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INFORMATION REPORT INFORMATION REPORT

CENTRAL INTELLIGENCE AGENCY

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COUNTRY USSR

REPORT

SUBJECT Manuals on the Soviet Aircraft Engines ASh-82 T and ASh-82 V (Description of engines & repair & maintenance procedures)

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THIS IS UNEVALUATED INFORMATION. SOURCE GRADINGS ARE DEFINITIVE. APPRAISAL OF CONTENT IS TENTATIVE.

English-language manuals on Soviet ASh-82 aircraft engines [redacted] No date or publication data appeared [redacted] manual. 50X1-HUM 50X1-HUM

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Attachment 1: The ASh-82 T Engine: General Information; 87 pages plus 18 pages of "Service Bulletins;" pages 46 and 80 are missing. The manual consists of instructions for the installation, operation, and maintenance of the engine.

Attachment 2: Aircraft Engine ASh-82 V: Repairs Manual; Book II; 81 pages plus 160 sketches of tools necessary for mounting and repair of the engine. The manual lists the tools, explains the purpose of each, and gives operating and maintenance instructions for a few.

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THE ASh-82 T ENGINE

GENERAL INFORMATION

(English Language)

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THE ASH-82T ENGINE

GENERAL INFORMATION

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Chapter I.

THE ASH-82T ENGINE GENERAL INFORMATION.

1. Engine Structure Principal Informations.

The aircraft engine ASh - 82 T /fig,1 and 2/ represents an air-cooled radial four-stroke petrol engine with 14 cylinders in two rows and with direct fuel injection.
The ASh - 82 T engine is provided with two channel planetary reducing device in the crank-case nose and one-speed radial supercharger placed at the rear of cylinder assembly.
Following accessory units are installed on the ASh - 82 T engine:
- on the crank-case nose : regulator of revolutions, two magnetos MB 14 T-2 and fuel oil-pump PMN-T.
- on the rear supercharger body - the fuel pump /704 A-V unit/.
- on the rear crank-case cover - the fuel pump NV-82 for direct fuel injection, the electro-innertial starter SKD-2, the generator GSR-6000A, the rear oil-pump MSh-6SV, the high-pressure pump NSh-13 and vacuum pump 612.

Fig.1 The ASH - 82 T Engine Viewed From Rear Righ-Hand
FRONT

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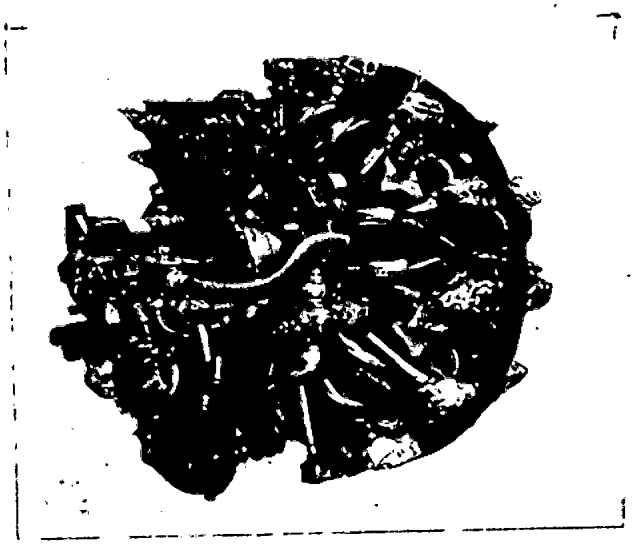

Fig.2 The ASH - 82 T Engine Viewed From Rear Right-Hand Side.

On the engine-propeller shaft nose is installed the four-blade propeller AV-50.

E n g i n e c r a n k - c a s e consists of crank-case nose, the central crank-case, the front and rear supercharger bodies and rear cover.

In the crank-case nose are installed the reducing gears, the propeller shaft and ducts to the units being installed on the nose. The central crank-case consists of four steel and two aluminium parts. In the internal crank-case spaces is placed the shaft with crank-mechanism and the drive parts of gas-distribution and balancing devices of the 2nd order.

On the crank-case steel parts are installed two cylinder rows. Each cylinder is fastened to the crank-case by means of twenty bolts through spherical washer. In the lower part of central crank-case are placed four flanges for fastening oil-drain tubes from the crank-case spaces.

To the rear transitional crank-case body is attached the front supercharger body which separates the rear crank-case space from the supercharger and at the same time acts as the collector-distributor of air to the cylinders.

Between the vertical wall of front supercharger-body provided with some ribs and with the case-type diaphragm /from the crank-case side/ is formed the expansion-chamber with labyrinths through which passes the cooling air for the engine.

The rear supercharger body is connected with the front supercharger body and forms together a space in which the rotors and the engine diffusor are placed. On the rear compressor body is fixed a rear crank-case cover, in the space between them are cog-wheels of supercharger rotor gear and of all units installed on the supercharger rear body and the crank-case rear cover.

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Through the vertical walls of the front and rear supercharger body passes the accessory drive shaft; on the shaft-journals on which is rotating the supercharger-rotor axle.
On the supercharger rear body are installed : from the upper part - the throttle-box /through the gear/, from the rightside - the combined drive of fuel-pump and of /mechanical and electrical/ tachometer, from the left side the oil-filter MFS-19, placed at oil-inlet in the engine main oil-inlet in the engine main oil-line with the oilsump being at the bottom.

T h e e n g i n e c y l i n d e r s are placed on the central crank-case in two rows in the alternate /staggered/ order and provided with floating seats and cast guides under the outlet valves, and the stiff seats and bronze guides under the inlet valves.
The air-supply from the supercharger into the cylinders is provided by means of fourteen feeding pipe-lines connected by one and to the cylinder and by the other end - to the supercharger front body.
The outlet cylinder parts of the front and rear row are directed to the rear side.
On each of the cylinder-heads are installed two spark-plugs SD-38-BC and one nozzle FB-10 KT.
T h e p i s t o n s , each piston is provided with five grooves with graphitized operation surfaces. On the piston there are placed three gas-tight and three oil-collecting rings.
The gas-tight rings are wedge-shaped. The upper chrom-plated steel ring has the cylindrical operation-surface. The piston-pin is fixed with plug-nuts upon cylinder.
T h e c o n n e c t i n g r o d s .
The engine is provided with two sets of connecting rods. For each of cylinder rows there is a set of connecting rods which consists of one main and six auxiliary connecting rods. The main connecting rods have front fastening of crank-head-nut in second cylinder of the front cylinder-row, and in the fifth cylinder of the rear cylinder row.
T h e c r a n k - s h a f t is detachable and consists of three main parts. The crank-shaft is rotating on the three roller bearing from which the first one is locked against the longitudinal movement and has two swinging counter-balancies for the damping of torsional vibrations and for the balancing of Ist stage inertia moments from gradually moving masses and the centrifugal forces of rotating masses. For the balancing of 2nd stage inertia movements from gradually moving masses on main journals of the crank-shaft are assembled 2nd stage balancies.
G a s d i s t r i b u t i o n . The front and the rear cylinder row have separated gas-distribution mechanism. The valve-operation is controlled by means of cam-rings, the pushing rods, push-pull rods and levers of valves. The cam-rings are rotating on steel supports which are centered on the extended rings of vertical walls of the front and the rear parts of central crank-case.
The front cylinder-row is controlled by means of a cam-ring and by means gear-wheels of the gas distribution, which are displaced in the front transitional body of the crank-case.

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The cylinder row is controlled by a cam-ring and by gear-wheels of gas-distribution inlet displaced in the rear space of the crank-case rear transitional body. The coupled /intermediate/ gas-distribution gear-wheels of the front and the rear cylinder row are made flexible.
The pushers with the guiding elements for each of cylinder-rows are concentrated, on the front and the rear crank-case transitional body, respectively.
E n g i n e g o v e r n o r . The engine governor is of planetory type with 31-54 gear ratio with two chanel oil ducts leading to the propeller, and consists of three main parts : the leading self-adjustable gear-wheel, the hub of which has been previously pressed in the hot state on the spline of crank-shaft part, of fixed self-adjusting gear-wheel fastened in the crank-case nose and of the propeller-shaft with 12 satellites rotating on the axes of satellite-housing fixed and connected with the propeller-shaft. The hollow propeller-shaft is supported on two journals of the extended end of the crank-shaft front part through two slide-bearing pressed into the propeller-shaft space. The crank-shaft is supported on down and side pressure-resisting ball-bearing which is installed on the recess of crank-case nose. For air-screw installation on the shaft there are splines of involute profile.
T h e e n g i n e s u p e r c h a r g e r is of centrifugal radial type with mechanical one-speed drive. The supercharger rotor is manufactured of forged aluminium and represents one assembly complete with control-unit. The rotor-drive-mechanism is placed in the supercharger body and consists of elastic gear-wheel of the component-drive of the doubled gear-wheel and rotor-drive shaft which is provided with gear-wheel.
The supercharger-diffuser is produced of magnesium-alloy and is installed on the rear supercharger-body with a great guarantee-clearance between its blades and the vertical wall of the front supercharger-body.
T h e a c c e s s o r y d r i v e . The engine accessory drives are taken from the engine crank-shaft through the gear-wheel systems. The drive-shafts of the direct injection pump NV-82 the high-pressure pump MSh 13 and the combined fuel-pump drive and the revolutions computing gauge are placed in the independent bodies which are installed directly into the crank-case rear cover-nose on the sliding-bearings.
T h e s t a r t e r s y s t e m . The starting of the engine is carried out by means of electro-inertial starter. To facilitate the starting there are installed on the engine electro-magnetic priming valve and two nozzles which deliver the fuel to the supercharger inlet in the moment of starting.

2. THE ENGINE PRINCIPAL DATA.

T h e G e n e r a l D a t a .

Mark of the engine . . . . . ASh - 82 T
The cooling system . . . . . Air
The cylinder disposition . . . . . Two rows

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The number of cylinders 14
The order of cylinder-numbering . . . . Taking for first the upper vertical cylinder of the rear row from behind the engine, clock-wise
Cylinder diameter in milimetres 155,5
Stroke of the piston in milimetres .. 155
The cylinder displacement in litres 41,2
The degree of compression . . . . . 6,9 ± 0,1
The direction of crank-shaft and the propeller rotation . . . . . Clockwise right-hand, seen from the rear cover-side.
The reduction gear . . . . . planetary, with 12 cylindrical satellites, with two channel oil supply to the feathering propeller
The reduction ration 31/54
The supercharger . . . . . One-speed contrifugal
The gear ratio 7,27

Engine Operation Conditions	Output in H.P.	The number of crank shaft r.p.m.	Prossure behind the super-charger in milli-metres mercury	The nominal height in metres	Fuel flow in kilo-grams per hour	The position of mixture self corrector of NV-82pump RS-24M regulator
Take-off /the time of non interrupted operation not more than five minutes	1900	2600	1250-25	ground	617-665	Aut.norm. mixture
Nominal /rated/	1530 1630	2400 2400	1020±10 1020±10	ground 1600	435-480	"
0,9 of nominal	1380	2300	940 ±10	ground	360-386	"
0,75 of nominal	1150	2200	850 ±10	ground	260-280	"
0,65 of nominal	995	2000	835 ±10	ground	199-209	Aut.lean mixture
0,60 of nominal	920	1800	820 ±10	ground	184-193	"
0,45 of nominal	690	1600	760 ±30	ground	138-145	"

Note.
The indicated conditions are values forchecking of the corect regulation of the fuel consumption during the engine ground-operation. In order to certify the minimum fuel consumption per kilometer at the cruise-flight speeds is necessary to fix the conditions of engine-operation recommended by the instruction according to the range calculation and aircraft-flight endurance.

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The limits of crank-shaft revolution in r.p.m.

a/ maximum permissible number of revolution during not more than 30 sec. 2700

b/ number of revolution at idle running at aircraft sustain operation 500-600

The cylinder head temperature measured by thermo-electrical thermometer on the spark-plug rear side of the 5th cylinder in deg.centigr.:

a/ minimum temperature for good acceleration 120

b/ recommendable not more than 225

c/ maximum permitted temperature at the take-off and climbing, not more than 15 minutes including the period for take-off not more than 5 min. 250

Fuel Supply System.

Fuel specification . . . . . petrol /benzine/B-95/130 with octane number not less than 95

Fuel pump :

Type	rotary /unit 704 A-V/
Direction of rotation	anticlockwise viewed from the tail-side
Gear Ratio	1
Direct-injection pump : type	NV - 82
a/ beginning of fuel injection according to the degrees of crank-shaft turning	30 deg $^{+3\ deg}_{-2\ deg}$ after the top-dead-point in the moment of suction /fixed on the 4th cylinder/.
b/ type	NV - 82
c/ direction of rotation	clockwise /right/ viewed from the tail side
d/ gear ration	0,16 /1:6/
e/ operation-order of the pump elements	1-10-5-14-9-4-13-8-3-12-7-2-11-6-1
f/ type of fuel-mixture regulator . . .	RS 24 M

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g/ nozzle, its type : number . . . . . FB-10 KT one for each cylinder

h/ the fuel-pressure on the NV-82 pump-inlet in kilograms per sq.cm . . . at full throttle not less than 1 at normal operation- 1,5 - 2

Lubricating System.

The kind and specification of oil . . . . Mineral, MK-22 or MS 20

Oil pumps . . . . . Two oil-pumps, the first MS-6SV of gear type with pumping in and out stages /installed on the rear cowling/. The second pump MNP-T of gear-type with pumping in and out stages /installed on the crank-case nose/.

The direction of rotation . . . . . clockwise, viewed from the tail side

Gear ratio of the rear pump 1.125

Gear ratio of the front pump . . . 1.19

Specific oil consumption at condition of 0,9 of nominal and loss in grams/ H.P./ hour . . . . . not more than 10

Oil-flow through the engine at nominal condition with the oil-temperature at the engine inlet of 65 deg. centigr. kilograms per min. . . . . 40 - 65

The heat-transfer of oil at nominal condition at oil-temperature of 65 deg. centigr. at the engine inlet in Kcal per min. . . . . no more than 1050

Oil-pressure during the operational conditions, at the oil-temperature of 40-90 deg.centigr.at the engine inlet in kg per sq.cm: . . . . . .

in the rear oil pump not less than 5,5
in oil-cleaner MF 3 19 min. 5,0 kg/cm3
at the front oil-pump, not less than 4,5
in the crank-case nose on the regulator inlet at least 4
in the variable pitch propellor main-line . . . . . 40 +3

The oil-pressure for regulation at the oil-temperature at the engine inlet at 60 deg.centigr. at 0,9 nominal conditions in kilograms per sq.cm. : 50X1

- at the rear oil pump	5,8	6,2
- in the front oil-pump	4,5	5

Minimum oil-pressure in the rear oil-pump at idling running S=600 r.p.m. in kilograms per sq.cm. not less than 3

Oil temperature at the engine inlet measured at the rear oil-pump in deg.cent. :

recommendable	65
minimum	40
maximum permitted at sustain operation	80
maximum permitted during not more than 10 minutes not less than	90

Oil-temperature at the engine outlet in deg.centigr. :

recommendable	not more than	115
maximum permitted during not more than 10 minutes		125

Gas distribution.

Inlet and outlet stages in the degrees of crank-shaft turn :

Inlet beginning	23 deg + 10 deg till top dead point
Inlet end	66 deg after low dead point
outlet beginning	74 deg till the low dead point
outlet end	25 deg + 10 deg after upper dead point

The clearance between the lever-roller and the valve-rod at the cool engine in millimetres :

- at the checking of the gas distribution stages 1,9
- set for the operation 0,35
- admissible during the clearance checking at the operating engine at cool condition : $0{,}35 \begin{smallmatrix} +\,0{,}25 \\ -\,0{,}10 \end{smallmatrix}$

The ignition system.

Number and type of magneto	two magnetos MB 14 T-2 with constant angle of ignition spark-advance
Ignition spark-advance for both magnetos in the degrees of crank-shaft /magneto setting angle/	23+1 deg till the upper dead point of the compression stroke /the setting is to be carried out in the second cylinder/.
The order of ignition in cylinders . .	1-10-5-14-9-4-13-8-3-12--7-2-11-6-1
Direction of magneto-rod revolution	in opposite sense to clock-wise direction viewed from the tail-side
gear ratio	1,75

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clearance between the interruptor contact in millimetres . . . . . 0,2 - 0,3 50X1

number and type of spark-plugs . . . . . two screened plugs SD-38-BS in each cylinder

clearance between the spark-plug electrodes in millimetres . . . . . 0,28 - 0,36

The engine accessories.

Regulator of revolution number	R 50
Rotation-direction of the generator-rod	anticlockwise viewed from tail-side
Gear ratio	1.027
Electro-inertial starter of combined action	unit SKD -2
Propeller	AV-50, four-blade type of 3,8 diamete

drive to the tachometers, the shaft-rotational direction and gear ratio :
one drive with two shafts - one shaft with left rotation with the gear ratio of 1.5 for the tachometer with mechanical transmission, the second one of clockwise rotation with the gear ratio of 0.9 for the tachometer with : electrical transmission.

Supplementary units.

The current generator	GSR - 6000 A.
Rotational direction of the generator-rod	anticlockwise direction /left/ viewed from the generator rod-side
Gear ratio	2.74
high-pressure oil-pump, type	NSh - 13
rotational direction of the high-pressure oil-pump rod	anticlockwise, viewed from rod-side
Gear ratio	1

Note.
The rotational direction of the devices-shafts viewed from the shaft-rod side. The rotational direction of the devices-drive viewed from the flange-side from below of the device.

Weight and dimensions of the engine.

Weight of the dry engine /with starter in kilograms/ . .	1020 ± 2%
Lenght of the engine including the NV - 82 pump in millimetres	2010 + 10
Diameter of the cover of the valve-housing in millimetres	1300 + 5

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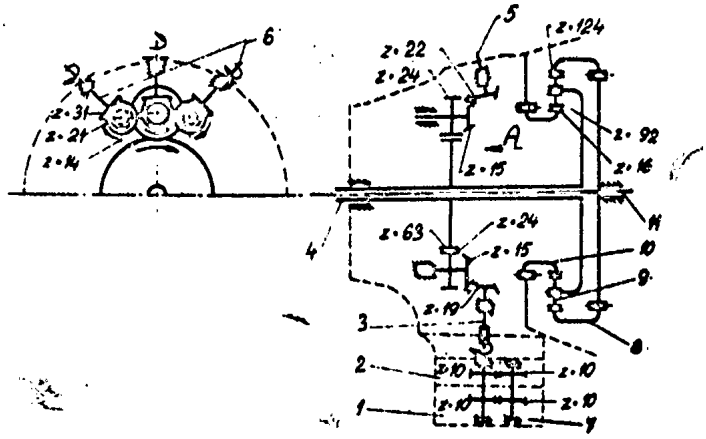

Fig. 3 The scheme of the reducing unit and the accessory unit-drives, assembled in the crank-case nose :
1.pumping-out stage. 2.supercharging stage. 3.oil-pump drive. 4.propellor-shaft. 5.revolution-regulator drive. 6.magneto drive. 7.oil-pump. 8.reducer main gear wheel. 9.satellite gear /12 pieces/. 10.immovable gear wheel of the reducer. 11.crank-shaft.

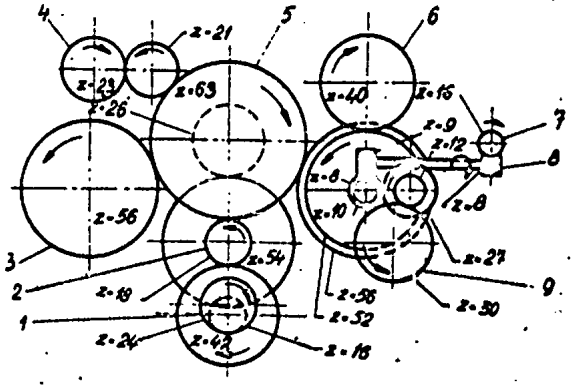

Fig. 4 The scheme of the accessory-units drive assembled in the supercharger-rear body and on the rear cowling /view from the back-side/
1. the MSh-13 pump drive. 2.the supercharger vanes shaft drive /twofold gearwheel/ 3.the MSh 6SV oil pump drive. 4.the generator drive. 5. the accessory-units drive with gear-wheel for elastic engagement. 6.vacuum pump drive. 7.the electrical revolution computing gauge drive. 8.petrol pump drive. 9.the EV-82 pump drive.

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Chapter II.

The engine preparation for flight.

1. Engine preparation for starting.

During the engine preparation for starting it is necessary : Check the filling of the fuel and oil tanks which shall be carried out with taking account of flight-duration.
The oil poured in the oil tank shall be filtered by means of a mesh-filter installed in the filling pistol /not No.24/ and by means of oil-tank neck-filter.
During the filling of the oil-system, if the full oil-amount was previously drained, open the connecting-fitting muffle 26 /Fig.5/ on the front oil-pump and expell the air from the line untill the oil comes out in the full flow. After finishing this operation put on the muffle and secure it by nut-lock.

2. Drain the fule sump of the aircraft fuel system.

3. Check the hermetical sealing of the high pressure cock, of the fuel system and the operation of plunger fuel-pump. For this purpose make the following arrangements. Switch on the plunger-fuel-pump with the at closed fire-cock and ascertain on the pressure gauge if there is the total absence of fuel pressure. If the fire h.p. cock is fully hermetically closed the pressure gauge pointer should be in the zero position.
Open the h.p. cock, switch on the plunger pump and ascertain at p.g. if there is some fuel-pressure.
Check if the electro-magnetic priming valve is in good order by 2.3 short-duration switching of the priming switch and ascertain if there is any fuel flow through the back line connecting fitting of the rear supercharger body.
Cut-off the plunger fuel pump.

4. Check the good condition and smoothness of the travel of control of the throttle, regulator of revolutions mixture self-adjusting device of the RS 24 M regulator /of the NV - 82 pump/, the oil cooler flaps as well as by the cowling gills.
The checking shall be carried out in the full range of controls travel.

5. Ascertain if there are not indentations on the airscrew blades.

6. Check the if the drain-lines leading from the inlet-pipes of the seventh, eighth, nineth cylinder, are clean. The checking up of the drain-pipes is not allowed.

7. The engine preparation for starting-up at ambient air temperature lower than 5°C should be carried out according to the hints, mentioned in the part.IV. ENGINE OPERATION AT LOW TEMPERATURE OF EXTERNAL AIR.

8. Immediately before the starting /the ignition being switched off/ check the airscrew. If excessive effort shall be used when giving the propeller the rounds put off from the sixth, seventh, eighth, nineth cylinder the plugs and give to the propeller 3-4 full rounds for draining out the cumulated fuel or oil from the low cylinder of the combustion-chambers. If the turning of the propeller proceeds normally /without any excessive effort/ put the plugs back in the cylinders, fullfilling the requirements stated in the chapter VII /P.9/ and give once more some rounds to the propeller.
The short period of time between the giving the round to the propeller and the starting of the engine shall not exceed 15 min. In the adverse case the giving rounds to the propeller shall be repeated. 50X1

Note.
During the repeated starting during one day, when after the engine stop pass more than 15 min. and the cylinder head temperature will exceed 60 deg.centigr. the giving round to the propeller can be carried out by the electro-starter, the flywheel being previously put into operation.

2.The engine starting.

1. Set the cowling flaps into the position OPENED.
2. Set the oil-radiator flaps into the position CLOSED.
3. Set the mixture self-adjusting device of the RS 24 M regulator /of the MV - 82 pump/ into the position automatic normal mixture.
4. Set the lever of throttle into the position which corresponds to 800 - 900 r.p.m.
5. Set the control-lever of the revolution-regulator into the position FINE-PITCH.
6. Set the electro-starter over-switch into the position START and rotate the starter fly-wheel. The duration of the rotation of the flywheel is to be carried out in the period of 18 sec at the net-voltage of 24 V and 15 sec at the net-Voltage more than 27 V.

Note.
It is necessary that during electro-starter flywheel rotating the airscrew rotates. In adverse case it is necessary to reduce rotation-period and give the propeller some rounds in the clockwise direction for getting the starter-ratched from the connection with the engine crank-shaft. It is possible to switch consequently the electro-starter not more than five times with the interval of two minutes. After finishing this operation it is necessary to cool the starter down during the period not less than 10 minutes.

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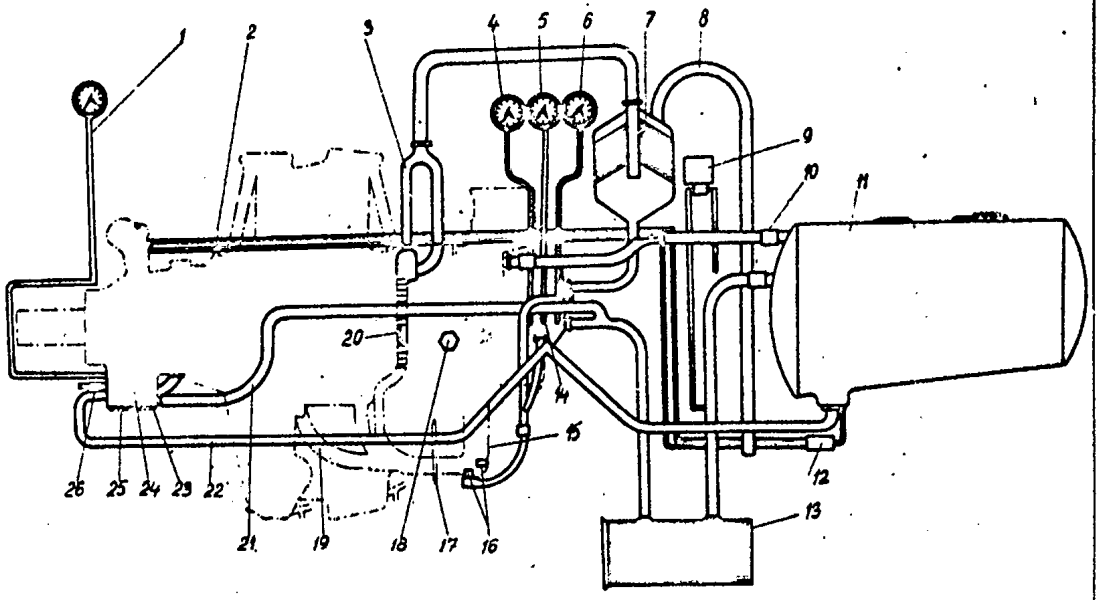

Fig. 5. The scheme of the enter oil circulation and ventilation.

1. The measurement of the oil-pressure in the front oil-pump.
2. The oil-duct to the selector-valves R-50. 3.The vent pipes.
4. The measurement of the oil-pressure in the rear oil-pump.
5. The measurement of the oil-temperature on the engine inlet.
6. The measurement of the oil-temperature on the engine outlet.
7. The disaerating. 8. The draining pipe. 9. The diluty sock.
10. The vent-pipes 11. The oil-tank. 12. The feathering pump.
13. The cooler. 14. The rear oil-pump. 15. The mesh-filters of the oil-bowl. 17. The condensed water drain. 18. The MFS-19 mesh-filter. 19. The return-pipes. 20. The vent in the diaphragm.
21. The front oil-pump out pumping main-line.
22. The oil duct to the front oil-pump.
23. The mesh-filter of the front oil-pump.
24. The front oil-pump. 25. The MFS 19-1 filter.
26. The connecting-fitting of the air-vent from the oil main-line.

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During this operation it is allowed only one switching on corresponding with the period of the combined-period of starter operating not including the time-term necessary for starting in the period of 22 sec. and the remaining with the combined operation term of 7 sec.

7. Switch on the oil-pump and the pressure in the fuel main-lain adjust to 1,5 - 2 kg per sq.cm.

8. After finishing the starting of the flywheel set the electro-starter over-switch to the position ON and after 1,5 - 2 airscrew rounds switch on the ignition and electro-magnetic valve of fuel-supply. The fuel supply is to be carried out by switching on each in duration of 2 - 3 sec. till the time when the operation of the engine will be constant. When the engine is in operation, cut-off the manometer and ascertain, if the readings on the oil-pressure manometers are normal. In the case that the oil pressure in the rear oil pump will not reach 3 kg per sq.cm during the period of 5 - 8 sec. the engine shall be stopped and the cause of malfunction found out and remeded.

9. At the constant engine-operation the fuel-supply is to be stopped and the control-level shall be set by smooth movement of the throttle into the position which corresponds to 1000 - 1100 r.p.m. and the oil pump shall be cut-off.
It is not advisable to open much and sharply the throttle during the engine starting and to supply the engine excessively with fuel.

10. In the case that the engine should not start after three starting attemps the starting shall be stopped, the cause of the malfunctions found out and remeded.

3. Warming and inspection of the engine - and accessories operation.

Engine warming-up.

The engine shall be warmed with the propeller fully relieved at 1000 - 1100 r.p.m. up to the beginning of the oil-temperature rise on the engine inlet; after this increase gradually the engine revolutions to 1500 - 1600 r.p.m. by opening the throttle and carry on the warming untill the oil temperature on the engine inlet will not be lower than 40 deg. centrigr. and at the engine outlet not lower than 45 deg. centrigr. After attaining the mentioned oil-temperatures it is necessary to increase consequently the engine-revolution to 2200 r.p.m. According to the engine warming open the cowling-flaps.

The engine is considered to be warmed up when the temperature of the cylinder heads will be not lower than 120 degr. the oil temperature on the engine inlet not lower than 40 deg.centrigr. and on the engine outlets not lower than 45 deg.centr. Inspect after the warming-up the engine and component operation.

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Inspection of the magneto and spark-plugs operation.

1. Set the revolution-regulator control-lever into the position FINE PITCH.
2. Set the control-lever of the throttle into the position which corresponds to 2200 r.p.m. and let the engine operate on those conditions during a period of 10 sec. for annealing of spark plugs.
3. Cut-off gradually for 5 - 10 sec. each of the magnetos. After checking one of the magnetos before the cutting-off of second one, let operate the both magnetos during the period of 5-10 sec. anneal the spark plugs. After the cutting-off of one magneto the decrease of engine revolution-number shall not exceed 100 r.p.m. The decreasing of the revolutions more than 100 r.p.m. indicates the malfunctioning of plugs, the ignition conductors of the magnetos.

Check of operation of propeller and of the revolution regulator.

1. Set the control-lever of revolution regulator into the position FINE PITCH.
2. Set the control-lever of engine throttle-flap into the position which corresponds to 2200 r.p.m. and reduce the revolution number to 1700 - 1800 r.p.m.
3. Set once more control-lever of revolution regulator into the position FINE PITCH and ascertain the engine revolution number. At the normal propeller and regulator operation the engine revolution number shall increase up to the ignitial number of 2200 r.p.m. during a period of 2 - 3 sec.

Check of generator-operation.

At the engine operation under the condition of 2000 - 2200 r.p.m. ascertain if the board-storage battery and ground electrical feeding are switched-off.

2. Put the generator over-switch into the position SWITCHED-ON; the voltage in this case shall be 28,5 V.
3. Adjust the loading to 100 A by switching on the consumers of electrical power.
4. Reduce the engine revolution number to 1000 r.p.m.; in this case it is necessary to adjust the revers-current relay and the voltmeter indications shall fall down to zero.
5. Rise the engine revolution number to 2000 - 2200 r.p.m. At the normal operation of the generator, of the voltage-regulator and reverse-current relay, the voltmeter indications shall restore to 28,5 V.
6. After finishing the check of the generator-operation switch-off the consumers of electrical power.

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Engine operation check at the constant revolutions.

1. Set the control-lever of revolution-regulator into the position FINE PITCH.
2. Set the control-lever of throttle into the position which corresponds to 2200 r.p.m.
3. Slow down the propeller revolution to 1700 - 1800 r.p.m.
4. By smooth opening and shutting of the throttle change the supercharger /R/k/ to 100 - 150 r.pm. mercury in comparison with the original state. During this operation the engine revolution number shall remain stable. At sharp shutting or opening of the throttle the engine revolution number can correspondingly decrease or increase to 100 - 200 r.p.m. but during the period 1 - 2 sec. the revolution shall stabilize to the previous state i.e. 1700 - 1800 r.p.m. After checking the engine operation at constant revolutions move the control-lever of revolution-regulator into the position FINE PITCH. The engine revolutions number during this operation shall increase to 2200 r.p.m.

The inspection of the propeller feathering system.

The inspection of the propeller feathering system on the ground can be carried out partly or fully as well as operating or non operating. The complete inspection of the airscrew feathering system is carrid out after the engine, /or installing dismanteled for a certain time/, the revolution regulator and of the propeller or of any other of the feathering-system components as well as after passing of 100 hours of permanent operation.

The partial propeller feathering system inspection will be carried out in the following order :

1. Set the control-lever of revolution regulator into the position FINE PITCH.
2. Set the control-lever of throttle into the position which corresponds to 2200 r.p.m.
3. Switch on the feathering pump for short-duration untill the revolutions will decrease to 150 - 200 r.p.m.
4. At the moment of revolution decrease beginning when the propeller comes into the feathered position switch on the feathering-pump. After cutting-off the feathering-pump the engine revolution shall stabilize to the previous state /2200 r.p.m./.

The complete inspection of the propeller-feathering system is carried out in the same order as the partial inspection ; during this operation the feathering of the propeller blade on the operating engine /on the ground/ are carried out at engine revolutions of 1000 r.p.m. at the supercharge Pc - 400-500 mm mercury.

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At the propeller-blade feathered position it is allowed to operate /on the ground/ the engine at approximately 500 r.p.m. During the warming-up of the engine without supercharge the engine-operating time on the ground with the propeller-blades in feathered position shall be kept at minimum /not more than 15 sec./.

Engine operation at nominal conditions.

During the engine operation at nominal conditions the self-adjusting device lever of mixing regulator RS-24 M /of NV-82 pump/ should be in the position AUTOM.NORMAL MIXTURE and the indications of gauges shall be as follows.

The revolution number in r.p.m.	2400
Supercharger in mm mercury	1020 ± 10
Oil-pressure in the rear oil-pump in kg sq.cm. not less than	5,5
The oil-pressure in the front oil-pump in kg per sq.cm not less than	4,5
The fuel pressure in kg per sq. cm	1,5 - 2,0
The oil temperature on the engine inlet in deg.cent. not more than	80
The temperature of cylinder heads in deg.cent. not more than	225

Check of engine operation at idling speed throttle.

At the check of engine operating at idling speed the control lever of revolution regulator shall be in the position FINE PITCH and the self-adjusting device lever of the RS-24 M mixture regulator /the NV - 82 pump in the position autom.normal mixture. At the engine idling speed operation of the indications of the gauges shall be as follows.

The revolution number in r.p.m.	500 - 600
The oil-pressure in the rear oil pump in kg per sq. cm not less than	3,0
The oil-pressure in the front oil pump in kg per sq.cm not less than	2,5
The fuel pressure in kg per sq.cm not less than . .	1,0

The inspection of engine acceleration.

Check the engine-operation in the period of 1,5 - 2 sec. smoothly opening the throttle from the position FINE PITCH to the position which corresponds to the maximal or take-off revolutions. The engine shall operate without slaps, vibrations and derangement. At the engine acceleration inspections of self-adjusting device-lever of RS 24 M Regulator mixture /the NV 82 - pump/ shall be in the position AUTOM.NOM.Mixture; the control-lever of revolution-regulator in the position FINE PITCH. The cylinder head temperature shall be not lower than 120 deg.centr.

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The engine operation inspection at take-off conditions.

The inspection of the engine-operating at take-off conditions is carried out simultaneously with the engine acceleration-inspection.

1. At the take-off conditions engine operation the indications of the devices shall be as follows.

The revolutions number in r.p.m.	2600
The supercharge in mm mercury	1250 ± 225
The fuel pressure in kg per sq.cm.	1,5 - 2
The oil pressure in the rear oil-pump in kg per sq.cm not less than	5,5
The oil pressure in the front oil-pump in kg per sq.cm not less than	4,5
The cylinder head temperature in deg.centr. . . not more than . .	250
The oil temperature at the engine inlet in deg.centr. not less than	80

2. The engine operation at take-off conditions in the period more than five minutes after the warming-up of the cylinder heads is not allowed.

3. The repeated inspections of engine operating at take-off conditions, it is necessary to carry out separated time-terms with cooling of the engine in the intervals between the testings.

4. The engine stopping.

Cool down the engine, therefore :

- set the control-lever of revolution regulator into the position FINE PITCH. Open fully the cowling gills and open partly the oil-radiator flap.
- set the engine at 650 - 1000 r.p.m. and let it operate at revolutions till the minimally lowest possible temperature of the cylinder-head has been reached.

The engine-stopping is permitted at the cylinder head temperature not exceeding 175 deg.centr.

Note.
In the summer-conditions when there is no possibility of engine cooling to 175 deg.centr. it is necessary to let the engine operate at 650 - 1000 r.p.m. till the lowest cylinder head temperature has been reached.
In this case it is allowed to stop at the cylinder head temperature not more than 190 deg.centr.

2. After engine cooling to the already indicated cylinder head temperature increase the revolutions to 1700 - 1800 r.p.m. for a period 10 - 15 sec. For spark-plug annealing, after which operation shall be reduced to 800 - 900 r.p.m.

Stop the engine, putting the self-adjusting device-control lever of RS 24 M Regulator mixture /the MV - 82 pump/ from the position aut.non.oper. into the position STOP and after ceasing of

detonations open fully the throttle for expelling of the exhaust gases out of the cylinders.
Cut-off the ignition after propeller-rotation stop.

5. Shut the throttle and pull the self-adjusting device-lever of RS 24 M Regulator mixture /NV - 82 pump/ into the position AUTOMATIC NORMAL MIXTURE. In this position the mixture-corrector lever shall remain till the next starting of the engine.

6. Shut the high-pressure cock. In the case of fuel leakage into the engine crank case the high pressure cock has to remain in the locked position till the next engine starting.

7. After the engine's stopping carry out the operations prescribed for after-flight inspection /see p.22/

Note .

1. At the engine cooling the self-adjusting device-lever of RS 24 M Regulator mixture /NV - 82 pump/ shall be in the position automatic normal mixture.

2. It is forbidden to cover the cowling gills and cover the engine with covering at the temperature of cylinder-head more than 120 deg.centr. to avoid the damaging of the ignition insulating ducts.

Chapter III.

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The engine flight operation.

1. Before take-off it is necessary to ascertain if the engine has been satisfactorily warmed-up. The cylinder head temperature shall be not less than 120 deg.centr. and the inlet oil-temperature in theengine shall be not less than 40 deg.centr. The indications of all devices which control the engine operation shall be within the limits of prescribed conditions. The oil-pressure at the rear oil-pump shall be not less than 5,5 kg per sq.cm and at the front oil-pump not less than 4 kg per sq.cm, the fuel pressure not less than 1,5 kg per sq.cm.

2. During the take-off and climbing the maximum permitted temperature of the cylinder head is 250 deg.centr. during a period not longer than 15 minutes.

3. The not interrupted engine operation at the take-off conditions is not allowed to take more than 5 minutes.

4. At the sustained engine operation at the horizontal flight the cylinder head temperature as well as oil-temperature at the inlet shall be as follows :

   The cylinder head temperature

   The recommended temperature . . . . . 170 - 190 deg.centr.

   The permissible temperature . . . . . 250 deg.centr.

   The minimum temperature /for a good acceleration conditions/ . . . . . 120 deg.centr.

   The oil-temperature at the engine - inlet

   The recommended temperature . . . . . 50 - 70 deg.centr.

   The permissible temperature 80

   The minimum temperature 40

5. The maximum permissible oil temperature in the period not less than 10 minutes at the engine inlet at 90 deg.centr. and more than 125 deg.centr. at the engine outlet.

6. At the change of engine - operation conditions it is necessary to maintain the following sequence of operations :

   the less straining flight - conditions, first of all decrease the super-charging and then reduce the r.p.m. to required range, at the more straining conditions first of all rise the number of revolutions and then the super-charging.
   This operation sequence during the changing of the conditions is necessary in order not to allow the engine-overloading, it is the supercharging shall be not too high at the low revolution-number.

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7. For reducing the fuel-consumption of the engine-operation in the conditions at 0,65 nominal or lower it is necessary to put the self-adjusting device-lever of RS - 24 M Regulator mixture /the NV - 82 pump/ into the position AUTOMATIC LEAN MIXTURE OPERATION.

When changing the engine-operation from the cruising conditions to the high ones /2200 r.p.m. or more/ it is necessary to put previously the self adjusting device-lever of regulator-mixture into the position AUTOMATIC NORMAL MIXTURE and then rise the engine-operations conditions.

8. At the sustained gliding it is necessary to open periodically the throttle or to shut the c wling slaps to avoid the engine over cooling. The cylinder-head minimum temperature at gliding shall be not l wer than 120 deg.centr.

9. During the gliding with throttle back, open the throttle consequently for the period of 2 - 3 sec. in order to avoid the possible propeller rotating at the higher than permitted revolution number /2700 r.p.m./.

To open the throttle sharply can not be recommended.

10. At the approach conditions the self-adjusting device-lever of RS 24 M regulator mixture /the NV - 82 pump/ shall be put into the position AUTOMATIC NORMAL OPERATION the revolution regulator control-lever into the position FINE PITCH, for giving the engine the possibility in case of necessity of getting into the take-off revolution number.

11. a/ During flight observe the temperature of cylinder heads No 2 and 5. If the temperature of the heads of these cylinders drops by 30 to 50°C at constant engine speed the following is necessary :

- check the readings of the UPRN-1 indicators,
- check by sight, whether no smoke comes out from the exhaust tubes of the engine.

At damaging of normal readings of the UPRN-1 indications, or when ascertaining smoke from the exhausts, throttle the gas, set the airscrew into feathering position, switch off the ignition and close the fire cock.

The drop of temperature of the head and smoke at the exhaust indicates a fault in the operation of the cylinder No 2 or 5.

b/ Inspection of the rear engine oil filter each day is temporarily introduced. If metal chips will be found in the oil filter, the engine should be taken off the aircraft and handed over to the repair shop.

c/ Increase the checking of oil consumption of the engine during flight. At the rate of 0,6 of the nominal one, the oil consumption should be within the limits 4 - 6 litres per hour.

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If sudden rise of the consumption is ascertained, throttle the gas, set the airscrew into the feathering position, switch off the ignition and close the fire petrol cock; after landing inspect the oil filters of the engine and when metal chips are discovered, take the engine off the aircraft. If the increased consumption is not caused by the engine, remove oil leakage.

d/ It is forbidden under weather conditions of ice forming to increase the heat-rate of the engine above 200°C by closing of the engine cowl, because it could result in damaging of the engine.

12. After every flight it is necessary to note in the engine history sheet the time and the engine-operation conditions showed by the control devices indications during the flight and imperfections recorded during the engine operation.

Chapter IV.

The engine operation at the external-air low temperature.

The external air low temperature requires a great care and personal attention of the air-crew in performing the jobs necessary for the engine-starting preparations.

To make easier the engine-starting and the engine maintenance at low temperature of external-air the engine warming-up is to be carried out by warming up the air and by diluting the oil with petrol /bensine/.

The general instructions for engine-servicing at the external-air low temperature are indicated below and are to be performed in addition to the requirements already mentioned in the chapter II.

The diluting of the oil with petrol /benzine/.

The oil-diluting with petrol /benzine/ at low temperature is used for reducing the oil-viscosity. Using of the diluted oil secures its normal supply into the engine, sufficient lubricating the details, the normal operation of the airscrew and of the revolution-regulator and facilitates and accelerates the preparation of the engine for the starting, because it is not necessary to warm-up the oil and even the engine shall be warmed less than ordinary.

During the engine-warming-up after the starting with the diluted oil and after the engine testing a substantial part of fuel evaporates and the oil-viscosity, not mentioning the increasing of the temperature is kept within permitted limits.

During the oil-diluting with petrol /benzine/ one has to fulfill the following prescriptions :

1. The diluting of the oil with petrol /benzine/ in the engine-oil-system is carried out when the expected for-casted minimum temperature of the external-air during 24 hours, for going the following starting will be 5 deg.centigrades or lower.
2. The maximum-permitted fuel-amount in the oil, circulating through the engine shall not exceed 16 per cent, what secures the engine-starting without the proceeding oil-warming-up the oil-temperature of 20 degr.centigrades.

   The necessary fuel amount for oil-diluting is dependent of the external air-temperature indicated in the table 2.

The fuel amount for oil-diluting.

Minimum external-air temperature forcasted for 24 hours before the starting in deg.cent.	The necessary fuel amount in the oil, in percents :
From + 5 to - 5	5 - 6
From - 5 to - 20	15

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3. The oil-diluting is carried out on the engine operating at 1200 r.p.m. /at the flight-day and before the engine-stopping/ by means of pouring of the fuel into the oil-line through the electro magnetic-valve EKR - 3.

Note.

The duration of switching of the electromagnetic valve EKR - 3 depends of the oil-system structure this is indicated in the instructions of air-craft servicing.

4. The engine inlet-oil-temperature during the diluting is to be carried out at a temperature within 40 - 50 degr.centigrades; the pressure-decreasing of the oil is permitted to 05 kg/sq centimetre.

5. For filling of the propeller-mechanism with the diluted-oil /during the end of the deluting - procedure/ at the shut valve EKR - 3, increase the engine revolution-number up to 2200 r.p.m. and carry out by 2.3 manipulation with the regulator-control-lever the decrease of the revolution from 2200 r.p.m. to 1700 r.p.m.

6. After finishing of the oil-deluting-procedure shutt off the electromagnetic valve EKR - 3 and stop the engine.

7. The oil-pressure in the front oil-pump during the diluting procedure shall be not less than 3 kg/sq.centimetre at 1200 r.p.m.

8. Note in the engine history sheet the oil-pressure at the front-oil-pump at the end of the diluting-procedure and the time which was necessary for the diluting-procedure.

9. When the engine has operated with the diluted-oil more than 40 - 45 minutes, it is necessary to carry out the oil-dilution once more.

10. If the engine, started with the diluted oil, has operated less than 40 min. and for any reason it is necessary to stop it for prolonged period an additional oil-diluting is to be carried out in dependence of the temperature of the surrounding air and of the operating time of the engine with deluted oil. The oil pressure in the front oil-pump shall be not lower than 3 kg/sq. centimetre during the diluting at 15 - 16 degr.

Preparation of the engine group of the aircraft for winter.

1. In winter period, at air temperature drop, it is necessary to prepare the protective covers so that it would be possible to fill the oil system and to warm-up the engine with warm air without removing them from the engine cowling.

2. Mount the piping or the hoses from the warming-up equipment.

3. Check the tightness of the diluting cock and connect-up to the oil duct the tube for petrol supply from the diluting cock in case, taht ti has been disconnected.

Preparation of the engine for starting-up.

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1. If the air temperature sunk below -5° C before the first starting-up on the beginning of the flying day, it is necessary to warm-up the engine by means of a heater, provided with a forcing fan. The warm air from the heater should be simultaneously lead into the space of the front and rear oil-pumps. Mind, that the warm air current does not point directly on the ignition cables and the rubber hoses of the oil duct, because they could be damaged by sudden warming-up.

   The air temperature coming from the heater must be within the limits from 100 up to 120° C. The engine should be warmed-up to the temperature of 5° C of the cylinder heads when filling the oil system of the engine with diluted oil and to the temperature of 30 - 40° C of the cylinder heads, when filling the oil system with warm non diluted oil.

   Remark :

   If the oil is not diluted, it is possible to start up the engine at repeated starting-up during the operational day without previous warming-up supposing that the oil temperature and the temperature of cylinder heads is at least 5° C.

2. Before starting-up the engine and after its parking with drained oil, fill the oil system either with diluted oil /according to the table 2/, or with non diluted oil, warmed-up to the temperature of 75 - 80° C.

3. It is possible to start-up the engine without exchange of oil, if oil in the engine oil system has been previously diluted with regard to the lower temperature of the ambient air and in reality the weather got warmer.

4. If oil has been diluted with regard to the higher temperature of the ambient air and in reality the weather got colder, it is possible to start-up the engine only after previous warming-up of oil in the whole oil duct of the engine. In this case oil should be warmed-up to a temperature by 5° C higher than the original temperature of diluting.

   If at starting-up of an engine after a long-term parking the temperature of external air is below - 5° C, the oil tank, the oil cooler andthe oil duct for oil supply and outlet should be warmed-up to the oil temperature at the entry into the engine of 15 - 20° C.

Starting-up, warming-up and testing of the engine.

Starting-up of the engine is carried out according to the hints, mentioned in the part II, with the following remarks :

1. After starting-up of the engine observe especially carefully the indication of oil pressure gauge. If oil pressure in the main oil pump does not reach 3 kg/cm2 after 3 - 5 sec. from the starting-up, the engine is to be stopped and the defect should be removed.

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2. At external air temperatures bel w -15° C it is not recommended to increase the speed above 1200 r.p.m., until the difference between the oil inlet and oil outlet temperatures does not reach 5° C.

3. At engine test, set 2 - 3 times the airscrew from SMALL climbing on GREAT climbing and vice versa, in order to fill the airscrew hub with warmed-up oil. At the first engine test before the take-off set the airscrew blades partially into the feathering position.

4. If the oil pressure drops during engine operation on the ground at more than 1200 r.p.m. below 3 kg/cm2 due to a considerable dilution by petrol, oil must be drained and the engine oil duct should be filled with fresh non diluted oil, and than retest the oil pressure.

Warning :
Excessive oil dilution can result in leakage of the diluting cock.

5. During engine operation on the ground and during flight with diluted oil the oil pressure in the front and rear oil pumps can be on the beginning by 0,5 kg/cm2 lower than the normal one, but after 40 - 45 minutes of engine operation the oil pressure must raise to the normal one. Otherwise, the conditions of starting-up, warming-up and testing of the engine do not differ from conditions determined for summer operation.

The engine stopping.

1. In case of the assumed aircraft standing during which the oil can be cooled to a temperature of 5 degr. centigrades or less it is necessary to carry out before stopping the engine the oil-dilution with fule, as allready mentioned.

2. If it is not necessary to keep the aircraft in the readiness for the flight and engine shall be bound to the standing at the corresponding air temperatures of 5 degr. centigrades or less, it is advisable to drain after the engine-stopping the oil out of the whole oil-system to avoid its thickening or to carry out the oil-diluting in respect to sorrounding air-temperature of 5 degr. centigrades.

Note :

The oil-draining should be carried out through the cocks of oil-tank, oil-pump and oil-radiator /cooler/.

Chapter V.

The engine servicing.

The reliable engine operation during the established operation term can be guaranted only if all operation-prescriptions which are indicated in this instructions-booklet will be fullfillet, it is, the quality of the after-flight inspection and execution of all periodical servicing in due time.

For the engine and its accessories following periodical servicing are prescribed :

- after the first check of a new installed engine,
- after every 50 ± 5 hours of engine operation during the flight
- after every 100 ± 5 hours of engine operation during the flight.

The after-flight engine inspection.

The after-flight engine inspection represents the most important kind of engine maintenance-operations which guarantee the engine readiness for the next flights. During the execution of the after-flight inspection it is necessary to carry out following operations :

1. Open the cowling of the aircraft engine paying attention to the signs of fuel and oil leakage.
2. On the uncooled engine drain 0,5 - 1 liter oil from the oil-pump through the mesh funnel No. 24 /576 meshes per 1 sq.cm/, ascertain the if the mesh is clean and if in the oil are not any sediments.
3. Ascertain by touch the cylinder - head temperature at revealed cold /little warmed/ or over-warmed cylinder heads ascertain and remedy the causes of malfunctioning.
4. Check the reliability of the fastening and tightening of the extending stub-pipe joints with cylinder-head stub-pipes. Inspect the exhaust gas collectors and ascertain if there are not any cracks or splits especially at the welded joints, if the nuts of the clamps are not loosened and if the exhaust gases do not escape. Check if the wire of nutl cks which fasten the inlet lines and the pusher-lever housings and the tightening bolts of the MV - 82 pump as well as the high pressure tubes, leading to the nozzles are in order.
5. Ascertain the reliability of the fastening of inlet-pumps to the cylinder head and to the front compressor body.

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6. Ascertain if there is not oil-leakage from the engine and oil-line fastening. If there are some faults in the packings these must be remedied by tightening or by changing for new ones.

7. Inspect the fuel-lines. Ascertain if there is no leakage in the joints and if they are reliable tightened. Ascertain if there is no fuel-leakage from the fuel-pump drainage.

8. Inspect the NV - 82 pump it's fittings and ascertain :

- if there is not leakage from under the high-pressure pipes connecting fittings and from under the centrifugal air-separator.
- if the pump the mixture regulator RSM 24 M and it's transitories are reliably fastened as well as if the joining fittings of the pump are reliable.
- if the operation of pump-lever is normal /the lever is to be easily manipulated by hand putting it up and down/.
- if there are not foreign particles and if are not mutual touches of the high-pressure lines as well as if they don't with the engine components.

The clearances the pipes in the points of their fastenings /packings/ are permitted to be not less than 3 mm. The clearance between the pipes and engine components shall be not less than 5 mm. The vibrating and interfering pipes are to be fastened; the lines with cracks or too worn out shall be changed.

The fastening of the elastic hoses shall be reliable; in the case of necessity the touching of the hoses upon the engine components and upon the air-craft are to be removed.

9. Inspect the fastening of the engine to the frame and of the frame to the aircraft, the fastenings of components on the engine /paying especial attention to the generator fastening/ and ascertain the reliability of the fastening of the previously mentioned to the pipe-lines and the electrical cables.

10. Check the fastening and the clean-lines of the drain-pipe-channels /connecting fittings/ of the inlet pipes to the eight and nineth cylinder.

11. Check the good functioning, the reliability of joinings, their locks, the smoothness of the operation, the absence of not tolerated clearances of the engine and components control - mechanism.

12. If there are during the flight the enormous radio-interferences check the state of screening of the engine-ignition system. The screening hoses shall not have any damaged coatings.

13. Check the position of connecting knees of spark-plugs in relation to the exhaust pipes and secure by turning the knees the distance between them and the exhaust-pipes which shall be not less than 20 - 25 mm. Check the point of ignition-line-fastening.

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2. The periodical servicing after the 1st check of the new installed engine and after every 50 ± 5 hours of engine flight-operation.

1. To carry out all servicing prescribed for after-flight inspection.
2. Check the state of the oil-pump filter /NV 82 - pump/, of MFS 19 - 1 and MFS 19 filters, and the filter installed at the inlet into the revolution regulator. Putting the filters on their place they shall be washed out by means of petrol /benzine/ and lubricated with oil MK - 22 or MS - 20.

   Note.
   If during the ismpection and washing out the filters of the oil-pump NV - 82 will be found out that more than 75 per cent of the surfaces of mesh-filter are dirt-covered it is necessary to check as well as the filter of the regulator RS - 24 M.
3. Dismantle and inspect the magnetic lock of the front oil-pump.
4. Inspect the state of all filters of the fuel supply system and of the NV 82 pump.
5. Check the tightness of the oil-diluting system cock. At warm weather the diluting system shall be cut-off and blinded.
6. Wash out with petrol /benzine/ the hinge-joints and engine control-lever and its components and after this inject in the hinges the lubricating material CIATIM - 201 or the mixture composed of 50 per cent of technical grease and 50 per cent aircraft oil.

3. Periodical servicing after each 100 ± 5 hours of engine flight-operation.

1. Carry out all servicing prescribed after the first check of new installed engine and after every 50 ± 5 hours of engine flight operation.
2. Drain fully the oil out of the oil-system and change it for a new one.
3. Check if the valve-springs are well functioning and ascertain if there are not clearances at the axes of the lever-rollers. Levers which have radial clearance on the roller-axes more than 0,3 mm are to be changed for new ones.
4. Check the clearance between the lever-roller and inlet- and outlet valve-rods. The clearance at the cool engine shall be in the limits of $0,35 \pm \begin{matrix} 0,25 \\ 0,15 \end{matrix}$ mm at the position of piston in the top-dead centre in the moment of ignition. The best order for inspecting the clearances is following : giving the aircraft-propeller successively turnings by 90 - 100 deg. inspect successively the clearances of cylinder 1, - 14, -13, -12, -11, -10, -9, -8, -7, -6, -5, -4, -3, -2, in case of need adjust the clearances. After clearance

adjusting all valve-lever screws of all cylinders shall be locked in position in which the lever shall be placed between marks /lines/ andof regulating screw and the screw itself shall exceed over the surfaces of the inlet valve-lever. From 0 to 5 mm and over of the outlet valve lever from 2 - 4 mm /Fig.6/.

5. After the first 100 hours of engine operation take-away the propeller and check if the nut of the shaft-fixing bearing screw is well tightened. The nut shall be tightened till it shows resistance. After checking of the nut tightening check the state of the propeller-shaft grooves of the propeller hub cones and the shaft-screwing. Put the propeller on the propeller shaft as already indicated on the page.

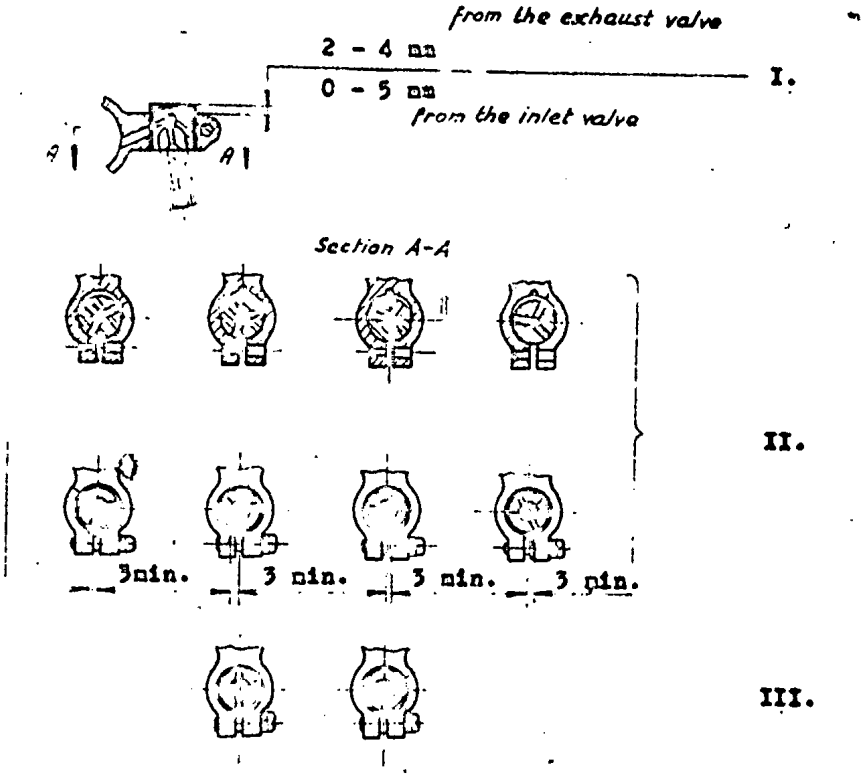

Fig. 6. The installation of the valve lever adjusting screws at the adjusting of the clearances between the lever-roller and the valve-end.
I. The inclined position of the height of the screw in the valve lever.
II. The correct position of the screw according to lever section.
III. The undercut position of the screw according to cuts in the lever. /The propeller oil channel fits with the groove/

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6. Carry out an entire checking of the propeller-feathering system.

7. Check the tightening of all durit clamps of joints of the engine and aircraft.

8. Check the tightening of the nuts fastening the outlet lines. Carry this check without putting the lock-nuts off.

9. Carry out the p.s. of the electro-starter SKD - 2 for which purpose

   a/ take-off the plate of electro-starter and blow with dry air the collector and the brush-assembly.

   b/ cheke the height of the brushes and if necessary cut down the chamfered edges of 0,5 x 30 all on front and rear sides of the operating surface. The brush-height shall be not less than 15 mm after taking off of the brush cuttings down the chafered edges. The brushes of less dimensions than prescribed are to be changed.

   c/ put the brushes on their place and fashon then

   d/ put on both flats /plates/.

10. Carry on the periodical servicing on the generator for which purpose it is necessary to check.

   a/ the reliability of the wire lock of the bolts and screws.

   b/ the close-tightening of the screw of clamps, which fasten the surrounding coating as well as of termined nuts and bolts. If necessary tighten the screws and nuts.

   c/ the correct installations and smoothenoss of the brush travel in the brushholders, as well as the correct position the spring which press the brushes to the colector. The pressing shall be placed always within the groove made in the brush.

   d/ the height of the brushes. The brushes the height of which has been worn out to 17 mm or less it is necessary to replace them by new of the same kind; the measuring shall be carried out of the most worn out part of brush, The brushes shall enter into the seats of brush-holders without any difficulty and they shall be carefully fitted to the collector by means of abrasion glass-paper of quality 00. After finishing the abrasion the generator is to be carefully blown through by warmed air to remove the brush-dust.

   e/ check if the brush-fibres are not damaged. Give especial care to conditions of brush-fibres at the pint where they leave the brush and the cable-end-piece.

   f/ operating collector surface. At the normal operating on the operating collector-surfaces is formed as light darkening, so called POLISH but without any trace of burning. At appearing of thin coating or residues it is necessary to wipe them with a clean rag slightly weted in petrol /benzine/ after this the generator shall be blown through to remove the soilings. The soilings which can not be removed with the rag shall

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be removed from the collector by means of glass-paper of quality 00. The use of emerypaper is strictly forbidden. In case of wearing out or burnings of thecollector surface the generator shall be changed.

g/ the rigidity of fastening of the shelter from the collector and stab.pipe side, and the good condition of the spring washers.

11. Carry out the periodic.servicing on the magneto, for this purpose take away from the magneto the screen with distributor and check the state of the following assemblies :
of the interrupting mechanism, all screw-connections of which shall be checked /with exception of the clamping/ of interrupting mechanism, the stateof all connections and theclearance between the contact of the interrupting mechanism.
The clearance shall be kept in limits 0,2 - 0,3 mm. The residues which appear on thecontacts are to be cleaned with a special velvet file. At appearing of oil on the contact-surfaces the contacts are to be wept with chamois-leather weted in pure spirit.

- the distributing mechanism, at which the good functioning of the high-voltage outlet contact spring in the socket of the distributor cowling and the setting of the carbon to the spring - are to be checked. In case of necessity change the wrong part using the set of individual reserve parts. The discovered dirt on the distributor cowling and on the roating part shall be cleaned by clean chamois-leather. The distributor cowling and the rotating part with chamfered edges shall be replaced.
- Check the grease-state on the cog. If there is no grease it is necessary to wipe the cog untill glitters by means of clean rag weted in turbine-oil L. /not permitting the leakage/ and put on the interruptor cushionfelt 2 - 3 drops of turbine-oil L.

It is forbidden towash the rotating part and the distributer by means of benzine /petrol/ or wipe them with a rag wetted in petrol.

12. To carry out the adjusting operations with the spark-plugs for the purpose of which it is necessary to carry out the following sequence of operations:

a/ take all spark-plugs out off the engine. The screwing of the spark-plugs out of the cylinder-heads is to be carried out only after the engine has been cooled and the temperature of the cylinder heads does not exceed the temperature of 40 deg. centigr. The screwing out of the spark-plugs is to be carried out with a wrench provided with a handle no longer than 200 mm. During the screwing out it is forbidden to give the wrench-handle any stroke. All the spark-plugs for the screwing out of which it was necessary to use the handle longer than that mentioned before in the case of their reinstallment in the engine they shall be strickly inspected as to their hermecity and spark-forming.

b/ check by means of the PI or JISKRA apparatuses the spark-forming and hermecity of all removed spark-plugs.

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The checking of the spark-plugs shall be carried out in the following sequence of operation :

- wash the spark-plug interial by means of purified petrol preventing the penetrating of it into the screen space and dry them afterwards.
- check the spark-plugs if they are not mechanical damaged.
- clean the spark-plugs by sand-blasting to remove the burnings and blaze the spark-plugs chambers by means of clean dry air under the pressure of 4 - 5 kg per sq.cm.
- check by feeler gauge of 0,28 - 0,36 millimetres thickness the clearance between the central and the side electrodes and if necessary carry out their adjustment. The clearance adjustment is carried out only by means of the device /PM/, especially arranged for this purpose.
- check the spark-plugs as to their spark-forming ability by help of the device PM or JISKRA; the new spark-plugs shall be checked at the pressure of 15 kg per.sq.centimeter and the already used at the spark-plugs pressure of 12 kg per sq.cm.
- check the hermecity of the spark-plugs under the pressure of 20 kilogrames per sq. centimeter. By this checking the volume of out-flowing air shall not exceed the amount of thirty bubbles in the period of 30 sec.

e/ Reinstall the spark-plugs into the engine as already mentioned before

- check the coincidance indications of the device UPRN - 1 with the MV - 02 pump link-lever. The method of checking has been already given in the paragraph No. 12 - Checking of the fuel-supply.

4. The oil change.

The oil change in the aircraft and engine oil-system is to be carried out every hundred hours of engine operation. In case that in the mesh of the oil-filter will be found sand, fibrous dirt and resin sediments, the oil must be changed independently from the time for which it was used in operation. The washing out of the oil-tank and of the oil-system shall be carried out at the engine replacement.

Chapter VI.

The unpacking, the degreasing and the installation of the new engine into the aircraft.

The unpacking, the degreasing and the installation of the new engine into the aircraft is proceeding in the following order :

1. Remove the sealings of the packing-case. Take off the cover by loosenings the nuts of the bolts which are fastening the cover of the chest. During the taking off the cover proceed carefully to avoid any damage of the engine.
2. Take out the case-cradle, the boxes with components and the single set of spare parts.
3. Take away from the engine the parafined paper and ascertain if the engine is complete according to packing-list. Undertake an enternal inspection of the engine.
4. In case that the engine is protected against corrosion for a period of two years it is necessary to proceed as follows :
   - cut through the polyvinylchloride wrapping and push the wrapping edges down.
   - take away of the engine the parafined paper and the small bags filled with silicagel, hinged upon the engine, take out of the small box two small bags filled with silicagel, take out the humidity indicator, hinged at the front and at the rear part of the engine /see the instruction enclosed to every packed engine/.
5. For an easier removal of the grease from the external and internal parts of the engine it is necessary to warm it up in a furnace at the temperature of 40 - 50 degr.centigr., the engine being during the heating operation covered with the wrapping. In order to avoid the penetration of the grease into the generator and electro-starter during theremoval of grease from the regulator, protect them by means of greased paper or by means of a special wrapping.
6. Take out of the plug-ports the complec or the dehydratory /drying/ containers in case of the inhabiting of the engine for a period of two years and take out the blinding nut of the exhaust ports of all cylinders.
7. Remove the grease out of the cylinders and the internal spaces of the engine, by turning the crank-shaft by means of a wrench untill the grease will be fully drained from the cylinders and the oil-pump.

Note.
To ensure better draining of the protecting grease out of the M7 - 82 pump put the lever of the pump into maximum opened position.

8. Inject through the plug-ports into all cylinders an amount of 50 - 75 gr. of pure aircraft-oil /warmed/ at piston piston-lower-dead-center. and give the shaft 2 or 3 rounds.

9. Insert the spark-plugs into the cylinders and fasten the knee-pieces of the ignition lines.

10. Lock all the ports of the engine and of the components with the blinding nuts for protecting of the internal engine spaces from getting dirty.

11. Wash the grease from the external surfaces of the engine and the components by means of a hair-brush wetted in petrol /benzine/ or by means of a sprayer. Blast the engine with hot dry air or wipe it by means of a rag.

W a r n i n g . To wash the internal spaces of the engine and of the rubber hose with petrol or kerosene is forbidden.

12. Wash out the protecting grease from the external fuel-pump surfaces /acmp. 704 A - V/ and submerge it into the fuel-container and give to the rotor-rod so many rounds till the grease is completely removed.

Note. The removal of the grease from the remaining components including the pump M7 - 82 is not necessary!

13. Carry out the adjusting operations which are in accordance with characteristics of the power-plant of the given aircraft-type and which are better to be carried out before the engine-installation on the aircraft. /the completing or the changing of individual deflectors brackets and connectings fitting and so forths/

14. Install on the engine the frame /with the internal-cowling ring/, the throttle-box, the transitional element of the throttle-box, the fuel-pump drive and other components and equipment.

15. Install the engine on the aircraft and carry out the assembly of engine-plant equipment. Take the engine out of the packing-case by means of pulley with minimum loading of 1.5 ton.
For the engine lifting-up use a special cable-hanger. For fastening the hangers on the engine it is necessary to take off the bolt-nuts of the cylinder outlet-valve levers. No. 2 and 13 and the cylinder inlet valve lever No. 3 and 14 and put the eye-provided plate nuts on the lever bolts /fig.7/. The rings of the longer hanger fasten on the cylinders No. 3 and 13, the rings of the shorter hangers on the cylinders No. 2 and 14. For giving the engine the inclined or vertical position it is necessary to provide the propeller shaft with the lifting plate nut in the eye of which one puts the pulley-hook.

16. After the installation of the engine in the aircraft it is necessary to carry out the grease-removal by heat. For this purpose it is necessary to warm the engine in a furnace to the cylinder-head temperature of 40 deg.centigr.

For an easier removal of the lubricant, which during a long term preservation for two years could penetrate even into the intake tubes of the 6th and 11th cylinders, it is necessary to dismount these tubes and to drain the preserving lubricant. Then mount the tubes again.

In this way appearance of hydraulic shock in the 6th and 11th cylinders due to the suction of lubricant from the intake tubes into the cylinder space is prevented.

- fill the oil tank with new aircraft-oil warmed to 75 - 80 deg. centigr.
- give the engine crank-shaft 2 - 3 rounds by turning the propeller; carry out the combined rotating with the starter /in the period not longer than 22 sec./ until the warmed oil comes out of the oil-pump drain-cock.
- start the engine as given in the chapter II.
- after starting the engine let the engine operate at 1200 r.p.m. during the period of 8 - 10 minutes and then stop the engine.
- drain the oil out of the engine, of the oil tank and out of the whole oil-system.
- the drained oil, regarding to the fact that it contains the lubricating material, cannot be regenerated and is not suitable to be used a second time.
- carry out the inspection of the powerplant and ascertain if there will be a good connection of all control-mechanisms and the absence of fuel- and oil-leakage.

17. Take off, inspect and wash out the mesh-oil filter MFS - 19 and MFS - 19 - 1 and put it on their place. Fill another time the oil tanks with pure warmed oil and carry out the complete checking of the engine and of the operating of all its parts.

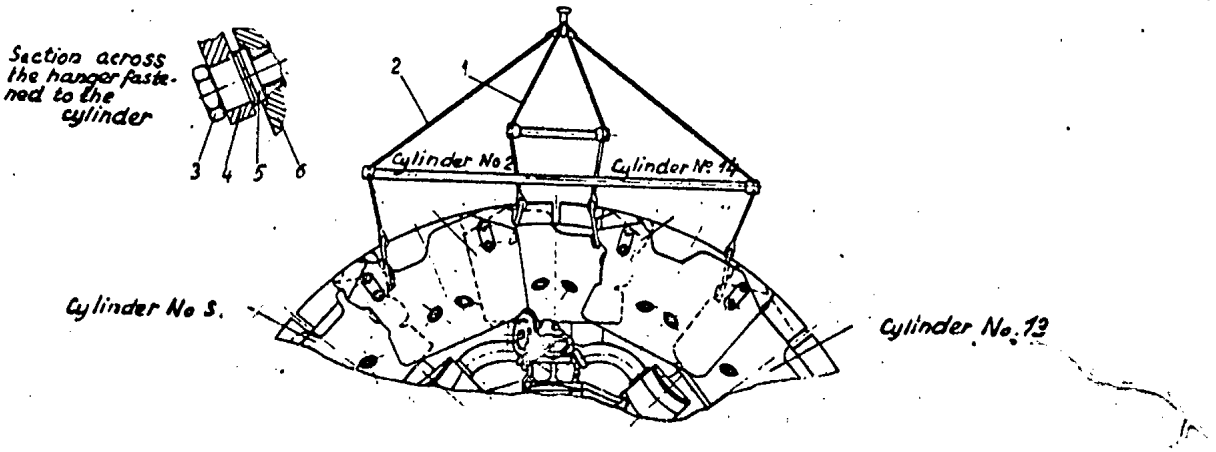

Fig. 7. The engine ASHT /the front view/ with indication of places for fastening of the eye provided plate nuts /hangers/.

1. the front hanger /short one/
2. the rear hanger /long one/
3. the hanger-nut /with lock/
4. the hanger /disc/
5. the washer to be placed under the valve lever axle nut
6. the cylinder head.

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Chapter VII.

Installing, removal and adjusting of accessory units.

1. The front and rear oil pump.

Installing of oil-pump.

At the installing of the oil-pumps on the engine it is necessary to carry out operations, as follows :

1. take-off the wrapping and the transport nuts.
2. for better removal of the protecting grease from the external and internal spaces carry out the warming up to a temperature of 40 - 50 deg. centigr.
3. Wash the external part of the pump with purified /clean/ petrol.
4. Plunge the pump in purified /clean/ petrol and wash it out and turn it by the rod to both sides during a period of 3 minutes.
5. Give it a blast by dry air and dry it at the temperature of 18 - 20 degr.centigr.
6. Take out from the front oil-pump the oil-filter MPS 19 - 1 and dismantle it. Inspect the net and the internal space of the filter-body, wash it out in purified petrol, dry it with warmed air and reassemble.
   Lubricate abundantly the filter with pure aircraft-oil and put it on its place. Put under the filter-flange an inserting-piece.
7. Check the fluent and smooth rotation of the oil-pump gear-wheels, giving some rounds to the drive shaft by hand.
8. Put on the studs which are fastening the oil-pump to the crank-case nose-flange and the rear cover, inserting pieces. For securing of the hermetical sealings when installing oil-pumps on the engine it is necessary to take a special care inspecting if all the fastened flanges are thoroughly clean.
9. During the installation of the front oil-pump on the crank-case nose flange it is necessary to give a special care to the correct installing of the conical rubber fastening-ring on the oil-supply into the crank-case nose and the installing of transitional clamps connecting the oil-pump drive axle with the grooved clamp of the pump.

The checking and the adjusting of the oil-pressure.

When the change of the oil-pump has been carried out, the dismantling or the adjusting of the reducing-valves of the oil-pumps etc., it is necessary to check the oil-pressure at the engine revolutions of 2300 r.p.m. /table 3/

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Table 3.

The oil-pressure in the oil-pump

Oil - pump	Oil-pressure in kilograms per sq. cm.	Oil-temperature at the engine-inlet in deg.centigr.
The rear pump	5.8 - 6.2	65
The front	4.5 - 5.0	65

In case of the not complying of the oil pressure with the standards at the f r o n t oil-pump, it is necessary to carry out operations in following order :

- screw and put off the reducing-valve-cap
- take out the lock from the opening of the adjusting stopper
- adjust the pressure within the limits of the standard by turning the turn-screw of the stopper.

Note.
Turning the adjusting stopper clockwise will result in the increase of oil-pressure, when turning anticlockwise a decrease of oil-pressure will result.

When giving to the adjusting stopper one full round, the oil-pressure will change approximately by 0.4 kilogram per sq.centimetres.

After finishing the adjusting operations the lock shall be put on through the valve-body-grooves into the opening /hole/ of the regulating-stopper; tightly close the cap-nut and lock it by a wire.

Check the regularity of the oil-pressure at the next due engine checking.

The oil-pressure regulation on the rear oil-pump is to be carried out in following order of operations :

- screw and take off the adjusting screw-cap
- loosen with a wrench the lock-nuts of the adjusting screw holding it simultaneously in its position by a screw-driver.

Adjust the oil-pressure within the standards by turning the regulating-screw and holding at the same time the lock-nut by means of a wrench.

Note.
When turning the regulating-stopper clockwise an increase of oil-pressure will result; when turning anticlockwise an increase of oil-pressure will result. When giving the adjusting stopper one full round the oil-pressure will change approximately by 0.6 kilograms per sq.cm.

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- after finishing the adjusting -operating the lock-nut of the adjusting -screw shall be screwed on and the cover-ring shall be screwed on and locked.
Check the regularity of the oil-pressure at the occassion of the next engine-checking.

W a r n i n g . The oil pump reducing valve-adjusting is permitted only after a close checking of the oil-duct hermecity and the exactness of the indications of the devices.

2. The fuel pump 704 A - V.

The installation of fuel pump.

During the fuel-pump installation on the engine-drive it is necessary to carry out following operations :

- remove the grease from the pump by washing it with petrol /benzine/ jet by turning oil-pump-rotor and holding the pump by the rod.
- check the cleaness of the supporting engine-drive surfaces and the cleaness of the pump-flange.
- put the tightening-washer upon the drive-flange
- install the pump on the engine and tighten smoothly and lock the nuts.
- join to the connecting-fitting of the fuel-pump-body a check-pipe and lead it out behind the power-plant cowling.

The fuel-pressure regulation.

/fig.8/

In case of the fuel-pressure-deviation from prescribed standards it is necessary to carry out the following order of operations : remove the stop-nut lock of the adjusting-screw of the oil-pump.
- turn the cap by half round and at the same time hold it in its position by a screw-driver.

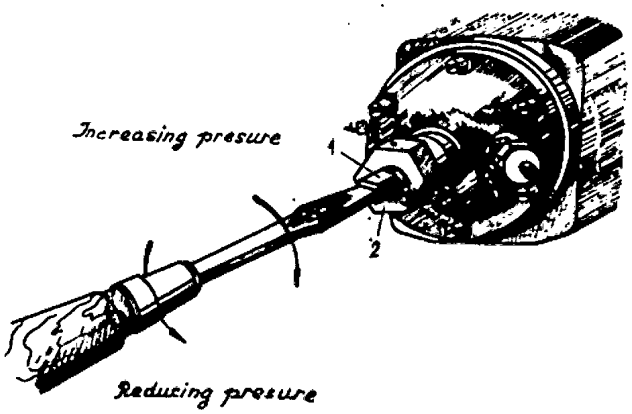

Fig.8 The fuel pressure regulating :

1. the adjusting screw cap
2. the adjusting screw.

- adjust the fuel-pressure to the limits of 1.5 - 2 kilograms per sq.centimeter and at the same time in order to increase the fuel-pressure turn the adjusting screw clockwise. In order to reduce the fuel-pressure turn it anticlockwise. One round of the adjusting screw represents the fuel-pressure change of about 0.1 kilogram per sq.cm.
- screw up and lock the cap-nut of the adjusting screw.

The regularity of the fuel-pressure adjusting is to be checked during the next engine checking.

3. The installation of the electrostarter.

During the electrostarter installation on the engine it is necessary to carry out following operations :

- remove from the electrostarter the protecting grease using a hair-brush wetted in purified petrol /benzine/ and then blase with warmed air the electrostarter surfaces.
- put on the flange of engine crank-case rear cowling an inserting piece of 0.8 ± 0.1 milimetres thickness.
- install the electrostarter on the crank-case rear cowling
- put the washer and fasten the starter by selflock-nut.

4. The installation of the generator.

During the generator installation on the engine it is necessary to carry out following operations :

- put on the flange of the engine crank-case rear cowling an inserting piece, being of 0.8 ± 0.1 milimetres thickness,
- install the generator on the engine from the left side in order to lead the grooves of the generator - shaft freely, without crossing, into the grooves of the generator-drive-shaft-clamps.
- install the washers and fasten the generator with self locking-nuts.

5. The installation of high-pressure oil-pump NSH - 13.

During the installation and the removing of the pump, it is necessary to watch carefully the even tightening or screwing off, of all nuts fastening the pump and the drive front body to the rear cowling. To avoid the drive-body breaking it is necessary to take care that the upper nuts will be not screwed off in case that the two lower nuts fastening the drive-body /or vice versa/, have not been screwed on.

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6. The installing of the revolution regulator on the engine and the adjusting of the maximum and minimum revolution stops.

The installation and the adjusting of the regulator on the engine is to be carried out in the following operation order :

1. Before installing the regulator on the engine remove the protecting grease from all outer surfaces of the device by means of hair-brush, wetted in petrol /benzine/.
2. Check by hand the smoothness of regulator-shaft rotating at the surrounding temperature not less than 15 deg.centigr.
3. Wipe thoroughly the supporting engine surfaces and regulator surfaces and ascertain if there are not any foreign particles.
4. Put on the crank-case nose surface the tightening reinforced washer so that it shall not cover oil inlet and outlet channels.
5. Install the regulator on the studs and faston it. The tightening of the nuts is to be carried out step by step in the cross sequence to avoid the overlaping of the flange and to avoid the jamming of the regulator driving shaft.
6. Install the regulator control lever in the cockpit into the position COARSE PITCH and turn the regulator roller axle by hand clockwise untill it shows resistance /the regulator slight valve spring is fully extended/.
   In this position of the regulator control lever and the regulator-roller axle, put the roller on the axle and faston the control cables on the roller.
7. Carry out the installation of the maximum revolution stop; for this purpose following operations have to be done :
   - start and warm the engine at fully unloaded propeller,
   - set the engine revolutions to 2200 r.p.m. and push three times the regulator control-lever from the FINE PITCH to the COARSE PITCH and vice versa.
   - set the regulator control-lever into the intermediate position between the fine and the coarse pitch /nearer to the position of fine pitch/.
   - set by means of control-lever the supercharge of 1250 milimetres of mercury.
   - set slowly the control-lever of the regulator to the side of unloading of the air-screw till the revolution-speed of 2630 - 2670 r.p.m. will be reached, without touching the throttle control-lever and after doing this the propellor shall be loaded until 2600 r.p.m. will be reached.
   - stop the engine without touching the regulator control-lever and bring the maximum revolution stop on the regulator-roller closely to the stop on the regulator head and faston it in such a way that would not allow any further turning of the roller for unloading of the propellor.

- start the engine and check the accuracy of the maximum revolution stop installation; at the regulator control-lever position on the maximum-revolution stop and at the supercharge of 1250 -25 cm of mercury, the engine revolution speed shall be 2600 ± 20.r.p.m. and by the insignificant displacement of the regulator control-lever /only 5 - 6 millimetres/ -in the direction of propeller loading, the engine revolution-speed shall drop to 20 - 30 r.p.m.

Note.
After the maximum revolution stop installation in order to avoid the possibility of wind milling of the propeller during the take-off in the case of the irregular stop installation, it is recommendable to carry out first take-off by slightly loaded propeller /by 50 - 100 r.p.m.
The checking of the regular stop-installation during the flight shall be carried out by unloading /zero-pitch/ the propeller. In case that the engine will get more r.p.m. that desirable, the propeller is to be loaded to 2600 r.p.m. /without touching the regulator control-lever/ carry out the landing. After stopping the engine reset the maximum-revolution stop as indicated above.

8. Carry out the installation of maximum revolution stop; for this purpose it is necessary to carry out as follows :

- start and warm up the engine by fully unloaded propeller, set the engine-revolution to 2200 r.p.m. without touching the throttle control-lever; load the propeller by means of the regulator control-lever to 1400 r.p.m.

- stop the engine without touching the regulator control-lever, bring the minimum revolution stop on theregulator-roller to the regulator-hend stop and fasten it in such a way that it does not allow any further turning of the roller for the propeller-loading.

7. The installation and dismantiling of the AV - 50 aimcrow.

The propeller installation.

1. The new propeller shall be installed to the engine in accordance with the instructions.

2. Because the installation of the propeller 21 on the engine-shaft is carried out without dismanteling of the cylinder from the propeller-hub body - 22 - it is necessary before the propeller-installation to loosen the nut -4- of the oil-duct and to put off the locking plug 3. /Fig. 9/

3. Inspect the propeller-shaft nose and its thread and ascertain if there are not any chips, foreign particles ect.; if necessary wipe the shaft by means of a rag wetted in petrol /benzine/. Check the tightening of the stop-bearing-nut. The nut shall be

tightened until its resistance by some strokes of the locksmith's hammer /weight : 400 grams/ given to the handle of the wrench. Set the propeller-shaft into the position at which the pin on the grooves is in the upper part.

4. Check the thread of the propeller-shaft nose by putting on them the rings provided with thread /rings No. 701778/ which shall be turned round by hand smoothly around the whole propeller-shaft nose thread.

5. Put the rear cone 12 the colour of which has been inspected on the propeller-shaft; before this operation the cone should be coated by a thin layer of pure aircraft-oil.

Note.
The dye print test of cone is to be carried out after the propeller has been installed and then again taken down for the inspection of the cone. The surface of the cone which fits closely according to the colour-test shall be at least 60 percent of the whole area and shall be gapless. For securing the mentioned tight fitting it is permitted to turn the cone by 180 deg.

6. Put on the rear cone the setting clamps 1 /Fig. 10/ which during the propeller setting, limits the propeller-hub motion upon the shaft and protects the thread of the front cone-nut and the propeller-shaft against foreign particles.

7. Put the ring-washer 13 /see Fig. 9/ and the stop ring 14 on the propeller-shaft and tighten them closely to the rear cone.

8. Put in the propeller-shaft nose the inserting piece 11, the connecting fitting /9/ and tighten the nut /16/ having before greased its thread with slight film of engine oil. The connecting fitting /9/ shal be put freely and without strain on the oil-ducting pipes in the propeller shaft.

9. Screw on the nut /16/ of the connecting fitting /9/ by means of a wrench with the effort of 40 - 50 kgm.

10. Put on the stop washer /17/ so that the two straigh teeth disc will enter into the bush-grooves of the connecting fitting /9/ and the three inflected teeth will enter into the stop-groove of the nut 16.

11. Check the fitting of the two gasket /19/ on the bush /9/.

12. Grease with engine-oil the thread and the groove of the propeller shaft.

13. Lift the airscrew by means of tackle and of the hinge to the propeller shaft height /lift the propeller by the first and second blades and cylinder/.

14. Take out from the openings of the propeller-hub the protecting /transporting/ blinding nut.

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15. Set the propeller on the propeller-shaft and swing carefully it upon the shaft until the front cone-nut butt /18/ touches closely to the propeller-shaft nose.

Note.
On the cylindrical surface of the propeller-hub body rod is a spherical port arranged for quick finding out the position of the groove provided with thread in the propeller-hub. At the propeller installation the spherical port shall be placed against the pin on the propeller-shaft grooves.

16. Put the wrench into the oil-duct-groove where the lock-brush has been dismantled and leading the wrench in the direction of the low part of the engine axis, turn it once or twice to permit the nut /18/ of the propeller front cone to screw on by one or two windings on the propeller-shaft nose.

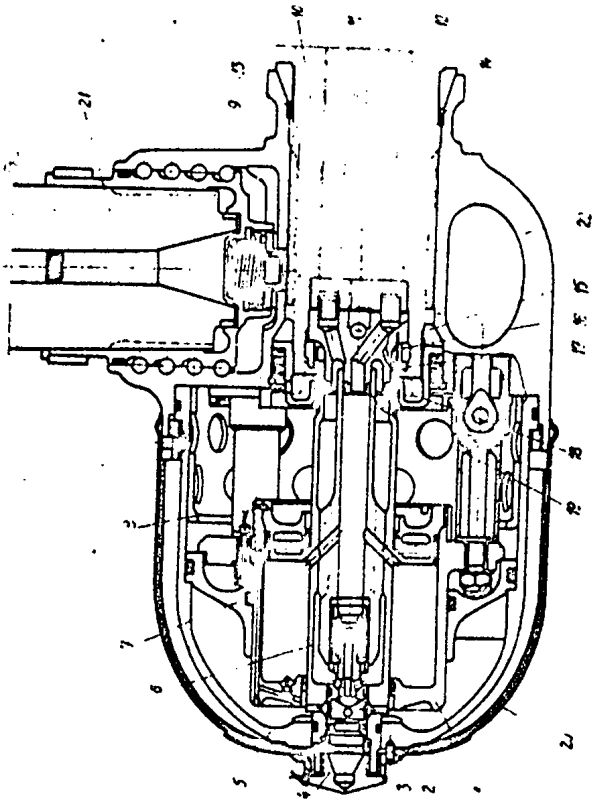

Fig. 9. The AV - 50 propeller hub /longitudinal section/

1- cylinder, 2- pin, 3- the lock, 4- the oil duct nut 5- the propeller cylinder, 6- the oil duct, 7- the piston of operating range, 8- the range plug, 9- the connecting fitting, 10- the propeller /engine/ shaft,

11- the connecting fitting inserting piece /washer/, 12- the rear body, 13- the stop ring washer, 14- the stop ring, 15- the front cone, 16- the connecting fitting nut, 17- the stop /lock/ washer, 18- the front body nut, 19- the gasket /the rubber fastenings/, 20- the warm insulation, 21- the propeller, 22- the propeller hub body.

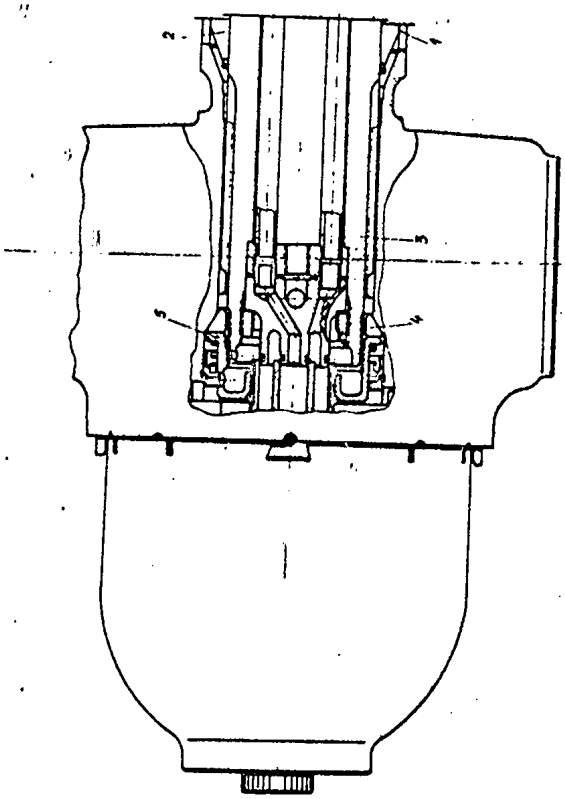

Fig. 10 The installation of the AV - 50 propeller.

1- the installing clamp,
2- the rear cone,
3- the reducer shaft nose
4- the front cone
5- the front cone nut

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17. Take off from the rear cone the setting clamp, screw definitely and tighten the propeller front cone nut 18 by the effort of 100 - 120 kgm.

18. Check with a leaf-gauge of 0.05 millimeter the close fitting of the rear cone butt to the propeller-shaft stop bearing nut butt /the feeler gauge/ shall not pass through/ and check as well as if the propeller hub is tightely installed on the rear cone.

19. Put the lock-plug /3/ in the oil-duct groove, when during this the two pins /2/ pressed into the plug /3/ shall enter into the propeller cylinder ports /5/. The fitting of the pins with the ports is realised by means of the transposition of the plug on the grooves and by turning round the oil in the direction of the front-cone nut tightening clockwise, viewed from the propeller-cylinder side.

20. Screw on the nut /4/ of the oil-duct and tighten it with an effort of 15 - 20 kG and lock it by wire to the lock-plug /3/.

21. Check the propeller blade, pulsation. The pulsation of the propeller trailing edge at the distance of 1000 millimeters from the shaft axis shall not exceed 2 millimetres.

22. Put a mark on the rear propeller-hub butt against the thread of the rear cone.

Removing of the airscrew.

1. Release and screw the nut /4/ of the oil duct and take off the lock-bush /3/.

2. Put the wrench in the oil-duct groove, put in the wrench-hole the handle and after putting on it a pipe of 2 meters lenght, loocen the propeller front-cone-nut until the nut screws freely. After this take from the handle the pipe and screw off the nut from the propeller shaft nose finally.

   Note.
   In case that the front-cone nut shall not unscrew it is permitted to give some slight strikes by small hammer on the pipe end untill the nut begins to screw off.

3. Take off with care the propeller from the shaft by means of a tackle.

4. Put on the propeller shaft nose the protecting blinding nut.

5. The packing ring /14/, the washer /13/ and the rear cone /12/ take away from the propeller shaft.

6. Loosen and screw off the nut /16/, take out the locking washer and bush /9/, then take off the inserting piece.

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Note.

1/ the operations No. 5 and 6 shall be carried out only in the case of changing the components for the new ones or in the necessity to inspect them.

2/ at the repeated mounting of the propeller, the mark put on the hub during the propeller installation, shall fit with the rear cone thread.

8. The magneto installation on the engine and adjusting of interruptor clearances.

Before installation of the magneto on the engine it is necessary to remove the protecting grease for which reason it is necessary to carry out following sequence of operations :

1. Remove the grease from the rotor-shaft rod.
2. After taking off the screen and the distributor remove the protecting grease from the cam by help of the dry tissuie or chamois-leather.
3. Take off the screen the distributor, remove the protecing grease from the springs and from the limiting stops of the interupter as well as of the its fastening components preventing the greasing of the felt of the contacts and of textelite-plastic cushion.
4. After finishing the removal of the grease, the cam shall be covered with sligh film of turbine oil /specification L/, preventing the greasing of the interrupter contacts or of the surfaces near the contact.
5. During the removal of the grease from the magneto after its long time storing, it is necessary to wipe the cap thoroughly until it glitters, by means of a rag wetted in turbine-oil /specification L/. The oil leakage after the wiping are inadmissible. Give into the oil-cups 5 - 8 drops and on the interruptor cushion felt 2 - 3 drops of turbine-oil /specification L/.
6. The interrupter contacts shall be wiped by chamois -leather, wetted in pure spirit.

W a r n i n g s .

1/ In case that the protecting grease has not been previously removed the magneto does not operate at all.
2/ It is categorically forbidden to remove during the degreasing the grease and wipe the magneto interrupter and its components by petrol /benzine/ and cleaning wool.
3/ If some corrosion shall be found out on the interruptor springs as well as on the operating profile of the cam, it is necessary to change these components. The removal of the corrosion upon these components is inadmissible.

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Magneto installing on the engine.

The installing of the magneto on the engine can be carried out as well as by the help of the adjusting disc and the adjusting piece as well as by taking off the magneto. The installation of the magneto shall be carried in the following swquence of operations :

1. Set by turning round of the magneto the operating electrode 2 of the rotating part against the mark 1, signed on the surface of the magneto rear cover /Fig.11/ In this position of the rotating part shall begin the interrupting of the contacts of interruptor, what is checked by a colophane film of 0.03 - 0.05 mm of thickness previously pressed between the contacts. The beginning of contacts switching off can be checked as well by means of the light gauge.
2. Take off the fuel pump of the engine and install the regulating disc on the fuel-pump drive flange. Install the adjusting piece in the spark-plug ports of the second cylinder and ascertain the plunger top dead-center of this cylinder at the moment of ignition. Mark this position upon the regulating disc.
4. Turning round the propeller, set the engine crank-shaft /according to the regulating disc/ into the position, at which the plunger of the cylinder No.2 does not reach the top dead center at the moment of ignition after 21 deg. ± 1 deg., according to the angle at wahi the crank-shaft has been turned /round/.
5. Install the magneto on the crank-case nose flange without fastening it definitely, fasten the magneto shaft to the drive-shaft.
6. Turning round the magneto into the extreme positions, limited by the oval flange ports, check if during this operation is carried out the dislocking of the interrupter contacts. If the dislocking of the contacts does not take place, it is necessary to take off the magneto, to turn round the rotating part by one or two rounds and repeat the operation of magneto setting upon the engine trying to reach the beginning of dislocking of the interrupter contacts. After this operation the nuts hall be put on the washers studs and tightened.
7. Tighten the nuts fastening the magneto into the position permitting to remove the magneto slightly by hand strikes.
8. Ascertain the beginning of the dislocking of the interruptor contacts, the beginning of the contacts dislocking shall take place after 21 ± 1 deg. to the top dead center in the point of ignition in the second cylinder which can be reached only by turning round the magneto on the studs striking slightly by hand its body.
9. Tightening the nuts fastening the magneto definitely and lock them up.

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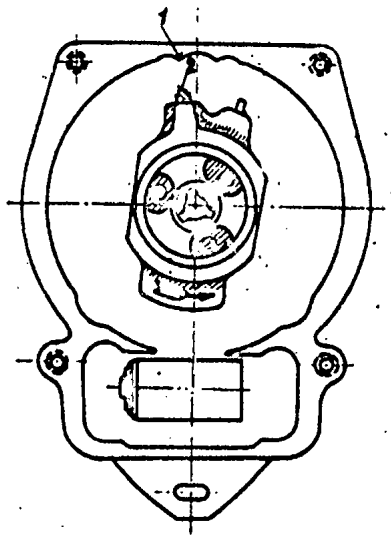

Fig. 11 The position of the rotating part at the magneto installation on the engine.

1- the mark on the magneto rear cowling flange.

2- the operating electrode of the rotating part.

Note.

During the magneto-adjusting to the setting angle of 21 + 1 degree it is necessary to choose the clearance in the transmission to the rotating part of the distributor and to the needle of adjusting disc from the side opposite to the normal rotational direction.

10. Set the distributor upon the magneto in order to get high voltage outlet in its mounting in the distributor -

- the distributor must be correctly set on the key
- the falling out prevent of the carbon from its mounting in the distributer.

11. Install the screen and fasten it on the magneto. At the installing of the magneto on the engine -from what the magneto was already dismantled- it is necessary to carry out following sequence of operations :

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a/ take off the screen and the distributor from the magneto, which is to be changed.

b/ turn round the engine crank-shaft by means of the propeller until the fully disl cking of magneto-interrupter contacts. Check the clearance between the contacts. The clearance shall be of 0.2 - 0.3 millimetres.
In case that the clearance is out of these limits, it is necessary to adjust it.

c/ by turning the crank-shaft round, set the rotating part operating electrode against the mark, signed upon the magneto rear cover area.at the locked contact-position of the interrupter. Put the celophane - film of 0.03 - 0.05 millimeters thickness between the interrupter contact and turn slowly round the crank-shaft by means of the propeller, set the beginning of contact dislocking. After finishing this operation the crank-shaft of the engine shall not be turned up until the final installation of the new magneto.

d/ loosen and screw off the magneto fastening nut and take off the magneto of the engine.

e/ install the magneto on the engine carrying out operation in the same sequence /according to the paragraphs 5, 6, 7, 9, 10, 11/ indicated for the magneto installing with help of the regulating disc and adjusting piece.

The adjusting of clearance between the interrupter contacts.

1. For adjusting of clearance between the interrupter contacts of the magneto it is necessary to loosen two screws /3/ /Fig.12/, fastening the interrupter support and turning round the excentric screw /2/ and the cam-top and after this operation tighten screws /3/. The clearance between the contacts is to be set within the limits of 0.2 - 0.3 millimeters.

W a r n i n g . After each interrupter clearance adjusting, it is necessary to make a note in the magneto history sheet.

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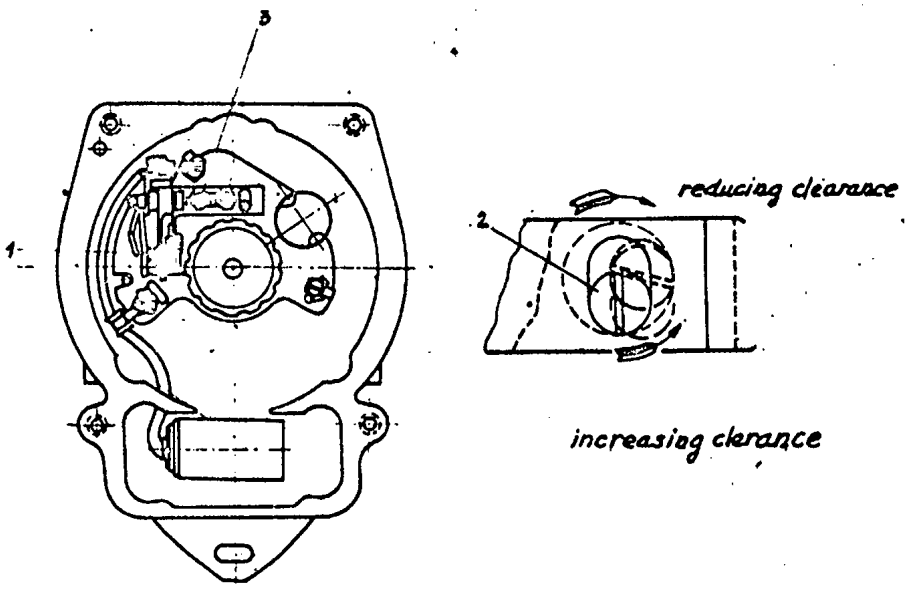

Fig. 12 The adjusting of the clearance in the magneto-interruptor.

1- clearance, 0.2 - 0.3 millimetres at the position of the interruptor-hammer on the cog.

2- the excentrical screw.

3- the screw for fastening of the interruptor support.

9. Installation of spark-plug in the engine.

During the spark-plugs installation in the engine it is necessary to carry out following sequence of operations :

1. Wash by means of purified petrol /benzine/ the protecting grease from the spark plugs, preventing the petrol to penetrate into the spark-plug screen area. It is forbidden to wash the spark-plugs in the container. Blow the spark-plugs through by means of warmed air at a pressure of 4 - 5 kilograms per sq.centimeter and to dry them. Inspect the spark-plugs and ascertain if there are no damages and presence of dirt in the spark-plug interior. The spark-plugs which are delivered in stiff individual packings without protecting grease, can be installed on the engine without the previous inspections if there are not traces of damaging or humidity.

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2. Put the new packing ring at the part provided with a thread of the spark plug and grease the thread with graphite-grease of specification ST, preventing penetration of grease into the interior and electrodes of spark-plug.

3. Check the seat surface of the spark-plug on the engine cylinder-head. The thread and the butt of the spark-plug mounting place are to be clean and free of foreign particles. The installation of the already operating spark-plugs in the engine without their inspection is forbidden.

4. The spark-plugs are to be screwed into the cylinder head by hand and definitely tightened with a special spark-plug wrench. The momentum at the spark-plugs tightening shall not exceed 6 kilograms. As the spark-plugs are provided with ceramic insulation the handling with them shall be very carefull.

5. Before the screwing of the angle-piece on the spark-plug it is necessary to inspect the contact-mechanism, the spring-end shall be deflected inside and the insulating sleeve shall be undamaged. The angle-piece joint-nut shall be screwed on the spark-plug screen by hand and afterwards definitely tightened with a special wrench, the arm of which is not longer than 100 millimetres.

10. The NV - 82 pump installation on the engine and its adjusting.

Before the pump installation on the engine it is necessary to remove the protecting grease for which purpose it is necessary to carry out following sequence of operations :

- remove the grease from the external surfaces by washing the pump with purified petrol /benzine/
- take off the packing caps and blinding nuts as well as the labels from the flange ports.
- pour into the pump through the fuel-duct connecting fitting purified petrol at the limb-lever set in position of maximum supply, turn round the cam-plate by the rod untill the petrol is going of the pumps connecting fittings.
- carry out the external pump inspection, check out the smooth and the easy operation of the limb-needle from the position OFF into the position MAXIMUM SUPPLY, check the smooth operation of ball-joinings of all push-pull rods.
- the installation of NV - 82 pump on the engine is to be carried out either by the regulating disc or by the pump which shall be replaced for a new one.

The pump installation by the regulating disc and adjusting piece.

The installation of the pump is carried out in the cylinder No. 4 in the following sequence of operations :

1. Take off the fuel pump /unit 704 A - B/ from the engine.

2. Set the regulating disc on the fuel pump-drive flange and the adjusting piece into the port for the spark-plug of the cylinder No. 4 Ascertain the top dead center of the cylinder at the suction-stroke.

3. Turning round the crank-shaft by the propeller clockwise, set the plunger of the cylinder No. 4 into the position of 30 deg. ± 3 deg. after the top dead center at the moment of suction which corresponds with beginning of the fuel-jet into the cylinder.

4. Screw out the stopper /2/ /Fig. 13/ of the inspection-opening in the pump body placed against the fourth pump element. Set the plunger of the fourth pump element at the beginning of the jet. For this purpose turn the cam-plate of the pump by the rod in such a manner, that the extending groove ov the rod is placed against the mark - 1 - on the fastening flange of the pump.
During this operation the mark - 5 - on the pusher shall respond accurately with the mark - 4 - on the wall of the inspection-opening /during the motion from the pump-flange to the fuel-line connecting fitting.

5. Ascertain if all the flange-butt areas of drive and pump are clean. Install the washer on the drive-flange and make sure if the ports in the drivefor inlet and outlet of oil are not covered.

6. Install the pump on the drive, press it by means of the rod to the regulating sleeve of the drive and turning round the crank-shaft by the propeller in the direction of operation within the limits of 28 - 33 deg. after the top dead center at the moment of suction in the cylinder No. 4 and join the pump rod with the drive.
Should the pump-rod not fit with the drive-sleeve it is necessary to carry out following sequence of operations :

- turn round the crank-shaft by means of the propeller in the operational direction until the pump-rod does not enter into the grooves of the regulating sleeve of the drive.

- ascertain if the marks on the pusher and on the inspecting opening of the pump body are placed one against other.

If there is no coincidence between marks it is necessary to turn round the crank-shaft by the propeller somewhat against the previous direction and afterwards during the turning round in the operational direction reach the concidence of the marks.

- take off the pump-mark the position of regulating sleeve /of the drive/ marking it by means of pencil upon the drive body cover and upon the regulating sleeve butt.

- install the crank-shaft into the position which corresponds with the position of the jet beginning /30 deg./ after the top-dead center at the moment of sautions in the cylinder No. 4.

During this operation the regulating sleeve is turned round and the mark of its butt is moving off from the mark upon the pump-drive body cover.

- take out the regulating sleeve-lock and reset the sleeve so that the marks will coincide.
- put on its place the lock of regulating sleeve and turning round the crank-shaft by the propeller within the permitted limits for the pump-installation, join the rod with the drive.

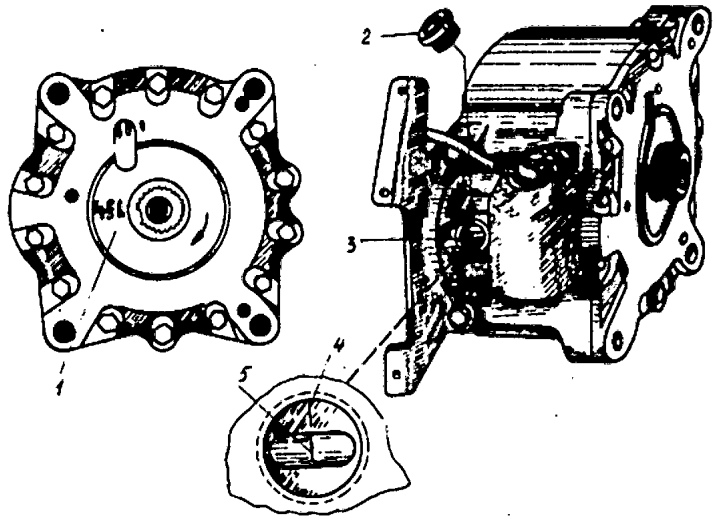

Fig. 13 The installation on the engine of the NV - 82 pump.

1- the mark on the pump body flange,
2- the plug
3- the inspection opening placed against the fourth pump-element,
4- the mark on the pusher body,
5- the mark on the pusher of the fourth pumps- element.

7. Fasten the pump by means of two diagonally displaced nuts and check the perfect installation on the engine. If the pump is well installed the moment of mark coincidence on the pusher of the fourth pump-element and on the inspection opening upon the pump body shall be within the limits of 28 - 33 deg. Finally fasten the pump, screw the stopper of inspecting opening in the pump body and fasten the fitting.

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NV - 82 pump installation on the engine after replacement of the pump in need of replacement.

If there are no doubts about the perfect installation of the pump which is to be replaced the installation of a new pump can be carried out without use the regulating disc. In this case it is necessary before taking the pump placed on the engine, to set the engine crank-shaft in the position which corresponds to the fuel-jet beginning in the cylinder No. 4., for which purpose it is necessary to carry out following sequence of operations :

1. At the pump which shall be removed screw off the stopper /2/ of the inspection opening of the 4th element.
2. Turn round the crank-shaft in the operational direction by the propeller until the mark 5 on the pusher of the 4th pump-element coincides with the mark 4 on the inspection wall. /During the pusher-movement in the direction from the pump-flange to the fuel connecting fitting/.
3. Put marks on the propeller and on the crank-case nose, indicating the position of the crank-shaft in the movement of coincidence of the marks upon the pusher and wall of the inspection-opening and take off the pump from the engine. After this operation the crank-shaft shall not be turned till the installing of the new pump on the engine.
4. Replace the cam-plate of the new installed pump into the position which corresponds with the beginning of the fuel jet in the 4th cylinder for which purpose it is necessary to carry out the following operations :
   - screw out the inspecting opening cup of the 4th pump element out of the pusher body.
   - turn round the rod in direction of the arrow /which is to be found on the pump-flange/, install the cam-plate of the pump so, that the passing-groove of the rod moves to the mark 1 on the fastening flange of the pump to the engine and that the mark on the 4th pump-element pusher coincides with the mark put on the inspection-opening wall; during this operation the pusher shall move in the direction from the pump-flange to the fuel connecting fitting.
5. Put the washer on the drive-flange and ascertain if the openings for inlet and outlet of oil are not covered by it.
6. In the prescribed position of the engine crank-shaft of the pump-cam-plate, join the pump-rod with the drive-sleeve.
7. If the cam-plate rod groove does not fit with the drive-sleeve grooves, it is necessary to take out the groove-sleeve lock and by displacement of the grooved sleeve reach the mutual fitting of the cam-plate rod grooves with the sleeve-grooves. After this, mount the lock of the grooved sleeve, mount and tighten the pump to the engine.

11. Installation of nozzles and high-pressure pipes.

During the installation of the nozzle and the high-pressure pipes it is necessary to carry out following sequence of operation :

1. The new nozzle is to be washed by purified petrol /benzine/ before installing it into the engine and blazing by means of pressed air.
2. Take off the cups from the both ends of the nozzle and ascertain if there is a washer made of heat treated soft annealed soft red copper and the threads in fastening cone are in normal condition.
3. Grease the copper-washer with aircraft-oil, set it upon the nozzle, screw the nozzle into the cylinder by hand and finally tighten the nozzle by stop wrench No. 702 156, 702 161 up to the stop of nozzle lower-cone and in the corresponding cone of the cylinder mounting. For the tightening of the nozzle shall be used the setting rods 701430, 701432, 701623 by using the translational /joint/ 701437 which shall be set between the wrench and the rod with the ratchet 700760 of a length of 250 millinetres. The prolongation to more than 250 millinetres is not allowed.
4. In case of high-pressure pipe change by a new one it is necessary to wash it before installing with purified petrol under the pressure of 1 - 2 kilograms per sq. cm. to blaze the pipes by air is forbidden.
5. The fastening of the high-pressure pipe it is necessary to carry out in the fastening clamps so that any vibration will be prevented. The pipes shall not touch one another and the metal-parts of the engine. The clearance between the pipes on the places of fastening in the clamps is permitted to be not more than 1.5 millimetres and in other places not more than 3 millimetres. The clearance between the pipe and the engine components shall be less than 5 millimetres.
6. Check the coaxiality of the high-pressure pipe with the nozzle and the transitional connecting fitting. If the divergency of axis is more than 5 millimetres the pipe shall be arranged until the coaxiality is reached.
7. To avoid the pipe-crack and damaging during the screwing and tightening of the high-pressure pipe niple-nuts it is necessary to hold by wrench the nozzles or the connecting fittings in order to prevent the turning through.
8. After the tightening of the nuts all pipe joinings and fastenings shall be locked.

12. The checking of the fuel composition.

The fuel-consumption checking shall be carried out after the replacing of the NV - 82 pump or the RS - 24 M mixture - regulator. Before the flight for measuring the fuel-consumption on the engine operating

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on ground it is necessary to check the indication of the pump-limb at rated conditions and at 0.45 of the rated conditions. The indications of the limb shall be not lower thanthe indications of the second engine upon which the NV - 82 pump and the RS - 24 M regulator have not been changed.

W a r n i n g . Before the fuel-consumption the checking device UPRN 1 has to be gauged. The gauging of the device is carried out in following sequence of operations :

a/ switch on the operational feeding from the battery.

b/ During the motion of NV - 82 pump limb lever from up down and from down up, at every 10 deg. of the limb, note the corresponding indication of the device UPRN 1. The checking shall be carried out at the whole range of limb-lever, from zero to 120 degrees. The difference of the indications of the UPRN 1 device shall not exceed 2 deg.

c/ From the indications of the UPRN device shall be taken the arithmetical average value and read from the corresponding indications of the limb-lever.
The attained value shall not differ by ± 2 deg. at all checked points.

d/ The difference of the indications /correction/ shall be taken in account at the measurement of the limb-indications when using the UPRN 1 checking device.

For the certifying the fule-consuhption per hour it is necessary to carry out following operations :

1. The measurement of the fuel-consumption per hour shall be carried out by the indications of the checking device UPRN 1 under the check conditions after 5 minutes of engine operation in the horizontal flight at the height of 400 - 600 metres above sea level. The oil-temperature at the engine inlet shall be within 55 - 65 deg.centigr. The conditions under which the measurement of the fuel-consumption per hour shall be carried out are indicated on the table 4.

CONDITIONS	NUMBER OF REV/ IN R.P.M.	SUPERCHARGE Rk IN MILLIMETRES MERCURY	FLIGHT-HEIGHT ABOVE SEA-LEVEL IN METRES
Rated	2400	1020	400 - 600
0,45 of rated . . .	1600	760	400 - 600
Long range cond. . .	1890	660	3000

2. Estimate the measured fuel-consumption at the rated conditions and 0.45 of rated conditions, using the formula

$$G_n = G_f + / \psi_n - \varphi_f / k$$

S-E-C-R-E-T

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where :

G_f - represents the fuel-consumption taken from the table of the NV - 82 pump form for the corresponding conditions.

G_n - the pump-limb angle according to the indication of the checking device UPRN - 1 during the measurement

f - the limb-angle taken from the NV - 82 pump table corresponding to the G_f.

k - the value of the dividing of the one limb-degree in kg per hour; for the rated conditions k = 6 kg per hour; for 0.45 of the rated conditions k = 4 kg per hour.

3. Calculate the measured fuel-consumption at the long range conditions at the height of 3000 m / n = 1890 r.p.m., P_k = 660 millimetres of mercury/ by using the formula :

$$G_n = 1{,}05\ G_f + (\ n - f\ )\ k_1$$

where 1.05

represents the constant coefficient of the calculating of the fuel consumption by the pump from the 0.6 of rated conditions / n = 1800 r.p.m./ to the long range condition / n = 1890 r.p.m./, P_k = 660 millimetres of mercury.

k_1 - the value of the division of the one limb degree. For the long range condition k_1 = 4.65 kg per hour.

4. Adapte the measured fuel-consumption to the standard temperature of the surrounding air, according to the following formulas :

$$G_{ad} = G_n \frac{500 + t_n}{512}$$

for the height of 3000 metres

$$G_{ad} = G_n \frac{500 + t_n}{495.5}$$

where

G_n - the measured fuel consumption

t_n - the measured surrounding air temperature at the height of 500, 512, 495.5- the constant coefficients calculated at the standard temperature for the height of 500 - 3000 metres.

5. At the correct regulation of the mixture amount the obtained results shall be ordered as follows :

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for rated conditions . . . . . 450 - 404 kg per hour

for 0,45 of rated conditions . . . . . 140 - 148

for the long range conditions . . . . . 140 - 150

Carry out the accurate adjustment of the mixture- regulator RS 24 M if the quoted fuel-consumption per hour does not suit the already mentioned limits.
For instance :
Ascertain the fuel consumption per hour if during the flight were shown the following limb-indication :
at rated condition of 74 deg, at 0.45 of rated condition 34 deg. and at the long range condition 30 deg. The surrounding air temperature at the moment of measurement in the height 400 - 600 m equals to 30 deg. and at the height of 3000 metres 10 deg.centigr.

TABLE 5.

The air pressure Pk at the inlet into the aneroid-box at the temperature equal to 15 deg.centigr. in millimetres mercury	360	715	780	780	785	870	945	1160
The pump drive revolutions in r.p.m.	100	267	300	333	367	383	400	433
The pump-lever limb indications in degrees	21	35	41	41	46	62	76	103
The fuel-consumption per hour in kg per hour /effective/	22	145	186	202	266	366	464	637

N o t e .
At the checking of the fuel-consumption it is necessary to use only the tables fourn in the pump history-sheet of the engine being checked. In the table 5 the rated condition / n_{pump} = 400 r.p.m./ corresponds the consumption per hour of 464 kilograms per hour and the limb indication of 76 deg.

The condition of 0.45 of rated /n_{pump} = 267 r.p.m./ corresponds with hour consumption of 145 kilograms per hour at the indication of the limb at 35 deg.

For the long-range conditions will be taken the given values of 0.6 of the rated conditions and n_{pump} = 300 r.p.m. which corresponds with consumption of 186 kg per hour at the limb indication of 41 deg.

According to the formula /1/ and /2/ we calculate the measured fuelconsumption for the rated condition :

$$G_m = G_f + / \quad m - \quad f / .k = 464 + /74-76/.6 =$$

= 452 kg per hour

For 0.45 of rated condition :

$$G_m = G_f + / \quad m - \quad f /.k = 145 + /34-35/.4 = 141 \text{ kg per hour}$$

For the long-range condition :

$$G_m = 1.05\ G_f + / \quad m - \quad f /.k_1 = 195 + /30-41/.4.65 =$$

= 144 kg per hour

According to the received values we calculate the quoted fuel-consumption by using formulas /3/ and /4/. For the rated condition at the height of 400 - 600 metres :

$$G_{ad} = 452 \frac{500 + 30}{512} = 452 \times 1.035 = 467 \text{ kg per hour}$$

For 0.45 of rated condition at the height of 400 - 600 metres :

$$G_{ad} = 141 \frac{500 + 30}{512} = 141 \times 1.035 = 146 \text{ kg per hour}$$

For the long range condition at the height of 3000 metres :

$$G_{ad} = 144 \frac{500 + 10}{495.5} = 144 \times 1.03 = 148 \text{ kg per hour}$$

The obtained fuel consumption per hour are within the permitted limits and the adjusting of the mixture quantity is not necessary.

The adjusting of the RS 24 M Regulator and NV - 82 Pump.

The adjustment of RS 24 M Regulator of the NV - 82 pump is carried out in case that the due consumption would not correspond to the indicated standards.

Before the adjusting it is necessary to ascertain if the unsatisfactory engine operation is caused by the failure of the fuel-mixture and not by other engine malfunctioning. The adjustment of the regulator RS 24 M is carried out by turning the aneroid-bush or the corrector screw /Fig. 14/.

During the adjustment it is necessary to carry out the following sequence of operations :

1. The turn roundof the aneroid bush or of the corrector screw clockwise causes the leaning of the fuel mixture and the turning in the opposite direction causes the riching of the mixture at all engine operation-conditions, excepting the conditions of IDLE SPEED for which the corrector screw turning causes reverse results.

2. The RS 24 M regulator adjustment is fundamentally carried out in two different kind of conditions : rated and 0.45 of rated /adjusting conditions/. The fuel-flows at other conditions do not need special adjustment.

3. The change of fuel-consumption in kg per hour at the adjustment by the aneroid-bush or the corrector screw are indicated in the following table /No.6/.

T a b l e 6.

THE CHANGE OF FUEL-CONSUMPTION IN KG PER HOUR ACCORDING TO THE ENGINE CONDITIONS

Engine operation conditions	Position of the mixture self-corrector of the RS 24 M regulator	Engine r.p.m.	Change of fuel consumption in kg per hour	
			at the aneroid bush turning by ten divisions /1/5 of a turn	at the corrector screw by three teeth /half a turn/
Idle speed	Aut.norm.mixt.	600	2.0	1.12
0.45 of rated cond.	Aut.lean mixt.	1600	7.5	0
0.6 of rated cond.	Aut.lean mixt.	1800	8.0	1.0
0.65 of rated cond.	Aut.lean mixt.	2000	8.0	1.0
0.75 of rated cond.	Aut.norm.mixt.	2200	16.5	2.5
0.9 of rated cond.	Aut.norm.mixt.	2300	19.0	6.0
rated condition	Aut.norm.mixt.	2400	17.5	8
take-off condition	Aut.norm.mixt.	2600	14	12.5

The RS 24 M regulator adjustmentis carried out as follows :

by using the table six adjust by means of the aneroid-bush the fuel-consmuption at the 0.45 of rated condition. After this measure the fuel-consumption. If it is necessary to adjust the consumption at rated conditions by meansof the corrector-screw the fuel-consumption at 0.45 of nominal conditions remains without change, as the corrector-screw at the 0.45 of rated conditions has no influence on the mixture composition /see table 6/.

13. The adjustment of R.P.M. at idling speeds.

The adjustment of the revolution-number at idle running is carried out by the idle speed stop - screw placed on the throttle-housing. At the screwing out of the screw the revolution-number decrease, at screwing in it increases. After r.p.m. adjustment it is necessary to carry out the reliable locking of the screw by means of a lock-nut. The revolution-number at idle-running depends also upon the mixture composition at idling speed and can be changed by enriching or leaning of the mixture-composition.
For getting a rich mixture the stop-screw of the serve-drive of the RS 24 M mixture regulator shall be turned clockwise and for getting a lean mixture anticlockwise.

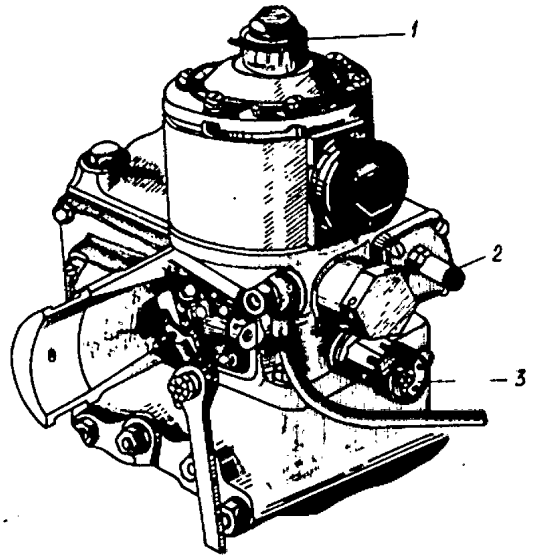

Fig. 14. The adjusting places of the RS - 24 M regulator adjusting.
1- the pressure box, 2- the stop screw of the serve-drive,
3- the corrector screw.

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Chapter VIII.

Engine malfunctioning, their causes and there remedy.

Most engine malfunctioning and failures are cause by violation /breach/ engine-operating-prescriptions and of the engine-maintenance. For an accurate and prompt discovering of the malfunctioning and its removal /remedying/ it is necessary to know the causes of its origin and to take in due time measures for removing the causes of malfunctioning /table 7/.

The fundamental malfunctionings of the engine-operation, their causes and forms of their repair.

Item No.	THE CAUSE OF MALFUNCTIONING	THE FORM OF REMEDYING
1.	The engine has not started or after the starting during the first revolutio stops.	
	1. The insufficient rotation motion of the electrostarter flywheel /a short of switching on or a low voltage in the electrical circuit/.	Check the circuit.voltage /shall not be less than 24 volts/ and prolong the period of switching on of the electrostarter in dependence to the circuit voltage.
	2. Insufficient fuel-supply malfunctioning supply solenoid-valve.	Increase the supply of the engine.
	3. The engine overcharged.	Charge the supply valve. Turn the propellor by 3 - 4 rounds direction.
	4. The fuel-filters contamination at the throttle fully opened.	Clean the fuel-filters.
	5. The spark-plugs excessively oiled or dirty.	Take-off the sprak-plugs and check their state, wash them and dry.
	6. The greasing of the contacts of the magnetointerruptor or absence of clearance between the contacts.	Clean the contact from grease of the magneto-interruptor and the clearance.
	7. Uncorrect connecting or confusing of the conductors connecting ot the magneto from the startingc oil	Check the regularity of the connecting and the state of the ignition-conductor contacts.

ITEM No.	THE CAUSE OF MALFUNCTIONING	THE FORM OF REMEDYING
2.	The engine operates inconstantly at idling speed.	
	1. Insufficient revolutions at idling speed.	Adjust by the stop screw the opening of the gas-trottle, securing 500 - 600 r.p.m.
	2. Fault adjusting of gas-mixture composition idling speed.	Adjust the composition at idling speeds, as indicated in the chapter VII.
	3. The air-adverse suction in the engine suction-system.	Check all the sealings of the suction-system, their tightening, the state of the washen etc. Repair all discovered malfunctionings.
3.	The engine vibration.	
	1. The spoiled propeller balancing the madmissible blade-pulsation or inaccurate blade-pulsation or inaccurate blade-setting.	Check the blade-setting according to the setting angles and the fastening of the blades to the hub. Check the pulsation of the blades.
	2. The self loosening of the magneto rotating piece fastening.	Tighten the fastoning screws of magneto rotating part.
	3. The self of the fastening-screw of the magneto-interrupter.	Tighten the fastening screw of magneto-interruptor.
	4. Shortening of the brush or wearing out of the brush.	Change the brush.
	5. Greasing of the magneto-interrupter contacts or the gap in the interrupter spoiled.	Clean the interrupter-contacts, adjust the gap.
	6. The pearcing of the ignition conductor insulation, the burning of conductors, wrong contacts in the circuit etc.	Check the ignition-circuit. Change the wrong conductors.

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7. Unsatisfactory spark-plug operation.	Wash, dry and check the spark-plugs for spark forming.
8. Malfunctioning of individual nozzles.	Change the wrong nozzles.
9. The spring failure or the failure of the NV - 82 pump plungers.	Change the NV - 82 pump.
10. The spoiling of the clearance between the lever-roller and the valve-rod at one oil more cylinders.	Adjust the clearance.

4. The engine smoke exhausting.

1. The mixture is rich.	Check the fuel-consumption pump-limb and adjust the NV - 82 pump.
2. One or more cylinders do not operate.	Find out the causes of malfunctioning and repair them.
3. The duct PK-hose leading to by dirt into the pressure on tool box of the regulator RS - 24 M, the lock of hermetical tighteness at the fittings of this house. This causes the smoke exhausting at a super-charge less than 600 - 650 mm mercury.	Inspect the hose of the duct PK into the pressure control-box; blaze and inspect the connecting-fittings of the joints.
4. The installation or damaging of the pressure box, wearing out or damaging of the RS - 24 M ragulator components.	Replace the complete set of pressure boxes, replace the RS - 23 M regulator.

5. Low oil-pressure.

1. Presence of foreign particles under the reducing-valve.	Dismantle, wash out, assemble and install a new reducing valve.

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2. Malfunctioning of the pressur gauge or of the its ducts.	Replace the pressure gauge or its ducts.
3. Oil-overheating oil-dilution.	Change the oil.
4. Excessive of oil by petrol /kerosine/.	Change the oil and ascertain if there is not the fuel-leakage through the diluting cock.
5. Unsufficient level of the oil in the oil.	Fill the oil tank as prescribed.
6. Unsufficient adjustment of the oil pump reducing-valve.	Adjust the reducing-valve.

6. Risel oil-temeprnture.

1. The thermometre malfunctioning.	Replace the thermometre.
2. The oil-cooler malfunctioning.	Replace the oil-cooler.
3. The engine inner parts malfunctioning.	Inspect the engine-filters, in case of chips pressure in the filters check its nature and if necessary carry out the engine dismanteling.
4. Unsufficient oil-quality in the oil-system.	Ascertain the oil quality a refile the oil-tank.

7. The cylinder head overheating.

1. Uncorrect mixture composition.	Check the fuel-consumption and if necessary adjust the B7 - 82 norm.
2. The low fuel-octan-number.	Refill the aircraft fuel tank with prescribed fuel.
3. The malfunctioning of the thermo-couple of the galvanometer or their ducts.	Check, gauge or replace the device.
Hindered flow of air along the cylinder /spark-plug/ upon which is installed the termo-couple.	The remedinte of causes of insufficient air-flow.

4. Uncorrect setting of clearances in the cylinder-valves.	Adjust the clearance of the cy- 50X1 linder-valves.
5. Uncorrect spark advance ignition of the magneto.	Reset the spark advance ignition.
6. The leakage of exhaust-gases into the thermocouple.	Remove the causes of the leakage.

8. The rich mixture supplied to the engine during the climbing.

1. The uncorrect air circulation in the pressure box of the RS - 24 H regulator of the NV - 82 pump, caused by choking or dirt infecting the nozzle or the hose of the air duct from the RS - 24 H regulator.	Check the air-circulation. Repair the malfunctioning parts.

9. The lean mixture supplied to engine during a climbing.

1. The soiling of the ports connecting the altitude pressure doses /aneroid/ of the RS - 24 H regulator with the external /atmosphere/. The failure of altitude pressure doses of the RS - 24 H regulator.	Clean the altitude pressure doses /aneroid/ port. Change the pressure doses /aneroid/ set and check the fuel-flow.

10. Unsatisfactory operation of the individual cylinders.

1. The failure of the high-pressure pipe.	Replace the high-pressure pipe.
2. The soiling or the malfunctioning of the nozzle.	Inspect it and in case of necessity replace the nozzle.
3. Fuel-leakage from high-pressure pipe connections.	Tighten the fittings or replace the pipe.
4. The jamming of the NV - 82 pump individual /the engine-control-lever is moved with difficultly.	Take the NV - 82 pump of the engine and repair by replacing the pumping element.
5. The failure of the plunger-return-spring the NV - 82 pump.	Take of the NV - 82 pump and repair it by replacing the spring.

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6. The jamming of the super-charging-valve of the pump.	Disconnect the high-pressure pipe, the connecting, fitting. Take-off valve, inspect and wash them out. In case of jamming replace the valve.
7. Uncorrect fastening in the cylinder-valve-setting.	Gauge the compression in the cylinder. Take out the cylinder which shows the low compression and replace the wrong /details/.

11. The oil-leakage from the dearating vents.

1. The oil tank is overfilled.	Check the oil tank filling. Drain the oil surplus.
2. The oil overheating.	Change the oil.
3. The gas-penetration into the engine crank-case.	Check the compressior in the cylinder take of the cylinder of a low compression and replace the wrong components.
4. The oil-over diluting by petrol /benzine/.	Check the hermeticity of the diluting-system, change the oil.

The compression si to be checked at the warme engine /the temperature of the cylinder-heads of 10 - 40 deg. centigrade/ by sharp turning round the propeller during the measurement. The checking is to be carried out by using a pressure-gauge, put on the cylinder in place of a spark-plug. The compression shall not be loss than 3 kg per sq.centimetre. An insignificant air-leakage through the valve-outlet of the chocked cylinder is permissible.

Chapter IX.

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Protecting against corrosion of the engine installed on airplane.

1. The general information.

The corrosion of the engine components is one of the reason which causes the malfunctioning of the engine during the operation. In dependence to the degree of the corrosion effect, the corrosion leads to the premature worn out and results in the increase of clearances between the engaged operating components and the accumulation of dirt-particles in the oil-line, what can cause malfunctioning of the engine during its operation.

The engine protection against corrosion is one of the main measures protecting the engine components against corrosion and securing their [illegible] operation. Therefore it is necessary to give in due time [illegible]ulary a lubricating run to the engine which is out of the [illegible]tion by the aid of recommended anti-corrosive lubricating ma[illegible]ls.

2. For inhabiliti[illegible]f the engines out of the operation, following anti-corrosive [illegible]ubricating materials are to be recommended :

a/ for protec[illegible]ng of internal engine surfaces - lubricating material [illegible]. 58 M.

b/ for protec[illegible]ing of external engine surfaces lubricating-materials No. 59.

If the lubricating material No. 59 is not available it can be replaced by gun-grease or technical grease.

3. The engine details which are coated with varnishes and zinc-plated, do not need any protection against corrosion.

4. The propeller shaft /after removal of the propeller/ is to be greased by technical grease or gun-grease UPZ - 3005 - 51, with maximum possible viscosity.

5. The engine installed on the aircraft can be kept either in hangars, or in the aerodrome. In both cases the engine has to be subjected to anti-corrosion maintenance depending on the period during which the aircraft has been out of operation.

6. The maximum period for which the aircraft can be out of operation without protection equals seven days and under the condition that the surrounding temperature is not higher than 5 degrees centrigrade below zero; and fifteen days under the condition that the surrounding temeprature being less, than five degrees centigrade below zero.

7. In the case of the engine's operational interruption of more than indicated in the above mentioned period /not later than seven or fifteen days/ it is necessary to perform the engine anti-corrosion protection at the required period as indicated beneath. It is permitted as well as to perform the required engine run for lubrication at the running condition of 1000 - 1200 r.p.m. during the period which is necessary to obtain the oil-temperature 40 up to 50 deg. centigrade at the engine inlet port, but not less than 15 - 20 mites.

8. It is forbidden to protect the engine against corrosion by the aid of diluted oil.

2. Protecting against corrosion of the engine for a period one month and its degreasing after the storing.

1. Drain the condensed water from the lower part of the engine oil system /through the oil pump and oil-tank draining cocks/.
2. Drain the fuel out of the fuel-tank and replace it by the fuel not containing the product R - 9.
   Note.
   It is unnecessary to drain the fuel under the condition that the engine will be run with purified /clean/ petrol /benzine/ from a separate tank.
3. To run the engine under the condition of 1000 - 1200 r.p.m. in the period necessary for attaining the oil teneprature from 40 to 50 degrees centigrade on the engine inlet but not less than 15 - 20 min.
4. On the warmed engine /at the cylinder-head temperature of 10 up to 40 degrees centigrade/ remove the spark-plug with the throttle fully forward and give the propeller three to four rounds in order to remove the exhaust-gases out of the combustion area of the cylinders.
5. Inject in each of the cylinders, through the spark-plug ports, 100 - 150 gram new oil /MK - 22, MS - 20/ warmed up to 40 - 50 degrees centigrade and give 2 - 3 rounds in order to give the proportional distribution to the cylinder-walls. The oil-injection into the cylinders perform by means of ball-onded sprayer at the piston lower dead center.
6. Inject one more the oil in every cylinder by the rate of 100 - 120 gram without turning the propeller-shaft round.
7. Reset the spark-plug.
8. Protect with lubricating material No. 59 all the outside components of engine andof the units /having been previously wiped with the rag/ which are not protected with warnish-wating and zine-plating.

9. In the storing period at the temperature of surrounding air of more than 5. deg.centigrade it is necessary to give the propeller shaft about 4 rounds every ten days. The crank-shaft turning round is to be done under the condition of switched-off NV - 82 pump. It is necessary to turn round the engine propeller shaft under the condition of surrounding temperature being less than 5 deg. centigrade.

10. It is no allowed to increase this period of protection against corrosion over 30 days. If it is necessary to increase this period the engine must be degreased and newly protected for the required period. Before the second protection it is necessary to run the engine, on all conditions during a 30 minutes period and to carry out the protection of the engine.

11. The engine which were protected against corrosion fro the period of 1 month are not subjected to degreasing prior to restarting. For this purpose drain the oil from lower cylinders and wash the engine with petrol /benzine/. The preparation of the engine for the starting and the starting perform in accordance to the prescriptions given in the chapter II.

3. The engine protecting for a period of two months and degreasing after the finished. Keeping out of operation.

1. Drain the condensed water /humidity/ from the lower points of engine oil system /through the cocks of oil-pump and oil tank/.

2. Drain the petrol /benzine / from the fuel-tank and replace it by the petrol non containing the product R - 9.
Note.
It is not necessary to drain the petrol /benzine/ but under the condition that the engine will be run with pur /clean without R - 9 product/ petrol /benzine/ from a separate tank.

3. Run the engine under the condition of 1000 - 1200 r.p.m. in the period of time necessary for attaining the oil temperature from 40 - 50 degrees centrigrade on the engine inlet, but not less than 15 - 20 min.

4. Drain the oil from the engine and from the oil tank; drain the fuel from the tanks, For the complete oil and fuel drain, the drain-cocks must remain opened.

5. On the warmed engine /at the cylinder-head temperature of 10 up to 40 degrees centigrade/ remove the front spark-plug with the throttle fully forward and give the propeller four rounds in order to remove the exhaust gases out of the combustion area of the cylinders.
Note.
For removal of fuel out of the spaces of the NV - 82 pump give the crank-shaft some rounds, the main-fuel cock being shut, or after draining of the fuel, the lever of the NV - 82 pump set into the position of maximum delivery.

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6. Preserve the pump NV - 82 by misture composed of 60 per cent purified petrol /benzine/ B - 70 and 50 per cent aircraft oil in the following order :

- disconnect the elastic hose of fuel-duct leading to the centrifugal air-separator;
- join to the fuel-duct-connecting-fitting the hose of the small tank of 4 - 5 litres cubic capacity /if there is no small tank it is possible to use instead of it a funnel/.
- set the pump lever in the position of maximun output.
- set the small tank above the pump at the heigh of 0.5 - 1 meter and pour in the pump 3.5 - 5 litres of oil-petrol mixture;
- give the airscrew 10 - 15 rounds up to the mixture full flow from the tank into the pump NV - 82.
- dismantle the hose from the fuel-duct-connecting-fitting and put on its place an elastic fuel-duct-hose leading to the centrifugal air-separator. Set and fasten the control-lever of NV - 82 pump into the position OFF.

7. Inject in each cylinder through the spark-plug-ports an amount of 100 - 150 grams of lubricating material No. 58 M previously warmed to the temperature of 15 - 30 degrees centigr., this being done, give the propeller-shaft 2 - 3 rounds. The injection of lubricating material into the cylinders is to be carried out by means of the ball-lended sprayer at the lower piston dead center.

8. Inject a second time in each cylinder a quantity of 100 - 150 gr. of lubricating material No. 58 M without giving the airscrew-shaft any round.

9. Lock the spark-plug-ports by means of special blinding plugs or put the spark-plugs on their places.

10. Lock the air intake, the exhaust stub /exhaust gas collector/, decoration vents and other remaining openings.

11. Protect with lubricating material No. 59 the external engine surfaces and components which are not coated by varnishes or zinc-plated; before doing this wipe the engine with a rag.

12. It is forbidden to prolong the period of protection beyond the two months time term. After passing of this term the engine can be protected a second time for a term of one to two months, but before the second protecting the old grease must be removed of the engine.

13. The removal of the protecting grease is to be carried out in following order :
- wash the external parts of the engine with petrol and blast the engine with the preheated air.

- put out the spark plugs and giving the propeller-shaft round drain the lubricating material from the lower cylinders. Preparing of the engine to the start and the starting is carried out as indicated in the chapter II.

14. In the case of necessity of a repeated engine protection for a term of one to two months it is necessary to run the engine at all operational conditions during 30 min.; this being done one can carry out the protecting against corrosion.

15. It is permitted to repeat the two-months protecting only one. - This term of second protection passed it is necessary to carry out before the next protecting an inspection of the internal engine parts; from every row of cylinders one cylinder shall be dismanteled to find out wheather there is no corrosion on the cylinder internal surfaces. All these operations shall be noticed in the engine history sheet.

4. The engineprotection for a period up to six months and the removal of the protecting grease after its storing.

Note.
The engine dismantled from the aircraft and protected against corrosion by using dehydratory /drying/ element container and the bags with silicagel, placed in hermetically closed cover of polyvinyl chloride blanket, can be stored during a period of one year.

1. Drain the oil out of the whole engine oilsystem immidiately after the engine stopping drain the fuel out of the fuel tanks.
Note.
It is not necessary to drain the fuel under the condition that the engine will be run with pure /clean/ petrol /benzine/ from a separate fuel tank.

2. Fill the oil tank with the new oil MK - 22 or MS - 20. Fill the fuel tank with pur /clean/ petrol /benzine/ without the product R - 9.

3. Let the engine run at the operation at conditions of 1000 - 1200 r.p.m. during the period necessary for attaining the oil temperature of 40 - 50 deg. centigr. on the entire inlet, but not less than 15 - 20 minutes.

4. Drain the oil out of the engine oil system and the petrol /benzine/ out of the fuel main-line. The drain-cocks shall be kept fully open to attain a complete oil and petrol /benzine/ drain.

5. On the warm engine /at the cylinder-head-temperature of 10 - 40 deg.centigr/ take off the front spark-plugs and at the fully opened throttle give the crank-shaft 4 full rounds by means of propeller r. remove the combustion products out of the cylinder.

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Note.
For removal fuel out of the spaces of the NV - 82 pump give the crank-shaft some rounds after draining the petrol /benzine/, the lever of the NV - 82 pump being set into the position of maximum delivery.

6. Protect the pump NV - 82 with a mixture composed of 60 per cent of pur benzine B 70 and 40 per cent aircraft oil in the following order :

   - dismantle the elastic hose of the fuel duct leading to the centrifugal air-separator.
   - join to the fuel-duct connecting-fitting the hose of the small tank of 4 - 5 litres cubic capacity /if there is not small tank, it is possible to use instead of it a funnel/.
   - set the switch-on lever into the position of maximum supply.
   - set the small tank above the pump at the height of 0,5 - 1 m and pour into the pump 3,5 - 4 litres of oil - petrol mixture.
   - give the airscrew to 10 - 15 rounds so that the mixture flows fully from the tank into the pump NV - 82.
   - dismantle the hose from the fuel-duct connecting-fitting and put on its place an elastic fuel duct-hose, leading to the centrifugal air-separator. Set and fasten the control-lever of NV - 82 pump into the OFF position.

7. Inject in each cylinder through spark-plug-ports an amount of 100 - 150 gram lubricating material No. 58 M previously warmed to the temperature 15 - 30 deg. centigrade. The injection of the lubricating material into the cylinders is to be carried out by means of the ball-ended sprayer at the lower piston dead center.

8. Fill entirely the internal engine-space with lubricating material No. 58 M warmed up to 15 - 30 degrees centigr. Pour the lubricating material through the crank-case nose in the deaerating vents.

   Note.
   The crank-case internal space being filled with the lubricating material No. 58 M during the protection of the engine dismantele1 from the aircraft for a period of one year, it is necessary to turn over the engine with the propeller-shaft up for a better filling of all the spaces by lubricating material.

9. Give the crank-shaft by means of the propeller 8 - 10 rounds and drain after this operation all the lubricating material out of the engine.

   Note.
   The lubricating no.58 M used for filling of the negine, can be used 10 times under the conditions that all the measures of precaution the possibility of infecting the lubricating material with foreign substances will be observed.

10. Fill the pumping assembly of the fuel-pump entirely. In the supplying connecting fitting with 100 - 150 gr. clean aircraft-oil warmed up to 50 - 70 deg.centr.,with giving the crank-shaft 3-4 rounds by means of the propeller.

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11. At the same time with the oil-pump protecting will be carried out the pressure-wasning of internal parts of the engine oil system with oil warmed to the temperature 60 - 80 deg.centigr., under the pressure of 5 - 6 atmospheres, contemporaly with the oil-drain, by giving the engine crank-shaft some rounds by using the propeller.

The oil pressure-washing of the engine oil system is carried out by means of ground pumping unite through a filter of Kuno-type installed in the compressor rear body space instead of oil-mesh-filter MSF - 19.

Note.
It is forbidden to use the oil drained out of the engine for the repeated pressure wash or and to the regeneration, because it contains protecting lubricating material.

12. Inject the second time an amount of 100 - 150 gr. of lubricating material No. 58 M in each cylinder through the spark-plug-ports without giving any round to the crankshaft.

13. Shut the spark-plug ports with a special blinding plugs or install the spark-plugs back on their places.

14. Cover with polyvinylchloride blanket the air-intake exhaust-gas stub-pipes /exhaust gas collector/ cleaerating vents and their openings.

15. Carry out the protecting of the external parts of the engine and of the accesory units, which are not protected by warnish-coating and zinc-plating, with the lubricating material No. 59 condensed, thickened with 1 - 2 per cent of ceresine or technical grease warmed up to 60 - 80 degr.centigr. or with aircraft - oil thickened by 4 - 10 per cent ceresine.

16. Dismantle the propeller, wash out with petrol /benzine/ the grooves, the winding of the propeller and the propeller-hub. Crease with gun-grease or technical grease and install the propeller.

17. All the protecting operation of engine and its accesory units shall be carried out one after another without any interruption. It is not allowed to carry out the protection of the engine and its accesory units during the rain.

18. To repeate or to increase the period of storing of the engine - for term more than six months is forbidden. After expiring of this term. the protecting grease shall be removed off the engine.

19. Removal of the protecting grease off the engine is carried out in the following order :

- for easy removal of the protecting lubricating material from the internal and external engine parts carry out the warming of the engine to 40 - 60 degr.centigr. Carry out the warming of the engine, covered by protecting cover by means of warming device, provided with compressing ventilators.

During the removal of grease from the engine protect the generator and the electro-starter by means of greased-paper or a special cover, to avoid the penetration of grease in the internal parts of generator or electro-starter.

- wash the external parts of the engine with petrol /benzine/ and blast the engine by warmed air.
- put out the spark-plugs and drain the lubricating material out of the lower cylinder by giving the propeller 10 - 15 rounds.
- carry out the pressure-washing of internal engine oil main-line with warmed oil /60 - 80 deg.centigr./ under the pressure of 5 - 6 atmosph. with the simultanous oil draining and giving the crank-shaft some round by the propeller.
- take off the propeller, wash out with petrol /benzine/ the grooves, the thread of the propeller - shaft and the propeller-hub. Grease the grooves, the thread of the propeller-shaft nose, the cones of propeller-hub by a slight layer of aircraft-oil and install the propeller.
- fill the oil-system with warmed oil, start the engine and let it operate under the operational conditions of 1000 - 1200 r.p.m. during the period of 10 - 12 minutes. After the heat degreasing drain the oil of the whole main-line.

Chapter X.

The board-tools for engine-servicing.

For the engine servicing following tools and equipment which are placed into the tool-bag /701955/ are used /Fig. 15/.

Marking on the figure	Tool main mark number	Tool designation	Numeration of details, where the tools are to be used
1	1	double ended closed /wrench/ 9 x 11	For fastening of the nuts of the covers of the air receiver, adapted of the clamp, of high-pressure lines of front oil-pump lines and the drain lines, the oil filters and of the deflector tightening bolts.
2	3	double ended spanner closed /wrench/ 14 x 15	For fastening nuts of the body of the NV - 82 pump drive the flange of supporting ball bearing, of the generator and electro-starter.
3	4	double ended closed spanner /wrench/ 18 x 19	
4	5	small hammer	
5	10	tap wrench	To be used with the wrenches No. 823061 and 701379.
6	15	wrench 19	For the nut of the spark-plug elbow piece.
7	17	wrench 16	For the nut of the pump drive to the rear cowling fastening.
8	19	wrench	For the inlet-pipe sealing nut.

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	24	tap-wrench	Is to used with the wrenches 700542, 700641, 700828, 823001, 701293.
10	25	double ended closed wrench 20 x 22	For the bolt of the inlet and outlet valve-lever, for the bolt of the additional filter to the NV - 82 pump for checking the filter of the oil-bowl.
11	28	wrench for NV - nuts	For the nuts of high-pressure pipe fastening.
12	29	wrench of accessory-drive	For the nut of electro-starter fastening.
13	30	wrench 13 x 13	For the fastening nuts of the magneto, of the oil-pump, of the vent valve-lever housing, for the rear body and rear cover of the oil-pump, for the drive of the tachometer, of the fuel-pump, of the drain pipe flanges.
14	32	double ended open wrench 7 x 9	For the nuts fastening the clamp, for the plugs of the oil-channels.
15	33	two sided open wrench 11 x 13	For plugs of the oil-pump, the rear compressor body and the adaptor of the compressor rear body, for the screw fastening the oil-pump to the rear body, for the nuts fastening the pump /NSh - 13/ drive for pipe connecting fittings of out-and inlet, for the vacuum valve drive, for the deflector.
16	34	double ended open wrench 14 x 16	For the connecting fitting of the pressure measurement, for the joint clamp connecting fitting of joining the high pressure tube, for plug the oil-pump, for the bolts fastening the front and rear oil filter to the filter body. For the nut fastening the frames to the compressor front body.

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17	36	double ended opened wrench 19 x 22	For nuts of oil-duct connecting fitting to the rear gas distribution, for the outlet and inlet valve, lever bolt, for the sleeve of the outlet Pk, for the turning nipel of the rear, cowling, for the oil-pump filter plug, for the oil connecting-fitting cap, for the sleeve and the nuts of the screened hoses of the ignition collector ducts.
18	37	double ended wrench 24 x 27 /2 pieces/	For the nuts and sleeve of the inlet and outlet Pk, for the front oil-pump and oil-pump drain-cock sleeve nut, for the oil-pump non-return valve plug.
19	38	double ended wrench 15 x 17	For fastening of drive cover nuts of generator and starting of the NV - 82 pump duct to the rear cover, for the NV - 82 drive cover to the drive-body for the NV - 82 pump, for the bearing flange, for the cowling : for the high pressure pipe joint-nut, for the Pk outlet tube sleeve.
20	56	flat pliers	For split pin splitting, for locking of screw and nuts.
21	114	wrench 15	For the nus fastening the generator and the revolution regulator.
22	121	wrench 13	For the nuts guiding the pusher.
23	69	closed wrench 7 x 7	For the inlet and outlet valve-lever stop-screw.
24	70	double ended opened wrench 30 x 32	For the NV - 82 pump main-filter nut, for the Pk inlet connecting fitting, for the inlet connecting fitting and for the rear oil-pump return.

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25	88	small screw driver /compl./	
26	89	big-screw driver /compl./	
27	90	wrench-lever /compl./	Used together with ratched wrench and with removable wrench heads and wrench-knuckle.
28	91	wrench-lever	dtto
29	92	wrench-lever with knuckle	dtto
30	97	screw driver	Used together with ratched wrench.
31	-	tools /compl./	dtto

The tool box contains :

78	701413	Head of socket wrench 15
79	701414	dtto - 18
80	701415	dtto - 13
81	701416	dtto - 19
82	701417	dtto - 16
83	701418	dtto - 7
84	701419	dtto - 11
85	701420	dtto - 9
86	701421	dtto - 9
87	701422	dtto - 14
93	701457	Wrench articulation /compl./
94	701452	Wrench - compl.
95	701453	Head of socket wrench 7
107	701623	Wrench stem /compl./
	467005	Hook

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32	112	701658	Open wrench, double ended 36 x 41	For the union nut or Pk feed, for the nuts and the lid of the pressure reducing valve of the front oil-pump, for the plugs of the non return valve of the rear oil pump.
33	115	701663	Drift	For assembly works
34	109	701664	Wrench /special/	For nuts of the NSh 13 pump
35	123	701754	Gauge /compl./	For measuring of plays between the valve stem and the rocker roller.
36	144	701868	Articulated wrench for tightening of sparking plugs /calibrated/	
37	145	701870	Fixed spanner for tightening home the plugs /compl./	
38	156	701936	Wrench for fixing screws of cylinders	
39		16353	Wrench for the union nut	
40		16354	Wrench for plugs of the inspection hole of the NV - 82 pump	
41		82365	Wrench for the latch of the cam disc of the NV - 82 pump	
42		R-40-903	Wrench for special nut of the r.p.m. governor	
43			Spanner 17	For FB - 10 K nozzle
44			Wrench open, double ended 9 x 11	
45			Wrench	
46			Wrench	
47			Grease gun with OKB - 122 - 715 lubricant.	

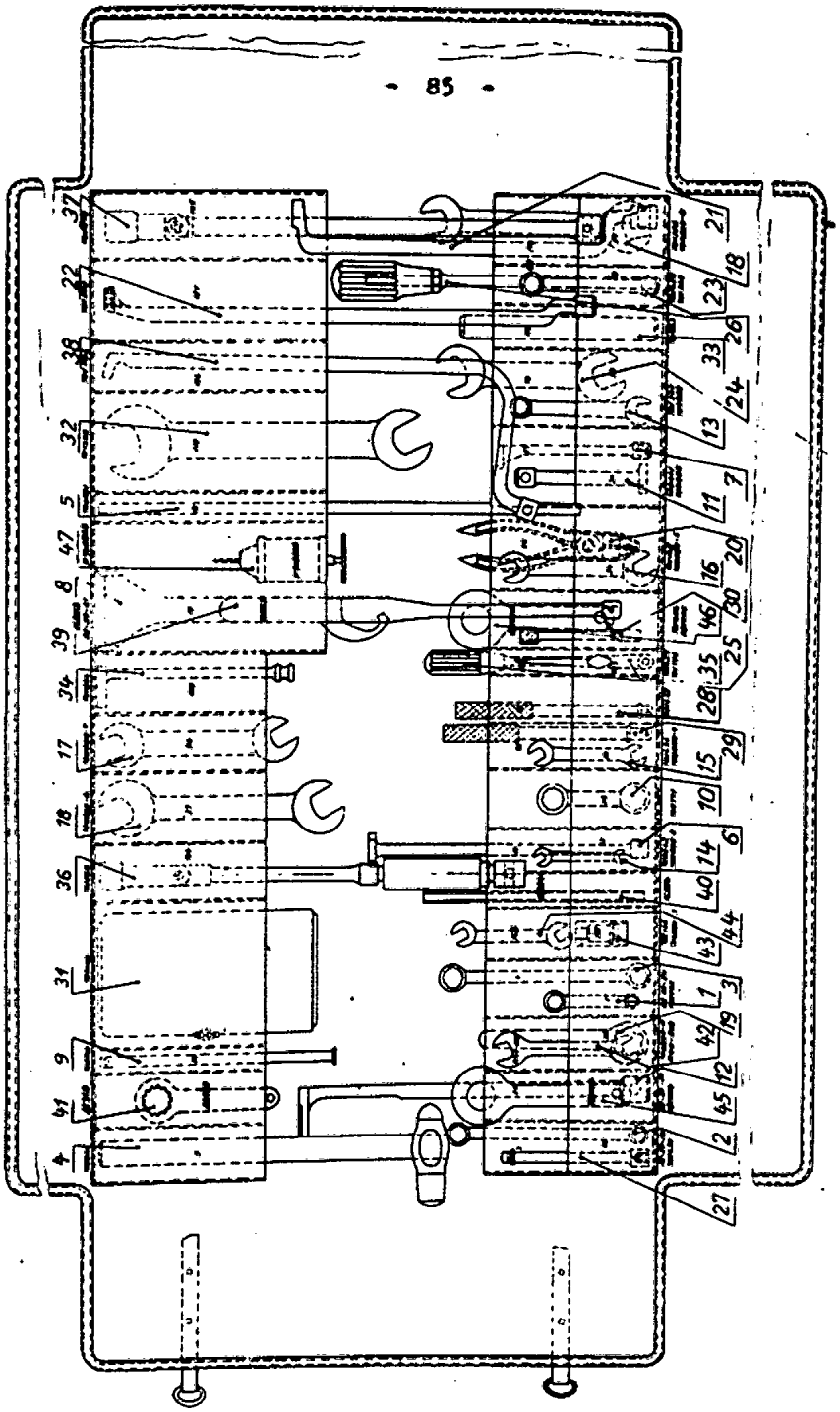

Fig. 15 The board tool-bag.

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C O N T E N T S

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SERVICE BULLETIN
Ash-82T aircraft engines

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USING THE COMBINED ACTION ELECTRIC STARTER FOR ROTATING THE Ash-82T ENGINE CRANKSHAFT

Using the SKD-2 combined action electric starter for rotating the crankshaft prior to Ash-82T engine starting.

It is possible to make use of the SKD-2 combined action electric starter for pulling the crankshaft through by means of direct cranking immediately before engine starting, instead of manual propellor swinging, as specified in the operational instructions. Accelerating of the starter fly wheel is not required.

Before pulling the crankshaft through by means of a SKD-2 combined action electric starter be sure that ignition is "OFF" and that the NV-82 injection pump manual control lever is set to "STOP" position. After this, and without turning the starter fly wheel, engage starter and keep it engaged for about 5 to 7 seconds, during which the crankshaft must turn approximately through 5 revolutions.

In case that it is not possible to pull the engine crankshaft through by means of the combined action electric starter /supplied with a power of normal voltage of 24 Volts/ disengage starter, unscrew one sparking plug from each of No. 5, 7, 8 and 9 cylinders and pull the crankshaft manually by the propeller blades through 3 to 4 complete revolutions, so as to remove oil and petrol from the cylinder heads. The attempt to pull the crankshaft through by means of the SKD-2 combined action electric starter, as well as engine starting should not last longer than 15 minutes. Otherwise repeat pulling the crankshaft through.

CAUTION: It is not permitted to pull the engine crankshaft through, making use of the inertia of the accelerated starter fly wheel, because at the first attempt to start the engine any quantity of oil and petrol compound in the combustion chambers of the cylinder heads might cause hydraulic shocks and thus put the connecting rods out of true or result in some other serious damage to the engine.

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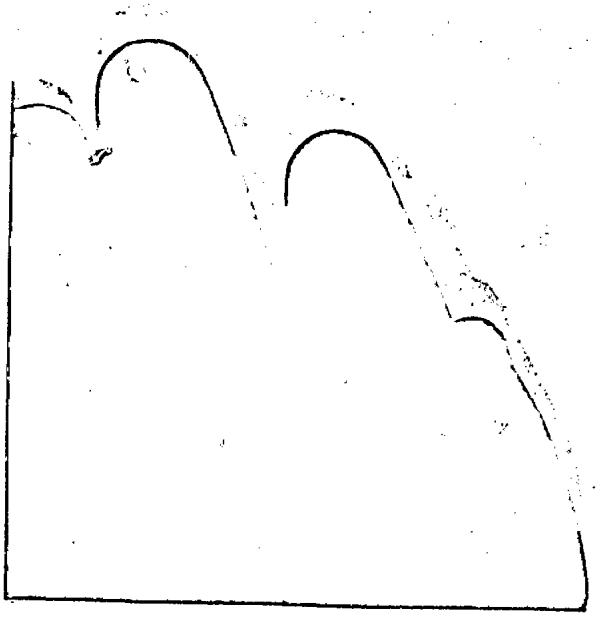
MASTER ROD BUSHING FRONT RETAINING RING SPRING CHANGE

During the overhauls and further repairs of the ASh-82T engines it is necessary to change the springs, Dwg No. 105529, of the master rod bushing front retaining ring.

The springs Dwg No. 105529 should be changed irrespective of their outer appearance.

The springs are supplied by the manufacturer in group sets. The springs to be used for further repairs of these engines, are supplied by the manufacturer when ordered by the maintenance shops only.



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COOLING OF ENGINES BEFORE STOPPING IN HIGH AMBIENT AIR TEMPERATURE

Due to high ambient air temperatures, which are encountered during the warmer periods of the year while on ground, it is difficult to cool the operative engine to cylinder head temperature corresponding to 175 - 190 degrees Centigrade prior to stopping the engines.

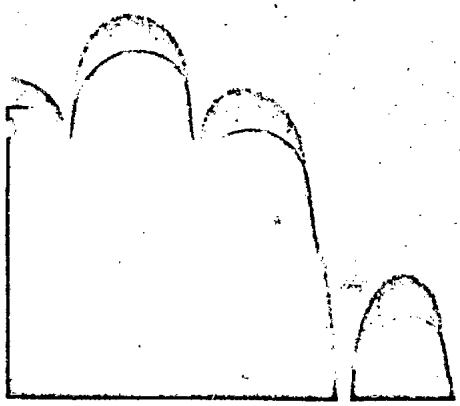
To improve cooling during engine stopping it is recommended partially to enrich the mixture manually by means of the RS-24M mixture control.

The following procedure should be adopted in cooling the operative engine before its stopping:

Set the propeller speed governor control lever to "LOW PITCH" position. Open fully the engine cowl flaps and oil cooler shutters. Adjust the engine revolutions from 800 to 1000 rpm. Move the RS-24M mixture control control lever from "AUTO-NORMAL" to "AUTO-RICH" position.

Keep shifting the lever, until the engine revolutions drop by about 100 to 150 rpm maximum /as compared with initially adjusted revolutions/.

After this, maintain the engine operating in lower speed range and on "AUTO-RICH", until the cylinder head temperature drops to 175 degrees Centigrade approximately. On attaining this temperature value stop the engine observing the procedure prescribed in the relevant operation instructions.



SERVICE BULLETIN
Ash-82T aircraft engines

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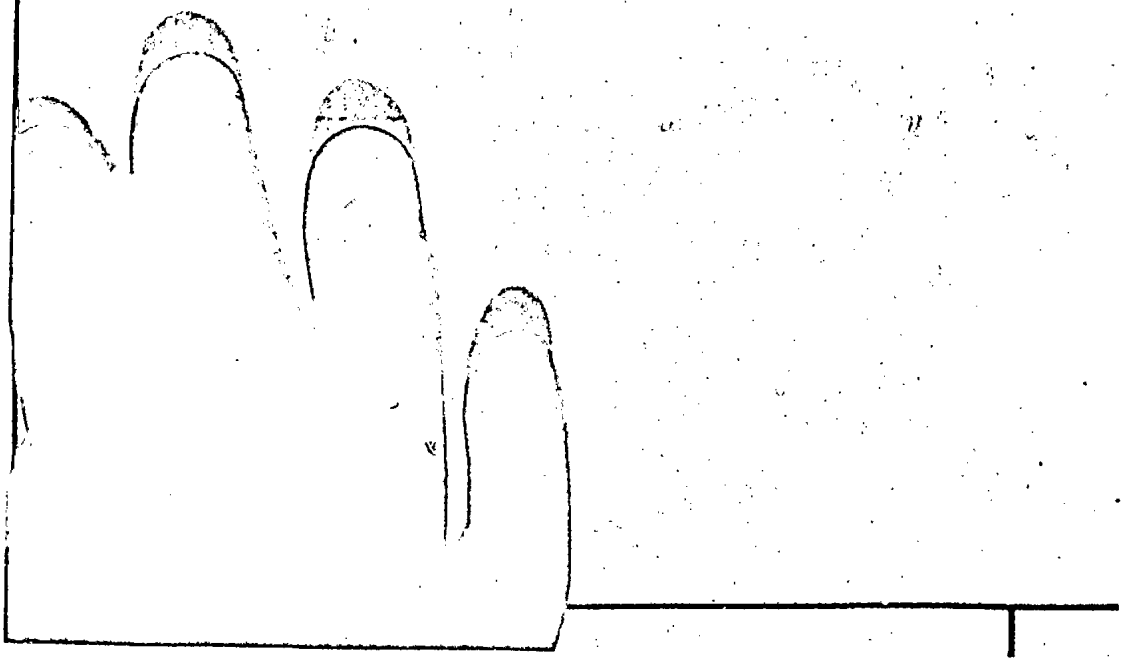
TYPE FB-10K NOZZLE TIGHTENING WITH THE AID OF A TORQUE WRENCH

With all the Ash-82T engines the production number of which ends with a zero aircraft tool kits are delivered. In these kits is enclosed, besides other tools, also a torque wrench Dwg No. 702161 /Figure 1/ which is used for tightening of the type FB-10K nozzle. The prescribed tightening torque is 4.5 kilogramme-metres. This wrench can be used also for the nozzle unscrewing in this case functioning as an ordinary one.

When tightening the nozzle use the torque wrench as an assembly with details, enclosed in the tool kit, the result of which will be an easier access to the nozzle:

wrench head Dwg No. 702156 /Fig. 2/
wrench shank Dwg No. 701430 /Fig. 2/
wrench joint Dwg No. 701437 /Fig. 2/
tap wrench Dwg No. 700760 /Fig. 2/

Through the use of the torque wrench Dwg No. 702161 proper tightening of the nozzles is guaranteed on engines in operation.



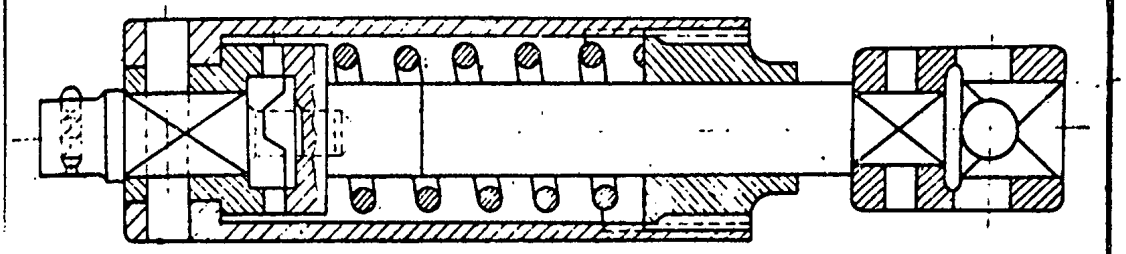
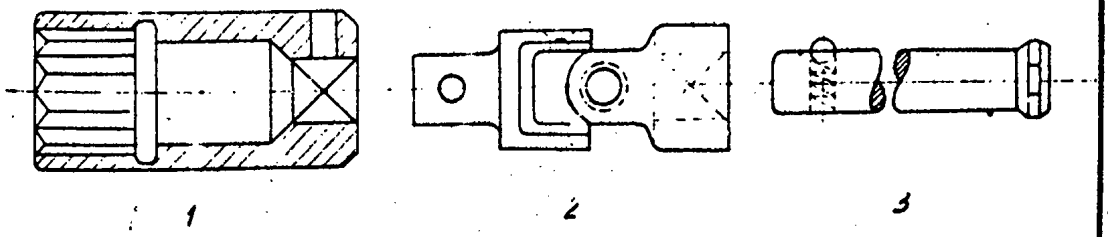


Fig. 1. CALIBRATED MOMENT WRENCH 707161 FOR JET TIGHTENING.



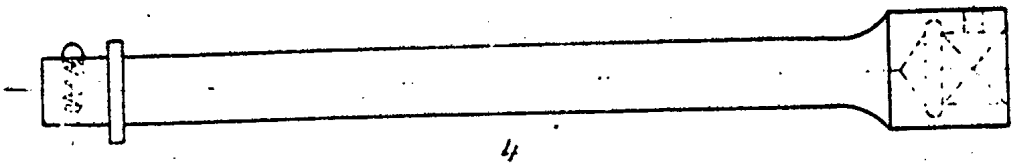
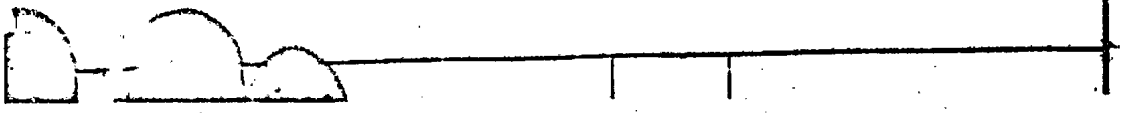


Fig. 2. INTERMEDIATE PARTS AND TAP WRENCH, OF THE WRENCH No 702161 : 1-WRENCH ; 2-JOINT ; 3-TAP WRENCH ; 4-SHANK.



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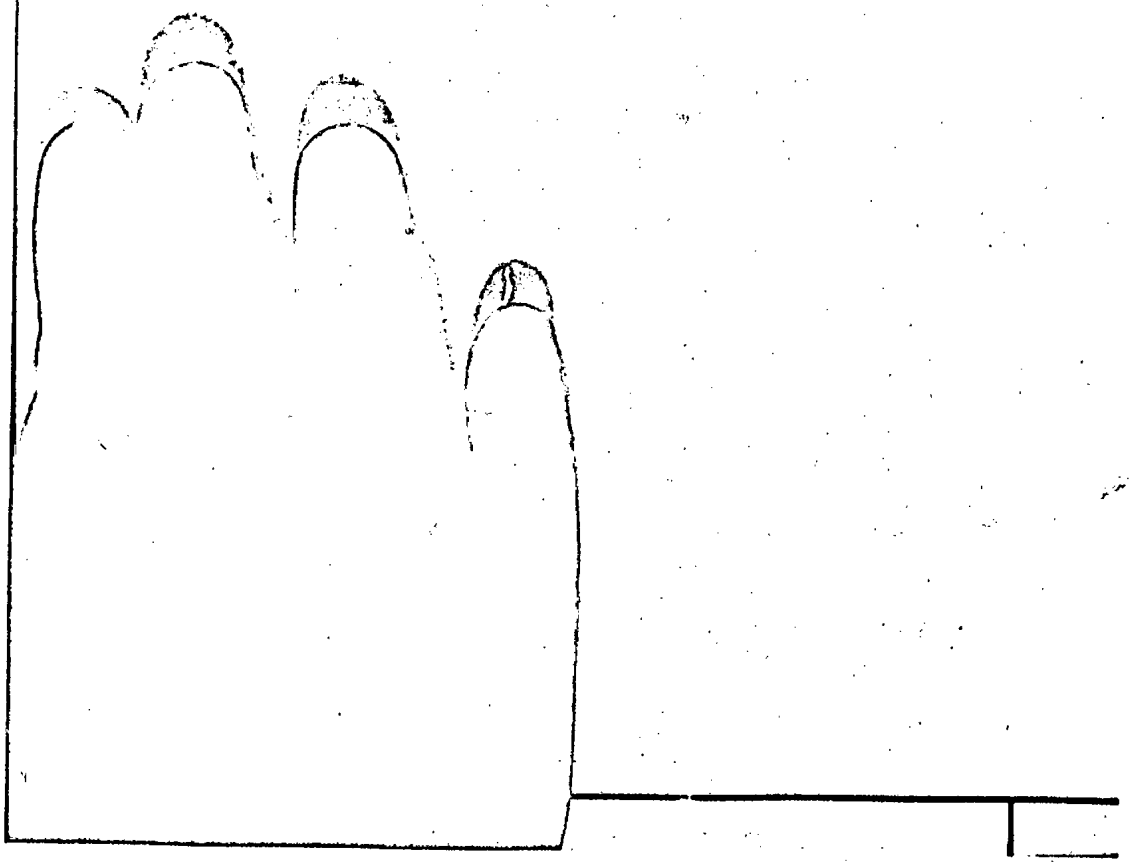
Ash-82T ENGINE EXHAUST VALVE RADIOGRAPHY INSPECTIONS

In view of the fact that faulty functioning may occur with the exhaust valves during service operation, the following instruction for all Ash-82T engine overhaul shops should be noted.

During overhaul of original Ash-82T engines of the No. 4 and 5 Series and during overhaul of all Czechoslovak-made Ash-82T engines it is necessary to carry out radiography inspections of the valve stem inner hollows of all exhaust valves, in spite of the fact that they may be recognized as serviceable by their outward appearance.

The exhaust valve radiography inspections are carried out in order to establish the extent of the valve stem hollow walls etching.



SERVICE BULLETIN
Ash-82T aircraft engines

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CHECK OF FUEL CONSUMPTION AND ADJUSTING THE RV-82 INJECTION PUMP ON THE Ash-82T ENGINES

Check of fuel consumption and eventual adjustment of the RV-82 injection pump is carried out if any doubts arise as to its proper adjustment, that is, for example, in case an increase or decrease of fuel consumption is observed as compared with normal consumption, or as routine check during scheduled inspections after installation of the engine on the aircraft, during change of the mixture control unit and during change of the injection pump on the engine which is mounted on the aircraft.

To carry out this follow the procedure as outlined below:

1/ Carry out synchronization check of the injection pump scale readings with those of UIRN-1 device, installed in the pilots compartment in the following way:

a/ Switch on the aircraft battery.

b/ During the upward and downward movement of the injection pump scale pointer register at every 10 degrees the appropriate readings of the UIRN-1 check device. Carry out the check within the scale range from 10 to 80 degrees. Mutual difference in the readings can be ± 2 degrees.

c/ From two obtained readings of the UIRN-1 device take arithmetical mean and subtract from appropriate values of the scale pointer. The value obtained in this way must not exceed ± 2 degrees.

NOTE: In case the difference does not correspond to prescribed tolerance of ± 2 degrees it is necessary to carry out additional adjustment of the UIRN-1 device transmitter, which is mounted on the mixture control.

2/ Carry out the check of injection pump adjustment during the engine ground operation, during the engine check and during preliminary calculation of fuel consumption. The regimes, during which the check is carried out, and the other values necessary for check, are identical with those for the flight check and are listed in Chart I. The calculation during the ground test is the same as that during the flight check.

CAUTION: This method of check on the ground is not a definite one as long as some more practice with the injection pump adjustment is not acquired. The obtained values will be usually lower than the values, obtained during flight, and it is thus necessary to take it in mind when evaluating the result of check.

3/ Carry out the flight check and find the readings of the UIRN-1 device. Reading should be done after every five minutes of continuous flight on appropriate regime.

The temperature of inlet oil during the measurement should be within 55 to 60 deg. Centigrade.

Regimes and altitudes, during which the check is carried out, are listed in Chart I.

Regime	Altitude metres	Corresponding rpm	Corresponding Boost pressure millimetres of mercury	Prescribed fuel consumption kg/hour	Remark
Long range	2000	2040	740	190-205	During the flight with an aircraft the engines of which have the mixture control with series-made cam, the mixture control lever should be in AUTO-LEAN position. In case there is a modified cam on the mixture control unit the lever should be in AUTO-NORMAL position.
Normal /rated/	300	2400	1020	445-485	This regime should be checked in case of additional adjustment of long range fuel consumption only.

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NOTE: The time of flight during checking should be at least 8 minutes.

4/ Calculate the true fuel consumption, corresponding to position of pointer on the injection pump scale during the flight. /For this purpose it is necessary to find out from the test log the fuel consumption and pointer displacement on scale for long range regime /revolutions of pump = 333 rpm, which corresponds to 2000 rpm of engine; and the same for normal /rated/ regimes: revolutions of pump = 400 rpm./

Because the engine revolutions during the flight on long range regime equal 2040 rpm it is necessary to adjust fuel consumption, listed in the test log, in the ratio of 2010/2000 = 1.02.

In view of the fact that the fuel consumption listed in the test log chart is calculated with the fuel of specific weight of 0.740, it is necessary to adjust the consumption in the ratio of true weight of fuel.

Further it is necessary to subtract from the pointer displacement values of the scale, listed in the test log chart, the scale values obtained during the flight on the UPRN-1 device.

In view of the fact that due to change of setting by 1 degree the fuel consumption changes by 4.85 kilograms per hour for long range regime and by 5.8 kilograms per hour for normal /rated/ regime it is necessary to multiply the differences of scale readings by 4.85 kilograms per hour, or by 5.8 kilograms per hour respectively. The result should be subtracted from the fuel consumption proportionally adjusted.

The obtained consumption should be converted on standard temperature. During ambient air temperature of 10 deg. Centigrade higher than standard one, the calculated consumption per hour increases by 1 per cent and vice versa.

Example of fuel consumption calculation.

1/ For long range regime.
According to the test log of the NV-82 injection pump is the fuel consumption /at revolutions of pump = 333 rpm/ 201 kilogrammes per hour and the pointer angle on scale 41 degrees.

By adjustment of revolutions and specific weight of fuel it was calculated:

Coefficient of revolutions correction

2040/2000 = 1.02

Coefficient of fuel specific weight correction

0.720/0.740 = 0.973, where 0.720 is true fuel specific weight, in the given case

201 x 1.02 x 0.973 = 199.5 kg per hour

The pointer angle obtained during the flight on the scale is 39 degrees, and thus the difference of scale readings is

41 deg. - 39 deg. = 2 degrees

2 x 4.85 = 9.7 kilogrammes per hour, the fuel consumption is thus

199.5 - 9.7 = 189.8 kilogrammes per hour.

Because the ambient air temperature during measurement was +25 deg. Centigrade, that is by 10 deg. Centigrade higher than the standard one, it is necessary to add another 1 per cent to the consumption.

Thus the true fuel consumption is

189.8 + 1.898 = 191.7 kilogrammes per hour.

2/ For normal /rated/ regime.

According to the test log the consumption is /at revolutions of pump = 4000 rpm/ 450 kilogrammes per hour and angle on the scale 75 degrees. With respect to the difference of specific weights, the fuel consumption will be

450 x 0.973 = 438 kilogrammes per hour.

The angle obtained was during the flight on scale of 78 degrees. Thus the difference is

78 deg. - 75 deg. = 3 degrees

3 x 5.8 = 17.4 kilogrammes per hour

The fuel consumption is 438 + 17.4 = 455.4 kilogrammes per hour. With respect to temperature increase by 10 deg. Centigrade above the standard one, it is necessary to add another 1 per cent to the consumption. Thus true fuel consumption is

455.4 + 4.554 = 459.95 kilogrammes per hour.

Mixture control adjusting

In case the calculated fuel consumption differs from the prescribed values it is necessary to carry out adjustment of the mixture control.

Mixture control adjustment is carried out by means of aneroide casing and screw of the corrector. During this it must be born in mind that:

a/ turning the aneroide casing by 10 graduations /1/5 of revolution/ this corresponds to change of fuel consumption when on long range regime by 8 kilogrammes per hour and when on nominal /rated/ regime by 17 kilogrammes per hour;

b/ turning the corrector screw by 3 graduations /1/2 of revolution/ this corresponds to change in fuel consumption when on long range regime by 1 kilogramme per hour and when on nominal /rated/ regime by 8 kilogrammes per hour.

When turning the aneroide casing clockwise the fuel consumption decreases and vice versa. During this all the points of mixture control adjusting characteristic transfer to the right or left by about a certain value, but the value in direction of lean mixture or enriched mixture on nominal /rated/ regime will be greater than on idling. It is because of this that adjusting with the aid of aneroide casing is practically used for change of fuel consumption on cruising regimes.

When turning the corrector screw anti-clockwise the fuel inlet increases at 0.6 nominal /rated/ regimes till the take-off regimes, while at the same during idling decreases. It follows from that that by the screw adjustment it is practically possible to increase and decrease fuel inlet on normal /rated - nominal/ and take-off regimes, but that this does not change fuel inlet on 0.45 nominal /rated/ regime and that it changes little the fuel inlet on other cruising regimes.

CAUTION: When adjusting fuel consumption on regimes lower than 0.75 nominal /rated/ the control lever should be in "AUTO-LEAN" position, at regimes of 0.75 nominal /rated/ and higher in "AUTO-NORMAL" position. On idling it should be in "AUTO-NORMAL" position.

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NOTES:

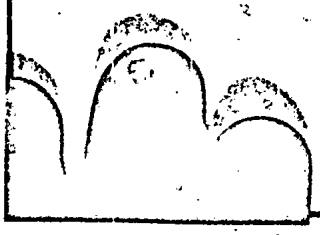
1/ During the flight in ranges with high ambient air temperatures, in altitudes and regimes mentioned here, pay attention to scale readings. In case the difference in readings, against the previous reading, will be greater than 3 degrees or more to the direction of lean mixture, move the mixture control lever in "AUTO-NORMAL" position.

2/ At the ambient air temperature of minus 25 deg. Centigrade and lower, it is possible to increase specific fuel consumption over 225 grammes per HP per hour at cruising regimes.
In this case correction of fuel consumption is permitted by adjusting the mixture control so, that fuel consumption converted on standard temperature will not be higher than 210 kilogrammes per hour at regime of n = 2040 rpm and boost pressure of 740 millimetres of mercury. During calculation the correction on fuel specific weight is not done.

3/ In case there is a series-made cam installed in the mixture control the mixture control lever should be in "AUTO-NORMAL" position during the flight in altitudes higher than 4000 metres at all regimes.

Idling adjustment

Number of idling revolutions is adjusted by means of idling stop screw, placed on the throttle flap casing. When loosening the screw the revolutions decrease, while the screw tightening the revolutions increase. After the adjustment it is necessary to secure the screw with the aid of a lock nut. A number of idling revolutions are depended on the mixture composition during idling and can be changed provided the mixture strength changes. Regulation of mixture during idling is done with the aid of servo-drive stop screw in the following way: when turning it clockwise the mixture is enriched and vice versa.



SERVICE BULLETIN
Ash-82T aircraft engines

1. OIL DRAINING FROM No. 9 CYLINDER INTAKE ROCKER BOX COVER OIL SUMP
2. TIGHTENING OF THE INJECTION PIPE NUTS
3. NV-82 TYPE INJECTION PUMP

1. Oil draining from No. 9 cylinder intake rocker box cover oil sump

When depreserving the Ash-82T engine of Series No. 5 and when installing this engine on the aircraft and during depreservation of engine which is installed on the aircraft and preserved for a certain time according to the relevant instructions contained in "Ash-82T engine Service and Maintenance Manual" it is necessary, prior to the first engine operation, to drain oil from the oil sump, situated in No. 9 cylinder intake rocker box cover.

For oil draining the following procedure should be adapted:

a/ Unscrew plug Dwg No. 82-54-58, using the wrench Dwg No. 00880-7, and take down aluminium washer Dwg No. 118451 /see Figure 1, Page 3/.

b/ During depreservation drain all collected oil from the oil sump of the cylinder intake rocker box cover.

c/ Slide washer Dwg No. 118451 on the plug and screw in the plug, sealing it afterwards with a drop of white lead.

2. Tightening of the injection pipe nuts

When changing the injection pipes, which are used with the engines of Series No. 5, it is necessary for tightening pipe nuts to use a torque wrench Dwg No. 701935 with extension Dwg No. 2-30-1, 2-30-2, 2-30-3 and 2-30-4 and tighten the nuts using a torque of 2.7 to 3.5 kilogramme metres. This wrench and extension are stocked in every fifth aircraft kit.

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3. NV-82 type injection pump

On the Series No. 5 engines the NV-82 type injecti on pumps will be mounted, adjusted for mixture enrichment by about 5 to 7 per cent for the front row cylinders as against the rear row cylinders, while at the same time No. 2 and 5 cylinders /those with master rods/ will be also enriched by about 5 to 7 per cent as compared with their respective row.

There is a thermal insulating cap on the capsule case of the RS-24M mixture control.

In case of a failure of the NV-82 type injection pump change the defective pump for another that has been adjusted for mixture enrichment or in whose certificate this adjustment has been entered.

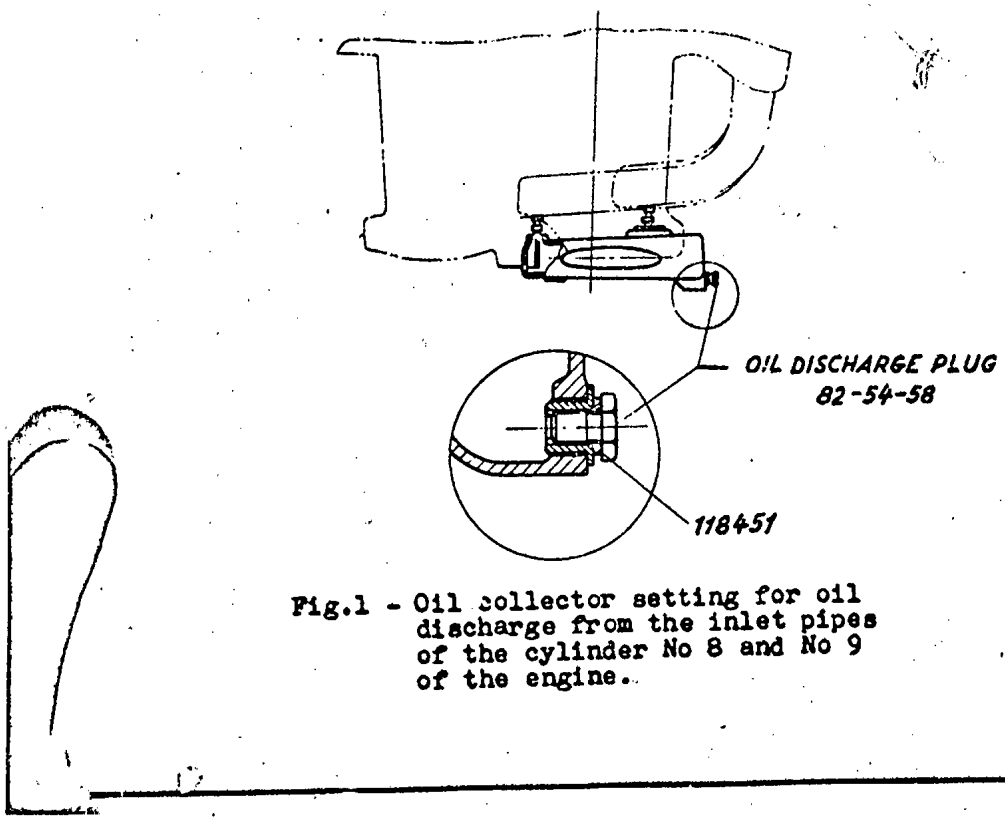


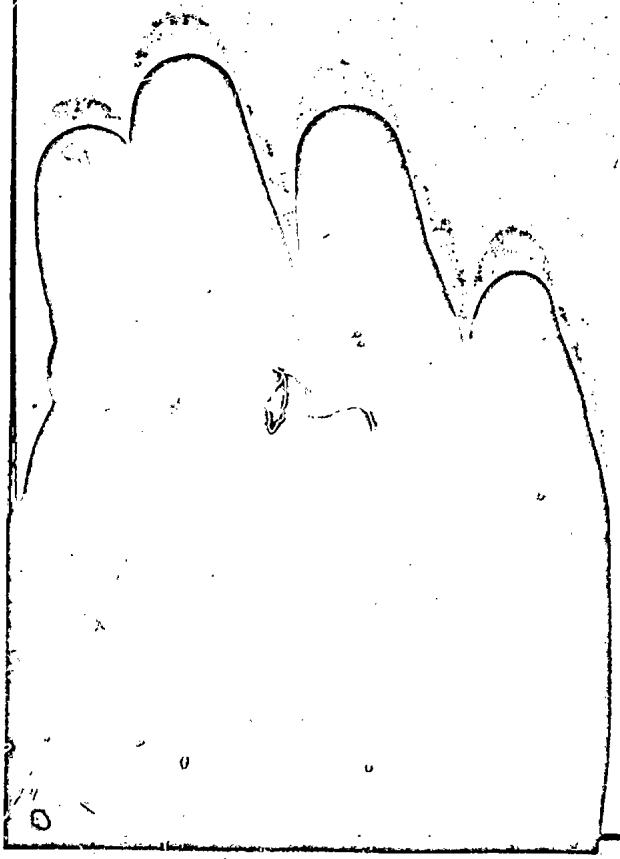
Fig.1 - Oil collector setting for oil discharge from the inlet pipes of the cylinder No 8 and No 9 of the engine.

ALTERATION OF THE PINCH FIT OF THE FRONT AND REAR MAIN BEARING INNER RACES ON THE CRANKSHAFT

In order to prevent galling and erosion /pitting/ of the inner races of front and rear main bearings, in which the crankshaft is supported, the manufacturer recommends to maintenance shops that during the Ash-82T engine overhauls it is necessary to select the pinch fit of the inner diameters of the rear and front bearing races on the crankshaft within 0.03 and 0.015 millimetres instead of within 0,03 and 0.004 millimetres.

The radial clearances of the roller bearings installed on the crankshaft, should be:

at the front roller bearing, 0.025 millimetres minimum;
at the rear roller bearing, 0.015 millimetres minimum.



SERVICE BULLETIN
Ash-82T aircraft engines

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A NEW METHOD OF MEASURING SIDE CLEARANCES OF COMPRESSION RINGS IN PISTON GROOVES

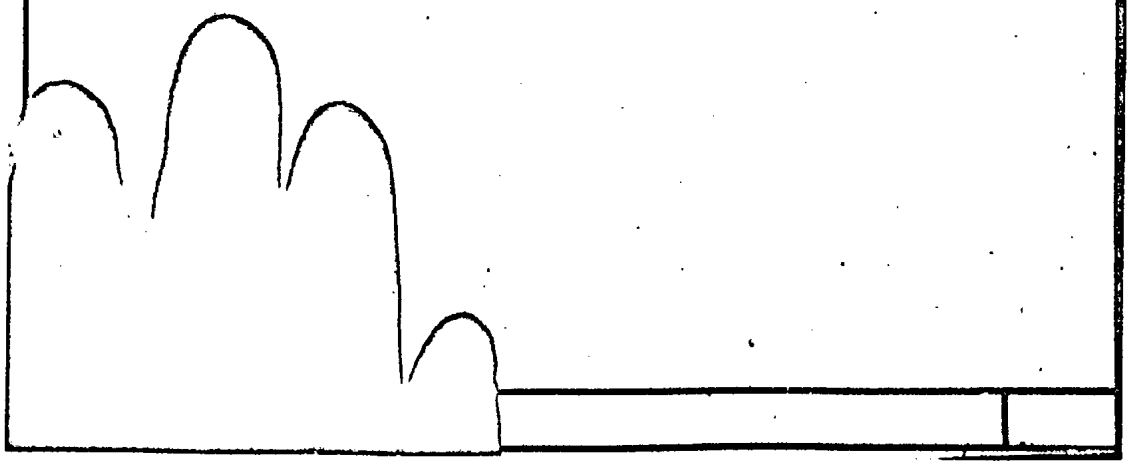
In order to improve checking of compression ring side clearances in the Ash-82T engine piston ring grooves the manufacturer has introduced a new method of side clearance checking with the aid of a fixture, Dwg. No. 11-72-54-79 /see Figure 1/.

The following procedure is recommended by the manufacturer for clearance measurement during the Ash-82T aircraft engine overhaul:

1. Place piston with installed rings with its bottom down on the fixture Dwg. No. 11-72-54-79 so that the axis of piston pin hole is aligned with the axis of the bolt /1/.
2. Turning the handle /3/ shift the sliding pins /2/ till they contact the surface "A" /of the pins/ in the piston upper part. With the pins shifted the rings will be centered by the surface "B" of the sliding pins so that the rings will protrude 0.7 millimetres with respect to the outer diameter of the piston upper part.

CAUTION: In order to prevent piston damage during shifting the sliding pins move the piston in the fixture without lifting it. The ring clearances should be positioned between the sliding pins only.

3. Measure the ring side clearances in the piston ring grooves with the aid of a gap gauge at least in four places /at each pin/. Clearances should be within 0.2 to 0.3 millimetres.



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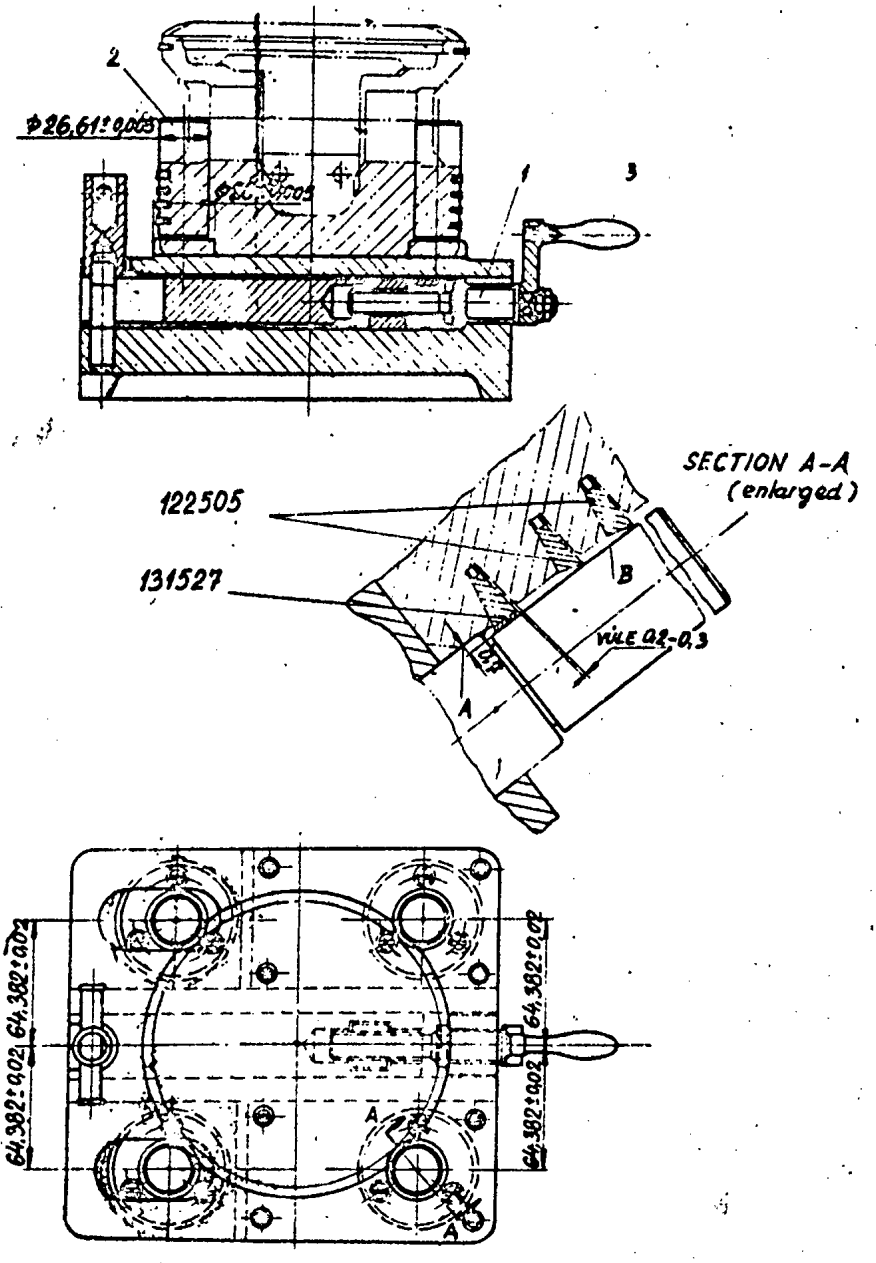


Fig. 1.

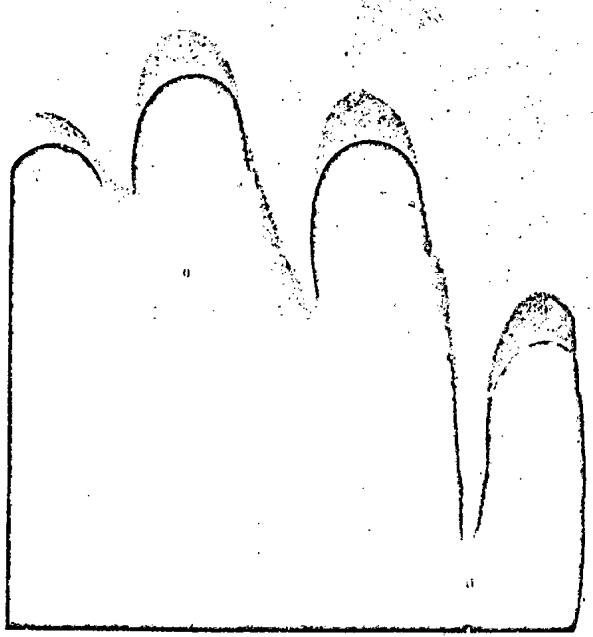
DRAINING OIL FROM NO. 6 AND 11 CYLINDER INTAKE PIPES AFTER DEPRESERVATION THE Ash-82T ENGINE

The presence of any quantity of oil and petrol compound in the combustion chambers of the No. 6 and 11 engine cylinder heads might cause hydraulic shocks and thus serious damage to the engine. In view of this fact it is therefore urgently recommended before starting the engine for the first time and, of course, after engine depreservation, to drain all collected oil from No.6 and 11 cylinder intake pipes.

The procedure of draining oil from the pipes should be as follows:

After engine depreservation and after the warm-up loosen No.6 and 11 cylinder intake pipe clamps, remove the clamp jaws, shrink the rubber gaskets up on the intake pipes and drain oil through the interstices between intake pipes and intake connections.

After draining the oil place the intake pipes in their proper position on the engine, put rubber gaskets into their places, fit the clamp jaws on and tighten the intake pipes by means of clamps to the cylinders.



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AIRCRAFT ENGINE ASh-82 V

REPAIRS MANUAL

Book II

(English Language)

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AIRCRAFT ENGINE AШ-82 B

Repairs Manual

BOOK II

Illustrated Specifications for Mounting and Repair Tools and Fixtures

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CONTENTS

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INTRODUCTION

The illustrated specifications for the repair and mounting tools and fixtures are based upon the Manufacturer's specifications for respective items and are intended as a supplement to the Repairs Manual for Engine AE-82B, Book I, 1957.

The specified list contains all tools and appliances indispensible for servicing the engine and for repairing it in mobile aircraft repair units and in stationary repair shops. The tools and fixtures contained in the list are delivered to the User in the following sets.

(a) aircraft tool kits for servicing the engine. The tool kit includes a complete set of wrenches for plugs, pipe connections, bolts and nuts located on the outside of the engine;

(b) sets of tools for running repairs in mobile repairing units;

(c) sets of mounting tools and fixtures for engine complete disassembly and assembly;

(d) sets of mounting and repair tools and fixtures for engine overhauls in repair shops, including also sets of mounting, repair and aircraft inboard tools and fixtures.

This List does not contain general purpose tools and fixtures, or auxiliary fixtures used at the works for engine production. Tools specified for repairs of engine accessories that are manufactured at separate plants are not included into this List either.

When receiving tools and fixtures from the storehouse the User must consult not only the given book but also the List of Tools and Fixtures to be delivered along with each set of equipment as the list of tools and fixtures is usually changed by the Manufacturer to meet the modifications in the engine design.

For convenience's sake each tool and fixture is specified in the book twice. Chapters 2, 3 and 4 list the tools and fixtures according to their Specifications: mounting and repair tools and fixtures (Specification Symbol CMTHH), mounting tools (Specification symbol CMT), tools and fixtures for field repair (Specification symbol CMP). Chapter 5 lists all tools and fixtures according to increase of their serial numbers (specification symbols).

The column DESIGNATION contains the Manufacturer's designation corresponding to the Dwg No. Each tool or fixture bears a stamp mark in accordance with their designation while aircraft inboard tools are marked with symbols only.

All mounting and repair tools and fixtures listed in the book are divided according to the following designation symbols:

Symbol	Description of tools and fixtures
6Э0000	Tools and fixtures made according to drawings of the Manufacturer's field repair shop
011-000	Mounting stands and trucks
А-1/000	Measuring tools
А-5/000	Standard mandrels
А-6/000	Measuring appliances
А-12/000	Inserts for dial gauges
А-14/000	Special feeler gauges
Б-2/000	Sealing broaches
Д-4/000	Holders for rolling-in tools
Д-5/000	Lapping tool holders
Д-6/000	Holders and mandrels for milling cutters
Б-1/000	Mandrels
К-1/000	Open-end wrenches
К-2/000	Socket wrenches
К-3/000	Wrenches for studs
К-6/000	Box wrenche
К-7/000	Torque indicating wrenches
К-1/000	Gauges
К-17/000	Gauges for splines and slits
К-18/000	Various special gauges
К-13/000	Template depth gauges
К-18/000	Templates for length, height and depth measurements
М-2/000	Tap wrenches and threading dies
М-4/000	Machine taps for ferrous metals
НГ-2/000	
НД-6/000	Drill-type chucks and holders with grips
П-1/000	Setting appliances
П-3/000	Jigs
П-5/000	Grinding appliances
П-6/000	Fitter's appliances
П-12/000	Lapping and buffing appliances
С-1/000	Drills
СО-1/000	Dynamometers
Т-05/000	Machine reamers with tapered shanks
Т-06/000	Machine reamers
Т -1/000	Hand reamers
Т -4/000	Machine reamers with straight shanks
Т-18/000	Manual and machine reamers
У -2/000	Fitter's all-purpose tools
У-40/000	Various tools
У-41/000	Various lapping tools
У-45/000	Rolling-in tools for connecting rod bushings
У-50/000	Removers
Ц -2/000	Countersinks

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Symbol	Description of tools and fixtures
Ч-15/000	Reference gauges
ЭП-000	Electric heaters

In addition to the list of mounting and repair tools the book contains:

(a) operating instructions for some complicated appliances (See Chapter 6);

(b) instructions on periodic inspections and testing of checking devices, mandrels and gauges (Chapter 7);

(c) brief description of washing equipment, airtest diagrams, and description of separate devices (Chapter 8);

(d) drawings of tools subjected to resharpening (Chapter 9).

Chapter I

AIRCRAFT INBOARD TOOL SET
(Fig. 1)

Listed below are aircraft inboard tools supplied either with each engine, or with every 10th engine, or with every 40th engine, or supplied to special orders only.

The tools prescribed for the engine accessories as well as the tools not supplied with each engine are marked in the List below with digits 1, 2 and 3 placed at the end of the tool designation number:

(a) tools marked with digit 1 are supplied with every 10th engine (its number ending in 0);

(b) tools marked with digit 2 are supplied with each engine, the tools being designed for the engine accessories;

(c) tools marked with digit 3 are supplied either with every 40th engine, or to special orders.

Reference No. (Fig.1)	Designation No.	Symbol	Description	Purpose
1	2	3	4	5
33	700002	1	Wrench, double-end, closed, S=9x11	For nuts fastening: oil filter to crankcase nose-piece, oil filter to supercharger rear housing, magnet control switches to crankcase nose-piece, oil separators to crankcase nose-piece, screening hose to crankcase nose-piece, screening hose to cylinder head, intake pipe clamp, high-pressure pipe brackets, throttle valve to its axle, magnet valve to throttle box, clamp for hose running from aneroid chamber.
29	700004 (82-30-58)	3	Wrench, double-end, closed, S=14x17	For nuts of clamp screws fastening: screening hoses to push-rod casings, four high-pressure pipes, as well as high-pressure pipes to push-rod casings. For screws fastening: cylinder deflectors, accessories case cowling, bracket to HB-82B direct-full injection pump body, high-pressure pipes. For nuts securing: clutch casing to crankcase nose-piece, HB-82B pump drive body to crankcase rear cover, HB-82B pump to pump drive body, engine cowling to cylinder heads, pipes of electromagnetic priming valve, mounting lugs to supercharger front housing, oil pump to crankcase rear cover, throttle box adapter to supercharger rear housing. For oil filter cover attachment bolt. For plugs of oil separator pipe unions.
27	700005 (82-30-59)	4	Wrench, double-end, closed, S=18x19	For nuts fastening: aneroid chamber boost (p_k) return hose, pipe union supplying oil to valve timing mechanism. For nuts of intake and exhaust valve levers attachment bolts.
6	700016	5	Hammer	For all kind of tapping.
25	700054[1]	6	Valve spring compressor	For intake and exhaust valve springs, used for assembly and disassembly operations.
16	700381	10	Handle bar	For wrenches 700382, 700650, 701379.
21	700382	11	Wrench, socket, S=14	For bolts fastening cylinders to crankcase.
-	700487[3]	-	Slinging system, front (See Fig.8)	For engine attachment.
-	700488[3]	-	Slinging system, rear (See Fig.8)	For engine attachment.
36	700542	15	Wrench, socket, S=19	For nuts of spark plug angle-pieces.
32	700641	17	Wrench, socket, S=16	For three inside nuts fastening HB-82B pump drive body to crankcase rear cover.

1	2	3	4	5
15	700650 (82-30-61)	19	Wrench	For nut fastening intake pip to supercharger front housing.
4	700760	24	Handle bar	For wrenches 700542, 700641, 700828, 700850, 701293, 701299.
38	700771	25	Wrench, double-end, closed, S=20x22	For plugs of crankcase nose-piece, oil sump filter, for oil sump magnet plug.
				For ignition harness connections.
				For rear pump connections; for attachment of oil scavenge pipe, oil temperature pick-up unit.
45	700828	28	Wrench, socket, open, S=15	For high-pressure pipe nuts.
1	700850 (82-30-01)	29	Wrench, socket, S=15	For electric starter nuts.
49	700859	30	Wrench, double-end, S=13x13	For nuts attaching: magneto to crankcase nose-piece, electromagnet control switches to crankcase nose-piece, oil pump to crankcase nose-piece, throttle valve box to adapter, throttle valve axle lever, clutch cover and cooling fan straightener to clutch body, valve lever box covers, oil sump to supercharger rear housing, breathers to supercharger front housing, fuel pump and its drive to supercharger rear housing, flange of pipe supplying oil to valve timing mechanism, cylinder deflectors, HB-82B pump drive body to crankcase rear cover.
				For screws fastening: oil supply and oil return pipes, oil sump to supercharger rear housing plug to oil sump.
35	700880-2	32	Wrench, double-end, open, S=7x9	For nuts fastening: oil separators to crankcase nose-piece, electromagnet control valves to crankcase nose-piece, screening hose clamps to cylinder heads, throttle valve to its axle.
				For nuts of clamp screws fastening: high-pressure pipes, aneroid chamber boost (P_k) return hose, screening hoses

1	2	3	4	5
				to crankcase nose-piece and to push-rod casings.
				For screws securing magneto distributing block covers.
				For plugs of crankcase nose-piece, supercharger front housing, throttle box adapter, front oil pump, oil sump.
41	700880-4	33	Wrench, double-end, S=11x13	For nuts fastening: oil separators to crankcase nose-piece, oil filters to crankcase nose-piece and to supercharger rear housing, electromagnet control switches to crankcase nose-piece, magneto to crankcase nose-piece, oil pump to crankcase nose-piece, cover to clutch casing, clutch cover and fan straightener to clutch casing, valve lever box covers, oil sump to supercharer rear housing, breathers to supercharger front housing, fuel pump and its drive to supercharger rear housing, flange of pipe supplying oil to valve timing mechanism, HB-82B pump drive body to supercharger rear housing and cover to drive body, throttle valve lever stops, bracket for four high-pressure pipes, throttle box to adapter, throttle valve axle lever, electromagnet valve to throttle chamber.
				For screws securing: cylinder deflectors, oil supply and oil scavenge pipe flanges, brackets for high-pressure pipes.
				For screw nuts of clamps fastening: intake pipes, cylinder deflector yokes, high-pressure pipes.
				For oil separator pipe unions and their screw caps.
				For plugs of supercharger

1	2	3	4	5
				front and rear housings, throttle box adapter, front and rear oil pumps.
47	700880-5	34	Wrench, double-end, open, S=14x16	For nuts fastening HB-82B pump drive body to crankcase rear cover.
				For pipe unions of supercharger front housing pipe unions supplying pressure (P_k) to aneroid chamber, pipe unions of supercharger rear housing, condensate draining pipe unions and oil separator pipe unions.
				For oil separator pipe union screw caps.
				For fuel priming elbow connections when starting the engine.
10	700880-7	36	Wrench, double-end, open, S=19x22	For nuts of intake and exhaust valve rocker lever bolts.
				For pipe unions of ignition harness, valve timing mechanism oil supply system, oil scavenge pipes, aneroid chamber boost (P_k) return hose, rear oil pump temperature pick-up unit.
				For plugs of crankcase nose-piece, oil sump filter; as well as for oil sump magnet plug.
8	700880-8	37	Wrench, double-end, open, S=24x27	For pipe unions of: rear oil pump, oil sump, aneroid chamber pressure (P_k) supply and return pipes.
				For oil sump drain cock body.
				For revolution counter cap.
31	700880-11	38	Wrench, double-end, open, S=15x17	For nuts fastening: clutch casing to crankcase nose-piece, HB-82B pump drive body to crankcase rear cover, rear oil pump to crankcase rear cover, throttle box adapter to supercharger rear housing, HB-82B pump to drive body, fuel pressure transmitter tubes, fuel priming pipe and elbow connection, pipe connection of pressure (P_k) transmitter in supercharger front housing, high-pressure pipes, mounting lugs to supercharger front housing.
48	701148	56	Pliers, flat	For locking operations on nuts, screws, plugs, pipe connections, and caps.
20	701150[1]	57	Wrench, socket	For reducing valve body of front and rear oil pumps.
46	701293	114	Wrench, socket, S=19	For generator fastening nuts.
12	701299	121	Wrench, socket, S=11	For nuts of valve guides.
52	701363	69	Wrench, double-end, closed, S=7x7	For coupling screws of intake and exhaust valves.
				For screws fastening: magneto distributing block cover, clamp of two high-pressure pipes.
				For crankcase nose-piece plugs.
50	701364	70	Wrench, double-end, open, S=30x32	For pipe connections of: rear oil pump, aneroid chamber pressure (P_k) supply pipe.
				For caps of rear and front oil pumps reducing valves.
2	701379[1]	75	Wrench, socket	For push-rod casing lower nuts.
34	701386[1]	76	Device	For removing push-rod casings on assembled engine.
42	701425	88	Screw-driver, small	For screws and bolts provided with a slot for a screw-driver and serving to fasten or lock engine parts, also for adjusting screws.
				For plugs provided with a slot for a screw-driver.
53	701428	89	Screw-driver, large	For screws and bolts having a slot for a screw-driver and serving to fasten or lock engine parts, also for adjusting screws.
				For plugs provided with a slot for a screw-driver.
28	701430	90	Wrench shank	Used with ratchet wrench, wrench changeable heads and wrench hinge.
40	701432	91	Wrench shank	Used with ratchet wrench, wrench changeable heads and wrench hinge.
39	701434	92	Wrench shank, with hinge	Used with ratchet wrench, wrench changeable heads and wrench hinge.
26	701456	97	Screw-driver	For screws and bolts having a slot for a screw-driver and

1	2	3	4	5
				serving to fasten or lock engine parts, also for adjusting screws. For plugs having a slot for a screw-driver.
5	701460	-	Tool case (See Fig. 2 and Specifications for Tool Case)	These tools (ratchet wrench, wrench shank, wrench hinge, and socket wrench heads) are used for nuts, bolts, screws and plugs, which are difficult of access with non-detachable wrenches. Threading die is used for correcting 1M 8x1 thread of studs, bolts and screws.
17	701651[1]	110	Wrench, double-end	For push-rod casing upper nuts and ignition harness nuts.
24	701658	112	Wrench, double-end, open, S=36x41	For union nut of aneroid chamber pressure (p_k) supply hose. For oil sump return pipe union. For nut and cap of front oil pump reducing valve.
11	701663	115	Drift	Used with hammer for tapping.
54	701674	-	Fit (cover)	For aircraft inboard tools supplied with every 10th engine (engine Nos ending in 0).
19	701729[1]	117	Wrench, box	For reduction gear nut.
43	701754	123	Feeler gauge, special	For checking clearance between valve stem and rocker arm roller.
-	701764[3]	-	Slinging system (See Fig. 7)	For engine attachment (fastened to clutch flange).
14	701785[1]	136	Wrench	For reducing valve bodies of front and rear oil pumps.
13	701868	144	Torque indicating wrench	For tightening spark plugs, calibrated for 6 kg-m.
3	701870	147	Wrench, socket, hinged	For spark plugs.
44	701871	147	Wrench, double-end, S=24x46	For assembly operations.
37	701922	154	Pliers	For knurled nuts and caps.
9	701944	159	Screw-driver	For clutch variable section jet.
7	701959	159	Head for wrench	For clutch non-return valve body.
23	702096	209	Screw-driver	For clutch variable section jet needle.
18	16353[2]	16353	Wrench	For union nut of aneroid chamber pressure (p_k) supply pipe union.
51	16354[2]	16354	Wrench	For HB-82B pump followers box inspection hole plug.
22	82350[2]	82350/1	Wrench, socket	For HB-82B pump feel pipe unions and injectors.
30	82365[2]	82365	Wrench, closed	For shank of HB-82B pump cam disc.

Tool Box

(Fig.2)

The tool box (unit 701460) supplied with every engine, contains an all-purpose wrench (ratchet), a set of wrench heads, a threading die, a hinge, and a wrench shank.

Reference No. (Fig.2)	Designation No.	Symbol	Description
3	700861	31	Threading die, for 1M 8x1 thread
13	701413	78	Head, socket wrench, S=15
15	701414	79	Head, socket wrench, S=18
10	701415	80	Head, socket wrench, S=13
16	701416	81	Head, socket wrench, S=19
14	701417	82	Head, socket wrench, S=16
5	701418	83	Head, socket wrench, S=7
9	701419	84	Head, socket wrench, S=11
8	701420	85	Head, socket wrench, S=9
6	701421	86	Head, socket wrench, S=9
12	701422	87	Head, socket wrench, S=14
4	701437	93	Hinge, wrench
2	701452	94	Wrench (ratchet)
7	701453	95	Head, socket wrench, S=7
1	701459	-	Box, for tools
11	701623	107	Shank, wrench

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Chapter 2

MOUNTING TOOLS AND FIXTURES

Fig. No.	Designation No.	Description	Quantity according to Specification GMPAZ 651	GMR 651
1	2	3	4	5
		General Purpose Tools and Fixtures		
3	011-65	Small mounting stand for assembly crankcase with crankshaft	4	-
4	011-69	Mounting stand with removable plate for engine assembly and disassembly	5	-
5	700002	Wrench, double-end, closed, S=9x11	10	10
5	700003	Wrench, double-end, closed, S=13x13	10	10
5	700004	Wrench, double-end, closed, S=14x15	10	5
5	700005	Wrench, double-end, closed, S=18x19	7	5
5	700016	Hammer	1	1
5	700256	Wrench, socket, S=13x15	10	10
5	630124	Wrench, socket, S=11	10	10
5	630317	Timing gauge for determining T.D.C. of cylinder piston	1	1
6	701361	Wrench, S=15, for generator and starter fastening nuts	7	5
6	700880-8	Wrench, double-end, open, S=24x27	5	5
6	700880-11	Wrench, double-end, open, S=15x17	7	5
6	701148	Pliers, flat	2	1
6	701425	Screw-driver, small	4	5
6	701428	Screw-driver, large	5	5
6	114500	Mounting lug for fastening engine to stand	28	28
7	700534	Feeler gauge	3	3
7	700755	Wrench, socket, S=7x11	10	10
7	700641	Wrench, socket, S=16	7	5
7	700756	Wrench, socket, S=9x11	10	10
7	700880-2	Wrench,double-end, open, S=7x9	10	10
7	700880-4	Wrench,double-end, open, S=11x13	10	10
7	700880-5	Wrench, double-end, open, S=14x16	7	5
7	700880-7	Wrench, double-end, open, S=19x22	5	5
7	700880-6	Wrench, double-end, open, S=14x17	7	5
7	700511-3	Wrench, hinged, S=13	10	10
7	701764)	Slinging system for engine attachment	3	3
8	700487)		3	3
8	700488)		3	3
9	K-1/1205	Wrench for ignition harness nuts	5	4
9	K-7/1025	Torque indicating wrench, calibrated from 0 to 5 kg-m	3	2
9	K-7/1015	Torque indicating wrench, calibrated from 0 to 13 kg-m	6	3
9	K-7/1022	Torque indicating wrench, calibrated from 10 to 40 kg-m	4	2
9	K-7/1027	Torque indicating wrench, calibrated from 0 to 18 kg-m	3	3
10	P-6/10193	Plug for stopping crankshaft nose end hole when pumping oil through crankshaft (after it is assembled with the crankcase)	1	1
10	P-6/8668	Plug for stopping crankshaft rear end hole when pumping oil through crankshaft (after it is assembled with the crankcase)	1	-
10	P-6/8669	Plug for stopping crankshaft front end hole (nearest to the crankpin) when pumping oil through crankshaft (after it is assembled with crankcase)	1	1
10	P-6/10378	Handle bar for turning crankshaft by splines of its front part (with crankcase nose-piece and clutch removed)	2	2
10	P-6/10380	Bolt for lifting crankcase nose-piece by clutch intermediate shaft	6	5
10	P-6/10379	Device for limiting crankshaft forward axial travel	2	2
11	P-6/10968	Mounting tool for fan rotor and its fairing	1	1
11	y-2/1156	Drift for bending lugs of locks that fix the bolts of crankshaft side split rings (used also during clutch assembly)	1	1
11	P-6/10926	Fixture for jacking up crankshaft	1	1
11	y-2/1946	Scriber (magnet)	2	-
11	P-6/10571	Adjusting disc for checking valve timing	1	1
11	y-2/2034	Drift for bending lugs of locks that fix the crankshaft side split rings	1	1
12	P-6/11443	Fixture for turning crankshaft by fan support bracket	3	3

1	2	3	4	5
13	П-6/10474	Device for limiting crankshaft backward axial travel	2	2
13	П-6/10518	Link nut for lifting engine by splined collar of engine clutch	3	3
13	П-6/10521	Bolt for turning crankcase by crankshaft nose end (after crankcase is assembled with crankshaft)	3	2
13	П-6/10540	Fixture for keeping clutch splined collar from turning when tightening its nut	2	2
13	П-6/10541	Lifting attachment for turning crankcase assembled with crankshaft, by splined flange	3	2
14	011-68	Stand for engine slushing	2	-
		Tools and Fixtures for Assembly of Crankcase Nose-Piece, Clutch and Straightener		
15	П-6/10553	Mounting plate for crankcase nose-piece (for stand П-6/9521)	3	-
15	П-6/9521	Stand for crankcase nose-piece assembly (used also for supercharger assembly)	3	-
15	ЭН-167	Electric heater for heating intermediate shaft splines when mounting intermediate shaft on engine	1	-
16	СО-1/1331	Reducing unit for tightening intermediate shaft coupling bolt Note: Reducing unit must be calibrated and packed together with wrench К-7/1022 (See Fig.9)	1	-
17	700511-2	Wrench, socket, hinged, S=13	7	5
17	630125	Wrench, socket, S=13	10	10
17	700890	Wrench, for plugs with internal hexagon, 9 and 19 mm	7	5
17	А-6/5981	Dynamometer (with adapter) calibrated from 1000 to 3000 gr, to measure friction of engagement clutch shifter slide valve	2	1
17	А-6/5894	Device for checking bevel gear clearances in magneto drive	1	1
17	А-6/6019	Device for checking clearances between accessories drive spur gear teeth	1	1
17	А-12/1639	Calibrated sleeve to check clearance between pressure collar adjusting ring and end face of spring well	1	1
17	К-1/1225	Wrench head (S=9) for oil separator attachment nuts	5	4
17	К-1/1226	Wrench head (S=15) for nuts fastening splined collar to intermediate coupling	5	4
17	К-1/1222	Wrench head (S=15) for ratchet piston body attachment nuts	5	3

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1	2	3	4	5
18	К-2/1410	Socket wrench (S=15) for high-pressure pipe nuts	6	5
18	К-2/1515	Wrench for front oil pump drive shaft nut	5	5
18	К-2/1514	Wrench for magneto drive shaft nut	5	5
18	К-2/1448	Wrench head (S=15) for fan rotor bolts	5	4
18	К-2/1522	Wrench head (S=13) for straightener nuts	5	3
18	К-2/1523	Wrench (S=130) for splined collar nut	3	4
18	К-6/1149	Wrench, closed (S=19), for keeping front oil pump and magneto shafts from turning	4	3
18	К-6/1114	Wrench, closed (S=15) for ratchet piston attachment nuts	6	5
19	К-2/1524	Wrench for pressure collar nut	5	3
19	К-2/1526	Wrench for preliminary tightening of intermediate shaft coupling bolt	4	3
19	К-2/1525	Wrench for splined collar nut	4	3
19	П-6/9428	Clamp for intermediate shaft hole (used during washing)	2	-
19	К-6/1161	Wrench for front oil pump reducing valve	4	4
20	П-6/10519	Remover for crankcase nose-piece with clutch	2	1
20	П-6/10486	Fixture for front oil pump assembly	1	1
20	П-6/10524	Stand for intermediate shaft	1	-
20	К-2/1550	Wrench for intermediate shaft coupling bolt	5	4
21	П-6/11280	Stand for splined collar mounting and dismounting	1	1
22	П-6/10555	Appliance for pressure collar assembly	1	1
22	П-6/10529	Remover for clutch drive disc	2	2
22	П-6/10556	Appliance for washing clutch drive disc	1	-
22	П-6/10574	Centring device for clutch discs, used for assembly operations	1	1
22	П-6/10876	Remover for splined collar	2	2
22	П-6/10873	Remover for clutch cover	1	1
22	П-6/10654	Device for mounting splined collar on intermediate shaft	1	1
23	П-6/9865	Pipe union used with washing appliances	2	-
23	П-6/10382	Device for mounting oil seal sleeve of crankcase nose-piece	1	1
23	П-6/10517	Air supplying device used to check friction clutch piston travel	1	1
23	П-6/10464	Appliance for washing front oil pump	1	-
23	П-6/10520	Remover for adapter flange used to pull the latter from splined collar of clutch	2	1
23	П-6/10554	Device for compressing springs of pressure collar	1	1
24	А-6/6100	Device for checking clearances between teeth of bevel gears of magneto, front oil pump and fuel pump drives	2	2
24	К-7/1026	Torque indicating wrench, calibrated from	3	2

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1	2	3	4	5
25	П-4/11257	Appliance for mounting and dismounting front oil pump shaft lock	2	1
25	П-4/11479	Appliance for checking operation of ratchet piston	1	1
11	Ж-2/1156	Drift for bending lugs of locks that secure ratchet piston body support nuts	1	-
25	П-4/10546	Fixture for keeping splined collar from turning when tightening its nut	1	1
		Tools and Appliances (Fixtures) for Assembly of Crankshaft		
26	А-4/5018	Fixture for checking crankshaft run-out	1	-
26	А-14/1285	Feeler gauge for checking clearance in master rod side sealing	3	2
26	Ж-2/1296	Wrench head for nut of crankshaft centre part plug bolt (shown in Dwg Ж-2/1225)	3	2
26	Ж-2/1231	Socket wrench (S=14) for counterweight pin bolt nuts	3	3
26	А-4/5801	Indicator clamp for measuring elongation of crankshaft coupling bolts	1	1
27	Ж-4/1152	Wrench for crankshaft coupling bolts	7	5
27	Ж-4/1148	Double-end closed wrench (S=16x17) for crankshaft rear part lubricating nozzle	3	3
27	Ж-2/1520	Bit stock for nut of crankshaft rear part	3	2
27	Ж-2/1362	Wrench for crankshaft rear part nut	3	3
27	П-4/4867	Fixture used for washing crankshaft (replaced by fixture П-4/7178, Fig.28)	-	-
27	П-4/4754	Fixture for crankshaft assembly	1	1
28	П-4/7209	Brake wedge for separating crankshaft web hole lugs	3	3
28	П-4/7178	Clamp used for washing crankshaft (instead of fixture П-4/4867, Fig.27)	1	-
28	П-4/8243	Stopper for crankshaft rear part	2	1
28	П-4/8644	Fixture for keeping counterweight pin bolts from turning	2	2
28	П-4/10375	Drift for pressing in crankpin plugs	2	1
28	П-4/10476	Remover for crankshaft split ring	2	2
28	П-4/10394	Remover for crankshaft rear roller bearing	2	2
28	П-4/8918	Stand for wrench Ж-2/1362 (See Fig.27)	2	2
29	П-4/10478	Plug for crankpin	1	1
29	П-4/10677	Puller for front crankshaft roller bearing	3	2
29	П-4/10874	Puller for crankpin plugs (has been replaced by puller А-4356/0517) (See Fig.30)	-	-
29	У-2/1937	Caulking tool for bending crankshaft nozzles lock tabs	1	1
29	А-4356/0517	Puller for crankpin plugs (to be used instead of puller П-4/10874, Fig. 29).	3	2

1	2	3	4	5
		Tools and Fixtures for Assembly of Crankcase and Timing Mechanism		
31	Ж-2/1095	Socket wrench for plug of timing mechanism double-rim gear shaft	7	4
31	Ж-2/1450	Wrench (S=17) for bolts of crankshaft split rings	7	5
31	Ж-2/1349	Socket wrench for bolts of crankshaft split rings assembling to ... Ж-2/1305)	7	5
31	Ж-2/1560	Socket wrench (S=11) for screws of timing mechanism double-rim elastic gear cover	5	3
31	Ж-2/1480	Socket wrench (S=11) for nuts of tappet guides	7	5
31	Ж-6/1150	Wrench head (S=19) for crankcase coupling bolt nuts (instead of wrench head Ж-6/1121)	5	3
31	Ж-6/1140	Box wrench (S=19) for crankcase coupling bolt nuts	6	5
31	П-6/9288	Appliance for mounting tappet lock	1	1
31	П-6/3588	Device for lifting assembled crankcase	3	1
31	П-6/9267	Remover for tappet lock	1	1
32	Ж-6/1139	Box wrench (S=18) for nuts of crankcase coupling bolts	7	4
32	П-6/10425	Appliance for protecting crankcase joint surfaces from damage	1	-
32	П-6/10426	Appliance for protecting crankcase joint surfaces from damage	1	-
33	П-6/10427	Appliance for protecting crankcase joint surfaces from damage	4	-
34	П-6/10445	Device for assembly of timing mechanism double-rim elastic gear	1	1
35	П-6/10424	Device for assembly of elastic gears	1	1
		Tools and Fixtures for Assembly of Connecting Rods		
36	Ж-2/1472	Socket wrench (S=16) for master rod bushing lock bolts	7	5
36	А-6/5489	Ring for levelling knuckle pin ends	1	1
36	Ж-2/1502	Wrench head (S=16) for master rod lock bolts (used with wrench Ж-7/1027, Fig.9)	6	2
36	П-6/4772	Device for pressing in knuckle pins	2	1
36	Д-5/1720	Tool holder for finishing knuckle pin large holes in master rod cheeks (replaced by tool holder Д-5/1739)	-	-
-	Д-5/1739	Tool holder for finishing knuckle pin large holes in master rod cheeks (interchangeable with tool holder Д-5/1720)	1	1

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1	2	3	4	5
36	Д-5/1721	Tool holder for finishing knuckle pin small holes in master rod cheeks (replaced by tool holder Д-5/1740)	-	-
-	Д-5/1740	Tool holder for finishing knuckle pin small holes in master rod cheeks (interchangeable with tool holder Д-5/1721)	1	1
36	П-6/4767	Stand for master rod assembly	1	1
36	П-6/7892	Set of wedges (21 pieces) for master rod cheeks, used when pressing knuckle pins in and out	1	1
-	П-6/8494	Appliance for washing knuckle pin (replaced by appliance П-6/11206, Fig.37)	-	-
36	Д-18/11394	Template for measuring master rod crankpin bushing inner diameter by applying a hole indicating gauge	1	1
36	У-2/2010	Caulking tool for bending lugs of locks that secure master rod bushing lock attachment bolts	1	1
37	П-6/11206	Appliance for washing knuckle pin (instead of appliance П-6/8494)	1	-
		Tools and Fixtures for Assembly of Cylinders		
38	СО521	Stand for cylinder assembly	2	-
38	К-2/1553	Wrench for tightening cylinder bolts (with application of a dynamometer)	15	10
38	К-2/1551	Socket wrench for tappet guide attachment nuts (used with a pneumatic drill)	8	8
39	701363	Double-end closed wrench (S=7x7) for coupling screws of intake and exhaust valve levers	7	5
39	700382	Socket wrench (S=14) for cylinder bolts	15	10
39	701379	Socket wrench for push-rod casings lower nuts	6	2
39	А-6/4973	Appliance for measuring exhaust valve seat concentricity	1	1
39	А-6/5464	Appliance for checking valve lever bearing play	1	1
40	700650	Wrench for inlet pipe nuts	10	10
40	А-1/1208	Appliance for measuring intake and exhaust valve lift	1	-
40	А-6/4008	Fixture for measuring piston ring side clearances	1	1
40	К-1/1076	Open wrench (S=14) for cylinder bolts (for preliminary tightening)	7	5
40	К-1/1209	Open wrench for push-rod casing nuts	6	5
40	К-2/1280	Socket wrench (S=17) for injectors	5	3

1	2	3	4	5
40	Д-13/9321	Template (depth gauge) for measuring valve stem depth relative to spring retainer on assembled cylinder	1	1
41	П-6/9139	Device for installing piston rings	1	1
41	П-6/10485	Piston ring compressor	4	2
41	П-6/10499	Cylinder setting bolts (group I - 70 pieces, group II - 5 pieces)	75	75
41	У-2/1988	Pliers for push-rod casing assembly	1	1
41	Ч-15/4624	Gauge, to adjust appliance А-6/4973, used to check exhaust valve seat for concentrical alignment	1	1
42	К-18/3783	Gauge for selecting piston rings by piston ring gaps	1	1
42	П-6/8194	Guide pin for installation of valve lever	2	2
42	П-6/5771	Device for washing the valve lever	1	-
42	П-6/9389	Taper for mounting oil seal ring on push-rod lower casing	1	1
42	П-6/9227	Taper for installing oil seal ring on push-rod casing	1	1
42	П-6/9245	Device for displacing oil seal hose of push-rod casing	2	1
43	П-6/6011	Appliance for washing the tappet rods	1	-
-	700054	Valve spring compressor (See Fig.1, Ref. No. 25)	3	3
		Tools and Fixtures for Assembly of Supercharger		
15	П-6/9521	Stand for supercharger assembly (also used for crankcase nose-piece assembly)	3	-
44	П-6/9543	Plate for assembly of supercharger	2	-
44	П-6/10398	Plate for assembly of crankcase rear cover	2	-
45	А-6/6609) 45 А-6/6610)	Devices for checking parallel alignment of holes for accessories drive shaft and double-speed transmission shaft (used together with mandrels А-6/6591-5, А-6/6591-7 and А-6075-0345)	1	-
45	Ч-15/6960	Gauge for adjusting device А-6/6610	1	-
45	А-6/6591-5	Mandrel for checking axial and parallel alignment of holes for accessories drive shaft and double-speed transmission shaft	1	-
45	А-6/6591-7	Mandrel for checking axial and parallel alignment of holes for accessories drive shaft and double-speed transmission shaft	1	-
-	А-6075-0345	Mandrel for checking axial and parallel alignment of holes for accessories drive shaft and double-speed transmission shaft of	1	-

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1	2	3	4	5
		engines with 400-hour service life (used with mandrel A-6/6591-7)		
46	A-6/5907	Device for measuring clearances between teeth of reduction gear shaft planetary pinion and double-rim gear	1	1
46	K-6/1008	Closed wrench (S=13) for supercharger rear housing nuts	7	5
46	K-6/1021	Closed wrench (S=16) for supercharger front housing nuts	7	5
46	П-6/5913	Fixture for keeping gear box shaft from axial displacement	2	2
46	К-2/1408	Socket wrench (S=13) for crankcase rear cover nuts	5	3
46	К-2/1447	Socket wrench (S=7) for accessories drive shaft cover screws	7	5
47	П-6/10400	Appliance for installing accessories drive shaft springs	1	1
-	А 6350-0867	Appliance for installing accessories drive shaft springs (for engines with 400-hour service life)	1	1
48	П-6/7797	Plug for rear oil pump pipe union, used during pneumatic tests	1	-
48	П-6/8359	Removing stud (M6x1) for accessories drive shaft oil slinger	2	2
48	П-6/8002	Mandrel for mounting gear box shaft rubber ring	1	1
48	П-6/10813	Lifting attachment for mounting assembled supercharger	2	2
48	У-2/1930	Caulking tool for bending lugs of supercharger impeller nut lock	1	-
48	У-2/1870	Caulking tool for bending lugs of accessories drive shaft cover screw locks	1	1
48	У-2/1821	Caulking tool for locking screws of supercharger impeller shaft toe-bearing	1	-
48	П-6/9571	Fixture for assembly and disassembly of reduction gear shaft	1	2
-	А 6350-0868	Fixture for assembly and disassembly of reduction gear shaft (for engines with 400-hour service life)	1	1
49	А-6/3375	Fixture for checking gap in expander ring of double-speed transmission larger piston	1	1
49	Л-13/13138	Template for checking distance from accessories drive shaft end face to crankcase rear cover flange	1	-
49	А-14/1430	Plates (0.4 mm thick) for checking clearance between supercharger diffuser and impeller (used with feeler gauges)	2	2
49	К-2/1405	Wrench head for supercharger impeller shaft nut	4	3
49	К-1/1167	Open wrench (S=15) for high-pressure pipe nut	10	8
49	К-1/1213	Open wrench (S=6.5) for fuel pump drive attachment studs	3	3
49	К-1/1134	Open wrench (S=41) for oil sump pipe union	5	3
49	К-2/1425	Wrench head (S=11) for gear screws of transmission to HB-82B pump drive	5	3
50	К-2/1517	Wrench for upper auxiliary drive	4	3
50	К-2/1316	Socket wrench (S=9) for reduction gear shaft plug	2	1
50	П-6/10920	Plug for support to check travel of double-speed drive smaller piston	1	1
50	К-2/1374	Wrench for generator drive shaft nut	4	3
51	П-6/3694	Fixture for assembly and disassembly of double-speed drive friction clutch	1	1
-	А6350-0869	Fixture for assembly and disassembly of double-speed drive friction clutch (for engine with 400-hour service life)	1	1
51	А-6/5849	Fixture for checking travel of double-speed drive larger piston	1	1
52	П-6/10387	Appliance for washing the crankcase rear cover	1	-
52	К-2/1369	Wrench for supercharger impeller shaft nut	2	2
53	П-6/8368	Clamp for installing lock of double-speed drive friction clutch	1	1
53	П-6/10413	Ratchet for fixing supercharger impeller shaft against turning	2	2
53	П-6/9622	Appliance for washing reduction gear shaft	1	-
53	П-6/10447	Appliance for washing supercharger rear housing	1	-
53	П-6/10475	Appliance for washing accessories drive	1	-
		Tools and Fixtures for Assembly of HB-82B Pump Drive		
54	А-6/4771	Device for checking gear clearances	1	1
54	П-6/6507	Appliance for washing HB-82B pump drive body	1	-
54	П-6/6508	Appliance for washing HB-82B pump drive cover	1	-
54	К-17/1239	Appliance for checking axial alignment of crankcase rear cover groove with HB-82B pump drive shaft splines	1	1
54	К-17/2140	Gauge for checking axial alignment of HB-82B pump drive shafts	1	1

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1	2	3	4	5
		Appliances and Fixtures for Assembly of Revolution Counter Drive		
55	A-6/5890	Device for measuring drive gear clearances	1	1
55	П-6/10443	Appliance for washing the drive body	1	-
55	П-6/10484	Fixture for assembly and disassembly of drive	1	1
56	A-6/6239	Fixture for checking axial play of	1	1
56	A-6/6238	revolution counter drive shaft	1	1
		Fixture for Assembly of Oil Sump		
56	П-6/3562	Fixture for washing and air testing the oil sump	1	-
56	П-6/8871	Plug for oil sump drain pipe	2	-
56	П-6/3976	Plug for oil sump oil sucking off pipe union	1	-

Chapter III

REPAIR TOOLS AND FIXTURES

Fig. No.	Designation No.	Description	Quantity per set according to Specification СМРШ
1	2	3	4
		Gr.79. General purpose Tools	
57	630152	Appliance (wrench with set of tool posts) for driving in studs M6x1, M8x1, M10x1, M11x1, M12x1.5, M13x1.5	3
57	630207	Eccentric for removing studs, from 6 to 13 mm in dia.	3
57	630281	Appliance for screwing in bushings (threaded sleeves) with M8x1 inner thread	1
57	630282	Device for screwing in bushings (threaded sleeves) with M6x1 inner thread	1
57	630734	Universal handle bar for tools with square shanks	2
57	T-1/1009	Reamer for lock holes, 3 mm in dia.	1
57	У-50/1001	Remover No.3 for studs, 6 mm in dia.	3
57	У-50/1002	Remover No.4 for studs, 8 mm in dia.	3
57	У-50/1003	Remover No.5 for studs, 10 mm in dia.	3
58	М-2/1006	Tap M8x1.25, to calibrate holes for studs of crankcase rear cover, front oil pump, magneto, supercharger front housing diaphragm, РПД regulator, НВ-82В pump, double-speed transmission support, crankcase drain pipes and for studs of upper and lower auxiliary drive flanges	3
58	М-2/1032	Tap M10x1.5, to calibrate holes for studs of crankcase nose-piece, nose-piece thrust flange, front oil pump, generator, and for studs of lower auxiliary drive flange	3
58	М-2/1074	Tap M5x0.8, to calibrate threaded sleeves for screws of magneto and generator drive seal supporting rings	3
58	М-2/1076	Tap M5x0.8, to calibrate holes for studs of oil separators	3

1	2	3	4
58	M-2/1137	Tap M7x1, to calibrate holes for studs of front and rear oil pump filters	3
58	M-4/1033	Tap M6x1, to calibrate bushings serving to attach cylinder deflectors	3
58	M-2/1218	Tap 13x2, to calibrate holes for studs of mounting lugs and of supercharger front housing breathers	3
58	M-2/1219	Tap M11x1.5, to calibrate holes for studs of supercharger front housing, MB-82B pump, and starter	3
58	M-2/1291	Tap M8x1, to calibrate bushings (threaded sleeves) serving to fasten upper auxiliary and generator drive glands	3
58	M-2/1381	Tap M8x1.25, to calibrate holes of throttle box flanges	4
58	M-4/1063	Tap 12x1.5, to calibrate holes in oil pump bodies to receive threaded sleeves	3
		Tools and Fixtures for Repair of Crankshaft	
59	A-6/3974	Fixture for checking alignment of counterweight pin holes	1
60	630468	Lapping tool for crankpins	2
60	A-6/5803	Fixture for checking perpendicularity of rear counterweight bushing holes to counterweight slot	1
60	A-6/2909	Fixture for checking perpendicularity of front counterweight bushing holes to counterweight slot	1
60	A-6/5806	Mandrel for checking parallel alignment of pin holes in rear counterweight (used together with fixture A-6/3974)	1
60	A-6/5807	Mandrel for checking parallel alignment of pin holes in front counterweight (used together with fixture A-6/3974)	2
61	A-6/2134	Fixture for checking perpendicularity of counterweight bushing holes to slot working surface	1
61	П-6/8526	Fixture for pressing in bushings of front and rear counterweights	1
62	П-6/10532	Plate for fixture П-6/8526, for front counterweight	1
62	П-6/10756	Plate for fixture П-6/8526, for rear counterweight	1
62	A-6/4168	Fixture for testing counterweight bushing surfaces with marking compound	1

1	2	3	4
		Tools and Fixtures for Repair of Second Order Balancer Support	
63	П-3/10011	Jig, to drill and enlarge holes for stops	1
63	П-6/10210	Appliance for pressing on bushing of balancer support	1
63	E-1/6182	Mandrel for buffing balance support bushing	1
64	Ч-2/1097	Jig bushing, to preliminary enlarge holes for balancer support bushing stops (used together with jig П-3/10011)	2
64	Ч-2/1096	Jig bushing, to size holes for balancer support bushing stops (used together with jig П-3/10011)	2
64	T-1/1387	Finishing reamer to make holes for support bushing oversize stops	2
64	T-1/1386	Reamer for preliminary sizing of holes for support bushing oversize stops	2
		Tools and Fixtures for Repair of Crankcase Intermediate Section	
65	M-4/1269	Tap M11x1.5, to calibrate thread in crankcase holes for cylinder attachment bolts	7
65	M-4/1264	Tap with effective diameter enlarged by 0.5 mm (M11.5x1.5), to thread crankcase holes for cylinder attachment bolts	9
		Tools and Fixtures for Repair of Timing Mechanism Cam Ring and Double-Rim Gear	
66	П-1/4457	Fixture for cam ring, used when expanding bushings	1
67	П-5/4135	Fixture for grinding cam ring bushing	1
68	K-1/1023	Roller for setting cam ring by splines	8
68	K-1/1015	Roller for checking double-rim gear position when set for bushing grinding	8
68	E-1/5473	Mandrel for setting double-rim gear when recessing the bushing end face	1
68	Ж-40/1416	Rolling-in tool for cam ring bushings	1
68	C-1/1193	Drill for double-rim gear bushing lock hole	3
68	T-4/1195	Reamer for double-rim gear bushing lock hole	3
68	П-6/8011	Device for pressing in double-rim gear bushing	1
68	П-3/9911	Fixture for drilling lock hole in double-rim gear bushing	1
		Tools and Fixture for Repair of Connecting Rods	
69	630398	Tools and appliances for replacing connecting rod bushings (set of punches, blocks, broaches, rolling-in tools and countersink for pressing,	1

1	2	3	4
		sealing and facing the bushings)	
69	630399	Box for tools and appliances 630398	1
70) 71) 72)	П-6/10905	Jig for boring connecting rod bushings	1
73	630716	Reducing gear for longitudinal feed of cutting tool when boring the bushings (used with jig П-6/10905)	1
74	630718	Cutting tool used to bore master rod crankpin end bushing	5
74	630719	Cutting tool used to bore articulated connecting rod crankpin end bushings	5
74	630720	Cutting tool used to bore connecting rod piston end bushings	5
74	А-5/1604	Mandrel for master rod crankpin end hole used when checking distance between hole axes and parallel alignment of rod holes (used with fixture А-6/1681 and mandrel А-5/2490)	1
74	630721	Template for checking shape of cutting tools 630719 and 630720	1
74	630706	Fixture for pressing in and removing master rod crankpin end bushing	1
74	630562	Guide pins for pressing in master rod crankpin end bushing	2
74	А-5/2490	Mandrel for holes of master rod and articulated rod piston end bushings used when checking distance between hole axes and parallel alignment of connecting rod holes (used with fixture А-6/1681 and mandrels А-5/1604 and А-5/2488)	1
74	А-5/2471	Mandrel for master rod check holes used when checking parallel alignment of knuckle pin hole axes (used with fixture А-6/1681 and mandrel А-5/2490)	1
74	А-5/2488	Mandrel for holes of articulated connecting rod crankpin end bushing used when checking distance between hole axes and parallel alignment of connecting rod holes (used with fixture А-6/1681 and mandrel А-5/2490)	1
75	Б-2/1165	Broach for zero group bushings of articulated connecting rod crankpin ends	1
75	Б-2/1512	Broach for zero group bushings of connecting rod piston ends	1
75	Б-2/1643	Sealing broach for III and IV group bushings of connecting rod piston ends (included into set 630398)	1
75	Б-2/1644	Sealing broach for I and II group bushings of connecting rod piston ends (included into set 630398)	1
75	Б-2/1645	Sealing broach for III and IV group bushings	1

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1	2	3	4
		of articulated connecting rod crankpin ends (included into set 630398)	
75	Б-2/1646	Sealing broach for I and II group bushings of articulated connecting rod crankpin ends (included into set 630398)	1
75	Д-5/1278	Stone holder for honing head У-41/1513	12
75	Д-5/1724	Stone holder for honing head У-41/2147	8
76	А-6/1681	Fixture for checking distance between connecting rod bushing hole axes and parallel alignment of hole axes	1
77	Л-13/12390	Depth gauge for adjusting travel of cutting tools when boring the master rod crankpin end bushing	1
77	Л-13/12391	Depth gauge for adjusting travel of cutting tools when boring the connecting rod piston end bushings	1
77	Л-13/12392	Depth gauge for adjusting travel of cutting tools when boring the articulated rod crankpin end bushings	1
77	У-40/1030	Insert for honing head У-41/1513 (See Fig.80)	7
77	У-40/1130	Insert for honing head У-41/2147 (See Fig.80)	6
77	У-45/1015	Rolling-in tool for connecting rod piston end bushings (included into set 630398, used with tool holder НГ-2/1002)	1
77	У-45/1016	Rolling-in tool for articulated connecting rod crankpin end bushings (included into set 630398, used with tool holder НГ-2/1002)	1
77	НГ-2/1002	Chuck for rolling-in tools У-45/1015 and У-45/1016	1
77	НД-6/1009	Holder for counterbore П-2/1419 (included into set 630398)	1
77	П-2/1419	Counterbore for facing connecting rod bushings (included into set 630398)	2
77	П-6/3497	Pliers for compressing connecting rod piston end bushings before pressing them in	1
77	П-6/3498	Pliers for compressing articulated connecting rod crankpin end bushings before pressing them in	1
78	П-12/1436	Fixture for honing bushing hole in master rod crankpin end	1
79	П-12/2079	Fixture for honing knuckle pin holes in master rod cheek	1
79	П-12/1747	Centring bushing for fixture П-12/2079	1
80	У-41/2147	Honing head for master rod cheek holes	1
80	У-41/1513	Honing head for articulated connecting rod pins designed for articulated connecting rod pins Honing head for hole to receive master rod crankpin	1
		Tools and Fixtures for Repair of Cylinders	
81	У-41/1282	Honing head for cylinder liner	1

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1	2	3	4
82	П-3/9432	Fixture for setting cylinder when enlarging the intake and exhaust valve guides	1
83	Д-6/1003	Holder for reamer Т-06/1133 for exhaust valve guide	1
83	Е-1/1013	Mandrel for pressing in intake valve guide	1
83	К-18/4687	Gauge for checking concentricity of exhaust valve guide hole and valve seat face	1
83	К-18/6105	Gauge for checking concentricity of intake valve guide hole and valve seat face	1
83	НГ-2/1004	Chuck for reamer Т-05/1350 of intake valve guide	1
77	НГ-2/1002	Chuck for reamer Т-06/1133 of exhaust valve guide (used with holder Д-6/1003)	1
83	Х-2/1081	Bit stock for cleaning intake and exhaust valve guide holes	1
83	Т-06/1133	Reamer for exhaust valve guide	3
83	Т-05/1350	Reamer for intake valve guide	3
84	Т-1/1447	Reamer for sizing the intake valve guide	2
84	Т-1/1446	Reamer for sizing the exhaust valve guide	2
85	П-6/9980	Device for pressing out exhaust valve floating seat	1
85	НБ-6/1002	Adapter bushing for boring hole receiving the exhaust valve guide	1
85	П-6/9324	Wedge bushing for exhaust valve seat	5
85	Ц-1/2242	Counterbore for making exhaust valve guide hole	2
85	Т-1/1429) Т-1/1430) Т-1/1431)	Reamers for holes receiving the exhaust valve guides	2 2 2
86	П-6/9372	Expander for centring the reamer when finishing the exhaust valve guide hole	1
86	А-6/5354	Fixture for measuring exhaust valve seat diameter	1
86	Ч-15/5032	Gauge to adjust fixture А-6/5354	1
86	П-6/9333	Fixture for pressing in exhaust valve floating seat	1
87	П-6/11070	Fixture for pressing in exhaust valve guide	1
87	А-6/5399	Fixture for checking concentricity of exhaust valve guide and floating seat	1
88	630781	Holder of lapping tool Ж-41/1860 for exhaust valve	3
88	Д-5/1593	Holder of lapping tool Ж-41/1859 for exhaust valve seat	3
88	630141	Wrench for lapping exhaust valve and its seat	4
88	630761	Appliance for manual counterboring the valve seats (used with counterbore 630615)	1
88	Ж-41/1859	Lapping tool for exhaust valve seat	10
88	Ж-41/1860	Lapping tool for exhaust valve	10

1	2	3	4
86	630160	Wrench for lapping the intake valve and its seat	4
88	630615	Counterbore for manual counterboring the valve seats (used with fixture 630761)	8
89	М-2/1448	Tap (2М24х1.5), to tap out hole for spark plug bushing	4
89	М-2/1489	Tap (1М20х1.5), to tap out hole for injector bushing	4
90	К-3/1096	Device for screwing in injector bushing	1
90	К-3/1002	Device for screwing in spark plug bushing	1
90	М-2/1230	Tap (М14 х 1.25) for calibrating the injector bushing thread	4
90	М-2/1355	Tap (М18 х 1.5) for calibrating the spark plug bushing thread	4
90	П-3/4853	Jig, to drill lock hole in spark plug bushing	1
90	П-3/8021	Jig, to drill lock hole in injector bushing	1
		Devices for Repair of Valve Levers	
91	П-6/11086	Device for pressing bearing into valve lever	1
91	П-6/1636	Device for pressing bearing out of valve lever	1
		Tools and Devices for Repair of Supercharger Impeller Drive Double-Rim Gear	
92	К-1/1422	Roller for setting double-rim gear when grinding the bushing	8
92	К-1/1209	Roller for correcting double-rim gear by its inner rim when grinding the bushing	8
92	П-6/10329	Device for rolling in the bushing	1
92	П-6/10302	Device for pressing in the bushing	1
92	Т-18/1194	Reamer for enlargement of double-rim gear bushing	3
-	А6125-0019	Reamer for enlargement of double-rim gear bushing (for engines with 400-hour service life)	2
92	Ж-40/1880	Rolling-in tool for double-rim gear bushing	1
		Tools and Devices for Repair of Auxiliary Drive Oil Seals	
93	Д-5/1514	Holder of lapping tool for spherical surface of revolution counter drive packing ring	1
93	П-12/2069	Mandrel for lapping spherical surface of revolution counter drive supporting ring	1
93	Д-5/1511	Holder of lapping tool for end faces of generator and magneto drive packing rings	1
93	Е-1/5514	Mandrel for lapping spherical surface of revolution counter drive packing ring	2
93	П-6/3458	Ring (dummy) for fixing magneto drive thrust ring during lapping	1

1	2	3	4
93	Д-5/1513	Holder of lapping tool for end faces of revolution counter drive packing ring	1
93	П-12/2023	Holder of lapping tool for magneto drive supporting ring	1
93	П-6/7670	Ring (dummy) for fixing generator drive supporting ring during lapping	1
93	Д-5/1631	Holder of lapping tool for generator drive supporting ring	1
93	У-41/1978	Lapping tool for spherical surface of generator drive supporting ring	3
93	У-41/2110	Lapping tool for counter drive shaft	2
93	П-12/2022	Mandrel for lapping spherical surface of generator and magneto drive packing rings	1
93	П-12/1839	Mandrel for lapping end face of revolution counter drive packing ring	1
93	У-41/2024	Lapping tool for end face of generator drive supporting ring	3
93	Д-5/1603	Holder of lapping tool for end faces of generator drive supporting ring	1
93	П-12/2058	Mandrel for lapping end face of revolution counter drive supporting ring	1
93	П-12/2115	Mandrel for lapping end face of magneto drive shaft	1
93	П-12/1719	Mandrel for lapping end face of generator drive coupling	1
93	П-19/1009	Mandrel for lapping spherical surface of generator drive supporting ring.	1

Chapter 4

TOOLS AND FIXTURES FOR FIELD REPAIRS

Fig. No.	Designation No.	Description	Quantity per set according to Specification CHBP
1	2	3	4
		General Purpose Tools and Fixtures	
1	701746	Kit with aircraft borne tools	1
5	630317	Timing gauge for determining piston T.D.C.	1
9	К-7/1015	Torque indicating wrench, calibrated from 0 to 13 kg-m	1
9	К-7/1022	Torque indicating wrench, calibrated from 10 to 40 kg-m	1
9	К-7/1027	Torque indicating wrench, calibrated from 0 to 18 kg-m	1
12	П-6/11443	Fixture for turning crankshaft by fan support (instead of cranking tool П-6/10538)	1
13	П-6/10518	Nut for lifting engine by clutch splined collar	1
13	П-6/10541	Lifting attachment for turning crankcase (assembled with crankshaft) by its splined flange	1
97	630152	Appliance (wrench with set of tool posts) for studs M6x1, M8x1, M10x1, M11x1, 12x1.5, 13x1.5	1
97	630207	Eccentric for removing studs, from 6 to 13 mm in dia.	1
97	630281	Appliance for screwing in threaded bushings with M8x1 inner thread	1
97	630282	Device for screwing in bushings with M6x1 inner thread	1
97	630734	Handle bar for tools with square shanks	1
97	У-30/1001	Remover No. 3 for bushings and studs, 6 mm in dia.	2

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1	2	3	4
77	[illegible]	Reamer No. 4 for bushings and studs, 8 mm in dia.	2
77	[illegible]	Reamer No. 5 for bushings and studs, 12 mm in dia.	2
78	69078	Gauge for measuring compression in engine cylinders	1
		Tools and Fixtures for Repair of Ignition Distributors and Drive	
7	K-7/1522	Torque indicating wrench, calibrated from 15 to 45 kg-m (calibrated end used together with vrench T-41/1521)	1
11	[illegible]	Mandrel for installing fan rotor and fairing	1
12	[illegible]	Fixture for keeping splined collar from turning when tightening its nut	1
16	T-41/1521	Retaining gear unit for tightening intermediate shaft coupling bolt (calibrated and used together with wrench K-7/1522)	1
17	K-1/1525	Wrench head (14), for oil separator nuts	1
18	K-2/1448	Wrench head (Se13), for fan rotor bolts	1
18	K-2/1522	Wrench head (Se13), for straightener nuts	1
18	K-2/1523	Wrench (Se13), for splined collar nut	1
19	K-2/1524	Wrench for pressure collar nut	1
19	K-2/1525	Wrench for splined collar nut	1
20	P-4/10519	Remover for crankcase nose-piece with clutch	1
20	K-2/1550	Wrench for intermediate shaft coupling bolt	1
22	P-4/10676	Remover for splined collar	1
22	P-4/10654	Device for installing splined collar on intermediate shaft	1
23	P-4/10517	Air supplying device used to check friction clutch piston travel	1
23	P-4/10520	Remover for adapter flange, to pull it from clutch splined collar	1
		Tools and Fixtures for Repair of Engine Cylinders	
1	70054	Valve spring compressor	1
36	630021	Stand for assembly and disassembly of cylinder	1
38	K-2/1553	Wrench for cylinder bolts (to be used with a dynamometer)	2
39	70136J	Double-end closed wrench (S=7x7) for intake and exhaust valve coupling bolts	2
39	70038J	Socket wrench (Se14) for cylinder bolts	2
40	K-1/1076	Open-end wrench (Se14) for cylinder bolts (used for primary tightening)	2
41	P-4/10485	Piston ring compressor	1
42	P-4/8194	Guide pin for mounting valve levers	1

1	2	3	4
42	P-6/9389	Taper for installing oil seal ring on push-rod lower casing	1
42	P-6/9227	Taper for installing oil seal ring on push-rod casing	1
45	M-4/1269	Tap (M11x1.5), to calibrate thread in crankcase holes for cylinder attachment bolts	1
45	M-4/1264	Tap with effective diameter enlarged by 0.5 mm (11.5x1.5), to thread crankcase holes for cylinder bolts	1
45	P-6/9324	Wedge bushing for exhaust valve seat	3
46	630781	Holder of lapping tool Y-41/1860 for exhaust valve	1
46	K-5/1593	Holder of lapping tool Y-41/1859 for exhaust valve seat	1
46	630161	Wrench for lapping exhaust valve and its seat	1
46	630761	Appliance for manual counterboring the valve seats (used with counterbore 630615)	1
46	Y-41/1859	Lapping tool for exhaust valve seat	10
46	Y-41/1860	Lapping tool for exhaust valve	10
46	630160	Wrench for lapping the intake valve and its seat	1
46	630615	Counterbore for manual treatment of valve seats (used with appliance 630761)	1
90	K-3/1096	Device for screwing in injector bushing (thread 14x1.25)	1
90	K-3/1002	Device for screwing in spark plug bushing (thread 1M18x1.5)	1
90	M-2/1230	Tap 14x1.25 for calibrating thread in injector bushing	1
90	M-2/1355	Tap 1M18x1.5 for calibrating thread in spark plug bushing	1
90	P-3/4853	Jig, used to drill lock hole in spark plug bushing	1
90	P-3/8021	Jig, used to drill lock hole in injector bushing	1
		Tools and Fixtures for Repair of Supercharger	
46	K-6/1008	Closed-end wrench (S=1) for supercharger rear housing nuts	1
48	P-6/8359	Removing stud (thread M6x1) for accessories drive oil slinger	1
49	K-1/1167	Open-end wrench (S=15) for high-pressure pipe nut	2
49	K-1/1213	Open-end wrench (Se6.5) for studs fastening fuel pump drive	1
49	K-1/1134	Open-end wrench (S=41) for oil susp pipe union.	1

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Chapter 5

LIST OF MOUNTING AND REPAIR TOOLS AND FIXTURES
ARRANGED AS TO DESIGNATION NUMBER INCREASE

Fig. No.	Designation No.	Description	Quantity according to Specification CKP2 651	CKM 651	CL 6
1	2	3	4	5	6
40	A-1/1208 (AM-2226)	Appliance for measuring intake and exhaust valve lift	1	-	-
74	A-5/1604 (DT-1882)	Mandrel for master rod crankpin end holes; used when checking distance between hole axes and parallel alignment of master rod holes (used with fixture A-6/1681 and mandrel A-5/2490)	1	-	-
74	A-5/2471 (K6075/0132)	Mandrel for master rod check holes; used when checking parallel alignment of axes of knuckle pin holes (used with fixture A-6/1681 and mandrel A-5/2490)	1	-	-
74	A-5/2498 (K6075/0048)	Mandrel for holes of articulated rod crankpin end bushing hole; used when checking distance between hole axes and parallel alignment of connecting rod hole axes (used with fixture A-6/1681 and mandrel A-5/2490)	1	-	-
74	A-5/2490 (K6075/0052)	Mandrel for holes of master rod and articulated connecting rod piston end bushing holes; used when checking distance between hole axes and parallel alignment of connecting rod holes (used with fixture A-6/1681 and mandrels A-5/1604 and A-5/2488)	1	-	-
76	A-6/1681 (AM-1387)	Fixture for checking distance between connecting rod bushing hole axes and parallel alignment of hole axes	1	-	-
61	A-6/2134 (AM-1408)	Fixture for checking perpendicularity of counterweight bushing holes to slot working surface	1	-	-
60	A-6/2909 (AM-1405)	Fixture for checking perpendicularity of front counterweight bushing holes to counterweight slot	1	-	-
26	A-6/3316 (K6360/0233)	Fixture for checking crankshaft run-out	1	-	-
49	A-6/3375 (AM-1503)	Fixture for checking gap in double-speed drive larger piston expander ring	1	1	-
59	A-6/3974 (K6360/0191)	Fixture for checking parallel alignment of pin holes in counterweights	1	-	-
40	A-6/4008 (K6360/0085)	Fixture for measuring piston ring side clearances	1	1	-
62	A-6/4168 (K6360/0324)	Fixture for checking counterweight bushing surfaces with marking compound	1	-	-
54	A-6/4771 (K6360/0029)	Device for checking gear clearances in HB-62B pump drive	1	1	-
39	A-6/4973 (K6360/0461)	Appliance for measuring concentricity of exhaust valve seat	1	1	-
86	A-6/5354 (K6360/0551)	Fixture for checking diameter of exhaust valve seat	1	-	-
87	A-6/5395 (K6360/0461)	Fixture for checking concentricity of exhaust valve guide and floating seat	1	-	-
39	A-6/5464 (K6360/0084)	Appliance for checking valve lever bearing play	1	1	-
36	A-6/5489 (K6035/0046)	Ring for levelling knuckle pin ends	1	1	-
26	A-6/5801 (K6360/0202)	Indicator clamp for measuring elongation of crankshaft coupling bolts	1	1	-
60	A-6/5803 (K6360/0326)	Fixture for checking perpendicularity of rear counterweight bushing holes to counterweight slot	1	-	-
60	A-6/5806 (K6360/0328)	Mandrel for checking parallel alignment of pin holes in rear counterweight (used with fixture A-6/3974)	1	-	-
60	A-6/5807 (K6360/0193)	Mandrel for checking parallel alignment of pin hole in front counterweight (used with device fixture A-6/3974)	2	-	-
51	A-6/5849 (K6360/0487)	Fixture for checking travel of double-speed drive larger piston	1	1	-
55	A-6/5890 (K6360/0031)	Device for measuring gear clearances in revolution counter drive	1	1	-
17	A-6/5894 (K6360/0489)	Device for checking bevel gear clearances in magneto drive	1	1	-
46	A-6/5907 (K6360/0527)	Device for measuring clearances between teeth of reduction gear shaft planetary pinions and double-rim gear	1	1	-
17	A-6/5981	Dynamometer (with adapter), calibrated	2	1	-

1	2	3	4	5	6
	(K6360/0488)	from 1000 to 3000 gr; to measure friction of engagement clutch shifter slide valve			
17	A-6/6019 (K6360/0234)	Device for measuring clearances between spur gear teeth of magneto and front oil pump drives	1	1	-
24	A-6/6100 (K6360/0486)	Device for checking clearances in bevel gears of magneto, front oil pump and fuel pump drives	2	2	-
56	A-6/6238 (K6360/0491)	Fixtures for checking axial play of revolution counter drive shaft	1	1	-
56	A-6/6239) (K6360/0027)		1	1	-
45	A-6/6591-5)	Mandrels for checking axial and parallel	1	-	-
45	A-6/6591-7) (K6075/0164)	alignment of holes for accessories drive shaft and double-speed transmission shaft	1	-	-
45	A-6/6609) (K6360/0485)	Fixtures for checking parallel alignment of holes for accessories drive shaft and	1	1	-
45	A-6/6610) (K6360/0484)	double-speed transmission shaft (used with mandrels A-6/6591-5, A-6/6591-7 and A-6075-0345)	1	1	-
17	A-12/1639 (K6075/0165)	Calibrated sleeve, to check clearance between pressure collar adjusting ring and spring well end face	1	1	-
26	A-14/1285 (K6018/0002)	Feeler gauge for checking clearances in master rod side sealing	3	2	-
49	A-14/1430 (K6034/0193)	Plates (0.4 mm thick) for checking clearance between diffuser and impeller (used with feeler gauge)	2	2	-
75	Б-2/1165 (ПР-544)	Broach for zero group bushings of articulated rod crankpin ends	1	-	-
75	Б-2/1512 (ПР-545)	Broach for zero group bushings of connecting rod piston ends	1	-	-
75	Б-2/1643 (ПР-777)	Sealing broach for III and IV group bushings of connecting rod piston ends (included into set 630398)	1	-	-
75	Б-2/1644 (ПР-799)	Sealing broach for I and II group bushings of connecting rod piston ends (included into set 630398)	1	-	-
75	Б-2/1645 (ПР-779)	Sealing broach for III and IV group bushings of articulated rod crankpin ends (included into set 630398)	1	-	-
75	Б-2/1646 (ПР-776)	Sealing broach for I and II group bushings of articulated rod crankpin ends (included into set 630398)	1	-	-
75	Д-5/1278 (АЗ-1039)	Stone holder for honing head Ж-41/1513	12	-	-
93	Д-5/1511 (K6274/0002)	Holder of lapping tool for generator and magneto drive packing ring end faces	1	-	-

1	2	3	4	5	6
	Д-5/1513 (K6351/0035)	Holder of lapping tool for revolution counter drive packing ring end faces	1	-	-
93	Д-5/1514 (K6351/0036)	Holder of lapping tool for spherical surface of revolution counter drive packing ring	1	-	-
93	Д-5/1593 (K6465/0019)	Holder of lapping tool Ж-41/1859 for exhaust valve seat	3	-	1
93	Д-5/1603 (K6278/0003)	Holder of lapping tool for generator drive supporting ring end face	1	-	-
93	Д-5/1631 (K6351/0025)	Holder of lapping tool for generator drive supporting ring	1	-	-
75	Д-5/1724 (АЗ-1840)	Stone holder for honing head Ж-41/2147	8	-	-
	Д-5/1739 (K6465/0006)	Tool holder for sizing knuckle pin large holes in master rod cheek (interchangeable with tool holder Д-5/1720, Fig. 36)	1	1	-
	Д-5/1740 (K6465/0005)	Tool holder for cleaning knuckle pin small holes in master rod cheek (interchangeable with tool holder Д-5/1721, Fig. 36)	1	1	-
83	Д-6/1003 (ДВ-348)	Holder for reamer Т-06/1133 for exhaust valve guide	1	-	-
83	Е-1/1013 (K6350/0182)	Mandrel for pressing in intake valve guide	1	-	-
68	Е-1/5473 (K6315/0065)	Mandrel for mounting valve timing mechanism double-rim gear when recessing the bushing end face	1	-	-
93	Е-1/5518 (K6351/0031)	Mandrel for lapping spherical surface of revolution counter drive packing ring	2	-	-
63	Е-1/6182 (K6331/0051)	Mandrel for buffing bushing of second order balancer support	1	-	-
40	К-1/1076 (K6441/0027)	Open wrench (S=14) for cylinder bolt preliminary tightening	7	5	2
49	К-1/1134 (K6441/0025)	Open wrench (S=41) for oil pump pipe union	5	3	1
49	К-1/1167 (МК-720)	Open wrench (S=15) for high-pressure pipe nut	10	8	2

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1	2	3	4	5	6
9	K-1/1[illegible] (K6A41/0069)	Wrench for ignition harness nuts	5	4	-
40	K-1/1[illegible] (K6A41/0068)	Open wrench for push-rod casing nuts	6	5	-
49	K-1/1[illegible] (K6A41/0064)	Open wrench (S=16.5) for fuel pump drive attachment studs	2	3	1
17	K-1/1222 (K6A41/0059)	Wrench head (S=15) for ratchet piston body attachment nuts	5	3	-
17	K-1/1225 (K6A41/0030)	Wrench head (S=9) for oil separator attachment nuts	5	4	1
17	K-1/1226 (K6A42/0059)	Wrench head (S=15) for nuts fastening splined collar to intermediate clutch	5	4	-
63	K-2/1081 (K6A42/0142)	Bit stock for cleaning bores of intake and exhaust valve guide holes	1	-	-
31	K-2/1[illegible] (K-[illegible])	Socket wrench for plug of timing mechanism double-rim gear shaft	7	4	-
26	K-2/1231 (K6A42/0016)	Socket wrench (S=14) for counterweight pin bolt nuts	5	3	-
40	K-2/1280 (K6A42/0096)	Socket wrench (S=17) for injectors	5	3	-
26	K-2/1[illegible] (K6A42/0010)	Wrench head for nut of crankshaft middle part plug bolt (shown in Dwg K-2/1225)	5	2	-
50	K-2/1316 (K6A42/0028)	Socket wrench (S=9) for reduction gear shaft plug	2	1	-
31	K-2/1349 (K6A42/0081)	Socket wrench for attachment bolts of crankshaft split rings (according to Dwg K-2/1305)	7	5	-
27	K-2/1362 (K6A42/0004)	Wrench for crankshaft rear part nut	5	3	-
52	K-2/1369 (K6A42/0098)	Wrench for supercharger impeller shaft nut	2	2	-
50	K-2/1374 (K6A42/0031)	Wrench for generator drive shaft nut	4	3	-
49	K-2/1405 (K6A42/0091)	Wrench head for supercharger impeller shaft nut	4	3	-
18	K-2/1410 (K6A42/0029)	Socket wrench (S=15) for high-pressure pipe nuts	6	5	-

1	2	3	4	5	6
29	K-2/1425 (K6A42/0092)	Wrench head (S=11) for gear screws of transmission to HB-82B pump drive	5	3	-
45	K-2/1447 (K6A42/0090)	Socket wrench (S=7) for accessories drive shaft cover screws	7	5	-
18	K-2/1448 (K6A42/0107)	Wrench head (S=15) for fan rotor bolts	5	4	1
32	K-2/1450 (K6A42/0084)	Wrench (S=17) for crankshaft split ring bolts	7	5	-
36	K-2/1472 (HK-796)	Socket wrench (S=16) for master rod bushing lock bolts	7	5	-
32	K-2/1480 (K6A42/0082)	Socket wrench (S=11) for tappet guide nuts	7	5	-
46	K-2/1488 (K6A42/0077)	Socket wrench (S=13) for crankcase rear cover nuts	5	3	-
36	K-2/1502 (K6A42/0011)	Wrench head (S=16) for bolts of master rod bushing lock (used with wrench K-7/1027, Fig. 9)	6	2	-
18	K-2/1514 (K6A42/0079)	Wrench for magneto drive shaft nut	5	5	-
18	K-2/1515 (K6A42/0067)	Wrench for front oil pump drive shaft nut	5	5	-
50	K-2/1517 (K6A42/0068)	Wrench for upper auxiliary drive shaft nut	4	3	-
27	K-2/1520 (K6A42/0020)	Bit stock for crankshaft coupling bolts	3	2	-
18	K-2/1522 (K6A42/0019)	Wrench head (S=13) for straightener nuts	5	3	1
18	K-2/1523 (K6A42/0060)	Wrench (S=130) for splined collar nut	3	4	1
19	K-2/1524 (K6A42/0071)	Wrench for pressure collar nut	5	3	1
19	K-2/1525 (K6A42/0072)	Wrench for splined collar nut	4	3	1
19	K-2/1526 (K6A42/0070)	Wrench for preliminary tightening of intermediate shaft coupling bolt	4	3	-
20	K-2/1550 (K6A42/0104)	Wrench for intermediate shaft coupling bolt	5	4	1

1	2	3	4	5	6
38	K-2/1551 (K6442/0080)	Socket wrench for tappet guide nuts (used with an air drill)	8	8	-
38	K-2/1553 (701936)	Wrench for cylinder bolts (used with a dynamometer	15	10	2
31	K-2/1560 (K6442/0066)	Socket wrench (S=11) for screws of timing mechanism elastic double-rim gear cover	5	3	-
90	K-2/1002 (KK-817)	Device for screwing in spark plug bushing	1	-	1
90	K-3/1096 (ДК-52)	Device for screwing in injector bushing	1	-	1
46	K-6/1008 (K6442/0076)	Closed wrench (S=13) for supercharger rear housing nuts	7	5	1
46	K-6/1021 (K6350/0232)	Closed wrench (S=16) for supercharger front housing nuts	7	5	-
18	K-6/1114 (K6441/0013)	Closed wrench (S=15) for ratchet piston nuts	6	5	-
32	K-6/1139 (K6442/0086)	Box-wrench (S=18) for crankcase coupling bolts	7	4	-
31	K-6/1140 (K6442/0085)	Box-wrench (S=19) for crankcase coupling bolts	6	5	-
27	K-6/1148 (K6442/0087)	Double-end closed wrench (S=16x17) for crankshaft rear part lubricating nozzle	5	3	-
18	K-6/1149 (K6442/0075)	Closed wrench (S=19) for fixing magneto and front oil pump drive shafts against turning	4	3	-
31	K-6/1150 (K6442/0012)	Wrench head (S=19) for crankcase coupling bolt nuts (instead of wrench head K-6/1121)	5	3	-
27	K-6/1152 (K6441/0004)	Wrench for crankshaft coupling bolts	7	5	-
19	K-6/1161 (K6442/0018)	Wrench for front oil pump reducing valve	4	4	-
9	K-7/1015 (701196)	Torque indicating wrench, calibrated from 0 to 13 kg-m	6	3	1
9	K-7/1022 (K6442/0065)	Torque indicating wrench, calibrated from 10 to 40 kg-m	4	2	1
9	K-7/1025 (K6442/0058)	Torque indicating wrench, calibrated from 0 to 5 kg-m	3	2	-

1	2	3	4	5	6
	K-7/1026 (K6442/0052)	Torque indicating wrench, calibrated from 0 to 1 kg-m	3	2	-
9	K-7/1027 (K6442/0064)	Torque indicating wrench, calibrated from 0 to 18 kg-m	3	3	1
60	K-1/1015 (AO-1226)	Roller for checking timing mechanism double-rim gear position when grinding the bushing	8	-	-
60	K-1/1023 (K9-501)	Roller for setting oom ring by its splines	8	-	-
52	K-1/1209 (K6084/0473)	Roller for setting supercharger impeller drive double-rim gear by its inner rim when grinding the bushing	8	-	-
92	K-1/1422 (K6390/0013)	Roller for setting supercharger impeller drive double-rim gear when grinding the bushing	8	-	-
54	K-17/2139 (K6063/0024)	Gauge for checking axial alignment of crankcase rear cover recess with HB-82B pump drive shaft splines	1	1	-
54	K-17/2140 (K6063/0025)	Gauge for checking axial alignment of HB-82B pump drive shafts	1	1	-
42	K-18/3783 (K6084/0206)	Gauge for selecting piston rings by their gap clearances	1	1	-
83	K-18/4887 (KY-639)	Gauge for checking concentrical alignment between exhaust valve guide bore and seat face	1	-	-
83	K-18/6105 (K6035/0145)	Gauge for checking concentrical alignment between intake valve guide bore and seat face	1	-	-
40	K-13/9321 (K6031/0263)	Depth-gauge for measuring valve stem sinking in relation to spring retainer on assembled engine	1	1	-
77	K-13/12390 (K6084/0421)	Depth-gauge for adjusting travel of cutting tools when boring the master rod crankpin end bushing	1	-	-
77	K-13/12391 (K6084/0411)	Depth-gauge for adjusting travel of cutting tools when boring the connecting rod piston end bushings	1	-	-

1	2	3	4	5	6
77	A-13/12332 (Д6,05/0410)	Depth-gauge for adjusting travel of cutting tools when boring the articulated rod crankpin end bushings	1	-	-
49	A-13/13138 (Д6031/0061)	Template for checking distance between accessories drive shaft end face and crankcase rear cover flange	1	-	-
36	A-18/11394 (Д6035/0143)	Template for measuring master rod crankpin bushing inner diameter with a hole indicating gauge	1	1	-
58	M-2/1006 (Д6134/0023)	Tap M8x1.25, to calibrate holes for studs of crankcase rear cover, front oil pump, magneto, supercharger front housing diaphragm, РПК regulator, НВ-82В pump, double-speed transmission support crankcase oil drain pipes, and for studs of upper and lower auxiliary drive flanges	3	-	-
58	M-2/1032 (Д6134/0066)	Tap M10x1.5, to calibrate holes for studs of crankcase nose-piece, crankcase nose-piece thrust flange, front oil pump, generator and for studs of lower auxiliary drive flange	3	-	-
58	M-2/1074 (ПС-709)	Tap M5x0.8, to calibrate adapter sleeves for screws of magneto and generator drives seal supporting rings	3	-	-
58	M-2/1076 (Д6134/0105)	Tap M5x0.8, to calibrate holes for oil separator studs	3	-	-
58	M-2/1137 (Д6134/0026)	Tap 6x1, to calibrate holes for studs of front and rear oil pump filters	3	-	-
58	M-2/1218 (Д6134/0050)	Tap 13x2, to calibrate holes for studs of engine mounting lugs and supercharger front housing breathers	3	-	-
58	M-2/1219 (Д6134/0075)	Tap M11x1.5, to calibrate holes for studs of supercharger front housing, НВ-82В pump and starter	3	-	-
90	M-2/1230 (ПС-716)	Tap 14x1.25, to calibrate thread in injector adapter sleeve	4	-	1
58	M-2/1291 (Д6134/0055)	Tap M8x1, to calibrate bushings(adapter sleeves)serving to fasten generator and upper	3	-	-

1	2	3	4	5	6
		auxiliary drive glands			
90	M-2/1355 (ПС-1005)	Tap wrench M18x1.5, to calibrate spark plug bushing	4	-	1
58	M-2/1381 (Д6134/0039)	Tap 8x1.25, to calibrate holes in throttle box flanges	4	-	-
89	M-2/1448 (Д6134/0083)	Tap 2M24x1.5, to thread holes for spark plug bushing	4	-	-
89	M-2/1489 (Д6134/0082)	Tap M20x1.5, to thread hole for nozzle bushing	4	-	-
58	M-4/1033 (ПС-602)	Tap M6x1, to calibrate holes in cylinder deflector attachment bushings	3	-	-
58	M-4/1063 (Д6134/0054)	Tap 12x1.5,to calibrate holes for adapter sleeves in oil pump bodies	3	-	-
65	M-4/1264 (Д6132/0040)	Tap with effective diameter enlarged by 0.5 mm (11.5 x 1.5); used to thread crankcase holes for cylinder bolts	5	-	1
65	M-4/1269 (Д6132/0039)	Tap (11x1.5), to calibrate crankcase holes for cylinder bolts	7	-	1
77	НГ-2/1002 (ПС-119)	Holder (chuck) for rolling-in tools У-45/1015 and У-45/1016 and reamer Т-06/1133	2	-	-
83	НГ-2/1004 (ПС-119) (ДВ-349)	Holder (chuck) for reamer Т-05/1350 of intake valve guide	1	-	-
77	НД-6/1009 (ДЗ-389)	Holder for countersink М-2/1419 (included into set 630398)	1	-	-
85	НМ-6/1002 (ДВ-348)	Adapter bushing used for sizing hole for exhaust valve guide	1	-	-
66	П-1/8457 (Д6312/0028)	Device for setting cam washer when expanding the bushings	1	-	-
90	П-3/8853 (ОКБ-5913)	Jig to drill lock hole in spark plug bushing	1	-	1
90	П-3/8021 (Д6307/0082)	Jig to drill lock hole in nozzle bushing	1	-	1
82	П-3/9432 (Д6302/0223)	Fixture for setting cylinder to bore inlet and exhaust valve guides	1	-	-

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1	2	3	4	5	6
63	П-3/9911 (К6302/0059)	Fixture for drilling lock hole in double-rim timing gear bushing	1	-	-
63	П-3/10011 (К6304/0199)	Jig for drilling and sizing lock holes in second order balancer support bushing	1	-	-
67	П-5/4135 (Р6332/0019)	Fixture for grinding cam washer bushings	1	-	-
94	П-6/1636 (К6350/0380)	Device for pressing bearing out of valve lever	1	-	-
93	П-6/3494 (К6351/0024)	Dummy ring for fixing magneto drive supporting ring during grinding	1	-	-
77	П-6/3427 (АП-4547)	Pliers for compressing connecting rod piston end bushings when pressing them into connecting rod	1	-	-
77	П-6/3496 (АП-4563)	Pliers for compressing articulated rod crankpin end bushings when pressing them into connecting rod	1	-	-
56	П-6/3562 (К6364/0154)	Device for washing oil sump and testing it with compressed air	1	-	-
31	П-6/3588 (К5361/0007)	Device for lifting assembled crankcase	3	1	-
51	П-6/3694 (К5350/0282)	Device for assembly and disassembly of double speed drive friction clutch	1	1	-
27	П-6/4754 (К5350/0138)	Fixture for crankshaft assembly	1	1	-
36	П-6/4767 (АЗ-927)	Stand for master rod assembly	1	1	-
36	П-6/4772 (АП-4723)	Device for pressing in articulated rod knuckle pins	2	1	-
46	П-6/5533 (К5350/0295)	Device for fixing gear box shaft against axial displacement	2	2	-
42	П-6/5771 (К6474/0010)	Appliance for washing valve lever	1	-	-
43	П-6/6011 (К6474/0045)	Appliance for washing tappet push-rod	1	-	-
54	П-6/6507 (К5474/0037)	Appliance for washing МВ-82Б pump drive body	1	-	-
54	П-6/6508 (К5474/0035)	Appliance for washing МВ-82В pump drive body cover	1	-	-
28	П-6/7178 (К5474/0011)	Appliance for washing crankshaft (interchangeable with appliance П-6/4867, Fig. 27)	1	-	-
28	П-6/7209 (К 6350/0281)	Wedge for separating the crankshaft web lugs	3	3	-
93	П-6/7670 (К6351/0024)	Ring (dummy) for fixing generator drive supporting ring during lapping	1	-	-
48	П-6/7797 (К6364/0036)	Plug for rear oil pump pipe union used during air pressure tests	1	-	-
36	П-6/7892 (К6350/0097)	Wedges (set of 21 pieces) for master rod cheeks; used to press knuckle pins in and out	1	1	-

1	2	3	4	5	6
23	П-6/8002 (К6350/0180)	Mandrel for mounting reduction gear shaft rubber ring	1	1	-
48	П-6/8011 (К6350/0181)	Device for pressing in double-rim timing gear bushing	1	-	-
53	П-6/8194 (АО-2507)	Guide pin for mounting valve levers	2	2	1
61	П-6/8263 (К6358/0013)	Plug for crankshaft rear part	2	1	-
28	П-6/8359 (К6350/0179)	Reaming stud (М8х1) for accessories drive shaft oil slinger	2	2	1
10	П-6/8368 (К6350/0303)	Clamp for mounting double speed drive friction clutch lock	1	1	-
10	П-6/8426 (К6350/0033)	Appliance for pressing in front and rear counterweight bushings	1	-	-
10	П-6/8668 (К6474/0031)	Device for fixing counterweight pin bolts against turning	2	2	-
10	П-6/8669 (К6474/0052)	Plug for crankshaft rear part hole; used when pumping oil through crankshaft assembled with crankcase	1	-	-
56	П-6/8871 (К6364/0061)	Plug for crankshaft nose-piece rear hole; used when pumping oil through crankshaft assembled with crankcase	1	1	-
28	П-6/8918 (К6350/0051)	Plug for oil sump drain pipe	2	-	-
41	П-6/9139 (АШ-1322)	Support for wrench А-2/1362; used when tightening crankshaft rear part nut	2	2	-
42	П-6/9227 (К6350/0059)	Device for mounting piston rings	1	1	-
42	П-6/9245 (К6350/0034)	Taper for mounting oil seal ring on push-rod casing	1	1	1
31	П-6/9267 (К6350/0273)	Device for displacing oil seal hose of push-rod casing	2	1	-
31	П-6/9288 (К6350/0041)	Remover for tappet lock	1	1	-
65	П-6/9324 (К6358/0052)	Appliance for mounting tappet lock	1	1	-
86	П-6/9333 (К6350/0328)	Wedge bushing for exhaust valve seat	5	-	3
		Device for pressing in exhaust valve floating seat	1	-	-

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1	2	3	4	5	6
80	П-6/9552 (К6351/0090)	Expander for centring the reamer when finishing the exhaust valve guide hole	1	-	-
42	П-6/9389 (К6358/0051	Taper for mounting oil seal ring on push-rod lower casing	1	1	1
19	П-6/9428 (К6474/0053)	Clamp for intermediate shaft hole; used during washing	2	-	-
15	П-6/9521 (К6350/0045)	Stand for assembly of crankcase nose-piece and supercharger	6	-	-
44	П-6/9543 (К6350/0047)	Plate for assembly of supercharger	2	-	-
45	П-6/9571 (К6350/0309)	Device for assembly and disassembly of gear box	1	2	-
56	П-6/9578 (К6358/0049)	Plug for oil sump oil sucking-off pipe union	1	-	-
53	П-6/9622 (К6474/0053)	Appliance for washing reduction gear shaft	1	-	-
23	П-6/9665 (К6474/0051)	Pipe connection for washing devices	2	-	-
65	П-6/9980 (К6350/0327)	Device for pressing out exhaust valve floating seat	1	-	-
10	П-6/10193 (К6474/0034)	Plug for crankshaft nose-piece hole; used when pumping oil through crankshaft assembled with crankcase	1	1	-
63	П-6/10210 (К6358/0021)	Appliance for pressing on second order balancer support bushing	1	-	-
92	П-6/10302 (К6350/0359)	Device for pressing in supercharger impeller drive double-rim gear bushing	1	-	-
92	П-6/10329 (К6307/0001)	Device for rolling in supercharger impeller drive double-rim gear bushing	1	-	-
28	П-6/10375 (К6350/0178)	Drift for pressing in crankpin plugs	2	1	-
10	П-6/10378 (К6350/0044)	Handle bar for turning crankshaft by its front part splines (with the crankcase nose-piece and clutch removed)	2	2	-
10	П-6/10379 (К6350/0055)	Device limiting crankshaft axial forward travel	2	2	-
10	П-6/10320 (К6350/0245)	Bolt for lifting crankcase nose-piece by clutch intermediate shaft	6	5	-
23	П-6/10352 (К6350/0035)	Device for mounting crankcase nose-piece oil-seal bushing	1	1	-
52	П-6/10387 (К6474/0041)	Appliance for washing crankcase rear cover	1	-	-
28	П-6/10394 (К6350/0037)	Remover for crankshaft rear roller bearing	2	2	-
44	П-6/10398 (К6350/0048)	Plate for assembly of crankcase rear cover	2	-	-
47	П-6/10400 (К6350/0151)	Appliance for mounting accessories drive shaft springs	1	1	-

1	2	3	4	5	6
53	П-6/10413 (К6350/0280)	Ratchet for fixing supercharger impeller shaft from turning	2	2	-
35	П-6/10424 (К6350/0083)	Device for assembly of timing mechanism elastic gears	1	1	-
32	П-6/10425 (К6350/0070)	Appliances for protecting crankcase joint surfaces against damage	1	-	-
32	П-6/10426 (К6350/0063)		1	-	-
33	П-6/10427 (К6350/0069)		4	-	-
55	П-6/10443 (К6474/0054)	Appliance for washing revolution counter drive body	1	-	-
34	П-6/10445 (К6350/0046)	Device for assembly of timing mechanism double-rim elastic gear	1	1	-
53	П-6/10447 (К6474/0044)	Appliance for washing supercharger rear housing	1	-	-
23	П-6/10464 (К6364/0129)	Appliance for washing front oil pump	1	-	-
13	П-6/10474 (К6360/0056)	Device for limiting crankshaft axial backward travel	2	2	-
53	П-6/10475 (К6474/0009)	Appliance for washing accessories drive shaft	1	-	-
28	П-6/10476 (К6350/0079)	Remover for crankshaft split ring	2	2	-
29	П-6/10478 (К6474/0050)	Plug for crankpin hole	1	1	-
55	П-6/10484 (К6350/0299)	Device for assembly and disassembly of revolution counter drive	1	1	-
41	П-6/10485 (АМ-1227)	Piston ring compressor	4	2	1
20	П-6/10486 (К6350/0260)	Device for assembly of front oil pump	1	1	-
41	П-6/10499 (К6881/0002)	Cylinder setting bolt (70 pieces of I group, 5 pieces of II group)	75	75	-
23	П-6/10517 (К636А/0124)	Device for supplying air to check friction clutch piston travel (engaging clutch)	1	1	1
13	П-6/10518 (К6350/0243)	Nut for lifting engine by clutch splined collar	3	3	1
20	П-6/10519 (К6350/0341)	Remover, to take off crankcase nose-piece together with clutch	2	1	1
23	П-6/10520 (К6350/0331)	Remover, to take adapter flange off clutch splined collar	2	1	1
13	П-6/10521 (К6350/0242)	Bolt for turning crankcase assembled with crankshaft by crankcase nose-piece	3	2	1
20	П-6/10524 (К6364/0121)	Support for intermediate shaft	1	-	-
22	П-6/10529 (К6350/0332)	Remover for clutch drive disc	2	2	-

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1	2	3	4	5	6	
62	П-6/10532 (К6350/0277)	Plate of fixture П-6/0526 for front counterweight	1	-	-	
13	П-6/10540 (К6350/0316)	Fixture for fixing splined collar against turning when tightening its nut	3	3	1	
13	П-6/10541 (К6350/0329)	Lifting attachment for turning crankcase assembled with crankshaft by splined flange	3	2	1	
15	П-6/10553 (К6350/0310)	Mounting plate for crankcase nose-piece (belongs to stand П-6/9521)	3	-	-	
23	П-6/10554 (К6350/0337)	Device for compressing pressure collar springs	1	1	-	
22	П-6/10555 (К6350/0294)	Device for assembly of pressure collar	1	1	-	
22	П-6/10556 (К6364/0158)	Appliance for washing clutch drive disc	1	-	-	
11	П-6/10571 (К6350/0150)	Adjusting disc for checking valve timing	1	1	-	
22	П-6/10574 (К6350/0360)	Device for centring clutch discs during assembly	1	1	-	
22	П-6/10654 (К6350/0248)	Device for mounting splined collar on intermediate shaft	1	1	1	
62	П-6/10756 (К6350/0325)	Plate of fixture П-6/0526 for rear counterweight	1	-	-	
48	П-6/10813 (К6350/0096)	Lifting attachment for assembled supercharger	2	2	-	
22	П-6/10873 (К6350/0245)	Remover for engaging clutch cover	1	1	-	
22	П-6/10876 (К6350/0244)	Remover for splined collar	2	2	1	
29	П-6/10877 (К6350/0042)	Remover for crankshaft front roller bearing	3	2	-	
70 71 72	П-6/10905 (К6356/0031)	Jig for boring connecting rod bushings	1	-	-	
50	П-6/10920 (К6364/0157)	Plug for double-speed drive support; used to check travel of smaller piston	1	1	-	
11	П-6/10926 (К6350/0283)	Fixture for jacking up crankshaft	1	1	-	
11	П-6/10956 (К6350/0257)	Mandrel for mounting fan rotor and fairing	1	1	1	
87	П-6/11070 (К6350/0225)	Device for pressing in exhaust valve guide	1	-	-	
91	П-6/11086 (К6350/0074)	Device for pressing bearing into valve lever	1	-	-	
37	П-6/11206 (К6474/0024)	Appliance for washing knuckle pin (instead of appliance П-6/9494, Fig. 36)	1	-	-	
25	П-6/11257 (К6350/0035)	Device for installing and removing front oil pump shaft lock	2	1	-	
21	П-6/11280	Stand for assembly and disassembly of	1	1	-	

1	2	3	4	5	6	
	(К6350/0336)	splined collar				
18	П-6/11443 (К6350/0350)	Fixture for turning crankshaft by fan support	3	3	1	
15	П-6/11479 (К6350/0247)	Device for checking operation of ratchet piston	1	1	-	
78	П-12/1436 (К6374/0054)	Fixture for boring bushing hole in master rod crankpin end	1	-	-	
93	П-12/1719 (К6315/0141)	Mandrel for lapping generator drive coupling end face	1	-	-	
78	П-12/1747 (К6374/0020)	Centring bushing for fixture П-12/2079	1	-	-	
93	П-12/1839 (К6351/0030)	Mandrel for lapping end face of revolution counter drive packing ring	1	-	-	
93	П-12/2022 (К6463/0007)	Mandrel for lapping spherical surface of generator and magneto drive packing rings	1	-	-	
93	П-12/2023 (К6463/0000)	Holder of lapping tool for magneto drive supporting ring	1	-	-	
93	П-12/2068 (К6315/0142)	Mandrel for lapping end face of revolution counter drive supporting ring	1	-	-	
93	П-12/2069 (К6315/0143)	Mandrel for lapping spherical surface of revolution counter drive supporting ring	1	-	-	
79	П-12/2079 (К6374/0021)	Fixture for honing knuckle pin holes in master rod cheeks	1	-	-	
93	П-12/2115 (К6351/0125)	Mandrel for lapping end face of magneto drive shaft	1	-	-	
93	П-19/1009 (К6350/0092)	Mandrel for lapping spherical surface of generator drive supporting ring	1	-	-	
68	С-1/1193 (СС-503)	Drill for lock hole in double-rim timing gear bushing	3	-	-	
16	СО-1/1331 (К6350/0259)	Reducing unit for dynamometric tightening of intermediate shaft coupling bolt (to be calibrated and used together with wrench К-7/1022, Fig. 9)	1	-	1	
64	Ч-2/1096 (К6378/0058)	Jig bushing for final sizing of holes for locks of second order balancer support bushing (used with jig П-3/10011)	2	-	-	
64	Ч-2/1097 (К6378/0057)	Jig bushing for preliminary sizing of holes for locks of second order balancer support bushing (used with jig П-3/10011)	2	-	-	
41	Ч-15/4624 (К6084/0570)	Gauge, to adjust appliance А-6/1973 used to check exhaust valve seat for concentrical alignment	1	-	-	
86	Ч-15/5032 (К6084/0517)	Gauge, to adjust fixture А-6/5354	1	-	-	
45	Ч-15/6960 (К6084/0441)	Gauge, to adjust fixture А-6/6610	1	-	-	

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1	2	3	4	5	6
89	M-1/2242 (K6111/0025)	Counterbore, to make exhaust valve guide hole	2	-	-
77	M-2/1811 (JT-522)	Counterbore for facing connecting rod bushings (belongs to set 630398)	2	-	-
83	T-05/1350 (K6121/0124)	Reamer for intake valve guide	3	-	-
83	T-06/1133 (K6121/0160)	Reamer for exhaust valve guide	3	-	-
57	T-1/1009 (K6126/0002)	Reamer for lock holes, 3 mm in dia.	1	-	-
64	T-1/1306 (K6126/0009)	Reamer for preliminary sizing of holes for second order balancer support bushing over-size locks	2	-	-
64	T-1/1307 (K6126/0010)	Reamer for final sizing of holes for second order balancer support bushing over-size locks	2	-	-
85	T-1/1429 (K6126/0016)	Reamers, to make holes for exhaust valve guides	2	-	-
85	T-1/1430 (K6126/0017)		2	-	-
85	T-1/1431 (K6126/0018)		2	-	-
84	T-1/1446 (K6126/0015)	Reamer for final sizing of hole for exhaust valve guide	2	-	-
84	T-1/1447 (K6126/0014)	Reamer for final sizing of hole for intake valve guide	2	-	-
60	T-4/1195 (PM-1917)	Reamer for lock hole in double-rim timing gear bushing	3	-	-
92	T-10/1194 (K6120/0053)	Reamer for bushing of supercharger impeller drive double-rim gear	3	-	-
11	J-2/1156 (K6413/0015)	Drift for bending lugs of locks fixing crankshaft split ring bolts and ratchet piston housing support nuts	2	1	-
48	J-2/1021 (K6413/0013)	Caulking tool for locking supercharger impeller shaft step bearing screws	1	-	-
40	J-2/1870 (K6413/0001)	Caulking tool for bending lugs of locks fixing accessories drive shaft cover screws	1	1	-
40	J-2/1930 (K6350/0178)	Caulking tool for bending lugs of lock fixing supercharger impeller shaft nut	1	-	-
29	J-2/1937 (K6350/0161)	Caulking tool for bending lugs of locks fixing crankshaft lubricating nozzles	1	1	-
11	J-2/1946 (K6350/0028)	Scriber (magnetic)	2	-	-
41	J-2/1958 (M6444/0004)	Pliers for assembly of push-rod casing	1	1	-
36	J-2/2010 (K6413/0014)	Caulking tool for bending lugs of locks fixing master rod bushing lock bolts	1	1	-
11	J-2/2034 (K6350/0142)	Drift for bending lugs of locks fixing crankshaft split ring bolts	1	1	-
77	J-40/1030	Insert for honing head J-41/1511 (Fig. 80)	7	-	-

1	2	3	4	5	6
77	J-40/1130 (K6378/0063)	Insert for honing head J-41/2147 (Fig. 80)	6	-	-
60	J-40/1416 (K6423/0005)	Rolling-in tool for cam ring bushings	1	-	-
92	J-40/1850 (K6423/0025)	Rolling-in tool for supercharger impeller drive double-rim gear bushing	1	-	-
81	J-41/1202 (AP-7150)	Honing head for cylinder sleeve	1	-	-
90	J-41/1513 (AP-5238)	Honing head for bushing hole in master rod crankpin end	1	-	-
88	J-41/1859 (K6107/0013)	Lapping tool for exhaust valve seat	10	-	10
88	J-41/1860 (K6107/0014)	Lapping tool for exhaust valve	10	-	10
93	J-41/1976 (K6107/0022)	Lapping tool for spherical surface of generator drive support ring	3	-	-
93	J-41/2024 (K6107/0015)	Lapping tool for generator drive support ring end face	3	-	-
93	J-41/2110 (K6107/0097)	Lapping tool for speed counter drive shaft	2	-	-
80	J-41/2147 (AP-7928)	Honing head for knuckle pin holes in master rod cheeks	1	-	-
77	J-45/1015 (MP-30)	Rolling-in tool for connecting rod piston end bushings (included into set 630393, used with holder MP-2/1002)	1	-	-
77	J-45/1016 (MP-29)	Rolling-in tool for articulated rod crankpin end bushings (included into set 630398, used with holder MP-2/1002)	1	-	-
57	J-50/1001 (M3-1)	Remover No. 3 for studs, 6 mm in dia.	5	-	2
57	J-50/1002 (M3-2)	Remover No. 4 for studs, 8 mm in dia.	5	-	2
57	J-50/1003 (M3-3)	Remover No. 5 for studs, 10 mm in dia.	5	-	2
8	630124 (M6442/0009)	Socket wrench, 5x13	10	10	-
17	630125 (K6442/0155)	Socket wrench, 5x13	10	10	-
57	630152 (AP-6965)	Wrench with set of post tools for screwing in studs M6x1, 1M8x1, 1M10x1, 1M11x1, 12x1.5, 13x1.5	3	-	1
88	630160 (K6442/0099)	Wrench for lapping inlet valve and its seat	4	-	1
88	630161 (AO-2491)	Wrench for lapping exhaust valve and its seat	4	-	1
57	630207 (AP-6900)	Eccentric for screwing out studs, 6 to 13 mm in dia.	3	-	1
57	630281 (AO-2454)	Device for screwing in threaded sleeves with 5x1 inner thread	1	-	1

50X1

1	2	3	4	5	6
57	630282 (AO-2694)	Device for screwing in threaded sleeves with G-1 inner thread	1	-	1
5	630317 (AP-4035)	Sizing gauge	1	1	1
69	630398 (AP-7110)	Set of tools and appliances for replacing connecting rod bushings (set of punches, blocks, broaches, rolling-in tools and a countersink for pressing, sealing and facing of bushings)	1	-	-
69	630399 (T-1)	Box for set 630398	1	-	-
60	630468 (AP-7093)	Lapping tool for crankshaft front and rear journals	2	-	-
38	630521 (AM-1167)	Stand for assembly and disassembly of cylinder	2	-	1
74	630562 (AO-2508)	Guide pins for pressing in master rod crankpin end bushing	2	-	-
88	630615 (K6116/0107)	Reamer for manual reaming of valve seats (used with device 630761)	8	-	1
94	630678 (K6364/0155)	Compression gauge for measuring piston pressure in working cylinder	-	-	1
74	630706 (AP-7048)	Device for pressing in and pressing out master rod crankpin end bushing	1	-	-
73	630716 (AP-7205)	Reducing gear of cutting tool longitudinal feed drive connecting rod bushings (employed with jig П-6/10905)	1	-	-
74	630718 (EC-5942)	Cutting tool for master rod crankpin end bushing	5	-	-
74	630719 (EC-5941)	Cutting tool for articulated rod crankpin end bushings	5	-	-
74	630720 (EC-5940)	Cutting tool for connecting rod piston end bushings	5	-	-
74	630721 (KM-462)	Template for checking cutting tools 630719 and 630720	1	-	-
97	630734 (LK-85)	Handle bar for tools with a square shank	2	-	1
88	630761 (AP-7112)	Device for manual countersinking of valve seats (used with countersink 630615)	1	-	1
88	630781 (K6465/0018)	Holder for lapping tool Э-41/1860 for exhaust valve	3	-	1
5	700602	Double-end closed wrench, S=9x11	10	10	-
5	700603	Double-end closed wrench, S=13x13	10	10	-
5	700604	Double-end closed wrench, S=14x15	10	5	-
5	700605	Double-end closed wrench, S=13x19	7	5	-
5	700616	Hammer	1	1	-
1	700654	Valve spring compressor	5	3	1
5	700656	Socket wrench, S=13x15	10	10	-
39	700682	Socket wrench, S=14, for cylinder bolts	15	10	2

1	2	3	4	5	6
	700687	Engine slinging system	3	3	-
	700688	Engine slinging system	3	3	-
7	700511-2	Hinged socket wrench, S=13	7	5	-
	700511-3	Hinged wrench, S=13	10	10	-
	700534	Clearance gauge	3	3	-
	700641	Socket wrench, S=16	7	5	-
10	700650	Wrench for exhaust pipe nuts	10	10	-
	700755	Socket wrench, S=7x11	10	10	-
	700756	Socket wrench, S=9x11	10	10	-
	700880-2	Double-end open wrench, S=7x9	10	10	-
	700880-4	Double-end open wrench, S=11x13	10	10	-
	700880-5	Double-end open wrench, S=14x16	7	5	-
	700880-6	Double-end open wrench, S=14x17	7	5	-
	700880-7	Double-end open wrench, S=19x22	5	5	-
	700880-8	Double-end open wrench, S=24x27	5	5	-
	700880-11	Double-end open wrench, S=15x17	7	5	-
17	700890	Wrench for plugs with inner hexagons, 9 and 19 mm	7	5	-
	701148	Flat pliers	2	1	-
8	701361 (701293)	Wrench, S=15, for generator and starter nuts	7	5	-
19	701363	Double-end closed wrench, S=7x7, for exhaust and inlet valve lever coupling screws	7	5	2
19	701379	Socket wrench for push-rod casing lower nuts	6	2	-
6	701425	Screw-driver, small	4	5	-
6	701428	Screw-driver, large	5	5	-
1	701746	Airborne tools bag	-	-	1
9	701764	Engine slinging system	3	3	-
3	011-65 (10923)	Small stand for assembly of crankcase and crankshaft	4	-	-
14	011-68 (10924)	Stand for engine slushing	2	-	-
4	011-69 (10925)	Stand with adjustable plate for engine assembly and disassembly	5	-	-
6	11A500	Mounting lug for attaching engine to stand	28	28	-
15	3П-167 (3-9121)	Electric heater for heating intermediate shaft splines before installing	1	-	-
-	A6075-0345	Mandrel for checking axial and parallel alignment of holes receiving accessories drive shaft and two-speed gear box of A00-hr service life engines (used with mandrel A-6/6591-7)	1	-	-
	A6125-0019	Reamer for supercharger impeller drive double-rim gear bushing (for A00-hr service life engines)	2	-	-
20	A6350-0517	Remover for crankshaft crankpin plugs (instead of remover П-6/10874, Fig. 29)	3	2	-

1	2	3	4	5	6
-	A6350-0867	Device for mounting accessories drive shaft springs (for 400-hr service life engines)	1	1	-
-	A6350-0868	Device for assembly and disassembly of gear box shaft (for 400-hr service life engines)	1	1	-
-	A6350-0869	Device for assembly and disassembly of two-speed drive friction clutch (for 400-hr service life engines)	1	1	-

Chapter 6

OPERATING INSTRUCTIONS FOR EMPLOYMENT OF SOME COMPLICATED REPAIR APPLIANCES AND DEVICES

This chapter contains Instructions for the following appliances and devices:

Designation	Description
630716	Reduction gear for cutting tool longitudinal feed when boring connecting rod bushing
A-6/1681	Device for checking parallel alignment of connecting rod holes and distance between them
A-6/2134	Device for checking counterweight bushing holes for normal alignment with recess working surface
A-6/3974	Device for checking parallel alignment of pin holes in counterweights
P-3/9432	Fixture for cylinder to be used when reaming the inlet and exhaust valve guides
P-3/10011	Jig for drilling and sizing lock holes in second order balancer support bushing
P-5/4135	Fixture for lapping cam ring bushings
P-6/8526	Appliance for pressing in bushings of front and rear counterweights
P-6/10905	Jig for sizing connecting rod bushings
P-12/1436	Fixture for honing hole in master rod for crankpin end bushing
SO-1/1331	Reduction gear for tightening intermediate shaft coupling bolt
Y-41/1282	Honing head for cylinder liner
Y-41/1513	Honing head for master rod hole for crankpin end bushing
Y-41/2147	Honing head for knuckle pin holes in master rod cheeks
-	Torque indicating wrenches (given below are instructions on their calibration)

Reduction Gear 630716 for Cutting Tool Longitudinal Feed When Boring Connecting Rod Bushings

(Fig. 73)

The reduction gear can be employed together with any device used for manual sizing of holes. One turn of the feeding screw of the reduction gear ensures a

minimum feed of the cutting tool up to 0.13 mm, which provides for an adequately clean bore.

To size connecting rod bushings the reduction gear is used together with jig П-6/10905 and is connected to it with the help of uprights available in the set. The torque is transmitted to the feeding screw through a pair of gears selected so as to provide for a change in the longitudinal feed.

Feeding screw 6 (Fig. 95), with a 2-mm thread pitch, is connected to coupling 1 of the tool holder with the help of pin 5. Drive gear 8 has inner pin 7 entering the longitudinal groove of the feeding screw. Driven gear 16 has an inner thread to receive the feeding screw when the latter is turned by the handle. Intermediate gears 9 and 11 are mounted on eccentric shaft 13 and are meshed with gears 8 and 16 fitted on feeding screw 6.

The rotation of the feeding screw is transmitted through drive gear 8 to gears 9, 11 and 16. Gear 16 rotates in the direction of the feeding screw rotation but at a lower speed, thus reducing the longitudinal feed of the cutting tool in comparison with the feeding screw thread pitch. By selecting the transmitting gears the cutting tool feed may be adjusted for up to 0.13 mm per one turn of the screw.

After sizing, coupling 1 is disconnected from feeding screw 6 and the latter is returned to its original position by manipulating handle 17 and by turning lever 20 to disengage gears 9 and 11 from gears 8 and 16. Locking lever 14 will turn together with lever 20 and will lock gear 16. With the gears in this position, feeding screw 6 will have a feed of 2 mm per one turn.

Fixture A-6/1681 for Checking Parallel Alignment of Connecting Rod Holes and Distance between Them

(Fig. 96)

The fixture is used to check:

(a) distance between master rod and articulated rod hole axes;

(b) parallel misalignment of holes in two planes (angularity and misalignment).

The check is conducted with the help of mandrels and a dial gauge, the latter being mounted on the working surface of the check plate.

One mandrel is used to set the connecting rod upon the V-blocks of the device while the other mandrel is employed to check the holes by means of the dial gauge.

The axes of the V-blocks and the plate surface must be parallel within 0.05.

It should be borne in mind during the check that the mandrel length and the distance between the rules of the device are equal to 200 mm, that is why the dial gauge readings will show two times the true values.

The device mounts a set of angles with check surfaces that were used before for checking connecting rods of other types of engines.

Fixture A-6/2134 for Checking Counterweight Bushing Holes for Parallel Alignment with Recess Working Surface

The fixture (Fig. 97) is used to check perpendicularity of the counterweight

bushing hole axes in relation to the recess working surface.

The check is performed with the help of mandrel 2 and dial gauge 3.

The counterweight with assembled mandrel 2 is set with its inner surface upon the two bars of device 1 so that the mandrel disc is above counterweight 4.

The leg of dial gauge 3 is lowered to reach the mandrel disc, and perpendicularity of the counterweight bushing hole axis in relation to the recess is determined by moving the dial gauge over the surface. The measurement is taken over the length of 100 mm. Fixture A-6/2134 is used with mandrel A-6/2909 for the front counterweight and mandrel A-6/5803 for the rear counterweight.

Fixture A-6/3974 for Checking Parallel Alignment of Counterweight Pin Hole Axes

(Fig. 98)

The fixture is used for checking parallel alignment of pin holes in counterweights. The check is performed with the help of mandrels and a dial gauge which is mounted upon the working surface of the plate.

One mandrel is used to set the counterweight upon the V-blocks, while the other mandrel is inserted into the two other holes located below the first holes. The V-block axis and the plate surface are made parallel to each other.

The check is performed as follows. The distance between the plate and the mandrel is measured after the counterweight is mounted on the V-blocks and the mandrels are inserted into the holes. The measurement is taken by means of the dial gauge over a length of 200 mm. Parallel alignment of all holes is determined by the difference in the distances from the plate to both ends of the mandrel.

The dial gauge readings equal two times the true values.

Fixture П-3/9432 for Cylinder to be Used When Reaming the Inlet and Exhaust Valve Guides

The device is used to ream the inlet and exhaust valve guides.

The cylinder is installed in the device in the following ways:

1. Raise cross-piece 3 (Fig. 82) by rotating handle 2.
2. Set the cylinder upon support 1 with exhaust valve seat face upon the taper of centring bushing 5.
3. Align the exhaust valve guide with bushings 4 and 5 by using centring pin 6.
4. Lower cross-piece 3 by rotating handle 2. Secure the cylinder on support 1 by pressing bushing 4 to the valve guide shoulder.
5. Remove centring pin 6.
6. Lock shaft of handle 2 by turning handle 10, thus fixing cross-piece 3 in place.
7. Ream the valve guide, centring the reamer by bushings 4 and 5.

Notes: 1. Bushings 4 and 5 are made removable to allow bushings 8 and 9 to be used instead when reaming the inlet valve guide.

2. Pins 6 and 7 differ in the diameters of the centring part. The pins are selected so as to provide for a tight fit in the exhaust or inlet valve guides.

Fig. 99 illustrates the reaming process on the exhaust valve guide. Fig. 100 shows the way to check fixture П-3/9432 with the help of device А-6/3033.

50X1

Jig П-3/10011 for Drilling and Sizing Lock Holes for Second Order Balancer Support Bushing (Fig. 101)

The jig serves to drill holes in the second order balancer support after pressing the bushing upon it.

For drilling, the balancer support is placed into the jig so that jig lug 9 enters the cut-off spline recess on the balancer support. The balancer support is fixed in place with washer 3, by screwing nut 2 on the jig stud.

Place the jig with the balancer support on the drilling machine table so that the drilling machine axis coincides with the axis of jig bushing 7, and drill the hole.

The jig has six holes. Three holes with pressed-in bushings are designed for drilling balancer support oil feed passages, 3 mm in dia., while the three other holes located in the upper part of the jig are used for drilling and sizing the holes for locks.

Drilling and sizing of the lock holes is performed through changeable bushings 7.

In drilling and sizing holes to receive oversize locks, changeable jig bushings 7 are used of the following diameters:

1. 3.9-mm bushing for drilling.
2. 4.215-mm bushing 4-2/1097 for primary sizing.
3. 4.255-mm bushing 4-2/1096 for final sizing.

Fixture П-5/4135 for Lapping Cam Ring Bushings (Fig. 67)

The fixture serves to secure and to centre the cam ring for lapping its bushings after pressing them in.

The cam ring is installed upon ring 1 or 6 of the fixture with the face of the gear rim on the outside.

Then the cam ring is centred by screws 7 and is pressed to the fixture faceplate by clamps 2 or 5 installed over the cam ring gear rim face.

Clamps 3 and 4 are used when repairing other types of engines, as fixture П-5/4135 is also applicable for repair of all engines of earlier make.

Appliance П-6/8526 for Pressing In Bushings of Front and Rear Counterweights (Fig. 102)

The appliance is used for pressing the bushings into the front and rear counterweights.

The bushings are pressed in as follows:

1. Insert the pin with clamp 4 into the appliance housing bushing located between centring bushings 7.

The pin of the clamp is fastened by a split-type lock. The pin is provided with a slot which receives the locking block when the pin is turned through 90°.

2. Insert supporting plate 5 into the recess of counterweight 1.
3. Install the counterweight upon centring bushings 6 of the appliance.

4. Adjust plate 5 with respect to bushings 6 and the holes in the counterweight with the help of punch 3.
5. Fasten the counterweight by means of clamp 4 and press the bushings into two holes on the counterweight side until they thrust against plate 5.
6. Remove the counterweight from the appliance.
7. Remove the clamp pin 4 and install it into the appliance housing bushing located between centring bushings 6.
8. Without removing plate 5, adjust the counterweight with respect to the appliance centring bushings and secure it in the appliance with clamp 4.
9. Press bushings into the two holes on the counterweight other side until they thrust against plate 5.
10. Remove the counterweight from the appliance.

Jig П-6/10905 for Sizing Connecting Rod Bushings

The jig is used for:

1. Boring bushings of master rod crankpin end to a hyperbolic shape.
2. Boring bushing of master rod piston end.
3. Boring bushings of articulating connecting rod crankpin and piston ends.

The jig П-6/10905 is used together with reduction gear unit 630716 and ensures finish of the bushing surfaces as required by the Specifications.

1. Boring of Master Rod Crankpin End Bushing to Hyperbolic Shape

Installation of Master Rod into Jig.

1. Install adjusting devices 3 into the jig body (Fig. 103).
2. Install pin 7 into the lug of the jig.
3. Insert centring bushing 6 into the connecting rod piston end and mount the bushing together with the rod upon pin 7.
4. Install uprights 7 (Fig. 104) together with plate 2 and thrust ring 1 into the jig body. Uprights 7 are fastened in the jig body with a special lock.
5. Slightly tighten the nuts on the uprights.
6. Assemble dial gauge mandrel 6 along with bushing 5, limit ring 4 and handle 3. Fix the dial gauge to mandrel 6. Install the assembled mandrel into the jig body.
7. Set ring 4 on mandrel 6 so that the dial gauge leg is 10 mm away from the bushing front end. Lock the ring in place with screw 8.
8. By rotating handle 3, centre the master rod according to the dial gauge readings accurate within 0.005 mm.
9. Loosen ring 4 and shift the dial gauge so that its leg is 10 mm away from the bushing opposite end. Lock the ring by screw 8. Check master rod centring by the dial gauge readings; permissible run-out is not over 0.005 mm.
10. Fasten the master rod properly.
11. Check master rod centring as instructed under Items 8 and 9.
12. Remove the dial gauge mandrel.

After all these operations the master rod is considered to be properly fixed for boring the crankpin end bushing.

Boring of Crankpin Rod Bushing
(Fig. 105)

1. Put master form 7 on mandrel 8. Assemble cutting tool 5 with spring 6 and install it into the mandrel.
Insert block 3 into the cutting tool and screw on adjusting nut 4.
2. Adjust the cutting tool as instructed in Section 4 of Chapter 6.
3. Mount bushing 9 and handle 10 upon mandrel 8.
4. Install bushing 2 into the jig body.
5. Install the assembled mandrel into the body of the jig.
6. Install reduction gear 1 (630716) into the end face holes of bushing 4.
7. Connect coupling 11 of the mandrel with the reduction gear motion screw.
8. Set the cutting tool into the initial position (the end chamfer surface must be on the master form before the bushing).
9. Switch on the reduction gear feed line and bore the bushing.

2. Boring of Master Rod Piston Rod Bushing

1. Install screw clamp 1 (Fig. 106) into the jig body.
2. Insert centring mandrel 6 into the lug of the jig body.
3. Mount master rod on mandrel 6, install bushing 4 over the mandrel.
4. Select setting bushing 1 (Fig. 107) according to connecting rod piston end bushing. The bushing is selected by the smallest gap between the setting bushing and the connecting rod bushing.
5. Mount bushing 1 on mandrel 2.
6. Install centring bushing 4 into the jig body.
7. Put centring bushing 6 on mandrel 2 and insert the bushing with the mandrel into the jig.
8. By rotating mandrel 2 by the shank (by means of the eccentric), set the master rod in a proper position for bushing 1 to easily enter the master rod piston end bushing.
9. Fasten the master rod as follows:
(a) rotate screw 3 (Fig. 106) until clamp 1 moves out of its seat to bear against the master rod flange;
(b) lock the clamp with screw 5;
(c) if the mandrel becomes tight in the connecting rod, adjust the press upon the connecting rod by screws 3 and 5 to provide for easy movement of the mandrel.
10. Remove bushing 6, mandrel 2 and bushing 1 (Fig. 107).
11. Install cutting tool 5 (630720) into mandrel 7 and adjust it as instructed in Section 4 of Chapter 6.
12. Put bushing 6 on mandrel 7 and insert them into the jig body.
13. Install reduction gear 3 into the end face holes of bushing 4, connect the coupling of mandrel 7 with the reduction gear feeding screw. Mount the handle on mandrel 7 and bore the master rod bushing.

3. Boring of Articulated Rod Bushings

1. Select setting bushing 1 (Fig. 107) according to the bushing to be bored. The setting bushing is selected by the smallest gap to the connecting rod bushing.
2. Install the articulated connecting rod on plate 3 (Fig. 108). The connecting rod is installed upon the plate with its blade flange face marked with the letter M (examined on the magnetic flaw detector) and being stamped with the engine number. This face serves as the base surface during the boring procedure.
3. Install centring bushing 4 (Fig. 107) into the jig.
4. Insert mandrel 2 into bushing 1. Put centring bushing 6 over mandrel 2 and insert them into the jig body. At this, bushing 1 must enter the connecting rod bushing.
5. Put plates 3 (Fig. 108) on pins 2 and mount two screw clamps 1. Fasten the connecting rod by the screw clamps.
6. Remove mandrel 2 and bushing 1 (Fig. 107). Install mandrel 7 with cutting tool 5 (630719 or 630720, depending on the bushing to be bored).
7. Mount reduction gear 3 (630716), connect the coupling of mandrel 7 with the reduction gear feeding screw. Fasten the handle to mandrel 7 and bore the connecting rod bushing.

4. Cutting Tool Adjustment for Drilling and Boring Connecting Rod Bushings

Adjustment for Drilling

1. Set cutting tool 3 into mandrel 2 (Fig. 109).
2. Install the depth gauge with its V-block upon the mandrel so that pin 1 of the depth gauge touches the cutting edge of the cutting tool.
3. Adjust the cutting edge protrusion with the aid of screw 5 until surface B of pin 1 is flush with basic surface A of the depth gauge. The position of the pin is to be checked by touch (with the finger's nail) or with a dial gauge.
4. Fix the cutting tool in position with set screw 4.

Adjustment for Boring Serial Bushing
(Fig. 109)

The cutting tool is adjusted in the same way as for drilling. The cutting tool protrusion is to be adjusted until surface C of pin 1 is flush with surface A of the depth gauge.

Adjustment for Boring Over-Size Bushing
(Fig. 109)

1. Adjust the cutting tool for sizing a serial bushing.
2. Adjust the dial gauge zero according to surface A of the depth gauge and shift the dial gauge leg to surface C of depth gauge pin 1.
3. Make the cutting tool overhang by value K (according to the dial gauge):

$$K = \frac{S_1 - S}{2}$$

Where: S_1 – diametral clearance between worn-out bushing and shaft journal (or pin).
S – serial clearance (according to Table of Fits).

The adjustment of the cutting tool for boring master rod crankpin end bushing to hyperbolic shape with the help of a micrometer or depth gauge is shown in Figs 110 and 111.

Fixture П-12/1436 for Honing Hole in Master Rod for Crankpin End Bushing

The fixture (Fig. 78) is used for setting the master rod for honing the wr pin end bushing hole in the master rod and for guiding the honing head during t honing process.

After pressing-in the knuckle pins, master rod 6 (Fig. 112) to be honed is installed into adjustable clamp 8 of the fixture base placed upon the honing ma chine table. On aligning the master rod hole with the honing head, the master r is clamped with cap nut 4 screwed on the lower end of guide bushing 3. Cap nut has special handles for this purpose.

Bars 2 contact the inner cylindrical surface of guide bushing 3 thus guidi the honing head when it moves up and down. The inclined borings in the guide bu ing walls pass the cooling liquid upon the master rod honed surface.

Abrasive honing stones 9 are adjusted to the required distance by means of the floating bushing which moves reciprocally together with the honing head.

Operating Instructions

Prior to honing all friction surfaces of the fixture must be well lubricat with oil.

See that floating bushing 1 of the fixture moves reciprocally during the h head operation. No seizure is allowed. The spring of the floating bushing must be tightened so as to provide for free movement of the bushing together with th honing head.

Seizure of the unit of floating clamp 8 is not permissible. The master rod when properly set and clamped by the cap nut, must easily turn together with t fixture. To process different diameters of the master rod holes, floating clamp bushings of different diameters are required.

Friction surfaces of the fixture and honing head must be periodically oil

Reduction Gear CO-1/1331 for Tightening of Intermediate Shaft Coupling Bolt

The reduction gear (Fig. 113) consists of two gears fastened between the h and the cover. Drive gear 3 mounts adapter 2 for torque indicating wrench K-7/1 Driven gear 1 has adapter 4 for the intermediate shaft coupling bolt of the m ging clutch.

To tighten the coupling bolt, the reduction gear is placed with its hous the engaging clutch cover flange and is fastened to it, the splined shank of a 4 being connected with the coupling bolt head. The coupling bolt is tightened means of torque indicating wrench K-7/1022 applied with a torque of 85-100 kg through adapter 2.

Prior to tightening the coupling bolt, the reduction gear wheels should b lubricated and checked for easy run when turned by hand.

Reduction gear CO-1/1331 is calibrated together with torque indicating wr K-2/1022. The wrench bears the stamping of its designation and the number of th corresponding reduction gear set.

The reduction gear ratio is 5:1.

Honing Head Y-41/1282 for Cylinder Liner (Fig. 114)

The honing head is designed for final finishing of the cylinder liner mirror ed is used in vertical honing machines. To hone cylinder liners of different meters the head is provided with a device for adjusting the abrasive bars to the liner diameter.

The device for shifting the abrasive bars in the radial direction consists of nut, three bushings, a spring, pins and a cone. One pin serves for coupling, all ther pins are used for the radial feed of the abrasive bars. The abrasive bars re adjusted to the liner diameter by means of the cone which is shifted with the lp of the nut.

The working part of the head comprises the outer spring, rod, connecting pin, ead body and stone holders with abrasive bars fastened by means of plates and screws. The outer spring holds the honing head in the vertical position so as to align the head axis with the honing machine spindle.

The total length of the honing head is 618^{+5} mm.

The honing head is connected with the honing machine spindle by means of an adapter sleeve with a hinge joint. The hinge joint provides for self-adjustment of the honing head in relation to the honed inner surface of the cylinder liner.

During operation the honing head receives reciprocal and rotary motion from the honing machine spindle.

Maintenance and Operating Instructions

During operation the honed surface must be supplied with cooling liquid.

The cylinder with the liner to be honed is installed in the fixture on the vertical honing machine table and is aligned with the spindle of the machine. The misalignment of the cylinder liner and spindle axes must not exceed 0.125 mm at a length of 500 mm.

The honing head speed depends on the r.p.m. of the honing machine spindle.

For honing use abrasive stones, 14x14x100 mm in size. Soiled and damaged stones must not be used.

All wearing surfaces of the honing head must be regularly examined and oiled.

The cooling liquid must be fed under pressure. In honing, kerosene is usually used for cooling.

For long-term storage the honing head recess formed by the head body and cone must be packed with lubricant through the hole for one of the pins shifting the abrasive bars apart. This is done by means of a lubricating gun.

To lubricate all other surfaces, the honing head must be submerged into oil and held there for some time to allow the oil to get into the inner recesses of the head.

In case of wear the cone and the pins adjusting the bars may be repaired. All other parts of the honing head, in case of wear or damage, must be replaced.

Honing Head Y-41/1513 for Master Rod Hole for Crankpin End Bushing (Fig. 60)

The honing head is designed for vertical honing machines to hone bushing holes in the master rod crankpin end. The hole surface is finished with abrasive bars fastened in the head working part and automatically adjusted to fit the bushing hole diameter.

The honing head supplied according to the Delivery List is used with insert [illegible]/1030 and stone holder [illegible]-5/1270.

The device for radial feed of the abrasive bars consists of cams and bushes, a bearing, damper, pin, cone and outer spring. The outer spring returns all parts of the mechanism into the non-working position. The cams actuate the mechanism to automatically adjust the bars as soon as the head is switched on for operation. The cams actuate the mechanism to automatically adjust the bars as soon as the head is switched on for operation. The cone serves to shift the stone holders in the radial direction.

The working part of the head comprises the rod, pin, body and stone holders with stones. The rod and the body are coupled with the help of the connecting pin. Through the bushing and the insert the honing head receives strictly axial reciprocal motion.

The total length of the honing head is 757±5 mm.

The honing head is fixed to the honing machine spindle.

The correct axial movement of the head is ensured by the bushing of the appliance.

Centring of the master rod hole is provided by installing the master rod in the fixture with a floating clamp.

The rotary and reciprocal motion is imparted to the head by the spindle of the honing machine.

During operation the abrasive stones of the head remove extra metal from the hole surface.

Operating and Maintenance Instructions

During operation the cooling liquid is fed to the honed surface through the slant passages made in the guide bushing of the appliance.

The master rod with the hole to be honed is secured in fixture [illegible]-12/1436 on the vertical honing machine table and is aligned with the honing machine spindle. The misalignment of the guide bushing and spindle axes must not exceed 0.125 mm at a length of 500 mm.

The honing head speed depends on the r.p.m. of the honing machine spindle.

For honing, abrasive stones, 8x9x65 mm, are used. Soiled and damaged stones must not be used for honing.

All wearing surfaces of the honing head must be regularly examined and oiled. After replacement the new stones require no sizing. The cooling liquid must be abundantly fed under pressure.

For long-term storage the honing head must be submerged into oil and kept for a minute to allow the oil to get into the inner recesses of the head.

The textolite inserts guiding the honing head in the bushing and the master rod hole must be replaced in case of wear. New inserts shall be sized prior to installing.

Honing Head Y-41/2147 for Knuckle Pin Holes in Master Rod Cheeks (Fig. 6e)

The honing head is designed for vertical honing machines to hone knuckle pin holes in master rod cheeks. The hole surfaces are treated with abrasive stones fixed in the honing head working part and automatically adjusted to the hole diameter.

The honing head is used with insert Y-40/1130 and stone holder B-5/1724. The stone adjusting mechanism consists of cams, bushings, one bearing, two springs, a cone. The cams actuate the mechanism to automatically adjust the stones as well as the head is switched on for operation. The cone serves to shift the stone holders in the radial direction. The springs return the mechanism into the non-operating position.

The working part of the head comprises the rod, body and stone holders with abrasive stones. The inserts ensure a strictly axial reciprocal motion of the working part.

The honing head is fixed to the honing machine spindle. The strictly axial reciprocal movement of the operating head is ensured by the bushing of the appliance.

The master rod hole is centred by installing the master rod in the fixture with the aid of a floating clamp.

The rotary and reciprocal motion is imparted to the head by the spindle of the honing head.

Operating and Maintenance Instructions

During operation the cooling liquid is fed to the honed surface through the slant passages in the bushing of the appliance.

The master rod with the holes to be honed is secured in fixture B-12/2079 (Fig. 115) on a vertical honing machine and is aligned with the honing machine spindle. Misalignment of the guide bushing and honing machine spindle must not exceed 0.125 mm over a length of 500 mm.

The honing head speed depends on the r.p.m. of the honing machine spindle.

For honing stones, 4.5x6x15 mm, are used. Honing with soiled or damaged stones is not permissible.

All wear surfaces must be periodically examined and lubricated. After replacement the bars require no sizing. The cooling liquid must be fed under pressure.

For long-term storage the honing head must be submerged into oil and kept submerged for some time to let the oil get into the inner recesses of the head.

The textolite inserts must be replaced in case of wear. New inserts must be sized prior to installing.

Calibration of Torque Indicating Wrenches

The following wrenches are subjected to checking (calibration): K-7/1015, K-7/1022, K-7/1025, K-7/1026, K-7/1027.

In case their Certificates are available the wrenches are tested as follows:

1. Fix the wrench in the appliance.

2. Suspend the required weight from the wrench handle with the help of a wire rope passing through the opening in the handle. The weight value and the distance from the head of the wrench to the place of suspension are recorded in the Certificate.

3. Check the value indicated by the scale pointer. The pointer should stop against a torque value corresponding to that recorded in the Certificate.

4. In case the value differs from the Certificate value, change the wrench calibration after determining the true value of each division of the wrench.

If the wrenches have no Certificates testing is performed in the following way:

1. Measure the distance from the wrench head centre to the centre of the hole in the wrench handle.

2. Fix the wrench by its head in the appliance.

3. Pass the wire rope through the handle opening.

4. Suspend a load of such a weight that when multiplied by the distance from the wrench head centre to the centre of the handle hole, it corresponds to the lowest torque value indicated on the wrench scale. This done, the pointer must stand against the lowest torque division on the wrench scale.

5. Similarly test all other divisions of the wrench scale. If during the test the pointer stops exactly against the divisions corresponding to the torque applied, calibration of the wrench will not be changed.

If the pointer stops against divisions which do not correspond to the product of the weight and the distance between the wrench head and handle opening, the wrench must be calibrated anew (i.e. the true value of each division on the wrench scale must be determined).

Chapter 7

PERIODIC INSPECTION AND TESTING OF CHECKING DEVICES, MANDRELS AND GAUGES

Prior to each application the devices must be subjected to external examination for mechanical damage and corrosion.

Before use the device must be thoroughly washed with gasoline; all friction surfaces must be coated with a thin oil film.

After each scheduled inspection a corresponding record is made in the certificate of the device.

Worn-out mandrels may be restored by chrome-plating followed by sizing according to the Drawing.

Listed below are checking devices, mandrels and gauges to be examined, terms of examination and tolerances.

Fig. No.	Designation	Description	Checking schedule	What is to be checked
1	2	3	4	5
116	A-5/1604	Mandrel for hole in master rod crankpin end	Once every three months	Concentric alignment of working surfaces. Concentric misalignment is caused by wear of parts 1 and 2 along diameter K. Diametral clearance must not exceed 0.015 mm
116	A-5/2471	Mandrel for knuckle pin holes in master rod cheeks	Same	Same
116	A-5/2488	Mandrel for bushing hole in articulated rod crank-pin end	Once every three months	Same
116	A-5/2490	Mandrel for bushing hole in connecting rod piston end	Same	Same

50X1

1	2	3	4	5
117	A-6/1681	Fixture for checking parallel alignment and distance between connecting rod bushing hole axes	Same	Check according to Instructions given in Fig. 117 Permissible parallel misalignment of surfaces A is within 0.005 mm
118	A-6/2134	Fixture for checking perpendicular alignment of counterweight bushing hole axes to counterweight recess working surface	Once every month	Concentric alignment of working surfaces. Non-concentric misalignment is caused by wear of parts 1 and 2 along diameter K. Diametral clearance must not exceed 0.015 mm
119	A-6/2909	Fixture (mandrel) for checking perpendicular alignment of front counterweight bushing hole axes to counterweight recess	Once every three months	Parallel alignment of surfaces indicated in Fig. 120 (a) distance between bushing axes; (b) wear of bushings 1 and pins 2 along diameter; diametral clearance must not exceed 0.01 mm (Fig.
120	A-6/3974	Fixture for checking parallel alignment of pin holes in counterweight	Once every month	Wear of stem along diameter. Wear limit diameter 22.012 mm Working surface
121	A-6/4160	Fixture for checking counterweight bushing end faces by means of marking compound	Same	
122	A-6/4973	Fixture for checking concentric alignment of exhaust valve seat	Same	Permissible concentric misalignment of working surfaces is 0.005 mm. Concentric misalignment is caused by wear of parts 1 and 2 along diameter K. Diametral clearance must not exceed 0.015 mm
123	A-6/5409	Ring for checking planes of knuckle pin end faces	Once every three months	
123	A-6/5803	Device for checking perpendicular alignment of rear counterweight bushing hole axes to counterweight recess	Same	

2	3	4	5
A-6/5806	Mandrel for checking parallel alignment of pin holes in rear counterweight	Once every three months	Permissible concentric misalignment of working surfaces is 0.005 mm. Concentric misalignment is caused by wear of parts 1 and 2 along diameter K. Diametral clearance must not exceed 0.015 mm
A-6/5807	Mandrel for checking parallel alignment of pin holes in front counterweight	Same	Same
K-18/3783	Gauge for selecting piston rings by gap	Once every month	Wear of working surface. Wear limit is diameter 155.52 mm
K-18/4887	Gauge for checking concentric alignment of exhaust valve guide hole to seat face	Once every three months	Concentric alignment and wear of stem working surface. Wear limit is diameter 21.985 mm
K-18/6105	Gauge for checking concentric alignment of inlet valve guide hole and seat face	Same	Concentric alignment and wear of stem working surface. Wear limit is diameter 12.675 mm
D-6/10905	Jig for connecting rod bushings	Once every month	Wear of working surfaces of mandrels and bushings which enlarges diametral clearance. Clearance between parts 1 and 2 and parts 2 and 3 must not exceed 0.01 mm
K-7/1015 K-7/1022 K-7/1025 K-7/1026 K-7/1027	Torque indicating wrenches	Same	Calibration of wrench (Read Ch.6, "Checking Torque Indicating Wrenches")
A-6/5981	Dynamometer for measuring friction of engaging clutch control sliding valve (Fig 17)	Same	Calibration of scale
Y-41/1859	Lapping tool for exhaust valve seat (Fig. 88)	Each time prior to application	Lapping tool face angle
Y-41/1860	Lapping tool for exhaust valve (Fig. 88)	Same	Lapping tool face angle

50X1

Chapter 6

DESCRIPTION OF FLUSHING EQUIPMENT, DIAGRAMS FOR TESTING ENGINE UNITS FOR PRESSURE TIGHTNESS, AND DESCRIPTION OF SEPARATE DEVICES

1. Washing Equipment 03-04/061, Type NIAGARA (NIAGARA)
(Fig. 127)

The washing equipment is used for washing soiled parts and units with the help of special solvents.

The washing equipment consists of a casing, a chain conveyer, a solvent heater, a washing chamber, and a ventilation arrangement.

The casing is welded of sheet and angle iron. The casing accommodates the chain conveyer, solvent tank, heater and sprayers.

On the chain conveyer inlet and outlet, the casing has rubber curtains on each side.

The conveyer is a Gall's chain with a pitch of 25 mm. It is 780 mm wide moves on eight sprockets mounted on one driving and three support shafts.

The chain is tightened by means of a special arrangement which shifts the drive shaft. The tightening arrangement is located at the inlet of the chain conveyer into the washing chamber.

The parts pass 3620 mm in the washing chamber, from its inlet to its outl The chain of the conveyer is actuated by an electric motor through a worm reduction gear with a gear ratio of 1:60.

The torque from the electric motor (not less than 0.8 kW and 1500 r.p.m.) transmitted to the reduction gear by means of a belt drive, and from the reduc gear to the conveyer shaft through a chain drive.

The conveyer drive shaft rotates at a speed of 1 r.p.m., while the convey speed is 0.8 m/min.

The heater comprises two coils made of 1" pipes into which steam heated to 110°C is fed under a pressure of 2-3 kg/sq.cm. The steam is supplied to each coil separately. The heater is installed under the entire bottom surface of the tank on small supports and is arranged so as not to touch the tank bottom.

The steam is fed to the heater through a system of pipes. Two valves are installed at the steam inlet into the heater. They serve to control the solvent temperature in the tank by reducing or increasing steam delivery to the heater.

The tank is filled with 960 lit. of washing liquid which makes 0.8 of the whole volume of the tank.

The washing chamber accommodates four sprayers arranged in the upper and lower parts of the chamber. Each sprayer directs four jets of the liquid. The washing liquid is supplied along the pipe line by a centrifugal pump with a capacity of 41 cu.m/hr. The pump is driven by an electric motor consuming 10 kW at 1500 r.p.m. The pump is connected to the electric motor through a coupling.

The exhaust ventilation arrangement is located in the upper part of the casing and is designed to exhaust the washing liquid vapours into the atmosphere.

Operating Instructions

Small parts are flushed in containers while large parts are arranged on the chain line on special supports.

Place the parts upon the chain line and then switch on the conveyer and the centrifugal pump. The centrifugal pump will feed the washing liquid through the sprayers upon the parts which are washed from above and from below.

On passing the washing chamber the parts become clean of lubricant and dirt. The washing liquid temperature is from 60 to 80°C.

In case the parts are covered with a thick coat of lubricant or are excessively dirty, stop the chain line when the parts are in the zone of washing and keep them under the liquid jets from 5 to 10 minutes; then switch on the conveyer again and take the clean parts off the chain. Dry the parts with compressed air.

Maintenance Instructions

When the washing chamber operates, remove the oily film from the washing liquid surface in the tank every 4 or 5 hrs.

Daily subject the washing liquid to analyses.

Clean the washing chamber and change the liquid weekly. A thorough cleaning of the washing equipment should be performed once every two months.

2. Bath TC-2351 for Flushing the Oil Channels in Engine Parts
(Fig. 128)

To remove metal particles, sediment and carbon deposits from the oil channels, the parts are flushed in a special closed bath which accommodates several parts simultaneously.

Parts and units removed from the engine should be flushed with kerosene at a pressure of 2 to 3 kg/sq.cm.

New parts and units taken out of spare sets and also service parts with replaced bushings should be flushed with oil MK or MC at a temperature of 60 to 75°C and a pressure of 4 to 5 kg/sq.cm.

The bath (Fig. 128) is a metal container made of sheet and angle iron with a hinged cover having celluloid or organic glass inspection windows.

The parts and units are placed upon grid 6 inside the bath.

To flush the oil channels, the oil (or kerosene) is delivered along the pipe line by gear pump 2 and is fed to the part through a hose. The oil pump is driven by an electric motor of an explosion-proof design, consuming 0.6-1 kW at 1200 to 1800 r.p.m.

On passing through the oil channels the oil is drained through the grid into tank 5 from where it flows into the oil pump through oil filter 3 of MGC-19 type.

To change the oil (kerosene) drain valve 7 is provided in the tank.

...il temperature is measured by vapour-pressure thermometer 10 while ... pressure is registered by pressure gauge 9. The instruments are located o... the bath casing, on the right-hand side, so as to be visible to the operator.

3. Cabinet П-6/1X4 for Pulse Washing (Fig. 129)

The cabinet for pulse washing is a metal casing of rectangular shape, ma... of sheet and angle iron. The casing accommodates a grid for the parts to be washed. The upper part of the cabinet is provided with an exhaust ventilation arrangement. Located under the cabinet is drain tank 5 to receive the gasoline running down from the parts during washing. From the drain tank the gasoline is pumped into tank 2 which is located on the cabinet wall.

The parts are washed through pulverizer 7 connected by one hose to the compressed air line and by the other hose to gasoline tank 2.

After washing the parts are dried with compressed air fed from compressed air line 1 through hose 9.

To avoid inflammation of the gasoline, the parts are placed for washing on special supports and, besides, the cabinet is earthed.

The sediment is removed from tank 5 through drain valve 6.

4. Installation СБ-12/82 for Flushing Hot Oil through Engine

The installation for flushing hot oil through the engine is an oil system comprising an oil tank, pumps, and piping with filters and a pressure relief valve (Fig. 130).

The installation is used for final cleaning of the engine prior to testing it on the stand.

The oil used for flushing is grade MK or MC oil (either fresh or a half-and-half mixture of fresh and regenerated oil). The temperature of the oil is to be maintained within 60 to 75°C, by means of steam. Hoses 10 and 11 of the oil delivery line are connected to the gauze filters of the front and rear oil pan. The oil is scavenged from the engine through hose 5 connected to the oil sump. Oil delivery and scavenge are performed by oil pumps 4, 9 and 13 of МК-5I and МК-1 types.

Filters 3 and 14 are used to filter the oil. Filter 3 (cambric bag-type insert) is cut into the scavenge line before pumps 4 and 13, while one of filter 14 is installed before the oil tank.

The impurity content in the oil is checked by examining the cambric bag-type insert of filter 3 which consists of a metal gauze No. 24 (576 cells per 1 sq.cm) and the cambric insert. The filtering elements of filters 14 consists of three metal gauzes No. 24 in the shape of cylindrical sleeves and of one cambric bag put over the inner gauze sleeve (Fig. 131).

To catch steel particles, constant magnets are installed at the filter outlets.

The oil pressure in the delivery line after filter 14 (Fig. 130) must be from 5.5 to 6.5 kg/sq.cm. while the oil pressure in the crankcase nose-piece, as measured by pressure gauge 6, must be not less than 1.8 kg/sq.cm.

When flushing hot oil through the engine, regularly turn the crankshaft by ...wheel 7 mounted on flange 15 of the engagement clutch.

To service the installation:

1. Examine and wash the filters daily.
2. Every day prior to operation check the oil in the tank for proper ...lity.

The check is performed by pumping the oil into the tank filler through ...e 11 or 10 fitted at the end with a filter (cambric bag).

3. Once a week thoroughly clean all oil tanks and filters.

5. Appliance П-6/10469 for Flushing Crankcase Nose-Piece

The appliance is designed for flushing oil channels in the crankcase nose-...ce.

The appliance is equipped with a set of plugs to stop the nose-piece oil ...es and flanges during flushing (Fig. 132).

The flushing liquid is fed through the connection screwed into the plug of ... crankcase nose-piece central bushing hole.

6. Appliance П-6/4867 for Flushing Crankshaft Front and Rear Parts

The appliance is used for flushing the oil channels in the crankshaft front ... rear parts.

The appliance is installed on the crankpin of the crankshaft front or rear ...ts (Figs 133 and 134). A special connection is provided to attach the hose ...ding the flushing liquid.

During flushing, the recesses of the crankshaft rear or front part crankpins ... stopped with plug П-6/10478, while plug П-6/8263 (Fig. 134) is additionally ...talled to stop the main journal hole when flushing the rear part oil channels.

7. Appliance П-6/11206 for Flushing Knuckle Pins

The appliance is employed for flushing oil channels in knuckle pins and is ...igned for flushing pins separately or whole sets of them simultaneously.

The device is made in the form of a tubular ring (See Fig. 37) with welded-... nipples having axial holes and inner threading. The nipples receive adapter ...nections which serve to attach knuckle pins when their oil channels (Fig. 135) are being pressure washed.

A special connection is provided to attach the hose feeding flushing liquid to the appliance.

8. Appliance П-6/10392 for Flushing Front Part of Crankcase Intermediate Section

The appliance is used to flush the oil channels in the crankcase intermediate section front part feeding oil to the front part of the valve timing mechanism.

Appliance 2 (Fig. 136) is fastened on the studs of the intermediate section front part flange at the hole passing the oil from the crankcase nose-piece into the annular recess formed in the nose-piece-to-intermediate section joint.

A pipe [illegible] for [illegible] into the appliance to secure the hose that serves to feed washing liquid.

Plugs 1 (part [illegible]/10374) are used additionally to stop the tappet guide holes. During the flushing processes the plugs must be removed for a short time in succession to allow the liquid to pass along the oil channels running to the tappet guides.

9. Appliance [illegible]/10472 for Flushing the Rear Part of Crankcase Intermediate Section

The appliance is used to flush the oil channels in the rear part of the crankcase intermediate section feeding oil to the rear part of the valve timing mechanism.

Appliance 2 (Fig. 137) is made in the form of a flange with a connection to attach the hose that serves to feed the washing liquid. The flange of the appliance is fastened on the studs of the flange attaching the pipe passing oil from the crankcase rear cover into the annular recess formed in the crankcase intermediate section rear part-to-rear section joint.

When washing the oil channels in the crankcase intermediate section plugs (part [illegible]/10374) are used additionally to stop the holes of the tappet guides. During the flushing process the plugs are successively removed for a short time for the washing liquid to pass along the oil passages running to the tappets.

10. Appliance [illegible]/10387 for Flushing Crankcase Rear Cover

The appliance is used for flushing the oil channels in the crankcase rear cover.

The appliance (See Fig. 52) also includes bushings, washers, pins and plates for stopping holes and bushing openings during the flushing process (Fig. 138).

The hose feeding the flushing liquid is attached to the connection of the bushing that closes the opening of the rear cover central bushing on its inner side.

11. Appliance [illegible]/6011 for Flushing Push-Rod Body

The appliance (Fig. 43) is employed for flushing the oil channels in the push-rod body and their ball ends.

The push-rod body and their ball ends are placed for flushing between the base of the device and its upper part (Fig. 139).

The hoses feeding the flushing liquid are attached to the connections installed in the upper part of the appliance.

12. Appliance [illegible]/10475 for Flushing Accessories Drive Shaft

The appliance (Fig. 53) is used for flushing the oil channels in the accessories drive shaft.

The accessories drive shaft is placed for flushing upon the middle support of the appliance (Fig. 140) and is fixed in the axial direction with a nut screwed into one of the extreme supports.

The hose that serves to feed the flushing liquid is attached to the connection

screwed into the appliance bushing pressed with the nut to the end face of the accessories drive shaft.

13. Appliance [illegible]/10464 for Flushing the Front Oil Pump

The appliance is designed for flushing the oil channels in the housing of the front oil pump.

The appliance consists of a base and three plugs to close the wells and openings in the oil pump housing.

The oil pump is installed for flushing upon the base of the appliance (Fig. 141) and is fastened to it, while the openings for the pressure relief valve and for oil inlet as well as the oil scavenge well are closed with plugs of the appliance.

The hose feeding flushing liquid is attached to the connection screwed into the plug of the scavenge well.

14. Appliance [illegible]/3562 for Flushing Oil Sump

The appliance (Fig. 56) is used for flushing the inner recesses of the oil sump.

For flushing, the oil sump is placed with its flange upon the appliance and is fastened by means of special clamps (Fig. 142).

The flushing liquid supply hoses are attached to the connections screwed into the plate of the appliance.

15. Appliance [illegible]/6507 for Flushing Drive Body of [illegible]-82B Direct Fuel-Injection Pump

The appliance is used for flushing the oil channels in the drive body of the [illegible]-82B Vireot fuel-injection pump.

To flush the oil channels in the drive body the appliance is installed into the opening of the drive shaft bushing and is fixed by means of a special stud and an eccentric (Fig. 143).

The hose feeding flushing liquid is attached to the connection protruding out of the drive body.

16. Appliance [illegible]/6508 for Flushing the Cover of [illegible]-82B Pump Drive Body

The appliance is used for flushing the oil channels in the cover of the [illegible]-82B pump drive body.

For flushing, the bushing supporting the drive shaft is closed with a pipe connection of the appliance (Fig. 144).

The appliance is fastened on the cover with the help of a threaded pin which is screwed into the cover screw clamp. The flushing liquid supply hose is attached to the connection closing the bushing of the drive shaft.

... [illegible] for Testing Engine Units for Pressure Tightness

Given below are diagrams and sketches of compressed air installations for testing engine separate units for pressure tightness.

Fig. 145 represents a diagram for testing the assembled engine prior to installing the supercharger upon it and drawings of the devices and fixtures used during the test.

Given in Fig. 146 is the diagram used in testing assembled superchargers.

Fig. 147 gives the diagram for testing the supercharger rear housing.

Fig. 148 represents the diagram for testing the oil sump for leakage.

18. Device for Determining Residual Magnetism

The device is designed for determining residual magnetism in parts subject previously to magnaflux examination.

The device consists of frame 3 (Fig. 149) built of a transformer iron [illegible] with coils (windings) 1 and 2 on its ends. The coils (windings) are connected in series. The coils are wound of 0.17-mm wire and have a total of 3000 turns.

The coil leadouts are connected to a sensitive galvanometer (recommended sensibility is 45 mV) with the zero in the middle of the scale.

Residual magnetism is detected by measuring the electromotive force that appears in the coils of the device when the magnetized part is moved near the frame. The value of the residual magnetism is determined by the readings of the galvanometer.

The part is considered fully demagnetized if pointer deflection does not exceed ±0.1 mV.

19. Device for Determining Breaking Moment of Magneto Interrupter Contacts

The device is used for determining the breaking moment of the magneto contacts when the magneto is installed on the engine.

The device (Fig. 150) consists of two step-down transformers, four lamps and wiring.

The transformer primary winding is rated for 110 or 220 V (depending on the voltage of the lighting mains).

The secondary winding has two leadouts for 3 and 5 V. The lamps used in the device are of the flash-light type.

The circuits are connected so that each magneto (left-or right-hand one) is served by one transformer and two lamps.

The primary windings of both transformers are phased and are connected in parallel. The lamps are also inserted in parallel (two lamps per one transformer).

The ends of the secondary windings are connected so as to form two separate electric circuits.

For operation, the device is connected to the local lighting mains, one wire being connected to the engine frame and the two remaining wires (right-and left-hand ones) to the magneto primary winding terminals.

The moment of breaking is determined by the lamps which light up when the contacts are broken and go out when the contacts are closed.

The lamps light up as soon as the contacts are broken because the transformer secondary winding circuit becomes closed through the engine frame.

Chapter 9

TOOLS SUBJECT TO RESHARPENING

Given below are drawings of cutting tools subject to resharpening during [illegible]re work.

After sharpening, the working surfaces and edges of the tools must have the [illegible] indicated in the drawings (Figs 151-160).

S-E-C-R-E-T
NO FOREIGN DISSEM

50X1

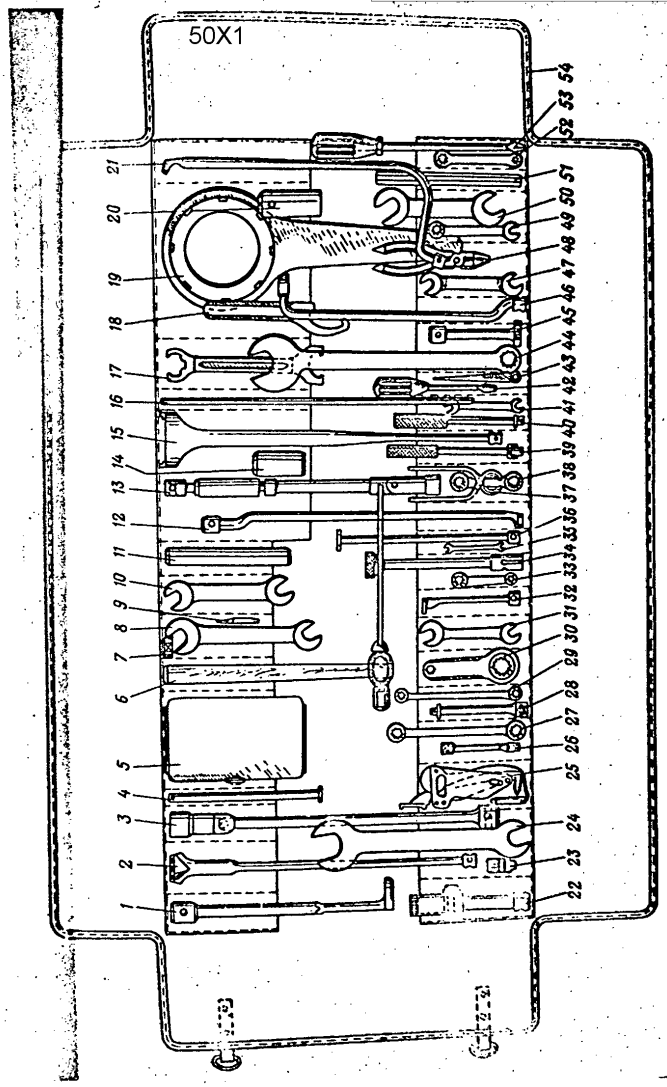

FIG. 1. AIRCRAFT ENGINE TOOLS KIT

S-E-C-R-E-T
NO FOREIGN DISSEM

50X1

FIG. 2. TOOL CASE

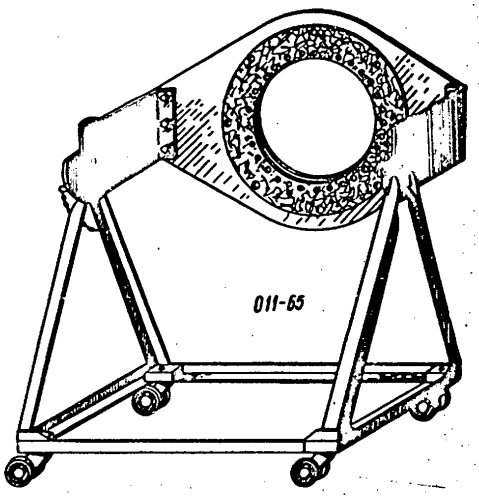

FIG. 3. SMALL STAND FOR ASSEMBLING CRANKCASE WITH CRANKSHAFT

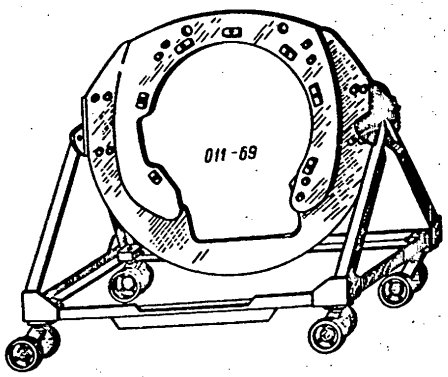

FIG. 4. STAND WITH ADJUSTABLE PLATE FOR ENGINE ASSEMBLY AND DISASSEMBLY

50X1

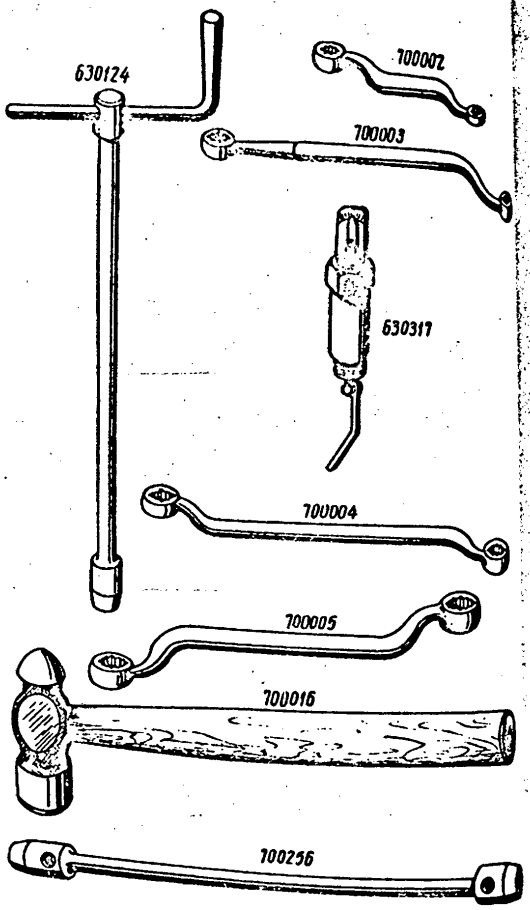

FIG. 5. GENERAL PURPOSE TOOLS

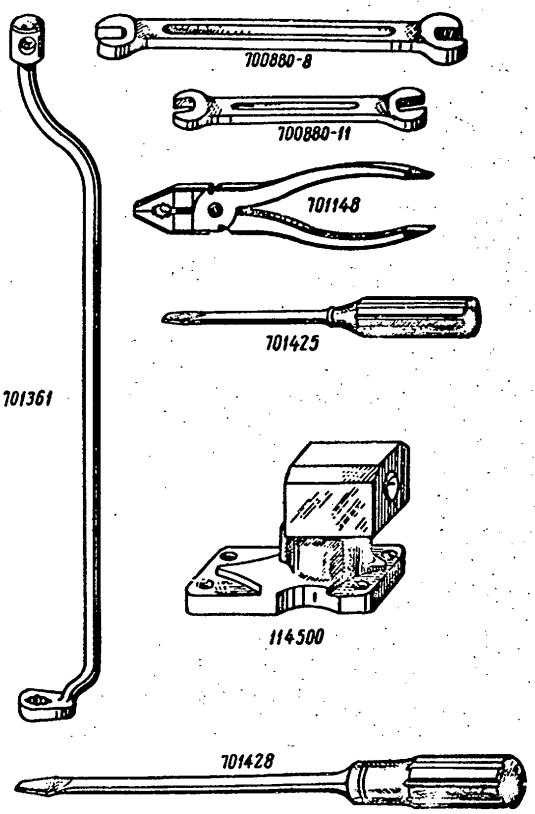

FIG. 6. GENERAL PURPOSE TOOLS

50X1

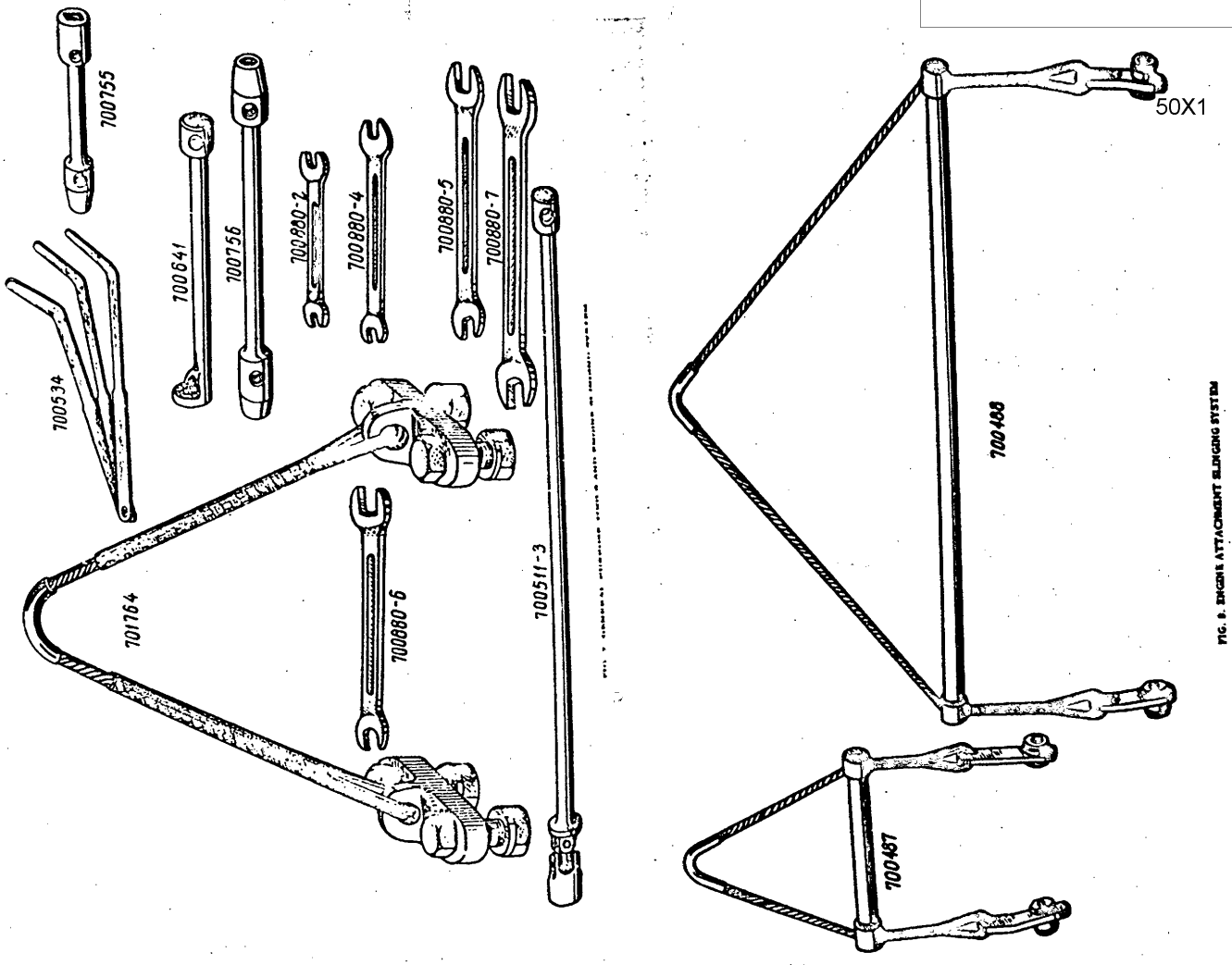

FIG. 8. ENGINE ATTACHMENT SLINGING SYSTEM

S-E-C-R-E-T
NO FOREIGN DISSEM

50X1

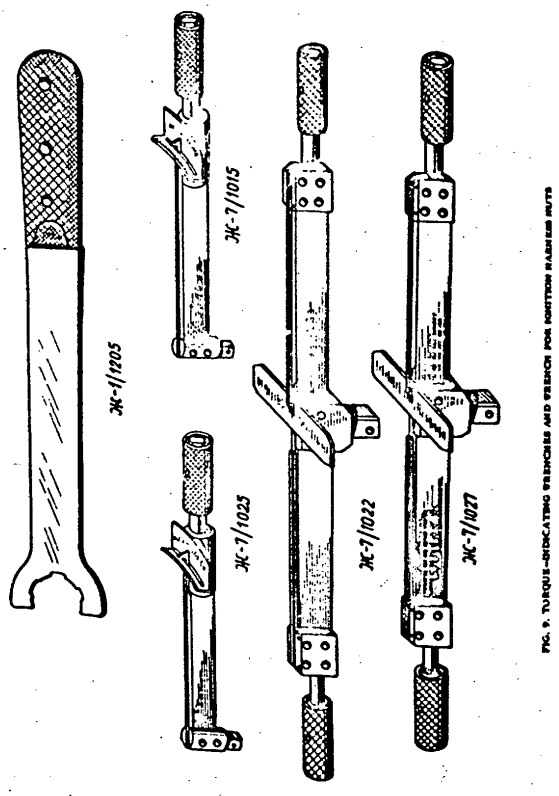

FIG. 9. TORQUE-INDICATING WRENCHES AND WRENCH FOR ROTATION RADIUS RODS

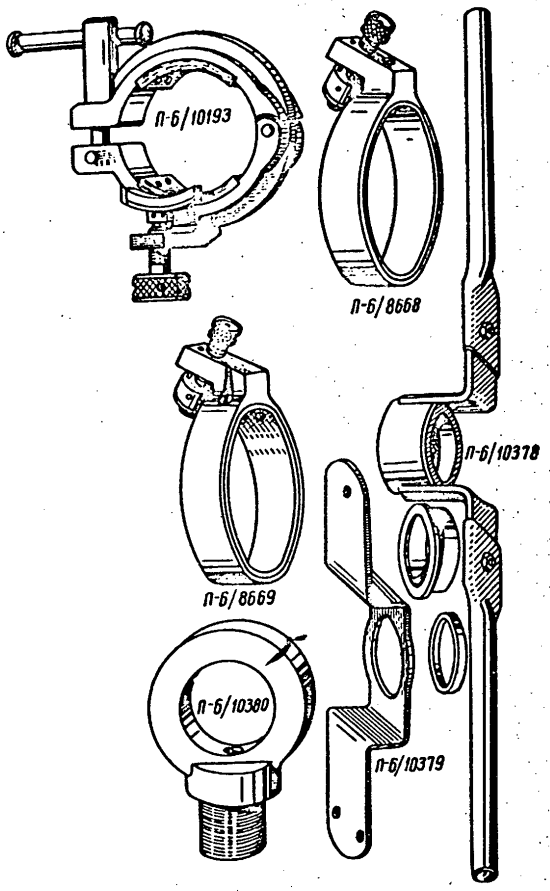

FIG. 10. GENERAL PURPOSE APPLIANCES AND FIXTURES

S-E-C-R-E-T
NO FOREIGN DISSEM

50X1

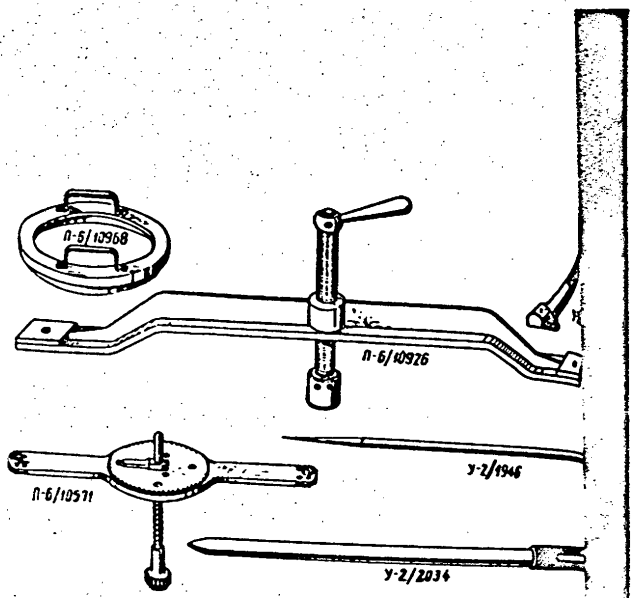

FIG. 11 GENERAL PURPOSE TOOLS APPLIANCES AND FIXTURES

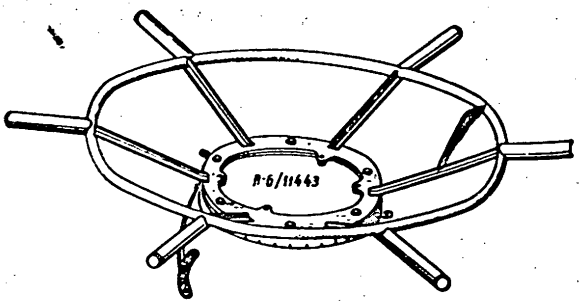

FIG. 12. FIXTURE FOR TURNING CRANKSHAFT BY 3 AXIS SUPPORT

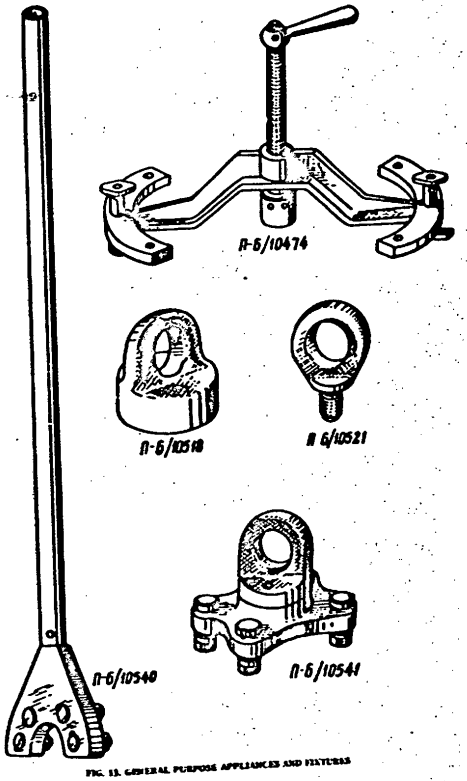

FIG. 13. GENERAL PURPOSE APPLIANCES AND FIXTURES

50X1

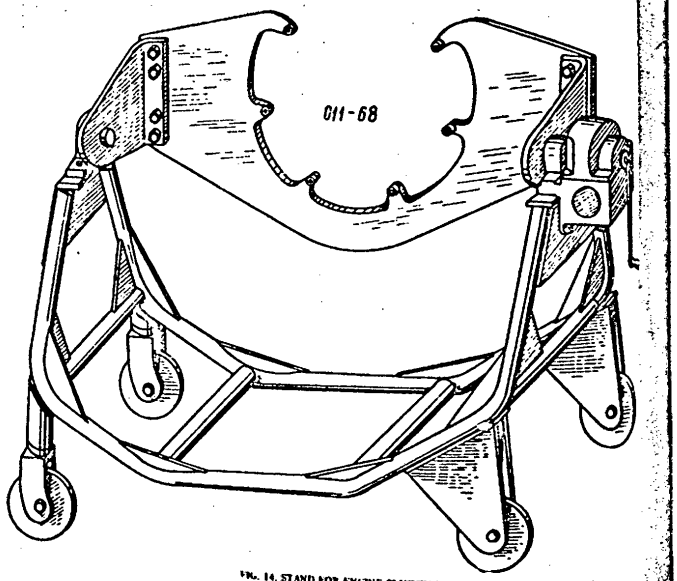

FIG. 14. STAND FOR ENGINE SLUSHING

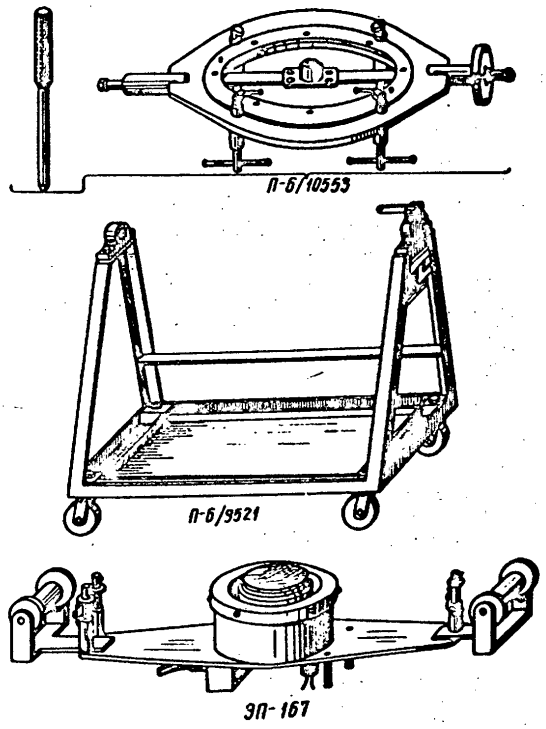

FIG. 15. DEVICES FOR ASSEMBLY OF CRANKCASE NOSE-PIECE AND ENGAGEMENT CLUTCH

50X1

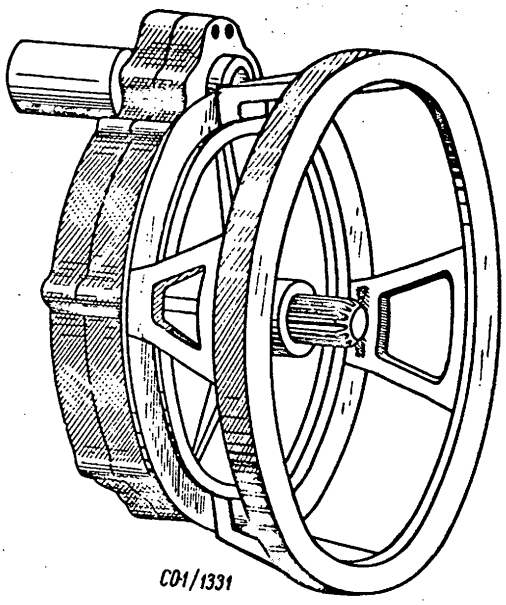

FIG. 16. REDUCING UNIT FOR TIGHTENING INTERMEDIATE SHAFT COUPLING BOLT

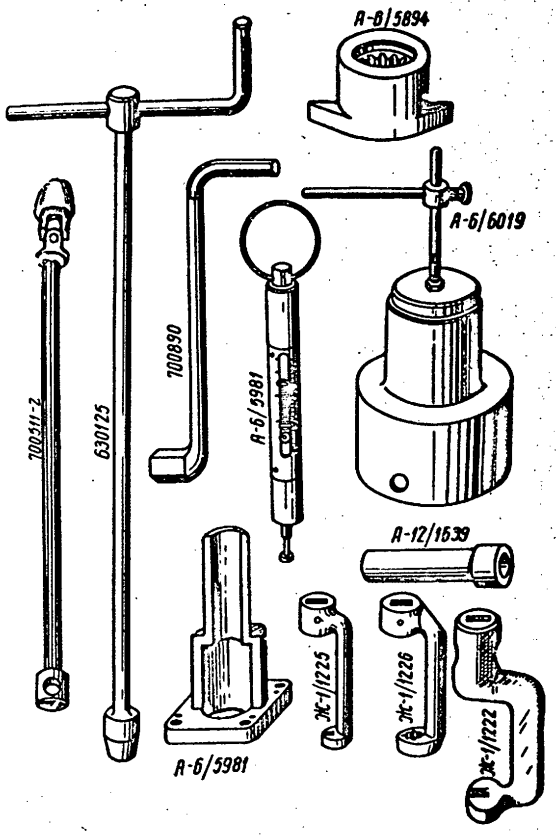

FIG. 17 TOOLS AND APPLIANCES FOR ASSEMBLY OF CRANKCASE NOSE-PIECE AND ENGAGEMENT CLUTCH

50X1

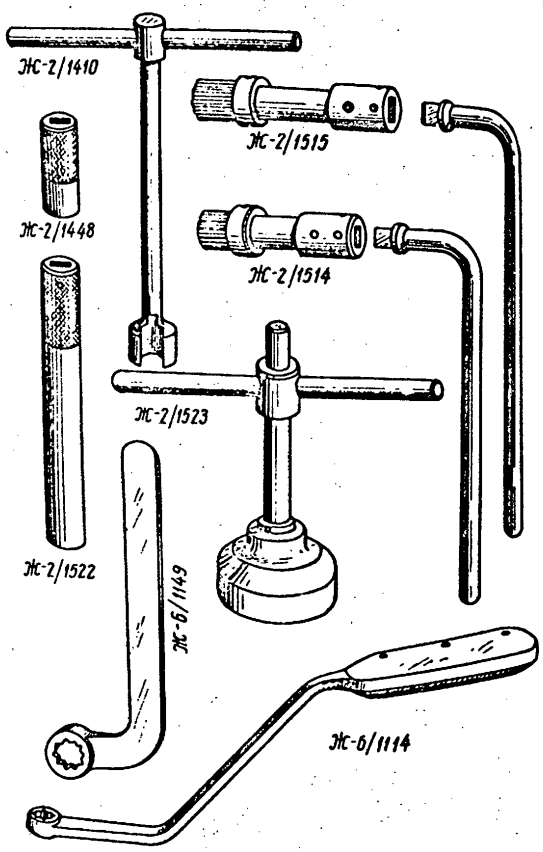

FIG. 18. TOOLS FOR ASSEMBLY OF CRANKCASE NOSE-PIECE, ENGAGEMENT CLUTCH AND STRAIGHTENER

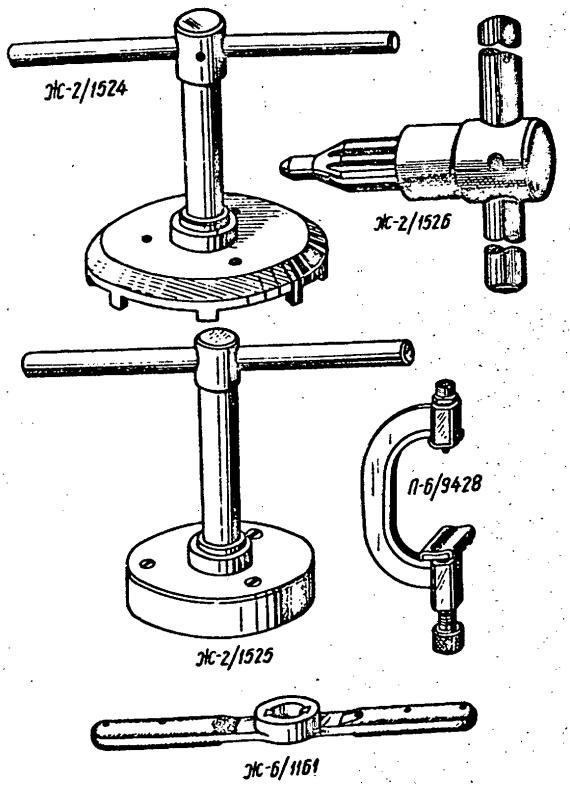

FIG. 19. TOOLS FOR ASSEMBLY OF CRANKCASE NOSE-PIECE AND ENGAGEMENT CLUTCH

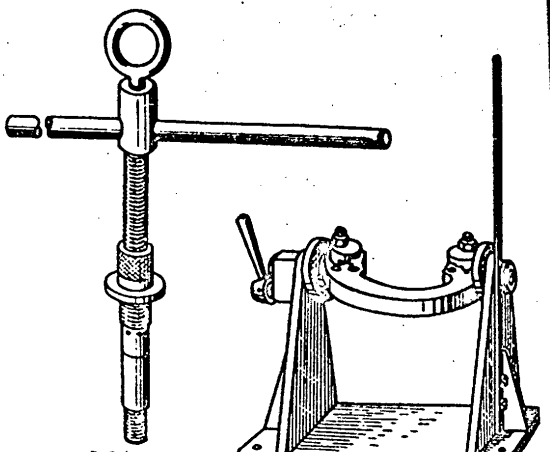

FIG. 20 TOOLS AND FIXTURES FOR ASSEMBLY OF CRANKCASE NOSE-PIECE AND CLUTCH

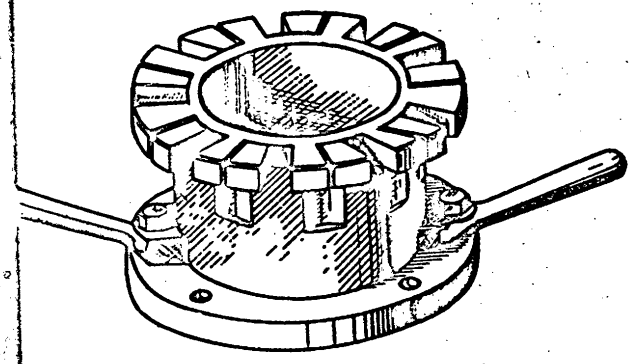

FIG. 21. STAND FOR ASSEMBLY AND DISASSEMBLY OF SPLINED COLLAR

50X1

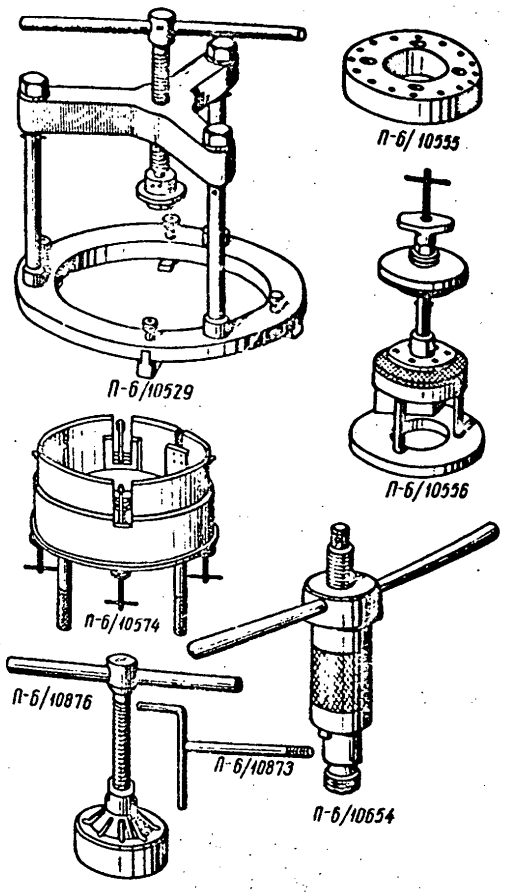

FIG. 22. DEVICES FOR CLUTCH ASSEMBLY

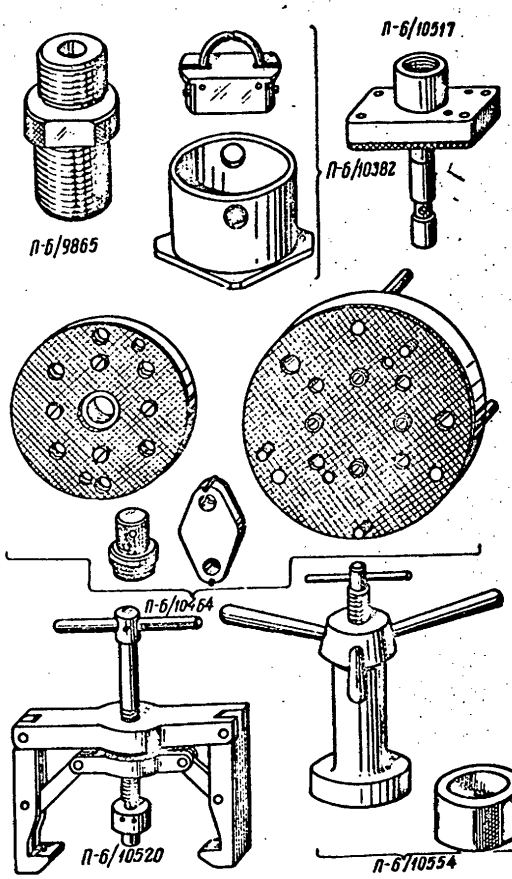

FIG. 23. DEVICES FOR ASSEMBLY OF CRANKCASE NOSE-PIECE AND CLUTCH

S-E-C-R-E-T
NO FOREIGN DISSEM

50X1

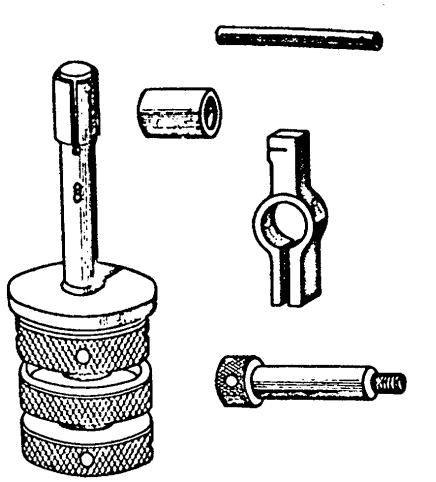

FIG. 24. TORQUE INDICATING WRENCH AND DEVICE TO CHECK GEAR CLEARANCES

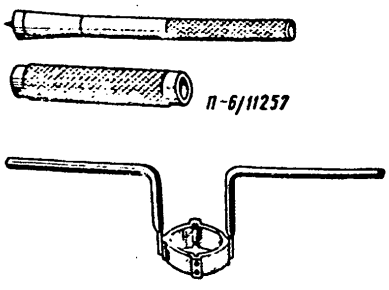

FIG. 25. APPLIANCES FOR MOUNTING AND DISMOUNTING FRONT OIL PUMP LOCK AND FOR CHECKING OPERATION OF RATCHET PISTON

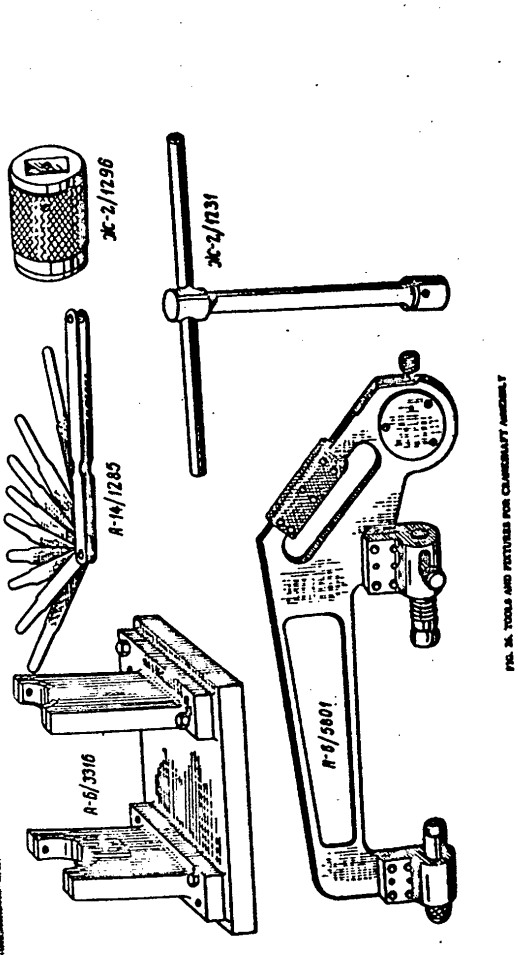

FIG. 26. TOOLS AND FIXTURES FOR CAMSHAFT BEARINGS T

S-E-C-R-E-T
NO FOREIGN DISSEM

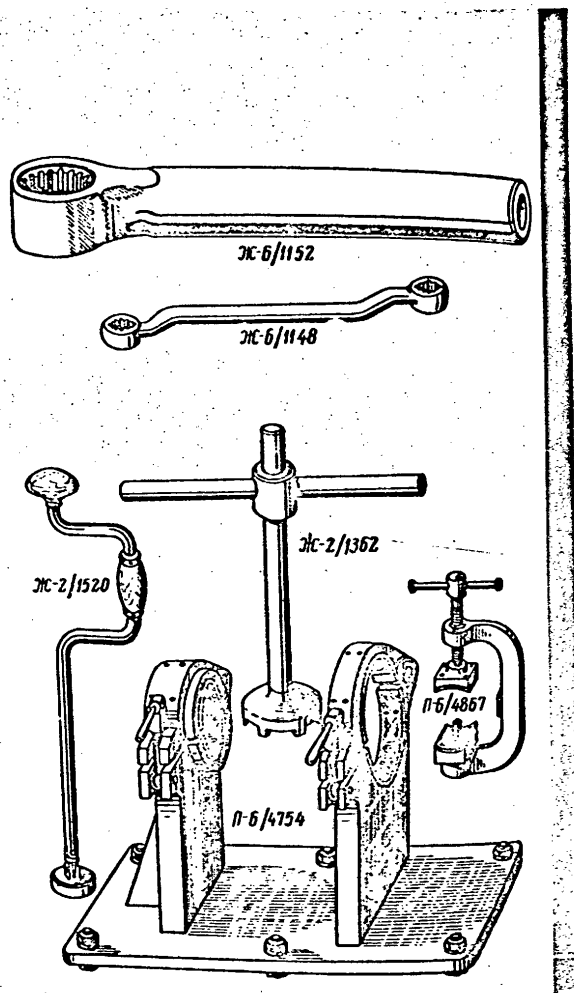

FIG. 27. TOOLS AND FIXTURES FOR CRANKSHAFT ASSEMBLY

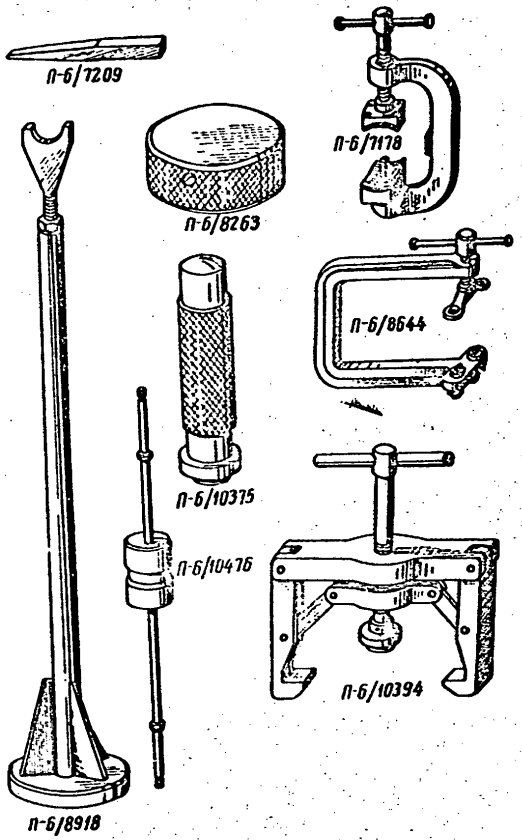

FIG. 28. TOOLS AND FIXTURES FOR CRANKSHAFT ASSEMBLY

50X1

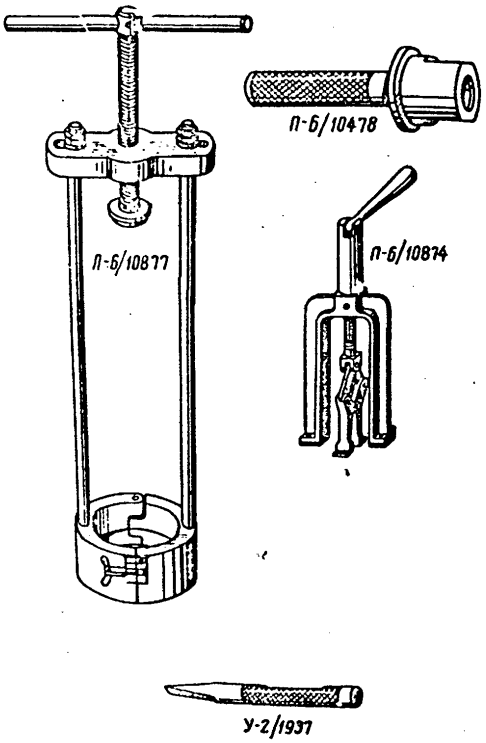

FIG. 29 TOOLS AND FIXTURES FOR CRANKSHAFT ASSEMBLY

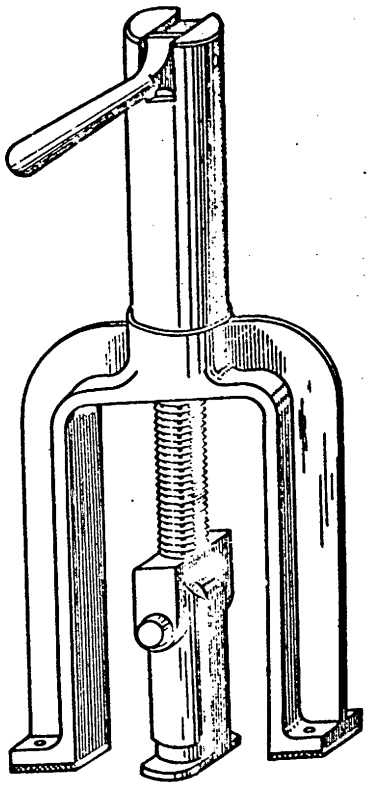

FIG. 30. REMOVER FOR CRANKPIN PLUGS

50X1

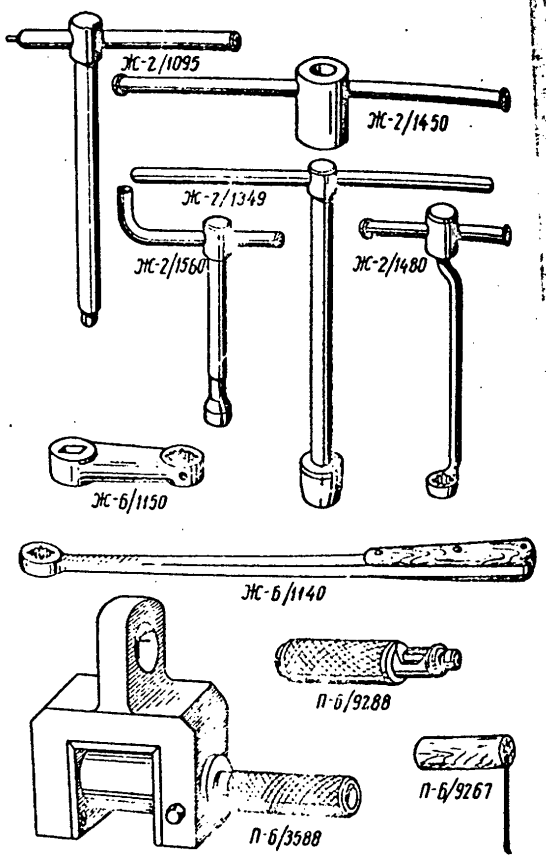

FIG. 31. TOOLS AND FIXTURES FOR ASSEMBLY OF CRANKSHAFT AND TIMING MECHANISM

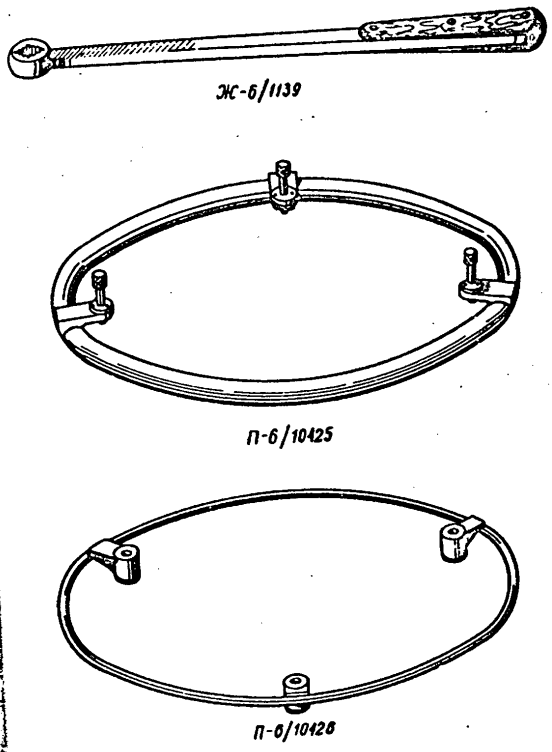

FIG. 32. TOOLS AND APPLIANCES FOR CRANKCASE ASSEMBLY

50X1

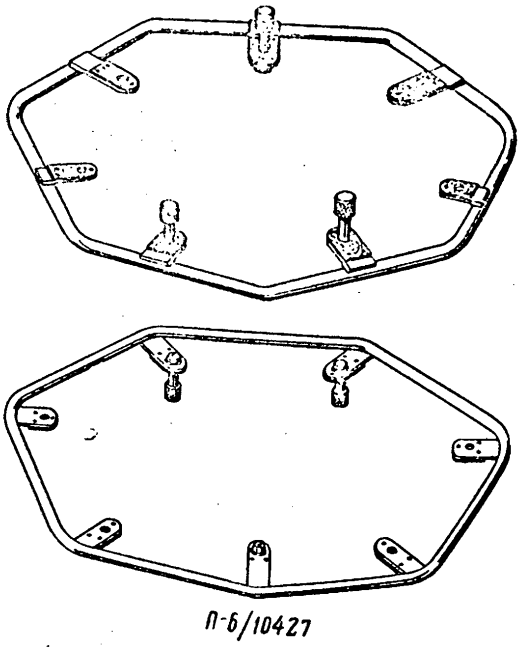

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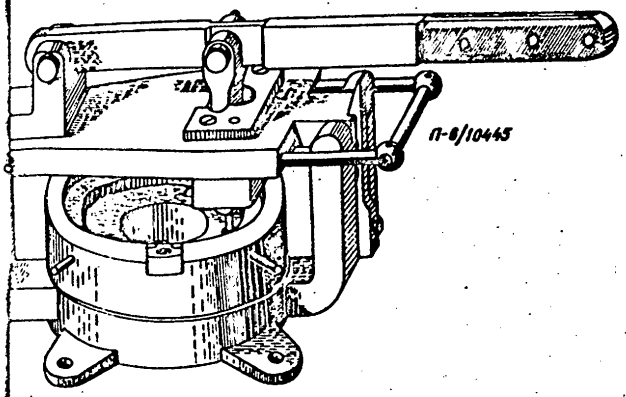
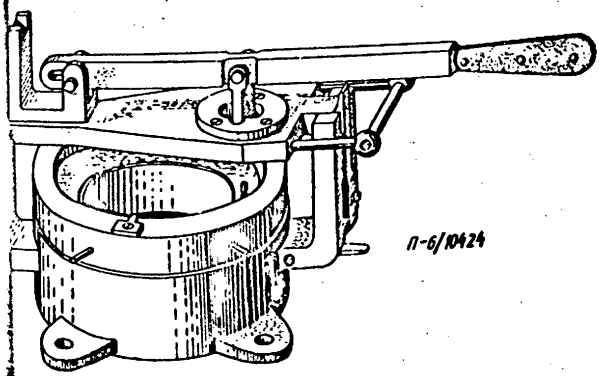
FIG. 33. APPLIANCE FOR PROTECTING CRANKCASE JOINT SURFACES AGAINST DAMAGE



П-6/10445

34. DEVICE FOR ASSEMBLY OF TIMING MECHANISM DOUBLE-RIM ELASTIC GEAR



П-6/10424

FIG. 35. DEVICE FOR ASSEMBLY OF ELASTIC GEARS

50X1

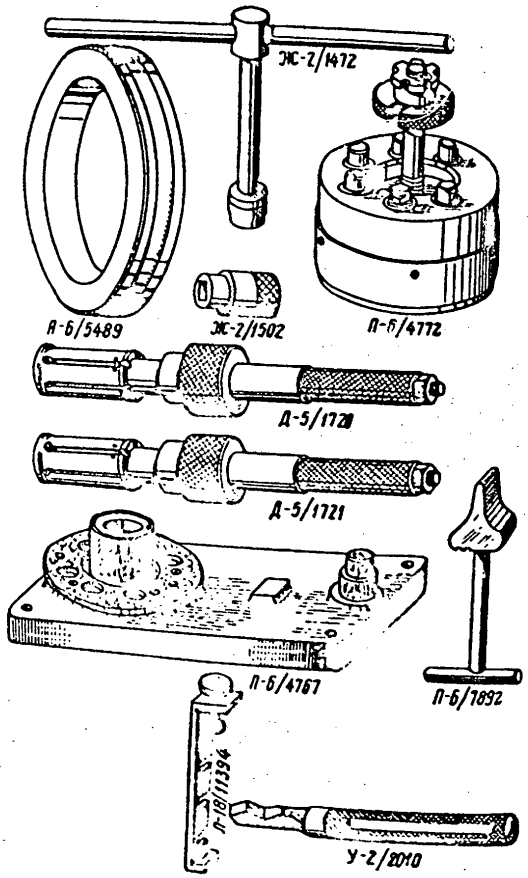


FIG. 36. TOOLS, FIXTURES AND APPLIANCES FOR ASSEMBLY OF CONNECTING RODS

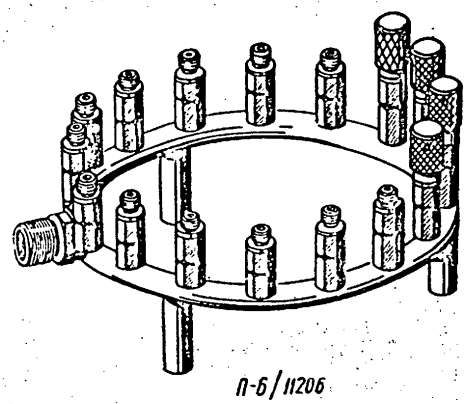


FIG. 37. APPLIANCE FOR KNUCKLE PIN WASHING

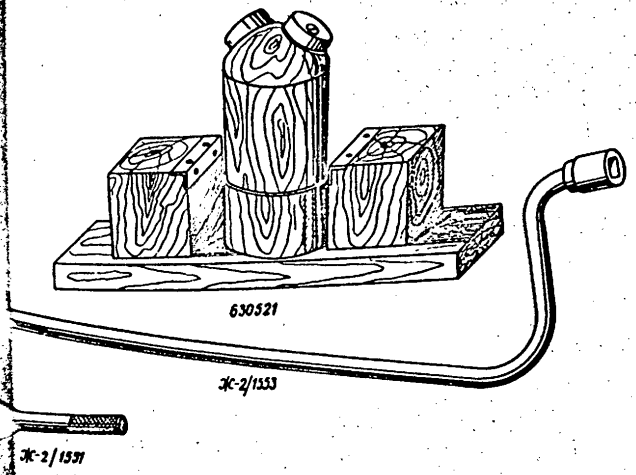


FIG. 38. TOOLS AND FIXTURES FOR CYLINDER ASSEMBLY

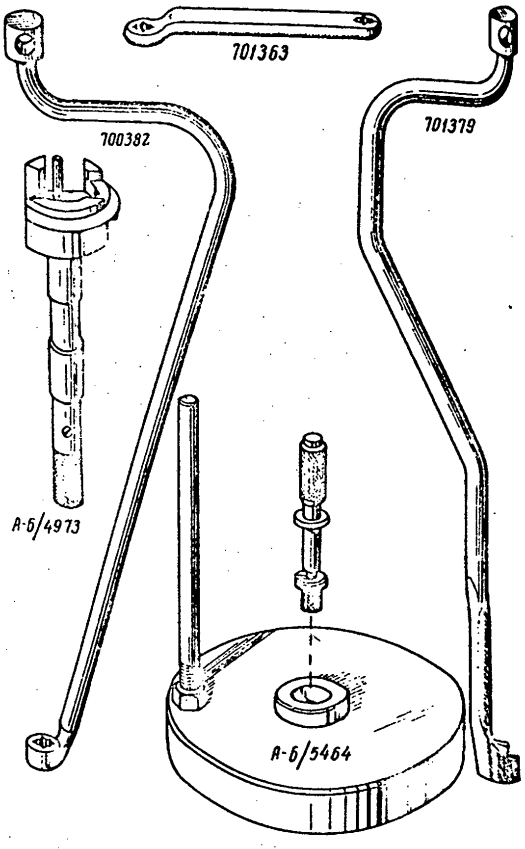


FIG. 39. TOOLS AND FIXTURES FOR CYLINDER ASSEMBLY

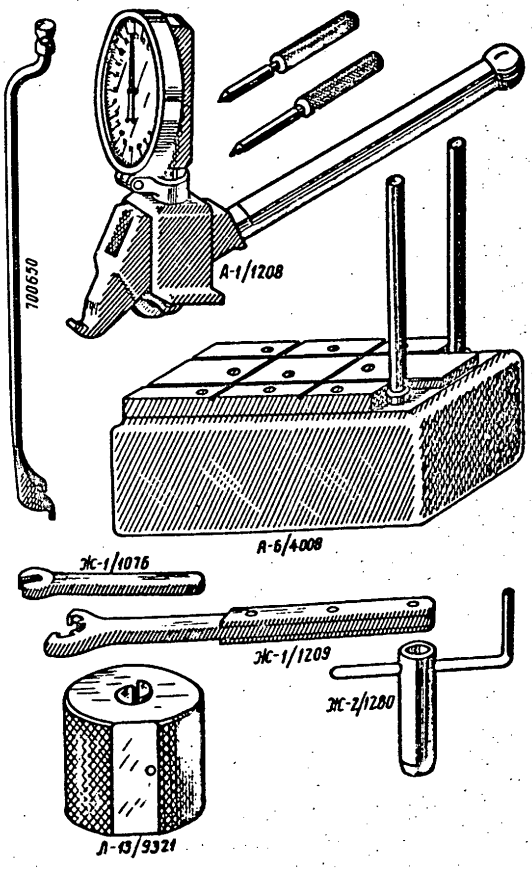


FIG. 40. TOOLS AND FIXTURES FOR ASSEMBLY OF CYLINDERS AND PISTONS

50X1

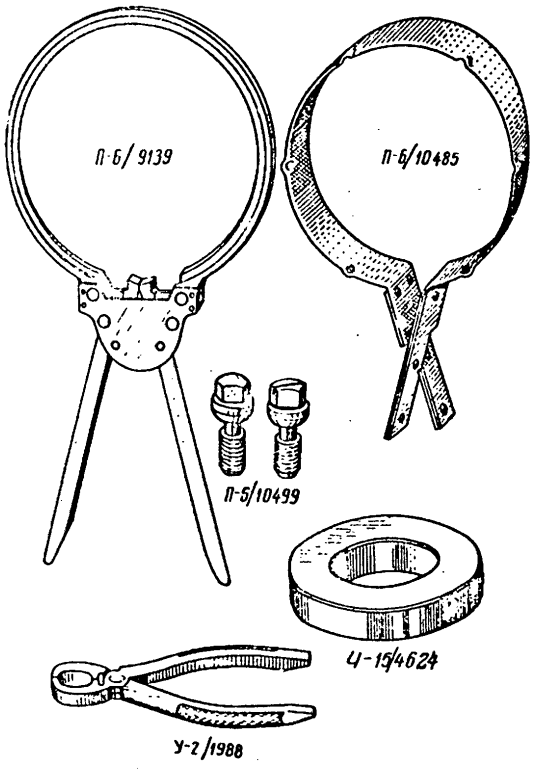


FIG. 41. TOOLS AND FIXTURES FOR ASSEMBLY OF CYLINDERS AND PISTON

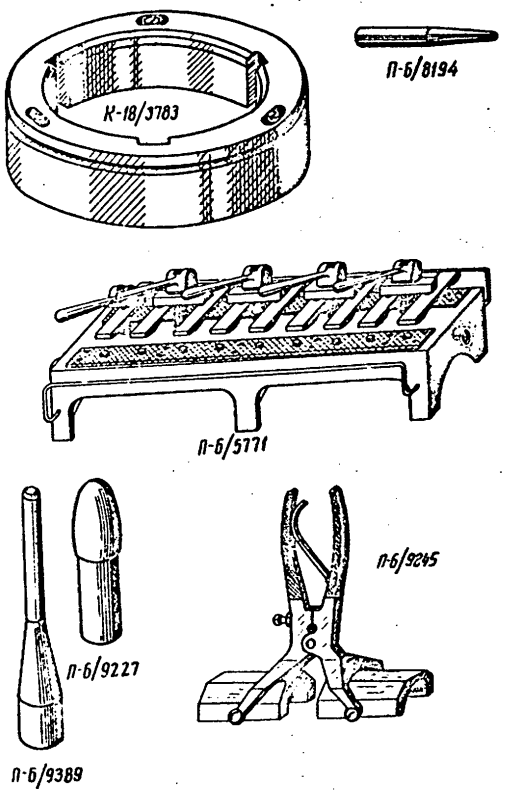


FIG. 42. TOOLS AND FIXTURES FOR CYLINDER ASSEMBLY

50X1

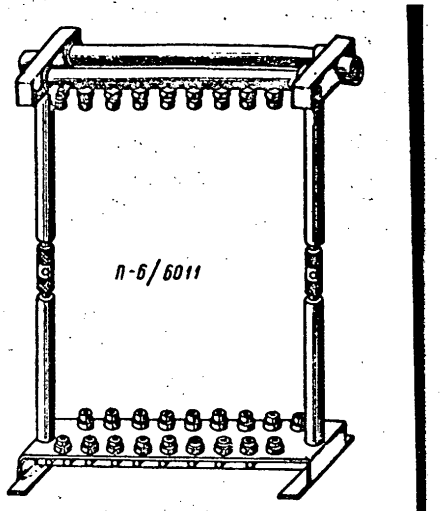


FIG. 43. APPLIANCE FOR TAPPET PUSH-ROD WASHING

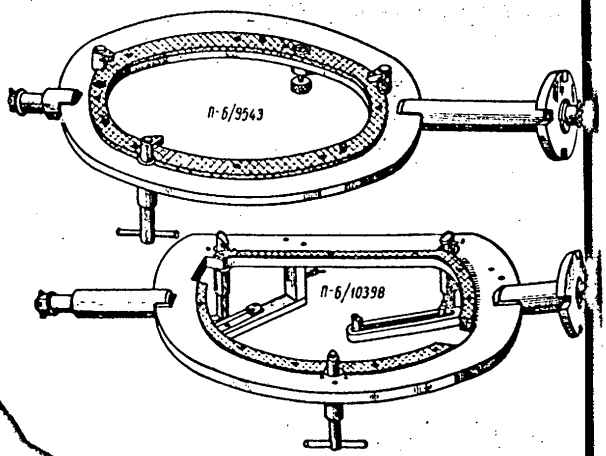


FIG. 44. PLATES FOR ASSEMBLY OF SUPERCHARGER AND CRANKCASE REAR COVER

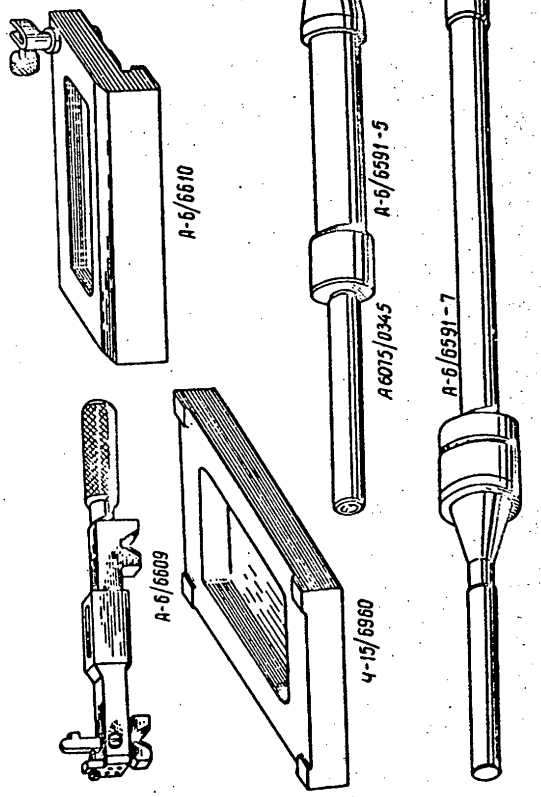


FIG. 45. APPLIANCES FOR SUPERCHARGER ASSEMBLY

50X1

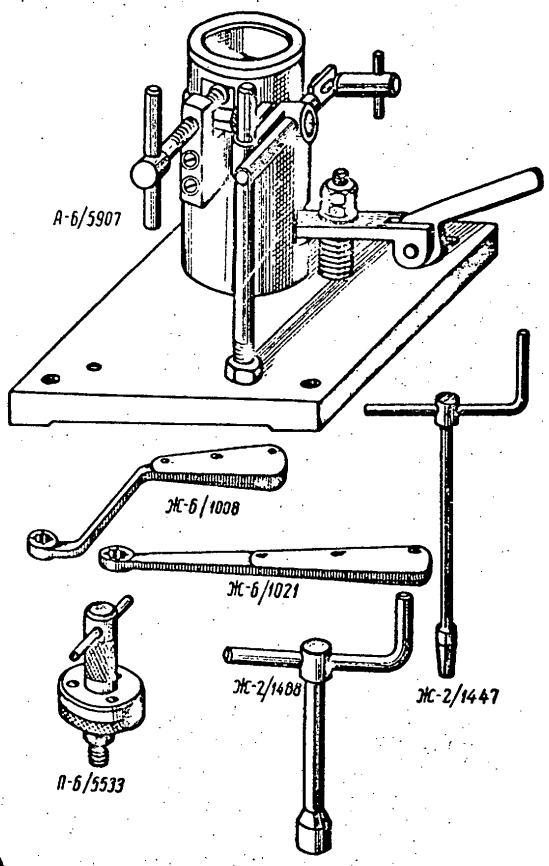


FIG. 46. TOOLS AND FIXTURES FOR SUPERCHARGER ASSEMBLY

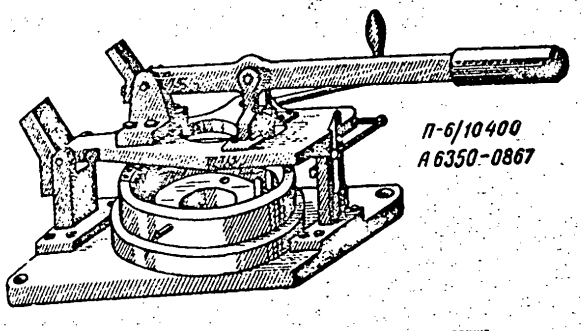


FIG. 47. APPLIANCE FOR MOUNTING ACCESSORIES DRIVE SHAFT SPRINGS

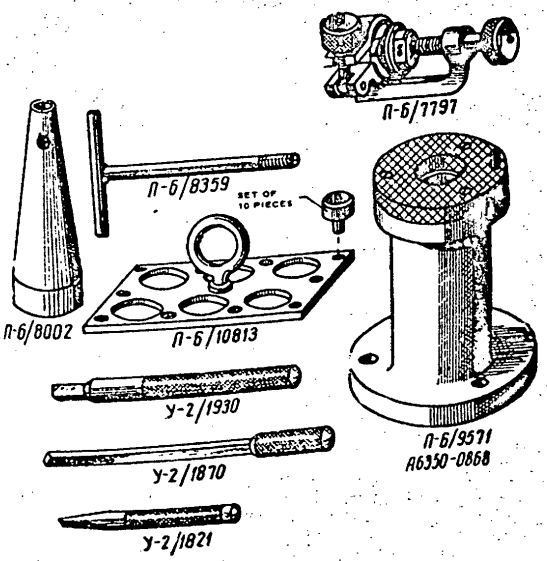


FIG. 48. TOOLS AND FIXTURES FOR SUPERCHARGER ASSEMBLY

50X1

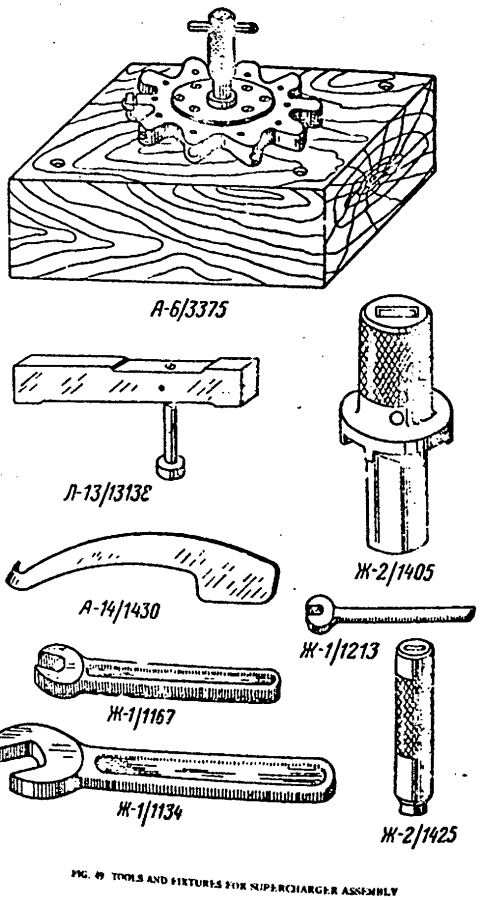


FIG. 49 TOOLS AND FIXTURES FOR SUPERCHARGER ASSEMBLY

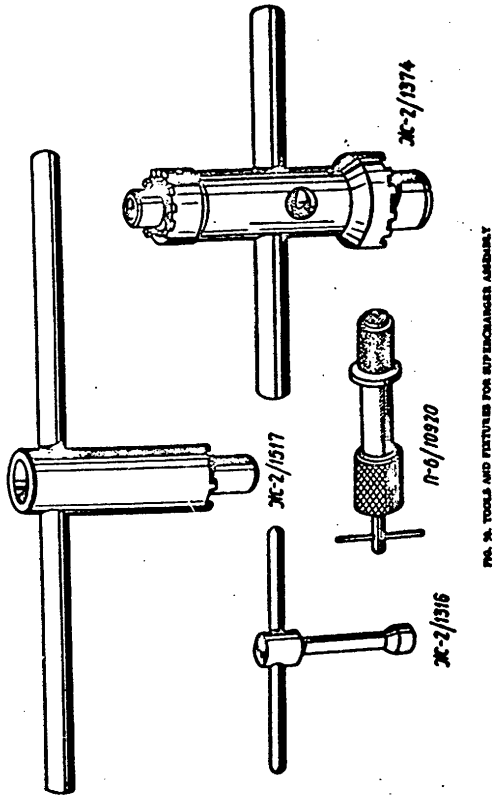


FIG. 50. TOOLS AND FIXTURES FOR SUPERCHARGER ASSEMBLY

50X1

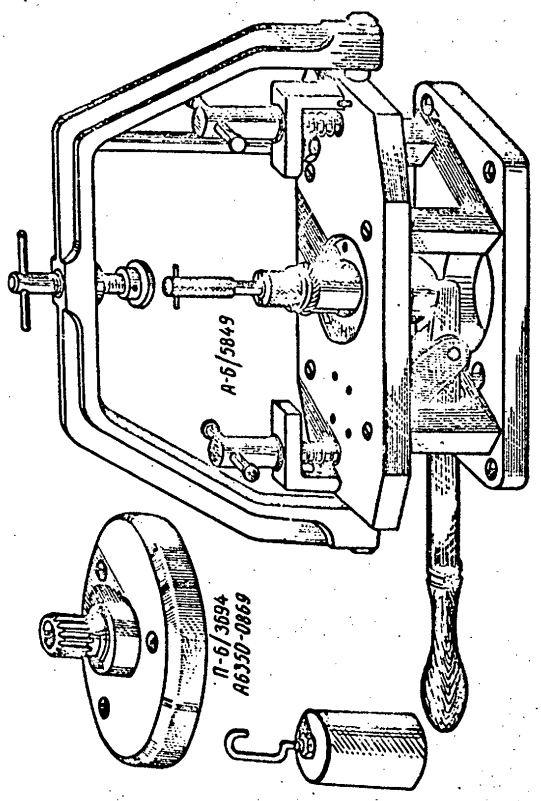


FIG. 11. FIXTURES FOR SUPERCHARGER ASSEMBLY

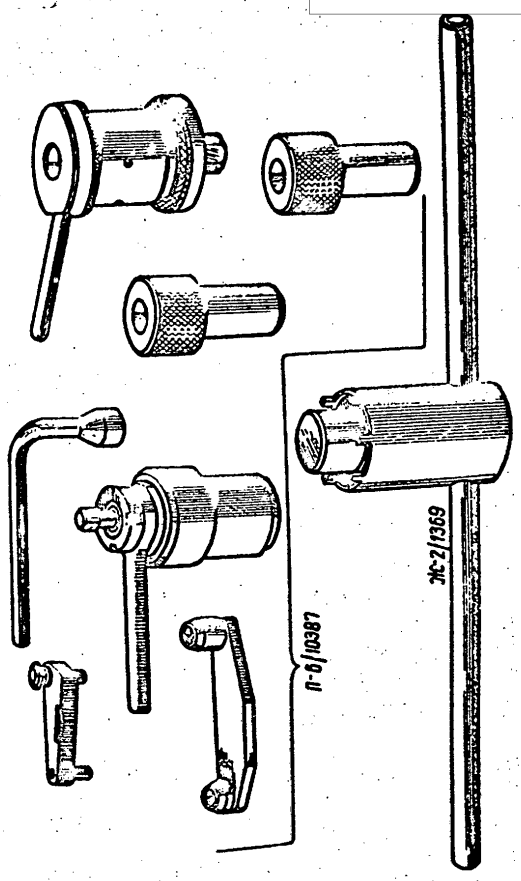


FIG. 12. TOOLS AND FIXTURES FOR SUPERCHARGER ASSEMBLY

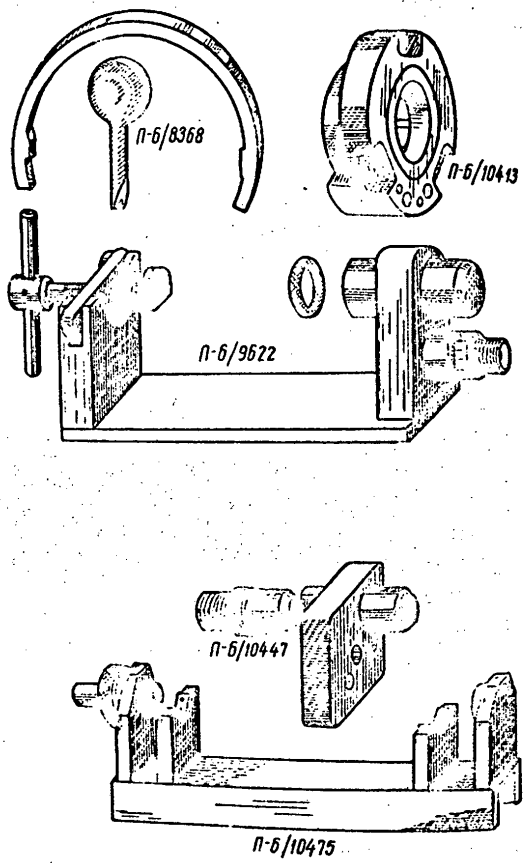


FIG. 53. APPLIANCES FOR SUPERCHARGER ASSEMBLY

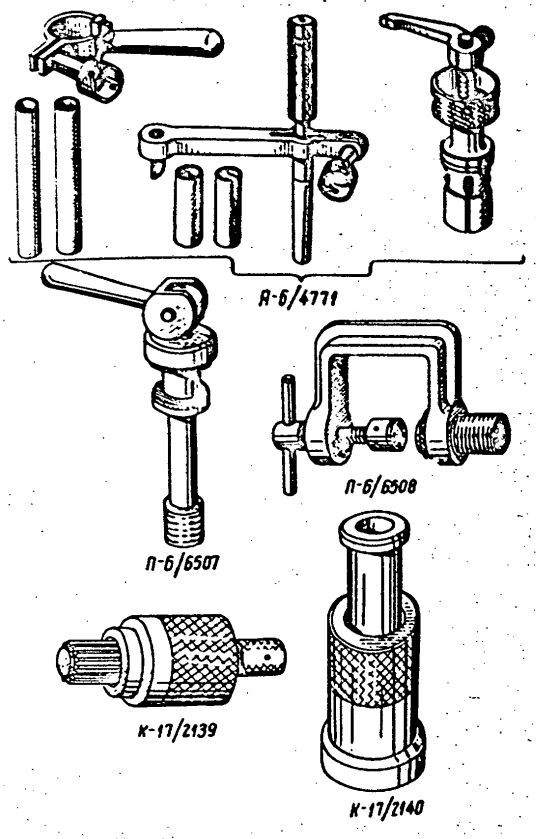


FIG. 54. APPLIANCES FOR ASSEMBLY OF [illegible] PUMP DRIVE

50X1

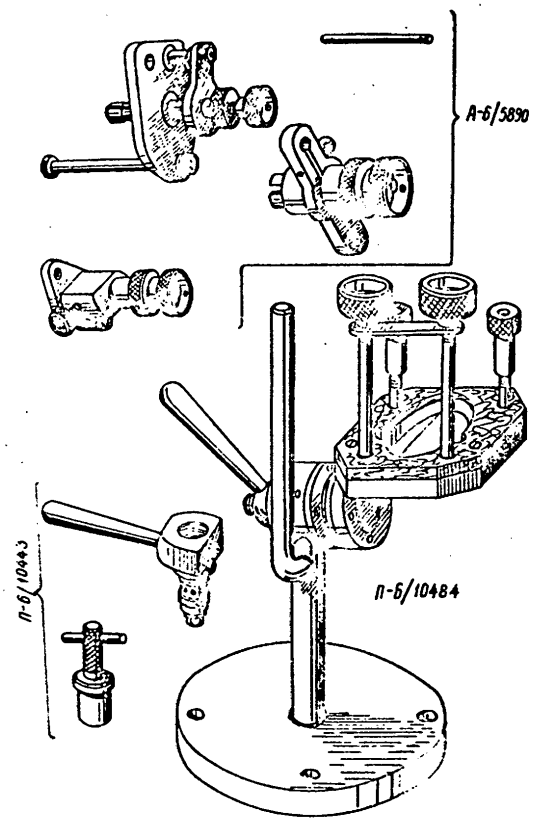


FIG. 55. APPLIANCES FOR SPEED COUNTER DRIVE ASSEMBLY

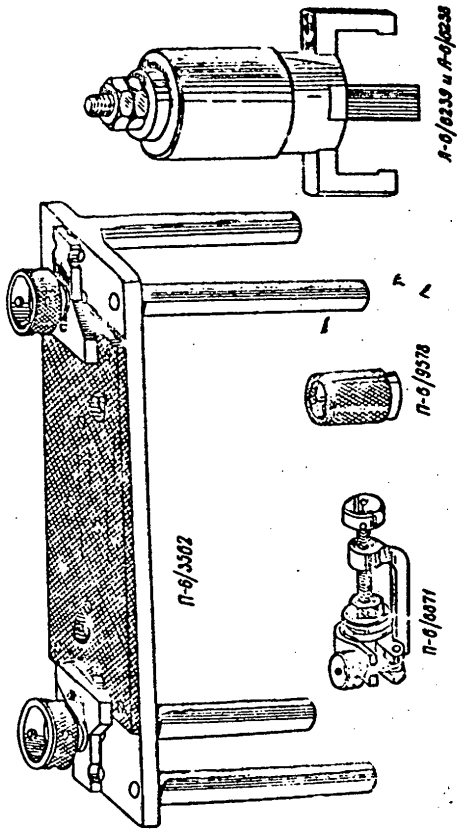


FIG. 56. FIXTURES FOR ASSEMBLY OF SPEED COUNTER DRIVE AND OIL SUMP

S-E-C-R-E-T
NO FOREIGN DISSEM

50X1

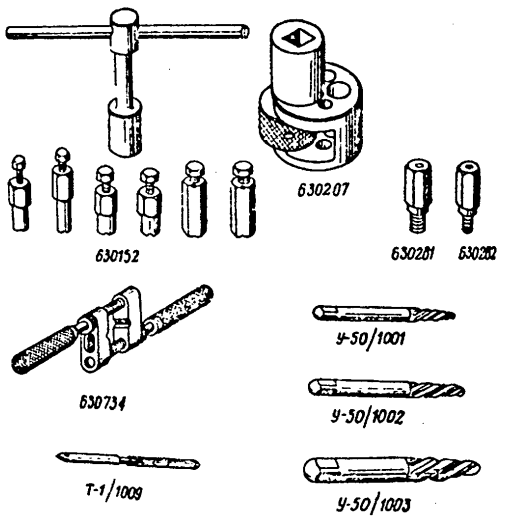


FIG. 57 GENERAL PURPOSE TOOLS

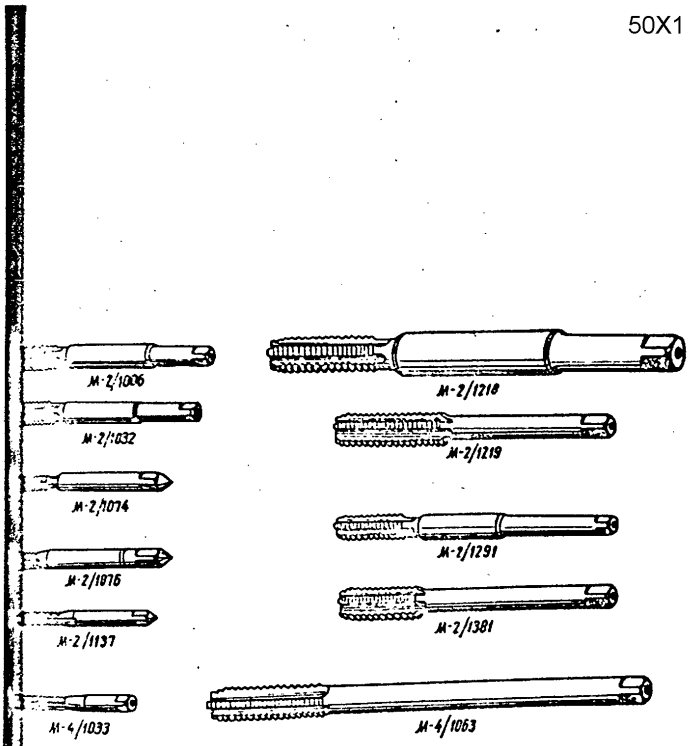


FIG. 58. GENERAL PURPOSE TOOLS (TAPS)

S-E-C-R-E-T
NO FOREIGN DISSEM

50X1

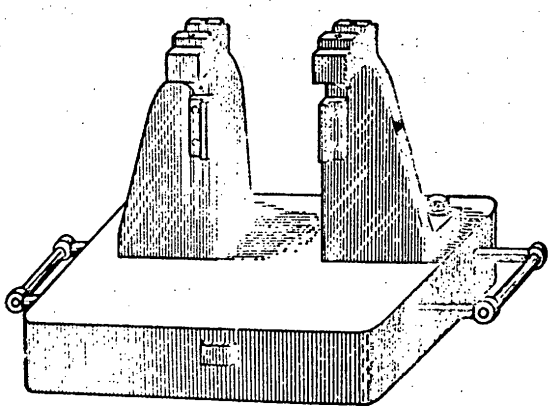


FIG. 99 FIXTURE FOR CHECKING ALIGNMENT OF PIN HOLES IN COUNTERWEIGHTS

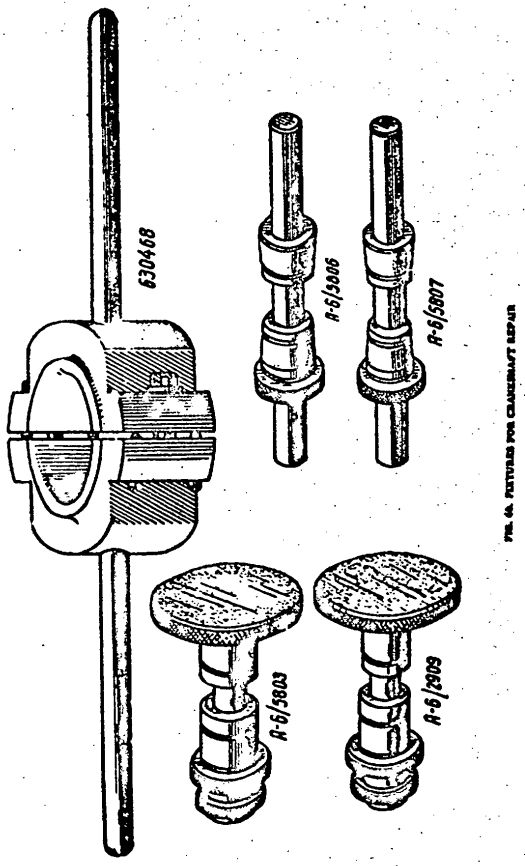


FIG. 66 FIXTURES FOR CRANKSHAFT REPAIR

S-E-C-R-E-T
NO FOREIGN DISSEM

50X1

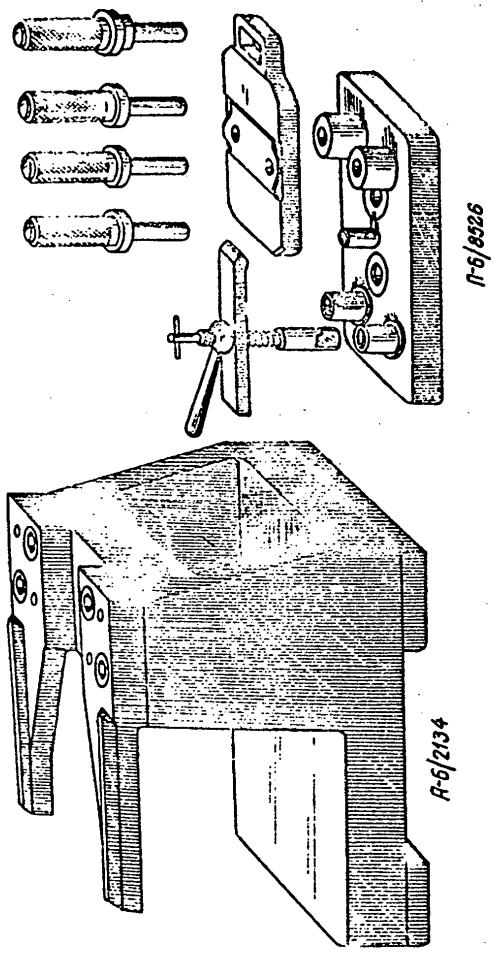


FIG. 61. FIXTURES FOR CRANKSHAFT REPAIR

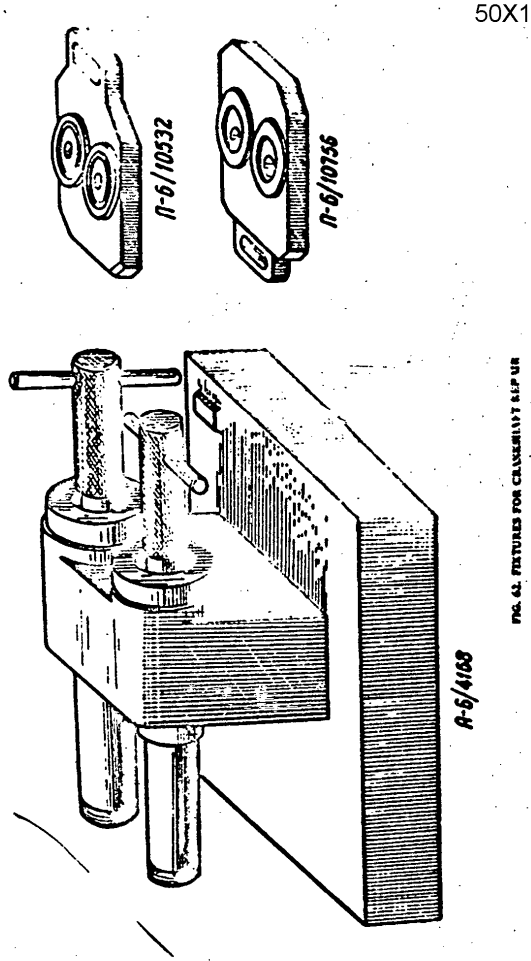


FIG. 62. FIXTURES FOR CRANKSHAFT REPAIR

S-E-C-R-E-T
NO FOREIGN DISSEM

50X1

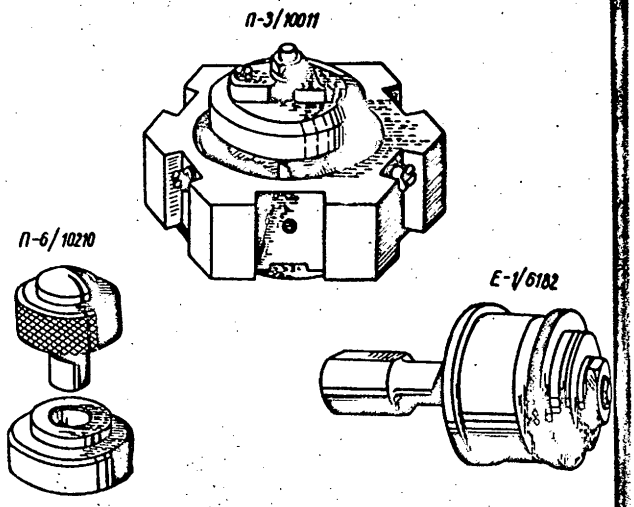


FIG. 63. FIXTURES FOR REPAIR OF SECOND ORDER BALANCER SUPPORT

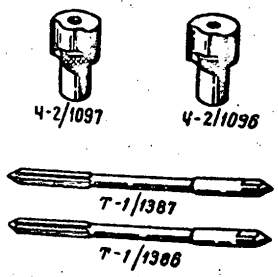


FIG. 64. TOOLS AND DEVICES FOR REPAIR OF SECOND ORDER BALANCER SUPPORT

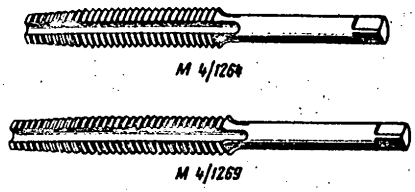


FIG. 65. TOOLS (TAPS) FOR REPAIR OF CRANKCASE INTERMEDIATE SECTION

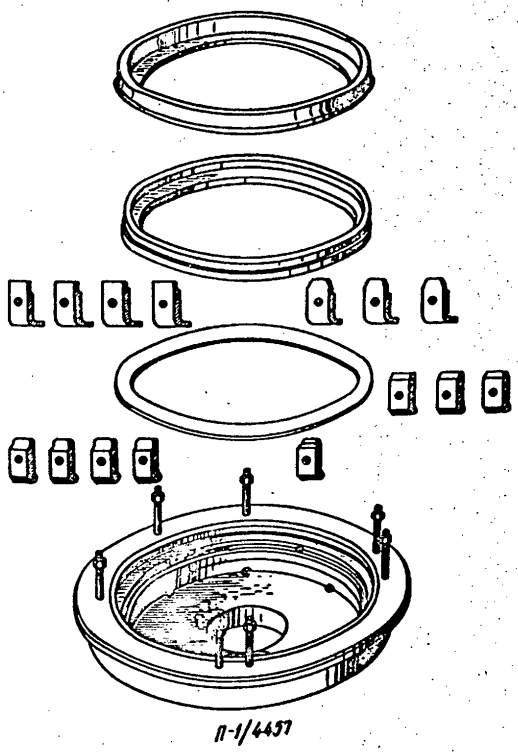
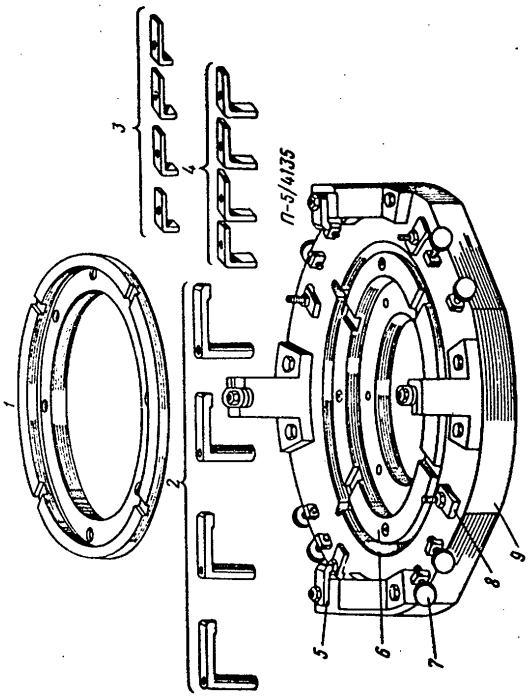


FIG. 66. FIXTURE FOR SETTING CAM RING WHEN EXPANDING BUSHINGS

50X1



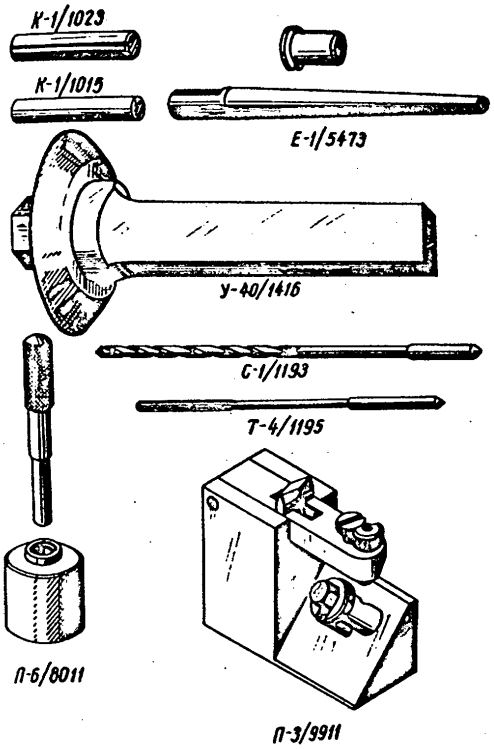
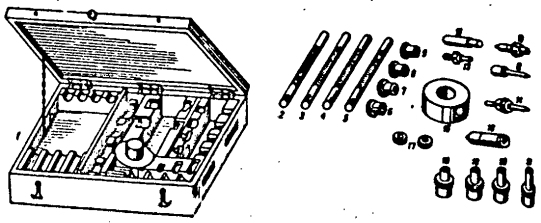
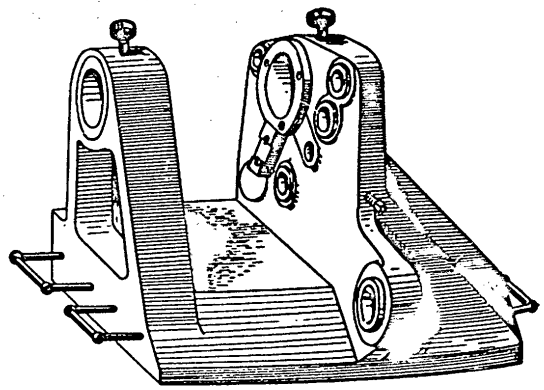
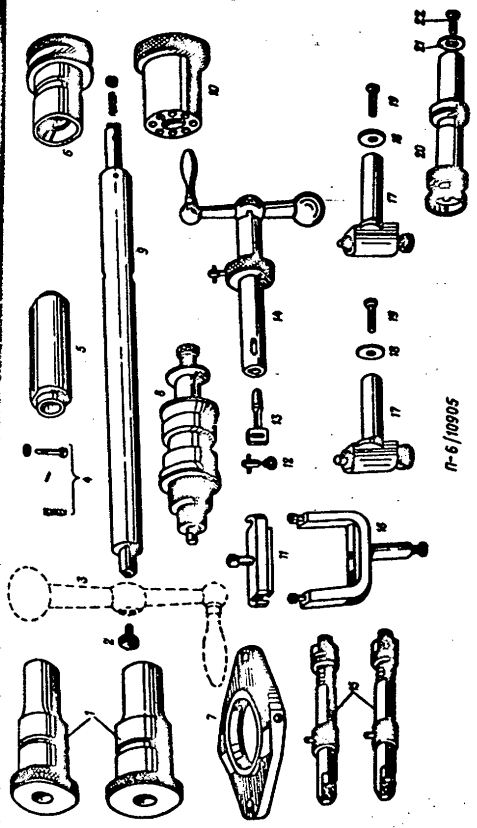


FIG. 68. TOOLS AND FIXTURES FOR REPAIR OF CAM ... AND BUSHING – RIM TIMING GEAR OF TIMING MECHANISM

50X1







50X1

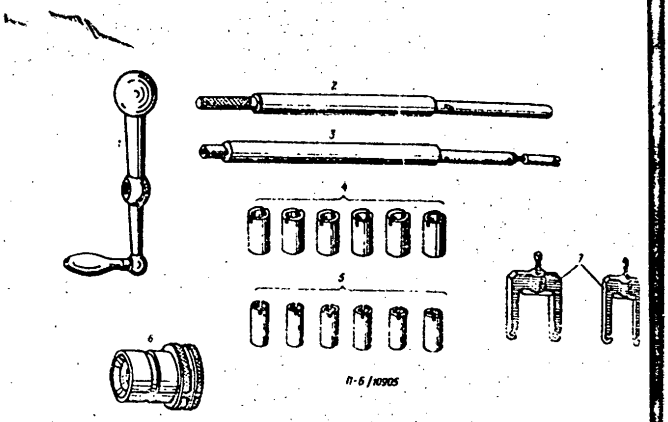
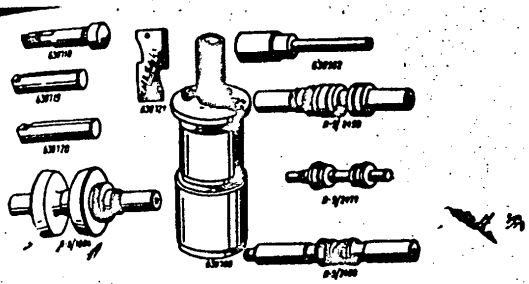
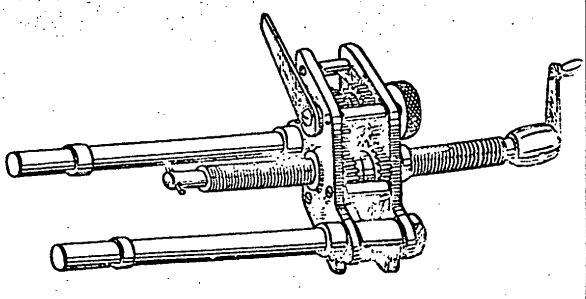


FIG. 74. TOOLS AND FIXTURES FOR REPAIR OF CONNECTING RODS





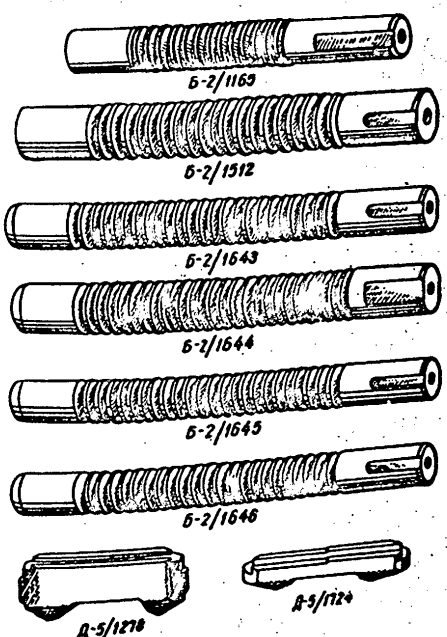
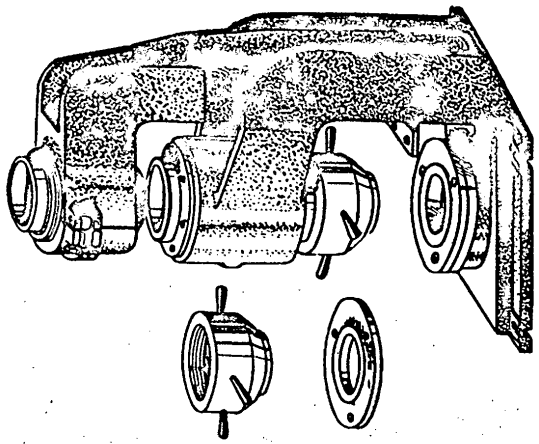
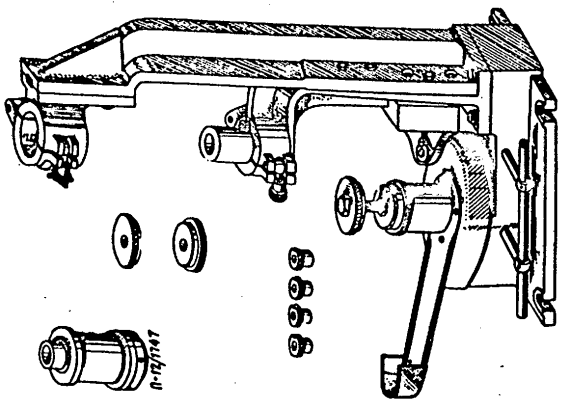


FIG. 75. BRACKETS AND STOPS HOLDERS USED FOR REPAIR OF CONNECTING RODS

50X1





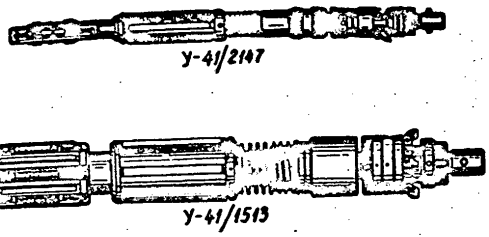


FIG. 80 HONING HEADS FOR MASTER ROD CHECK HOLES AND HONING HOLE IN MASTER ROD CRANKPIN END

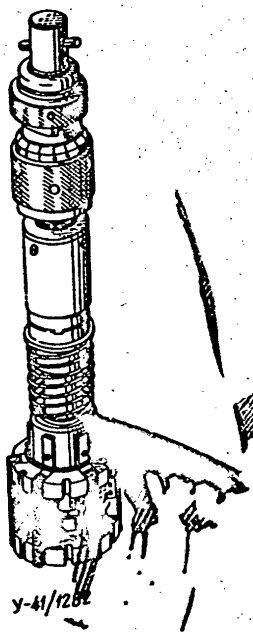


FIG. 81 HONING HEAD FOR CYLINDER LINER

50X1

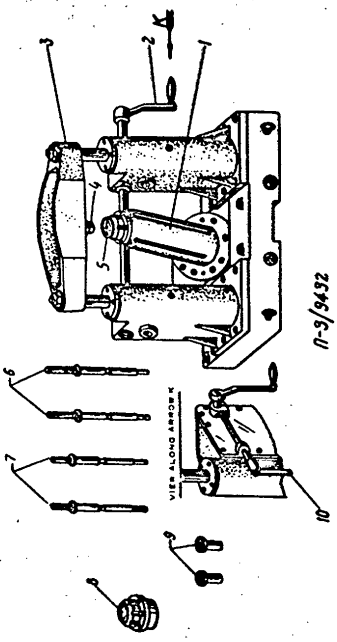


FIG. 82. FIXTURE FOR CYLINDER SETTING WHEN REAMING EXHAUST AND INLET VALVE GUIDES
1 — supports; 2 — handles; 3 — cross-member; 4 — bushing; 5 — covering sleeves; 6 and 7 — covering pins; 8 — cross-piece; 9 — big sleeve; 10 — bushing for cross-member; 11 — screw.

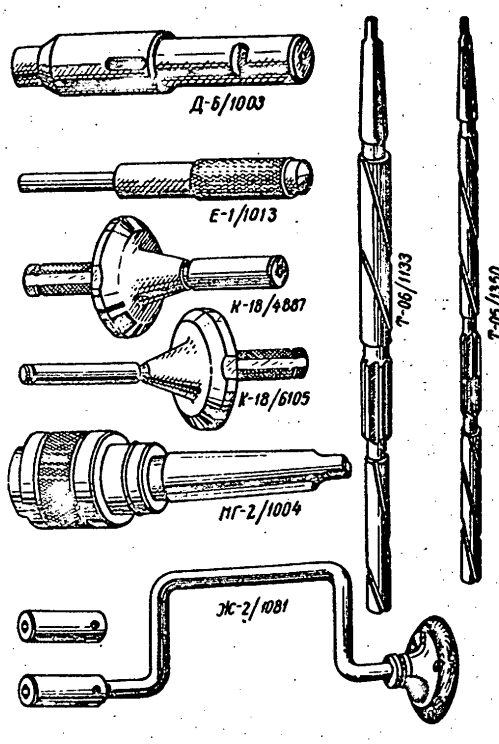


FIG. 83. TOOLS AND APPLIANCES FOR REPAIR OF CYLINDERS

S-E-C-R-E-T
NO FOREIGN DISSEM

50X1

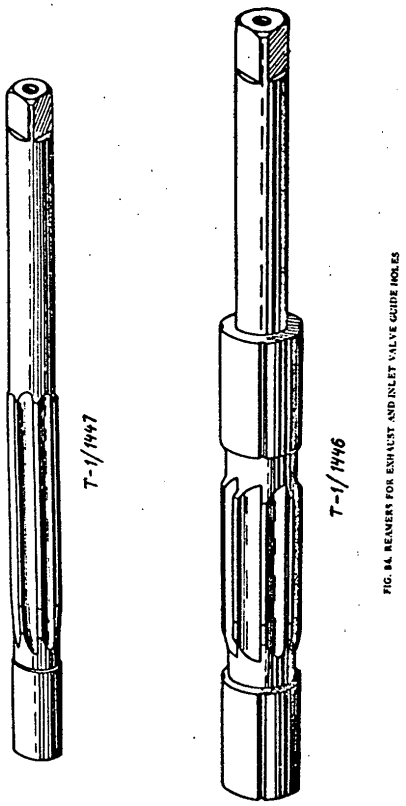


FIG. 84. REAMERS FOR EXHAUST AND INLET VALVE GUIDE HOLES

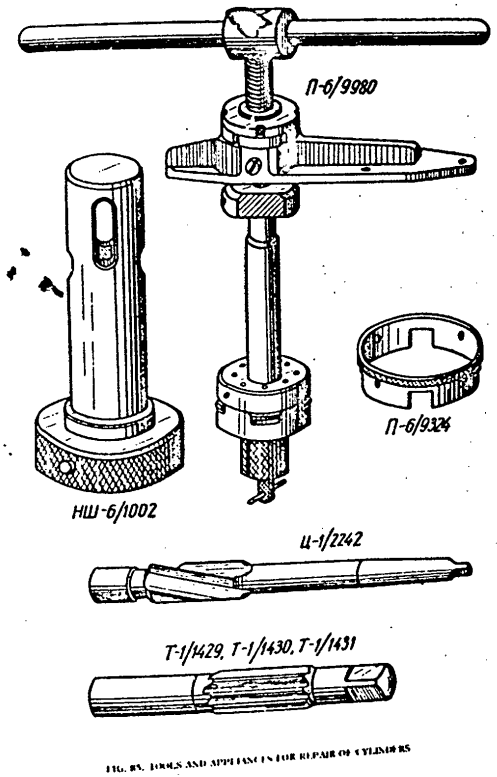
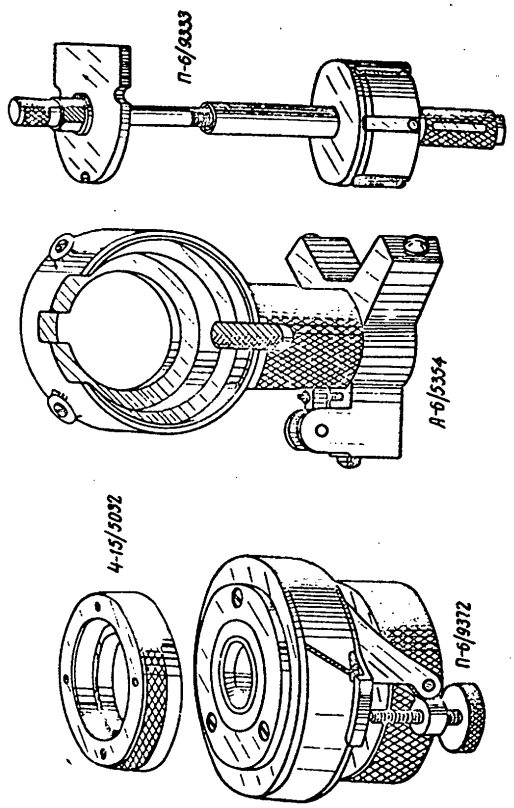
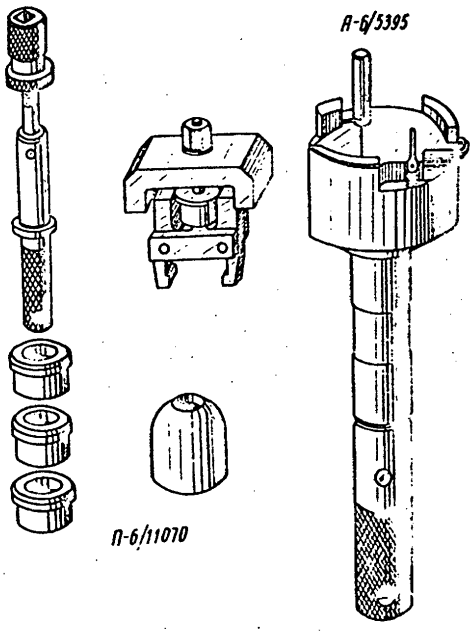


FIG. 85. TOOLS AND APPLIANCES FOR REPAIR OF CYLINDERS

S-E-C-R-E-T
NO FOREIGN DISSEM

50X1





50X1

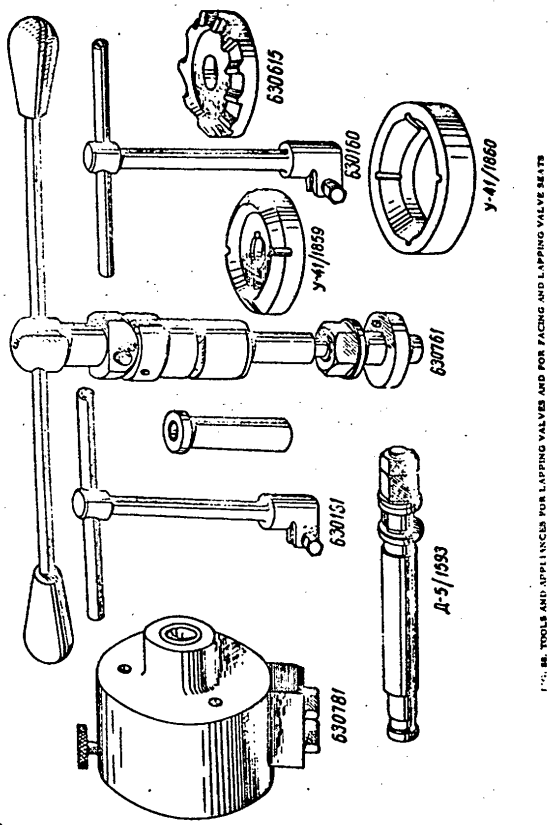
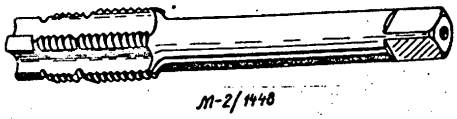


FIG. 88. TOOLS AND APPLIANCES FOR LAPPING VALVES AND FOR FACING AND LAPPING VALVE SEATS



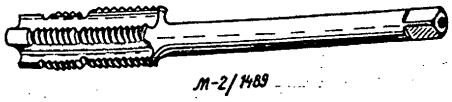
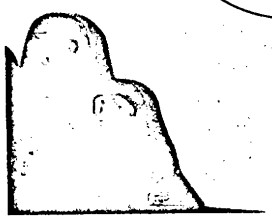
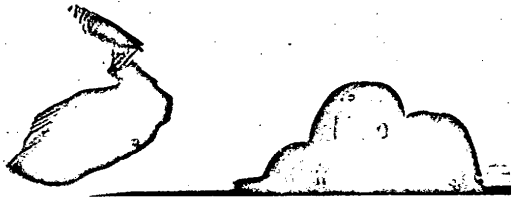


FIG. 89. TAPS FOR THREADING HOLES FOR SPARK PLUG AND PRIMING NOZZLE BUSHINGS





50X1

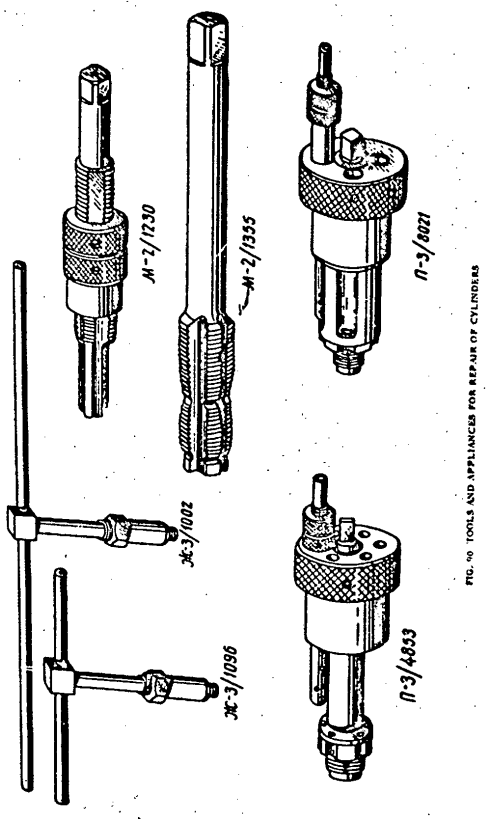


FIG. 90. TOOLS AND APPLIANCES FOR REPAIR OF CYLINDERS

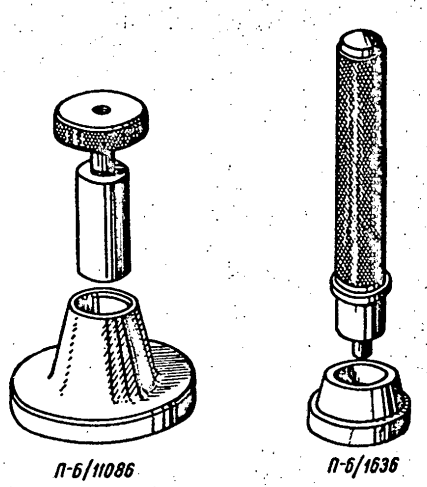


FIG. 91. DEVICE FOR PRESSING IN AND OUT VALVE LEVER BEARING

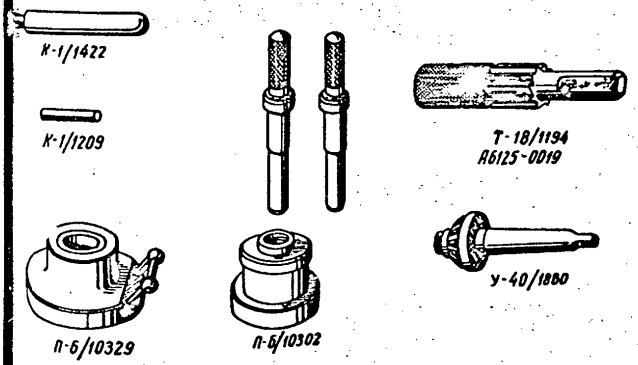


FIG. 92. TOOLS AND DEVICES FOR REPLACING BUSHING OF SUPERCHARGER IMPELLER DRIVE DOUBLE-RIM GEAR

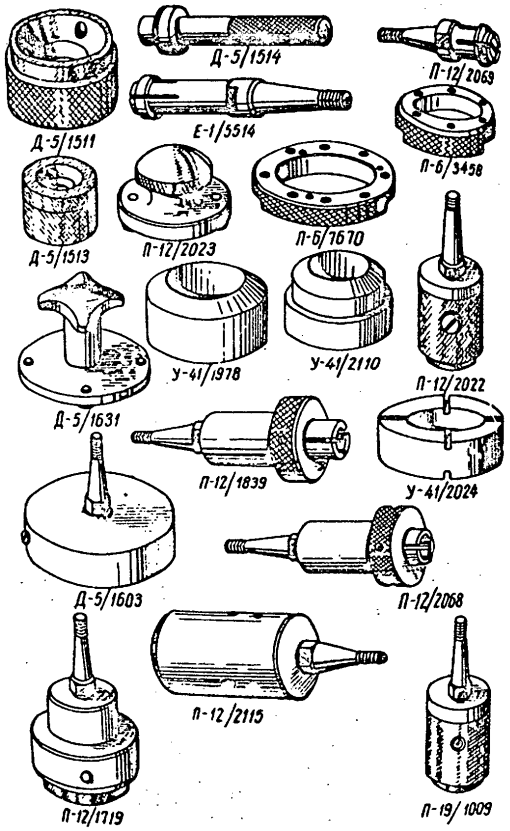


FIG. 93. TOOLS AND DEVICES FOR REPAIR OF ACCESSORIES DRIVE OIL SEALS

FIG. 94. GAUGE FOR MEASURING COMPRESSION IN ENGINE CYLINDERS

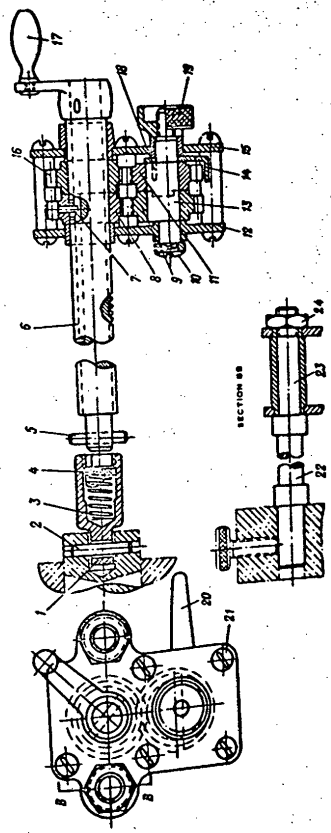


FIG. 95. CUTTING TOOL LONGITUDINAL FEED REDUCTION GEAR USED WHEN BORING CONNECTING ROD BUSHINGS

50X1

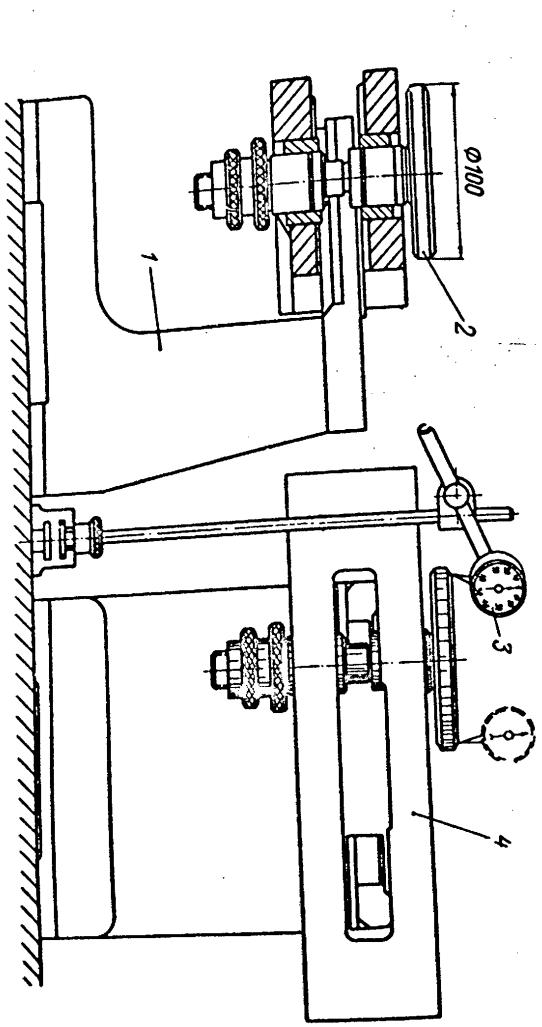


FIG. 97. CHECKING PERPENDICULAR ALIGNMENT OF COUNTERWEIGHT BUSHING HOLES TOWARD RECESS BORING SURFACE
1 – Gauge A-46/3134; 2 – Gauge A-46/3909; 3 – dial gage; 4 – counterweight

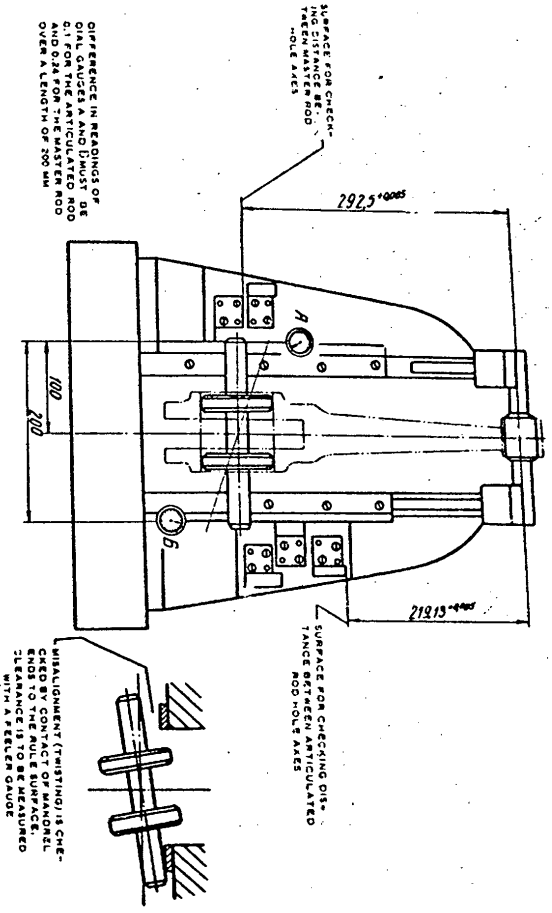


FIG. 96. CHECKING PARALLEL ALIGNMENT OF CONNECTING ROD BUSHINGS AND DISTANCE BETWEEN THEIR AXES ON FIXTURE A-46/1681 WITH THE AID OF MANDRELS AND A FEELER GAUGE

50X1

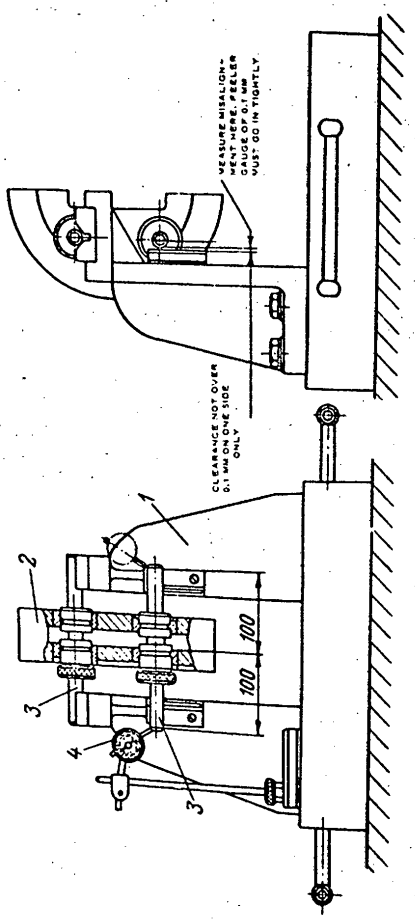


FIG. 98. CHECKING PARALLEL ALIGNMENT OF PIN BUSHING HOLES IN COUNTERWEIGHT
1 – fixture A-6, 30°4; 2 – counterweight; 3 – mandrels; 4 – dial gauge

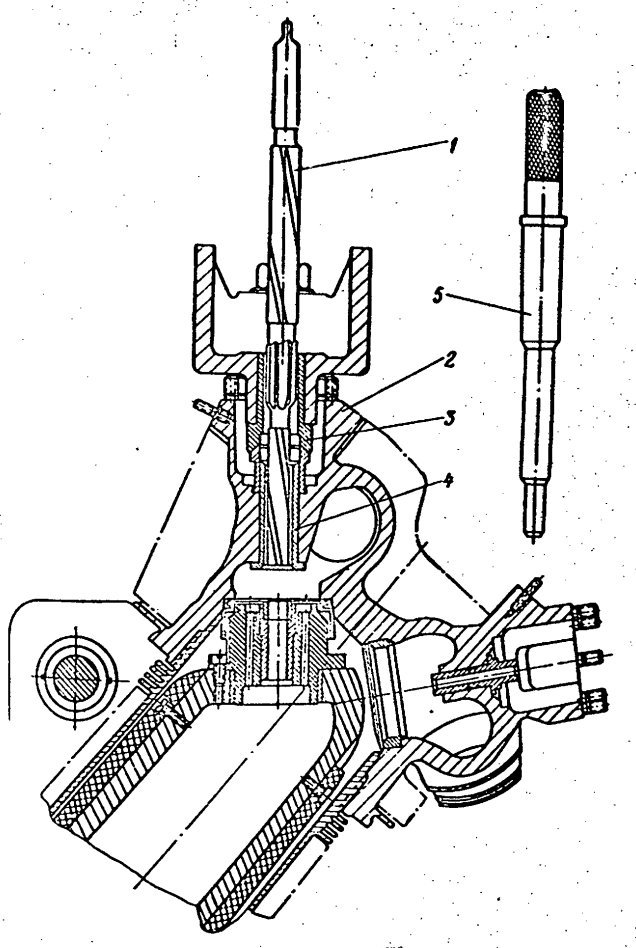


FIG. 99. REAMING EXHAUST VALVE GUIDE
1 – reamer; 2 – cylinder; 3 – tapered bushing (reaming tool); 4 – exhaust valve guide; 5 – centering pin

50X1

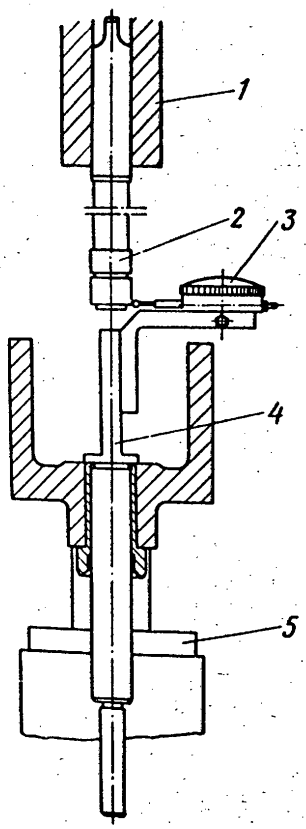


FIG. 100. CHECKING DEVICE 11-3'9432 BY DEVICE A-6/3033
1 – spindle; 2 – mandrel; 3 – dial gauge; 4 – holder; 5 – device 11-3'9432

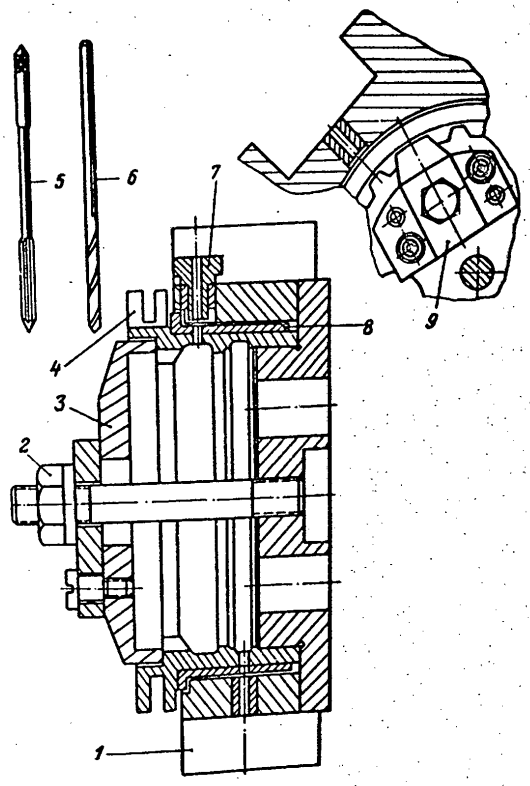


FIG. 101. DRILLING AND REAMING LOCK HOLES IN SECOND ORDER BALANCER SUPPORT BUSHING
1 – jig 11-3'10011; 2 – nut; 3 – washer; 4 – balancer support; 5 – reamer; 6 – drill; 7 – jig bushing; 8 – balancer support bushing; 9 – jig lock

50X1

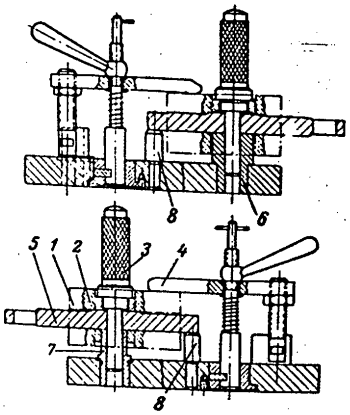


FIG. 102. PRESSING IN COUNTERWEIGHT BUSHINGS
1 – counterweight; 2 – counterweight bushing; 3 – punch; 4 – clamp; 5 – plate; 6 – centring bushing; 7 – centring bushing; 8 – pin

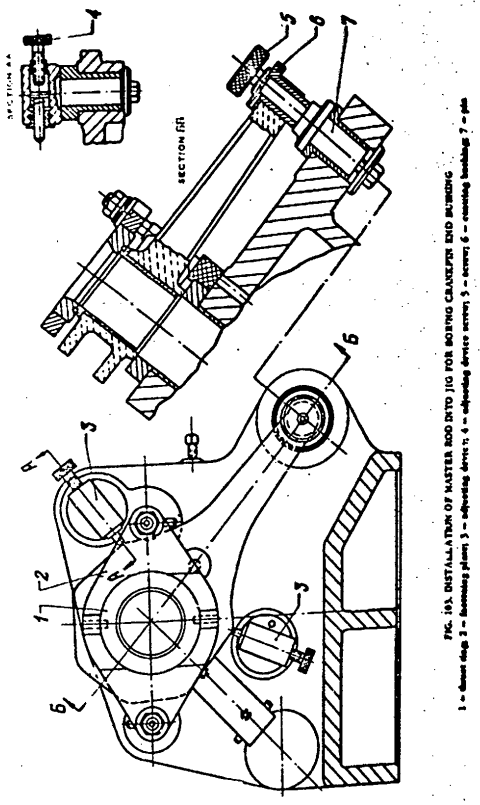


FIG. 103. INSTALLATION OF MASTER ROD INTO JIG FOR BORING CRANKPIN END BUSHING
1 – dowel dog; 2 – fastening plate; 3 – adjusting screw; 4 – adjusting device screw; 5 – screw; 6 – centring bushing; 7 – pin

50X1

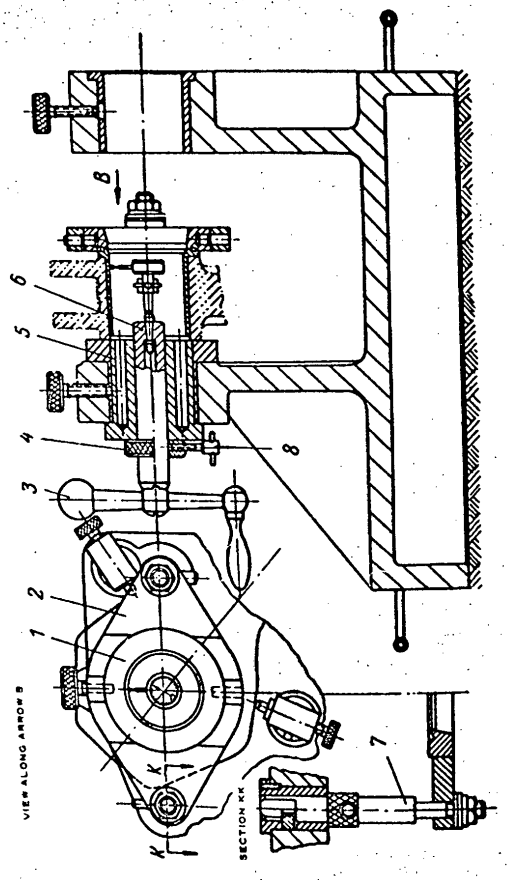


FIG. 104. CENTRING OF MASTER ROD IN JIG FOR BORING CRANKPIN END BUSHING
1 – thrust ring; 2 – fastening plate; 3 – handle; 4 – limit ring; 5 – bushing; 6 – dial gauge mandrel; 7 – upright; 8 – screw

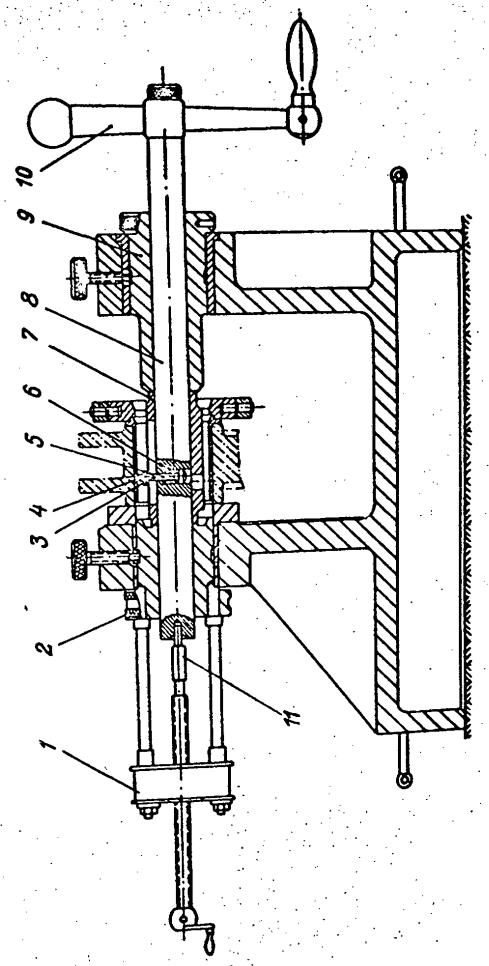


FIG. 105. BORING MASTER ROD CRANKPIN END BUSHING
1 – reference gear 6.507.116; 2 – bushing; 3 – chuck; 4 – adjusting nut; 5 – cutting tool; 6 – spring; 7 – master bar; 8 – mandrel; 9 – bushing; 10 – handle; 11 – coupling

50X1

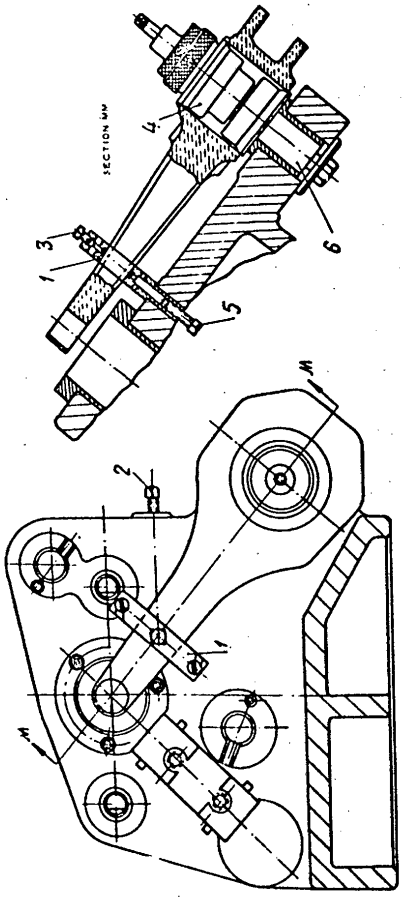


FIG. 106. INSTALLATION OF MASTER ROD INTO JIG FOR BORING PISTON END BUSHING
1 – screw clamp; 2 – screw; 3 – clamp screw; 4 – bushing; 5 – clamp locking screw; 6 – centring mandrel

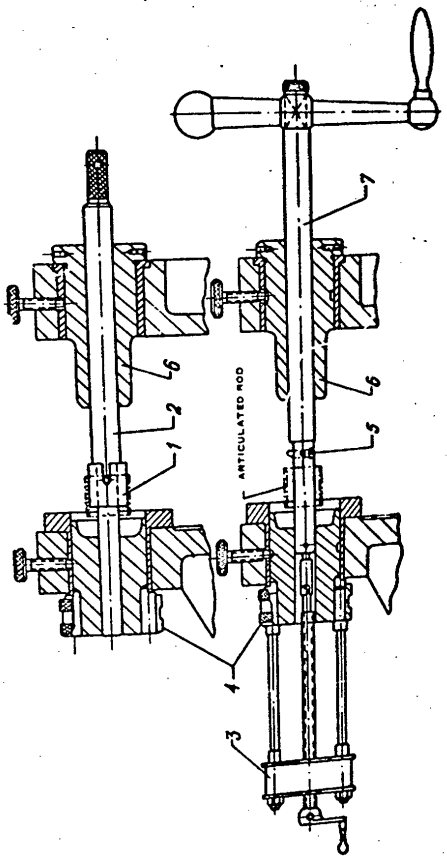


FIG. 107. CENTRING AND BORING PISTON END BUSHING
1 – setting bushing; 2 – centring mandrel; 3 – reduction gear 630716; 4 – centring bushing; 5 – centring nut; 6 – centring bushings; 7 – mandrel

50X1

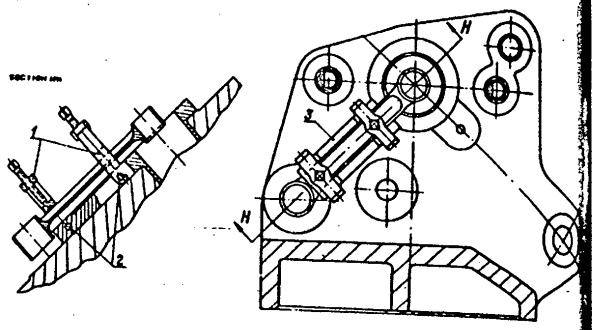


FIG. 108. INSTALLATION OF ARTICULATED ROD INTO JIG FOR BORING ARTICULATED ROD BUSHINGS
1 – screw clamps; 2 – supporting plate pins; 3 – supporting plate

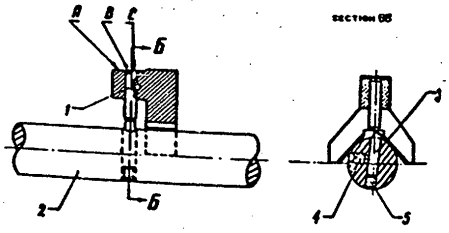


FIG. 109. CUTTING TOOL ADJUSTMENT FOR BORING CONNECTING ROD BUSHINGS
1 – depth gauge pin; 2 – mandrel; 3 – cutting tool; 4 – set screw; 5 – adjusting screw

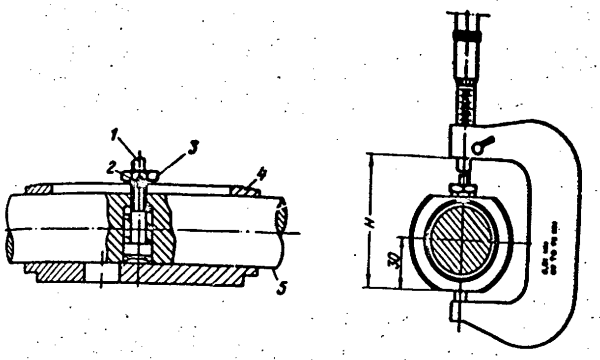


FIG. 110. CUTTING TOOL ADJUSTMENT WITH THE AID OF A MICROMETER FOR BORING MASTER ROD CRANKPIN END BUSHING
1 – cutting tool; 2 – block; 3 – adjusting set; 4 – master bush; 5 – mandrel

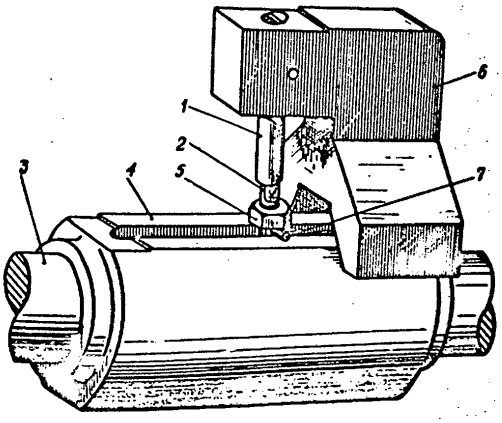


FIG. 111. CUTTING TOOL ADJUSTMENT WITH THE AID OF A DEPTH GAUGE FOR BORING MASTER ROD CRANKPIN END BUSHING
1 – depth gauge pin; 2 – cutting tool; 3 – mandrel; 4 – master bush; 5 – adjusting set; 6 – depth gauge; 7 – slide block

50X1

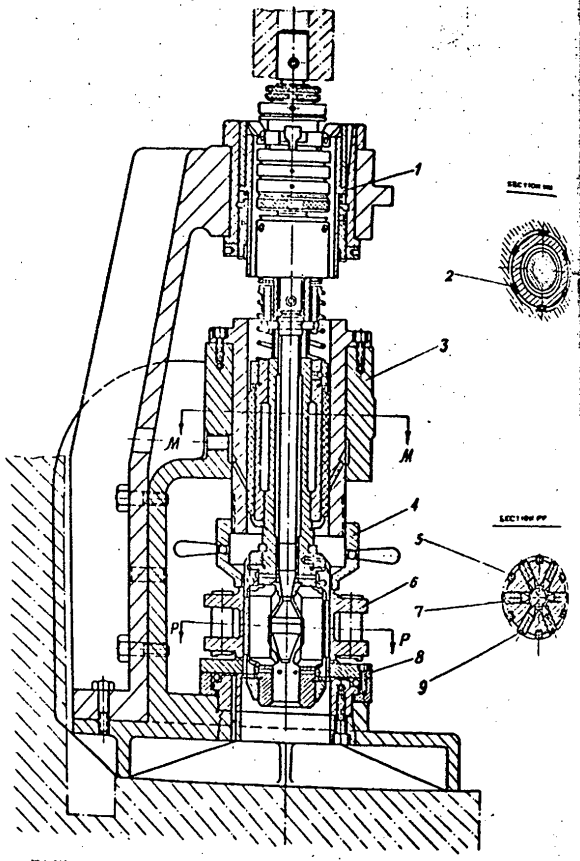


FIG. 112 HONING BUSHING HOLE IN MASTER ROD CRANKPIN END WITH THE AID OF FIXTURE II-12/1146
1 – floating bushing; 2 – honing head guiding bars; 3 – guide bushing; 4 – cap nut with handles; 5 – bars for guiding honing head in master rod bore; 6 – master rod; 7 – stone holder; 8 – floating clamp; 9 – abrasive bonne

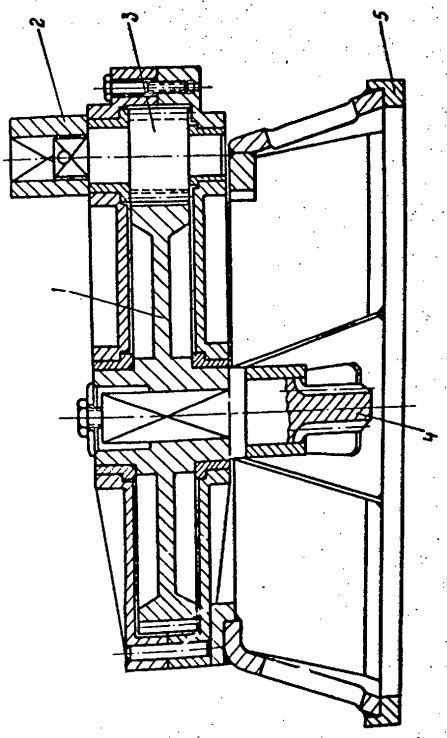
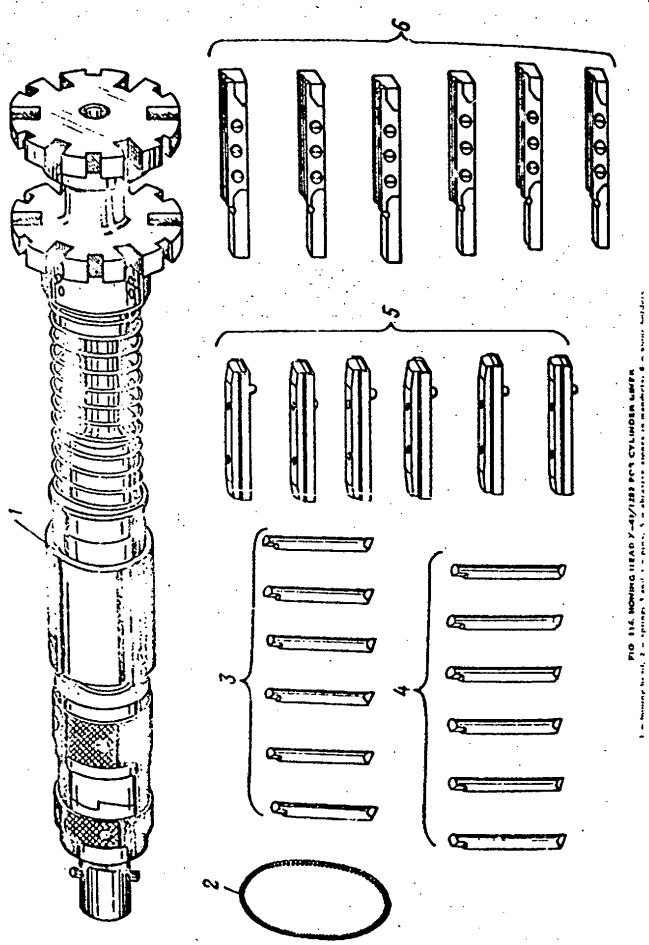
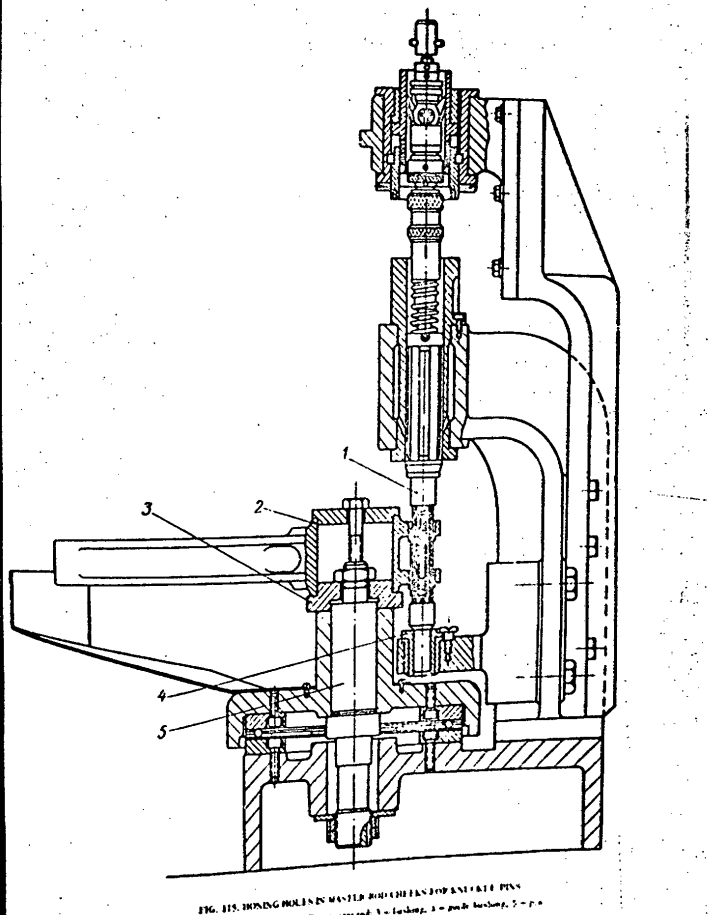


FIG. 113. REDUCTION GEAR FOR TIGHTENING INTERMEDIATE SHAFT COUPLING BOLT
1 – drive gear; 2 – adapter; 3 – drive gear; 4 – adapter; 5 – base





50X1

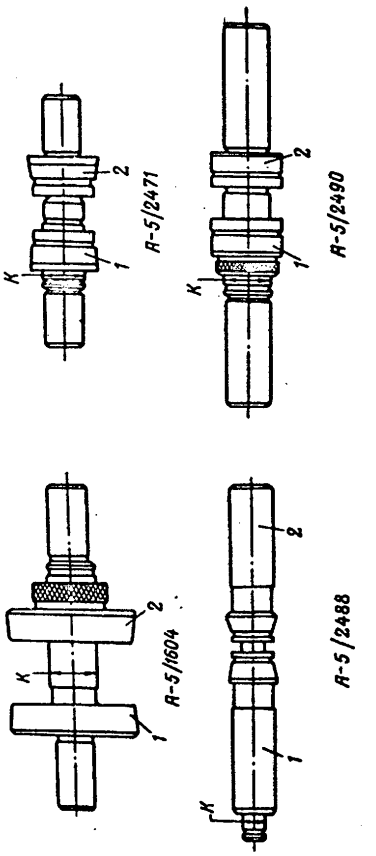
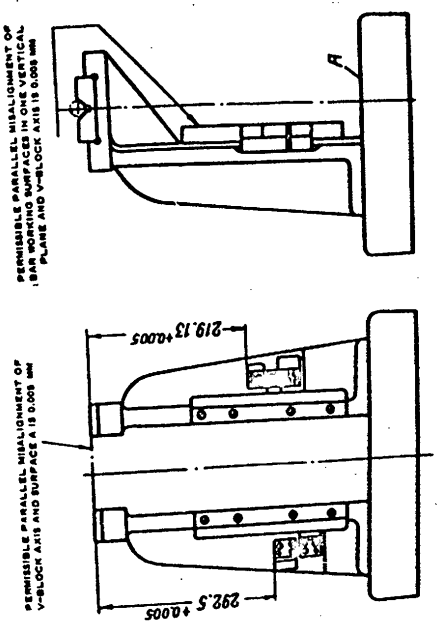


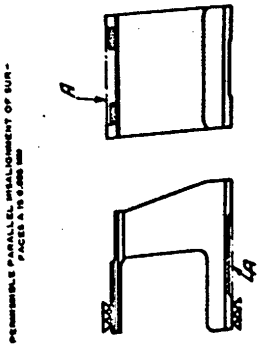
FIG. 116. HANDRELS USED FOR CHECKING PARALLEL ALIGNMENT OF MASTER ROD AND ARTICULATED ROD BUSHING HOLE AXES AND DISTANCE BETWEEN THEM



PERMISSIBLE PARALLEL MISALIGNMENT OF 150 MM WORKING SURFACES IN ONE VERTICAL PLANE AND V-BLOCK AXIS IS 0.005 MM

PERMISSIBLE PARALLEL MISALIGNMENT OF V-BLOCK AXIS AND SURFACE A IS 0.005 MM

FIG. 117. FIXTURE FOR CHECKING PARALLEL ALIGNMENT OF CONNECTING ROD BUSHING HOLE AXES AND DISTANCE BETWEEN THEM



PERMISSIBLE PARALLEL MISALIGNMENT OF SURFACES A IS 0.005 MM

FIG. 118. FIXTURE FOR CHECKING PERPENDICULAR ALIGNMENT OF COUNTERWEIGHT BUSHING HOLE AXES TO COUNTERWEIGHT RECESS WORKING SURFACE

IF AN LIMIT OF K IS DETERMINED BY CLEARANCE BETWEEN PARTS 1 AND 2 WHICH MUST NOT EXCEED 0.015 MM

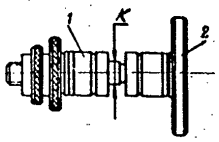


FIG. 119. FIXTURE FOR CHECKING PERPENDICULAR ALIGNMENT OF FRONT COUNTERWEIGHT BUSHING HOLE AXES TO COUNTERWEIGHT RECESS

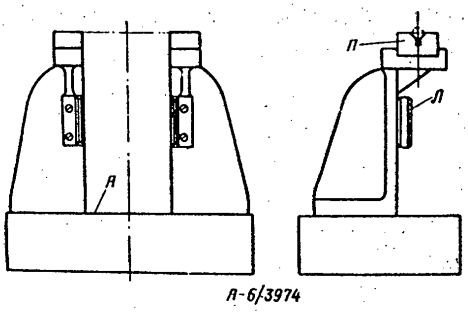


FIG. 120. FIXTURE FOR CHECKING PARALLEL ALIGNMENT OF PIN HOLES IN COUNTERWEIGHTS

1 – axis of shaft placed upon V-block II must be parallel with surface A within 0.005;
2 – surfaces 1 of rules must be in one plane within 0.015 mm

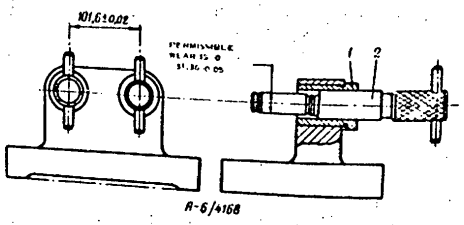


FIG. 121. FIXTURE FOR CHECKING COUNTERWEIGHT BUSHING SURFACES BY MEANS OF MARKING COMPOUND

1 – bushing; 2 – pin

PERMISSIBLE WEAR IS Ø 22.012

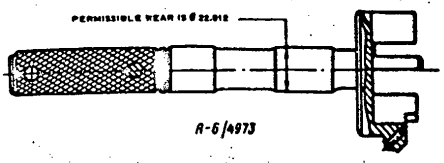
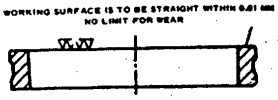


FIG. 122. FIXTURE FOR CHECKING CONCENTRICAL ALIGNMENT OF EXHAUST VALVE SEAT

WORKING SURFACE IS TO BE STRAIGHT WITHIN 0.01 MM
NO LIMIT FOR WEAR



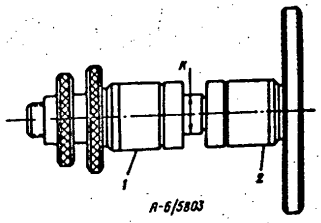
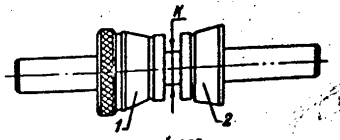


FIG. 123. RING FOR CHECKING PLANE OF KNUCKLE PIN END FACES AND DEVICE FOR CHECKING PERPENDICULAR ALIGNMENT OF REAR COUNTERWEIGHT BUSHING HOLES TO COUNTERWEIGHT RECESS

1 and 2 – parts



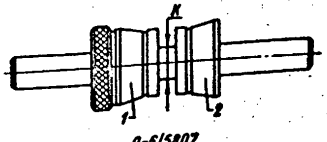


FIG. 124. MANDRELS FOR CHECKING PARALLEL ALIGNMENT OF PIN HOLES IN COUNTERWEIGHT

1 and 2 – axis

50X1

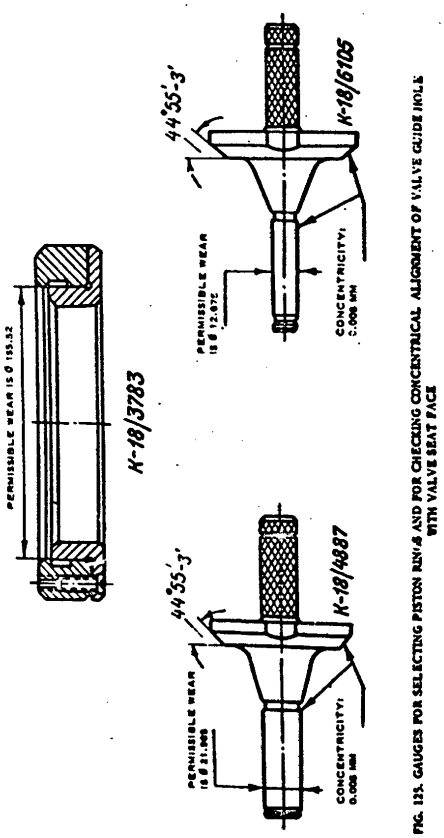


FIG. 135. GAUGES FOR SELECTING PISTON RINGS AND FOR CHECKING CONCENTRICAL ALIGNMENT OF VALVE GUIDE HOLE WITH VALVE SEAT FACE

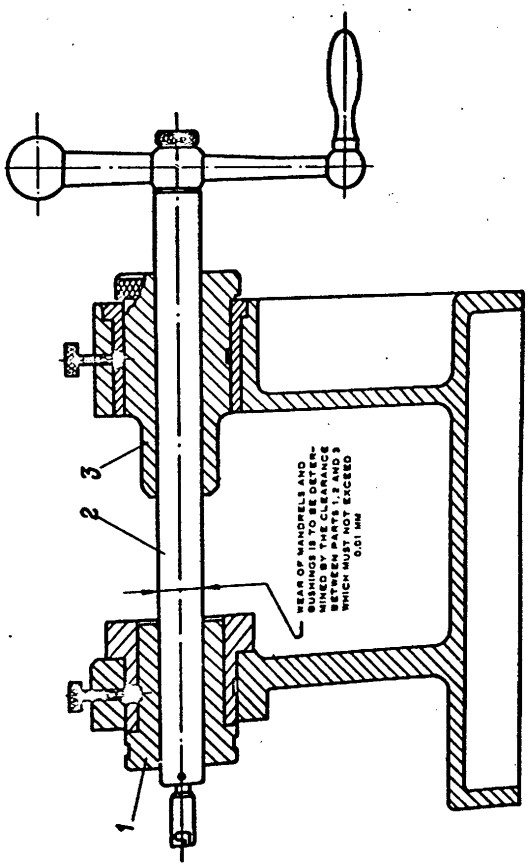


FIG. 136. JIG FOR BORING CONNECTING ROD BUSHINGS
1 – bushing; 2 – mandrel; 3 – bushing

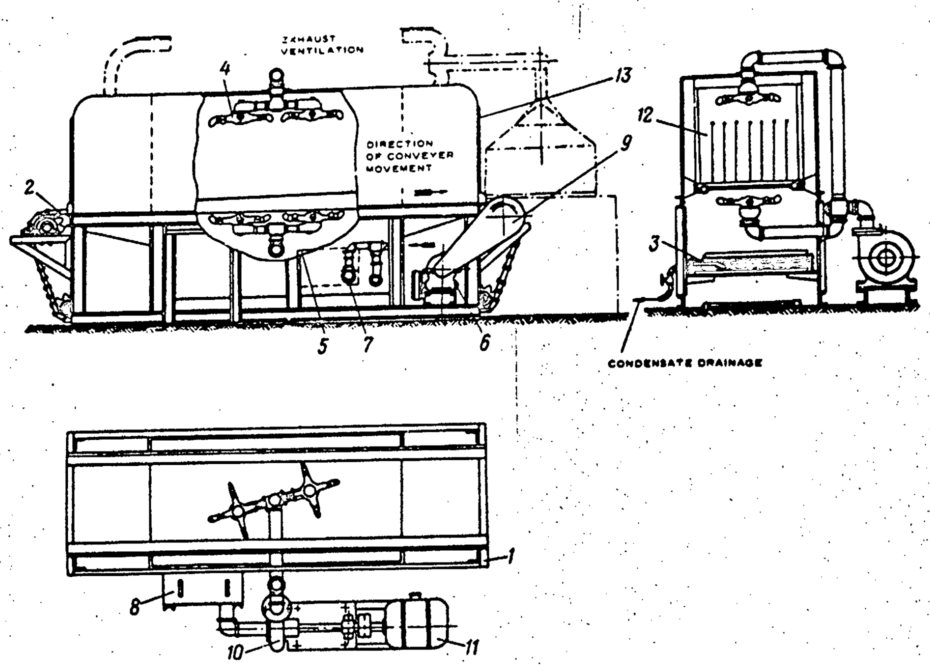


FIG. 12?. EQUIPMENT, TYPE NIAGARA, FOR FLUSHING ENGINE PARTS

1 – casing; 2 – conveyer; 3 – heater; 4–sprayer; 5 – hatch; 6 – reduction gear; 7 – piping; 8 – tank; 9 – conveyer drive; 10 – centrifugal pump Ф–4; 11 – electric motor, [illegible]–1510 10; 12 – rubber curtain, 800x950 mm; 13 – leather substitution curtain, 750x800 mm

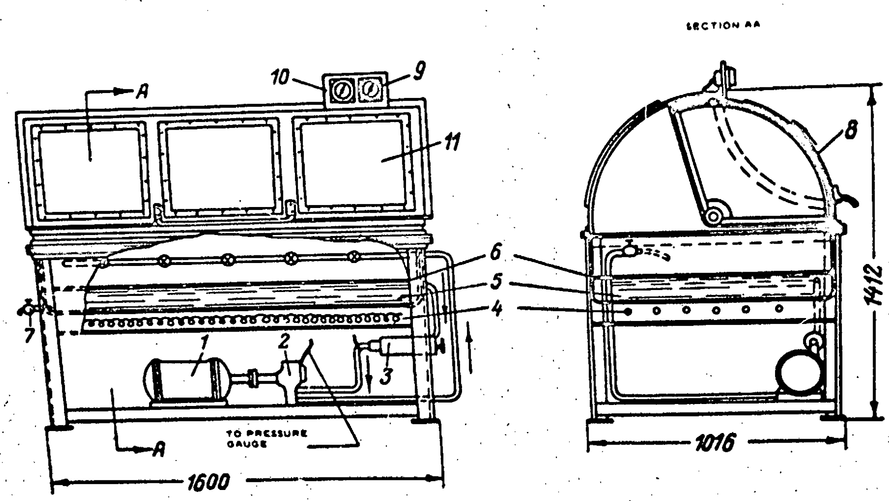


FIG. 128. BATH FOR FLUSHING OIL DUCTS OF ENGINE PARTS

1 – electric motor of explosion-proof design (0.6 to 1 kW; 1200 to 1800 r.p.m.); 2 – oil pump, ЯШ–8 or ЯШМ–25А; 3 – oil filter, ЯФС–19, in casing; 4 – steam or electric oil heater (for oil baths only); 5 – tank for oil or kerosene; 6 – iron grid; 7 – flushing liquid drain valve; 8 – both hinged cover; 9 – remote pressure gauge; 10 – remote thermometer; 11 – inspection window (celluloid)

S-E-C-R-E-T
NO FOREIGN DISSEM

Declassified in Part - Sanitized Copy Approved for Release 2013/10/25 : CIA-RDP80T00246A072200300001-6

50X1

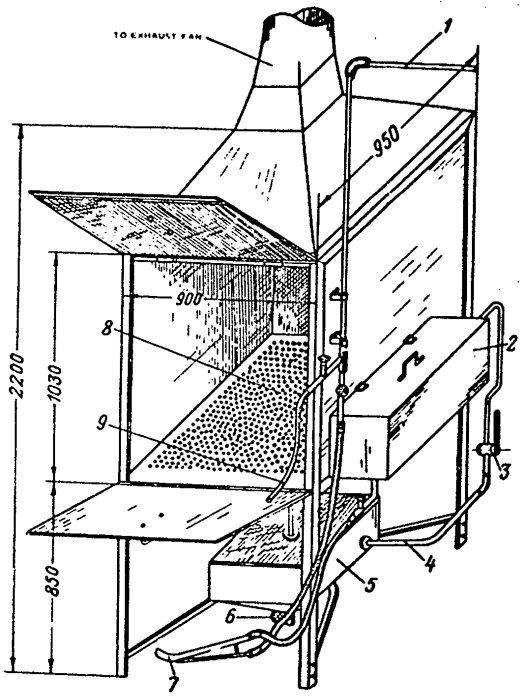
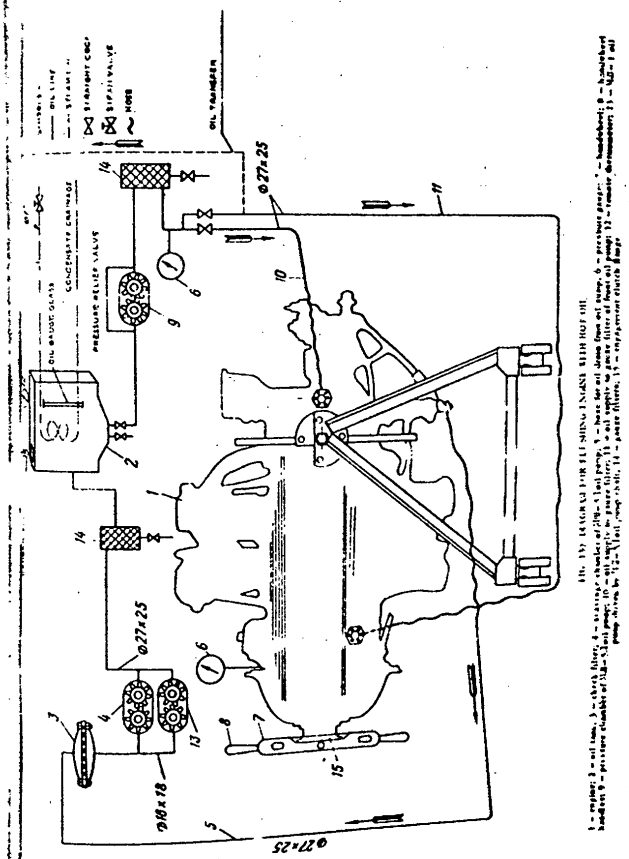


FIG. 129 CABINET FOR PETSE FLUSHING

1 – air supply line; 2 – gasoline tank; 3 – gasoline hand transfer pump; 4 – drain tank-to-gasoline tank pipe; 5 – drain tank; 6 – gasoline drain valve; 7 – pulverizer; 8 – grid; 9 – compressed air hose used for drying



50X1

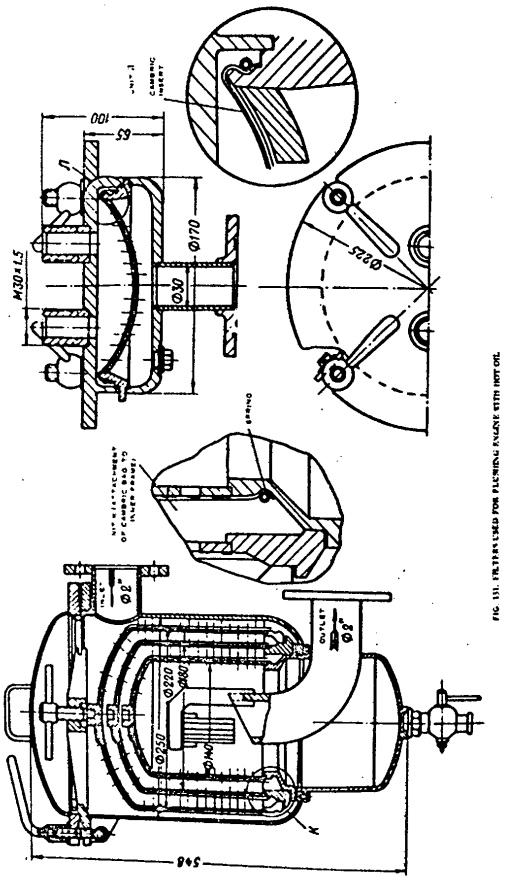
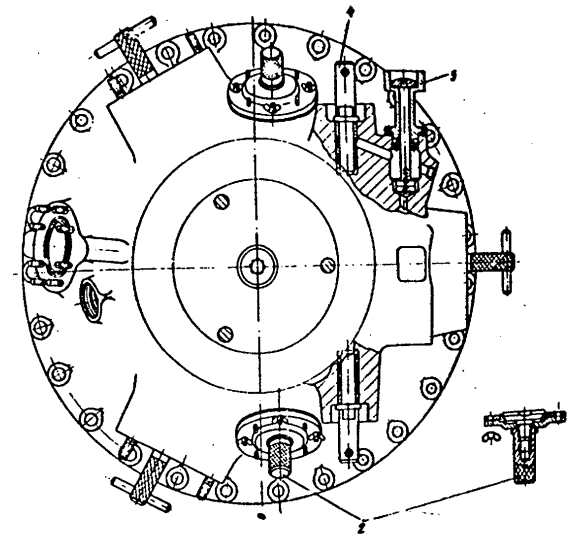


FIG. 131. FILTER USED FOR FLUSHING ENGINE WITH HOT OIL



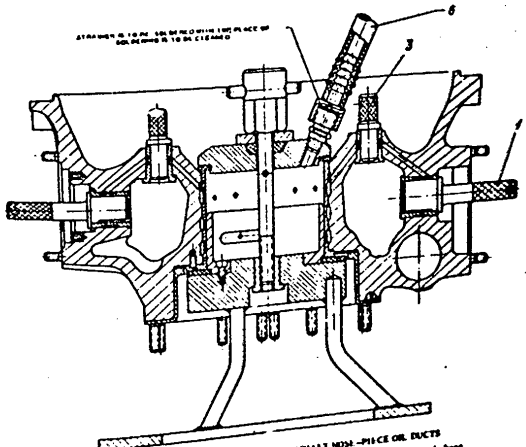


FIG. 132. APPLIANCE FOR FLUSHING CRANKSHAFT MAIN-PIECE OIL DUCTS
1 – plug, 2 – screw plug, 3 – plug, 4 – screw plug, 5 – plug, 6 – flushing liquid supply hose

S-E-C-R-E-T
NO FOREIGN DISSEM

50X1

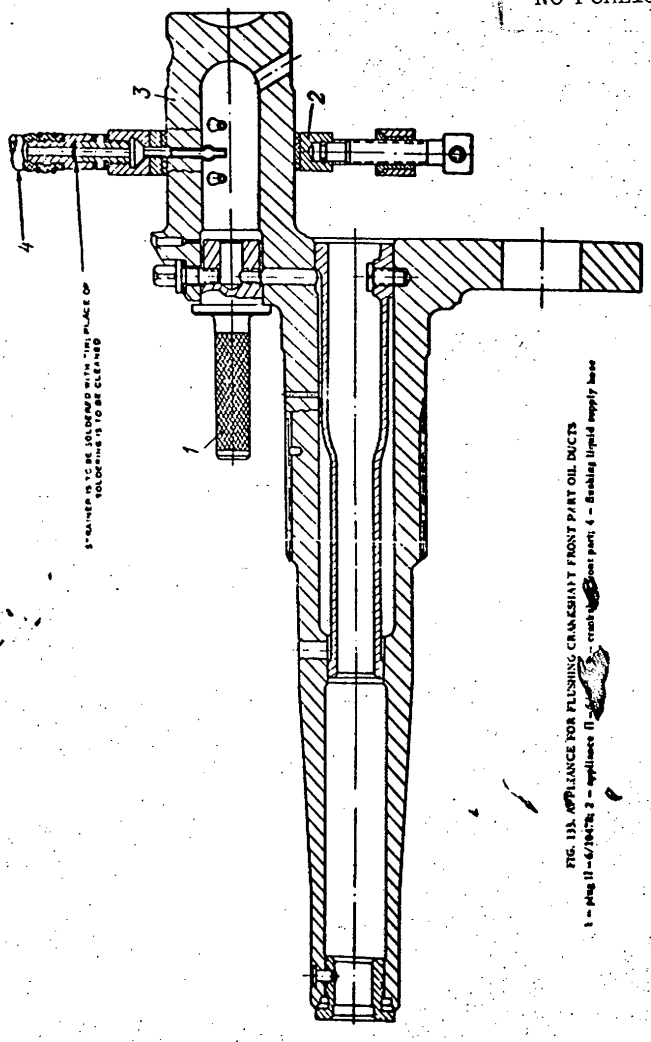


FIG. 133. APPLIANCE FOR FLUSHING CRANKSHAFT FRONT PART OIL DUCTS
1 – plug 11-6/1847; 2 – appliance 11-6/1847; 3 – crank[illegible] front part; 4 – flushing liquid supply hose

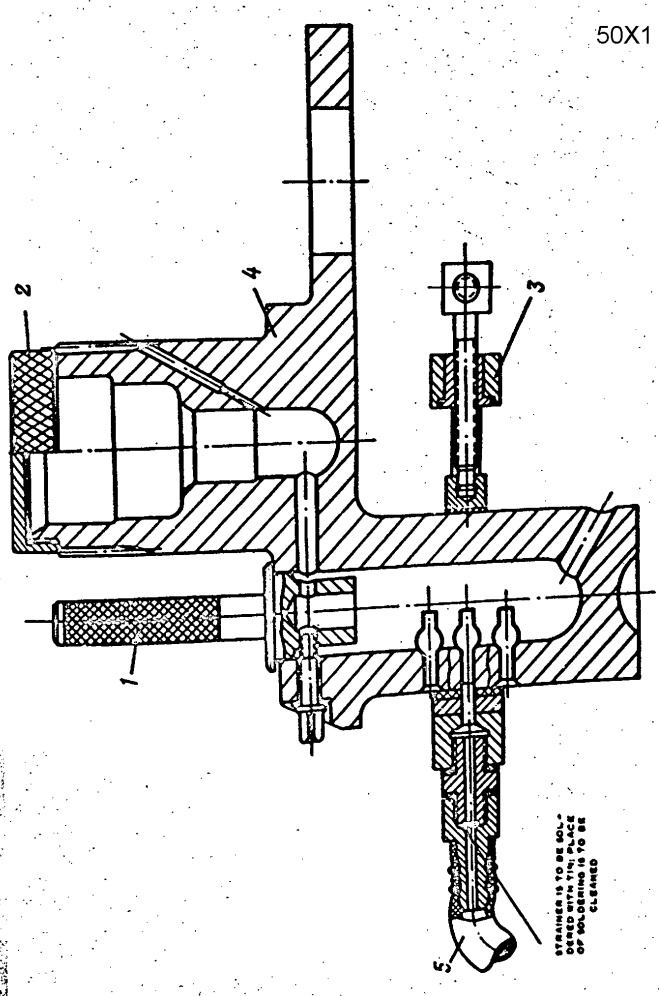


FIG. 134. APPLIANCE FOR FLUSHING CRANKSHAFT REAR PART OIL DUCTS
1 – plug 11-6/1847; 2 – plug 11-6/1847; 3 – appliance 11-6/1847; 4 – crankshaft rear part; 5 – flushing liquid supply hose

S-E-C-R-E-T
NO FOREIGN DISSEM

S-E-C-R-E-T
NO FOREIGN DISSEM

50X1

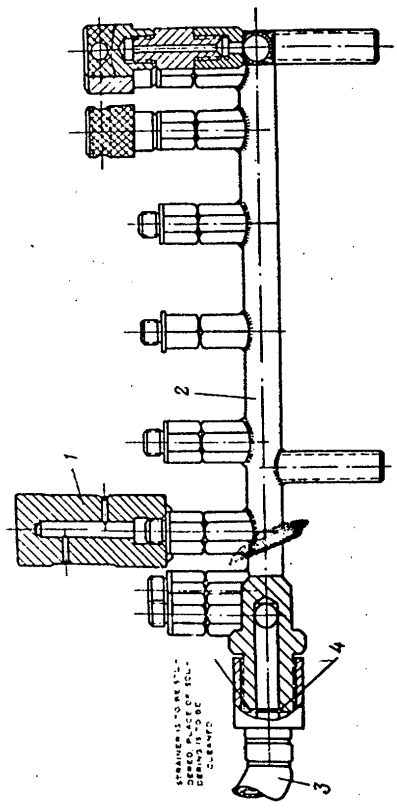


FIG. 135. APPLIANCE FOR FLUSHING KNUCKLE PINS OIL DUCTS
1 – knuckle pin; 2 – appliance; 3 – flushing liquid supply hose; 4 – strainer

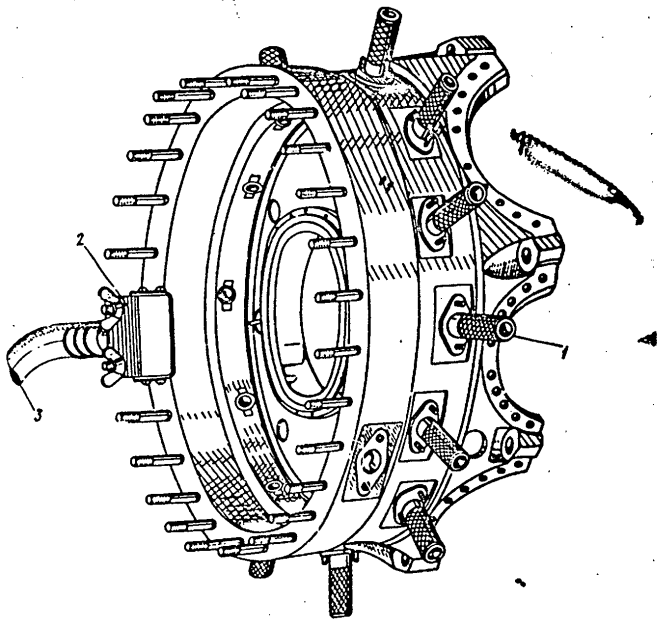


FIG. 136. APPLIANCE FOR FLUSHING OIL DUCTS OF CRANKCASE FRONT INTERMEDIATE PART
1 – plug 11-6,18274; 2 – appliance 11-6,78252; 3 – flushing liquid supply hose

S-E-C-R-E-T
NO FOREIGN DISSEM

50X1

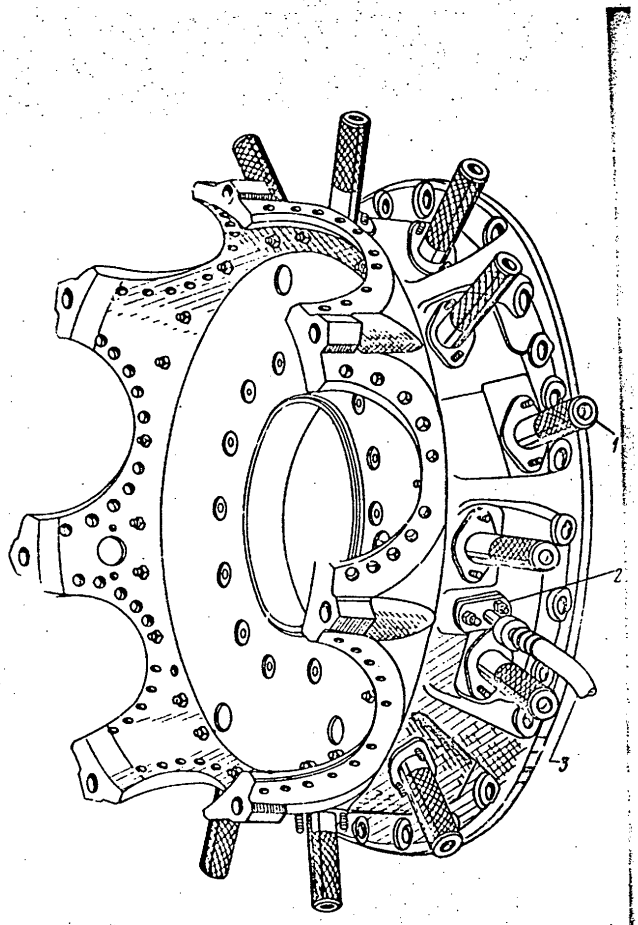


FIG. 147. APPLIANCE FOR FLUSHING OIL DUCTS OF CRANKCASE AND REAR INTERMEDIATE PARTS
1 – plug II-A 10874, 2 – appliance II A 10877, 3 – flushing liquid supply hose

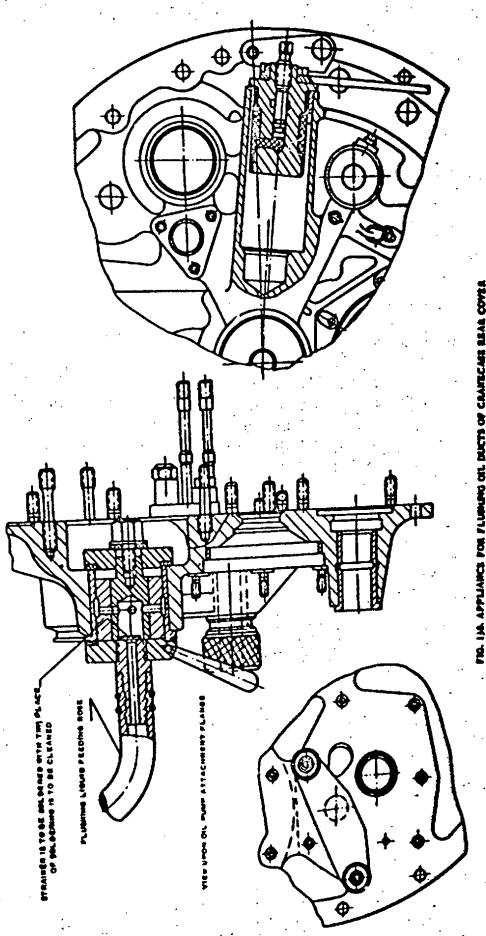


FIG. 148. APPLIANCE FOR FLUSHING OIL DUCTS OF CRANKCASE REAR COVER

50X1

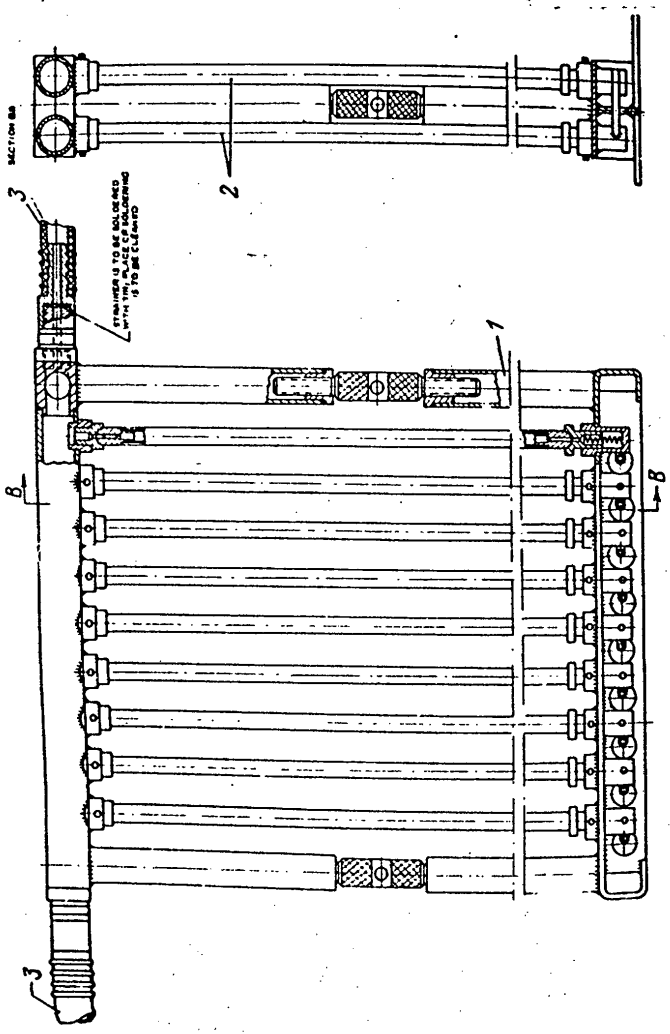


FIG. 139. APPLIANCE FOR FLUSHING OIL DUCTS IN PUSH-ROD

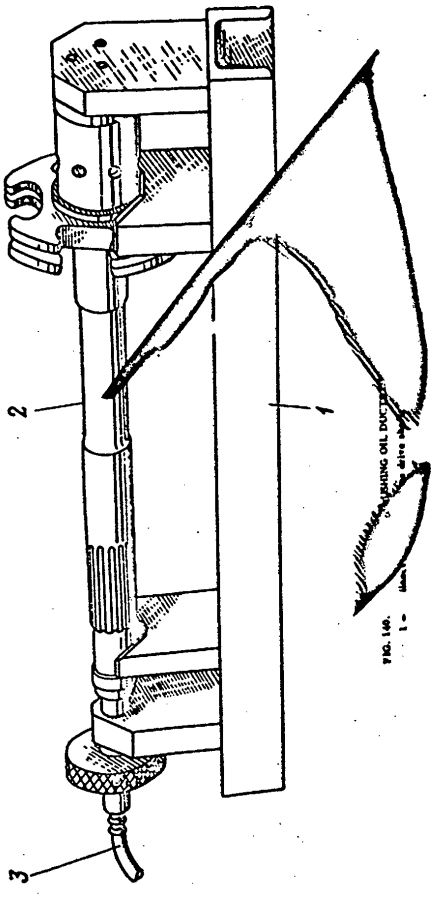


FIG. 140.

50X1

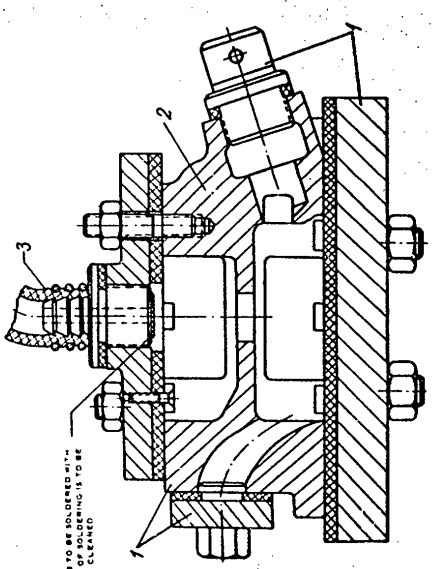


FIG. 141. APPLIANCE FOR FLUSHING OIL DUCTS IN FRONT OIL PUMP BODY
1 – appliance; 2 – from oil pump body; 3 – flushing liquid supply hose.

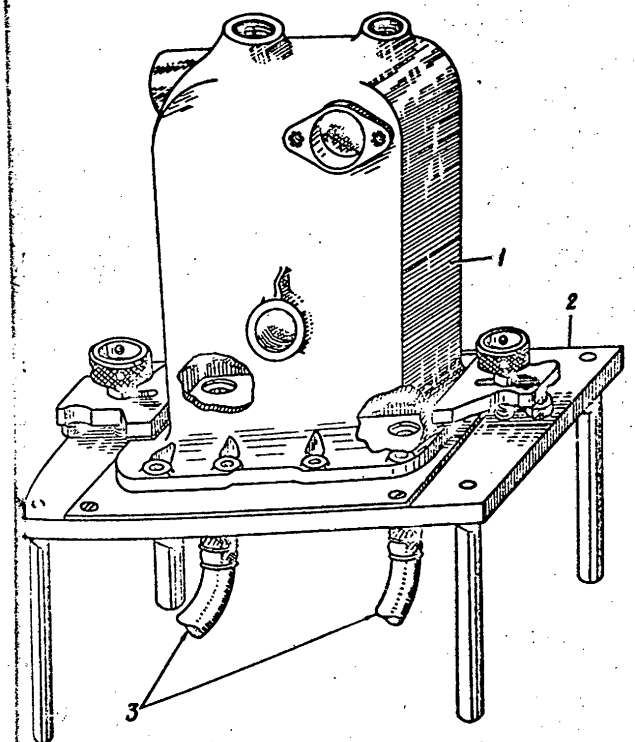


FIG. 142. APPLIANCE FOR FLUSHING OIL SUMP HOLE RECESSES
1 – oil sump; 2 – appliance; 3 – flushing liquid feeding hose

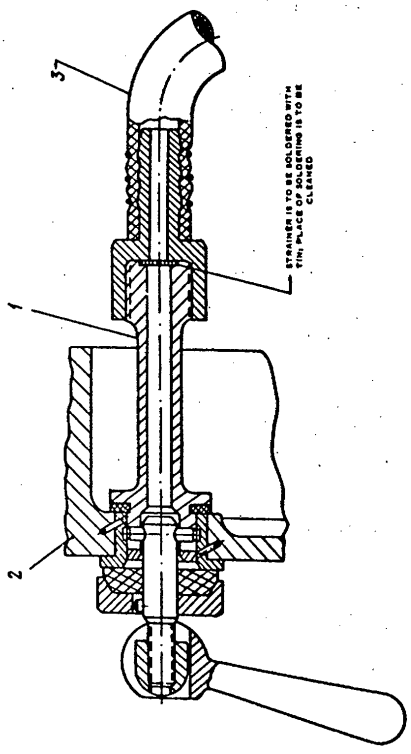


FIG. 143. APPLIANCE FOR FLUSHING OIL DUCTS OF HB-82B PUMP DRIVE HOUSING

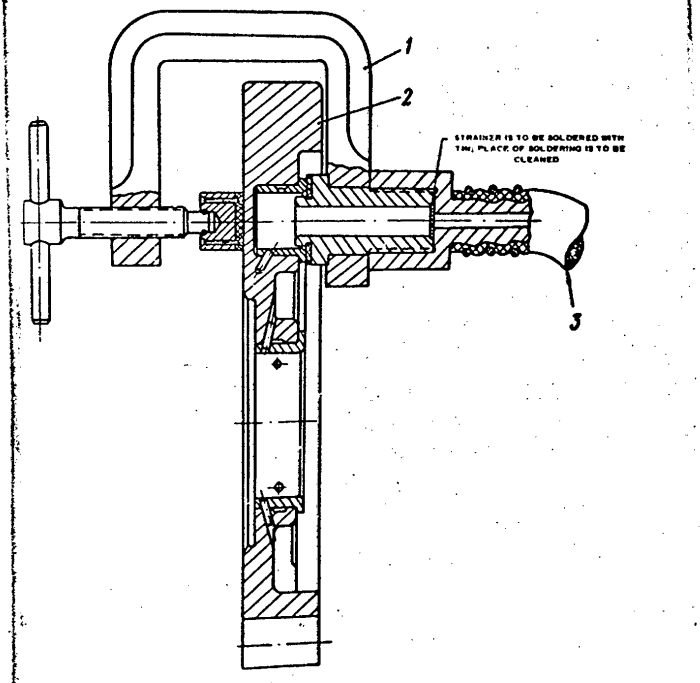


FIG. 144. APPLIANCE FOR FLUSHING OIL DUCTS OF 111-82H PUMP DRIVE HOUSING COVER
1 – appliance; 2 – 111-82H direct fuel injection pump drive housing cover; 3 – flushing liquid feeding hose

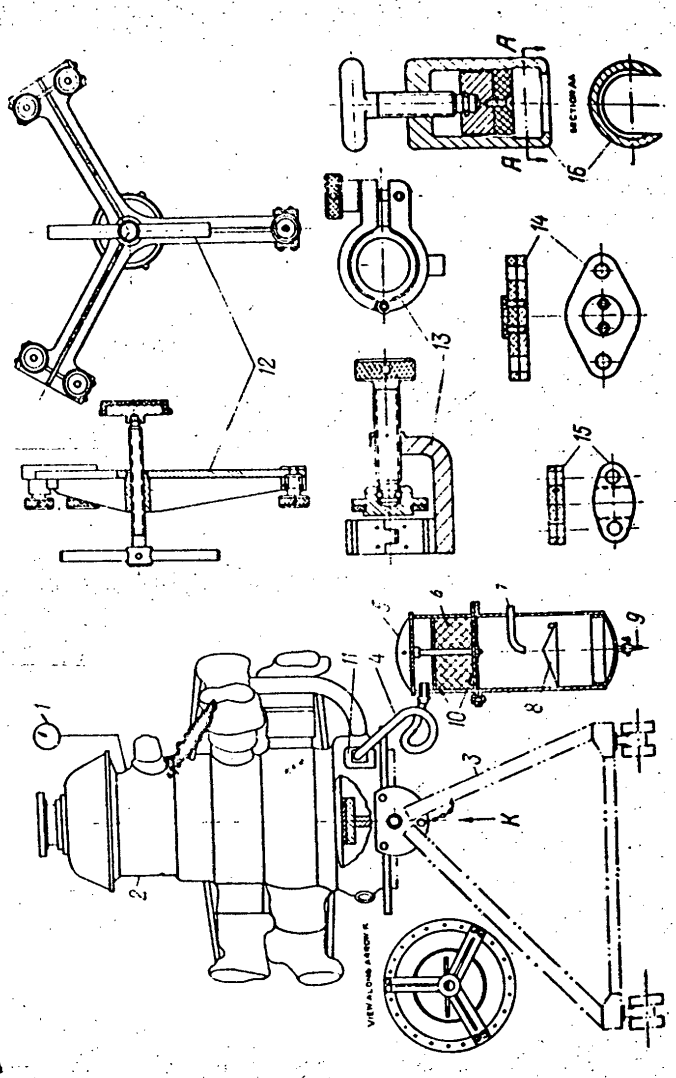


FIG. 145. TESTING ENGINE WITH COMPRESSED AIR

1 – pressure gauge; 2 – regulator; 3 – damping vessel; 4 – air feed hose to supercharger drum housing (or other); 5 – water-and-oil trap; 6 – cotton fabric; 7 – compressed air feed hose; 8 – oil delivery hose; 9 – drain valve; 10 – nozzles; 11 – breather hole; 12 – supercharger drum housing cement backing plug; 13 – front oil pump pipe plug; 14 – crankcase drum hole plug; 15 – rear oil pump pipe plug; 16 – crankcase drum hole plug; AA – engine hole plug oil sump; K – engine hole gauge

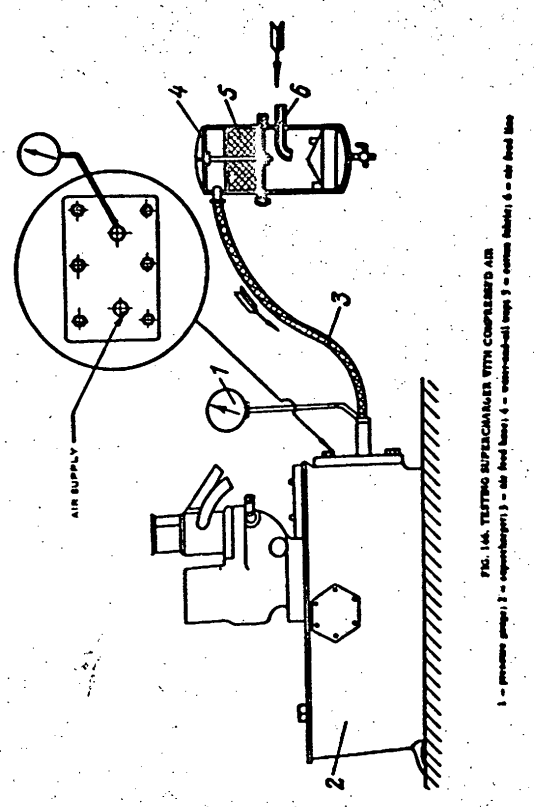
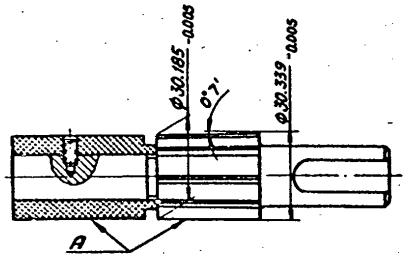


FIG. 146. TESTING SUPERCHARGER WITH COMPRESSED AIR

1 – pressure gauge; 2 – supercharger; 3 – air feed hose; 4 – water-and-oil trap; 5 – cotton fabric; 6 – air feed line

50X1



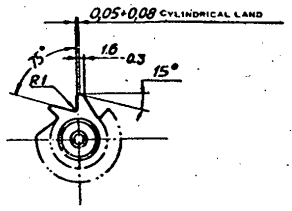


FIG. 155. REAMER T-18 1194 FOR SUPERCHARGER IMPELLER DOUBLE-RIM GEAR BUSHING

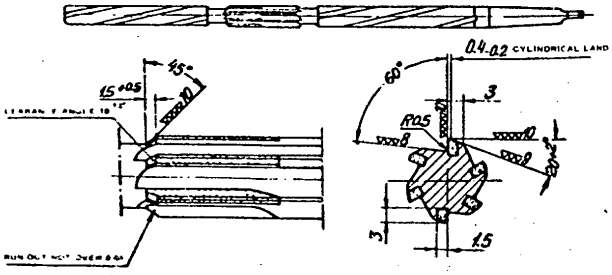


FIG. 156. REAMER T-05 1358 FOR INLET VALVE GUIDE

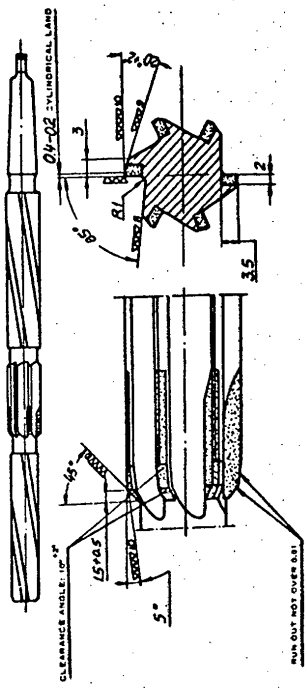


FIG. 157. REAMER T-06/1120 FOR EXHAUST VALVE GUIDE

50X1

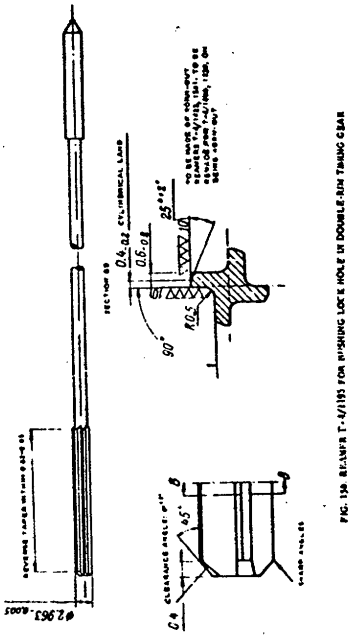
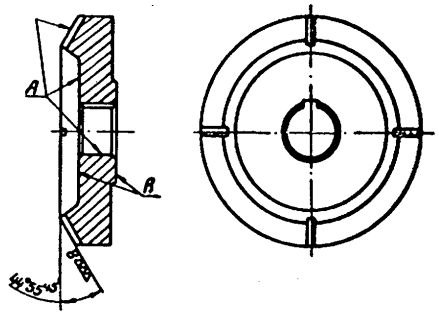


FIG. 158. REAMER T-41/195 FOR BUSHING LOCK HOLE IN DOUBLE-RUN TIMING GEAR



PERMISSIBLE PERPENDICULAR AND CONCENTRICAL MISALIGNMENT OF SURFACES A IS NOT OVER 0.02 MM. PERMISSIBLE PARALLEL MISALIGNMENT OF SURFACES B IS NOT OVER 0.05 MM

FIG. 159. LAPPING TOOL T-41/1858 FOR EXHAUST VALVE SEAT

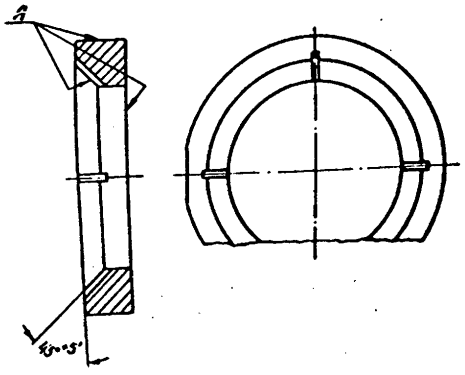
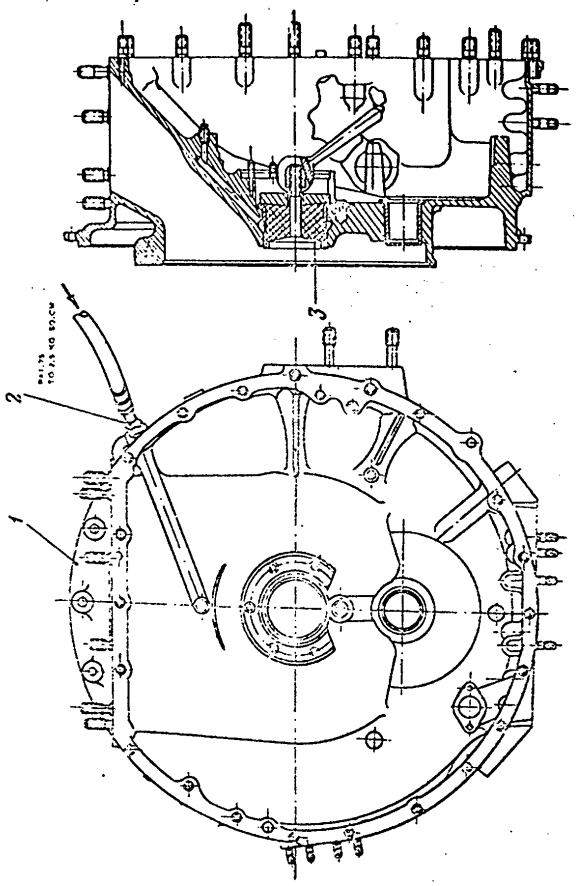


FIG. 160. LAPPING TOOL T-41/1888 FOR EXHAUST VALVE
Permissible perpendicular and concentrical misalignment of surfaces A is not over 0.02 mm.

50X1



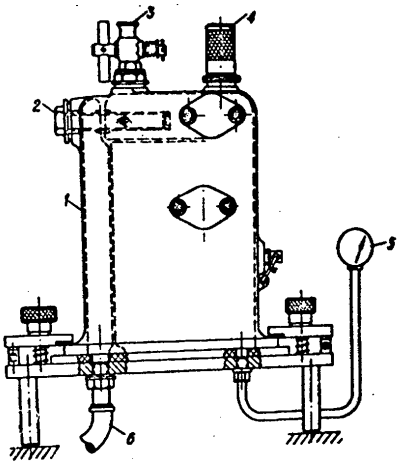


FIG. 148. TESTING OIL SUMP WITH COMPRESSED AIR
1 – oil sump; 2 – oil sump fitter; 3 – oil drain valve; 4 – plug; 5 – pressure gauge; 6 – air feed hose

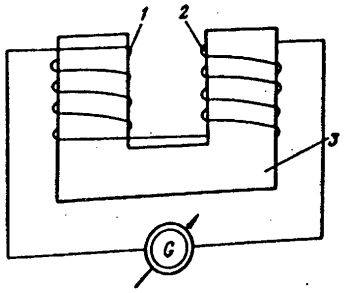


FIG. 149. SCHEMATIC DIAGRAM OF DEVICE FOR DETERMINING RESIDUAL MAGNETISM
1 and 2 – coils (windings); 3 – beam

50X1

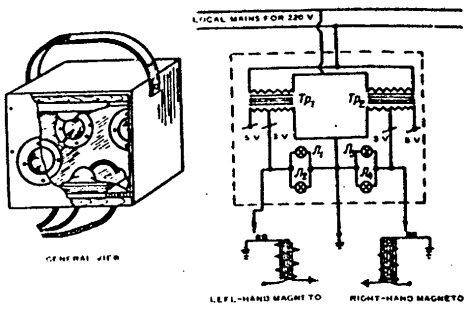


FIG. 150. GENERAL VIEW AND CIRCUIT DIAGRAM OF DEVICE FOR DETERMINING BREAKING MOMENT OF MAGNETO CONTACTS

Tp_1 and Tp_2 – step-down transformers; l_1, l_2, l_3 and l_4 – bulbs (3.5 V, 0.25 W) as used in flash lamps

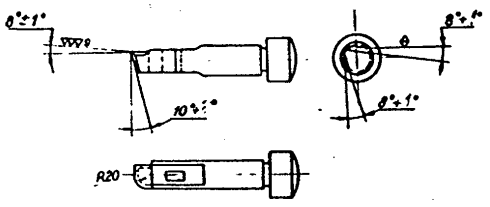


FIG. 151. CUTTING TOOL 650718 FOR BORING MASTER ROD CRANKPIN END BUSHINGS

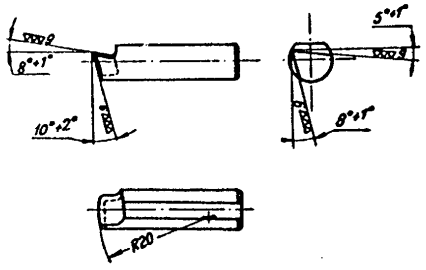


FIG. 152. CUTTING TOOL 650719 FOR BORING ARTICULATED ROD CRANKPIN END BUSHINGS

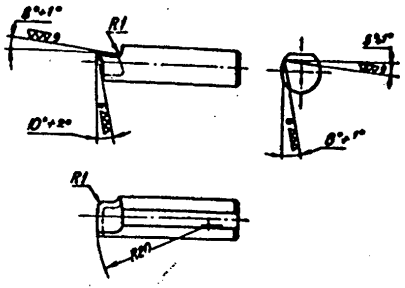


FIG. 153. CUTTING TOOL 650720 FOR BORING CONNECTING ROD PISTON END BUSHINGS

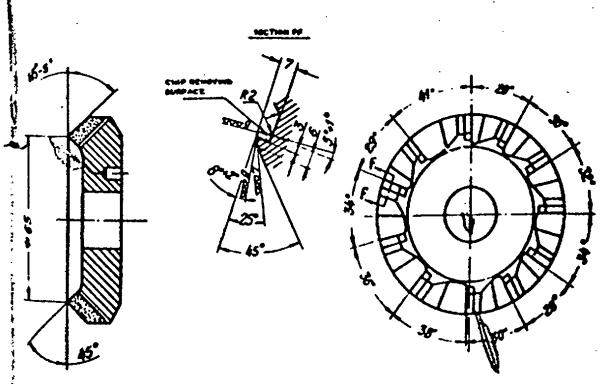


FIG. 154. COUNTERBORE 650615 FOR MANUAL TURE OF VALVE SEATS