I.A.ARO MUSCEL CÎMPULUNG

SERVICE ARO 24
REPAIR HANDBOOK

24 . E-39.07.000

1 FOREWORD

This repair handbook is intended to the personal working in maintenance and repair shops, as a guide for the operations necessary for the cross country cars ARO 24 and its variants, in accordance with the technical documentation and the technical instructions, specific to these types, elaborated by MUSCEL MECHANICAL ENTREPRISE.

It is also used by the specialists, which are leaders of transport entreprises or garages for ARO cars, and by the drivers, pupils from the car drivers and mechanics school.

The present handbook, together with operator's handbook and the spare parts liste, explains the methods to be applied in order to obtain an operationing, maintenance and repairing of quality, which will inorease the ARO cars reliability and maintenability.

The problems analised in this handbook are of three kinds:

- The everyday's maintenance and service.
- Properly repairing of the motor vehicle.
- The prescribed periods for the operations, mentioned in maintenace and repairing paragraphs.

The first part of the handbook contains instructions for usual maintenance, in various periods, indicated in the SERVICE notebook of the motor vehicle, and the methods for performing of these operations, both during the guarantee period of the motor car and out of it.

The second part shows in detail the methods of symptomatic diagnosticating for various troubles, which can appear during car operation, the methods of remedying them respectively the order for dismantling and refitting the repaired parts, or for changing them; the methods of checking the import and assemblies and parts, for which the functional sizes are indicated, respectively for the repair sizes when this repairing mode is allowed.

The same parts show also the tools, the special devices and verifiers for ARO cars, T.D.V. which are listed in the recapitulative table, at the end of the book, and where is indicated a liste of indexes under which these are manufactured at MUSCEL MECHANICAL ENTREPRISE.

A performed repair will be of high quality only if the remounted parts will be integrate within the allowable wearing limits or will be changed by new, original parts.

The third part of this handbook contains the normed periods, devided for each service operation repair, which can be considered as a calculation base for determining manual labour.

A maintenance and a repair of high quality can be obtained only by respecting strictly the indications of this handbook.

The improving modifications for the ARO vehicles, after or between the handbook issue, are advised to the purchasers by means of the repair handbook suppliments, which are delivered together with the car.

In the present, third edition are introduced a lot of improvements, in comparison with preceding issue, due to comulating of engine--and motor vehicle repair handbooks, to avoid references from a handkook to the other. The graphic material is also improved, enclosing the figures of the tools, devices and service-verifiers (T.D.V.).

The chapters about repairing and adjusting of body assemblies, of heating system and ventilation, of electrical equipment, etc. are more developed and the grouping of operations is better.

CHAPTER I. GENERALITIES

1.1. METHODOLOGICAL INDICATIONS CONCERNING REMEDYING OPERATIONS

The overhauling operations for the motor vehicle must be done with accuracy. Before any dismantling, the parts and the assemblies surfaces must be cleaned by washing and wipping, in order to obtain them completely dried and clean, as well as the adjacent parts must be cleaned, to avoid impurities to penetrate inside the mechanisms.

If the parts, which are to be dismantled, influence each other, or if they are mounted together, they must be marked by a particular sign, for instance, by slight scratching of the free surfaces, to permit, by refitting them, to obtain again the initial position. The condition is imposed by respecting normal clearances or tightenes, which must be assured.

After dismantling, the parts must be washed in white-spirit or another similar solvent.

On reffering to the plastics and rubber parts, it must be observed that the solvents should not damage them. The parts should be wipped with textile cloth, which produces no links and they should be checked visually and dimensionally (when the sizes are indicated), in order to discover the faults.

The surfaces which remain free after dismantling of checked parts, should be protected by cartboard, specially in case of opened housings.

On dismantling assembled parts, it is not allowed to introduce sharp things between thir contact surfaces, in order to remove them.

To facilitate the surfaces' removing, when removing assembled components, it should be performed slight bits, laterally to direction of tightining, by means of a wooden rubber hammer.

If the removing of the two parts does not succeed in this way, one should insist, by washing the contact areas with organic solvents, in order to

soften the paint film, which penetrated in the joint areas of the adjacent sufaces.

Before remounting the dismanled parts, it should be done the last inspection for blows, scratches or impurities. The parts which operate in lubricated spaces, can be lubricated before their remounting with greases or oils of the same quality.

The assemblies, which have oil bath or water chamber (engine block, gear box, differential housing, etc.), must be sealed. Therefore the gaskets, which should be mounted, should be in perfect condition, and the screws (bolts) which are fixing the covers, should be tightened from the center to outside, diagonally and alternatively.

In case that the tightening of bolts has a special importance, such as crankcase main bearing covers or cylinder head fastening bolts the torque indicator wrenches, should be used and the tightening should be done with a torque whose value is indicated in the chapter of respective repair.

In case that a bolt passes through a chamber with fluid, it should be assured a sealing of respective joint, by using sealing solutions (such as "Locktite", "Omrifitt" etc.), which should not block up the bolts. Before applying the sealing solution, the surfaces should be degreased.

The parts which allow remedying by machining, should be machined up to the sizes immediately lower, while the conjugated parts should be choised from the adequate repair class, so that the clearances, respectively normal tightening (indicated in the handbook) could be realized.

The parts for which the repair sizes are not indicated and which exceed the tolerances range, should be repaced with original parts.

If on the ARO vehicle are mounted other engines than ARO L-25 or ARO D-127 (Diesel) engine their derivates, the maintenance indications of the engine supplier should be applied, for the engine and its devices.

1.2. CODITION OF THE MAINTENANCE & REPAIR OPERATIONS

The maintenance & repair operations are marked by a number of 7 (seven) figures.

The number of an operation is diveded into 5 groups separated by points.

The first group has a single figure, that is to say:

- By figure 1: intervention on the vehicle lifted upon an inspecting ramp after returning from the travel, respectively having its lubricants heated up to the working temperature.
- By figure 2: Intervention on the vehicle is made when the vehicle is parked in the workshop or on an inspecting ramp.
- By figure 3: The case when the respective unit is taken down from the vehicle and fixed on a special device which facilitates the operation to be done
- By figure 4: The case when the repair operation is carried out on a normal workshop bench.
- By figure 5: If the respective operation concernes various adjustings and functional tests.

On describing various operations, there will be no refferences, concerning the unit situation (mounted or taken down from the car), but only when it will be strictly necessary.

The second group, having a single figure, "0" or "1", means if the operation is carried out directly, (marked by "0"), or if it needs also other prelimenary operations, (marked by "1"), indicating the order in which these operations must be carried out.

The third group, having two figures indicates the order number of the unit, on which is carried out the operation, so as it is to be seen in the first Table.

The fourth group, having also two figures, indicates the order number of the operation carried out concerning the unit indicated in the second group.

The fifth group, having a single figure, marks the order number of the operation step, marked in the fourth group, as far as this operation is extensive and needs its dividing in successive, characteristic steps; in opposite case, it is marked by "0"

1.2.1 TABEE I. CODIFICATION OF MAIN UNITS WHICH COMPOSE THE ARO-24 CROSS-COUNTRY CARS

Ref. No.	Name of unit	Code No.
0	1	2
1	Engine - mounted on the vehicle	01
2	Cylinder block	02
3	Cylinder head - (assy)	03
4	Piston and piston rod - (assy)	04
5	Crankshaft - (assy)	05
6	Fuel pump	06
7.	Water pump	07
8	Inlet & exhaust manifolds	08
9	Engine lubricating system	09
10	Engine - taken down from the vehicle	10
11	Fuel supply system, up to the fuel pump	11
12	Exhaust system, beginning from the exhaust manifold	12
13	Engine cooling system - outside of it	13
14	Fuel injection pump	14
15	Carburettor	15
16	Engine clutch	16
17	Gear box	17
18	Transfer box	18
19	Brake and cluch control	19
20	Servobrake	20
21	Front R.H. & L.H. cross propeller shafts	21
22	Rear propeller shafts	22
23	Front differential	23
24	Rear axle	24
25	Rear differential	25
26	Front & rear bumpers	27

0	1	2
27	Chassis frame - (assy)	28
28	Front & rear suspension	29
29	Front axle	30
30	Wheel (assy)	31
31	Free wheeling hub	32
32	Steering mechanism	34
33	Hydraulik brake system - exclusively its control	35
34	Electrical equipment on the engine	36
35	Electrical equipment - exclusively the engine	37
36	Tool, outfit & spare parts set	39
37	Power take-off	42
38	Belt pulley	43
39	Winch (assy)	45
40	Body (assy), taken down from the car	50
41	Body	51
42	Windscreen; windscreen wiper & washer	52
43	Cowl and arrangements on the cowl	53
44	Rear tailgates	56
45	Tilt framework & tilt	57
46	Metalic superstructure	58
47	Inside upholsteries	60
48	Front lateral doors	61
49	Rear lateral doors	62
50	Rear door	63
51	Safety belts; bars against overturn	65
52	Driver's seat	68
53	Passenger's seat	69
54	Rear side benches	70
55	Rear longitudinal bench	75
56	Heating & ventilating system	81

0	1	2
57	Obturating parts	82
58	Radiator grill, external & inner wings	84
59	Engine bonnet; intermediary systems	85
60	Motor vehicle - generally	99

1.3. METHODOLOGICAL INDICATIONS FOR TIME NORM ESTABLISHMENT

In the Chapter about the time norms it is indicated the allowed times, in numerical order of the operations to be carried out.

In the time norm are comprised all the preparing stages, necessary for the intervention; as well as these, which are necessary to be able to deli ver immediately the motor vehicle, in good working order, to the owner.

Reffering to the code of operation, one should observe if the second group has the figure "1" or "0".

If there is a figure "0", the time norm will be as such, and the operation will be performed directly, without other prelimenary operations; if there is the figure "1", to the normed time must be added the times provided for the preliminary operations, indicated in the text of the respective operation.

To facilitate this procedure, it is also indicated the page number of the handbook where is found again described the respective operation.

On the vehicles generally overhaulings, the times will be taken as such, without suplementary times for the preliminary operations, and their sum should be corrected by the sub-unitary coefficient K, depending of the equipping degree of the workshop with special T.D.V. (tool . devices . verifiers), specific for the cross-country ARO-cars, and on the yearly series, in which these operations are performed in the respective workshop, as it can be seen in the Table II.

The sum of times should be corrected by the product: $K_1 \times K_2$

TABLE II

Reff. No.	Equipping degree of the workshop and repairs'series	Correction coefficient for endowment - K_1	Correction coefficient for repairs series - K_2
1	Minimal equipping with T.D.V. for SERVICE (T.D.V. marked with astariak)	0,9	-
2	Equipping with T.D.V. in complete set, as indicated in the handbook	0,75	-
3	Serial repairs, up to 25 per year	-	0,9
4	Serial repairs, up to 26 - 27 per year	-	0,8
5	Serial repairs, up to 76 - 200 per year	-	0,65
6	Serial repairs, over 200 per year	-	0,55

1.4. THE ARO CAR MODELS WHICH ARE REPAIRED ACCORDING TO THIS REPAIR HANDBOOK

1.4.1. The ARO-240 vehicle is intended for goods'and persons'transport,having two lateral doors, rear lower tailgate and a tilt framework with impermeable tilt.

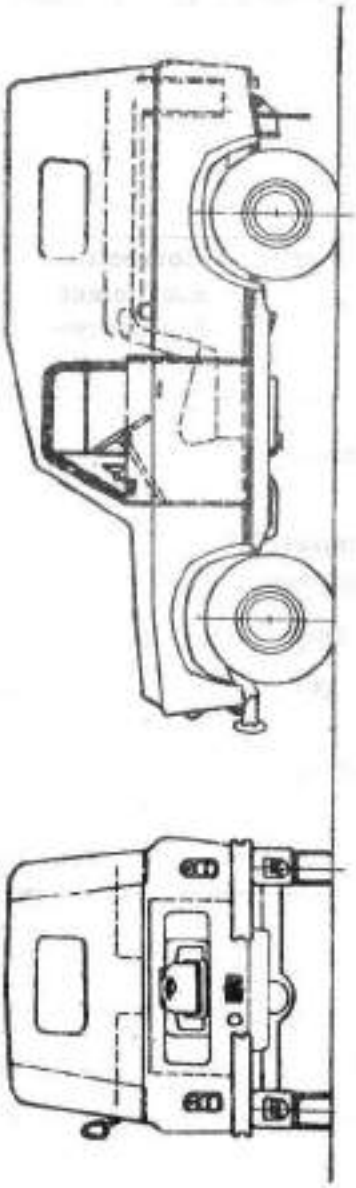


Fig.1.1. ARO 240 OUT ROAD VEHICLE
A vehicle for goods and persons

1.4.2. The ARO-241 vehicle is intended for goods and persons, having four side doors, a rear lower tailgate, the folding rear bench and impermeable tilt.

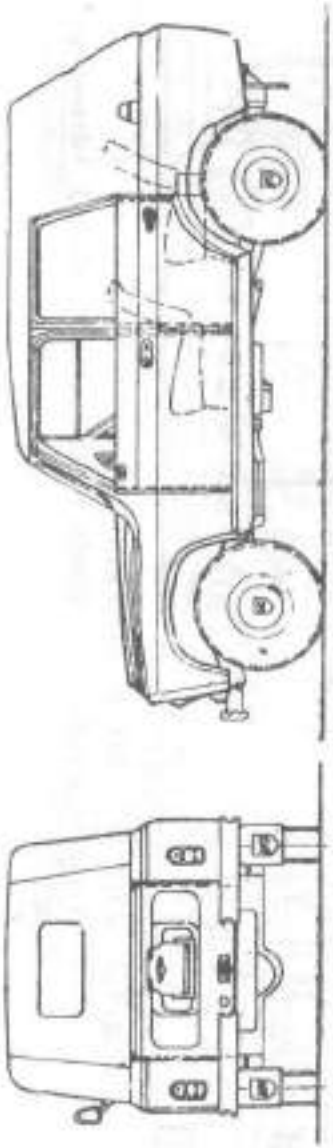


Fig.1.2. ARO 241 OUT'ROAD VEHICLE
A vehicle for persons, having a framework with tilt.

1.4.3. The ARO-242 vehicle is a light pick-up truck, for goods, especially having high specific weight; the bucket can be covered with the til and the driver's cab is metallic, completely closed.

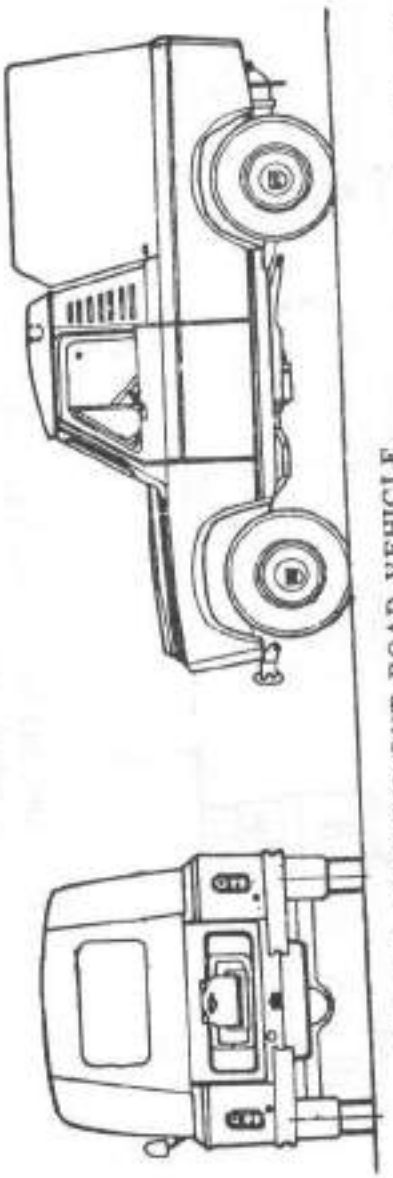


Fig. 1.3. ARO 242 OUT ROAD VEHICLE
A pick-up vehicle for goods, with metallic, closed driver's cab.

1.4.4. The ARO-243 vehicle is intended for goods and persons, having two side doors, a rear door and complete metallic body.

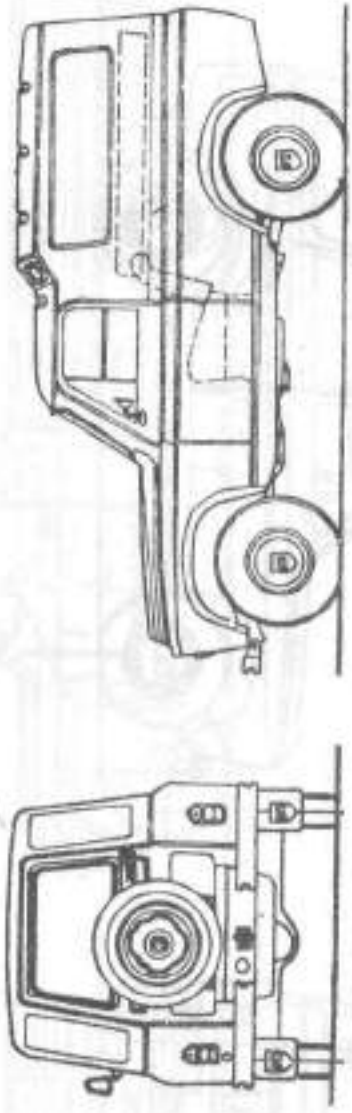


Fig. 1.4. ARO-243 OUT TOAD VEHICLE
A vehicle for goods and persons, having complete metallic body.

1.4.5. The ARO-244 venicle is intended for persons and eventually for goods transport, having four side doors and two rear tailgates (upper and lower), a folding rear bench and complete metallic body.

1.4.6. The ARO-320 vehicle is a pick-up truk, having increased wheelbase, metallic closed cab und independant goods'bucket, with a tilt.

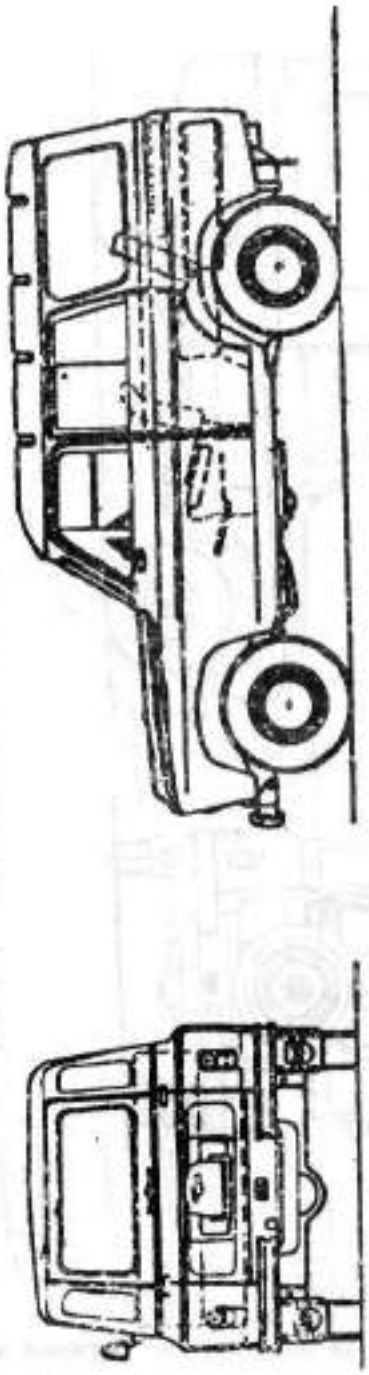


Fig.1.5. ARO-244 OUT ROAD VEHICLE
A vehicle for persons and small goods having complete metallic body with foor side doors and upper & lower tailgates.

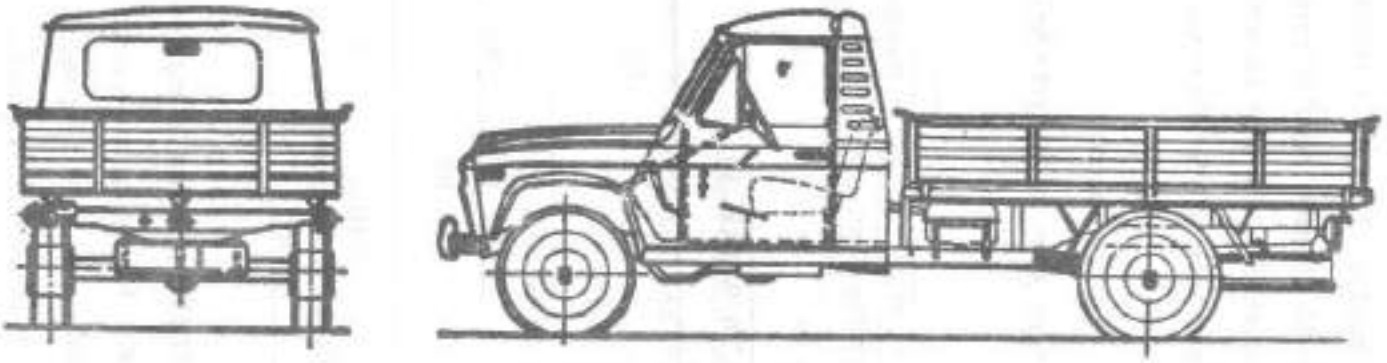


Fig. I. 6. ARO-320 OUT ROAD VEHICLE
A pick-up slight truck, having metallic, closed driver's cab and a goods bucket with a tilt.

1.4.7. As variants of the above mentioned vehicles are the ARO vehicless with the right hand drive. Within of the handbook, where it will be the case, there will be done references concerning particular operations, depending on R.H. position of the steering wheel.

Another classification of variants is conditioned by the Diesel engine D-127, which equips the ARO vehicles, instead of the ARO L-25 gasoline engine. The overhauling of this engine type is presented in a separate chapter and as far as the other units will be affected by the presence of Diesel D-127 engine, there wil be done necessary references.

1.5. THE LUBRICANTS USED FOR ARO MOTOR VEHICLES

Ref. No.	Name of lubricant	Period of use	Quality		Handbook symbol	Notes
			Roumanian	Equivalent		
1.	Engine	In summer	M 30 extra	SAE 40	UL 1	ARO L-25 engine
		In winter	M 20/20 W extra	SAE 10	UL 2	Idem
		t^{o} - 10^{o}C	Idem	SAE 10	UL 3	Idem
		In summer	M 10 super 2	SAE 30	UD 1	ARO D 127 engine
		In winter	M 20/20 W super 2	SAE 10 W SAE 20 W	UD 2	Idem
2	Transmission oil	Permanently	T 90 EP 2	SAE 90	UT	-
3	Rolling bearings and joints	Idem	UM 175 LiCaPb 3	Multipurpose grease	UR	-

1.6. MUSCEL MECHANICAL ENTREPRISE has a right to assure improvements for ARO motor vehicles, without informing the owners of this handbooks, which handbooks can be completed up to date by procuring the yearly supplement of this repair handbook, which is published yearly, in the first quarter of the year.

CHAPTER II. CURRENT MAINTENANCE

Manufactured in order to roll at least 120,000 equivalent km, without essential repairs, the ARO vehicles require a dayly current maintenance, consisting of checkings, lubricants changings, cleaning of parts, adjusting the clearings, replacing worn-out parts (oil filtering element, brake piston cups, tires, etc.).

The current maintenance should be carried out by a specialized stuff of the SERVICE-workshops, which are endowed with tools, devices and checkers, specific for ARO vehicles, adequate for all necessary interventions, or in garages, adequately endowed.

2.1. FREQUENCY OF PERIODICAL MAINTENANCE

The current maintenance should be carried out according to the indications of the operator's handbooks, and the SERVICE-hotebook.

2.1.1. CAPACITIES: CASINGS, RECEIVERS, INTERSPACES FOR LUBRICATING

In the below given Table V are indicated capacities of various casings, receivers and interspaces, which should be filled with lubricants or orther functional fluids for ARO motor vehicles, whose characteristics are marked in the Table III or by describing respective operations.

TABLE V CAPACITIES

Ref. No.	Casing receiver, interspace	Type of fluid	Unit of measure	Feeding point	Capacity	Remarks
0	1	2	3	4	5	6
1	Ignition distributor shaft	Oil	drops	1	3-4	For ARO L-25 engine
2	Gasoline engine oil bath	"	litres	1	5,0	Idem
3	Diesel engine oil bath	"	"	1	6,0	For ARO D-127 engine
4	Diesel engine air cleaner	"	"	1	0,3	Idem
5	Gasoline engine air cleaner	"	"	1	0,3	For ARO L-25 engine
6	Gear box	"	"	1	2,0	
7	Transfer box	"	"	1	1,0	
8	Front differential	"	"	1	1,0	
9	Rear differential	"	"	1	1,2	
10	Propeller shaft head	Grease	kg	4	0,08	
11	Propeller shaft spiders	Grease	kg	8	0,04	
12	Steering gear box	Oil	"	1	0,35	
13	Pivot case	Oil	"	1	0,02	
14	Steering rod heads	Grease	kg	4	0,01	
15	Front suspension linkages	"	"	2	0,01	
16	Wheel roller bearings	"	"	4	0,80	

0	1	2	3	4	5	6
17	Cluich throwout sleeve	Grease	kg	4	0,06	
18	Hinges, latches locks	"	"	-	0,03	
19	Propeller shaft middle bearing	"	"	1	0,25	
20	Outer flange needle bearings	"	"	2	0,01	
21	Storage batterv	electro-lyte	litres	1	6,0	
22	Cooling radiator	cooling	litre	1	12,0	
23	Gooling radiator complete	Idem	"	1	13.0	
24	Supplimentary heating system	Idem	"	1	1,5	
25	Simple brake system	fluid	"	1	0,75	
26	Servo brake system	Idem	"	1	0,85	
27	Gasoline/Diesel oil tank	Fuel	"	1	95,0	
28	ARO 320 fuel tank	Fuel	"	1	90,0	
29	Windscreen washing system	washing fluid	"	1	1,0	
30	Supplementary engine oil cooling system	oil	"	1	1,0	For ARO L-25 engine
31	Hydraulic clutch control system	Brake fluid	"	1	0,3	

2.1.2. PERFORMING LUBRICATING

On performing lubricating one should take care that during lubricanting operation the impurities or powders from the environment do not penetrate in the lubricated spaces, because they could cause the rapid damaging of lubricated parts

OP. 2.0.01.02.0 - OIL LEVEL CHACKING IN THE ENGINE BATH

Oil level chacking may be done about half an hour after the engine stopping.

Take out the oil gauge and observe the level reached by oil. This should be comprised between the two marks, MIN and MAX. If there are doubts, conserning the level observed on the gauge, this one should be wipped with a cloth, which does not produce lints, and then introduced again in this hole. Then, take out again the oil gauge and check the oil level.

Normally there is a low oil consumation, so that, in a course of time there is a tendency of decreasing to minimal level. By reaching this minimal level, complete the oil with 500 m.l. with fresah oil, of the same quality as that in the engine bath. Then wipe the eventual drops of the adjacent parts.

OP. 2.0.01.04.0 AIR CLEANER INSPECTION BY ARO L-25 ENGINE

Disconnect air cleaner from the carburettor connection pipes and the cylinder head connection pipes, by loosening the fastening collars on the filter. Then, by slight lateral blows remove the air cleaner cover (see fig. 2.1.) and observe the clogging degree of the filtering cartridge and the oil condition. In case that the vehicle has operated on the dusty roads, the observed clogging will be greater and it will be necessary a filter washing and oil changing, as described by Op. 2.0.01.05.0.

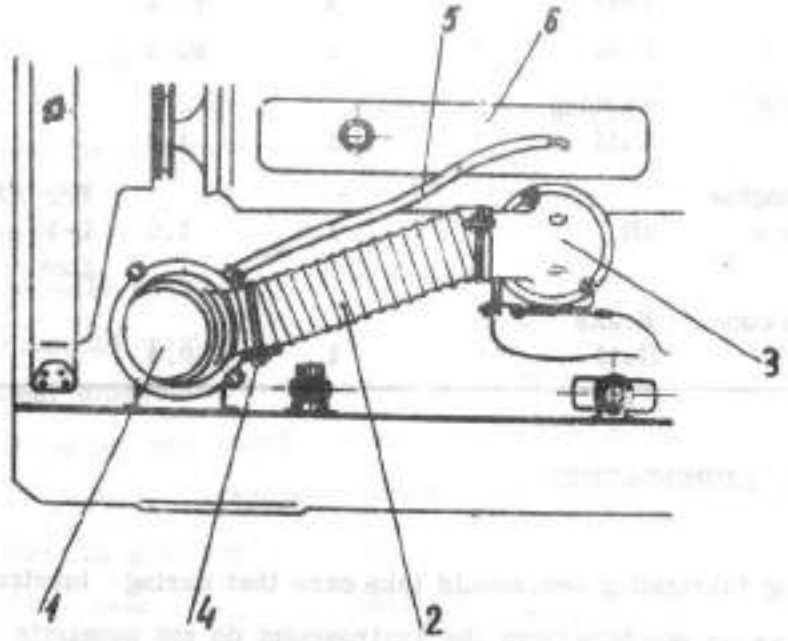


Fig. 2.1. AIR CLEANER CONNECTION TO ENGINE
1. Air cleaner; 2: Connecting hose; 3. Connecting elbow; 4. Hose clamp; 5. Cylinder head cover bleeding tube; 6. Cylinder head cover.

OP. 2.0.17.01.0 OIL LEVEL CHACKING IN THE GEAR BOX

This operation should be performed 5 minutes after stopping the car better on a ramp). A tray for the run-off oil is necessary as well as a source

Lightly remove the level plug (see fig.2.2.) and in case the oil starts overflowing, immediately replace the plug and fasten it, because there is enough oil. Otherwise, top up with the same transmission oil through the filling hole, till the oil starts flowing out at the level plug hole. After topping up, replace and fasten the plugs.

If there are available specialized oil supplying systems, under pressure, the filling with oil can be carried out by means of a sonde, through the level plug hole till the oil begins to drop out around the sonde (see fig.2.2.).

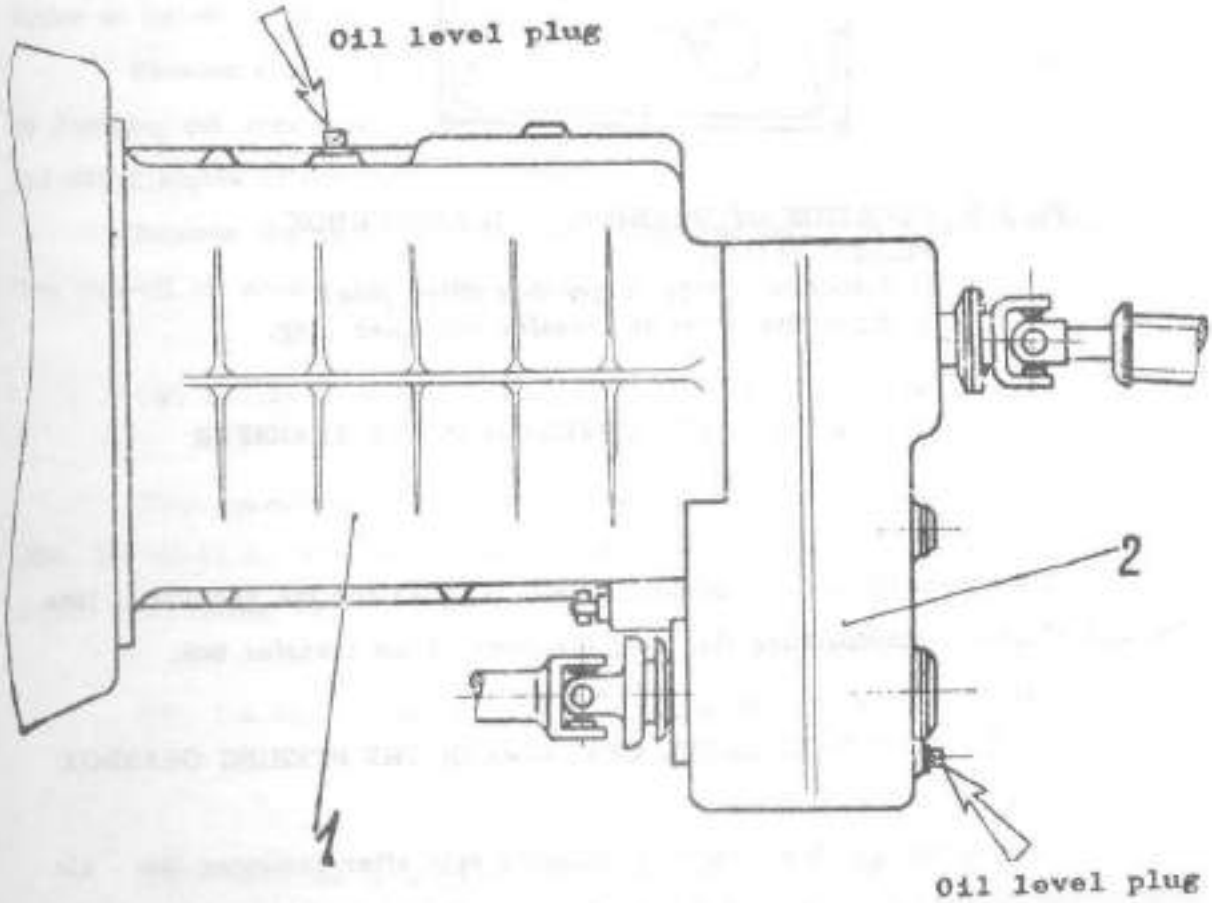


Fig.2.2. TOP VIEW OF GEAR TRANSFER BOX
1. Gear box; 2. Transfer box; (the arrows indicated the oil level pluge).

Then replace the level plug (and the filling plug also, if it was removed) and wipe dry the adjacent areas, eventually touched by oil.

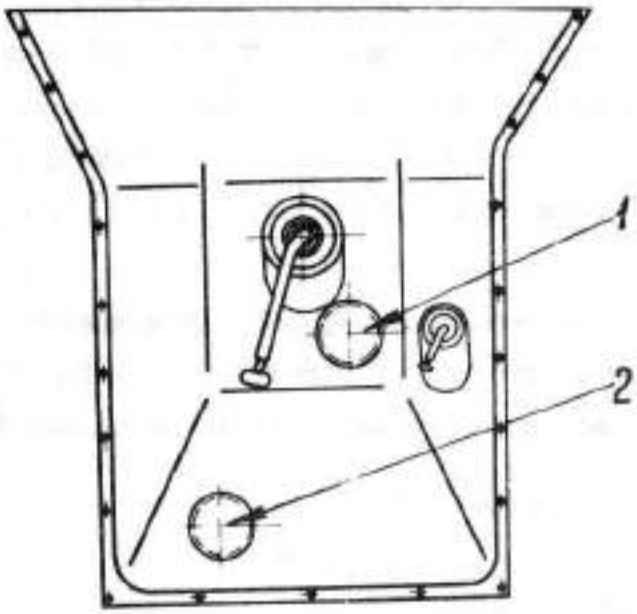


Fig.2.3. LOCATION OF GEARBOX TRANSFERBOX FILLER PLUGS.
1. Inspection cover of gearbox filler plug;
2. Inspection cover of transfer box filler plug.

OP. 2.0.18.01.0 OIL LEVEL CHECKING IN THE TRANSFER BOX

This operation is to be performed similarly as for the gearbox, (see Op. 2.0.17.01.0), manipulating this time the plugs of the transfer box.

OP. 2.1.34.03.0 OIL LEVEL CHECKING IN THE STERING GEARBOX

The steering gearbox plug is accesseble only after removing the air cleaner (the stages 2.0.08.01.1 and 2.1.08.01.2). Therefore it is recommended to performe tais opr ration at the same time with the cleaning of the air clea-

Remove the plug, placed on the top of the steering gearbox and in case the oil level does not longer reach the plug, top it up using the same transmission oil (indicated in this handbook).

Refit the plug and remount the air cleaner in reverse order as by dismantling.

OP. 2.0.23.01.0 OIL LEVEL CHECKING IN THE FRONT DIFFERENTIAL

It is preferable to performe this operation on a ramp, having at disposal a tray for the run-off oil as well as a source of transmission oil.

This operation should be performed 5 minutes afier stopping the car, in order to let oil to gather at the bottom of the bottom of the differential housing

Remove the upper filling plug and check if oil is at the hole edge or is drppping out over this. If there will be not enough oil it must be completed till it begins to flow out.

Replace the gasket and the plug. The plug should be clean on replacing. The run-off oil should not be used again.

OP. 2.0.25.01.0 OIL LEVEL CHECKING IN THE REAR DIFFERENTIAL

This operation is to be performed similarly as for the front differetial (Op. 2.0.23.01.0). The level plug is located on the rear axle housing, on its upper side, facing with the differential.

OP. 2.0.01.01.0 D OIL LEVEL CHECKING IN THE D-127 ENGINE BATH

This operation is identical with that, which was indicated for the ARO L-25 engine (Op.2.0.01.02.0), with the different location only of the oil level gauge.

OP. 2.0.01.01.0 LUBRICATING THE BREAKER CAM OF THE ARO-L-25 ENGINE IGNITION DISTRIBUTOR

Remove the cover fastening clamps of the ignition distributor, together with the ignition wire set.

Take out the oil gauge from the engine oil sump and let drop some oil drops upon the felt of the distributor cam shaft head.

Push back the oil gauge in its hole; replace the cover in its normal position and fasten it with the clamps (see fig. 2.4.).

Check correct connection of the ignition wires.

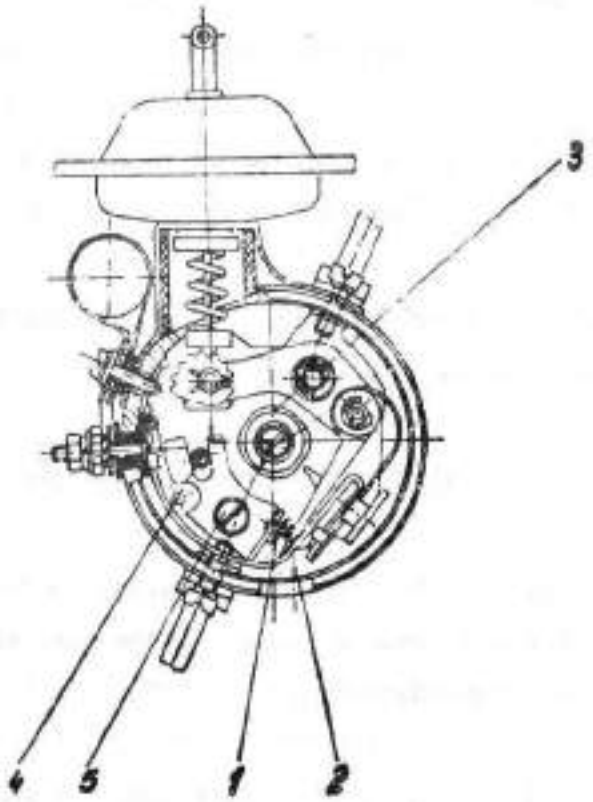


Fig. 2.4. TOP VIEW OF IGNITION DISTRIBUTOR WITH REMOVED COVER.
1. Fixed contact; 2. Breaker arm point; 3. Breaker cam;
4. Adjusting screw; 5. Screw fastening fixed point plate.

OP. 1.0.01.03.0 OIL CHANGING IN THE ARO L-25 ENGINE BATH

This operation should be performed, stopping the engine, 5 minutes after the engine reached its working temperature, in order to be able to drain the oil out from all the components of the engine.

The draining of oil can be performed throug the magnet plug hole, placed at the bottom of the oil bath, or by drowing oil by means of a sonde,through the oil gauge hole. Before draing oil, remove the filling hole cap placed on the cylinder head cover.

In case the oil bath is drained by running-off, put firstly a tray under the magnetic plug and unscrew it. When the oil runaing-off occures not flowing, but dropping, wipe off any possible impurities from the magnetic plug and re-screw it tightly. Check firstly if its gasket is in good condition.

In case of drawing out the oil by means of a sonde, first remove the oil level gauge (dip rod) and then introduce the sonde through the hole. Oil is sufficiently eliminated when the sonde can no longer draw out but fine drops. In this case also it is useful to unscrew the oil bath plug and remove eventual impurities, collected by the magnet.

Replace the magnetical plug and after pulling out the sonde, introduce again the oil gauge in its hole, after having wipping it off of possible impurities.

Refeeding of engine with fresh oil is carried out through the oil filler cap, on the top of cylinder head. After, that, replace the oil filler cap and fasten it by slight turning.

OP. 3.0.01.05.0 OIL CHANGING IN THE AIR CLEANER

The operation is carried out in several stages:

St.2.0.08.01.1 DISCONNECTING AIR CLEANER FROM THE ENGINE

Remove hose clamps which fasten the hoses on the air cleaner connecting sockets, and namely: from the connecting hose to carburettor and from the aeration hose of cylinder head. (see fig.2.1.).

On remounting the operations should be done in reverse order.

St. 2.1.80.01.2 TAKING DOWN AIR CLEANER FROM THE ENGINE

This stage is performed by disconnecting air cleaner from the engine, respectively by performing the stage 2.0.08.01.1.

Loosen the clamp fastening the air cleaner on the inner wing (the mud-guard), by removing the nut (acces through the space for wheel).

Bemove the air cleaner from the clamp.

On remounting the operations should be done in reverse order.

St. 2.0.08.01.0 CLEANING OF THE AIR CLEANER FILTERING ELEMENT

Remove the clamps fastening the cover on the cleaner body and, by slight lateral blows remove the cleaner cover.

Wash filtering element in gasoline or white spirit, in a specially provided room, to avoid fire risks.

Empty out the used oil from the cleaner housing and wash the housing just like the filtering element.

Pour into cleaner housing fresh oil and replace filtering element, fastening it with the clamps.

OP. 1.0.17.02.0 OIL CHANGING IN THE GEABBOX

This operation should be performed about 5 minutes after coming back from a journey, while the gearbox is still hot and the oil could run-off as possible completely.

Take off the inspection rubber cover from the gearbox hood (see fig. 2.3) as well as the gearhox filling plug.

Place under the vehicle, facing the gearbox, a collecting tray, and remove the oil level plug and then the draining plug from the lower side of the gearbox, letting the used oil to flow out.

Pour fresh oil, of indicated quality and quantity through the filling hole till the oil starts flowing through the oil level hole.

If a supply system under pressure is available, feed with oil through the oil level hole, by means of a sonde. The feeding should be continued till oil begin to drop out through the oil level hole.

Screw back the level and the filling plugs ; then wipe thoroughly all traces of oil, to avoid collecting of impurities and to be abe to descover eventual oil leakages.

OP. 1.0.18.02.0 OIL CHANGING IN THE TRANSFER BOX

This operation is to be performed as for the gearbox, the plugs having identical functions. (see Op. 1.0.17.02.0).

OP. 2.0.22.01.0 LUBRICATION OF PROPELLER SHAFT SLIDING YOKES.

Move the vehicle so that the grease nipples, placed on the sliding yokes of the propeller shafts, reach successively a suitable position for greasing.

By means of a grease gun push grease through the nipples of the sliding yoke until it begins to emerge through the hole of the cover, which obturates the splined bore, towards the cardan joint.

OP. 2.0.22.02.0 LUBRICATION OF PROPELLER SHAFT SPIDERS

Move slightly the vehicle so that the grease nipples, placed on the cardan spiders, reach successively a suitable position for greasing. By means of a grease gun push grease through the grease nipples, untill it begins to leak around the needle bearings. Wipe excess of grease.

OP. 2.0.34.01.0 LUBRICATION OF STEERING KNUCKLE PIVOT

This operations is performed by means of a grease gun, pushing grease throught the grease nipple, placed on the cover plate protecting the pivot. The access to this place is below the engine bonnet.

Remove excesse of grease, by wipping dry.

OP. 2.0.34.02.0 LUBRICATION OF DRAGLINK ROD HEADS

This operation is performed by means of a grease gun, pushing grease through the grease nipples, mounted on the rod heads.

Push grease up to refuse. Wipe then the excess of grease.

To facilitate this operation lift the vehicle on ramp.

OP. 1.0.23.02.0 OIL CHANGING IN THE FRONT DIFFERENTIAL

This operation should be performed about 5 minutes after coming back from a journey, so that oil will be still hot and could run-off as possible completely.

Put under the differential a collecting tray and then unscrew, successively the oil level plug and the drain plug.

Let oil run off untill it begins to drop rarely.

Wipe impurities on the drain plug and screw it, together with its gasket.

Feed differential with fresh oil, through the oil level hole, until oil begins to flow out around the feeding sonde.

If measuring possibilities are available. pour oil in prescribed quantity.

Wipe impurities on the oil level plug and screw it, together with its gasket.

OP. 1.0.25.02.0 OIL CHANGING IN THE REAR DIFFERENTIAL

The operation is performed in the same way as for front differential. (see Op. 1.0.23.02.0).

OP. 2.0.29.01.0 LUBRICATION OF FRONT SUSPENSION LINKAGES

The operation is performed easier when the vehicle is lifted on a ramp to permit the simultaneous upper and lower access.

By means of a grease gun push grease into grease nipples provided in the extremity areas of the R.H.& L.H. steering knuckles.

Wipe grease excess from the adjacent areas.

OP 1.0.01.01.0 D CHANGING OIL IN THE DIESEL D-127 ENGINE BATH

This operation is identical with the same operation for MM ARO L-25 engine (see Op. 1.0.01.03.0). The only differences are the lubricant quality, the positions of the drain plug and the oil filler cap of cylinder heads.

OP. 2.1.16.01.0 LUBRICATING THE CLUTCH THROWOUT SLEEVE

This operation is rather difficult to be performed, due to difficult access in to the lubrication area.

It is necessary to take down transmission tunnel cover, to have access throught the clutch cover openng, or to take down the lower clutch housing cover.

St. 2.0.53.01.0 TAKING DOWN OF THE TRANSMISSION TUNNEL COVER

Remove the control level knobs of the gearbox and transfer box, in order to slide off the rubber protecting boots from the levers.

Remove the screws fastening the transmission tunnel cover on the floor pan and the cowl and lift the cover, by sliding the rubber boots, taking it completely down or making only enough space for access in the working area.

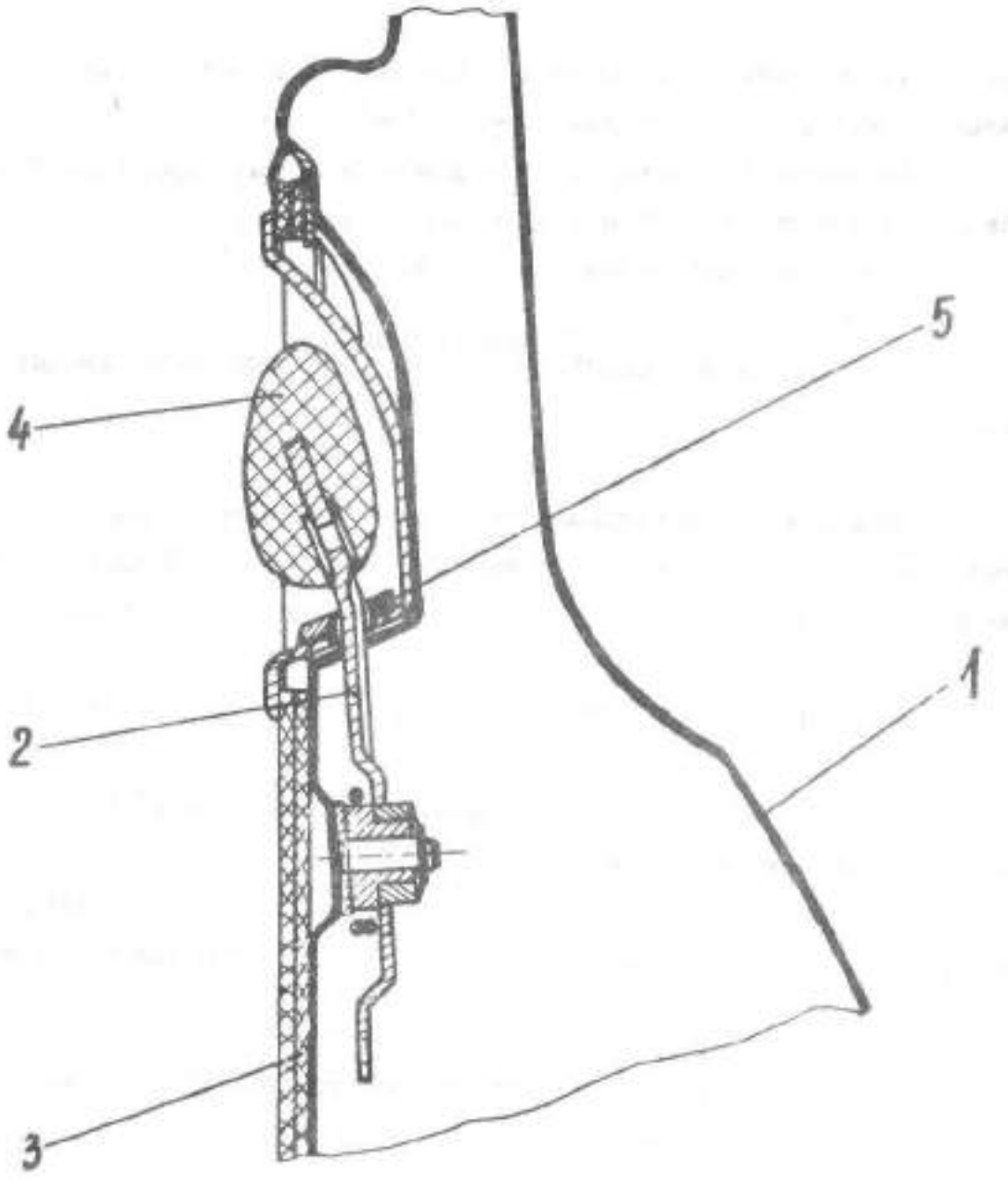


Fig. 2.5. INNER FRONT DOOR LOCKING HANDLE
1. Outer front door panel; 2. Inner locking; handle; 3. Door upholstery; 4. Locking handle knob; 5. Ornamental plate.

Remounting is performed in the reverse order.

St. 2.0.16.01.1 LUBRICATING OF THE THROWOUT SLEEVE

Apply grease with a wooden spattle on the gerabox flange, operating in the same time the clutch pedal in order to make slide the throwout sleeve and to grease it on the whole surface.

Pay attention to not let grease in excess, which could reach accidentally on the cluth friction disc, what could generate difficulties in its operation.

OP. 2.0.99.01.0 LUBRICATION OF DOOR LOCKS, HINGES LATCHES

Grease the door mechanisms, locks and tailgate latches as follows:

St. 2.0.61.01.1 DISMANTLING OF FRONT DOOR UPHOLSTERY

Dismantle, by pulling off, the knob of the inner door locking handle.

Dismantle the handle ornamental plate, and its shell, by removing the fastening screws (see fig. 2.5.).

Take down the arm-rest, removing the M 6 hexagonal screws, by means of a box wrench (see fig. 2.6.)

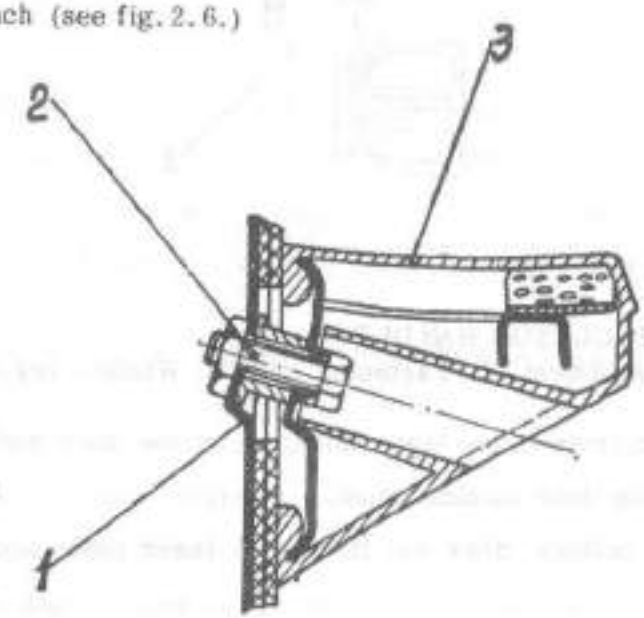


Fig. 2.6. ARM-REST FASTENING ON THE DOOR PANEL
1. Inner door panel; 2. Fastening screw; 3. Arm-rest.

Remove from the central side of the window reggulator handle, paying attention to not damage it, and remove the nut fixing the handle on the shaft.

Remove, by axial drawing, the window regulator handle and its cover plate (see fig.2.7).

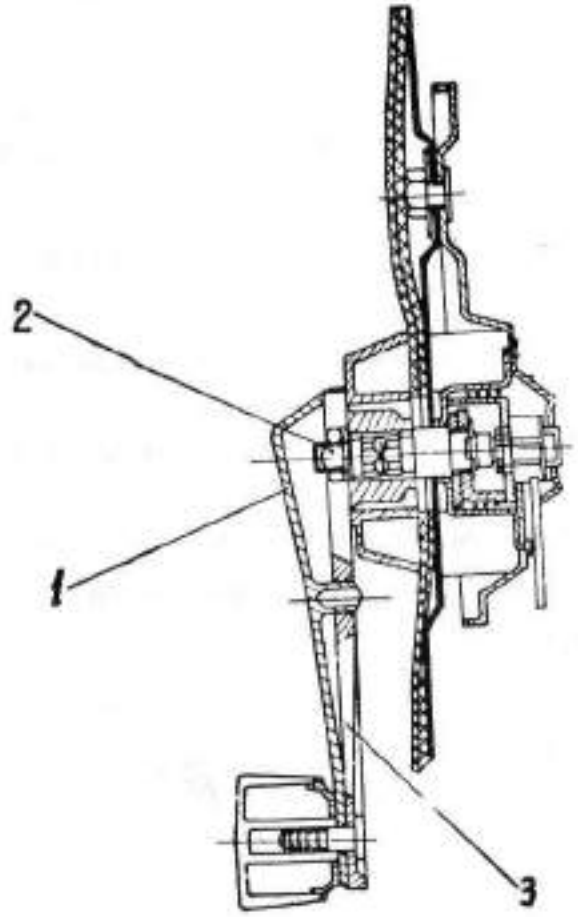


Fig.2.7. WINDOW REGULATOR HANDLE
1. Handle revetment; 2. Fastening nut; 3. Window regulator handle.

Remove the buttons fixing the upholstery on the door and then remove the upholstery from the door outside panel.

By removing buttons, draw out firstly the inner piece and then the outer one.

By remounting the upholstery, performe the operations in reverse order. Before remounting, wipe the upholstery with a detergent solution, then with water, to remove detergent and finaly wipe it dry.

St. 20.61.01.2 LUBRICATION OF THE FRONT DOOR MECHANISMS

Through the openings of the inner door panel lubricate, by means of a wooden spattle, without laying grease in excess, the window regulator mechanism, and namely: toothed quadrant; linkage joints.

The greas ing the door locking mechanism: door lock handle joint, the door lock and safety locking device.

ADVISE: Do not lubricante the lock, incorporated in the outer door handle, to avoid its blocking by dust or its freezing in winter.

The door hinges should be lubricated with oil.

St. 2.0.62.01.3 DISMANTLING OF REAR DOOR UPHOLSTERY

Take down the ash tray.

Take down the arm-r st (see fig. 2.6).

Remove by axial drawing, the knob of the inner door locking handle.

- Dismantle the ornamental plate and the shell of the locking handle. (see fig. 2.5.).
- Remove the crane handle.
- Remove the buttons fixing the upholstery on the inner door panel. By removing buttons, draw out firstly the inner pieces.
- Take down the door upholstery from the upper and lower guide.
- The upholstery remounting should be performed in reverse order.

St. 2.0.62.0.1.4. LUBRICATION OF REAR LATERAL DOOR

- Through the openings of the inner door panel lubricate, by means of a wooden spattle, without laying grease in excess, the door locking mechanism and the inner handle joint.
- The door hinges should be lubricated with oil.

St. 2.0.56.01.5 LUBRICATION OF LOWER TAILGATE LOCKING DEVICE

- Open the lower tailgate and lubricate with some drops of oil the latch, operating it concomitatly from outside, in order to lubricate the contact faces between the latch and its guide in the tailgate (see fig.2.8.).

- Lubricate also the lower hinges of the tailgate.

- Remove oil in excess by wiping. Do not let oil to flow on the painted surfaces.

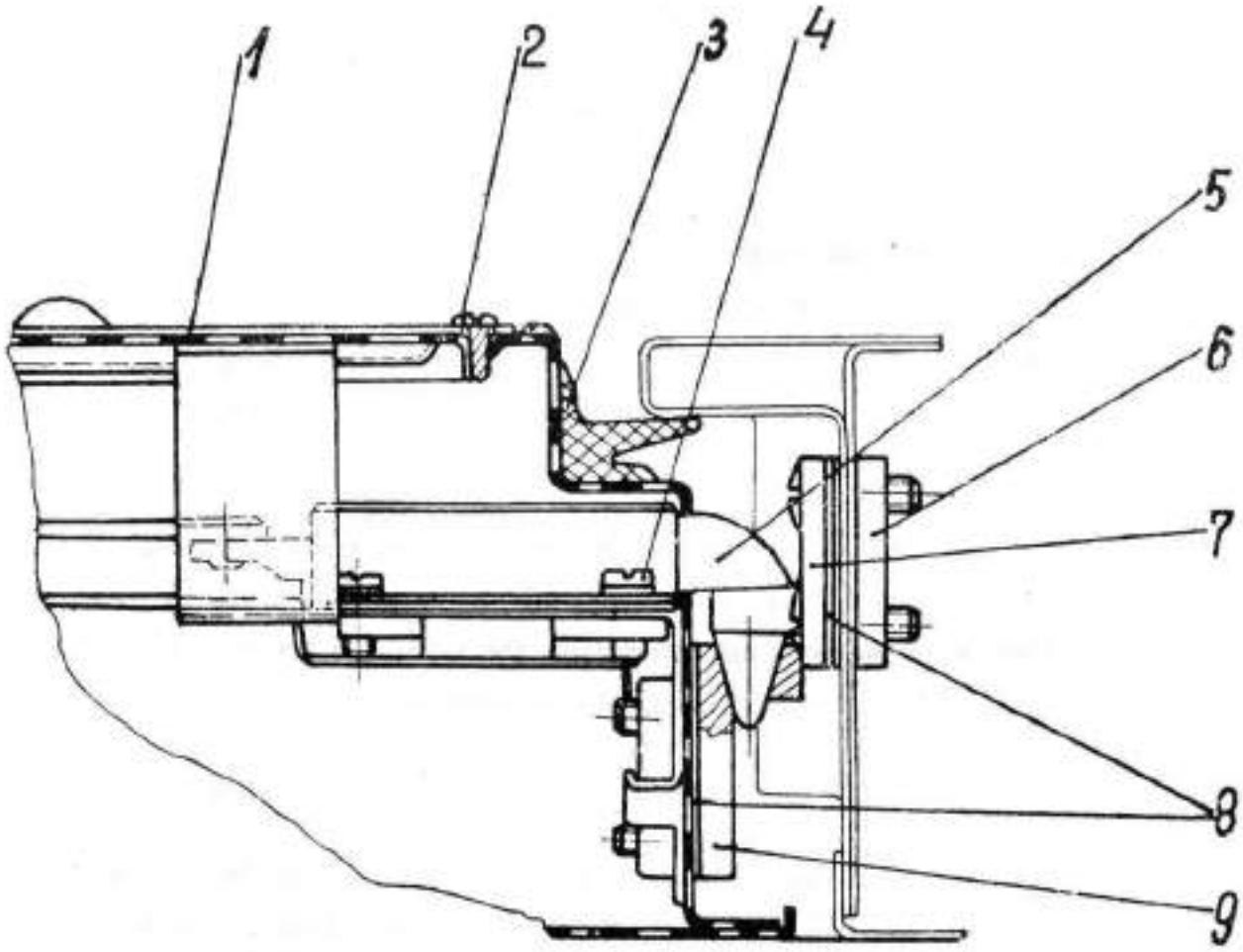


Fig.2.8. LOWER TAILGATE LOCKING DEVICE
1. Obturating cover; 2. Screw; 3. Weather strip; 4. Screw; 5. Locking device; 6. Threaded plate; 7. Wedged plate; 8. Adjusting spacer. 9. Wedged mobile bridle .

St. 2.0.56.01.6 LUBRICATING UPPER TAILGATE SUPPORTING DEVICE

- Lift up upper tailgate and lubricate with some drops of oil its supporting device, the latch and joints.

- Lubricate also the upper hinges.

- Remove excess of oill by wiping. De not let oil to flow on the painted surfaces.

- Do not lubricate the key lock to avoid its blocking, specially in winter, by freezing.

St. 2.0.63.01.7 DISMANTLING REAR DOOR UPHOLSTERY

- Draw out the buttons fastening the upholstery on the rear door; after that, remove the panels. By removing the buttons, draw out firstly the inner piece and then the outer one.

St. 2.0.63.01.8 LUBRICATING REAR DOOR LINKAGES

- Through the openings of the inner door panel lubricate, by means of a wooden spattle, without laying grease in excess, the mechanism of inner handle.

- Do not lubricate the key lock to avoid its blocking.

- Let some drops of oil upon the door hinges and door lock strikers.

OP. 2.1.34.04.0 OIL CHANGING IN THE STEERING GEARBOX
- VERSION BY DISMANTLING -

- Take down air cleaner from the car, according to Op. 2.1.08.01.2.

Since the draining of steering gearbox can be performed only through the filler plug hole and it is necessary to take down the steering gearbox, it is advisable to perform oil changing when the steerin gearbox is taken down for other maintenance operations also.

For taking down of steering gearbox there are necessary many preliminary operations, as: dismantling of drop-arm, electrical disconnecting of steering gearbox, undoing the joint with steering wheel axle.

St. 2.0.34.04.1 DISMANTLING THE DROP-ARM

- Remove th split pin and the nut, fastening the drop-arm.
- Mark the mutual position of the drop-arm and its shaft.
- Remove drop-arm by means of D.148 extractor.

By refitting take care to respect correct position of drop-arm on its shaft. By assembling drop-arm on shaft splines, use a rubber ot plastic hammer.

- Srew the nut with a socket wrench, up to refuse, and secure nut with a new 5.0 x 25 split pin.

St. 2.0.34.04.2 ELECTRICAL DISCONNECTING OF COLUMN

- Remove the split pin and the screw fastening stearing shaft in steering shaft flange.
- Mark mutual position between axle and flange, taking into account that the fastening screw passes partially through the steering shaft, securing position blocking, so that refitting in another position gets impossible.
- Loosen U-bolt fastening steering column on cowl.
- Loosen U-bolt fastening steering column on facia panel.
- By means of a rubber or plastic hammer blow slightly the joint of upper and lower steering shafts, until the splines of lower shaft come out from the flange.

On refitting performe the operatins in reverse order and use new splint pins.

St. 2.0.34.04.4 TAKING DOWN STEERING FROM THE CHASSIS

- Remove split pins securing the nuts which fasten steering gearbox.
- Unscrew the nuts, draw out the fastening bolts and remove steering

On remounting, performe the operations in reverse order and use new split pins.

St. 2.0.34.04.5 OIL CHANGING IN THE STEERING GEARBOX, BY DRAINING

- Remove the filling plug and let oil flow out until it will drop rarely.
- Pour fresh oil up to the filling hole edge and replace the filling plug, after having wiped it from impurities.

OP. 2.0.34.06.0 OIL CHANGING IN THE STEERING GEARBOX, BY MEANS OF A SONDE

- If in the workshop is available a sonde for drawing out oil from housings, annex at its end an elastic, plastics tube, which would allow its moulding inside of the gearbox.
- Remove filling plug, push in the hole the elastic tube, up to the lower place of the gerabox and draw out oil, until it will be delivered dropwise.
- Pour in fresh oil up to the filling hole edge and replace the filling plug, after having wiped it from impurities.

OP. 2.1.31.01.0 LUBRICATING FRONT WHEEL BEARINGS

As far as lubrication of bearing should secure grease penetrating between the rolling components, their greasing can be performed only by their dismantling from the wheel hub, respectively from the outside flange journal.

St. 2.0.31.01.1 TAKING DOWN THE WHEEL

- Lift the car using a jack, which, should be propped as indicated in fig. 2.9, until the wheel will rise 10...15 mm over the ground

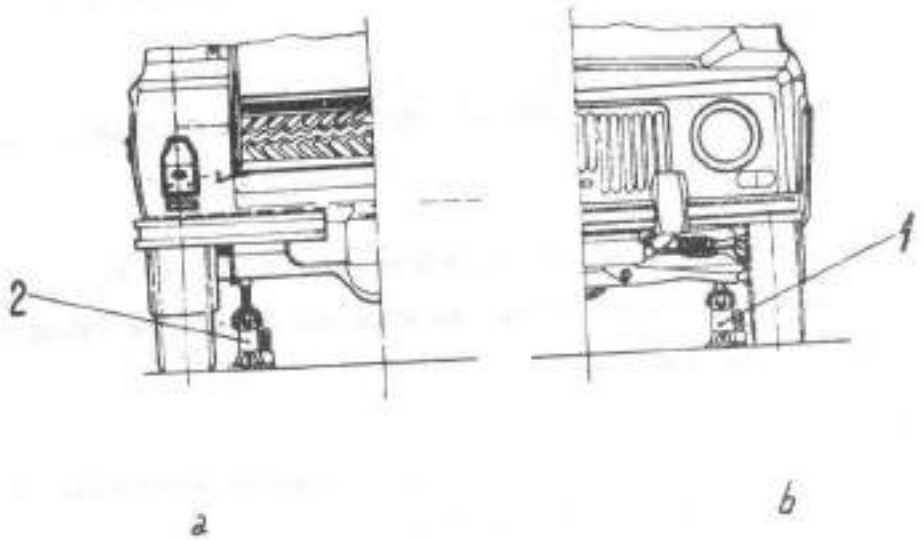


Fig. 2.9. FITTING HYDRAULIC JACK ON TAKING WHEELS DOWN
1. Fitting jack on taking front wheel down; 2. Fitting jack on taking rear wheel down.

- Unscrew the wheel nuts, by means of a pneumatic wrench (for M 14) or by means of the starting handle from the car's tool outfit.

- Remove the wheel (30 kg weight), lifting it slightly, in order to not damage the wheel bolts.

- On remounting the wheel performe the operations in reaverse order.

- On screwing back the nuts draw up firstly two opposite nuts, in order to secure correct seating on their tapered faces.

- During the definitive tightening, up to refuse, with the minimal force, by means of the starting handle, tighten each second nut rotating every time the wheel.

St. 2. 0. 31. 01. 2 STRAIGHTENING FRONT WHEEL DRIVING JOINT - VERSION WITH DRIVING BUSHING (CONNECTING FLANGE)

- Remove the hub cap.

- Remove the axle cap, by means of S.121 extractor, and the O-Ring seal (see fig. 2.10).

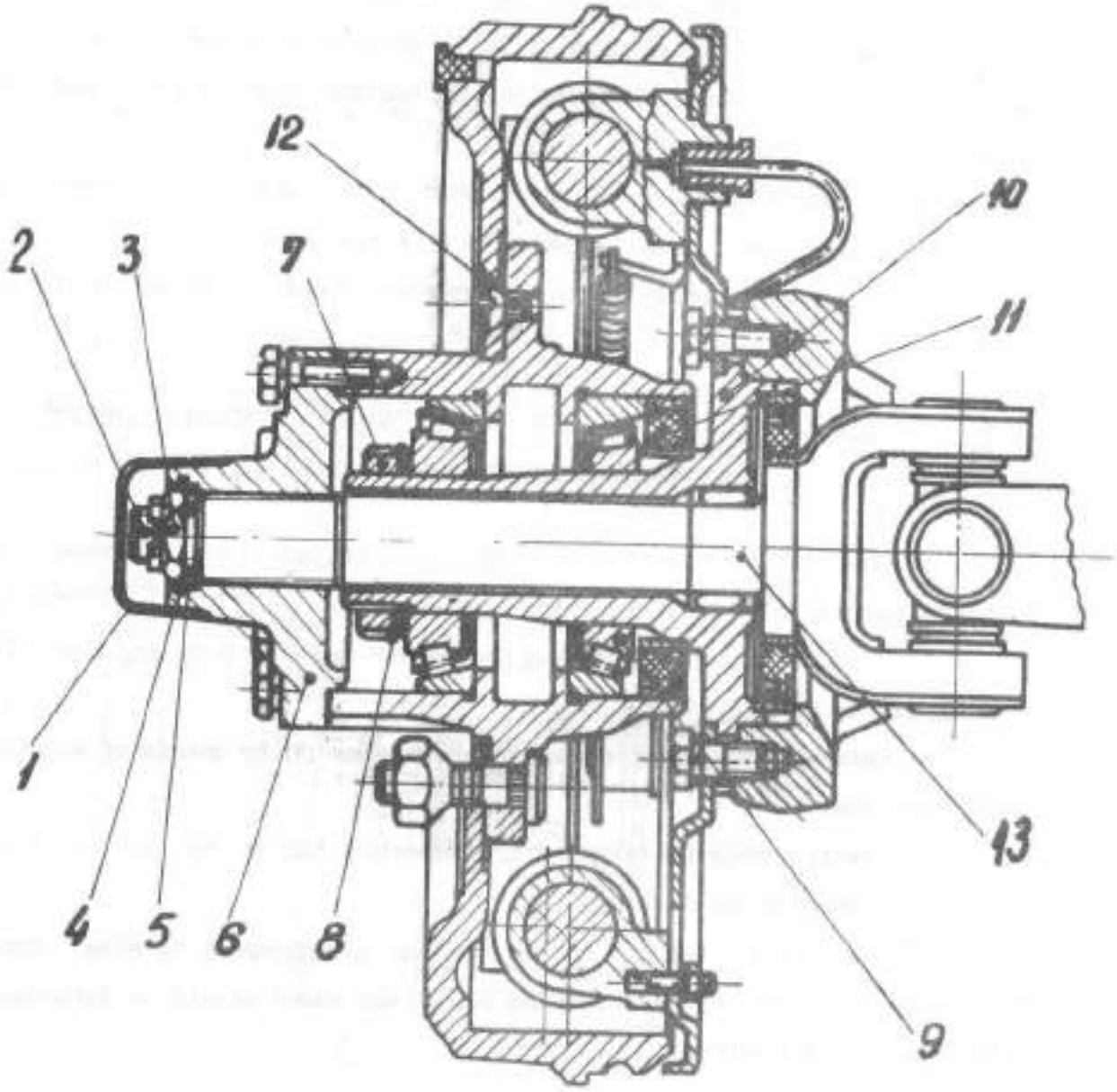


Fig. 2.10. FRONT WHEEL BRAKE DRUM KING PIN ASSY.
- VERSION WITH DRIVING BUSHING -
1. Axle protecting cap; 2. Split pin; 3. Nut fastening king pin; 4. Lock washer; 5. Thrust washer; 6. Driving bushing; 7. Bearing securing nut; 8. Bearing nut lock plate; 9. Inner bearing race; 10. Outer flange. 11. Oil sealing ring; 12. Brake drum fastening screw; 13. King pin.

- Remove the split pin, securing steering knukle nut.

- Unscrew the nut fastening driving bushing on steering knukle.

- Unscrew the bolts fastening driving bushing on brake drum and remove the bushing and gasket.

When reassembling, perform the dismantling operations in reverse order, and check if gasket is not damaged. Use a new split pin.

By fastening steering knukle nut the wheel should be turned in the inner limit position.

St. 2.0.31.01.3 DISMANTLING FRONT WHEEL DRIVING JOINT
- VERSION WITH FREE WHEELING FRONT HUBS -

- Unscrew bolts fastening the free wheeling hub cover and remove the cover (2) (see fig.2.11).

- Remove the split pin (5) and uscrew the nut (6), fastening the free wheeling hub on steering knukle (10).

- Remove snap ring (7) and thrust washer (8) by means of special S 102 nose pliers.

- Unscrew bolts (4) fastening free wheeling hub on the steering knukle (10) and remove it by axial sliding.

When refitting, perform the dismantling operations in reverse order, using a new split pin. By tightening the nut (6) the wheel should be deflected in the inner limit position.

St. 2.0.31.01.4 REMOVING FRONT WHEEL OBTURATING COVER
- VERSION WITH UNDRIVING WHEELS -

- Unscrew bolts fastening the obturating cover on the brake drum hub and remove the cover and its gasket.

When refitting check if the gaslet is not damaged.

St. 2.1.31.01.5 TAKING BRAKE DRUM HUB ASSY DOWN

- Undo lock plate securing nut which fastens the bearing and then uscrew the nut by means of special S 103 wrench.

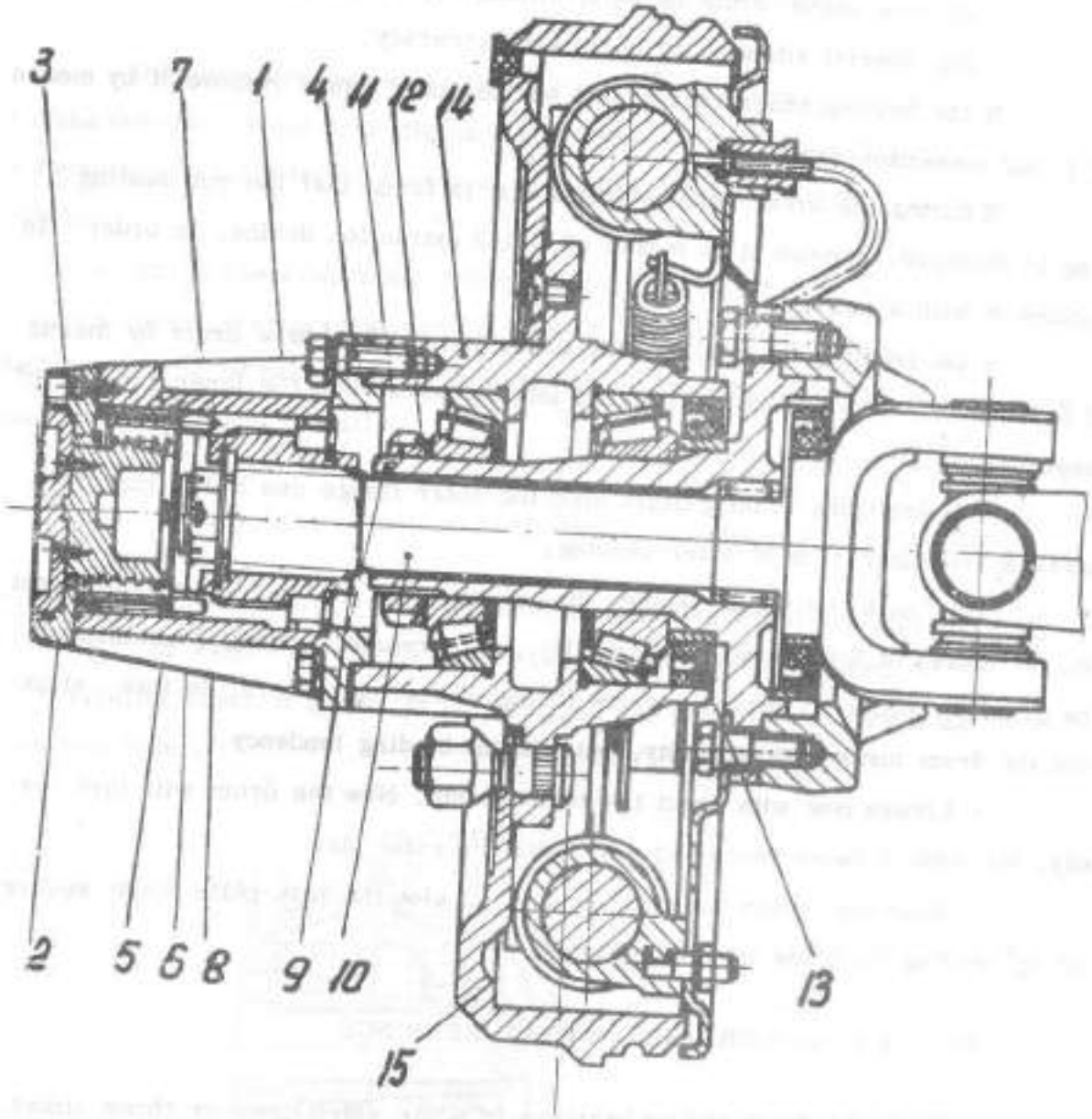


Fig. 2.11. FRONT WHEEL BRAKE DRUM GING PIN ASSY
- VERSION WITH FREE WHEELING HUB -
1. Free wheeling hub assy; 2. Free wheeling hub cover; 2. Fastening screw; 4. Bolt fastening free wheeling hub on wheel hub; 5.Split pin; 6. Nut fastening free wheeling hub on king pin; 7. Snap ring; 8. Thrust washer; 9. Outer flange; 10. King pin; 11. Nut securing wheel bearing; 12. Bearing nut lock plate; 13. Oil sealing ring; 14. Wheel hub; 15. Brake drum.

- Remove brake drum by axial sliding, by means of D 101 extractor.

- Pay special attention to operation accuracy.

If the bearing inner race is left on the outer flange remove it by means of D 102 extraction device.

If during the brake drum extraction it is found that the hub sealing ring id damaged, remove it by means of D 103 extraction device, in order to replace it with a new one.

- On refitting the sealing ring press it into the brake drum by means of S 106 mandrel, after having pressed into the wheel hub the inner race of inner bearing.

- On refitting braking drum upon the outer flauge use S 107 mandrel, pressing the inner race of outer bearing,

Put back the thrust washer (8) and snap ring (7) and tighten the nut (6), by means of S 103 wrench (manually), up to refuse, turning concomitantly the drum, in order to secure correct fitting of bearing rollers. In this situation the drum turns with difficulty, but without binding tendency.

- Loosen now with about 1/4 turn the nut. Now the drum will turn easily, but without being perceived any radial or axial play.

- When the loosen nut reaches with its slot the lock plate blade, secure nut by bending the blade into the nut slot.

St. 4.1.31.01.6 GREASING WHEEL BEARINGS

- Wash the drum and its bearings in white spirit, two or three times, each time with fresh solvent, in order ot remove any trace of grease. Pay special attention to operation accuracy and fire danger.

- Check with this occasion the bearing races and rollers for wear traces, such as: superficial exfoliations, fatigue craters, corrosions, tinges owing to unsatisfactory lubrication and overheating of bearings, in such cases the faulty bearings should be changed.

- Introduce, by means of a wooden spattle grease of prescribed quality, between the bearing races and rollers; grease in excess is not useful.

OP. 2.1.31.04.0 GREASING REAR WHEEL BEARINGS

This operation needs preliminary stages, as follows;

- Take down the wheel from de car, according to Op. 2.0.31.01.1.
- Remove wheel driving components, according to Op. 2.0.31.01.1, described
- below.
- Take drum & wheel hub assy, down according to Op. 2.1.31.01.5.
- Grease wheel bearings according to Op. 2.1.31.01.6.

Refitting should be performed in reverse order, by respecting the provisions mentionned for each operation.

St. 2.0.31.04.1 REMOVING DRIVING COMPONENTS OF REAR WHEELS

- Unscrew bolts fastening rear axle drive shaft on the wheel hub (see fig.2.12).
- Remove by axial drawing the drive shaft and the sealing gasket.

On refitting check if gasket is not damaged and perform the operations in reversre order.

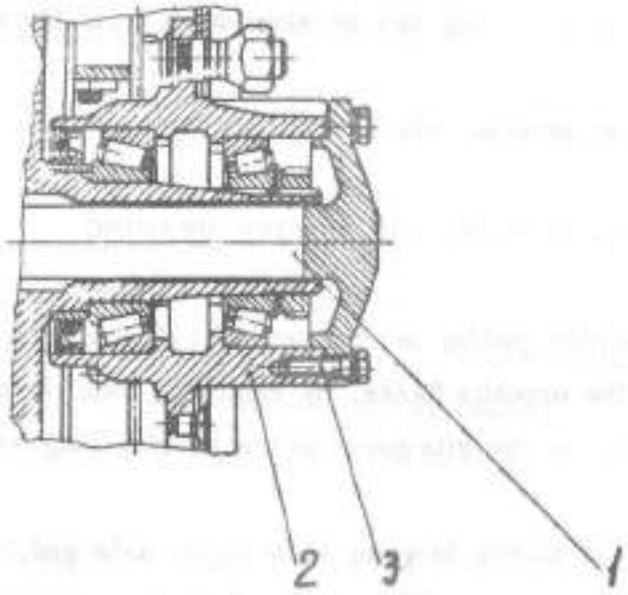


Fig.2.12. REAR AXLE DRIVE SHAFT FASTENING ON WHEEL HUB
1. Rear axle drive shaft; 2. Wheel hub; 3. Bolt fastening. drive shaft on wheel hub.

OP. 2.1.22.03.0 LUBRICATING PROPELLER SHAFT MIDDLE BEARING
(Only for ARO-320 pick-up truk)

To lubricate the propeller shaft middle bearing it should be taken down.

St. 2.1.22.03.1 TAKING MIDDLE BEARING DOWN

- Undo the blades of lock plates of the bolts securing propeller shafts on the middle bearing flanges.
- Unscrew bolts and remove propeller shafts.
- Remove wire lock and nut fixing washer from the middle bearing axle, on the rear axle side.
- Holding the opposite nut, unscrew the flange nut and remove the flange from the axle slots. Unscrew bolts fastening the cover on the bearing body.
- Undo split pins of the bolts fasteing the bearing cover on chassis cross-member.
- Loosen the nut and remove the bolts.
- Remove the bolts from the same side where was removed the flange.
  In this situation the middle bearing can be taken down from the chassis cross-member.
  Refitting is performed in reverse order, renewing the split pin.

OP. 4.1.22.03.2 GREASING THE MIDDLE BEARING

- Put the partially dismantled middle bearing into D-118 dismantling device and continue to dismantle the opposite flange, by removing lock plates and nuts.
- Unscrew bolts fastening the opposite cover on the bearing body and remove cover and oil seals.
- By means of a rubber or plastic hammer blow in the axle end, which will come out, on the opposite side, together with on of the two bearings (see fig.2)
- Wash dismantled parts 2 - 3 times in white-spirit, each time fresh, in order to remove completely any trace of old grease.

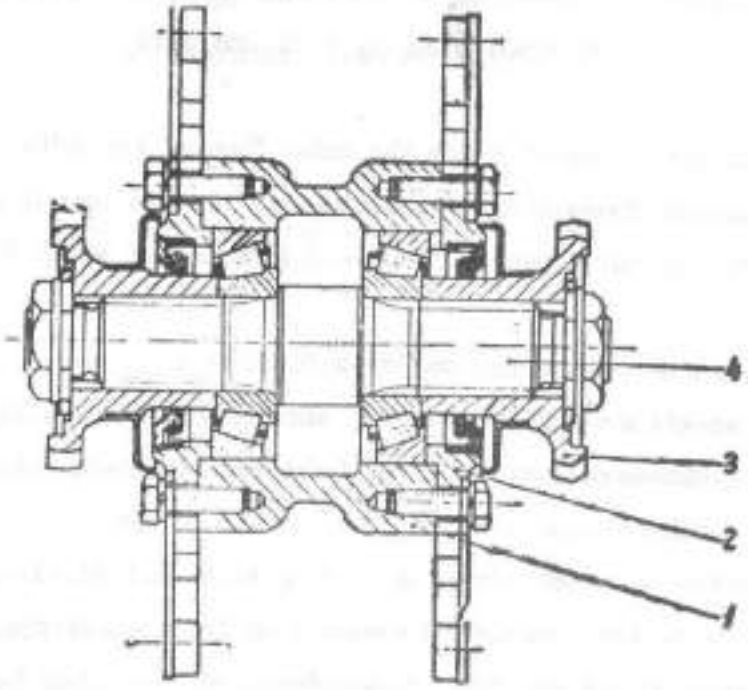


Fig. 2. 13. PROPELLER SHAFT MIDDLE BEARING

1. Middle bearing body; 2. Bearing fastening flange;
3. Connecting flange; 4. Middle bearing shaft.

- Before greasing check oil seals and bearings, for wear, pinches, respectiyely the bearings for superficial exfoliations, fatigue craters, corrosions, tinges due to unsatisfactory lubrication and overheating.
- Perform greasing so that grease penetrates between the rollers, up to the bearing races.

  Grease in excess leads to unsatisfactory lubrication.
- Replace the parts with traces of wear.
- Perform refitting in reverse order.

OP. 2.1.30.01.0 LUBRICATING NEEDLE BEARING INSIDE OUTER FLANGE (see fig. 2.10 and 2.11)

- The needle bearings, mounted inside the outer flange, are difficult of access, and need successive dismantling of some assemblies, so that it is advisible to performe this operation concomitantly with greasing of wheel bearings. For this:
- Take the wheels down, according to Op. 2.0.31.01.1.
- Remove front wheels driving components, according to Op. 2.0.31.01.2 or Op. 2.0.31.01.3. By the cars with undriving front axle the needle bearings do not exist in the outer flange.
- Take drum wheel hub assy down, according to Op. 2.1.31.01.5.

All these operations are common for greasing of front wheel bearings.

- Take brake anchor plates and outer flange down, as described below.

On refitting performe the operations in reverse order.

St. 2.1.30.01.1 TAKING BRAKE ANCHOR PLATE OUTER FLANGE DOWN; GREASING NEEDLE BEARING OF OUTER FLANGE

This operation is preceded by those mentionned in Op. 2.1.30.01.0.

- Undo connection between brake cylinder and brake hose. Put before, under the wheel, a tray to collect brake fluid which eventually would flow out from the hose.
- Unscrew bolts fastening brake anchor plate and outer flange on the steering knukle (see fig. 2.10). Remove brake anchor plate.
- Draw out axially, from the axle shaft, the outer flange in which is pressed the needle bearing.
- Wash outer flange 2 - 3 times in white-spirit, each time fresh, in order to remove completelly the old grease.
- Put in the needle bearing fresh grease up to the rollers top.
- Check on this occasion the oil seal condition and replace it if there are faults upon the sealing edge. The operation should be performed with special care

concerning its accuracy, as far as the needle bearing is open.
Refitting should be performed in reverse order.
- After refitting performe the brake system bleeding, according to Op. 2.0.35.02.0 indications.

2.2. MECHANICAL MAINTENACE

Mechanical maintenance consists in periodical inspection of various assemblies of the car and changing in due time the worn-out parts and those which are important for car operation safety. The mechanical maintenance has the same periodicity as the lubrication operations. So both of them could be performed in the same time. The car maintenace should be performed according to coded operations.

2.2.1. ARO L-25 ENGINE MAINTENANCE

OP. 2.0.01.06.0 CLEANING OIL FILTER

Filter element clesning is performed on occasion of oil changing in the engine bath - namely, once on every second oil changing.
The operation is performed on the ground,with access under the engine bonnet, after having put a tray under the oil filter area.
Unscrew oil filter center shaft (see fig. 2.15 - indicated by arrow), and remove filter box and filter element.

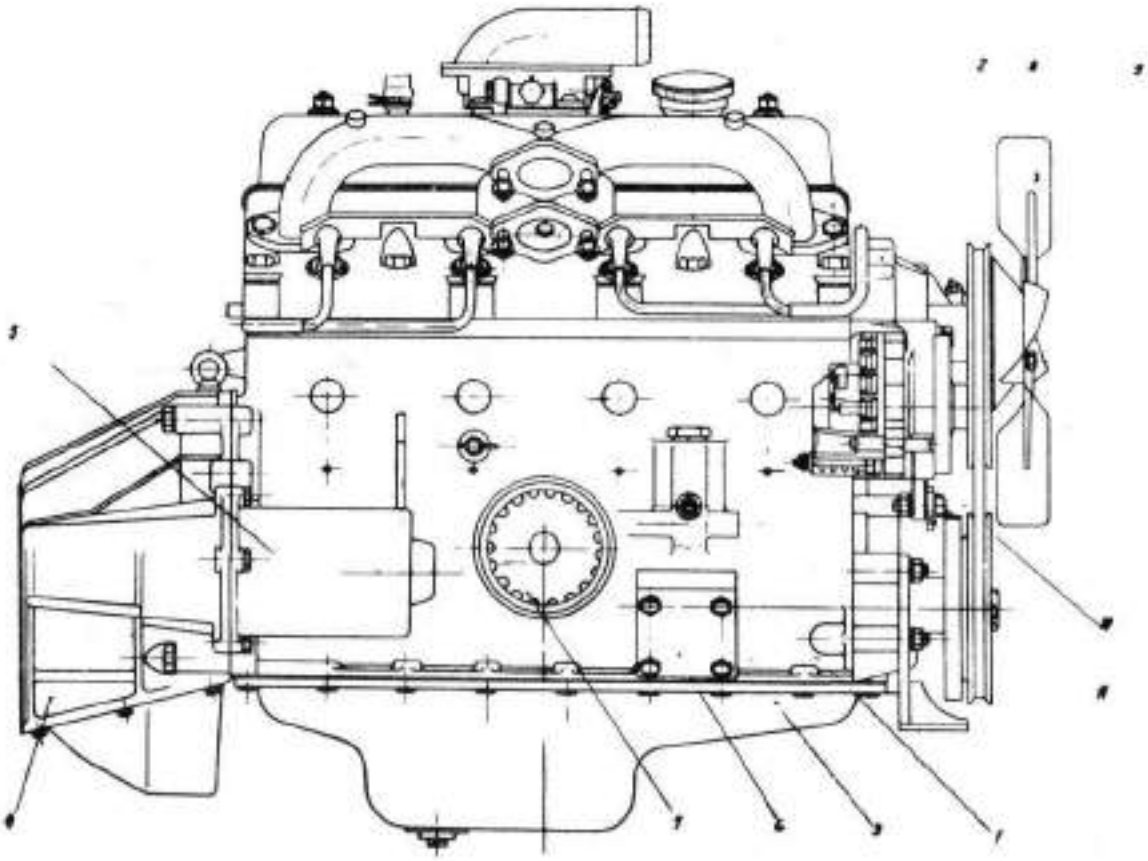


Fig. 2.14. ARO L-25 ENGINE

1. Cylinder block; 2. Cylinder head; 3. Oil bath; 4. Clutch housing; 5. Starting motor; 6. Oil pump; 7. Oil filter; 8. Water pump; 9. Cooling fan; 10. Alternator; 11. Timing gear cover.

- After having taken all necessary countermeasures against fire, wash filter element and filter box, 2 - 3 times, in fresh solvent (white-spirit) or gasoline).

  In case that box gasket is deformed, or damaged (has fissures, pinches, etc) change it with a new, original one.

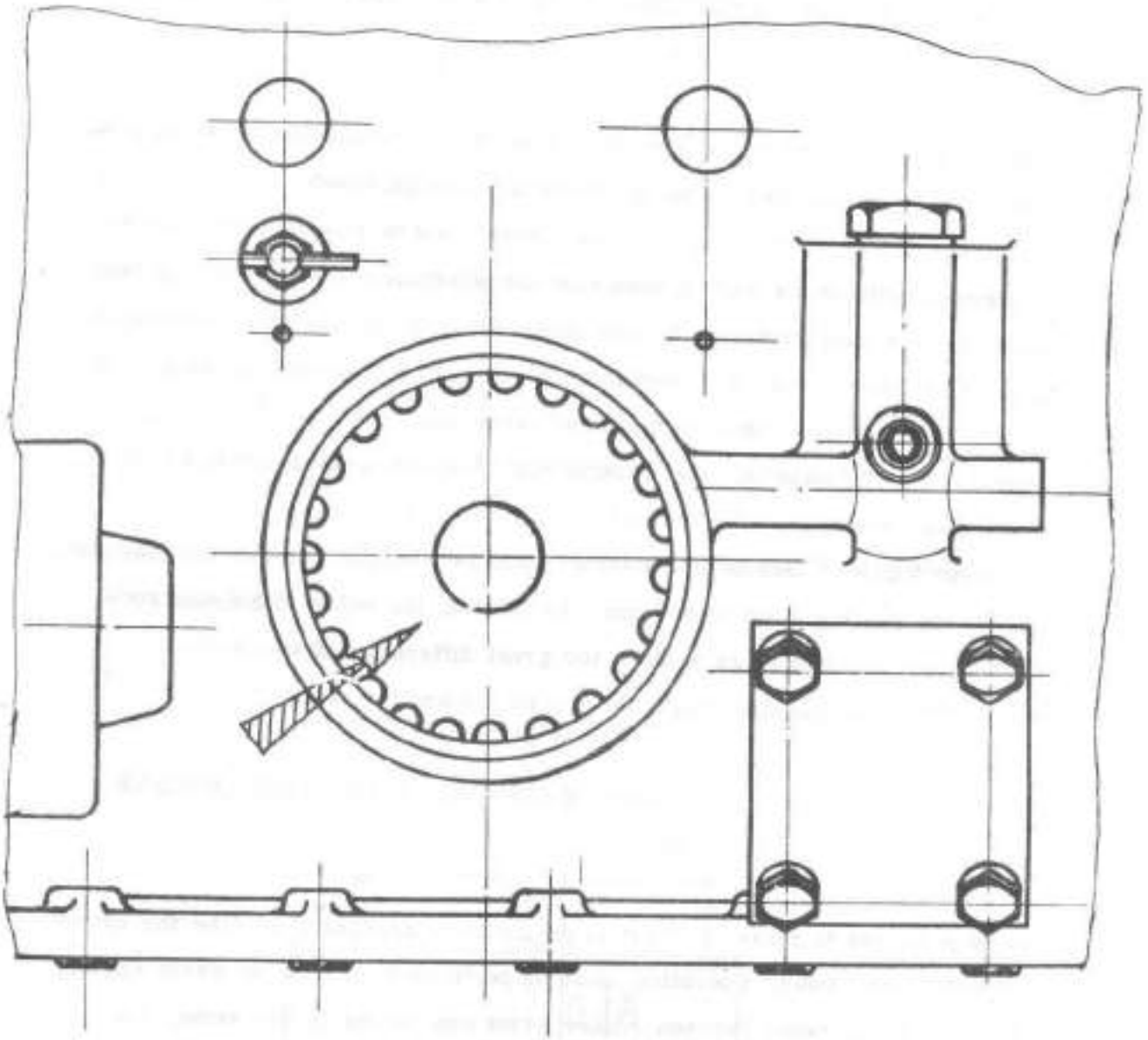


Fig. 2-15. ARO L-25 ENGINE OIL FILTER
(indicated by arrow)

Refit oil filter in reverse order.

The filter center shaft should be tightened with a torque of 2.5 - 3.5 daN.m.

OP. 2.0.01.07.0 CHECKING, EVENTUALLY ADJUSTING SPARKING PLUGS

- After having removed ignition wire set, clean area around the spraking plugs with a jet of compressed air or by means of a rough brush.
- Unscrew sparking plugs using only the special spark plug wrench existing in the tool outfit of the car. In case that the sparking plugs have no faults which require their replacing by new plugs (fissured insulation, loosened insulation in metal fiting or melted ignition pin), clean the plug working end by means of a wire brush and adjust the spark gap.
  Normally, on dismantling, the working end of sparking plugs must be clean, dry and the spark gap of 0.7 mm.
- Check spark gap by means of the feeler gauge. If the gap does not correspond, reduce the spark gap up to 0.7 mm, by bending the outer mass electrode.
- On refitting sparking plugs avoid a too great difference of temperature, between engine and sparking plugs (the engine hot and the plugs cold).

OP. 2.1.01.08.0 CHECKING, EVENTUALLY ADJUSTING ROCKER ARMS

To have access to rocker arms it is preliminary necessary to take the cylinder head cover down. Operation could be performed on cold or warm engine, because the clearance between rocker arms and valves is the same, i.e. 0.45 mm.

St. 2.0.01.21.1 TAKING DOWN CYLINDER HEAD COVER

- Undo the connection between air cleaner and cover connecting socket.
- Unscrew the hemispherical nut from the cylinder head coverand remove then the flat washer and rubber gaskets.

- Remove cover from stud bolts, payng attention to not damage cylinder head cover gasket. Dismantled parts should be sheltered from impurities.
- On refitting the cover performe all operations in reverse order.
- Tighten the two nuts with a torque of 2,5 - 3,5 daN.m.

St. 2.1.01.08.2 ADJUSTING CLEARANCE BETWEEN VALVES AND ROCKER ARMS

This operation is performed after removing cylinder head cover, according to Op. 2.0.01.21.1.

A well determined clearance between valves and rocker arms has a great importance for correct engine operation.

- Crank the engine, by means of the starting handle, two or three turns to rid the tappets, push rods and adjusting screws of superfluous oil.
- Turn still the crankshaft, following this time with attention untill the mark "0" on damper of crankshaft pulley falls in line with timing pointer (see fig. 2.16) and the valve No.1 (counted from the front of the car) is in opened position (descended).

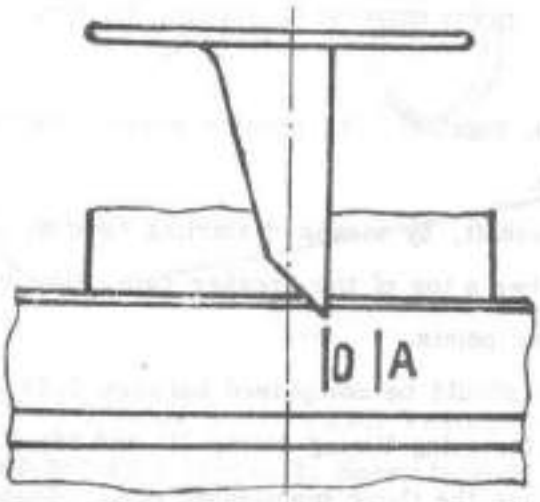


Fig.2.16. CORRECT CRANKSHAFT POSITION AGAINST THE TIMING POINTER, ON ADJUSTING VALVE CLEARANCES.

In this situation No.4 piston nears end of compression stroke and the clearance of valves I.4, I.2, E.3 and E.4 (I- inlet, E- exhaust valve), respectively, in numbering order, the valves 3, 5, 7 and 8, should be 0.45.mm.

- The clearance is checked by means of the feelre gauge, introducing between the valve shaft the blade of 0.45 or the adjacent one.
- Turn again the crankshaft with 360° more, untill the mark "0" falls again in line with timing pointer.
- In this position check the clearance of valves I.1, I.3, E.1 and E.2, respectively the valves nr.1, 2, 4 and 6.
- In case that the clearance of some valves does not correspond with indicated value, perform consectuively clearance adjusting, as followe:
- Slacken special nut/locking the adjusting screw (1) and by means of a screwdriver turn adjusting screw till required 0.45 mm clearance is obtained (see fig.2.17). The clearance should be measured with a feeler gauge.
- Lock adjusting screw by tightening special nut (2).
- After locking nut check clearance anew.

OP 2.0.01.09.0 CHECKING, EVENTUALLY ADJUSTING IGNITION DISTRIBUTOR BREAKER POINTS GAP

- Remove distributor cap, together with ignition wires, distributor rotor and vacuum connecting tube.
- Rotate slowly the crankshaft, by means of starting handle, untill the insulated breaker arm heel reaches a top of the breaker cam. Now we have the maximal gap between breaker points.
- In this position the gap should be comprised between 0.35 and 0.45 mm, if not, slacken screw (4) fastening timing clamp (1) and adjust its position, untill the points gap reaches the above mentionned value. Check gap by means of feeler gauge blades (see fig.2.18).

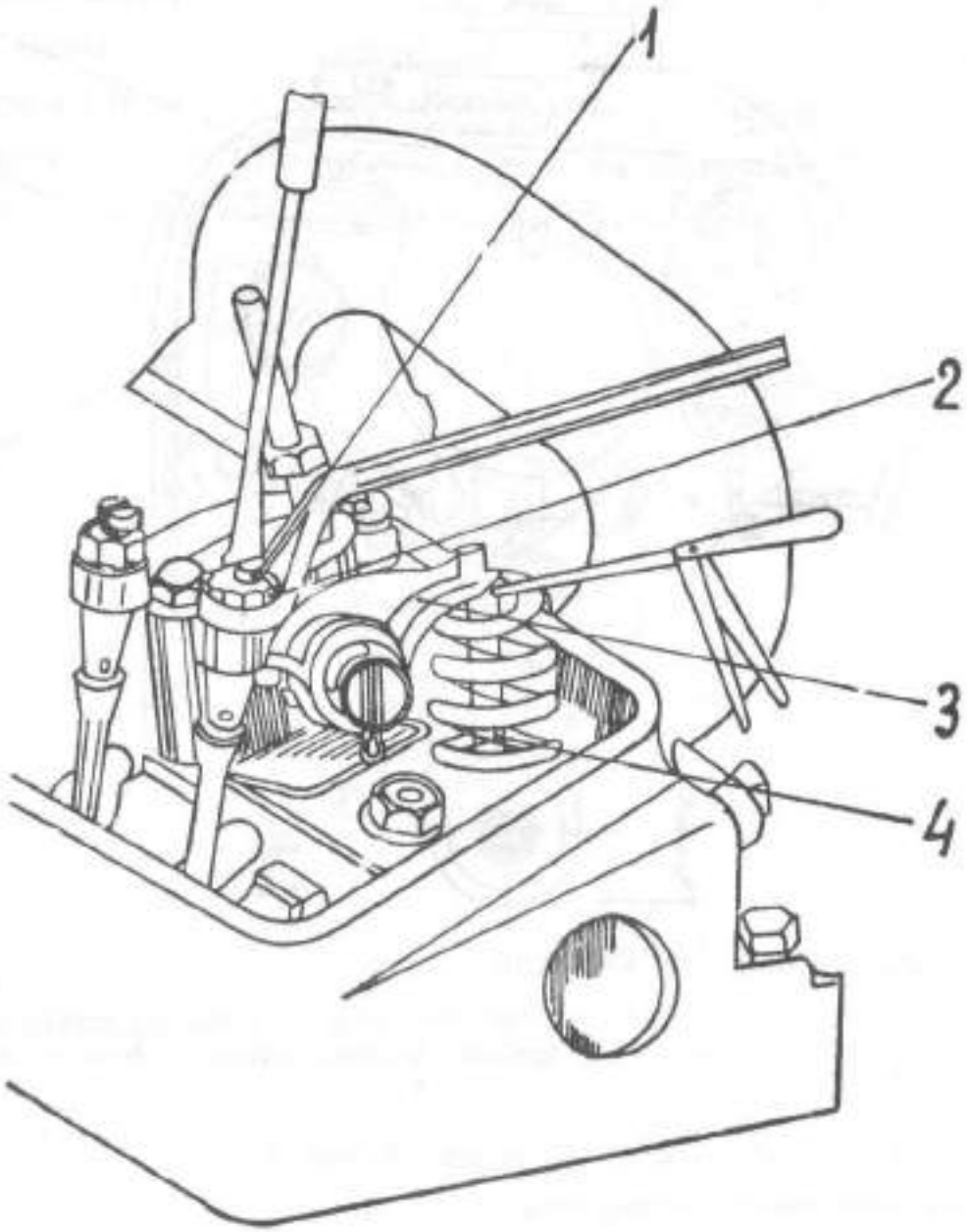


Fig. 2.17. ADJUSTING CLEARANCE BETWEEN VALVES AND ROCKER ARMS.

1. Clearance adjusting screw; 2. Screw locking nut; 3. Rocker arm; 4. Valve shaft.

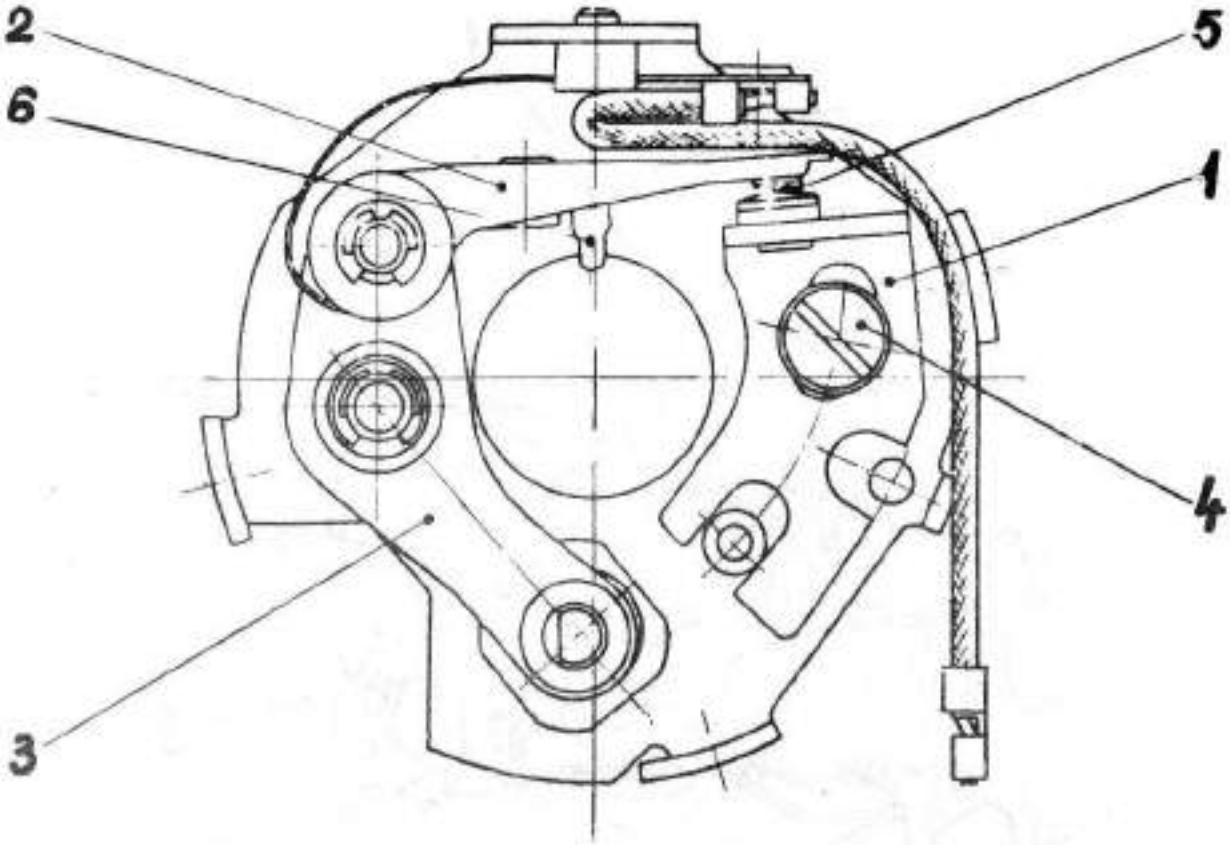


Fig.2.18. IGNITION BREAKER MECHANISM.

1. Fixed point plate; 2. Breaker point arm; 3. Adjusting mobile plate; 4. Adjusting screw; 5. Ignition breaker points; 6. Breaker arm heel.

- Retighten screw (4) of timing clamp, in order to lock it.

Refitting is performed in reverse order.

- Check finaly if ignition wires are correctly connected in the distributor cap.

OP. 2.0.01.10.0 CHECKING, EVENTUALLY CORRECT STRETCHING OF THE FAN V-BELT

- After a mileage of about 6.000 km, before starting for a new journey, lift engine bonnet and check fan V-belt tension (see fig.2.19). The belt may be considered rightly stretched, when on being depressed with a 3 - 4 kg force.

between alternator and water pump pulley (1 and 2 - fig.2.19), its dip does not exceed 10 - 15 mm.

- If the dip is greater, loosen the bolts fastening the alternator and by deplacing outwards, by means of a tyre lever, the alternator, try to obtain correct dip. In this position tighten the bolts fastening the alternator.

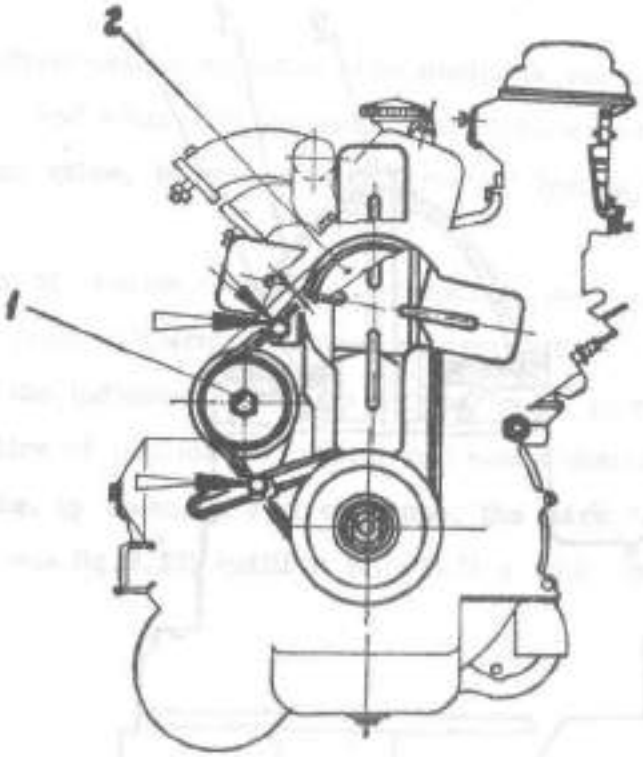


Fig.2.19. ADJUSTING THE FAN V-BELT STRETCHING
1. Alternator pulley; 2. Water pump pulley.

OP. 2.0.01.11.0 CHANGING OIL FILTERING ELEMENT

- The operation is the same as that for cleaning oil filter (see op.2.0.01.06.0), with the difference that the filtering element is no more washed but replaced by a new, original one.

OP. 2.0.01.12.0 CLEANING FUEL PUMP FILTERING ELEMENT

- Unscrew bolt (2), fastening filter cover (3) (see fig. 2.20), and remove successively: pump filter cover, sealing gasket and filtering strainer (3).
- Clean filtering strainer from impurities, by washing it 2-3 times in clean gasoline (pay special attention for avoidning fire danger).

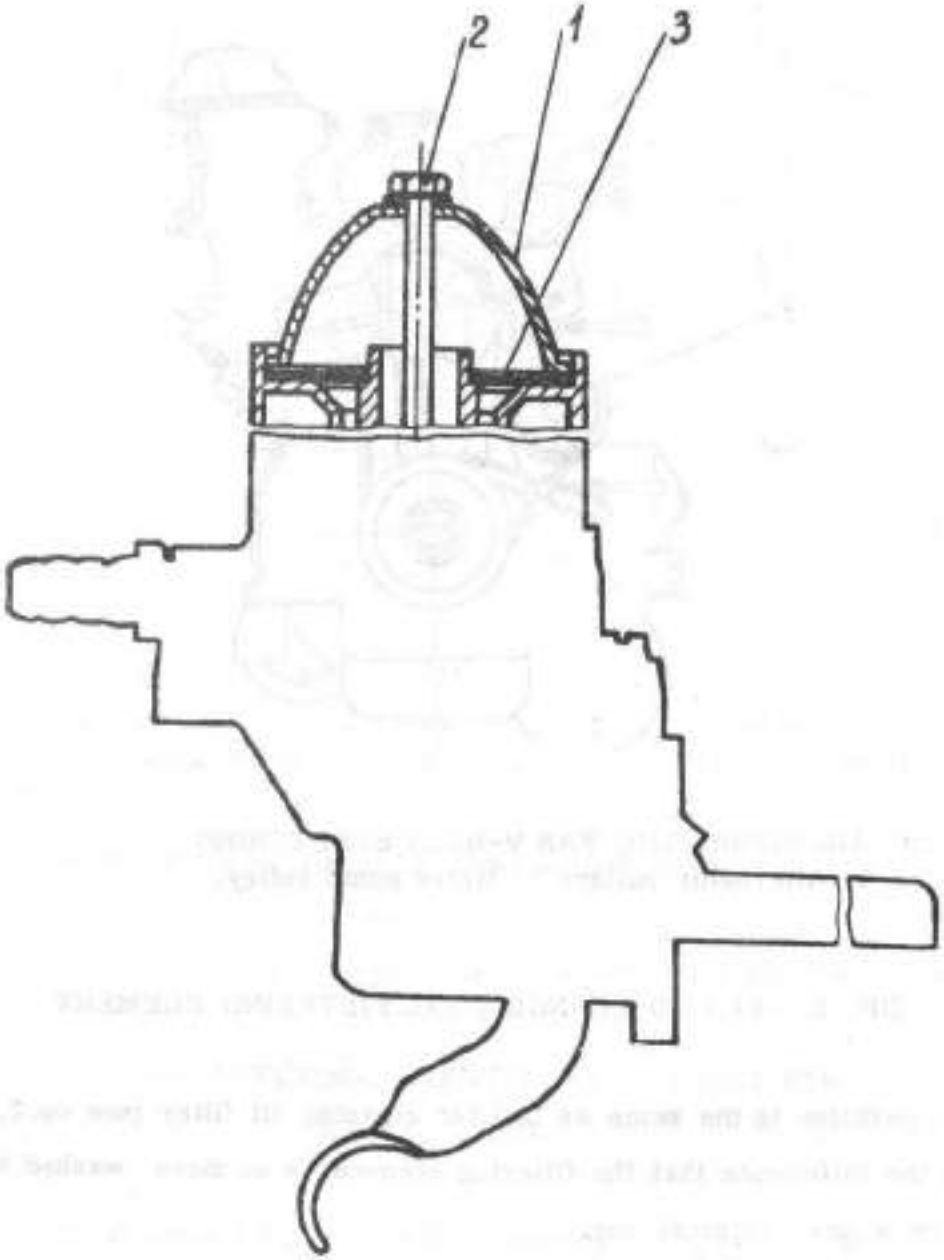


Fig. 2.20. FUEL PUMP
1. Fuel pump strainer cover; 2. Cover fastening bolt; 3. Fuel filtering strainer.

- Dry filtering strainer by blasting it with compressed air.
- Finaly inspect it against light for eventualy impurities.
- Refit all in reverse order.

OP. 2.0.01.13.0 CHECKING AND EVENTUALLY ADJUSTING IGNITION DISTRIBUTOR OCTANE SELECTOR

- Check and adjust octane selector when engine is running at a speed of about 1.600 r.p.m. and when vacuum controlled advance is disconnected.
  The measured value, by means of electronical testing equipment, should be 16...18°.
  Disconnecting of vacuum controlled advance is carried out by removing connecting hose from distributor vacuum control unit.
- In case that the indicated value can not be found, loosen flange for adjusting angular position of ignition distributor and rotate distributor, observing in the same time, by means of a stroboscope, the mark "A" on damper of crankshaft pulley (see fig. 2.21) until it falls in line with timing pointer.

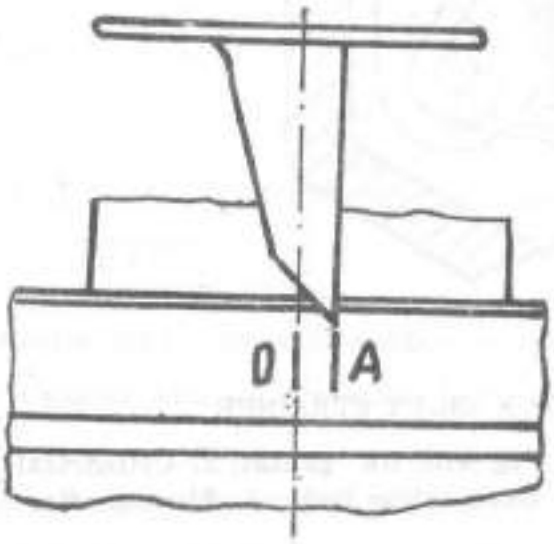


Fig. 2.21. ADJUSTING IGNITION TIMING BY ARO L-25 ENGINE

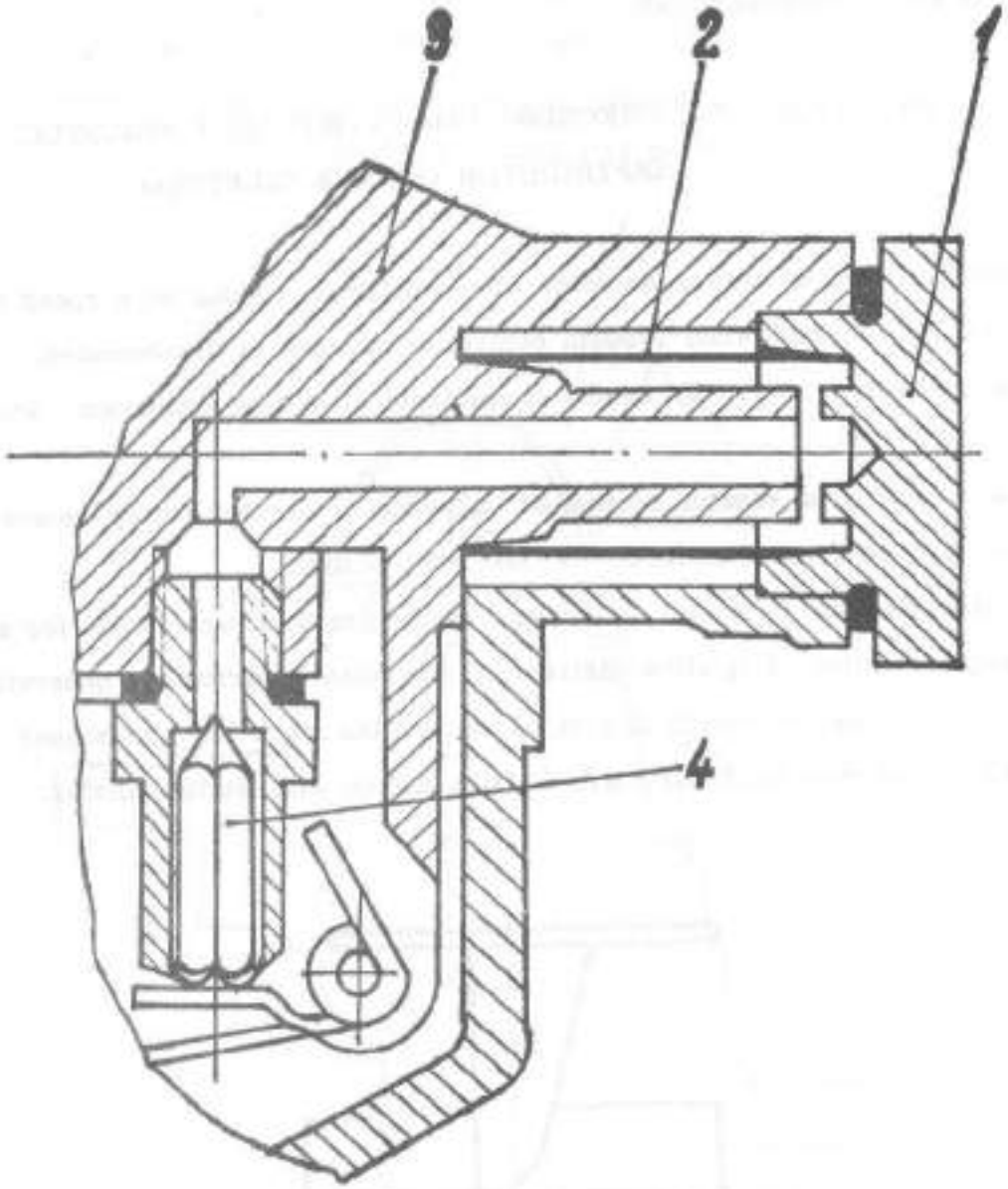


Fig. 2.22. CARBURETTOR INLET STRAINER

1. Strainer plug with its gasket; 2. Cylindrical gauze strainer; 3. Carburettor body; 4. Float needle.

- In so adjusted position tighten the screw fastening the distributor flange and refin connection with vacuum control unit.

OP. 2.0.01.14.0 CLEANING CARBURETTOR INLET FILTER (STRAINER)

- Remove the plug near the carburettor feeding pipe.
- Carefully remove the cylindrical gauze strainer, checking in the same time if gasket or strainer are not deformed of fissured and it the sealing surface has no blows (see fig.2.22).
- Wash filter strain 2 - 3 times in clean, fresh gasoline (pay special attention for avoiding fire danger).
- Check against the light if in the screen meshes are still fixed impurities.
- Performe refitting in reverse order, according special attention for fitting strain, protecting bush and sealing gasket, in order to avoid deforming of respective components.

OP. 2.0.01.15.0 CLEANING CARBURETTOR JETS

For cleaning carburettor main and idle jets it should be removed air connection elbow (adapter), which is consected with air cleaner. So you will get access to the main and idle jets, (1) and (2) - fig.2.23.

St. 2.0.01.15.1 DISMANTLING AIR CONNECTION ELBOW OF CARBURETTOR

- Unscrew nuts fastening the air connection elbow on carburettor.
- Remove the elbow together with air connecting hose, to get access to the jets area.
- Pay special attention for performing this operation with the most accuracy, because penetrating of solid impurities into carburettor, respectively into mixing chamber can lead to heavy damages of carburettor or of engine itself.

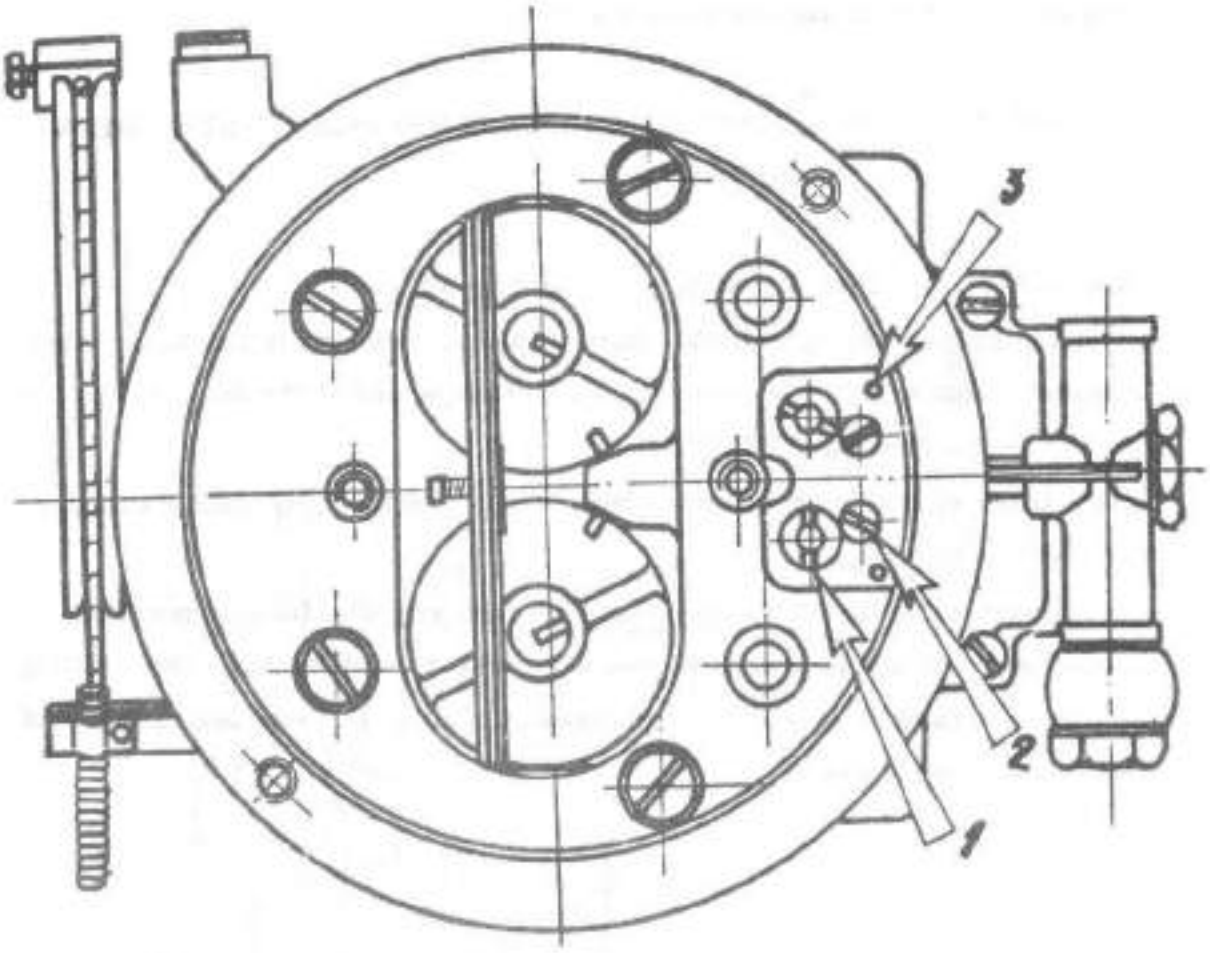


Fig. 2.23. ACCESS TO CARBURETTOR JETS

1. Main jet; 2. Idle jet; 3. Idle speed air bleed.

- Perform refitting in reverse order.

St. 2.0.01.15.2 MAINTENCE OF JETS

Under the air connection elbow, in the feeding socket area, there are the two main and the two idle jets. (see fig. 2.23).

- Unscrew with attention all four jets, without forcing them, and clean them by washing, 2 - 3 times in fresh gasoline. Pay special attention for the counter measures against fire danger!

- Dry jets by blasting with compressed air.

  WARNING: In case of a correcf maintenance the jets have practically an unlimited endurance!
- If impurities cannot be removed by washing and air blasting, use soft wooden small sticks, of suitable shape.

  WARNING! Do not use any other materials, which will cause jet decalibration, with utmost unfavourable consequences concerining the engine operation and fuel consumption, needing finaly their replacement.
- Refitting is performed in reverse order.

OP. 2.0.01.16.0 WASHING CYLINDER HEAD COVER FILTER

- For this it is necessary to remove cylinder head cover, according to 2.0.01.21.1.
- Wash cover inside with gasoline or white-spirit, taking firstly all counter-measures against fire danger.
- Remove wires fastening the wire net filter on the oil filler and remove the filter.
- Wash filter 2-3 times in fresh gasoline, in order to remove completely all impurities,
- Refit filter in the cover oil filter, fastening it with wires at its ends, in order to not let it get out accidentally.

OP. 2.0.01.17.0 CHECKING CYLINDER HEAD FASTENING

This operation is to be performed when the engine cold, concomitantly with washing of cylinder head cover filter, when the cover is removed and you have access to the bolts fastening cylinder head.

- Firstly check tightening of the 10 bolts, by means of a torque wrench in the sequence recomended in fig.2.24, at a torque of 7.4 daN.m. (see fig.2.24).
- Repeat the checking at a torque of 12 - 13 daN.m (kg).

- In case that some bolts have been found loosen at this torque, mark them for next inspection and then tighten them at the indicated torque.

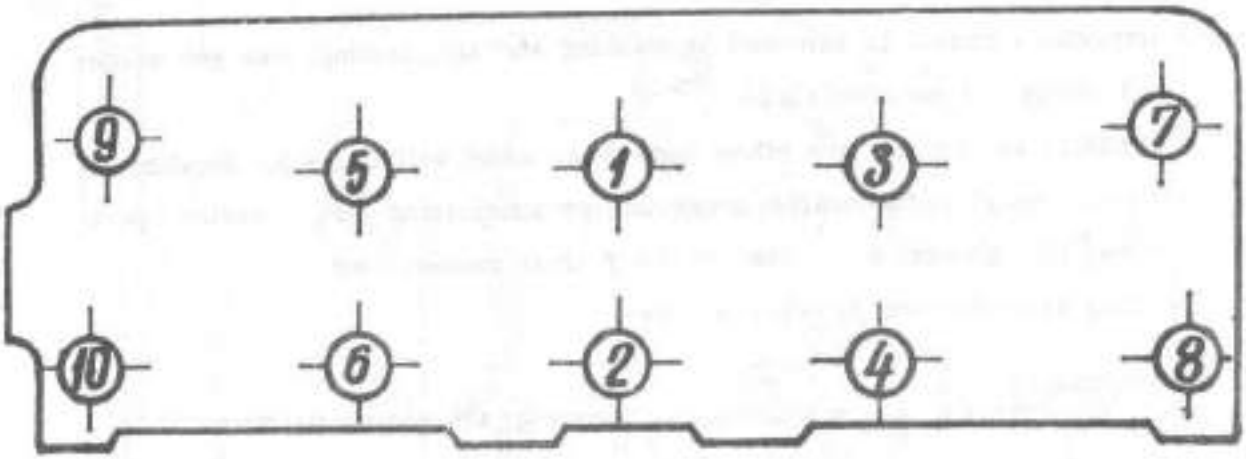


Fig. 2.24. CYLINDER HEAD BOLTS FASTENING ORDER.

- Replace the cylinder head cover, in accordance with Op. 2. 0. 01. 21. 1, start the engine and let it run half an hour at a low speed (about 1,200 r.p.m.).
- When the engine got warm, remove again the cylinder head ccover and repeat the tightening at a torque of 12-13 daN.m. - this time with the engine warm.
- Reassemble the cylinder head cover.

  In case that on a new checking the same bolt is found loosen - a little probable situation - it means that this bolt suffered the steel flow phenomenon and must be replaced with a new bolt.

OP. 2.0.01.18.0 CHECKING IGNITION WIRE SET OF ENGINE

- Remove ignition wires from distributor and check their terminals condition. If they have impurities or traces of oxidation, clean them with fine emery paper.
- Refit ignition wires on distributor, taking care for ignition order.

OP. 2.0.01.19.0 REPLACING SPARKING PLUGS

- Perform necessary operations as described in Op. 2.0.01.07.0, with the only difference that the replaced sparking plugs should have the same thermal value.

OP. 2.0.01.20.0 CHECKING ALTERNATOR

- The operation should be performed when engine is stoped.
  It is not allowed any intervention on alternator or on its connections with the engine electric equipment, when engine runs, because it can damage the alternator.
- Check condition of all connections, which should be stiff and without oxidations. In contrary case, remove them and clean them slightly with fine emery paper, up to clean metal. Then refit them.
- Dismantle brush-holder assy, and clean it from powder, by means of a rough brash. The wear limit of brushes is 6 mm. and when this size is reached, replace brushes.
- Refit brush-holder assy on alternator.

OP. 1.0.01.22 ADJUSTING CARBURETTOR FOR INDLING SPEED

This operation can be carried out by means of an electronic testing equipment or by a skiller worker having sufficient experience.
The adjusting is performed when engine is in its normal thermical operation, and when accelerator pedal is free.

- Operating the butterfly adjusting screw (1) (see fig. 2.25), adjust engine speed at about 750 r.p.m.
- Screw completely the R.H. idle mixture adjusting screw (2) and then unscrew it 1- 25 turns.
- Repeat the same operation with the L.H. idle mixture adjusting screw.

Unscrewing of both adjusting screws is performed between the two indicated limits untill an uniform running of engine is obtained.

- After that, operate again the butterfly adjusting screw (1), untill the engine speed of 750 r.p.m. is obtained.

OP. 2.0.37.04.0 CHECKING STARTING MOTOR CONNECTIONS

- Check starting motor connections which should be stiff and without impurities or any oxidation.

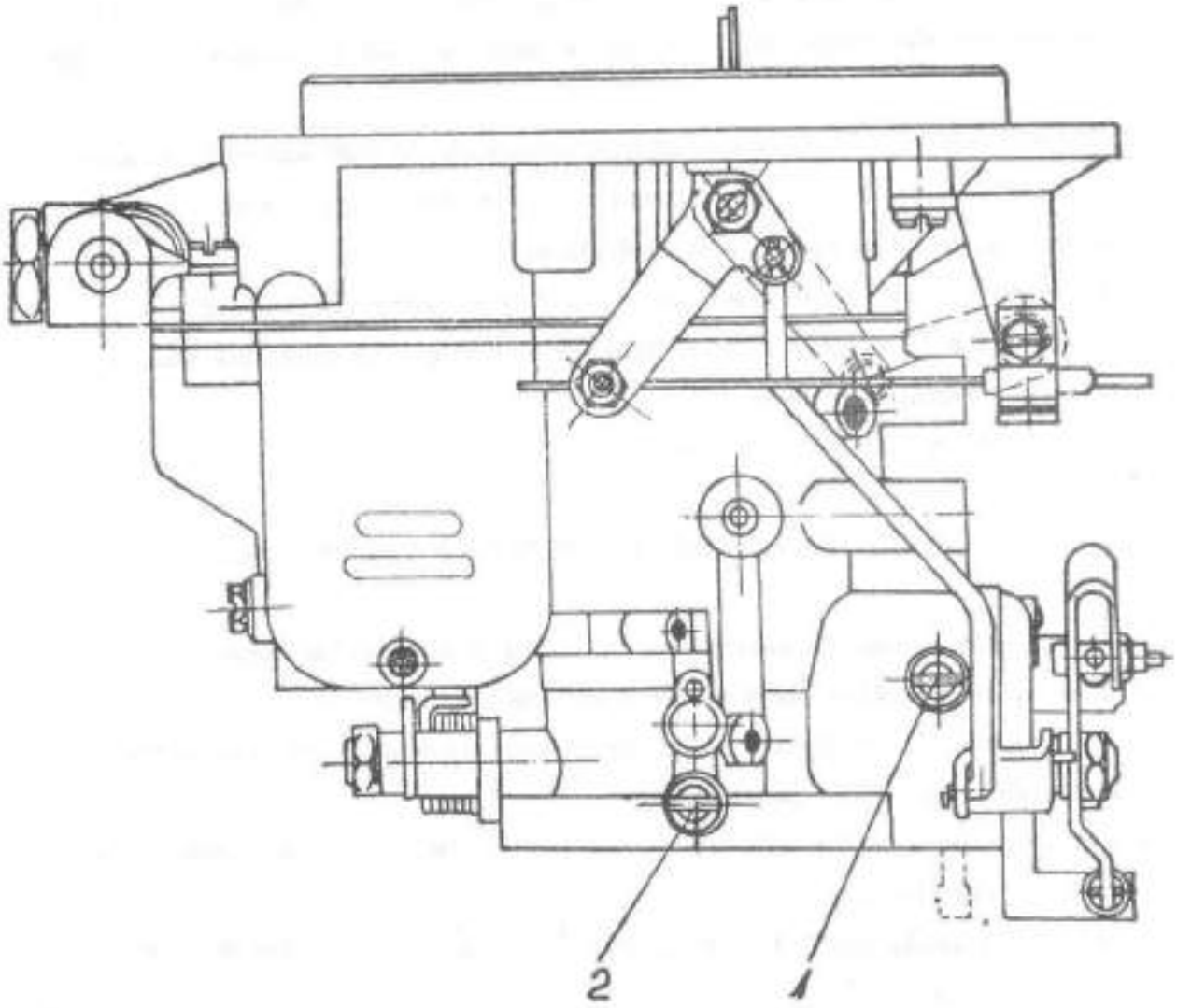


Fig. 2.25. LOCATION ON CARBURETTOR OF IDLE SPEED ADJUSTING SCREWS.
1. Butterfly adjusting screw; 2. Idle mixture adjusting screw.

- If necessary, undo connection from motor terminal and clean the components up to clean metal, using a fine emery paper.
- Refit connection, tightening well respective nut.

OP. 2.0.37.05.0 CHECKING STARTING MOTOR COMMUTATOR

- Loosen the screw of cover band and remove it.
- Remove plastic protection, in order to uncover commutator and commutator brushes area.
- Clean with a rough brush powder deposit from brushes, commutator, brush springs and connection leads.
- Check brushes for rate of wear and if their lengthn decreased under 15 mm, they should be replaced (see chapter concering starting motor repair).
- Check also wear of rate and cleanlines of commutator. If it will be strictly necessary (flame round the commutator, during operation), it is allowed a slight polishing, but only with very fine glasspaper (not emery paper).
- Blast starting motor with compressed air or clean it with a smouth brush, in order to remove powder produced by polishing commutator.
- Replace plastic protection and tighten the fastening screw.

2.2.3. S-127 DIESEL ENGINE MAINTENACE

D-127 engine maintenace is specific to middle speed Diesel engines, with rotary pump and electrical starting by means of ARO car storage battery.

OP. 2.01.04.0 D CHECKING TIGHTNESS OF JOINTS

Besides usual indications concerning checking of eventual oil or brake fluid leaks, pay special attention for high pressure fuel lines, concerning the joints on fuel pump and fuel injections.

- If you will find the joint adjacent areas got wet with fuel, replace absolutely the faulty joint components.

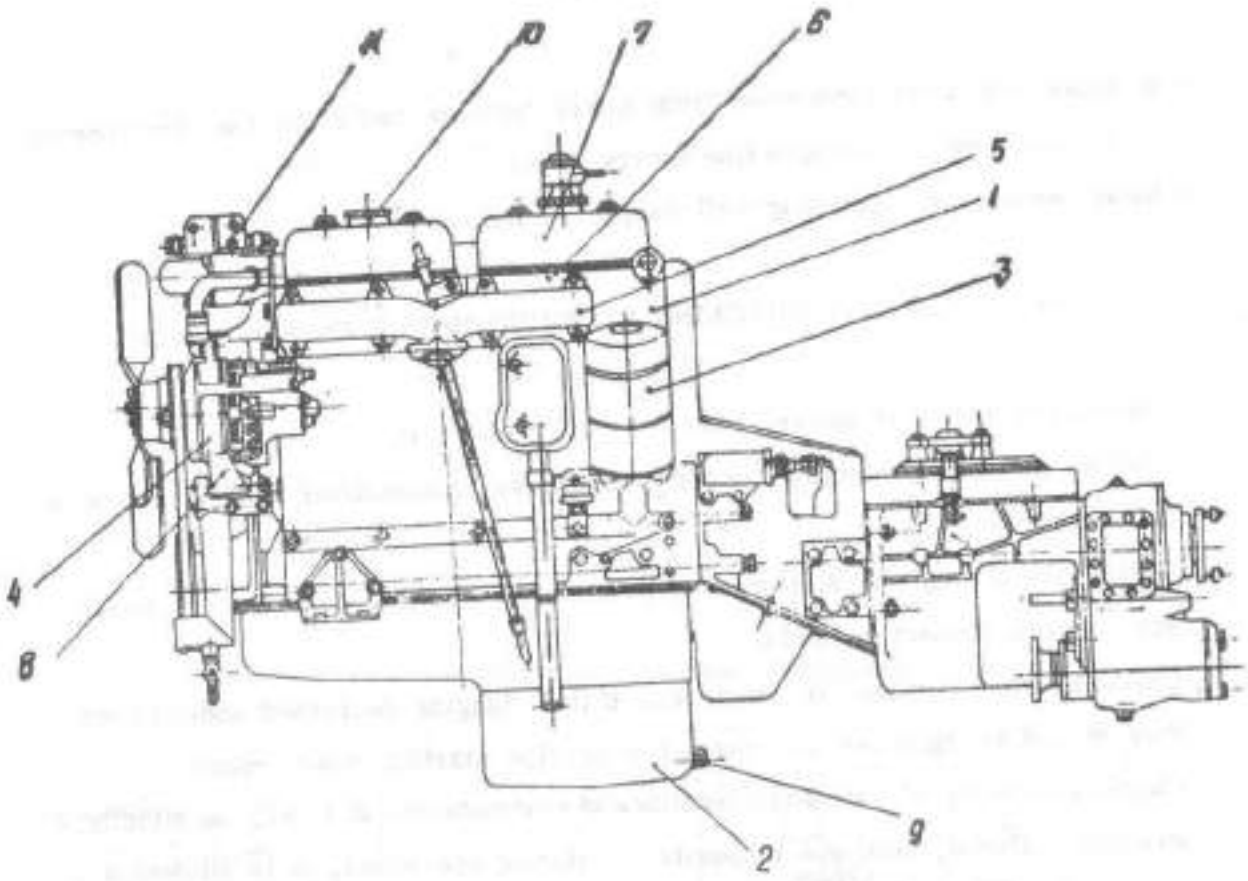


Fig. 2.26. ARO D-127 DIESEL ENGINE SIDE VIEW
1. Cylinder block; 2. Oil bath; 3. Oil filter; 4. Alternator; 5. Exhaust manifold; 6. Cylinder head; 7. Cylinder head cover; 8. Water pump; 9. Oil bath draining plug; 10. Oil filler cap; 11. Safety oil filter.

OP. 2.0.01.05.0 D CHECKING FASTENING OF D-127 ENGINE ASSEMBLIES

The Diesel engine is strongly shaking on idle speed; this can cause loosening of various assemblies fastening by means of bolts and nuts.

- Check, and if loosened, tighten:

Exhaust manifold fastening bolts;

Alternator support fastening bolts;

Clutch housing fastening bolts;

Nuts fastening gearbox on clutch housing;

Bolts fastening exhaust pipe on exhaust manifold;

Bolts fastenirg starting motor;

Nuts fastening injection pump.

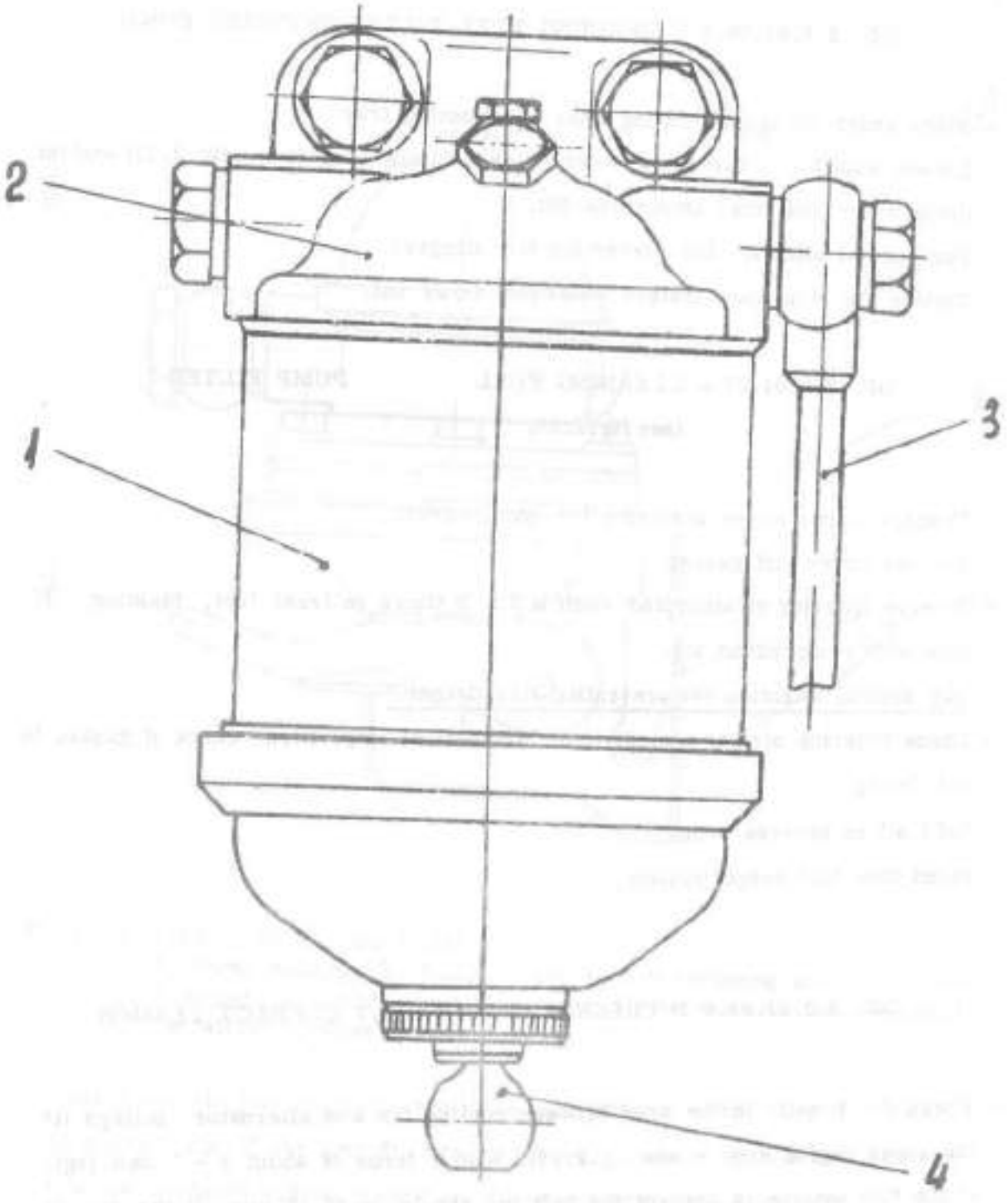


Fig. 2.27. AGGLOMERATING FILTER
1. Filter body; 2. Filter cover; 3. Feeding pipe; 4. Impurities draining plug.

OP. 2.0.01.06.0 D DRAINING FUEL FILTER SETTLING BOWL

- Place under the agglomerating filter a collecting tray.
- Loosen with 3 - 4 turns the lower filter draining plug (see fig.2.27) and let drain water and other impurities out.
  Pay special attention for preventing fire danger!
- Tighten the plug when instead water fuel flows out.

OP. 2.0.01.07.0 CLEANING FUEL PUMP FILTER

(see fig. 2.28)

- Unscrew upper screw fastening fuel pump cover,
- Remove cover and gasket.
- Remove filtering strainer and wash it 2 - 3 times in fresh fuel, blasting it then with compressed air.
- Pay special attention for preventing fire danger.
- Check filtering strainr against light for eventual impurities, check if gasket is not damaged.
- Refit all in reverse order.
- Bleed then fuel supply system.

OP. 2.0.01.08.0 D CHECKING FAN V-BELT CORRECT TENSION

- Press the V-belt, in the area between cooling fan and alternator pulleys (in the upper engine area - see fig.2.29), with a force of about 5 - 7 daN (kg); if the belt tension is correct the belt dip should be of 12 mm. If the dip is more then 12 mm, the V-belt should be tensioned.
- For this, slack the bolt fastening alternator in its position and tilt alternator outside, to obtain correct belt tension.

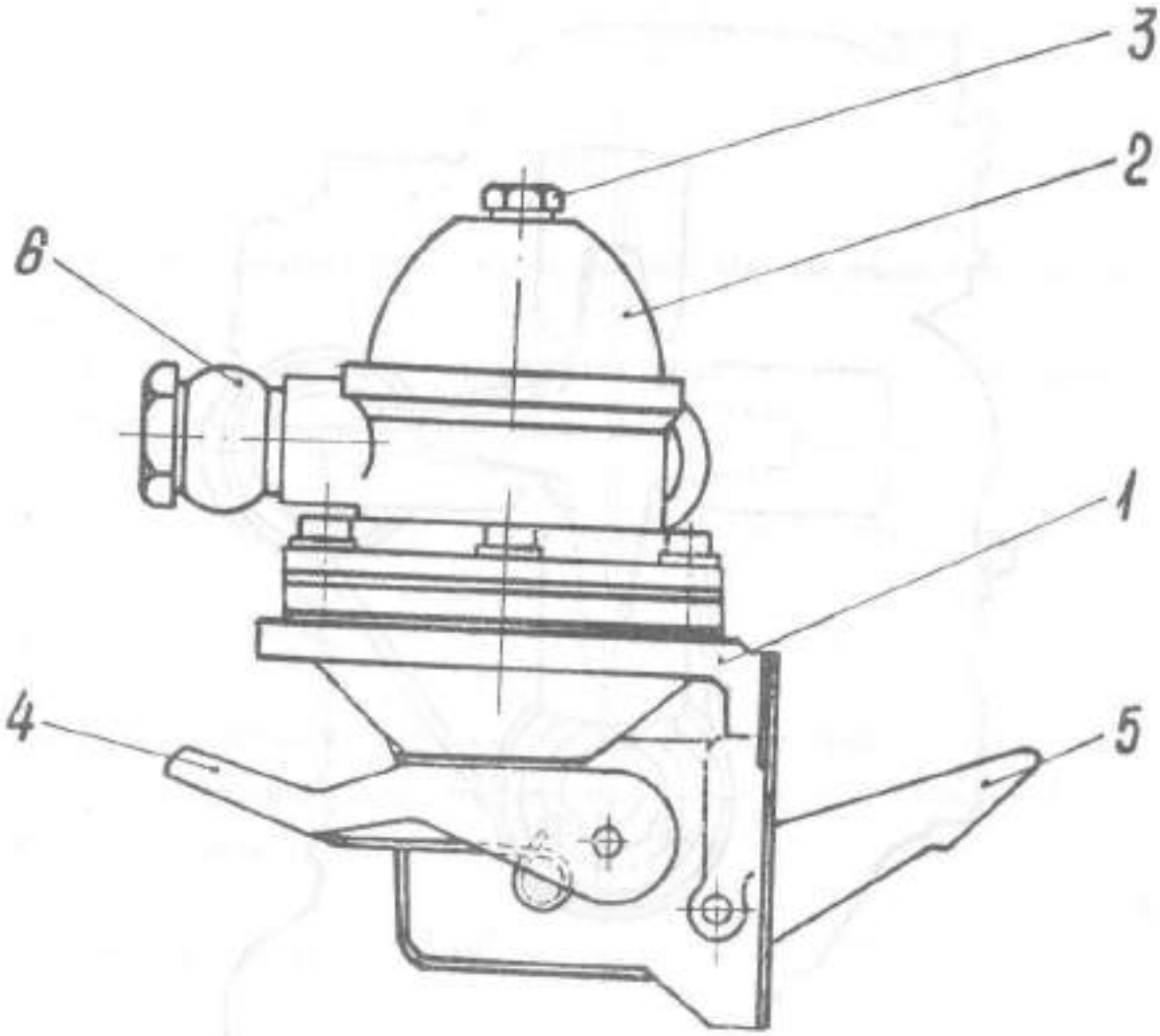


Fig. 2.28. DIESEL FUEL OIL PUMP
1. Pump housing; 2. Pump cover; 3. Bolt fastening pump cover; 4. Rocker arm for manual operation; 5. Rocker arm for mecanical operation; 6. Hose nipple.

- After a certain journey check again the belt tension, which normally maintains its correct dip. If the belt dip has increased, it means that a new belt stretching is produced and the V-belt should be replaced with a new one.

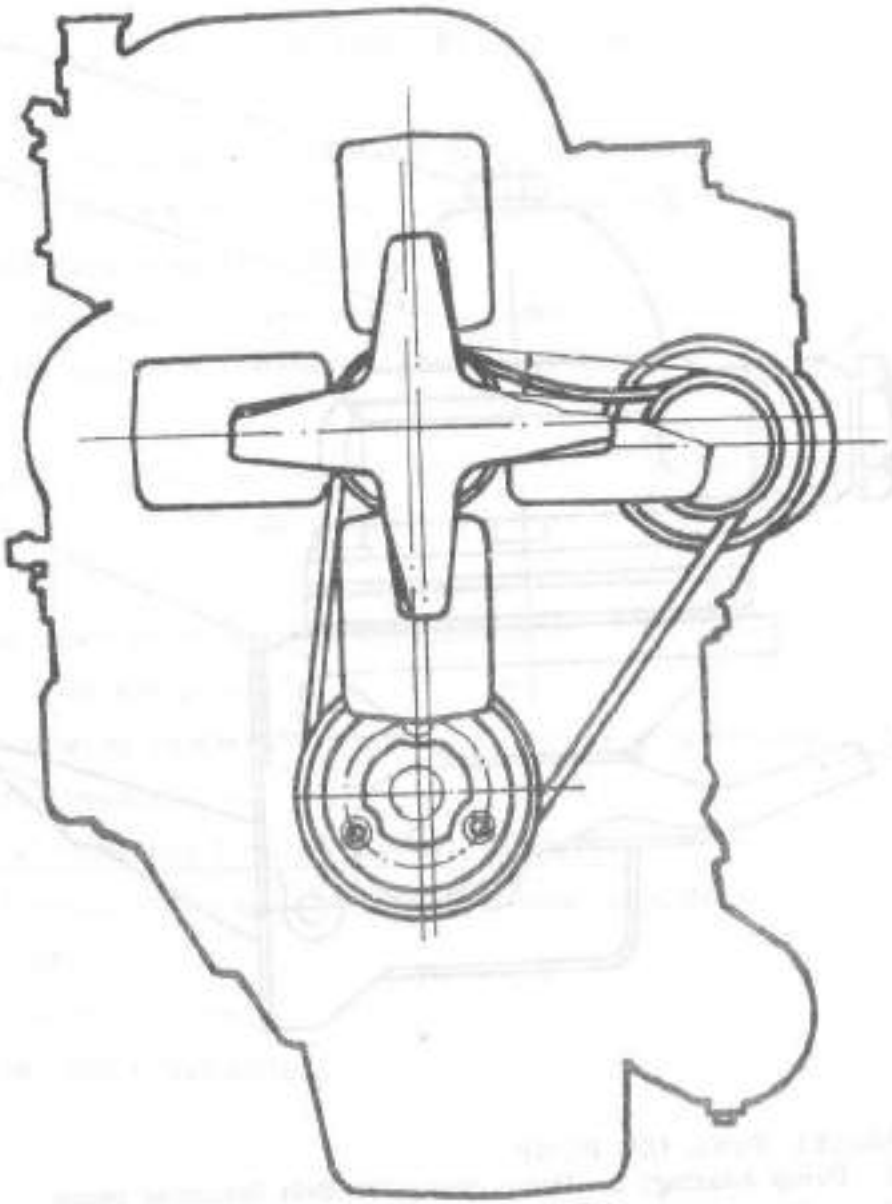


Fig. 2.29. CHECKING ELEMENT FASTENING ON D-127 ENGINE

OP. 2.0.01.09.0 D CHECKING RADIAL AND AXIAL RUNOUT OF PULLEYS

- Inspection is performed during engine running, visually.

The runout of pullerys has a great importance concerning the belt endurance. This inspection is facilitated by the belt vibration near the pulley having a runout.

- If a pulley runout is found, take respective pulley down in order to remediate it, according the respective repair chapter.

OP. 2.0.01.10.0 D VOLTAGE REGULATOR MAINTENANCE

- Check ignition breaker points condition, but only when the engine does not run.
- Check if there are any impurities or oxides.
- If yes, undo the connections and clean the points with a fine abrasive paper.
- Refit then electrical connections, taking care to respect the leads position.

OP. 2.0.01.11.0 D STARTING MOTOR CURRENT MAINTENANCE

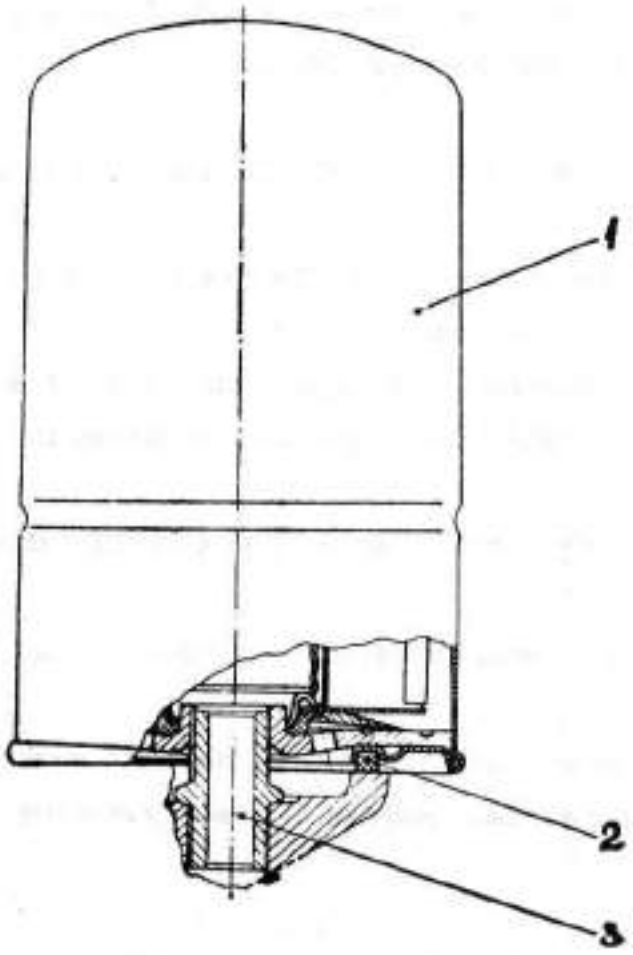
- This operation is performed similarly as described in 2.0.37.04.0 and 2.0.37.05.0.
- Check if starting motor pinion and flywheel ring gear meshing is correct. For every observed anomaly perform necessary remedying as indicated in the repair chapter.

OP. 2.0.01.12.0 D CHANGING OIL FILTERING ELEMENT

- Unscrew the filtering element from its support and replace it with a new one (see fig.2.30).
- Pay special attention on refitting the sealing gasket.

OP. 2.0.01.13.0.D CHANGING FILTERING ELEMENT OF THE FUEL SETTLING FILTER

- Unscrew the upper bolt fastening the filtering element, remove it from the filter and replace it with a new one.
- Tighten then bolt with a torque wrench, using a torque of 0.8.-1.1 daNm(kgm). Filtering element replacing should be performed when troubles of fuel supply system appear.



2.30. OIL FILTERING ELEMENT FASTENING ON D-127 ENGINE

If after replacing filtering element of the fuel settling filter there is no improvement, performe changing of the safety filter filtering element. On this occasion check the gasket condition and replace the faulty gaskets.

- Pay special attention for operation accuracy: any impurity introduced in the fuel circuit may cause heavy trobles of the injectors operation.
- Pay special attention for preventing any fire danger.
- Finaly bleed the fuel supply system.

OP.2.0.01.14.0.D. CHECKING INJECTORS CONDITION

For checking injector it is necessary to take them from cylinder head down, performing the checking on the workbench and paying special attention for operation accuracy and full safety against fire danger.

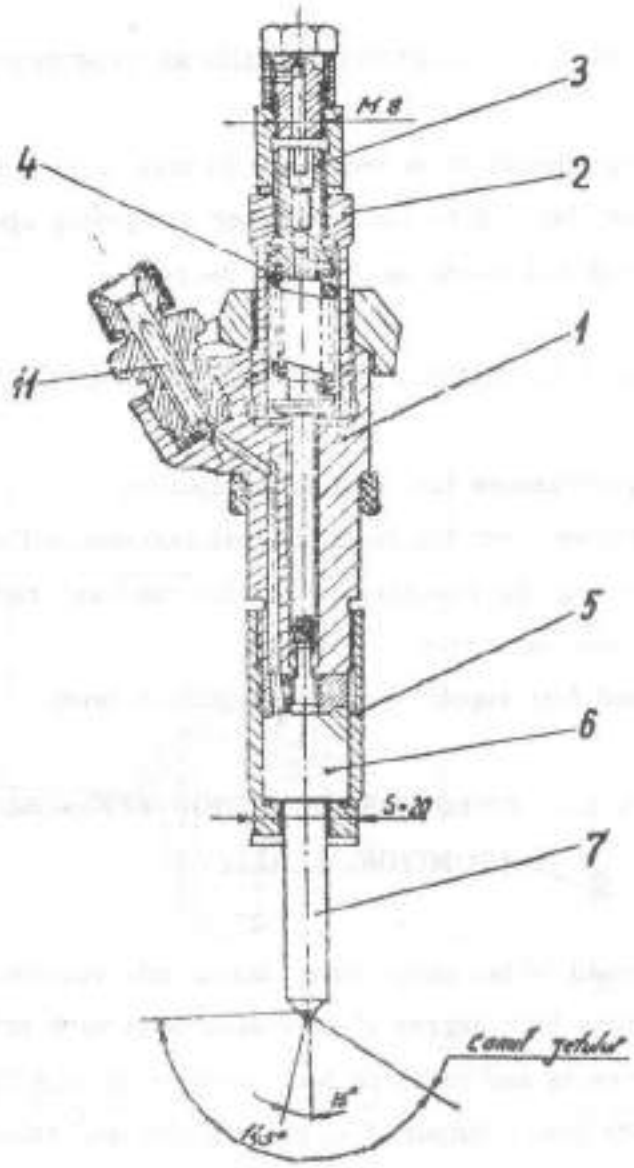
St.2.0.01.14.1.D. TAKING INJECTORS FROM CYLINDER HEAD DOWN

- Disconnect the high pressure fuel pipe from injector.
- Disconnect and remove from injectors the fuel leakages collecting pipe.
- Unscrew nuts fastening the injectors on cylinder head and remove the injectors.
- Refit injectors in revrese order.
- After refitting bleed fuel supply system at injectors level.

St.4.1.01.15.0.D. CHECKING INJECTION PRESSURE AND FUEL ATOMIZING QUALITY

- The test bench should be per ectly clean, taking into account that the injectors are assembled withaa high degree of prccision, with very small clearances betwenn the components and on its perfect operation is depeding engine operation, concerning the power output, fuel consumption and exhaust gases.
- Fit injector so as it was taken down from the cylinder head, on the injection pressure testing device, D-501, and perform checking by manually actuating of dovice.

  If automizing is not correct, dismantle and clean the atomizer.
- Remove injector cover and loosen the adjusting screw untill the injector spring becomes free.
- Unscrew atomizer nut and remove atomizer, taking care the the atomizer niddle should not fall from its body out.
- Clean by means of a rough brush the crust deposit on the atomizer head.
- For softening carbon deposit crust, immerse the respective components in frash white-spirit or other organic solvent.

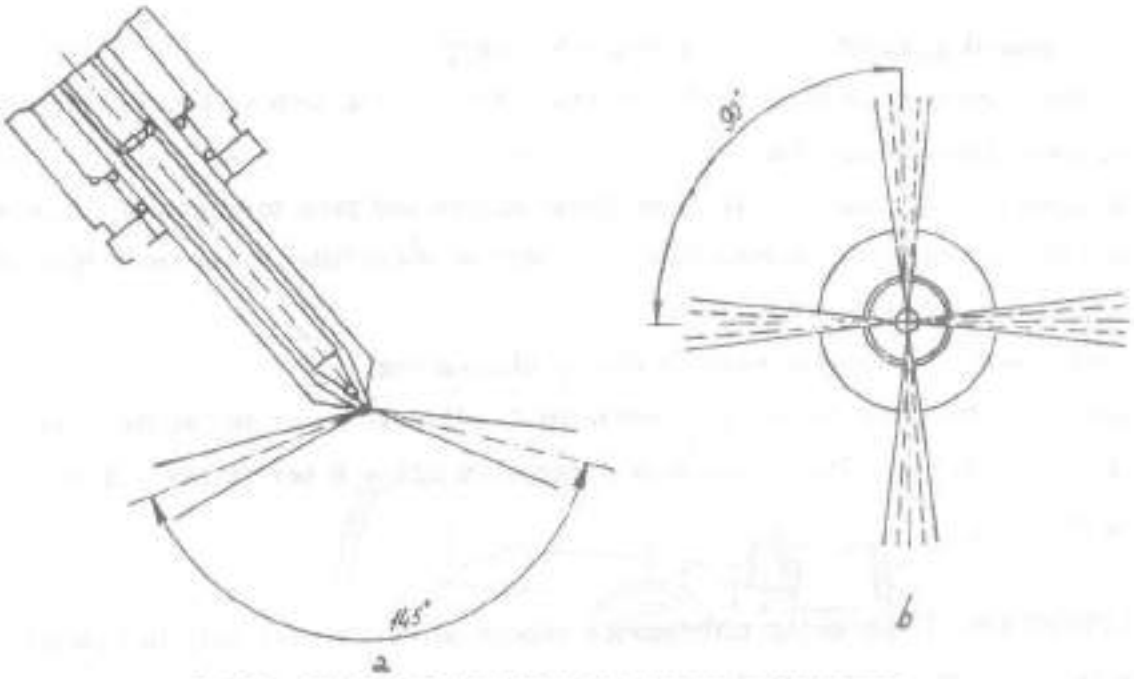


2.31. D-127. DIESEL ENGINE FUEL INJECTOR

1.-Injector cover; 2.-Injector cover; 3.-Adjusting screw; 4.-Injector adjusting spring; 5.-Atomizer nut; 6. Atomizer (sprsy); 7.- Atomizer needle; 8.-Injector filter.

ATTENTION ! Do not uncouple injector needles and atomizers, because they are not interchangeable !

- After first cleaning check if needle slide easily in the atomizer body.



2.32.. CORRECT ASPECT OF FUEL ATOMIZING

- The atomizer body should not have any kind of mechanic damages, nor any tinge by oxidation, due to overheating.
- For removing carbon deposit from the atomizer delivery chamber, remove the needle, and by means of the special S-501 tool clean the chamber, by rotating and pressing the point jaw upon the chamber wall.
- Clean in the same manner the cone body and the small cilindrical space on the top of the cone, using the S-502 tool (successively both the tool ends).
- Atomizing oriffices should be cleaned by means of the special A-502 drift. The needle should be out from the fastening bush for a length of 1,5 - 2 mm. A greater length facilitate the needle breaking and the needle end, remained in the oriffice, brings atomizer out of use.
- Clean needle point using the wire brush from the car tool outfit, fastening firstly the needle in the special S-502 device.
- After mechanical cleaning of neddle and atomizer, as explained above, wash the components in fresh white-spirit, 2-3 times, and blast them with compressed afr.
- If it will be found that the needles are blue coulored, due to overheatings, or that the sealing surface is dull, repiace the couple atomizer body-needle with a new one.

- Pay special attention for preventing fire danger !
- Perform refitting of needle in the atomizer body having both of them immersed in clean, ffresh Diesel fuel.
- Remove injector filter fit it on D-561 device and pass through the filter a fuel flow, contrary to normal flow in order to clean filter from impurities. If the filter is clogged, replace it.
- Refit injector in reverse order to that on dismantling.
- Before refitting the cover, fit injector on D-501 device and adjust the injector spring force, so that it opens at a pressure of 225 $\pm$ 5 bar (1 bar = 1,02 kg/cm^2).

ATTENTION; The injector maintenance should be carried out only in special workshops, having adequate tools and devices'equipment.

OP.2.0.01.16.0.D. CHECKING & ADJUSTING THE VALVE CLEARANCE

This operation needs preliminary taking down of calinder heads.

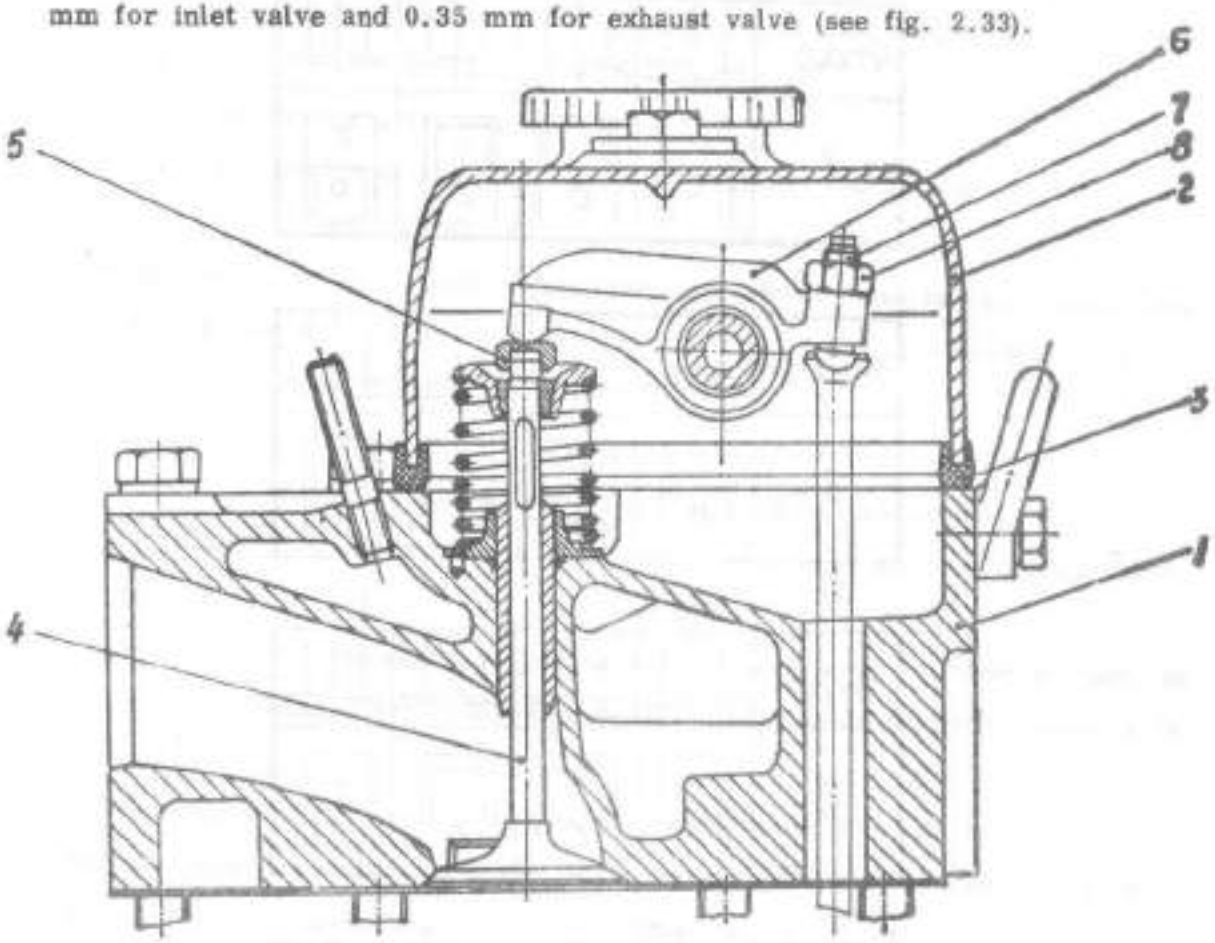
St.2.0.01.16.1.D. TAKING DOWN OF CYLINDER HEADS

- Loosen successively special nuts, fastening the two cylinder head covers.

ATTENTION ! The special nuts, having incorporated a lock piece, can not be completely removed. So, loosen them untill they get free!
- Remove the covers with care, the sealing gasket can be sligtly adhered on sealing surface due to pressing for a long time.
- Performe this operation with much accuracy, in order to evoid penetrating of impurities into engine lubricating circuit.
- Refit cylinder head covers in reverse order paying special attention for correct fitting of gaskets betwen the covers and cylinder heads.

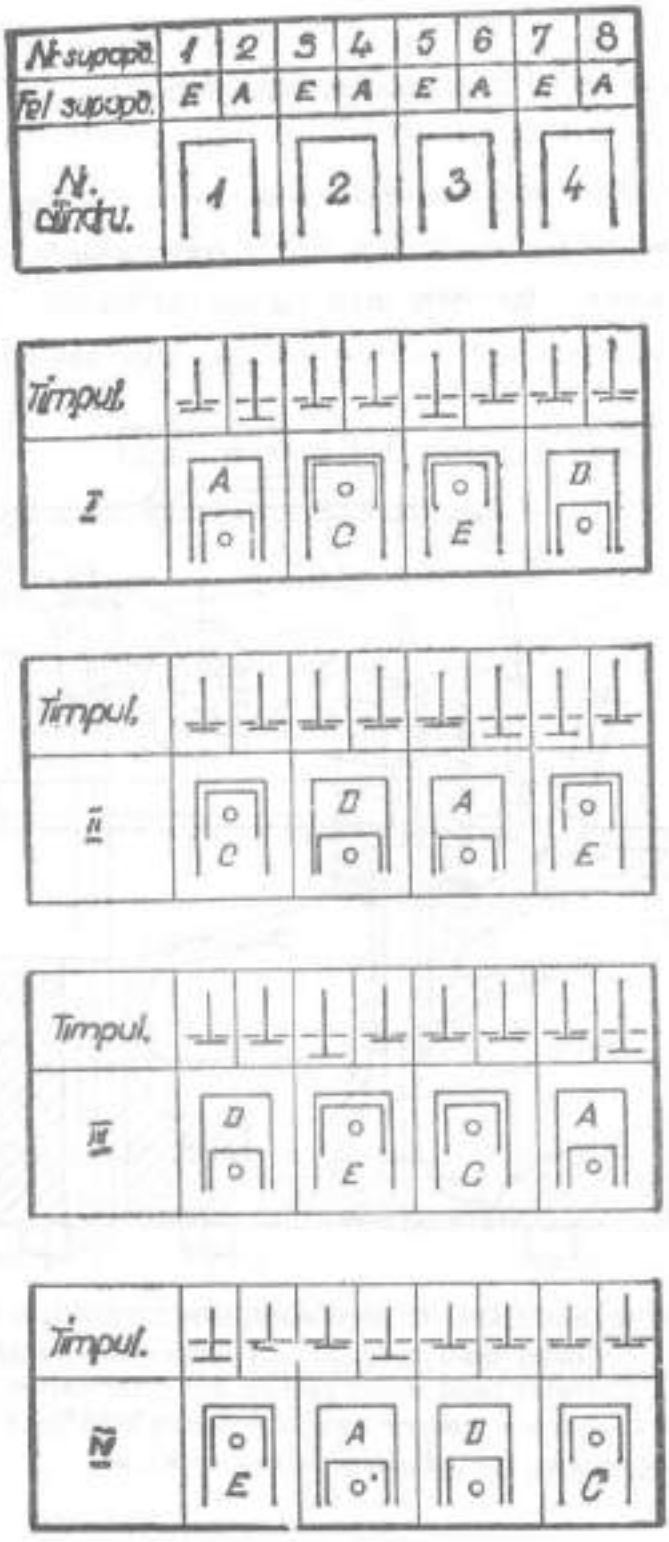
St. 2.0.01.16.2. CHECKING & ADJUSTING VALVE CLEARANCE

- After taking cylinder head covers down, performe checking the clearamce between valves and rocker arms, by means of feeler gauges. When engine is cold the clearance between the valve stem tip and and rocker arm should be of 0.25 mm for inlet valve and 0.35 mm for exhaust valve (see fig. 2.33).



2.33. CROSS SECTION OF D-127 ENGINE CYLINDER HEAD - 1.- Cylinder head body; 2.- Cylinder head cover; 3.- Cylinder head cover gasket; 4.- Inlet valve; 5.- Valve tip; 6.- Rocker arm; 7.- Valve clearance adjusting screw; 8.- Adjusting screw lock nut.

- The valve order, counting from the cooling fan (front of engine), is the fol - lowing:
- The inlet valves, marked with "A" (Admisie = Inlet), are numbered 2,4,6,and 8.



2.34. DIAGRAM OF THE FOUR CYCLES BY D-127 ENGINE
Nr. supapă = Valve No; Fel supapă = Valve kind; Nr. cilindru = Cylinder No; Timpul = Cycle; A = Inlet; C = Compression; D = Expansion; E = Exhaust.

- The exhaust valves, marked with "E" (Evacuare = Exhaust), are numbered: 1, 3, 5 and 7.

The firing order is: 1 - 3 -4 - 2, so that during the four cycles the situation is such as in the Fig. 2.34.

- When engine is cold crank it several turns, in order to eleminate oil in excess between the components; crank then further, untill nr.1 piston neare end of compression str i.e. its inner dead center.
- In this position the clerances should be:
  - For valves E1 and E5 - 0,35 mm clearance
  - For valves A2 and A4 - 0,25 mm clearance
- Crank now agian the engine a complete turn (360^{o}) ; now the nr.1 piston reaches again its inner dead center, this time at the end of exhaust stroke.
- In this position the clearances should be:
  - For valves E3 and E7 - 0,35 mm clearance
  - For valves A6 and A8 - 0,25 mm clearance

If you will find by some valves different clearances, performe the clearance adjusting, as follows:

- Loosen the nut, locking the adjusting screw, using a socket wrench; then, by means of a screw-driver, turn the screw, untill above indicated clearance is obtained.
- Holding adjusting screw in this new position, tighten the lock nut.
- After locking the adjusting screw, crank engine 2 - 3 turns and check again the clearances, according to indicated dbagram.

OP. 2.0.01.17.0.D. CHANGING FILTERING ELEMENT OF SAFETY FILTER

This operation is performed similarly as on changing filtering element of the fuel settling filter, as described in Op. 2.0.01.13.0.D.

OP. 4.0.37.06.0. ALTERNATOR COMPLETE MAINTENANCE

This operation is common for both the engine types, the alternators being indentical. To perform its complete maintenance, the alternator should be taken down from the engine.

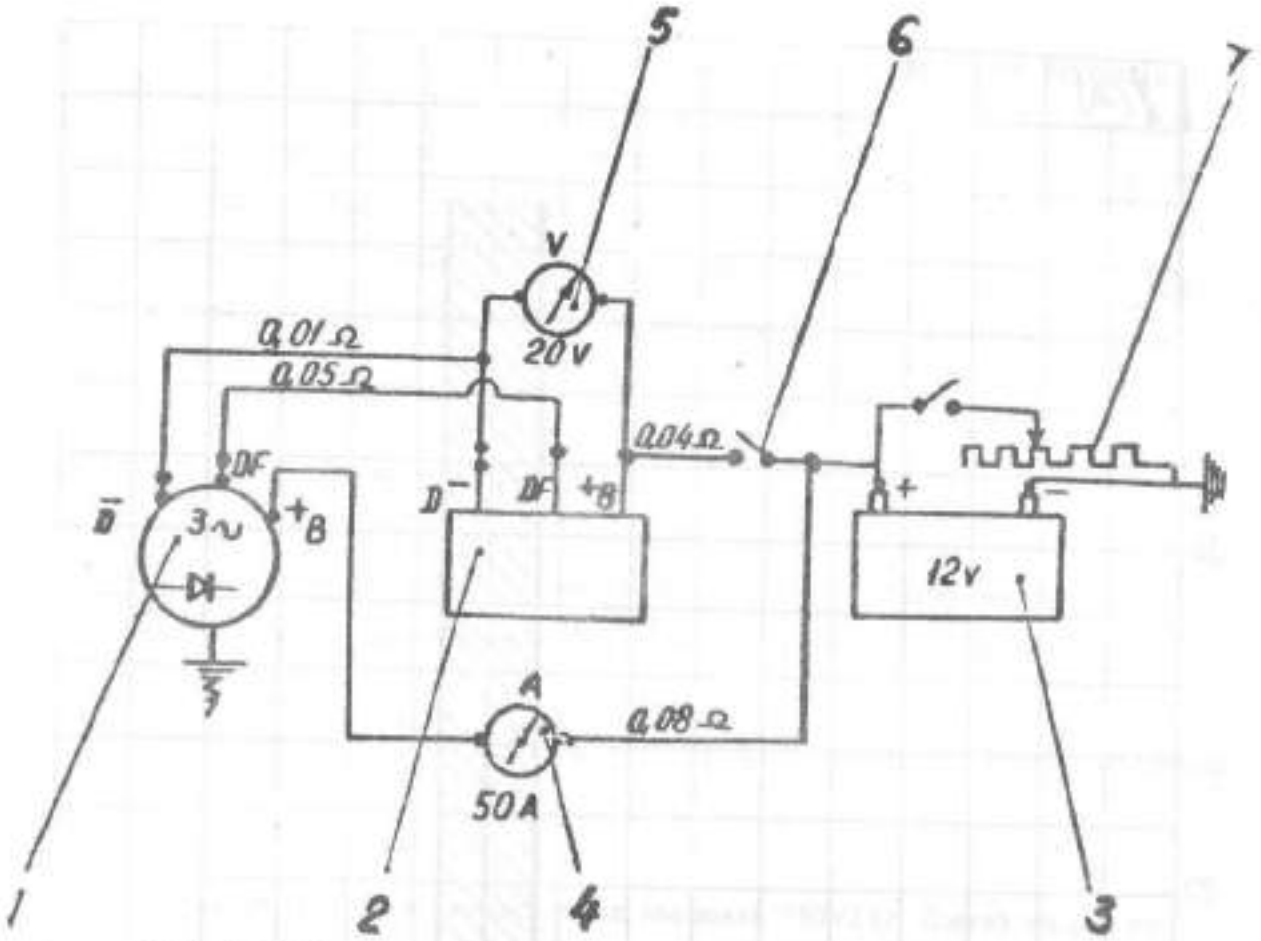
St.2.0.37.06.1. TAKING ALTERNATOR DOWN FROM THE ENGINE

- Performe alternator taking down when engine is stoped.
- Disconnect alternator from the rest of electric equipment. For this:
- Unscrew bolt fastening alternator support and tilt alternator, in order to remove the drive V-belt.
- Remove bolt from the alternator hinge eye.
- Bring alternator on the workshop bench, in order to performe its complete maintenance.
- Refitting alternator is performed in reverse order, taking care to adjust correct V-belt tension, as discribed in Op. 2.0.01.10.0 - for the ARO L-25 engine, respectively in Op. 2.0.01.08.0-D, for the ARO D-125 engine.
- Pay also attention for correct connecting of alternator, according to the wiring diagram All connecting contact surfaces should be clean, or if necessary be cleaned.

St. 4.0.37.06.2. ALTERNATOR - VOLTAGE REGULATOR TEST

- After having performed alternator current maintenance, as prescribed in Op. 2.0.01.20.0, take down voltage regulator from the car and carry out the connection test diagram, as shown in fig.2.35. Take care that electric resistance of connecting wires should not exceed the values indicated in diagram.
- By means of a load resistor adjust alternator current output from 2 Amp. to 40 Amp.

NOTE: Voltage regulator should be fastened on a metal plate, in the same position as on the car.



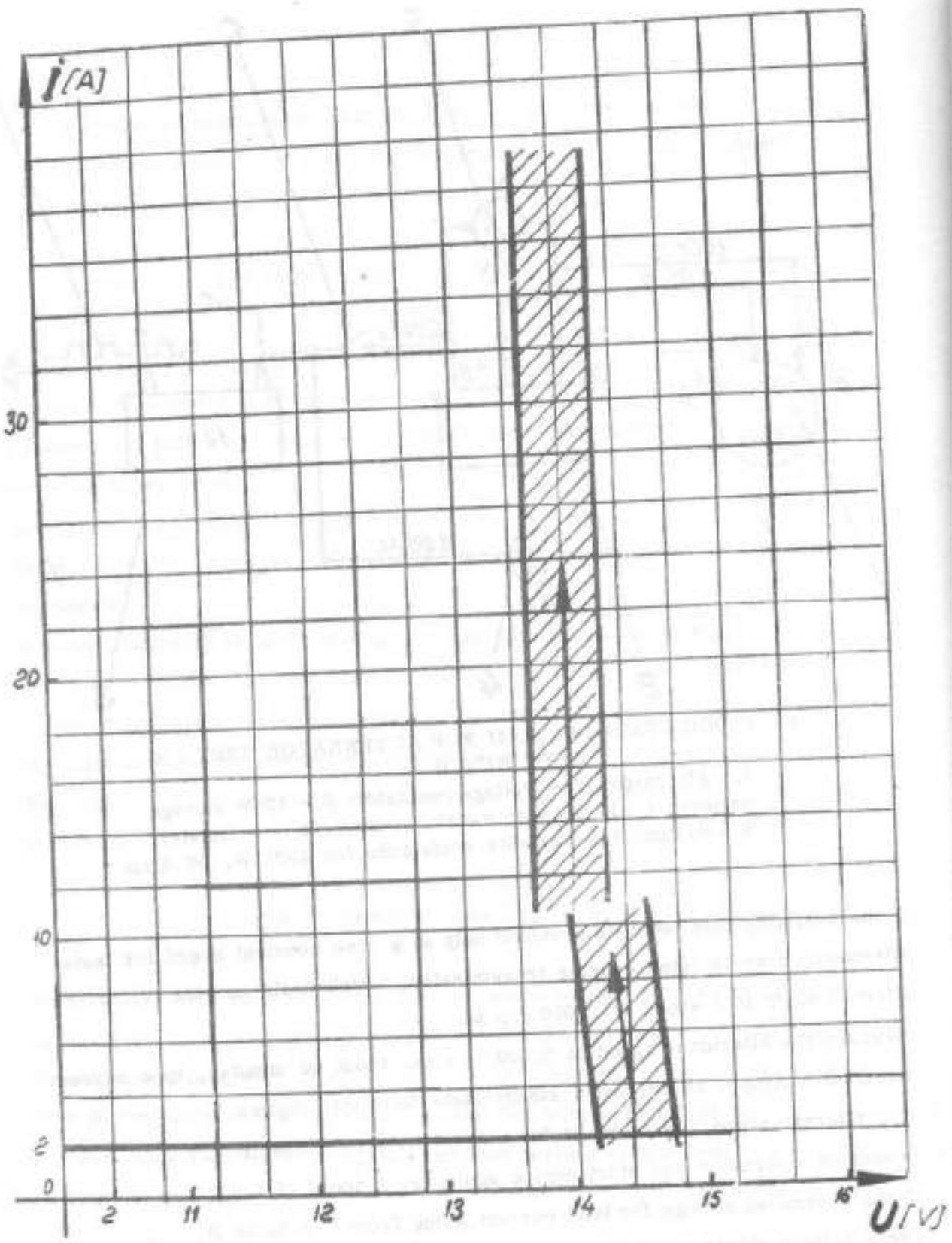
2.35. CONNECTION DIAGRAM FOR ALTERNATOR TEST ON TEST BENCH

1.- Alternator; 2.- Voltage regulator; 3.- 12 V storage battery; 4.-50 Amp.ammeter; 5.-20...25 V voltmeter; 6.- Switch; 7.- Variable resistance for 1000 W, 50 Amp.

If the available test bench is provided only wi h one constant speed for tested alternator, tray to fetch a drive transmission, which could be able to drive alternat shaft at a speed of 5,000 r.p.m.

- Maintain the alternator speed at 5,000 r.t.m. about 50 minutes, by a current output of 5 Amp.- stabilizing a steady-state thermical regime.
- Stop alternator and disconnect it for a short time from the battery.
- Reconnect alternator and start engine again, at a speed of 5,000 r.p.m.
- Check controlled voltage for load current going from 2 A to 30 A.

These voltage values should be enclosed in the hatched area, represented in the diagram fo fig.2.36.



2.36. REGULATING CHARACTERISTIC OF VOLTAGE REGULATOR

- If the voltage regulator is faulty, replace it. Its repairing is not advisable.
- After plotting the regulating characteristic you can, by means of a load variable resistance measure the load which can be obtained at a speed of 5,000 r.p.m. This load should be of 34 A at 14 V voltage.
- If, after replacing voltage regulator the values indicated in the Fig.2.36 cannot be obtained, perform alternator repair, checking the excitation circuit and the block of diodes.

2.2.4. BRAKE SYSTEM MAINTENANCE

In this chapter is described the maintenance of hydraulically controlled foot (service) brake and mechanically controlled hand (parking) brake.

OP. 2.0.19.01.0. CHECKING & TOPPING UP BRAKE FLUID IN BRAKE SYSTEM

Correct brake fluid level should reach the mark "NIVEL" (Level) on the compensating reservoirs of the brake and cluth master cylinders.
For topping up use only the SUPER - CS-4102201 brake fluid. If this type of fluid is not availabele, use another brake fluid, corresponding to SAE 170.3 a brake fluid, provided at the whole fluid quantity in the brake system will be changed with the new fluid.

- On topping up or changing brake fluid, check, by actuating pedals, if the holes feeding the master cylinders are free.
- If the brake fluid was completely changed, both brake & clutch hydraulic control systems should be bled, according to Op.2.0.35.02.0.

OP. 2.0.35.04.0. CHANGING FLUID IN BRAKE &CLUTCH HYDAULIC CONTROL SYSTEMS

St.2.0.35.04.1. CHANGING FLUID IN BRAKE CONTROL SYSTEM

- Connect to each bleed nipple of wheel brake cylinder a brake fluid - resisting hose (PVC or mipolam) and introduce their ends into transparent vessels with brake fluid.

- Unscrew (2 - 3 turns only) the bleed nipples, successively, beginning with the nearest cylinder; then depress many times the brake control pedal, untill from the hose connected to the bleed nipple air bubbles getout.
- Tighten the loosened bleed nipple and repeat this operations on the next cylinder and perform so on up the most remote cylinder (rear R.H. wheel). Let this last bleed nipple open.
- Feed the master cylinder compensating reservoir with fresh brake fluid and depress many times the brake control pedal untill air bubbles stop getting out (pay attention to not let the master cylinder reservoir completely empty, refilling it with brake fluid during this operation).
- When air bubbles get no more out, tighten respective bleed nipple and repeat the bleeding the last but one cylinder, loosening the bleed nipple and so The last wheel brake cylinder which should be bleeded is the nearest to the master brake control cylinder. (i.e. front L.H.wheel cylinder);
  When brake fluid changing, respectively air bleeding were correctly performed, the brake control pedal should stop being depressed before reaching the cowl - the all four wheels being braked.
  When brake pedal stroke end is not firm but rather elastic, it indicates an insufficient brake system bleeding. In that case repeat the above described operation, beginning with the most remote wheel brake cylinder, successively up to the nearest one.
- Pay attention for bleed nipple tightening and inspect them for fluid leakages.
- Finaly remove connected hoses and vessels with brake fluid.

St. 2.0.35.04.2 CHANGING FLUID IN THE HYDRAULIC CLUTCH CONTROL SYSTEM OF THE ARO CARS, EQUIPPED WITH ARO L-25 ENGINE

- Having access from the car bottom side, performe bleeding hydraulic clutch control system (see fig. 2.37), in the same manner as on changing fluid in the brake control system, acoording to Op. 2.0.35.04.1.

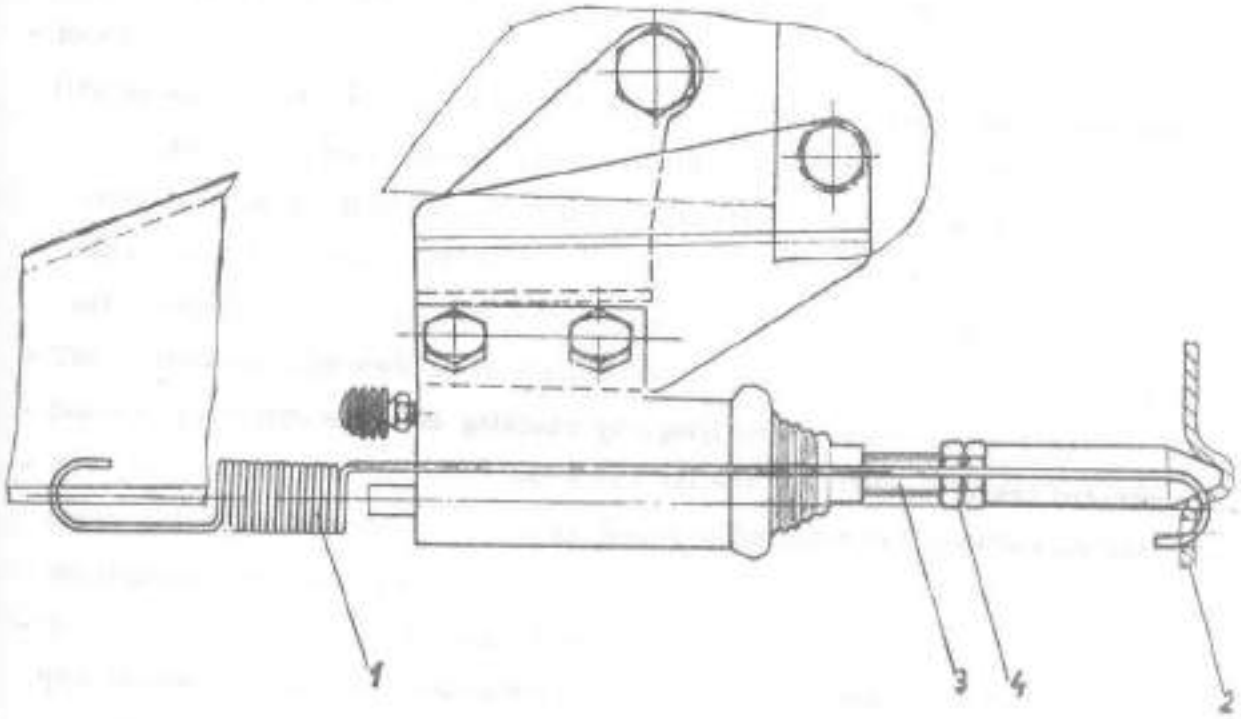


Fig.2.37. CLUTCH CONTROL MECHANISM
1. Pull-back spring; 2. Clutch release fork; 3. Slave cylinder rod; 4. Adjusting nut.

St. 2.1.35.04.3 CHANGING FLUID IN THE HYDRAULIC CLUTCH CONTROL SYSTEM OF THE ARO CARS, EQUIPPED WITH ARO D-127 ENGINE.

The access to clutch master cylinder is possible through the car inside, after taking down transmission tunnel cover as described in the Op. 2.0.53.01.0.

- Further performe the operation in the same manner as on changing fluid in the brake control system (Op. 2.0.35.04.1) depressing this time the clutch control pedal.

OP. 2.0.35.02.0 BLEEDING BRAKE HYDRAULIC CONTROL SYSTEM

- This operation is performed in the same manner as Op. 2.0.35.04.0, except the draining out the fluid existing in the system.

OP. 5.0.99.06.0 CHECKING SERVICE (MAIN) BRAKE SYSTEM

Checking is performed on special test stand, measuring the brake power o each wheel, or along a test trip fulfillingthe below indicated conditions, The car brake system has a play self-adjusting mechanism for self-compemsating of brake shoes wear, so that normally the brake power of R.H. wheels is equal tothat of L.H.wheels. In case that special cheker indicate the brake powers having a difference between them moré then 15%, it should be performed a brake system remedying, by checking of brake cylinders, brake shoe and brake drums.

- If the special brake power checker is not available, performe a braking test along a road having at least 4 meters width and a good adherence (asphalt, concrete) at a speed of 40 km/h and in dry weather.
- At this speed, on depressing progressevely the brake pedal, the car should stop on a distance of 12 m, without deviating from the straight line.
- If the brake power of R.H.wheel is different from that of L.H.wheel and the car will deviate on braking, the remedying of the brake system is necessary.
- For this, check which wheel had less brake power, indicated by the brake power checker, or, if the checker was not available, which wheel remained outwards the curved car trace. The necessary intervention should be performed on this wheel.

OP. 2.0.35.01.0 INSPECTING SERVICE BRAKE CONDITION

- Lift the car upon the inspection ramp.
- Inspect the car underside for brake fluid leakages from wheel brake cylinders (radial fluid traces on the inner side of wheel rims, for fluid leakages from pipe assembling nuts, for copper lines blows which can narrow down the brake pipes as well as for brake hose blisters.
- Inspect under the engine bonnet connections between the compensating reservoirs and the master cylinders, as well as between cylinders and the rest of brake system.

- Depressed brake pedal should stop firmly before reaching the cowl.
- Replace faulty parts with new ones. If depressed brake pedal does not stop firmly, bleed again the brake system, as described in the Op. 2.0.35.02.0.

OP. 2.0.19.02.0 CHECKING AND EVENTUALLY ADJUSTING BRAKE CLUTCH PEDAL POSITION AND STROKE

- The operation is carried out inside the car (see fig.2.38). For this:
- Set adjusting device V.101 on body floor under pedal.
- Now adjust pedal position adjusting screw (1) till the lower point of pedal touches the top margin of V.101 device and adjusting screw contacts cowl. Now, tighten back nut of the screw (1).
- To adjust pedal stroke, slacken lock nut (4) and screw or unscrew piston pushing rod (5) so that a small play remains between piston and piston pushing rod (5), allowing a 10-15 mm free travel of pedal.
- In this position of piston pushing rod tighten lock nut (4).

OP. 2.0.01.22.1 ADJUSTING THROWOUT BEARING CEEARANCE OF ARO L-25 ENGINE (see fig.2.37)

This operation is accessible from car underside.

- Set free the pull-back coil spring (1) and push clutch release fork (2) till the throwout bearing contacts adjusting screws of clutch release levers (see also fig.4.93).
- In this position tighten adjusting rounded nut, till it contacts release fork (2); then slacken it back two turns in order to secure necessary clearance for throwout bearing.
- In this position tighten lock nut (4), retaining piston pushing rod, by means of a screw-driver, introduced in rod slotted hole.

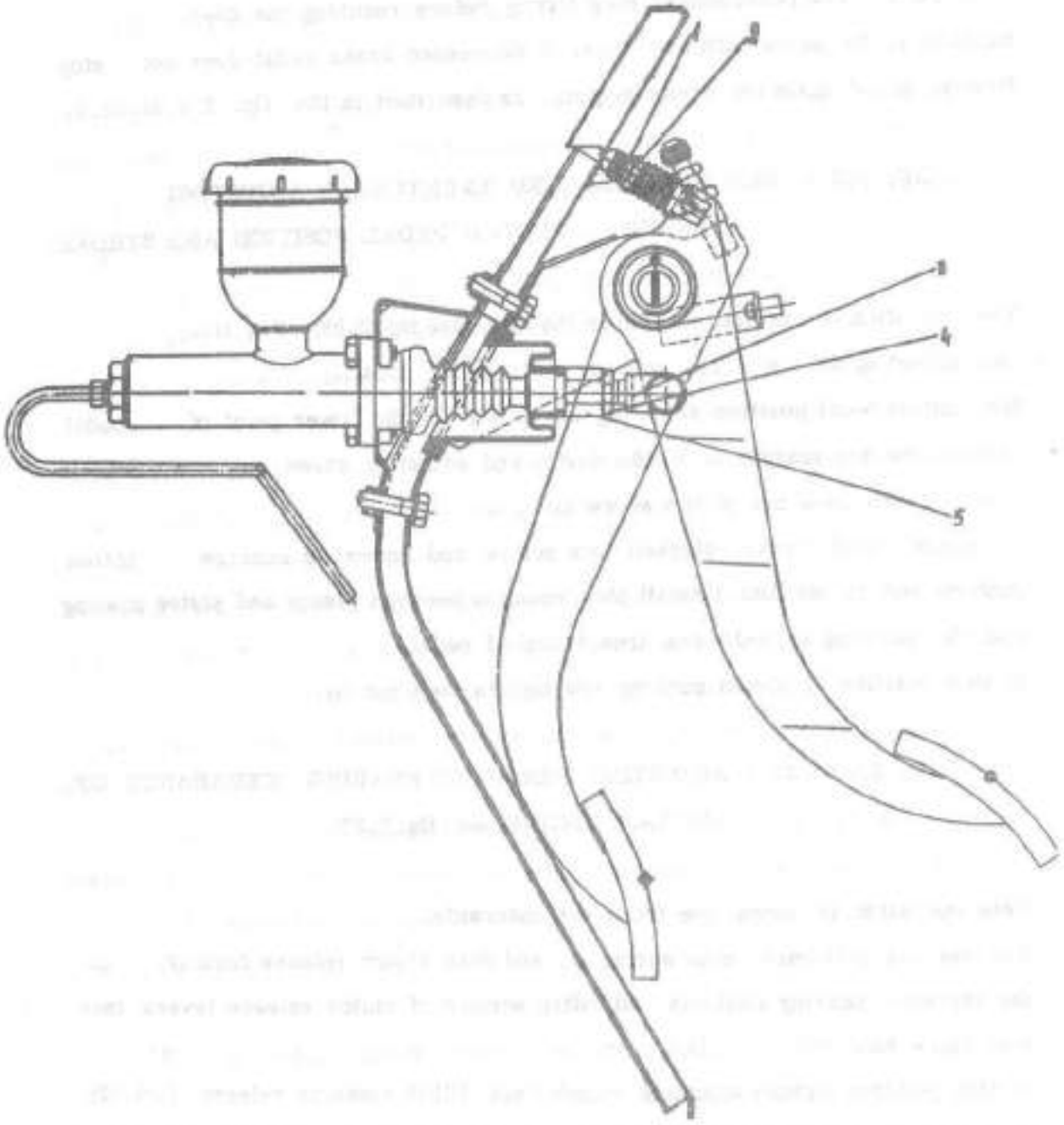


Fig. 2.38. BRAKE &CLUTCH HYDRAULIC CONTROL SYSTEM
1. Clutch brake position adjusting screw; 2. Stop screw (1) locking nut; 3. Forked rod; 4. Lock nut; 5. Piston pushing rod.

OP. 2.1.01.18.2-D ADJUSTING CLUTCH THROWOUT BEARING CLEARANCE OF ARO D-127 ENGINE

This operation can be carried out having access inside the car, after removing transmission tunnel cover, as described in Op. 2.0.53.01.0.

- After removing the cover, perform clearance adjustment as described in preceding operation (2.0.01.22.1).

OP. 2.0.35.06.0 CHECKING BRAKE SHOES WEAR.

This operation is performed according to maintenace schedule but also when a braking trouble is found on its inspection, according to paragraph 5.0.99.06.0.

- Take respective wheel down, as described in Op. 2.0.31.01.1.
- Before checking brake shoes wear check play self-adjustment mechanism condition.

St. 2.1.35.06.1 CHECKING PLAY SELF-ADJUSTMENT MECHANISM

- Depress brake pedal till it stops and then release it slowly.
- Introduce feeler gauges through the brake drum opening (see fig.2.39) and check the clearance between brake drum surface and brake shoe linings. The found value should be comprised between 0.2 and 0.3 mm.
- Rotating the drum check clearance along each shoe.
- Repeat chacking clearance after a few minutes. If the found clearance value will be greater the play self-adjusting system, inside the brake cylinder is faulty and should be replaced with a new, original part.

St. 2.1.35.06.2 TAKING BRAKE DRUM DOWN FOR CHECKING SHOE LININGS WEAR

- Taking brake drum down needs preliminary taking down of respective wheel, as described in Op. 5.0.99.06.0.

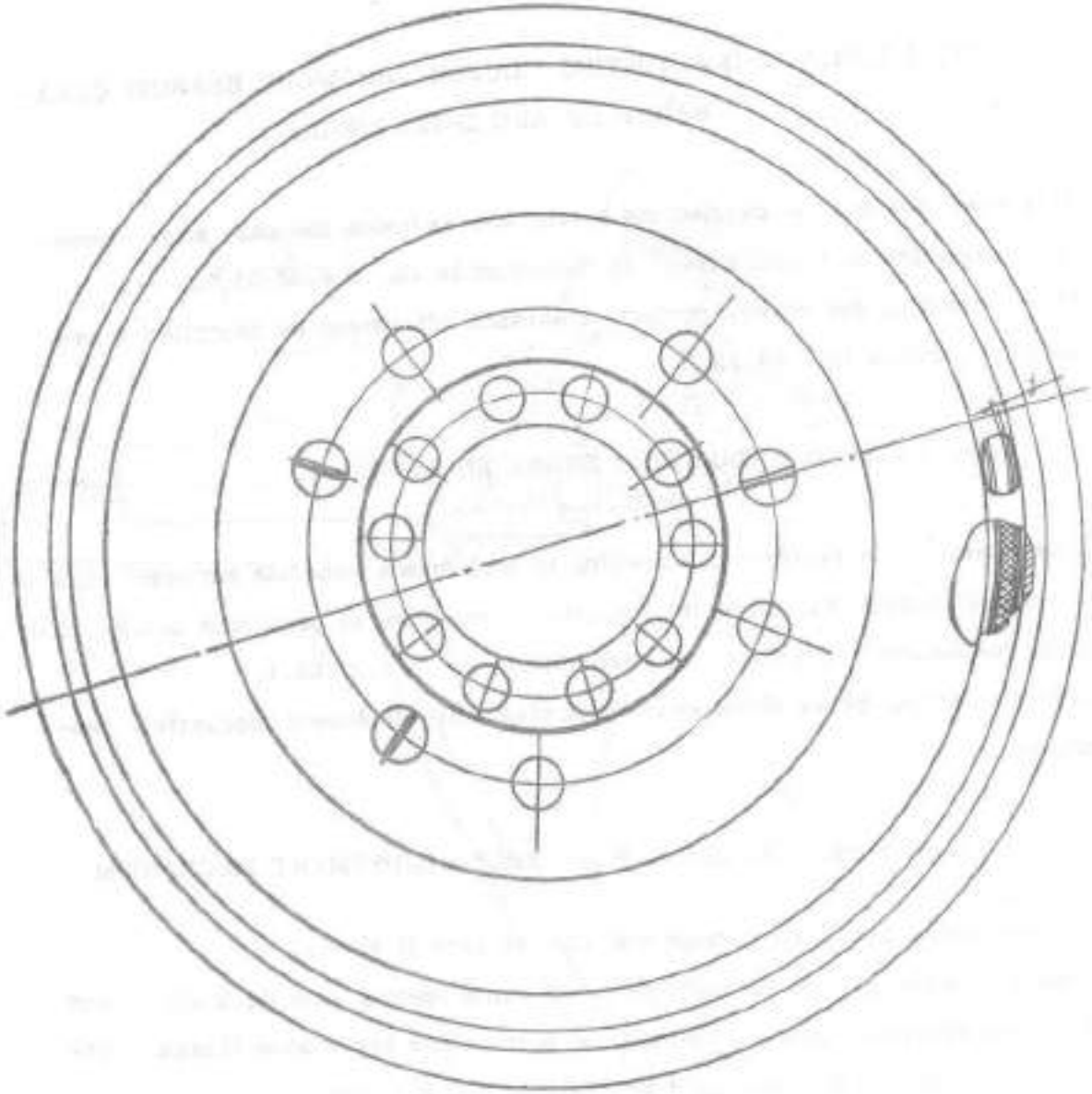


Fig. 2. 39. BRAKE DRUM OPENING FOR ADJUSTING THE BRAKE SHOES THE CLEARANCE.

- After taking down the wheel, remove brake drum from the wheel hub, after having unscrewed the fastening bolts, remove the drum by slight lateral blows, using a rubber or plastic hammer.
- Inspect shoe lining riveting: the rivet heads should be under the shoe lining surface. If not, replace respective brake shoe.

On refitting brake drum perform operation in reverse order.

St. 2.1.35.06.3 CHANGING BRAKE SHOES OF THE FRONT WHEELS

This operations needs preliminary taking down of the wheel and the brake drum, as above described (St. 5.0.99.06.0 and 2.1.35.06.2).

- Push brake shoe (2) (see fig. 2.40) outside, against the spring (4) action, untill the shoe rib gets out from cylinder back slot, move the shee laterally and release it slowly near the cylinder back slot.
- Perform in the same manner with the second shoe; now both shoes are free and can be removed from the brake anchor plate (1).
- On refitting brake shoes fasten firstly the two springs (4) into respective holes of each shoe, introduce on shoe end in the respective cylinder back slot. Them, using still a lever, push the second shoe outside and introduce its end into the slot of the second cylinder.
- Blow slightly bot shoes, by means of a rubber hammer, in order to set them correctly, under strong spring action, in the cylinder slots.
  ATTENTION! As long as the both shoes are taken down or fitted on their correct place, but without brake drums, do not depress the brake pedal, because the brake pistons under fluid pressure will be damaged by shifting and blocking!
- On refitting brake drum bring firstly both shoes in their initial position (building a cylindrical surface), blowing them slightly with a rubber hammer, parallelly to cylinder axis.

St. 2.1.35.06.4 CHANGING BRAKE SHOES OF THE REAR WHEELS

Taking down brake shoes of rear wheels needs preliminary operations i.e. taking rear wheel down (Op. 5.0.99.06.0), taking brake drum down (Op. 2.1.35.06.2) and disconnecting parking brake system from rear wheel, as described below (St. 2.0.35.06.2).

St. 2.0.35.06.5 DISCONNECTING PARKING BRAKE FROM REAR WHEELS BRAKING SYSTEM

- Loosen parking brake Bowden cable pushing forwards brake control handle and then slacking nut (4) and lock nut (5) - (see fig. 2.41), unscrewing both untill the cable is loosened, i.e. up to the end of adjusting rod (3) (access from car underside).

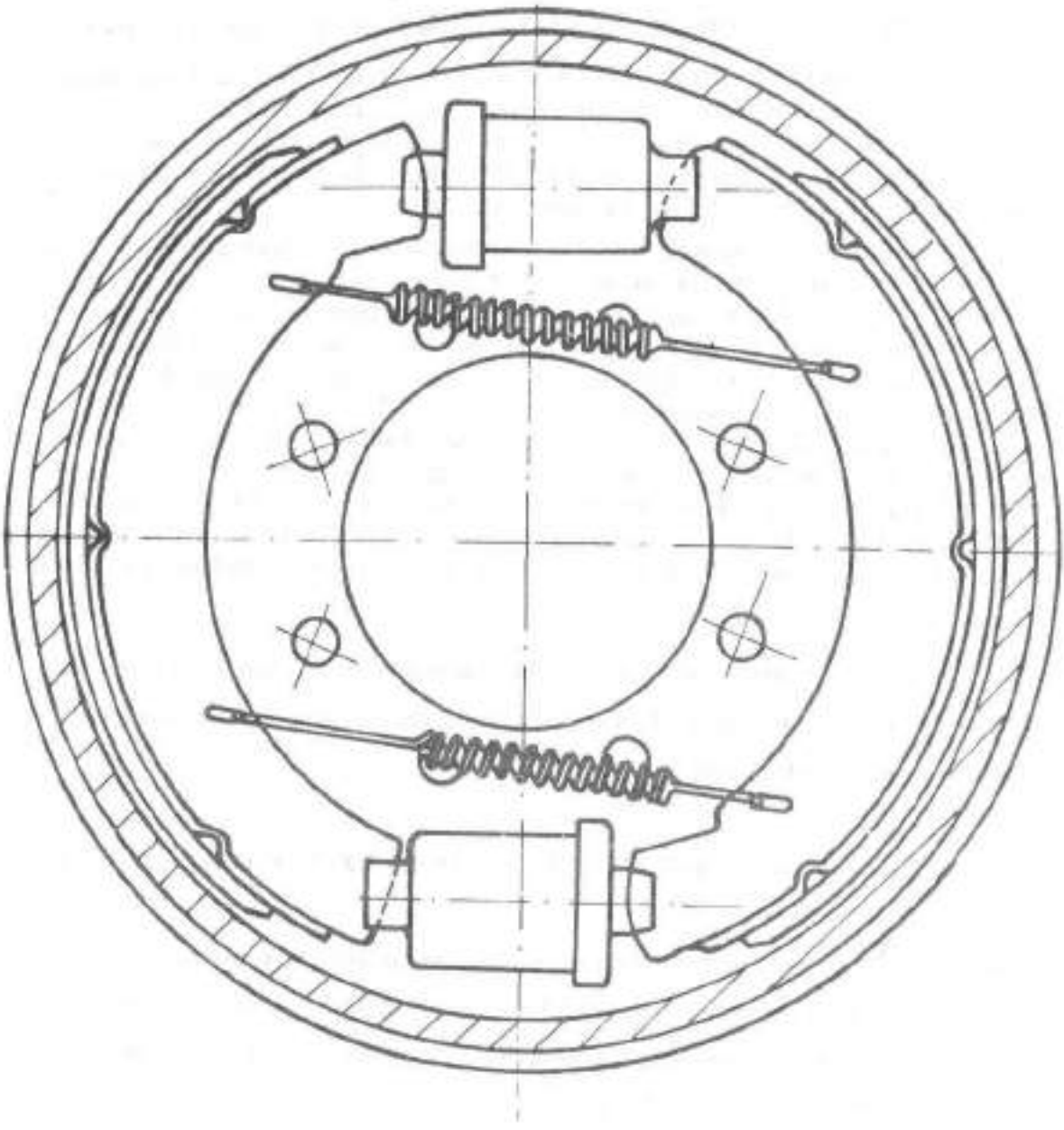


Fig. 2.40. FRONT WHEEL BRAKE ANCHOR PLATE
1. Front brake anchor plate; 2. Brake shoe; 3. Front wheel brake cylinder; 4. Retracting spring.

- If after repeated adjustments both nuts have reached the end of adjusting rod (3), remove completely both nuts and brake pulley fork, making free the Bowden cable and respectively the parking brake mechanism.

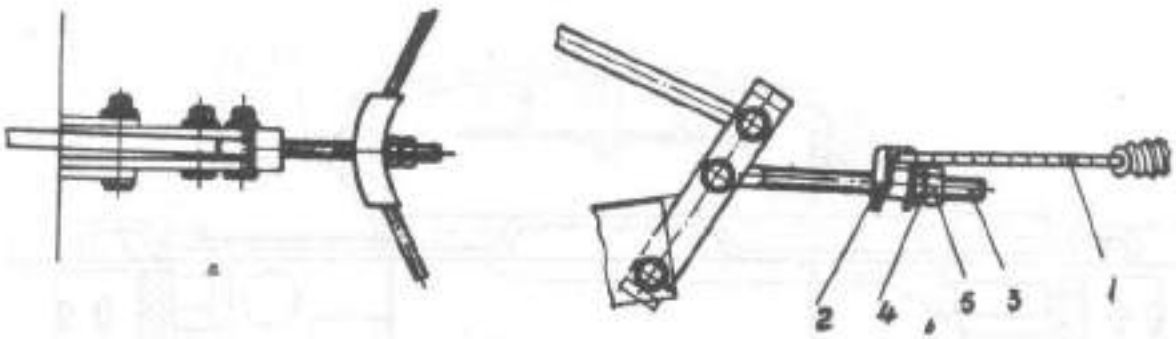


Fig. 2.41. BOWDEN CABLE TENSION ADJUSTING SYSTEM FOR HAND BRAKE CONTROL.
1. Brake cable; 2. Distributing piece; 3. Threaded rod; 4. Cable tension adjusting nut; 5. Lock nut.

- On refitting perform operations in reverse order.

ATTENTION! After changing worn out brake shoes with new ones, having different thickness, a readjusting of parking brake get necessary, naturally after refitting brake shoes and drum.

St. 2.1.35.06.6 TAKING REAR WHEEL BRAKE SHOES DOWN

- After loosening Bowden cable of parking brake, the levers controling the brake shoes get free in their hinges and can be positioned in a suitable manner.
- Using a lever (see fig. 2.42) remove the end of one shoe from brake cylinder slot and then from shoe support.
- The free shoe loosen the both retracting springs, making so possible removing of the second brake shoe.
- On refitting brake shoes perform operations in reverse order.
  Pay attention for correct setting of parking brake control levers and for correct setting of brake cylinder boots, i.e. the brake shoe end should not press and damage the boots.

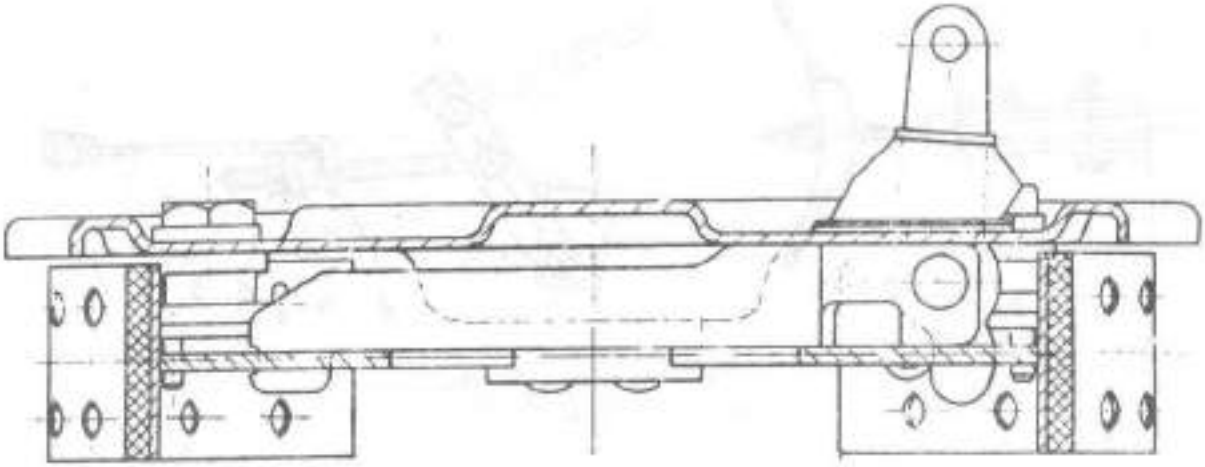


Fig.2.42. REAR WHEEL BRAKE ANCHOR PLATE.

- Perform refitting similarly with refitting front wheel brake shoes (Op. 2.1.35.06.3).

St. 2.0.35.06.7 ADJUSTING PARKING BRAKE

- Put a jack behind one of the rear wheels and lift the car, till the wheel gets free.
- Push parking brake control handle forwards up to refuse.
- In this handle position tighten adjusting nut untill the Bowden cable is tightened up and the free rear wheel is braked.
- Then slacken gradually the nut untill the wheel can be rotated.
- Lock the adjusting nut by tightening counter nut (adjusting rod should get out of nut at least (5 mm).

  After performing this adjusting the parking brake should hold at most on the fifth tooth of the notched locking quadrant.

OP. 2.1.35.05.0 CHANGING PISTON CUPS OF BRAKE & CLUTCH MASTER CYLINDER (see fig.2.43)

- Disconnect master cylinder from the brake control pedal by loosening the counter nut and then by unscrewing completely the piston pushing rod (3) (see fig.2.43).

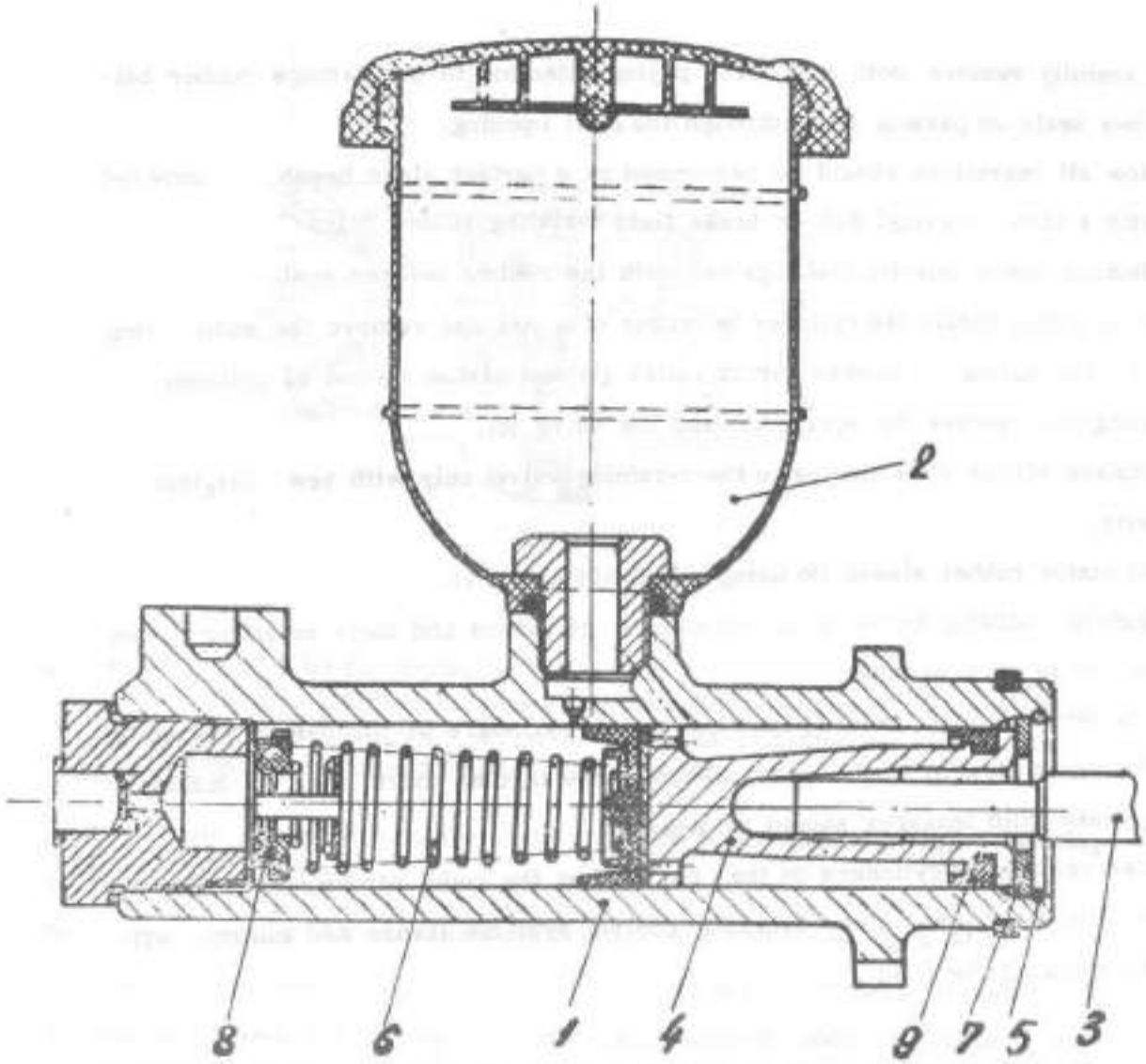


Fig. 2.43. BRAKE MASTER CYLINDER
1. Master cylinder; 2. Compensating brake fluid reservoir; 3. Piston pushing rod; 4. Master piston; 5. Clip ring; 6. Master cylinder spring; 7. Thrust collar; 8. Valve for brake system pression; 9. Master piston cup.

- Disconnect electrical leads (from the brake master cylinder) and all connecting pipes from both brake and clutch master cylinders.
- Protect with plastic plugs or polyethylene foil, in order to avoid penetrating of impurities into hydraulic circuit.
- Unscrew the cylinder fastening bolts: access may be got from below the engine bonnet.

- Carefully remove both cylinders, paying attention to not damage rubber bellows seals on passing them through the cowl opening.
- Now all operations should be performed on a perfect clean bench, covered with a thick polyvinyl foil or brake fluid resisting rubber foil.
- Remove piston pushing rod together with the rubber bellows seal.
- Push piston inside the cylinder by means of a rod and remove the snap ring (5). The spring (6) pushes thrust collar (7) and piston (4) out of cylinder. Going on, remove the spring (6) and the valve (8).
- Replace rubber cups (inclusive the retaining valve) only with new original parts.
- Fit piston rubber sleeve (9) using only S. 109 mandrel.
- Perform refitting brake & clutch master cylinders and their mounting on the car in reverse order.
- It is recommended, before mounting master cylinders on the car to proced to a tightness test by applying a pressure of 90 kg/cm^2 (bars) for 3 minutes; no brake fluid leakages should be observed.
- After remounting cylinders on the car, adjust the pedal stroke, according to Op. 2.0.19.02.0 and bleed hydraulic control systems (brake and clutch), without changing the fluid.

St. 2.1.35.05.2 CHANGING PISTON CUPS OF FRONT WHEEL BRAKE CYLINDERS

- Put a jack under respective wheel lift the car and take down:
  - The wheel, according to Op. 5.0.99.06.0
  - The brake drum, according to Op. 2.1.35.06.2
  - Brake shoes, according to Op. 2.1.35.0.6.3
- Getting access from the car underside disconnect brake cylinders from hydraulic brake control system, unscrewing the pipe fastening nuts.
- Protect the free pipe ends with plastic plugs or polyethylene foil, in order to avoid penetrating of impurities into hydraulic circuit.

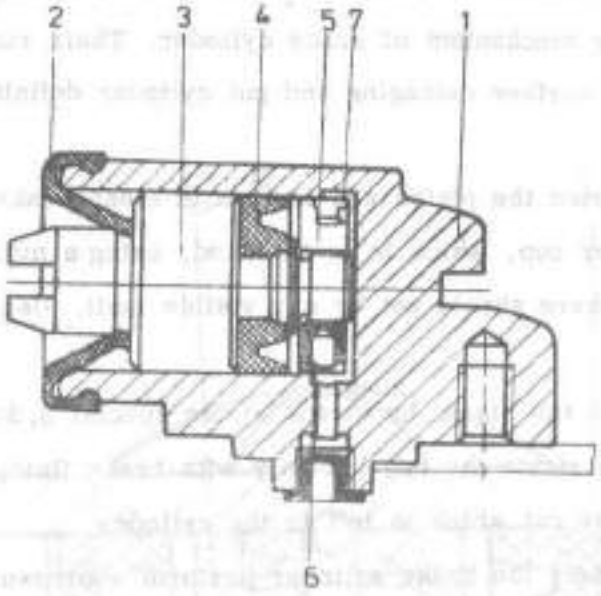


Fig. 2. 44. FRONT WHEEL BRAKE CYLINDER.
1. Brake cylinder; 2. Brake cylinder boot; 3. Brake piston; 4. Front brake piston cup. 5. Nut of brake shoes selfadjusting mechanism; 6. Spring positioning pin; 7. Ring spring.

- Unscrew nuts fastening brake cylinders on the brake anchor plate, getting access from underside the car.
- Going on, perform the successive operation on a bench (see fig. 2. 44).
- Remove firstly brake cylinder boot (2) and then the piston with its rubber cup (5) and (4). Check the spring for oxidation traces; if oxidation traces or rust spots will be found, renew the spring.
- Fasten ther. cylinder in a bench vice, paying attention to not deforme it ! (for great series use special device).
- Using the special S. 301 wrench, unscrew piston and remove it together with rubber cup, if the last one is damaged.
- Inspect cylinder surface for visible scratches and if there are fine scratches, it is allowed to polish cylinder surface using only very fine emery paper (granulation 800 and more). Polish surface until its roughness will disappear.
- If scratches will not disappear after a slight polishing, replace cylinder and the piston.

ATTENTION! It is forbidden to remove the nut with its spring, which constitute the self-adjusting mechanism of brake cylinder. Their removing will cause grave cylinder surface damaging and put cylinder definitly out of operation.

- Remove rubber cup from the piston and wash it in clean brake fluid.
- Inspect the new rubber cup, which is to be fitted, using a magnifying lens. On the sealing edge there should not be any visible fault. Use only original rubber cups!
- Fit new rubber cup on the piston by means of the special S. 302 drift. To make fitting easier lubricate the cup but only with brake fluid.
- Screw the piston in the nut which is left in the cylinder.
- After refitting completely the brake cylinder perform a pressure test by means of D 302 manual pressure device, applying a pressure of 90 kg/cm^2 (bars) for 3 minutes. In this time no fluid leakage should appear.
- Now perform remounting brake cylinder with the new piston cup on the car, in reverse order as on dismantling it. Pay special attention by tightening all nuts of fluid pipes.
- Bleed the brake system, as described in Op. 2. 0. 35. 04. 0 - except the fluid changing.

St. 2. 1. 35. 05. 3 CHANGING PISTON CUPS OF REAR WHEEL BRAKE CYLINDERS

- Loosen the parking brake Bowden cable by unscrewing counter nut and the threaded sleeve mounted on adjusting rod (see Op. 2. 1. 35. 05. 2).
- Lift the car on a jack and remove the wheel.
- Perform all operations similarly as described above, concerning the front wheel brakes.
- Finaly bleed the brake system and adjust the parking brake, according to Op. 2. 1. 35. 06. 7.

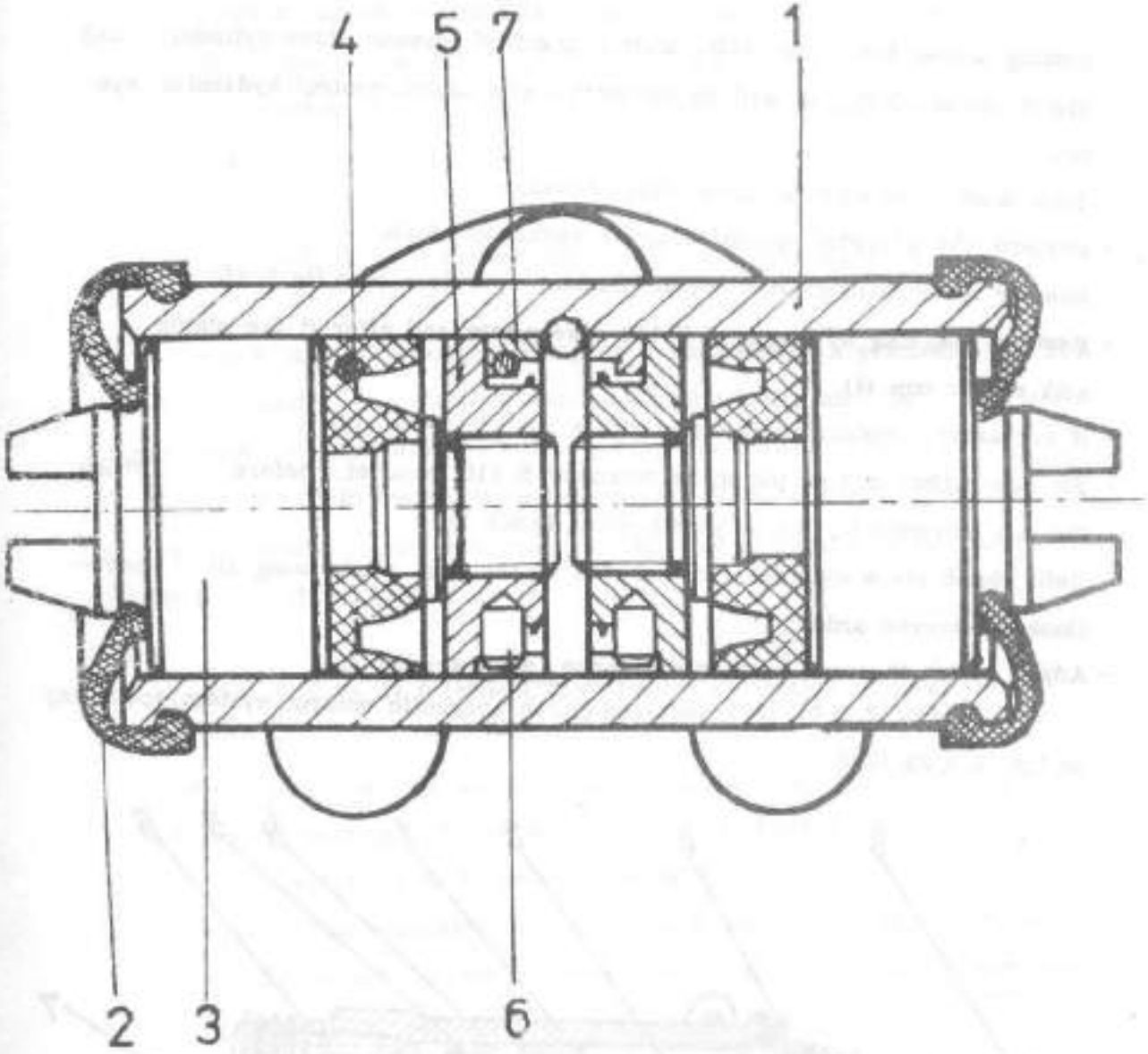


Fig. 2. 45. REAR WHEEL BRAKE CYLINDER
1. Brake cylinder; 2. Brake cylinder boot; 3. Brake piston; 4. Brake piston cup; 5. Nut of brake shoes selfadjusting mechanism; 6. Spring positioning pin; 7. Ring spring.

St. 2.0.35.05.4 CHANGING PISTON CUP OF CLUTCH CONTROL SLAVE CYLINDER, MOUNTED ON ARO-L-25 ENGINE.

- Getting access from underside, undo connection between slave cylinder and clutch release fork, as well as connection with clutch control hydraulic system.
- Take down slave cylinder from clutch housing.
- Perform the following operations, on a workshop bench,
- Remove slave cylinder boot (8) and pushing rod (2) - (see fig. 2.46).
- Remove snap ring by means of S 102 nose pliers and after it the piston with rubber cup (4).
- If necessary, replace rubber cup with a new, original one.
- Fit new rubber cup on piston by means of S 110 mandrel. Before fitting the cup lubricate it, but only with clean brake fluid.
- Refit clutch slave cylinder and mount it on the car, performing all operations in reverse order.
- Adjust clutch throwout bearing clearance, as described in Op. 2.0.01.22.1 and bleed clutch hydraulic control system, according to Op. 2.0.35.02.0.

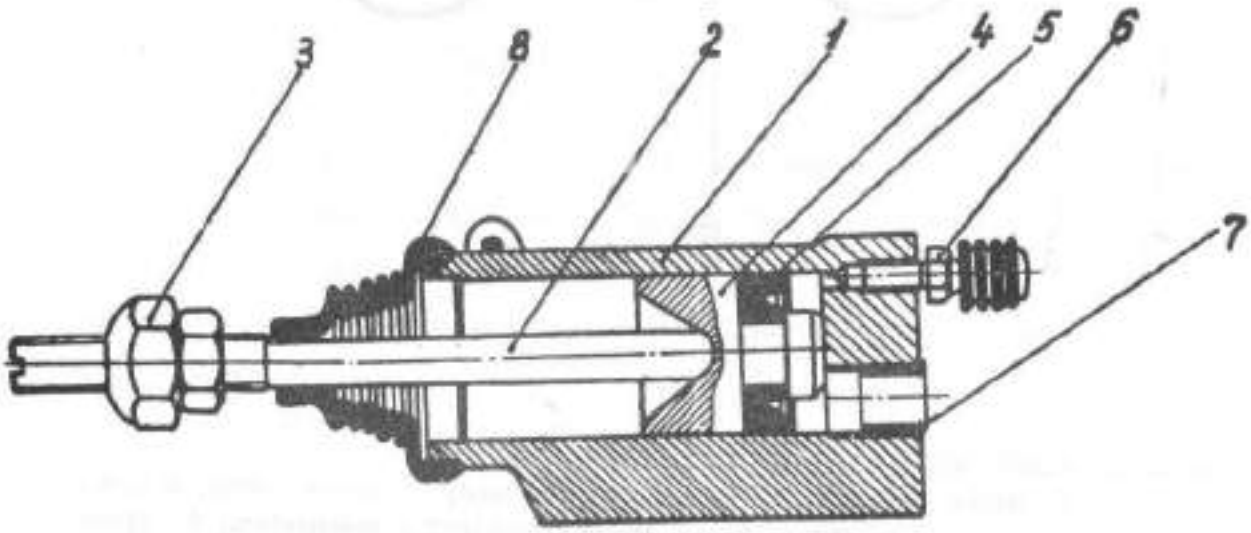


Fig. 2.46. CLUTCH CONTROL CYLINDER.
1. Slave cylinder; 2. Piston pushing rod; 3. Rounded adjusting nut; 4. Slave piston; 5. Slave piston cup; 6. Bleed nipple; 7. Feeding connection; 8. Slave cylinder boot.

St. 2.0.35.05.5D CHANGING PISTON CUP OF CLUTCH CONTROL SLAVE CYLINDER, MOUNTED ON ARO D-127 ENGINE

- To get access to clutch control slave cylinder take down preliminary transmission tunnel cover, as described in Op. 2.0.53.01.0.
- The other operations are the same as for ARO L-25 engine, (see Op. 2.0.35.05.4).

OP. 5.0.99.07.0 CHECKING HAND PARKING BRAKE

- Lift the car upon an arranged ramp or a road having a gradient of 30% (about 16°), stop it by actuating main, hydraulic brake and, by applying a force of about 40 daN (kg), pull the parking brake handle.
  On slacking the main hydraulic brake, the car should remain motionless on the ramp (braked). If not, perform the adjusting of parking brake, as described in Op. 2.0.35.06.7.

OP. 2.0.35.03.0 INSPECTING PARKING BRAKE CONDITION

- Pull parking brake handle, which should reach at most the fifth tooth of notched locking quadrant. If brake handle climbs beyond the fifth tooth, perform brake adjusting as in Op. 2.0.37.06.7.
- Getting access from underside of car, check if counter nut is well tightened, if there are no oxidation areas on the cable; if yes, the Bowden cable should be replaced (see: Overhauling the parking brake).
- Check cable fastening on car chassis and if cable does not touch moving or vibrating parts.
- Check cable protecting envelope condition.

2.2.5. MAINTENANCE OF STEERING SYSTEM

A correct operation of steering system is determined by steering gearbox, hinges correct conditions, by tyre balance and pressure, by steering wheels angles.

OP. 5.0.99.09.0 CHECKING STEERING SYSTEM CONDITION

- Driving on road, check if on curvatures the necessary force to turn steering wheel is equal in both senses, without any friction or jaming tendency. There should not be steering wheel trepidations.
- Observe if driving on shourt curvatures the tyres do not touch steering system components.
- On driving out of a road curve the steering should return in its forward running position. At the end a slight correction of steering wheel position is allowed.
- Check the car running straight forwrds:
  On a horizontal, dry road, having no lateral wind, a car, running at a moderate speed of 30 - 40 km/h, straight worwards, when the steering wheel is left free should not deviate laterally more then one meter on a distance of 50 meters.
  If above mentionned troubles will occur, perform necessary interventions, described in the chapter "Repairs".

OP. 2.0.34.05.0 ADJUSTING STEERING WHEEL ANGULAR PLAY

Driving a car straight forward, the angular play of steering wheel should not exceed 15° (about 50 ...m on steering wheel periphery).
As far as a great angular play makes difficult the car controlability it is necessary to adjust the clearance between steering roller and steering hourglass worm of steering gearbox, as follows:

- Bring front wheels in "straight ahead" position, by turning steering wheel.
- Getting access from underside of car, unscrew locking nut (1) - (see fig. 47) and remove it together with external tooth lock washer (2).
- Turn clockwise adjusting screw (3) untill angular play of steering wheel reaches acceptable limits, but without making difficult the steering wheel rotation.

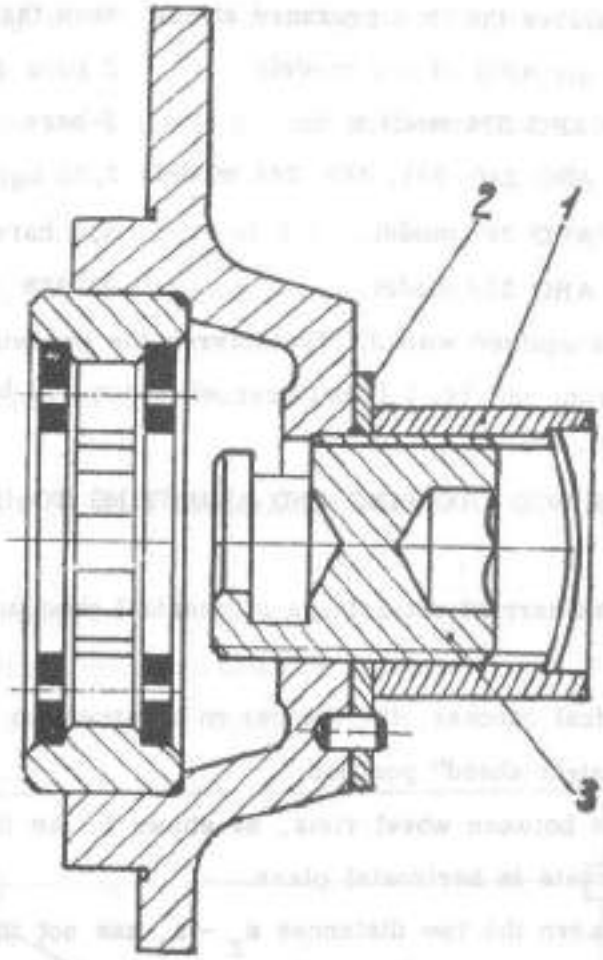


Fig. 2. 47. STEERING WHEEL ANGULAR PLAY ADJUSTING SYSTEM.
1. Nut locking angular play adjusting screw (3); 2. External tooth lock washer; 3. Adjusting screw.

- In order to judge the results of adjusting, lift the car, by means of a jack, so that both front wheels lose touch with the ground.
- In case that the adjusting screw (3) was tightened up to refuse, but the steering wheel play did not decrease, it means that this play results from steering drag link knukles or from steering spider and the trouble remedyed according to indications of chapter "Repairs".
- After performing play adjusting refit the lock washer (2) and locking nut (1).

OP. 2. 0. 31. 02. 0 CHECKING TYRE PRESSURE

The tyre pressure should be checked when in an ambient temperature (in summer, about 25°C and in winter, about 0°C).

At indicated temperatures the tyre pressure should have the following values:

- Front wheels: for all ARO 24 car models 2 bars (kg/cm^2)
  for ARO 320 models 3 bars
- Rear wheels: for ARO 240; 241; 243; 244 models 3,25 bars
  for ARO 242 model 3,5 bars
  for ARO 320 model 5 bars

For the aro 24 cars equiped with JR 78-15 tyres the pressures will have the following values: front wheels: 2 bars; rear wheels = 2,5 bars

OP. 5.0.99.10.0 CHECKING AND ADJUSTING TO-IN

This operation can be carried out using a mechanical checker as well as on an optical bench.

- On using a mechanical checker, lift the car on an inspection ramp, having front wheels in "straight ahead" position.
- Measure the distance between wheel rims, as shown in the fig. 2.48, performing both measurements in horizontal plane.
  It the difference between the two distances $a_2 - a_1$ has not the indicated value (1... 4 mm), performe the "to- in" adjusting, as follows:

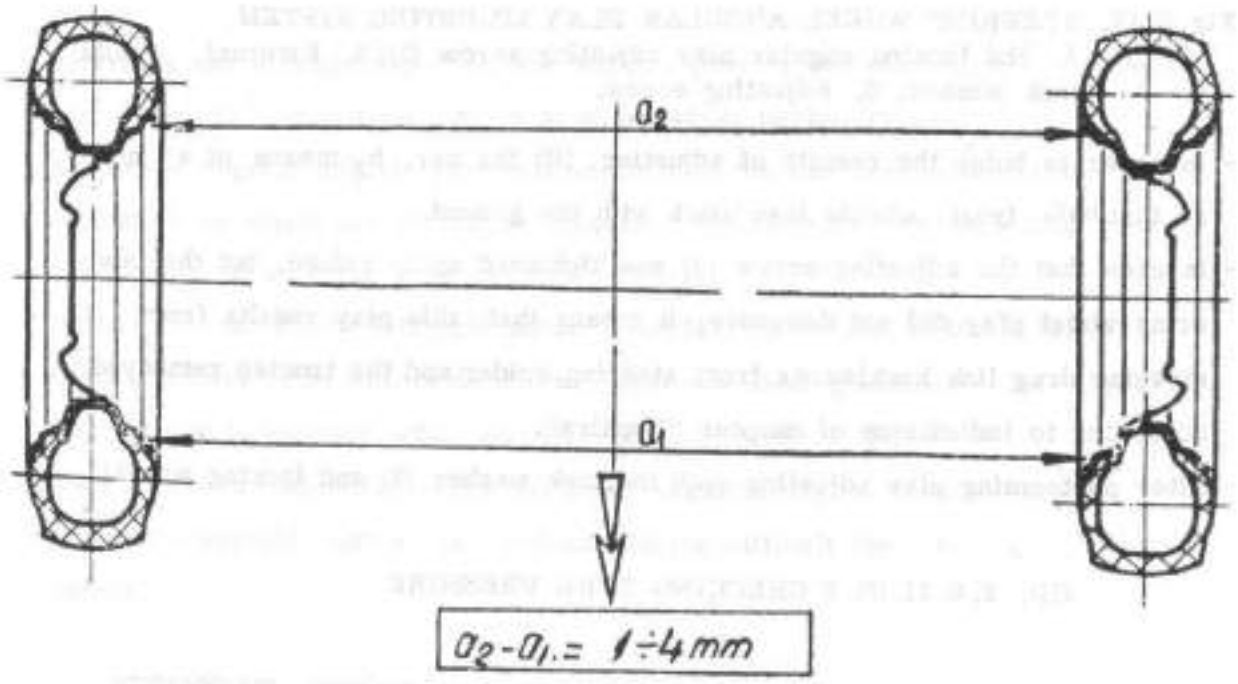


Fig. 2.48. MEASURING FRONT WHEEL TOE-IN.

- Remove split pins of the nuts tightening the draglink clamps, and slacken the nuts.
- Turn in the same sense the R.H. and L.H. draglink untill the correct to-in value is obtained.
- Tighten the nuts with a torque of 0.9 ... 1.5 daN.m (kg.m) and secure the nuts with new 1.6 x 25 slit pins.

ATTENTION: A wrong to-in adjusting leads to rapid wear of tyres (fish scales shaped) and causes steering instability.

OP. 2.0.31.03.0 CHANGING WHEELS BETWEEN THEM

After a car running of about 6000 km, in order to obtain an unifrom wear of tyres, i.e. their maximal endurance, perform the changing of wheels between them, as shown in the fig. 2.49.

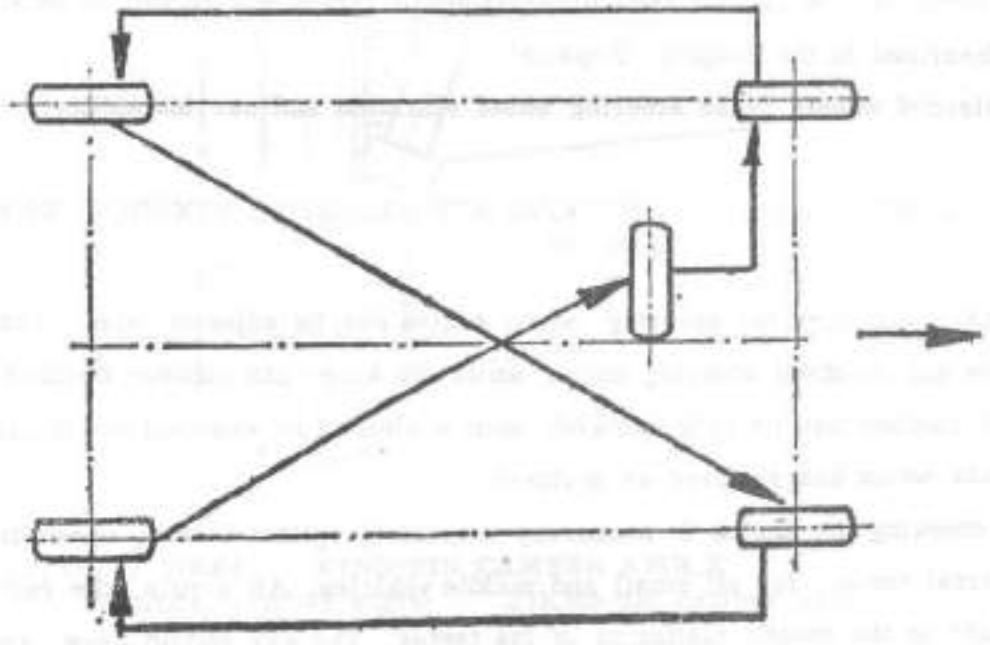


Fig. 2.49. DIAGRAMA OF CHANGING WHEELS BETWEEN THEM.

If a tyre blow off occurs, change respective wheel with the spare wheel Then, at first stopping at a SERVICE workshop refit the faulty wheel and perform again its dynamic balancing (see Op. 2.0.99.13.0).

— Take down the spare wheel and fit repaired wheel on its place, in order to respect the above indicated wheels changing (fig. 2. 49).

OP. 2. 0. 09. 13. 0 DYNAMICAL BALANCING OF WHEELS

The wheel balancing is carried out on special checking and dynamicaly balancing machines.

The wheels which have an unbalance less than 60 grams in the area of rim edge (ø 400 mm) can be considered as acceptable for further running.

If the found unbalance is more than 60 g performe dynamical balancing of the wheel using original counterweights or weights which fit on the wheel rim, fastened with clamps in such a manner that an accidental detachment will be impossible.

If the found unbalance exceeds 140 g. in both planes, a balancing by means of counterweights is not recommended and a remedying should be performed, as described in the chapter "Repairs".

Unbalanced wheels cause steering wheel vibration and car instability.

OP. 5.0.99.10.0 CHECKING AND ADJUSTING STEERING WHEELS ANGLES

On ARO jeep cars the steering wheel angles can be adjustet, i. e. camber, caster and maximal steering angle, while the king- pin camber doubled with wheel camber can be only checked, with a view of an eventual overhauling of the car which has suffered an accident.

For checking the angles is necessary a special, optical tester, which is an universal tester, for all small and middle vehicles. As a rule, the car is brought on the mobile platforms of the tester. The car should have correct tyre pressure (as indicated in Op. 2. 0. 31. 02. 0), steering wheel angular play up to 15^{o} and steering wheel to-in of 1...4 mm). If necessary, the angular play should be firstly adjusted, as described in Op. 2. 0. 34. 05. 0.

- Performe measurements according to tester instructions.

St. 5.0.99.10.1 CHECKING AND ADJUSTING CAMBER ANGLE

The camber angle value is $1^{o} \pm 30'$, provided that between the R.H. and the L.H. wheel the angle difference should not be more than 45', (see fig. 2, 50).

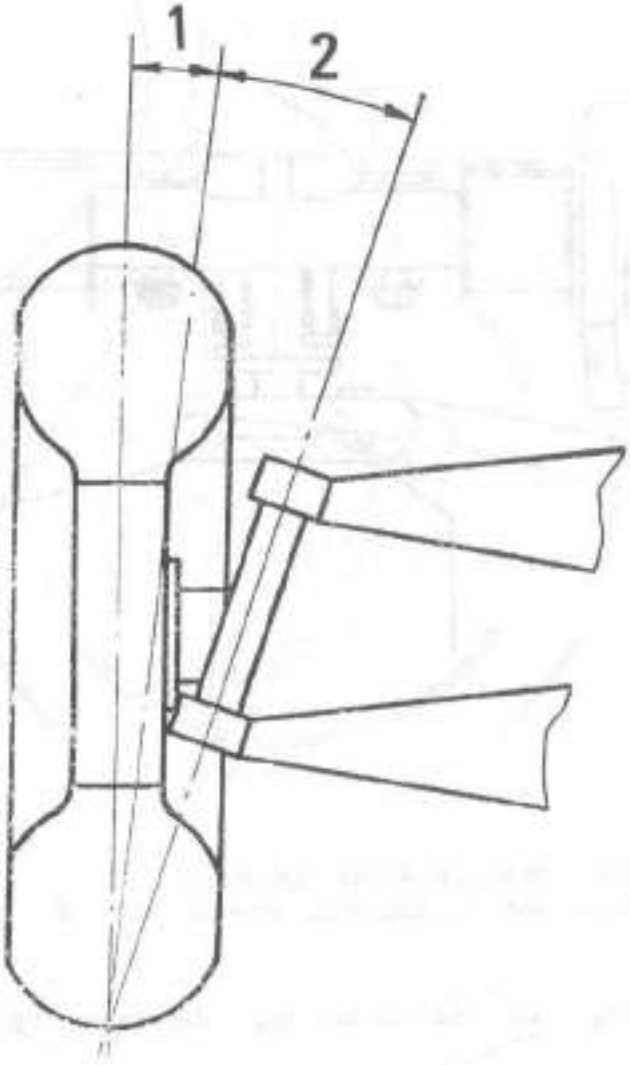


Fig. 2. 50. FRONT WHEEL KING-PIN CAMBER ANGLE
1) Wheel camber angle; 2)King-pin camber angle.

If this condition is not fulfilled, perform respective adjusting. (see fig. 2, 51).

For this:

- Remove counter nuts (1) from upper control arm support (3).
- Slacken nuts fastening the support (3) and remove or introduce adjusting plates, equaly on both bolts, knowing that for each adjusting plate of 1 mm thickness the camber angle changes with $0,25^{o}$, i.e. 15'.

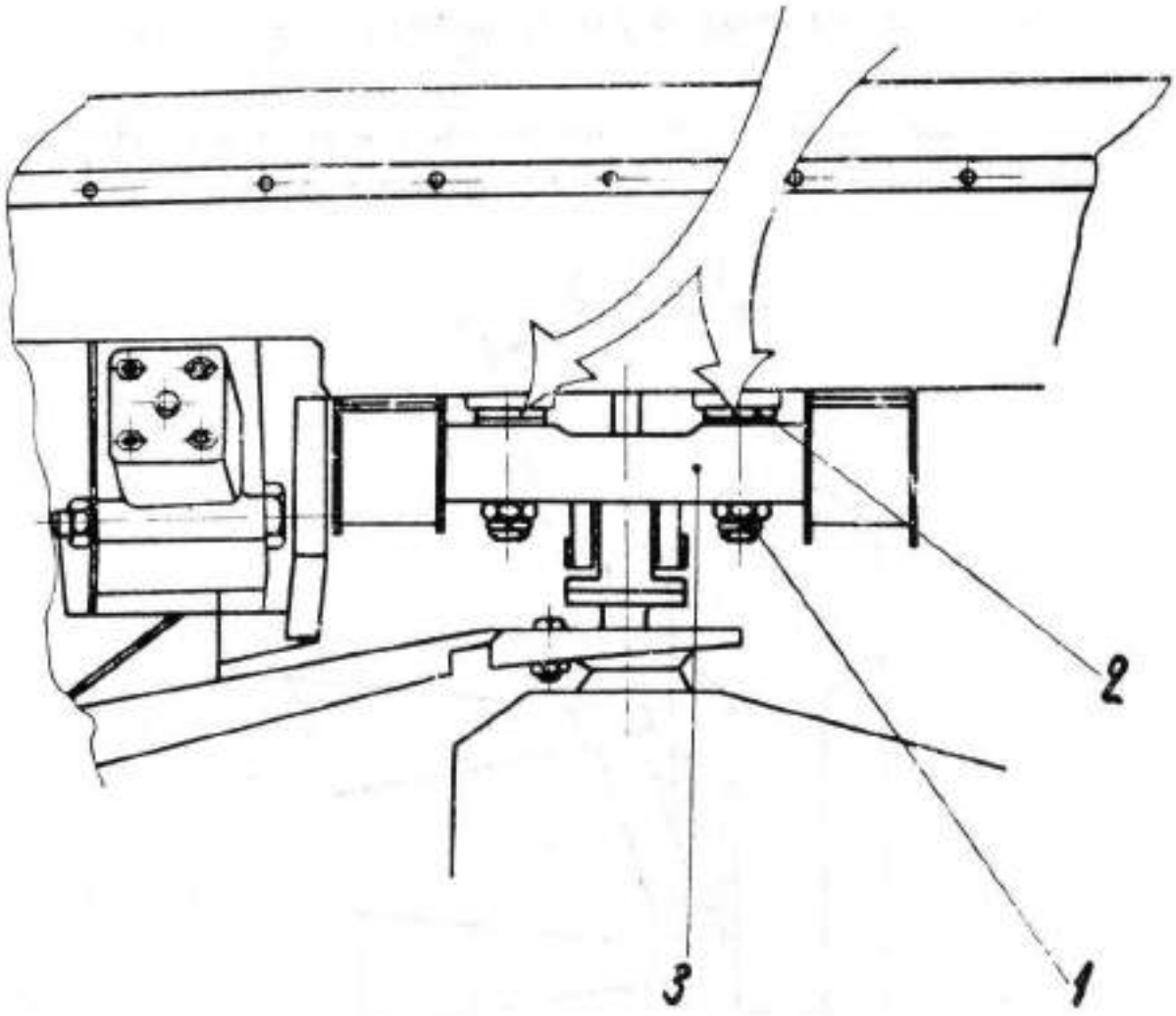


Fig. 2.51. ADJUSTING CAMBER &CASTER ANGLE
1. Fastening nut; 2. Adjusting washer set; 3. Upper control arm bracket.

By adding adjusting plates the camber angle decreases; by taking out, it increases.

- Tighten then the nuts and counter nuts with a torque of 7 daNm (kgm).
- If caster angle should be also adjusted, tighten the nuts after performing this second adjusting.

St.5.0.99.10.2 CHECKING AND ADJUSTING CASTER ANGLE

When the car is unloaded, the caster angle value should be 20' $\pm$ 45" provided that between the R.H. and L.H. wheel the caster angle difference should not be more than 45" (see fig. 2.52).

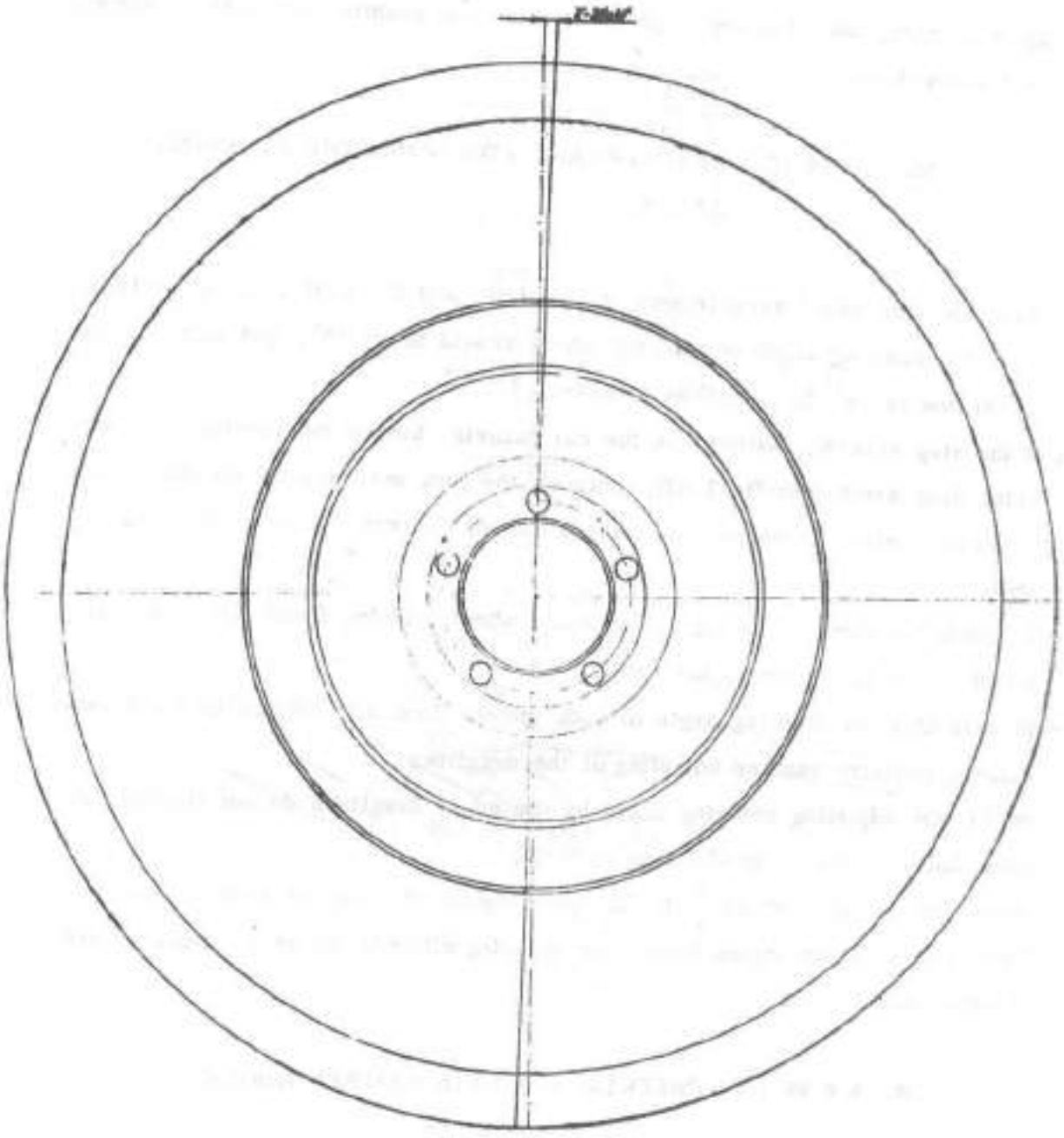


Fig. 2. 52. STEERING WHEEL CASTER ANGLE
$= 20' \pm 45''$.

- If the angle deviations are more than 1^{0}, the caster angle should be adjusted, by moving spacing plates, from front bolt to the rear one, in order to decrease the caster angle, knowing that the removing of a spacing plate of 1 mm thickness change the caster angle value with 40' (from the front to rear bolt) less, while moving the plate from rear to front bolt increases the agle value.

- After finishing the adjusting, tighten the nuts and counter nuts with a torque of 7 daNm (kgm).

St. 5.0.99.10.3 CHECKING AND ADJUSTING THE STEERING ANGLE.

- Turn steering wheel successively to the R.H. and the L.H., up to the limit the steering angle of internal wheel should be of 30°, and that of external one of $26^{\circ}\ 30'$, with an allownce of $\pm\ 1^{\circ}$.
- If the stop screws, fastened on the car chassis, hinder the turning of steering drop arms (see fig. 2.53), unscrew the lock nuts and adjust the bolt position in order to secure for internal wheel correct value of steering angle (30°).
- Perform the same adjusting for opposite wheel, turning firstly the steering wheel to the L.H., up to the limit.
- In case that the steering angle of both wheels does not enclose in the allowed values, perform another adjusting of the draglinks.

  NOTE: On adjusting steering angle by means of draglinks do not tighten draglink bolts, before a readjusting of to-in.
- When caster angle adjusting is finished, tighten the nuts of stop screws.

  Uncorrect steering angles cause car steering difficult (to great affort on steering wheel).

St. 5.0.99.10.4 CHECKING KING-PIN CAMBER ANGLE

- It is measured in the same time with the wheel camber angle and its value should be $10^{\circ} \pm 30'$, provided that between the R.H. and L.H. wheel the difference should not exceed 45' (see fig. 2.50).

  The value of this angle cannot be adjusted but in the limit of the wheel camber angle.

  Eventual deviations require remedyings, according to prescriptions of chapter "Repairs".

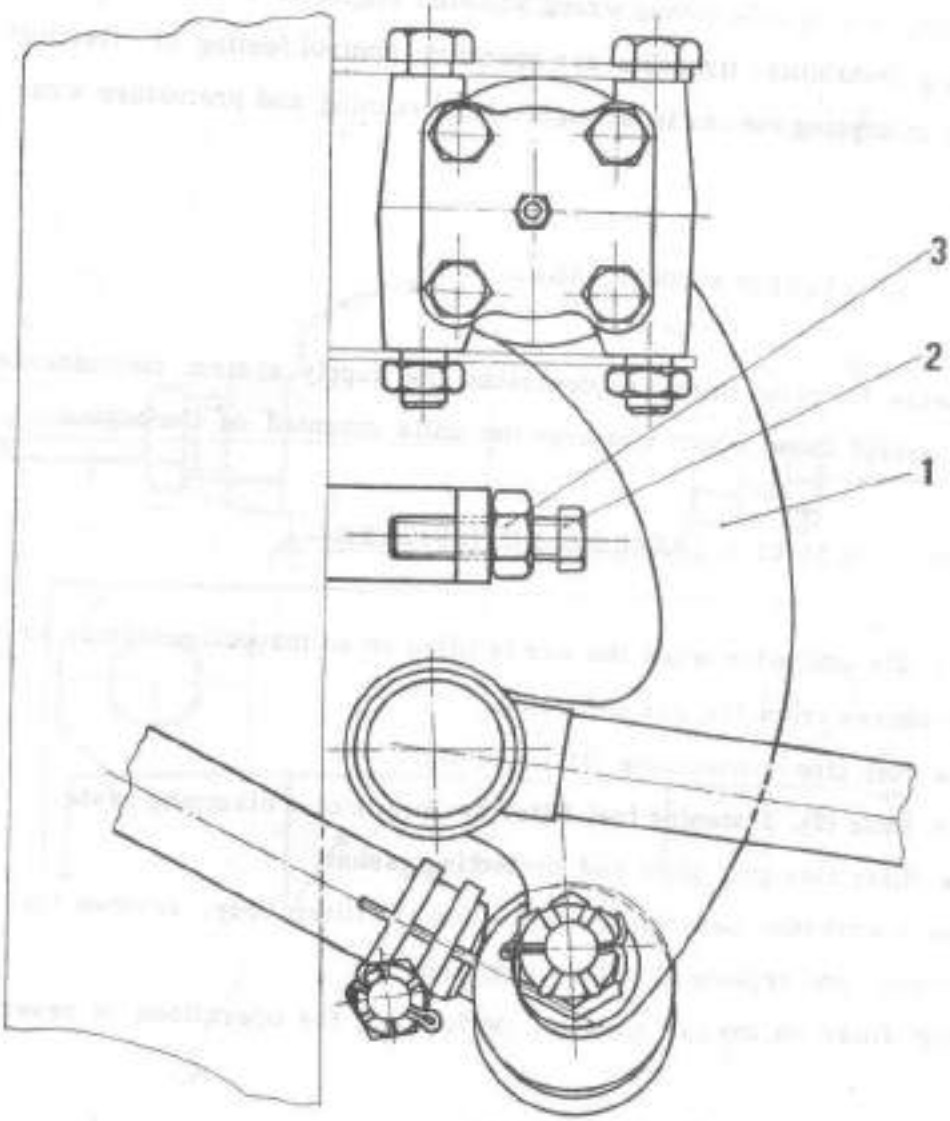


Fig. 2. 53. ADJUSTING STEERING ANGLE
1. Drop arm; 2 Serew limiting steering angle; 3. Lock nut.

St. 5. 0. 99. 10, 5 CHECKING TO-IN

If steering angle adjusting was performed, it is necessary to adjust again the to-in according to Op. 5. 0. 99. 10. 0.

The driving of a vehicle having wrong adjusted angles of steering wheels leads to steering instability, tiresome car operation control feeling of "floating", difficulty in keeping the car in straight ahead running and premature wear of tyres.

2.2.6. SUPPLY SYSTEM MAINTENANCE

In the below following lines are described the supply system maintenance operations, except those which concerne the units mounted on the engine.

OP. 2.0.11.02.0 CHANGING FUEL FILTER

- Perform this operation when the car is lifted on an inspection ramp, in order to have access from the car underside.
- Unscrew fuel pipe connections (1) - see fig.2.54.
- Unscrew bolts (2), fastening fuel filter by means of a clamping plate.
- Remove filter clamping plate and protecting gasket.
- Now, on a workshop bench, unscrew the lower filter body, remove the filtering element and replace it with a new one.
- Refit fuel filter on the car chassis, performing the operations in reverse order.
- Check pipe connections for fuel leakages.

  IMPORTANT! Pay special attention to avoid any fire danger!

OP. 2.0.11.01.0 WASHING FUEL TANK (for gasoline or Diesel fuel)

- Perform this operation in a special arranged room, considering the fire danger!
- When the fuel level indicating instrument shows that the fuel tank is empty, unscrew the fuel tank drain plug, after having previously put a collecting vessel under the tank.

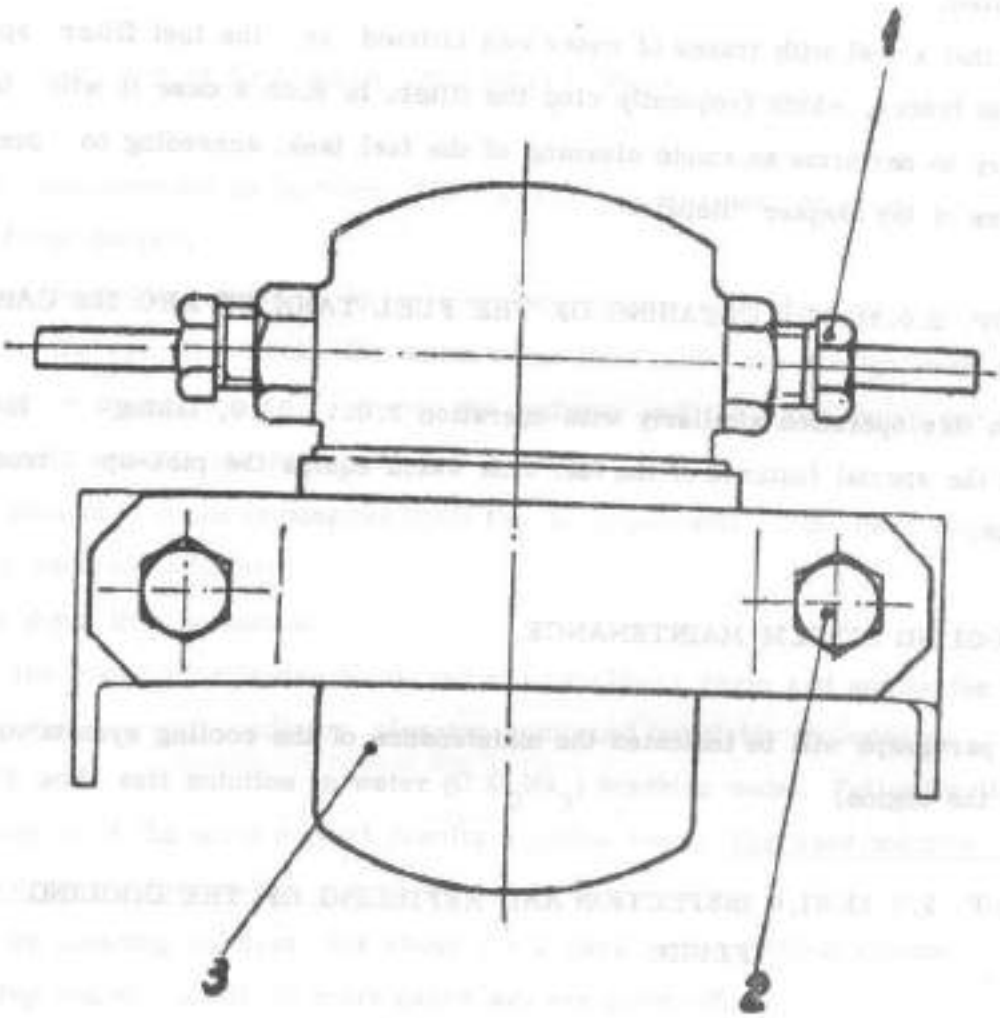


Fig. 2.54. 1. Fuel line connecting nut; 2. Bolt fastening fuel filter clamping blade; 3. Lower filter body.

righten then the radiator filler cap.

OP. 2.0.13.03.0 CHANGING ANTIFREEZE FLUID

It is recommended to perform this operation at the end of autumn.

- Drain the cooling system as indicated above (Op. 2.0.13.02.0).
- Shut all the cocks and fill up the system with clean water.
- Let the engine run for 5-10 minutes and drain again the cooling system.
- Shut again all the cocks and fill up the cooling system with fresh antifreeze fluid.
- Start again the engine and, as far as thefluid level decreases, (eliminating the air from the fluid) fill up the system with antifreeze fluid, untill the fluid level in expansion vessel reaches about 75% of it, or, if the cooling systemis not sealed, the fluid level should reach 10-15 mm above the radiotor core.
- Finaly, tighten the radiator filler cap.

OP. 2.0.13.04.0 DRAINING UP THE COOLING SYSTEM

- This operation is performed when the engine is not cooled with antifreeze fluid and a frost danger is possible (temperatures below $0^{o}C$).
- Drain completely the cooling system, by opening all the cocks and the radiator filler cap (the cocks mounted on cylinder head, cylinder block the hose connecting water pump with the radiator and the lower radiator basin).
- After water complete draining shut the cocks of cylinder block and lower radiator basin.

2.2.8. ELECTRICAL EQUIPMENT CURRENT MAINTENANCE

In this paragraph is described the current maintenace of electrical equipment, except the units mounted on the engine.

OP. 2.0.37.01.0 CHECKING STORAGE BATTERY CHARGING CONDITION

The storage battery charging condition is checked by measuring the electrolyte density. For this:

- Tilt backwards the R.H. passenger seat and remove the battery cover
- Wipe battery surface with a wet cleth, untill it is clean and then with a dry, clean cloth, antill the surface gets dry and clean.
- Unscrew the cell plugs and introduce in each cell the densimeter.

The electrolyte density should be the same in each cell, namely:

Battery condition	Electrolyte density (g/cm^3)	
	At $+15^0C$	In tropical zones
Charged 100%	1,28	1.24
Charged 50%	1.20	1.15
Discharged	1,12	1.09

If electrolyte density of one of the battery cells is under 1.20 g/cm^3, although the electrical equipment (alternator, voltage regulator, electrical connections) are in good conditions and charge well (according to instrument indication), the battery should be taken down in order to be checked and charged in a repair workshop.

- After checking the battery, screw the plugs of each cell, wipe well the battery surface, fit back the battery cover and tilt the passenger seat in its normal position.

OP. 2.0.37.02.0 CHECKING BATTERY CONNECTION

- Tilt backwards the passenger seat and remove the battery cover from the seat support.
- Wipe firstly with a wet cloth and then with a dry one the battery surface, untill it gets clean and dry.

Inspect battery connections for oxides or slackend connections. If necessary, undo both connections and clean them and the battery terminals, using emery paper. Remove all traces of resulted powder.

- Refit connections, securing a contact on a most possible great surface; protect connections with neutral grease.

OP. 2.0.37.03.0 CHECKING BATTERY ELECTROLYTE LEVEL

- Tilt backwards the passenger seat and remove battery cover from the seat support.
- Remove the plugs of each cell and inspect the electrolyte level; do not let electrolyte level to decrease below the upper edge of rippled PVC separators. Normally, the electrolyte level should surpass with 10-15 mm the edge of separators.
- Top up electrolyte always with distilled or half distilled water, but never with acid.
- If for some reason some electrolyte was poured out, top up the battery with fresh electrolyte, having the same density as that from battery.
- Finaly, screw the cell plugs, fit the battery cover and tilt back the passenger seat.

OP. 5.0.99.08.0 CHECKING DASHBOARD INSTRUMENTS

a) Check voltage indicator when the battery is on charging stage. After some successive travels, when generally the storage battery gets discharged (specially inside the localities), check the voltage indicator which should indicated the charging stage. To judge rightly the charging condition of battery, perform electrolyte density checking, as described above (Op. 2.0.37.01.0).

b) Check fuel level gauge on filling the fuel tank. When the fuel level gauge indicates 1/2, drive to a filling station and fill the tank with 40 liters fuel. In this new situation the fuel level, gauge should indicated 1/1.

c) The fuel level alert is checked when the fuel tank is completely emptied for cleaning. On refilling the fuel level alert should switch off when about 8-10 litres of fuel were poured in the tank.
Another manner of checking fuel level alert is to empty grdually the fuel through the drain plug. When the level alert lights, going on, the fuel quantity drained drained up to complete empying should be 8-10 litres.

d) The pilot lamps of flasher lights or main driving beam should be checked normally before every departure.

e) Checking of speedometer can be carried out driving on marked roads with a constant speed of 60 km/h (36 m.p.h.). During 5 minutes will be covered a distance of 4.6-4.9 km(2,85 - 3.02 milles).At a greater speed the spoedometer indicates with 6% more speed as the real speed. In order to performe a correct checking one should also take in account the rate of wear of tyres.

f) On normal engine running the oil pressure gauge should indicate a pressure of 2-4 bars (kg/cm^2), while at idle speed at least 0.5 - 0.8 bars.

g) The oil pressure alert should light on starting the engine and switch off after 2-3 seconds; if not, in case that the oil pressure gauge indicates the oil pressure existence, drive to the first SERVICE workshop for remedying the fault.

IMPORTANT:
If, on running engine there will be no oil pressure, the car should be hauled to a SERVICE workshop, for remedying the fault or the fault can be remedied on the spot, following the indicationns of chapter "Repairs".

h) Check the parking brake pilot lamp by pulling the brake lever, when the pilot lamp should light. On releasing the brake lever, the pilot lamp should switch off.

i) For checking hazard indicator switch on R.H., L.H., front and rear traffic indicators (flasher lamps) which should operate simultaneously.

OP. 2.0.99.12.0 ADJUSTING THE HEADLAMPS

The ARO jeep cars can be equiped with round or rectangular headlamps, provided with an adjusting device, in order to orrientate the light beam, according to loaded or unloaded car condition.

On the "F A D" rectangular headlamp (see fig. 2.55), the rocking level should be up "when the car is loaded and down, when it is unloaded.

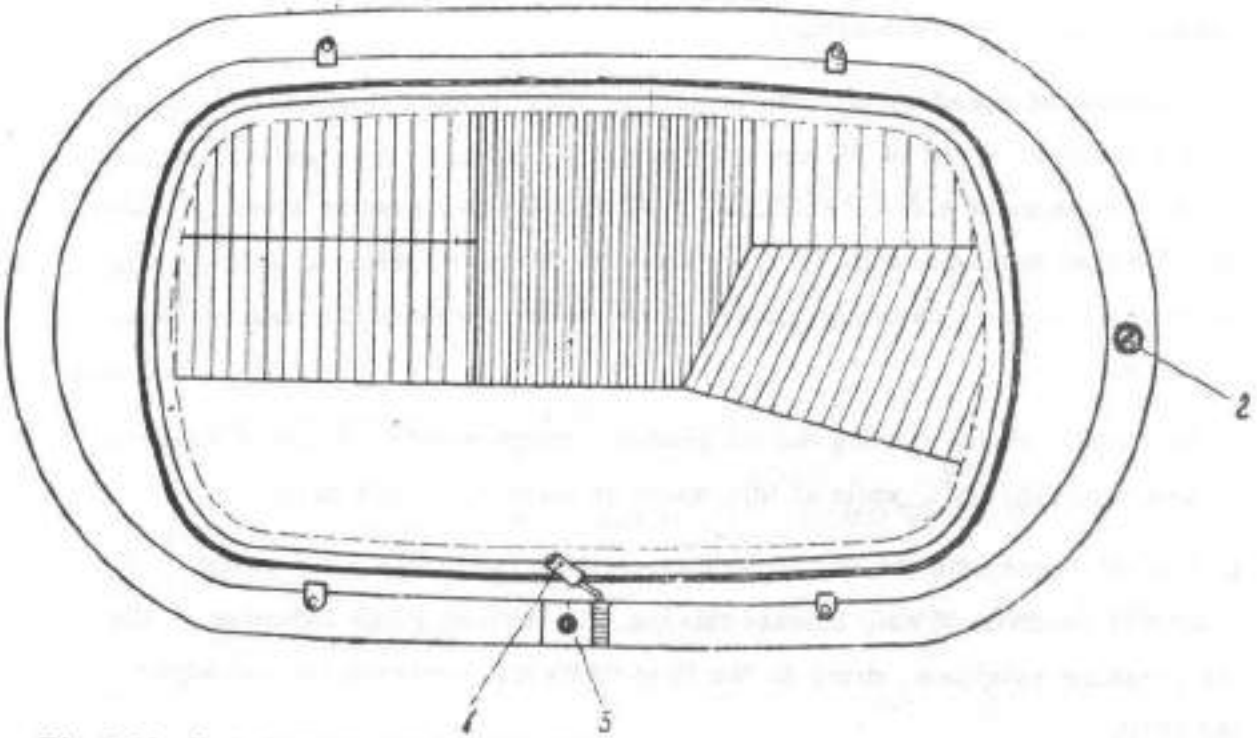


Fig. 2.55. F A D RECTANGULAR HEADLAMP
1. Headlamp rocking lever; 2. Horizontally adjusting screw; 3. Vertically adjusting screw

On the "F E R" rectangular headlamp (see fig. 2.56), the rocking lever (1) should be to the left, when the car is loaded, and to the right, when it is unloaded.

ATTENTION! Do not adjust the headlamps corresponding to unloaded condition when the car is loaded! The light beam will blind the drivers coming from opposite side, causing the danger for grave accidents.

To adjust correctly the headlamp range proceed as follows:

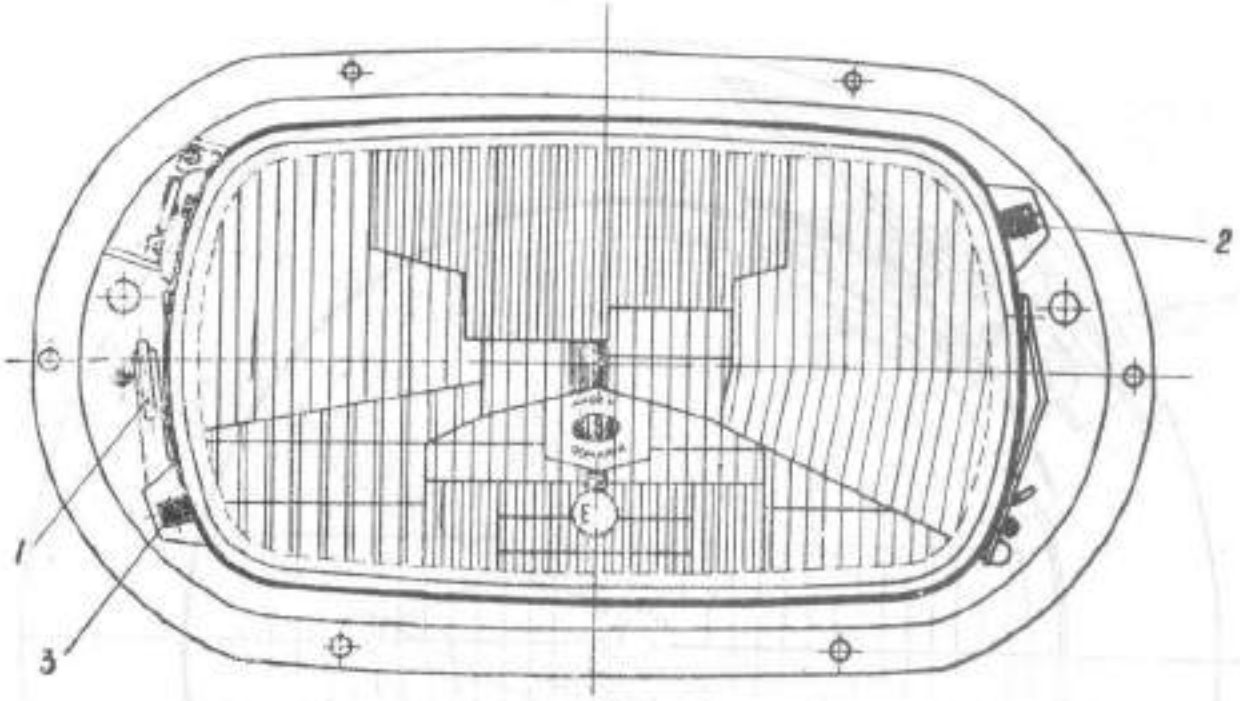


Fig. 2.56. F E R RECTANGULAR HEADLAMP
1. Headlamp rocking lever; 2. Horizontally adjusting screw; 3. Vertically adjusting screw.

- Position the vehicle, unloaded, with normal tyre pressure, on level ground, at a distance of 10 metres from a vertical white screen (a white wall, for instance), perpendicular to vehicle axis.
- Mark on the screen the distance between the headlamp axis (1140 mm), symmetrically to vehicle axis. To obtain a precise adjusting, trace firstly on the ground respective position of the vehicle wheels.
- Perform headlamp adjusting successively.
- Switch on the headlamps and check if they are both connected alike.
  If the two beams are not alike (one driving beam and the other one dipped), reverse the connections at one of the headlamps,
- Now, switch on dipped beam.
- The adjusting of the light beam direction, horizontally, upwards, is performed by turning the screw (2) (on the right side of the headlamps F A D and F E D or the screw (1), on the left side of the round headlamp (see fig. 2.57).

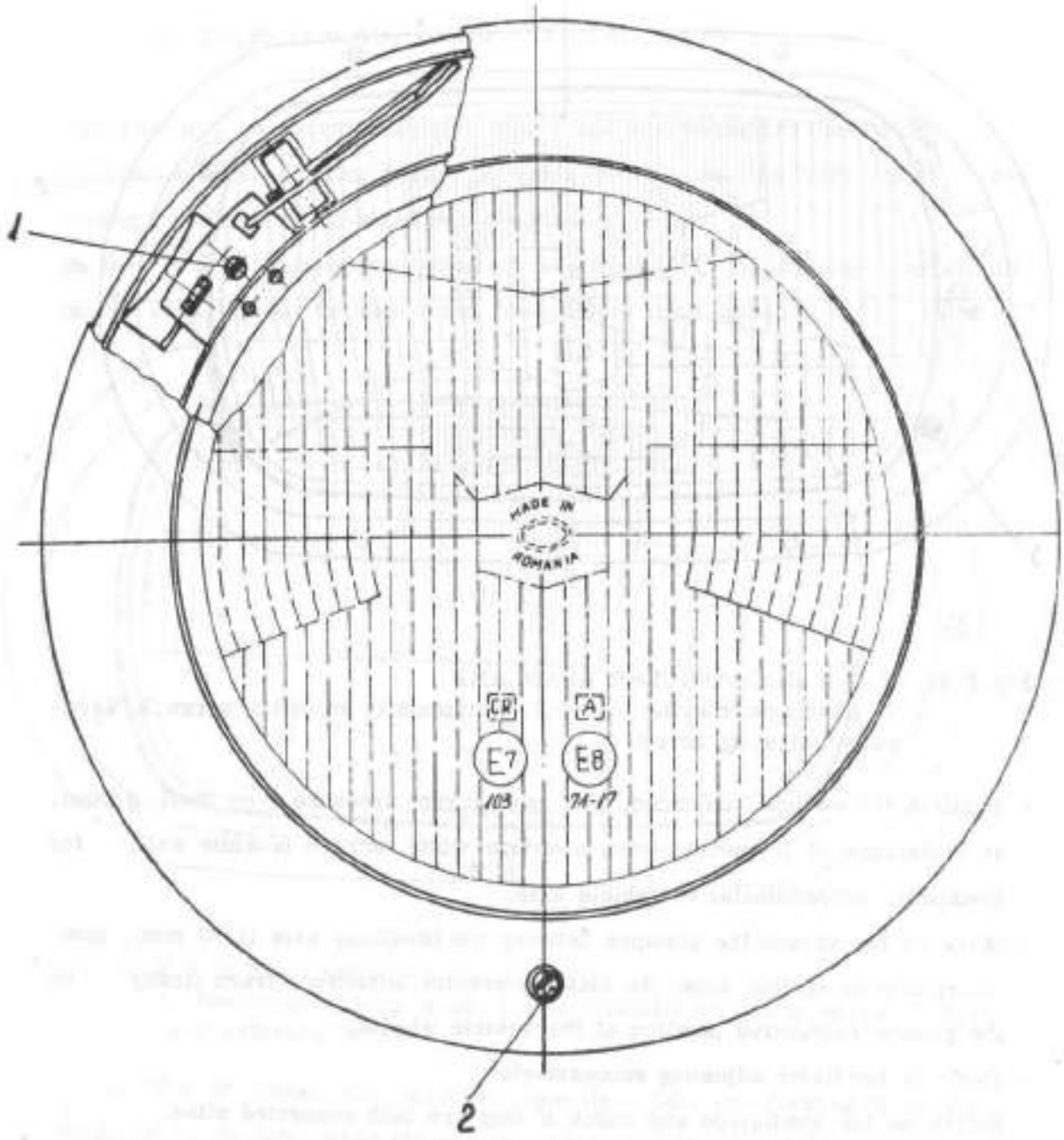


Fig. 2.57. ROUND HEADLAMP
1. Horizontally adjusting screw; 2. Vertically adjusting screw.

- Turn adjusting screw to the right or to the left untill the left angle corner of assymmetrical beam reaches the two vertical marked lines (see fig. 2.58).
- For vertical adjusting of the light beam turn on F A D headlamp the L.H. screw, while on F E R and round headlamp the lower one; adjust the beam so the height "A" of horizontal illuminated area has below indicated value, depending on vehicle model and the height of headlamp optic axis:

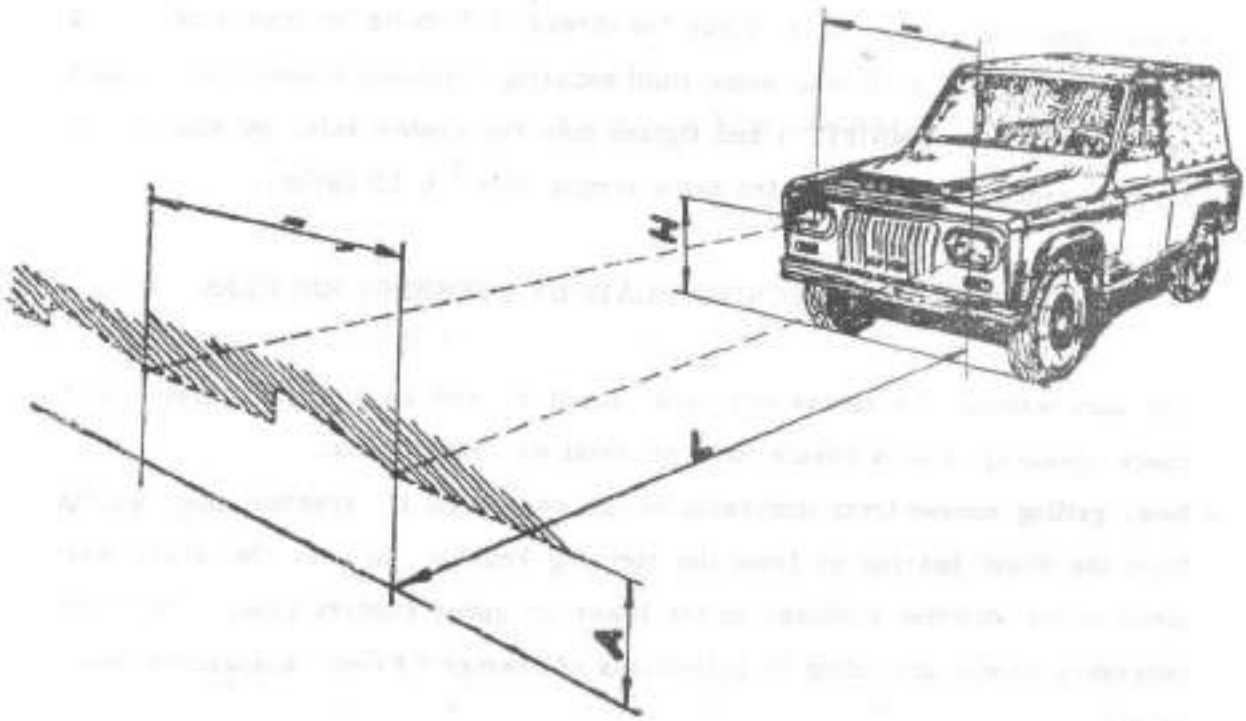


Fig. 2.58. HEADLAMP BEAMS CORRECT POSITION

Vehicle model	Height " A "
ARO 240, 242 and 243	H - 280 mm
ARO 241 and 244	H - 150 mm
ARO 320	H - 290 mm

- Perform the headlamps adjusting after each bulb changing.

2.2.9. MAINTENACE OF REAR AND FRONT SUSPENSION

OP. 2.0.29.02.2 TEGHTENING NUTS OF THE REAR AXLE SPRING U-BOLTS

- Slacken the counter nuts of the U-bolts, which fasten rear axle on the rear leaf springs.
- Using a torque wrench, adjusted for a torque of 4.9 $\pm$ 0.25 daNm (kgm) check the tightening of U-bolt nuts and, if necessary tighten nuts with this torque.

- After tightening counter nuts, clean the thread of U-bolts by means of a wire brush, apply on thread some fluid securing threaded connections (such as LOCKTITE or OMNIFIT) and tighten then the conter nuts, by means of torque wrench, adjusted vor the same torque (4.9 ± 0.25 daNm).

OP. 2.0.29.03.0 CHECKING PLAYS OF STEERING KNUKLES

- Lift successively, by means of a jack, the R.H. and L.H. front wheel and check manually if both wheels have no axial or radial play.
- Now, getting access from underside of the car check if eventual play results from the wheel bearing or from the steering knukles. In case that there are plays in the steering knukles, in the lower or upper control arm, perform necessary repair according to indications of chapter "Front suspension repairs".

OP. 2.0.29.04.0 CHECKING FRONT AND REAR SUSPENSION

- Lift the car on an inspection ramp and check from underside of the car the locking of all bolts fastening the suspension control arms, as well as the tightening of the shims for adjusting steering angles.
- Check correct location of suspension coil springs and intergrity of upper and lower rubber bump stops. In case of faults, perform necessary remedying according to indications of chapter "Front suspension repairs".
- Check correct location of rear leaf springs and their fastening on chassis.The springs should not have lateral or longitudinal displacements, both situations showing damaging of some assebly components.
- Check for fastening of shock absorbers and for integrity of spring rubber pads.
- In case of faults, permorm necessary remedying according to indications of chapter "Rear suspension repairs".

2.2.10. OTHER MAINTENANCES

OP. 2.0.99.05.9 CHACKING BOLTS FOR CORRECT TIGHTENING AND SECURING

Perform checking and eventual retightening, with prescribed torque, of bolts, nuts and counter nuts of below indicated assemblies:

TIGHTENINGS ON CURRENT MAINTENANCE

TABLE VII

Key No.	The place where should be checked the tightening	Tightening torque (daNm)	(ft. lbs)
1.	Gearbox fastening on clutch housing	7.00 - 7.50	50.6 - 54.2
2.	Transfer box fastening on gearbox	7.00 - 7.50	50.6 - 54.2
3.	Clut housing fastening on cylinder block	5.00 - 6.00	36.1 - 43.4
4.	Exhaust pipe fastening on exhaust manifold (L 25)	3.50 - 4.50	25.3 - 32.6
5.	Exhaust manifold fastening on cylinder block (L 25)	3.50 - 5.00	25.3 - 36.1
6.	Inlet manifold fastening on L 25 engine cylinder block	3.50 - 5.00	25.3 - 36.1
7.	Exhaust pipe fastening on exaust manifold (D 127)	4.50 - 5.00	32.6 - 36.1
8.	Exhaust manifold fastening on D 127 engine cylinder block	4.50 - 5.00	32.6 - 36.1
9.	Inlet manifold fastening on D 127 engine cylinder block	4.00 - 5.00	28.9 - 32.6
10.	Carburettor fastening on inlet manifold	0.70 - 0.80	5.6 - 5.8
11.	Water pump fastening on cylinder block	2.50 - 3.50	18.2 - 25.3
12.	Thermostat housing fastening on cylinder block	1.70 - 2.50	12.3 - 18.2
13.	Alternator support fastening on cylinder block	6.50 - 8.50	48.0 - 61.5
14.	Starting motor fastening on ARO L 25 engine	1.70 - 2.00	12.3 - 14.4
15.	Starting motor fastening on ARO D 127 engine	1.70 - 2.20	12.3 - 15.9
16.	Oil filter fastening on ARO L 25 engine block	2.50 - 3.50	18.2 - 25.3
17.	Cylinder head fastening on engine block	2.50 - 3.50	18.2 - 25.3
18.	Diesel fuel filter fastening on D 127 engine	3.40 - 4.50	24.6 - 32.6

Key No.	The place where should be checked the tightening	Tightening torque (daNm)	(ft. lbs)
19.	Injection pump fastening on D 127 engine block	3.50 - 4.50	25.3 - 32.6
20.	Ignition distributor fastening on ARO L 25 block	1.70 - 2.50	12.3 - 18.2
21.	Fuel pump fastening on engine block	1.70 - 2.50	12.3 - 18.2
22.	Fastening of upper control arms on chassis cross member	6.50 - 8.00	48.0 - 57.8
23.	Fastening of lower control arms on chassis support	7.00 $\pm$ 0.50	50.6 $\pm$ 3.6
24.	Fastening of wheels	14.00 $\pm$ 1.00	101.0 $\pm$ 7.2
25.	Fastening of front and rear shock absorbers	2.50 - 4.00	18.2 - 28.9
26.	Fastening of rear axle U-bolts	4.90 $\pm$ 0.25	35.4 $\pm$ 1.8
27.	Engine bonnet latch fastening	2.50 - 4.00	18.2 - 28.9
28.	Fastening of lateral front and rear doors hinges	1.70 - 2.50	12.3 - 18.2
29.	Fastening of rear door hinges on ARO 243 car	1.70 - 2.50	12.3 - 18.2
30.	Fastening of lateral door catches	3.50 - 4.50	25.3 - 32.6
31.	Fastening of rear door clach on ARO 243 car	3.50 - 4.50	25.3 - 32.6
32.	Fastening of rear door guide on ARO 243 car	3.50 - 4.50	25.3 - 32.6
33.	Fastening of upper tailgate catch	3.50 - 4.50	25.3 - 32.6
34.	Fastening of car body on chassis	3.00 - 4.00	21.7 - 28.9
35.	Fastening of goods bucket on chassis (ARO 320)	3.50 - 4.50	25.3 - 32.6

NOTE: Check fastening of assemblies for securing with split pins.

SPLIT PIN SECURED PLACES TO BE CHECKED ON CURRENT MAINTENANCE

TABLE VIII

Key No.	The place where securing is to be checked	Split pin dimension (ø x L)
1.	Engine fastening on chassis	2.7 x 25 (mm)
2.	Steering gearbox fastening on chassis	2.0 x 25
3.	Steering pivot case fastening on chassis	2.0 x 25
4.	Steering drop arms fastening	5.0 x 50

Key No.	The place where securing is to be checked	Split pin dimensions (Ø x L)
5.	Nuts fastening the draglinks	3.2 x 25
6.	Nuts fastening draglink clamps	2.0 x 25
7.	Nuts securing fulcrum pins on connecting tie rod	3.2 x 28
8.	Nuts fastening upper and lower steering shaft	1.6 x 22
9.	Nuts fastening lower control arm on steering knukles	2.0 x 25
10.	Propeller shaft flange fastening	Lock plates
11.	Fastening of steering shaft flanges on flexible coupling	Lock plates

OP. 1.0.99.03.0 CHECKING FOR OIL, BRAKE FLUID, COOLING FLUID AND FUEL LEAKEGES

After coming with the car from a travel, which brought it in a steady state regime, lift the car on an inspection ramp and inspect the places where could be traces of wear or fluid leakages. Perform inspection from underside of the car.

- Check rear axle for brake fluid leakages (radial traces on wheel rim and tyres), inspecting connection joints between brake pipes and brake cylindres. Check also for oil leakages through differential filler and drain plugs, and also on propeller shaft flange.
- Check fuel tank for fuel leakages through the filler cap, the drain plug, fuel filter and fuel pipes connections.
- Check the engine for oil leakages, inspecting the rear bearing, jointing area between the oil sump and cylinder block, the area of oil filter fastening, the gearbox and transfer box pluge, the jointing area between gearbox and transfer box, the propeller shaft flanges, the fuel pump fastening area.
- Getting access under the engine bonnet, check if there are no leakages on brake & clutch master cylindres, on compensating reservoirs, on connecting pipes with the clutch slave cylinder.

- Check front differential for oil leakages near the covers, near axle drive shafts, at longitudinal propeller shaft flange.
- Check the front wheels for leakages, similarly as the rear wheels.
- Check cooling system for fluid leakages, inspecting all hose connections between water pump, thermostat, inlet manifold and heating system.
- On Diesel D 127 engine check specially the high pressure fuel pipe connections, as well as all pipe connections with the fuel pump, fuel filter, fuel tank, etc.

  In case that leakages were found but do not disappear after tightening respective connection element, perform necessary remedying according to indications given in the chapter "Repairs".

OP. 2.0.99.14.0 BODY MAINTENANCE

- Inspect for rest traces the body underside (mudguards, lower cowl and the body floor pan).

  In case that due to various causes the antirust and antiphonic paint coat was removed from the body steel sheet and rusted areas have appreared, these should be cleaned with abrasives, up to clean metal surface, applying after that a red lead minium prime paint coat (or equivalent prime paint). After 24 hours should be applied an antiphonic paint coat.
- If on upper body surface will appear deep scratches or paint exfoliations, proceed similarly as with the body underside, with the difference that the paint applied over the prime paint should have the body colour. This paint is supplied for each ARO vehicle, together with standard accessories. If it will be necessary more paint, get any paint equivalent to "EVERGLOSS" paints.

  The repainted area should be extend, after roughing adjacent areas with fine abrasive paper, up to jointing lines or borders of respective body component.
- Perform repainting by means of a paint spray gun. Protect body areas, which should not be painted, covering them with adhesive paper bands.
- Let dry the painted surface for 24 hours in a dust-free room.

OP. 2.0.99.02.0 REMOVING PROTECTIVE COAT

- The protective coat (a waxlike stuff, called "Procerin") can be removed, either with organic solvents (white-spirit, etc.) or with a common detergent solution.
- In both cases take special attention on removing the protective coat around the instruments and electrical connections, in order to avoid any short-circuit, or, on using organic solvents, any fire danger. Such areas should be cleaned using cloths weted with deconservant agent.
  In any case start the engine only after complete dry wiping of cleaned areas.

OP. 5.0.99.04.0 OPERATING INSPECTION ON DELIVERY OF STORED VEHICLE

- Check resistance of seals.
- Check the presence of tools outfit and spare parts of the vehicle, brought for maintenance.
- Check and top up:
  - Oil level in oil sump and air cleaner.
  - Oil level in gearbox, transfer box, front and rea differential and stearing gearbox.
  - Brake fluid level in brake clutch master cylinders.
  - Cooling fluid level in radiator.
- Check the presence of eventual leakages of oil, water, brake fluid, fuel.
- Check storage battery charging condition.
- Turn engine crankshaft 2 - 3 times by means of starting handle.
- Check air pressure in the 5 tyres.
- Check correct operation of:
  the engine, at idle speed and in full load.
- Dashboard instruments.
- Headlamps, front and rear flasher lamps, stop tail lamp, etc.
- The horn.

- Windscreen wiper and washer.
- Main and parking brake systems.
- Steering mechanism.
- Door locks.

CHAPTER III. POSSIBLE FAULTS AND THEIR CAUSES

During the vehicle traffic, and in the present case, the ARO vehicles, can occur various faults, due to vehicle traffic, normal wear of components, or as a result of some hidden flaws of the components and units of the vehicle. In order to facilitate the faults remedying, below will be presented possible faults, their causes and the manner of intervention.

ATTENTION: Always begin by shooting firstly the causes more simple when occur difficulties on starting or operating the vehicle. It is little possible that in case of a correct vehicle maintenance, the fault cause results from a faulty part or unit. For instance: discontonous engine running can be sooner caused by an impurity in the carburettor main jet as by a fault of timing system.

In many cases the faults are caused by external factors, such as road conditions, fuel changing or even driver's ability.

It is useful to intervene whenever it is observed that the vehicle performances are below the normal and not to let untill the situation grows worse and occurs an irremediable damage of certain parts and units.

3.1. THE FAULTS WHICH AFFECT THE VEHICLE DRIVING POWER

The vehicle cannot move without a driving power. It will have reduced performances if its engine does not normally run.

3.1.1. FAULTS OF VEHICLES EQUIPPED WITH ARO L-25 ENGINE

3.1.1.1. ENGINE DOES NOT START ON SWITCHING ON

3.1.1.1.1. STORAGE BATTERY IS DISCHARGED

- On switching on the starting motor, the vehicle lights grow dim or even die out.

Remedies:

- Check connections on battery terminals (Op. 2.0.37.02.0)
- Check connections on starting motor terminals (Op. 2.0.37.04.0)
- Check ground connection of starting motor (Op. 2.0.37.09.0)
- Check storage battery for its charging condition (Op. 2.0.37.01.0)

If the battery is discharged or defective, take it down from the vehicle and charge it (Op. 2.0.37.07.0) respectively replace it.

3.1.1.1.2. FAULTS ON ELECTRICAL WIRING

On switching on the starting motor the vehicle lights do not light. The causes should be sought on disconnected or broken electrical connections, on faulty starter switch or faulty starter relay.

For this:

- Check supply circuit up to starting motor (Op. 2.0.37.10.0)
- Check and eventually replace the starter switch (Op. 2.0.37.11.0)
- Check starting motor without taking it down from the engine (Op. 2.0.37.05.0).
- If necessary, take starting motor down (Op. 2.0.37.12.0) and preform a general maintenance inspection (Op. 4.0.37.06.0) or, if some faults will be found, perform their remedying (Op. 4.1.37.13.0).

3.1.1.1.3. FAULTS OF MESHING BETWEEN ELECTROMOTOR DRIVE AND FLYWHEEL

On switching on the starting motor there are heard the start-up of engine and, eventually, metalic, anormal noises, caused by bad Bendix drive meshing. Turn

crankshaft with 30-45° and try a new start-up. There can appear two situation: a) The engine starts normally: you can draw the conclusion that the flywheel ring gear has some teeth broken. b) Or the trouble occurs again, when the Bendix drive is faulty or the flywheel ring gear has all teeth broken.

In this case:

- Take downs tarking motor from emgine (Op. 2.0.37.12.0) and perform remedying of Bnedix drive (Op. 4.1.37.13.1).
- Take down engine from the vehicle (Op. 2.0.10.01.0), after having previously taken the gearbox down from engine (Op. 2.1.10.01.1).
- Put then the engine on a stand or special D.5 device, for setting and fastening engine on dismantling.
- Dismantle clutch housing (Op. 4.1.10.01.2) and then the clutch from the flywheel (Op. 4.1.16.02.0).
- Remove flywheel from the crankshaft (Op. 4.1.05.03.0).

Now you can perform, strictly speaking, the replacing of flywheel ring gear (Op. 4.1.05.03.1).

3.1.1.2. THE ENGINE IS CRANKED BY STARTING MOTOR BUT DOES NOT START.

3.1.1.2.1. FAULTS IN IGNITION SYSTEM.

In this situation there may be various causes and should be examined systematically, Namely, it may be: interruped ignition wires; interrupted circuit between ignition coil and ignition distributor; fouled spark plugs, decalibrated plugs or having fissured insulation; ignition distributor detuned or having faulty components; ignition coil burned out (as a result of stopped engine without switching off the current). To remedy the trouble:

- Check ignition wires current leakages (Op. 2.0.01.18.0).
- Check circuit between ignition coil and ignition distributor (Op. 2.0.37.15.0).
- Check, and eventually adjust air gap of spark pluge (Op. 2.0.01.07.0).

- Replace faulty spark plugs (Op. 0.01.19.0).
- Check, and if faulty, replace the ignition distributor condenser (Op. 2.0.37.16.0).
- Check, and eventually adjust contact-breaker gap of ignition distributor (Op. 2.0.01.09.0).
- Clean ignition distributor breaker points, if they are oxidated (Op. 2.1.01.23.0).
- Check ignition distributor cover for fissures and clean it (Op. 2.0.01.24.0).
- Check ignition distributor rotor and if faulty, replace it (Op. 2.0.01.25.0).
- Check ignition coil and if faulty, replace it (Op. 4.1.37.18.0), performing its checking on a bench, after having taken it down from the vehicle (Op. 2.0.37.17.0).

3.1.1.2.2. TROUBLES OF FUEL SUPPLY SYSTEM

The engine cannot start if there is no fuel supply (or the engine is flooded). The trouble shooting is performed successivley;

- Check firstly on fuel level gauge if there is fuel in the tank.
- If yes, check carburettor main jet for clogging.
- Check spark plugs for degree of wetting.
- Check fuel pump operation (Op. 2.0.01.26.0). If the pump does not supply fuel, clean the pump filter (Op. 2.0.01.12.0).
- Check fuel lines for continuity and tightness (Op. 2.0.11.06.0).
- Check and eventually replace fuel pump diaphragm (Op..2.1.01.26.1).
- Take down fuel pump from the engine (Op. 2.0.01.27.0) and perform its general overhauling, replacing worn parts (Op. 4.1.06.01.0). In case that the fuel pump supplies, go on with trouble shooting, as follows:
- Check and eventually clean carburettor inlet filter (Op. 2.0.01.14.0).
- Check and eventually clean the carburettor main jets (Op. 2.0.01.15.0).
- Check spark plug heads in order to see if engine is not flooded (Op. 2.0.36.01.0). If a spark plug is wet, dry <u>all</u> spark plugs and perform engine starting as for a flooded engine, i.e. with accelerator pedal in its middle position, without actuating the accelerator pump and switching on the switchin on the starting motor many times, untill you will get fuel elimination from the engine and the engine starts.

Check air cleaner for clogging and, if necessary, clean it (Op. 2.0.08.03.0).

- Check muffler rear pipe for clogging with mud, and if necessary, clean it (Op. 2.0.12.01.0).
- Check if there is no water in the fuel supply system (Op. 2.0.11.05.0).
- Check carburettor float chamber; if engine got flooded, check if float assy position is correct (Op. 2.1.15.02.2).
- Check carburettor needle valve tightness on its seat or eventually if the needle valve seat is not clogged (Op. 2.1.15.02.1).
- Check air duct tightness between carburettor and cylinder head (if there is no air infiltration) (Op. 2.0.08.02.0).

3.1.1.3. THE ENGINE TURNS SLOWLY AND DOES NOT START

On switching on the starting motor the vehicle lights grow much dim and the engine turns slowly, irregularly, without be able to start.

The cause can be: discharged storage battery, loosened electrical connections between starting motor and battery, insufficient battery electrolyte level or engine oil viscosity too high. To remedy the trouble:

- Check battery electrolyte level (Op. 2.0.37.03.0).
- Check battery charging condition (Op. 2.0.37.01.0) and, if necessary, charge it (Op. 4.0.37.07.1).
- Check connections on battery terminals (Op. 2.0.37.02.0)
- Check connections on starter relay (Op. 2.0.37.08.0).
- Check connections on starting motor (Op. 2.0.37.09.0).
- Check engine oil viscosity and eventually replace it (Op. 2.0.01.28.0).

3.1.1.4. ENGINE RUNNING INTERRUPTED BY MISFIRING

- Misfirings can occur in exhaust muffler, due to ignition faults, incorrect air-fuel mixture, disadjusted advanced ignition or jammed exhaust valves (lack of clearance between valve steam and guide).

Misfiring can also occur in carburettor, due to lean mixture, wrong heat range of spark plugs or sparks of low intensity. There can also be a mechanical cause, i.e. incorrect clearance of valves.

To remedy misfirings in exhaust muffler:

- Chack ignition system operation,by observing the spark of ignition distributor center plug as well as of spark plugs (Op. 2.0.36.02.0); in case that the sparks are intermittent, check and eventually adjust the distributor breaker gap (Op. 2.0.01.09.0) or clean oxidated breaker points (Op. 2.1.01.23.0).
- If the spraks are still intermittent, check engine electric equipment for current supply (Op. 2.0.37.15.0). Namely:
- Check advanced ignition (Op. 2.01.01.13.0).
- Check exhaust valve clearance (Op. 2.1.01.08.2).
- Check exhaust valve condition (Op. 2.1.01.30.1), after having previously taken down cylinder head cover (Op. 2.0.01.21.1), rocker arm shaft assy (Op. 2.1.01.29.0) and cylinder head (Op. 2.1.01.30.0). To remedy misfirings in carburettor, perform following operations:

3.1.1.5. THE ENGINE STARTS AND THEN STOPS

- Check fuel pump operation (Op. 2.0.01.26.0). In case that fuel pump supply is not satisfactory, perform remedyin in following order:
- Clean fuel pump inlet filter (2.0.01.12.0).
- Check fuel pump diaphragm (Op. 2.1.01.26.1) or take down the pump from the engine (Op. 2.0.01.27.0) and perform its complete overhauling (Op. 4.1.06.01.0).
- Check and eventually clean the carburettor inlet filter (Op. 2.0.01.14.0).
- Clean carburettor main jets (Op. 2.0.01.15.0).
- Check and eventually adjust fuel level in carburettor float chamber (Op. 2.1.15.02.2), after having previously removed carburettor adapter and carburettor cover (upper body) (Op. 2.0.01.15.1 and 2.1.15.02.0). Clean then the needle valve seat (Op. 2.1.15.02.1).
- Check the spark plugs and eventully replace them if their heat range is wrong (Op. 2.0.01.07.0).
- Check the spark on ignition distributor center plug and on the spark plugs (Op.2.0.36.02.0). If the spark is weak, check and eventually clean the ignition breaker points. Check also ignition distributor cover for fissures and clean it (Op. 2.0.01.24.0).

- Check also H.T. leads.
- Check inlet valve clearance (Op. 2.1.01.08.2).

In case that the trouble cause will be not found in supply or ignition system, check inlet valve condition (Op. 2.1.01.30.2), after having previously removed the cylinder head cover (Op. 2.0.01.21.1).

3.1.1.5. THE ENGINE STARTS AND THEN STOPS

This trouble occurs most frecvently, due to fuel shortage or insufficient fuel supply. To remedy the trouble:

- Check fuel presence in the fuel tank, by means of fuel level gauge (on dashboard) - (Op. 2.0.11.04.0).
- Check fuel pump operation (Op. 2.0.01.26.0). Ir the fuel supply is insufficient, perform the following interventions:
- Check and eventually clean the fuel pump inlet filter (Op. 2.0.01.12.0).
- Check continuity and tightness of fuel pipes, leading to fuel tank (Op. 2.0.11.06.0).
- Check fuel pump duaphragm and, eventually, replace it (Op. 2.1.01.26.1)
- Take down fuel pump from the engine (Op. 2.0.01.27.0) and perform its general overhauling, replacing worn out components (Op. 4.1.06.01.0).

In case that the fuel pump supply is satisfactory, the trouble should be seeked beyond the fuel pumpl, respectively:

- Check and eventually clean the carburettor inlet filter (Op. 2.0.01.14.0).
- Check and eventually clean the carburettor main jets (Op. 2.0.01.15.0).
- Remove carburettor adapter (2.0.01.15.1) and carburetor cover (Op. 2.1.15.02.0), inspecting float assy position in the float chamber (Op. 2.1.15.02.2) and clean the needle valve seat (Op. 2.1.15.02.1). In case that the needle valve is jamming,due to its wear, remedy it by grinding its point or replace needle valve (Op. 2.1.15.02.3).
- Check if there is no water in fuel (Op. 2.0.11.05.0).

3.1.1.6. THE ENGINE RUNS ONLY WHEN CHOKE IS PULLED

The trouble can occur due to carburation troubles or mechanical causes. Perform investigations in the following order:

- Check and eventually clean the idling jets (Op. 2.1.15.03.0), after having previously removed the carburettor adapter (Op. 2.0.01.15.1).
- Adjust the idle speed running (Op. 1.0.01.22.0).

Mechanical causes occur in the timing gear, in the area of valves.

- Check clearance between rocker arms and valves (Op. 2.1.01.08.2).
- Check inlet and exhaust valves condition (Op. 2.1.01.30.1), after having previously removed cylinder head cover (Op. 2.0.01.21.1), rocker arm shaft (2.0.01.29.0) and cylinder head (Op. 2.1.01.30.0).
- Check if there are broken springs or valves jammed in their guides.

3.1.1.7. THE ENGINE HAS NO OUTPUT

The trouble occurs due to: defective supply of fuel mixture, from carburettor, whose throttle butterflies do not open completely, due to mechanical causes; overrich fuel mixture (much black smoke at the muffler, because the choke is jammed or carburettor is flooded; the engine is too hot, due to lack of cooling water or there is too much lime scale in the engine cooling system, causing knocks on engine running; wrong clearances of engine valves; clogged exhaust system.

In case of overrich fuel mixture, causing black smoke at muffler:

- Check choke for correct operation (Op. 2.1.15.04.0).
- Check carburettor float chamber for flooding (Op. 2.1.15.02.3).
- Check needle valve wear (Op. 2.1.15.02.1).

In the other situations perform following operations, untill the trouble is found:

- Check clearance of valves (Op. 2.1.01.08.2).
- Check exhaust system for clogging with mud (Op. 2.0.12.01.0).

- Check correct operation of throttle control (Op. 2.0.11.07.0).
- Take carburettor down from the engine (Op. 2.1.15.01.0) and check control mechanism of throttle butterflies (Op. 2.1.15.05.0).

If on running engine occur knocks, check cooling fluid level in the cooling system (Op. 2.0.13.01.0); check cooling system for scale deposit, which should be removed, as described in Op. 2.0.13.02.0..

3.1.1.8. NOT ALL ENGINE CYLINDERS ARE OPERATIONG

This trouble is detected through distinctive noise, as well as through the lack of engine power. The possible causes can result from respective cylinder or from ignition problems: fouled spark plugs or having fissured H.T. insulation (ground leakages); faulty ignition H.T. wires (interruped or having fissured insulation, causing ground leakages); ignition distributor cover fissured near the plug of faulty cylinder (ground leakages). It can be also a mechanical trouble, as: exhaust valve jammed in its shut position: displaced or bent valve push rod; exhaust valve spring broken, so that the valve is always open; broken piston.

Perform checking and remedying in following order:

- Check respective spark plug and, eventually, replace it (Op. 2.1.01.31.0).
- Check H.T. ignition wires (Op. 2.0.01.18.0).
- Check and clean ignition distributor cover (Op. 2.0.01.24.0).
- Check inlet valves condition (Op. 2.1.01.30.2).
- Check exhaust valves condition (Op. 2.1.01.30.1).
- Inspect, and if broken, replace the valve springs (Op. 2.1.03.01.0).
- Check respective piston and, if broken or faulty, perform engine overhauling, with faulty piston replacing (Op. 4.1.04.02.1).

3.1.1.9. THE ENGINE RUNS ONLY WHEN THROTTLE BUTTERFLIES ARE OPEN.

This trouble can occur when the idle jets are clogged, the idle speed operation is out of order, air inleakage into inlet system or overrich mixture results from carburettor.

Perform successively the following checkings and remedyings:

- Check and clean idle speed jets (2.1.15.03.0).
- Check inlet system for air inleakages (Op. 2.0.08.02.0) and eventually replace inlet manifold gasket (2.1.08.02.1).
- Check air cleaner for clogging (Op. 2.0.08.03.0).
- Check carburettor float chamber (Op. 2.1.15.02.2)
- Check if needle valve shuts the fuel supply, performing precursory works, indicated in respective operations.

3.1.1.10. THE ENGINE DOES NOT STOP ON SWITCHING OFF THE CURRENT

It happens that, allthough the current is switched off, the engine continue to run, irregularly, due to self-ignition, due to too hot spark plugs, engine overheating or wrong clearances of exhaust valves. To remedy the trouble:

- Check the heat range of spark pluga on the engine (Op. 2.0.01.07.0).
- Check the fan V-belt tension (if it slips) (Op. 2.0.01.10.0).
- Check, and eventually top up the fluid in the cooling system (Op. 2.0.13.01.0).
- Remove scale deposit in the cooling system, if it is the case (Op. 2.0.13.02.0).
- Check thermostat for correct operation (Op. 2.0.13.05.0).
- Adjust clearance of exhaust valves (Op. 2.1.01.08.2).
- Clean and remove carbon deposit from cylinder head (Op. 2.1.03.02.0). They cause hot points for self-ignition.

3.1.1.11. THE ENGINE KNOCKS ON RUNNING

The engine knock (detonation) is a premature ignition of the fuel mixture, the burning front starting from one or many "hot points", existing in the combustion chamber. It appers through a distinctive noise (very sharp, as produsad by metallic blows in the cylinder head) and lack of engine power.

The causes can result from a too great ignition advance, from carbon deposit in the combustion chamber (on valves and walls), from overheated engine, from the fuel having octane number inferior to the correct one or from a too lean mixture.

The shooting of possible causes and their remedying is performed in the following order:

- Check and eventually adjust octane selector (set spark) (Op. 2.0.01.13.0).
- Check fan V-belt for correct tension (Op. 2.0.01.10.0).
- Check cooling fluid level in the radiator (2.0.13.01.0).
- Check thermostat for correct operation (2.0.13.05.0).
- Check and eventually remove scale deposits from cooling system (Op. 2.0.13.02.0).
- Drain completely the fuel tank and fill it with new fuel, having correct octane number; on this occasion remove water and settlings from the fuel tank, washing it after that (Op. 2.0.11.01.0).
- Check and clean carburettor main jets (2.0.01.15.0).
- Check fuel pump operation (2.0.01.26.0) and if its supply is not sufficient, check its inlet circuit (2.0.11.06.0), check and clean its inlet filter (Op. 2.0.01.12.0); check and, if necessary, replace fuel pump diaphragm (Op. 2.1.01.16.1); finaly, if necessary, perform complete overhauling of the fuel pump.
- If fuel pump supply is sufficient, seek the trouble cause between the fuel pump and carburettor, checking and cleaning its inlet filter (Op. 2.0.01.14.0).
- Check carburettor needle valve (Op. 2.1.15.02.1).
- Check fuel level in the float chamber (Op. 2.1.15.02.2).
- Clean carbon deposit from spark plug heads (Op. 2.0.01.07.0); replace spark pluge if their heat range is not adequate (Op. 2.0.01.19.0).
- Remove carbon deposit from combustion chamber (Op. 2.1.03.02.0).

3.1.1.12. THE ENGINE MAKES RHYTHMICAL, ANORMAL NOISES (IT KNOCKS)

The possible causes of these knocks can be:

- Engine running with detonations, which produces greater forces than normally upon piston pin and crhakshaft connecting rod bearings.
- Advanced wear of crankshaft connecting rod bearins.
- Grave troubles of the cluth.
- Slacken of connecting rod bearing covers.

In all these situations an engine general overhauling is absolutely necessary; otherwise can occur extremely grave engine damages.

In case of engine knocks, specific to detonations, perform checkings and remedyings indicated at § 3.1.1.11.

In the second case take engine down from the vehicle (see Op.2.0.10.01.0) and overhaule completely the clutch (Op. 4.1.04.02.0).

3.1.1.13. ENGINE OIL PRESSURE TOO LOW

The trouble is observed on the dashboard oil pressure gauge; besides, the oil pressure alert lights, when engine is running.

The trouble should be immediately found and removed; otherwise it represents a danger of grave engine damaging.

The causes should be sought in the engine oil circuit, excessive bearing clearances, excessive wear of oil pump drive gear, or defective oil circuit tightness, allowing fuel or water inleakages into oil circuit.

Perform checking and remedying in following order:

- Check firstly oil level in the engine sump, if it is not increased, due to fuel or water inleakage (Op. 2.0.01.32.0). If yes, drain completely the oil sump, in order to ascertain the presence of fuel or water in oil (Op. 1.0.01.03.0).
- Check fuel pump for fuel leakage to oil sump (Op. 2.0.01.32.1).
- Check tightenesa of cylinder head gasket (2.1.01.32.2).
- Check integrity of cylinder liner ring gaskets (Op. 2.0.01.32.3), and if water leakages will be observed, perform complete overhauling of the engine, concerning waterproofing of cylinder liners. (Op. 4.1.10.02.0).

- Take oil pump down from the engine (Op. 2.0.01.33.0) and check its rate of wear (Op. 4.0.09.01.).
- Perform a complete inspection and checking of clearances between main journals and crank pins, and respective bearings (Op. 3.1.05.04.1). and (Op. 3.1.05.04.2).
- Check also clearances of camshaft bearings (Op. 3.1.02.02.0).

Perform previously all necessary works for respective operations.

3.1.1.14. TOO HIGH OIL CONSUMPTION OF ENGINE

A high oil consumption occurs as a result of damaging of gaskets, causing oil leakages, namely: at rear main crankshaft bearing, at oil sump gasket, oil filter gasket, between pistons and cylinder liners (due to excessive clearances between piston rings and piston ring grooves), excessive clearances between valve stemps and their guides.

It can occur an anormal oil consumption if the used oil is not adequate (as quality and quantity).

To descover the trouble causes and to remedy it, perform the following operations:

- Check oil in the engine sump for its adequate quality and, eventually replace it completely (Op. 2.01.01.28.0).
- Check the spark pluge heads in order to judge combustion quality (Op. 2.1.01.31.).
- Check if there are no leakages of oil at rear main bearing (Op. 2.0.01.35.1) Perform remedying according to respective operation.
- Check if there are no leakages at oil filter gasket, and eventually, change the gasket (Op. 2.0.01.35.3).
- Observe exhausted smoke if it is whitish (without being water vapours in frosty weather). If smoke is whitish it shows that oil burns in the cylinders. If such a phenomenon is oberved (see Op. 2.0.01.34.0). seek the source of oil inleakage into combustion chambers.

- Check compression ratio of cylindres (Op. 2.0.01.36.0) and if this ratio is lower than normal, perform complete checking of clearances between piston rings and piston grooves (Op. 4.1.04.02.0).
If compression ratio is normal, it means that oil leakages are not caused by piston rings. In this case check clearances between the valves stems and their guides (Op. 3 1.03.03.0), performing then necessary remedyings.

3.1.1.15. TOO HIGH COOLING WATER CONSUMTION OF ENGINE

The cooling water loss can occur by water evaporation, if engine runs too hot or if radiator filler cap is faulty. There can occur also water loss through various joints between cooling system components, through fissured expansion vessel or fissured radiator cells, through damaged cylinder head gasket.

To remedy the trouble, perform following operations:

- Check fan V-belt tension (Op. 2.0.01.10.0).
- Check presence of scale deposits in the cooling system (Op. 2.0.13.02.0) and remove it.
- Check thermostat operation (Op. 2.0.13.05.0).
- Check cooling system tightness (Op. 2.0.13.06.0).
- Check radiator filler cap (Op. 2.0.13.07.0).
- Replace fissured expansion vessel (Op. 2.0.13.06.1).
- If fissured, repair the cooling radiator (Op. 4.0.13.08.0).
- Check cylinder head tightening (Op. 2.0.01.17.0).

3.1.1.16. TOO HIGH FUEL CONSUMTION OF ENGINE

The causes of excessive fuel consumtion are to be found in the engine itself and its afferent systems, as well as in the other mechanisms and units,whose troubles generally introduce a supplimentary output and, implicitly, suppliment tary fuel consumtion.

Below will be presented the more important causes and remedyings which can be performed:

- The use of unadequate fuel, concerning its wrong octane number or impurities content. In such a case, drain completely the fuel tank, clean it and fill it with adequate fuel (correct octane number) (Op. 2.0.11.01.0).
- Octane selector is disadjusted, causing too late ignition.

  Adjust octane selector (fixed ignition advance) (Op. 2.0.01.13.0).
- Overrich mixture, causing black smoke in the exaust gases. To remedy the trouble:
- Check air cleaner for clogging (Op. 2.0.08.03.0).
- Check carburettor float chamber for correct fuel level (Op. 2.1.15.02.2).
- Check carburettor main jets if they are not decalibrated.
- Other cause of excessive fuel consumption is the vehicle driving at a speed above the economical one.
- Running of a too cold engine (in winter). In such situation check thermostat operation (Op. 2.0.13.05.0);
- Exhaust system is partially clogged, throttling exhaust of fumes. In such a case:
- Check all exhaust pipes and muffler for clogging (Op. 2.0.12.01.0).
- Check muffler for eventual faults, which obstruct partially circulation of fumes (Op. 2.0.12.02.0).
- Excessive wear of combustion chamber tightening. In this case:
- Check cylinder compression ratio (Op. 210.01.36.0).

  Other cause may be: Vacuum advance control faulty or too little gap of breaker points. To remove the trouble:
- Remedy ignition distributor by replacing its vacuum control unit (Op. 4.0.36.03.1).

CHAPTER IV. REMEDYING OF ARO VEHICLES

4.1. ARO L-25 ENGINE

4.1.1. PRESENTATION OF ENGINE

4.1.1.1. GENERAL DESCRIPTION

The ARO out road (Jeep type) motor vehicles and their variants are equipped with ARO L-25 engines.

The ARO L-25 engine is a four stroke row engine, with 4 cylinders,igaition distributor, fuel pump and carburettor. The iron cast cylinder block has four detachable, wet liners, supported by upper block face and sealed at their lower end with rubber O-rings.

- The cylinder head, common to all four cylinders, has wadged shape combustion chambers.
- The crankshaft, made of special high-strength noduiar cast iron, is supported on 5 shell bearings, while the camshaft is made of the same special cast iron and rests on 3 anti-friction bushes (see fig. 4.1.).
- The crank drive consists of pistons, floating piston pins, forged in an I shape beam piston rods, two compression and one oil scraper piston rings. The piston connecting rods are assembled with half bearings on crank pins.
- The valve gear consists of overhead valves (mounted in cylinder head), actuated by rocker arms.
- The fuel supply system comprises the fuel tank, fuel filter, fuel pump, air cleaner, carburettor and inlet manifold (see fig. 4.2.).
- The engine is lubricated by oil pressure (oil pump & oil filter) and by splashing.
- The engine is cooled by water (or antifreeze cooling fluid) circulation, with cooling fan, radiator, water pump and temperature controling thermostat.

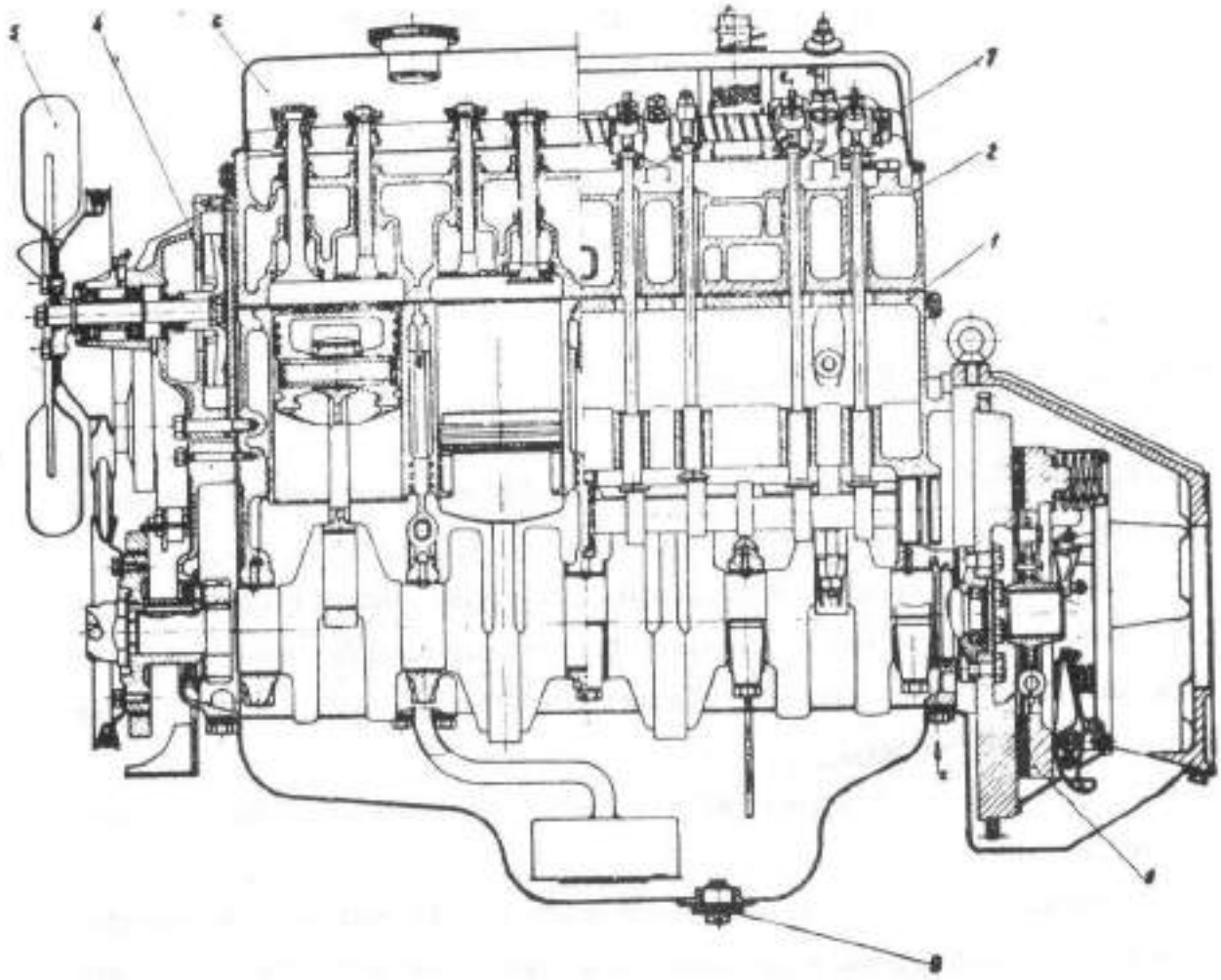


Fig.4.1. LONGITUDINAL SECTION OF ARO L-25 ENGINE
1. Cylinder block; 2. Cylinder head; 3. Clutch; 4. Water pump; 5. Cooling fan; 6. Cylinder head cover; 7. Rocker arm shaft; 8. Magnet draining plug.

4.1.1.2. ENGINE MAIN FEATURES

- Type	Four stroke row eninge, with carburettor and spark ignition
- Fuel	Gasoline, having octane number 90.
- Firing order	1 - 2 - 4 - 3
- Number of cylinders	Four, vertical in line
- Bore	97 mm (3.819 in.)

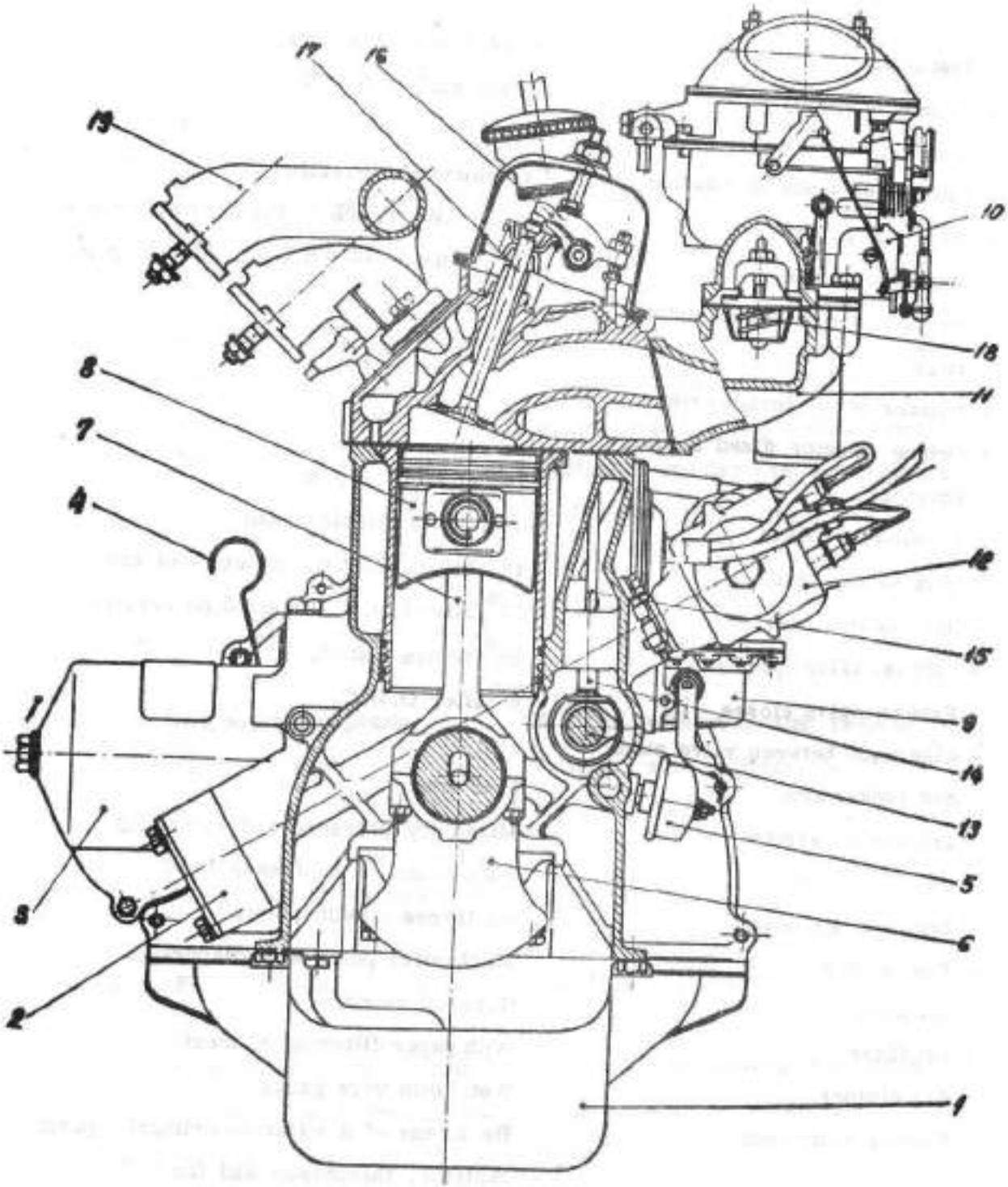


Fig. 4.2. CROSS SECTION OF ARO L-25 ENGINE.
1. Oil sump; 2. Oil pump; 3. Oil filter; 4. Oil dip stick; 5. Oil pressure manometric sensor; 6. Crankshaft; 7. Piston rod; 8. Piston; 9. Fuel pump; 10. Carburettor; 11. Inlet manifold; 12. Ignition distributor; 13. Camshaft; 14. Tappet; 15. Push rod; 16. Rocker arm; 17. Valve; 18. Thermostat; 19. Exhaust manifold.

Piston stroke	- 84.4 mm (3.323 in.)
- Cylinder capacity	2.495 cm^3 (152 in^3)
- Compression ratio	8 : 1
- Crankshaft sense of rotation	In clockwise direction
- Maximum output	61 $\pm$ 5% kW (83 $\pm$ 5% H.P.) at 4.000 r.p.m.
- Maximum torque	17.3 daNm (ℓ 12.5 ft. lbs) at 2900 r.p.m.
- Number of copression piston rings	2
- Nummer of oil scraper rings	1
- Octane selector (fixed ignition advance)	16° at 1,000 r.p.m.
- Location of valves	O.H.V. in cylinder head
- Inlet valve opens	12° before O.D.C. (outer dead centre)
- Inlet valve closes	57° after I.D.C. (inner dead centre)
- Exhaust valve opens	58° before I.D.C.
- Exhaust valve closes	8° after O.D.C.
- Clearance between valve stem and rocker arm	0.45 mm
- Lubricating system	Mixed (by pressure and splashing)
- Engine cooling	With water or antifreeze fluid.
- Engine suspension	On three elastic points
- Fuel supply	Mechanical pump with diaphragm
- Oil pump	Gear oil pump
- Oil filter	With paper filtering element
- Air cleaner	Wet, with wire gauze
- Cooling water feed	By means of a water centrifugal pump radiator, thermostat and fan.
- Water temperature control	By means of thermostat
- Carburettor	DCD dual body with differentiated opening
- Nominal voltage	12 V d.c. negative ground
- Ignition distributor	3231 Electroprecizie type
- Advanced ignition control	Centrifugal and vacuum controled

- Breaker points gap	0.35 - 0.45 mm
- Sparking plugs (make/type)	SINTEROM M 14 x 225
- Sparkplug electrodes gap	0.7 mm
- Starting motor (make/type)	UMEB D 1,2 - 12
- Alternator (make/type)	UEPS, 1111 type (12 V d.c. 35 A)
- Voltage regulator (make/type)	UEPS, 1410 type
- Engine idle speed	750 r.p.m.
- Dry engine weight with gear and transfer box	300 kg (660 lbs)
- Valve control	By pushing rods and rocker arms
- Crano shaft	Casting of modular cast iron, supported by five main bearings, dynamicaly balanced, being assebled with the flywheel and clutch.
- Engine thermal condition	Cooling fluid temperature: from 80 $^{\circ}$C $\pm$ 2 $^{\circ}$C up to 96 $^{\circ}$C $\pm$ 3 $^{\circ}$C.
- Lubricating system capacity	6 litres, without cooling radiator; 7 litres, with radiator.
- Oil pressure	Max. 4.9 bars

4.1.2. FUEL PUMP TROUBLES AND THEIR REMEDYINGS

4.1.2.1. FUEL PUMP DISCRIPTION AND MAIN FEATURES

Fuel pump draws gasoline from the fuel tank and delivers it to carburettor.

The pump is of the diaphragm type and is actuated by an excentric of the camshaft through the agency of a rocker arm (see fig. 4.3.).

At a camshaft speed of 1250 r.p.m. the pump draws fuel from a depth of 0.750 m and supplies it up to a height of 0.500 m, by an output of 60 l/min. At a zero output the oil pressure rises up to 0.177-0.294 bars. The maximal diaphragm frequency is of 2300 osc/min.

At a frequency of 1250 osc/min. the priming of the pump occurs during 7 seconds.

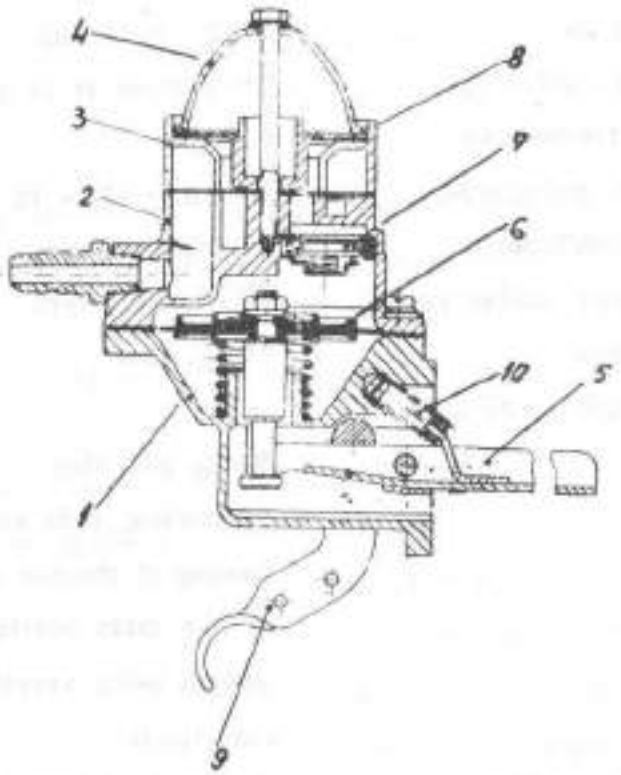


Fig. 4.3. FUEL PUMP
1. Lower pump body; 2. Middle pump body; 3. Upper filter body; 4. Filter cover; 5. Rocker arm; 6. Diaphragm; 7. Valve; 8. Strainer; 9. Hand level; 10. Backmoving spring; pushing rocker arm upon the camshaft.

The pump consists of three bodies and a cover which fastens all components.

The lower body (1), which fastens the pump on cylinder block, by the agency of two bolts, has a rocker arm (5), actuated by the camshaft excentric, and a hand level (9). The rocker arm shaft is fixed by two tips, pressed on the shaft ends and set in the pump body. The contact between rocker arm and camshaft excentric is provided by the spring (10).

The middle body has the two valves (7), whose fittings are pressed and set in it, and an outlet pipe connection, towards carburettor.

Between the two bodies is fastened the diaphragm (6).

On the tappet (2) - (see fig. 4. 4.) - whose lower end is connected with rocker arm clevis, is fastened the diaphragm (1), between two curved washers (3) and sealing gasket.

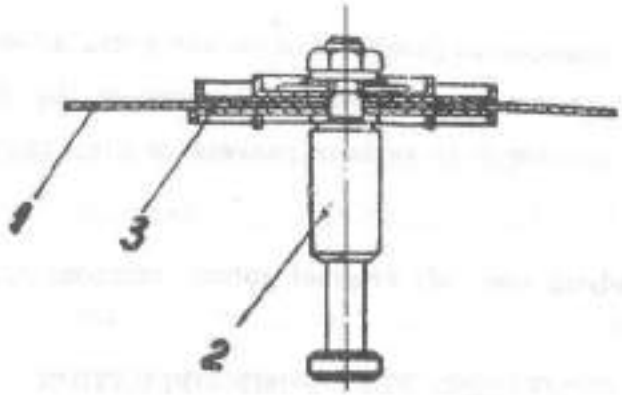


Fig. 4.4. FUEL PUMP DIAPHRAGM ASSY
1. Diaphragm; 2. Diaphragm tappet; 3. Diaphragm washer.

In the lower pump body, under diaphragm, is a spring which always holds diaphragm in pushed position.

The two pump bodies are assembled, having between them the diaphragm as a sealing gasket.

A central bolt fastens the cover (4) and upper body (3) on middle body (2) (fig. 4.3.).

Between upper and middle bodies is a sealing gasket, while between the cover and upper body is fastened a strainer (fine fuel filter).

On the upper body is the inlet pipe connection.

4.1.2.2. FUEL PUMP TROUBLES AND THEIR REMEDYING

The pump troubles can be easier observed when the engine is mounted on vehicle, but they can also be detected separately. Thus:

- The pump does not supply fuel, although there are no fuel leakages in the hand lever area and the fine strainer was cleaned. The trouble is due to faulty valves, which do not close tightly, or to diaphragm spring, which is deformed or broken. In that case is necessary to replace the valves (OP. 4.1.06.01.1). or the spring (Op. 4.1.06.01.2).
- The pump does not draw the fuel and there are fuel leakages near the rocker arm. In that case the diaphragm is fissured and should be replaced (Op. 2.1.01.26.1).

The pump shows fuel leakages on gaskets and rocker arm, although it is supplying fuel. It means that the gaskets are fissured or the diaphragm has a slight fissure. It is necessary to replace gaskets or diaphragm, according to Op. 4.1.06.01.3.

ATTENTION: On remedying use only original rubber components, fuel resistant.

OP. 2.0.01.26.0 CHECKING FUEL PUMP OPERATION

This operation is performed before taking down the pump from engine.

- Remove carburettor supply tube and actuate manually the pump. If there is a null or insuficient fuel supply, the trouble is caused by clogged fine strainer, which should be cleaned (Op. 2.0.01.12.0).
- If after strainer cleaning the trouble still persists, the cause should be sought in the fuel line pipes, checking them for tightness and free fuel passing (Op. 2.0.11.06.0).
- Now, if the fuel line (the fuel tank filter inclusively) is in good order, the trouble should be inside of the fuel pump, which should be taken down from engine and overhauled.
- Taking down of the fuel pump should be also performed if there are fuel leakages on its gaskets or around near the hand lever. Diagnosing is done according to indications of parapragh 4.1.2.2.

OP. 2.0.01.27.0 TAKING DOWN THE FUEL PUMP FROM ENGINE

ATTENTION ! Take all necessary measures to avoid any fire danger!

- Remove the pipes connecting the pump with fuel tank and carburettor.
- Take down the pump and bring it on a work bench.

On remounting the pump on engine, perform operations in reverse order.

OP. 2.1.01.26.1 REPLACING FUEL PUMP DIAPHRAGM

After taking down the fuel pump, fasten it in bench vice, having protected jaws. Then:

- Unscrew bolts fastening the middle body on lower body (see fig.4.3.).
- Remove with much care the upper boddy, because the strong tightening of both components, with diaphragm between them, has caused its rather important adherence. Do not use sharp tools, introduced between the two sealing surfaces!
- Unscrew the nut fastening the curved washer (3) (see fig. 4.4.) on diaphragm (1). Pay much attention on unscrewing the nut, because the spring pushes the whole assembly out from the tappet (2).
- Replace faulty diaphragm with the new, original one.
- If there are leakages near the hand lever, but the diaphragm has no fissures, replace sealing gasket which is under the diaphragm, set on the lower curved washer.
- On refitting the pump, perform operations in reverse order.

OP. 2.0.01.32.1 CHECKING FUEL PUMP FOR FUEL INLEAKAGES INTO OIL SUMP

- Actuate manually the fuel pump and check if some leakages occur near the hand lever. If this situation is doubled by oil level increasing in the engine sump, concomitantly with oil thining, it means that the pump diaphragm is fissured. For trouble remeding:
- Take down the pump from engine (Op. 2.0.01.27.0) and replace diaphragm or sealing gasket, between diaphragm and lower curved washer, on the tappet (Op. 2.1.01.26.1).

ATTENTION! On all intervention concerning the fuel supply system take special measures to avoid fire danger!

OP. 4.1.06.01.0 COMPLETE OVERHAULING OF THE FUEL PUMP AND REPLACING ITS WORN OUT COMPONENTS

This overhauling is carried out on work bench, after taking down the fuel pump from engine (Op. 2.0.01.27.0).

A fuel pump in good order should supply 60 l/min. $\pm$ 10%, when its rocker arm is actuated with a frequency of 1250 osc/min, drawing gasoline from a depth of 0.750 m and supplying it up to height of 0.500 m, in atmosphere standard conditions (760 Hg mm pressure and 20°C temperature). If these conditions are different, respective corrections should be done.

If these standard performances are not realized, it means that there are worn out components in the pump: decalibrated spring, faulty valves, which do not close - and should be replaced.

- For spring replacing, see Op. 4.1.06.01.2.
- For valves replacing, see Op. 4.1.06.01.1

Peform refitting of the pump in reverse order.

Pay special attention for fire danger!

OP. 4.1.06.01.2. REPLACING DIAPHRAGM CONTROL SPRING

- Take down fuel pump from engine block (see Op. 2.0.01.27.0).
- Unscrew cover bolt and remove the pump cover (4) - see Fig.4.3. - fine filter strainer (8), sealing gasket, upper pump body (3) and gasket sealing upper body.
- Unscrew bolts fastening middle body and remove middle body, paying attention to not damage the diaphragm.
- Detach carefully diaphragm all around, from lower body.
- Remove the rocker arm control spring and shift the rocker arm pin, in order to get control tappet free.
- Remove diaphragm assembly, together with control tappet, making diaphragm pushing spring free.
- Now, check this spring, which compressed up to a lenght of 21 mm should have a force of 5.5. $\pm$ 0.6 daN (13 lbs.). Do not forget that this main spring provides correct performances of the pump. As always, on any intervention in the fuel supply system, pay special attention for fire danger preventing!

OP. 4.1.06.01.1 REPLACING THE PUMP VALVES

- Take all necessary measures against fire danger!
- Take down the fuel pump from engine (see Op. 2.0101.27.0).
- Unscrew the bolt of the pump cover and remove cover, fine strainer, cover sealing gasket, upper pump body and its gasket.
- Unscrew bolts fastening middle body on the lower body and remove carefully the middle body, in order to not damage the diaphragm.
- Remove both valves (which are pressed in the middle body) and replace them with new, original valves.
- Refit the pump in reverse order.
- Pay attention for fire danger!

OP. 4.1.06.01.3 REPLACING PUMP SEALING GASKETS

- Take down the fuel pump from engine (Op. 2.0.01.27.0).
- Unscrew bolt fastening the cover and remove the cover, to make accessible its gasket.
- Remove middle pump body, to make accessible its gasket. For this, unscrew bolts fastening it on lower body.
- Remove from lower body the gasket, if it has adhered to body, due to prolonged pressing.
- Remove spring (10) (see fig.433.), which actuate the rocker arm.
- Remove, by shifting, the rocker arm pin, and remove rocker arm, making free diaphragm-tappet assemply; pay attention for this operation because the the diaphragm is always pushed by the spring, located under it.
- Remove diaphragm and dismantle it from tappet, making accessible the sealing gasket on the tappet.

ATTENTION! The gasket should be replaced only with original components, fuel resistant.

Refit the fuel pump in reverse order.

As always, pay special attention for preventing any fie danger!

- Finaly check if the new gaskets provide the tightness of the pump.

4.1.3. CARBURETTORS TROUBLES AND REMEDY

4.1.3.1. DESCRIPTION OF CARBURETTOR AND MAIN CHARACTERISTICS

The 36/42 DCD carburettor is of vertical type with downdraft, having two mixture chambers with double venturies (one primary step and one secondary step) and a constant level chamber balance with the zone from the air filter oval.

Each mixing chamber is provided with an obturating valve placed each on a valve port axle. The control of the obturating valve opening and closing is made mechanicaly, differentiately.

The 36/42 DCD carburettor is provided with:

- acceleration pump with piston, actuated by a lever solidary with one of the obturating valve port axles;
- stud for the control depression of the vacuumatic advance;
- choke with air valve mechanicaly controled by means of flexible cable from the motor vehicle's cabin;
- the compensation of the fuel mixture is performed by progressive drawing out from the depression of the main nozzle (air braking);
- qualitative the mixture for slow idle running is adjustable for each mixture chamber by of the adjusting srews of both steps;
- quantitative the fuel mixture is adjusted by the opening of the obturating valve of the primary step.

The 36/42 DCD carburettor comprises calibrated mechanisms

(1 unit = 1 miccron) Thus	First step	Second step
0	1	2
- little ventury		9
- little ventury discharge hole		5
- big ventury (ventury cone)	28	28
- main nozzle (marked calibration)	120	125
- air brake main nozzle (marked calibration)	260	260
- emulsion tube (marked)	F3	F3

0	1	
Idling gear and progressive		
- fuel nozzle for idle running (marked calibration)	52	75
- air nozzle for idle running (marked calibration)	160	70
Acceleration mechanism		
- accelerator pump piston stroke		12 ± 0,5
- accelerator pump charging valve		closed
- accelerator pump discharging nozzle (marked)	60	
Constant level mechanism		
- fuel inlet valve (obturator with needle)		200
Other calibrated parts		
- load nozzle	50	50
- transfer holes	90	90

4.1.3.2. OPERATION OF THE CARBURETTOR'S MECHANISMS

Faulty carburettor operation is found by faulty carburation, respectiveiy by back fires, exhaust of unburnt gases (with much smoke), high fuel consumption, resulting usualy from disadjusting of one carburettor mechanisms.

4.1.3.2.1. NORMAL RUNNING MECHANISM OPERATION

The fuel from the constant level chamber, passes through the two main nozzles 1 (see. fig. 4.5) arrives into emulsion tubes 2, where it mixes the air that passes through the main air braking nozzles (3).

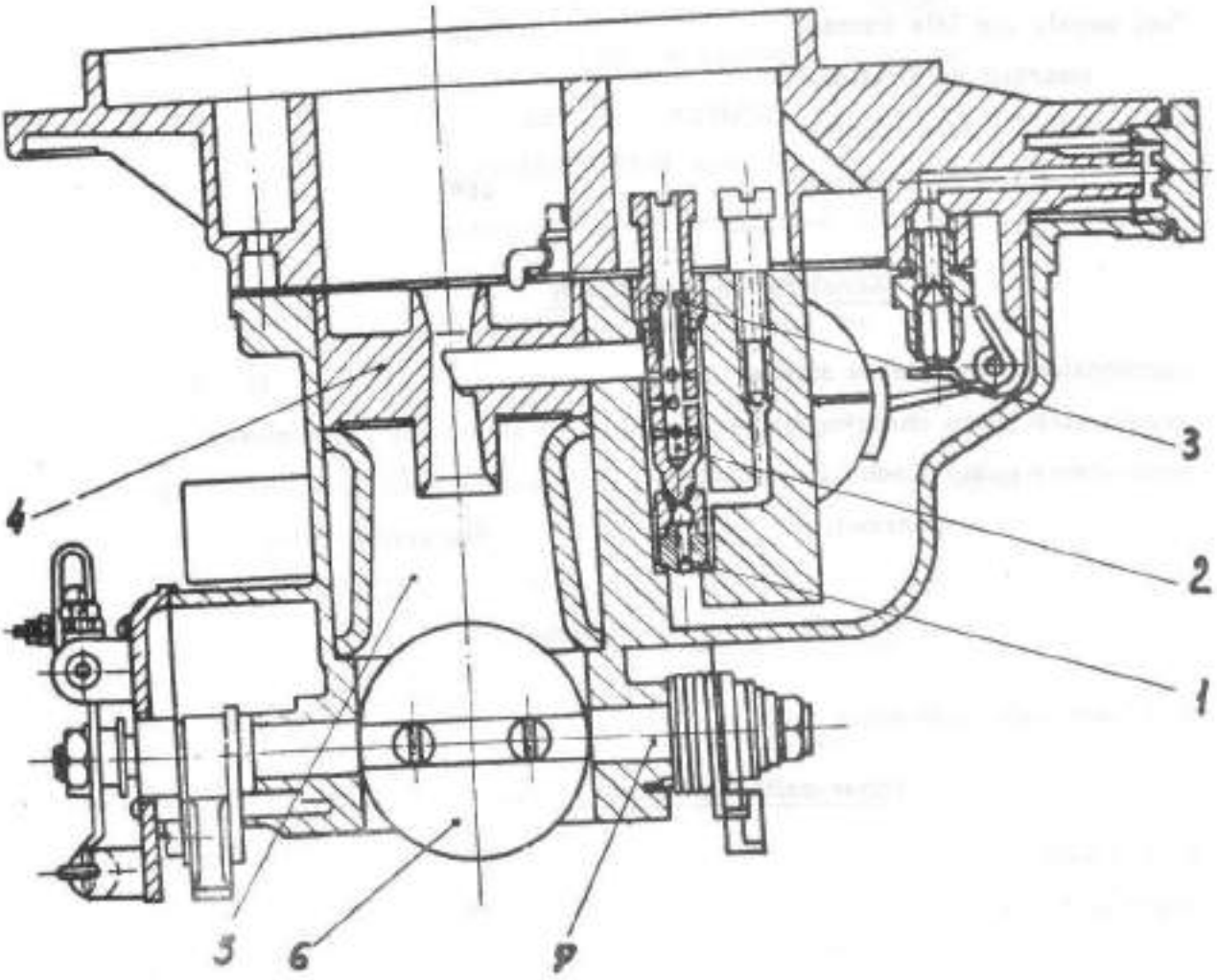


Fig. 4.5. CROSS SECTION OF CARBURETTOR.
NORMAL OPERATION SYSTEM.
1. Main jet; 2. Emulsion tube; 3. Jet correction air bleed;
4, Mixture centring guide; 5. Venturies; 6. Throttle butterfly;
7. Butterfly shaft.

Combustible mixture is absorbed through the mixture centring guide 4, and from here, finely atomized, is mixes with the fresh air into the ventries 5.

The combustible mixture consumption, respectively the engine autput is controled by the agency of the accelerator valves 6, actuated by rotating of shaft 7 from the accelerator control system.

Position of valves and their differentiated motion, is so that the valve of step I opens first and than the valve of the second step is assured by sector 2 and lever 3, see fig. 4.6.

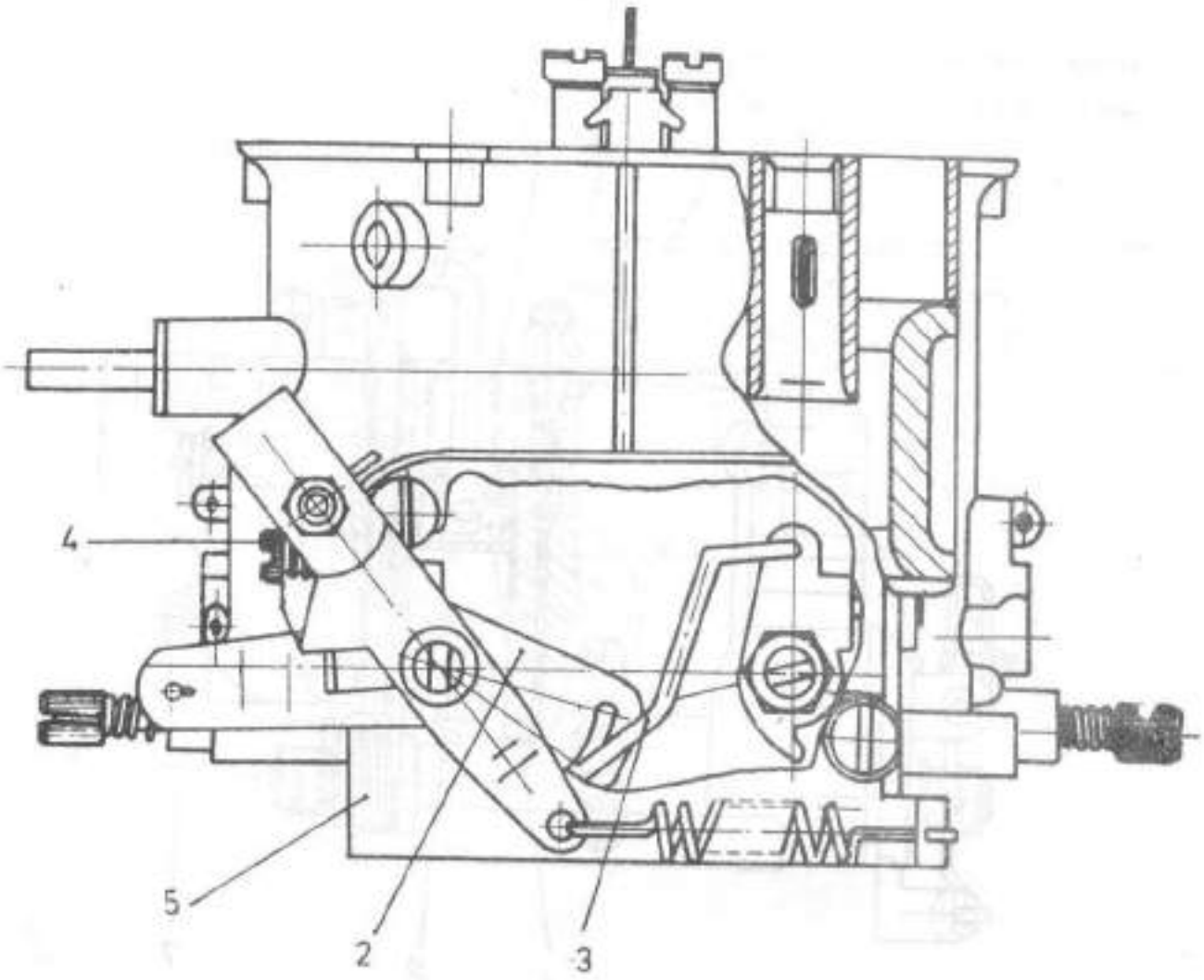


Fig. 4.6. MECHANISM OF SINCRONIZED MOTION OF THROTTLE BUTTERFLIES.

For high loads the fuel mixture is enriched by opening of the load valve (2) actuating the acceleration pump piston when the acceleration pedal is actuated at maximum stroke see. fig. 4.7.

In that moment the piston actuates the load valve opening access of the suplimentary gasoline that passes through the enriching nozzle 3 towards the mixture venturies.

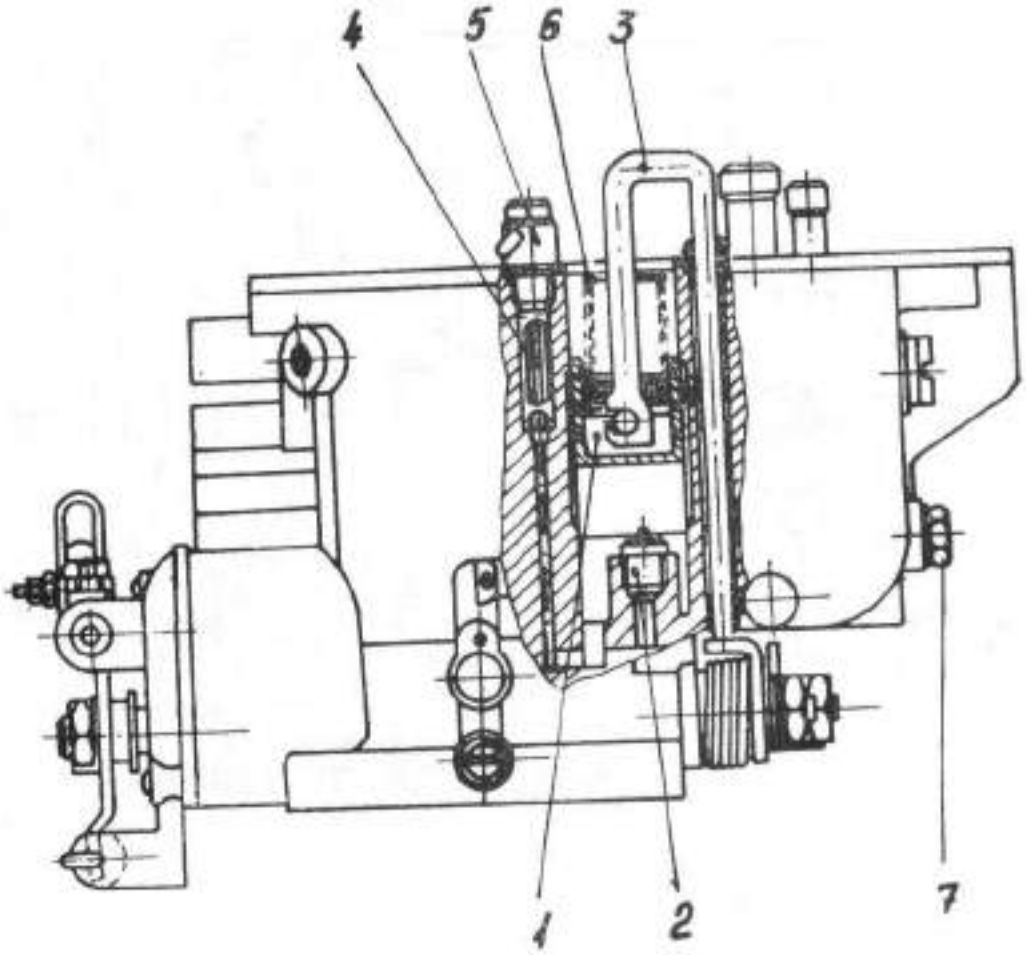


Fig. 4.7. INLET (CHARGE) VALVE
1. Accelerator pump piston; 2. Inlet (charge) valve; 3. Acceleration piston control rod; 4. One-way valve; 5. Accelerator distribuitor for supplementary fuel on acceleration or full load; 6. Accelerator piston spring.

4.1.3.2.2. OPERATING OF THE CONSTANT LEVEL CHAMBER

In the superior carburettor body see fig. 4.8 there is the mechanism for flow adjusting, so that the level in the chamber remains constant.

On the passing channel from the inlet pipe connexion towards the carburettor's chamber, the obturator with needle is mounted (marked 200) being screwed in and tightened by a gasket.

A swingable support wears the 2 floaters and by the front and rear levers actuates the needle in to the obturator with needle and limits the opening

strexe so that between the caps inferior part and floater's surface existes a space of 7,5 - 8 mm above the full closed position and 13 - 13,5 for the full open position.

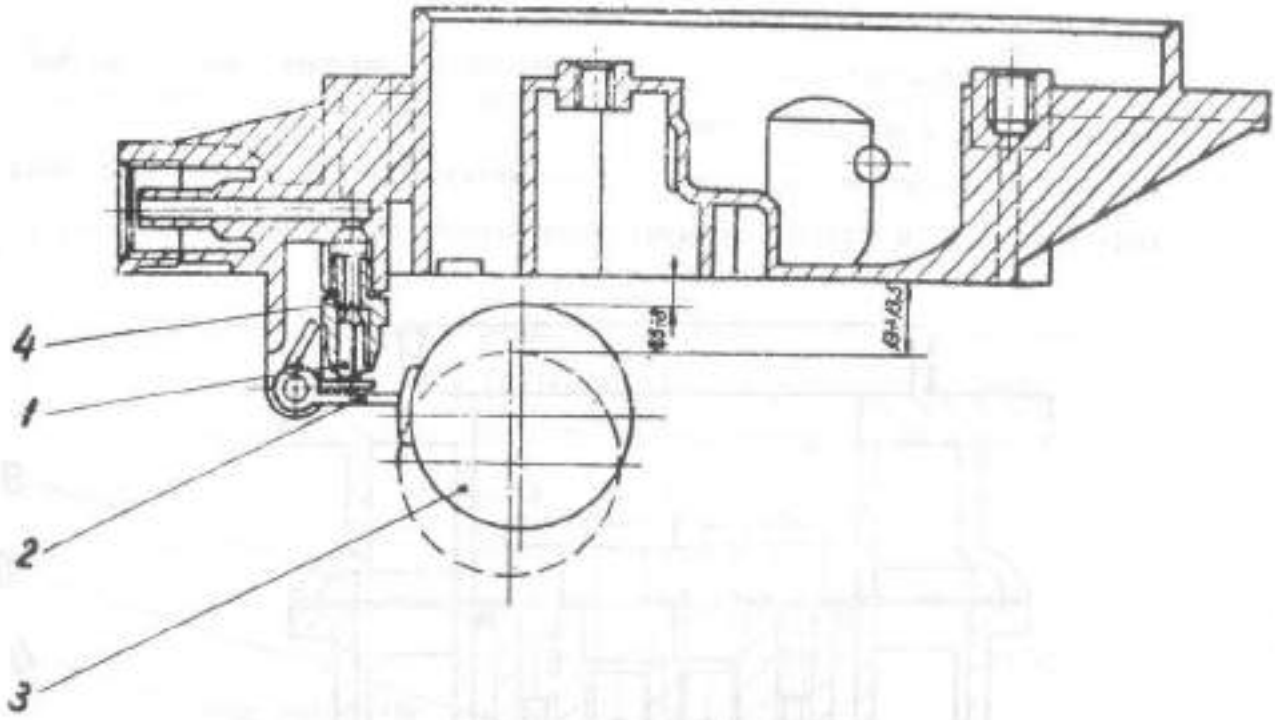


Fig. 4.8. CARBURETTOR UPPER BODY WITH FUEL CONSTANT LEVEL MAINTAINING MECHANISM
1. Needle valve; 2. Actuating lever; 3. Float assy; 4. Neddle valve body.

The swinging assy with the 2 floaters has a weight of 12,5 gr.

4.1.3.2.3. OPERATION BY SLOW AND PROGRESSIV RUNNING

The fuel from the constant level chamber (1) see. fig. 4.9, passes through the main nozzles 9 to the idle nozzles 10.

The butterfly throttles (2) being almost closed no sufficient depressure is formed in the mixture centerings, so that combustible mixture can be formed in the emulsion tubes (3), which could be drawn into the mixture chamber (ventury).

The fuel comes into the emulsion channel 4 where it is mixed with the air that comes through the air nozzle (8).

The formed con.bustible mixture passes through the channels to the idle supply holes (5) and mixes with the air which passes al a great speed close to throttle butterfleis (2).

The adjusting screws (6) doses combustible mixture amount, so that engine runs at a minimum speed.

To accelerate the engine it is necessary a greater amount of combustible mixture it is obtained by progressive opening of throttle butterflies.

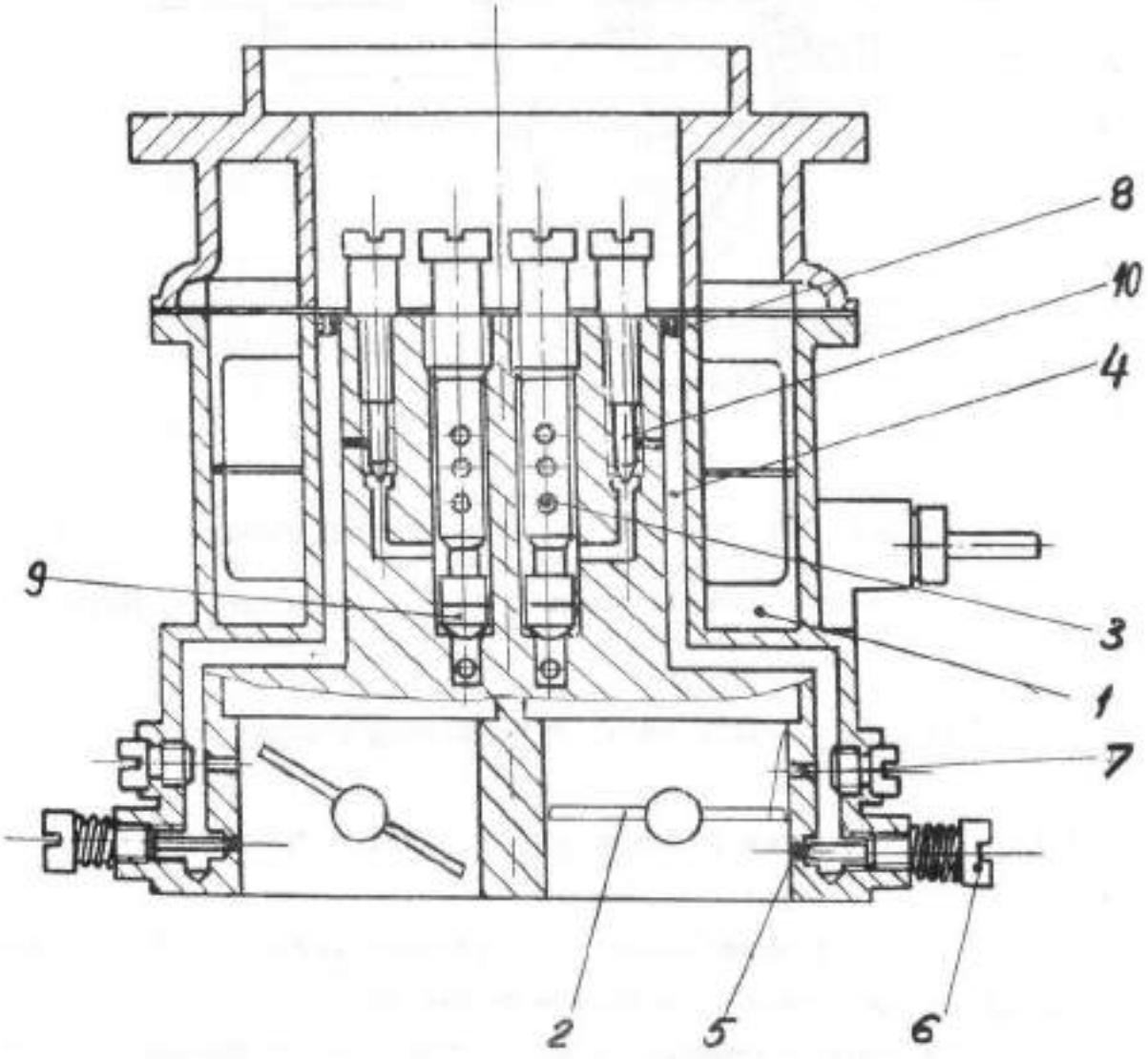


Fig. 4.9. IDLING OPERATION MECHANISM
1. Float chamber; 2. Throttle butterflies; 3. Emulsion tubes; 4. External emulsion tube; 5. Idle speed supply hole; 6. Idle operation adjusting screws; 7. Holes for acceleration starting (progressive operation); 8, Idle running air bleed. 9. Main nozzles; 10. Idle Nozzles.

The local depression which arives between the butterfly I. st. step and wall causes the drawing of combustible mixture suplimentary amount through calibra.ed transfer holes 7.

The drawing of suplimentary mixture in cresses as the butterfly I. st. step opens more up to a limit when the depression between the butterfly step 1 and carburettor's wall descreases, but in this time a sufficient depression is reached in mixture centering guide, so that the main nozzles being to operate.

4.1.3.2.4. OPERATION ON ACCELERATING

When the accelerator pedal is pressed down, together with the butterflies (1) opening (see.fig.4.10) the accelerator pump control lever gets free (2) and accelerator piston (3) is pushed by the spring (4) pusting fuel through connecting channel (5) to the mixture chamber.

On passing the fuel pushes the ball valve (6) and arrives through accelerator fuel distributor (7) above the mixture chamber of step 1 (8).

The ball valve is maintained in its shul position by the natural weight of the valve weight (9).

When the foot is taken from the accelerator pedal and the butterflies get free to shut (an external spring actuates upon the actuating lever of the accelerator butterflies the actuating rod (2) is rised and together with it the piston. The depression that is formed under the piston closes the ball valve (6) and opens the fuel aspirating valve, from the constant level chamber filling again the cylinder (11) in view of a new acceleration.

4.1.3.2.5. OPERATION ON ENGINE STARTING (WITH THE PULLED CHOKE

The engine starting needs for a short time a very rich combustible mixture.

Pulling the choke, the control lever (1) see. fig. 4.11 rotates the choke valve 2 closing the air access to mixture chamber.

By means of a linkage, a half-opened position of the throttle butterfly of step I (3) is assured.

The starting motor is started by rotating crankshaft of the engine.

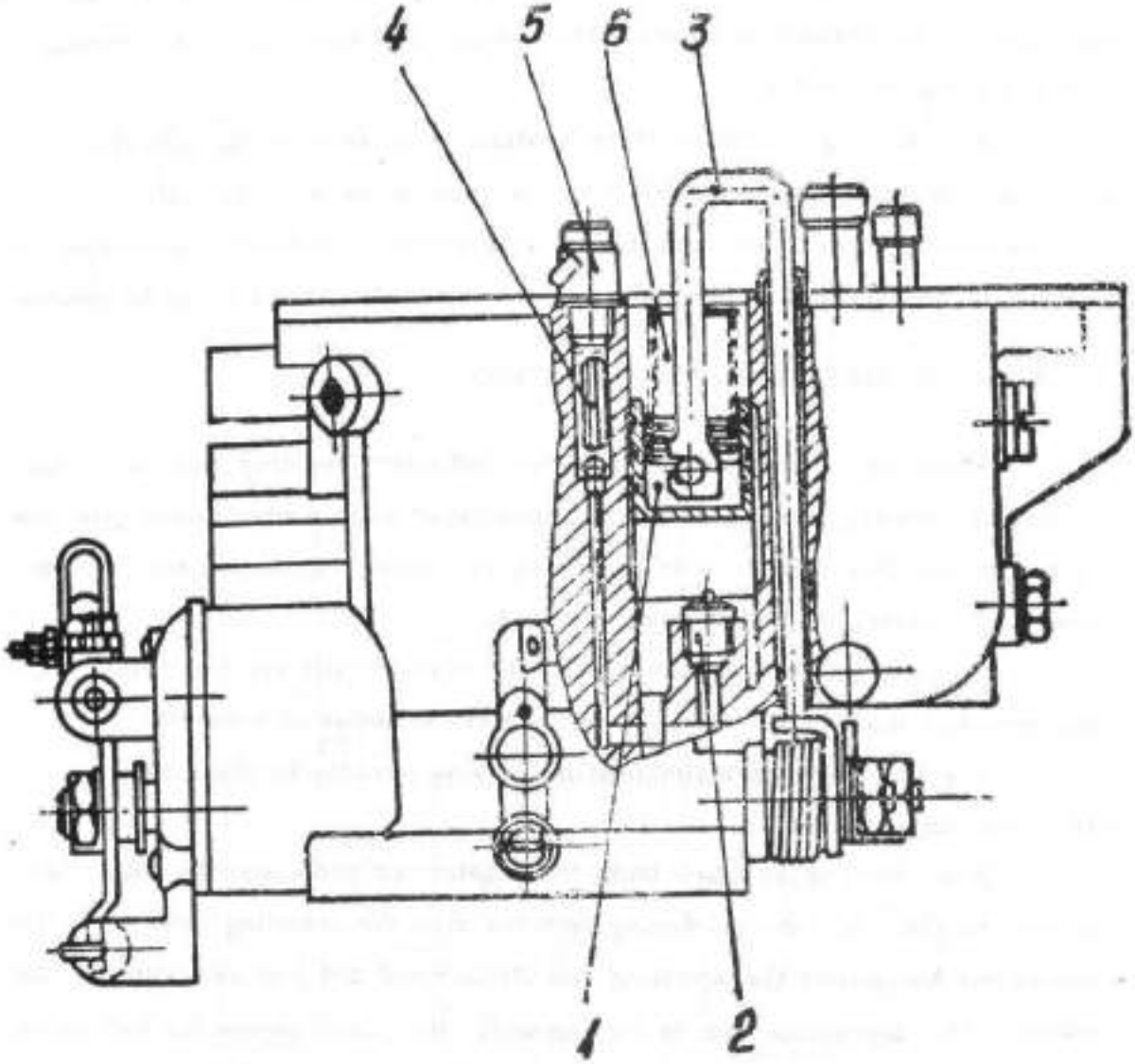


Fig. 4.10. CARBURETTOR ACCELERATION MECHANISM
1. Accelerator pump control lever; 2. Pump piston control rod; 3. Accelerator pump piston; 4. Accelerator piston spring; 5. Connection part; 6. Valve ball; 7. Accelerator fuel distributor; 8. Mixture chamber; 9. Valve weight; 10. Discharge valve; 11. Accelerator pump cylinder.

The arising depression draws through the part of mixture centring guides of step I (4) a very rich, combustible mixture which facilitates engine starting.

Once the engine started the formes depression is greater and opens the air valve (6) allowing a greater air jet which reduces the inriching of the

mixture sprayed from the mixture centering guid tubes (4) allowing a regular engine operation.

During engine heating the choke valve (2) must be opened progressively.

4.1.3.3. CARBURETTOR TROUBLES AND THEIR REMEDYINGS

Except the troubles, which are to be remedyed on normal carburettor maintenance and which do not require its taking down from the vehicle, there are some faults which do not require its taking down.

Carburettor troubles have as immediately observable effect incorrect engine running.

The lack of fuel on engine can result from carburettor, whose needle valve seat is clogged with impurities, which have passed through inlet fine filter. It can also result from incorrect fuel level in the float chamber, due to worn needle valve, which jammed in its seat.

For remedying these troubles perform succesively: needle valve seat cleaning (Op. 2. 1. 15. 02. 1), correct float assy. position checking (Op. 2. 1. 15. 01. 2) and needle valve wear checking (Op. 2. 1. 15. 01. 3).

- Too great fuel supply, which floods the engine, can result from needle valve which does not close tightly on its seat, causing a too high fuel level. It can also result from decalibrated main jets.

For remedying of these troubles perform the checking of needle valve (Op. 2. 1. 15. 01. 3) , checking of fuel level in float chamber (Op. 2. 1. 15. 01. 2) and checking the main jets for decalibration (Op. 2. 1. 15. 06. 0).

- The engine does not accelerate, because carburettor accelerator piston is worn out, the valves of accelerator circuit are faulty (do not close tightly), the accelerator piston spring is decalibrated or broken, or the ports of accelerator circuit are clogged.

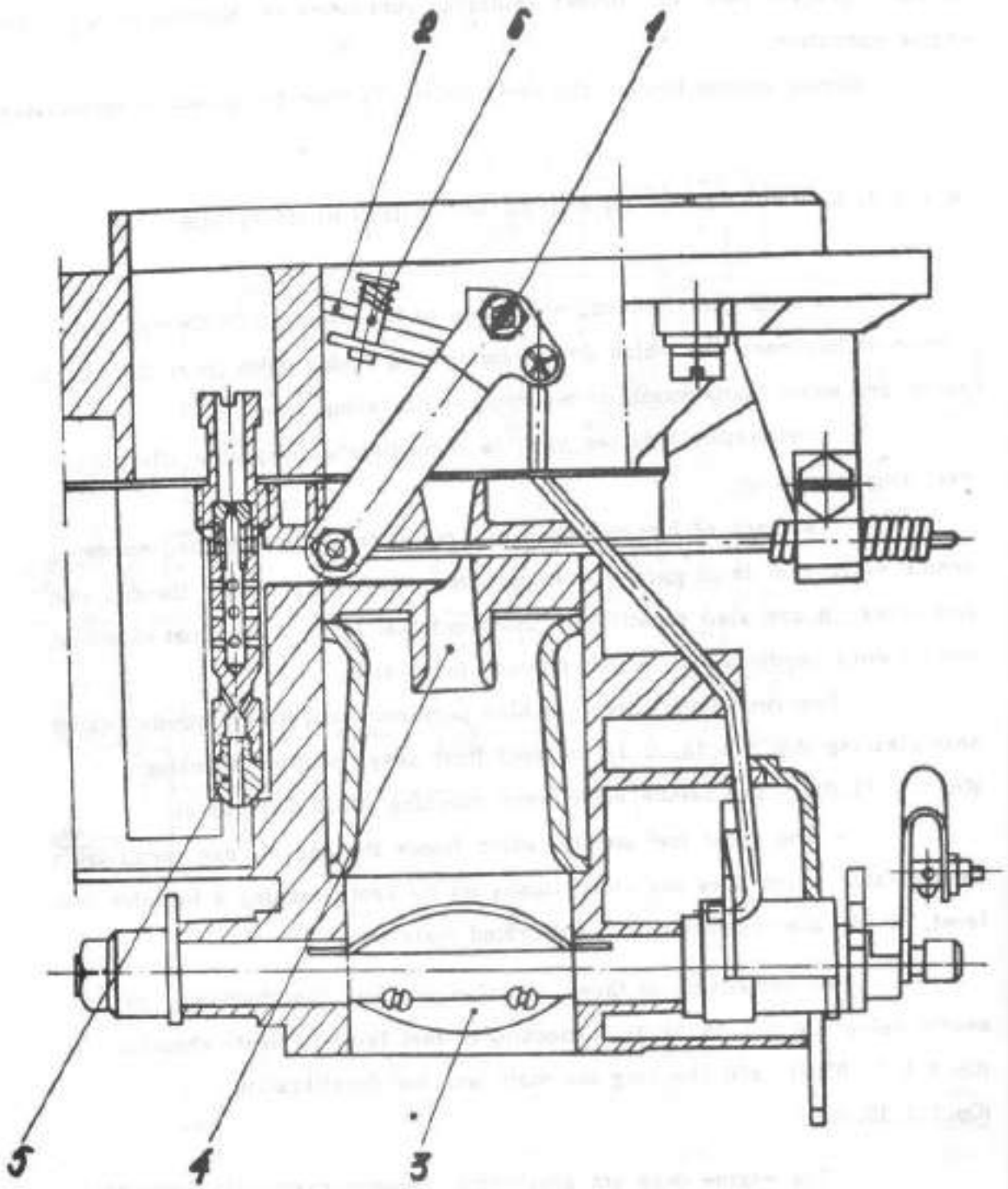


Fig. 4.11. ENGINE STARTING MECHANISM
1. Control 'evel; 2. Choke valve; 3. Throttle butterfly; 4. Mixture centring guide; 5. Main jet; 6. Choke valve.

The trouble remedying needs taking down from engine of lower carburettor body (Op. 2.1.15.02.0) and checking, respectively repair of accelerator mechanism (Op. 4.1.15.07.0).

- The idle engine running cannot be correctly adjusted, due to clogged or decalibrated idle jets.

Perform cleaning of idle jets and idle running holes (Op. 2.15.03.0), after having previously taken carburretor down from engine (Op. 2.1.15.02.0).

The choke actuating is insufficient or, on the contrary, floods quickly the engine. For remedying, check correct choke operation (O . 2.1.15.04.0).

- The engine running is irregular, due to unequal fuel supply of cylinders. This trouble can result from faulty throttle butterflies mechanism, which should be checked as in Op. 2.1.15.05.0.

OP. 2.1.15.01.0 TAKING CARBURETTOR UPPER BODY FROM ENGINE

- Disconnect carburettor from air cleaner, by dismantling the adapter (Op 2.01.01.16.1).

ATTENTION! Take all necessary measures to avoid any fire danger!

- Disconnect carburettor from the fuel pump.
- Dismantle carburettor upper cover by unscrewing the 6 upper bolts (four inside and 2 outside, near inlet pipe connection).

Take care to not damage the gasket between the two carburettor bodies, what can cause air inleakages.

As long as the carburettor will remain with its upper body dismantled it should be covered with a plate, as tightly as possible, in order to hinder any penetrating of impurities in carburettor, and further, into engine itself, which can endanger gravely the engine:

- Perform carburettor refitting in reverse order.

OP. 2.1.15.02.0 TAKING DOWN MIXING CHAMBERS BODY FROM ENGINE

- Take carburettor upper body down, as described in Op. 2.1.15.01.0.
- Take carburettor lower body (mixing chambers body) down from inlet manifold, making free concomitantly insulating and the two sealing gaskets.
- Protect inlet manifold with a cover, to avoid impurities penetrating.

On refitting take special care for correct setting of components, in order to avoid any air inleakages.

- Refit carburetor in reverse order.

OP. 2.1.15.01.1 CLEANING CARBURETTOR NEEDLE VALVE AND ITS SEAT

- Dismantle upper carburettor body, according to Op. 2.1.15.01.0.
- Put the upper carburettor body on a work bench, with the floats upwards and remove float spindle.
- Remove carefully the floats assembly taking care to not deform its levers.
- Remove needle valve, which is now free.
- Unscrew the needle valve seat, together with its gasket and clean the seat by air blasting. On occasion, use for cleaning a wooden chip.
- After cleaning refit all in reverse order.

OP. 2.1.15.01.2 CHECKING CARBURETTOR FLOAT CHAMBER FOR RIGHT LEVEL

- Dismantle upper carburettor body, as described in Op. 2.1.15.01.0.
- Check distance between float top and upper body underside (without gasket), which should be of 7.5 - 8 mm for float upper position, and of 13 - 13.5 mm for its lower position. If these distances are wrong, correct them by bending of the front and rear levers of the float assembly, which actuate the needle valve and limit its stroke, untill correct distances will be obtained (above mentionned).

- If bothe mentionned distances are correct, but the carburettor is altough flooded, it means the the float weight is wrong. In this case remove thefloat assembly spindle and weigh the float assembly. The float weight should be of 21.5 g (0.44 ozs).
- In case that the float assembly got heavier, due to fuel inleakage, heat moderately the assembly up to 60 - 70°C (140-158°F), untill the fuel evaporates.
- Check the fissure through which the fuel penetrated into respective float, by introducing the cold float assembly in warm water: the air from inside will expand and will come out in shape on fine bubbles, marking so the fissure.
- Close the fissure by tinning, without exceeding the tin weight of 0.1 g (0.056 drams).
- If the floats bodies are deformed, there is nothing doing and they should be replaced with original float assembly.
- Refit all in reverse order.

OP. 2.1.15.01.3 CHECKING NEEDLE VALVE WEAR

- Dismantle carburettor upper body, as described in Op. 2.1.15.07.0.
- Put it on a work bench, with the floats upwards and remove the float assembly spindle.
- Remove carefully the float assembly, without deforming its front and rear levers.
- Remove needle valve, which is now free.
- Unscrew needle valve seat and remove it with its gasket.
- Check if needle valve closes tightly, by the agency of compressed air and water and soap.
- If the needle valve does not close tightly, replace it. For lack of a new needle valve, grind the point of the worn needle valve under an angle of 60° and repeat tightness cheking, if the result is still negative, replace the needle valve seat.

OP. 2.1.15.03.0 CHECKING AND CLEANING IDLE JETS

- Disconnect carburettor from air cleaner, by taking down carburettor adapter, according to Op. 2.0.01.15.1.
- Unscrew idle running jets and blast them with compressed air; if it will be stricty necessary, you can use for disclogging wooden needles, but so that wooden chips do not remain in the jet hole.
- Unscrew partially the idle running adjusting screws and clean by air blasting the ports of idle running system.
- Check also the holes which are in the throttle butterflies chambers. If the outlet holes are clogged, unscrew completely the idle adjusting screws and the sealing plugs, above them - which provide access to the progressive running holes - and clean them by air blasting or with wooden chips.
- Refit all in reverse order.
- Adjust now idle engine running, as indicated in Op. 1.0.01.22.0.

OP. 2.1.15.04.0 CHECKING CHOKE CORRECT OPERATION

- Disconnect carburettor from air cleaner, by dismantling its adapter, according to Op. 2.0.01.15.1.
- Check if choke valve is normally opened and if, on a slight depressing of its spring tappet, it opens more (see fig.4.11, tappet (6)).
- Check if on rotating the choke shaft (1) the valve oscilate correctly, closing its inlet, in its position "Choke pulled".
- If the shaft is curved and its rotating occurs with jammings, or does not close the chamber, it should be completely dismantled. For this:
- Unscrew the two screws which fasten the choke valve on its shaft and remove the valve.
- Remove choke shaft control lever and pull out the shaft in order to straighten it or replace it with a new original shaft.
- Refit all in reverse order.

2. 1. 15. 03. 0. VERIFYING OF BUTERFLY THROTTLE MECHANISM

Unmount of inferior carburettor body according to operation 2. 1 15. 02. 0.

Notice by the inferior part if the butterflies have a differentiated motion, open first the step I. and then the II-nd step.

If you notice the butterflies clearance on the axle tighten the fixing screws.

In case of a to big displacement or a to big wear out unmount the protecting cap (5) fig. 4. 6 of sector (2) and of lever (3) so that you can replace the damaged parts by original parts.

Mounti is done in contrary order of unmounting.

Verifyng of carburettor flange flatness

- Unmount the carburettor from the inlet manifold;
- turn it with the inelt manifold laying flange up wards;
- verify the flange flatness by means of a metal ruler.

When a distorsion on the carburettor flange is noticed rework the flange's surface.

OP. 2. 1. 15. 06. 0 CHECKING MAIN JETS FOR DECALIBRATION

- Take down carburettor adapter to air cleaner, according to Op. 2. 0. 01. 15. 1
  Remove the two main jets.
- Check jet orifice diameter, by the agency of a calibrated wire, corresponding to the marked value on jet. Faulty jets should be replaced with original ones.
- Refit carburettor in reverse order.
- After that, adjust again carburetor for idle engine running. (Op. 1. 0. 01. 22. 0).

OP. 4. 1. 15. 07. 0 CHECKING AND REMEDYING ACCELERATOR MECHANISM

The engine does not accelerate. This trouble can result from: leakiness of discharge valve (10) - see fig. 4. 7), causing fuel back leakage from accelerator cylinder; accelerator piston wear, causing fuel back leakage between piston and cylinder wall; decalibrated or broken accelerator piston

spring, which normally should push the piston on accelerating, supplying more fuel.

To remedy trouble:

- Take down upper carburettor body, according to Op. 2.1.15.01.0.
- Remove discharge valve (10) and check it for tightness, by the agency of compressed air and water with soap.
- Remove accelerator piston, by extracting its control rod (3) and check its rate of wear, by measuring. It is not allowed a clearance between the piston and cylinder more that 30 microns (0.030 mm).
- Dismantle accelerator distributor (5), from upper side of carburettor body, and clean it, if clogged, by air blasting.
- Check if accelerator piston spring (6) is decalibrated or broken.
- Remove ball valve (6) and its weight (9) (see fig. 4.10) - by overturning the carburettor body, paying attention for ball valve, and clean port of accelerator circuit by air blasting.
- Replace faulty parts with new, original ones.
- Refit all in reverse order.

OP. 2.1.15.08.0 CHECKING OVERLOAD MECHANISM

- Take down carburettor upper body, according to Op. 2.1.15.01.0.
- Remove acc. distributor (7) - see fig. 4.10 - and check it for tightness, by agency of compressed air and water with soap.
- Remove accelerator piston, after extracting its control rod (2).
- Remove discharge valve (6) and check it for tightness, by the agency of compressed air and water with soap.
- Refit all in reverse order.

4.1.4. TROUBLES AND REMEDYINGS OF LUBRICATING SYSTEM

4.1.4.1. LUBRICATING SYSTEM DESCRIPTION

The lubricating system of ARO L-25 engine is of mixed type, i.e. pres-

connecting rod big end bearings, camshaft bearing bushes, rocker arm shaft bearing and oil pump-ignition distributor driving shaft are pressure lubricated. All other moving parts (timing gear, distributor driving gear, the contact between tappets and cams) are lubricated by splash or drip (see fig. 4.12).

The oil pump (2) draws oil from oil sump through strainer (1) and delivers it through oil piping in the oil filter (3). On the pipe connecting the pump with the fine filter is a pressure control valve, protecting the pump.

From the fine filter oil passes through oil central manifold.

From here, oil passes under pressure to crankshaft journals and then, throug the parts in crankshaft, to crank pins bearings.

On the the other hand, oil passes from central manifold to camshaft bushes and to rocker arm shaft.

Through the ports and holes, provided in cylinder block, oil arrives by dripping upon valve tappets, on timing gear, on ignition distributor gear, while through other ports oil, which escapes at the extremities of the main journal and crank pin bearings, produce an oil mist in the oil sump room (fine oil drops), which lubricates the other moving parts.

4.1.4.1.1. THE OIL PUMP

The oil pump is a single stage gear pump with inner spur gears and a ratio $Z_1 : Z_2 = 4 : 5$ (see fig. 4.13).

The maximal pump pressure, limited by the pressure control valve (mounted on cylinder block) should be 4.9 daN/cm^2 (71 lbs/in^2).

The maximal pump speed is 2,300 r.p.m.

The bolts, fastening the pump on cylinder block, should be tightened with a 1.5 - 1.8 daNm torque (11 - 13 ft.lbs).

The maximal torque, necessary to rotate the unloaded pump (the rotation should not have a tendency of braking or jamming) should not exceed 2.5 daNm (18.4 ft.lbs).

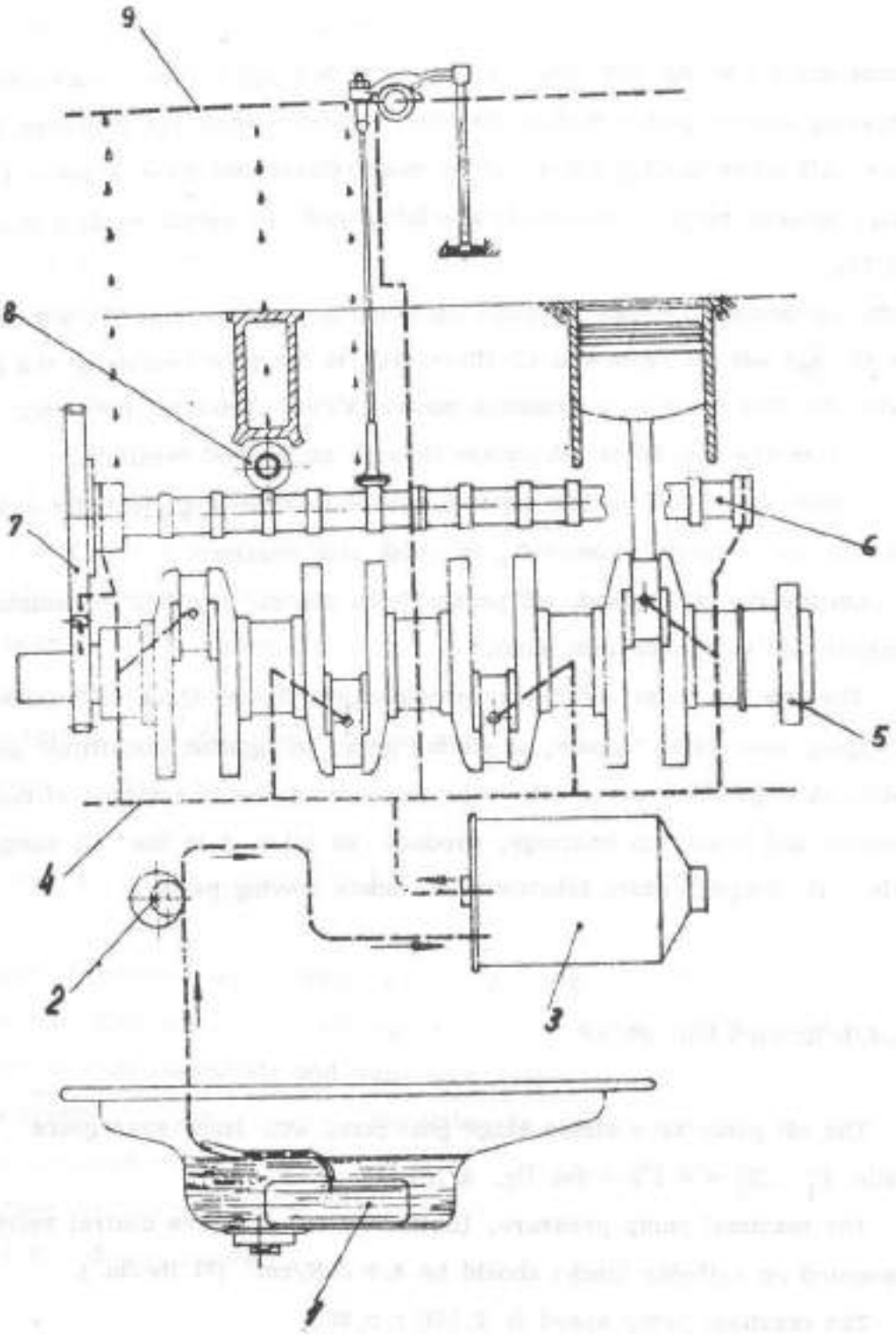


Fig. 4.12. DIAGRAM OF ENGINE LUBRICATION
1. Oil sump strainer; 2. Oil gear pump; 3. Oil filter; 4. Oil central manifold; 5. Crankshaft; 6. Camshaft; 7. Camshaft gear; 8. Ignition distributor driving gear; 9. Rockerarm shaft.

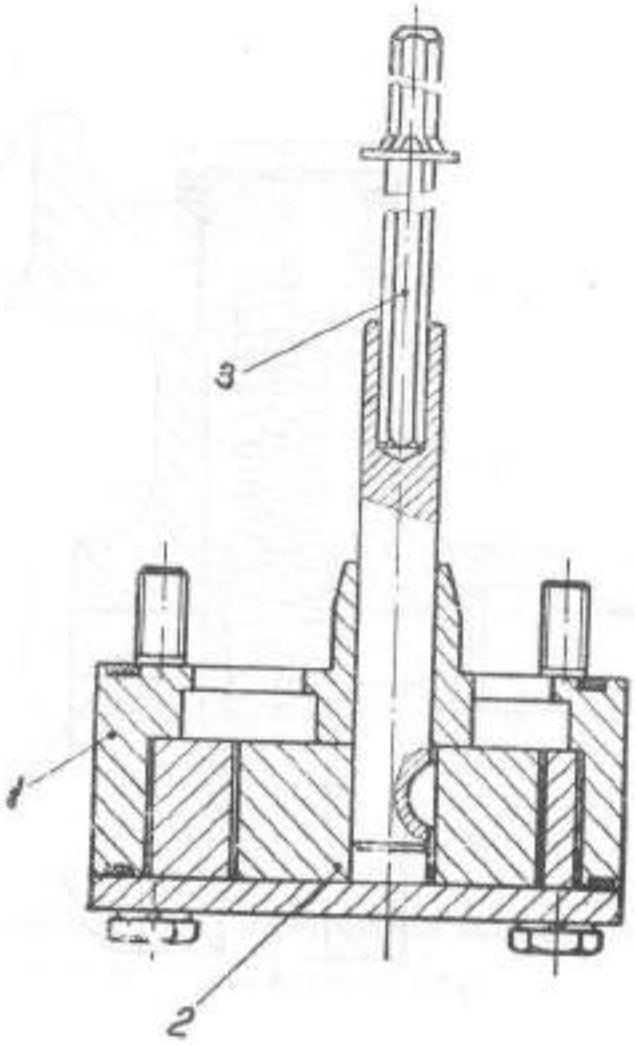


Fig. 4. 13. OIL PUMP

1. Oil pump housing; 2. Inner rotor; 3. Drive shaft

On the pump supply port of ø 1, 5 x 5 mm, the pressure, before the orifice, should be:

- at 1000 r.p.m. ..... min 3, 5 bars
- at 250 r.p.m. ..... min. 2. 5 bars

The clearance between pump inner rotor and driven gear should be at least 0, 02 min, going, due to wear, up to max. 0, 130 mm.

4. 1. 4. 1. 2. OIL PRESSURE CONTROL VALVE

The pressure control valve is of plunger type, and, besides the safety relief valve role, it has also a regulating one, maintaining at different pump speeds an adequate pressure in the lubricating system (see fig. 4. 14).

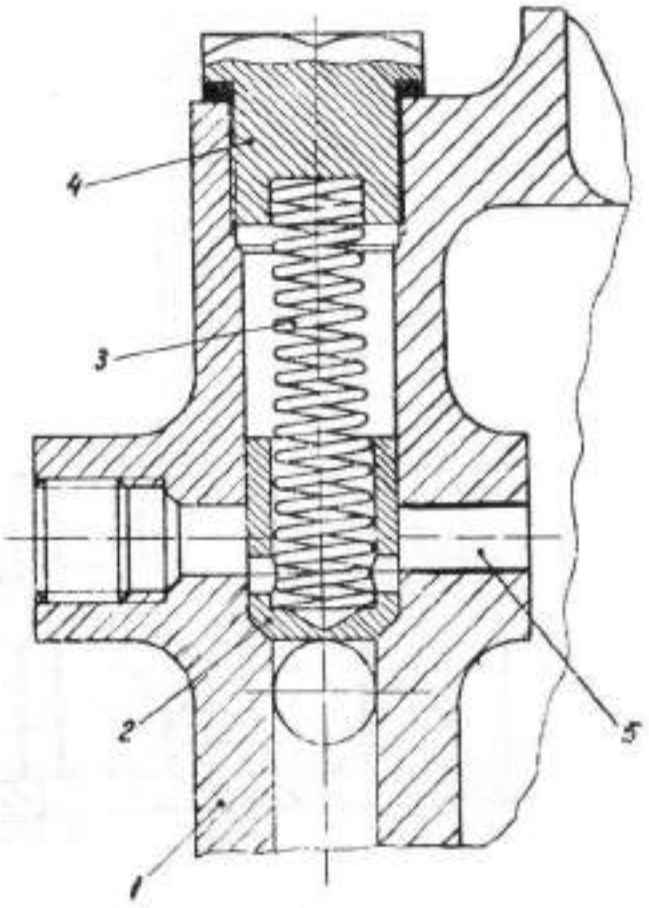


Fig. 4.14. OIL PUMP PRESSURE CONTROL VALVE.
1. Cylinder block body; 2. Oil relief valve piston; 3. Oil relief valve spring; 4. Screw plug with gasket; 5. Oil relief port.

The pressure control valve begins to open at a pressure of 2.5 daN/cm^2 (35.6 lbs/in^2) and is fully open at 4.9 daN/cm^2 (69.7 lbs/in^2).

The coil spring (3), depressed to 43 mm lenght, is rated for 5.5 - 0.4 daN (12 - 0.9 lbs) force.

4.1.4.1.4. OIL SUMP

The oil, drawn from the oil sump by the pump, passes throug the rough filtering strainer. In the strainer, connected by a pipe with cylinder bloc there are two filtering gauzes of different fineness, designed to hinder rough impurities to reach the oil pump.

4.1.4.1.5. SUPPLEMENTARY OIL FILTER

Some engines are equipped, on demand, for areas with heavy duty operation conditions, with a second, supplimentary oil filter, interposed before the fine filter, in order retain the rough impurities (50 microns) (see fig. 4.16).

4.1.4.1.6. CENTRIFUGAL FILTER

The carankshaft has collecting hollows, in the transition zones, where oil passes and, owing to centrifugal force oil sets down the finest impurites, which escaped out from the filtering chain.

To clean these collecting hollows, unscrew recessed square plugs secured against slacking by punching.

4.1.4.2. TROUBLES AND REMEDYINGS OF LUBRICATING SYSTEM

Besides the troubles of lubricating system, due to its component units, it can occur other troubles, having repercussions on engine lubricating, such as: oil pollution (Op. 2.0.01.28.0), inleakages of water or fuel in the oil (Op. 2.0.01.32.0) through cylinder head gasket (Op. 2.1.01.32.2), around cylinder linerO-ring gaskets (Op. 2.0.01.32.1),respectively around the fuel pump hand lever (Op. 2.0.01.32.1),oil loss by burning(Op.2.0.01.34.0) causing engine output decrease by reduced compression (Op. 2.0.01.36.0),or oil leakages through crankshatf rear main bearing (Op. 2.0.01.35.1), thorugh oil sump gasket (Op.2.0.01.35.2) or through oil filter gasket (Op. 2.0.01.35.3).

In case that oil pressure is low, although there are no visible oil leakages, check firstly fuel pump for rate of wear (Op. 4.0.09.01.1), taking it previously down from engine (Op. 2.0.01.33.0).

If the fuel pump is in good order, the oil pressure diminution is due to too great bearing clearances, the trouble which should be remedyed on general engine overhauling.

The oil pollution can result from failure of oil fine filter, due to faulty by-pass valve or oil filter inner valve (Op. 2.0.09.02.0 and Op. 2.0.09.03.0),or from double filtering system failure (Op. 2.0.09.04.0).

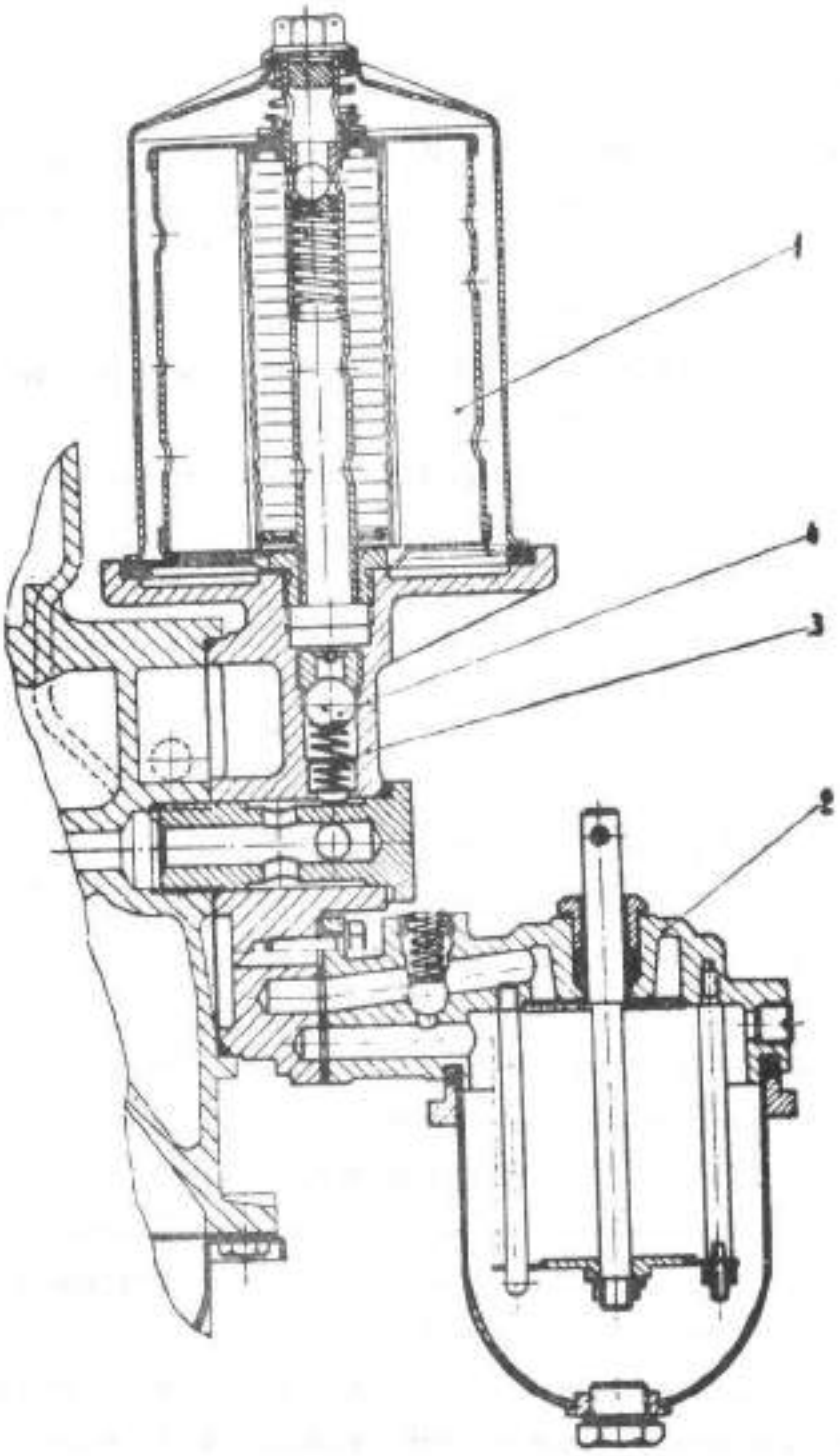


Fig. 4.16. LONGITUDINAL SECTION OF DOUBLE FILTERING SYSTEM.

1. **Fine oil filter**; 2. Rough oil filter; 3. **Intermediate support**;
4. **One way valve.**

OP. 1.0.01.28.0 CHECKING OIL FROM THE ENGINE

- After stopping the engine, pull out oil dip stick and inspect oil aspect: the oil should not contain opaque impurities, should not have anormal viscosity or muddy aspect. In case that such aspects are observed, seek for trouble source, according to § 4.1.4.2.

OP. 2.0.01.32.0. CHECKING OIL LEVEL INCREASE

- Pull out the oil dip strick and check oil level on it. If maxdmal oil level is exceeded, it is a sign that other fluids (water or fuel) have penetrated in the lubricating system. If oil got thinner, it means that fubl has penetrated in it, and the trouble should be remedyed according to Op. 2.0.01.32.1.
- If the oil has maintained its normal viscosity, but has a turbid, muddy aspect, or even fine water drops can be observed in it, it means that water is present in oil and you should seek for causes of water inleakages and after remedying the trouble, change the oil.

OP. 2.0.01.32.2 CHECKING INTEGRITY OF CYLINDER LINER GASKETS

- Inspect on the right side of cylinder block the four small holes (about ø 4 mm), provided for eventually water leakages. They are drilled in the area between the two cylinder liner rubber 0-rings. In case that the first (upper) 0-ring got weakened, on respective cylinder block face appear water leakages, marked by rust traces. It is an alert sign, because it gets possible that the second (lower) 0-ring could also weaken, causing certainly water inleakage into oil sump.
- In such a case both 0-rings of respective cylinder liner should be replaced (see Op. 2.1.02.03.0).

OP. 2.1.01.32.2 CHECKING TIGHTNESS BETWEEN CYLINDER HEAD AND CYLINDER BLOCK

- Drain oil from engine oil sump, according to Op. 1.0.01.03.0.
- Take down cylinder head, acc. to Op. 2.0.01.21.1.
- Take down exhaust manifold, acc. to Op. 2.0.08.04.0.
- Take down air cleaner adapter from carburettor (Op. 2.0.01.15.1).
- Take down carburettor from inlet manifold (Op. 2.0.08.05.0)-
- Take down thermostat elbow, acc. to Op. 2.0.07.02.0.
- Take down inlet manifold, acc. to Op. 2.0.08.06.0.
- Take down rocker arm shaft assembly, acc. to Op. 2.1.01.29.0.
- Drain water from cooling system, acc, to Op. 2.0.13.04.0.
- Take down water pump, without taking down the engine from vehicle, acc. to Op. 2.1.01.37.0.
- Take down cylinder head from engine block, acc. to Op. 2.1.01.30.0.
- Check firstly the aspect of cylinder head gasket, for fissures between passes for oil and water (from engine block into cylinder head) or for rust traces, connecting these passes, marking so water leakages between the passes.
- If gasket will be found faulty, it should be changed with a new one.
  In case that there will be found two rust traces it means that the cylinder head was not enough tightened on cylinder block or cylinder - head surface or that of cylinder block is not flat. In that case:
- Check flatness of cylinder head by means of a metallic rule and a feeler gauges set, so as it is shouwn in the fig. 4.17:
- The maximal allowed deviation is of 0.035 mm/100 mm and max. 0.1 mm on the whole cylinder head lenght. If it is exceeded it is allowed to true up the cylinder head mounting surface, according to indications conserning general engine overhauling.
- Performe the same checking on cylinder block mounting surface.
  If the trouble persists (i.e. water leakages), a complex checking of cylinder head is necessary, for fissures in its material. This checking is performed on general overhauling of the engine.

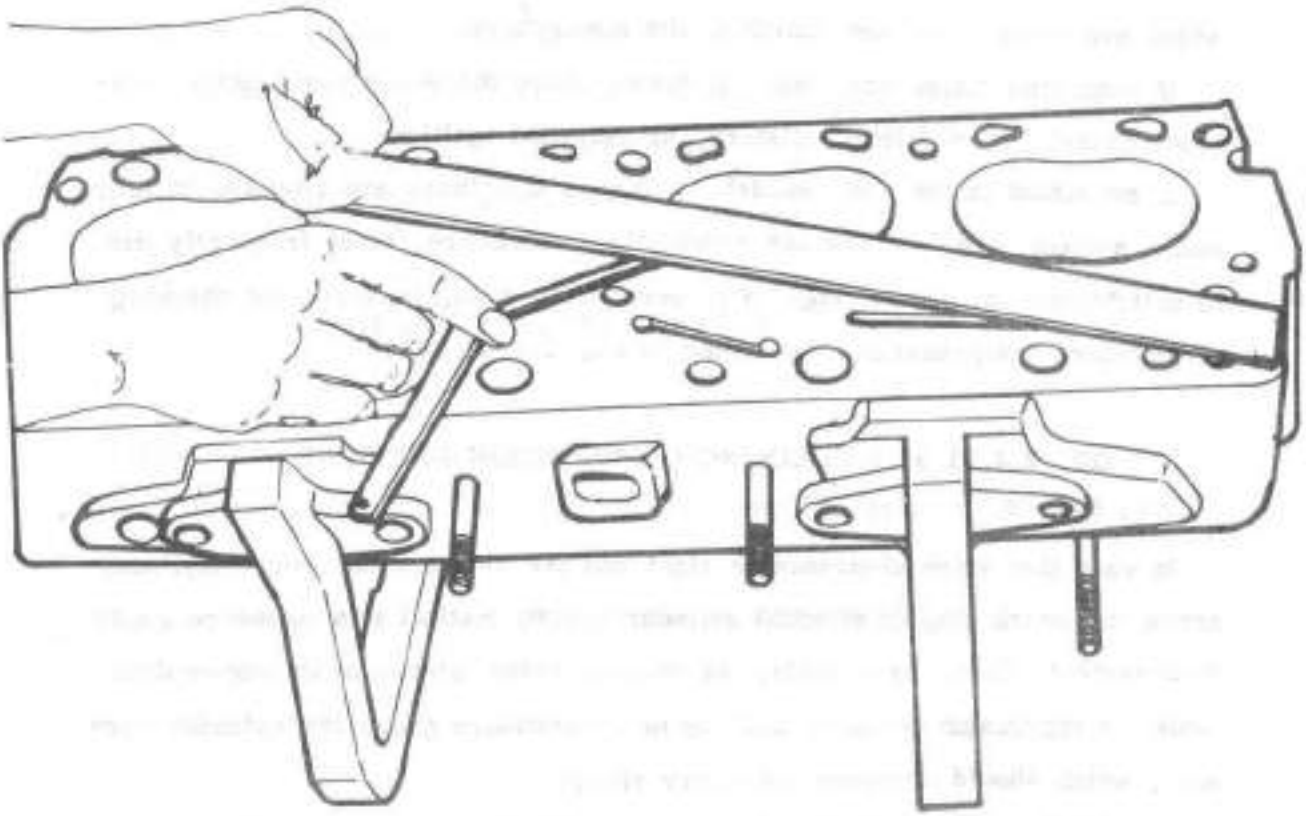


Fig. 4. 17. CHECING FLATNESS OF CYLINDER HEAD

- Refit all assemblies in reverse order, tightening cylinder head according to Op. 2. 0. 01. 17. 0, and all other bolts with torques indicated in Table VII.
- Fill fresh, adequate oil into engine sump.
- Fill cooling system with water or antifreeze fluid, acc. to Op. 2. 0. 13. 09. 0.
- Start engine for a test operation, following cylinder head gasket tightness, observing the small control holes on cylinder block for eventually water leakages. Check oil level and aspect in the sump, cooling fluid in expansion vessel or in cooling radiator, for oil films.

OP. 2. 0. 01. 34. 0 ESTIMATING IGNITION PROCESS ACCORDING TO EXHAUST GASES APPEARANGE

Normally, the exausted fumes from rear muffler pipe should be colourless or, in winter, in frosty weather, it should contain water vapours,

which evaporate again and vanish in the atmosphere.

If exhausted fumes are black, it means there there are carburation troubles, caused by overriched mixture, or retarded ignition.

If exhausted fumes are whitish, it means that there are troubles in lubricating system, i.e. oil reaches combustions chambers, most frequently due to untightness of piston rings. For certainty's sake, perform the checking of cylinders compression, according to Op. 2.0.01.36.0.

OP. 2.0.01.36.0 CHECKING COMPRESSION PRESSURE

In case that valve clearance is right and the valves close correctly, unscrew the spark plug of checked cylinder and fit instead it a pressure gauge (manometer). Then, by cranking the engine, bring piston in its upper dead center (compression position) and follow on pressure gauge the cylinder pressure, which should decrease only very slowly.

- In case that the pressure decreases quickly, check piston - cylinder assembly and replace faulty components, as indicated on chacking clearances between piston rings and piston grooves (see Op. 4.1.04.03.0).

OP. 2.0.01.35.1 CHECKING REAR MAIN BEARING FOR OIL LEAKAGES

Inspect from underside of vehicle if there are no oil leakages around the oil filter. If oil leakages are abundant, the oil filter gasket should be replaced, acc. to Op. 2.0.09.05.0.

OP. 2.1.01.38.0 CHANGING SUMP GASKET

- Drain out oil from oil sump, acc. to Op. 1.0.01.03.0
- Getting access from underside of vehicle, unscrew all bolts which fasten oil sump on cylinder block. Remove the sump and its gasket.

- Wash oil sump from all impurities, settled on it.
- Refit oil sump on engine block, using a new, original gasket and tightening bolts with a torque of 1.7 - 2 daNm. (12.3 - 14.7 ft.lbs)
- Refill engine with fresh, adequate oil.

OP. 2.0.01.33.0 TAKING DOWN THE OIL PUMP

- Drain lubricating system acc to Op. 1.0.01.03.0.
- Unscrew the four bolts, fastening the oil pump on engine block, and remove the pump.
  Pay special attention for 0-ring gaskets; if deformed, they should be replaced by original parts.
- On refitting tighten bolts with a torque of 1.7 - 2 daNm (kgm). (12.5 - 14.7 ft.lbs)

OP. 4.0.09.01.1 CHECKING OIL PUMP FOR RATE OF WEAR

The oil pump troubles can result from the wear of its components or wrong mounting. Due to wear the pump cannot provide necessary supply and pressure. In this situation:

- Take down the oil pump from engine, acc. to Op. 2.0.01.33.0.
- Check frontal play of both gears, which should be comprised between 0.035 and 0.130 mm. The radial play should be max. 0.130 mm. In case of gear wear, replace both gears. The central, driving gear, is pressed on the driving shaft and secured with a pin.
- Another trouble may occur by oil leakages at the pump joint on the engine block or at the pump cover, due to twisted ar faulty gaskets. In this case replace the gaskets with original parts.
- After refitting the oil pump on engine, fill engine sump with fresh, adequate oil.

OP. 2.0.09.02.0 CHECKING AND REMEDYING OIL PRESSURE CONTROL VALVE

The valve plunger can get jammed due to impurities or decalibrated (or even briken) spring. To remedy the trouble:

- Unscrew the plug (4) - see fig. 4.14 - and remove it with its gasket.
- (Do it an hour after engine stopping).
- Remove piston spring and check it, verifying its camber, refered to its force. If the spring is decalibrated or broken, replace it with a new, original spring.
- If the valve plunger is jammed, spray it with white-spirit or another organic solvent, remove it, wash all components in white-spirit and refit all in reverse order.
- Refit pressure control valve on engine block.

OP. 2.0.09.03.0 CHECKING AND REMEDYING OIL FINE FILTER

Normally the oil fine filter does not get faulty; only the filtering elements get worn by clogging with impurities, and should be replaced with a new one, or the sealing gasket can get broken.

If, in case of an accident, the filter box was deformed, the whole filter should be replaced with a new one.

To remedy a faulty filter it should:

- Drain the engine lubricating system, acc. to Op. 1.0.01.03.0.
- Unscrew filter center shft (6) - see fig. 4.15 - and remove the whole assembly.
- Remove from filtar box (4) the filtering element (5), center shaft gasket (8) and positioning oil spring (7).
- Remove centershaft (6) from filter box.
- Unscrew from cylinder block assembling nut (2) and remove filter box seat with gasket (1). Remove faulty gasket (3).

- Fit on the filter box seat periphery a new gasket (3).
- Fit back filter box seat (1), having the two holes upwards, on cylinder block, fastening it with the assembling nut.
- Refit all filter components in reverse order.
- Refit filter on cylinder block and tighten center shaft with a torque of 2,5 - - 3,5 daNm (kgm). (18,4 - 25,8 ft.lbs)
- Refil engine with fresh, adequate oil.

OP. 2.0.09.04.0 CHECKING AND REMEDYING OIL DOUBLE FILTERING SYSTEM

- Drain engine lubricating system, acc. to Op. 1.0.01.03.0.
- Take down fine oil filter (1) from intermediate support (3) - see fig. 4.16.-
- Unscrew special bolt, fastening the support on engine block. Remove support and its O-ring sealing gasket.
- Remove from intermediate support rough oil filter (2), together with its gasket.
- Remove from intarmediate support the closing plugs.
- Unscrew from support, in the setting area of the fine filter, the one-way valve seat, and remove the valve ball together with its closing spring. The spring should be calibrated for 0,1 daN (kg), at 21,8 mm lenght and for 0,2 daN at 17,6 mm lenght.
- Dismantle rough oil filter as follows: (see fig. 4.18)
- Unscrew the four bolts, fastening the filter sediment bowl (2) on filter body (1).
- Remove sealing gasket (3).
- Remove, by unscrewing, shorting pressure control valve cap (4) and remove valve spring (5) and valve ball (6).
  The spring should be calibrated for $0,7 \pm 0,1$ daN (kg) at 43 mm, respectively for $2,5 \pm 0,35$ daN at 16,3 mm lenght.
  In case that there are oil leakages around the central rod (8), although the the packing gland was tightened up to refuse (9), the latter should be unscrewed and its packing changed (10).

NOTE: 1 daN = 1,02 kg = 2,2 lbs.

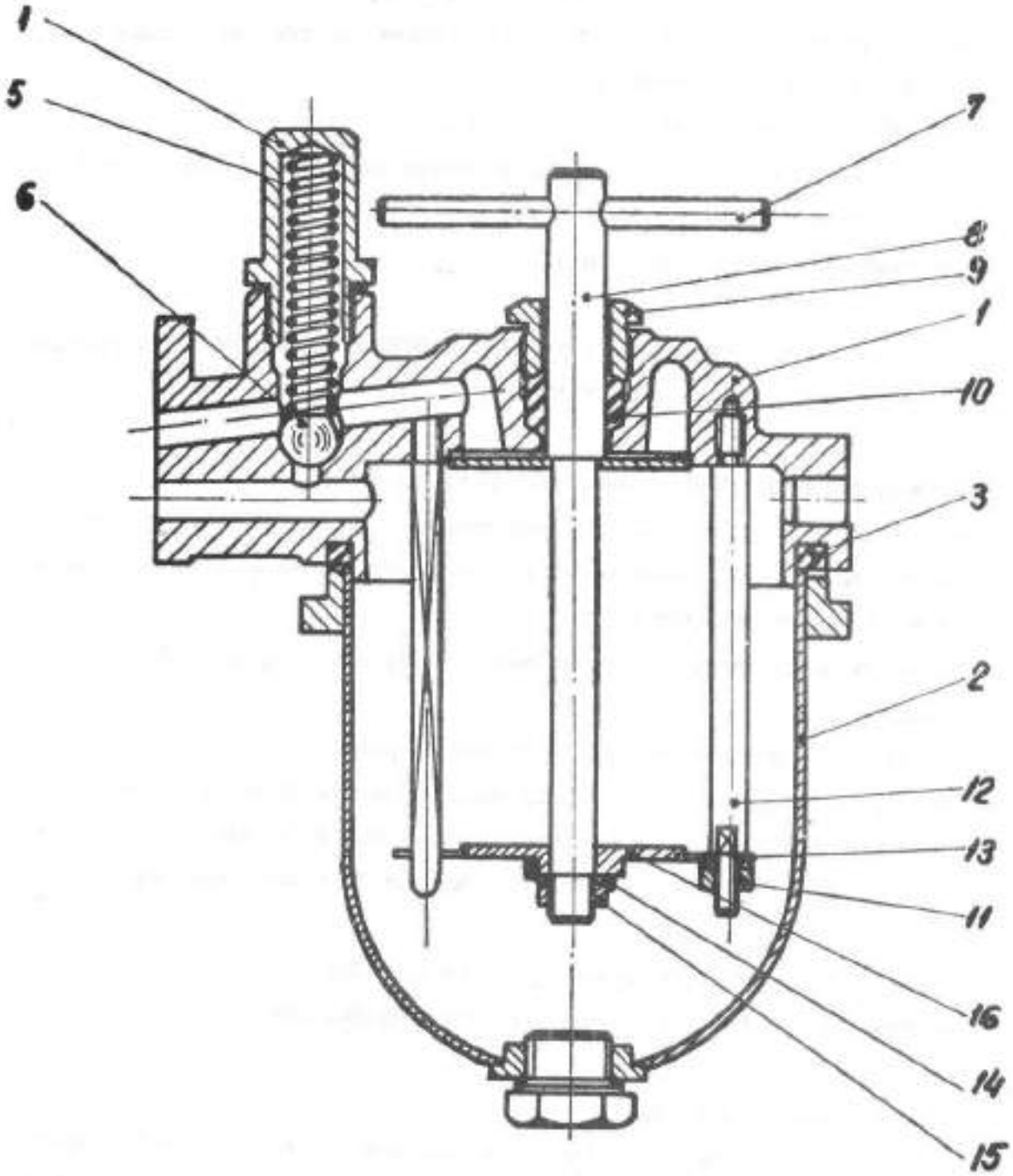


Fig. 4. 18. SECTION OF ROUGH OIL FILTER.

1. Rough filter body; 2. Sediment bowl; 3. Bowl gasket; 4. Shorting pressure control valve; 5. Valve spring; 6. Valve ball; 7. Control rod handle; 8. Central rod; 9. Packing gland; 10. Packing; 11. Nut; 12. Lateral rod; 13. Backing plate; 14. Lock washer; 15. Central rod nut; 16. End disk.

Only in extreme case, when the filter got blocked up (the center rod cannot be ratated), even after and abundant washing, performe dismantling of filtering blades (159 blades). For this:

- Unscrew the three nuts (11), removing them from lateral rods (12), and removing spring washers and backing plate (13).
- Undo central rod lock sher (14). After that, unscrew central rod nut (15) and remove lock washer and end disk (16).
- Remove, one by one, the filtering rosettes, spacers and centring plates, from the central squ e shaft, untill the faulty pieces will be found and removed.
- Replace faulty filtering rosettes with new, original parts, or, if there are less than 2% deteriorated pieces, you can give them up.
- Refit rough oil filter in reverse order to that on dismantling.
- Refill engine with fresh, adequste oil.

OP. 2. 0. 09. 05. 0 REPLACING GASKET OF FINE OIL FILTER

- Drain engine lubricating system, acc, to Op. 1. 0. 01. 03. 0.
- Unscrew center shaft (6) - see fit. 4. 15 - and remove it together with filter box.
- Unscrew from cylinder block assembling nut (2) and remove filter box seat (1), having sealing rubber gasket around it (3).
- Replace faulty gasket with a new, original one.
- Refit all filter components in reverse order; take care that the filter box seat shoudl have its two holes positioned upwards on cylinder block.
- Refill engine with fresh oil.

4. 1. 5. TROUBLES AND REMEDYINGS OF THE COOLING SYSTEM, MOUNTED ON THE ENGINE

The water pump is of single-stage, centrifugal type, serving to forced circulation of cooling water, inside the engine. It is driven by the engine, by the agency of a V-belt.

At a speed of 2200 $\pm$ 50 r.p.m. and at a static pressure, measured between the pump inlet and outlet, of 550 mm Hg (mercury column), the pump discharge is 6500 litres p.hour.

Maximal speed of the pump is 4.800 r.p.m.

The characteristics of the pump, at different speeds, are given in graph (fig. 4.19).

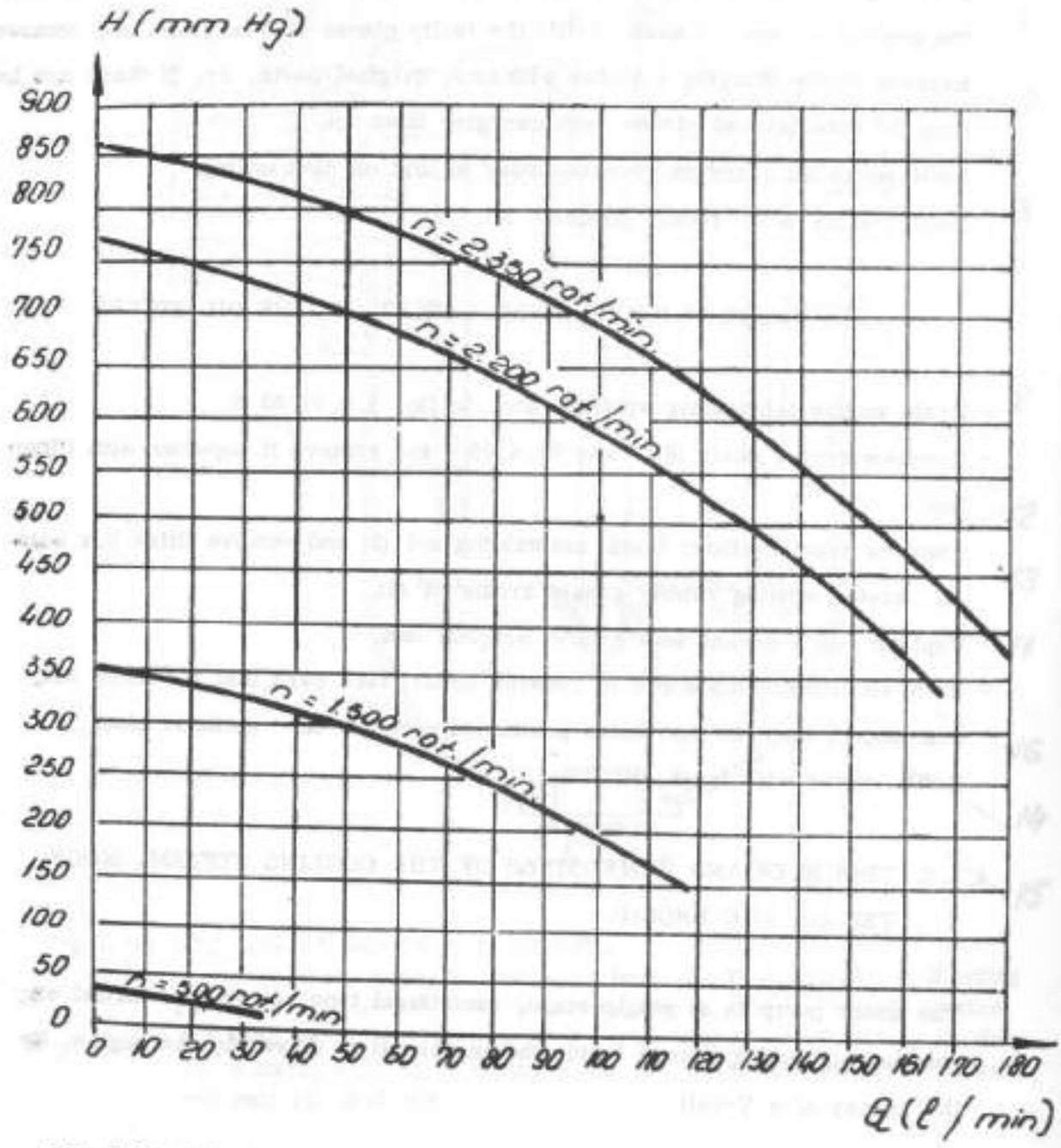


Fig. 4.19. WATER PUMP CHARACTERISTICS AT DIFFERENT SPEEDS AND STATIC PRESSURES.

The pump body is an aluminium casting. Its shaft is fitted with two shielded, selflubricating ball bearings (9) - see fig. 4.20 -

On the flange, fitted on the pump shaft, is fastened the cooling fan and pump driving pulley, securing the air circulation around the engine.

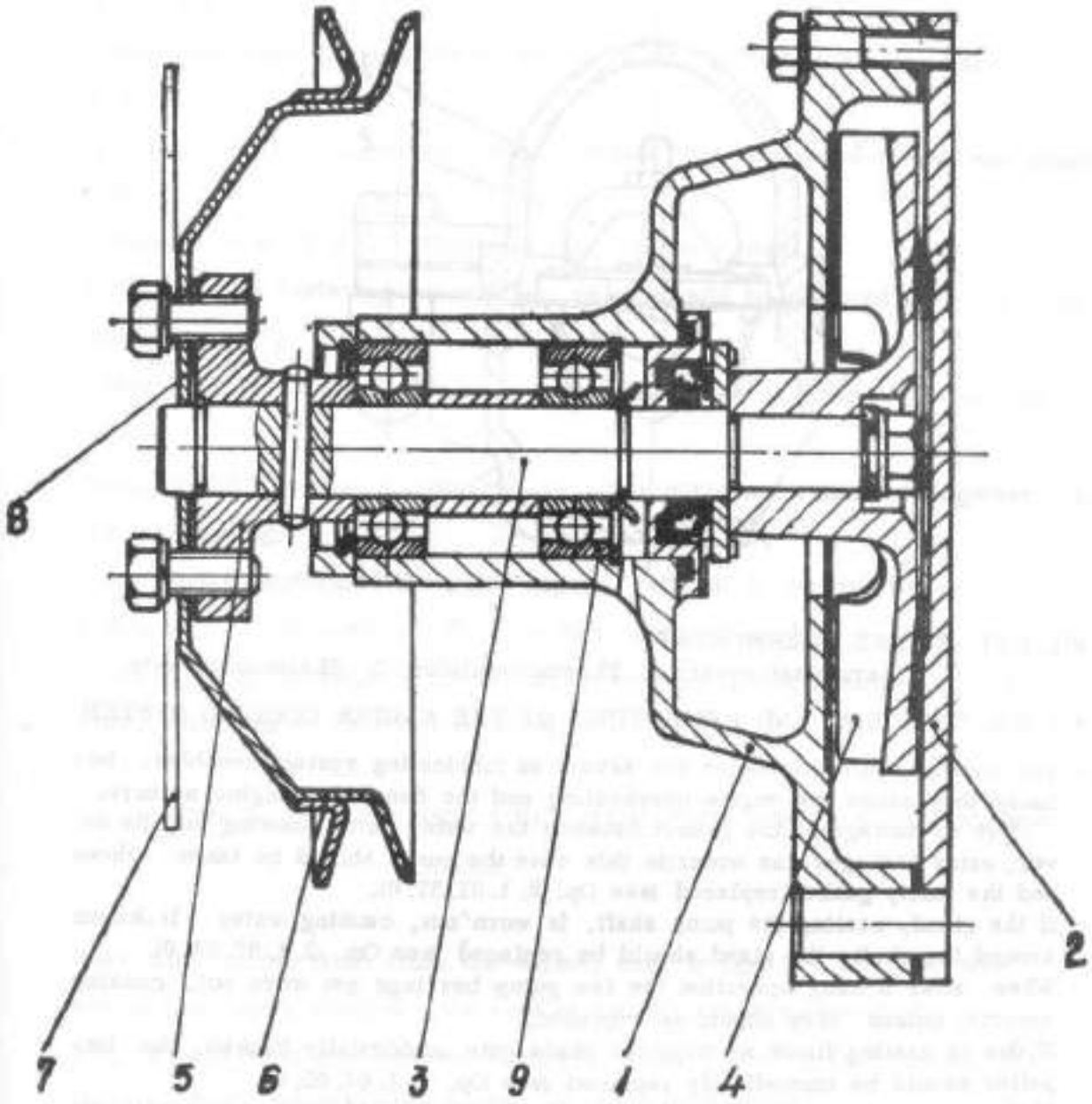


Fig. 4.20. WATER PUMP
1. Pump housing; 2. Pump housing cover; 3. Water pump shaft; 4. Pump impeller; 5. Pulley flange; 6. Water pump pulley; 7. Cooling fan; 8. Shim for adjusting pulley plane position; 9. Shielded ball bearing.

nen closed, i.e. up to 82°C (180°F) water temperature, the thermostat eads water through the engine. At 82°C the thermostat begins to open, securing mixed water circulatio, through the engine and through the radiator. At 90°C (194°F), thermostat is completely open, i.e. 10.5±1 mm, and leads the water flow through the cooling radiator.

The thermostat is located in elbow of inlet manifold and by the agency of a hose it provides the heating of inlet manifold.

When the water temperature decreases up to + 78°C (172,4°F), the thermostat closes again the flow to radiator. The allowed temperature deviations are ± 2°C.

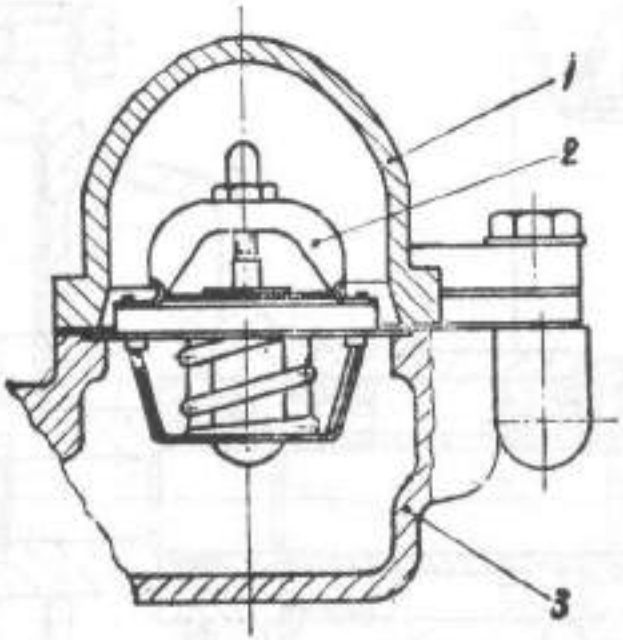


Fig. 4.21. ENGINE THERMOSTAT
1. Thermostat cover; 2. Thermoregulator; 3. Thermostat body.

4.1.5.2. TROUBLES AND REMEDYINGS OF THE ENGINE COOLING SYSTEM

- The cooling system trobules are severe as lubricating system troubles, because they cause the engine overheating and the danger of engine seizure.

  Due to damage of the gasket between the water pump housing and its cover, water leakages can occur; in this case the pump should be taken down and the faulty gasket replaced (see Op. 2.1.01.37.0).
- If the gland, sealing the pump shaft, is worn out, causing water leakages around the shaft, the gland should be replaced (see Op. 2.1.07.03.0).
- When, after a long operation the two pump bearings get worn out, causing anormal noises, they should be replaced.
- If, due to casting flaws an impeller blade gets accidentally broken, the impeller should be immediately replaced (see Op. 2.1.07.05.0).
- If thermostat does not correctly operate or is jammed, the engine will get overheated. The faulty thermostat should be checked and, eventually replaced (see Op. 2.0.13.05.0)
- Check also all hose connections for tightness on inlet manifold, thermostat, water pump and other cooling system units (see Op. 2.0.13.06.0).
- If water leakages will appear around the small, free holes on the right side of cylinder block (in the car driving sense), it shows that some cylinder liner sealing O-rings are damaged and it is necessary to replace faulty O-rings (see Op. 2.1.07.01).

OP. 2.1.01.37.0 TAKING WATER PUMP DOWN, WHEN ENGINE IS ON THE CAR

- Drain cooling system, according to Op. 2.0.13.04.0.
- Disconnect and remove expansion vessel (if the cooling system is of sealed type), acc. to Op. 2.0.13.06.1.
- Disconnect water pump from hoses leading to thermostat and the heating system.
- Disconnect water pump from radiator outlet hose (connected to radiator lower tank).
- Slacken alterantor V-belt tensioner and remove V-belt.
- Unscrew bolts fastening fan cowling, which should be removed over the fan and water pump.
- Unscrew bolts fastening the fan on the pump pulley and remove it and the pulley.
- Unscrew the three bolts fastening the water pump and remove it together with the fan cowling.
- After having performed the pump repair, refit all in reverse order.
- Refill engine with cooling fluid, according to Op. 2.0.13.09.0.
- After starting the engine, inspect and check the cooling system for its tightness, according to Op. 2.0.13.06.0.

OP. 2.1.07.03.1 REPLACING GASKET OF WATER PUMP HOUSING COVER.

- Take water pump down from the engine, acc. to Op. 2.1.01.37.0, after having previously drained the cooling system, as described in Op. 2.0.13.04.0 and disconnected expansion vessel, acc. to Op. 2.0.13.06.1.
- Unscrew bolts fastening the cover on the pump housing.
- Remove the cover and its gasket.
- Replace the faulty gasket and refit all in reverse order.
- Refill cooling system with cooling fluid, acc. to Op. 2.0.13.09.0.

Start the engine and check if there are no fluid leakages, as described in Op. 2.0.13.06.0.

OP. 2.1.07.03.0 REPLACING THE GLAND OF WATER PUMP SHAFT

- Drain the cooling system, acc. to Op. 2.0.13.04.0.
- Disconnect and remove the expansion vessel (if the vehicle has a sealed cooling system), acc. to Op. 2.0.13.06.1.
- Take water pump down from engine, as described in Op. 2.1.01.37.0.
- Remove pump housing cover, together with its gasket, without damaging the latter.
- Clamp up the shaft driving flange in a parallel bench vice and unscrew the nut securing the pump impeller on the shaft.
- Remove spring lock washer, thrust washer and the shaft gasket; remove then the pump impeller from the shaft.
- Remove textolite sealing washer and draw out the rubber gasket together with the pressure spring.
- Replace rubber gasket with a new, original one and refit the pump in reverse order.
- Refit the pump on the engine and refill the cooling system, according to Op. 2.0.13.09.0.
- Start the engine and check its cooling system for fluid leakages, as described in Op. 2.0.13.06.0.

OP. 2.1.07.04.0 REPLACING WATER PUMP BALL BEARINGS

- Drain cooling system acc. to Op. 2.0.13.04.0.
- Disconnect and remove expansion vessel (if vehicle has sealed cooling system), acc. to Op. 2.0.13.06.1.
- Take water pump down from the engine, as described in Op. 2.1.01.37.0.
- Remove the pump housing cover.

- Clamp up the shaft driving flange in a parallel bench vice and unscrew nut securing the pump impeller on the shaft.
- Remove spring lock washer, thrust washer, shaft gasket, impeller and the gland.
- Drill out the rivetted dowel pin, securing the driving flange on the pump shaft, drepress it and finhly draw out the flange from the shaft.
- Remove snap ring - see fig. 4.20 -, by the agency of nose pliers and draw out annular shim from the shaft flange end.
- Draw out the shaft, together with both bearings (see fig. 4.22), from the pump housing.

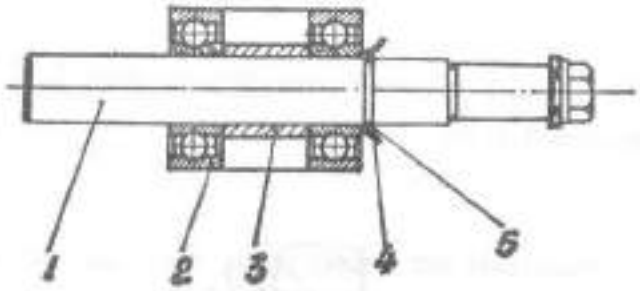


Fig. 4.22. WATER PUMP SHAFT
1. Pump shaft; 2. Half-sealed ball bearing; 3. Spacer sleeve; 4. Water deflector; 5. Snap ring.

- Adjust the hole for dowel pin, in order to remove any burr.
- Remove the outer bearing from the shaft.
- Remove the spacer sleeve from the shaft.
- Extract, by the agency of a press, the second bearing from the shaft.

On mounting new bearings perform operations in following order:

- Press inner bearing on the shaft, up to water deflector (5) (fig. 4.22).
- Extract from the pump housing the gland cage.
- By the agency of a hydraulic press deprees the shaft, together with inner bearing, into the pump housing, untill the bearing outer race touches on the snap ring.
- Fit on the shaft the spacer sleeve.

- Press the second bearing, also by means of a press

  ATTENTION! On pressing the bearings in the pump housing, sit it on the gland cage back edge, in order to evoid the pump housing deformation.

- Fit upon the outer bearing the annular shim and after it, the snap ring.
- Fit on the shaft the driving flange and secure it with a new dowel pin (Ø 5 x x 32), riveting it at both ends.
- Fit on the opposite end of the shaft the gland, the shaft sealing gasket, the pump impeller, again the shaft gasket, washer, spring lock washer. Tighten finaly all components with the nut, using a moderate torque.

  Further the mounting should be performed in reverse order as on taking pump down.

- Refill cooling system with cooling fluid, acc. to Op. 2. 0. 13. 09. 0.
- Check cooling system for for fluid leakages, acc. to Op. 2. 0. 13. 06. 0.

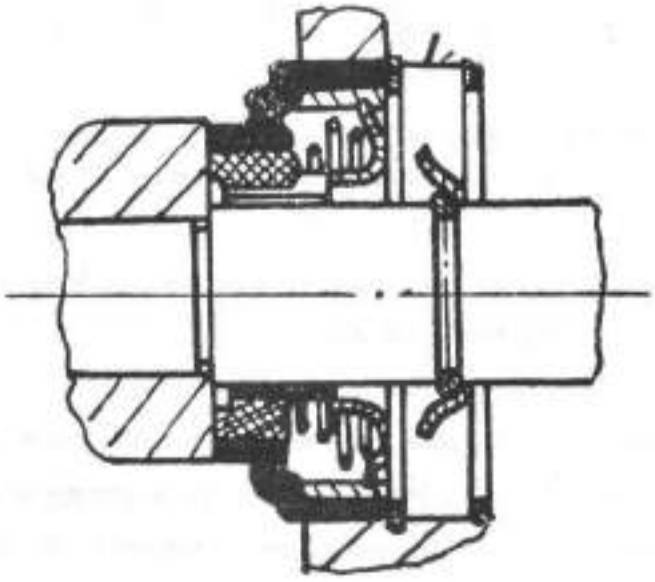


Fig. 4. 23. WATER PUMP SHAFT SEALING GLAND (VERSION).

OP. 2. 1. 07. 05. 0 REPLACING WATER PUMP IMPELLER

- Drain cooling system, according to Op. 2. 0. 13. 04. 0.

- Disconnect and remove expansion vessel (if the vehicle has a sealed cooling system) according to Op. 2. 0. 13. 06. 1.
- Take down the water pump from engine, as described in Op. 2. 1. 01. 37. 0.
- Remove pump housing cover, together with its gasket.
- Unscrew the nut securing impeller on the shaft and remove the thrust washer and the shaft gasket.
- Draw out the pump impeller.

  After fitting the new, original impeller, refit all components in reverse order.
- Refill cooling system with cooling fluid, accordint to Op. 2. 0. 13. 09. 0.
- Check cooling system for fluid leakages, acc. to Op. 2. 0. 13. 06. 0.

OP. 2. 0. 07. 02. 0. DISMANTLING THERMOSTAT ELBOW

- Drain cooling system, acc. to Op. 2. 0. 13. 04. 0.

  If it will be necessary to perform an intervention on thermostat, it is sufficient to unscrew the two bolts which fasten the thermostat elbow. The latter, with its flange fastens the thermostat collar.

  If thermostat housing has some pores, or if from some other reasons it will be necessary to take thermostat elbow down, disconnect firstly connecting hoses, leading to inlet manifold, water pump and cylinder head. Then, unscrew the two bolts and remove thermostat housing, assembled with the connecting elbow, removing also respective gasket. Once taken down, the thermostat housing assembly can be disassembled, in order to take thermostat out.
- Refit all components in reverse order.
- Refill cooling system with cooling fluid, acc. to Op. 2. 0. 13. 09. 0.
- Check cooling system for fluid leakages, acc. to Op. 2. 0. 13. 06. 0.

OP. 2. 1. 07. 01. 0. REPLACING CYLINDER LINER O-RING GASKET

- Drain engine lubricating system, acc. to Op. 1. 0. 01. 03. 0.
- Drain engine cooling system, acc. to Op. 2. 0. 13. 04. 0.

- Disconnect carburettor from the fuel pump and acceleration throttle control mechanism.
- Undo connections between cylinder head and air cleaner, between cylinder head and thermostat elbow, between carburettor and air cleaner.
- Undo connection between cylinder head and heating system.
- Remove cylinder head cover, acc. to Op. 2.0.01.21.1.
- Take rocker arm shaft down, acc. to Op. 2.1.01.29.0.
- Disconnect muffler exhaust fore pipe.
- Take assembled cylinder head down.
- Getting access from underside of vehicle, take engine oil sump down, removing it together with its gasket.
- Turn engine crankshaft, by the agency of the starting hadnle, bringing crankpin of respective cylinder (where water leakage occured) in its lower position (outer dead centre).
- Unscrew big end cap bolts of respective piston rod.
- Remove big end cap, using slight blows by means of a rubber or plastic hammer.
- Turn again the crankshaft, in order to bring the piston in its inner dead centre.
- By means of a wooden rod (for instance, the rubber hammer shaft), blow slightly on the piston bottom (from inside of engine), so that piston with its rings goes out of cylinder.
- Remove the piston, put it on a beach, with the piston rod upwards, and set big end cap on its bolts, in order to not uncouple both big end half bearings.
- Draw out respective cylinder liner by means of special D 303, extractor.
- Replace faulty 0-ring gasket, fitting a new, original one in its groove (on cylinder liner).

  ATTENTION. Before fitting the new 0-ring gasket, check respective groove edges for burrs, which could damage the new gasket, on passing over them. If some burrs will be found, clean them by means of a scraper, taking care to remove all resulted cuttings.

- Wet both 0-rings with solution of soap in water, and refit cylinder liner into engine block, using special D 304 device.
- Further, perform refitting of all components in revrse order, following the below griven indications:
- On introducing the piston with its rings use S 17 assembling sleeve.
- The nuts securing big end cap should be tightened with a torque wrench, adjusted for a torque of 6.5 - 7.0 daNm (kgm). (48 - 51.6 ft. lbs)
- On tightening bolts which fasten cylinder head on the engine block should be observed the indications given in Op. 2.0.01.17.0.
- Refill engine with oil, according to Op. 1.0.01.03.0.
- Refill engine cooling system with cooling fluid, acc. to Op. 2.0.13.09.0.
- Check cooling system for its tightness, acc. to Op. 2.0.13.06.0.

OP. 2.1.07.01.1 REPLACING CYLINDER LINER 0-RING GASKET OF ANOTHER CYLINDER, DURING THE REPAIR OPERATION 2.1.07.01.0.

- Crank the engine, by means of the starting handle, untill the crank pin of respective cylinder reaches its lower position (outer dead centre), and perform the same operations of dismantling and replacing faulty 0-ring gasket, as above described (Op. 2.1.07.01.0).
- After this second intervention refit engine in reverse order.

4.1.6. TROUBLES AND REMEDYINGS OF ENGINE ELECTRIC EQUIPMENT

4.1.6.1. DESCRIPTION OF ENGINE ELECTRIC EQUIPMENT

The engine electric equipment consists of:

1. Ignition system, including ignition distributor, ignition coil, H.T. lead set and spark plugs.
2. Alternator.
3. Starting motor.

4.1.6.1.1. IGNITION SYSTEM

The ignition distributor provides the jump of spark in due, optimal time, by an adjusting depending on engine load (vacuum controlled advance, depending on vacuum in the inlet manifold - see fig. 4.24. and on engine speed (centrifugal advance - see fig. 4.25).

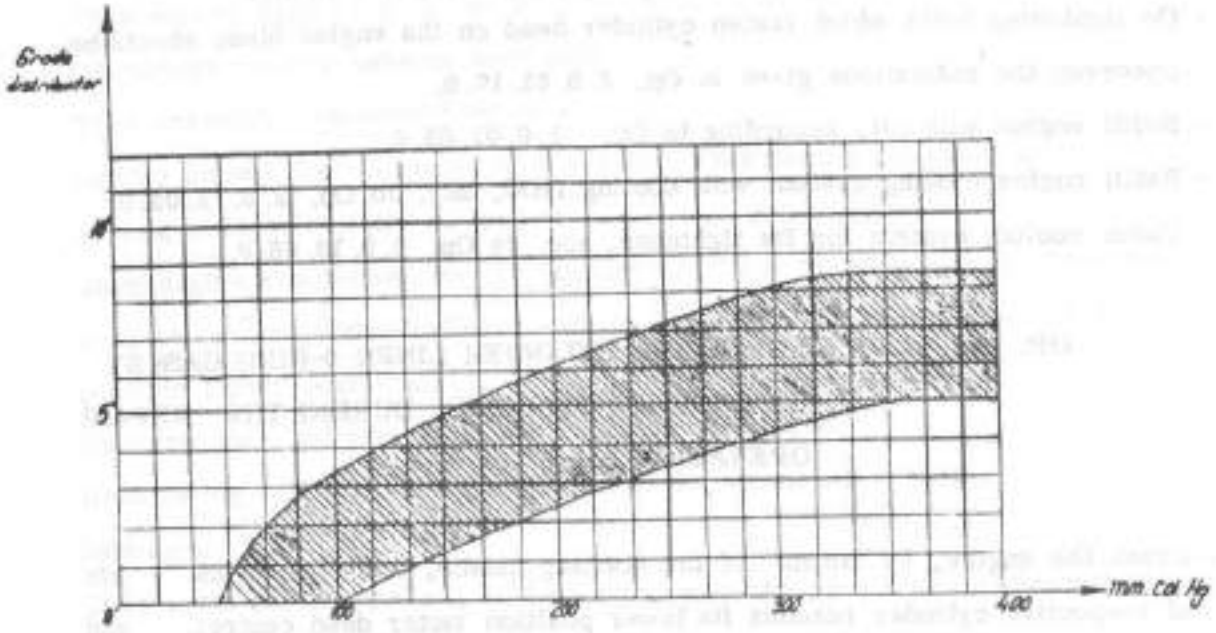


Fig. 4.24. DIAGRAM OF AUTOMATIC IGNITION ADVANCE ANGLE CHANGING, DEPENDING ON PRESSURE (VACUUM CONTROLLED ADVANCE).
- Advance angle = f (mm Hg. pressure)

The distributor breaker points are parallel and are pressed with a force of 0,45 $\pm$ 0,1 daN (kg). (1,12 $\pm$ 0,24 lbs)

The distributor insulating cover can endure without breakdown an electric voltage of 12,000 V and 50 Hz (at a temperature of 80°C) between H.T. distributor plugs and the ground (vehicle body).

The ignition coil is fitted on the vehicle body, below the bonnet.

The starting motor has a nominal output of 1,4 kW and is provided with a motor coupling electromagnetic mechanism on

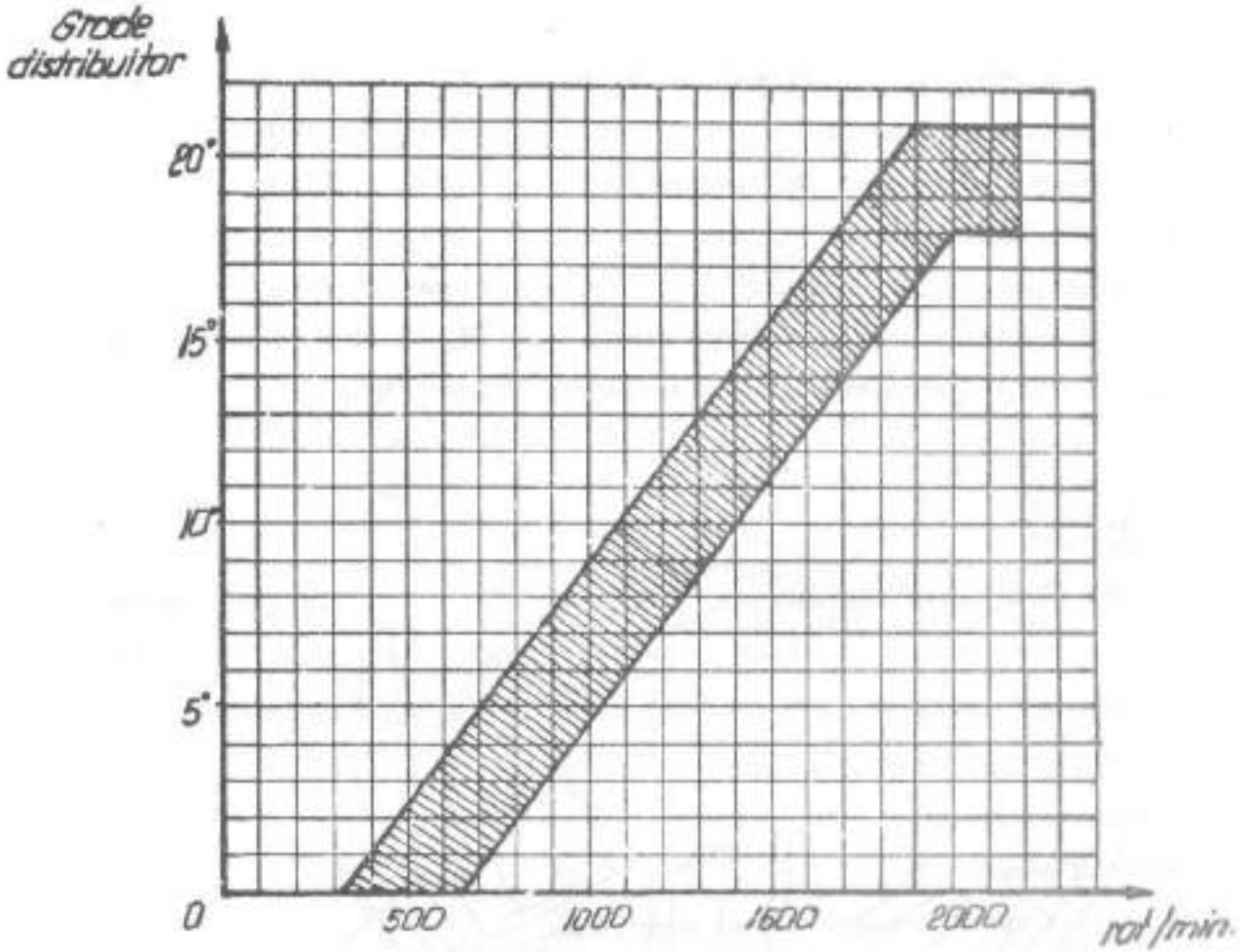


Fig. 4.25. DIAGRAM OF AUTOMATIC IGNITION ADVANCE ANGLE CHANGING, DEPENDING ON ENGINE SPEED (CENTRIFUGAL ADVANCE)

starting engine, and throwing out, by force of inertia, when engine starts. On unloaded running the starting motor has a speed of min. 4,000 r.p.m. and needs a current of 90 Amp.

On maximal load (braking torque of 1.8 daNm), its terminal voltage can decrease up to 5 V, at a maximal current of 550 Amp.

The maximal motor speed, allowed for 20-sec., is 75000 r.p.m.

The Bendix drive maintains the coupling with the engine up to engine speed of 310 ... 390 r.p.m. (or a starting motor speed of 5100 ... 6300 r.p.m. respectively); over this speed decoupling occurs automatically.

The maximal wears, allowed for the starting motor components, are:

- for commutator diameter: max. 1 mm
- for armature shaft journals diameter: max. 0.2 mm
- for bronze bushes inside diameter: max. 0.15 mm
- for steel bush inside diameter: max. 0.3 mm

The brushes should be changed after a wear of 50% of their initial height or after 12,000 startings (about 3 years vehicle operation).

The three-phase alternator, (see fig. 4.26), operates together with voltage regulator, type 1410, and the storage battery of 12 V terminal voltage. Both alternator and regulator are produced by UEPS - factory.

ALTERNATOR MAIN FEATURES:

- Nominal voltage	12 V
- Maximal output	500 W
- Necessary speed to begin current supplying at 14 V	950 r.p.m.
- Supplied current at 14 V and 3000 r.p.m. in steady state	30 A
- Maximal exciting (field) current	3,2 A
- Maximal continuous speed	10,000 r.p.m.
- Overspeed	12,000 r.p.m.
- Field coil resistance between the two slip rings, at 20°C	4,7 Ohms
- Sense of rotation	indifferent

These features are stated with brushes having the contact surface completely shaped

As shown in the graph (fig. 4.27), the magnetizing coil is powered from storage battery, by the agency of voltage regulator.

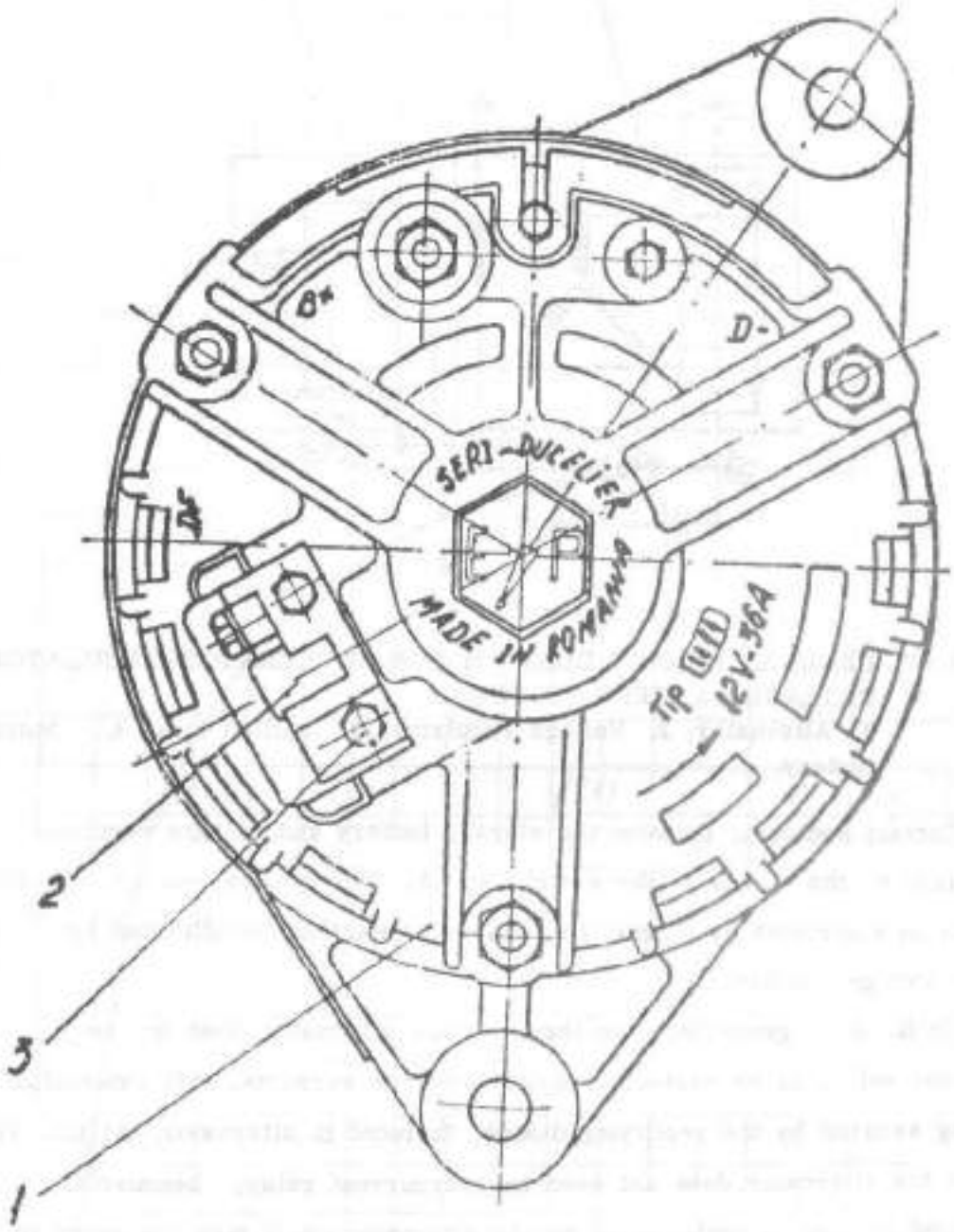


Fig. 4.26. FRONT VIEW OF ALTERNATOR.
1. Slip ring endshield; 2. Brush-holder block; 3. Screws securing bursh-holder block on endshield