mm. A 0.05 mm feeler gauge should not pass beneath a straight edge placed on the plane of the head.

Rear crankcase cover. The deviation from shape of the end of the cover at the point of contact with the compressor crankcase should not exceed 0.06 mm. Conicity of the end of the cover at the point of contact with the seal is 1:8. This end of the cover should fit tightly against the conical portion of the rear cover seal. If there are cracks or wear in the friction surfaces, the cover should be replaced.

Rear cover seal. The conicity of the end of the seal contacting the end of the cover is 2-4°. If there are cracks or increased wear in the friction surface, the cover seal should be replaced.

Rear cover seal spring. In case of a loss of elasticity, it should be replaced.

Exhaust valve spring. This spring should be replaced when it loses its elasticity.

Pulley. Mismatch between ends of slot and new pulley ±0.4 mm. Permissible displacement of pins without repair not over 1.0 mm. If there are cracks present, the pulley should be replaced. Before installation on the compressor, the balance of the pulley should be checked. The pulley is statically balanced. The permissible imbalance of the pulley is 15 gcm.

Exhaust valve, plug and seat of exhaust valve. The valve should contact the entire working surface tightly. The valve and seat should have no scratches. Misfit between working surface of rod and valve face should not exceed 0.03 mm.

Assembly of compressor unit should be performed under conditions eliminating the possibility of getting dust and dirt on the parts being assembled.

Before assembly, the compressor parts should be carefully washed in a degreased solution and dried.

Nipples and plugs should be screwed into the ZIL-130 compressor and held with type AK-20 glue, and sealing gaskets should be lubricated with resyl resin or nitrocellulose paint.

Installation of crankshaft bearings. Bearings should be pressed onto the main bearing necks of the shaft using a mandrel and hammer. The fit of the bearings on the shaft neck should be somewhere between a clearance of 0.008 mm and an interference of 0.020 mm.

Seat the stop washer on the rear end of the shaft, put on the rear bearing fastening nut, tighten the nut with a wrench and insert the key, after bending one ear of the washer into the slot.

Testing radial clearance of connecting rod bearings. Place the crankshaft in a vise. Place a connecting rod onto one neck of the crankshaft and fasten it down with bolts and nuts, which tighten (1.5-1.7 kgm). The connecting rod should rotate freely on the neck of the shaft, requiring identical force in either direction. The clearance between the shaft neck and the rod bearing in this case should be between 0.026 and 0.076 mm. When rod bearings are installed on a shaft neck with a plate as thick as the maximum clearance, it should wedge.

Assembly of piston to rod and rings. Press plugs into wrist pin and measure length of pin assembled with plugs. The length of the pin should be not over 59.5 mm. The fit of the plugs with the pin should have an interference of 0.05-0.25 mm. When the piston is connected to the rod, the wrist pin should be lubricated with pure oil for the motor.

The fit of the wrist pin in the piston must be between 0.015 mm clearance and 0.009 mm interference.

When the piston is assembled with the rod, perpendicularity of the axes of the lower rod heads and generatrix of the piston skirt must be checked.

The rings (as for the motor) must be installed on the compressor piston. The rings are placed on the pistons with the internal turned steps upward, the end closures of the rings are set at intervals of 120° around the circle.

Assembly of compressor cylinder head. Fasten the head in a vise. Screw seats 7 into the recesses in head 1 with a square wrench (Figure 16-25), after inserting gaskets 8. Install the exhaust valves 5 in the seats, then springs 4 on the valves. Place gaskets 2 on plugs 3 and screw the plugs into the holes in the head. Then tighten them down with a cylinder wrench, placing a tap wrench in the aperture.

Screw the cooling liquid angle fitting into the head, plus the compressed air nipple and the plug.

Assembly of the compressor. If bushings 1 (Figure 16-26) of the plunger were pressed out, they must be pressed into the hole in the block with an interference of 0.045-0.115 mm. A spacing of 32.5 mm from the cylinder block split to the bushing must be maintained. Valve seats 5 are pressed into the holes in the block with an interference of 0.021-0.075 mm to the stop in the shoulder of the aperture. Intake valve guides 10 are installed.

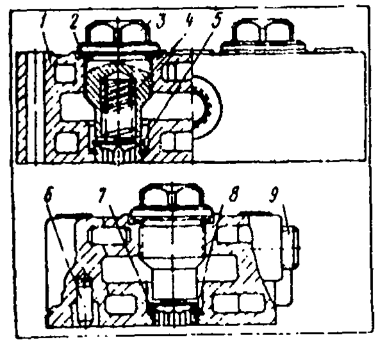


Figure 16-25. ZIL-130 Compressor Cylinder Head: 1, head; 2, 8, gaskets; 3, exhaust valve plug; 4, valve spring; 5, exhaust valve, 6, intake valve spring guide rod; 7, valve seat; 9, compressed air nipple

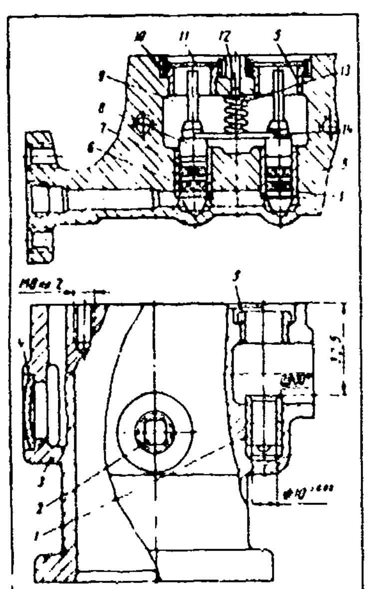


Figure 16-26. Compressor Cylinder Block 1, plunger bushing; 2 and 4, plugs; 3, block; 5, intake valve seat; 6, sealer; 7, sealer; 8, shaft seat; 9, shaft; 10, valve guide; 11, intake valve; 12, guide spring; 13, crosspiece spring; 14, crosspiece

Set the bushing of plunger 7 in the hole, after putting on sealer 6. Place one shaft 9 assembled with collar 8 into the plunger. Set one end of the crosspiece on the step of the shaft collar and, while inserting the second shaft, set the other end of the crosspiece on the step of the second shaft collar. Set the crosspiece spring into the aperture in the guide block. Install spring 13 of crosspiece 14 with a screw driver.

Install and tighten the nipples and plugs in the holes in the block. Screw the lugs back into the cylinder blocks if they were unscrewed during dissembly.

Assembly of compressor crankcase. Place the case on a plate, front end downward. Set the crankshaft vertical, directing the front bearing through the rear bearing hole. Supporting the shaft with one hand and using the other hand to pull down on the press lever, press the bearings into the seats in the crankcase, together with the shaft.

Remove the case from the press, connected to the cylinder block, inserting the gasket, and fasten it to the lugs with the nuts, placing spring washers beneath the nuts.

Installation of pistons. Remove the nuts and connecting rod caps. Check the installation of rings on the piston and rotate the rings until their ends come at intervals of 120° around the circle. The piston, together with its rings and connecting rod, can be inserted in the cylinder using a model 2494 device (Figure 16-27). Remove tightening screw 3 from the slot in support 5, wrap collar 1 around the piston rings, return the screw to the slot and, by rotating it, compress the rings so that they are forced down into their slots, level with the surface of the piston. Then lubricate the cylinder with oil, place the piston skirt into the cylinder and by tapping gently on the piston with a wood or rubber hammer, force the piston into the compressor cylinder all the way, guiding the bearing onto the crankshaft neck. Use this same method to install the other piston in the cylinder of the compressor. Install the connecting rod caps and bushings, turn the nuts onto the connecting rod bolts and tighten them to 1.5-1.7 kgm, then insert keys.

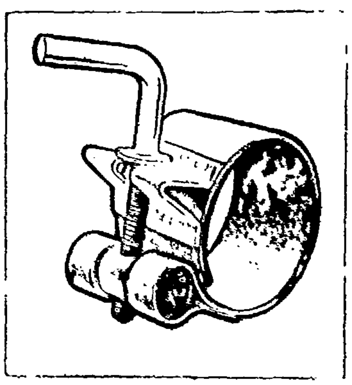


Figure 16-27. Model 2494 Device for Installation of Piston With Rings Into Compressor Cylinder

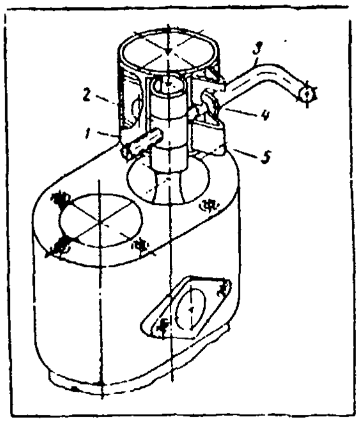


Figure 16-28. Installation of Piston With Connecting Rod and Rings Into Cylinder of Compressor Block Using Model 2494 Device: 1, collar; 2, nut; 3, screw; 4, washer; 5, support

When matching the key slots on the nut to the apertures in the crankshaft bolt, the nut cannot be rotated, since this alters the necessary torque of the rod nuts.

Installation of cylinder head. Install the intake valves on their seats in the cylinder block, place the head gasket on the cylinder block split, seat the intake valve springs over the guide rods.

Install the head on the cylinder block. While holding the springs of the intake valves, tighten the nuts on the block lugs and fasten them with an open end or socket wrench (torque 1.2-1.5 kgm).

Connect the air feed line to the block with a gasket and fasten it with bolts.

Installation of compressor caps. Press the rubber frame gland into the seat of the front cap, using a hammer and mandrel, place grease in the gland, install the cap and gasket on the split of the block and fasten it down with bolts, placing spring washers under the heads of the bolts.

Before installing the rear cover, the sealer spring must be placed into the seat on the crankshaft, settings its end in the hull in the shaft. Place the sealer in the seat, connecting it to the spring. Install the cap and gasket and tighten it with bolts, placing spring washers beneath the bolt heads.

Screw the oil input nipple into the cover.

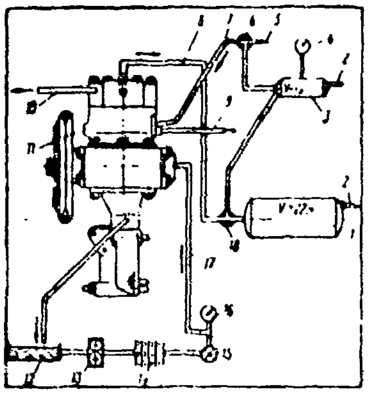


Figure 16-29. Diagram of Test Stand for Compressor: 1, 22 l tank; 2, 9 kg/ cm^2 safety valve; 3, 1 l tank; 4 and 16, manometers; 5, calibrated apertures; 6 and 18, three-way valves; 7, relief device pipe; 8, compressed air pipe; 9 and 10, pipes for cooling water; 11, compressor; 12, oil tank; 13, oil pump; 14, oil filter; 15, valve; 17, pipe feeding oil to compressor

Installation of compressor pulley. Install the key in the slot in the shaft with a hammer, set the pulley on the cone of the front end of the crankshaft, guiding the slot in the pulley over the key. Put on the nut and press the pulley further onto the shaft cone to the stop, then key the nut.

Installation of lower cover bracket. Fasten the compressor in a vise so that the crankshaft plane of the crankcase is directed upward. Place the gasket on the plane of the crankcase, install the cover on the crankcase, tighten the four bolts, placing spring washers beneath their heads, and tighten the cover bracket. Install the pressure regulator on the compressor with its gasket.

After completing the assembly of the compressor, its operation must be tested on a test stand (Figure 16-29) or on an engine.

When testing the compressor on the stand, the rotating speed of the compressor shaft must be 1200-1350 rpm. The pressure of oil fed into the compressor should be 1.2-2.5 kg/cm^2, the oil temperature 40-50° C. The compressor should be allowed to operate at the idle for five minutes. During the running-in process, checks should be made for oil leakage, heating of bearings and slapping of pistons, wrist pins and exhaust valves. At 1200-1350 rpm of the crankshaft, with tank 3 connected to the atmosphere through a calibrated aperture of 1.6 mm in diameter, the manometer should show a pressure in the tank of at least 6 kg/cm^2 (counterpressure). With this mode of operation of the compressor, not over 1.5 cm^3 oil should enter the tank per hour.

The compressor is tested for oil throughput capacity at 1200-1350 rpm with oil pressure 1.5-2.0 kg/cm^2. Under these conditions, the quantity of oil flowing through the drain aperture in the compressor crankcase cover (with open calibrated aperture) should be not over 500 g in five minutes.

Testing of the operation of the relief system is performed by feeding compressed air under not over 5 kg/cm^2 pressure into the relief chamber, at which point plungers 7 (see Figure 16-26) should rise and fully open intake valves 11. When the pressure is removed, the plungers should return sharply due to the action of the return springs to their initial position. This operation must be tested at least three times.

The exhaust valves can be checked for tightness by connecting the head of the compressor to tank 3 (see Figure 16-29) with a volume of 1 l, as shown on the diagram, with a pressure of 6.5-7.0 kg/cm^2. The pressure drop in the cylinder should be not over 0.5 kg/cm^2 in 40 sec.

Leak testing of connections is made with a soap solution with an air counterpressure of 6.5 kg/cm^2.

Before installation on the compressor, the pressure regulator must be checked, tested and adjusted to operate within the required air pressure limits.

Installation of compressor on engine. Install the compressor on the engine manually, guiding the holes in the bracket cover onto the lugs on the motor cylinder head. Put on the nuts by hand, then tighten them with a wrench. Place the drive belt around the pulley and adjust the belt tension by rotating adjusting collar 4 (Figure 16-30) with special wrench 3, after backing off stop screw 1. Belt 5 of the drive of the ZIL-130 compressor should be tightened so that when a force of 4 kg is applied to it, the belt is deflected by 5-8 mm.

After completing adjustment of belt tension, coupling 4 must be fastened with stop bolt 1 and keyed. Connect the pipe which carries the compressed air and the cooling water hose to the nipples in the head.

Connect the hose bringing air to the compressor to the connection tube. Connect the hose bringing cooling water to the nipple on the cylinder block. Connect the oil lines to the nipples.

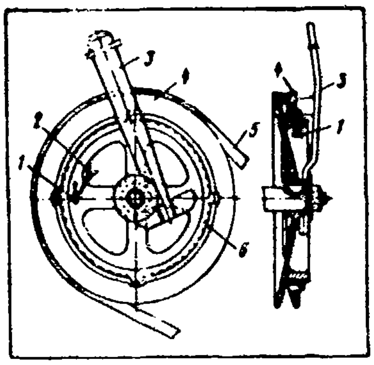


Figure 16-30. Adjustment of Compressor Drive Belt Tension: 1, stop bolt; 2, key; 3, wrench; 4, adjusting coupling; 5, drive belt; 6, compressor pulley

To dissemble the AR-11 pressure regulator, clamp it in a vise and perform dissembly in the following sequence.

Remove the screws fastening cover 1 (see Figure 16-9), remove the washer and cover. Back off counternut 6, remove adjusting cap 2 and the two support balls 4 and spring 3 together, then withdraw shaft 5. Unscrew seat 16 of the exhaust valve, remove it together with counternut 6 and stop washer 18, then remove adjusting shims 17. Unscrew plug 10 and withdraw ceramic filter 11. Remove the body of the regulator from the vise and remove ball valves 14 and 13 and spring 12 of the valve, by rotating the body with the valve housings downward.

Assembly of the pressure regulator is performed in the reverse sequence.

Testing the pressure regulator for tight sealing is performed by wetting the output aperture in the housing and the threaded joints with a soap solution.

The top valve is checked with the regulator turned on, the bottom valve is checked by reducing the pressure until the regulator switch is off.

Air leaks through the upper or lower valves should not cause the formation of soap bubbles for five seconds. Air leaks through the threaded joint are not permitted.

If the pressure regulator does not maintain the air pressure within the required limits, it should be dissembled, washed in gasoline and defective parts should be replaced.

In case of damage to the ball valve seats, the pressure regulator must be replaced.

In case of damage to the surface of the balls, they should be replaced and the pressure regulator adjusted.

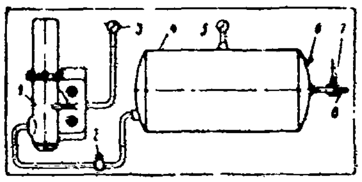


Figure 16-31. Diagram of Test Stand for Pressure Regulator: 1, regulator; 2, valve; 3 and 5, manometers; 4, air tank; 6, 9 kg/cm^2 safety valve; 7, three-way valve; 8, air supply from pneumatic system

The regulator should switch on when the pressure in the pneumatic system is increased to 7.0-7.4 kg/cm^2, causing the compressor to switch off and stop the flow of air into the air system. The regulator should switch off when the pressure in the pneumatic system drops to 5.6-6.0 kg/cm^2, at which time the compressor should switch on and begin to feed air into the pneumatic system.

In order to check the upper pressure limit, valve 2 and valve 7 must be open (Figure 16-31) and cylinder 4 filled with compressed air, beginning at zero pressure in the cylinder up to 7.0-7.4 kg/cm^2, while observing the readings of the manometers. When the pressure in the cylinder (manometer 5) reaches 7.0-7.4 kg/cm^2, valve 13 (see Figure 16-9) should open and switch on the regulator, and the reading of manometer 3 (Figure 16-31) should be the same as that of manometer 5, i. e. 7.0-7.4 kg/cm^2. After seeing that the indications of the manometers are correct, valve 7 should be closed.

In order to test the lower pressure limit, valve 7 should be open slightly, gradually releasing the air and observing the manometers. As soon as manometer 5 shows a pressure of 5.6-6.0 kg/cm^2, the needle on manometer 3 should rapidly drop to zero. Valve 14 (Figure 16-9) opens and the regulator is switched off.

If manometer 3 (Figure 16-31) does not show the required pressure in testing the upper and lower pressure limits, this means that the regulator must be adjusted. This is done by removing the screws, removing cover 1 (Figure 16-9), backing off counternut 6 and, by rotating cap 2, adjusting valve 14 to open at the low pressure limit of 5.6-6.0 kg/cm^2, when the compressor should start operating and feed air into the pneumatic system of the truck.

When adjusting the regulator, tightening the cap down causes the pressure to increase, while backing it off causes the pressure to decrease. After adjustment is completed, tighten the counternut against the cap, then check the upper pressure level.

If valve 13 does not operate at 7.0-7.4 kg/cm^2, the upper pressure level must be adjusted, adjusting the movement of the valves. This is done by withdrawing seat 16, changing the number of adjusting shims 17, until intake valve 13 opens at the upper pressure limit of 7.0-7.4 kg/cm^2, at which point the compressor should stop working.

In this adjustment, increasing the number of shims 17 causes the pressure to decrease, while decreasing the number of shims increases the pressure.

After adjusting the regulator, fasten the seat in place with stop washer 18 and its screws. Then remove the regulator from the test stand, install it on the compressor and check its operation on the truck.

In case the regulator does not operate properly, it must be adjusted once more.

Dissembly and assembly of the safety valve. The safety valve (see Figure 16-10) is adjusted so that it opens when a pressure of 9.0-9.5 kg/cm^2 is reached in the system. The valve is adjusted to this pressure with adjusting screw 6, held in place by counternut 5.

The safety valve must not leak. Leak testing of the valve is performed with a soap solution. In order to eliminate leaks, the valves should be dissembled, carefully washed in kerosene, dried and reassembled.

The sealing band of seat 1 and ball 3 should have no scratches or other surface damages. In case of damage to the ball, it should be replaced. In case of damage to the sealing band of the seat, the entire safety valve should be replaced.

Dissembly and assembly of combined brake valve. In order to protect the stop signal switch from damage, it must be removed from its seat in the valve before dissembly. This is done by pressing the valve in a vise and withdrawing body 25 (see Figure 16-11) of the switch, together with all its parts. To remove the lever body, disconnect lever 33, remove the cover of the body together with protective boot 2. Remove the bolts fastening the lever body to body 8 of the valve. If necessary remove the levers, cam shaft 32 and the shaft with small lever 29.

In order to remove large lever 3 with shaft 7, its axis must be pressed out and the lever removed together with arm 1.

In order to remove shaft 7 from the trailer valve section, back off counternut 30, remove shaft guide 6 from the body of the valve with a wrench.

In order to remove the truck valve section valve unit, the plug from the valve cap must be removed, followed by the entire unit: the diaphragm, seat 17, exhaust valve 19, the return spring and input valve seat with adjusting shims 13.

To remove the diaphragm unit of the truck valve section, the mounting bolts of the truck valve cover must be removed, after which the cover is removed together with the diaphragm spring. Then withdraw the entire unit: the diaphragm, exhaust valve seat 17 and the guide cup. To remove the diaphragm with the seat body, the mounting nut is removed and the unit is separated into parts.

After removal of the unit, cup 28 and balancing spring 27 are removed together from the valve cavity.

Removal of the diaphragm unit and valves from the trailer section of the valve system is performed just as for the tractor section.

Dissembly of the trailer valve section shaft requires that balancing spring 5 be squeezed in a vise and the locking ring be removed (Figure 16-32 a), then the stop washer removed from the shaft and the spring taken off of the shaft guide. The cup of the truck valve section is removed similarly. After replacing worn parts, the combined brake valve is assembled in the reverse sequence.

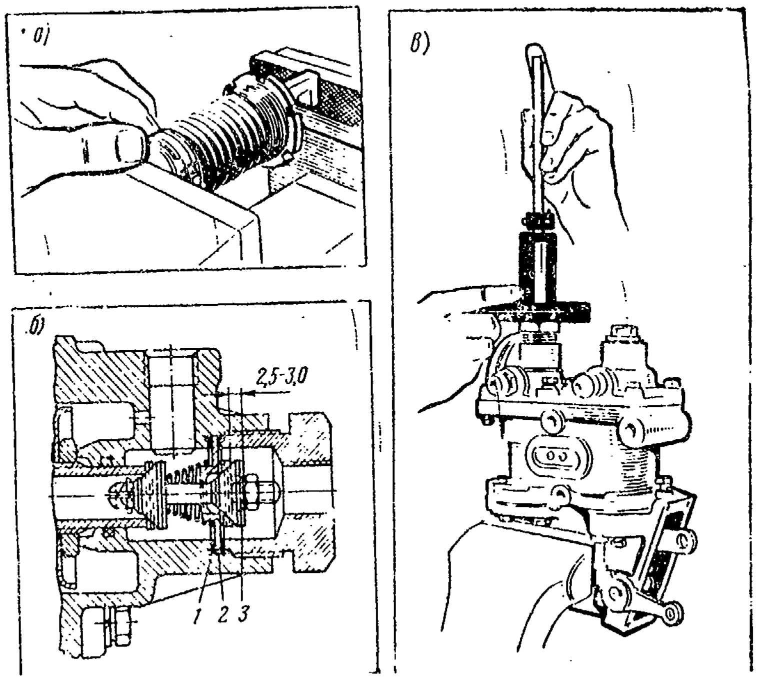


Figure 16-32. Shaft of Trailer Valve Section: a, dissembly of shaft; b, working travel of intake valve; c, measurement of working travel of intake valve: 1, adjusting shims; 2, intake valve seat; 3, intake valve

Before assembly, the friction surfaces of the valve must be washed with clean kerosene, dried with a soft rag and lubricated with a thin layer of type TSIATIM-201 lubricant.

Testing and adjustment of combined brake valve. Each brake valve which has been repaired and assembled must be tested on the pneumatic installation illustrated on Figure 16-33. The air pressure in air tank 3 should be 7 kg/cm^2 and should be maintained for the entire test period. The air should be fed to the intake valve.

One hole in the upper and lower covers of the brake valve should be plugged, the other holes connected to cylinders 6 and 8. Electrical current is fed to the stop signal from power supply 11 at 5 a, test lamp 10 and fuse 12 are connected into the electric circuit.

The pneumatic installation can be used to check for leaks and operation of the brake valve and stop switch, and also to adjust the valve.

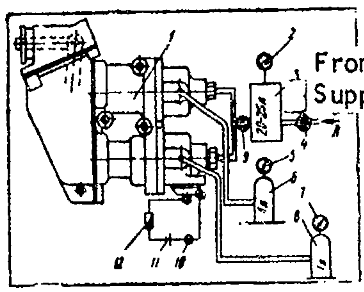


Figure 16-33. Installation for Testing of Combined Brake Valve: 1, brake valve being tested; 2, 5 and 7, manometers; 3, 6 and 8, air cylinders; 4, bypass valve; 9, three-way valve; 10, test lamp; 11, power supply; 12, 5 a fuse: A, air supply from source

In the brake valve, the free travel of lever 3 (Figure 16-11) of the valve, the free travel of lever 33 of the hand brake, the working travel of shaft 7 of the trailer section, the travel of intake valves 14 and 19 of the trailer and truck sections and the air pressure in the trailer valve section are checked.

The free travel of lever 3 and lever 33 not causing movement of the valve diaphragm should be 1-2 mm, determined by rocking the levers.

The free travel of levers 3 and 33 can be adjusted with bolts 4 and 34 after backing off the counternuts, which are then tightened following adjustment.

The working travel of shaft 7 of the trailer brake valve section should be not over 5 mm. Adjustment of the shaft travel is performed by bolts 31 and fastened down with a counternut.

The air pressure in the trailer brake valve section should be 4.8-5.3 kg/cm^2, and during braking the pressure should drop rapidly to zero.

The operating travel of intake valves 14 and 19 of the trailer and truck sections should be 2.5-3.0 mm (see Figure 16-32 b).

If there is a deviation in valve travel from the recommended value, adjustment must be performed using shims 13 (see Figure 16-11) placed beneath seat 15 of the valve. By decreasing or increasing the number of shims, the valve travel can be set at the normal length. Measurements can be performed with a measuring rule or rod depth measuring device (see Figure 16-32 c).

In order to check the tightness of seal and operation of the brake valve, bypass valve 4 must be closed (see Figure 16-33), then lever 3 (Figure 16-11) of the brake valve rapidly pushed to the stop. The indication of manometer 7 (Figure 16-33) should rise from zero to the indication of manometer 2, while the pressure shown on manometer 5 should drop from 4.8-5.3 kg/cm^2 to zero.

The increase in the pressure on manometer 7 and the drop in pressure on manometer 5 should occur rapidly. In this position, the indications of manometers 5 and 7 should be watched for one minute. Air leaks are not permitted.

When the lever is rapidly lowered, the pressure on manometer 7 should drop sharply to zero, while the pressure shown by manometer 5 should increase rapidly from zero to 4.8-5.3 kg/cm^2. This test should be repeated at least three times.

If there is a deviation from the limiting pressure, adjustment must be made by rotating guide 6 of the shaft (Figure 16-11) with counternut 30 backed off, after which the counternut must be retightened. Adjustment is performed with the body of the levers removed.

With smooth application and removal of loads on the lever of the brake valve, the changes in the indications of manometers 5 and 7 (Figure 16-33) should occur smoothly, i. e. each intermediate position of the lever should correspond to intermediate indications of the manometers.

When the lever is held in its intermediate positions, the indications of manometers 5 and 7 should remain steady.

When the manual brake valve drive lever is moved, the pressure on manometer 5 should drop from 4.8-5.3 kg/cm^2 to zero, while the pressure on manometer 7 should remain the same, i. e. should be zero.

In order to determine the operation of the stop signal switch, the continuity of the insulation must be checked. This is checked by connecting a voltage of 220 v into the circuit, with a 50 w bulb connected in series. The voltage should be applied to the terminals (in the off position) and to the body for 5-6 sec.

The moment when the stop signal switch switches on should be determined using dc power. The current should be 5 a, the voltage 12 v. In order to determine the moment of switching, lamp 10 should light when the air pressure is between 0.2 and 0.8 kg/cm^2, determined by manometer 7. The stop signal should switch off within the same pressure limits. During testing, the air pressure should be raised and lowered smoothly, in order to see precisely the moment when the test lamp of the stop signal switches on and off.

Final adjustment of the pneumatic drive of the brake valves on the truck can be performed according to the "assembly and dissembly of wheel brakes" section.

Assembly and dissembly of individual brake valve. Since the individual brake valve is similar in design to the lower section of the combined brake valve, its dissembly, assembly and adjustment are performed the same as for the lower section of the combined valve.

Separating valve and connecting head. In order to remove the separating valve (Figure 16-14) and connecting head (Figure 16-15), the lines must be disconnected and the mounting bolts removed from the frame. Installation of the separating valve and connecting head is performed in the reverse sequence.

The separating valve and connecting head are practically never dissembled due to their high operating reliability. They should be checked for leaks at an air pressure of 10 kg/cm^2. If there are no air leaks, the devices are operating properly. The separating valve and connecting head are not adjusted.

When the body or plug of the separating valves must be replaced, the surfaces must be ground to fit and checked for leaks. Tightness of the separating valve is tested with the valve closed at a compressed air pressure of 8 kg/cm^2.

To dissemble the brake cylinders, loosen the nuts on the bolts retaining covers 4 (Figure 16-13) and remove the cover and diaphragm 2. Then withdraw shaft 3 with springs 6 and 7 from the body of the cylinder. The shaft should be separated from the adjusting lever.

The adjusting lever is not dissembled, and if it is not operating properly it is replaced with a new one. When necessary, the adjusting lever can be dissembled, breaking the glued contact.

If the body or cap of the diaphragm of the brake cylinder is bent, they must be straightened or replaced. After repair of the brake cylinder, it must be tested for leaks. To do this, press on the brake pedal, filling the cylinder with compressed air, then spread a soap solution around the caps of the flanges, points of passage of bolts tightening the flanges, point of passage of shaft through chamber body and holes in the body.

Air leaks will be detected by the soap solution. In order to eliminate air leaks, tighten all bolts on the cap evenly. If the leak continues, the diaphragm must be replaced.

The service life of brake cylinder diaphragms is two years.

Dimensions of Parts

Table 16.3

BASIC DIMENSIONS OF WHEEL BRAKE PARTS, MM

Dimension	Vehicle	Nominal or Repair	Permissible Without Repair
Front and Rear Brake Shoes Assembled (Figure 16-34)			
Shoe material -- type KCH 35-10 cast iron (standard GOST 1215-59) or AL15V aluminum alloy (standard GOST 2685-53) or AL10V aluminum alloy (ghost 2685-53). Lining material: for ZIL-157K -- asbestos cold molded composition 6KH1 (technical condition No. UN-1007); ZIL-130 and ZIL-131 -- hot molded asbestos composition 1-59 (technical condition No. UN-1022) or 14363 (No. UN-1033)			
Diameter of hole for shoe axis (cast iron) for all front and rear brakes	ZIL-157K	28.000-28.033	28.15

Table 16.3 Continued

Dimension	Vehicle	Nominal or Repair	Permissible Without Repair
Hole diameter for shoe bushing (aluminum) all front and rear brakes	ZIL-157K	29.600-29.633	-
Hole diameter for shoe bushing (cast iron or aluminum) all front and rear brakes	ZIL-131	29.600-29.633	-
Hole diameter for shoe bushing (cast iron and aluminum): front brake	ZIL-130	29.600-29.633	-
rear brake (up to 1967)		29.600-29.633	0
Diameter of supporting surface for expanded shoe axis (aluminum) of rear brake (since 1967)	ZIL-130	28.00-28.14	28.25
Radius of friction surface of shoe without lining, all front and rear brakes	ZIL-131	194.75-195.25 174.8-175.2	- -
Radius of friction surface of shoe without lining: all front brakes	ZIL-130	194.75-195.25	-
rear brake (up to 1967)		194.75-195.25	
rear brake (after 1967)		205.75-206.25	-

Table 16.3 Continued

Dimension	Vehicle	Nominal or Repair	Permissible Without Repair
Radius of working surface of shoe with lining:			
front and rear brakes	ZIL-131	Nominal 209.6-210.0	-
		First Repair 210.1-210.5	-
front brakes of all models	ZIL-130	2nd " 210.6-211.0	-
		3rd " 211.1-211.5	-
		4th " 211.6-212.0	-
rear brakes (up to 1967)	ZIL-130	5th " 212.1-212.5	-
		6th " 212.6-213.0	-
front and rear brakes	ZIL-157K	Nominal 189.85-190.15	-
		1st Repair 190.35-190.65	-
		2nd " 190.85-191.15	-
		3rd " 191.35-191.65	-
		4th " 191.85-192.15	-
		5th " 192.35-192.65	-
		6th " 192.85-193.15	-
rear brakes (since 1967)	ZIL-130	Nominal 209.4-210.0*	-
		First Repair 210.1-210.7	-
		2nd " 210.8-211.4	-
		3rd " 211.5-212.1	-
		4th " 212.2-212.8	-
		5th " 212.9-213.5	-
		6th " 213.6-214.2	-
Width of front shoes	ZIL-130	70.0	-
Width of rear shoes	ZIL-130 (up to 1967)	100	-
Width of rear shoes	ZIL-130 (since 1967)	140	-

*Due to the use of profiled linings on the rear wheels of the ZIL-130, the center of working of the outer surface of the linings is displaced relative to the center of working of the outer surface of the shoe.

Table 16.3 Continued

Dimension	Vehicle	Nominal or Repair	Permissible Without Repair
Thickness of support lug of cast iron shoe	All Vehicles	12.0	-
Diameter of holes of roller support in rear brake shoe	ZIL-130 (since 1967)	20.00-20.14	-
Width of all shoes	ZIL-157K	70	-
Same	ZIL-131	100	-

Aluminum Shoe Side Piece

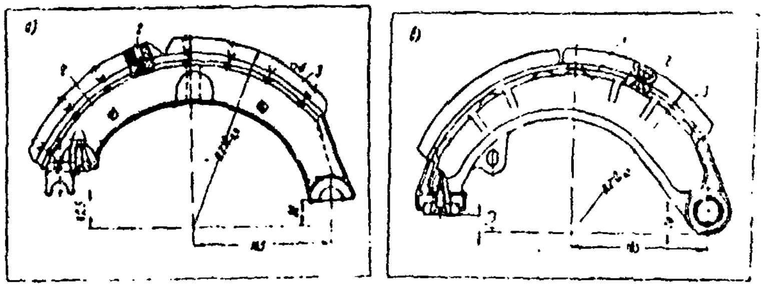
Type 20 Steel (GOST 1050-60), Depth of Hardened Layer
1.0-1.4 mm, Hardness HRC 56-62

Dimension	Vehicle	Nominal or Repair	Permissible Without Repair
Thickness of side piece	All Vehicles	8.8-9.0	7.5

Rear Brake Support

KCH 35-10 Cast Iron (GOST 1215-59)

Diameter of hole for large diameter of shoe axis	ZIL-130	35.00-35.05	35.15
Diameter of hole for small diameter of shoe axis	Same	22.00-22.045	22.15



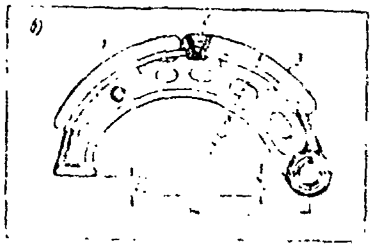


Figure 16-34. Brake Shoes for: a, ZIL-130; b, ZIL-157K; c, ZIL-131; 1, shoe; 2, rivet; 3, friction lining

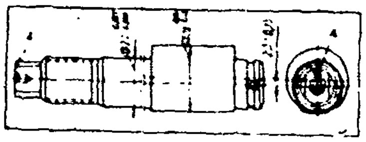


Figure 16-35. Axis of Rear Brake Shoe for ZIL-130: A, mark

Axis for Front and Rear Brake Shoes (Figure 16-35)

Steel 45 (GOST 1050-60), Hardened Layer Depth 1.0-2.5 mm; Hardness HRC 50-62

Dimension	Vehicle	Nominal or Repair	Permissible Without Repair
Diameter of neck of axis for hole in shoe:			
all front and rear brakes	ZIL-131, ZIL-157K	27.87-27.94	27.8
all front brakes	ZIL-130	27.87.27.94	
rear brake (up to 1967)	ZIL-130	Same	

Table 16.3 Continued

Dimension	Vehicle	Nominal or Repair	Permissible Without Repair
Diameter of axis neck for hole in front and rear brake bracket	ZIL-157K and ZIL-131	21.915-21.975	21.8
Diameter of shaft neck at aperture in rear brake support (post 1967):			
large diameter	ZIL-130	34.900-34.989	34.8
small diameter	ZIL-130	21.915-21.975	21.8
Eccentricity of neck	All trucks	2.35-2.65	
Thread Diameter	Same	2M0 × 1.5 cl. 2	

Shoe Lining

Special Strip. Soft Tombac (TSMTU 54-41), 0.85 mm Thick
(May be Replaced by L-90-1 Tombac)

Internal diameter of liner after pressing and finishing	ZIL-130 ZIL-131 and ZIL-157K (for aluminum shoe)	28.000-28.045	28.15

Brake Disc of Front and Rear Brakes With Shoe Axis Bracket

Disc Material -- Type 08 Steel 5 mm Thick (GOST 4041-48),
Material of Shoe Axis Bracket Type KCH 35-10 Cast Iron (GOST 1215-59)

Diameter of hole in bracket for front and rear brake shoe axis	ZIL-157K, ZIL-131	22.00-22.045	22.15

Table 16.3 Continued

Dimension	Vehicle	Nominal or Repair	Permissible Without Repair
Diameter of hole in bracket for shoe axis:			
front brakes	ZIL-130	22.00-22.045	22.15
rear brakes (pre 1967)	ZIL-130	22.00-22.045	22.15
rear brakes (post 1967)	ZIL-130	(see rear brake support)	-
Brake Drums, Front and Rear Brakes Type SCH 24-44 or SCH 18-36 Cast Iron (GOST 1412-54)			
Internal diameter of drum	ZIL-130	Nominal 420.00-420.38	-
		1st Repair 421.00-421.38	-
		2nd " 422.00-422.38	-
		3rd " 423.00-423.38	-
		4th " 424.00-424.38	-
		5th " 425.00-425.38	-
		6th " 426.00-426.38	-
	ZIL-157K	Nominal 380.00-380.38	-
		1st Repair 381.00-381.38	-
		2nd " 382.00-382.38	-
		3rd " 383.00-383.38	-
		4th " 384.00-384.38	-
		5th " 385.00-385.38	-
		6th " 386.00-386.38	-
	ZIL-131	Nominal 420.00-420.25	-
		1st Repair 421.00-421.25	-
		2nd " 422.00-422.25	-
		3rd " 423.00-423.25	-
		4th " 424.00-424.25	-
		5th " 425.00-425.25	-
		6th " 426.00-426.25	-
Hub hole diameter	ZIL-130		
	front wheel	150.00-150.16	-
	rear wheel	234.00-234.185	-
	ZIL-157K	180.00-180.16	-
	ZIL-131	214.000-214.073	-

Front and Rear Brake Spreader Cams
Type 45 Steel (GOST 1050-60), Depth of Hardened Layer 1.5-3.5 mm;
Hardness HRC 50-62

Dimension	Vehicle	Nominal or Repair	Permissible Without Repair
Diameter of rear spreader cam support neck	ZIL-130	37.50-37.66	37.45
Diameter of rear spreader cam support neck	ZIL-157K, ZIL-131	37.900-37.968	37.85
Diameter of front spreader cam support neck	Same	37.900-37.968	37.85
Thickness of teeth of spreader cam splines of front and rear brakes	Same	5.76-5.86	5.5

Adjusting Lever Body
Type KCh 35-10 Cast Iron (GOST 1215-59)

Dimension	Vehicle	Nominal or Repair	Permissible Without Repair
Diameter of adjusting lever bushing aperture	ZIL-130 ZIL-157K ZIL-131	15.000-15.027	-
Width of adjusting lever slot	ZIL-130 ZIL-157K ZIL-131	26.14-26.28	-

Table 16.3 Continued

Adjusting Lever Bushing
Type A12 Steel (GOST 1414-54), depth of hardened layer 0.15-0.30 mm; hardness HRC 56-62

Dimension	Vehicle	Nominal or Repair	Permissible Without Repair
Outer diameter of bushing	ZIL-130 ZIL-157K ZIL-131	15.045-15.080	-
Inner diameter of bushing	Same	12.06-12.18	12.25

Adjusting Lever Worm Gear

Type 45 Steel (GOST 1050-60), Hardness HRC 27-32; Number of Teeth -- 27

Thickness (gauge height 2.0 mm)	ZIL-130, ZIL-157K, ZIL-131	2.97-3.04	2.85
Width of depression in splined portion of gear	Same	5.89-5.945	5.75

Adjusting Lever Worm
Type 40Kh Steel (GOST 4543-61), Hardness HRC 28-32; Number of Passes -- 1

To Thickness (gauge height 2.0 mm)	ZIL-130, ZIL-157K, ZIL-131	2.97-3.04	2.85

Table 16.3 Continued

Adjusting Lever Worm Axis of Front and Rear Brakes
Type 45 Steel (GOST 1050-60), Hardness HB 197-241

Dimension	Vehicle	Nominal or Repair	Permissible Without Repair
Wrench size on worm axis	ZIL-130 ZIL-157K, ZIL-131	11.76-12.00	-

Brake Cylinder and Spreader Cam Axis of Front and Rear Brakes
KCH 35-10 Cast Iron (GOST 1215-59)

Dimension	Vehicle	Nominal or Repair	Permissible Without Repair
Diameter of aperture for spreader cam neck	ZIL-157K	38.00-38.05	38.15
Diameter of bushing aperture	ZIL-130	39.6-39.639	-

Brake Cylinder Bracket and Spreader Cam Bushing
Type LS 74-3 Brass, Strip 0.78-0.85 mm Thick (GOST 2208-49)

Dimension	Vehicle	Nominal or Repair	Permissible Without Repair
Internal diameter of bushing after pressing and working	ZIL-130	38.025-38.060	38.80

Table 16.4

Dimensions of Brake Springs, mm

Name of Unit	Vehicle	Number of Turns	Outer Diameter of Turn	Length in Free State	Length Under Load
Brake Shoe Return Spring For ZIL-130 and ZIL-131 Trucks Spring Wire Group II, Diameter 4 mm (GOST 9389-60); for ZIL-157K Truck, Spring Wire Group I, Diameter 4 mm (GOST 5047-49)					
Front and rear brakes	ZIL-131	20.5	23.7-24.3	130	180 (at 74-85 kg)

Table 16.4 Continued

Name of Unit	Vehicle	Number of Turns	Outer Diameter of Turn	Length in Free State	Length Under Load
Front brakes	ZIL-130	20.5	23.7-24.3	130	180 (at 74-85 kg)
Rear brakes (pre 1967)	ZIL-130	20.5	23.7-24.3	130	180 (at 74-85 kg)
Rear brakes (post 1967)	ZIL-130	20	25	242	286 (at 95-120 kg)
Front and rear brakes	ZIL-157K	21	23.7-24.3	226.0	270 (at 70-80 kg)
Adjusting Lever Worm Stop Spring					
Spring Wire Group I, Diameter 1.5 mm (GOST 9389-60)					
Front and rear brakes	ZIL-130, ZIL-157K, ZIL-131	8	7.25-7.75	16	14 (at 7-10 kg)

Table 16-5

BASIC DIMENSIONS OF HAND BRAKE PARTS, MM

Dimensions	Nominal	Permissible Without Repair
Hand Brake Bracket		
KCH 35-10 Cast Iron (GOST 1215-59)		
Diameter of aperture for large spreader cam neck bushing	29.600-29.633	-
Diameter of aperture for small spreader cam neck bushing	21.600-21.633	-

Table 16-5 Continued

Dimensions	Nominal	Permissible Without Repair
Diameter of aperture for shoe axis	18.000 18.035	-
Diameter of aperture for gland: ZIL-130	84.00 84.07	84.1
ZIL-157K and ZIL-131	82.00 82.07	82.1
Assembled Brake Shoe for Hand Brake		
Shoe Material AL10V Aluminum Alloy (GOST 2685-53), Liner -- Asbestos Composition 6KKh-1 Cold Molded (No. TU UN-1007)		
Radius of shoe surface without liner	121.7 122.3	-
Diameter of aperture for shoe axis	24.00 24.14	24.25
Shoe width	65	-
Radius of shoe surface with liner	130.7 131.4	-
Width of seat for shoe thrust bearing	26.00 26.14	-
Shoe Axis		
40 Kh Steel (GOST 4543-61); Hardness HB 255-285		
Diameter of neck of axis at hole in hand brake bracket	17.965 18.000	-
Diameter of neck axis at hole in shoe	23.86 24.00	23.8

Table 16-5 Continued

Dimensions	Nominal	Permissible Without Repair
Thread diameter	M18x1.5 cl.2	-
Shoe Thrust Bearing		
Type 20 Steel (GOST 1050-60); Nitrided Layer Depth 1.0-1.4 mm; Hardness HRC 56-62		
Thickness of shoe thrust bearing	7.8-8.0	7.3
Width of shoe thrust bearing	25.955 26.000	-
Spreader Cam		
Type 45 Steel (GOST 1050-60) Depth of Hardened Layer 1.0-4.0 mm; Hardness HRC 56-62		
Large neck diameter	27.915 27.975	27.8
Small neck diameter	19.915 19.975	19.87
Large Spreader Cam Bushing		
Soft Strip of Tombac, Thickness 0.85 mm		
Outer diameter of bushing	29.700 29.745	-
Inner diameter of bushing	28.04 28.08	28.15
Small Spreader Cam Bushing		
Soft Tombac Strip, 1.0 mm Thick		
Outer diameter	21.7 21.745	-
Inner diameter	20.04 20.08	20.15

Table 16-5 Continued

Dimensions	Nominal	Permissible Without Repair
	Hand Brake Adjusting Lever	
	Type 35 Steel (GOST 1050-60); Hardness HB 149-187; Number of Adjustment Holes -- 6	
Diameter of lever adjusting holes	10.000 10.058	10.20
	Hand Brake Drum	
	SCH 18-36 Cast Iron (GOST 1412-54)	
Internal drum diameter:		
Nominal	260.000 260.185	-
1st Repair	261.000 261.185	-
2nd Repair	262.000 262.185	-
Outer drum diameter	290.0	-
Aperture diameter at flange	95.015 95.050	-
	Large Return Spring	
	Spring Wire Group II, Diameter 3.5 mm (GOST 9389-60); Number of Turns -- 20	
Length of spring in free state	100.0	-
Length of spring under 50-60 kg load	132.0	-
External diameter of turns	19.8 20.2	-

Table 16-5 Continued

Dimensions	Nominal	Permissible Without Repair
	Small Return Spring	
	Spring Wire Group II, Diameter 3.5 mm (GOST 9389-60); Number of Turns -- 10	
Length of spring in free state	66.0	-
Length of spring under 50-60 kg load	82.0	-
External diameter of spring	19.8 20.2	-

Table 16-6

DIMENSIONS OF COMPRESSOR PARTS, MM

Dimensions	Nominal	First Repair	Second Repair	Permissible Without Repair
		Crankcase		
		SCH 15-32 Cast Iron (GOST 1412-54);		
Diameter of bearing apertures	72.00 72.03	-	-	72.05
		Cylinder Block		
		SCH 15-32 Cast Iron (GOST 1412-54);		
Cylinder diameter	60.00 60.03	60.40 60.43	60.80 60.83	-
		Piston		
		SCH 15-32 Cast Iron (GOST 1412-54); Post 1967 Cylinders Made of AL10V Aluminum Alloy		
Diameter (Figure 16-36) D	59.64 59.70	60.04 60.10	60.44 60.50	-

Table 16-6 Continued

Dimensions	Nominal	First Repair	Second Repair	Permissible Without Repair
D_1	53.60 53.80	54.00 54.20	54.40 54.60	-
D_2	59.94 59.97	60.34 60.37	60.74 60.77	-
Piston Rings				
SCH Cast Iron (No. 7 Uk-15); Hardness HRB 96-106				
Diameter	52.00 60.00	52.40 60.40	52.80 60.80	-
Crankshaft				
Type 45 Steel (GOST 1050-60); Depth of Hardened Layer 1.5-3.0 mm; Hardness HRC 52-62				
Diameter of big end neck	35.003 35.020	-	-	-
Diameter of shaft neck at gland	23.860 24.000	-	-	-
Diameter of aperture for rear crankcase cover seal	25.000 25.033	-	-	-
Diameter of conical neck (conicity 1:8)	20.5	-	-	-
Connecting Rod				
Type 40 Steel (GOST 1050-60); Hardness HB 207-241				
Diameter of apertures in upper head for bushing	14.000 14.019	-	-	14.05

Table 16-6 Continued

Dimensions	Nominal	First Repair	Second Repair	Permissible Without Repair
		Rear Crankcase Cover		
		SCH 35-10 Cast Iron (GOST 1215-59)		
Diameter of aperture for external bearing circle	70.00 72.12	-	-	-
		Rear Cover Seal		
		SCH 15-32 Cast Iron (GOST 1412-54)		
Outer diameter of seal	24.96 24.98	-	-	-
		Pulley		
		SCH 15-32 Cast Iron (GOST 1412-54)		
Diameter of small conical aperture (conicity 1:8) for crankshaft neck	20.01	-	-	-
		Rear Cover Seal Spring		
		Spring Wire Group I, Diameter 1.4 mm (GOST 9389-60); Number of Turns 5.5, Number of Working Turns 3.5		
Length of spring in free state	25.0	-	-	-
Length of spring under 3-4 kg load	15.0	-	-	-
Diameter of turns	17.4 17.8	-	-	-

Table 16-6 Continued

Dimensions	Nominal	First Repair	Second Repair	Permissible Without Repair

Wrist Pin

Type 20 Steel (GOST 1050-60); Depth of Hardened Layer 0.6-1.0 mm; Hardness HRC 56-62

Table 16-7

MARKINGS OF WRIST PINS AND PISTONS FOR DIMENSIONS, MM (FIG. 16-37)

Group	Diameter of Aperture in Piston for Pin	Pin Diameter	Color of Marking
I	12.503 12.500	12.500 12.497	Blue
II	12.500 12.497	12.497 12.494	Red
III	12.497 12.494	12.494 12.491	White
IV	12.494 12.491	12.491 12.488	Green

Table 16-8

DIMENSIONS OF CRANKSHAFT CON ROD NECKS, MM (Fig. 16-38)

Dimension	Rod Neck
Nominal	28.479-28.500
1st Repair	28.179-28.200
2nd Repair	27.879-27.900

Table 16-9

MARKING OF UPPER ROD HEAD FOR DIAMETERS OF WRIST PIN APERTURE, MM

Group	Diameter of Aperture	Color
I	12.507-12.504	Blue
II	12.504-12.501	Red
III	12.501-12.498	White
IV	12.498-12.495	Green

Table 16-10

BASIC DIMENSIONS OF PARTS OF ZIL-130 COMPRESSOR RELIEF DEVICE, MM

Dimension	Nominal	Permissible Without Repair
	Intake Valve Plunger A12 Steel (GOST 1414-54)	
Diameter of plunger neck for bushing	9.915 9.965	9.9
Width of sealing ring slot	2.70 2.82	-
	Plunger Bushing L62 Brass (GOST 1019-47)	
External diameter of bushing	13.080 13.115	-
Internal diameter of bushing	10.00 10.03	10.04
	Intake Valve Guide A12 Steel (GOST 1414-54)	
Diameter of seat for intake valve guide	9.915 9.965	9.9

Table 16-10 Continued

Dimension	Nominal	Permissible Without Repair
Diameter of intake valve stem	4.00 4.08	4.10

Intake Valve Return Spring

Spring Wire Group I, Diameter 1.2 mm (GOST 9389-60); Total Number of Turns -- 7; Number of Working Turns -- 5

Length of spring in free state	20.0	-
Length of spring under 3.2-3.8 kg load	16.0	-
Internal diameter of turns	6.60 6.86	--

Intake Valve

Type 85 Steel (GOST 2052-53); Hardness HRC 50-55

Diameter	18.26 18.40	-
Thickness	0.88 1.00	0.8

Intake Valve Seat

Type 35 Steel (GOST 1050-60)

Diameter of intake valve seat neck	17.040 17.075	-

Intake Valve Spring

Spring Wire Group I, Diameter 0.6 mm (GOST 9389-60); Total Number of Turns -- 10; Number of Working Turns -- 8

Length of spring in free state	15.0	-

Dimension	Nominal	Permissible Without Repair
Length of spring under 35-45 g load	13.0	-
Internal diameter of turns	7.5 7.86	-
External diameter of turns	9.4	-

Exhaust Valve Spring

Spring Wire of 65g Steel, Group II, Diameter 1.1 mm (GOST 1071-41); Total Number of Turns -- 15; Number of Working Turns -- 13

Dimension	Nominal	Permissible Without Repair
Length of spring in free state	26.0	-
Length of spring under 0.5-0.6 kg load	26.5	-
Turn diameter	13.3 14.0	-

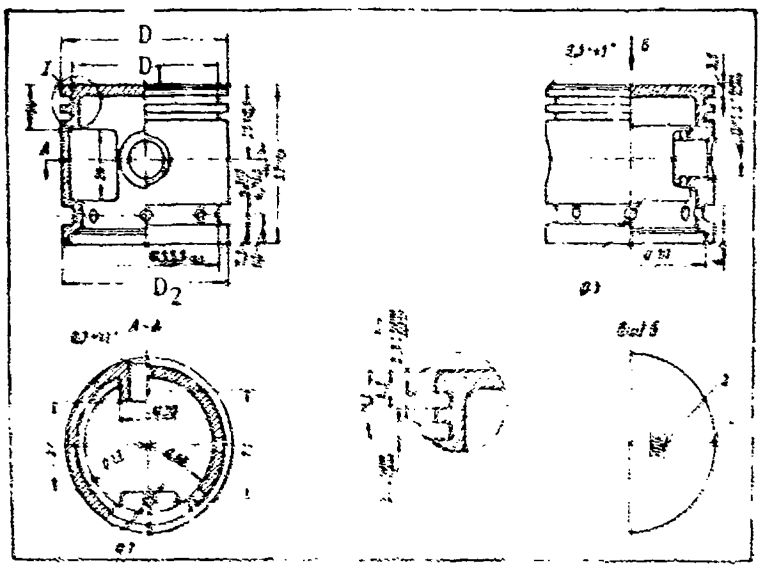


Figure 16-36. Compressor Piston: D, diameter of piston head; D_1, diameter of measured in slots for piston rings; D_2, diameter of piston skirt; 1, axial line; 2, represents repair dimensions of piston

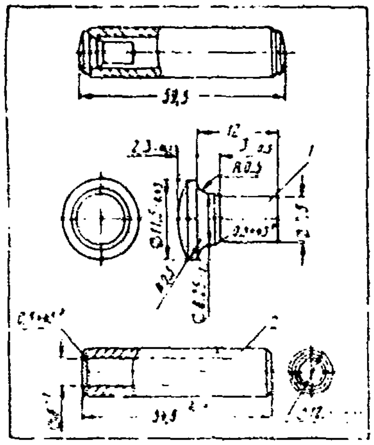


Figure 16-37. Wrist Pin of Compressor With Plug: 1, plug; 2, pin

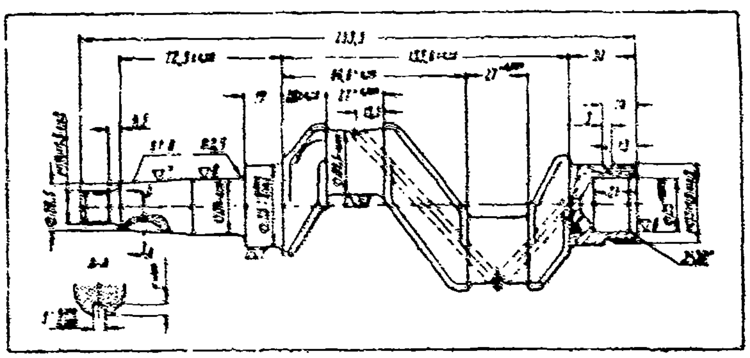


Figure 16-38. Compressor Crankshaft

Chapter 17

CABIN, BODY AND PLATFORM

Structure

Cabin. The ZIL-157K, ZIL-130 and ZIL-131 trucks are equipped with all metal, three-place cabins.

The cabin of the ZIL-157K (Figure 17-1) with heat insulating roof and cabin back, with opening left windshield half, ventilating hatch and roll-up windows. On special order, the cabin roof is equipped with a viewing hatch opening to the outside. The windshield is flat, consisting of two halves; the left half of the windshield opens. The rear window does not open. The windshield and rear window are made of stalinite.

The cabins of the ZIL-130 and ZIL-131 (Figure 17-2) have panoramic, non-opening windshields (one-piece or made of two halves), equipped with heat insulation and rubber floor mats. There are two ventilating hatches with covers in the cabin roof, opening outward. When the hatch is used, the cover snould be fixed in the open position by means of the clamp installed on the hatch lever. The rear glass is flat, non-opening. The windshield and rear glass are made of stalinite.

The hood and fenders of the ZIL-157K and ZIL-130 are shown on Figure 17-3 and 17-4.

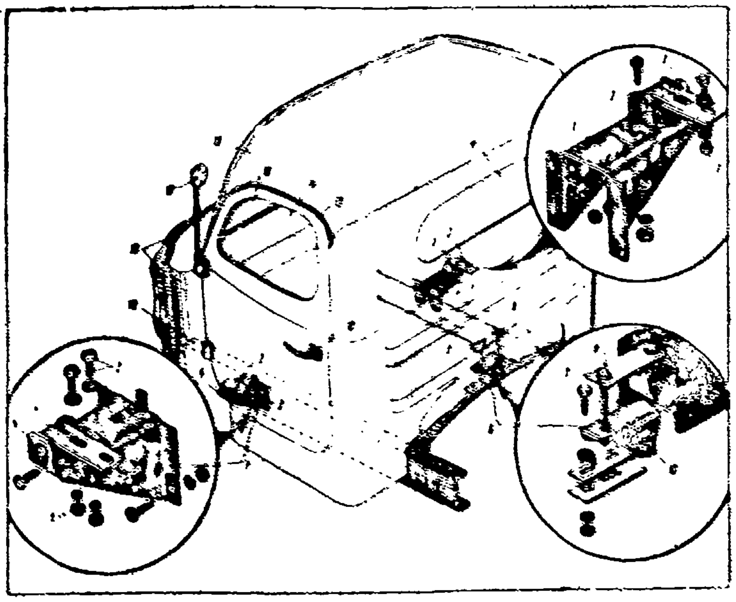


Figure 17-1. Cabin of ZIL-157K: 1 and 6, cabin support brackets; 2 and 9, bolts; 3, hinges; 4 and 10, axes; 5 and 8, nuts; 7, plate; 11, rear glass; 12, door handle; 13, door; 14, door glass; 15, cabin roof; 16, windshield; 17, mirror; 18, sealing liners of hood; 19, longitudinal member

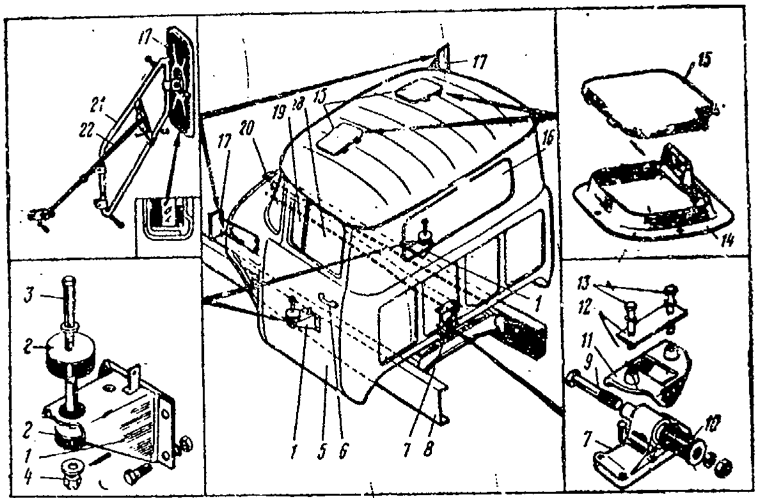


Figure 17-2. Cabin of ZIL-130 and ZIL-131: 1 and 7, cabin mounting brackets; 2, rubber support cushions; 3, 9 and 13, bolts; 4, nuts; 5, cabin door; 6, outside door handle; 8, longitudinal frame member; 10, shock absorbing rubber bushing; 11, suspension bracket; 12, insert; 14, hatch base; 15, hatch cover; 16, rear window; 17, rear view mirror; 18, door glass; 19, vent wing; 20, windshield; 21, mirror bracket; 22, moving bracket adjustor

Hoods. The hood of the ZIL-157K truck is a four-part, hinged hood opening on both sides by lifting. The hood of the ZIL-130 and ZIL-131 is an alligator type. Loops are used to hold the hood in the open position between 40 and 90 degrees using springs and a system of levers. The right loop has a safety hook to prevent accidental closing of the hood. The hood latch is the normal type used with an alligator hood.

The latch is mounted on the outside. In order to open the hood, one must reach in through a hole in the radiator facing and pull lever 5 of the latch (17-5). The hood is relatched by simply closing it.

Cabin doors. The doors of the cabin of the ZIL-157K (Figure 17-6) are equipped with locks for locking from inside, and the right door has a lock for locking from the outside using the ignition key. The side windows of the doors are flat roll-up types; the glass lifting mechanism is a two-lever type (Figure 17-7) with a brake mechanism preventing the glass from dropping. The door stops and closures (Figure 17-8) open and close the right and left doors from the inside and outside with handles. The right door can be locked from the outside (using the ignition key). Both door locks can be locked with buttons.

The lock mechanisms are mounted below the outer door handle on the door panels.

The door stops are independent units, not combined with the locks.

The doors of the cabin of the ZIL-130 and ZIL-131 (Figure 17-9) have roll-up windows and rotating vent wings. The windows are rolled up and held in position by means of single lever glass lifting mechanisms. These mechanisms (Figure 17-10) include brake mechanisms preventing the glass from dropping. The glass lifting mechanism requires no adjustment during operation.

Installation and removal of locks and glass lifting mechanisms is performed through a hatch on the inner panel of the door. Both doors have locks which can be operated from the inside and outside of the cabin (Figure 17-11). The locks of the left and right doors can be locked from inside by means of a button. The right door can be locked from the outside as well, using the ignition key.

The door is opened from inside by means of a rotating handle on the inner door panel. If the lock button is depressed, it automatically pops up when the door is slammed.

The door lock is also a door positioner, preventing the door from handing on its hinges.

Windshield wipers. The ZIL-157K uses a two-blade pneumatic type SL-22 windshield wiper (Figure 17-12) with a type KR-11 reduction valve. The pneumatic motor is a single-cylinder type with a lever driving the second wiper.

The piston seals are leather. The air distributor is a valve type.

The ZIL-130 and ZIL-131 trucks use double-blade type SL-440 wipers (Figure 17-13) with a type KR-24 valve. The pneumatic motor (17-14) is a single-cylinder type with a slide valve distributor, lever drive and a mechanism which returns the wipers to the lower edge of the glass.

The piston seals are rubber. The operating diagram of the SL-440 wiper is shown on Figure 17-15.

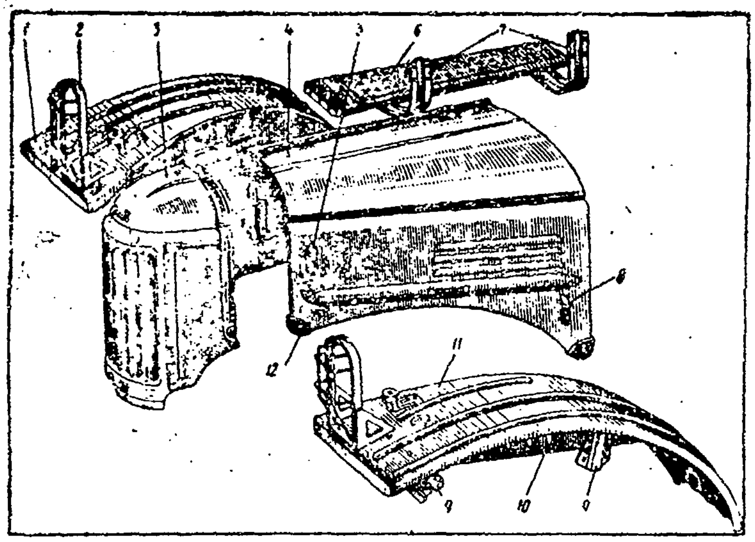


Figure 17-3. Hood and Fenders of ZIL-157K: 1 and 11, fenders; 2, head light guard; 3, radiator cover; 4, hood; 5 and 8, hood latches; 6, right bracket (left not shown); 7 and 9, supporting brackets; 10, spray shield; 12, rubber mount

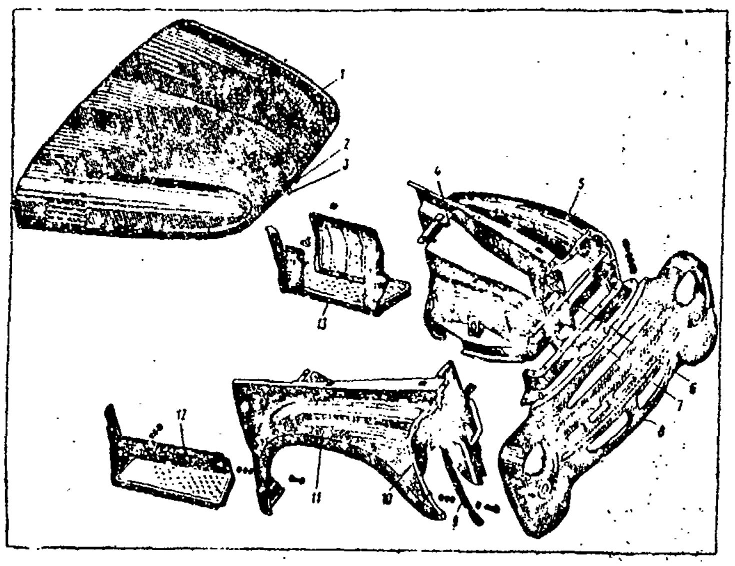


Figure 17-4. Hood and Fenders of ZIL-130: 1, hood; 2, hood latch rod; 3, hood safety latch; 4, spray shield; 5 and 11, fenders; 6, 9 and 10, seals; 7, hood latch; 8, radiator shield; 12 and 13, supports

Windshield washer. The ZIL-130 and ZIL-131 trucks are equipped with a windshield washer (Figure 17-16, 17-17). The device consists of a rubber reservoir 3 (see Figure 17-16), installed beneath the instrument panel in the cabin, two sprayers 4 located on the front panel of the cabin in front of the windshield 5, diaphragm pump 1 installed on the cabin floor with pedal drive 2.

Cabin seats. In the ZIL-157K, the driver seat is a single-place seat, the passenger seat is a two-place seat (Figure 17-18). The seat can be adjusted to three positions forward and back. The drivers seat back can be adjusted as to tilt.

The seat bottoms and backs are spring-type, covered with artificial leather, mounted on a wooden frame with metal covering.

In the ZIL-130 and ZIL-131, there is a single place driver seat (Figure 17-19) which can be adjusted in the horizontal direction. The seat and back can be adjusted as to tilt. The passenger's seat is a two-place seat, non-adjustable. The bottoms and backs of the seats are made of sponge rubber, covered with artificial leather, mounted on a metal-covered wooden base.

Cabin heater. All trucks are equipped with heaters except for trucks designed for operation in hot climate regions. Cabin heating is by hot water from the engine cooling system, with a water radiator and a centrifugal fan forcing hot air to heat the cabin and defrost the windshield.

The hot water is fed to the heater radiator of the ZIL-157K (Figure 17-20) from the engine cylinder cooling jacket, and to the heater radiator of the ZIL-130 and ZIL-131 (Figure 17-21) from the inlet pipe cavity.

The heater is enclosed in a shell which also serves as a warm air reservoir. The warm air is pumped from this reservoir by the fan into the parts of the cabin to be heated and onto the windshield.

The platform of the ZIL-157K (Figure 17-22) is made of wood, and tilting brackets are installed along the sides.

The rear wall is a tilting type, with two suspension points.

The platform of the ZIL-130 truck is wooden (Figure 17-23) with metal edging and metal transverse support beams. The rear wall and side walls are tilting types, the front wall does not move. The platform is adapted for installation of a tarpoline. Several types of platforms are installed on the ZIL-130: the standard type (with normal sides), a platform with built-up sides and top frame. These types of platforms are installed on order.

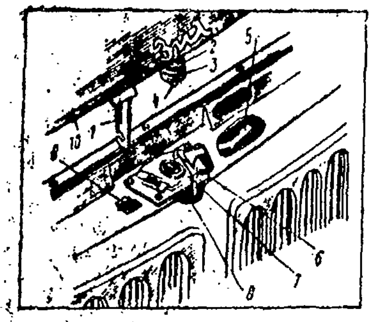


Figure 17-5. Hood Latch: 1, safety latch; 2, rod spring; 3, rod cup; 4, rod; 5, latching lever; 6, lever axis; 7, latch body; 8, lever spring; 9, spring with seat for safety hook; 10, hood

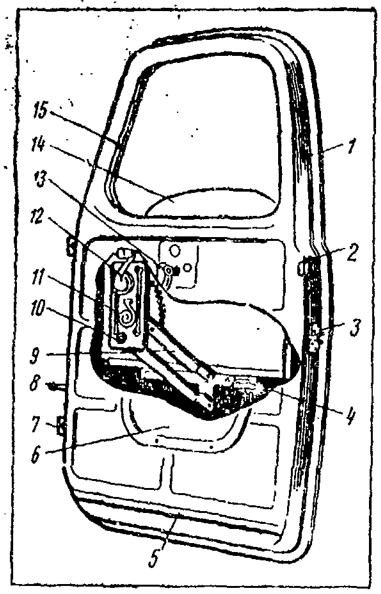


Figure 17-6. Cabin Door of ZIL-157K: 1, 5 and 6, seals; 2, latch bar; 3, stop wedge; 4, connector; 6, hatch cover; 7, door hinges; 8, door limiter (stop); 9, lifting levers; 10, adjusting screw; 11, glass lifter; 12, window crank; 13, door handle; 14, window glass

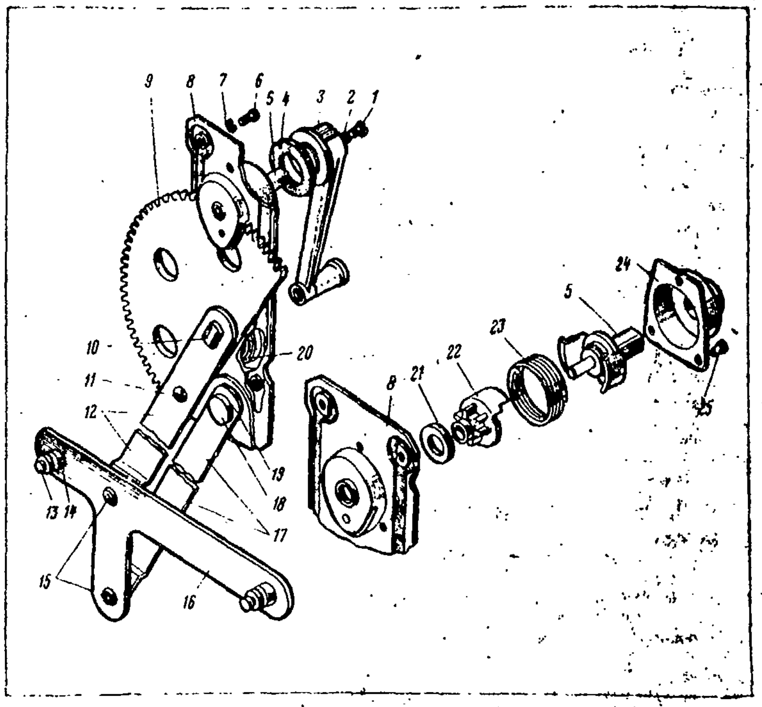


Figure 17-7. Roll-up Window Mechanism of ZIL-157K: 1 and 6, screws; 2, 7 and 19, washers; 3, handle; 4, sealing ring; 5, drive shaft; 8, window lifting mechanism; 9, window lifting sector; 10, sector axis; 11 and 25, rivets; 12, driving lever; 13, roller axis; 14, roller; 15, lever pins; 16, T-shaped lever; 17, driven lever; 18, lever adjusting screw (adjustment axis); 20, window spring; 21, flat washer; 22, brake mechanism gear; 23, spring; 24, brake mechanism body

The platform of the long wheel base ZIL-130G is shown on Figure 17-24.

The platform of the ZIL-131 is wooden with metal facing and metal cross-beams. The rear wall is tilting, the front and side walls do not tilt. Tilting seats are installed along the side walls. The rear wall has suspended steps; the wide walls are equipped with grids. The platform of the ZIL-131 truck is equipped with a removable center bench. The center bench has a removable back. The platform carries seats for top frame members.

Maintenance

Maintenance of the cabin and body parts includes dissembly and washing operations, which must be performed each day, as well as operations involving checking of mounting units of the cabin and fenders, which must be performed during TO-2. Door hinges and locks should be lubricated each one or two TO-2 cycles.

Repair

Typical defects of cabins and fender parts include dents, cracks and rips in panels, damage to equipment and paint, seat covers and internal cabin panels.

Dents should be straightened, cracks welded and ground down even with the base metal.

Solder surfacing with subsequence piling is permitted.

Elimination of dents, cracks and holes in cabins and hood and fender parts. Dents in metal cabin panels are eliminated by straightening, deep scratches by solder surfacing. Dents not involving bending and drawing of the metal can be banged out using wooden or rubber hammers.

The initial shape of the part is restored by hammering out and straightening. The straightening tools (Figure 17-25) include special hammers and supports placed on the inside of the panel.

The working surfaces of tools for hammering and straightening must be completely smooth.

During the process of elimination of dents, a metal support, selected according to the shape of the surface being repaired, must be placed beneath the surface being straightened and pressed tightly against it by hand, while the opposite side is struck with a straightening hammer, immediately opposite the support (Figure 17-26). Gradually moving the support, pound down bulges and eliminate small dents. Smooth the straightened surface with a file and sandpaper.

If dents in the opposite direction are discovered during straightening, straightening is continued although these dents are not sanded off.

During straightening of slight dents, straightening is begun at the edges and hammer blows gradually moved to the middle. If dents are deep, without folds or sharp bends, blows should be initially applied to the center and gradually moved out to the edges. If there are sharp bends or folds, straightening should be begun at the bend or fold.

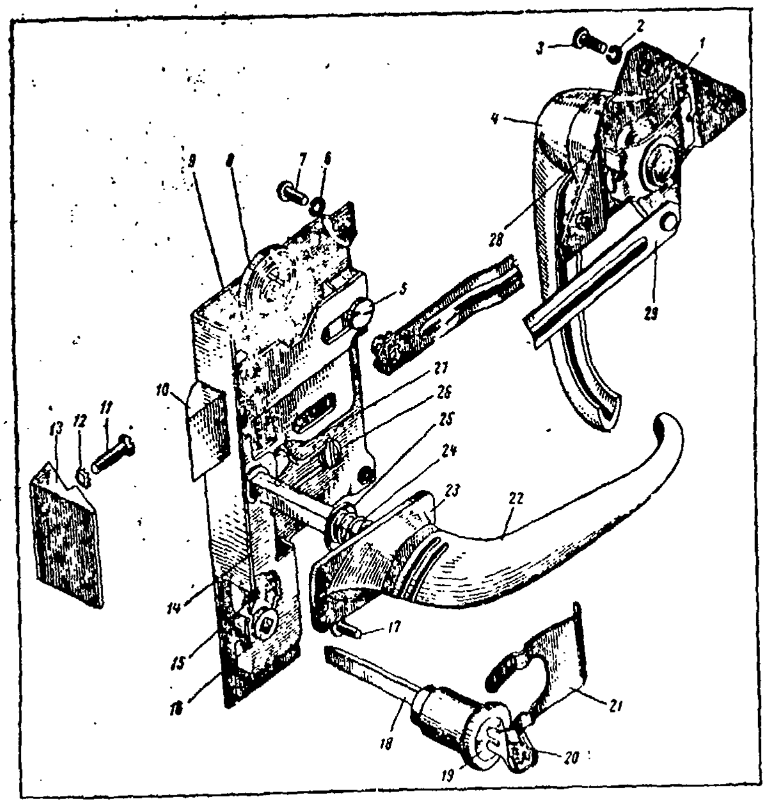


Figure 17-8. Lock and Lever of Right Door of ZIL-157K: 1, lock drive lever; 2, 6 and 12, washers; 3, 7, 11 and 17, screws; 4, inside handle; 5, pin; 8, lock spring; 9, lock body; 10, lock bolt; 13, lock face plate; 14, face cover; 15, lock slide; 16, lock cam; 18, door locking mechanism; 19, door lock; 20, key; 21, lock mounting plate; 22, outside handle; 23 and 28, mounting plates; 24, lever spring; 25, spring cup; 26, latch spring; 27, latch; 29, lock drive member

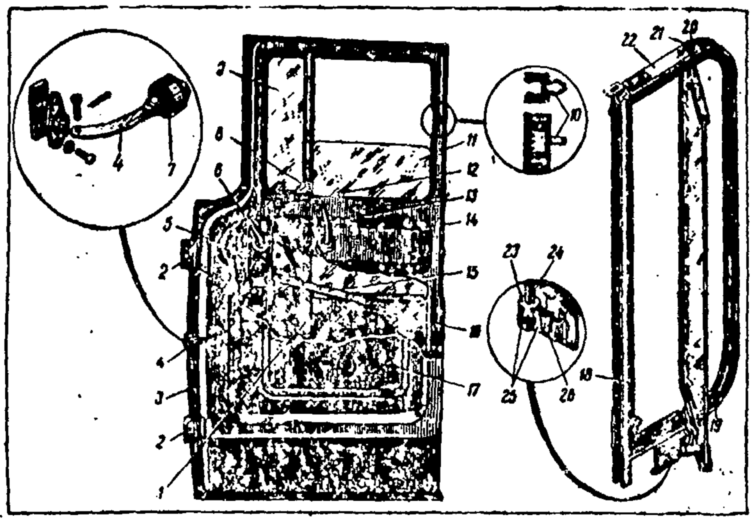


Figure 17-9. Right Door of ZIL-130 and ZIL-131 Cabin: 1, roll-up window guide; 2, door hinge; 3, door seal; 4, door limiter; 5, glass lifter; 6, window crank; 7, limiter buffer; 8, vent wing catch; 9, vent wing; 10, seal mounting pins; 11, roll-up window; 12, plug; 13, inside door handle; 14, cover; 15, window lifting arm; 16, crosspiece; 17, hatch cover; 18 and 19, vent wing seals; 20, vent wing glass frame; 21, upper axis of vent wing; 22, vent wing seal frame; 23, bushing of axis; 24, lower vent wing axis; 25, clamp; 26, retaining screw

Cracks and holes are welded shut following straightening of the surface, using plates if the damage is great. Gas welding is used, with a number one welding tip when operating with metal 0.5-1.0 mm thick and a number two tip for metal 1-3 mm thick.

In case of a large crack on a fender, a steel plate is installed on the outside and riveted to the fender. A fender with a dent including a tear is repaired by rejoining the tear and welding it, then straightening the dent and smoothing the surface.

A plate is welded to the inside edge of the fender to give it stiffness.

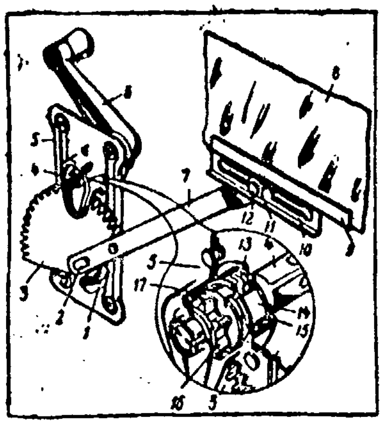


Figure 17-10. Roll-up Window Mechanism of ZIL-130 and ZIL-131 Cabin Door: 1, balancing spring; 2, axis of geared sector; 3, geared sector; 4, brake mechanism drive shaft; 5, window winder body; 6, window crank; 7, lever; 8, window glass; 9, clamp; 10, crosspiece; 11, roller; 12, roller axis; 13, brake mechanism spring; 14, drive mechanism shaft guide; 15, brake mechanism body; 16, driving gear; 17, gear support

A stretched fender is repaired by cutting off the excess metal. The cutting area is evened with a hammer, and the side is but welded. The edge of the side is reinforced at the point of welding by welding on a steel plate on the inside of the fender.

In case of deep corrosion damage to the floor board of the cabin, the damaged areas may be cut away and replaced with plates welded in.

Slight irregularities which cannot be removed by straightening are surfaced with a tin-lead solder or powdered plastic and sanded smooth. When solder is used, the area should be cleaned until shiny and tinned with soldering paste, which does not require preliminary etching of the surface with hydrocloric acid, after which POS-18 or POS-30 solder is applied. Then clean and grind the surface with sandpaper, preparing it for later painting.

When plastics are used, the sector treated is smoothed with abrasive stones to produce a rough surface.

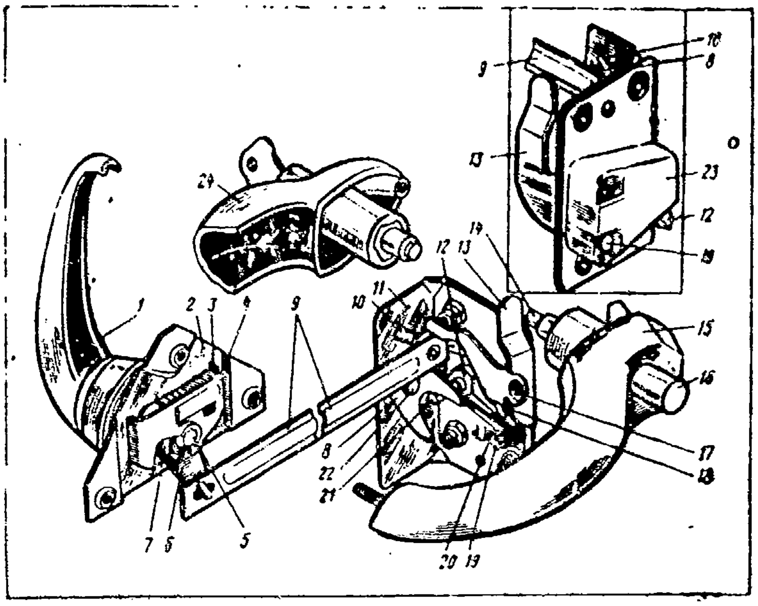


Figure 17-11. Door Lock of ZIL-130 and ZIL-131: 1, inside door handle; 2, door handle mechanism body; 3, coil spring; 4, spring cover; 5, lock drive mechanism axis; 6, lock drive lever; 7, coil drive spring; 8, door lock guide; 9, lock drive member; 10, door lock guide positioning spring; 11, lock body; 12, lock detent; 13, lock lever; 14, button shaft; 15, outside door handle; 16, door handle button; 17, door lock lever axis; 18, lever support; 19, detent axis; 20, detent axis spring; 21, spring support; 22, guide axis; 23, wedge; 24, right outer door handle with ignition switch

The sector repaired is heated to 160-180° C. Heat resistant type TPF-37 plastic is applied to the surface using a gas-flame plastic sputtering installation (UPN-4U) until all dents are filled in and a smooth surface is produced, after which the plastic is compacted, smoothing the surface with a steel roller.

After the plastic has hardened, the surface is cleaned and ground.

In order to smooth individual irregularities on the surfaces of fenders and other parts (primarily in difficultly accessible locations), mastics based on epoxy resin are sometimes used. These mastics solidify well at any temperature and have good strength, chemical resistance and low shrinkage following hardening.

The mastic is made up of epoxy resin, the binder material, and a filler, which may be carbon black, mica powder, cast iron or iron powder or ground asbestos.

In order to assure rapid hardening of the mastic, a hardener is added in the form of polyethylene polyamine, and dibutyl phthalate is added to increase the impact toughness.

The compositions of the mastic are presented below.

First Composition

ED-6 resin	100 weight parts or 48.78%
Dibutyl phthalate	60 weight parts or 29.27%
Black (filler)	35 weight parts or 17.07%
Polyethylene polyamine	10 weight parts or 4.88%

Composition Two

ED-6 resin	100 weight parts or 40.0%
Dibutyl Phthalate	50 weight parts or 20.0%
Mica powder (filler)	20 weight parts or 36.0%
Polyethylene polyamine	10 weight parts or 4.0%

In order to prepare the mastic, dibutyl phthalate is added to the epoxy resin, heated to 60-80° C, and carefully mixed. The filler is then added and the entire mass is once more mixed for five minutes.

In this form, the mixture can be stored in a closed vessel for a long time. Before using the mastic, the polyethylene polyamine is added, and then mixed in with the epoxy resin.

After this component is added, the mastic hardens in twenty minutes.

Before the mastic is applied, the metal surface is cleaned and degreased. The mastic is applied to the area to be repaired with a spatula and spread smooth. After solidification of the mastic (after 10-15 hours) it is easily subjected to mechanical working.

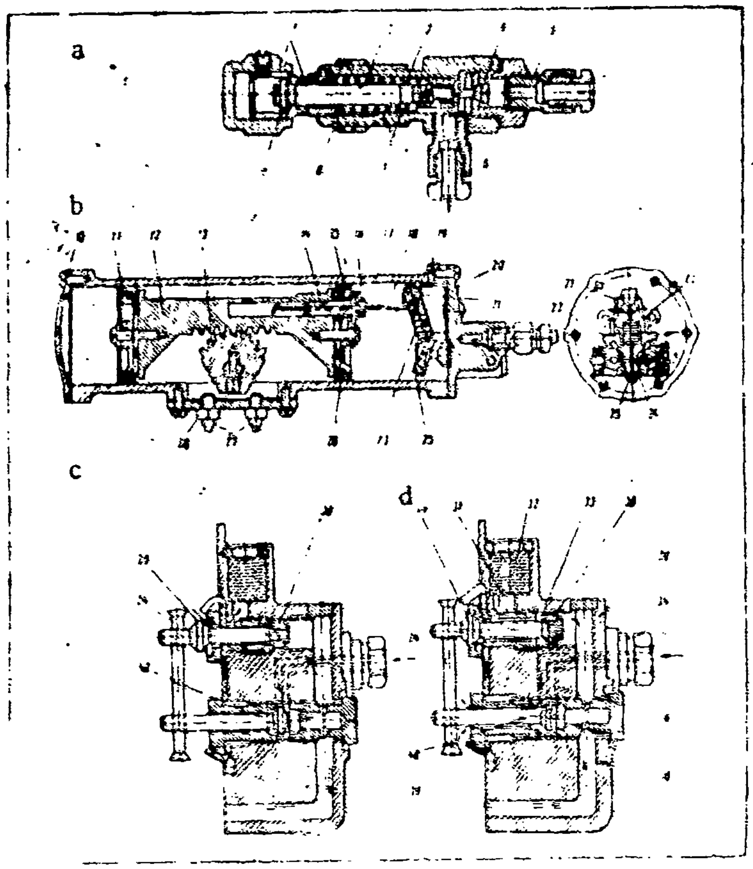


Figure 17-12. SL-22 Windshield Wiper With Operating Valve and Distributor Mechanism: a, KR-11 operating valve and reducer; b, windshield wiper in cross section; c, position of parts of distributor mechanism as piston moves left to right; d, position of parts of distributor mechanism as piston moves right to left: 1, screw with head; 2, shaft; 3, collar; 4, valve; 5, air supply nipple; 6, air exhaust nipple; 7, washer; 8, shaft spring; 9, pin; 10 and 20, cover; 11, piston; 12, rack; 13, pinion; 14, adjusting collar; 15, leather collar; 16, adjusting clutch; 17, body; 18, arm; 19, stop; 21 and 25, brackets; 22, bracket axis; 23, bracket spring; 24, valve crosspiece; 26, collar spacing ring; 27, pinion limiting screws; 28, counternut; 29, 30 and 40, valves; 31, 33, 35, 36, 38 and 39, channels; 32, filter; 34, nipple; 37, seat

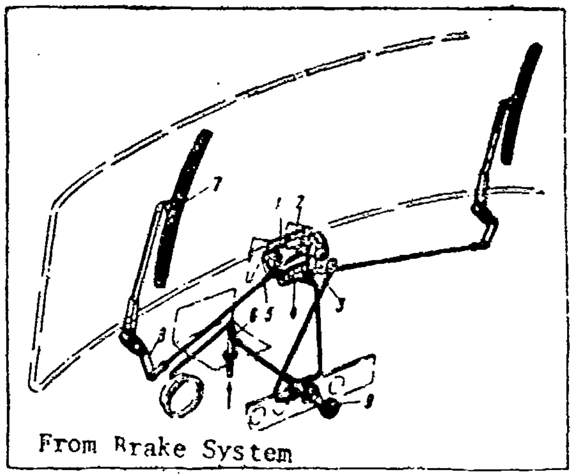


Figure 17-13. SL-440 Windshield Wiper: 1, pneumatic windshield wiper motor; 2, top cover; 3, two-arm lever; 4, valve distributor body; 5, windshield wiper drive arm; 6, air supply from pneumatic system; 7, wiper; 8, windshield wiper drive lever; 9, windshield wiper control button

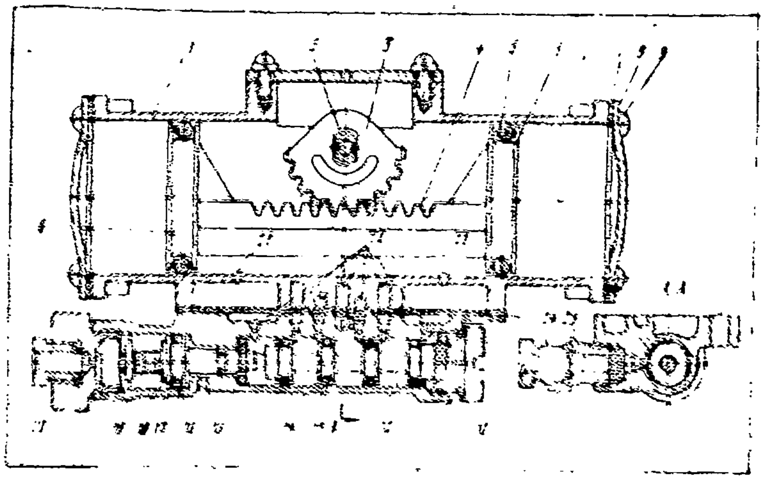
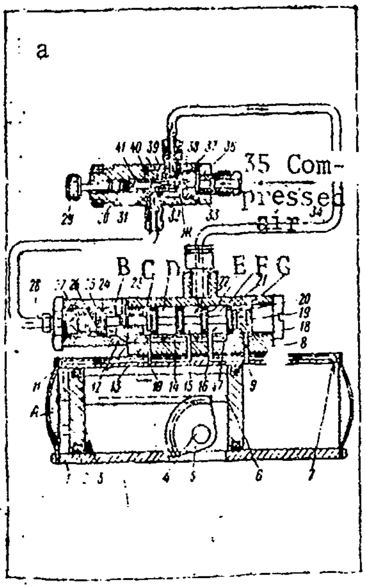
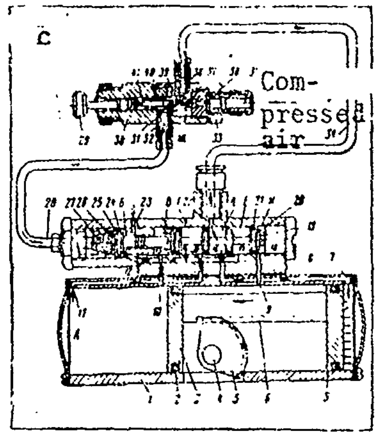


Figure 17-14. Pneumatic Motor of SL-440 Windshield Wiper: 1, body of pneumatic motor; 2, working shaft; 3, pinion; 4, rack; 5, 13 and 16, rubber sealing rings; 6, piston: 7 and 24, shims; 8, cover; 9, screw; 10, plug; 11, distributor body; 12, assembled valve; 14, valve piston; 15, aperture for draining of air at moment of stopping and parking of wipers; 17, parking piston; 18, parking piston valve; 19, valve spring; 20, air exhaust nipple; 21 and 23, apertures admitting air to cylinder to limit travel of pneumatic motor piston; 22, apertures and channels connecting pneumatic motor cavity to distributor valve cavity; 26, nipple supplying air from starting valve to distributor





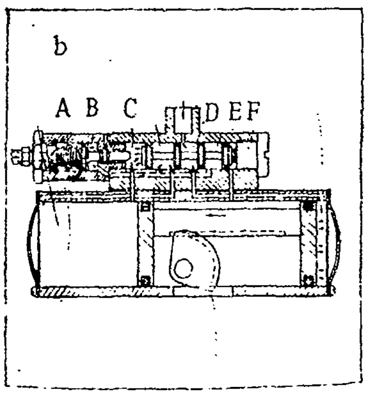


Figure 17-15. Operating Diagram of SL-440 Windshield Wiper: a, motion of pneumatic motor piston left to right; b, motion of pneumatic motor piston right to left; c, stopping of pneumatic motor with wipers parked in extreme position; 1, pneumatic motor cylinder; 2, 21 [illegible] 24, rubber sealing rings; 3, pistons; 4, shaft of pinion; 5, geared pinion; 6, geared rack; 7, 9, 10 and 11, apertures in pneumatic motor cylinder; 8, distributor body; 12, channels; 13, 14, 15, 16, 17, 18, 22 and 23, distributor apertures; 19, valve piston; 20, valve; 25, parking piston; 26, rubber valve; 27, parking valve spring; 28 and 34, tubing; 29, starting valve lever; 30, starting valve body; 31, aperture in seat; 32, 35, 36 and 38, starting valve nipple channels; 33 and 39, valve seats; 37, ball valve; 40, exhaust aperture of valve; 41, starting valve needle; A, B and G, cavity; C, D, E, J, F -- chambers

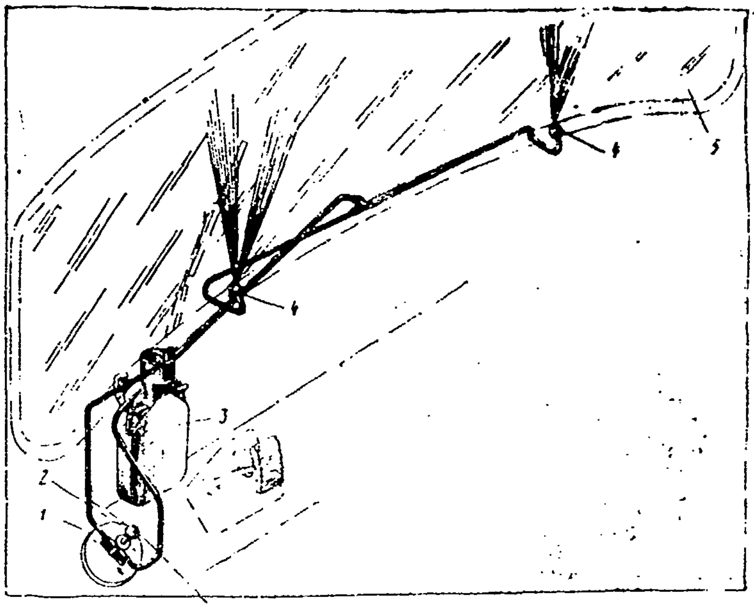


Figure 17-16. Windshield Washer for ZIL-130 and ZiL-131.

The doors of the cabin of the ZIL-157K truck. If there are defects in the door or the units located inside the door, they must be removed before repair.

To remove the cabin doors, the limiters must be disconnected, then the hinge pins tapped out and the doors removed.

Depending on the type of repair, the hinges may be unscrewed without knocking out the pins.

In fitting cabin doors, the following clearances should be used: between doors and cabin loop supports -- up to 5 mm, between the edges of doors and edges of rear cabin uprights -- up to 8 mm, between the edges of doors and lower cabin edge -- up to 10 mm.

Door locks. In order to remove the lock (see Figure 17-6), the outer handle must be removed by withdrawing one screw. Remove the inner handle 13, by removing one screw. Remove the lock mounting screws and, removing cover 6 of the door hatch, withdraw the lock together with the lock drive from the door. Figure 17-8 shows a lock with drive and with door handles, assembled.

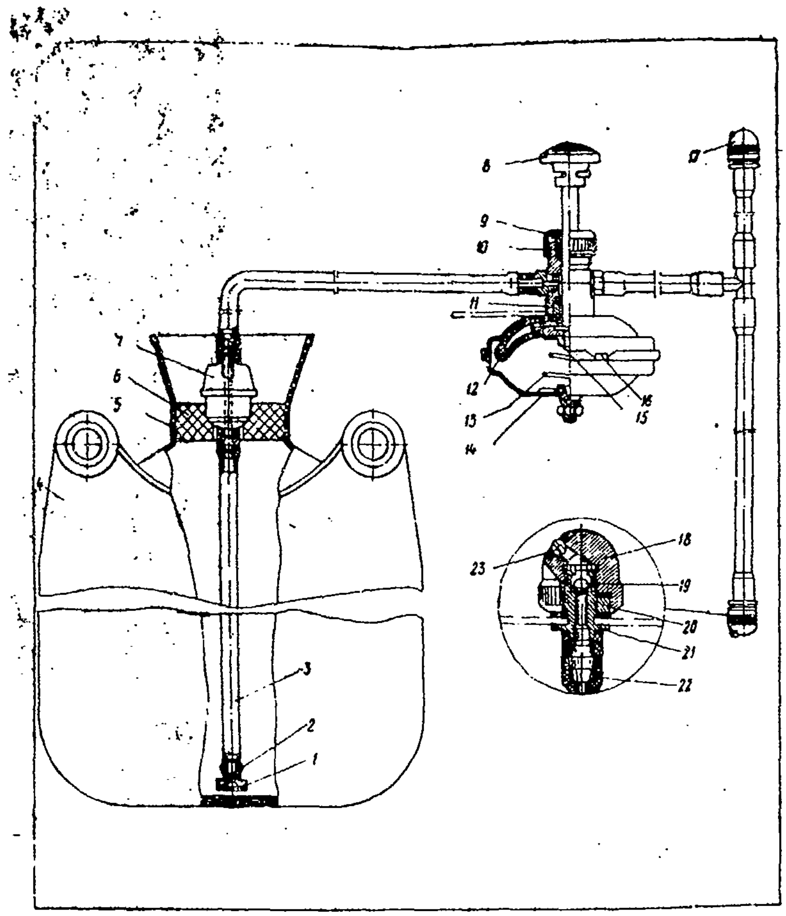


Figure 17-17. Windshield Washer of ZIL-130 and ZIL-131 Trucks: 1, screen filter; 2 and 19, ball valves; 3, tube; 4, reservoir cover; 5, rubber reservoir; 6, plug; 7 and 11, junctions; 8, pump drive pedal; 9, gland nut; 10, gland; 12, diaphragm; 13, diaphragm spring; 14, pump body; 15, diaphragm nut; 16, body lug; 17, sprayer; 18, sprayer head; 20, nipple nut; 21, nipple; 22, hose; 23, nozzle

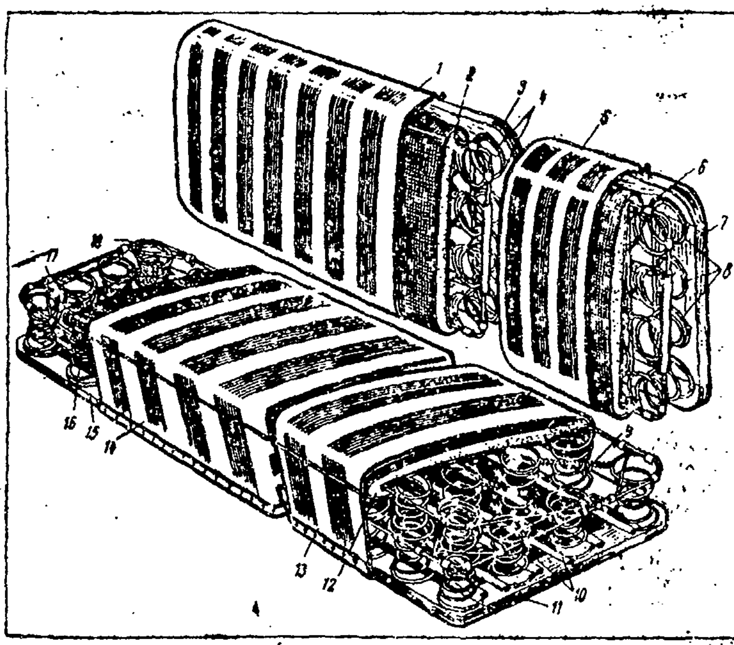


Figure 17-18. Seat of ZIL-157K: 1 and 5, passenger and driver seat backs; 2, 6, 12 and 16, padding; 3, 7, 11 and 15, wooden frames of seat and back; 4, 8 and 17, springs; 9, tension springs; 13 and 14, passenger and driver seats; 18, edge wire

In case of damage to spring 8 of the lock or if the seating of bolt 10 into its recess is weakened, they should be replaced.

The dimensions of the aperture in detent 27 for the outside door handle should be 8.05-8.50 mm; if the aperture is larger, the detent should be replaced.

In case of wear to the supporting surface of face 13 or the working portion of bolt 10, they can be surfaced or replaced.

If the pin connecting the tail of the bolt to the body is weakened, the pin should be replaced.

The drive arm cannot be bent, the spring cannot be damaged. If necessary, the arm can be straightened, the spring replaced.

If the fastening of the arm pin to the lock drive and rivet joint of the arm pin 29, sliding in the slots in the tail of the bolt, are weakened, the pins should be replaced.

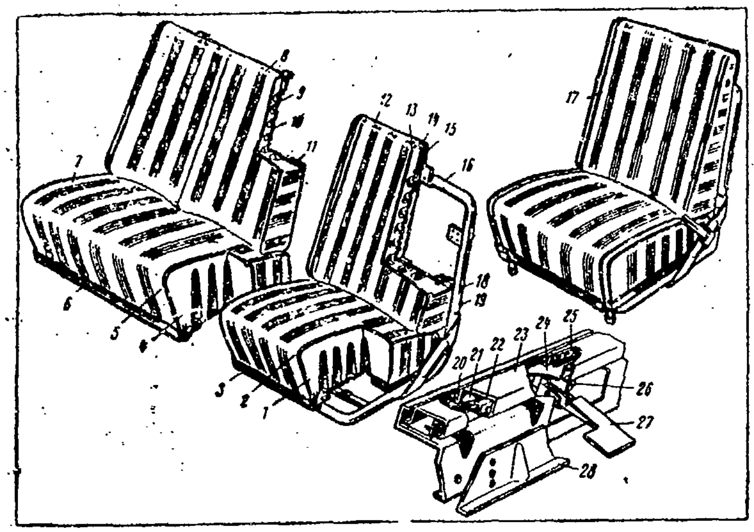


Figure 17-19. Seats of ZIL-130 and ZIL-131: 1, 4, 10 and 14, foam rubber; 2, 5, 9 and 13, covering; 3 and 6, edging; 7, passenger seat bottom; 8, passenger's seat back; 11 and 15, frames; 12, driver's seat back; 16, back holder; 17, driver's seat assembled; 18 and 19, screws for adjustment of back position; 20 and 21, balls; 22, ball separator; 23, moving guide; 24, non-moving guide; 25, vertical slots in moving guide; 26, stop mechanism axis; 27, longitudinal seat adjustment stop lever; 28, bracket fastening seat to floor of cabin

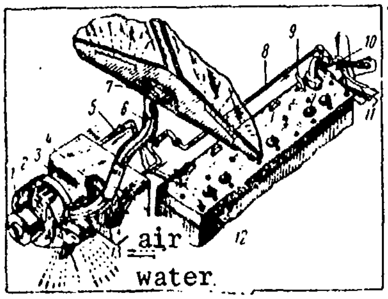


Figure 17-20. ZIL-157K Cabin Heater: 1, electric motor; 2, centrifugal fan; 3, cover; 4, radiator; 5, intake line; 6, hose; 7, distributor; 8, feed line; 9, hose delivering water to compressor, 10, water pump; 11, hose returning water from compressor; 12, valve; 13, fan body; 14, fan body valve

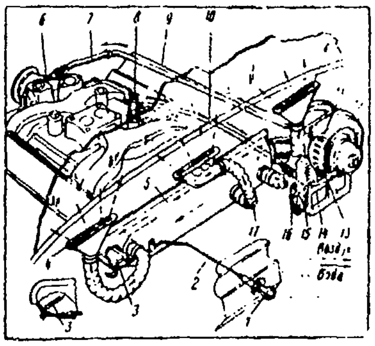


Figure 17-21. ZIL-130 and ZIL-131 Cabin Heater: 1, lever controlling heater channel valve; 2, line; 3, heater channel valve forcing air to defroster (shown in open position); 4, defroster nozzle; 5, channel; 6, water pump; 7, hose draining water from heater; 8, valve; 9, cylinder head valve cover; 10, line carrying water to heater; 11, centrifugal fan; 12, electric motor; 13, radiator; 14, fan body valve; 15, valve locating spring; 16, valve control lever; 17, defroster hose

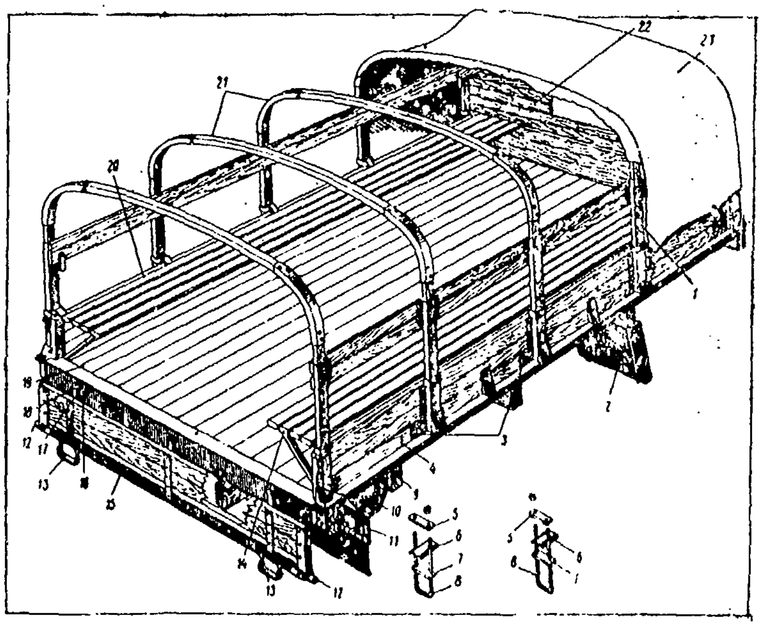


Figure 17-22. Platform of ZIL-157K: 1, top bar guide; 2 and 11, spray shields; 3, hooks; 4, side wall; 5, cover piece; 6, cover; 7, spacer; 8, stirrup; 9, crossbeam; 10, locking chain; 12, stop loop; 13, steps; 14 and 20, platform side seats; 15, rear wall; 16, lower support loop; 17, support pin; 18, upper support loop; 19, base of platform; 21, top bars; 22, front wall; 23, top

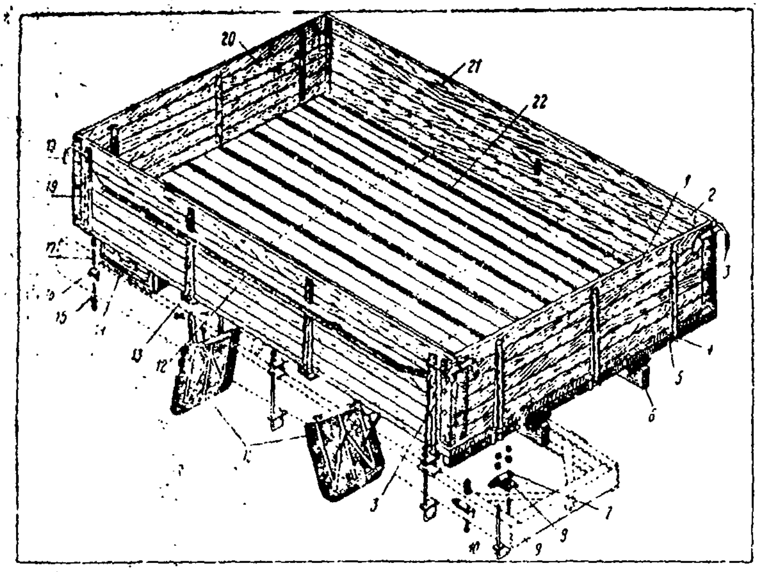


Figure 17-23. Platform of ZIL-130: 1, rear wall; 2, side wall; 3 and 19, lock bolts; 4, lower loop; 5, support pin; 6, longitudinal beam; 7, cover; 8, clamp; 9, frame; 10, stirrup; 11, spray shields; 12, supplementary beam; 13 and 18, upper support loop; 14, tool box; 15, bracket bolt; 16, bracket; 17, spring; 20, front wall; 21, bolt; 22, platform base

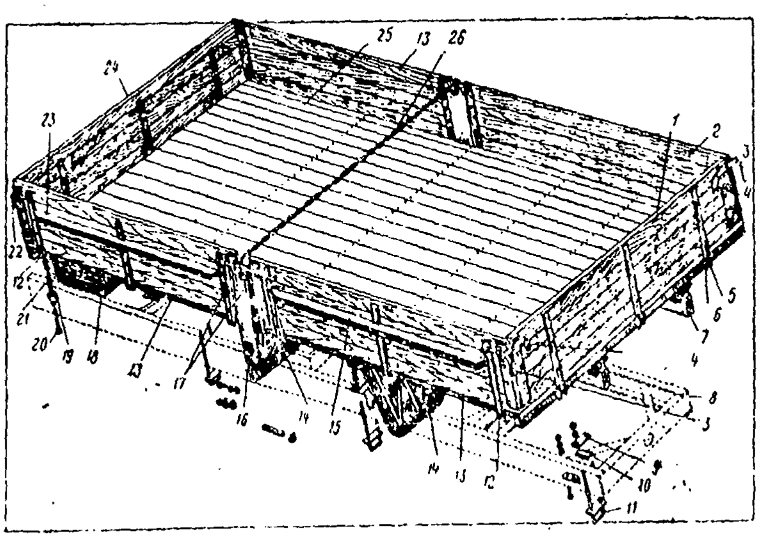


Figure 17-24. Platform of ZIL-130G: 1, rear wall; 2 and 13, side walls; 3, 17 and 22, lock bolts; 4, lock hook; 5 and 12, lower loops; 6, support pin; 7, longitudinal beam; 8, frame; 9, cover; 10, clamp; 11, stirrup; 14, spray shields; 15 and 23, supplementary beams; 16, side uprights; 18, tool box; 19, bracket; 20, bracket bolt; 21, spring; 24, front wall; 25, platform base; 26, upright support chain

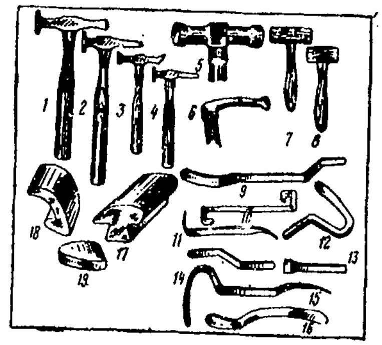


Figure 17-25. GARO Model 2146-1 Tool Set for Repair of Dents in Cabins and Fenders: 1-6, hammers; 7 and 8, mallets; 9-16, straighteners; 17, 18, 19, supports

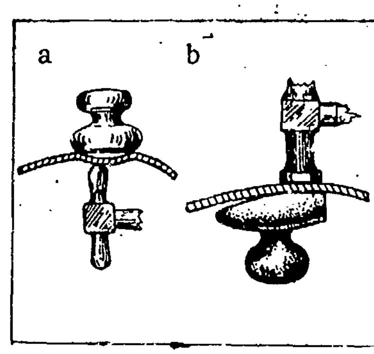


Figure 17-26. Straightening of Dents: a, hammering; b, adjusting

Glass lifter and door glass. In order to remove the door glass, it must be lowered to its extreme bottom position (Figure 17-27). Then the glass is removed from the glass lifter through the hatch in the door by withdrawing the roller of the lifter through the circular aperture in crosspiece 6 of the glass clamp. After this, holding the glass so that it moves up slightly, take it at points C and D and move it from position I to position II along arrow A. In this position, the glass can be removed through the window hole.

It should be kept in mind that the glass raising mechanism should not be removed to replace the glass.

In order to remove the glass raising mechanism, first remove its crank 12 (see Figure 17-6). Then withdraw the glass raising mechanism retaining screws, holding it in the hand, and withdraw it through the hatch in the door.

Bends in the levers, pinion and body, damage to the balancing spring or brake mechanism springs are not permitted. When necessary, bent parts should be straightened, springs replaced.

In case of weakness in riveted joints, rivets or roll and ball joint axes, they should be replaced.

In case of great wear to pinion teeth or gears, the worn parts should be replaced.

In the glass raising mechanism fully assembled, the levers should move freely, without wedging.

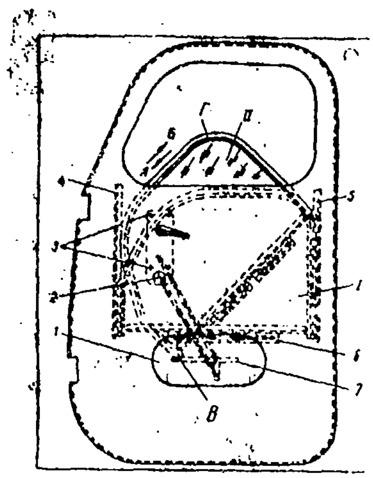


Figure 17-27. Removal of Window Glass From ZIL-157K: 1, hatch cover; 2, plug; 3, glass raising mechanism mounting screw; 4 and 5, glass guides; 6, crosspiece; 7, T-shaped glass raising lever

The roller axes must be riveted so that the edges of the riveted ends do not seize the glass holder, but rather slip along it.

The stamped projection in the body should press the pinion tightly against the body, not allowing it to unmesh from the gear.

The longitudinal clearance of the drive shaft 5 (see Figure 17-7) should not exceed 1.0 mm. The radial clearance at the end of the shaft on the side of the square should not exceed 2.0 mm.

Free rotation of arm 3 before beginning of movement of the levers should not be over 180°.

Uneven twisting of the balance spring and slipping of turns is allowed if it is not accompanied by a scraping noise.

The braking device should be tested by operation with a load of 10 kg, the smoothness of travel -- with a load of 6 kg applied at the center of T-shaped lever 16.

Parallel travel of the T-shaped lever should be tested in a device reproducing the operating conditions of the glass lifting mechanism in the door. The permissible deviation of the T-shaped lever from the horizintal position at the upper and lower positions should be within limits of 3.0 mm at the ends of the lever.

The spring toothed washer 19 should hold the adjusting screw to prevent its motion along the oval aperture in the body.

Adjusting screw 18 (regulating axis) of the glass lift mechanism lever should be tightened following adjustment of the position of the levers on the door (torque 1.5-2.0 kgm).

The parts of the glass lifting mechanism should have undamaged anti-corrosion coating.

Installation of door glass. The glass should be installed in the inclined position as shown on Figure 17-27 (position II). In this position it is most convenient to install the glass in the guides. Taking the glass and applying force at points C and D, it is rotated in the direction of arrow B to position I. After this the glass is lowered until the rollers mounted on T-shaped lever 7 of the glass lifting mechanism match the round apertures in the crosspiece. If the rollers in the glass lifting mechanism do not match the apertures in the crosspiece, the mismatch should be elimi[illegible] by adjusting the glass lifting mechanism using screw 18 (see Figure 17-7).

When the glass is raised by rotating the crank, the rollers enter the guides of the crosspiece. In order to be sure there is no skew of the glass, it must be lifted to an uppermost position. In this position, the skew will be most visible. In case of detection of skew, the glass lifting mechanism must be adjusted. To do this, remove the plug of the adjusting screw of the glass lifting mechanism 18 from the door, back off its nut and move the screw along the slot in the body of the glass lifting mechanism in either direction to a position which will eliminate the skew of the glass. The adjusting screw nut must be tightened in this position.

The force on the glass lifting arm necessary to move the glass should not exceed 5 kg. If this force is insufficient, the reason must be determined and eliminated.

The cabin doors of the ZIL-130 and ZIL-131 should open and close freely. Welding of door hinges to the cabin body uprights is not permitted. Door latches should operate correctly with both inside and outside handles.

The axes of the upper and lower door hinges 2 should be in line (Figure 17-9). The doors of the cabin must close tightly without skewing in the door frame.

The permissible clearance between the door and the cabin must be as follows: outside clearance between panel 2 of rear portion of cabin and door 1.5-7.0 mm (Figure 17-28 a); outside clearance at top in the area of the water drain between frame 4 of the side and the top -- 2.5-6.5 mm (Figure 17-28 b); internal clearance between panel 3 of frame of cabin side and internal edge of door 1 -- 2-7 mm.

If defects are determined in the equipment installed within the door it should be removed from the door cavity and repaired.

Door latches. Before removing the door latch, remove the inside handle (pressing out the socket with a screw driver, removing the pin and then removing the handle from the shaft), then remove the outside door handle. To do this, remove the mounting screw at the rear end of the handle, then remove the nut fastening down the front end of the handle through the inside hole of the door panel with a socket wrench and remove the handle from the door. Remove the four door lock mounting screws, remove the lock from its seat in the door and lower the panel, disconnect the drive arm and remove the lock through the door hatch.

Remove the three mounting screws retaining the lock drive unit with a screw driver and remove the unit through the door hatch.

The door stop should be adjusted with the latch and finally mounted with the doors hung and adjusted.

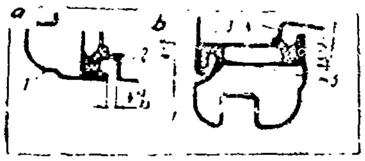


Figure 17-28. Clearances During Installation of Doors in Frames: a, permissible outer clearance between rear portion of cabin and door; b, permissible inner clearance between frame facing and door and top outer clearance in the area of the water drain between the side and top; 1, cabin door; 2, panel of rear portion of cabin; 3, panel of cabin side frame; 4, cabin side frame; 5, weather seals

The glass lifting mechanisms in the ZIL-130 and ZIL-131 doors should raise and lower the window glass smoothly without skewing or seizing. The force on the arm of the glass lifter should not exceed 4 kg during raising, 3 kg during lowering.

Before removing the glass lifting mechanism, remove its crank handle (by pressing out the socket with a screw driver, removing the pin and withdrawing the handle). Remove the decorative shield by pressing out the four holders with a screw driver.

Withdraw the four glass lifting mechanism mounting screws and withdraw the mechanism through the hatch in the door panel.

Installation of the glass lifting mechanism is performed in the reverse sequence. The glass lifting mechanism requires no adjustment when the glass is replaced.

Door window and vent window. The door vent windows should contact the seal tightly in the closed position. The force required to open and close the vent wing should not exceed 2-3 kg.

In order to remove the glass in the door window and vent wing (see Figure 17-9), remove the screws retaining cover 17 of the hatch on the inside of the door and remove the cover. Remove the internal panel plug, after lowering the glass. Remove the roller of the glass lifter lever from the slot in the crosspiece in the clamp and drop the glass still lower.

Remove the bolt which retains the glass guide.

Back off the screw fastening the clamp of the vent wing axis. Remove the door glass seal together with its four clamps. Remove the lower seals with three buttons on each.

Remove the wood screw holding the vent wing upright to the upper portion of the door. Tilt the vent wing together with the upright toward the window and withdraw it through the space between the door panels.

Withdraw the door glass from the space between panels.

In dissembling the vent wing, a screw driver is used to withdraw upper axis 21 from the frame. Withdraw screw 26 mounting lower axis 24 of the vent wing and remove clamp 25.

Withdraw the vent wing glass from the clamp and frame and its andle; withdraw the sealing rubber from the slot in the clamp using a screw driver.

The rubber seals used at the points of contact with glass and cabin should be lubricated with paste, which helps them to seal, assuring water tightness of the cabin.

The stalinite cabin glass should be 5.5-6.5 mm thick. Waviness, yellowing and cracks in the glass are not permitted.

Removal of fenders, hoods and cabin from the ZIL-157K.

Dismount the hood retainer, remove the tension arm and hood.

Disconnect the wires from the intermediate connecting panels and electric equipment. Remove the head lights and parking lights. Disconnect the tubes from the pneumatic brake system, and in three-axle trucks, also disconnect the tubes from the tire pressure adjusting system. Remove the seats.

Remove bolts 2 (see Figure 17-1) and bolts 1 mounting the cabin onto the supports at the front and rear suspension points. Disconnect the mounts with the transverse frame on the right side of the transfer box.

Remove the steering wheel from its shaft and disconnect the steering column mounting collar at the cabin bracket.

Disconnect the brake pedal arm, speedometer cable and the arm of the pedal controlling the choke valves.

Remove the pedal hatch covers and the hatch cover for the shift lever and hand brake lever.

Place hooks in cabin doors and remove cabin from truck. As the cabin is removed, care must be exercised to prevent damage to instruments and mechanisms.

Removal of fenders. Remove nuts from bolts mounting fenders to frame brackets and to floor board, as well as nuts from bolts mounting splash panels to frame. Remove fender from frame brackets together with splash panels.

Removal of radiator fairing. Remove nuts from bolts mounting fairing to radiator frame and remove fairing from truck.

Removal of fenders and cabin from ZIL-130 and ZIL-131. The fenders and hood can be removed from the cabin after removal of the cabin from the truck or with the cabin on the truck. In both cases, complete dissembly should be begun by removing the hood. To remove the hood, remove the nut fastening the right and left brackets and remove the hood.

Removal of radiator fairing and fenders. Disconnect wires from instruments and connecting panels of electrical equipment, remove lights and parking lights.

Remove nuts from bolts fastening radiator fairing to fenders and splash panels. If the fenders and fairing are being removed together, this operation need not be done. Withdraw radiator frame mounting bolts and bolts connecting fenders to radiator frame, back off screw with screw driver and disconnect radiator cover control cable from control lever. Remove radiator fairing without frame.

Remove bolts mounting fenders to cabin, to floor board, splash panel and radiator frame. Remove fenders togethe. with splash panels.

Remove nuts mounting battery shield and bolts mounting left bracket to cabin. Remove running board and brackets together.

Removal of cabin. Loosen screw in clamp and disconnect heater hose.

Disconnect air valve and choke manual control cables, loosening two cable mounting screws at carburetor.

Disconnect manometer hose nipple and T-connection in right air line. Disconnect pressure regulator line to compressor and from T-connection to brake valve.

Disconnect carburetor line from choke control pedal.

Remove pin connecting brake valve pedal lever and arm; remove tension spring.

Disconnect gear pedal and intermediate lever.

Disconnect steering shaft from steering column by removing nut and knocking out wedge with hammer.

Disconnect speedometer cable from transmission. Remove seats. Remove bolts 3 (see Figure 17-2) fastening cabin to side suspension brackets; disconnect bolts 13 mounting the cabin on the rear suspension bracket and remove support 12.

Open cabin doors, place clamps of lifting device and remove cabin from truck (Figure 17-29).

Installation of cabin, fenders and hoods on trucks. The repaired cabin and fenders are installed on the frame using the same methods used to remove the cabin.

During assembly of the cabin, hood and fenders of the ZIL-130 and ZIL-131, the following are permitted: mismatch of edges of fender 1 (Figure 17-30 a) with radiator fairing not over 1.5 mm, due to heating of fairing 2; mismatch of edge of hood 3 with panel 4 of front portion of cabin ±1.5 mm; clearance between them 3.5-8.5 mm (Figure 17-30 b); mismatch of edge of fender 6 with panel 5 of front portion of cabin ±2 mm, clearance between them 2-6 mm (Figure 17-30 c); mismatch of edges of fender 7 and door ±1.5 mm, clearance between them 1.5-7.0 mm (Figure 17-30 d).

The windshield and rear window of the ZIL-157K are held in by covers with seals retained with screws.

When a damaged glass is replaced, the screws are withdrawn, cover and seal removed and the glass is pushed out. Installing a new glass, it must be pressed in place with the cover and seal and held with the screws.

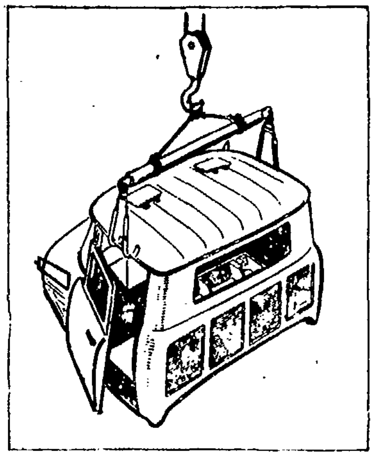


Figure 17-29. Removal of Cabin From ZIL-130

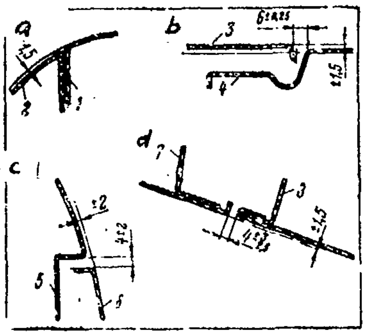


Figure 17-30. Permissible Clearances During Installation of Cabin Units and Fenders: a, permissible mismatch of edges of fender with radiator fairing; b, permissible mismatch of edge of hood with panel of front portion of cabin and clearance between them; c, permissible mismatch of edge of fender with panel of front portion of cabin and clearance between them; d, permissible mismatch of edges of fender and door of cabin and clearance between them; 1, 6 and 7, fender; 2, radiator fairing; 3, hood; 4 and 5, panel of front portion of cabin; 8, cabin door

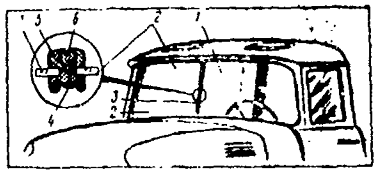


Figure 17-31. Installation of Divided Windshield on ZIL-130 and ZIL-131: 1, left half of panoramic glass; 2, right half of panoramic glass; 3, upright with seal and lock, assembled; 4, cross section of upright; 5, seal; 6, seal lock

The windshield and rear window of the ZIL-157K are held in by covers with seals, retained with screws.

When a damaged glass is replaced, the screws are withdrawn, cover and seal removed and the glass is pushed out. Installing a new glass, it must be pressed in place with the cover and seal and held with the screws.

The curved windshield and rear window of the ZIL-130 and ZIL-131 are held in place by means of rubber seals and a rubber lock. The ZIL-130 and ZIL-131 also allow installation of a divided curved windshield consisting of two halves (Figure 17-31). The two halves are held in place by the rubber parts plus metal upright 4.

When a complete panoramic windshield is replaced, a screw driver is used to remove the locking section, placed in a longitudinal slot in the middle of the seal. The screw driver is used to bend back the upper edge of the seal along the entire length of the glass. Holding the glass from the outside, push strongly on the inside of the glass to force out the right or left upper corner of the glass then gradually withdraw the entire upper portion of the glass, after which the glass is removed from the hole. Remove the gasket seal and clean it to remove old waterproofing compound.

The rear window is removed in a similar manner.

To install the curved windshield, clean the flange around the windshield hole to remove old waterproofing compound and apply fresh waterproofing compound to the outer edge of the flange in the windshield hole using a wooden trowel (Figure 17-32). Then install rubber seal 1 on flange 6 of the hole in the cabin. The installation should be begun in the lower center portion of the windshield aperture, pressing slot 4 over the flange in the direction of the arrow shown on the figure.

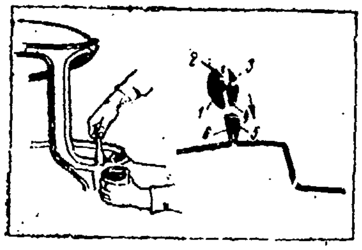


Figure 17-32. Application of Waterproofing Compound to Flange Around Windshield Hole: 1, glass seal; 2, glass slot; 3, slot for locking strip; 4, flange slot; 5, waterproofing compound; 6, flange

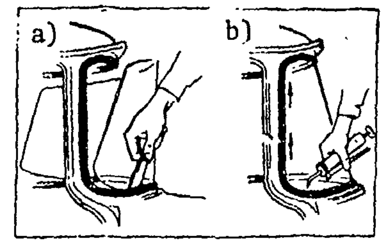


Figure 17-33. Installation of Windshield in Cabin of ZIL-130 and ZIL-131: a, guiding glass into slot in gasket; b, application of waterproofing compound to slot between glass and gasket

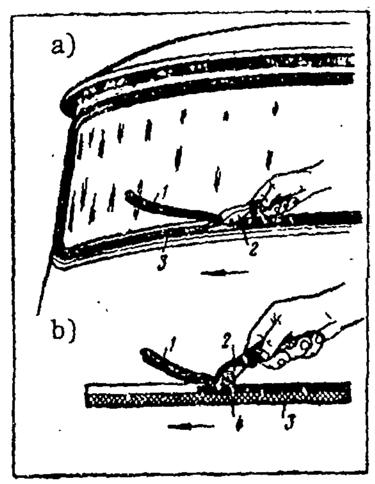


Figure 17-34. Installation of Rubber Sealing Strip in Windshield Gasket of ZIL-130 and ZIL-131: a, installation of sealing tool with sealing strip in gasket slot; b, installation and rolling of rubber sealing strip into gasket slot; 1, rubber sealing strip; 2, installation tool; 3, glass sealing gasket; 4, roller of installation tool

Insert the glass into the windshield position, guiding its lower portion into the slot in the gasket. Then, by periodically pressing down on the glass and helping with light taps with a rubber hammer, force the glass down into its required position. In order to avoid bending the edge of the gasket slot during installation of the glass, the glass should be guided into the slot using a wooden trowel (Figure 17-33 a). Safety glasses should be worn to protect the eyes during installation of the windshield.

After the windshield is installed in the cabin, waterproofing compound must be placed in the slot between the sealing gasket and glass around the outside using a lever-plunger type sprayer (Figure 17-33 b).

The last operation in installation of the glass is installation of the rubber sealing strip in slot 3 (see Figure 17-32) of the gasket. Installation of the rubber sealing strip must be performed in the following sequence: place strip 1 (Figure 17-34 a) into the hole in the head of the installation tool 2, place the head of the tool into the slot in gasket 3 and roll the strip into the slot with roller 4 (Figure 17-34 b) of the installation tool along the entire length of the gasket. The free ends of the rubber sealing strip are cut off so that the ends of the sealing strip touch each other in the slot. Remove the excess waterproofing compound from the glass.

The device for installation of the sealing strip is shown on Figure 17-35.

The rear window glass of the cabin is installed the same way as the windshield.

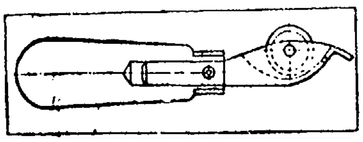


Figure 17-35. Tool for Installation of Rubber Sealing Strip in Slot of ZIL-130 and ZIL-131 Windshield Gasket

Dissembly and assembly of SL-22 windshield wiper. In case of a breakdown of the windshield wiper, it is recommended that it be removed, cleaned out with compressed air, and if necessary dissemble to eliminate the defect. Dissembly of the windshield wiper should be performed by a specialist thoroughly familiar with the device.

In dissembly of the type SL-22 windshield wiper, the cover mounting screws 20 should be removed (see Figure 17-12), then the cover removed, removing spring 23 to prevent damage to the gasket and parts of the distributing mechanism. Check the proper operation of spring 23, inspect the valves and blow out the channels.

In case of defective leather collars 15, remove rack 12 together with pistons 11 and replace the collars.

The leather collars of the piston should contact the walls of the cylinder tightly throughout the entire length of the working stroke of the piston. The leather of the collars must be elastic, without cracks, tears or other defects.

The valve mechanism should assure accurate switching of the air channels. The valves must provide tight sealing when the channels are closed. Worn parts are replaced.

The wipers and shafts must be straightened if bent, corrosion removed. The assembled windshield wipers should be tested in the truck.

With the glass wet and a pressure of 1 kg/cm^2 in the air line, the windshield wipers should operate at the rate of five complete cycles per minute, no less; with a pressure of 2 kg/cm^2 in the air line, the wipers should operate at 50 complete cycles per minute, no less.

The rubber wiper should clean the wet glass, leaving no tracks or dirt after 50 complete wiping cycles (no more).

The wipers should move smoothly and evenly across the glass. The difference in travel time in the two directions should not exceed 30%.

The torque on the operating shaft of the windshield wiper should not drop below 8 kgcm when the air pressure is dropped to 1 kg/cm^2.

If the starting valve-reducer is dissembled (Figure 17-12) to eliminate defects, remove nipple 5, then valve 4. After this, the valve is dissembled partially or completely, depending on defects found.

Dissembly and assembly of SL-440 wiper. When defects appear in the wiper, the reason for the defect should be determined, and only then should the wiper be dissembled.

In case of a problem with the rubber sealing rings 5 (see Figure 17-14) of piston 6 of the pneumatic motor, cover 8 of the body should be removed, the piston and rack 4 removed from the cavity, the rings replaced, the cylinder channels cleaned and blown out with compressed air. When the channels are blown out, valve 12 and parking pistons 17 should be removed from the distributor body. At the same time, check rubber sealing rings 13 of the valve, parking piston ring 16 and distributor insert 24. After eliminating defects, assemble the windshield wiper and operation test it.

During dissembly of the starting and adjusting valve, it should be kept in mind that ball valve 37 (see Figure 17-15) is not fastened in and may fall out. During assembly, the valve should be held vertically upward by seat 39, into which, after placement of ball valve 37, seat 33 is screwed. Failure to observe this rule may cause wedging of the ball between the ends of seats 33 and 39.

Rubber sealing rings 13 (see Figure 17-14) of pistons 14 of the valve distributing mechanism should not pass compressed air from one chamber to the other.

The rubber sealing rings of the pneumatic motor piston and valve should be elastic, without cracks, splitting or swelling.

The requirements placed on the SL-440 windshield wiper are the same as those placed on the SL-22 wiper.

The windshield wipers should develop at least 45 complete cycles per minute with an air pressure of 6.5-7.5 kg/cm^2.

The travel time in one direction should not differ from the travel time in the other direction by more than 30%, with smooth, uninterrupted movement over the curved glass and without impacts when the directi n of movement changes.

During assembly of the windshield wipers, parts and seals are lubricated with lubricant No. 158.

Dissembly and assembly of windshield washer. The reservoir is dissembled in case of plugging of filter 1 (see Figure 17-17). To dissemble, remove tube 3 together with plug 6 and wash the reservoir. During assembly of the reservoir, tube 3 is installed vertically so that it stops 5 mm short of the bottom of the rubber reservoir.

During cleaning of the pump or replacement of diaphragm 12, separate the tubing from junction 11 at the pump, remove the head of the pedal 8, back off nut 9 of gland 10, bend back lugs 16 and separate the lower portion of body 14 of the pump. Remove junction 11 and remove the diaphragm together with the shaft. Removing nut 15, remove diaphragm 12.

The pump is assembled in the reverse sequence. The lower portion of the diaphragm should be held firmly with nut 15, the upper portion -- with junction 11. Gland 10 is tightened so that water does not leak from the pump.

In case of plugging of the sprayer, remove its head 18, clean valve channel 19, blow through the jet 23 and reassemble.

When the washer is installed on the truck, the pump tube connections, reservoir plug and sprayer T-piece must be reliably tightened.

Fill reservoir 5 only with filtered water. The direction of the stream of water should be adjusted by rotating head 18 of the sprayer and nozzle 23.

Cabin seats. During the repair of sprung seats, misshapen seat and back cushions are dissembled, broken and weakened springs are replaced, the springs are retightened and fastened to the frame. The springs are fastened with metal brackets, special clamps and twine.

The seat cushion is fastened to the seat base with hooks fastened to the seat frame.

Sponge rubber seats and backs are not repaired. The covers on seats and backs are repaired in case of dirt, torn or worn places.

Heater. In case of a defect in the cabin heater radiator, it is removed from the cover and sent off for repair. The heater radiator is repaired in the same manner as the radiator of the engine cooling system. After repair, the radiator is tested for tightness of seal in a water bath with an excess air pressure of 1 kg/cm^2 for the ZIL-157K heater radiator and 1.5 kg/cm^2 for the heater radiator of the ZIL-130 and ZIL-131.

Data on the electric fan motor can be found in Chapter 19. Bent fan blades can be straightened using a support and hammer.

Cleaning and washing of the heating system of the cabin is performed at the same time as washing and cleaning of the engine cooling system.

Platform. The following requirements are placed upon repair of the platform.

Wood material used to repair and manufacture the platform must have a moisture content of not over 22%.

The longitudinal and transverse platform beams, as well as the extreme outer floor boards and upper side wall boards must be made of first quality pine (GOST 3008-45). The remaining parts of platforms are made of second grade pine or spruce (GOST 3008-45).

Wood parts of the platform must be planed smooth, should have no steps or splinters. Floor boards must be squared, side wall boards must be grooved.

The cut ends must be cleaned, without splitting.

Table 17-1

PAINTS AND SOLVENTS

ZIL-157K	ZIL-130 and ZIL-131
Nitrocellulose lacquers: No. 507 (GOST 7930-56); or No. 517 (TUMKhP 4355-56);	Alkyd melamine enamel ML-12 (GOST 9754-61): ML-12-30 green;
Solvent No. 646 (GOST 5630-51);	ML-12-78 khaki; ML-12-40 blue; ML-12-86 sand;
Base coat GF-020 (GOST 4056-63); Solvent (GOST 1928-50)	ML-12-70 light gray; Solvent (GOST 1928-50); Base Coat GF-020 (GOST 4056-63)

During repair of platforms, the following are permitted:

Use of longitudinal and transverse beams previously used with wear of ends of up to 20 mm on each end, split up to one-fourth thickness and 100 mm length, scratches up to 10 mm deep, 30 mm wide and 500 mm long;

Use of boards worn 5 mm in thickness, base beams worn to 8 mm;

Installation of middle floor boards of not over two pieces, fastened to two transverse beams;

Splinting of not over one middle board on side wall if each end of the board and splint are bolted.

During assembly of platforms, the following requirements must be followed.

Assembled longitudinal and transverse beams must not be bent.

Remaining parts must be:

Transverse beams parallel to each other;

90° angle between transverse and longitudinal beams;

Boards of platform floor square connected must butt at edges (clearance in joints of boards after natural drying should not exceed 3 mm through entire lengtn, 5 mm at individual points for up to 500 mm length);

Platform wall boards must butt each other tightly at the edges (clearances up to 2 mm over entire length of board and local clearances of not over 3 mm for length up to 500 mm are permitted);

Circular washers at least 2 mm thick must be placed beneath nuts and bolts directly contacting wood;

Bolts are installed with heads on inside of platform (bolt ends must not protrude beyond nuts by more than one bolt diameter);

Platform sides are tightly closed (only standard side latches are used, and must act freely, without great force), clearances between open sides and platform base not over 5 mm, up to 7 mm permitted in individual places for lengths up to 300 mm;

Through cracks on side boards and floor boards permitted up to 200 mm long, not including bolt holes;

Platform edging must be tightly against wood parts, local clearances not over 3 mm for up to 200 mm length.

After repair of cabin, hood and fenders and platform, these parts are painted. Table 17-1 presents the types of paints and solvents recommended for painting of ZIL-130, ZIL-157K and ZIL-131 trucks.

§5. Electrical Equipment.

Chapter 18. Electrical Equipment of Motor.

Structure

Electrical Equipment Circuits

The in-line and V-type motors use single-wire electrical equipment systems. The nominal voltage is 12 v. The negative terminal of the current supply is connected to the chassis of the truck. Up to 1960, in-line motors were manufactured with an electrical system in which the positive terminal was connected to the chassis.

The equipment used on various motors is summarized in Table 18-1.

Diagram of electrical equipment of ZIL-157K motor (Figure 18-1). Some of the in-line motors installed in the ZIL-157KG have electrical equipment with a shielding device to suppress radio interference; shielded generator, voltage regulator, distributor, coil and additional installation of a radio interference filter. The spark plugs are shielded with a common metal cover.

The electrical equipment system of the ZIL-130 includes the same set of basic equipment as in the in-line motors, but arranged to operate with an 8 cylinder engine (Figure 18-2). This system was used in all ZIL-130 motors up to the beginning of 1967.

A significant increase in secondary voltage can be achieved in a battery ignition system only by increasing the current broken by the distributor contacts. However, contacts made of tungsten do not allow further increases in current interruption due to high contact face wear (burning, erosion, etc.).

A new 12 v breaker-transistor ignition system (Figure 18-3) introduced in some ZIL-130 trucks beginning in 1967, contains, in addition to the equipment described above a transistorized distributor (TK102), the B114 ignition coil installed in place of the B13 coil, plus additional resistor SE107.

This system operates together with any type of breaker and distributor in which the breaker points are not shunted by a spark-damping condensor.

TABLE 18-1

ELECTRICAL EQUIPMENT

Vehicles	Generators	Voltage Regulators	Distributors	Coils	Spark Plugs	Starters	Transistorized Distributors	Radio Interference Filters
ZIL-157K Stake Bed Truck	G108-V	RR24-G	R21-A	B1	SN55-B or A-16-U	ST15-B	-	-
ZIL-157KV Tractor Truck	G56-B	RR23-B	R21-A	B1	Same	Same	-	-
ZIL-157KG Truck with Shielded Electrical Equipment	G118	RR24-E	R51	B5-A	Same	Same	-	FR81-F FR82-F
ZIL-130, ZIL-130V, ZIL-130G, ZIL-130D and ZIL-131A Trucks with Non-transistor Ignition	G130	RR130	R4-V	B13	A15-B or A13-B	ST130	-	-
ZIL-130, ZIL-130V, ZIL-130G, ZIL-130D and ZIL-131A Trucks Equipped with Transistorized Ignition	G130	RR130	R4-D	B114	A15-B or A13-B	ST130	TK102	-
ZIL-130E and ZIL-131 Trucks with Shielded Electrical Equipment	G51	RR51	R102	B102-B	SN307	ST2*	-	FR81-F FR82-F

* The ST130 starter is installed on the ZIL-130E.

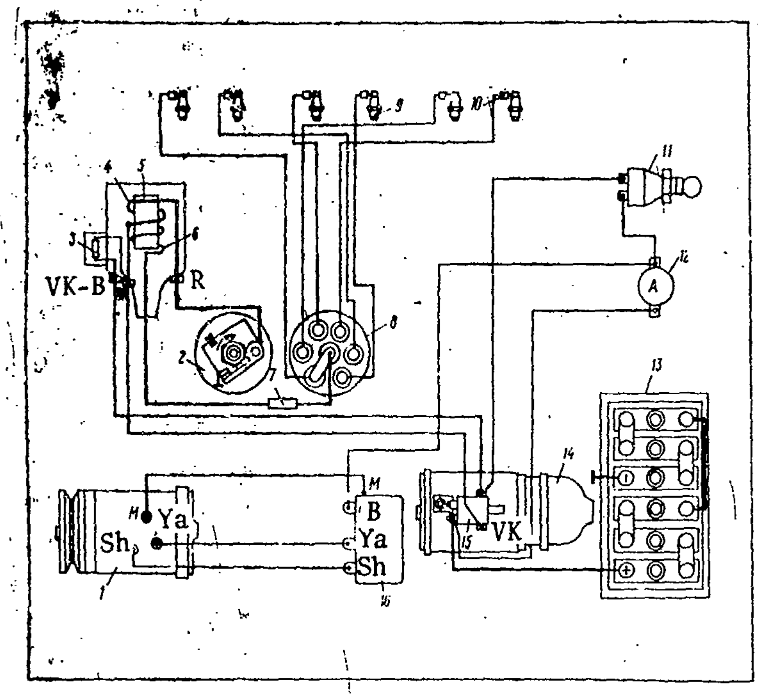


Figure 18-1. Diagram of Electric Equipment of In-line Motor.
1, generator, 2, breaker, 3, additional resistor, 4, primary circuit of coil, 5, coil, 6, secondary circuit of coil, 7 and 10, resistors, 8, distributor, 9, spark plugs, 11, ignition switch, 12, ammeter, 13, battery, 14, starter, 15, starter solenoid, 16, voltage regulator.

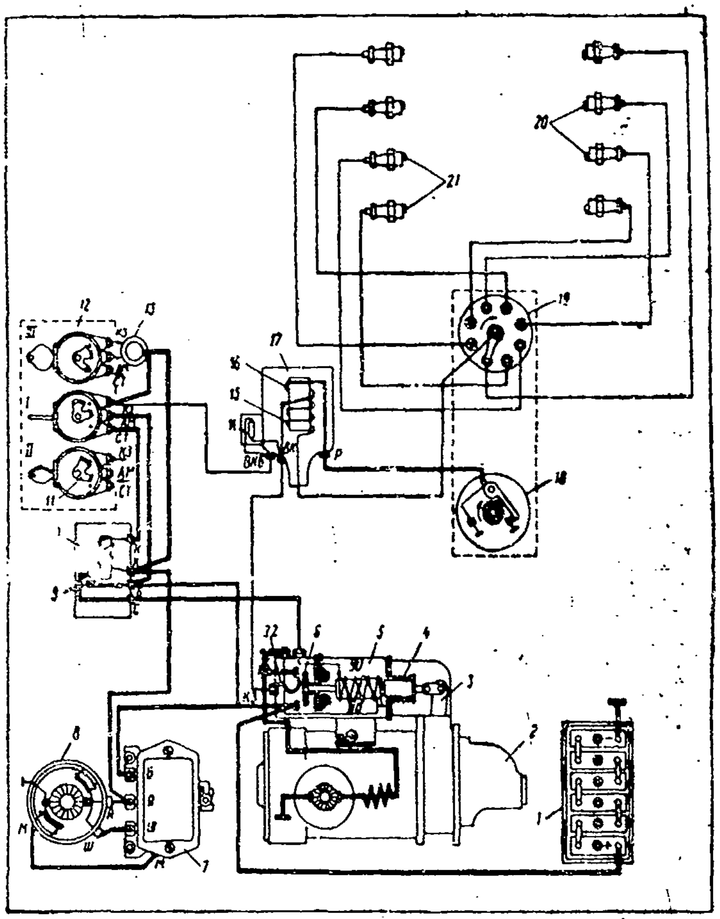


Figure 18-2. Diagram of Electrical Equipment of V-8 Motor.
1, battery, 2, starter, 3, lever, 4, core spring, 5, power relay, 6, moving contact, 7, voltage regulator, 8, generator, 9, starter solenoid contacts, 10, starter solenoid, 11, moving terminal of ignition switch, 12, ignition switch, 13, charge testing light, 14, additional resistor, 15, secondary winding, 16, primary winding, 17, coil, 18, contact breaker, 19, distributor, 20 and 21, right and left cylinder group spark plugs, 22, additional resistor terminal.

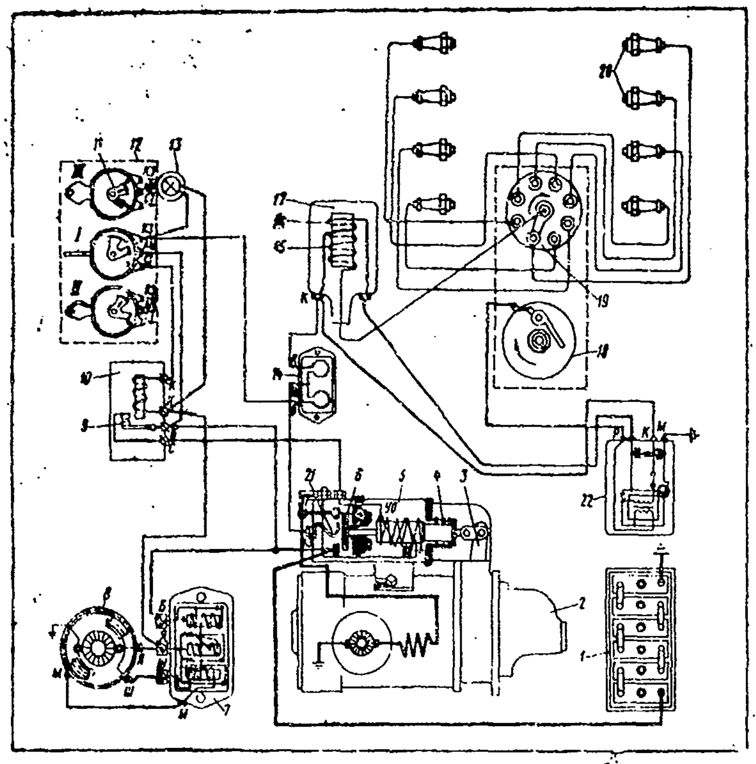


Figure 18-3. Diagram of Electrical Equipment of ZIL-130 and ZIL-131A Motors, Equipped with Transistorized Ignition:
1, battery, 2, starter, 3, lever, 4, core spring, 5, power relay, 6, moving contact, 7, voltage regulator, 8, generator, 9, starter solenoid contacts, 10, starter solenoid, 11, moving terminal of ignition switch, 12, ignition switch, 13, charge light, 14, additional resistor, 15, secondary windings, 16, primary windings, 17, ignition coil, 18, contact breaker, 19, distributor, 20, spark plugs, 21, additional resistor terminal, 22, transistor commutator.

The operation of a transistorized ignition system differs in principle from the operation of an ordinary ignition system in that the current in the primary of the coil is commutated by a transistor, and the contacts in the distributor interrupt only the transistor control current, which is 6 to 8 times less than the current passing through the contacts in an ordinary ignition system. Therefore, the breaker points in this new system undergo practically no wear. Furthermore, the transistor ignition system develops a higher secondary voltage which basically solves the problem of providing continuous operation of the motor throughout the entire range of operating speeds.

The new ignition system improves the starting qualities of the motor and pickup of the truck. The economy of engine operation is improved by better combustion of the mixture under partial loads, and also by elimination of over expenditure of fuels resulting from maladjustment of the ignition system occurring during operation due to burning and wear of contact breaker points.

Electrical system of ZIL-131 motor. The ignition system of the ZIL-131 (Figure 18-4) is similar to the electrical system of a ZIL-130 motor, but without the transistorized equipment. All equipment and wires are equipped with shielding devices and filters to suppress radio interference, as well as a ground switch.

The ZIL-131A truck is equipped with the same equipment as the ZIL-130.

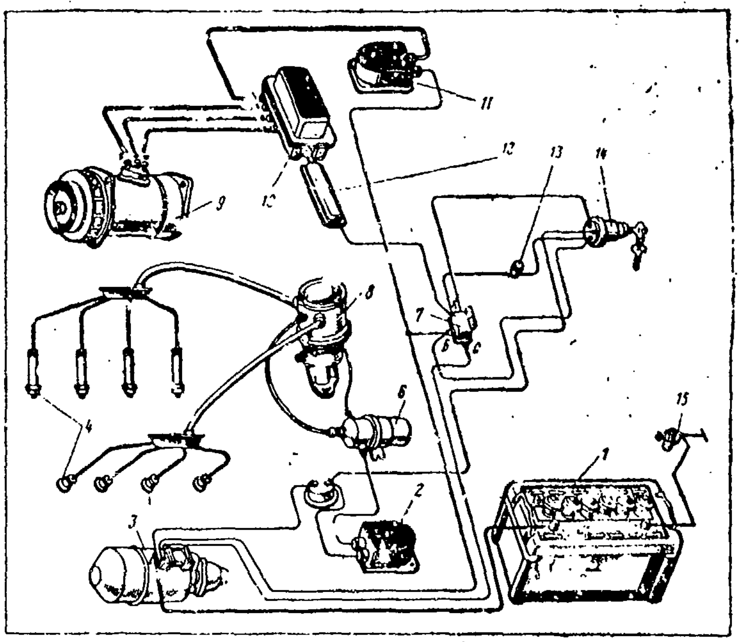


Figure 18-4. Diagram of Electrical Equipment of ZIL-131 and ZIL-131V Trucks:
1, battery, 2, radio interference filter in ignition coil circuit, 3, starter, 4, spark plugs, 5, additional resistor of ignition coil, 6, ignition coil, 7, additional starter solenoid, 8, distributor, 9, generator, 10, voltage regulator, 11, radio interference filter in voltage regulator circuit, 12, FR200 condensation filter, 13, charge lamp, 14, combined ignition switch and starter switch, 15, ground switch.

Electrical Equipment.

All generators (Figure 18-5, 18-6) used on ZIL motors are dc generators with shunt excitation, operating in combination with voltage regulator relays. The technical characteristics of the generators are presented in Table 18-2.

The designs of the generators are identical.

The armature rotates on two ball bearings. The internal space of the generator is ventilated using a ribbed fan made in one piece with the drive pulley.

TECHNICAL CHARACTERISTICS OF GENERATORS TABLE 18-2.

Parameters	G108-V, G118	G56-B	G130	G51
Nominal voltage, v	12	12	12	12
Maximum power, w	225	350	350	450
Maximum current, a	20	28	28	35
Rotating speed of generator shaft required to produce 12.5 v at 20°C, rpm:				
at zero current	1,150	1,000	1,450	1,450
at maximum current	1,850	1,450	2,550	1,900
Idle current (with 12 v at terminals) with generator operating in motor mode, a	5	7	5	12
direction of rotation of generators shaft	Right	Right	Right	Right
weight, kg	7.6	14.5	11.0	14.5
number of poles	2	4	2	4
spring pressure on brushes, G	600-800	1,200-1,700	1,200-1,700	800-1,300
brush height, mm	21	23.5	23.5	23.5
minimum permissible height, mm	14	17	17	17
Impedence of winding of 2 generator field coils, ohm	6.64-7.36	-	7.7-8.5	9.2
Diameter of wire in coil, mm	0.72-0.77	0.69-0.74	0.77-0.83	0.74-0.80
Nominal diameter of shaft neck of generator armature at ball bearing on driven side, mm	16,994-17,006	16,994-17,006	16,994-17,006	16,994-17,006
Diameter of armature winding wire, mm	PEV-2 1.16-1.27	PEV-2 1.56-1.89	PEV-2 1.35-1.44	1.16-1.27

TECHNICAL CHARACTERISTICS OF GENERATORS TABLE 18-2 (cont).

Parameters	G108-V, G118	G56-B	G130	G51
Nominal diameter of shaft necks of generator armature at bearing on collector side, mm	14,994-15,006	14,994-15,006	14,994-15,006	14,994-15,006
Permissible beating of armature in direction of diameter, mm	0.08	0.08	0.08	0.08
Nominal collector diameter, mm	42.66-43.00	49.16-49.50	42.66-43.00	49.5
Permissible beating of generator collector relative to shaft, mm	0.03	0.03	0.03	0.03
Depth of micanite wear requiring collector repair, mm	0.5-0.8	0.5-0.8	0.5-0.8	0.5-0.8
Nominal diameter of ball bearing aperture in generator cover at collector end, mm	35,000-35,027	35,000-35,027	35,000-35,027	35,000-35,027
Nominal diameter of ball bearing aperture in generator cover at driven end, mm	40,000-40,027	47,000-47,027	47,000-47,027	47,000-47,027
Dimensions of generator, mm:				
length	245	285	265	288
width (at pulley)	136	133	150	112

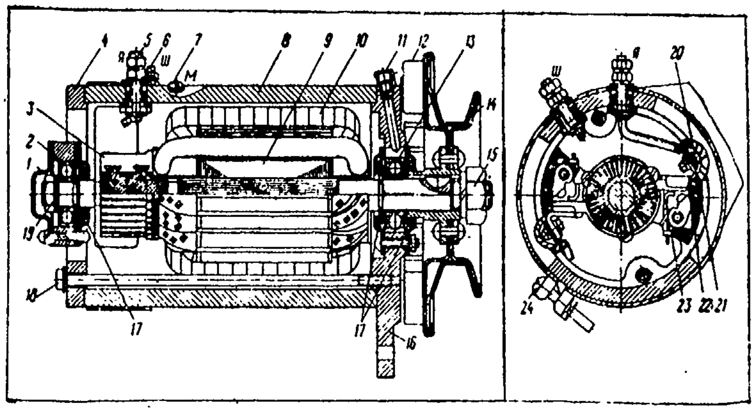


Figure 18-5. The G130 Generator:
1, damming cover, 2, collector end bearing, 3, collector, 4, generator cover at collector end, 5, A terminal, 6, B terminal, 7, ground screw M, 8, body of generator, 9, armature, 10, excitation winding, 11, bearing oiler, 12, fan, 13, driven end bearing, 14, driving pulley, 15 and 19, nuts, 16, driven end cover, 17, glands, 18, bolt, 20 and 24, screws, 21, brush holder, 22, brush spring, 23, brush.

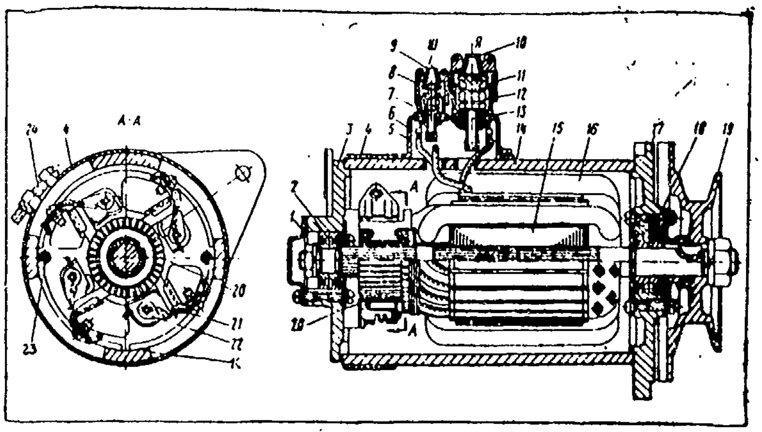


Figure 18-6. The G51 Generator:
1, bearing cover, 2 and 18, bearings, 3, collector end cover, 4, protective strip, 5, shield box, 6, excitation winding coil contact lead, 7, contact fork of terminal III, 8 and 11, pressure nuts of shielded wire, 9 and 10, conical bushings, 12, control fork nut, 13, contact fork of A terminal, 14, body, 15, armature, 16, excitation winding, 17, driven end cover, 19, pulley, 20, collector, 21, brush, 22, brush holder, 23, bolt, 24, screw.

The G51 generator (see Figure 18-6) is shielded, the negative brushes 21 installed in noninsulated brush holders 22 and connected to the body of the generator. The positive brushes of the generator are installed in insulated brush holders and connected to the A lead. The two ends of the pairs of excitation windings 16 of the generator are connected to the B leads, while the other two ends of these coils are connected to the negative brush holders. The B and A leads are placed inside a special box 5 in the shield fastened to the body.

Ball bearings 2 and 18 are mounted in covers 3 and 17, and armature 15 of the generator rotates in the bearings. The bearings are closed tight, equipped with rubber seals.

The generator can be submerged in water, but cannot operate in water due to the strong wear of the brushes which results.

When the truck crosses a ford 1.4 m deep, the generator drive is disconnected (fan belt is removed).

Holes are provided in the protective strip for drainage of water which may enter the generator.

Voltage regulators (Figures 18-7, 18-8) used on the ZIL trucks are similar in design and consist of three electromagnetic devices located on a common panel: the back current relay, opening and closing the electrical circuit between generator and battery; the current limitor, protecting the generator from overloads; and the voltage regulator, maintaining the voltage within fixed limits as the rotating speed of the generator and load in the circuit change.

The RR23-B and RR51 voltage regulators, operating with high power 4-pole generators (350 and 450 w) models G56-B and G51, have four electromagnetic devices, two of which are parallel operating voltage regulators. The excitation current of these generators reaches significant values; therefore, in order to decrease sparking across the voltage regulator contacts, and also to provide for reliable operation of the generator, its excitor winding is separated into two branches, each of which includes a separate voltage regulator.

The basic technical data on the voltage regulators are presented in Table 18-3.

Distributors. The ZIL motors use one of the following types of distributors.

R21-A (Figure 18-9, a) for 6 cylinder motors; R51 (Figure 18-9, c) shielded for 6 cylinder motors;

R4-V (Figure 18-9, b) for 8 cylinder motor, nontransistor ignition; R4-D, for 8 cylinder motor with transistor ignition (similar in external appearance to R4-V); R102 (Figure 18-10), shielded for 8 cylinder motor with nontransistor ignition.

The technical characteristics of the distributors are presented in Table 18-4.

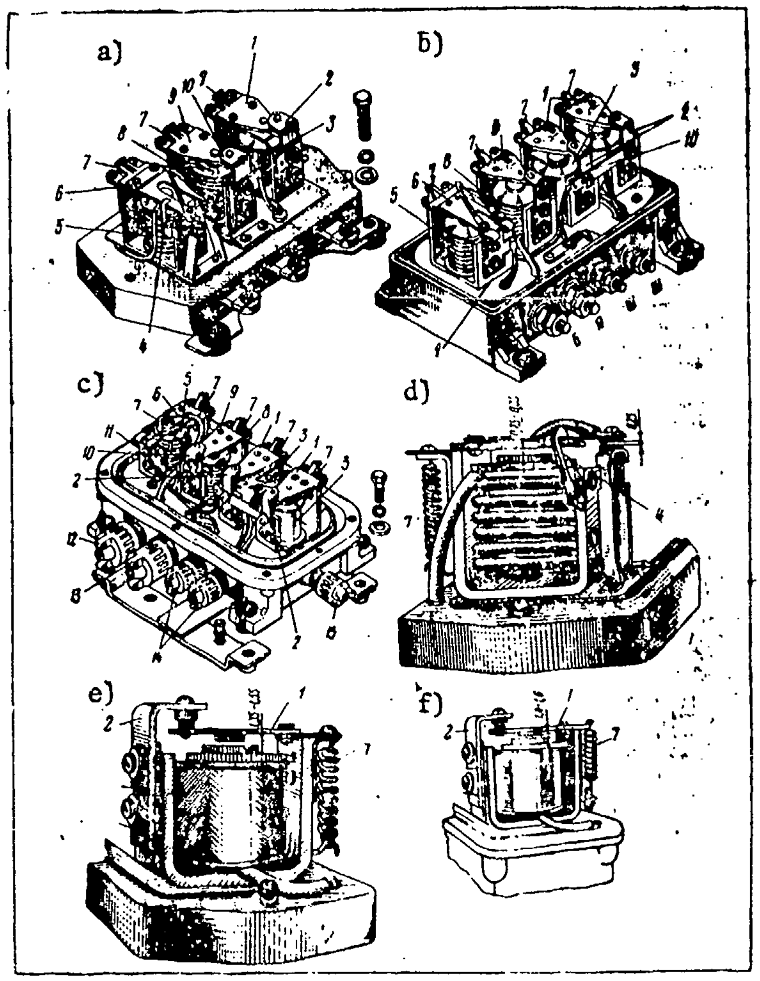


Figure 18-7. Voltage REgulators and Their Parts:
a, RR130 voltage regulator, b, RR23-B voltage regulator, c, RR51 voltage regulator, d, RR24-G, RR24-E, RR130, RR23-B and RR51 back current relay, e, RR24-G, RR24-E and RR130 voltage regulator, f, RR23-B and RR51 voltage regulator: 1, 6 and 9, relay armatures, 2, 10 and 11, relay bases, 3, 5 and 8, relay coils, 4, limitor, 7, spring, 12, B terminal, 13, A terminal, 14, Br terminal, 15, G terminal.

The designs of the distributors are identical in principle.

In order to provide continuous operation of the ignition system of the 8 cylinder motors, the current in the primary of the coil is increased slightly in comparison to coils installed on the 6 cylinder motors, which have lower compression ratio. Therefore, metal transfer at the breaker point (formation of a bulge on one contact and a depression on the other) occurs more intensively, which decreases the service life of the contacts somewhat.

In order to avoid a sharp decrease in service life of breaker points in the nontransistor ignition system, they should be cleaned with an abrasive plate, removing only the bulge of metal of one point, without removing the depression (crater) in the other point. We must recall that unnecessary cleaning of points only decreases their service life.

Equipment in the transistorized ignition system. In order to eliminate intensive burn up of contact points and increase their service life, a transistor ignition system has been developed (Figure 18-11), in which the contact in the distributor are loaded only with the current controlling the transistor (up to 0.8 a), not with the total current of the primary of the coil (up to 7 a), due to which burning and erosion of contacts is practically completely eliminated and cleaning of points is practically never needed.

At the same time, due to the very slight current developed across the contacts, which is incapable of penetrating a film of oil or oxide, the cleanliness of these contacts must be carefully maintained. If the contact becomes oily, they must be washed with clean gasoline. If an oxide layer forms on the points, it must be removed with an abrasive plate, without removing metal.

The R4-D distributor, designed to operate with transistor ignition, differs from the R4-V distributor only in that it has no condensor, which is unnecessary in a transistor system. The R4-D distributor operates together with transistor commutator TK102, ignition coil B114 and additional resistors CE107.

The transistor commutator includes one power transistor (GT701A) a stabilitron (D817V), a diode (D7Zh), a special 2-winding transformer Tr, condensors C_1 (1 μf) and C_2 (50 μf), and resistors of 20 and 2 ohms.

The transistor commutator is mounted in a cast aluminum body having a ribbed outer surface to increase heat transfer; the total area of the outer surface of the commutator is about 470 cm^3.

Within the body are all elements of the transistor commutator except for the GT701A transistor, which is fastened outside in the throat and is cast in epoxy resin to assure an air tight seal. The body of the transistor is not insulated; it directly contacts the body of the commutator, facilitating effective heat transfer from the transistor. The GT701A transistor is a germanium type, with permissible voltage between emitter and collector 160 v and maximum permissible collector current 12 a. The use of a germanium transistor requires the development of a commutator body with ribs to improve heat transfer and placement of the device in the cabin of the truck, i.e. in an area of relatively low temperatures.

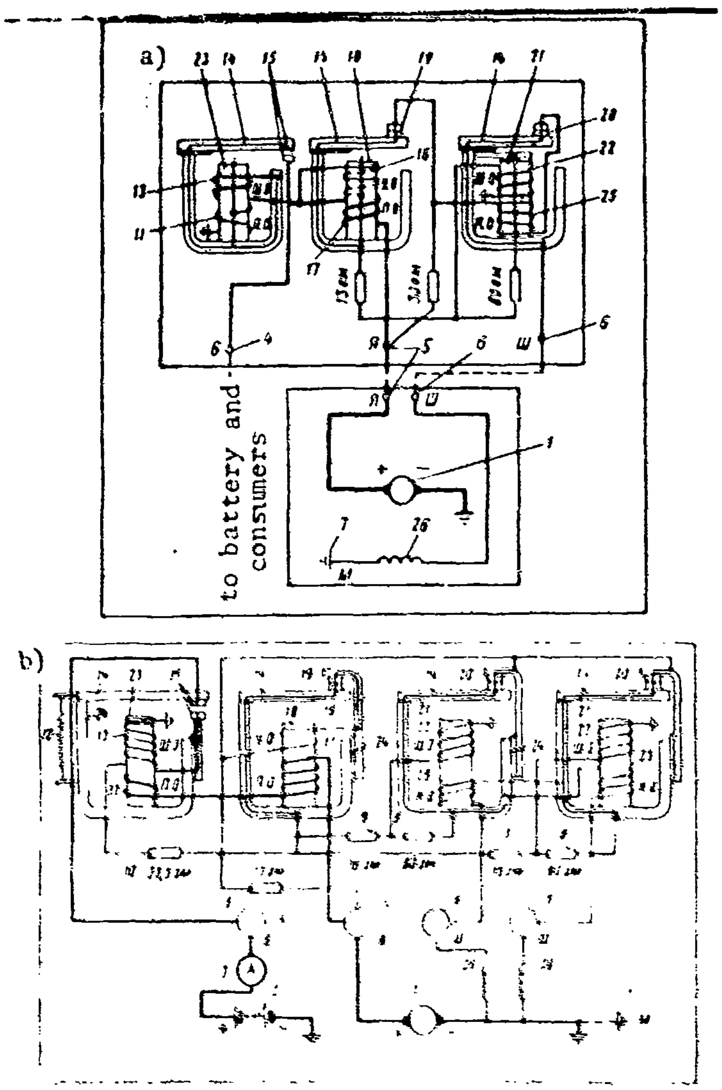


Figure 18-8. Schematic Diagram of Voltage Regulators and Generators: a, RR130 voltage regulator, b, RR23-B and RR51 voltage regulators; 1, generator, 2, battery, 3, ammeter, 4, B terminal, 5, A terminal, 6, Br terminal, 7, G terminal, 8, 9 and 10, resistors, 11, 13, 16, 17, 22 and 25, relay windings, 12, relay spring, 14, relay armatures, 15, 19 and 20, relay contact, 18, 21 and 23, relay cores, 26, excitor winding.

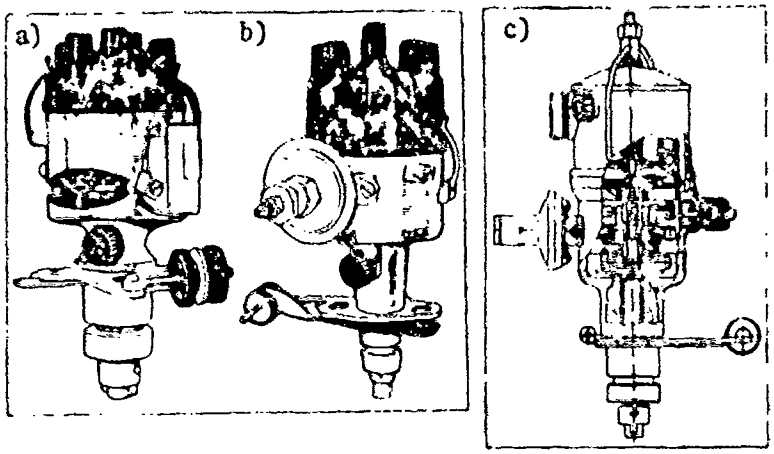


Figure 18-9. Distributors:
a, R21-A, b, R4-V, c, R51.

The stabilitron, diode, condensor C_1 and resistors R_1 and R_2 are combined into a common unit, filled with a special compound.

The stabilitron, through which significant current flows when the emf is limited by self-induction of the primary winding of the ignition coil, is equipped with a special heat radiator to avoid overheating.

Electrolytic condensor C_2 is placed inside the commutator separately. The terminal well is fastened to the side wall of the transistor commutator. The commutator has a flat metal bottom.

TECHNICAL CHARACTERISTICS OF VOLTAGE REGULATORS TABLE 18-3.

Parameters	RR24-G, RR24-E	RR23-B	RR130	RR51
Voltage at which back current relay switches on at 20°C, v	12.2-13.2	12.2-13.5	12.2-13.2	12.2-13.2
Back current at which relay switch is off at 20°C, a	0.5-6.0	0.5-6.0	0.5-6.0	0.5-0.8
Voltage maintained by voltage regulator at 20°C at 3,000 rpm of generator, v:				

TECHNICAL CHARACTERISTICS OF VOLTAGE REGULATORS TABLE 18-3 (cont).

Parameters	RR24-G, RR24-E	RR23-B	RR130	RR51
with load current of				
10 a	13.8-14.8	-	-	-
14a	-	13.7-15.1	-	-
15a	-	-	13.8-14.8	-
18a	-	-	-	13.8-15.0
Maximum load current permitted by current limitor, a	17-19	26.5-29.5	26-30	33-37
Clearance between open contacts in all three relays: by current, current limitor and voltage regulator, mm	0.25	0.4-0.7	0.25	0.4-0.7
Clearance between armature and core with closed contacts, mm:				
by current relay	0.25-0.35	1.3-1.6*	0.25-0.35	1.3-1.6*
current limitor	1.35-1.55	1.4-1.6	1.35-1.55	1.4-1.6*
voltage regulator	1.35-1.55	1.4-1.6	1.35-1.55	1.4-1.6*
Dimensions of voltage regulators, mm:				
length	135	178	135	206
width	108	128	108	126
height	62	101	62	101
Weight of voltage regulator, kg	0.9	3.5	0.9	4.0

* With contacts open.

The transistor commutator can operate only at temperatures not over +70°C and not under -60°C.

The contact transistor system operates as follows. When the ignition is turned on, after the distributor points are closed, the transistor is opened and current passes through additional resistor SE107, the primary winding of the ignition coil, through the emitter-collector junction of the transistor, the resistance of which is slight with closed distributor points. The distributor points carry very little current (up to 0.8 a).

When the distributor points open, the transistor is "blocked" since it is switched into the "cutoff" state. After blocking of the transistor, the current in the primary winding of the coil disappears, and the energy stored in the primary of the coil is converted into high voltage energy in the secondary, which is fed through the distributor to the spark plugs. At the same time the high voltage is developed in the secondary, a high emf is induced in the primary, which must be limited by the D817-V stabilitron. The D7Zh diode, connected in the opposite direction to the stabilitron, limits the current through the stabilitron in the forward direction.

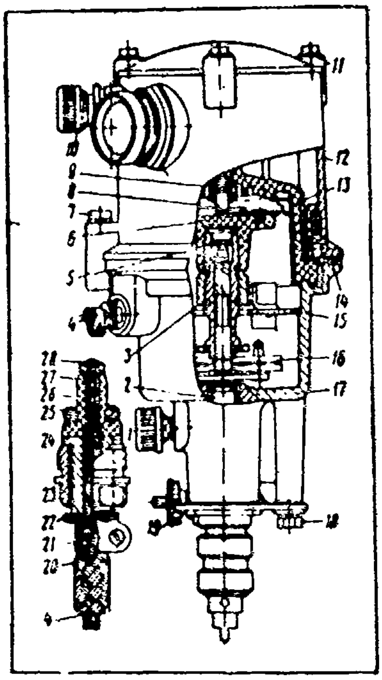


Figure 18-10. The R102 Distributor:
1, oiler, 2, distributor shaft, 3, cam, 4, shielded low voltage terminal, 5, moving contact, 6, rotor, 6, 7 and 11, screws, 8, contact angle piece, 9, spring, 10, lead to ignition coil, 12, shield with high voltage wire shielding inserts, 13, distributor cap, 14 and 25, sealing rings, 15, plate, 16, centrifugal regulator, 17, distributor body, 18, distributor mounting bolt, 19, octane adjuster nut, 20, shielding braid, 21, clamp, 22, washers, 23, pressure nut, 24, guide sleeve, 26, insulating sleeve, 27, conductor core, 28, contact point.

The R102 distributor is designed to operate with the ZIL-131 and ZIL-130E engines with shielded electrical equipment. It is a shielded, field, 8 cylinder distributor with a centrifugal spark advance mechanism (no vacuum advance is used).

To obtain access to the distributor, the entire shield 12 is removed (see Figure 18-10), by removing the 3 mounting bolts. The low and high voltage leads from the coil are sealed by rubber rings 25. In order to seal the connection with the shield, there is a slot in the body of the distributor, carrying sealing ring 14. The internal cavity of the distributor is provided with forced ventilation to avoid accelerated burning of the distributor points, wear of high voltage plastic parts and corrosion of internal metal parts due to the influence of the ozone formed by sparking. Forced ventilation is provided by 2 holes in the body of the distributor with a conical thread for connection of flexible ventilation hoses. Ventilation is with filtered air arriving through the engine air cleaner.

In order to reduce the level of radio interference produced by the ignition system, the distributor cap contains a combined contact angle piece a with a resistance of 8,000 to 13,000 ohms.

In the coil, the 12 v low voltage current is transformed to a high voltage current at up to 25,000 v (in the B114, up to 30,000 v).

TECHNICAL CHARACTERISTICS OF DISTRIBUTORS TABLE 18-4.

Parameters	R21-A	R51	R4-V	R4-D	R102
Type of Engine	6 Cylinder		8 Cylinder		
Direction of rotation seen from cover			Right		
Dimension, mm:					
total length	212.0	314.0	257.0		295
width (at octane corrector and plates)	208.5	208.5	166.0		177
Shaft diameter, mm			12,682-12,700		
Internal diameter of bushing aperture, mm			12,694-12,712		
Diameter of bushing hole, mm			15.87-15,90		
External diameter of bushing, mm			15.95-16.07		
Permissible axial clearance of shaft (longitudinal play), mm			0.25		
Point gap, mm	0.35 0.45		0.30-0.40	0.30-0.40	0.30-0.40
Capacitance of condensor, µf	0.17 0.25		0.25-0.35	-	0.25-0.35
Elasticity of lever spring, G	400-600		500-650	500-650	500-650
Greatest ignition advance (in degrees of crankshaft rotation), produced by:					
vacuum advance mechanism	18	18	19	19	-
centrifugal advance mechanism	20	20	19	19	19
Advance of distributor shaft under influence of centrifugal advance mechanism, decrees, at engine speed, rpm:					
400	1.5-3.5	1.5-3.5	6.5-9.5	6.5-9.5	6.5-9.5
600	4-6	4-6	-	-	-

TECHNICAL CHARACTERISTICS OF DISTRIBUTORS TABLE 18-4 (cont).

Parameters	R21-A	R51	R4-V	R4-D	R102
800	6-8	6-8	11.5-14.5	11.5-14.5	11.5-14.5
900	7-10	7-10	-	-	-
1,200	-	-	16-19	16-19	16-19
1,500	7-10	7-10	-	-	-
Advance of distributor shaft under influence of vacuum advance mechanism, degrees, with rarefaction, mm Hg:					
80	-	-	0-1	0-1	-
100	0-2	0-2	0-2	0-2	-
200	-	-	5-7	5-7	-
230	3-5	3-5	-	-	-
250	-	-	7.5-9.5	7.5-9.5	-
400	7-9	7-9	-	-	-

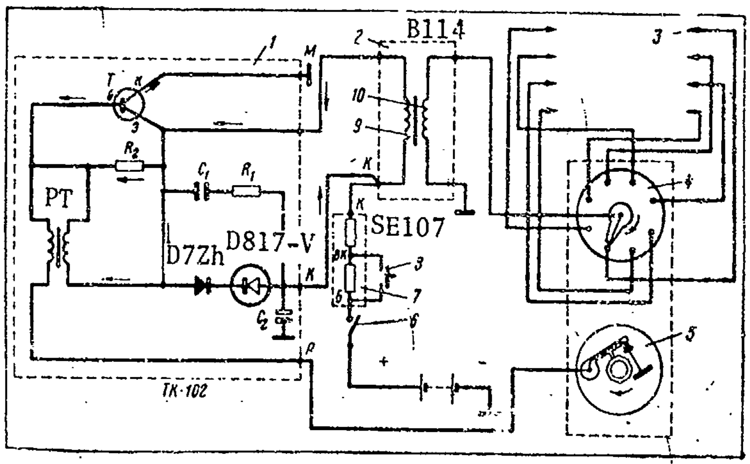


Figure 18-11. Diagram of Transistor Ignition System:
1, TK102 transistor commutator, 2, B114 coil, 3, symbol for spark plug, 4, distributor, 5, contact breaker, 6, ignition switch, 7, SE107 additional resistor, 8, lead to starter contacts, 9, ignition coil primary, 10, ignition coil secondary, T, germanium transistor, PT, pulse transformer, D7Zh, germanium diode, D817-V, silicon stabilitron, R_1 and R_2, resistors, C_1, one μf condensor, C_2, 50 μf condensor, R, M, K., VK and B, representation of terminals; b, c, e, transistor electrodes (base, collector and emitter).

All coils used on ZIL engines are similar in their design, equipped with an additional resistor through which the current passes which feeds the primary of the coil. When the engine is started with the starter, the additional resistor is automatically disconnected, the current enters the primary of the coil, bypassing the resistor, thus reenforcing the spark and facilitating starting of the engine.

Figure 18-12 shows a general view of the type B13 coil with its additional resistor, as installed on the ZIL-130 engine. This ignition coil is similar in external form to the B1 coil installed on the in-line engines, which has no shielding equipment. The B5-A coil is installed on in-line engines with shielded equipment; the additional resistor is separate from the coil.

The B102-B shielded ignition coil is installed on the ZIL-131; the additional resistor is located separately.

The B114 ignition coil is installed on the motors of the ZIL-130 and ZIL-131A, equipped with transistor ignition. The additional resistor is separate from the coil.

The technical data on ignition coils and additional resistors are presented in Table 18-5.

The SN55-B or A16-U spark plugs (Figure 18-13) are single units, with 14 × 1.25 mm threads, used on all in-line engines, including those with shielded ignition systems.

The A15-B and A13-B spark plugs are also single units, with 14 × 1.25 mm thread, and are used on the V engines of the ZIL-130 and ZIL-131A. The A13-B plugs have short insulator bodies, are colder, and are used when the V engines operate under severe operating conditions with intense, continuous loading during the summer time, and also under hot climate conditions. The A15-B and A13-B spark plugs are not interchangeable with the SN55-B and A16-U spark plugs.

TECHNICAL CHARACTERISTICS OF COILS TABLE 18-5.

Parameters	B1	B5-A	B13	B103-B	B114
Voltage, v	12	12	12	12	12
Low voltage winding:					
wire diameter, mm	0.72	-	0.72	0.86-0.92	1.25
number of turns	330	-	270	287-293	179-180
impedence at 20°C, ohms	1.95	-	1.5	0.92	0.42
High voltage coil:					
wire diameter, mm	0.1	-	0.07	0.070-0.085	0.06
number of turns	18,500-19,500	-	26,000	16,000-20,000	41,000-41,500
impedence at 20°C, ohms	3,880	-	-	6,650	22,300

TECHNICAL CHARACTERISTICS OF COILS — TABLE 18-5 (cont).

Parameters	B1	B5-A	B13	B103-B	B114
Additional resistor:					
wire diameter, mm	0.4	-	0.3	0.45	0.7
impedence at 20°C, ohms	1.25-1.35	1.25-1.45	-	1.50-1.65	1.04
Impedence of nickel wire at 20°C, ohms	1.35-1.45	-	1.0-1.1	-	-
Dimensions of coil, mm:					
length	147	161	147	186	147
width	63.5	66.0	63.5	145	63.5
height	84.7	76.5	84.7	79	84.7

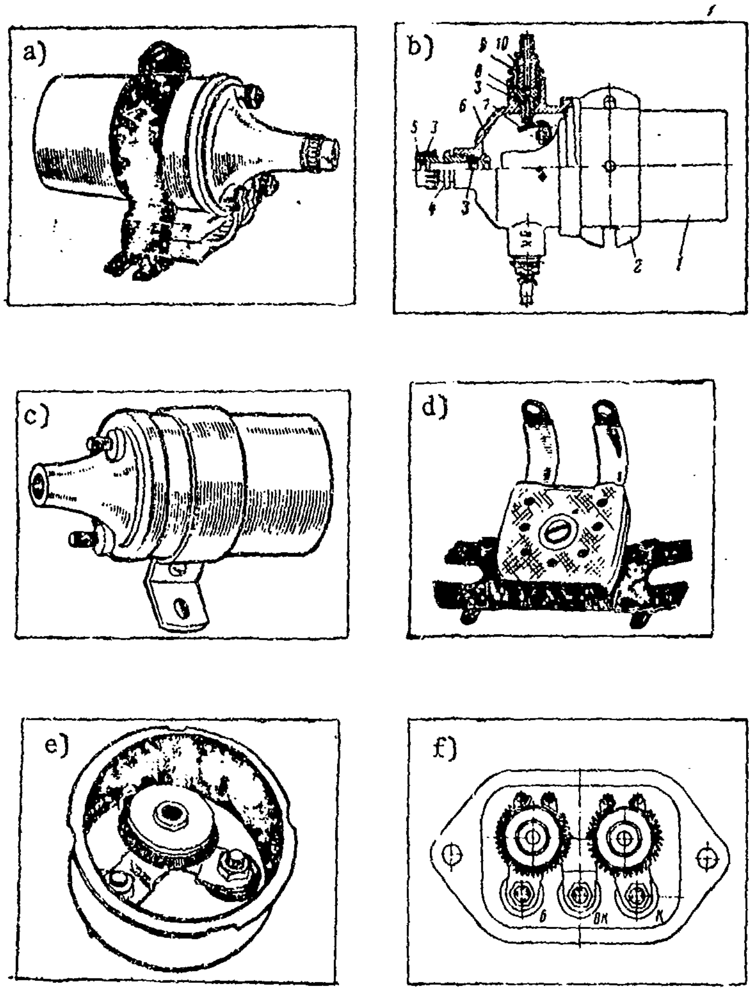


Figure 18-12. Coils:
a, B13, b, B102-B, c, B114, d, additional resistor of B1 and B13 coils, e, additional resistor for B5-A and B102-B coils, f, additional resistor for B114 coil.

The type SN-307 shielded plugs (with shielding collar), sealed, have an M14 × 1.25 mm thread at the tip, M18 × 1 mm thread for the upper portion of the shield which carries the cover nut. The spark plugs include: sealing rubber sleeve 17 (see Figure 18-13), which seals the wire lead to the spark plug; ceramic insulator 18 of the shield and ceramic insert 19, including a spark damping resistance of 1,000 to 7,000 ohms to decrease the level of radio interference produced by the ignition system and decrease burn up of the electrodes in the plug.

The contact of the wire with the electrode of insert 19 is achieved by contact device 20 type KU-20A or KU-20E. A rubber sealing ring is placed around the end of the high voltage wire protruding from shielding collar 21, then the wire is inserted in the contact device. The core of the wire, bared for a length of 8 mm, is inserted into the hole in the sleeve rolled into the base of the ceramic cup of the contact device and arranged so that the contact device is pressed against the wire.

The spark plugs are among the most important items in the ignition system, since their condition determines the reliability of operation of the entire system to a significant extent. In case of scale formation on the spark plugs, a current leak will form, causing a decrease in the voltage in the secondary of the coil. Burning of electrodes increases the gap between them, requiring an increase in the voltage in the spark gap, which in some cases may even exceed the maximum voltage developed in the ignition system, causing missing. The condition of spark plug electrodes should be systematically checked.

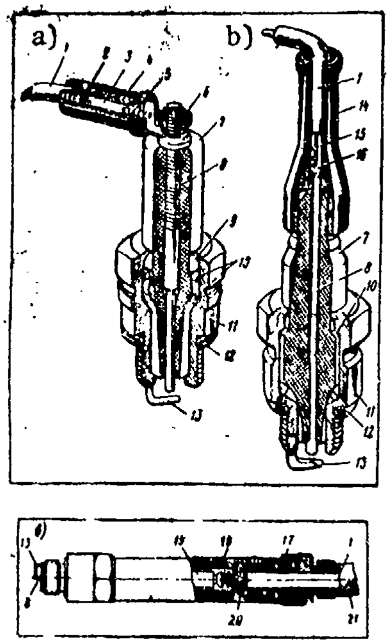


Figure 18-13. Spark Plugs:
a, A16-U and SN55-B, b, A15-B, c, SN307; 1, high voltage wire, 2, contact coil, 3, high-resistance carbon resistor, 4, carbolite resistor body, 5, spring, 6, terminal retaining nut, 7, insulator, 8, central electrode, 9, body ring, 10 and 12, sealing rings, 11, plug body, 13, side electrode, 14, tip sleeve, 15, tip contact, 16, plug tip, 17, sealing sleeve, 18, ceramic sleeve, 19, insert, 20, contact device, 21, shielding sleeve.

Normal and continuous operation of a spark plug can be assured if the lower portion of the insulator is heated to 500-600°C (self-cleaning temperature). At this thermal mode, self-cleaning of the spark plug insulator of scale and oil is best. If the insulator sleeve temperature drops to 450°C, scale is deposited, causing a leakage of current to ground, and the motor will begin to miss. The deposition of scale on the insulator occurs most intensively if the motor operates at a long time at the idle with the crankshaft turning over slowly, or if the truck is driven for long periods of time at low speed in fourth or fifth gear.

With fouled plugs (when dry scale is deposited on the insulator) starting of a cold motor becomes difficult; if the plug insulator surface is wet, it is impossible to start the motor when it is warm. With a temperature of the lower insulator of 750°C, ignition of the mixture begins to occur due to the actual heat of the spark plug, rather than the spark across the electrodes.

Prevention of overcooling or overheating of the plug can be achieved by selecting the required type of plug, differing as to core material, tip length and method of sealing of the central electrode.

Suppressing resistance. In order to suppress radio and television interference, ZIL-157K trucks, which have no shielded ignition, carry suppressive resistors of 7,000 to 14,000 ohms in the high voltage wires from coil to distributor and from distributor to spark plugs. The central high voltage wire carries an SE-01 resistor, the plug wires carry SE-02 resistors.

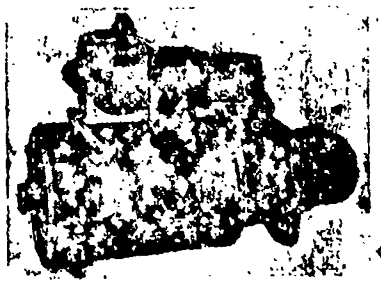


Figure 18-14. The ST130 Starter.

When type PVV high voltage wires with polyvinyl chloride plastic insulators are used on the ZIL-130 vehicles, 8,000-12,000 ohm resistors are connected in series with the metal core; when type PVVO wire is used, which has a metal core (with distributed resistance), no suppressing resistor is required.

Starters. In-line ZIL motors use the type ST15-B starter. V-type motors used on the ZIL-130 carry the ST130 starter (Figure 18-14). The V-type motors of the ZIL-131 and ZIL-131V use the type ST-2 sealed starter.

The starters are dc electric motors with series excitation, powered by the battery. The ST15-B starter has a mechanical drive and a free wheeling clutch. The starter solenoid is mounted on the starter. The electrical circuit of the ST15-B starter includes no blocking. The ST130 and St2 starters have electromagnetic drive located with the starter and an additional solenoid installed on the front wall of the cabin. The starter switch is combined with the ignition switch on the dashboard. The electrical circuits of the ST130 and ST2 starters include starter blocking.

Specifics of ST2 starter. The starter is fully sealed, allowing it to be used to start the motor even when it is submerged in fresh water (during crossing of fords).

Sealing of the starter is achieved as follows. The inspection windows for access to the brushes are protected with a metal cover placed over the body of the starter and sealed with 2 rubber rings. The junctions between the body and cover on the starter solenoid drive end are sealed with rubber rings. The aperture for the starter lever access in the cover on the drive end is sealed with a special cap, sealed with a rubber liner.

The output terminals of the starter solenoid are sealed by means of rubber washers. The connections of the starter solenoid are sealed with rubber rings.

The seating flange of the starter cover is sealed in the crankcase with a rubber ring.

The technical characteristics of starters are presented on Table 18-6.

TECHNICAL CHARACTERISTICS OF STARTERS. TABLE 18-6

Parameters	ST15-B	ST130 and ST2
Nominal voltage, v	12	12
Power, hp	1.8	1.5
Number of poles	4	4
Direction of rotation	Right	Right
Idle mode:		
current consumption, a	75 (not over)	80 (not over)
rotating speed of armature shaft, rpm	5,000	3,500
voltage across terminals, v	12	12
Full braking mode:		
power consumption, a	600 (not over)	650 (not over)
voltage across terminals, v	8 (not over)	9 (not over)
brake torque, kgm	2.6	3.0
Brush spring force, G	800-1,300*	800-1,300*
Brush height, mm	14	14
Least permissible brush height, mm	7	7
Starter collector diameter, mm	39.4-40.0	39.4-40.0
Limiting diameter of starter collector during repair, mm	37.3	37.3
Beating of collector, mm	0.05 (not over)	0.05 (not over)
Beating of armature iron relative to brushes, mm	0.25 (not over)	0.25 (not over)

*The brush spring force of the ST2 starter is 1,200-1,500 G.

TECHNICAL CHARACTERISTICS OF STARTERS. TABLE 18-6 (cont).

<table>
<tr><th>Parameters</th><th>ST15-B</th><th>ST130 and ST2</th></tr>
<tr><td>Diameter starter shaft neck, mm
on collector end
on drive end</td><td colspan="2">
16.13-16.17
12,445-12,470</td></tr>
<tr><td>Permissible wear of starter armature shaft neck, mm</td><td colspan="2">0.05</td></tr>
<tr><td>Diameter of armature shaft neck in gear bushing, mm</td><td colspan="2">13,945-13,970</td></tr>
<tr><td>Diameter of armature shaft neck in intermediate bearing, mm</td><td colspan="2">18,915-18,975</td></tr>
<tr><td>Diameter of bushing aperture in cover on collector end, mm</td><td colspan="2">16.20-16.24</td></tr>
<tr><td>Permissible wear of cover bushing aperture at collector end, mm</td><td colspan="2">0.05</td></tr>
<tr><td>Outer diameter of bushing on collector end, mm</td><td colspan="2">19.30-19.45</td></tr>
<tr><td>Diameter of aperture in cover on collector end for bushing, mm</td><td>19.22-19.27</td><td>18.97-19.03</td></tr>
<tr><td>Permissible wear of aperture in cover for bushing on collector end, mm</td><td colspan="2">0.05</td></tr>
<tr><td>Diameter of aperture in cover bushing on drive end, mm</td><td colspan="2">12,500-12,535</td></tr>
<tr><td>Permissible wear of aperture in cover bushing on drive end, mm</td><td colspan="2">0.02</td></tr>
<tr><td>Outer diameter of bushing on drive end, mm</td><td colspan="2">16.06-16.21</td></tr>
<tr><td>Diameter of bushing aperture in cover on drive end, mm</td><td>16,000-16,023</td><td>15.93-16.00</td></tr>
<tr><td>Permissible wear of aperture in cover for bushing on drive end, mm</td><td colspan="2">0.05</td></tr>
<tr><td>Diameter of aperture in bushing for armature shaft neck, mm</td><td>14.00-14.07</td><td>14.00-14.06</td></tr>
<tr><td>Permissible wear of aperture in bushing for shaft neck at drive end, mm</td><td colspan="2">0.03</td></tr>
<tr><td>Outer diameter of drive bushing, mm</td><td colspan="2">15.8-15,945</td></tr>
<tr><td>Diameter of aperture for drive bushing, mm</td><td colspan="2">15.65-15,725</td></tr>
<tr><td>Diameter of aperture in bushing at intermediate bearing, mm</td><td colspan="2">19.07-19.21</td></tr>
<tr><td>Permissible wear of aperture in bushing for intermediate bearing, mm</td><td colspan="2">0.02</td></tr>
<tr><td>Diameter for bushing of intermediate bearing, mm</td><td colspan="2">21.67-21.72</td></tr>
</table>

Parameters	ST15-B		ST130 and ST2
Permissible wear, mm		0.02	
Outer diameter of intermediate bearing bushing, mm		21.76-21.9	
Clearance between bushing and armature shaft, mm		0.15 (not over)	
Dimensions of starters, mm:			
length	320		330*
width	157.5		194.7

*For ST2 starter length 340 mm, width 206 mm.

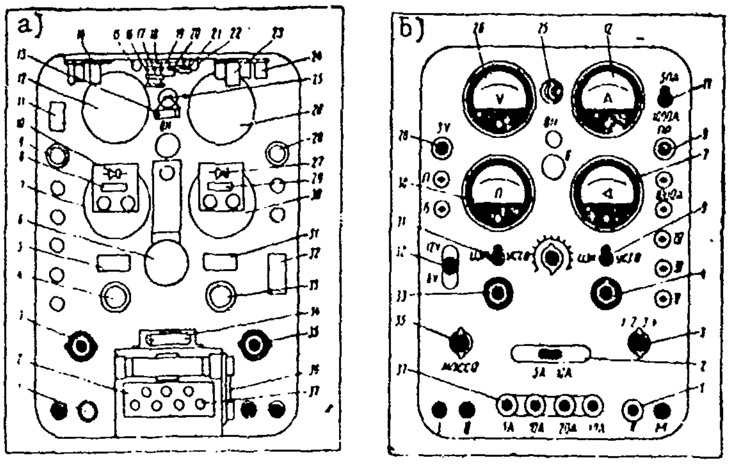


Figure 18-15. NIIAT E-5 Device for Testing of Electrical Equipment on Truck: a, diagram of panel of instruments from below, b, diagram of panel of instruments from above. 1, rheostat switch, 2, load rheostat, 3, testing switch, 4, SP1 resistor (1 ohm), 5, switch for indicator of point closing angle, 6, spark discharger, 7, indicator of angle of closed state of points, 8, 300 ohm resistor, 2 w, 9, interruptor button, 10 and 27, DGTS27 rectifiers, 11, ammeter switch, 12, ammeter, 13, 1 ohm resistor, 14, tachometer sensor, 15 and 22, 0.25 μf condensor, 16, 2,000 ohm resistor, 17, 1,600 ohm resistor, 18, 372 ohm resistor, 19, 2 μf, 160 v condensor, 20, 30 ohm resistor, 21, SP1 resistor (4.7 ohms), 23, RR20 vibrator, 24, 15 ohm resistor, 25, neon lamp, 26, volt meter, 28, volt meter button, 29, 390 ohm resistor, 2 w, 30, tachometer, 31, tachometer switch, 32, volt meter switch, 33, 0-100 ohm potentiometer, 34, FMTS battery, 3.7 v, 35, ground switch, 36, 75 mv, 50 a shunt, 37, range switch.

Maintenance

Checking of electrical equipment on the truck using the NIIAT E-5 instrument. To test the parameters of electric equipment during operation of trucks, it is recommended that the universal portable electric testing device model NIIAT E-5 be used.

The NIIAT E-5 device (Figure 18-15) is designed for testing and adjustment of the electrical equipment directly on the truck with both in-line and V-eight engines.

The device allows the following:

testing of batteries and individual elements without load and under starter load;

testing of 6-12 v dc generators producing up to 500 w power;

testing and adjustment of all elements in the voltage regulator on engines with not over 6 cylinders;

testing of electrical circuits and low voltage power consumption for continuity, current leakage and voltage drop;

testing of the condition of the points in the distributor;

testing of angle of closed state of distributor points;

testing of condensor of distributor for condition of insulation (leakage);

testing of ignition coil for spark formation;

testing of starters up to 2 hp in full braking mode.

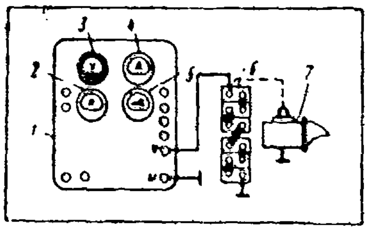


Figure 18-16. Diagram of Testing of Battery:
1, NIIAT E-5 device, 2, tachometer, volt meter, 4, ammeter, 5, contact closing angle indicator, 6, battery, 7, starter.

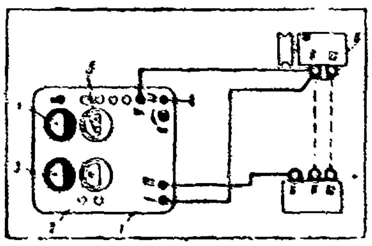


Figure 18-17. Diagram of Testing of Generator in Motor Mode:
1, NIIAT E-5 device, 2, tachometer, 3, ammeter, 4, volt meter, 5, contact closing angle indicator, 6, generator, 7, voltage regulator.

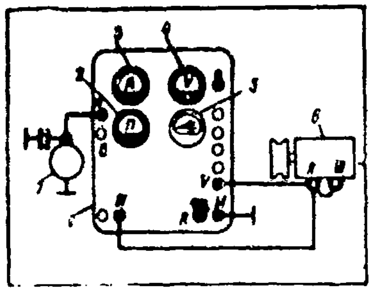


Figure 18-18. Diagram of Testing of Generator at Beginning of Output and Full Output:
1-6, (see Figure 18-17), 7, distributor.

The NIIAT E-5 device for checking of electrical equipment is placed beside the truck on its stand. Before beginning any tests, the ground polarity switch 35 must be set in the position corresponding to the ground polarity of the equipment on the vehicle being tested, and the switch of the volt meter 32 must be set in position corresponding to the supply voltage of the electrical equipment of the vehicle being tested (6 or 12 v).

Testing of battery. Before beginning the check, the cleanliness and tightness of the contacts in the starter circuit should be checked.

The G lead (Figure 18-16) of the device to the output of the battery, connected to the ground of the vehicle, the V lead of the device to the battery lead connected to the starter.

Volt meter 26 (see Figure 18-15) indicates the voltage of the battery without load. Testing of the battery under load is performed by turning on the starter (with the ignition disconnected).

The voltage of the fully charged battery under load should be at least 10.2 v in a 12 v system. The time of testing of the starter under load should not exceed 5 sec, since the battery is loaded with a current of 200-300 a during this test.

Checking of the generator in the engine mode. Remove the drive belt from the generator. Set switch 11 of the ammeter in the 50 a position. Lead II (Figure 18-17) of the device is connected to lead B of the voltage regulator. Leads I and V are connected to the A lead of the generator, the Br and A leads of the generator are connected by a jumper. Lead G of the device is connected to the ground of the vehicle. Disconnect load rheostat 2 (see Figure 18-15). The generator begins to operate as an electric motor. Ammeter 12 shows the current expended by the battery, which should not exceed 5 a. Increased current indicates that there is mechanical damage or shorting in the armature winding. Even rotation of the armature should be observed.

Uneven rotation indicates shorting in the collector plates.

Testing the generator for beginning of output and full output. Replace the drive belt on the generator pulley. Disconnect the Br and A leads from the generator (Figure 18-18). Connect leads II and V of the device to the A lead of the generator, connect the A and Br leads of the generator by a jumper. Connect the G lead of the device to the ground of the truck, and connect lead II of the device to the output of the distributor.

With the power supply battery removed from the device, lead B of the device is connected to lead B of the voltage regulator. Set the tachometer indicator on zero, which is done by setting the tachometer switch 31 (see Figure 18-15) in the "zero set" position and, by rotating the knob of potentiometer 33, causing the needle of tachometer indicator 30 to move over the red mark on the scale. After this, set switch 31 in the "measure" position. Switch 11 of the ammeter is set in the 50A position. Disconnect load rheostat 2. Start the motor and, while smoothly increasing the rotating speed, note the rotation speed at which the generator is excited to its nominal voltage. Then, without turning off the motor, turn on load rheostat 2 and, by adjusting the rotating speed and load current of the generator, set the nominal value of voltage and load current.

If the rotating speed of the generator is not above that noted on its documentation, the generator is operating properly.

A defective generator must be removed from the truck and sent in for repair.

Testing of voltage regulator. Testing of back current. Disconnect the wire from lead B of the voltage regulator (Figure 18-19) and connect it to output I of the instrument. Output II of the instrument is connected to output B of the voltage regulator. Disconnect rheostat 2 (see Figure 18-15). Start the motor and increase its speed until the back current relay operates. At this moment, ammeter 12 will show the charging current of the battery.

Gradually decrease the rotating speed of the engine. The charging current of the battery will decrease. When the ammeter needle reaches zero, switch the ground switch 35, at which point the ammeter will show the discharge current of the battery.

At the moment when the contacts of the back current relay open, the ammeter will show the maximum back current, after which its needle will drop rapidly to zero. The back current should be between 0.5 and 6 a.

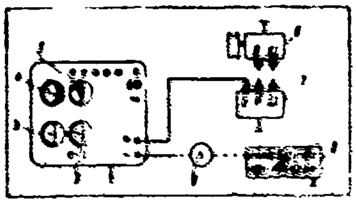


Figure 18-19. Diagram of Testing of Back Current:
1-7, (see Figure 18-17), 8, battery, 9, additional ammeter.

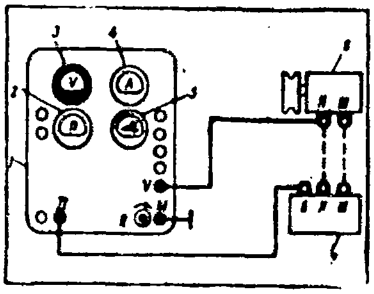


Figure 18-20. Diagram of Testing of Voltage at Which Back Current Relay Switches:
1-5, (see Figure 18-16), 6, generator, 7, battery.

Testing of switching voltage of back current relay. Disconnect the wire from lead B of the voltage regulator (Figure 18-20). Connect lead II of the instrument to lead B of the voltage regulator. Connect lead G of the instrument to the ground of the vehicle. Connect lead V of the instrument to lead A of the generator. Switch on rheostat 2 (Figure 18-15) and set the load of the generator at 5-10 a. Start the motor and, smoothly increasing the speed, follow the indications of volt meter 26. At first the voltage will increase smoothly, but at the moment of closure of the contacts of the back current relay, the volt meter needle will be deflected sharply to the left.

The maximum back current relay switching voltage should be 12.2-13.2 v.

Testing of voltage regulator. Disconnect the wire from lead B of the voltage regulator (Figure 18-21). Connect leads II and V of the instrument to lead B of the voltage regulator. Connect lead G of the instrument to the ground of the vehicle. Connect lead II of the instrument to the output of the distributor and set the tachometer indicator at zero.

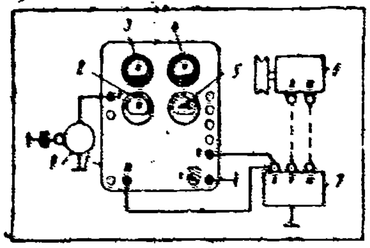


Figure 18-21. Diagram of Testing of Voltage Regulator and Current Limitor:
1-7, (see Figure 18-17), 8, distributor.

With the battery of the instrument 34 (see Figure 18-15) removed, connect lead B to lead B of the voltage regulator.

Start the motor and increase its speed to 1,900-2,000 rpm. Volt meter 26 will then indicate the voltage set by the voltage regulator, which should be 13.8-14.8 v. Testing is performed with various generator loads.

Testing of current limitor. The connections made are the same as in the preceding test and, without changing the rotating speed, use rheostat 2 to increase the load on the generator, following the indications of ammeter 12 and volt meter 26. As the load is increased, a moment will arrive when, in spite of further decreases in rheostat resistance, the ammeter needle stops moving, while the indications of the volt meter decrease.

The maximum value of current will correspond to the adjustment of the current limitor and should be 17-19 a for the RR24-G voltage regulator and 26-30 a for the RR23-B voltage regulator.

When necessary, the voltage regulator must be adjusted.

Adjustment of RR24-G, RR24-E and RR23-B voltage regulators is described in the section on "dissembly and assembly" in this chapter.

Since the NIIAT E-5 instrument has no tachometer scale for the 8 cylinder motor, the RR130 voltage regulator cannot be tested on the vehicle.

In order to test the RR130 voltage regulator, it must be removed from the vehicle and tested on a test stand (Figure 18-22, 18-23).

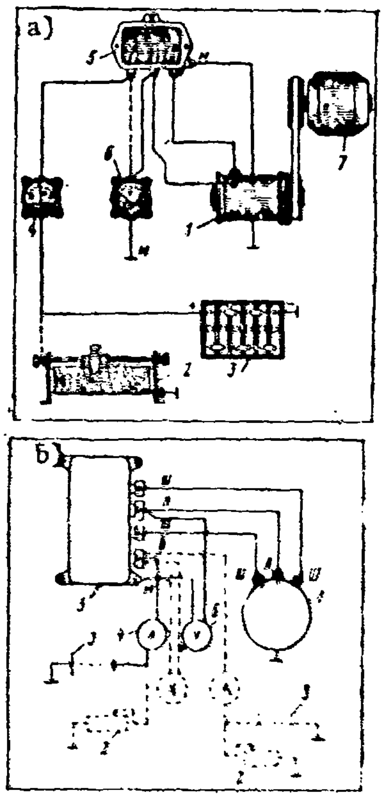


Figure 18-22. Diagram Showing Connection of Instruments in Testing of Voltage Regulators: a, RR24-G, RR24-E and RR130, b, RR23-B and RR51; 1, generator, 2, rheostat, 3, battery, 4, ammeter, 5, voltage regulator, 6, volt meter, 7, electric motor.

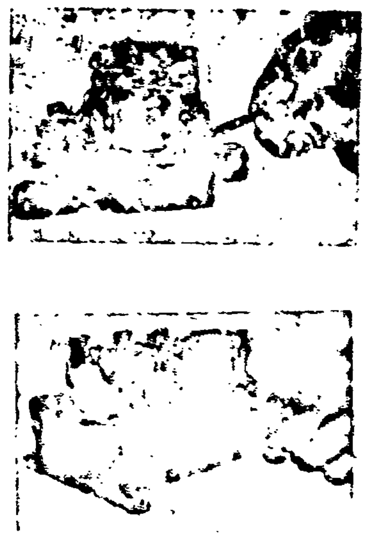


Figure 18-23. Method of Adjustment of Voltage Regulators: a, bending holder of voltage regulators RR130, RR24-G and RR24-E, b, rotation of nut on spring holder of RR23-B and RR51 voltage regulators.

Testing of low voltage circuit. If a battery refuses to hold a charge, in spite of positive tests of battery and generator, the reason may be a partial short circuit in the wires.

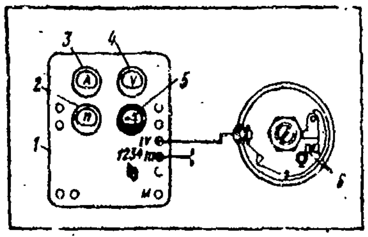


Figure 18-24. Diagram of Testing of Contact Resistance in Distributor and Determination of Their Condition:
1-5, (see Figure 18-17), 6, distributor points.

In order to establish the location of a short circuit, disconnect the battery lead and connect the ammeter of the device in this interval using leads I and II (see Figure 18-15).

With all power consuming devices turned off, the ammeter needles should rest on zero. Movement of the needle indicates a leak. In order to determine the location of the leak, disconnect the circuits of the power consuming devices one at a time in sequence. If disconnection of one device causes the leak to stop, this is the device which is damaged.

The voltage drop across various sectors of the circuit can be measured using volt meter 26 of the instrument set in the 0-3 v range.

Connection of the volt meter is performed using the V and G leads.

Testing of resistance of breaker points and determination of condition of points. Lead VI of the instrument (Figure 18-24) is connected to the output of the distributor, lead III -- to the ground of the vehicle. Set test switch 3 (see Figure 18-15) in position 1. Rotating the crankshaft of the motor manually, close the contacts of the distributor. The indications of closing angle indicator 7 should be within the limits of the shaded area at the zero on the scale otherwise the contacts must be cleaned and adjusted or replaced.

Checking clearance between distributor points for closed state angle. Connect leads IV of the instrument with the distributor lead (Figure 18-25). Connect lead V of the instrument to lead B of the voltage regulator. Connect lead G of the instrument with the ground of the truck. Place test switch 3 (see Figure 18-15) in position 2.

Set switch 5 in "zero set" position and, using potentiometer 33, set the needle of the closing angle indicator on the red line on the scale.

Turn on the ignition and start the motor. The indications of the device at various motor operating speeds should correspond to 38-43° for the R21-A distributor and 29-33° for the R4-V distributor. In case the angle indicator readings do not correspond to these values, the clearance between points must be changed (loosen the screw and, by moving the support of the nonmoving contact, increase or decrease the gap).

Checking the condition of the condensor. Disconnect the condensor lead connected to the distributor, and connected to lead IV of the instrument (Figure 18-26).

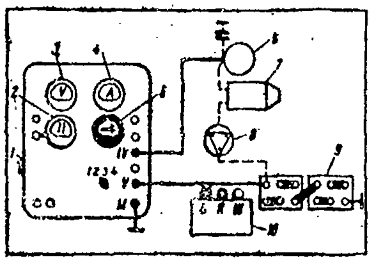


Figure 18-25. Diagram of Testing of Gap Between Distributor Points on the Basis of Contact Closing Angle:
1-5, (see Figure 18-16), 6, breaker, 7, ignition coil, 8, ignition switch, 9, battery, 10, voltage regulator.

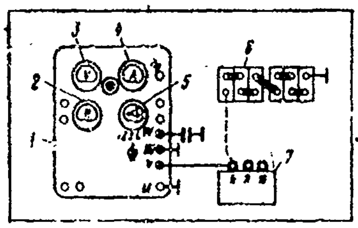


Figure 18-26. Checking the Condition of the Condensor:
1-5, (see Figure 18-16), 6, battery, 7, voltage regulator.

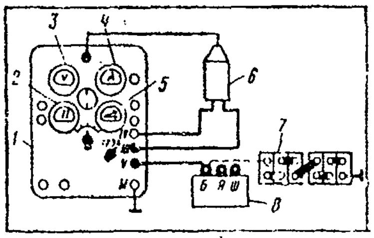


Figure 18-27. Checking Ignition Coil:
1-5, (see Figure 18-16), 6, ignition coil, 7, battery, 8, voltage regulator.

Lead III of the instrument is connected to the ground of the truck. (The condensor can be removed from the distributor and connected to these leads).

Lead G of the device should be connected to the ground of the vehicle, lead V of the device connected to lead B of the voltage regulator. Set test switch 3 (see Figure 18-15) in position 3 and, pressing button 9 of the distributor, observe neon lamp 25. If the condensor is operating properly, the neon lamp will flash at intervals of 8-10 sec. A condensor with a slight leak will cause the neon lamp to flash at intervals of 3-5 sec. A defective condensor will cause the neon lamp to flash at intervals of 1-1.5 sec or to glow continually. This type of condensor should be replaced.

Checking the ignition coil. Disconnect all low and high voltage wires from the coil (the coil can be removed from the truck). Connect the leads of the instrument as follows:

Lead III (Figure 18-27) to VK-B of the ignition coil;
Lead IV to lead R of the ignition coil;
The high voltage lead of the instrument -- to the high voltage lead of the ignition coil;
Lead M of the instrument -- to the ground of the vehicle;
Lead V of the instrument -- to lead B of the voltage regulator.

Set control switch 3 (see Figure 18-15) in position 4, set the lever of the spark gap discharger at 5 mm and press button 9 of the distributor. With continuous and intensive spark formation, increase the spark gap until spark formation occurs intermittently. Uninterrupted spark formation should be observed with a gap of no less 7 mm.

Defective ignition coils must be removed and replaced.

Testing the starter with full braking. Disconnect the wire from the starter lead. Place and fasten a 1,000 A, 75 mv shunt (from the set available) on the starter lead. Connect the starter wire to the other end of the shunt, the end with the nut and bolt. Connect the potential leads of the shunt to the "+1,000 A" and "-1,000 A" leads of the instrument (see Figure 18-15). Set switch 11 of the ammeter in the "1,000 A" position. Connect lead M with the ground of the vehicle (Figure 18-28), connect lead V of the instrument to the starter lead. Set the brakes of the vehicle, place it in gear and, without pressing the clutch engage the starter. Record the indications of ammeter 12 (see Figure 18-15) and volt meter 26, which should be not over 600 a for the ST15-B and not over 650 a for the ST130.

Before this check is made, the battery must be fully charged, since this will determine the power developed by the starter. In order to avoid discharging the battery excessively, the starter should not be left switched on for more than 5 seconds.

Defective starters must be removed and sent in for repair.

Testing of commutator in transistor ignition system. Testing of the operation of the transistor ignition system commutator is performed as follows. Disconnect the contacts of the distributor, turn on the ignition and test the voltage. With good wires and equipment, the voltages should show the following limits on the terminals of the additional resistor (see Figure 18-29):

on terminal B 12.0-12.2 v; on VK, 9 v; on terminal K, 7-8 v; on the terminals of the ignition coil, 7-8 v; on terminal R of the transistor commutator, 3-4 v.

The wires of the volt meter should be connected as follows: one end to the terminal, the other to ground.

If the wires and equipment are in order, but there is no voltage on terminal R of the transistor commutator, this means that the transistor commutator is defective and must be replaced.

When there is no spare transistor commutator available, the ignition system can be altered to a nontransistor type by replacing the B114 ignition coil with a B13 coil with additional resistor and installing a condensor on the distributor or by replacing the R4-D distributor with an R4-V distributor.

Warning: In order to protect the transistor ignition system from overloads, you must:

not leave the ignition turned on with the engine not running;
not allow the system to operate with an open circuit, i.e. with the high voltage wires disconnected from the spark plugs or with poor seating of the wires in the distributor cap or ignition coil;

not allow operation of the engine with excessive spark plug gaps. The gaps should be between 0.85 and 1.00 mm.

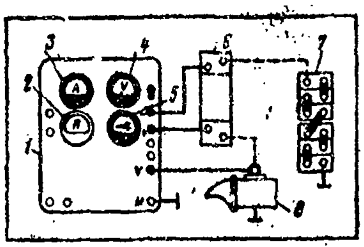


Figure 18-28. Diagram of Testing of Starter with Full Braking:
1-5, (see Figure 18-17), 6, 1,000 A shunt, 7, battery, 8, starter.

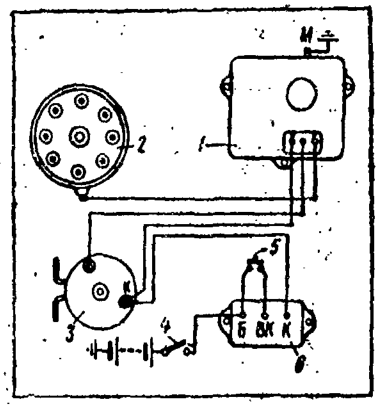


Figure 18-29. Diagram of Parts of Transistor Ignition System:
1, transistor commutator, 2, distributor, 3, coil, 4, ignition switch, 5, lead to starter contacts, 6, additional resistor.

Setting of ignition on in-line motor. Setting of the ignition on a motor from which the distributor has been removed (the distributor rotor shaft and octane corrector plate remain in place) should be performed in the following sequence:

remove the distributor cap, check and if necessary adjust the gap between distributor contact points;

set the position of cylinder 1 at the end of the compression cycle t.d.c. using the flywheel mark or the setting pin on the cover of the distributor gears;

loosen the tightening bolt in the upper plate of the distributor and set the distributor on the motor so that the vacuum regulator is at the top, the electrode of the rotor is opposite the terminal for the first cylinder in distributor cap. Fasten the distributor onto the motor;

rotate the adjusting nuts of the octane corrector so as to set the arrow in the upper plate at the "zero" scratch on the lower plate;

turn on the ignition and rotate the adjusting nuts of the body of the distributor counterclockwise until a spark appears between the end of the central wire from the coil and ground (at a distance of 2-3 mm);

beginning of opening of the contact can be tested on the basis of lighting of a lamp connected to the motor ground and the low voltage terminal of the distributor;

fasten the body in this position by the adjusting nuts of the octane corrector;

replace the distributor cap and high voltage leads and connect them to the spark plugs, screwed into the cylinder head;

test the correctness of placement of the wires in the distributor cap in correspondence with the firing order of the cylinder (1-5-3-6-2-4), and fasten down the distributor cap with the spring clips;

connect the tubing of the vacuum advance mechanism to the distributor.

The tiling for each type of gasoline must be determined by road testing as follows:

allow the motor to warm up to 75-90°C;

while driving down a level road sector in top gear, accelerate the truck from 10-15 to 50-60 km/hr by pressing the gas pedal to the floor, listening to the operation of the engine;

if the ignition is set properly, slight metallic knocking of the motor should be heard. Adjustment of the setting of the ignition is performed by rotating the octane corrector nut. When there is no detonation at all, rotate the body of the distributor by one or two division counterclockwise. It should be kept in mind that when the body of the distributor is rotated by one scale division on the plate of the breaker, the spark advance is changed by 4°.

Setting of ignition on V-type motor. Setting of the ignition on a motor from which the distributor has been removed must be performed in the following sequence (distributor drive shaft and octane corrector plate are left in place):

remove the distributor cap and check and if necessary adjust the gap between breaker points;

set the piston of the first cylinder at t.d.c. (see "testing and adjustment of valve clearances");

remove the bolt fastening the distributor to the octane corrector plate, install the distributor in the drive body seat so that the vacuum advance mechanism is directed toward the carburetor, and the rotor of the distributor is opposite the terminal of cylinder 1. Replace the bolt fastening the distributor to the upper plate of the octane corrector. If rotation of the distributor during setting of the ignition is to be performed by hand, the bolt should not be fully tightened.

If the rotation is to be performed with the adjusting nuts of the octane corrector, the bolt should be fully tightened, since otherwise the body of the distributor will not rotate;

turn on the ignition and rotate the body of the distributor counterclockwise until the breaker points open and a spark appears between the end of the central wire and the ground of the engine with a gap of 2-3 mm for the ordinary ignition system and 3-10 mm for the transistor ignition system;

the beginning of opening of breaker points can be tested on the basis of burning of a test lamp connected to the motor ground and the low voltage terminal of the distributor; after the ignition is set, the distributor must be tightened firmly to the upper plate of the octane corrector;

check the correctness of installation of the spark plug wires in the distributor cap in correspondence with the firing order of the cylinders (1-5-4-2-6-3-7-8), considering that the distributor rotor rotates in a clockwise direction.

Refinement of the ignition setting on the motor depending on the type of gasoline used should be performed using the octane corrector scale inscribed on the upper plate of the distributor by testing on the road for the appearance of the metallic pinging sound in the motor as follows:

warm up the motor to 80-90°C;

moving along a smooth and level road sector in top gear, accelerate the truck from 30 to 60 km/hr; this is performed by pressing sharply on the accelerator pedal while listening to the noise of the motor;

in case of strong detonation in this operating mode, rotate the octane corrector so as to move the indicator arrow of the upper plate along the scale in the "-" direction;

if there is no detonation at all in this operating mode, rotate the octane corrector not so as to move the arrow on the upper plate along the scale in the "+" direction.

With proper setting of the ignition, as the truck is accelerated, a light metallic ping will be heard, disappearing at 40-45 km/hr.

Testing tightening of contact forks of shielded generators. During TO-1, the nuts of the contact forks should be checked; this is done by loosening the cover nuts of the plug, removing the plug forks and testing the tightening of the forks. If the forks rock, the nuts must be tightened.

During replacement and removal of plug cover nuts, bending of the shield wires in the direction of motion of the nut must be avoided, since this can cause breakage of the shielding braid, as well as disruption of the electrical contact between the braid of the wire and the body. The cover nuts should be tightened only finger tight. Pliers or other tools should be used only when absolutely necessary; damage to the nipples and the cover nuts themselves must be avoided.

Testing operation of generator brushes. During TO-2 and after each crossing of a ford, the operation of the brushes should be checked. This is done by removing the protective tape from the generator, inspecting the brushes and collector to be sure that the brushes move freely in the brush holders and contact the collector tightly.

Check the pressure of the brush springs with a dynamometer. The brush spring force should be at least 600 G for the G108-V and G51 generators and at least 1,200 G for the G130 generator. The height of the brushes should be at least 14 mm for the G108-V and G51 generators and at least 17 mm for the G130 generator. Worn brushes should be replaced with new ones, which must be turned in to fit the collector.

New brushes are turned into the collector as follows: a strip of fine sandpaper as wide is the collector is long is placed between the brush and the collector. This is done by bending back the wire hook of the brush holder lever and raising the brush. The strip should cover at least half the circumference of the collector (over 180°) and must be turned with its rough side toward the brushes. The brush is then lowered and the strip is pulled through in the direction opposite to the rotation of the rotor until the brush fits tightly against the collector. As the paper is moved in the direction of rotation, the brush must be raised.

Testing of operating condition of generator collector surfaces. During TO-2, the condition of the operating surface of the collector should be tested; it should have no burned spots or dirty areas. In case of burned or dirty spots, the collector should be washed with a clean rag wet with gasoline. "Varnish" forms on the working surface of the collector during normal operation.

One should not confuse collector burned areas, which have a dull black color and are located at the edge of the collector plates, to the shiny, light brown or blue varnish, located over the entire surface of the collector.

The varnish should not be removed, since it improves the operation of the brushes.

If the dirty or burned spots do not come clean with the gasoline-wet rag, the collector must be cleaned with a fine sandpaper, rotating the armature by hand.

Emery paper should not be used. If burned spots cannot be removed with sandpaper, the generator must be removed from the motor, dissembled and the collector turned down until a smooth and shiny surface is produced.

Lubrication of generator bearings. The generator bearing on the drive end is lubricated by means of the oil port.

In order to lubricate the generator bearing on the collector end, clean the dust and dirt from the generator, remove the generator cover, remove the old lubricant and pour in fresh lubricant.

Voltage regulator. During TO-2, the tightness of the nuts on the contact forks and voltage regulator mounting nuts should be tested.

During TO-2, and also in case of abnormal charging of the battery (under charging or over charging), the electrical adjustment of the voltage regulator must be checked and adjusted if necessary.

The voltage regulator is tested the first time during the first TO-2; subsequently, it is checked during every other TO-2 maintenance cycle or when abnormal charging of the battery is noted.

The voltage regulator should be tested on a test stand in the operating position. It is also permissible to check the voltage regulator directly in the truck; a hot voltage regulator should not be checked immediately after stopping the motor.

For stand testing of the voltage regulator see the subsection on "Dissembly and Assembly" of this chapter.

Ignition coil and distributor. The plugs of the shielded low voltage leads are designed to take type PGVA wire 1.5 mm^2 (GOST 9751-61) with type LPRGS-E shielding braid 1.5 mm^2 (GOST 2262-50).

During assembly of the plug, the core of the PGVA wire must be cleaned for length of 17 mm and assembled in the plug so that all of the wires in the core enter the hole, after which the core is drawn up against the end of the installation in the contact aperture, the ends of the core are spread and soldered with POS-30 or POS-40 solder to the contact aperture without using acid and without strong heating to avoid damage to the insulating ring and wire insulation.

The soldered metal should protrude above the end of the contact aperture by not more than 0.5 mm and should steel the soldered aperture in the contact circle.

During straightening of the ends of the shield, it must not be too greatly tightened. To fasten the shield braid to the plug, the wire is placed between the washers in the plug, and the lug on one of the washers is bent around the other. After this, the shield is fastened to the ring on the plug with the collar.

After completion of installation of all wires and the ventilation system, the nuts of the low voltage contacts and ventilation nipples should be tested and fully tightened, as well as the bolt joints of the distributor.

During tightening of the bolts which fasten the top of the shield and the shield, do not tighten them to strongly, since the sealing joints between cap and shield and shield and body is provided by the rubber sealing rings between the metal surfaces; further tightening of the bolts does not improve the seal, merely causing damage to the threads or breakage of bolt heads; when the low voltage contacts of the plugs and high voltage leads are tightened, they also should not be turned too tightly; the seal is provided by the rubber sealing rings when the nuts are tightened normally.

During operation, the distributor points must be maintained in good condition, i.e. you must check for cleanliness and proper adjustment. Lubrication of moving parts must be checked; it should be recalled that oil from the crankcase of the motor cannot be used to lubricate the distributor, and that excess lubrication of the distributor is harmful, since it may cause rapid wear of points in case they become oily and failure of the distributor.

The cleanliness of the distributor and all its parts is important, particularly the insulating parts (cap, rotor, terminals, etc.).

The reliability of the contact between high voltage leads and the terminals on the distributor cap and ignition coil must be checked. The reliability of all contact between shielding parts on the motor must be tested.

Caution must be exercised to avoid breaking plastic parts (cap, rotor and mounting parts in distributor cap).

During TO-2, the plastic distributor cap should be rubbed with a clean, dry or gasoline-wet rag.

Inspect the cam, and in case it is dirty, clean it with a clean rag wet with gasoline.

Lubricate the distributor according to the lubrication chart.

After lubrication, check to be sure the lever is not seized on the axis; this is done by pressing down on the lever with the fingers and releasing it. When released, the lever should return rapidly (due to the spring) and the contacts should close with a click.

If the contacts do not close or the lever moves slowly, the seizing must be eliminated and the spring tension must be adjusted between 500 and 650 G by removing the lever and carefully bending the spring in either direction as necessary.

Check the cleanliness of the points, remove dirt and oil from the points as necessary, rub the contacts with a chamois wet with clean gasoline, then, holding the lever back, allow the gasoline to evaporate and rub the points with a clean, dry chamois.

The chamois may be replaced by any material which leaves no fibers on the points, while gasoline can be replaced only with alcohol.

Check the condition of the working surfaces of the points and clean them only in case of excessive transfer of metal from one point to the other or if the lump of metal on one point prevents the point gap from being measured.

The points should be cleaned with a thin (about 1 mm) abrasive plate or fine sandpaper.

Emery paper, needle file and other abrasives cannot be used to file the contacts.

In case of irregular motor operation, in no case should the point surfaces be cleaned until it has been established that the problem actually results from poor point surface condition.

In filing points, the built up material should be removed from one point. The points should not be cleaned to remove the crater (depression) on the other point. After filing, the points should be washed, dried as indicated above and adjusted for proper point gap.

In filing points, be sure to maintain the surfaces of the points parallel, so that the points touch over their entire surfaces (without any slips between them) during operation.

The setting of the ignition must be checked each time the distributor is removed from the truck.

Check and if necessary adjust the gap between points. The gap between points should be 0.3-0.4 mm.

Adjust the gap as follows:

rotate the distributor shaft until one node on the cam is set so as to produce the maximum point gap;

loosen the screw mounting the upright of the nonmoving contact and rotate the eccentric (in the split of the upright) with a screwdriver until the gap between the points is just wide enough to pass a 0.4 mm feeler gauge;

tighten the upright mounting screw of the nonmoving contact and test the gap again. The feeler gauge must be clean; it should be washed with gasoline before usage.

When necessary (in case of full point wear), the breaker point lever and contact upright can be replaced once during the guaranteed service life of the distributor; a spare upright and point lever will be found in the spare parts kit. The distributor wrench should be used to replace the lever.

Check the condition of the rubber sealing rings and replace if necessary.

The sealing rings can be replaced twice during the guaranteed service life of the distributor; 2 sets of sealing rings are delivered with each truck.

In the transistor ignition system, the breaker points are loaded only with the transistor control current, not with the full current of the ignition coil; therefore, burning and erosion of points are almost completely eliminated, and they require no cleaning. However, due to the extremely small current broken by the points, it is not capable of penetrating a film of oil or oxide, so that the cleanliness of the points must be particularly carefully maintained.

In case of oiling of points, they must be washed with clean gasoline. If the truck is operated for an extended period of time and a layer of oxide is formed on the breaker points, the points should be cleaned, i.e. rubbed with an abrasive plate or fine 100 grade sandpaper, being sure not to remove metal, which will reduce the service life of the points.

Care of the unshielded ignition coil and distributor is the same with the exception of the shielding parts.

Lubrication of distributor. To lubricate the cam bushing, breaker lever axis and cam follower, it is necessary to remove the distributor cap and add a few drops of oil.

On ZIL-131 trucks, do not lubricate the cam follower, since it is soaked with a constant supply of lubricant for the entire period of operation of the distributor.

Excessive lubrication of the cam bushing and breaker lever axis is harmful, since it causes spraying of the breaker points with oil, causing formation of scale on the points and missing of the engine.

Lubrication of the distributor shaft is performed by rotating the cover of a cap oiler by 1/2-1 turn.

Spark plugs. During TO-1, the spark plugs should be removed and check

Check the gap between the electrode with a wire gauge. The use of flat gauges is not permitted, since measurement of the gap with a flat gauge will produce an incorrect result (the measured gap will be less than the actual gap).

If the spark gap is found to be too large, it must be adjusted by bending only the side electrode. Bending of the central electrode will break the plug insulator. It is desirable to file the electrodes lightly before adjusting the gap in order to produce sharper edges, since blunt edges cause an increase in the voltage necessary to form a spark.

The gap should be adjusted to between 0.5 and 0.6 mm for SN307 plugs; 0.85-1.0 mm for A15-B plugs and 0.6-0.7 mm for A16U and A16S plugs.

If the spark plug insulator is covered with soot and scale, the plug must be cleaned.

Removal and replacement of the SN307 spark plug must be performed only with a plug ridge. If the spark plug itself is rotated in an attempt to remove the cap nut of the spark plug with the engine warm, do not attempt to grasp the shield with pliers. It is better to go ahead and remove the spark plug and then, gripping the hex nut section of the plug with the wrench, remove the cap nut. The tightening torque of the cap nut should be not over 2.5 kGm. The tightening torque of the spark plugs should be not over 3.5 kGm for all types.

When a spark plug is installed in a motor, the presence and condition of the sealing ring must be checked.

With normal operation of spark plugs in the motor, the insulator tip should be brown in color. A light yellow (almost white) color of the insulator indicates significant overheating of the plug.

Correct operation of spark plugs depends to a great extent on the thermal condition of the motor. At low air temperature, the motor must be heated (using a heating screen, cover the radiator intake).

After starting the motor cold, the trucks should not be immediately driven, since the plugs may misfire when cold.

When driving after being parked for sometime, accelerate for a longer period of time in lower gears before shifting upward.

The spark plugs may operate intermittently if the rules for starting the motor are not observed or if the fuel mixture is made to rich by using the choke when it is not needed.

Starter. During TO-1, the bolts mounting the starter to the motor must be tested and tightened if necessary.

After 25,000 km and subsequently during each TO-2 cycle, the starter should be removed from the motor. Remove the protective cover for access to the collector and brushes by blowing compressed air into the starter. The method of removal of the protective cover is illustrated on Figure 18-52 (for the ST-2 starter).

Check the condition of the operating surface of the collector. The operating surface of the collector should be smooth with no significant burned areas. In case there are dirty or burned areas, it should be wiped with a clean rag wet in gasoline. If this fails to remove the dirt or burned areas, the collector should be rubbed with fine sandpaper.

Check the position of the brushes in the brush holders; the brushes should move freely in the holders and should not be excessively worn. If the brushes are worn and their height is 6-7 mm (at the point of contact with the spring), they must be replaced. The pressure of the brushes against the collector for the ST-2 starter should be 1,200-1,500 G, for the other starters 800-1,300 G.

Test the tightness of screws mounting the tips of the brush channels to the brush holders. Tighten if necessary. Blow through the starter with dry compressed air or a hand pump to remove dust and dirt accumulated in the starter.

Before installation of the protective cover, the rubber sealing rings must be replaced with new rings, which should be lightly lubricated with brake fluid to allow easier installation of the cap. Before installation of the cap, check the seal of the starter (for the ST-2).

Lightly lubricate the shaft (point where drive unit moves) with pure oil as used for the motor.

If the starter must be dissembled during TO-2, the condition of the solenoid contacts must be checked. In case of significant burning of the contacts, they should be cleaned with sandpaper. If the contact bolts are greatly worn at the points of contact with the contact disk, they should be rotated by 180°.

Check the axial play of the starter armature; it should not exceed 1.0 mm. The necessary axial play is achieved by installing adjusting shims on the armature shaft neck at the drive end.

Check and when necessary adjust the drive gear travel; the clearance between the gear and the support ring with the solenoid armature fully shifted and the proper axial play should be 1.5-3.5 mm for the ST130 and ST2 starters and 0.8-1.3 mm for the ST15-B starter (clearance check with metal ruler).

Warning. The starter cover and drive unit must not be washed in gasoline or kerosene, in order to avoid washing away the lubrication on the bonds-graphite porous friction bearings.

After assembly, check the starter in the idle mode for brake torque.

When the ST2 starter is dissembled, all rubber sealing rings should be replaced with new rings (2 sets of rubber sealing rings are supplied with each starter). The following sequence is used to check the seal of the ST2 starter:

the starter is submerged in fresh water at room temperature, so that all parts in the starter are in the water, submerged to a depth of not over 50 mm;

air pressure of 0.1-0.2 kG/cm^2 is fed into the starter body. The test is continued for 5 minutes after this pressure is reached; water must not be allowed to enter through the cap on the drive side. This is prevented using a special sealing collar.

The starter is considered to have passed the test if there is no systematic visible air bubbling from a single location of the starter and solenoid during the last 3 minutes of the test.

Dissembly and Assembly.

Dissembly of generators. Before dissembly, the generator must be cleaned of dust and dirt using a fiber brush and a dry cloth.

After external cleaning, perform external inspection and check tightness of contacts (Figure 18-30).

If the generator is defective, it should be dissembled to reveal and eliminate the causes of the defects.

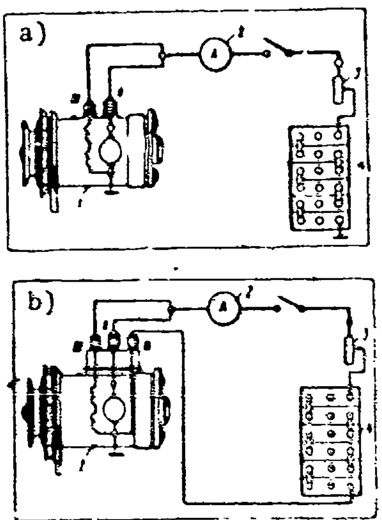


Figure 18-30. Diagram of Testing of Generators at Idle in Electric Motor Mode:
a, G140, b, G51;
1, generator, 2, ammeter, 3, rheostat, 4, battery.

We present below the process of dissembly of the G130 generator with individual comments concerning the G51 generator. Remove the bearing cover mounting screws on the collector end and remove the cap together with the gasket.

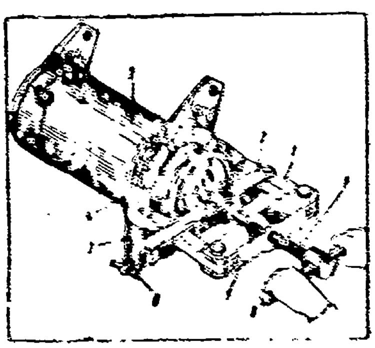


Figure 18-31. Removal of G130 Generator Pulley:
1, clamp, 2, cross piece, 3, generator, 4, pulley, 5, fitting, 6, cross piece screw, 7, traverse, 8, handle, 9, pour screw.

Remove the bearing mounting nut, holding the armature shaft by the pulley to prevent rotation; remove the support and spring washers from the shaft.

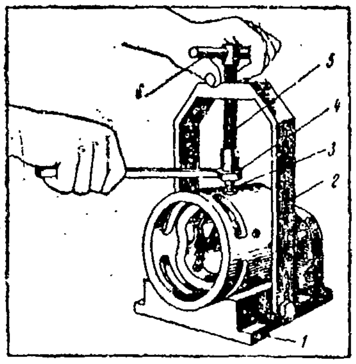


Figure 18-34. Device for Removal of Generator and Starter Pole Cores: 1, base, 2, bracket, 3, screwdriver, 4, wrench, 5, screw, 6, handle.

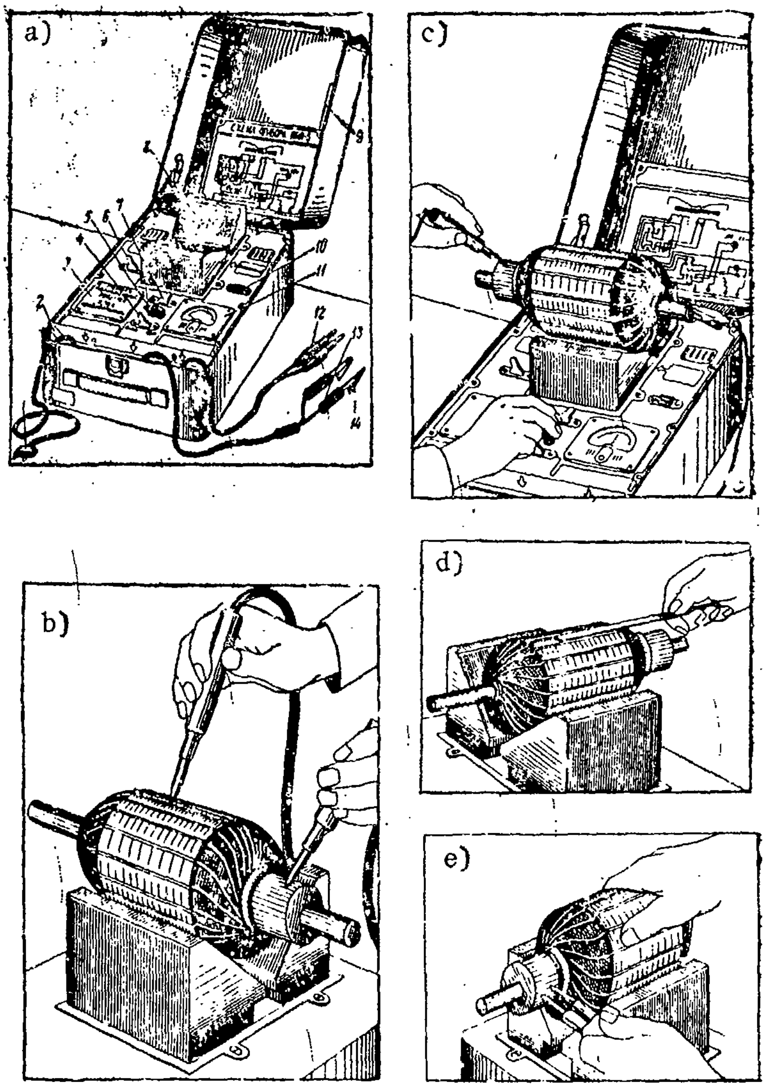


Figure 18-35. PPYa-5 Device for Checking of Generator Armature and Excitor Windings: a, instrument, b, checking of armature for short to ground, c, determination of point of short on ground using individual probe, d, determination of point of short to ground using steel test plate, e, determination of point of short to ground using double probe; 1, power plug, 2, yoke, plate, 3, switch panel, 4, test lamp switch, 5, rheostat, 6, "low" and "high" current switch, 7, toggle switch of device, 8, armature support prisms, 9, test plate, 10, test window, 11, measuring device for checking of armature windings and excitor windings, 12, probes, 13, clip handles, 14, alligator clip.

The conductor for the positive brush should be repaired or replaced together with the brush in case of damage insulation.

The lubricating hole in the cover must be clean to remove dust and old lubricant and a new oiler should be pressed into it.

The generator pulley should have no cracks. In case of wear of the pin channel, a new channel can be cut in a different position.

Testing of the armature. In order to test the windings of the armature, it is checked using a PPYa-5 device (Figure 18-35a) or a model 353PPYa. The device consists of a transformer with an open magnetic circuit, in which the armature windings act as the secondary. In addition to the transformer, the device has a test lamp, milli-ammeter with adjusting rheostat, contact probes and clips. The device is mounted in a closeable metal box and is powered by 220/110 v ac.

Before turning on the device, the armature to be tested must be placed on the prisms, after which the device is turned on. Turning on the device without an armature in place will cause the windings of the device to burn out.

The order of testing for a short circuit between armature and ground is as follows: place the armature on the prisms; plug in the instrument; set switch 4 in the "on" position; touch one contact probe to the shaft or to the iron plates of the armature, while touching the collector plate in turn with the other, as shown on Figure 18-35b. If there is no short to ground, the lamp will not light.

If there is a short of the armature to ground, the location of the short can be determined using the PPYa-5 as follows: take an alligator clip in place of the contact probe and clamp it over the end of the shaft (Figure 18-35c), turn on the device and touch the collector plates in order with the test probe (the needle of the measuring device will be seen to deflect); rotate the milli-ammeter knob so that the needle is deflected by a number of scale divisions convenient for reading (for example, 15 divisions); place the probe on each plate of the collector in order; as the shorted turn is approached, the indications of the instrument will decrease, and the reading will be equal to zero at the shorted point. In case of a short circuit in the collector, the needle will also indicate zero. When there is a short to ground of any turn in the windings in the middle of the armature, the indications of the device will be very low (1-4 scale divisions).

To detect a short circuited armature sector, steel test plate 9, fastened to the cover of the instrument, must be used. Lightly touching the surface of the armature with this plate (Figure 18-35d), rotate the armature slowly. If there is a short circuit in any section, the steel plate will be attracted to the armature over this section.

A shorted section can also be detected using the measuring instrument (milli-ammeter). To do this, plug in probes 12, set the armature to be tested on the prism and turn on the device. Press the probes against two neighboring collector plates as shown (Figure 18-35e), then turn on the milli-ammeter of the device and observe the indications of the milli-ammeter needle. At the short circuited section, the needle of the device will drop to zero. The armature must be replaced if shorted.

After testing the windings of a generator armature, the plates of the armature must be tested for beating relative to the shaft neck. Bending of an armature shaft is eliminated by straightening on a hand press. The beating of the armature plates should not be over 0.08 mm. The armature must have no torn winding sections, corrosion, one sided wear, gouges or shifting of armature plates (waviness).

If the collector of the armature is significantly worn, it must be turned down, if slightly worn, it must be ground with sandpaper.

Turning of a collector, as well as milling of the micanite between plates should be performed on a model 2155 lathe (Figure 18-36). This lathe weighs 32 kG, is small in size and can be installed on a standard workbench. If this machine is not available, when the micanite between collector plates must be turned down to 0.5-0.8 mm, a knife file can be used, specially made and installed in a mount as shown on Figure 18-36. When the knife file is used, the teeth should be ground down with an abrasive disk to the width of the slot between collector plates.

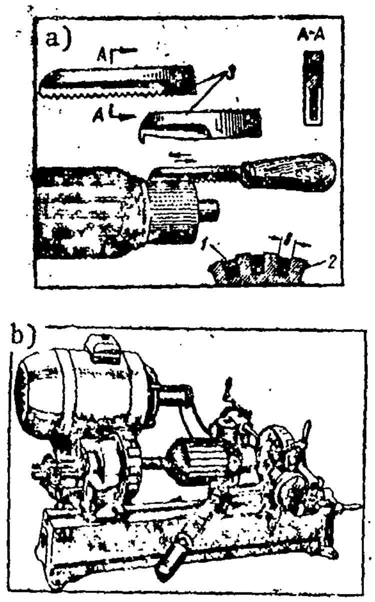


Figure 18-36. Removal of Micanite and Turning of Collectors of Generator and Starter Armatures: a, removal of micanite with a hand tool, b, model 2155 tool for turning of collectors and milling of micanite of generator armatures; 1, micanite, 2, collector plate, 3, tool, 4, width of slot.

After the collector is turned, it must be tested for beating. Beating of the collector relative to the shaft neck must not exceed 0.02-0.03 mm. The decrease in collector diameter following turning may be up to 3 mm from the nominal diameter. With greater wear, the armature must be rejected.

Testing of generator body. Damage to generator bodies is dividied into two groups: electrical and mechanical.

Mechanical damage is checked by means of an external inspection. Electrical damage must be determined during the testing process.

Electrical tests include tests for insulation strength in current carrying elements, tests of insulator operation and measurement of resistances in windings.

The primary types of electrical damage are: shorting of turns, shorting to ground due to damage to insulation, breakage of contact leads and connections between windings. The excitor windings can be tested without being removed from the body. This test for shorting between excitor winding and generator body can be performed on an induction device using the method shown on Figure 18-37a. A similar test can be performed with a test lamp using the plan shown on Figure 18-37b with a source of 220-500 v alternating current in 1 minute. If the lamp does not light, the insulation is considered to be in good condition.

Testing for shorting between turns for open excitor turns, as well as determination of the resistance of excitor winding coils are performed using an ohmmeter.

Shorting of turns in a coil can also be determined on the basis of heating of the turns using the PPYa-5 device. To do this, place the coil over the fitting and install it on the device as shown on Figure 18-38. Then turn on the alternating current in the transformer of the device. If the coil does not become hot in 5 minutes, there are no short circuits in the coil.

Testing of cover with brush holder. The method of testing for short circuits between the insulated brush holder and cover is illustrated on Figure 18-39. If the lamp connected in the electrical circuit of the device does not come on, there is no short circuit and the cover is ready for use.

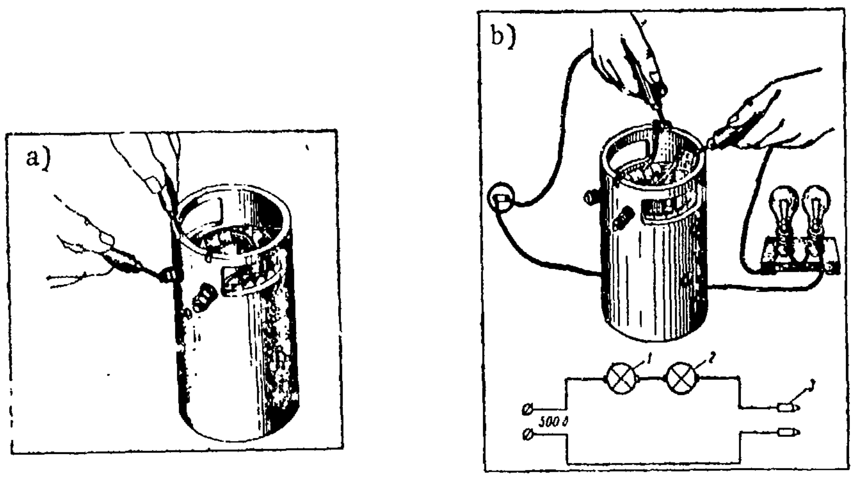


Figure 18-37. Testing Quality of Insulation of Generator Excitor Windings: a, method of testing on induction device with indicator lamp, b, method of testing using test lamp; 1 and 2, 15 w, 220 v lamps connected in series, 3 probes.

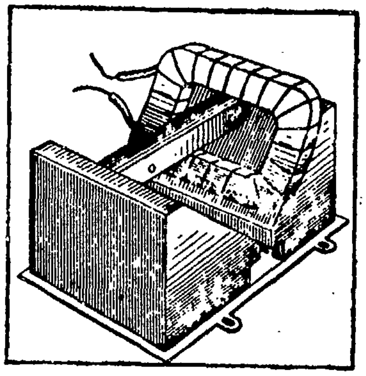


Figure 18-38. Determination of Short Between Turns of Generator Excitor Winding Using PPYa-5 Device.

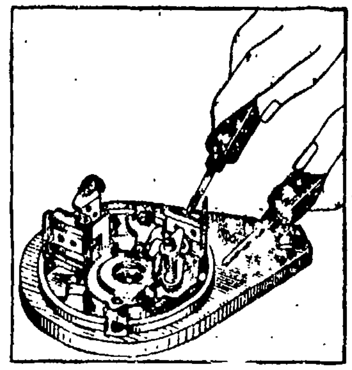


Figure 18-39. Testing of Cover and Brush Holders for Short Circuit.

Testing of generator shaft bearings. Generator bearings should be tested during external inspection following removal of grease and dirt, by rotating the bearing rings manually. In case of significant play or scratches of the bearing races or deformation of the balls, the bearings should be replaced.

Assembly of body of G130 generator. In case of replacement of excitor windings, their leads must be soldered to the Sh and Ya terminals. Insert the generator windings in the body, place the pole cores on them and fasten down with screws using the adapter (see Figure 18-34).

Place terminals Sh and Ya in the seats in the body with insulated bushings and fasten in place with nuts, after placing one insulating, one flat and one spring washer on each bolt, then tighten the retaining nuts with spring washers. Insert screw cap M with a spring washer in the body.

Installation of terminals and shielded plugs of the G51 and G118 generators must be performed in the following sequence: solder the tips to the output ends of the excitor windings, place the tips of the plugs in the holes, set the plugs in the insulated bushings of the shield, hand tighten both nuts and preliminarily tighten terminal plugs Sh and Ya (see Figure 18-6) in the box, install the shield of the box on the body of the generator, tightening it with screws, and final tighten the terminal plug nuts.

After installation of the generator on the truck, the contact forks of terminal Sh and Ya must be set in the terminal jacks; tighten the retaining nuts of the shielded conductors, together with the conical and rubber bushings.

Assembly and installation of generator drive end cover. Install the internal seal of the cover together with the internal collar, felt gland and outer collar on the shaft of the armature. Seek the stop ring on the shaft of the armature and put on the support ring, then install the bearing on the shaft (with a fit between an interference of 0.016 mm and a clearance of 0.006 mm). Install the cover on the drive end on the bearing, place the outer seal of the cover on the shaft together with the internal collar, felt gland and outer collar, fasten down the seal and cover on the armature shaft with nuts and bolts and spring washers.

Place the front cover on the generator body, directing the armature into the body, and the cover placer in the slot in the body.

Assembly and installation of cover on collector end of generator. Place the brush holders and pressure springs, fasten to the cover, on the axis. Fasten the seal together with the insert, inner clamp, felt gland and outer clamp on the inside of the cover with screws.

Place the bearing in the seat in the cover and install the cover on the body of the generator, directing the bearing onto the armature shaft. Install the rear cover bearing onto the armature shaft with a fit ranging from an interference of 0.016 mm to a clearance of 0.006 mm.

Place the two retaining bolts in the apertures in the cover on the collector end and, by tightening them, mount both covers and the body of the generator.

Place the pin in the slot in the shaft, place the pulley on the shaft, press it in place and fasten with a nut with a flat and a spring washer, preventing the pulley from rotating.

Tighten the bearing with a nut on the collector end.

Place lubricant in the rear bearing, install a cover cap with gasket and fasten it with screws.

Install the positive and negative brushes in the brush holder seats with a metal hook, bending back the spring levers of the brush holders with springs (see Figure 18-32). Fasten the tips of the excitor winding and brush wires onto the brush holder brackets with screws. Install the protective tape and fasten it down with the retaining screw.

The G108-V, G56-B and G51 generators are assembled in a sequence similar to the sequence for assembly of the G130 generator.

Testing of generator operation. The repaired generator must be tested in operation in the electric motor mode and in the generator mode.

To test the generator in the electric motor mode, the generator is fastened into a test stand or instrument and connected to a battery of the corresponding voltage as shown on Figure 18-30.

The generator armature should rotate to the right. Rotation of the armature in the opposite direction is a result of improper connection of the winding coils or brushes. The current consumed should not exceed the values indicated in the technical characteristics (see Table 18-2). If the current consumption exceeds the values indicated in the technical characteristics, this indicates improper assembly of the generator, and possible skew, seizing or wedging of the armature against the pole cores.

Too-rapid rotation of the armature indicates poor contact or an open circuit in the excitor windings.

When the generator is tested in the generator mode, the rotating speed of the armature should be checked at which the generator develops its nominal voltage without load (without connection of the rheostat and battery), and with full load. The load for the generator is created using the rheostat. Tests are performed using the M532 GARO test stand. This stand is equipped with an electric motor to drive the test generator and a mechanical variator, using which it is possible to change the rate of rotation of the generator armature smoothly during the testing process. The rotating speed of the armature is determined by a tachometer.

The final test of the operation of the generator is performed in combination with the voltage regulator. The operation of the other generators is tested similarly.

Testing and adjustment of voltage regulators. Contacts of voltage regulators, the contact surfaces of which show traces of burning and oxidation, are cleaned with a flat abrasive plate or sandpaper with subsequent blowing of the dust formed. Following cleaning, the contacts should be rubbed with a clean rag wet with gasoline or acetone. The cleaned contact surfaces must be strictly parallel to each other and must contact each other tightly. If the height of a worn contact is less than 0.5 mm, it should be replaced.

The RR130, RR24-G and RR24-E voltage regulators are checked using the M532 GARO test stand in combination with a standard generator or generator of the type with which it should operate. The test should be made by setting the voltage regulator on the test stand in a position similar to its position of installation on the truck. It is not recommended that the voltage regulator be tested hot, since the indications may be inaccurate.

During checking and adjustment of the voltage regulator, it should not be turned on for more than 5 minutes, since due to heating of the coil the regulator will produce improper indications. If adjustment requires more time, the test stand should be turned off after 5 minutes for 15-20 minutes cooling of the voltage regulator. An adjusted voltage regulator should be test for operating stability together with a generator.

Checking of a voltage regulator on the test stand requires the following instruments: dc volt meter with scale up to 30 v, accuracy class no lower than 1.5; dc ammeter with center zero and 40-0-40 a scale, accuracy class not lower than 1.5; load rheostat for at least 35 a current, tachometer with scale up to 5,000 rpm.

The diagram of connection of devices for testing of voltage regulators is presented on Figure 18-22.

To connect the volt meter to the B and Ya terminals of the RR24-E or RR51 voltage regulator, remove the nut, remove the plug, connect the volt meter wire to it and insert the plug into the jack of the voltage regulator so that the volt meter wire does not touch the body. After the test, remove the volt meter wire, reinsert the plug in the jack and tighten the nut.

Testing of the back current relay on the test stand is performed with the battery connected. To do this, connect ammeter 4 between terminal B and the battery using an additional wire. Volt meter 6 is connected to the Ya terminal and ground. The sliding contact of rheostat 2 is used to set the load in the circuit equal to half of the nominal generator current. Then, increasing the speed of rotation of the generator armature using electric motor 7, determine the voltage at which the contact of the back current relay close. At the moment of closure of the contacts, the needle on the volt meter will jump toward lower voltage. The voltage indicated by the volt meter at this moment (12.2-13.2 v) is the voltage at which the back current relay closes. Then, decreasing the rotating speed of the generator armature, use the ammeter to determine the back current (discharge current) at which the contacts open and the relay is switched off. The back current should be between 0.5 and 6.0 a.

If as the rotating speed of the generator armature is increased the voltage indicator by the volt meter does not increase, and the relay contacts do not close (volt meter arrow is not deflected, relay contacts do not close), first check and adjust the voltage regulated by the voltage regulator, then the voltage at which the back current relay closes.

Testing voltage regulator. In testing the voltage regulator, the following changes are made to the connection of the instruments: disconnect battery, connect volt meter to B terminal of voltage regulator (see dotted line on Figure 18-22a). The rotating speed of the generator armature is set at approximately 3,000 rpm. The moving contact of the rheostat is set so that the load on the generator corresponds to 10 a for the RR24-G and RR24-E voltage regulators and 15 a for the RR130 voltage regulator. The volt meter at this point should show the actual value of voltage being regulated as 13.8-14.8 v.

Checking of current limitor. The current limitor is tested using the same connection diagram used to check the voltage regulator.

Set the rotating speed of the generator armature at between 4,000 and 5,000 rpm. Then, gradually increasing the generator current using the rheostat, observe the needle of the ammeter for the moment of beginning of operation of the current limitor.

As the load is increased by the rheostat, the indications of the ammeter first increase, then the increase in indications stops. The maximum reading of the ammeter will correspond to the maximum current output by the generator, i.e. will correspond to the setting of the current limitor.

With a voltage of 12.5 v, the reading of the ammeter should be: 17-19 a for the RR24-G and RR24-E voltage regulators; 26-30 a for the RR130 voltage regulator; 26-29.5 a for the RR23-B voltage regulator; 33-37 a for the RR51 voltage regulator.

Testing and adjustment of RR23-B and RR51 voltage regulators. Testing is performed according to the diagram shown on Figure 18-22b. The order of testing is the same as for the RR24-G and RR130 voltage regulators.

Adjustment of voltage regulators should be performed in one of the following cases, detected upon testing:

if the voltage at which the back current relay switch is on differs from the limits indicated in the technical characteristics by more than 0.5 v;

if the voltage regulated is less than the voltage at which the back current relay switch is on (the relay does not switch on);

if the regulated voltage varies from the limits indicated in the technical characteristics by more than 0.5 v;

if the current regulated differs from the limits indicated in the technical characteristics by more than 1 a.

Before adjustment of the voltage regulator, the clearance and condition of contacts should be tested, and the gap should be adjusted if necessary.

The gap in the back current relay contacts of the RR24-G, RR24-E and RR130 voltage regulators is adjusted by bending of limitor 4 (see Figure 18-7d).

The clearance between the nonmagnetic step of armatures 1 and 9 (see Figure 18-7a) and the core of coil 8 of the current limitor and coil 3 of the voltage regulator is adjusted by moving the front uprights 10 and 2 vertically with their retaining screws loosened.

After adjustment, the screws are firmly tightened.

The clearances are similarly adjusted for voltage regulators RR23-B and RR51, by moving the uprights as indicated for voltage regulators RR130 and RR24-G.

The voltage at which the back current relay is switched on, as well as the voltage maintained by the voltage regulator and the current maintained by the current limitor are adjusted in case the values are too high by weakening, or in case the values are too low by tightening spiral spring 7 of the armature, by bending the holder upward or downward using a wrench. The method of bending of the holder during adjustment of spiral spring tension of the RR24-G, RR24-E and RR130 voltage regulators is indicated on Figure 18-23a.

Before adjustment of voltage regulators RR23-B and RR51, make sure that both voltage regulator relays operate together.

This is done by connecting a volt meter with a center-scale zero to their terminals.

If the arrow of the volt meter remains at zero, no adjustment of voltage regulator relays is required. If the needle deflects from zero, they should be adjusted in the following sequence.

The armature of the generator is rotated and a load of 14 a is set for the RR23-B or 18 a for the RR51 voltage regulator. Then the armature of one of the regulators is wedged in place. The contacts are forced closed using a match stick, which is carefully placed between armature 1 (see Figure 18-7f) and the core of the coil.

After this, smoothly increasing the rotation speed of the generator, the voltage of the first voltage regulator is adjusted, as close as possible to the mean value of 14.2 v.

The moment of beginning of operation of each voltage regulator can be determined from the vibration of the voltage regulator armature, which is easy to determine by lightly touching the armature with the finger.

In order to increase the voltage maintained by the regulator, tighten the spiral spring with its adjustment nut; in order to decrease the voltage maintained by the regulator, loosen the spiral spring with its adjustment nut (see Figure 1823b).

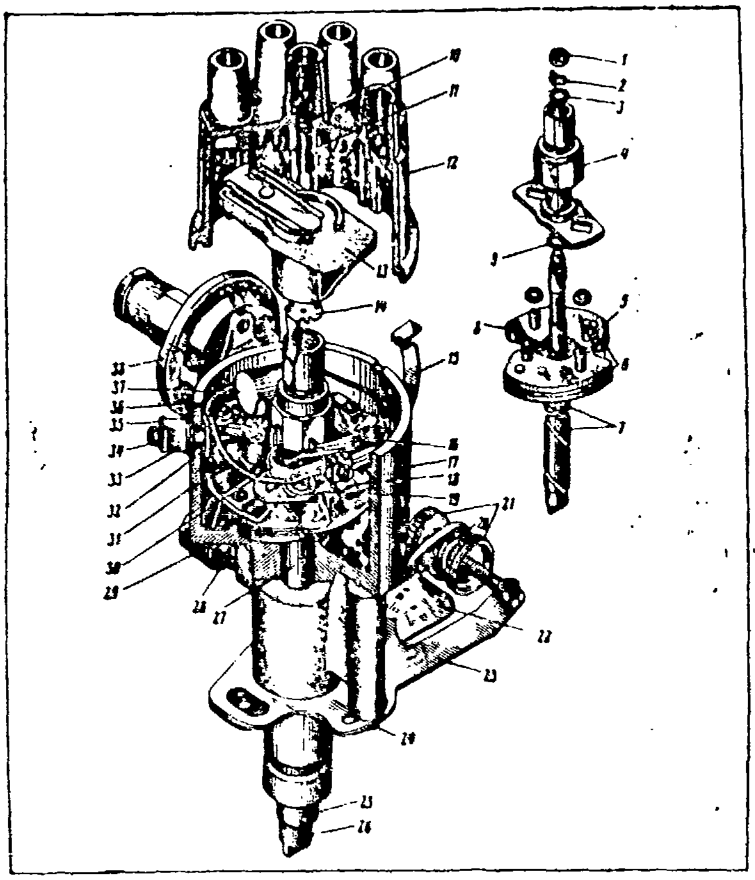


Figure 18-40. The R4-V Distributor:
1, felt pad, 2, sealing ring, 3 and 9, thrust washers, 4, breaker cam, 5 and 8, regulator plate springs, 6, regulator plate, 7, breaker shaft, 10, electrode spring, 11, central electrode, 12, cover, 13, rotor, 14, rotor spring plate, 15, spring cover holder, 16, breaker lever, 17, breaker body, 18, spring bracket, 19, moving disk, 20, guide bushing, 21, adjustment nuts of octane corrector, 22, lower plate of octane corrector, 23, upper plate of octane corrector, 24, plate mounting bolt, 25, pin, 26, shaft, 27, shaft bushing, 28, oiler, 29, oiler cover, 30, bracket with nonmoving contact, 31, primary circuit wire, 32 and 33, insulators, 34, primary circuit terminal, 35, terminal insulator washer, 36, ground wire, 37, condensor, 38, vacuum advance mechanism.

Then the first voltage regulator is released (match removed), the other regulator is wedged (matchstick placed between armature and core) and the voltage of the second voltage regulator relay is similarly adjusted, attempting to reach the mean value of 14.2 v.

After completion of individual adjustment, the regulated voltage is tested using the method indicated for the RR130 and other voltage regulators. The voltage adjusted must be between 13.7 and 15.1 v for the RR23-B and 13.8 and 15.0 v for the RR51 voltage regulator. If it goes beyond these limits, adjustment must be tested.

In adjusting any device in the voltage regulator, make sure that the locating edge of the corner piece enters the slot in the adjustment nut (see Figure 18-23b).

Dissembly of R4-V distributor (Figure 18-40). A distributor arriving for repair should be cleaned to remove dirt, dust and oil spots, then sent on for assembly.

The order of assembly of the distributor should be as follows.

Loosen 1 bolt 24 fastening the octane corrector plates to the body of the distributor, remove both plates 22 and 23 from the body together with the adjustment screws and the circular insert between plates. Remove cover 12, loosening both spring holders 15 manually, remove rotor 13 and perform further dissembly.

On the R102 distributor (see Figure 18-10) in order to remove the cap it is necessary to remove screws 7, screen 12 and cap 13. The sealing rings should be protected from damage.

On the R51 distributor, before removing the cap, the shield must be removed by removing one retaining nut.

Remove the screw mounting condensor 37 (see Figure 18-40), loosen the condensor wire mounting spring, disconnect the wire from the upright and remove the condensor from the inner portion of the distributor body.

On the R21-A and R51 distributors, the condensor is located outside the body.

The R4-D distributor has no condensor.

To remove vacuum advance mechanism 38, the two screws mounting it to body 17 of the distributor must be removed. Loosen one screw mounting the arm to moving disk 19, at the same time disconnecting one end of the ground wire (bar). Disconnect the arm from the axis of the moving disk and remove the vacuum advance mechanism.

The R102 distributer has no vacuum advance mechanism. To remove lever 16 (see Figure 18-40) of the breaker, loosen the screw mounting the primary circuit conductor terminal, disconnect the wire and remove the breaker lever and spring with a screwdriver.

To remove terminal 34 of the primary circuit, loosen the conductor mounting nut, disconnect the wire, remove internal insulator 32 and remove the screw terminal from the body with external insulator 33.

In the R51 and R102 distributors, terminal 4 (see Figure 18-10) of the primary circuit must be removed from the body by removing nut 23 and if necessary dissembling the terminal (in case of damage to the core, shielding braid, wear of the sealing ring or insulating bushing). During dissembly, unsolder contact 28, remove washers 22 and disconnect the terminal parts.

To remove terminal 4 from a distributor installed on a truck, simply remove retaining nut 23.

To remove the plate with the nonmoving contact of the breaker, remove one mounting screw of the plate and remove the plate from the shaft with a screwdriver.

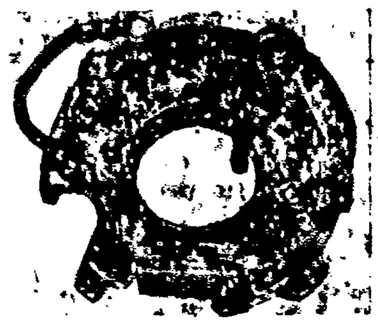


Figure 18-41. Moving and Nonmoving Disks Assembled with Bearing of Vacuum Spark Advance Mechanism.

To remove the moving and nonmoving disks with bearing together, loosen 2 screws holding the disks to the body, disconnecting the ground wire, then remove the two disk holders and remove both disks from the body of the distributor together with their bearing (Figure 18-41). The ball bearing on the moving disk should not be removed unless necessary, since it is rolled into the lower disk clamp.

The moving disk in the spreader bracket carries a felt pad which is removed, washed and replaced when necessary.

On the R102 distributor, there is no ball bearing, since the distributor carries no vacuum advance mechanism.

Dissembly of the breakers of the R21-A and R51 distributors is performed just as for the R4-V distributor.

Removal of centrifugal spark advance mechanism. Remove the felt pad (Figure 18-42a) from the cavity of the cam axis using a sharp metal rod, remove locking ring 7 with needle nose pliers (Figure 18-42b), remove the thrust washer from the shaft and cam 2 together with plate 8 (Figure 18-42c).

To remove the plate (weight) 3 of the centrifugal regulator, remove the two flat thrust washers from the shaft with needle nose pliers, remove 2 washers from limiting pins 5, remove 2 limiting springs 4 from pins 6 with needle nose pliers and remove both plates (weights) 3 of the regulator from the axes on the lower plate. Figure 18-42f shows the centrifugal spark advance mechanism of the R4-V distributor, while Figure 18-42e shows the shaft with the lower plate.

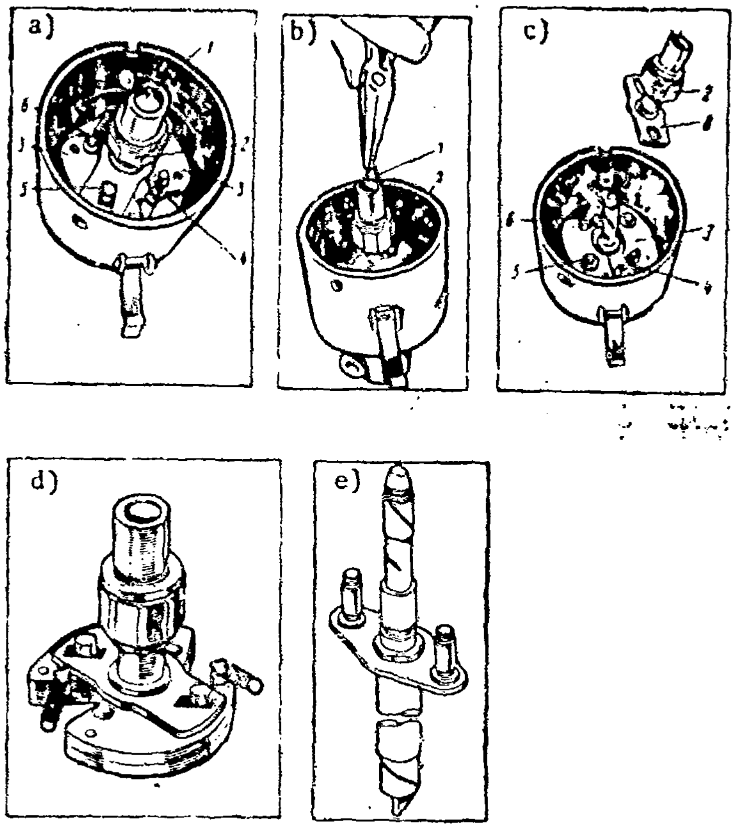


Figure 18-42. Dissembly of Centrifugal Spark Advance Mechanism of R4-V Distributor:
a, body with centrifugal regulator, b, removal of locking ring, c, body with breaker cam removed, d, centrifugal regulator, e, shaft together with lower plate;
1, felt pad, 2, cam, 3, plates (weights), 4, limitor springs, 5, limiting pins, 6, pins, 7, locking ring, 8, cam plate.

On the R21-A and R51 distributors, the breaker cam is mounted with a screw; when the cam is removed, the screw must be removed with a screwdriver. Figure 18-43 shows the individual operations involved in dissembly of the centrifugal spark advance mechanism of the R21-A distributor.

Removal of shaft and pressing of bushings from distributor body. Remove oiler 28 (see Figure 18-40) and set body 17 on the workbench, placing a hollow metal support beneath the clutch. Knock out clutch retaining pin 25. Remove the clutch from the end of the shaft, followed by the flat thrust washer and remove shaft 7 from the body together with the lower plate, fasten tightly to it.

Press out bushings 27 of the shaft from the body.

Testing of distributor parts. The insulator on the lever must be tested. If the insulator is greatly worn, the rotor or insulator should be replaced.

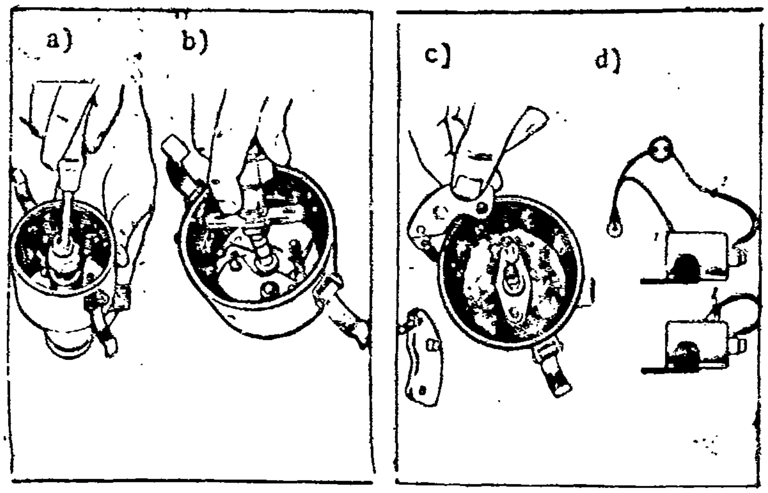


Figure 18-43. Dissembly of Centrifugal Spark Advance Mechanism of R21-A Distributor:
a, removal of cam mounting screw, b, removal of cam with plate, c, removal of weights, d, testing of condensor of R4-V distributor.

To replace the insulator, remove the clamp, install a new insulator and replace the clamp.

Checking of operation of condensor. The condensor can be tested by connecting it in series in an electric circuit consisting of a battery and a test light, or by connecting the condensor in a dc lighting circuit with a voltage of 127-220 v in series with an electric lamp (see Figure 18-43d).

If the lamp does not light or a small spark jumps between the condensor wire and its body when the condensor has just been disconnected from the circuit, the condensor is in good condition.

Assembly of R4-V distributor. Installation of breaker and distributor shaft. Press bushings 27 (Figure 18-40) into the body with an interference of 0.05-0.20 mm and turn them to the diameter of the shaft using a reamer. Insert the shaft, assembled as shown on Figure 18-42e, into the body, putting on the upper thrust washer. Then install the lower thrust washer and clutch of the drive and fasten it with its pin, spreading the ends.

The shaft should rotate freely in the bushings in the body, without seizing or wedging.

Installation of centrifugal regulator. Install both moving plates (weights) on the axes on the lower nonmoving plate of the shaft (see Figure 18-42c) of the regulator and connect them with limiting springs 4. Place one thrust washer on the distributor shaft, and both flat washers on the limiting pins 5 of the moving plates (weights). Install cam 2 with its bushing on the distributor shaft together with the upper nonmoving plate 8, the notches in which must be directed over pins 5 of the plates (weights) of the centrifugal regulator. Install the thrust washer on the end of the distributor shaft and fasten the breaker cam on the shaft with locking ring 7 (see Figure 18-42b). The breaker cam is fastened onto the R21-A distributor by means of its mounting screw (see Figure 18-43a).

After this, soak felt pad 1 (see Figure 18-42a) with oil and place it in the cavity in the cam.

Installation and mounting of the breaker on the moving disk can be performed before installing the disks into the distributor body, or after the moving disk has been installed and mounted in the body of the distributor, which is more frequently seen in practice.

Install the nonmoving and moving disks together with their bearing in the body and fasten them down with the 2 screws and spring washers.

Install the terminal of the primary circuit with insulators, fasten one end of a wire to it and tighten the nut.

To assemble terminal 4 (see Figure 18-10) of the R102 and R51 distributors, core 27 of the wire must be soldered to contact 28, and shield braid 20 must be straightened and held firmly by washers 22.

Install the plate with the nonmoving contact on the axis of the breaker lever; the eccentric for adjustment of the point gap should be on the forked end of the plate, and the plate must be preliminarily tightened with its screw.

Then install the breaker lever on its axis with its strip spring, connect it to the mounting screw and tighten it with the screw, after which connect the primary circuit wire.

Installation of equipment on distributor. Install the condensor and fasten it down, then connect the wire to the terminal and tighten the screw.

Install the vacuum advance mechanism, placing its arm on the axis of the moving disk, then fasten the body of the vacuum advance mechanism with 2 screws, after inserting the spring, adjusting shims and tighten the nut and sealing washer. The vacuum advance mechanism must be installed so that its arm rotates the moving disk to its extreme position, corresponding to late ignition. This position is adjusted by moving the body of the vacuum advance mechanism relative to the body of the distributor, rotating it by the oval apertures in the body of the vacuum advance mechanism. If this is insufficient, adjusting shims must be used, installed between the end of the vacuum advance spring and the end of the nipple. Precise adjustment is performed using an instrument.

Install the plates of the octane corrector on the body of the distributor and fasten them down.

After assembly of the distributor, lubricate the distributor lever axis, breaker cam and cam shaft with clean motor oil.

Also, the bushings of the shaft must be lubricated with grease through the oiler screwed into the body of the distributor.

Adjustment of distributors of all types used on ZIL motors is identical.

Adjustment of breaker point gap can be performed with the distributor removed from the motor or installed on the motor. Checking of the strength of the breaker spring and adjustment of the ignition advance mechanisms can be performed only with the distributor removed from the motor.

To adjust the gap (see Table 18-4), cam 1 (Figure 18-44) must be set in the position with the breaker points separated to the maximum, then the point gap must be measured with gauge 15 with all 8 cam lobes holding the points open.

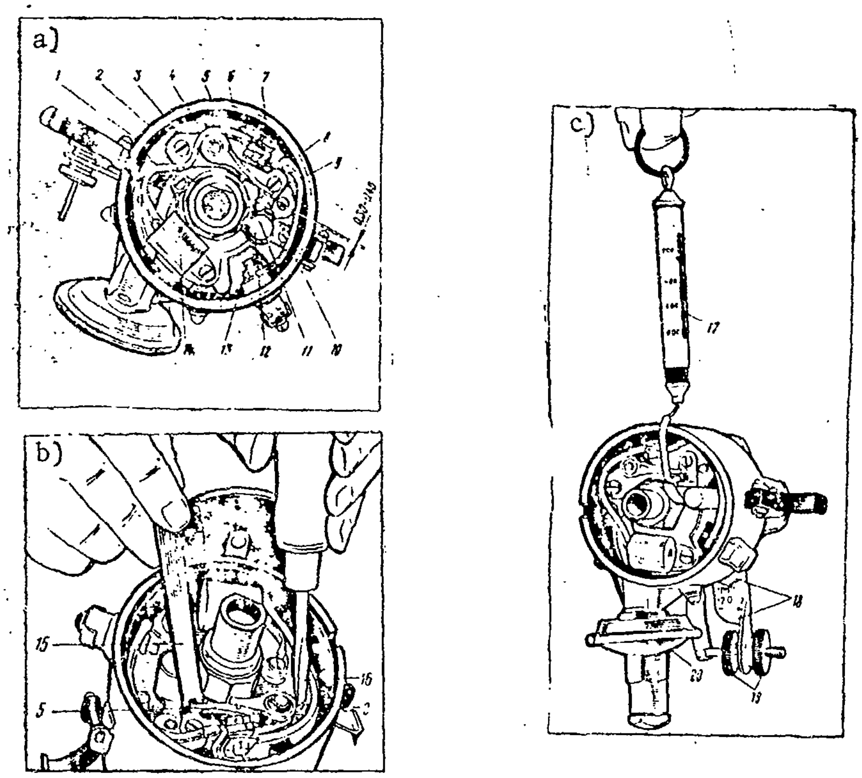


Figure 18-44. Adjustment of R4-V Distributor:
a, top view, b, adjustment of point gap, c, testing strength of spring with dynamometer;
1, cam, 2, adjusting eccentric, 3, plate, 4, axis, 5, lever, 6, spring, 7 and 8, screws, 9 and 10, points, 11, insulator, 12, felt pad, 13, terminal, 14, condensor, 15, gauge, 16, screwdriver, 17, dynamometer, 18, octane corrector plate, 19, adjusting nuts, 20, vacuum advance mechanism.

To adjust the gap, loosen screw 8 which holds down plate 3 with nonmoving point 10 and, rotating adjusting eccentric 2 with a screwdriver, set the normal gap measured by gauge 15, then tighten screw 8 and check the gap once more.

After adjusting the gap, check the strength of spring 6 on lever 5 of the breaker. A weak spring can cause misfiring at high speeds, while an accessibly strong spring will cause rapid wear of breaker points and cam lobes. The strength of the spring is tested with dynamometer 17, the end of which is cooked over lever 5 and pulled until a gap (separation) between the contact appears.

Testing of centrifugal and vacuum advance mechanisms can be performed only using an instrument with a spark discharge mechanism, variable speed electric motor and vacuum pump with manometer.

The octane corrector scale is set depending on the octane member of the gasoline used in the motor. The accuracy of setting of the ignition advance is determined using the octane corrector scale and is set with adjusting nuts 19.

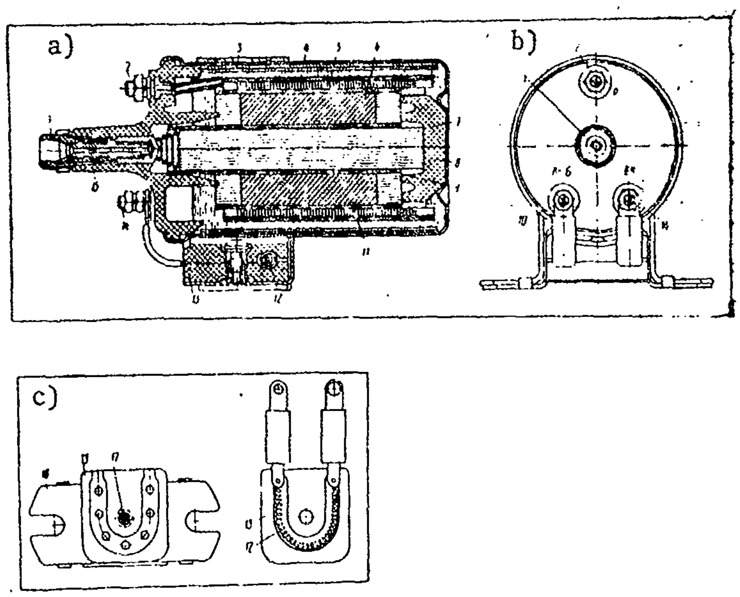


Figure 18-45. B1 Ignition Coil with Additional Resistor:
a, cross section of coil, b, view from end with terminals, c, additional resistor;
1, output terminal, 2, primary terminal, 3, coil cover, 4, compound mass, 5, primary, 6, secondary, 7, core, 8 and 13, insulators, 9 and 11, winding casing tubes, 10, VK-B terminal, 12, spiral, 14, VK terminal, 15, cover, 16, panel, 17, screw with bushing.

Ignition coils are not dissembled, but are tested assembled. When necessary, only the additional resistor can be dissembled to replace the spiral.

In order to remove the additional resistor from the B1 and B13 coils, remove the nut from terminals 10 and 14 (see Figure 18-45), remove the 4 mounting holders by which panel 16 of the resistor is held to the coil bracket with a screwdriver; remove the resistor terminals from the coil terminals and remove the additional resistor.

To remove spiral 12 together with its terminals, remove screw 17 holding the porcelain insulators 13, then remove the upper insulator and the spiral together with its terminals.

In replacing spiral 12 of the additional resistor, disconnect the ends of the spiral from its terminals, take a new spiral and weld its ends to the terminals. Then place the new spiral together with its terminals in the channel of the lower insulator, install the upper insulator and fasten down the parts of the insulator with screw 17. Install the additional resistor on the ignition coil and connect its terminal to the VK-B and VK terminals of the coil, then fasten them down with nuts.

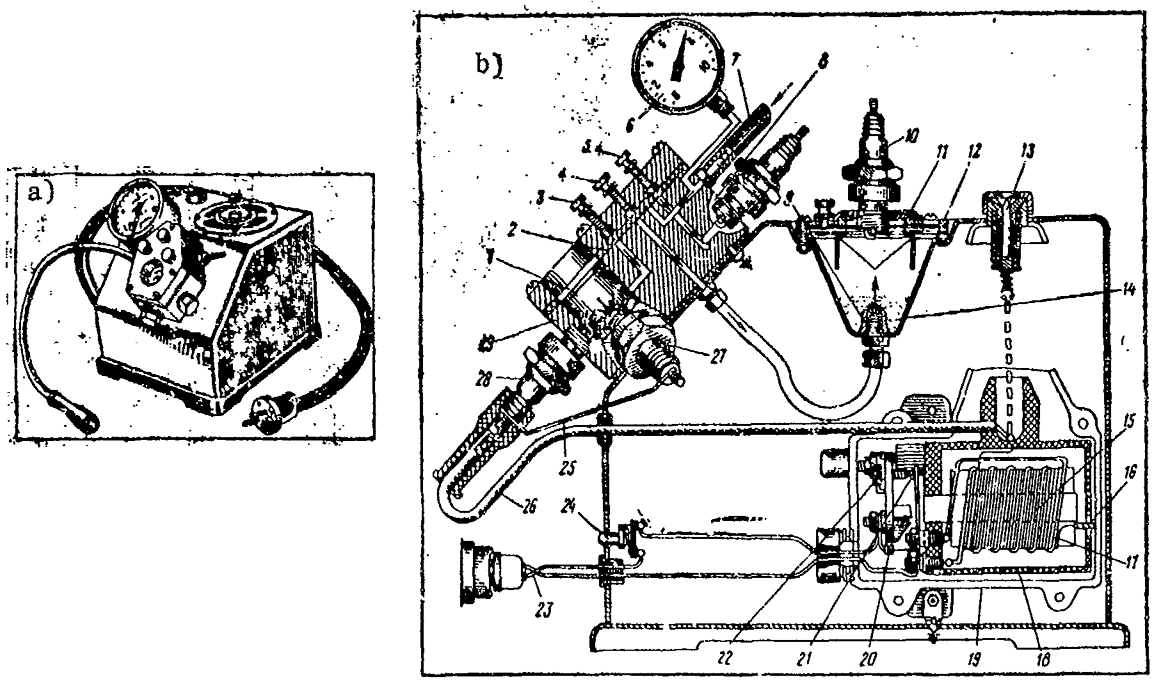


Figure 18-46. Model 514-2M Instrument for Cleaning and Testing of Spark Plugs: a, exterior view, b, diagram of instrument; 1, viewing window, 2, rubber diaphragm, 3, 4 and 5, adjusting screws of compressed air valves, 6, manometer, 7, air hose, 8, socket for blowing of plugs with compressed air, 9, operating jet, 10, plug installed for sand blasting, 11, interchangeable rubber collar, 12, body of sand blasting chamber, 13, discharger, 14, sand, 15, secondary of induction coils, 16, contact plate connecting secondary to ground, 17, primary of induction coils, 18, carbolite body of induction coil, 19, metal coil cover, 20, condensor, 21, moving breaker contact, 22, nonmoving (adjusting) breaker contact, 23, cord, 24, induction coil button switch, 25, cross connector, 26, high voltage line, 27, control plug, 28, plug being tested, 29, body of air chamber of device.

The additional resistor of the B5-A, B102-B and B114 coils is installed on the front wall of the cabin. The additional resistor is removed from the truck to replace the spiral.

The windings of the ignition coil are tested for spark formation on an SPZ-6 testing device. Lack of spark formation or instability of sparking indicates defects in the coil winding. In order to determine the condition of the windings (sharp between turns of primary or breakdown of insulation in secondary), measure their resistance, which should correspond to the data in the technical characteristics. Otherwise, defective ignition coils must be replaced.

Defects in the windings of coils most frequently appear as a result of overheating, resulting from a closed primary circuit when the motor is turned off and the key is left on. This may cause the ignition coil to heat up to 120°C or hotter.

Dissembly and assembly of spark plugs. Defective spark plugs removed from the engine are cleaned and tested. External inspection is used to reveal cracking of insulators, visible cracks or breakage of electrodes. Such plugs must be replaced.

Cleaning and checking of spark plugs is performed using the 514-2M device (Figure 18-46), consisting of a chamber for cleaning of plugs and a plug testing device.

To clean a plug, the plug 10 is screwed into the seat with its seal, then sand blasted for 5-10 sec.

After this, the plug is removed, inserted in seat 8 and blown with compressed air, the gap between the electrodes is tested with a wire gauge and when necessary the side electrode is bent to produce a gap of the proper width.

Before testing the gap, clean the central and side electrodes of the plug.

Plugs are tested under a pressure of 8-9 kG/cm^2, determined by manometer 6. To test a plug 28, it is screwed into the seat and connected with wire 26 to the induction coil inside the body of the device. The current is switched on by button switch 24 and the operation of the plugs is observed through viewing window 1; if the plug operates properly, the spark should appear without interruptions. A control plug 27 is screwed into the second seat in the chamber for comparison.

Interruptions in spark formation, lack of spark, sparking through cracks in the insulators indicate a defective plug which must be replaced.

Interruptions in sparking or absence of spark when a spark is present in the test plug indicate that the plug gap is improperly set.

Testing of starters before dissembly. In order to determine the condition of a starter, it must be tested without load on a test stand before dissembly. Starters should not be run for more than 1 minute.

Figure 18-47 shows a diagram of the electric circuit for testing of starters. If the operating speed of the armature and current consumption of a starter being tested do not correspond to the data presented in Table 18-6, the starter should be repaired.

Dissembly of ST15-B starter. Remove the nut mounting the cross piece to output terminal 6 (Figure 18-48) of the starter and remove the flat washer from the terminal. Remove the nut mounting the cross piece to terminal 7 of the switch, remove the washer and cross piece. Remove the two screws mounting switch 8 to the body of the starter and remove the starter switch assembled.

Unscrew the two tension bolts, remove them from the body; loosen the screw on the retaining strip and remove it from the body; remove the 4 brushes from the brush holder, lifting the retaining springs with a metal hook. Separate the body and remove the drive end cap from the armature, remove the body from the armature, remove the armature from the splined aperture in the drive clutch. Unscrew the two screws holding the support disk and bushing to the rear cover, remove the support disk and bushing and support washer. Remove the starter drive from the cover manually.

Dissembly of drive end cover. Preventing the lever axis from rotating with a screwdriver, unscrew the nut mounting the starter lever axis. Press out the lever axis, at the same time remove the two adjusting shims, one cup-shaped washer and spring, removing its end from the lever with a screwdriver.

Dissembly of starter body. To replace the starter excitor windings, loosen the two nuts mounting the negative brush wires and remove the brushes (the positive brushes are connected to the ends of the starter windings). Loosen the nut mounting output terminal 6 of the starter, remove the washer and insulating bushing from the terminal. Withdraw the terminal from its aperture into the body, bend back the terminal end of the winding and remove the insulating washer.

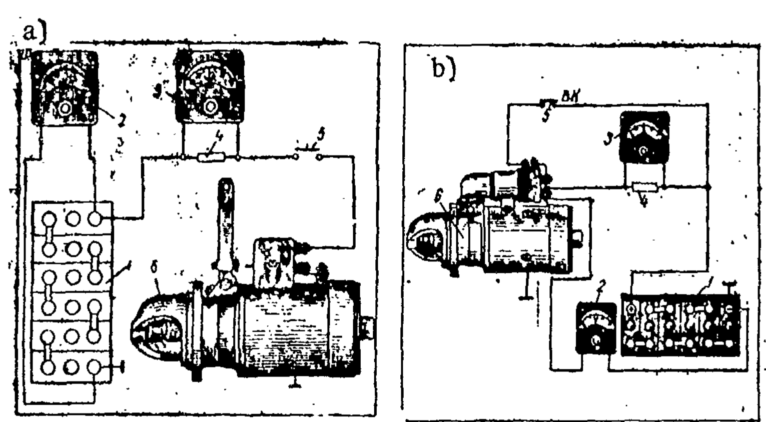


Figure 18-47. Diagram of Connection of Starter During Idle Testing:
a, ST15-B, b, ST130 and ST2;
1, battery, 2, volt meter, 3, ammeter, 4 shunt, 5, switch, 6, starter.

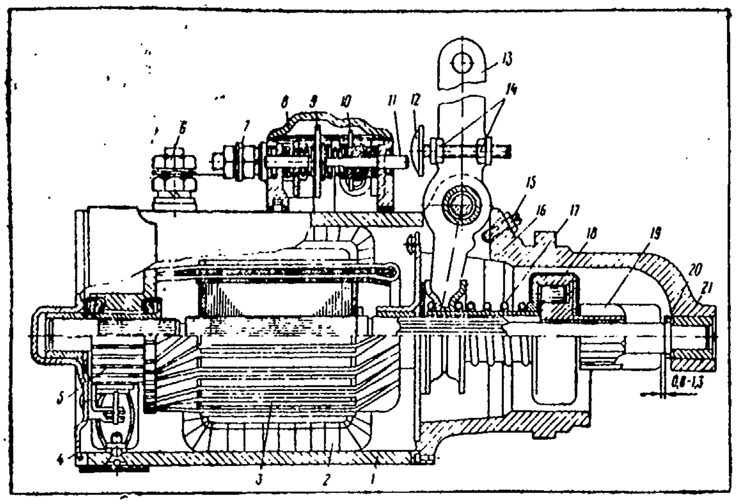


Figure 18-48. ST15-B Starter:
1, body, 2, excitor winding, 3, armature, 4, collector end cover, 5, collector, 6, output terminal of starter, 7, output terminal of switch, 8, switch, 9, main contact disk of switch, 10, additional contact disk connecting additional resistor of ignition coil, 11, switch plunger, 12, switch pusher, 13, lever, 14, counter nut, 15, lever support screw, 16, lever drive clutch, 17, return spring, 18, free travel clutch, 19, starter gear, 20, thrust washer, 21, drive end cover.

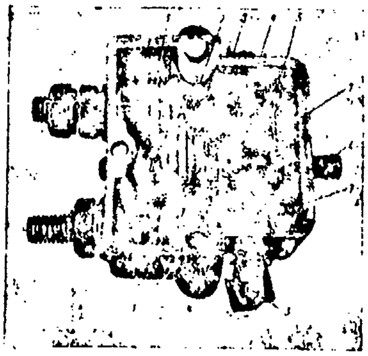


Figure 18-49. ST15-B Starter Solenoid:
1, starter switch contact, 2, moving disk contact, 3, terminals connecting leads from additional coil resistor, 4, terminal contacts, 5, additional moving contact disk, 6, starter solenoid shaft, 7, guide bushing mounting screw.

Using the screwdriver used to remove generator screws, remove the 4 screws mounting the pole cores with the adapter, remove the 4 pole cores from the winding and remove the starter winding.

The collector end cover is dissembled only when the brush holders must be replaced. When the bushings of the front and rear covers are worn, they are replaced with new ones.

In a properly operating solenoid (Figure 18-49) for the ST15-B starter, the nonmoving and moving contacts of the power circuit should be flat and clean. The moving contact disk 2 should contact the surface of the nonmoving contacts 1 tightly at all points, which is adjusted by installation of additional shims.

In case of burning or wear of contacts 1 of moving disk 2, as well as disk 5 and contacts 4, the procedure is to: remove the cover from the solenoid, removing the 2 screws; withdraw the guide bushing of shaft 6 of the solenoid by removing screws 7; withdraw the shaft together with the contact disks, clean the disks and contacts of the terminals, assemble the solenoid parts and fasten them down. In case of burning or wear of contacts 1, they may be rotated by 180°.

Dissembly of the ST130 starter. The designs of the ST130 and St2 starters are identical with the exception of the sealing of the ST2 starter.

The following sequences recommended for dissembly of the ST130 starter.

Disconnection of starter wire and terminals and removal of solenoid. Remove the 4 screws mounting cover 11 (Figure 18-50) of the solenoid and remove it, remove the pin from bar 12 of arm 10 and remove it from the aperture in lever 13 and arm 10 of the relay core, remove the fiber cover gasket, protective plate and rubber solenoid bushing.

Remove the nut fastening the end of the cross piece and output terminal of the starter windings, remove the nut fastening the second end of the cross piece, remove the cross piece connecting the solenoid to the starter winding from the terminals and disconnect the wire.

To remove the solenoid (Figure 18-51) from the body of the starter, remove the pins from the 2 solenoid mounting bolts, remove the stop washers with a screwdriver, then unscrew the bolts and remove the solenoid.

To remove the solenoid of the ST2 starter, first remove the screws mounting it to the starter body, disconnect the link of adjusting screw nut (Figure 18-52) from lever 10 of the drive and remove the solenoid.

Dissembly of starter into units. Loosen the screw mounting the protective strip and remove the strip and gasket from the body. To remove the collector brushes, remove the 4 screws mounting the brush wires and remove the brushes from the brush holders (2 positive and 2 negative), removing the pressure springs with a hook as used for removal of starter and generator brushes.

On the ST2 starter, protective cover 28 (see Figure 18-52a) is seated on the body with 2 rubber sealing rings, which do not allow the cover to be removed by hand. It is therefore recommended that the protective cover be removed using compressed air, pumped into the starter. To do this, remove cover holder 25, put on cap 31 (see Figure 18-52b) onto the neck of the cover on the starter drive end with seal 30 and pump compressed air into the starter through nipple 32. The compressed air will push off cover 28.

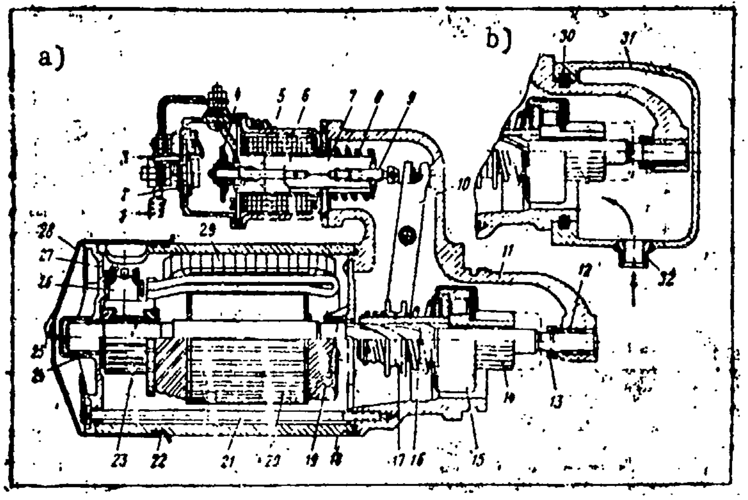


Figure 18-52. The ST2 Starter:
a, cross section of starter, b, method of pressing out protective cover with compressed air;
1, wire, 2, main nonmoving contact, 3, nonmoving contact for disconnection of ignition coil additional resistor, 4, moving contact, 5, solenoid, 6, solenoid windings, 7, armature, 8, return spring, 9, adjusting screw, 10, lever, 11, drive end cover, 12, 19 and 24, copper-graphite bearings, 13, sealing ring, 14, drive gear, 15, free travel clutch, 16, thread, 17, dog clutch, 18, starter body, 20, starter armature, 21, tension bolt, 22 and 30, sealing rings, 23, collector, 25, protective cover holder, 26, brush, 27, collector end cover, 28, protective cover, 29, starter winding, 31, supplementary cap, 32, nipple for input of compressed air.

Remove the 2 bolts 21 retaining the cover from the body, then remove the brushes, remove the front cover together with the brush holders, remove the body of the starter from the armature together with the solenoid.

To separate the armature from the cover on the drive end, remove the drive lever axis mounting nut, remove the drive axis, remove the 2 screws mounting the armature shaft center support disk, remove the armature from the cover body together with the starter drive and center support, simultaneously removing the starter drive lever.

The collector end cover and starter drive are dissembled only when necessary.

When replacing windings, the body of the ST130 starter is dissembled in the same manner as the body of the ST15-B starter, using the support device (see Figure 18-34).

Dissembly of starter drive. Remove the support washer from the armature shaft, remove the stop ring from the slot in the shaft, remove the stop ring from the gear using a sharp metal rod and screwdriver. Remove free travel clutch 5 (Figure 18-53) from the armature shaft together with the springs and dog clutch 7, remove the center support disk together with the bushing.

To replace the springs or dog clutch, remove the first stop ring with its guide bushing, the thrust washer of the spring, the small spring, remove the first half of the dog clutch; remove the second stop ring, remove the second half of the dog clutch, remove the large conical spring and the thrust washer of the spring. The free travel clutch is replaced with a new one in case of a defective internal mechanism.

Dissembly of starter solenoid. Remove screws 4 (see Figure 18-51) mounting cover 1 of the solenoid and remove the cover together with the terminals and gasket. To remove the terminals from the cover, remove nut 2 of the terminal holding the battery wire and the nut of the terminal holding the output wire of the starter winding and the cross piece, then remove the terminals from the apertures in the cover. Remove the nut mounting the terminal and nut 3 mounting the wire from the additional resistor of the ignition coil, remove the washers and remove the terminal together with the contact plate connecting to the moving contact (disk) when the starter is turned on, at the same time remove the insulating plate from the inside of the cover.

To remove moving contact 6 and armature 8 of the solenoid, remove the stop ring mounting the contact on the armature rod. Then remove the washer, moving contact, contact spring, armature spring holder from the side of the armature, after which remove armature 8 together with return spring 9. The windings of the relays, both pulling and holding, are not removed from the body, since they are in a special box.

After cleaning the contacts and replacing the insulating disks, assembly of the solenoid is performed in the reverse sequence.

Testing and repair of starter parts and units following dissembly. After dissembly, all starter parts and units should be subjected to testing to determine operability.

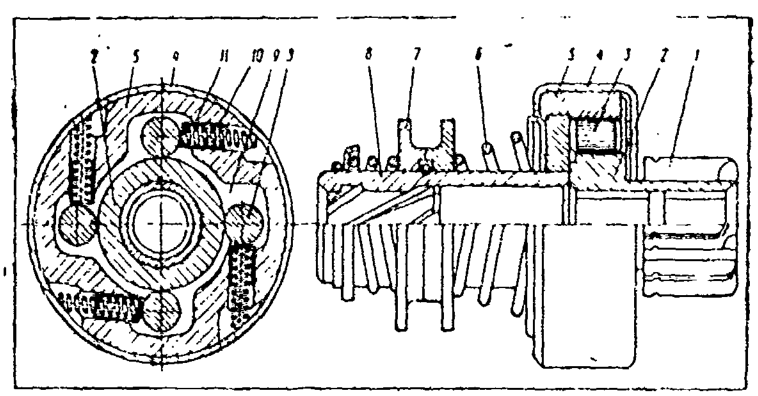


Figure 18-53. Drive of ST130 Starter: 1, drive gear, 2, gear hub, 3, roller, 4, clutch cover, 5, free travel clutch, 6, spring, 7, dog clutch, 8, blind bushing, 9, wedged groove in clamp, 10, pusher spring, 11, pusher.

Wear of shaft necks is eliminated by cleaning or grinding. Mutual beating of shaft necks must not exceed 0.10 mm.

In case of significant wear of the armature collector, it must be turned down. The diameter of the collector can be decreased by 3 mm in comparison to the nominal diameter. With slight collector wear, it is cleaned with sandpaper.

The height of the starter brushes is 14 mm, the maximum wear should not exceed 7 mm.

If the bushings of the armature shaft support are worn, they should be pressed out and replaced with new ones. The apertures must be turned out to the diameter of the armature shaft.

Before pressing in new copper-graphite bushings, they should be well dried at 100-150°C for an hour, then soaked in machine oil heated to 180-200°C for 2 hours.

The free travel clutch should provide free rotation toward the right (seen from gear end) and reliable wedging of the rollers in the opposite direction.

The moving contact disk of the starter solenoid should contact the surface of the nonmoving contact tightly in any position, which is adjusted by insertion of additional shims.

Electrical check and testing of the starting armatures is performed on the PPYa-5 device (see Figure 18-35) or the model 533PPYa device, used to test generator armatures. When testing a starter armature, the device should be switched to the high current position. The method of testing of starter armatures is similar to the method of testing a generator armature.

Testing of starter excitor windings is performed as for generator windings (see Figure 18-37, 18-38).

Testing of brush holder insulation in starter covers is performed as for generator covers (see Figure 18-39).

Assembly of starter is performed in the opposite order to dissembly.

When assembling the ST130 starter, installation and connection of the solenoid drive must be performed as follows. Install the relay on the body of the starter and fasten 2 bolts with stop washers, after which counter the bolts, bending 1 lug on the washer over a face of the bolt head. Connect the output wire of the starter and the end of the cross piece to the terminal of the solenoid and fasten them on the terminal with a nut; the other end of the cross piece is fastened to the output terminal of the solenoid with a nut, then connect the core of the solenoid to the starter drive lever, placing the pin in the aperture in the link and lever. Key the pin and install the cover after adjusting the starter drive mechanism.

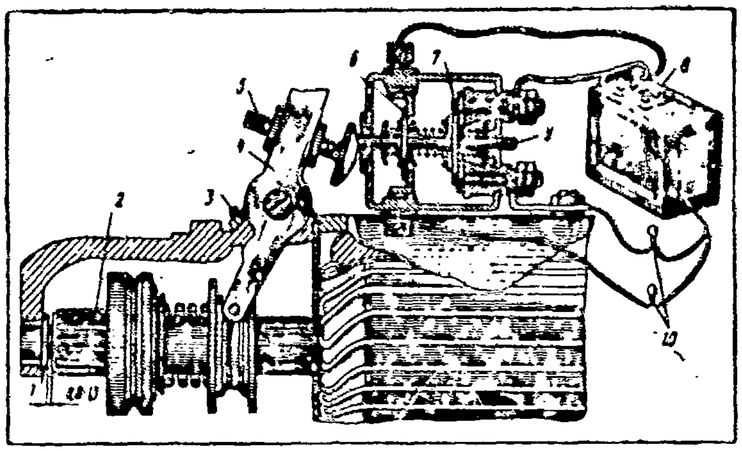


Figure 18-54. Diagram of Testing of Engagement of ST15-B Starter:
1, thrust washer, 2, drive gear, 3, adjustable lever support screw, 4, lever, 5, solenoid mechanism pusher, 6, contact disk connecting additional coil resistor, 7, contact disk connecting starter, 8, battery, 9, solenoid shaft, 10, control lights.

When assembling the ST2 starter, first connect the link of regulating screw 9 (see Figure 18-52) to lever 10 of the drive, then fasten the solenoid onto the starter body.

Testing starters. To idle test a starter, fasten it in the test stand and connect it to a battery as shown on the Figure (Figure 18-47).

During testing, the starter should not be turned on for more than 1 minute. During the testing process, check the rotating speed of the starter armature with a tachometer and the current consumption with an ammeter. These quantities should correspond to the technical characteristics presented in Table 18-6. For the ST130 and ST2 starters, also check the additional relay which should switch on with a voltage of 7-8 v, then switch off at a voltage of 3-4 v.

If the current consumed by the starter is higher than the specifications of Table 18-6, and the armature rotates at low speed, this indicates a skew, seizing or uneven clearance between armature and pole cores. The reason for low current consumption and low armature rotating speed may be poor contact of electrical circuit or of starter or poor contact between brushes and collector (weak brush springs). Extremely high current consumption and low speed of rotation indicates a short circuit in the starter.

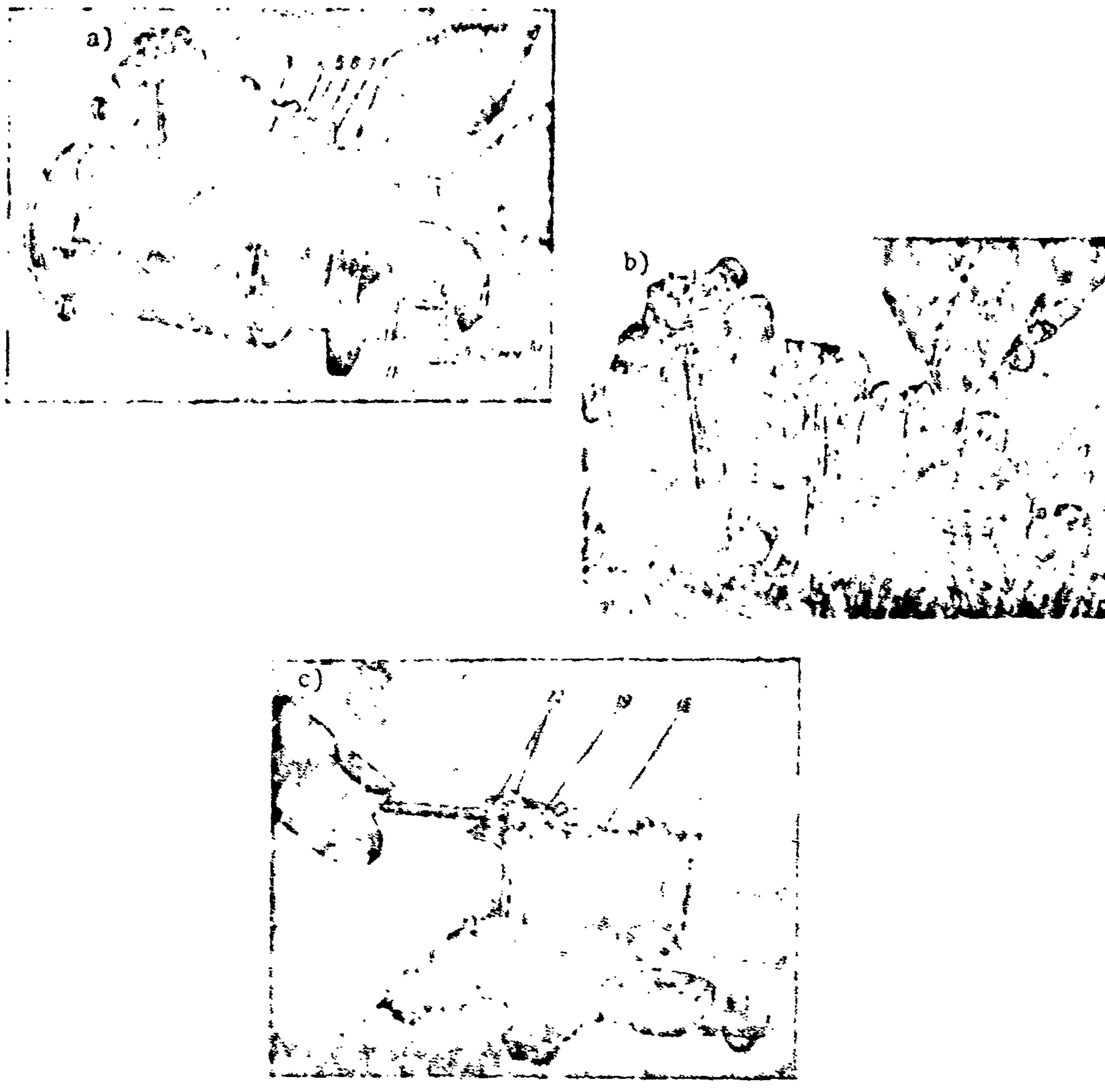


Figure 18-55. Adjustment of ST130 Starter:
a, adjustment of lever travel, b, adjustment of solenoid armature and drive gear travel, c, additional starter relay;
1, terminal, 2, solenoid, 3, solenoid armature, 4, adjusting screw, 5, link, 6, pin, 7, drive lever, 8, screwdriver, 9, wrench, 10, thrust ring, 11, gear, 12, cover body, 13, counter nut, 14, thrust screw, 15, lever axis, 16, spring holder, 17, spring, 18, additional relay armature, 19, armature travel limitor, 20, contacts.

The starter is tested under load using the same test stand with the armature of the starter fully braked. The current and torque developed by the starter are determined. The data produced in this test are compared to the data of the technical characteristics presented in Table 18-6.

Adjustment of ST15-B starter. The clearance between the gears and thrust washer and the moment of switching of the starter solenoid are adjusted.

In order to check the clearance between gears 2 (Figure 18-54) and thrust washer 1, press drive lever 4 until contacts 6 and 7 of the starter solenoid close and in this position measure the clearance between the end of the gear and the thrust washer. The clearance should be 0.8-1.3 mm. It is adjusted with screw 3.

The moment of switching of the starter solenoid can be tested by setting up an electrical circuit as shown on Figure 18-54. When lever 4 is moved to the point of full meshing of gear 2, pusher 5 of the solenoid should press against shaft 9 which, as it moves, first closes the internal terminals to switch on the additional coil resistor with contact disk 6, then closes the terminals to switch on the starter with disk 7. This should cause both control lights 10 to come on. If this does not occur, the travel of shaft 9 must be adjusted using pusher 5.

Adjustment of the ST130 and ST2 starters (Figure 18-55). The travel of the drive gear (gear travel) is limited by thrust ring 10. The gear should stop short of the thrust ring by 1.5-3.5 mm. To measure the indicated clearance, set up an electrical circuit, connecting the + terminal of the battery to the terminal of the power relay, the - terminal of the battery to the starter ground; armature 3 of the relay will be pulled in, and by means of lever 7, will push out drive gear 11. At this moment, measure the clearance, selecting the gear clearance by pressing lightly against the gear in the direction of the collector. If the clearance does not correspond to the proper distance, adjust the solenoid.

The solenoid is adjusted with screw 4, screwed into armature 3 and connected by link 5 to lever 7. To perform adjustment, remove pin 6 and disconnect link 7, then rotate adjusting screw 4 by turning the link.

To adjust the solenoid of the ST2 starter, remove the solenoid from the starter drive body.

If the clearance between the drive gear and thrust ring is too large, tighten the adjusting screw; if it is too small, loosen the adjusting screw of the relay armature. One rotation of the adjusting the screw corresponds to a movement of the drive gear along the axis of the starter armature by 1.7 mm. After adjustment, connect the link of the armature to the drive lever and key the pin.

For the ST2 starter, install the solenoid on the drive body, connecting the link of the adjusting screw to the drive lever. Then check the result of adjustment. If necessary, repeat adjustment.

After completion of adjustment of the relay armature travel and starter drive gear travel for the ST130, install thrust screw 17 (Figure 18-55b) so that lever 7, in the neutral position, contacts the screw 14. This is done by backing off counter nut 13 with a wrench and rotating the screw with a screwdriver, as shown on Figure 18-55a, after which the screw is fastened in place with the counter nut. After completion of adjustment of the starter drive, install the solenoid cover and fasten it down with screws.

The clearance and switching voltage of the additional relay are adjusted. The clearance between contacts 20 (Figure 18-55c) should be at least 0.4 mm. The clearance between the armature and core of the coil should be at least 0.2 mm with the contacts closed. The clearance in the contacts of the supplementary relay is adjusted by bending armature limitor 19.

Before adjustment, the contacts should be cleaned.

The voltage on the terminals of the coil of the relay when the contacts close is adjusted by changing the tension of spring 17 by bending holder 16.

The switching voltage of the additional relay is increased by increasing the spring tension, decreased by decreasing the spring tension. Thus, a voltage of 7-8 v necessary for switching of the starter circuit is set.

Design changes in ST130 starter. In order to increase the service life, facilitate dissembly and assembly during repair and maintenance, certain changes have been made in the design of the ST130 starter. In order to increase the mechanical strength and wear resistance, the material of the drive clamps and drive gear of the starter has been changed: they are now made of high alloy steel. To eliminate deformation, the guide springs in the free travel clutch are also made of high alloy steel.

In order to prevent movement of the plunger springs of the clutch and provide for a stable force, steel supports have been placed beneath them. To decrease radial beating of the clutch clamps, centering inserts have been pressed into the guide bushing, improving the operation of the drive in the idle mode and limiting skew of the clutch upon wedging of the rollers.

The connection of the excitor winding coils of the starter has been changed, by soldering tips onto the ends of the coils. The two leads are reliably fastened to a bolt installed on the body of the starter, which is connected in turn by a special bus to the starter solenoid. The two other ends of the coils are connected to the brush holder screws.

The design of the brush holders has been changed; they have been made in a box section with elongated brush guides, providing better fixation of the brushes and increasing their service life.

The connection of the brush cords to the ends of the excitor windings has been changed. Tips have been soldered on the ends of the brush cords, as onto the ends of the coils, and screw terminals have been made on the brush holders, to which the brush cords of all 4 brushes are connected. Thus all brushes are made removable, facilitating servicing and repair of the starter. The other two leads of the excitor windings are also connected to the screw terminals of the brush holders of the insulated brushes.

Before making the design changes, the brush cords of the insulated brushes were soldered to the ends of the excitor windings, and the brush cords connected to ground were fastened directly to the starter body.

Chapter 19. Electrical Equipment of the Truck.

Structure

Electrical Equipment Circuits

The electrical equipment of all ZIL trucks uses a single-wire connection plan. The negative terminals of the batteries are connected to ground. Nominal voltage 12 v. The electrical equipment (Figures 19-1, 19-2) of the trucks includes, in addition to the equipment on the motor (see Chapter 18), the battery, lights, and turn signals, horns, electric motors of the heater and ventilator, dashboard instruments and connecting wires.

The electrical equipment of the carburetor type engine represents a source of intensive radio interference, capable of hindering the operation of radio receivers on the truck or near it, or even of making operation of this equipment impossible. Trucks not designed for installation of radio receivers are equipped with nonshielded electrical equipment on the motors. The suppressor devices on these trucks consists of high resistance carbon resistors included in each of the spark plug wires.

On in-line motors, SE02 damping resistors are installed on the spark plug wires, while V-type motors carry SE14 resistors. The former are attached to the spark plugs by a contact nut, the latter are attached to the thread of the central electrode with a spring holder.

The ohmic resistance of the damping resistances is between 7 and 14,000 ohms.

The central high voltage line from the distributor to the coil carries an SE01 damping resistor of the same resistance on the in-line engines. Engines with shielded electrical equipment and V-type engines carry no damping resistor on the central line; it is mounted in the central lead of the distributor cap. Therefore, the use of a damping resistor in the central wire is not permitted on these engines.

The circuits of shielded electrical equipment of trucks have shielded devices, as well as radio interference suppression filters.

Figure 19-3 shows a diagram of the shielded electrical equipment of a ZIL-131 truck. The circuits of the shielded electrical equipment of ZIL-157K and ZIL-130E trucks are similar.

The electrical equipment which shielded devices is designed to reduce radio interference to 2 mv at a distance of 1 m from the engine in the 0.15-400 mHz range.

The system for suppression of radio interference on the trucks includes the following shielding instruments, hoses and conductors:

the G112 and G51 generators, with jacks for possible connection of shielded wires;
the RR24-E and RR51 voltage regulators, also having shielded plugs;
the R51 and R102 distributors;
the B5-A and B102-B coils with separate additional resistor SE40-A and SE102.

The wires connecting the voltage regulator to the ammeter (ZIL-157KG truck), as well as the wires between the ignition coil and the additional resistor include LC filters type FR81-A and FR82-A.

The high voltage wires from the ignition coil to the distributor and from the distributor to the spark plugs are shielded cables. A common metal shield is placed over the spark plugs on the cylinder head of the ZIL-157K engine.

Some of the low voltage wires have shielding braid, which is connected to ground through the plugs in the electrical devices.

The sensor circuits of the water temperature and oil pressure indicators include condensors.

Figure 19-4 shows the filter of the voltage regulator circuit in cross section and a diagram of the filter. Choke 6 is mounted in the lower portion of body 2, and consists of a circular core of pressed ferrite and a coil wound around the core. The choke is contained in a cover which shields it. The upper portion of the cover contains 2 condensors 5, connected in series with the choke. The leads from the condensors are connected to terminals 3, to which the wires of the common circuit of the electrical equipment are also connected.

The ignition coil filter circuit has the same design as the filter of the voltage regulator. They differ only in the current load and induction of the choke, indicated below in the technical characteristics (Table 19-1).

TECHNICAL CHARACTERISTICS OF RADIO INTERFERENCE FILTERS. TABLE 19-1.

Filter	Load Current, a	Induction of Choke (core and coil), μh, at least	Total Capicitance of Condensor, mf	Nominal Voltage, v
FR82-A (ignition coil filter)	5	420	2 ± 20%	from 6 to 26
FR81-A (voltage regulator filter)	30	80	2 ± 20%	from 6 to 26

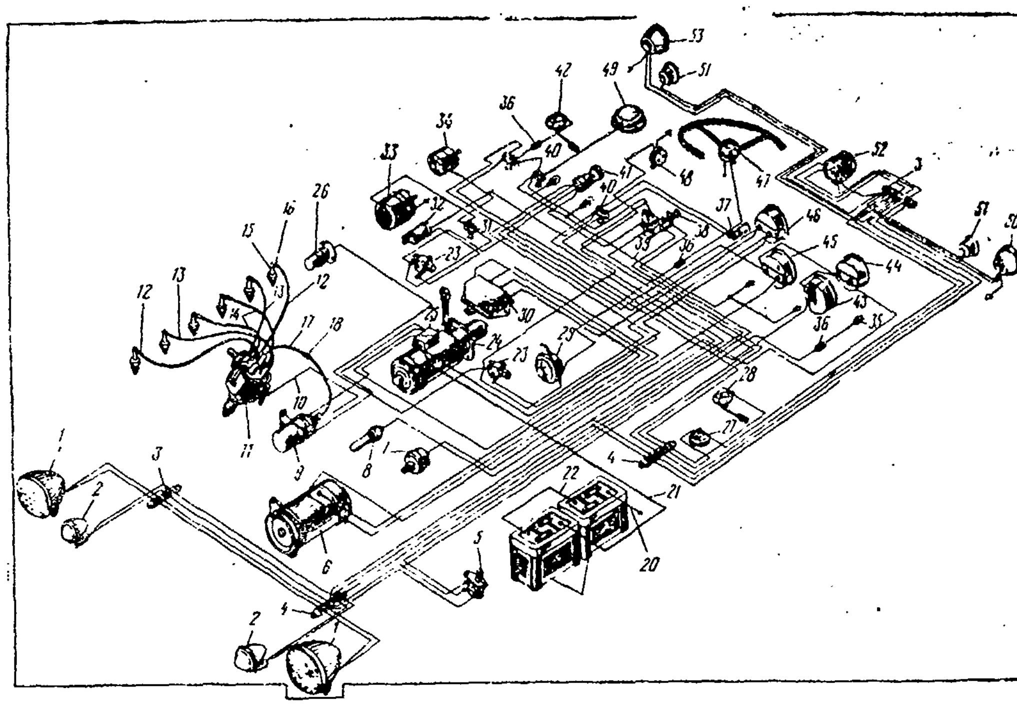


Figure 19-1. Diagram of Electrical Equipment of ZIL-157K:
1, headlights, 2, parking lights, 3 and 4, connecting panels, 5, foot dimmer switch, 6, generator, 7, oil pressure sender, 8, water temperature sender, 9, coil, 10, low voltage wire, 11, distributor, 12, 13, 14 and 17, high voltage wires, 15, spark plug, 16 and 18, suppressor resistors, 19, battery, 20, ground wire, 21, wire connecting battery and starter, 22, battery connecting wire, 23, button switch, 24, starter, 25, starter solenoid, 26, engine compartment light, 27, stop signal switch, 28 and 42, fuel level senders, 29, horn, 30, voltage regulator, 31, heater motor switch, 32, turn signal breaker, 33, cabin heater motor, 34, ventilator motor, 35, high beam indicator light, 36, wire connector, 37, turn signal indicator light, 38, central light switch, 39, wire connecting -- lights, 40, turn signal switch, 41, ignition switch, 43, fuel gauge, 44, water temperature gauge, 45, oil pressure gauge, 46, ammeter, 47, horn switch, 48, portable light jack, 49, cabin light, 50 and 53, tail lights, 51, stop signal lights, 52, trailer jack.

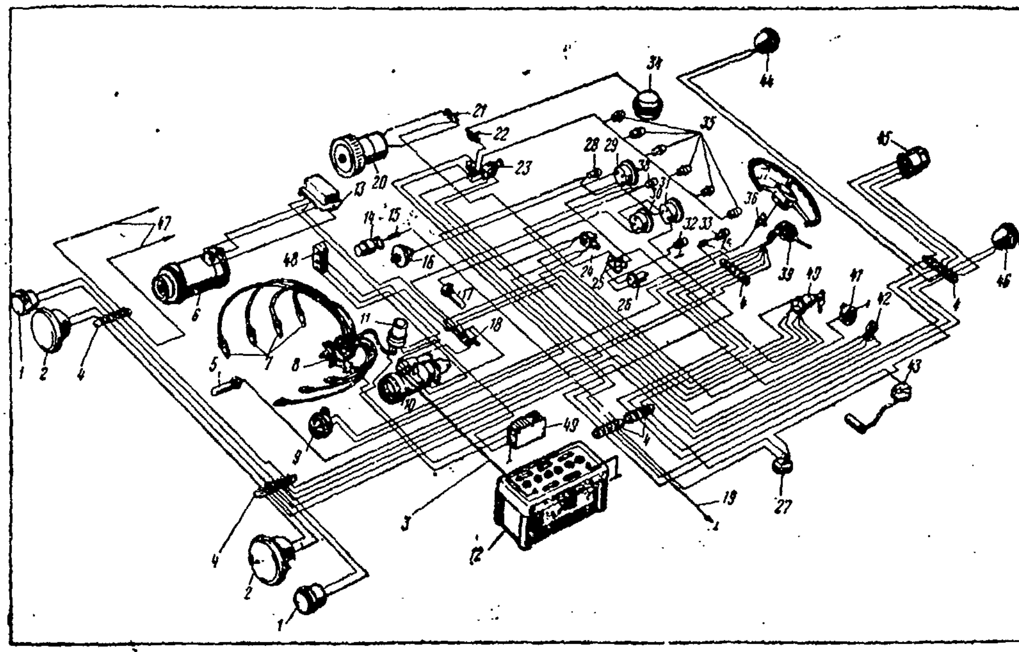


Figure 19-2. Diagram of Electrical Equipment of ZIL-130 with Transistor Ignition:
1, parking lights, 2, headlights, 3, wire connecting battery to starter, 4, connecting panels, 5, water overheat signal sender, 6, generator, 7, spark plugs, 8, distributor, 9, horn, 10, starter, 11, coil, 12, battery, 13, voltage regulator, 14, engine compartment light, 15, dual-jack connectors, 16, oil pressure sender, 17, water temperature sender, 18, additional starter relay, 19, wire connecting starter heater panel, 20, heater motor, 21, electric motor switch, 22, cabin light switch, 23, central light switch, 24, button circuit breaker, 25, group of 6 a bimetallic fuses, 26, turn signal breaker, 27, stop signal switch, 28, water overheat indicator light, 29, oil pressure gauge, 30, cooling fluid temperature gauge, 31, fuel level gauge, 32, turn signal indicator light, 33, high beam indicator light, 34, cabin light, 35, dash light, 36, signal current tap, 37, signal switch, 38, battery charge light, 39, turn signal switch, 40, ignition switch, 41, portable lamp jack, 42, foot dimmer switch, 43, fuel level sender, 44 and 46, tail lights, 45, trailer jack, 47, wire connecting starter heater units, 48, additional resistor of ignition coil, 49, transistor commutator.

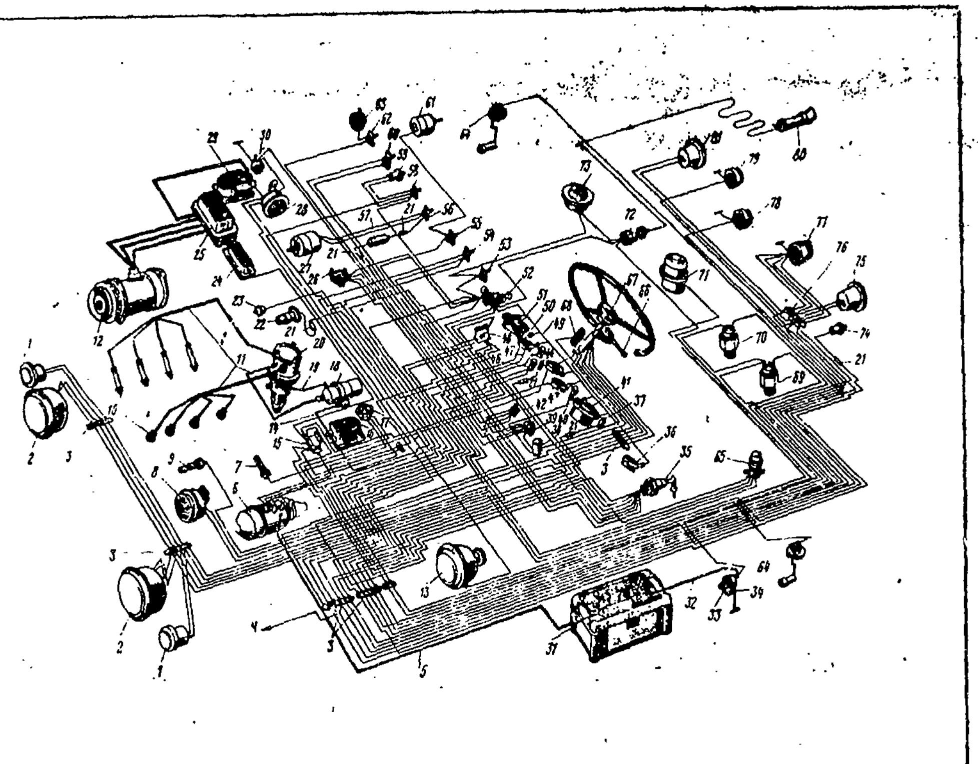


Figure 19-3. Diagram of Shielded Electrical Equipment of ZIL-131 and ZIL-131V: 1, parking lights, 2, head lights, 3 and 76, connecting panels, 4, wire connecting control panel of heater, 5, wire connecting battery with starters, 6, starter, 7, water temperature sender, 8, horn, 9, water overheat signal light sender, 10, spark plugs, 11, high voltage wires, 12, generator, 13, rotating spot light, 14 and 19, low pressure wires, 15, additional relay of starter, 16, radio interference filter in ignition coil circuit, 17, additional resistor, 18, ignition coil, 20, distributor, 21, two-jack connectors, 22, engine compartment light, 23, oil pressure sender, 24, FR200 condensor filter, 25, voltage regulator, 26, stop signal switch, 27, heater electric motor, 28, buzzer signal, 29, radio interference filter in voltage regulator circuit, 30, radio power jack, 31, battery, 32, battery ground cable, 33, battery ground switch, 34, wire from switch to ground, 35, combined ignition and starter switch, 36, manometer measuring air pressure in tires, 37, front suspension switch control lamp, 38, turn signal breaker, 39, unit of two bimetallic 6 a fuses, 40, turn signal indicator light, 41, speedometer, 42, 20 a vibration fuse, 43, fuel gauge, 44, high beam indicator light, 45, water temperature gauge, 46, battery charge test light, 47, water overheat light, 48, electromagnet relay, 49, dash light set, 50, oil pressure indicator, 51, pneumatic brake system manometer, 52, central light switch, 53, cabin light and search light switch, 54, fuel level sender switch, 55, cabin fan switch, 56, heater fan switch, 57, heater motor condensor, 58, search light switch, 59, search light switch button, 60, automatic front suspension switch, 61, cabin ventilator motor, 62, cabin light switch, 63, cabin light, 64, fuel level sender, 65, foot dimmer switch, 66, turn signal switch, 67, signal button, 68, signal contact device, 69 and 70, switches of electromagnet and test lamp of front suspension, 71, electric-air valve switching front suspension, 72, 78 and 79, portable light jacks, 73, cabin interior lights, 74, signal buzzer button, 75 and 81, tail lights, 77, trailer jack, 80, portable light.

As the voltage regulator and ignition system operate, current pulses arise which propagate throughout the entire length of the wires in the single-conductor system, and cause high frequency electromagnetic oscillations to radiate into the space surrounding the truck, creating radio reception interference (noise).

In order to prevent propagation of the current pulses, they are trapped and suppressed as they develop.

To do this, the electrical lines of wires connecting the voltage regulator and the ammeter, and also connecting the coil and the additional resistor include LC filters types FR81-A and FR82-A, which is a chunk (coil with circular core) and condensors to filter out the interfering current (radio interference) and direct them to ground.

The filters must operate normally at temperatures between -50°C and +50°C with relative humidities up to 98% under conditions of vibration and shock as the truck is driven.

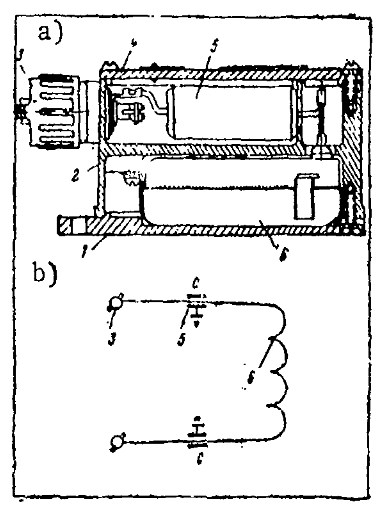


Figure 19-4. LC Filter of Voltage Regulator Circuit:
a, filter in cross section, b, diagram of filter;
1, base of body, 2, body, 3, output terminals, 4, cover, 5, condensors,
6, chunk.

Since 1967, the ZIL-130 and ZIL-131A trucks have carried electric equipment with transistor ignition.

Batteries

On the ZIL trucks. the batteries (Table 19-2) are installed beneath the cabins on the left side in separate recesses (Figure 19-5, 19-6). The battery holders of the ZIL-130 and ZIL-131 trucks are removable, equipped with plastic covers. The dimensions of the batteries are presented in Table 19-3.

The batteries installed on the ZIL-131 trucks use so-called hydrostatic plugs (Figure 19-7) which, in contrast to standard caps, are designed to isolate the internal cavity of the battery to prevent entry of water as the truck crosses a ford.

TECHNICAL CHARACTERISTICS OF BATTERIES TABLE 19-2.

Parameters	ZIL-157K	ZIL-130*, ZIL-131, ZIL-131A*, ZIL-131V
Type	3-ST-84-PD; 3-ST-84-PDC	6-ST-78-ERSZ; 6-ST-78-EMSZ
Voltage, v	12 (2 6 v batteries connected in series)	12
Capacity, a·hr	84	78
Current in 10 hour discharge, a	8.4	7.80
Current consumed by starter, a	250	235
First charge current, a	6	8
Normal charge current, a	8	8
Limits of change of voltage of individual cells, v	1.95-2.12	
Electrolyte	Sulphuric battery acid (GOST 667-53) mixed with distilled water	
Density of electrolyte at 15°C:		
regions with sharp continental climate with winter temperature below -40°C	1.34 (winter) / 1.30 (summer)	1.29 (winter) / 1.25 (summer); 1.31 / 1.27 (at end of charge)
northern regions with winter temperature to -40°C (year round)	1.31 (at end of charge 1.29)	1.27
central regions with winter temperature to -30°C (year round)	1.30 (at end of charge 1.27)	1.25
summer regions	1.28 (at end of charge 1.25)	1.23
Maximum electrolyte temperature, °C	45	
Level of electrolyte over plates, mm	10-15	
Monoblock	Asphalt-pitch	Ebonite
Separators	Wood	Mipor and fiberglass or miplast and fiberglass

*The ZIL-130 and ZIL-130A can also use the 6-ST-81-EMSZ battery, 81 a·hr capacity.

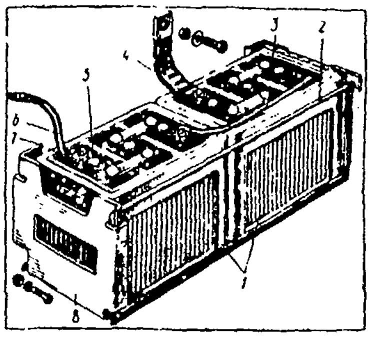


Figure 19-5. Installation of Batteries on ZIL-157K:
1, batteries, 2, battery well bar, 3, connecting wire, 4, ground cable, 5, battery connector bolt, 6, starter wire, 7, nut, 8, battery well.

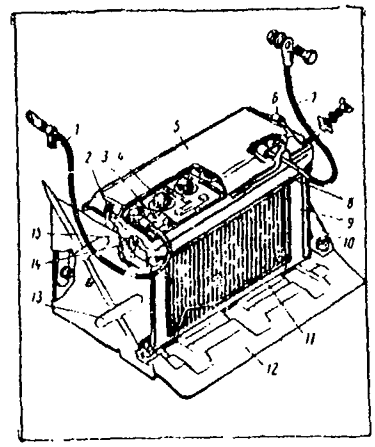


Figure 19-6. Installation of Battery on ZIL-130 and ZIL-131:
1, starter wire, 2 and 6, protective cover retainers, 3, tension bolt, 4, plug, 5, protective cover, 7, ground wire, 8, frame, 9, battery, 10, battery well bracket, 11, bracket, 12, battery well, 13, shield, 14, battery holder, 15, wing nut.

Under normal conditions, the excess gas pressure formed in the process of operation of the batteries flows freely into the atmosphere through two apertures in reflector one (Figure 19-7a) in the cap through channel 5, upper cavity 6, the aperture in reflector 4, lower cavity 3 and aperture 2 in the lower portion of the cap.

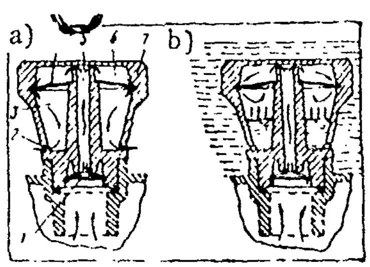


Figure 19-7. Hydrostatic Cap Under Various Conditions: a, during driving of truck under ordinary conditions (on dry land); b, during crossing of a river ford:
1, lower reflector, 2, outer apertures, 3, lower cavity, 4, upper reflector, 5, channel, 6, upper cavity, 7, cap.

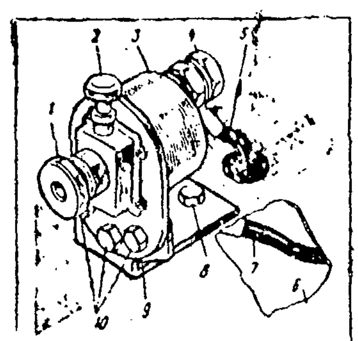
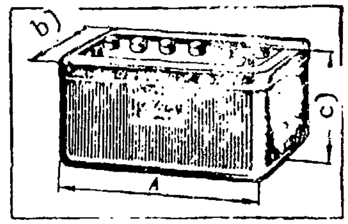


Figure 19-8. VK318 Battery Circuit Breaker:
1, detent, 2, lever, 3, body of breaker, 4, terminal, 5, lead from battery, 6, cabin floor, 7, lead to ground, 8, bracket mounting bolt, 9, bracket, 10, bolt mounting circuit breaker to bracket.

DIMENSIONS OF BATTERIES TABLE 19-3.



Battery	Dimensions A	B	C
3ST-84-PDC	272	188	220
3ST-84-PMSZ	272	188	220
6-ST-78-ERSZ	417	182	228
6-ST-78-EMSZ	417	182	228
6-ST-78-EMSZ	417	182	265*
6-ST-81-EMSZ	417	182	228
6-ST-81-EMSZ	417	182	265*

*For batteries with hydrostatic caps.

When a ford is crossed (Figure 19-7b), water enters the lower cavity 3 through apertures 2 in the plug, rising in this cavity until the gas pressure inside the battery becomes equal to the pressure of the water entering the lower cavity of the cap.

The height of the lower cavity of the cap is designed so that when the truck is submerged in water 1.4 m deep the water will not rise in this cavity as far as reflector 4, which protects channel 5 from random splashes of water from cavity 3. Reflector 1 in the cap prevents accidental splashing of the electrolyte into upper cavity 6.

After the vehicle finishes crossing the ford, the water drains freely out of the lower cavity through apertures 2.

The VK318 battery circuit breaker. The ZIL-131 carries a circuit breaker (Figure 19-8), which disconnects the battery from the chassis (ground). To disconnect the battery, press detent 1 of the lever, to reconnect the battery press lever 2 until a click is heard.

When the battery is disconnected, only the cabin light and the jack for connection of the portable lamp, located in the cabin, are still connected to the battery.

Lights and Light Signals

Headlights. The ZIL trucks use headlights (Figure 19-9, 19-10, 19-11, 19-12) with partially dismountable optical elements and aluminum reflectors:

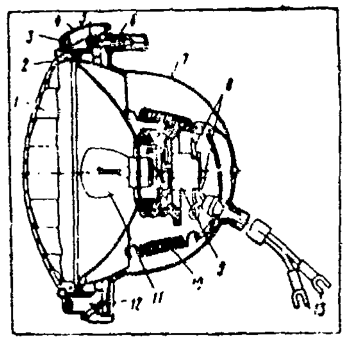


Figure 19-11. FG122-GT Headlight for ZIL-131:
Key as on Figure 19-10.

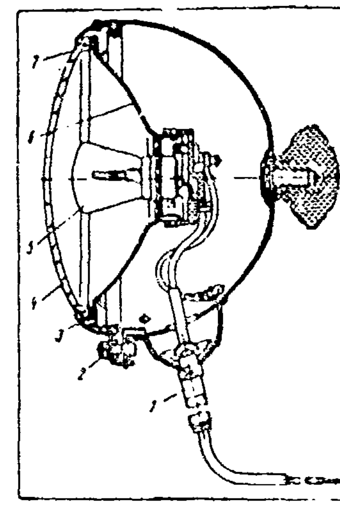


Figure 19-12. FG16-L Headlight (Search Light) for ZIL-131:
1 and 2, screws, 3, rim, 4, lens, 5, bulb, 6, reflector, 7, seal.

Parking Lights. Each ZIL truck is equipped with 2 parking lights (Figure 19-14, 19-15) of the following types:

PF10-T with 21+6 c bulbs	ZIL-157K
PF101-B with 21+6 c bulbs	ZIL-130, plus first models of ZIL-131
PF106, sealed, with 21+3 c bulbs	ZIL-131

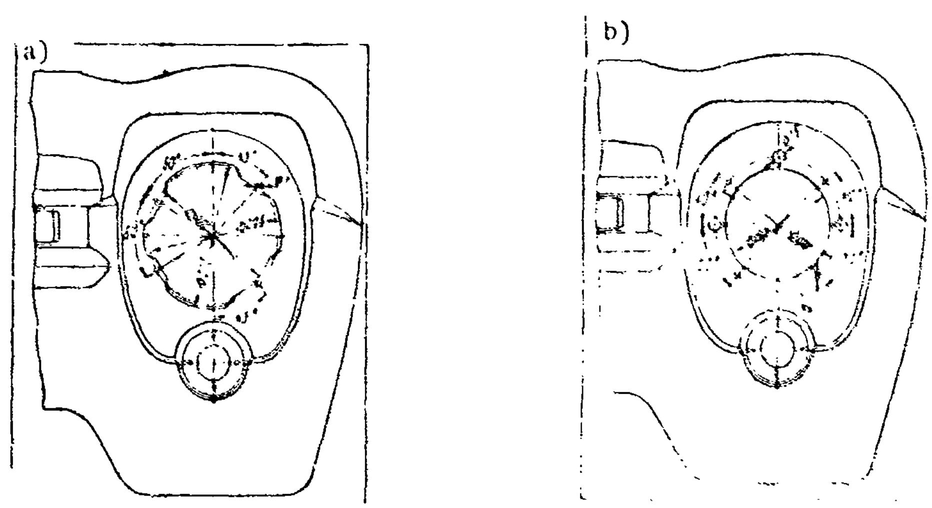


Figure 19-13. Dimensions of Headlight Recesses in Radiator Housing of ZIL-130 Trucks Made: a, up to 1966; b, since 1966.

FG1-A2	ZIL-157K, all versions
FG2-A2	ZIL-130 trucks up to 1966
FG122-G	ZIL-130 trucks, all versions, 1966 and later
FG122-I	ZIL-131 trucks; sealed headlights; the light masking device for this headlight is mounted beneath the rims without dissembly
FG16-L	ZIL-131 trucks (headlight -- controlled search light -- installed on rotating bracket).

The recesses for the FG2-A2 and FG122-G headlights in the radiator housing of the first and recent models of the ZIL-130 have different sizes (Figure 19-3). In order to install the small type FG122-G headlight in the housing for the FG2-A2, a conversion piece should be used, which can be made by the repair shop at any motor pool.

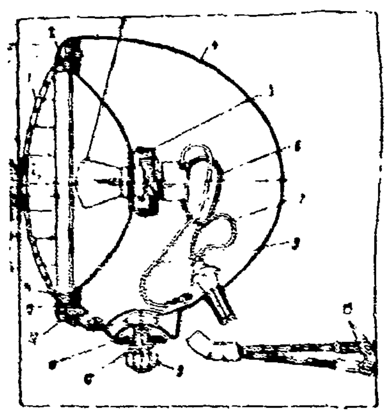


Figure 19-9. FG1-A2 Headlight for the ZIL-157K:
1, lens (glass), 2, inner rim, 3, bulb, 4, body of headlight, 5, cartridge, 6 and 7, low and high beam wires, 8, ground wire, 9, nut, 10, bolt, 11, washer, 12, screw, 13, outer rim, 14, sealing ring, 15, tips.

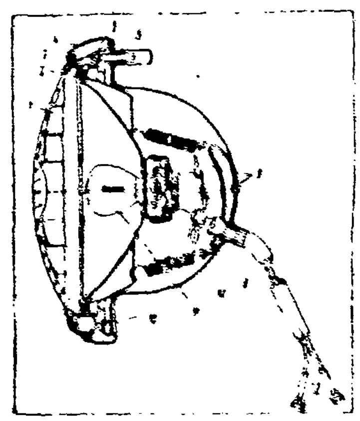


Figure 19-10. FG122-G Headlight of ZIL-130:
1, lens, 2 and 3, sealing rings, 4, outer rim, 5, adjusting screw, 6, nut, 7, body of headlight, 8, wires, 9, cartridge, 10 spring, 11, bulb, 12, rim screw, 13, tips.

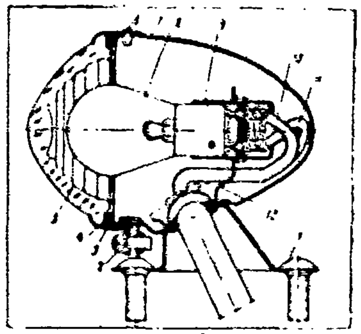


Figure 19-14. PF10-G Parking Lights: 1, bolt, 2, screw, 3, rim, 4, sealing gasket, 5, lens, 6, pin, 7, body, 8, bulb, 9, cartridge, 10 and 11, wires, 12, bracket.

Tail lights. The ZIL-157K, ZIL-130 and ZIL-131 trucks carry tail lights: FP101 (left) and FP101-B (right) with red plastic lenses (Figure 19-16), also serving as light reflectors. The tail lights carry 2 bulbs, 21 and 3 c.

Up to the third quarter of 1963, the ZIL-157K and ZIL-130 trucks carried FP13 (left) and FP13-K (right) tail lights with red glass lenses, using metal rims.

The central light switch of the trucks is used to turn on the headlights, parking lights, tail lights and dash lights. The ZIL-157K carries a central switch type P300-B (Figure 19-17), while the ZIL-130 and ZIL-131 use a type P44 switch (Figure 19-18).

The knob and central switch rod have 3 fixed positions, shown on the operating diagram (Figure 19-19): position zero -- knob pushed all the way in -- lights turned off; position I -- knob pulled out halfway -- parkings lights and tail lights (size marker lights) turned on; position II -- knob pulled all the way out -- headlights and tail lights (size marker lights) turned on.

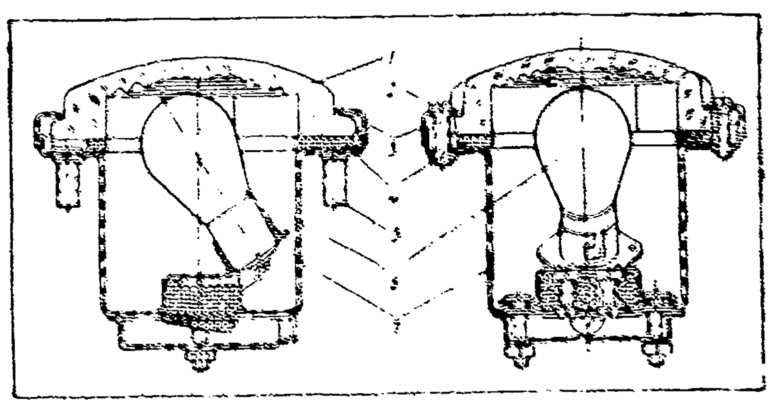


Figure 19-15. PF101-B Parking Lights:
1, lens, 2 and 5, screws, 3, rim, 4, sealing gasket, 6, bulb, 7, body.

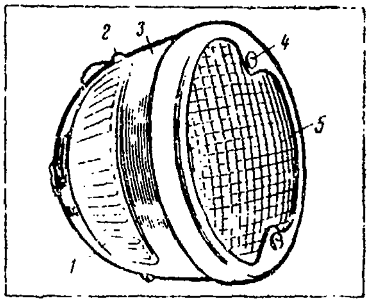


Figure 19-16. FP-101 Tail Light:
1, transparent glass, 2 and 4, screws,
3, body, 5, orange plastic lens.

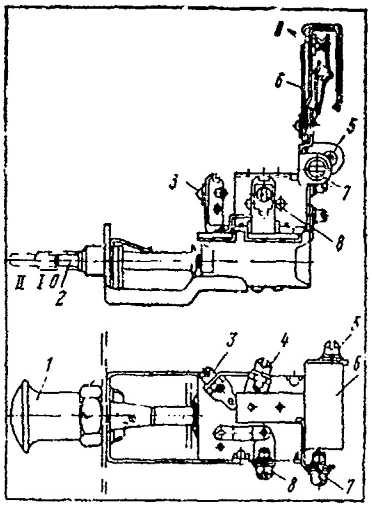


Figure 19-17. Central Light Switch Model P300-B:
1, knob, 2, rod, 3, terminal for connection of wire from foot dimmer switch, 4, terminal for connection of parking light wire, 5, terminal for connection of stop signal wire, portable light jack and cabin light, 6, bimetallic heat fuse, 7, power supply terminal, 8, terminal for connection of tail light wire, 9, fuse contacts.

On the ZIL-130 and ZIL-131, when the tail lights are turned on (positions I and II), slight rotation of the light switch knob turns on the dash lights, while further rotation of the knob adjusts the brightness of the dash lights.

Contacts 10 (see Figure 19-18) of the bimetallic fuse are closed with normal operation of the device. In case of an overload and an increase in the current to over 20 a, the contacts of the fuse separate.

The foot dimmer switch is installed on the floor of the cabin and is used to switch the lights from low beam to high beam and back (with the central light switch knob pulled all the way out). When the high beam is switched on, the high beam warning light on the dashboard also comes on.

The ZIL-157K carries a type P34 foot dimmer switch, while the ZIL-130 and ZIL-131 carry a type P53 switch (Figure 19-20). The design of the switch is identical, differing only in the method of mounting of the switches to the cabin floor.

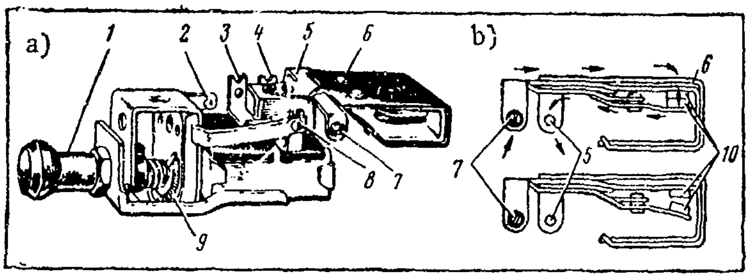


Figure 19-18. Model P44 Central Light Switch Assembled: a, switch, b, operating diagram of bimetallic heat fuse; 1, knob, 2, terminal for connection of dash light wire, 3, terminal for connection of foot dimmer switch wire, 4, terminal for connection of parking light wire, 5, terminal for connection of wires to stop signal, portable lamp jack and cabin light, 6, bimetallic heat fuse, 7, power supply terminal, 8, terminal for connection of tail light wire, 9, rheostat, 10, fuse contacts.

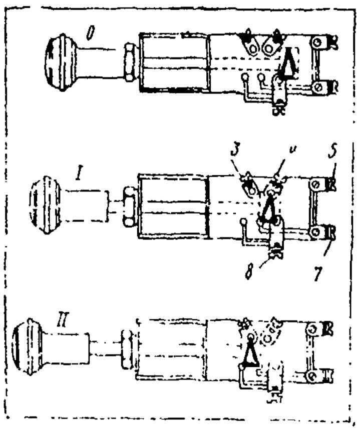


Figure 19-19. Operating Diagram of Central Light Switch (for position see Figure 19-18).

Turn signals. On the ZIL-157K, the turn signals work through the parking lights, in which the 21 c filament of the bulb is connected to the turn signal circuit. The rear turn signal indicator is the UP5 tail light (Figure 19-21) installed on the brackets of the right and left frame members. The bulb used in the turn signal lights is a 21 c bulb. The turn signal switch is located in the center of the upper portion of the dashboard of the cabin. A turn signal lamp on the dashboard flashes when the turn signals are turned on.

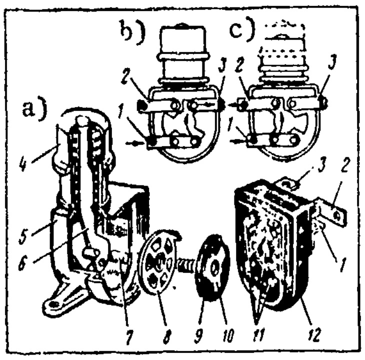


Figure 19-20. Foot Dimmer Switch:
a, cross section of switch, b, connection diagram on low beam, c, connection diagram on high beam;
1, terminal for wire from power supply, 2, terminal for wires from high beam and warning light, 3, terminal for wires from low beam, 4, button, 5, switch body, 6, rotating disk pusher, 7, disk axis, 8, rotating disk, 9, insulating disk of contact plate, 10, contact plate, 11, external contacts of terminals, 12, insulating body cover.

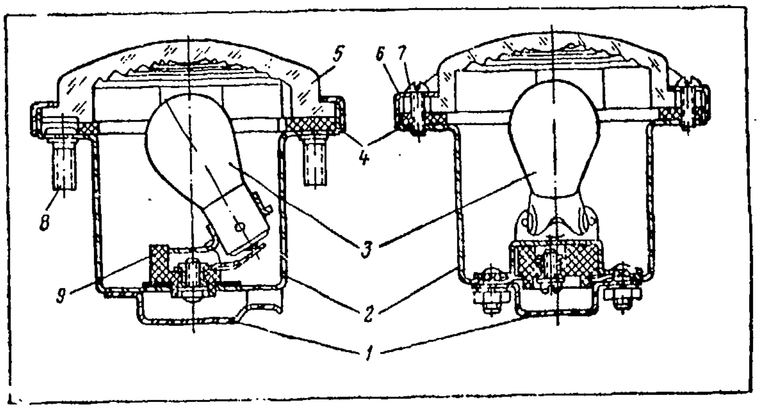


Figure 19-21. UP5 Turn Signal Light:
1, cover, 2, body, 3, 21 c bulb, 4, gasket, 5, lens, 6, rim, 7, screw, 8, pin, 9, cartridge.

On the ZIL-130 and ZIL-131, the front turn indicators are parking lights 5 and 8 (Figure 19-22), the 21 c filaments of bulbs 6 and 7 in which are designed for signaling turns. The rear turn signal indicators are the tail lights 12 and 15, in which the 21 c filaments of bulbs 13 and 14 are used to signal turns.

The turn signals include switch 3, mounted on the steering column. The right turn signal is turned on by raising the switch lever upward (clockwise). This causes the lights in the right parking light, right tail light and on the dash bulb to light.

Pulling the lever downward (counterclockwise) turns on the left turn signal

The turn signal lever should be moved smoothly, without hitting or jerking it.

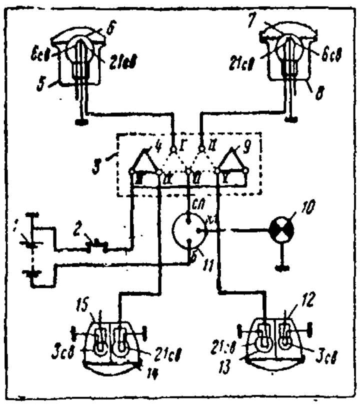


Figure 19-22. Diagram of Turn Signals and Switch (ZIL-130):
1, battery, 2, stop signal switch, 3, turn signal switch, 4 and 9, moving contacts of switch, 5 and 8, parking lights, 6 and 7, parking light signal bulbs, 10, dash light, 11, turn signal blinker, 12 and 15, tail lights, 13 and 14, rear turn signal indicator lights.

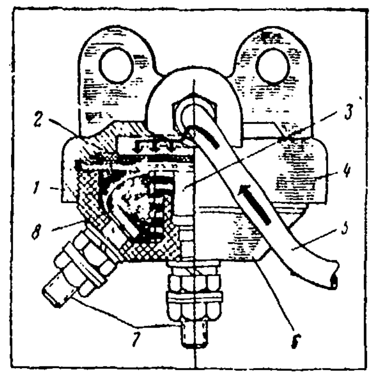


Figure 19-23. VK13-B Stop Signal Switch:
1, contact bus, 2, diaphragm, 3, upper contact, 4, body, 5, line from pneumatic system to switch, 6, contact well, 7, contact terminals, 8, contact spring.

The turn signals are automatically switched off when the vehicle returns to a straight line, since the steering wheel hub rotates the switch roller, returning it to the off position.

Dash light 10 turns on when the turn signals are turned on.

Turn signal switch 3 receives power through the stop signal switch 2 and through turn signal blinker 11.

As the truck rolls along on a straight line, moving contacts 4 and 9 connect terminals III, IV and V of the switch. When the contacts of switch 2 are closed during breaking, the 21 c bulbs in both tail lights come on. If the left turn signal is turned on, contact 4 connects terminals I, IV and VI. The current from blinker 11 is sent to the 21 c filament of the left parking light 5 and to the 21 c bulb of the left tail light 15. If the brake pedal is pressed at this time, the 21 c bult in right tail light 12 will also come on.

During this time, the light indicating the turn will flash intermittently, easily distinguishing it from the stop signal.

During a right turn, contact 9 connects terminals II, V and VI, thus connecting the bulb of the right tail light 12 and right parking light 8 to blinker 11.

The operating diagram of the turn signal with the RS57 blinker and P20 turn signal switch for the ZIL-157K truck is shown on Figures 19-24 and 19-25.

Turn signal blinkers. In order to interrupt the current sent to the signal bulbs of the turn signals, all ZIL trucks use the RS57 blinker, fastened to the bracket beneath the dashboard in the cabin.

The turn signal blinker is an electromagnetic type, controlled by heating filament 3 (see Figure 19-24). It is included in the power supply circuit of the turn signals, providing for flashing of the signal bulbs. The vibrating frequency of contacts 5 and frequency of interruption of light is 60-120 cycles per minute.

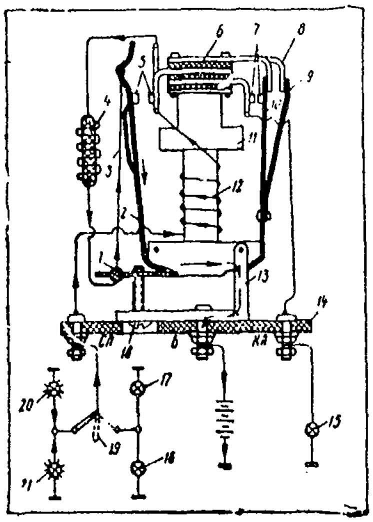


Figure 19-24. Diagram of RS57 Turn Signal Blinker:
1, glass insulator, 2 and 10, armatures, 3, glowing filament, 4, resistor, 5 and 7, contact, 6, insulating insert, 8, adjusting plate, 9, bronze plate, 11, core, 12, winding, 13, bracket, 14, panel, 15, dash light, 16 and 21, tail light signal bulbs, 17 and 20, parking light signal bulbs, 18, adjusting screw, 19, turn signal switch.

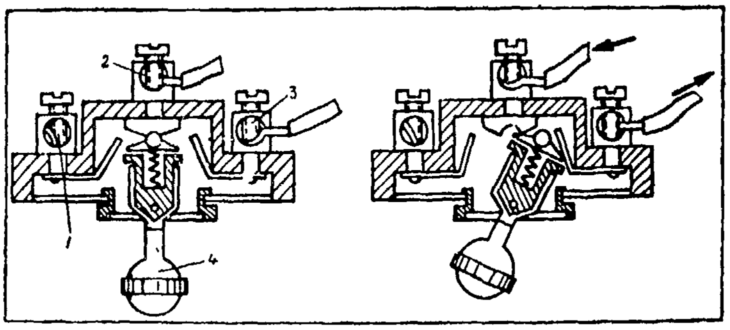


Figure 19-25. P20 Switch.
1, 2 and 3, terminals,
4, handle.

When the turn signal is switched on, if both bulbs are burning (in the parking light and tail light), dash turn signal indicator bulb 15 on the dashboard flashes green.

If the dash indicator light burns constantly, or does not come on, or the light flashes at varying frequency, this indicates a defect in one of the turn signal bulbs (in the parking light and tail light) or the blinker.

The clearance between the rubber roller of the switch and the hub of the steering wheel (in the neutral position of the lever) on the ZIL-130 and ZIL-131 should be 1-2 mm. The clearance is adjusted by moving the switch on its bracket in the horizontal position, after loosening the two mounting screws. After adjustment, the screws must be retightened.

Stop signal switch (VK13-B, pneumatic) on the ZIL-130 is located in the brake valve, and on the ZIL-157K and ZIL-131 -- on the dashboard (see Figure 19-23). When the brake pedal is pressed, switch 2 (see Figure 19-22) closes the circuit of the 21 c bulbs of the tail lights. In order to be able to distinguish between the turn signal and stop signal (when they are turned on simultaneously), the stop signal burns constantly, while the turn signal flashes.

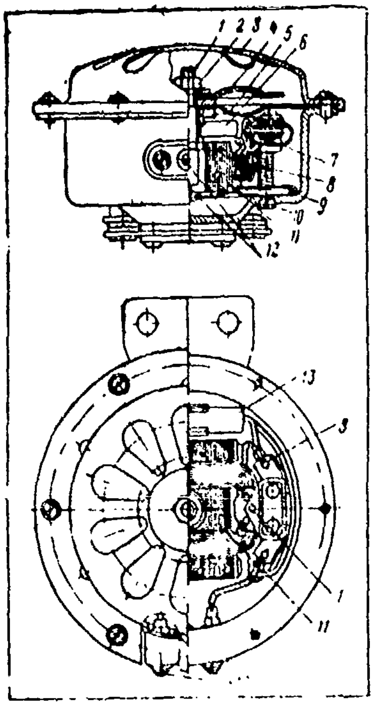


Figure 19-26. Electric Horn.
1, rod, 2, nut, 3, cover, 4, resonator,
5, membrane, 6, armature, 7, eruptor,
8, coil, 9, body, 10, adjusing screw,
11, core, 12, terminals, 13, condensor.

When driving in a straight line, when the turn signal is turned off, both tail lights burn. If the left turn signal is turned on and the brake pedal is pressed at the same time, the stop signal will be fed to the right tail light, and vice versa.

Horns

Electric vibrating horn type S56-G or S44 (Figure 19-26) is installed on the ZIL-130 and ZIL-131 trucks. The ZIL-130B1 tractor and the ZIL-131 truck also use a dual tone air horn.

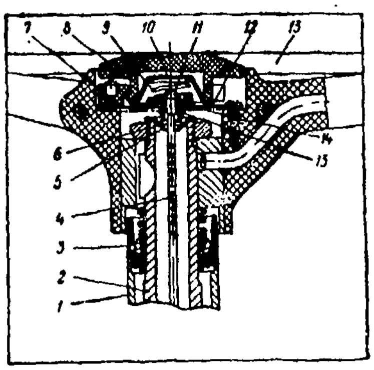


Figure 19-27. Horn Switch: 1, steering column, 2, steering shaft, 3, bearing, 4, conductor, 5 and 11, plates, 6, nut, 7, insulator, 8, switch button, 9 and 15, springs, 10, contact cap, 12, contact plate, 13, steering sheel, 14, insulating bushing.

The electrical horns are mounted on the front wall of the cabin beneath the hood or on the hood itself on the inside. The horns operate normally with voltages of 10.5-14.0, drawing a current of not over 2.5 a.

The horns are turned on by a switch button installed in the center of the steering wheel (Figure 19-27).

Dual tone air horn. On the ZIL-130V1 and ZIL-131, in addition to the electric horn, there is a dual tone (dual horn) type S40B air horn (Figure 19-28). The horn is turned on by the VK40 foot switch installed on the floor of the cabin.

The signal operates from compressed air at 4-10 kg/cm^2. The air is fed through valve 8 of switch 9 from the brake valve through a line connected to body 2 of the horn.

Cabin Ventilator and Heater Motors

The heater motors used are: on the ZIL-157K, the ME7-B motor; on the ZIL-130 and ZIL-131, the ME211. The motor is switched on by a separate switch on the dashboard. The power supply circuit of the motor includes a fuse between the ignition switch and the motor switch. The technical characteristics of the ME7-B and ME211 motors are presented in Table 19-4.

On order, a cabin ventilator is included, driven by an ME11 4 watt motor. This ventilator includes a heater switch.

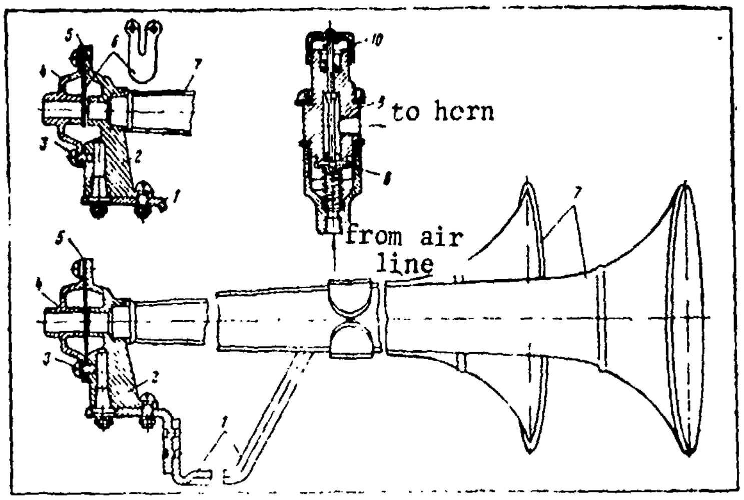


Figure 19-28. Pneumatic Air Horn with Switch:
1, bracket, 2, horn body, 3, screw, 4, body cap, 5, gasket, 6, vibrator, 7, signal horn, 8, switch valve, 9, switch, 10, switch button.

TECHNICAL CHARACTERISTICS OF ELECTRIC MOTORS   TABLE 19-4.

Parameters	ME211	ME7-B
Nominal voltage, v	12	
Nominal power, w	25	8
Direction of rotation from drive side	Right	
Rotating speed of shaft at nominal load, rpm	3,000	2,600

Instruments

Air pressure gauge in pneumatic brake system. The ZIL-157K carries a single-needle MD1-B manometer, while the ZIL-130 and ZIL-131 carry double needle MD213 manometers, the upper needle of which indicates the pressure in the air cylinders, the lower indicates the pressure in the brake cylinders. The MD1-B and MD213 manometers are designed for pressures of 10 kg/cm^2.

Tire pressure gauge. The ZIL-157K carries an MD6 manometer, designed for a pressure of up to 4 kg/cm^2, while the ZIL-131 carries an MD223 manometer designed for a pressure of up to 6 kg/cm^2.

The ZIL-157K is equipped with a model SP24-A speedometer, the ZIL-130 and ZIL-131 -- model SP201. Both types of speedometer have needle speed indicators and odometers. The speedometers are installed on the dashboard and driven by a flexible shaft.

Oil pressure gauge. The ZIL-157K uses a type UK28 oil pressure gauge in the engine lubricating system (Figure 19-29), while the ZIL-130 and ZIL-131 carry type UK201 gauges. Both pressure gauges are electric, pulse type, using a type MM9 sender.

Water temperature gauge. The ZIL-157K uses a type UK26-Ye water temperature gauge with a TM3 sender, while the ZIL-130 and ZIL-131 use type UK200 gauges with TM101 senders. Both type of gauges (Figure 19-30) are electric, pulse type, with calibrations up to 110°C.

Fuel level gauge. The ZIL-157K carries a type UB26-A fuel level gauge with a BM22-A sender, while the ZIL-130 and ZIL-131 carry type UB200 gauges with the BM117-A sender. Both types of fuel gauges are electric, with rheostat type senders installed in the fuel tank (Figure 19-31).

Ammeter. The ZIL-157K carries a type .P6-Ye dc ammeter. The ZIL-130 and ZIL-131 trucks do not carry ammeters (a ttery charge warning light is used instead).

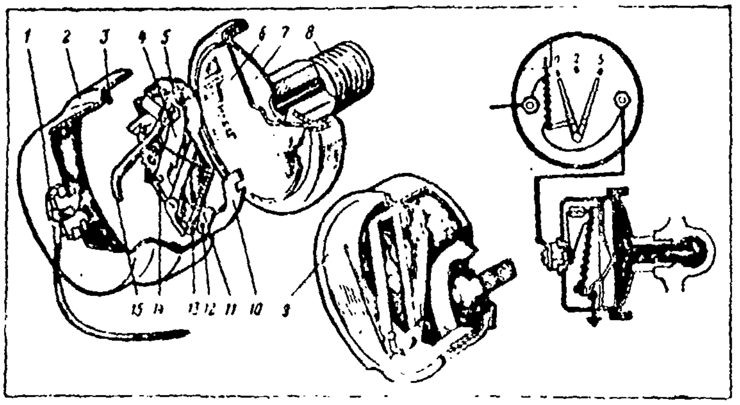


Figure 19-29. Oil Pressure Gauge Sender and Receiver: 1, terminal, 2, protective cap, 3, gasket, 4 and 12, brackets, 5, insulating gasket, 6, diaphragm, 7, body, 8, nipple, 9, oil pressure indicator, 10, disk, 11, bimetallic plate winding, 13, bimetallic plate, 14, adjusting support, 15, contact plate.

Electric Wiring

The electrical equipment is connected to the power supply using various types of wires (Table 19-5).

Maintenance

Battery

Maintenance of batteries is performed in correspondence with the standardized rules for care and maintenance of motor vehicle batteries (GOST 959-51). These rules are delivered with each vehicle manufactured at the plant.

During TO-1, check the level of electrolyte in all cells and fill with distilled water if necessary. Wipe off the surface of caps and walls of the battery with a clean rag wet in a 100% solution of ammonium hydroxide or a 10% solution of calcined soda, then with a dry rag. Wash the gas holes in the caps or plugs.

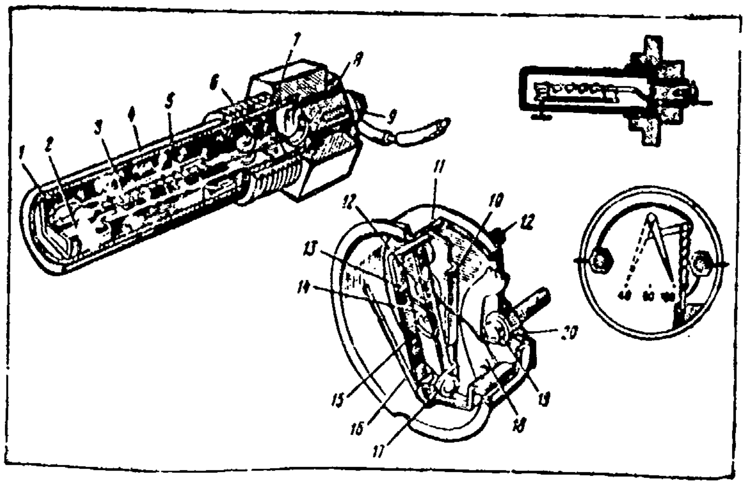


Figure 19-30. Water Temperature Gauge Receiver and Sender in Engine Cooling System:
1 and 13, bimetallic plates, 2, bracket with nonmoving contact, 3 and 15, windings, 4, sender body sleeve, 5, spacing bracket, 6, contact plate, 7, sender body, 8, insulating bushing, 9, sender terminal, 10, bracket, 11, indicator body, 12, terminal for conductor from ignition switch, 14, adjusting pinion, 16, indicator needles, 17, needle bracket, 18, pinion to rotate bracket during adjustment of indicator, 19, terminal for sender wire, 20, insulating plate.

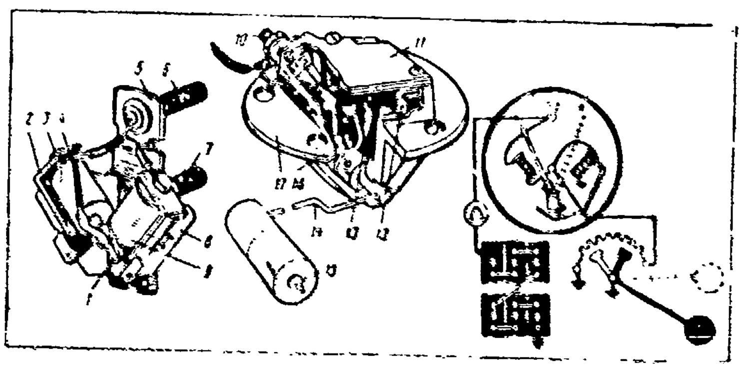


Figure 19-31. Fuel Gauge Sender and Receiver:
1, armature, 2, bracket, 3, left coil, 4, needle, 5, well, 6, terminal for wire from ignition switch, 7, terminal for wire from sender switch, 8, bracket, 9, right coil, 10, sender terminal, 11, cover of sender body, 12, connection of rheostat winding to ground, 13, rheostat, 14, float lever, 15, float, 16, sliding contact, 17, sender body.

TYPES OF WIRE USED IN TRUCK ELECTRICAL SYSTEMS. TABLE 19-5

Truck Type	Overall High Voltage Wire		Low Voltage Wire	Battery Cable
	Shielded	Unshielded		
ZIL-157KG	PVS-7	-	PGVA	ASI or PGVA
ZIL-157K	-	PVV	PGVA	ASI or PGVA
ZIL-130 and ZIL-131A	-	PVV	PGVA	PGVA
ZIL-130Ye, ZIL-131 and ZIL-131V	PVS-7	2	PGVA	PGVA

Three colored zones are set out on the volt meter scale, representing: green -- battery in good condition and charged; yellow -- battery needs charging; red -- battery must be charged or repaired.

To test the battery, the blade edges of the fork are pressed firmly against the connecting poles of the battery being tested for 5 sec; at the end of this time, the voltage recorded by volt meter 5 is noted.

If the battery is in good condition and fully charged, the voltage of each cell at the end of 5 seconds will remain unchanged at 1.7-1.8 v. If a cell shows a voltage of 1.4-1.7 v, the battery needs charging. If the voltage of one or more cells differs from the voltages of the other cells by 0.1 v or if the voltage after 5 seconds drops to 0.4-1.4 v, the battery is defective and must be charged or repaired.

If no load fork is available, individual cells can be tested with a volt meter with a 3-0-3 v scale with the starter operating and the ignition on; the test voltage should be 1.7-1.8 v. Batteries or individual cells should not be tested by shorting the terminals with metal objects, since this damages the plates, and the sparks resulting may ignite the gases liberated by the battery. It should be recalled that the voltage of a battery under load depends not only on the state of charge of the battery and its capacity, but also on the condition of the plates. A battery with sulfate-fouled plates loses voltage much more rapidly due to its high internal resistance and decreased battery capacity.

Testing of electrolyte density should be performed during TO-2. The density of the electrolyte in the batteries is determined by hydrometer 1 (Figure 19-33), enclosed in a glass tube with a rubber bulb 2. The higher the hydrometer floats in the electrolyte, the greater the density of the electrolyte. The density of the electrolyte is determined using the hydrometer scale, one scale division of which corresponds to the level of the upper meniscus (see point 3).

It should be kept in mind that the density of the electrolyte in a battery increases during charging, decreases during discharging.

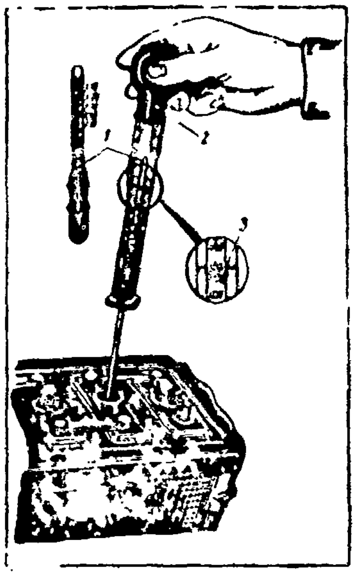


Figure 19-33. Testing Electrolyte Density: 1, hydrometer, 2, bulb, 3, reading point of upper meniscus.

The electrolyte is prepared in a vessel resistant to the action of sulfuric acid (ceramic, plastic, ebonite, lead). First pour the water into tank 4 (Figure 19-34), then the sulfuric acid, with continuous agitation. The acid, entering the large volume of water in small portions, heats the water evenly, thus avoiding splashing and the danger of burns.

During preparation of the electrolyte, burn safety precautions must be taken. There should always be a reserve of cold water and a 10% aqueous solution of ammonium hydroxide or soda as a first aid measure available.

It must be kept in mind that the density of the electrolyte can be used to determine the level of charge of each battery. It can be accepted with solution accuracy that a decrease in electrolyte density of 0.01 corresponds to 6% discharge of the battery. The density of the electrolyte with a fully charged battery and with a battery discharged by 25 and 50% is presented in Table 19-6.

It should be recalled that the service life of batteries depends also on proper operation of the voltage regulator, which must maintain the regulated voltage within the recommended minutes for the climatic zone in which the battery is used.

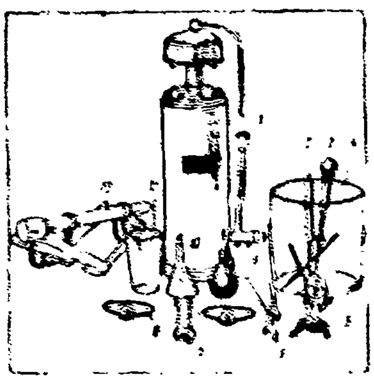


Figure 19-34. Equipment, Devices and Instruments for Maintenance of Batteries:
1, still for production of distilled water, 2, thermometer, 3, hydrometer, 4, tank for preparation of electrolyte, 5, loading fork, 6, battery connector remover, 7, form for welding on of rods, 8, grips for lifting of batteries, 9, bulb, 10, funnel, 11, beaker, 12, device for lifting battery plate units.

Electrolyte density. The density of the electrolyte, level of charge in individual battery cells and cleanliness of contacts are of primary importance for correct battery operation.

The electrolyte density is not a constant quantity; it changes depending on temperature conditions. Since the chemical composition of the electrolyte necessary for normal battery operation remains identical practically always, an electrolyte of higher density should be poured into batteries in cold regions, an electrolyte of lower density should be used in areas with hot climate (tropics) (see Table 19-2).

DENSITY OF ELECTROLYTE IN BATTERY, CORRECTED TO 15°C. TABLE 19-6.

Fully Charged Battery	Battery 25% Discharged	Battery 50% Discharged
1,310	1,270	1,230
1,290	1,250	1,210
1,270	1,230	1,190
1,230	1,190	1,150

In the summer, the water contained in the electrolyte evaporates actively, and must be replaced with distilled water in order to retain the required electrolyte level and density.

FREEZING POINT OF ELECTROLYTE DEPENDING ON DENSITY. TABLE 19-7.

Electrolyte Density, Corrected to 15°C	Freezing Point, °C	Electrolyte Density, Corrected to 15°C	Freezing Point, °C
1,050	-3.0	1,200	-25.0
1,075	-5.0	1,225	-37.0
1,100	-7.0	1,250	-50.0
1,125	-10.0	1,275	-59.0
1,150	-14.0	1,300	-68.0
1,175	-19.0	1,310	-66.0

Maintenance of batteries in winter must include measurement of electrolyte density since at low temperatures a low density electrolyte may freeze. Table 19-7 shows the freezing points of electrolytes as a function of density.

Bringing dry charge to battery into working condition. When batteries are received in the dry charged state (so manufactured), they must be prepared for charging at the charging station in correspondence with the instructions for maintenance of batteries.

For regions with winter temperatures down to -30°C, electrolyte with a density of 1.250 should be poured into the battery.

For regions with winter temperature down to -40°C, the density of the electrolyte should be 1.270 (year round); for regions with winter temperatures below -40°C, density should be 1.290 (winter) and 1.250 (summer); for southern regions, the density should be 1.230.

The electrolyte is prepared of sulfuric battery acid (GOST667-53) and distilled water in glass, ceramic, ebonite or lead containers (see Figure 19-34), into which first the distilled water, then the sulfuric acid is poured in a fine stream.

It is forbidden to pour water into concentrated acid, in order to avoid accidents resulting from splashing of the acid.

The temperature of the electrolyte poured into the batteries should not exceed 25°C.

The electrolyte should be poured into the batteries so that its level is 10-15 mm above the safety shield over the plates.

Three to four hours after filling of the battery with electrolyte, the battery should be charged. The battery can be charged if the temperature of the electrolyte is not over +30°C.

The first charge is conducted with a current of 5 a and should continue at least 5 hours. At the end of this time, charging is continued until abundant gas liberation occurs in all battery cells, and the charge and electrolyte density remain constant for three hours. Be certain that the temperature of the electrolyte during charging does not rise to over +45°C. If the temperature reaches +45°C, the charging current must be cut in half or charging must be interrupted until the battery cools to +30°C.

If after charging the density of the electrolyte differs from that listed above, the density must be adjusted. When the density is higher than normal, distilled water is added; if the density is lower than normal, electrolyte with a density of 1.400 is added.

In special cases after the electrolyte is poured into a dry charged battery, the battery can be installed on a truck without charging. It is recommended that the starter not be used to start the engine with power from such a battery until at least 3 hours following filling of the battery with electrolyte. After starting, the battery should be charged for 30-45 minutes by running the engine.

Lights and Horn

During daily inspection, inspect the lenses and check the operation of all light and signaling devices with various positions of the central and foot light switches, as well as the turn signals. Be sure that the dash signal lights operate properly.

During TO-1, perform the operations of daily inspection and check: mounting of headlights, parking lights and tail lights, central light switch, turn signal switch, mounting and condition of insulation of wires to headlights and parking lights, reliability of fastening of wire tips to terminals.

Clean the surface and terminals of the foot dimmer switch and stop signal switch, removing dust and dirt.

During TO-2, perform the operations of TO-1 and check the operation of all signal lights, audible signals, the installation of the headlights and the alignment of the headlights. Adjust if necessary.

During TO-2, check the mounting of the ventilator and cabin heater motors and their blades on the shafts, as well as the mounting of wires and switches.

Removal of graphite dust from the collector and cleaning of the motor collector should be performed following 75,000 kilometers of operation of the truck.

During TO-1 and TO-2, test the reliability of mounting of the horn and tighten the terminals, and clean dirt and dust from the horn.

After 25,000 operations (approximately), clean the head chamber of the air horn and its vibrators. Check the mounting of the compressed air tube periodically, as well as the mounting of the horn itself onto the truck.

Air horn switch 9 (see Figure 19-28) should operate with air temperatures between -30°C and +50°C without leaking.

The opening of valve 8 of the switch should occur when pedal 10 is pressed with a force of 12 kG with pressure in the air line 6 kG/cm^2.

Test Instruments

During maintenance of the instruments, avoid connecting the terminals of the test instrument senders to ground with the ignition on, since this will cause rapid heating and burn out of the indicator receivers. The terminals of an indicator receiver also must not be allowed to contact each other, since this might damage the sender.

During straightening of wires or connection of wires to instruments, a wire disconnected from the sender of any of the devices should not be connected to ground with the ignition turned on, since this might burn out the winding of the gauge.

The senders must be protected from dirt and the receivers must be protected from dust.

If any of the gauges fails to operate or operates incorrectly, check the condition of the wires and their connections; if they are in good condition, replace the sender or receiver as required.

When the oil pressure sender is replaced, it should be screwed into the threaded seat so that the mark (arrow marked up) on the cover of the sender is turned upward. Otherwise, the accuracy of the readings will be significantly reduced.

When dashboard parts are bent, they must be straightened. In case of a bent board lug, new lugs must be welded on.

A bent scale or needle in the fuel gauge can be repaired by straightening. In case of a short circuit of the winding, replace the winding or the entire instrument. If the connecting wire of the gauge comes unsoldered or is burned off, it should be resoldered. In case of overheating of the bimetallic plate of the indicator, it or the entire gauge should be replaced.

A bent scale or needle in the ammeter may be repaired by straightening. In the case of unbalancing of the ammeter needle, demagnetization of the permanent magnet or an increase in the clearance of the needle axis at the centers, the instrument should be replaced.

The correctness of the indications of the control instruments should be periodically checked during maintenance.

Electric Wiring

Unshielded wires. Testing of wires for insulator condition is performed by external inspection. If a bare spot is discovered on low voltage wires, it should be insulated (wound) with insulating tape. High voltage wires with damaged insulation must be replaced.

In order to determine a break in a wire, use a control light probe (Figure 19-35a), one contact of which is connected with alligator clip 6, the other -- with probe 3.

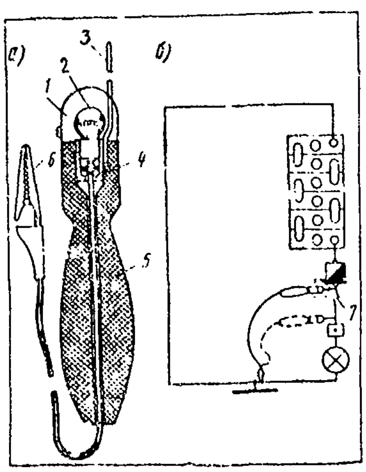


Figure 19-35. Test Lamp to Locate Open Circuit Points and Check Contacts:
a, test lamp, b, diagram of connection of test lamp to locate break in wire;
1, protective grid, 2, bulb, 3, probe, 4, cartridge, 5, handle, 6, wire and clip, 7, location of break in wire.

To determine the location of a break in a wire, the clip is connected to ground, and the probe is used to contact the terminals of the circuit in the direction from the nonoperating device toward the battery (Figure 19-35b). If there is considerable distance between terminals or if there are no terminals, the insulation of the wire can be pierced with the sharp end of the probe.

Testing is continued until the lamp lights. The point of the break in the wire will be located between the point of contact at which the lamp lights and the nearest point at which the lamp does not light. A broken wire must be replaced. As a temporary measure, the ends of a broken wire can be reconnected and wound with insulating tape.

In case of a short of a wire to ground, the wires should be insulated. Since the circuits of many current consumers are protected with fuses, usually a circuit in which a short has occurred will be immediately opened by the corresponding fuse.

To eliminate short circuits, inspect carefully all wires and wrap exposed areas with damaged insulation with insulating tape.

In order to maintain electric wiring in good condition and prevent wear, wires must be cleaned of dirt and dust, brackets and their mounting must be checked.

Shielded wire. Complete suppression of radio interference requires good contact between the metal parts of the motor, chassis and cabin and all electrical equipment, the common shield around the spark plugs braid of shielded wires.

During maintenance or assembly and dissembly of shielded electrical equipment, particular care must be taken in connecting all shields and devices to ground, and in preventing dirt and corrosion at mounting points.

During all work on shielded electrical equipment, in order to avoid short circuits and fires, disconnect 1 cable from the battery terminal.

When the spark plug and distributor shields are removed, after work is completed they must be replaced and carefully fastened down. Replacement of high voltage wires with other wires without damping resistors is not permitted.

In order to avoid disconnecting the shielding braid of the wire from the tips of the plugs of the voltage regulator, generator, radio interference filters and ignition coil, these wires must not be greatly tightened. If the shielding braid of the wire is disconnected, it must be carefully reconnected. This can be done using the available reserve of wire. Reconnection must be particularly carefully done in order to avoid seizing of individual shielding braid filaments against the core of the cable.

During reworking of wire tips for the low voltage wire of the ignition coil, the core of the conductor must be slipped through the tip until it rests against the insulator, being sure that all wires of the core are inside the collar of the tip. Where the core of the wire extends from the collar, the wires of the core must be spread evenly around all sides and the contact cap snapped in place.

The rubber sealing ring on the low voltage wire of the coil must be placed above the varnished cotton braid of the wire. The rubber ring must not rest directly on the rubber insulation of the wire with the varnished cotton braid shifted, since this will not provide the required seal.

Finishing of wires in the jacks of the generator, voltage regulator, radio interference filter and distributor is done in the following sequence (Figure 19-36).

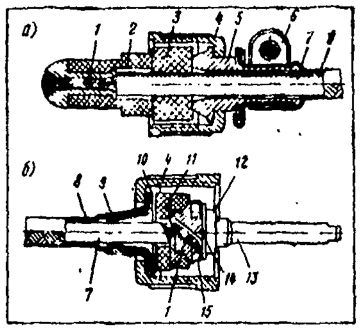


Figure 19-36. Finishing of Shielded Cables:
a, in tip collar; b, in jack;
1, core, 2, insulating collar, 3, sealing ring, 4, supporting nut, 5, metal ring, 6, clamp, 7, wire, 8, shielding braid, 9, outer conical ring, 10, inner conical ring, 11, insulating washer, 12, nut, 13, plug fork, 14, spring washer, 15, pressure cup.

Strip the end of the wire for a length of 20 mm, place nut 4 and conical ring 9 on the braid of the wire, tighten the shield braid 8 of the wire on the second conical ring 10, grounded by outer ring 9, bend the lugs of this ring and connect it to the inner ring. Be sure to cut off the ends of the shielding braid to be sure that the braid does not contact current carrying parts. Then, place washer 11 on the end of the wire. Loosen nut 12 on the contact fork, remove washer 14 and cup 15. Place the stripped end of the wire into the aperture in contact fork 13 on the end with the insulation ring and wrap the end of the wire once around the uncut portion of the contact fork. Put on cup 15, washer 14 and tighten down nut 12.

In straightening wires, be sure that the individual parts of the wire do not extend out from beneath cup 15, since they might cause a short circuit.

Solder the wires and tips without using acid.

In order to avoid burning and breakdown of the high voltage cover of the ignition coil, before tightening the retaining nut attached to the shield of the central wire, be sure that the tip of the wire is inserted fully into the terminal of the high voltage lead of the coil.

When tightening and loosening the retaining nuts of all plugs, be sure not to twist the shield together with the nuts, since this will cause damage to the shield braid and core of the wire, and will also disrupt the electrical contact between the braid and ground.

Tightening of retaining nuts of all shielded wire plugs, as well as shielding braids, must be performed only by hand. The use of pliers or other tools is permitted only in an emergency, and care must be taken to avoid damage to the contacts.

Be sure that water does not contact high voltage wires, since this may cause intermittent operation of the ignition system.

The condition of the contacts on shielded wires should be checked during TO-1, or under particularly severe operating conditions -- each 400-500 km. Tightening of wire tips should be performed to provide permanent and reliable electrical contact. The operation of the truck with loose screws and nuts is not permitted.

Dissembly and Assembly

Battery

Removal and replacement of batteries. To remove the 6-ST-78 battery from the ZIL-130 and ZIL-131, manually unscrew the shield retaining nuts and remove the shield. On the ZIL-131, disconnect lead 5 (see 19-8) of the battery switch. Remove the battery mounting by loosening the wing nut 15 (see Figure 19-6). Using bracket 11, remove the battery from its well together with the base and bottom support. Remove protective cover 5, releasing from holders 2 and 6. Disconnect the ground cable 7 and starter wire 1 from the battery terminals by loosening the terminal bolts 3. Lift up the handle and manually place the battery on truck 4 (Figure 19-37) for transport.

Work with batteries requires particular observance of the safety rules, since the materials used in acid batteries can cause poisoning, burns of the skin and damage to clothing.

To remove the 3-ST-84 battery (see Figure 19-5) disconnect the ground cable and starter wire from the terminals. Disconnect the wire connecting the batteries, remove the bolt and withdraw the battery from the well. To remove the batteries, a special handle 1 (see Figure 19-37) should be used, by placing clamps 2 on the battery terminals. Hand cart 4 should be used to transport batteries.

Requirements for batteries. The filler should have an even surface, without bulging or cracks. Leakage of electrolytes through leaks in the filler and cracks in the walls of the tank are not permitted. Output terminals 6 and 9 (Figure 19-38) and intercell connectors 8 must have the correct geometric shape without traces of oxidation or dirt.

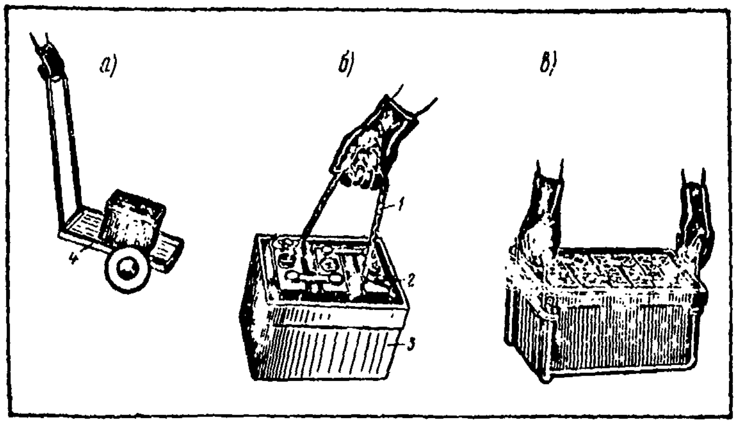


Figure 19-37. Transportation of Batteries:
a, transportation on hand cart; b, installation of lifting handle on battery terminals, c, battery with handles extended for lifting; 1, canvas handle, 2, metal clamp, 3, battery, 4, hand truck.

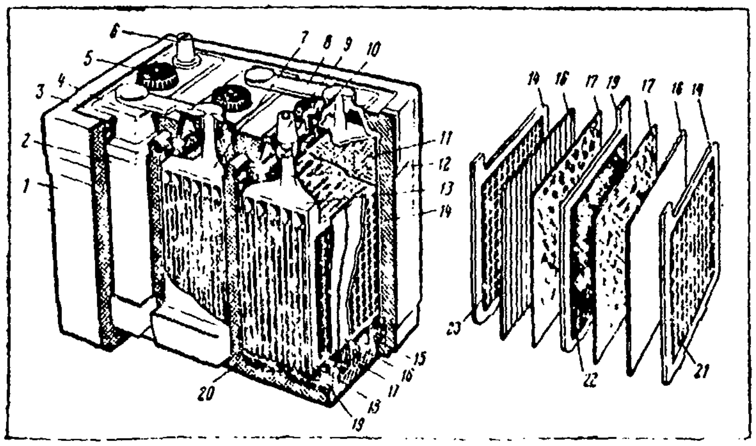


Figure 19-38. 3-ST-84 Battery, Cross Section:
1, monoblock, 2, acid resistant battery tank, 3, acid resistant filler, 4, battery cover, 5, cap with ventilating aperture, 6, negative battery terminal, 7, negative plate half block, 8, intercell connector, 9, positive battery terminal, 10, reflector, 11, safety shield, 12, common connector, 13, positive plate semiblock, 14, negative plate, 15, monoblock rib, 16, separator, 17, glass wall, 18, slime chamber, 19, positive plate, 20, monoblock barrier, 21, active mass of negative plate, 22, active mass of positive plate, 23, plate grid.

If the necessity arises of complete or partial dissembly of a battery, the individual parts of the dissembled battery are considered useable if:

the internal barriers 20 and walls of monoblock 1 have no dense, warping or cracks and scratches;
scratches on the outer walls, corners and ribs of the monoblock are not over 3 mm deep, area not over 2 cm^2;
the bending of warped plates 14 and 19 does not exceed 3 mm;
the number of empty cells and holes in the plates is not over 2, and they are not beneath the plate lugs;
the active mass 21 and 22 has fallen out of not over 7 cells without formation of through holes;
the thickness of the plate filled with active mass is not over 0.5 mm greater than the thickness of the grid;
the plate grids have no tracks or brakes;
the positive plates 19 are black to dark brown in color, soft to the touch with no white spots.

Lights and Signals

Removal and replacement of headlights. To remove the headlights from the ZIL-157K, disconnect tips 15 (Figure 19-9) of the wires, remove nut 9 and remove the headlight from the fender.

To remove the headlights from the ZIL-130 and ZIL-131, disconnect tips 13 (see Figures 19-10 and 19-11), remove screw 12 retaining the decorative outer rim 4 and remove it with seal 3. After this, while holding the heads of the bolts retaining the headlights, remove the nuts on the inside of the radiator fairing and remove the headlight from the seat. After removing the headlight, replace the decorative rim.

Installation of headlights is performed in the reverse sequence.

Dissembly and assembly of headlights. To dissemble the FG1-A2 headlights, remove screws 12 (see Figure 19-9), remove rim 13 and remove the optical element from the body of the headlight as a unit. In order to remove the bulb, remove carbolite cartridge 5, pressing inward with the hand and rotating it to the left.

To replace a broken lens, spread the reflector by hand, bending out all teeth of the gripper, then remove the damaged lens and the rubber gasket. Straighten out the teeth of the reflector with pliers or a hammer and replace the rubber gasket. Teeth on which the paint is damaged by bending must be repainted to prevent corrosion. Install the new lens and rebend the lugs using the proper tool (Figure 19-39). In exceptional cases, the lugs can be rebent manually using pliers by carefully bending 2 diametrically opposite teeth at the same time. The teeth should not be straightened out before manual rebending.

During dissembly of the optical element of the headlight, and also during subsequent assembly, the reflector should not be touched with the hands. If after the removal of the lens it is discovered that the reflector is quite dirty, before replacement of the lens it should be washed in clean water with a rag and dried in the inverted position (reflecting surface downward). To replace the bundle of wires, disconnect them from the cartridge and remove them from the headlight.

To dissemble the FG122-G (see Figure 19-10) or FG122-I (see 19-11) headlights, remove 1 screw 12 mounting outer rim 4 and remove the rim together with seal 3. Back off the 3 mounting screws retaining the optical element with a screwdriver, rotate the optical element rim to the left until the heads of the screws match up with the circular holes in the rim and remove the rim. Remove the optical element from the headlight and, holding it in the left hand, disconnect the plug with the right hand from the carbolite cartridge (Figure 19-40). Remove the carbolite cartridge from the optical element by pressing in lightly with the hand and rotating it to the left, then remove the bulb. If necessary, the lens can be moved according to the method described for the FG1-A2 headlight. The reflector is crimped in using the same device (see Figure 19-39). To change the bundle of wires, disconnect them from the plug, remove the retaining clamp and pull the bundle of wires from the headlight. Assembly of the headlight is performed in the reverse sequence.

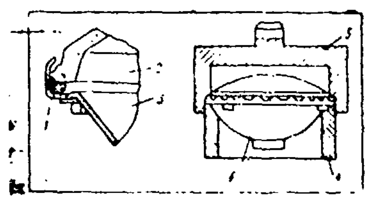


Figure 19-39. Device for Crimping Headlight Reflector Lugs:
1, rubber gasket, 2, lens, 3, reflector, 4, matrix, 5, dye, 6, optical element.

Figure 19-40. Removal of Optical Element.

Adjustment of headlights. To adjust the headlights, park the truck (unloaded) on a horizontal area, so that its longitudinal axis is perpendicular to a wall or special screen at a distance of 10 m. After this, divide the screen as follows.

Draw vertical line 4 (Figure 19-41) on the screen, corresponding to the axis of the truck.

On both sides of this line, draw 2 vertical lines BB at identical distance, equal to half the distance between the centers of the headlights.

Draw horizontal line 3 at the level of the height of the centers of the headlights above the ground.

Draw horizontal line AA 100 mm below horizontal line 3, passing through the centers of the headlights.

After completion of marking of the screen, turn on the high beam headlights and, with the right headlight covered, adjust the light of the left headlight so that the center of the light beam strikes the point of intersection of the lower horizontal line AA and the left vertical line BB.

To adjust the direction of the headlights of the ZIL-157K, loosen nut 9 (Figure 19-9) mounting the headlights and rotate the body of the headlight accordingly.

To adjust the right headlight, cover the left headlight and perform adjustment similarly, causing the center of the light beam to strike the point of intersection of the lower horizontal line AA (see Figure 19-41) and the right vertical line BB.

Be sure that the upper edges of the light beam of both headlights on the screen are at the same level, then tighten the headlights. After tightening the headlights, test the adjustment of the headlights and the direction of the light beams once more.

On the ZIL-130 and ZIL-131 vehicles, the headlight bodies are fastened rigidly in the seats in the radiator fairing with bolts and nuts. Adjustment of the direction of the headlight beam is performed using 2 adjusting screws 5 (see Figures 19-10 and 19-11). The outer rim of the headlight must be removed, and tips 13 of the bundle of wires connected to the electrical equipment circuit. The method of adjustment of the direction of the light beam of the headlights is shown on Figure 19-42. Rotating the adjusting screws, the optical element is rotated around its vertical or horizontal axis. After completion of adjustment, re-install the outer rim and fasten it down.

To remove a parking light, disconnect its wires from the current source, rotate the nuts and withdraw the parking light from its seat.

To dissemble the parking lights, remove screws 2 (see Figure 19-15), remove rim 3 and lens 1, protecting gasket 4 from damage, then remove bulb 6 from the cartridge.

To replace the wires or cartridge, remove the cartridge and wires from the body of the parking light.

The assembly of parking lights and their installation on the truck is performed in the reverse sequence from dissembly and removal.

To remove the tail lights from the truck, disconnect the electric wires from the power supply and remove them from their mountings.

To replace the bulbs, remove screw 4 (see Figure 19-16), remove the glass, protecting the gasket from damage, then remove the bulbs from the cartridges. To replace glass 1 of the license plate light, remove its mounting screws and remove the glass from the body of the tail light.

To dissemble the central light switch, remove the screw from terminal 8 (see Figure 19-18) mounting the connecting arm from the resistor. Bend back the 4 cover mounting lugs with nonmoving contacts and with the bimetallic switch.

Remove the cover with nonmoving contacts. Remove the 2 screws mounting the bimetallic switch 6 and remove it. Remove the moving contact with 3 projections and removing contact insulator. Remove the insulator spring and the ball retainer spring. Remove the knob and rod (the knob screws onto the rod). To remove rheostat 9, bend back the 4 lugs with a pair of pliers and remove it from the body as a unit.

When the current carrying parts contact ground, change the insulating parts.

The thickness of the silver contact layer must not be decreased by more than 0.15 mm.

The force required to move the shaft should be 1.5-4.5 kG. If the force is less than 1.5 or greater than 4.5 kG, the switch should be dissembled, the rod spring replaced and adjusted.

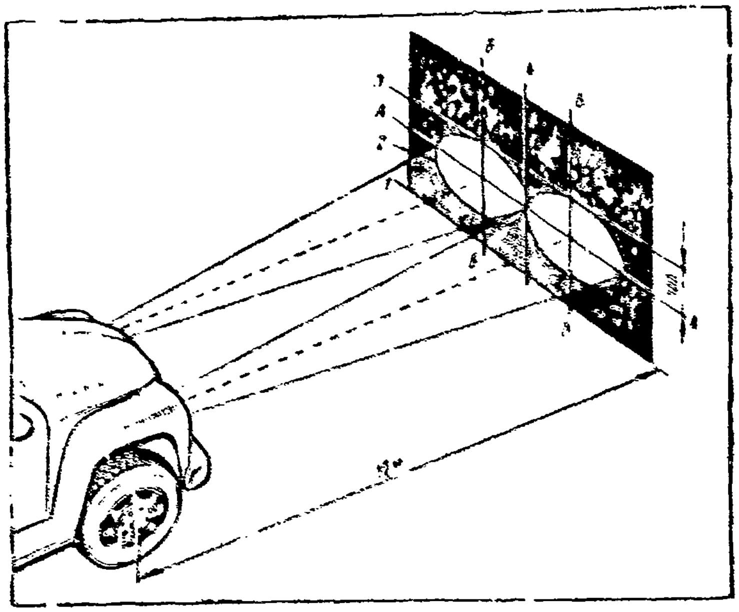


Figure 19-41. Marking of Screen for Headlight Adjustment:
AA, horizontal line 100 mm below center line of headlights; BB, vertical lines through centers of headlights;
1, ground level line, 2, contour line of light beams, 3, horizontal line of headlight centers, 4, vertical axial line of truck.

In case the switch rod and plate of lower contact of switch are bent, they must be straightened or replaced.

If there are cracks or other defects in switch parts, the defective parts must be repaired or replaced.

To dissemble the foot dimmer switch, disconnect cover 12 (see Figure 19-20) and press the parts out of body 5 for inspection and testing.

In case of burning of the surface of contacts 11, they must be cleaned or replaced.

In case of a broken clamp or wear of the rotating disk 8, it must be replaced.

If the disk spring or pusher is deformed, they must be replaced. If contact plate 10 is broken, it must be replaced, together with insulating disk 9.

To remove the turn signal from the truck, disconnect the wires from the power supply, disconnect the indicators and remove them from the brackets in the beams.

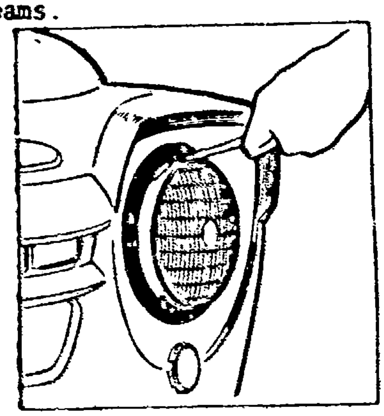


Figure 19-42. Method of Adjustment of ZIL-130 Headlights.

The method of dissembly and assembly of the front turn indicators is the same as the method of dissembly and assembly of the parking lights, and the same is true for the rear turn indicators and tail lights.

Repair and adjustment of turn signal blinker can be performed only in specialized shops. Adjustment of the blinker should be performed by means of screw 18 (see Figure 19-24) and plate 8.

Horns

Dissembly of electrical horn. Remove the 6 screws and remove cover 3 (Figure 19-26) with its gasket, membrane 5 with rod 1 and the electromagnet, consisting of core 11 and coil 8.

When coil 8 is removed, remove the terminal well mounting screw for the current carrying lead; unsolder the ends of the output lead of the coil from the terminals and the contact upright, and unsolder the line to condensor 13; remove the contact upright mounting screws together with the spring washers; unscrew and remove adjusting screw 10, remove the contact upright and adjusting screw spring; unscrew and remove the 2 coil mounting springs together with the spring holders; remove the coil with a screwdriver.

Adjustment of horn. Before adjustment, before removing cover 3, clean the contacts of interruptor 7 with an abrasive plate.

Adjustment of the horn (its loudness and tone) is performed with screw 10. Rotating the screw in either direction adjusts interruptor 7 and sets the clearance between armature 6 and core 11 and therefore sets the normal tone of the horn.

If adjustment with screw 10 does not produce satisfactory results, back off nut 2 with a box end ridge and rotate rod 1 by one-quarter turn with a screwdriver. Retighten the nut and, connecting the current, test the tone of the horn and its loudness, adjusting the horn by air using adjusting screw 10.

The horn is adjusted only in case the sound volume decreases or the tone varies.

To assure proper horn operation and increase its service life, avoid long honking.

If there is no sound from the horn, before adjusting the horn, be sure that the wires, interruptor contacts and condensor are in good condition. If there is a defect which might cause poor sound or lack of sound, it must be eliminated, and only then can the horn be adjusted if necessary.

In case of a short circuit in the horn, the bimetallic button circuit breaker operates (Figure 19-43); it is located in the cabin on the steering column bracket. Therefore, after eliminating a defect, the electrical circuit must be restored by pressing on button 5.

To remove the air horn, disconnect the compressed air line and remove the horn mounting bolts.

For dissembly and inspection of the horn, remove screws 3 (see Figure 19-28), remove 2 gaskets 5 (one adjustable) and remove 2 vibrators 6.

The horn vibrators should have no cracks or film of oil or dirt. In case of wear of the pins or cracks on the vibrators, they should be replaced.

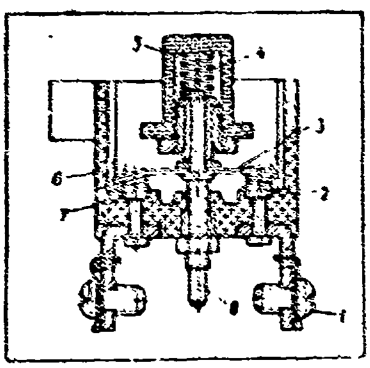


Figure 19-43. Button Type Circuit Breaker: 1, terminal screw, 2 and 7, terminals, 3, bimetallic plate, 4, spring, 5, button, 6, body, 8, adjusting screw.

With an air pressure of 6 kG/cm^2, the loudness of the horn should be at least 112 db at a distance of 1.0 m from the horn.

As the air pressure increases from 7 to 10 kG/cm^2, the horn should continue to sound, although the loudness may increase and pitch may change.

The horn should sound when cooled to -40°C or heated to +65°C.

Electric Motor of Heater and Ventilator

Dissembly and assembly of ME211 electric motor. Unscrew the nuts and remove 2 tension bolts, remove the cover from the motor body together with the armature, resting the ends of the armature shaft on the edge of the bench. Press the armature out of the cover, holding the brushes of the collector, remove the brushes and brush springs. Disconnect the excitor winding wire from the power terminal. If necessary, press out the pole cores with their clamps.

When it is necessary to replace the electric motor bearings, remove the clips and extract the bearings.

To dissemble the switch, remove the nut, pull out the rod and remove the button and plate together.

The ME211 motor is assembled in the reverse sequence.

Dissembly and assembly of the ME7-B motor are practically similar to dissembly and assembly of the ME211 electric motor.

-- Instruments

Speedometer. Checking of the indications of the speedometer unit should be performed on a test stand with a rotation counter and provision for alteration of the speed of rotation of the flexible speedometer shaft.

The indications of the speedometer are compared with the true number of rotations of the flexible shaft of the speedometer being tested. The dependence between the speed of the truck and the number of rotations of the flexible shaft of the speedometer is presented in Table 19-8.

TABLE 19-8.

SPEEDOMETER INDICATION AS A FUNCTION OF ROTATING SPEED OF FLEXIBLE SHAFT.

Indication of Speedometer, km/hr	Rotating Speed of Flexible Shaft, rpm	Indication of Speedometer, km/hr	Rotating Speed of Flexible Shaft, rpm
20	208	80	832
40	416	100	1,040
60	642	120	1,248

The readings of the speedometer must not be over 1.5% high, or 3% low.

If the indications of a speedometer being tested do not correspond to these tolerances, the speedometer must be replaced or sent for repair.

Testing of the oil pressure gauge is begun by testing the receiver. This is done by connecting the receiver in series to a 300 ma milli-ammeter and a 150-200 ohm rheostat, and connecting this circuit to a 12 v battery. The rheostat is used to change the current in the circuit, and the indications of the gauge are tested.

Indications should be read 2 minutes following setting of the necessary current. This holding time is necessary to warm up and stabilize the temperature of the windings and plate.

The indications of the oil pressure gauge are presented in Table 19-9. If the indications of the oil pressure gauge are within the limits shown in Table 19-9, check the sender, testing of which is performed together with a device tested by the method described above. Checking of the sender is performed at 2 points: 0 and 2 kG/cm^2. The indications of the sender must be within the limits shown in Table 19-9.

INDICATIONS OF OIL PRESSURE GAUGE AS A FUNCTION OF CURRENT. TABLE 19-9.

Current in Receiver Circuit, ma	Indications of Pressure Gauge, kG/cm^2
60	0
170	1.8-2.2
240	4.8-5.2

Testing of water temperature gauge is begun with the instrument itself using the same method as for the oil pressure gauge. The indications of the water temperature gauge as a function of current are presented in Table 19-10.

Testing of the water temperature sender is performed using a standard mercury thermometer together with a tested temperature indicator. The indications of the sender should correspond with the quantities presented in Table 19-10.

INDICATIONS OF WATER TEMPERATURE GAUGE AS A FUNCTION OF CURRENT. TABLE 19-10.

Current in Receiver Circuit, ma	Indications of Receiver of Water Temperature Gauge, °C
80	96-104
160	75-85
250	40-50

If the indications of the sender and receiver of the water temperature gauge fall outside the limits indicated in Table 19-10, the gauge set should be replaced or sent in for repair.

To check the fuel level gauge, it is fastened to a flange on a support so that the float lever can rotate freely around its axis. A sector showing scale divisions corresponding to the scale divisions of the indicator receiver should be placed in the plane of rotation of the lever: 0, 1/4, 1/2 and F. The angle of rotation of the lever on the axis perpendicular to the plane of the flange for all these positions is shown in Table 19-11.

TABLE 19-11.

ANGLE OF ROTATION OF FUEL LEVEL GAUGE SENDER FLOAT AS A FUNCTION OF POSITION.

Position of Sender Lever	Angle of Rotation of Sender Lever	
	BM22-A	BM117-A
0	31°	36°
1/4	48°	50°
1/2	63°	66°30'
F	89°	90°30'

TABLE 19-12.

RESISTANCE OF RHEOSTAT AND DEVIATION OF RECEIVER INDICATIONS AS FUNCTIONS OF POSITION OF SENDER FLOAT LEVER.

Position of Lever of BM22-A and BM117-A Senders	Resistance of Rheostat, ohms	Permissible Deviations of Receiver Indications, % of Scale Length
0	0-3	Axial line of needle within limits of outline of division
1/4	13-15	+5 -7
1/2	30-34	±7
F	36-58	+10

COMPARATIVE INDICATIONS OF TEST AND STANDARD AMMETERS. TABLE 19-13.

Reading Number	Indications of Ammeter Being Tested, a	Indications of Standard Ammeter, a
1	+20	+17-+23
2	+10	+8-+12
3	0	0
4	-10	-8--12
5	-20	-17--23

Rotating the lever to the 0, 1/4, 1/2 and F positions, measure the resistance of the rheostat of the sender using an ohmmeter. The resistances of the rheostat should be as indicated in Table 19-12.

The receiver of the fuel gauge is tested by comparing with an earlier tested, correctly operating sender.

If the resistance of the rheostat goes beyond the limits indicated in Table 19-12, the gauge should be replaced or sent in for repair.

Testing of the ammeter is performed by the method of comparison with a standard ammeter. The ammeter tested is connected in series with a standard ammeter, rheostat and battery. The standard ammeter used should be an electromagnetic ammeter with an accuracy class of no lower than 1.5 with measurement limits 30-0-30 a. Calibration of the ammeter being tested is performed using 2 scale points: with forward and reverse current direction. The direction of the current is changed by switching wires. The current itself is changed by means of the rheostat.

The indications of an ammeter being tested should correspond to the value shown in Table 19-13.

If the indications of the ammeter being tested go beyond the limits indicated in Table 19-13, the ammeter must be replaced or sent in for repair.

APPENDICES

APPENDIX 1. CHARACTERISTICS OF UNITS OF THE VEHICLES.

Units	ZIL-157K	ZIL-130	ZIL-131	ZIL-131A
Engine assembled (without clutch and transmission)	In-line, carburetor, 6 cylinder. Combined lubrication system. Liquid cooling system, closed, with forced circulation. 2-barrel type K-84M carburetor and exhaust pipe with separate intake channels. Fuel -- type A-66 gasoline. Lubricating system includes oil radiator, engine crankcase includes 2-section oil pump, upper section of which feeds oil into body of oil filter, lower section -- into oil radiator. Crankcase sump original. Maximum horsepower 109 hp at 2,800 rpm, compression ratio 6.2 or 110 hp with compression ratio 6.5. Torque 34 and 34.5 kGm respectively.	V-eight engine. Combined lubrication system. Liquid cooling system, closed, with forced circulation. K-88A carburetor. Fuel used -- A-76 gasoline. Maximum power 150 hp with 6.5 to 1 compression ratio at 3,200 rpm. Torque 41 kGm.	Same as on ZIL-130. Differs in new crankcase sump, foam-oil air cleaner; exhaust pipe made of foundry cast iron. Ignition and wires shielded. All connections in engine and instruments sealed to allow fording of rivers.	Same as on ZIL-131, but without shielded electrical equipment.
Radiator	Tube-plate or tube-snake type. Trucks delivered to tropical areas have radiators with condensation tanks.	Tube-snake, 3-row or 4-row.	Tube-snake, 4-row with sealed cap.	

APPENDIX 1. (Continued)

Units	ZIL-157K	ZIL-130	ZIL-131	ZIL-131A
Fan	6-blade, blade installation angle 38°.	6-blade, blade installation angle 30°. Ends of blades bent.	Same as on ZIL-130. Fan drive can be disconnected by loosening drive belt during fording, without disconnecting pump and compressor.	
Clutch	Same as on ZIL-130.	Single-disk, dry, with forced torsional oscillation damper.	Same as on ZIL-130. For sealing during crossing of fords, plug is screwed into cover of clutch casing in place of plug with pin. Seals installed between top and bottom half of clutch casing, beneath flange of clutch panel fork and in lower portion of front end of clutch casing.	
Transmission	Same as on ZIL-130. Differs in installation of transfer box levers on transmission and absence of central brake, which is installed on transfer box.	Mechanical, 5 speeds forward and 1 reverse. 5th gear is direct drive. Transmission equipped with 2 inertial type synchronizers for 2nd and 3rd, 4th and 5th gears. Transfer numbers of gears: first -- 7.44; second -- 4.1; third -- 1.47; fourth -- 1.47; fifth -- 1.0 Reverse -- 7.09. Central drum type brake installed on transmission.	Same as on ZIL-130. Difference is same as for ZIL-157K.	

APPENDIX 1. (Continued)

Units	ZIL-157K	ZIL-130	ZIL-131	ZIL-131A
Transfer box	Mechanical, 1 way, with 2 gears and front axle clutch. Transfer numbers of transfer box: 1st gear -- 2.27; 2nd gear -- 1.16.	None	Mechanical, 2 way, with 2 speeds. Transfer numbers: 1st gear -- 2.08; 2nd gear -- 1.0. Electro pneumatic control of switching of front axle, providing automatic switching of front axle upon engagement of 1st gear in transfer box.	Mechanical, 2 way, with 2 speeds. Transfer numbers: 1st gear -- 2.08; 2nd gear -- 1.0. Electro pneumatic control of switching of front axle, providing automatic switching of front axle upon engagement of 1st gear in transfer box.
Drive shaft	With intermediate support. Consists of 5 open type drive shafts with 9 needle-bearing universal joints. Since 4th quarter of 1962, 2-edge rubber glands installed on drive shaft bearings.	With intermediate support. Has 2 shafts with 3 universal joints with needle bearings. Splined connection sealed, located at rear end of intermediate shaft.	Without intermediate support. Consists of 4 drive shafts with 8 universal joints with needle bearings. .	Without intermediate support. Consists of 4 drive shafts with 8 universal joints with needle bearings. .
Front axle	Driving, with case separated invertical plane. Main drive individual, consisting of a pair of bevel gears. Transfer number 6.67; differential has 4 satellites. Half axles fully unloaded. Front, middle and rear axle reducers standardized.	Steering, axle forged, I-section. Axle height in central cross section 90 mm.	Driving, with steel welded case. Main drive dual: pair of bevel and pair of cylindrical gears. Half axes fully unloaded. Overall transfer number of main drive 7.339.	Driving, with steel welded case. Main drive dual: pair of bevel and pair of cylindrical gears. Half axes fully unloaded. Overall transfer number of main drive 7.339.

APPENDIX 1. (Continued)

Units	ZIL-157K	ZIL-130	ZIL-131	ZIL-131A
Rear axle	Rear and middle driving axles with case split in vertical plane. Main drive individual, consisting of a pair of conical gears. Transfer number of main drive 6.67. Differential has 4 satellites. Half axes fully unloaded.	Driving, with stamp-steel beam. Main drive dual: 1 pair of conical and 1 pair of cylindrical gears. Transfer number 4 ZIL-130, ZIL-130G and ZIL-MMZ-555 dump truck 6.45. On ZIL-130V1 tractor, transfer number of main drive -- 6.97. Differential has 4 satellites. Steel satellite cups. Half axes fully unloaded. Mounting of half axes to hubs with 12 pins 16 mm in diameter.	Rear and middle driving axle with steel welded cases. Main drive dual: pair of bevel and pair of cylindrical gears. Half axes fully unloaded. Differential with 4 satellites. Total transfer number of main transmission 7.399.	
Frame	Stamped, riveted, has longitudinal channel section beams connected by transverse beams. Towing hook with detent and shock absorbing spring.	Stamped, riveted, has longitudinal channel section beams connect with cross pieces. Towing hook with detent and rubber buffer.	Stamped, riveted, has longitudinal channel section beams connected with cross pieces. Towing hook with detent and rubber shock absorber.	
Front suspension	Longitudinal, earless semi-elliptical leaf springs, ends of which are set in rubber supports. Hydraulic shock absorbers, dual acting.	Longitudinal, single-ear semi-elliptical leaf springs. Rear ends of springs sliding. Hydraulic double acting telescopic shock absorbers.	Same as on ZIL-130.	

APPENDIX 1. (Continued)

Units	ZIL-157K	ZIL-130	ZIL-131	ZIL-131A
Rear suspension	Balance (on friction bearings) on longitudinal semi-elliptical leaf springs; pushing forces and reaction torque transmitted to reaction bars.	Double single-ear longitudinal semi-elliptical leaf spring. Front ends of springs fastened to frame brackets by removable ears and pins; rear ends sliding.	Similar in design to ZIL-157K suspension. Differs in greater spring length, increased number of leaves, fastening of 2 reaction bars and presence of reenforced mount of suspension brackets to frame.	
Wheels	With removable rims and bracing rings	Disks (7.0-20) with side rings	Similar in design to ZIL-157K. Differ in rim width.	
Tires	Special variable pressure. 12.00-18 size.	260-20" with permissible wheel load not under 1,860 kG.	Special variable pressure, 12.00-20.	
Tire pressure regulation system	Centralized, with internal air input to tires (through holes in pins and circular gap between pin and pin bushing). System controlled from cabin by means of pressure control lever through tire lever unit. Pressure control lever separate from valve limiting air pressure drop.	None	Centralized with internal input of air to tires (through hole in pin and drilled channel in half axle). Control from cabin by pressure control valve through tire valve unit. Pressure control valve combined with air pressure decrease limiting valve.	

APPENDIX 1. (Continued)

Units	ZIL-157K	ZIL-130	ZIL-131	ZIL-131A
Steering	With globoidal worm and crank with roller. Located on left. Transfer number of steering mechanism 23.5.	With built in hydraulic amplifier. Steering mechanism consists of screw with nut on circulating ball bearings and rack with geared pinion. Transfer number 20. Hydraulic pump of power steering blade type, double acting. Pump drive by belt from motor crankshaft.	Same as on ZIL-130. Differs in that system contains radiator for cooling of power steering fluid.	
Brakes: foot	Drum brakes of all wheels with pneumatic drive. Front and rear drum widths 70 mm.	Drum brakes on all wheels with pneumatic drive. Front drum width 70 mm, rear drum width 140 mm.	Drum brakes on all wheels with pneumatic drive. Front and rear drum width 100 mm.	
Hand	Same as on ZIL-130. Installed on transfer box.	Drum, with internal shoes, mechanical drive, acting on transmission. Installed on transmission.	Same as on ZIL-130. Installed on transfer box.	
Compressor	Pre 1965, compressor standardized with compressor of ZIL-164A. Later, standardized with compressor of ZIL-130.	2 cylinder, liquid cooling of head and block, driven by triangular belt. Bore 60 mm, stroke 38 mm.	Same as on ZIL-130.	
Air Cylinders	Standardized for All Two and Three Axle ZIL Trucks. Cylinder Capacity 20 1.			
Number of Air Cylinders	3	2	3	3

APPENDIX 1, (Continued)

Units	ZIL-157K	ZIL-130	ZIL-131	ZIL-131A
Brake valve	Same as on ZIL-130.	Combined with elastic diaphragm, controlling brakes of truck and trailer. Single brake valve with elastic diaphragm installed on ZIL-MMZ-555.	Same as on ZIL-130.	
Cabin	3 place, closed, all metal. Cabin ventilation through roll up windows inside doors, movable windshield and cabin ventilation hatch.	3 place, closed, all metal, with curved, nonopening windshield. Cabin ventilation through roll up windows and vent wings, as well as hatch in roof.	Same as on ZIL-130.	
Electrical System and Wiring	Single wire, negative ground. Wire bundles not interconnected. ZIL-157KG has shielded electrical equipment. ZIL-157KV tractors have high power generator.	Single wire, negative ground. ZIL-130 posts 1967 has transistor ignition.	Single wire, shielded, negative ground.	Same as on ZIL-130.
Voltage, v	12	12	12	12
Generator	G12V or G108-V dc 20 a, 250 w. ZIL-157KG carries shielded G112 or G116 generator. ZIL-157KV carries G56-B generator, 28 a, 350 w.	G130, dc, 28 a, 350 w.	G51, shielded, waterproof, dc, 37 a, 450 w.	Same as on ZIL-130.

APPENDIX 1. (Continued)

Units	ZIL-157K	ZIL-130	ZIL-131	ZIL-131A
Voltage Regulator	RR24-G, 12 v, 20 a, consists of back current relay, voltage regulator and current limitor. ZIL-157KG carries RR24-E, 12 v, 20 a shielded regulator. ZIL-157KV carries RR23-B regulator, 12 v, 28 a	RR130, 12 v, 28 a, consists of back current relay, voltage regulator and current limitor.	RR51, waterproof, shielded, consists of back current relay, 2 voltage regulators and current limitor.	Same as on ZIL-130.
Battery	2 6-volt 3-ST-84PD or 3-ST-84PDS batteries, 84 a·hr, connected in series, or 1 12-volt battery.	1 12-volt 6-ST-78EMSZ battery, 78 a·hr	1 12-volt 6-ST-78EMSZ or 6-ST-81EMSZ with hydrostatic plugs. Circuit includes VK318 battery switch.	Same as on ZIL-130.
Startor	ST15-B, 18 hp.	ST130, 1.5 hp.	ST2 sealed, 1.5 hp.	Same as on ZIL-130.
Distributor	R21-A, centrifugal and vacuum advance mechanisms, octane corrector with screw device to adjust ignition advance. ZIL-157KG carries shielded R51 distributor.	R4-V with centrifugal and vacuum advance mechanisms, octane corrector with screw device for adjustment of advance or R4-D when transistor ignition system is used. R4-D distributor differs from R4-V only in that it carries no condensor, unneeded with transistor ignition.	R102, shielded, sealed with centrifugal and vacuum advance mechanisms, octane corrector with screw for adjustment of ignition advance.	Same as on ZIL-130.

APPENDIX 1. (Continued)

Units	ZIL-157K	ZIL-130	ZIL-131	ZIL-131A
Coil	B1 with additional resistor, automatically connected during starting. ZIL-157K carries shielded coil type BS or BS-A.	B13 with additional resistor automatically connected during starting, or B114 when transistor ignition system is used.	B102-B, oil filled, shielded, sealed with separate additional resistor type SE102, automatically connected during starting.	Same as on ZIL-130.
Commutator of Transmission Ignition System	None	TK102	None	Same as on ZIL-130.
Additional Resistor of Contact Transistor Ignition	None	SE107	None	Same as on ZIL-130.
Spark Plugs	A16-U and SN55-B with 14 mm thread, nondissemblable. ZIL-157KG has plugs shielded with common shield for all 6 plugs.	A15-B or A15-S with 14 mm thread, nondissemblable.	SN307, shielded, sealed, nondissemblable with 14 mm thread	Same as on ZIL-130.
Ignition Switch	Key operated with lock.	VK21-Ye with lock, combined with starter switch.	Same as on ZIL-130.	
Horn	S56-G, without trumpet.	S44, electrical, without trumpet, vibration type, under hood. On ZIL-130V1 tractor, 2 tone S40-B air horn is also installed.	Two: 1 S44 electrical vibration horn; 1 S40-B 2-tone air horn. Also S39 buzzer signal.	Same as on ZIL-131 without S39 buzzer.
Headlights	2, FG1-A2, with dual filament bulbs 50+21 c. Sealed beam unit delivered on trucks for use in tropical countries.	2, FG122-G, with dual filament 50+40 c blubs.	FG122-GT with dual filament 50+40 c bulbs with sealed optical element and light masking fitting AS122-T.	Same as on ZIL-130.

APPENDIX 1. (Continued)

Units	ZIL-157K	ZIL-130	ZIL-131	ZIL-131A
Parking Lights	2, PF10-G, with 21+6 c bulbs, combined with turn signals.	2, PF101-G, with 21+6 c bulbs, combined with turn signals.	2, PF106 with 21+3 c bulbs, sealed, masked. PF101-B bulbs may be installed.	Same as on ZIL-130.
Search Light	None	None	None	FG16-L
Turn Signal Switch	P 20 or P20-A2, located in center of upper portion of dashboard.	P105-V fastened to steering column, switched on by lever, switches off automatically.	Same as on ZIL-130.	
Turn Signal Dash Lamp	One (1 c) installed on dashboard, turns on simultaneously with turn signals	One PD20-D (1 c) installed on dashboard, turns on simultaneously with RS57 turn signals.	Same as on ZIL-130.	
Turn Signal Blinker	RS57-V or RS57		RS57	
Left Tail Lights: left and right	FP13 with 2 21+3 c bulbs, FP13-K with 2 21+3 c bulbs (without license plate eliminating light).	FP101 with 2 21+3 c bulbs, FP101-B with 2 21+3 c bulbs (without license plate light)	2 FP106 with 21+3 c bulbs, sealed, masked. FP107 light, sealed, used for license plate elimination. FP101 (left) and FP101-B (right) tail lights may be installed.	Same as on ZIL-130.
Rear Turn Signals	2 UP5 with 21 c bulb installed on rear transverse frame member.	Combined with rear tail light (21 c).	Same as on ZIL-130.	
Central Light Switch	P7-B, 3 positions.	P44, 3 positions.	Same as on ZIL-130.	
Foot Dimmer Switch	P34, 2 positions.	P53-B, 2 positions.	P53, sealed, 2 positions.	Same as on ZIL-130.

APPENDIX 1. (Continued)

<table>
<tr><th>Units</th><th>ZIL-157K</th><th>ZIL-130</th><th>ZIL-131</th><th>ZIL-131A</th></tr>
<tr><td>High Beam Indicator Light</td><td>1 c, on dashboard, turned on simultaneously with high beam.</td><td>1.5 c, on dashboard, turned on simultaneously with high beam.</td><td colspan="2">Same as on ZIL-130.</td></tr>
<tr><td>Stop Signal Switch</td><td>Pneumatic, in brake valve.</td><td>Pneumatic, in brake valve.</td><td>VK13-B, pneumatic, on dashboard.</td><td>Same as on ZIL-130.</td></tr>
<tr><td>Dash lights</td><td>2 (1.5 c), turned on by light switch, located on dashboard.</td><td>7 (1.5 c), turned on by light switch, located on dashboard.</td><td colspan="2">Same as on ZIL-130. Additional light eliminates tire pressure gauge.</td></tr>
<tr><td>Light Illuminating Air Pressure Gauge</td><td>2 (1 c each), turned on by light switch.</td><td>Air pressure gauge and other instrument panel lights installed by each instrument.</td><td colspan="2">Same as on ZIL-130.</td></tr>
<tr><td>Cabin Interior Light</td><td>6 c, turned on by light switch on dashboard.</td><td>6 c, turned on by light switch on dashboard.</td><td colspan="2">Same as on ZIL-130.</td></tr>
<tr><td>Dash Light and Cabin Light Switch</td><td>P20-A2, 3 positions.</td><td>None</td><td>None</td><td>None</td></tr>
<tr><td>Cabin Light Switch</td><td>None</td><td>VK26-A2, 2 positions.</td><td colspan="2">Same as on ZIL-130.</td></tr>
<tr><td>Fuses</td><td>3, including: 2 PR2-B bimetallic button type 20 a (1 in circuit of heater motor and turn signal; 1 in circuit of horn, engine compartment and portable lights); 3rd, vibration type, in light circuit for central light switch.</td><td>4, including: 1 PR2-B bimetallic button type 20 a in electric horn and portable light plug circuit; another 20 a in external light and dash light circuit; additionally, a unit of type PR510-A 6 a bimetallic fuses is installed, 2 6 a fuses in the circuits of the heater motor, dashboard instruments and turn signal blinker circuits.</td><td colspan="2">Same as on ZIL-130.</td></tr>
</table>

APPENDIX 1. (Continued)

Units	ZIL-157K	ZIL-130	ZIL-131	ZIL-131A
Portable light jack	47K installed beneath hood on engine panel.	47K, installed in cabin on left side panel.	47K -- 2: 1, for the portable light; the other for radio power supply. PS400: 2, for the ZIL-131 and 1 for the ZIL-131A and ZIL-131V.	
Trailer plug	Same as on ZIL-130.	PS300, 7 terminal, on transverse frame.	Same as on ZIL-130.	
Engine compartment light	PD1-Zh, 3 c with switch on light.	PD2 with 3 c bulb, switch on light.	Same as on ZIL-130.	
Cabin heater motor switch	VK26-A in lower portion of front cabin wall.	P20-A2, 3 position, on cabin wall.	Same as on ZIL-130. Additional switch included for search light.	
Cabin heater motor	ME7-B, 12 v, shunted, 8 w.	ME211, 2 speeds, 25 w.	Same as on ZIL-130.	
Cabin ventilator motor	None	None	MEil, 1 speed, 5 w.	
Speedometer	SP24-A, needle speed indicator with odometer.	SP201, needle speed indicator with odometer.	Same as on ZIL-130.	
Oil pressure gauge	UK28, electric, pulse type manometer sender MM9 installed on cylinder block in oil line. Receiver located on dashboard.	UK201, electrical, type MM9 pulse type manometer sender. Receiver located on dashboard.	Same as on ZIL-130.	
Water temperature gauge	UK26-Ye electrical pulse type calibrated to 110°C. TMZ sender located in cylinder head. Receiver located on dashboard.	UK200, electrical, pulse type, calibrated to 110°C. TMZ sender. Reeeiver located on dashboard.	Same as on ZIL-130.	
Fuel level gauge	UB26-A, electrical. BM22-A sender, rheostat type, installed in fuel tank. Receiver located on dashboard.	UB200, electrical, BM117-A sender, rheostat type, in fuel tank. Receiver installed on dashboard.	Same as on ZIL-130.	

APPENDIX 1, (Continued)

Units	ZIL-157K	ZIL-130	ZIL-131	ZIL-131A
Manometer indicating pressure in air brake system	MD1-B, air type, designed for 10 kG/cm^2 pressure, installed on dashboard.	MD213, dual needle, upper needle shows pressure in air cylinders, lower shows pressure in brake cylinders. The manometer is designed for 10 kG/cm^2, installed on the dashboard.	Same as on ZIL-130.	
Tire pressure gauge	MD6, designed for 4 kG/cm^2, on dashboard.	None	MD233 with scale to 6 kG/cm^2.	Same as on ZIL-131.
Ammeter	AP6, dc, on dashboard.	None	None	None
Battery charge warning light	None	PD20-Ye	Same as on ZIL-130.	

APPENDIX 2. WEIGHT OF MAIN UNITS AND PARTS, kG.

<table>
<tr><th>Units and Parts</th><th>ZIL-157K</th><th>ZIL-130</th><th>ZIL-131</th></tr>
<tr><td>Engine with clutch</td><td>460</td><td>490</td><td>485</td></tr>
<tr><td>Engine with clutch and transmission</td><td>580</td><td colspan="2">600</td></tr>
<tr><td>Engine block</td><td>132</td><td colspan="2">144</td></tr>
<tr><td>Cylinder head</td><td>11</td><td colspan="2">15</td></tr>
<tr><td>Crankshaft</td><td>36</td><td colspan="2">41</td></tr>
<tr><td>Cam shaft</td><td>7</td><td colspan="2">6</td></tr>
<tr><td>Flywheel</td><td>22</td><td colspan="2">24</td></tr>
<tr><td>Clutch housing with pressure disk and levers</td><td>17</td><td colspan="2">17</td></tr>
<tr><td>Crankshaft with flywheel and clutch</td><td>67</td><td colspan="2">82</td></tr>
<tr><td>Clutch casing</td><td>29.5</td><td colspan="2">32</td></tr>
<tr><td>Intake and exhaust manifolds</td><td>21.3</td><td colspan="2">-</td></tr>
<tr><td>Intake manifold</td><td>-</td><td colspan="2">10.8</td></tr>
<tr><td>Exhaust manifold</td><td>-</td><td colspan="2">7.4</td></tr>
<tr><td>Oil pump complete</td><td>4.4</td><td colspan="2">5.5</td></tr>
<tr><td>Oil filters</td><td>16.1</td><td colspan="2">6.6</td></tr>
<tr><td>Water radiator</td><td>21.7</td><td>18.0</td><td>21.9</td></tr>
<tr><td>Transmission complete</td><td>104</td><td>117</td><td>104</td></tr>
<tr><td>Transmission casing</td><td>27</td><td>-</td><td>27</td></tr>
<tr><td>Transfer box</td><td>138</td><td>-</td><td>108</td></tr>
<tr><td>Transfer box casing with cover</td><td>40.6</td><td>-</td><td>37.4</td></tr>
<tr><td>Drive shaft with main and intermediate shafts of 2 axle trucks</td><td>-</td><td>35.7</td><td>-</td></tr>
<tr><td>Rear axle complete</td><td>345</td><td>498</td><td>432</td></tr>
<tr><td>Reducer of 2 axle trucks</td><td>-</td><td>126</td><td>-</td></tr>
<tr><td>Differential</td><td>121.0</td><td>87.7</td><td>120.0</td></tr>
<tr><td>Front axle complete</td><td>250</td><td>260</td><td>305</td></tr>
<tr><td>Middle axle complete</td><td>210</td><td>-</td><td>300</td></tr>
<tr><td>Frame complete</td><td>530</td><td>370</td><td>450</td></tr>
<tr><td>Front Springs</td><td>44.0</td><td>48.1</td><td>68.0</td></tr>
<tr><td>Telescopic shock absorber</td><td>4.0</td><td>4.0</td><td>4.0</td></tr>
<tr><td>Rear spring</td><td>48.5</td><td>72.7</td><td>52.0</td></tr>
<tr><td>Additional spring</td><td>-</td><td>25.3</td><td>-</td></tr>
<tr><td>Balancing suspension with springs</td><td>155</td><td>-</td><td>160</td></tr>
<tr><td>Reaction rod</td><td>8.6</td><td>-</td><td>8.6</td></tr>
<tr><td>Wheel and tire</td><td>109</td><td>95</td><td>127</td></tr>
<tr><td>Steering mechanism complete (without power)</td><td>30</td><td>-</td><td>-</td></tr>
<tr><td>Steering mechanism complete (with power amplifier)</td><td>-</td><td>29</td><td>29</td></tr>
<tr><td>Power steering pump</td><td>-</td><td>7.5</td><td>7.5</td></tr>
<tr><td>Compressor complete</td><td>19.2</td><td>19.2</td><td>19.2</td></tr>
<tr><td>Cabin complete</td><td>213</td><td>310</td><td>300</td></tr>
<tr><td>Cabin door</td><td>18</td><td>25</td><td>25</td></tr>
<tr><td>Hood</td><td>20</td><td>26</td><td>25</td></tr>
<tr><td>Platform</td><td>570</td><td>600</td><td>662</td></tr>
</table>

APPENDIX 3. Weight of Trucks, kG

Trucks	Weight of trucks equipped	Total weight of truck with load	Overall Weight Distribution: Without load, front axle	Without load, rear axle	With load, front axle	With load, rear axle	Total weight of truck and trailer with cargo
Two Axle Trucks							
ZIL-130	4,300	8,525	2,250	2,050	2,575	5,950	14,925
ZIL-130V1	3,860	-	2,115	1,745	2,425	5,960	14,585
ZIL-130G	4,575	3,800	2,275	2,330	2,800	6,000	15,200
ZIL-MMZ-555 and ZIL-MMZ-555A	4,800	9,300	2,190	2,380	2,840	6,455	-
ZIL-130-66	4,300	9,525	2,120	2,180	2,575	6,950	17,525
ZIL-130V1-66	3,860	-	2,115	1,745	2,470	7,000	16,485
ZIL-130G-66	4,575	9,800	2,275	2,300	2,800	6,910	17,800
Three Axle Trucks							
ZIL-157K (with 2,500 kG load)							
with winch	5,800	8,450	2,680	3,120	2,930	5,520	12,050
without winch	5,540	8,190	2,400	3,140	2,650	5,540	11,790
ZIL-157K (with 4,500 kG load)							
with winch	5,800	10,450	2,680	3,120	3,050	7,400	14,050
without winch	5,540	10,190	2,400	3,140	2,770	7,420	13,790
ZIL-157V (without semi-trailer)							
with winch	5,700	-	2,780	2,920			
without winch	5,440	-	2,500	2,940			
ZIL-131 and ZIL-131A (with 3,500 kG load)							
with winch	6,700	10,425	3,195	3,505	3,335	7,090	16,929*)
without winch	6,460	10,185	2,900	3,560	3,055	7,130	16,685*)
ZIL-131 and ZIL-131A (with 5,000 kG load)							
with winch	6,700	11,925	3,195	3,505	3,340	8,585	18,425
without winch	6,460	11,685	2,900	3,560	3,040	8,645	18,185
ZIL-131V (without semi-trailer)							
with winch	6,470	-	3,305	3,165			
without winch	6,225	-	3,040	3,185			

* When operating on class IV and V roads, including dirt roads, the total rate of loaded truck and trailer should be 14,425 kG for trucks with winches and 14,185 kG for trucks without winches.

APPENDIX 4. DIMENSIONS OF TWO AXLE TRUCKS, MM (Figure 1).

a Автомобиль	b Длина	c Ширина	d Высота по кабине	e Расстояние от передней оси автомобиля до задней стенки кабины	f Расстояние от переднего буфера до передней оси автомобиля	g База	h Расстояние от оси задних колес до заднего конца рамы	i Погрузочная высота платформы (без груза)	j Внутренние размеры платформы: k высота	l ширина	m длина	n Колея: o задних колес	p передних колес	q Дорожный просвет при полной нагрузке
	A	A_1	B	B_1	D	E	I	C	X	H	M	P	O	
ZIL-130	6675	2500	2335	1643	1075	3800	1462	1370	685	2326	3752	1790	1800	275
ZIL-130G ...	7610	2500	2330	1643	1075	4500	1712	1370	575	2325	4686	1790	1800	275
ZIL-130V1 ..	5280	2360	2345	1643	1075	3300	—	1380	590	2220	6070	1790	1800	275
ZIL-MMZ-555 (on ZIL-130D1 chassis)	5475	2425	2350	1643	1075	3300	902	—	—	—	—	1790	1800	275

Key: a, truck, b, length, c, width, d, height at cabin, e, distance from front axle of truck to rear wall of cabin, f, distance from front bumper to front axle, g, wheel base, h, distance from rear axle to rear end of frame, i, loading height of platform (without cargo), j, internal dimensions of platform, k, height, l, width, m, length, n, track, o, rear, p, front, q, road clearance with full load.

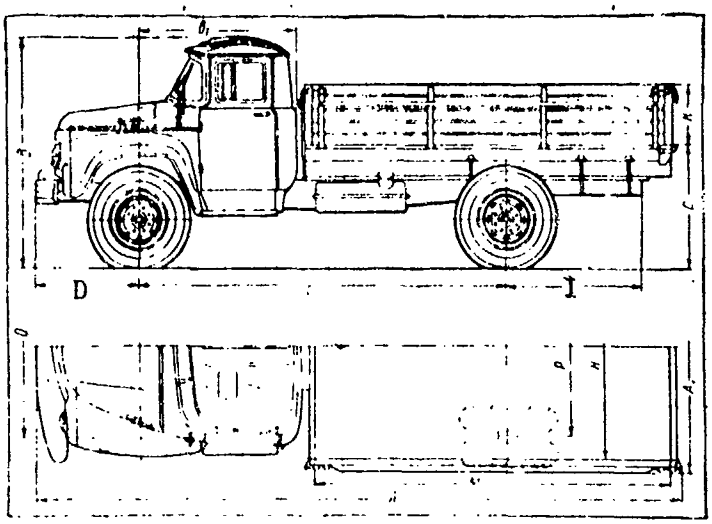


Figure 1. Dimensions of ZIL-130 Truck (Diagram).

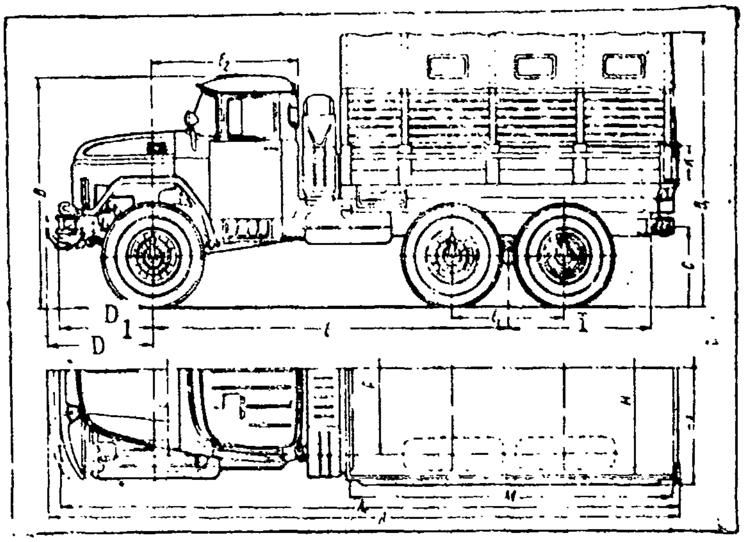


Figure 2. Dimensions of ZIL-131 Truck (Diagram).

APPENDIX 5. DIMENSIONS OF THREE AXLE TRUCKS, MM (Figure 2)

a	b		e	f		i*	j		m	n		q	r	s			w		z
	c	d		g	h		k	l		o	p			t	u	y	x	y	
	A	A1	A2	B	B1	—	E	E1	E2	D	Д1	H	C	K	H	M	P	O	
ZIL 157K and ZIL-157KG	6922	6684	2315	2360	2915	—	4225	1120	2068	1102	864	1371	1388	355	2090	3570	1750	1755	3:9
ZIL-157KV	6770	6532	2270	2360	—	1450	4225	1120	2068	1102	864	1371	—	—	—	—	1750	1755	310
ZIL-157KYe (for installation of special bodies)	6918	6680	—	2360	—	—	4225	1120	2068	1102	864	1371	—	—	—	—	1750	1755	310
ZIL-131 and ZIL-131A	7040	6900	2500	2480	2975	—	3975	1250	1650	1207	1067	1575	1430	346	2322	3600	1820	1820	330
ZIL-131V	6620	6480	2400	2480	—	1495*	3975	1250	1650	1207	1067	1370	—	—	—	—	1820	1820	330

*Height of plate 1495 mm correspond to load on saddle device.

Key: a, trucks, b, length, c, with winch, d, without winch, f, width, g, at cabin, h, at top, i, of saddle device (2650 kG load), j, wheel base, k, truck, l, rear truck, m, distance from front axle to rear wall of cabin, n, distance from front bumper to front axle of truck, o, with winch, p, without winch, q, distance from rear axle to rear end of frame, r, loading height, s, internal dimensions of platform, t, height, u, width, v, length, w, track, x, rear, y, front, z, road clearance with full load.

APPENDIX 6. DISTRIBUTION OF LOAD ON THREE AXLE SADDLE TYPE TRACTOR TRUCKS ON SADDLE DEVICE AND SEMITRAILER AXLE, kG.

a Дороги	b Максимальный вес полуприцепа с грузом		e Нагрузка на седельное устройство		h Нагрузка на ось полуприцепа	
	c ЗИЛ-157КВ	d ЗИЛ-131В	f ЗИЛ-157КВ	g ЗИЛ-131В	i ЗИЛ-157КВ	j ЗИЛ-131В
k По всем видам дорог, включая грязные и разбитые дороги	6250	7500	2650	3500	3600	4000
l По улучшенным грунтовым дорогам (скорость движения автомобиля не более 25 км/ч)	8650	10 000	3350	4000	5300	6000
m По дорогам с асфальто-бетонным покрытием .	11 150	12 000	4350	5000	6800	7000

Key: a, roads, b, maximum weight of semitrailer with cargo, c, ZIL-157KV, d, ZIL-131V, e, load on saddle device, f, ZIL-157KV, g, ZIL-131V, h, load on semitrailer axle, i, ZIL-157KV, j, ZIL-131V, k, for all types of roads including muddy and bumpy roads, l, improved dirt roads (speed not over 25 km/hr), m, paved roads.

APPENDIX 7. MINIMUM TURNING RADIUS AND DIP ANGLES.

	a Автомобили	b Наименьший радиус поворота (по крылу), м	c Углы свеса, град			
			d передний		g задний	
			e с лебедкой	f без лебедки	h с лебедкой	i без лебедки
j	ЗИЛ-130	8,0	—	38	—	27
k	ЗИЛ-130Г	9,1	—	38	—	22
l	ЗИЛ-130В1 (без полуприцепа)	7,0	—	38	—	47
m	ЗИЛ-ММЗ-555	7,0	—	38	—	—
n	ЗИЛ-157К	12	[illegible]	55	43	43
o	ЗИЛ-157КВ	12	[illegible]	55	55	55
p	ЗИЛ-131 и ЗИЛ-131А	10,8	36	45	40	40
q	ЗИЛ-131В	10,8	36	45	58	58

Key: a, trucks, b, minimum turning radius (at fender), m, c, dip angles, degrees, d, front, e, with winch, f, without winch, g, rear, h, with winch, i, without winch, j, ZIL-130, k, ZIL-130G, l, ZIL-130V1 (without semi-trailer), m, ZIL-MMZ-555, n, ZIL-157K, o, ZIL-157KV, p, ZIL-131 and ZIL-131A, q, ZIL-131V.

APPENDIX 8. BASIC POWER FOR ADJUSTMENT AND TESTING OF UNITS OF TRUCKS

Parameters	ZIL-157K	ZIL-130 & ZIL-131
Valve clearance (for intake in exhaust valves with engine cold), mm:		
between valve stem and rocker in V-type engines	-	0.25-0.3
between valve and pusher in in-line engines	0.20-0.25	-
Clearance between breaker points, mm	0.35-0.45	0.3-0.4
Clearance between spark plug electrodes, mm	0.6-0.7	0.5-0.6*
Oil pressure in lubrication system of warm engine at 1,000 rpm, kG/cm^2	2.5	2.5
Air pressure in air brake system, kG/cm^2	5.6-7.3	5.6-7.4
Normal temperature of fluid in cooling system, °C	80-90	80-95
Bend of drive belts with 4 kG forced, mm:		
fan, water pump and generator belts	15-20	8-14
compressor belt	15-20	5-8
power steering drive belt	-	8-14
Travel of brake cylinder shafts, mm:		
front wheels	35(not over)	15-25
rear wheels	Same	Same
Free travel of clutch pedal, mm	30-45	35-40
Full travel of clutch pedal, mm	130-150	180

*For ZIL-130, clearance is 0.85-1.0 mm.

APPENDIX 9. TYPES OF OILS AND LUBRICANTS USED FOR TRUCKS

Symbol	Units of Trucks	Type of Oil and Lubricant According To GOST
		Oils
M1	V-type engines	Phenol selective purification motor vehicle oil type AS-8 (GOST 10541-63) or ASZp-10 (MRTU 12N No 32-63)
M3	In-line engines on 3-axle vehicles	Summer: industrial type 50 oil (machine SU) (GOST 1707-51) or AS-8 and AS-10 motor vehicle oil (GOST10541-63); winter: motor vehicle AS-6 (GOST 10541-63) At any time of year: for the middle belt AKZp-10, for the far north and arctic -- AKZp-6 (GOST 1862-60)
M4	Transmission units	All Season: motor vehicle transmission oil TAp-15-V (MRTU 38-1-185-65). Substitute: transmission oil TAp-15, GOST 8412-57. With surrounding year temperature below -30°C for regions of the arctic and far north -- TAp-10 oil (GOST 8412-57)

Note: When substitute oils are used, change oil in transmission units 3 tim:s more frequently than when TAp-15-V oil is used.

Symbol	Units of Trucks	Type of Oil and Lubricant According To GOST
M5	winch and saddle device	T-14B oil (with additive) (MRTU 12N No 34-63) or TAp-15-V oil (MRTU 38-1-185-65) Substitute: special oil for transmissions and steering units (GOST 4002-53)

Note: This oil is so-called according to the GOST, but is not actually used for transmissions and steering units of ZIL trucks.

Symbol	Units of Trucks	Type of Oil and Lubricant According To GOST
M6	Power steering amplifier	Summer: type 22 turbine oil (GOST 32-53), substitute -- type 20 industrial oil (spindle 3) (GOST 1707-51); winter: spindle oil type AU (GOST 1642-50)
M7	Telescopic shock absorbers	AU spindle oil (GOST 1642-50) or a mixture of 50% transformer oil (GOST 10121-62) and 50% type 22 turbine oil (turbine 1) (GOST 32-53)
		Lubricants
C1	Bearings of units operating where water may reach them	Lubricant 1-13s (VTU NP 5-58) or lubricant YaNZ-2 (GOST 9432-60)
C2	Brake valve and generator bearing on collector end	Lubricant 158 (MRTU 12 No 139-64) or lubricant TSIATIM-201 (GOST 6267-59)
C3	Hinge joints and points lubricated through pressure oiler	Universal medium melting lubricant US-1 (press-solidol) (GOST 1033-51) and USS-1 or USs "motor vehicle" (GOST 4366-56)
C4	Jointed half axles of front driving wheels and king pins	Motor vehicle lubricant type AM (universal joint) (GOST 5730-51)
C5	Spring leaves	Graphite lubricant (USsA), GOST 3333-55.

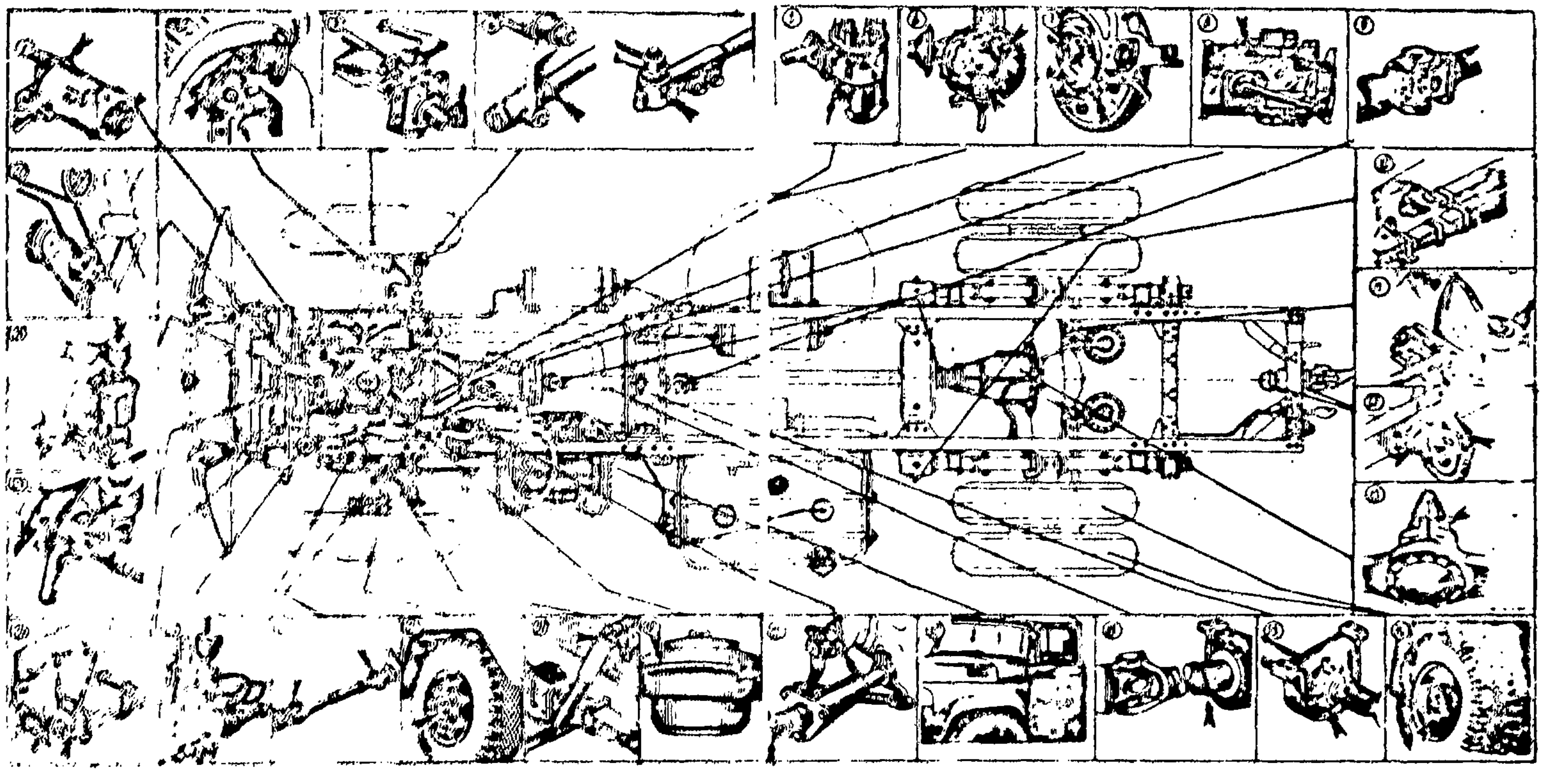


Figure 3. Lubrication Diagram of ZIL-130.

APPENDIX 10. LUBRICATION CHART OF ZIL-130.

Mechanisms	No. of Position on Lubrication Diagram (Fig.3)	No. of Lubrication Points	Quantity of Lubricant	Lubricant Symbol[1]	Lubrication Frequency, km			Notes
					TO-1	TO-2	Other	
King pins	3	4	As required	C3	+			When vehicle operates on dirty and dusty roads, lucricate daily
Bearings of front axle hubs	21	2	0.20 kg per hub	C1			10,000-18,000	Place 0.25-0.30 kg lubricate in hubs
Teloscopic shock absorbers	20	2	0.355 1	M7			25,000-30,000	Change oil in shock absorbers each 25,000-30,000 km, at least once per year
Distributor:								
shaft	5	1	As required	C1		+		
cam bushing	6	1	2-3 drops	M1		+		
breaker axis	6	1	1-2 drops	M1		+		
cam lubricator	6	1	4-5 drops	M1		+		
Transmission casing	8	1	5.1 1	M4			30,000-50,000	When TAp-15 or TAp-10 oil is used, change oil each 10,000-18,000 km
Front bearing of driving shaft of transmission (press oiler)	7	1	20-25 g	C1			10,000-18,000	Add oil by spray through oiler
Universal joint needle bearings	9	3	As required	M4		+		Lubricate through oiler to cross member until oil comes from valve

[1]See appendix 9.

APPENDIX 10. LUBRICATION CHART OF ZIL-130.

Mechanisms	No. of Position on Lubrication Diagram (Fig.3)	No. of Lubrication Points	Quantity of Lubricant	Lubricant Symbol	Lubrication Frequency km			Notes
					TO-1	TO-2	Other	
Spring pins	10 and 24	4	As required	C3	+			When truck operates on dirty & dusty roads, lubricate daily
Rear axle casing	13	1	4.5 kg	C3			30,000-50,000	When TAp-15 or TAp-10 oil is used, change every 10,000-18,000 km
Trailer hook	12	2	As required	C3	+			Lubricate when truck is used with trailer. When used without trailer, lubricate each 5,000-9,000 km
Axis of Dog and Detent of Trailer Hook	12	2	Several drops	M1	+			Same
Shafts of Spreader Cams of Front and Rear Brakes	12	6	As required	C3	±			Force in lubricant until fresh lubricant appears
Leaves of front, rear and supplementary springs		6	0.4 kg	C5			+	Lubricate between leaves during repair operations
Bearings of rear wheel hubs	14	2	0.25 kg per hub	C1			10,000-18,000	For 0.8 kg lubricant into hub
Bearings of intermediate support of drive shaft	15	1	0.04 kg	C3			2,200-2,600	Force in lubricant with sprayer until new lubricant appears from test aperture

APPENDIX 10. LUBRICATION CHART OF ZIL-130.

Mechanisms	No. of Position on Lubrication Diagram (Fig.3)	No. of Lubrication Points	Quantity of Lubricant	Lubricant Symbol	Lubrication Frequency km			Notes
					TO-1	TO-2	Other	
Sliding fork of drive shaft	16	1	0.25 kg	C3			15,000-27,000	Remove splined bushing, remove old lubricant and put in new lubricant
Bushing of clutch fork	18	2	As required	C3		+		Force in lubricant until fresh lubricant appears
Bushing of clutch pedal axis		1	Same	C3		+		Same
Power steering amplifier	23	1	2.8 l	M6				Test oil level in tan during TO-1 and add if necessary. Change oil twice per year (spring and fall)
Universal joints of steering column	22	2	As required	C1	+			Lubricate through oiler in cross piece
Splines of steering column		1	Same	C1			+	Once per year dissemble shaft, remove all lubricant lubricate splines with fresh lubricant
Engine crankcase	26	1	9.0 l	M1		+		If truck is used under dusty conditions, change oil during TO-1
Crankshaft governor sender	27	1	0.5-1.0 g	M1		+		-
Air filter of crankcase ventilator	26	1	0.11 l	M1		+		When truck is used under dusty conditions, change oil each day

APPENDIX 10. LUBRICATION CHART OF ZIL-130.

Mechanisms	No. of Position on Lubrication Diagram (Fig.3)	No. of Lubrication Points	Quantity of Lubricant	Lubricant Symbol	Lubrication Frequency km			Notes
					TO-1	TO-2	Other	
Steering arm hinges	4	4	As required	C3	+			When truck is used on dirty and dusty roads, lubricate arms each 400-500km
Generator:								
drive end bearing	1	1	3-5 drops	M1		+		Lubricate from oiler
collector end bearing	1	1	4 g	C2			35,000-40,000	Remove cap, remove old lubricant & poor in fresh
water pump bearing	25	1	0.07 kg	C1			20,000-35,000	Force in lubricant until fresh lubricant appears from control aperture
Engine air filter	19	1	0.63 1	M1			+	When operating under dusty air conditions, change oil daily
Worm couples of adjusting levers of wheel brakes	2	4	0.18 kg	C3			10,000-18,000	Remove plug, screw in press oiler & add lubricant
Door hinges	17	4	As required	M1		+		
Surface of saddle plate		1	0.2 kg	C3		+		
Saddle device		5	As required	M5	+			

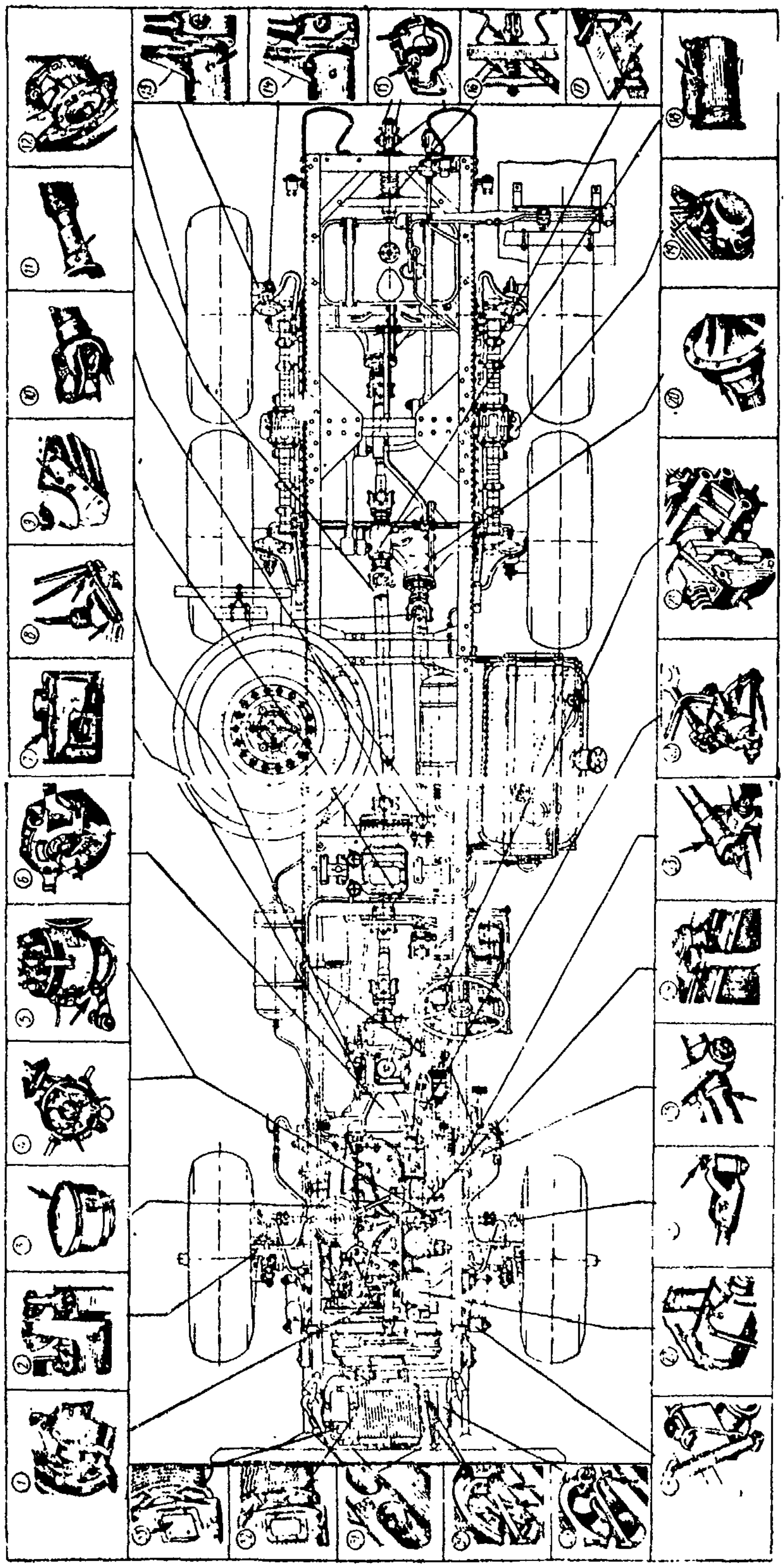


Figure 4. Lubrication Diagram of ZIL-157K.

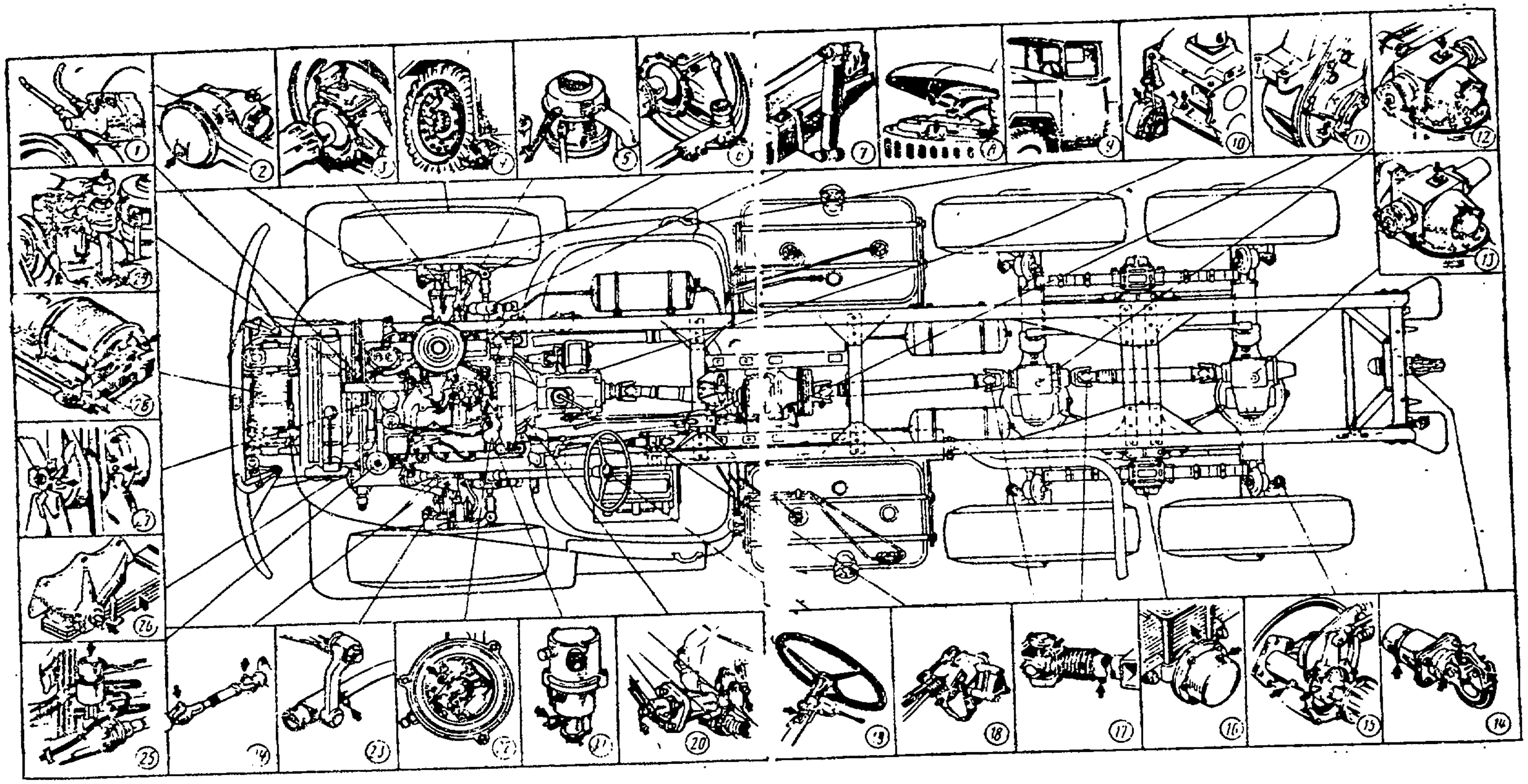


Figure 5. Lubrication Diagram of ZIL-131.

APPENDIX 11. LUBRICATION OF THREE AXLE TRUCKS.

ZIL-157K AND MODIFICATIONS

Mechanisms	No. of Position on Lubrication Chart (Fig. 4)	No. of Lubrication Points	Quantity of Lubricant	Symbol of Lubricant	Frequency, km			Notes
					TO-1	TO-2	Other	
Water pump	1	1	0.07 kg	C1	+			Each 6,000-12,000 km, squirt in lubricant until fresh lubricant appears at test hole
Fan bearing Crankshaft	-	-	-	-	-	-	-	
governor	-	-	-	-	-	-	-	
Front suspension hinges & king pins	2	2	2.2 kg	C4			+	Change lubricate after 12,000 km
Engine air filter	3	1	0.8 l	M3	+			When operated under dusty air conditions, change oil each 400-500 km
Distributor:								
cam bushing	4	1	2-3 drops	M3	+			
breaker lever axis	4	1	1-2 drops	M3	+			
cam lubrication point	4	1	4-5 drops	M3	+			
shaft	5	1	As required	C1	+			
Front bearing of driving shaft of transmission	6	1	20-25 g	C1		+		
Transmission casing:	7	1						
without winch power take off			51 l	M4			+	Check level, add oil when necessary each 1,000-1,800 km

APPENDIX 11. LUBRICATION OF THREE AXLE TRUCKS. (Continued)

ZIL-131 AND ITS MODIFICATIONS

No. of Position on Lubrication Chart	No of Lubrication Points	Quantity of Lubricant	Symbol of Lubricant	Frequency, km			Notes
				TO-1	TO-2	Other	
27	1	0.095 kg	C1			+	Each 16,000-24,000 km, squirt in until new lubricant appears from control aperture
27	1	0.025 kg	C1				Same
1	1	0.5-1.0 g	M1		+		
3	2	1.3 kg	C4			+	Add lubricant 4,000-6,000 km Change lubricant each 8,000-12,000 km
5	1	3.6 l	M1		+		Under dusty conditions, wash filter and fuel with fresh oil each day
22	1	2-3 drops	M1		+		
22	1	1-2 drops	M1		+		
22							
21	1	As required	C1		+		
-	-	-	-	-	-	-	-
10	1	5.1 l	M4			+	Wash and when necessary add oil after 4,000-6,000 km

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APPENDIX 11. LUBRICATION OF THREE AXLE TRUCKS. (Continued).

ZIL-157K AND ITS MODIFICATIONS

Mechanisms	No. of Position on Lubrication Chart (Fig. 4)	No. of Lubrication Points	Quantity of Lubricant	Symbol of Lubricant	Frequency, km			Notes
					TO-1	TO-2	Other	
With winch power take off			6.7 1	M4			+	Change TAp-15V oil each 18,000-35,000 km. If TAp-15 or TAp-10 is used, change each 6,000-12,000 km.
Shaft of transfer box control levers	8	2	As required	C3	+			
Transfer box casing	9	1	2.5 1*	M4			+	Check level, when necessary add oil each 1,000-1,800 km. Change TAp-15V oil each 18,000-35,000 km. Change TAp-15 oil each 6,000-12,000 km.
Universal joints (needle bearings), including winch drive	10	13	As required	M4	+			Lubricate through oiler in cross piece until oil appears from valves
Drive shafts (sliding fork), including winch drive	11	6	Same	C3	+			Dissemble shaft, remove old oil and pour in fresh
Hubs of all wheels	12	6	Each 4.8 kg				+	Add oil to outer collar of gland of air feed head (without removing it) each 3,000-6,000 km. Change lubricant after each 12,000 km.
Spreader cam shafts	13	6	As required	C3	+			
Contact ring of horn	-	-	-		-	-	-	-
Rubber roller of turn signal	-	-	-		-	-	-	

*If there is a power take off box on the transfer case, oil must be poured to level of top control plug, 4.1 1.

APPENDIX 11. LUBRICATION OF THREE AXLE TRUCKS. (Continued)

ZIL 131 and ITS MODIFICATIONS

No. of Position on Lubrication Chart	No. of Lubrication Points	Quantity of Lubricant	Symbol of Lubricant	Frequency, km			Notes
				TO-1	TO-2	Other	
		6.7 l	M4			+	Change TAp-15V oil each 24,000-36,000 km. If TAp-15 and TAp-10 oil is used, change each 8,000-12,000 km
11	1	3.3 l	M4			+	Check level, when necessary add oil each 4,000-6,000 km. Change TAp-15V oil each 24,000-36,000 km. Change TAp-15 oil each 8,000-12,000 km
17	11	0.3 l	M4	+			Lubricate through oiler in cross piece until oil appears from valves
17	5	0.7 l	C3			16,000-24,000	Dissemble shaft, remove old oil and pour in fresh
4	6	Each 0.8 kg	C1			+	Carefully lubricate rollers and outer rings of tapered bearings in each 8,000-12,000 km.
15	6	As required	C3		+		
19	1	0.001 kg	C5			+	Lubricate when repaired
19	1	As required	C2		+		Remove cover of turn indicator and lubricate roller

APPENDIX 11. LUBRICATION OF THREE AXLE TRUCKS. (Continued)

ZIL-157K AND ITS MODIFICATIONS

Mechanisms	No. of Position on Lubrication Chart (Fig. 4)	No. of Lubrication Points	Quantity of Lubricant	Symbol of Lubricant	Frequency, km			Notes
					TO-1	TO-2	Other	
Wheel brake adjusting lever worm couples	14	6	As required	C3		+		Remove plug, screw in oiler and add lubricant
Dog axis & detent of trailer hitch	15	2	Several drops	M3	+			Lubricate when operating with trailer. Without trailer, lubricate each 3,000-6,000 km.
Bushings in trailer hitch hook rod	16	2	As required	C3	+			Same
Leaves of front and rear springs	17	4	1 kg	C5			+	Lubricate to repair.
Casing of intermediate drive shaft support	18	1	0.25 l	M4		+		Add oil 1,000-1,800 km
Hubs of balancing suspension	19	2	0.65 kg each	M4		+		Add oil after each 1,000-1,800 km to test plug level
Front spring pins	-	-	-	-	-	-	-	-
Front, rear and middle axle casing	20	3	2.5 for each	M4			+	Test level and add if necessary each 1,000-1,800 km. Change TAp-15V oil each 18,000-35,000 km. Change TAp-15 or TAp-10 oil each 6,000-1,2000 km
Brake valve	21		As required	C2			+	Remove from truck, dissemble and lubricate friction parts each 25,000-30,000 km
Clutch engagement fork (press oilers)	22	2	As required	C3	+			Force in lubricant until fresh lubricant appears
Clutch pedal axis	22	1	Same	C3	+			Same

APPENDIX 11. LUBRICATION OF THREE AXLE TRUCKS. (Continued)

ZIL-131 AND ITS MODIFICATIONS

No. of Position on Lubrication Chart	No. of Lubrication Points	Quantity of Lubricant	Symbol of Lubricant	Frequency, km			Notes
				TO-1	TO-2	Other	
15	6	0.045 kg each	C3			8,000-12,000	Remove plug, screw in oiler and add lubricant.
14	2	As required	M1		+		Lubricate with drops from oiler
14	2	Same	C3		+		Lubricate through pressed oil
16	4	Total 1 kg	C5			+	Lubricate to repair.
-	-	-	-	-	-	-	-
16	2	0.325 kg each	M4			+	Add oil after each 1,000-1,800 km to test plug level
26	2	As required	C3	+			Lubricate daily under dusty conditions
2.12 and 13	3	5 1 for each	M4	+			Check level of oil in front axle using test plug and middle and rear axles using oil level indicator. Add oil if necessary. Change TAp-15V oil each 24,000-36,000 km. Change TAp-15 or TAp-10 oil each 8,000-12,000 km
18	1	As required	C2			+	Remove from truck, dissemble and lubricate friction parts each 35,000-40,000 km
20	2	Same	C2		+		Force in lubricant until fresh lubricant appears
20	1	Same	C3		+		Same

APPENDIX 11. LUBRICATION OF THREE AXLE TRUCKS. (Continued)
ZIL-157K AND ITS MODIFICATIONS

Mechanisms	No. of Position on Lubrication Chart (Fig. 4)	No. of Lubrication Points	Quantity of Lubricant	Symbol of Lubricant	Frequency, km			Notes
					TO-1	TO-2	Other	
Steering wheel casing	23	1	1 1	M4			+	Check level and add each 1,000-1,800 km as necessary. Change TAp-15 oil each 18,000-35,000 km. Change TA: -15 or TAp-10 oil each 6,000-12,000 km
Power steering mechanisms	-	-	-	-	-	-	-	-
Universal joints of steering column	-	-	-	-	-	-	-	-
Splines of steering wheel column	-	-	-	-	-	-	-	-
Enginge crank-case	24	1	11 1	M3	+			When truck operates under dusty air conditions, change oil after 400-500 km. Oil level in crankcase must be tested daily. When AS-6, AS-8 or AS-10 oil is used, change oil each 500-6,000 km.
Crankcase ventilation air filter	24	1	0.04 1	M3	+			Same
Steering arms	25 and 26	4	As required	C3			+	Lubricate after 400-500 km, at least once each 3-4 days

APPENDIX 11. LUBRICATION OF THREE AXLE TRUCKS. (Continued)

ZIL-131 AND ITS MODIFICATIONS

No. of Position on Lubrication Chart	No. of Lubrication Points	Quantity of Lubricant	Symbol of Lubricant	Frequency, km			Notes
				TO-1	TO-2	Other	
-	-	-	-	-	-	-	
23	1	2.8 1	M6			+	Check oil level in hydraulic pump tank each 800-1,200 km. Replace oil twice per year during seasonal maintenance in spring and summer.
24	2	0.04 kg each	M4		+		Lubricate through oiler into cross piece with fresh lubricant
	1	0.02 kg	C1			+	Once per year dissemble shaft, remove old lubricant splines with fresh lubricant
29	1	9.5 1	M1		+		When truck is operated under dusty conditions, change oil each 2,000-2,500 km. Check oil level in crankcase daily.
29	1	0.11 1	M1		+		Under dusty conditions, wash filter and add fresh oil each day
6 and 23	4	As required	C3	+			Under dusty conditions, lubricate daily

APPENDIX 11. LUBRICATION OF THREE AXLE TRUCKS. (Continued).

ZIL-157K AND ITS MODIFICATIONS

Mechanisms	No. of Position on Lubrication Chart (Fig. 4)	No. of Lubrication Points	Quantity of Lubricant	Symbol of Lubricant	Frequency, km			Notes
					TO-1	TO-2	Other	
Generator: drive side bearing	27	1	8-10 drops	M3		+		
Collector end bearing	27	1	3-4 g	S2 or S1		+		1st time, lubricate up to 25,000 km. Add S2 lubricant after each 25,000 km. When S1 is used, lubricate each 12,000 km
Telescopic shock absorbers	28	2	0.4 1 drops	M7			+	Change oil each 25,000 -30,000 km, at least once per year
Winch drum drive shaft	29	1	As required	C3	+			
Clutch of winch drive	30	1	As required	C3	+			
Winch drive clutch fork		2	Several drops	M3	+			
Winch drive guide roller	31	2	As required	C3	+			
Winch drum	32	2	As required	C3	+			
Winch reducing gear	33	1	2.4 1	M5			+	Change oil 1st time following 20-25 hours operation in summertime or 50-60 hours in winter; then, change oil each 75 hours in summertime and 200 hours in winter
Door hinges	-	-	-	-	-	-	-	-
Hinges of control arms and levers of:			As required	M3	+			Lubricate with several drops from oiler
clutch		2	Same	M3	+			
brake valve		7	Same	M3	+			Same
carburetor		8	Same	M3	+			Same

APPENDIX 11. LUBRICATION OF THREE AXLE TRUCKS. (Continued)

ZIL-131 AND ITS MODIFICATIONS

No. of Position on Lubrication Chart	No. of Lubrication Points	Quantity of Lubricant	Symbol of Lubricant	Frequency, km			Notes
				TO-1	TO-2	Other	
-	-	-	-				
7	2	0.45 1 each				+	Change oil each 35,000-40,000 km, at least once per year
28	2	As required	C3		+		Lubricate regardless of whether wench is used or not.
28	1	As required			+		Same
28	1	As required			+		Same
28	1	As required					Same
28	2	As required	C3		+		Same
28	1	2.4 1	M5				Change oil once per year during seasonal maintenance. After 5-10 operations, test oil level in reducer
8	4	As required	M1		+		Lubricate with oil dropper
		Same	M1	+			Lubricate with several drops from oiler
	2	Same	M1	+			
	7	Same	M1	+			Same
	8	Same	M1	+			Same

APPENDIX 11. LUBRICATION OF THREE AXLE TRUCKS. (Continued)

ZIL-157K AND ITS MODIFICATIONS

Mechanisms	No. of Position on Lubrication Chart (Fig. 4)	No. of Lubrication Points	Quantity of Lubricant	Symbol of Lubricant	Frequency, km			Notes
					TO-1	TO-2	Other	
Hand brake		6	As required	M3	+			Same
Transfer box		5	Same	M3	+			Same
Cabin door window mechanisms & latches	-	-	-	-	-	-	-	-
Surface of saddle device plates		1	0.2 kg	C3	+			
Saddle device		5	As required	M5	+			

APPENDIX 11. LUBRICATION OF THREE AXLE TRUCKS. (Continued)

ZIL-131 AND ITS MODIFICATIONS

No. of Position on Lubrication Chart	No. of Lubrication Points	Quantity of Lubricant	Symbol of Lubricant	Frequency, km			Notes
				TO-1	TO-2	Other	
	6	As required	M1	+			Lubricate with several drops from oiler
9	5	Same	M1	+			
	2	Same	M1		+		"
	1	0.4 kg	C3		+		Remove old lubricant and lubricate with thin layer
	5	0.1 1	M5	+			Lubricate through press oiler until fresh oil appears

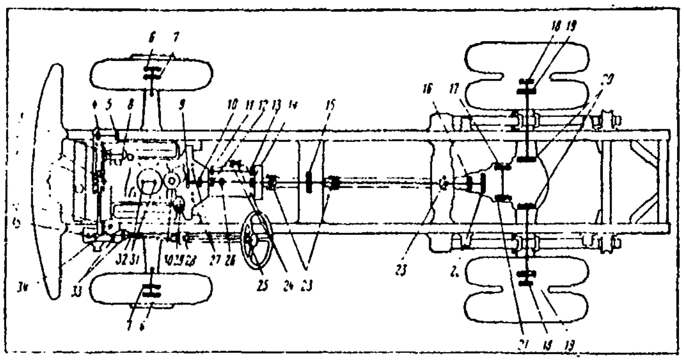

Figure 6. Diagram of Placement of Bearings on ZIL-130.

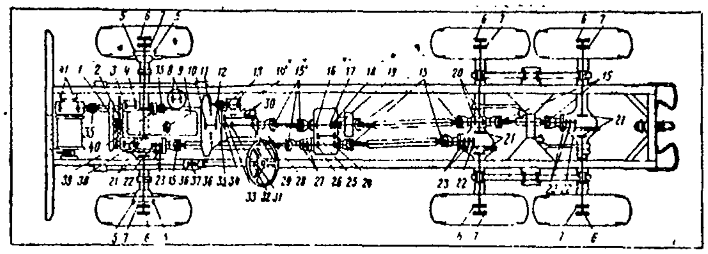

Figure 7. Diagram of Placement of Bearings on ZIL-157K.

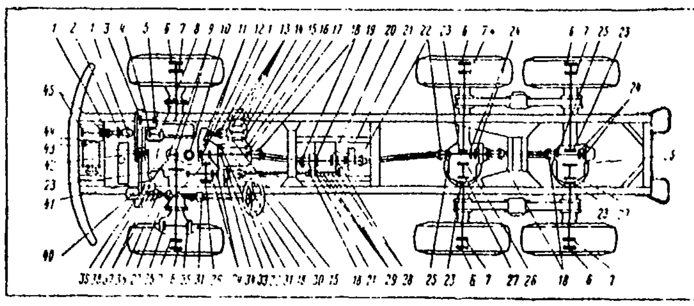

Figure 8. Diagram of Placement of Bearings on ZIL-131.

APPENDIX 12. BEARINGS IN TRUCKS.

Figure Number	No of Position on Figure	Bearing Number: According to ZIL specifications	Bearing Number: According to GPZ or GOST	Type	Name	Dimensions, mm: id	Dimensions, mm: od	Dimensions, mm: height	Number on Truck: ZIL-130	Number on Truck: ZIL-157K	Number on Truck: ZIL-131
7	2	120-1307050	20703A	Ball, radial, single row with felt seal	Rear bearing of water pump shaft	17	40	14	-	1	-
8	42	120-1307050	20703	Ball, radial, single row with felt seal on 1 side	Fan pulley hub bearing	17	40	14	-	-	2
7	1	120-130705k	20803	Ball, radial, single row with felt seal	Front bearing of water pump shaft	17	47	15.5	-	1	-
6 8	2 44	120-1307051	20803	Same	Rear bearing of water pump shaft	17	47	15.5	1	-	1
6 8	1 43	30657411	160703	Ball, radial, single row with rubber seal	Front bearing of water pump shaft	17	62	20	1	-	1
6 8	30 10	164-1017357	948102	Ball thrust, single row without circles	Bearing of filter of centrifugal oil cleaner	15.3	27.7	4.763	1	-	1
7	8	121-1107814	942/8	Needle with 1 outer stamped ring	Bearing of governor shaft	8	14	12	-	2	-
6	31	130-1107814-B2	80089	Ball, radial, single row with protective washer	Carburetor choke axis bearing	9	22	7	2	-	2
6 7	5 38	-	202	Ball, radial, single row	Generator cover bearing on collector end	15	35	11	1	1	-
8	5	-	180502K P	Ball, radial, single row with 2-sided seal and permanent lubricant supply	Same	15	35	14	-	-	1
7	39	-	203	Ball, radial, single row	Drive end generator cover bearing	17	40	12	-	1	-
6	4	-	303	Same	Same	17	47	14	1	-	-
8	3	-	303 180603P	Ball, radial, single row with 2-sided seal and permanent lubricant supply	"	17	47	15.5	-	-	1

APPENDIX 12. BEARINGS IN TRUCKS. (Continued)

Figure Number	No of Position on Figure	Bearing Number: According to ZIL specifications	Bearing Number: According to GPZ or GOST	Type	Name	Dimensions, mm: id	Dimensions, mm: od	Dimensions, mm: height	Number on Truck: ZIL-130	Number on Truck: ZIL-157K	Number on Truck: ZIL-131
6 7	29 9	-	706U	Ball, radial, single row	Distributor bearing	30	42	7*	1	1	-
6 7 8	3 3 8	120-3509112	50207	Ball, radial, single row with stop channel on outer circle	Rear bearing of compressor crankshaft	35	72	17	1	1	1
6 7	8 4	120-3509113	207	Ball, radial, single row	Compressor of crankshaft front bearing	35	72	17	1	1	1
7 6 8	12 10 34	306559-P	6888 11	Ball thrust, single row in collar	Clutch throw-out bearing	55	90	20.5	1	-	1
6 7 8	27 11 11	306230-P	-		Clutch lever rollers	-	1.6	12	152	152	152
6 7 8	9 10 12	110-1701225	60205	Ball, radial, single row with protective washer	Transmission driving shaft front bearing	25	52	15	1	1	1
6 7 8	12 34 33	306515-P	150212	Ball, radial, single row with stop channel on outer circle and protective washer	Transmission driving shaft rear bearing	60	110	22	1	1	1
6 7 8	24 30 15	120-1701180	64706	Roller radial with long cylindrical rollers w` without circles	Transmission reverse gear unit bearing	29.975	42	44.1	2	2	2
6 7 8	26 32 30	306229-P	-		Transmission driven shaft front bearing with synchromesh		8	20	14	14	14
6 7 8	14 29 17	306551-P	50310	Ball, radial, single row with stop channel on outer circle	Transmission driven shaft rear bearing	50	110	27	1	1	1

*Height of internal circle 7 mm, outer circle 6 mm.

APPENDIX 12. BEARINGS IN TRUCKS. (Continued)

Figure Number	No of Position on Figure	Bearing Number: According to ZIL specifications	Bearing Number: According to GPZ or GOST	Type	Name	Dimensions, mm: id	Dimensions, mm: od	Dimensions, mm: height	Number on Truck: ZIL-130	Number on Truck: ZIL-157K	Number on Truck: ZIL-131
6 7 8	33 11 32	306517-P	I-701	Roller radial with short cylindrical rollers without inner circle	Transmission intermediate shaft front bearing	42	72	19	1	-	1
7 6 8	28 13 16	306515-P	150308K	Ball, radial, single row with stop channel on outer circle and protective washer (with full filling of balls)	Transmission intermediate shaft rear bearing	40	90	23	1	-	1
6 7 8	23 15 18	164-2201044	804805	Needle without internal circle with rubber collar, universal	Drive shaft mounting bearings	25	39	31.2	12	40	24
8	22	131-2205033	804807	Same	Rear axle drive shaft cross bearing	33	50	32	-	-	8
6	15	306552-P	114 or 208114K	Ball, radial, single row	Drive shaft intermediate support bearing	70	110	20	1	-	-
7	20	121-1802238	7308	Roller, tapered	Intermediate support shaft bearing	40	90	25.5	-	2	-
7	27	121-1802238	7308	Same	Transfer box front axle drive shaft bearing	40	90	25.5	-	2	-
8	29	110-2904062	-	Needle	Transfer box front axle 1st and 2nd gear bearing	-	3	24	-	-	228
7	16	306482-P	27709U	Roller, tapered with high taper angle	Transfer box driven shaft front bearing	45	100	32	-	1	-
8	19	306538-P	150409	Ball, radial, single row with stop channel on outer circle and protective washer	Same	45	120	29	-	-	1

APPENDIX 12. BEARINGS IN TRUCKS. (Continued)

Figure Number	No of Position on Figure	Bearing Number: According to ZIL specifications	Bearing Number: According to GPZ or GOST	Type	Name	Dimensions, mm: id	Dimensions, mm: od	Dimensions, mm: height	Number on Truck: ZIL-130	Number on Truck: ZIL-157K	Number on Truck: ZIL-131
7	17	120-3103025	7608U	Roller, tapered	Transfer box driven shaft rear bearing	40	90	35.5	-	1	-
8	20	306447-P	102307	Roller, radial, with short cylindrical rollers without sides and separator, with two washers	Same	35	80	21	-	-	1
7	18	306482-P	27709U	Roller, tapered with high taper angle	Transfer box driven shaft front bearing	45	100	32	-	1	-
8	28	306418-P	42310	Roller, radial with cylindrical roller	Transfer box front bearing of driven shaft and rear bearing of front axle drive shaft	50	110	27	-	-	2
7	19	120-3103025	2608U	Roller, tapered	Transfer box driven shaft rear bearing	40	90	35.5	-	1	-
8	21	306603-P	150309	Ball, radial, single row with stop channel on outer circle and protective washer	Transfer box front axle drive shaft front bearing and driven shaft rear bearing	45	100	25	-	-	2
7	25	120-3103025	7608U	Roller, tapered	Front and rear bearings of intermediate shaft in transfer box.	40	90	35.5	-	2	-
7	26	306482-P	27709U	Roller, tapered with high taper angle	Front bearing of drive shaft for middle driven axle	45	100	32	-	1	-
7	24	120-3103025	7608U	Roller, tapered	Rear bearing of middle axle drive shaft of transfer box	40	90	35.5	-	1	-

APPENDIX 12. BEARINGS IN TRUCKS. (Continued)

Figure Number	No of Position on Figure	Bearing Number: According to ZIL specifications	Bearing Number: According to GPZ or GOST	Type	Name	Dimensions, mm: id	Dimensions, mm: od	Dimensions, mm: height	Number on Truck: ZIL-130	Number on Truck: ZIL-157K	Number on Truck: ZIL-131
6	16	120-2402025	7610U	Same	Rear axle bevel gear drive shaft front bearing	50	110	42.5	1	-	-
6	21	120-2402025	7610U	"	Rear axle straight cut driving gear shaft left bearing	50	110	42.5	1	-	-
6	17	306520-P	7611U	"	Rear axle straight cut driving gear shaft right bearing	55	120	46	1	-	-
6	22	120-2402041	7613U	"	Rear axle bevel driving gear shaft rear bearing	65	140	51.5	1	-	-
6	20	120-2403036	7215U	Roller, tapered	Right and left bearings of rear axle differential	75	130	27.6	2	-	-
7	21	121-2403036	807813U	Same	Front, middle and rear axle differential box cup bearings	65	110	30.5	-	6	-
8	23	306419-P	7214U	Roller, single row	Front, middle and rear axle differential bearings	70	125	26.5	-	-	6
7	23	308486-P	27709U	Roller, tapered with high taper angle	Outer bearings of shafts for front, middle and rear axle bevel gear drive shafts	45	100	32	-	6	-
7	22	306444-P	102605	Roller, radial with short cylindrical rollers	Internal bearings of front, middle and rear axle bevel gear driving shafts	25	62	24	-	3	-

APPENDIX 12. BEARINGS IN TRUCKS. (Continued)

Figure Number	No of Position on Figure	Bearing Number: According to ZIL specifications	Bearing Number: According to GPZ and GOST	Type	Name	Dimensions, mm: id	Dimensions, mm: od	Dimensions, mm: height	Number on Truck: ZIL-130	Number on Truck: ZIL-157K	Number on Truck: ZIL-131
8	24	306422-P	7512U	Roller, tapered, single row	Front, middle and rear axle driving bevel gear shaft bearings	60	110	30	-	-	6
8	25	30687-P	102210	Roller, radial with short cylindrical rollers without sides and separators with two washers	Rear and middle axle driving bevel gear shaft bearings	50	90	20	-	-	2
8	41	306444-P	102605	"	Front axle driving bevel gear shaft bearing	25	62	24	-	-	1
8	26	306424-P	102314	"	Front, middle and rear driven bevel gear bearings	70	150	35	-	-	3
8	27	306536-P	SKB 17070	Roller, tapered, two row	Front, middle and rear axle, straight cut driving gear shaft bearings	40	90	56	-	-	3
7	5	121-2304070	27706	Roller, tapered, with high taper angle	Front axle rotating pin bearings	30	72	24.5	-	4	-
8	35	306570-P	27308	Roller, tapered, single row	Front axle rotating pin bearing	40	90	25.5	-	4	-
6	6	120-3103025	7608K	Roller, tapered	Front wheel hub outer bearings	40	90	35.5	2	-	-
6	5	120-3103035	7611	"	Front wheel hub inner bearings	55	120	40	2	-	-
7	18	120-3104050	7815K1	Roller, tapered	Rear wheel hub outer bearings	75	135	44.5	2	-	-
6	19	306431-P	7517	"	Rear wheel hub inner bearings	85	150	39	2	-	-
7	6	306542-P	7515	"	Front and rear wheel hub outer bearings	75	130	33.5	-	6	-

APPENDIX 12. BEARINGS IN TRUCKS. (Continued).

Figure Number	No of Position on Figure	Bearing Number: According to ZIL specifications	Bearing Number: According to GPZ and GOST	Type	Name	Dimensions, mm: id	Dimensions, mm: od	Dimensions, mm: height	Number on Truck: ZIL-130	Number on Truck: ZIL-157K	Number on Truck: ZIL-131
8	6	306332-P	7215	Roller, tapered, single row	Wheel hub outer bearing	75	130	27.5	-	-	6
7 8	7 7	306440-P	7516	Roller, tapered	Front and rear wheel hub inner bearings	80	140	35.5	-	6	6
7	36	120-3401121	977909	Roller, tapered without inner circle	Steering mechanism worm bearing	46,673	72	14*	-	2	-
6 7	25 28 31 31	120-3401120	836906	Ball, radial-thrust stamped	Steering shaft bearing						
6 8	32 36	110-1602025	94904	Needle with one outer stamped ring	Steering screw bearing						
6 8	33 37	306560-P	958[illegible]05	Ball thrust	Steering mechanism bearing	25	52-56*	18	2	-	2
6 8	34 38	306514-P	154901	Needle without inner circle	Power steering pump body bearing	12	22	16	1	-	1
6	36	306610-P	1180304	Ball, radial, single row with 2 protective washers	Power steering pump bearing	20	52	18	1	-	-
8	39	306610-P	1180304 C9	Ball, radial, single row with 2 sided rubber seal and permanent lubricant reserve	Power steering amplifier pump bearing	20	52	18	-	-	1
7	37	120-3401072		Needle roller steering	-	-	3	16	-	42	-
7 8	14 13	110-1701180	64805	Roller, radial with long cylindrical rollers without circles	Constant mesh gear bearings from reversing constant mesh power take off	25	38	24.7	-	4	4

*At roller bearing height 17.2 mm, at circle -- 14 mm.

APPENDIX 12. BEARINGS IN TRUCKS. (Continued)

Figure Number	No of Position on Figure	Bearing Number: According to ZIL specifications	Bearing Number: According to GPZ and GOST	Type	Name	Dimensions, mm: id	Dimensions, mm: od	Dimensions, mm: height	Number on Truck: ZIL-130	Number on Truck: ZIL-157K	Number on Truck: ZIL-131
7 8	13 14	485- 4211112	307	Ball, radial, single row	Power take off reversing transmission main shaft bearing	35	80	21	-	2	2
7 8	35 1	110- 2201033	704702	Needle without internal circle, universal	Wench drive shaft joint bearings	16.3	30	21	-	12	12
7 8	40 2	110- 2202040	550206	Ball, radial, single row with 2 sided felt seal	Wench drive shaft support bearing	30	62	24	-	1	1
7 8	41 45	306482-P	277090	Roller, tapered with high taper angle	Wench reducer worm shaft bearing	45	100	32	-	2	2
6 8	35 40	306266-P		7,158-7,130**	Steering mechanism nut balls	-	-	-	31	-	31

* Outer diameter of lower circle 56 mm, upper circle 52 mm.
** Balls sorted by groups each 0.002 mm.