

**Maintenance and Service
instructions
for
Aero-engine HUOSAI-6A**

REPRODUCED IN THIS FORM
BY

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CAUTION

ENGINE MANAGEMENT

BEFORE STARTING THE ENGINE ENSURE INLET MANIFOLDS ARE DRAINED IN ACCORDANCE WITH THE MAINTENANCE MANUAL IF THE ENGINE HAS NOT BEEN STARTED FOR TWO DAYS OR MORE

AN ATTEMPT TO START THE ENGINE WITHOUT DRAINING THE INLET MANIFOLDS MAY RESULT IN DAMAGE TO THE ENGINE

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CHAPTER I

General description of aero-engine HUOSAI-6A

Section I. General information of engine construction

The aero-engine HUOSAI-6A is a single row, radial, air-cooling, four stroke, piston type aero-engine, having nine cylinders. The engine consists of following main components:

CRANKCASE

The engine crankcase is composed of five sections such as the reducer case, front cover, intermediate case, mixture collector, and rear cover.

The reducer case is cast from magnesium alloy, within it are installed a speed reducer and a driving mechanism for governor. In the front of it is located the thrust ball bearing for propeller which can be subjected to the pulling force from the propeller and limit an axial displacement. Above the speed reducer case is assembled the governor, and at the lowest position there is a scavenge opening.

The front cover is cast from magnesium alloy. At its upper side are mounted the thrust ball bearing of the crankshaft and the intermediate shaft of gas distribution

mechanism with driving gear of the governor.

The reducer case and the front cover are located on the front section of the intermediate case with eighteen studs.

The intermediate case made of forged aluminum alloy consists of the front and the rear sections jointed together by 9 bolts. The intermediate case is machined as an unit with both sections pre-assembled. Upon the intermediate case are arranged 9 cylinders, front and rear roller bearings, crankshaft connecting rod mechanism and oil sump. On the front section of the intermediate case, there are two rows of holes for installing the tappet guides.

The mixture collector is cast from aluminum alloy. It is fixed on the rear section of the intermediate case. Upon the collector there are 9 threaded holes for attaching the air inlet pipes. Moreover there are also 8 lugs with holes for fixing the engine frame. And at the lower position of the mixture collector is mounted carburetor adapter.

The rear cover is cast from aluminum alloy and located on the mixture collector. On the rear cover are mounted the generator, oil pump, fuel pump, air compressor, air distributor for starting, drive box of tachometer, and two magnetos.

CYLINDER AND PISTON ASSEMBLY

The cylinder is made up of two parts: aluminum alloy head and steel barrel. The cylinder head is screwed into the barrel by buttress thread.

Upon the cylinder head are cast the horizontal and

the vertical cooling fins and the rocker box. To the rocker box is fixed its cover by a steel cable. On the cylinder head are assembled a starting valve, two spark plugs, and one intake and one exhaust valve, Both valves are made of heat resisted steel.

Around the barrel there are annular cooling fins. At the lower section of the barrel there is a flange connecting with the intermediate case.

The piston is forged from aluminum alloy. Around the circumference of the piston are machined four grooves for piston rings. In two of which near the piston top are assembled respectively a chrome plated compression ring with trapezoid cross section. In the third groove are installed two oil scraper rings in groove shape. In the lowest groove is mounted a conical oil scraper ring, its conical tip is towards to the piston top. In the middle of the piston there are holes for piston pin, in which is assembled the piston pin. The piston pin floatably fitted in its hole, but its axial displacement is limited by two aluminum plugs.

CRANKSHAFT AND CONNECTING ROD MECHANISM

The crankshaft is forged from alloy steel, composed of the front and the rear sections connected together by a tie bolt. The internal cavity of crankshaft is the main oil passage of the engine. The crankshaft is supported on two bearings in the intermediate case. Its axial displacement is limited by the thrust ball bearing on the front cover. At two crank cheeks of the crankshaft are moun-

ted the counterweights respectively. The rear counterweight is removable pendulum.

The connecting rod mechanism consists of a master rod and eight articulating rods with its cross section as "I" shape. They are forged from alloy steel.

In the hole for the crankpin of the master rod is pressed a steel bushing with lead-bronze cast on its inner surface and over lead-bronze coating is plated with tin-lead alloy. Upon the master rod there are also eight bores for installing the articulating rod pins. Thus the master rod can connect with the articulating rods by the rod pins. The bronze bushing is separately pressed in those bores for the piston pin of the master rod and bores of both ends of the articulating rods. On both cheeks of the master rod are fixed the articulating rod pins by locking plate in order to prevent rotation and axial displacement.

SPEED REDUCER

The speed reducer is a planetary gear construction. It comprises a driving gear mounted on the splines of the crankshaft nose, three planetary gears mounted on the propeller shaft, and stationary gear fastened to the reduction case.

The propeller shaft nose is machined with the splines for erecting propeller. Behind the splines there is a shoulder for installing support bush and thrust bearing. Behind the propeller shaft is provided a box-like flange for placing three planetary gears. The tail of the propeller shaft is inserted into the front bush of the crankshaft as a rear supporting point.

GAS DISTRIBUTION MECHANISM

The gas distribution mechanism consists of driving mechanism of cam disk, cam disk, tappets, push rods mechanism, rockers mechanism and valve mechanism.

The cam disk is driven by the crankshaft through the driving gear and intermediate driving gear, and turned in opposite direction to the crankshaft.

The phase angle of gas distribution need not be adjusted. During the assembling of the engine, the gas distribution mechanism will only assemble according as mark.

SUPERCHARGER

The engine is provided with a centrifugal type, single speed, mechanically driven supercharger. It comprises a mixture collector, an impeller for increasing pressure, a diffuser, and a driving mechanism. The impeller is forged from aluminum alloy. On which there are fourteen vanes. The impeller is connected with the impeller shaft by means of splines. The diffuser is cast from aluminum alloy, which is prepared with thirteen guide vanes. The diffuser together with the rear cover are fixed to the back of the mixture collector.

FUEL SYSTEM

From fuel tank of the airplane the fuel passes through a rotary gasoline pump into a membraneous type carburetor, in which fuel will spray and form itself into working mixture after supercharger, and then the fuel enters into cylinders of the engine.

LUBRICATING SYSTEM

The friction surface of engine parts except cylinder wall, piston pin, rolling bearing is lubricated by splashing and all the rest is lubricated by means of pressed oil.

The gear type oil pump presses the oil into cavity of the vertical shaft in the rear cover, and from there the oil through the internal oil passage of the rear cover lubricates the driving mechanism of the accessories and the supercharger. The oil, from the vertical shaft to horizontal shaft, flows forwards into cavities of the crankshaft and the propeller shaft, and in passing lubricates the connecting rod mechanism, gas distributing mechanism, rocker of cylinder placing at upper position of the engine, and the reduction gear. In addition, the oil also flows into propeller pitch changing oil cylinder through the governor. All of the worked oil in engine flows downwards into the oil sump. By the oil scavenge pump the oil is drawn from the oil sump to the oil tank.

The cavity of the engine communicates with external atmosphere through the front and the rear vent pipes.

IGNITION SYSTEM

The mixture in cylinder is fired with the help of high voltage electric spark generated by two magnetos.

The left magneto provides for ignition of the front row spark plug, the right magneto provides for ignition of the rear row spark plug. In order to prevent radio communication from interference during operation of the ignition installation, all of which are equipped with shielding.

STARTING SYSTEM

The engine is started by compressed air. The compressed air passes through the compressed air distributor, air tube and starting valve, then enters into cylinder. In order to start engine easily, while starting, fuel can be sprayed directly into the mixture collector with fuel injection pump.

Section 2. Main technical data

1. General data

a. Cylinder

Bore (mm): 105

Total volume of cylinder (lit.): 10.161

Ordinal number of

cylinder:

The cylinders are numbered counterclockwise as viewed from rear, the toppest cylinder is the first.

b. Stroke of piston (mm)

Cylinder No. 4 (Master connecting rod): 130

Cylinders No. 3, 5, 130.15

Cylinders No. 2, 6, 130.23

Cylinders No. 1, 7, 130.25

Cylinders No. 8, 9, 130.39

c. Compression ratio: 6.2 ± 0.1

d. Rotational direction (viewed from rear)

Crankshaft: left

Propeller shaft: left

e. Reduction ratio of reducer: 0.787

- f. Type of propeller:
J2-G1 (wooden) or J9-G1 (metallic)
- g. Type of supercharger and increasing speed ratio:
Centrifugal, single speed mechanical transmission, increasing speed ratio: 8.77
- h. Altitude performance of engine: Not altitude
- i. Net weight of engine (kg): 200⁺²%
Note: Oil weight remained in engine after testing is about 2.5 kg
- j. External dimensions of engine (mm)
Diameter
(According to rocker cover): 980⁺⁵
Length: 965^{±3}
- k. Center of gravity for the engine is situated at engine horizontal axis and before plane of frame about 153 mm
- l. Guarantee terms of engine:
Time before first overhaul (counted from the date that the engine was delivered by factory): 600 hr. in 4 years.

2. Operating conditions of engine HUOSAI-6A

Operating conditions	Rotating speed (rpm)	Manifold pressure (mm. Hg)	Power (hp)	SFC (g/hp.hr)
Takeoff (throttle full open)	2350 ± 1%	P ₀ + 85 ± 10	285 ⁻² %	260 ~ 285
Rated (throttle full open)	2250 ± 1%	P ₀ + 80 ± 10	270 ⁻² %	255 ~ 270
Rated (0.65)	1950 ± 1%	660 ± 15	165	220 ~ 240
Rated (0.5)	1790 ± 1%	600 ± 15	130	210 ~ 230

Note: P_0 denotes current atmospheric pressure at local field.

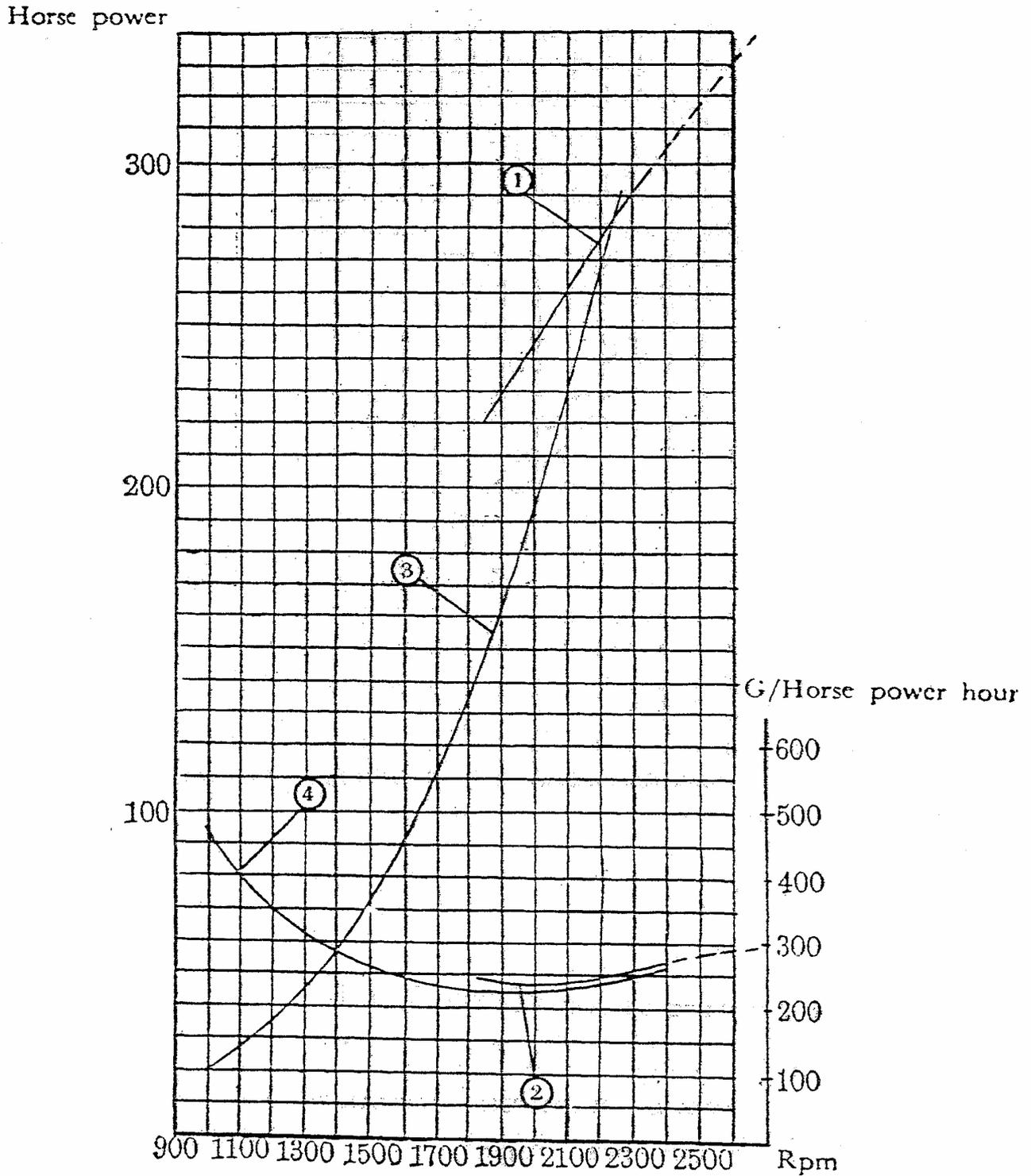


Fig. 1 External and throttle performance curves of engine
 1. External performance. 2. SFC according to external performance.
 3. Throttle performance. 4. SFC according to throttle performance.

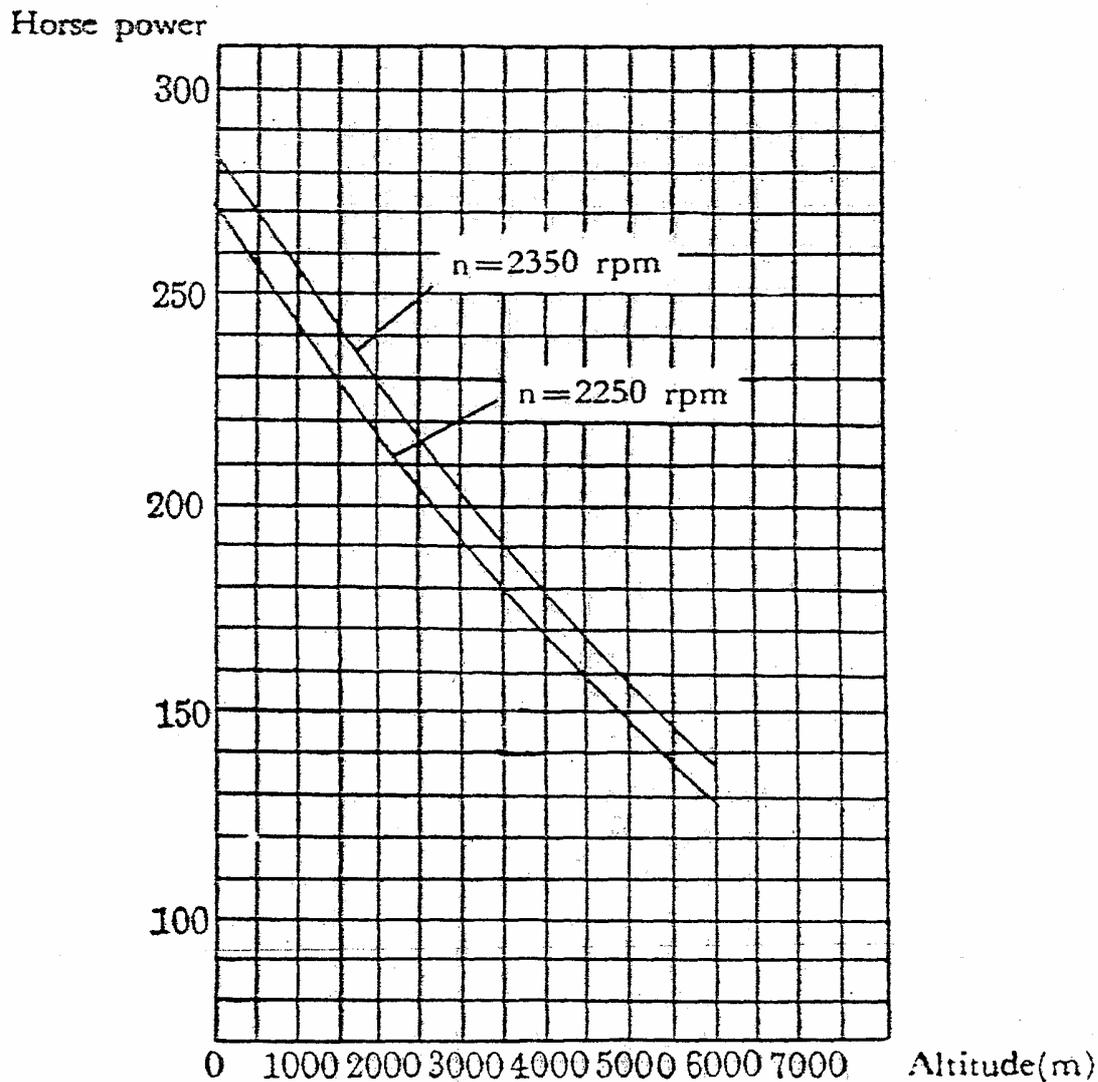


Fig. 2 Altitude performance curve of engine

3. Limit rotating speed of crankshaft

a. Max. permissible rotating speed (rpm)
 (at dive while manifold pressure not
 more than 500 mm. Hg): $2450 \pm 1\%$

b. Idling rotating speed (rpm): 500 ± 50

4. Accelerating performance of engine and its permissible time for continuous operation

a. Accelerating performance (time counted from idling speed to take-off) must be: 2-3 seconds

b. Permissible time for continuous operation

Take-off rating: 5 min.

Normal rating: 1 hour

Dive (at max. permissible rotating speed): 3 min.

5. Cylinder head temperature (according to temperature of spark plug at rear row in cylinder No. 4.)

a. Min. temperature for good positive accelerating performance: 120°C

b. Suitable temperature for level flight: 140-210°C

c. Max. temperature for continuous operation: Not more than 230°C

d. Max. temperature during continuous operation not exceed 15 minutes for take-off and climb Not more than 240°C

e. Max. temperature during continuous operation within 5 minutes for rapid climb: Not more than 250°C

f. temperature at stop:

Atmospheric temperature (°C)	Temperature for stopping of engine not higher than (°C)
below 25	150
over 25	165

6. Fuel and fuel supply system

a. Fuel specification: Aviation gasoline RH-70

b. Octane number of fuel: Not less than 70

- c. Carburetor
- | | |
|-------------------|---------------------|
| Type: | Membraneous QHQ-14A |
| Quantity (piece): | 1 |
- d. Gasoline pressure before carburetor (kg/cm²)
- | | |
|-------------------|--------------------|
| At idling speed: | Not less than 0.15 |
| At other ratings: | 0.2-0.5 |
- e. Fuel pump
- | | |
|-----------------------|--------------------|
| Type: | Rotary type XB-15A |
| Quantity (piece): | 1 |
| Transmission ratio: | 1.125 |
| Rotational direction: | Right |
7. Oil and lubricating system
- a. Oil specification: Aviation oil HH-20
- b. Specific oil consumption at 0.65 normal rating: Not more than 12g/hp.hr
- c. Oil pump
- | | |
|---------------------|------------------|
| Type: | Gear-type CB-32A |
| Quantity (piece): | 1 |
| Transmission ratio: | 1.125 |
| Rotating direction: | Left |
- d. Oil pressure in main passage (measuring at outlet of oil pump kg/cm²)
- | | |
|-------------------|-------------------|
| At idle speed: | Not less than 1.5 |
| At other ratings: | 4-7 |
- e. Oil inlet temperature (°C)
- | | |
|-------------------------------|-------------------|
| Suitable temperature: | 50-65 |
| Permissible min. temperature: | Not lower than 30 |
| Permissible max. temperature: | Not more than 75 |

Max. temperature during continuous operation not exceed 15 minutes:

Not more than 85

f. Max. scavenge temperature (°C) Not more than 125

g. Oil flow (kg/min.) when oil inlet temperature is 50-65°C at normal rating: 3.9-7.5

h. Radiate heat value of oil (kcal./min.) at normal rating: Not more than 160

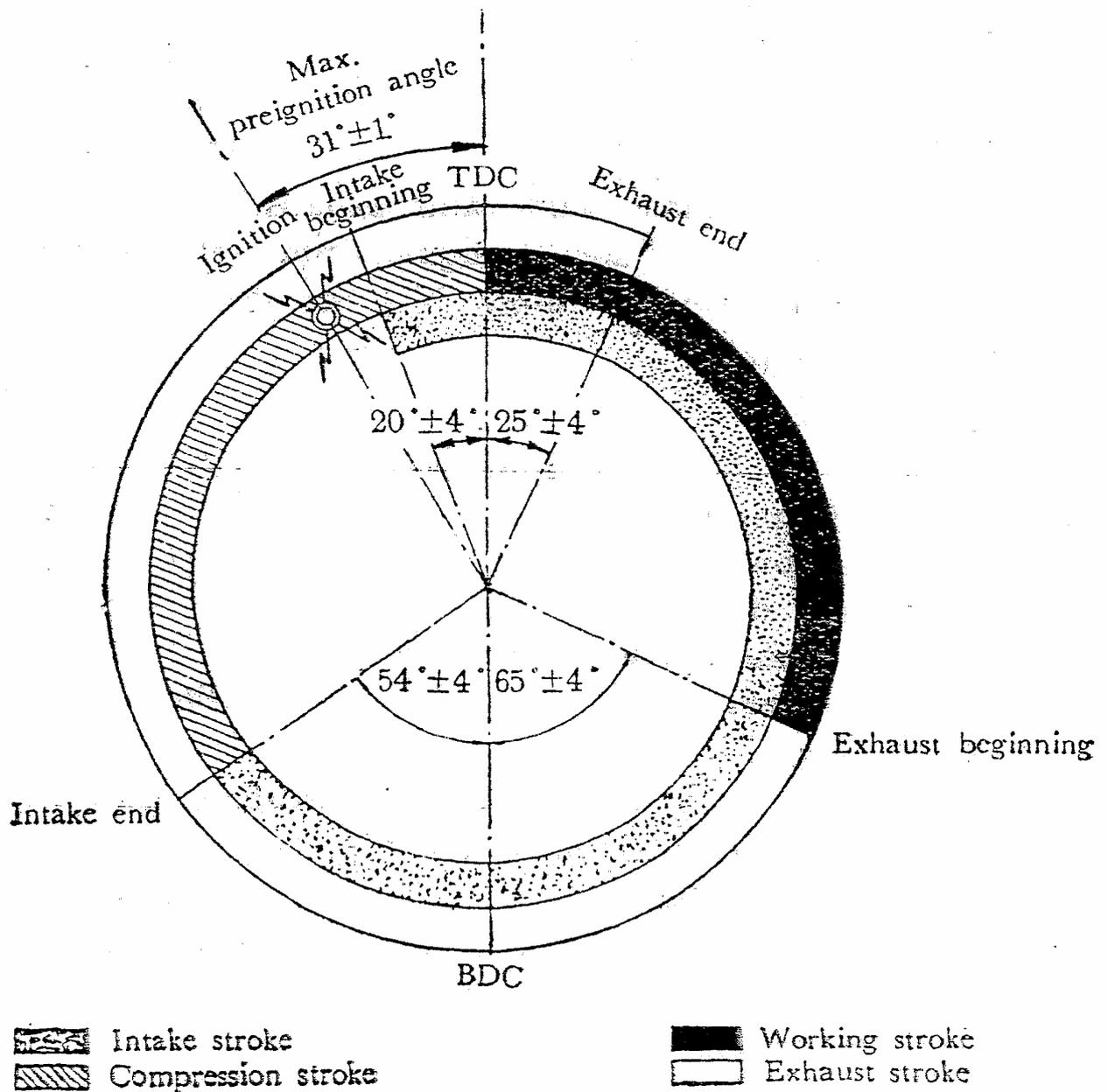


Fig. 3 Timing of gas distribution

8. Timing of gas distribution (It is necessary to check clearance of the intake valve and exhaust valve in hot state during checking of gas distribution timing, their clearance must be 1.1 mm.)

a. Intake valve

Opening before TDC: $20^{\circ} \pm 4^{\circ}$

Closing after BDC: $54^{\circ} \pm 4^{\circ}$

Intake time interval $254^{\circ} \pm 8^{\circ}$

b. Exhaust valve

Opening before BDC: $65^{\circ} \pm 4^{\circ}$

Closing after TDC: $25^{\circ} \pm 4^{\circ}$

Exhaust time interval: $270^{\circ} \pm 8^{\circ}$

c. Clearance of intake valve and exhaust valve in cold condition of engine (mm): 0.3-0.4

d. Max. stroke of valve (mm): Not less than 14.5

9. Ignition system

a. Magneto

Type: Four firing type, shielded CD-5

Quantity (piece): 2

Transmission ratio: 1.125

Rotational direction: Left

Gap of contact point for breaker of magneto (mm): 0.25-0.35

b. Spark plug

Type: Porcelain DZ-5

Quantity for each cylinder (piece) 2

Gap of spark plug (mm): 0.4—0.5

c. Firing order for cylinders: 1-3-5-7-9-2-4-6-8

d. When engine operates at normal rating or 0.65 normal rating, propeller is set at low pitch and only one magneto operates, drop of engine speed must not

exceed 60 rpm.

- e. Max. preignition angle of left and right magnetos (according to rotating angle of crankshaft): $31^{\circ} \pm 1^{\circ}$

10. Starting system

- a. Starting method for engine:

Starting provides with compressed air not more than 50 atm.

- b. Air compressor

Type Piston type KY-2

Quantity (piece) 1

Transmission ratio: 0.9

Rotational direction Right

Charging time compressing air to bottle (with capacity of 8 lit. till 50 kg/cm²)

At normal rating: Not exceed 15 min.

At 0.65 normal rating: Not exceed 18 min.

- c. Adjustment of compressed air distributor:

While the piston of cylinder No. 4 is situated at 9.5° after TDC of compression stroke (according to propeller rotational angle), air distribution valve is opened, so that hole permitted compressed air entering into cylinder is not more than 0.1 mm.

11. Other accessories

Name	Type	Quantity for each engine (piece)	Transmission ratio	Rotational direction
Governor	TS-1	1	1.045	Right
Generator	ZF-1.5	1	2.5	Left
Tachometer	Transmitter	1	0.5	Left

Note: The rotational direction of accessories is viewed from transmission direction.

CHAPTER II

Preflight preparation of engine

Section I. Preparation before starting

1. Before moving the aircraft, drain the fuel with foreign matters from fuel sump situated on the central wing of the aircraft, till the clean fuel flows out from which.

2. After taking off the preservative grease from the engine, and before its starting, screw off the oil drain thread plug of intake pipe of cylinders No. 4, 5, 6, and the front row spark plug and turn the propeller by hand, and drain oil accumulated.

3. Whether the engine has been stopped more than a couple of days or three times of starting are unsuccessful, must be screwed off oil drain thread plug of intake pipe of cylinders No. 4,5,6, turn propeller by hand, drain fuel and oil accumulated.

4. Whether the engine has been stopped more than seven days or the engine is just installed in the aircraft, before starting, should be accomplished with the following procedure:

a. Inject aviation oil into cylinders No. 1,2,3,8,9, with oil gun, oil injecting amount is 40-50g, and oil temperature is 40~60°C, during injection piston should be kept at BDC.

b. Inject aviation oil of 1.3-1.5 lit. with temperature 40~60°C through the front and the rear vent pipe of the crankcase respectively.

5. Inspect oil quantity in the oil tank. It should be not less than 12 lit.

Section 2. Engine test

1. Starting of engine

a. Set the lever for controlling altitude in fully open position.

b. If atmospheric temperature is lower, turn on the warm-up throttle in inlet passage.

c. Set the magneto switch in position "0", set the throttle in fully open position, turn propeller as engine rotational direction, meanwhile fill fuel 2-3 times with injector (in winter 4-5 times).

Caution: Fuel filling amount is not permissible too much, or else wash off oil on wall of cylinder, so that make piston in operation failure from bad wear, while generate also easy impact from hydraulic pressure.

d. Pull the lever for throttle backward correspondently to 700-900 rpm position.

e. Turn handle for wobble pump, make fuel pressure before carburetor to reach 0.2-0.5 kg/cm².

f. Give orders for leave propeller, after receiving the answer have left, set magneto switch in "1+2" position, connect starting switch, then press the starting button, in order to start engine (see fig. 4 curve for engine's test).

g. If it is difficult to start, the magneto must be closed, turn on the throttle fully, reverse the propeller 3-4 revolutions counter rotational direction, and drain exhaust gas. Then reverse the propeller 6-8 revolutions positively. Don't inject fuel into engine again, and make a fresh start

in accordance with above given procedure.

h. If the starting failed for three times, it is necessary to find out the causes. After remedy of trouble, inject with oil gun through the hole of the spark plug into cylinders No. 1,2,3,8,9, the aviation oil in amount 40-50g with temperature of 40-60°C. Turn propeller 3-4 revolutions positively, and drain fuel and oil accumulated in vent pipe for cylinders No. 4,5,6, then restart the engine.

i. After starting in the course of 15-20 seconds, if oil pressure is lower than 1.5 kg/cm², stop engine at once and remedy troubles.

j. After finishing of starting, should be locked the handle of injector.

2. Warm up engine

a. After starting, push the throttle to 1200-1400 rpm in order to warm up the engine.

b. When the temperature of cylinder head reaches 120°C, and inlet oil temperature reaches 30°C (but the diluted oil temperature is 20°C), the work for warming up engine is finished, at this time open gradually the switch for flap and radiator.

3. Inspect the operation under various ratings of the engine

a. Inspect generator voltage

After advancing the throttle to the position of 1600-1700 rpm, connect switch for "radio-compass", press button for "volt-amperemeter", check generator voltage, it should be 27.5 ± 1 volts.

As the generator works normally, the cut-off signal lamp for the generator should not flash.

After checking the generator voltage, it is ne-

cessary to cut off the switch for "radio-compass".

b. Check the engine for normal ratings.

After advancing throttle to the position of 2300 rpm pull the pitch changing handle, it makes possible to drop rotating speed to 2250 rpm, then, advance the throttle to fully open position again.

Rotating speed should be: $2250 \pm 1\%$ rpm

Manifold pressure should be:

Atmospheric pressure in current air field

$+80 \pm 10$ mmHg.

Oil pressure should be: $4-7$ kg/cm²

Fuel pressure should be: $0.2-0.5$ kg/cm²

Oil inlet temperature should be: $30-75^{\circ}\text{C}$

Cylinder head temperature: Not higher than 230°C

The engine should be operated stably without vibration.

c. Test for constant rotating speed

At the normal rating, make the throttle stepwise smaller, and reduce the manifold pressure for 100-150 mm Hg, at the same time the rotating speed should keep constant, then push throttle to normal rating again.

d. Check changing pitch

The checking for changing pitch should proceed at normal rating. Pull the pitch changing lever to high pitch position softly, if employ propeller model J2-G1, the rotating speed will be dropped to 1350-1450 rpm; and if employ propeller model J9-G1, the rotating speed will be dropped to 1500-1600 rpm. Then push the pitch changing lever to "low pitch" position, the engine come into take-off rating.

e. Check the engine for take-off rating, at this time:

Rotating speed should be:	2350 ± 1 % rpm
Manifold pressure should be:	
Atmospheric pressure in current field	+85 ± 10 mm Hg
Oil pressure should be:	4-7 kg/cm ²
Fuel pressure should be:	0.2-0.5 kg/cm ²
Oil inlet temperature:	Not more than 75°C
Cylinder head temperature:	Not more than 230°C

f. Check magneto and spark plug for their operations.

Pull throttle to position of 1950 rpm, let the left and the right magneto work individually for 15-20 seconds. As single magneto works, the rotating speed dropped by engine should not exceed 60 rpm. Before employing the left and the right magnetos alternatively, both magnetos should work 20-30 seconds simultaneously.

g. Check for acceleration

Within 2-3 seconds advance the throttle from the smallest position to fully open position. In this time the rotating speed should be changed evenly from idling to take-off rating.

When inspect acceleration, the cylinder head temperature should not be lower than 120°C, and oil inlet temperature should not be lower than 30°C.

h. Check the engine for idling

Retard the throttle to the minimum position, at this time the engine should be operated stably.

Rotating speed should be:	500 ± 50 rpm
Oil pressure should be:	Not less than 1.5 kg/cm ²
Fuel pressure	Not less than 0.15 kg/cm ²

Engine should not operate at idling for a long period, in order to avoid the spark plug splashed with oil.

4. Engine stop

a. Advance the throttle to the 700-800 rpm position for cooling the engine, and make the cylinder head temperature in accordance with the following table:

Atmosphere temperature (°C)	Temperature for stopping of engine (not higher than °C)
below 25	150
over 25	165

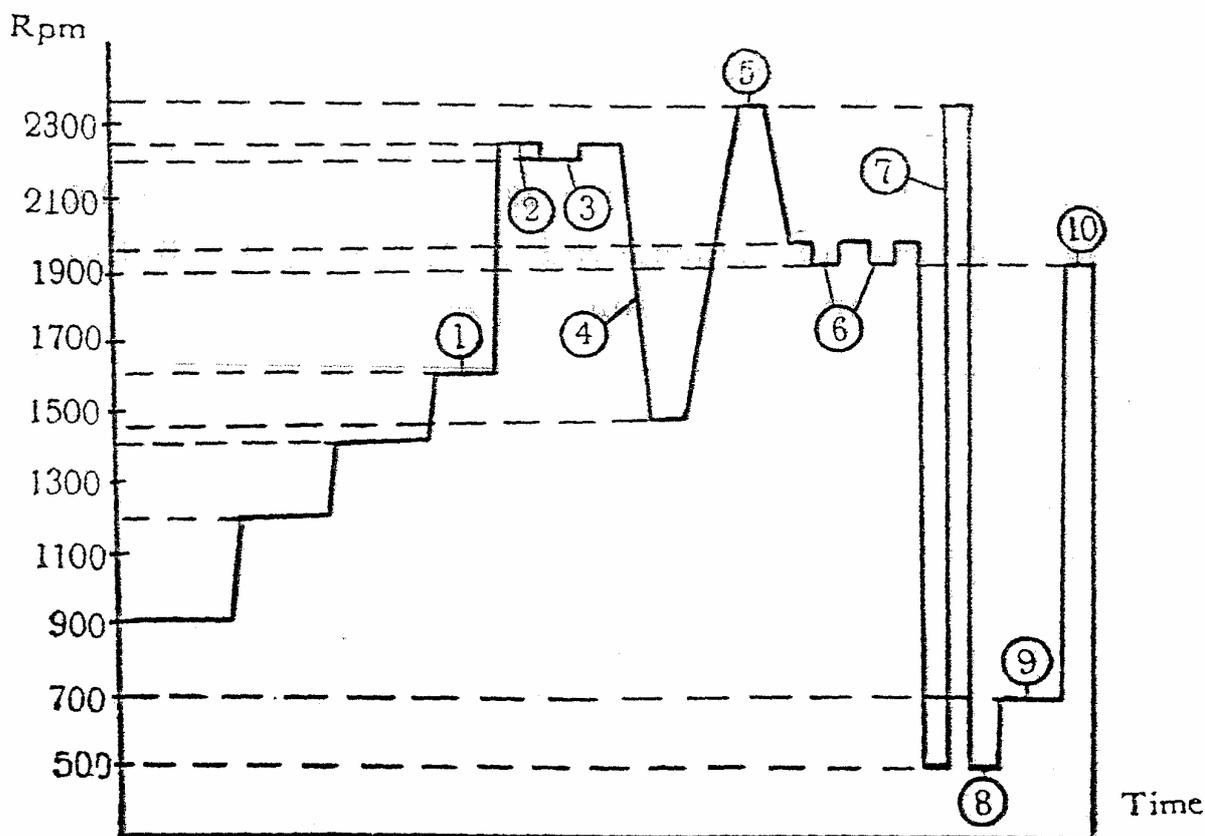


Fig. 4 Performance curve of run test for engine HUOSAI-6A

1. Checking of generator voltage,
2. Normal rating,
3. constant speed test,
4. Pitch changing test,
5. Take-off rating,
6. Checking of magneto,
7. Acceleration test,
8. Idling operation
9. Engine cooling,
10. Burning the spark plug.

b. Make engine rotating speed to 1900 rpm, and at this rating let engine operates for 10-15 seconds for burning spark plug, then pull the throttle to the 600-700 rpm position, cut off the magneto switch, and push the throttle rapidly to fully open position.

After stop of engine, cut off all the switches, and place the throttle at the idling run position.

Caution:

1) Must never stop the engine directly at higher rotating speed or at the rating operation.

2) Prohibit to stop engine by means of closing anti-fire switch, in order to avoid fire from resulting of back fire.

3) After any operating of engine, write down the indications of each instrument, engine operating condition and its running time in engine logbook.

CHAPTER III

Engine operation during flight

Section 1. Take-off

1. after warming-up of the engine, while increase uniformly the rotating speed and the manifold pressure to normal or take-off rating (according to the selected take-off rating), after that the indications of each instrument is in accordance with following requirements, begin to take-off:

Cylinder head temperature: 140-210°C (the optimum temperature 180°C)

Oil inlet temperature: 30-75°C (the optimum temperature 50-65°C)

Oil scavenge temperature: Not higher than 125°C

Oil pressure: 4-7 kg/cm²

Fuel pressure: 0.2-0.5 kg/cm²

2. Continuous operating time at take-off rating should not exceed 5 minutes.

Section 2. Climb

1. Climb must be accomplished at engine normal or cruising rating.

2. In the course of climb, suitable oil inlet temperature should be 50-65°C. If oil temperature reaches 85°C, engine continuous operation should not exceed 15 minutes.

3. As cylinder head temperature is 240°C , engine continuous operation should not be more than 15 minutes. When climb rapidly and when cylinder head temperature is 250°C , engine continuous operation should not be more than 5 minutes.

4. If oil temperature or cylinder head temperature exceed the above described values, should stop climb. After changing to level flight condition, if the temperature rises continuously, it is necessary to drop rotating speed. If the temperature could not drop down still, home at once.

5. The method for reducing engine power at flight
First reduce throttle in order to decrease manifold pressure, then pull the pitch changing lever to decrease rotating speed.

6. The method for increasing engine power at flight.
First advance the pitch changing lever to increase rotating speed, then push the throttle to increase manifold pressure.

Note: When taking off and climbing in winter, generally close the air inlet heater, so that the engine can generate enough power. If the air inlet temperature is lower than 15°C , the heater could be used yet.

Section 3. Level flight

1. The indications of each engine instrument of level flight should be as follows:

Cylinder head temperature:	140-210 $^{\circ}\text{C}$
Oil inlet temperature:	50-75 $^{\circ}\text{C}$
Oil scavenge temperature:	80-115 $^{\circ}\text{C}$

Oil pressure: 4-7 kg/cm²

Fuel pressure: 0.2-0.5 kg/cm²

2. Engine operating conditions of level flight

Operating conditions	Rotating speed (rpm)	Manifold pressure (mm. Hg)	Throttle position
Rated	2250 ± 1%	P _H + 80 ± 10	Full open
Cruising	0.65 rated	1950 ± 1%	Adjusting
	0.5 rated	1790 ± 1%	Adjusting

Note: P_H is the atmospheric pressure at the flight altitude.

The continuous operating time at rated operating condition should not exceed 1 hour (but after changing to small power in 3 minutes, to continue rated operation for 1 hour).

3. In case the atmosphere temperature is low, the aircraft flies continuously at operating condition, in order to avoid oil freezing in propeller oil cylinder, after each flight reaches 25-30 minutes, change the propeller from lower pitch to higher in range of 1950-1500 rpm, and after this vice versa, change the propeller from higher pitch to lower in the same range, next return to the original rotating speed.

4. Operation of the altitude governor for carburetor.

Carburetor altitude governor is used for adjusting the mixture ratio at altitude, usually for climbing or level flight higher than 500 m altitude. The method of operation as follows:

a. Set the pitch changing control lever in the lower pitch position.

b. First fix the throttle in the required operating speed position, then slowly move altitude control lever to the "full close" direction, until the rotating speed reaches max. value (i.e. the speed will drop for further advancing the lever).

c. Pull back the altitude control lever to "full open" direction, fix it until the rotating speed drops slightly.

d. Adjust the engine to wanted rating with the throttle and the pitch changing control lever.

Section 4. Dive, gliding and landing

1. Dive rotating speed should not exceed 2450 rpm (manifold pressure should not be more than 500 mm Hg), its continuous operation time should not exceed 3 minutes. Cylinder head temperature at dive and gliding should not be lower than 120°C.

2. During dive or gliding, set the altitude control lever in "full open" position.

3. After dive, never rapidly move the throttle lever, the moving time should not be less than 2-3 seconds for adjusting the engine from idling run to higher speed.

4. Gliding from altitude for a long period or gliding in winter, in order to prevent engine from overcooling, should close the shutter, turn on the throttle of the heater, and periodically advance the throttle a few seconds

for heating the engine, and let cylinder head temperature not lower than 120°C, and oil inlet temperature not lower than 30°C.

5. Gliding before landing, set the pitch changing lever in the low position, get ready for the engine rapidly into its take-off rating when required (so far as wrong visual check for landing or prohibit to land etc).

CHAPTER IV

Engine operation in winter

Section 1. Preparation in winter

1. Provision for a winter housing for engine.
2. In order to prevent textile rubber hoses and cables for engine from hot air influence while heating the engine, these parts should be covered with asbestos cord and coated with water glass.
3. Oil tank, speed governor and metal pipes, all of these should be warm preserved with felt jacket.
4. Wash the oil system, replace all the oil (at season).

Section 2. Oil Dilution with gasoline

1. Method for dilution
 - a. If ambient air temperature is lower than 5°C , after flight, dilute oil.
 - b. Start the engine, when oil temperature attains to $30-50^{\circ}\text{C}$ and rotating speed to 1600 rpm, ought to switch on for oil dilution, the connecting time for oil dilution is as following table:

Engine running time after the last dilution (min.)	Quantity in oil tank (lit.)		
	15	12	9
	In order to keep gasoline content of 8-13% in oil, the durative time for connecting dilution switch should be as follows:		
0-15	1 min. 43 sec.	1 min. 28 sec.	1 min. 14 sec.
15-30	2 min. 44 sec.	2 min. 21 sec.	1 min. 57 sec.
30-45	3 min. 27 sec.	2 min. 58 sec.	2 min. 29 sec.
45-60	3 min. 41 sec.	3 min. 17 sec.	2 min. 46 sec.
The oil without dilution	4 min. 36 sec.	3 min. 47 sec.	3 min. 10 sec.

c. After disconnecting the switch for oil dilution, make the engine to continue running at 1600 rpm for 3 minutes and control pitch changing handle 2-3 times simultaneously, then stop the engine according to the specification.

During oil dilution, cylinder head temperature should not be higher than 160°C, oil temperature should not be higher than 50°C.

2. Characteristics of the engine using diluted oil:

a. During warming-up the engine, the oil temperature is not lower than 20°C, the cylinder head temperature is not lower than 120°C, thus the engine warm-up had finished.

b. As engine just begins to run, allow the oil pressure to be 1 kg/cm² lower than the normal pressure. But after 20-30 minutes, the oil pressure should become normal.

c. When engine runs at idle if the oil pressure is lower than 1.5 kg/cm², should stop engine at once. If the oil is over diluted, renew all the oil in oil system.

d. If the ambient air temperature is lower than minus 20°C after flight, not dilute oil, but drain all the oil from the oil tank, radiator and the oil sump. Before next starting engine, fill enough aviation oil of 40-60°C into the oil tank, and fill 2-3 lit. aviation oil of 40-60°C through the front and the rear vent pipes of case.

Note: prohibit direct to fill gasoline into the oil tank so as to dilute oil.

Section 3. Warm-up of engine for start

1. When the atmospheric temperature is lower than

zero, warm-up engine before starting. the hot air temperature for heating engine should not be higher than 180°C.

When the atmospheric temperature is lower than minus 20°C, also heat the radiator, the hot air for heating should not exceed 100°C.

2. Heat engine with heating equipment until cylinder head temperature is not lower than 30°C.

3. After warming-up of engine, rotate propeller 3-4 revolutions positively. The rotation should be smoothly.

Section 4. Engine test

1. Engine test in winter must be carried out yet according to the specification in the first section of the second chapter "Engine test".

2. In order to prevent carburetor from freeze and to make engine running securely, the temperature of air entering into carburetor should not be lower than 15°C.

CHAPTER V

Maintenance of engine

Section I. Postflight inspection

1. If the engine appears in abnormal conditions during flight, it is necessary to find out its causes by ground test of engine and remedy it.

2. Check the engine and accessories for their connection.

3. Oil system

a. Inspect each pipe connective in oil system for seal. Check the vent pipe of oil tank for ventilation.

b. Drain 0.5 lit. oil from oil sump. Filter it with fine screen oil filter scoop. Check the oil for present of metal chip (When engine work time is comparatively little, check once per 10 hours).

4. Fuel system

a. Press fuel with wobble pump to pressure 0.2-0.5 kg/cm². Check fuel system for seal.

b. Examine the throttle of carburetor and the altitude control lever for their connection.

c. Check vent hole on the upper cover of fuel pump for ventilation.

5. Starting system.

a. Check the screen of air compressor for clean. Drain sediment from accumulated filter. (It is necessary to blow the pipe in winter).

b. Check every starting air distributing pipe and their adjacent parts for spacing.

6. Ignition system.

a. Check whether the elbow of spark plug is tightened. Don't allow the electric cable and other parts for meet.

b. Check spark plug on cylinder for fixing.

7. Air inlet and exhaust system.

a. Check air inlet pipe for damage by impact. The space between frame ring and air inlet pipe should not be less than 2.5 mm.

b. Check antidust screen for clean. If employ it in summer or dusty airport, remove the antidust screen and clean it with gasoline and paint it with oil.

c. Inspect exhaust pipe for burnt and crack.

d. Check rocker box cover and cable for fixing.

8. Engine mounting

a. Check the frame ring and struts for crack and deformation.

b. Check the shock absorbers of engine mounting. If press damage or aging to be place, replace it.

9. Check fixed support of governor for crack. The connection of control lever should be in order.

10. Check the generator and the electric wire for connection. Check vent pipe for clean.

Section 2. Periodic inspection

Note: 1. Record the result of periodic inspection on the engine log book.

2. The time employed of engine should include the operation time for engine ground test.

After the first flight for engine new installed in aeroplane, proceed the following work:

1. Finish the flown inspection work.
2. Check and clean oil filter for oil pump and oil sump.
3. Check and clean inlet oil filter and air filter for carburetor.
4. Remove the propeller.
 - a. Tighten the nut for thrust bearing of engine.
 - b. Check spline on the propeller shaft and propeller hub.
 - c. Check bush for propeller hub and its front and rear cones.
5. Mounting the propeller, tighten fixing nut for propeller torque of 50-60 kg.m.
6. If use a new propeller, check counterweight tightening bolt nut for fixing after the first flight or the first 5 hours, the tightening torque is 8 kg.m. If don't align the line on the propeller housing with the intermediate line on adapter sleeve dial, it is necessary to adjust it.

The periodic inspection after each 50 hours operation of engine

1. Carry out the postflight inspection items.
2. Check compression of every cylinder, which should be 3.5-6 kg/cm² (during inspection, it is the better that the best temperature for cylinder head ranges 40-60°C).
3. Remove the rocker box cover.
 - a. When the piston lies at top dead center of compression stroke, check the clearance between rocker pulley and end face of air valve lever, which should be 0.3-0.4 mm.

b. Check washer for air inlet and outlet rocker needle bearing, the washer should not be rotate. If it is so, then remedy it by tightening nut or replacing the gasket. Check rocker and washer for longitudinal clearance simultaneously, which should be 0.1-0.3 mm.

4. Remove the bottom oil drain threaded plug of carburetor and drain out the sediment from fuel chamber. Set the throttle in the full open position. Blow air nozzle of carburetor with compressed air. (In order to avoid to break the membrane, the blow pressure should not be higher than 0.5 kg/cm²).

5. Check and clean oil inlet filter and air filter of carburetor.

6. Remove the air filter of compressor and clean it.

7. For the first 50 hours periodic inspection, also check air inlet pipe nut for tightness.

8. Drain oil from the engine and the oil tank, fill fresh oil.

Note: If airport provided with cement running way, replace oil after per 100 hours operation of the engine.

The Periodic inspection after each 100 hours operation of the engine

1. Carry out the periodic inspection after each 50 hours operation of the engine.

2. Carry out the fourth item of the inspection after the first flight.

3. Check and clean the oil filter and the governor filter.

4. Check magneto.

a. Inspect the breaker for fixing. The rotation of lever in spindle should be free. Rub platinum contact

with pure alcohol. In the event of detection of burning out on which, it is necessary to repair or replace it. Inspect clearance between contacts which must be 0.25-0.35 mm.

b. Check the transformer and the distribution brush for fixing, rub off oil dirt. When there is crack on the distribution brush replace it.

c. Rub off oil dirt from distributor and cam.

d. Check the contact spring in the socket of distributor whether it is well or not.

e. Check the high voltage leading-out for its proportion.

5. Check generator.

a. Check contact in connecting of all the leads for reliability.

b. Check the brush for free moving in brush box.

c. Check commutator and brush, measure the height of brush (fig. 5). When the brush is worn and its height lower than 16 mm, it is necessary to replace.

d. Remove fan after per 300 hours operation, the interior of ball bearing (F302) must be painted with 7007 lubricating grease in addition.

6. Check spark plug.

a. Remove the spark plug from the engine, and proceed to visual inspection.

b. Rub off accumulated carbon from spark plug. Clean electrode with gasoline.

c. Adjust the gap of spark plug by special tool, the gap should be 0.4-0.5 mm. During adjusting the gap, prohibit to put feeler in space to compress the center electrode in order to avoid the crack of center

electrode and of ceramic insulation cone.

d. Check electrode for fire jump property using the special fire jump test equipment. When proceeds fire jump test with 9 atm, the spark generated between electrodes should keep 30 seconds.

e. If the spark plug is wet, it is necessary to rub interior of heat insulated tube and insulation cone using clean rag, then dry it in internal of 1 hour 30 min. under 120-130°C temperature, after this proceeds the fire jump test.

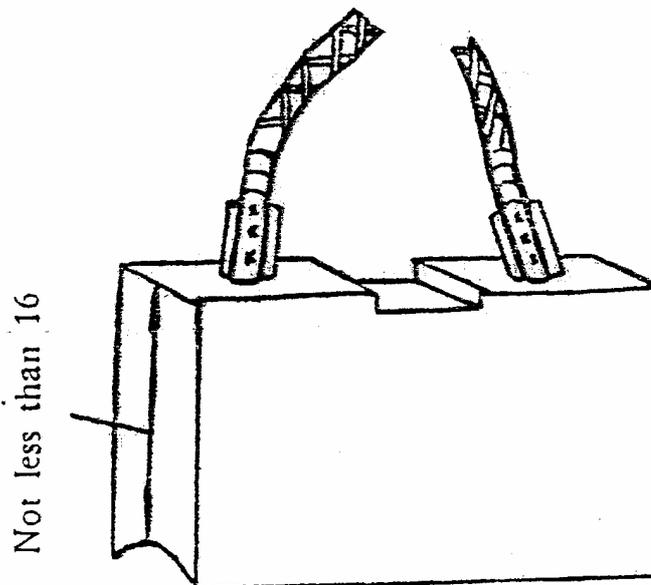


Fig. 5 The height of generator brush

CHAPTER VI

Replacement and adjustment of parts and accessories

Section I. Replacement and adjustment of oil pump

1. Replacement of oil pump
 - a. Remove the preventive compound at the oil pump. Soak the oil pump in clean aviation oil with the temperature of 80-100°C. Turn left the spline shaft by hand, remove the corrosion-preventive compound in interior of oil pump, then rub exterior surface.
 - b. Check the installation surface of oil pump, centering cylindrical surface and spline shaft. If scratch is found, it is necessary to blunt it with grind stone.
 - c. Assemble the rubber asbestos gasket on the installation surface of oil pump.
 - d. Assemble the oil pump. During installation, oil pump shaft should easy entered into spline of vertical shaft.
 - e. Set the washer on the stud. Uniformly tighten six nuts for fixing oil pump according to symmetrical direction.
 - f. Connect oil pipe. Secure that the adapter between pipes is sealed.
 - g. Start the engine to adjust oil pressure.
2. Adjusting of oil pressure

a. When the oil pressure is abnormal, regulate it with an adjusting screw (fig. 6).

Turn the adjusting screw clockwise, the pressure increases. While turn the adjusting screw counter-clockwise, the pressure decreases.

Turning of the adjusting screw through one and a half revolution is approximately corresponding to a change of 1 kg/cm^2 in oil pressure.

During the regulation, as tighten or loosen lock nut, it is necessary to fix the adjusting screw.

b. After regulation, start the engine, check the oil pressure.

As the rotating speed is 1950 rpm, the oil temperature is $30\text{-}50^\circ\text{C}$, the oil pressure should be $4\text{-}7 \text{ kg/cm}^2$.

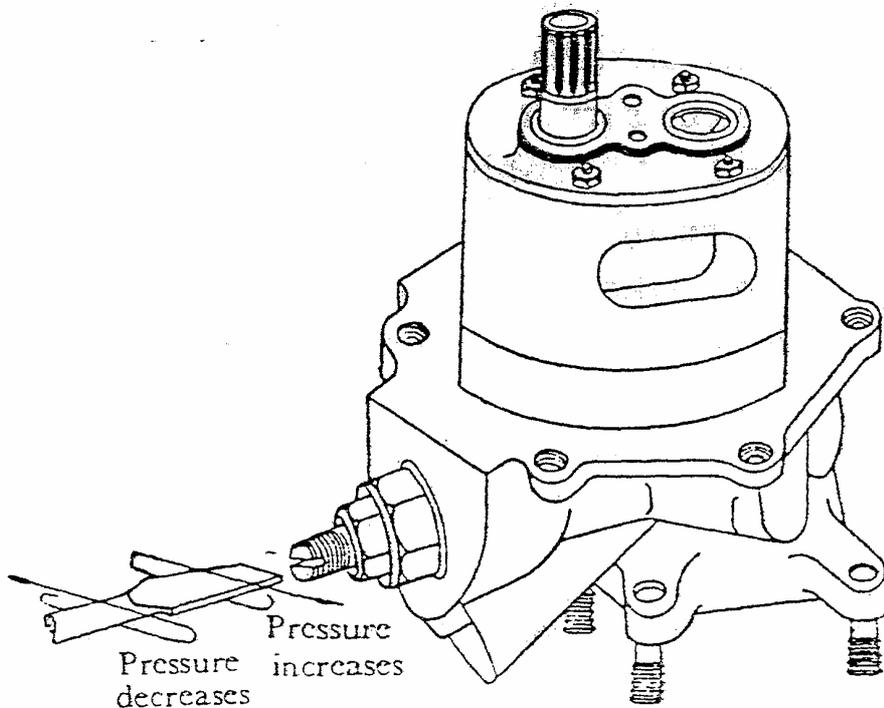


Fig. 6 Adjusting of oil pressure

Section 2. Replacement and adjustment of fuel pump

1. Replacement of fuel pump.

a. Remove the preservative grease from the fuel pump: rub the exterior surface of oil pump. Soak the fuel pump in clean gasoline, and thoroughly clean the interior of the oil pump by turning the rotor.

Note: If the fuel pump is conserved with antirust oil, it is necessary to turn rotor reversely in order to avoid that the antirust oil flows into pressure decreasing chamber.

b. Rub and check the installation surface of the oil pump, centering cylindrical surface and shaft tail. If there is scratch, it is necessary to blunt it with grind stone.

c. Set the gasket made of rubber asbestos on the installation surface.

d. Install the fuel pump, its shaft tail should enter the driven spindle of the oil pump smoothly.

e. Install the washer, uniformly tighten the four nuts for fixing the fuel pump.

f. Connect the fuel pipe, secure tightness of the connection.

g. Start the engine to adjust fuel pressure.

2. Adjustment of fuel pressure.

a. If the fuel pressure is abnormal, regulate it with the adjusting screw (fig. 7)

As turn the screw clockwise, the pressure increases,

while rotate the screw counterclockwise, the pressure decreases.

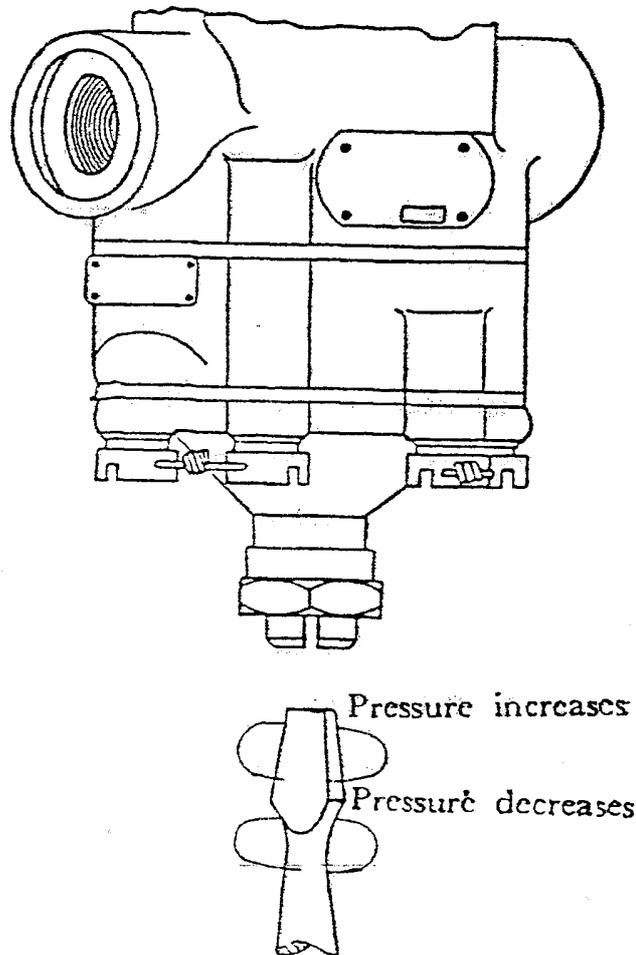


Fig. 7 Adjustment of fuel pressure

Turning the adjusting screw through one revolution is approximately corresponding to a change of 0.1 kg/cm^2 in fuel pressure.

During the regulation, as tighten or loosen the lock nut, it is necessary to fix the adjusting screw.

b. After regulation, it is necessary to start engine, check fuel pressure.

As the rotating speed is 1950 rpm the fuel pressure should be $0.2-0.5 \text{ kg/cm}^2$.

Section 3. Installation and adjustment of magneto

1. Installation of magneto

a. Before installing magneto on the engine, it is necessary to remove the preservative as required in certificate for the magneto.

b. Using the TDC indicator, to find out the TDC (top dead center) on the compression stroke of the fourth cylinder.

Dismount the spark plug at the front row of the fourth cylinder, plug the hole of the spark plug by hand, rotate the propeller positively, and thus as the pressure is felt by hand, that is a compression. Then rotate the propeller for 50-60 degrees reversely, install the TDC indicator, rotate the propeller positively, and thus, as the finger of TDC indicator points the max. value (when continue to rotate the propeller, the pointer will return), that is the top dead center.

c. Fix the timing meter pointer installation on the propeller blade, insert a scale of the timing meter in a clearance between flaps and aeroplane skin, and make the pointer to align the "O" of the scale.

d. Find out the setting angles for the magneto from the following table. Then reversely rotate the propeller for 50-60 degrees, and positively rotate the propeller until the pointer of timing meter indicates the TDC degrees found from the following table.

Degrees marked on rear cover of magneto (Automatic preignition angle)	Setting angle for magneto (Degree)
23	8.3 ± 0.7
23.5	7.9 ± 0.7
24	7.6 ± 0.7
24.5	7.2 ± 0.7
25	6.9 ± 0.7
25.5	6.5 ± 0.7
26	6.2 ± 0.7
26.5	5.8 ± 0.7
27	5.5 ± 0.7

e. Adjust the preignition angle for magneto according to the procedure written by the second item of this section i.e. "Adjustment of the preignition angle". Set the rubber asbestos gasket painted yellow sealing compound on the installation face of the magneto.

f. Make the working electrode of distributor brush to align the line on the magneto rear cover. Then install the magneto on the engine.

2. Adjustment of the preignition angle

When the preignition angle is incorrect, proceed the adjustment as the following method.

a. If the deviation of the preignition angle is minor, adjust it by rotating the magneto body.

As clockwise turn the magneto body, the preignition angle decreases.

While counterclockwise rotate the magneto body, the preignition angle increases.

As the magneto body shifts from one limited position to the another limited position, the preignition

angle will change approximately 4 degrees (the rotation angle for propeller shaft).

b. If the deviation of the preignition angle is great, proceed to adjust it by rotating coupling sleeve adjusting bolt.

As clockwise rotate the adjusting bolt, the preignition angle will increase.

While counterclockwise rotate the adjusting bolt, the preignition angle will decrease.

When the adjusting bolt of the coupling sleeve turns one revolution the preignition angle will be changed about 2-3 degrees (the rotating angle of propeller shaft).

Caution: Before regulating the couple sleeve, it is necessary to loosen the fixing bolt and the adjusting bolt for the couple sleeve. When regulate it, the end face of the adjusting bolt should lie tight against the end face of couple sleeve. After regulation, first tighten the adjusting bolt, and then tighten the fixing bolt.

c. After installing the magneto and adjusting the preignition angle, it is necessary to recheck whether or not the installation angle is right. When recheck it, insert a 0.03 mm feeler between contacts of breaker for magneto. Reversely rotate the propeller for 15-20 degrees, and next positively rotate the propeller. As magneto contact begins to cut-off, the feeler pad should be taken out freely. At this time the installation angle should meet the specifications in the table, and after this test the engine to inspect the proper operation of the magneto.

3. Adjust the gap between platinum contacts of magneto.

a. Unscrew two set screws "1" on set-adjustable plate "2" (Fig. 8). Rotate eccentric screw "3". As the cam locates at the top position, regulate the gap between contacts to 0.25-0.35 mm. And then fix the set screw "1" for the adjusting plate and locked.

b. Should keep clean the breaker contacts.

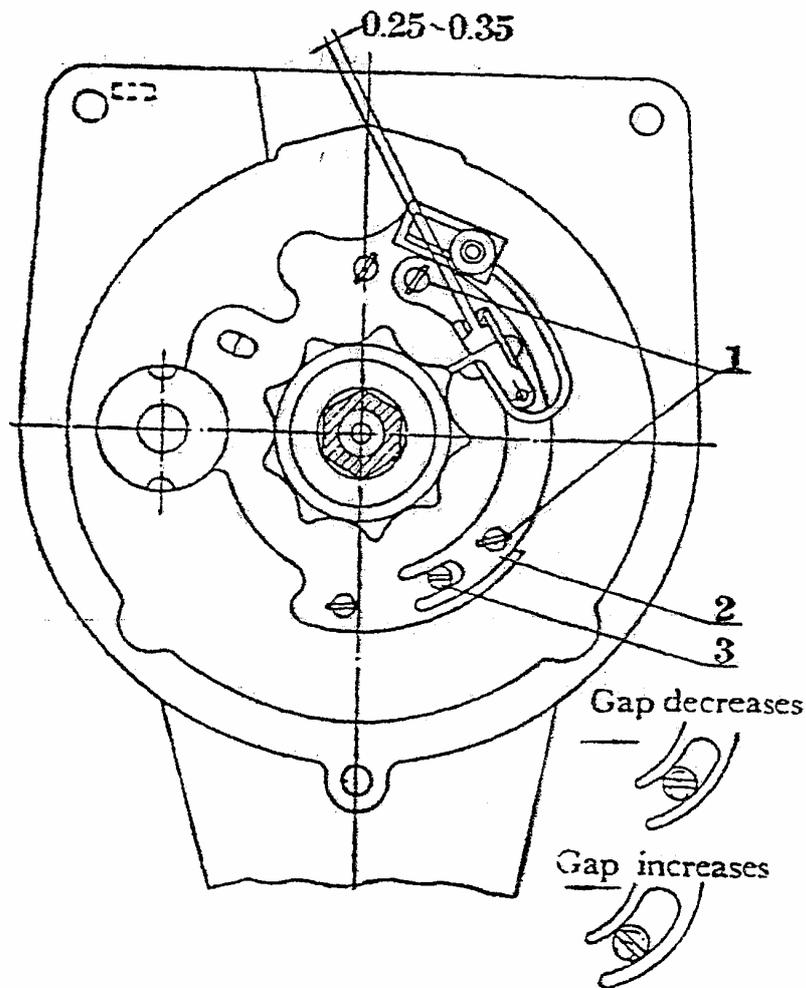


Fig. 8 Adjustment of gap at the breaker contact

Section 4. Installation and adjustment of carburetor

1. Installation of the carburetor

a. Remove the preventive grease from the carburetor

Wipe away the preventive compound of the exterior of carburetor thoroughly. Remove the drain plug from above part of fuel chamber. The air flow inlet pressure from speed pipe should not be higher than 0.5 kg/cm^2 , simultaneously gasoline in pressure of $0.2\text{-}0.5 \text{ kg/cm}^2$ pressed in from carburetor fuel inlet, that driving off the oil in fuel chamber, until clean gasoline flows out from draining plug hole at above part of fuel chamber, and then reinstall the draining plug at the above part. In order to clean needle (valve) and sprayer, push throttle from and back (Removing the preventive grease of interior of carburetor may be also proceeded, after carburetor has installed on engine, see the chapter VIII "Disseal work after six month conservation").

b. Check lock and lead-seal of carburetor for quality. The installation surface should keep clean, it should have not risk and dent. It is possible full to open and full to close throttle and high altitude rocker freely.

c. Wipe clean and check the installation surface of engine carburetor. If there is scratch, it is necessary to blunt it with stone.

d. Put a piece of rubber asbestos gasket between installation surfaces of carburetor and engine.

e. Set the carburetor on engine, set tab washer on the stud, tighten and locked four nuts.

f. Install the intake pipe of carburetor, control lever, and fuel tube. Be sure that control lever shifts freely, and that the adapter is well sealed.

g. Start engine to check carburetor under various ratings.

2. Adjustment of carburetor

Idle adjustment

a. Adjust idle mixture ratio with idle fuel needle (Fig. 9). As clockwise turn the idle needle, mixture change into lean; as counterclockwise turn idle needle, mixture changes into rich.

b. Change throttle opening with idle stop screw in order to adjust idle rotating speed (Fig. 10).

As screw in, the throttle opens bigger, the rotating

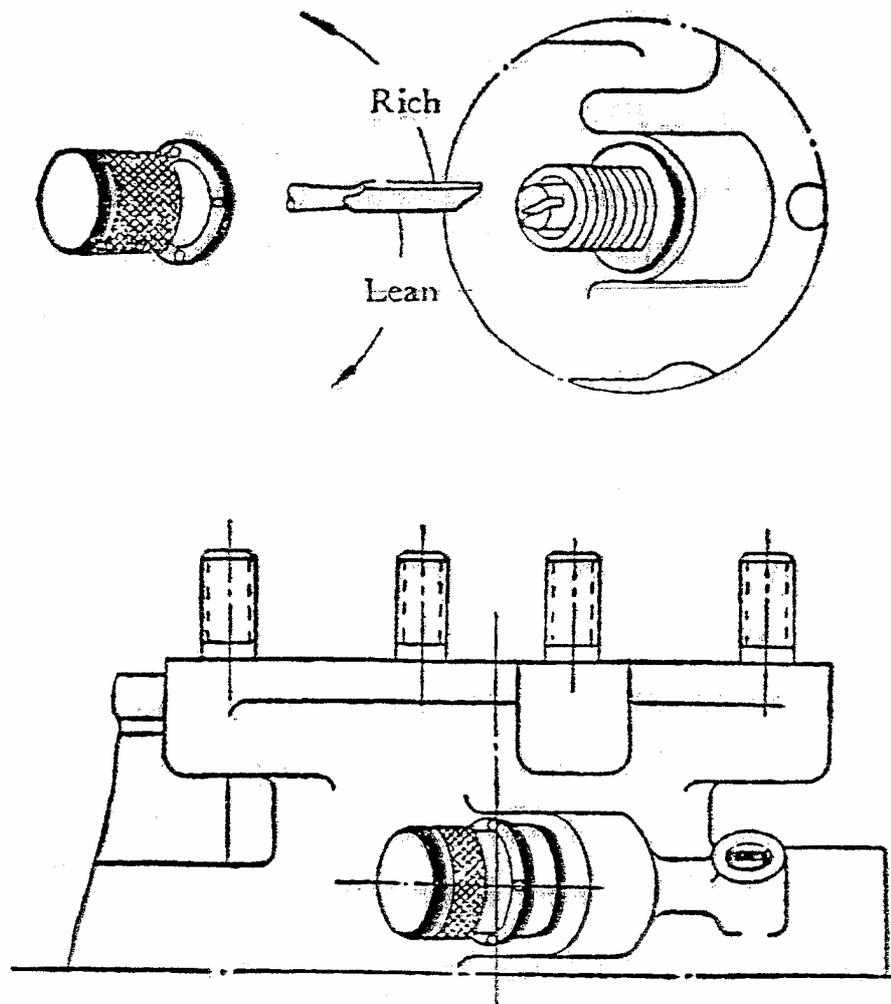


Fig. 9 Adjustment of idle mixture ratio

speed is increased; as screw out, the throttle closes smaller, and the rotating speed is decreased.

c. When engine runs at 500 ± 50 rpm, operation of which should be without vibration, exhaust gas without pop and black smoke, that is proved that the idle has well regulated.

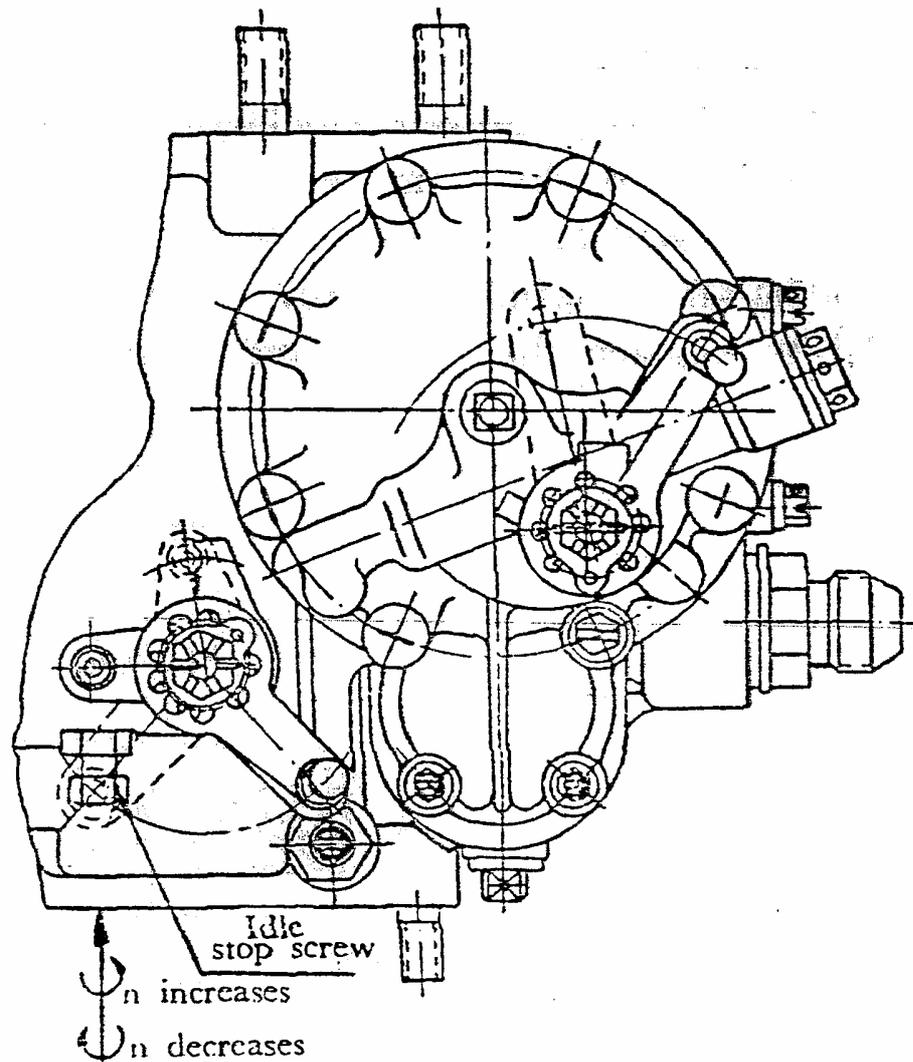


Fig. 10 Adjustment of idle rotating speed

Adjustment of cruise rating

a. Regulate the mixture ratio under cruise rating with main fuel needle (fig. 11).

As clockwise turn the adjusting screw of main fuel needle, the mixture gas change into lean; as counterclockwise turn the adjusting screw of main fuel needle, the mixture gas change into rich.

When the adjusting screw of main fuel needle rotates one division, the fuel consumption variation is 5-7 g/hp.h.

The adjusting range of adjusting screw of main fuel needle is generally allowed clockwise or counterclockwise to turn two divisions respectively from the position regulated by engine factory. If it does not meet the requirements after rotating the screw for two divisions, it is needed to replace the air limited nozzle.

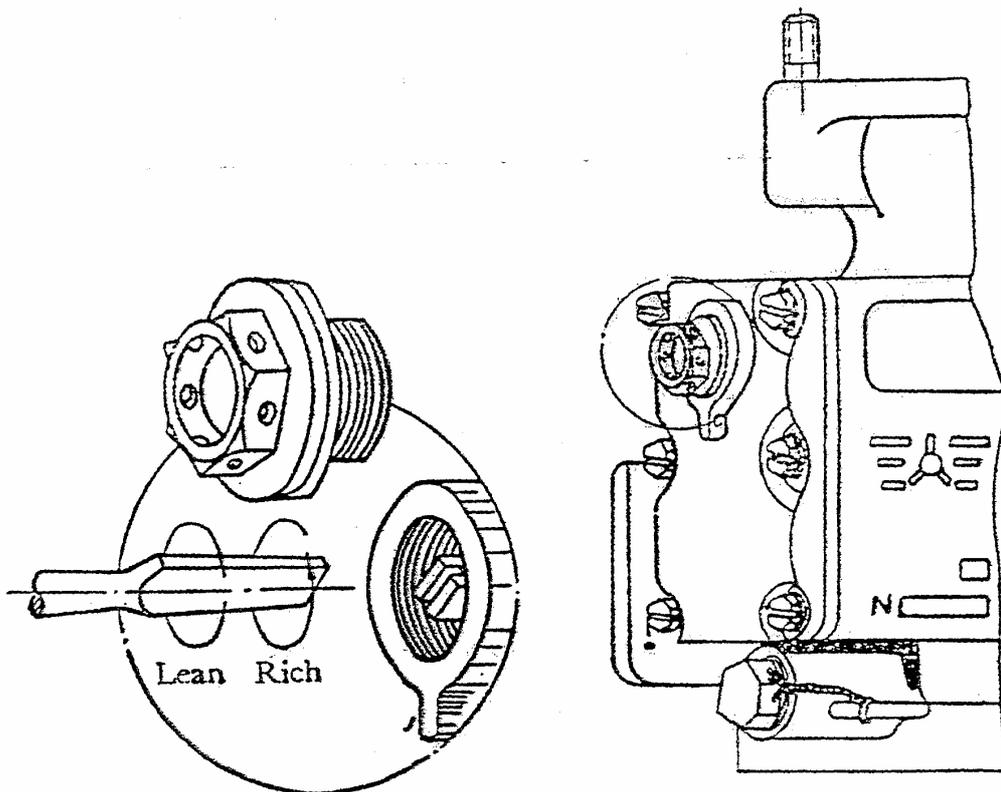


Fig. 11 Adjustment of main fuel needle

b. After the adjustment of cruise rating, it is necessary to check idle. Because the variation of main fuel needle position will influence the engine idle operation.

Adjustment of normal and take-off ratings

a. Regulate mixture ratio at normal and take-off ratings by replacing the air limited nozzle with various bore (fig. 12).

As the bore of air limited nozzle is increased, the mixture gas changed to lean; as bore of air limited nozzle is decreased, the mixture changes into rich.

When the bore of air limited nozzle changes to 0.1 mm, the fuel consumption variety is about 10 g/hp. h.

b. After air limited nozzle has been replaced, must check the operating conditions under cruise and idle ratings.

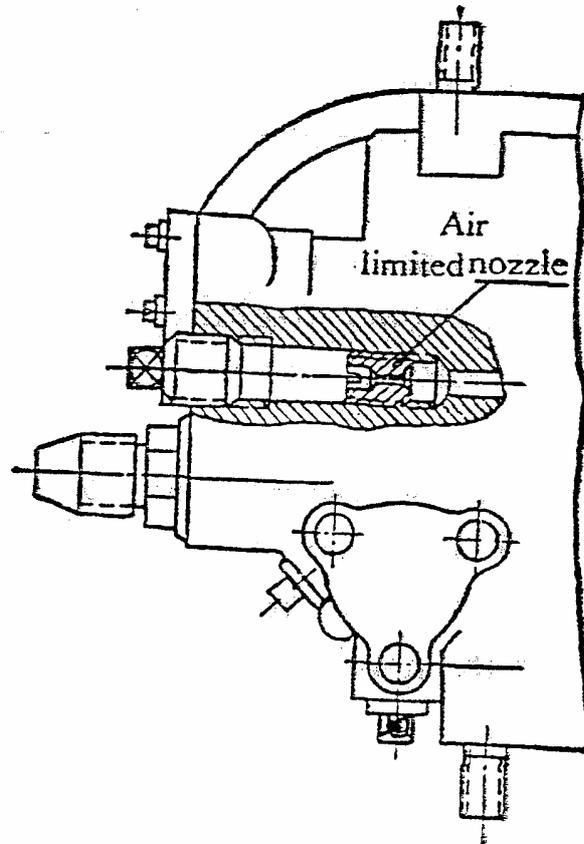


Fig. 12 Replacement of air limited nozzle

Section 5. Installation and adjustment of governor

1. Installation of governor

a. Remove antirust grease from the governor, wipe off conserving grease on the exterior.

b. Wipe off and check the installation surface of governor, centering cylindrical surface, driving shaft and spline of spindle tail. If there is scratch, must blunt it for repair with stone.

c. Set a piece of rubber asbestos gasket between installation surfaces of the governor and the case.

d. Mount the governor on the engine, put washer on the studs, and tighten four nuts.

2. Adjustment of governor

a. Turn the control shaft of governor to high pitch limited position (as viewed from governor, clockwise rotate it to the limit), and then return back 60 degrees.

b. Shift the high pitch move limited screw toward center for about 15 mm, and secure it.

c. Put splined rocker tightly by the high pitch move-limited screw, and set the rocker on the control shaft of governor.

d. Counterclockwise rotate the rocker with spline for 60 degrees, and then so contacted each other that adjusted the low pitch move limited screw.

e. Set the pitch change lever in cockpit at low pitch position.

f. Regulate the length of control lever, fix it at the rocker with spline.

g. Inspect the control system, be sure that between

the low pitch and high pitch move-limited screw there is no moving gap, dead angle and delay.

h. Start engine and check the proper operation of the governor.

As full open throttle set the pitch change lever at the low pitch position, in the case engine speed should be reached to $2350 \pm 1\%$ rpm.

When pull the pitch change lever under normal rating to a high pitch slowly, and when employ model J2-G1 propeller, the rotating speed will be dropped to 1350-1450 rpm; when employ model J9-G1 propeller, the rotating speed will be dropped to 1500-1600 rpm.

Close the throttle gradually at the normal rating, make manifold pressure to a drop of 100-150 mm. Hg, at that time the rotating speed should be kept.

i. When the governor could not meet the above stated requirements, regulate the rocker position of spline shaft and regulate the high-low-pitch move-limiting screw.

When shift the rocker for one tooth against spline, the speed variety is about 100 rpm. When rotate high pitch move-limiting screw for one revolution, the rotating speed changed about 40 rpm. When rotate the low pitch move-limited screw for one revolution, the rotating speed changes about 20 rpm.

Section 6. Replacement and adjustment of compressed air distributor for starting

1. Remove antirust grease from the air distribu-

tor for starting

a. Soak the air distributor for starting in gasoline:

Take down the distributor cover, remove conserving grease on internal and external surface of each part.

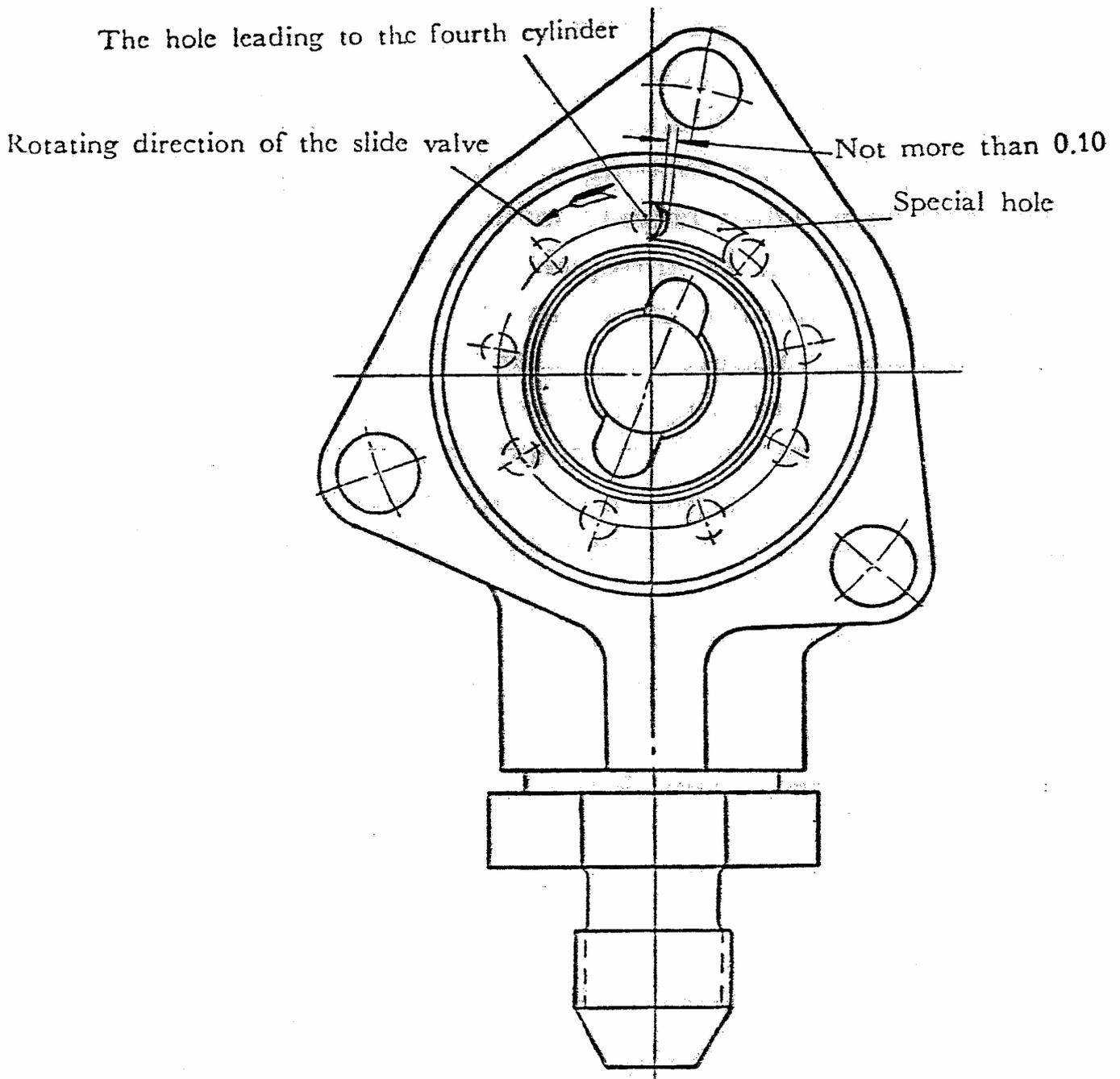


Fig. 13 Adjustment of air distributor for starting

b. Thoroughly wipe the surfaces of all parts and coat with a thin layer of oil on all friction surfaces.

2. Find TDC in compression stroke of the fourth cylinder with a TDC indicator and timer, and then positively rotate the propeller to 9.5 degrees beyond TDC. (According to propeller rotating angle).

3. Turn a slide valve according to rotating direction, when the hole leading to the fourth cylinder appears not more than 0.1 mm (Fig. 13), secure the slide valve with a fixture of air distributor for starting. Then install a gasket, hold the distributor cover assembly on the distributor housing, and then take off the fixture. If couldn't install it, should regulate the position about coupling sleeve.

4. Connect all of starting air tubes from cylinders to the distributor cover respectively

5. Start engine for checking the proper operation of the air distributor.

Section 7. Mounting and dismounting of spark plug

1. Coat the thread of spark plug with No. 4 high temperature lubricating grease, carefully, never drop the grease into spark plug hole and fall on electrode.

2. Mount a clean and flat copper washer on the spark plug (Because at rear row spark plug of the first and the fourth cylinder is installed thermocouple, don't assemble a copper washer).

3. Install a spark plug on cylinder, tighten it to the limit by hand, and then tighten it with special box spanner, torque should be not more than 4 Kg.m. As tighten the spark plug, prohibit additionally to employ a spanner handle or to knock the spanner.

4. Check contactor unit of high tension lead, there is not crack and damage, and then install the contactor unit into a screened tube of spark plug, and tighten the cover nut of bent pipe.

5. After the engine has been cooled, unscrew the spark plug with a special box spanner, while remove it, prohibit to knock it. The torque of unscrewing the spark plug is not more than 5 Kg.m. If the torque exceeds 5 Kg.m, need to proceed to a jumping test before remounting the spark plug on the engine.

Section 8. Replacement of air compressor

1. Remove antirust grease from the air compressor: Soak a compressor in oil at 80-100°C, the soaking time is not less than three minutes, and rotate a spindle tail for 5-7 rev. Then take it out, and wipe its external surface clean.

2. Wipe the fitting surface and spindle tail of the compressor clean. When there is scratch, must blunt it with stone.

3. Set a piece of rubber asbestos gasket between the rear cover and the fitting surface of the compressor, must pay attention to align all of the oil hole, install the compressor on the rear cover, the spindle tail of the compressor could come in spline of driving spindle easily.

4. Set a washer on the fixing studs, install and tighten six nuts securing the air compressor.
5. Connect the tube of compressed air to the air compressor, keep the adapters sealed.

Section 9. Replacement of generator

1. Remove the preservative grease from the generator: Wipe off conserving grease on spline spindle, fitting surfaces and exteriors.
2. Wipe clean and check the fitting surfaces and centering cylindric surface of the generator. When there is scratch, it is need to blunt it with stone.
3. Set a piece of rubber asbestos gasket between the rear cover and fitting surface of the generator.
4. Mount the generator on the rear cover, its spindle tail could come in spline of conic gear driving spindle easily, then install the tab washers, tighen four fixing nuts and lock them.
5. Connect a ventilating pipe of the generator and lead. Start engine and inspect the proper operation of the generator.

Section 10. Mounting and dismounting of the propeller

1. Preparation before installation
 - a. Remove conserving grease on exterior of the propeller, check that the exterior should have not scratch crack and serious varnish drop. Check the lock of nut for counterweight clamp. Clean and inspect the spline

in hub. When there is scratch, must blunt it with stone.

b. Wash all of parts of the oil cylinder, the front and the rear cones, nuts and contact surface of hub cone with gasoline. Then plate a layer of aviation oil.

c. Wipe clean and check the thread and spline of propeller spindle. When there is scratch, using stone to blunt it.

d. Colour check the mating condition between the propeller and cone, the colour area should be not less than 70% of total mating area. When does not meet the requirements, rotate the cone for 90-180 degrees, and then recheck it. If still does not meet the requirement, should replace the cone.

e. Install the nipple of hub, its tighten moment should be 8-10 Kg. m.

2. Mount the propeller on the engine:

a. Paint a thin layer of aviation oil on the thread of propeller spindle and its spline, hub spline and rear cone. Then install the propeller.

b. Coat a thin layer of aviation oil on the thread of fixing and the front cone, and then tighten the fixing nut with the front cone on the propeller spindle, its tighten moment should be 50-60 Kg.m.

c. Assemble the spring ring for removal into hub groove.

d. Install the star safety sheet and spring safety ring.

e. Mount safety washer at propeller nipple, and lock it on the fixing nut with two split pins or a safety wire of $\phi 1.2$ mm.

f. Install the oil cylinder: Turn the propeller

blades to lower pitch, and install the oil cylinder. After the flange of the oil cylinder enter into hub recess, rotate the oil cylinder for 30 degrees in any direction, then mount stop keys of the oil cylinder and set screw, and lock it.

g. After the propeller has been installed, turn the propeller blade to the high pitch, check the runout at trailing edge of the propeller blade in 1000 mm distance from the propeller spindle center, which should not exceed 1.5 mm.

Note: 1) Before installing of propeller on the engine, must proceed with a static balanced test on a balanced stand.

2) In winter install a warm keeping housing of oil cylinder to avoid oil freeze.

3. Dismount the propeller from the engine

a. Remove the lock, tighten out the screw of stop key of oil cylinder, and take off the stop key.

b. Turn the oil cylinder for 30 degrees in any direction, remove the oil cylinder.

c. Take out the spring lock ring and the star safety sheet.

d. Remove the lock washer of the propeller shaft nipple and the split pin of set screw, take out a lock washer.

e. Loosen the fixing nut, until the hub leaves from the rear cone, and remove the propeller. Must be given attention with the thread of the propeller shaft and its nipple, which should not be wounded.

f. Remove propeller and the parts of oil cylinder

should be conserved and packed according to the specification.

Section II. Replacement of cylinder

1. Dismounting of cylinder

a. Remove a section of master exhaust collector which obstructs dismounting of cylinder.

b. Remove the intake pipe. Plug the fitting holes of the intake pipe on the casing.

c. Remove the deflector of cylinder, spark plug and fixing nuts of compressed air tube.

d. Loosen nut of push rod jacket.

e. Turn the propeller to make the piston to TDC position.

f. Unscrew the fixing nuts of cylinder and tab washer.

g. Remove the cylinder, in that time should retain piston and connecting rod.

Caution:

1) When remove the fifth or sixth cylinder first must remove the oil sump.

2) When remove the lower cylinder, it must be careful, don't fall down the push rod, tappet head, and tappet spring.

3) Prohibit to rotate the propeller, after removing the fourth cylinder or else master connecting rod will incline from the vertical position to make piston rings of the ninth cylinder and other cylinder to leave from cylinder skirt.

2. Installation of cylinder

a. Coat clean oil on piston and cylinder interior,

set each piston ring notch in cross position (Fig. 14)

Set a rubber seal ring painted with yellow sealing compound and a piece of paper gasket on the cylinder skirt.

b. At the first clamp the piston ring with piston ring clamping strip, install cylinder next.

c. If the fourth cylinder was removed, must install the fourth cylinder in the first place.

d. Set up the tab washer (install the tab washer together with a small screw). Uniform tighten fixing nuts as diagonal order and lock it.

e. Tighten the nuts of push rod jacket and lock it.

f. Install the compressed air tube and fix it.

g. During mounting of the intake pipe, first tighten the sealing nuts on the intake pipe of case (carefully don't press the sealing ring into the case), then tighten the nuts at connection between the intake pipe and cylinder head, at last tighten the sealing nuts.

h. Installation of deflector.

Mount separator fixed deflector between the seventh and the eighth flap of cylinder (as counted to top from fitting flange of cylinder). If the bolt is not aligned with the center line of hole, must change the positions about deflector separator within the range of the seventh to eleventh flap, but make sure that the deflector separator should stand between the same flaps of adjacent cylinders.

i. Install the exhaust pipe and lock it.

j. Adjust the clearance between rocker pulley and air valve lever.

Section 12. Replacement of piston

1. Push out by hand or lightly knock piston pin with punch through the hole of rear plug, that makes the piston pin and front plug to be pressed out from the hole of piston pin (because the fit between the rear plug of the piston pin and the hole of piston pin is tight fit, therefore, don't take plug out during replacement of piston).

2. The weight of replaced piston (stamped on the top of piston) should be same with weight of the original piston as best, its difference is allowed to be not more than 5g.

3. Coat clean oil in pin hole of connecting rod and of piston, and on surface of piston pin and plug, afterwards install the piston (Note that the spherical end of piston pin plug should face out).

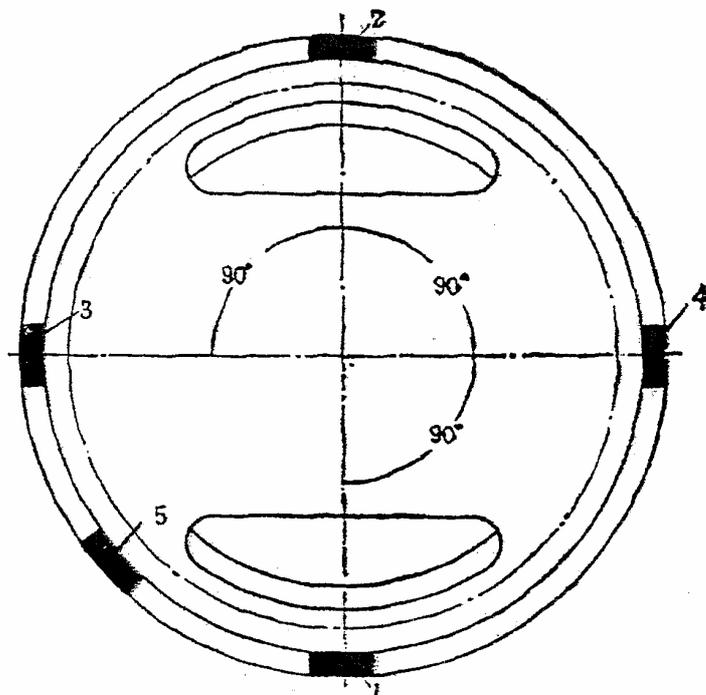


Fig. 14 Disposition of piston rings gap

4. Coat clean oil on side surface of piston, set each gap of piston ring in cross position (Fig. 14), then install cylinder.

Note: If there is a stamped augment mark on piston top i.e. a dimension augmented piston, it is only able to install the piston on a augmented cylinder.

Section 13. Replacement of piston ring

1. Wipe off the carbon deposit on the top surface of piston and at piston ring groove.

2. Remove the preservative grease from piston ring: remove sealing oil on surface of piston ring, and the surface should have not any dents and sand hole.

Piston ring	Positions of gap	Clearance of gap (mm)	Side clearance (mm)
The first groove	Against air intake valve	0.95-1.05	0.085-0.175
The second groove	The distance from the first groove is 180°.	0.95-1.05	0.085-0.175
The third groove	The distance from the second groove is 90°.	0.65-0.75	0.07-0.14
The fourth groove	The distance from the third groove is 180°.	0.65-0.75	0.07-0.14
The fifth groove	The distance from the fourth groove is 150°.	0.4-0.5	0.105-0.16

3. Installation of piston ring: in the first and the second piston ring groove, install trapezoid chrome plated air sealing piston ring: in the third groove, assemble two sloted oil wiping piston rings; in the fourth groove, mount a conic oil wiping piston ring, its conic crown (stamped a letter “上”) should face against top part (Fig. 15).

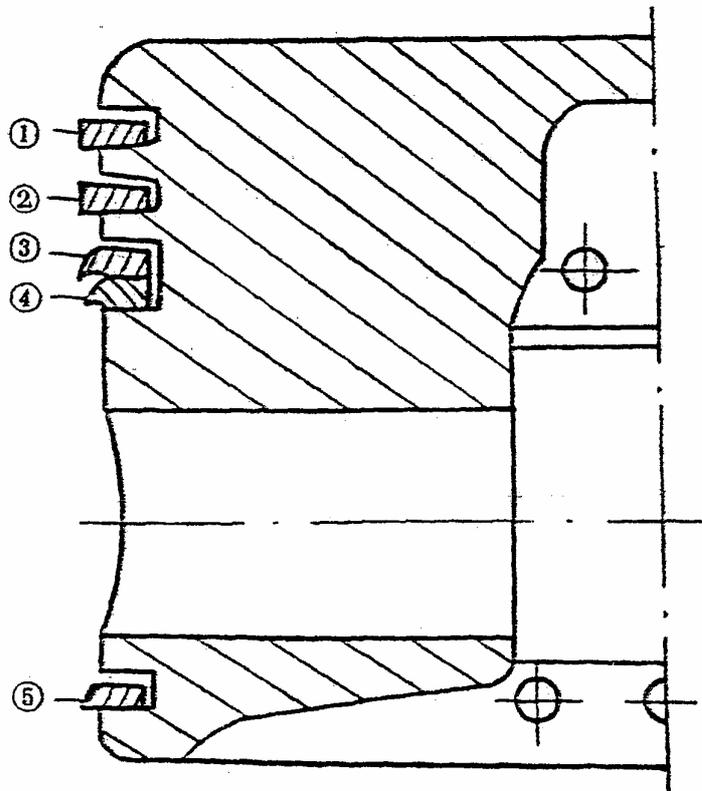


Fig. 15 Installation of piston rings

- 1,2, Chrome plated air sealing piston ring
- 3,4, Sloted oil wiping piston ring
- 5. Conic oil wiping ring

Note: When there is a stamped augment mark on side face of the ring, i.e. a dimension augmented ring,

it is only able to install the ring around an augmented piston.

Section 14. Running-in of engine after replacing the cylinder and piston assembly parts

1. Before starting of the engine, fill clean aviation oil of 40-50 g at 40-60°C temperature into the cylinder, in which the cylinder piston assembly parts have been renewed.

2. Start engine according to the second section of the second chapter.

3. The running-in of engine proceeds upon the following table:

Order number	Test content	Operations		Note
		Rotating speed (rpm)	Time (min.)	
1	start	700-900	3	1. During the running-in of engine, must set the propeller in lower pitch position. 2. During the running-in of engine, the temperature of cylinder head should not exceed 210°C, the inlet temperature of oil should be 50-65°C.
2	running-in	1000-1200	10	
	running-in	1400	10	
	running-in	1600	10	
3	stop	600-700		

4. After running-in of engine, check the fireproof-wall, oil pump, and oil filter in oil sump. When the oil filter is clean, proceed to complete test according to the second section of the second chapter for inspecting the engine's operation.

5. After test, check again the oil filter, and if it is clean, it is possible to continue to employ the engine.

6. When have replaced more than four sets of piston ring or more than four pistons and cylinders, the time of running-in of the engine should be increased twice.

Section 15. Replacement of oil sump

1. Wipe clean the mating surface between the oil sump and the case.

2. Set a flange gasket of the rear part of oil sump on fixed studs of oil sump.

3. Put the oil sump on the studs, set washers, uniformly tighten two rear fixing nuts.

4. Measure the clearance between the oil sump and the front section flange of the master case with feeler, clearance should be 1.15-1.85 mm. The clearance may be secured through to select the thickness of flange gasket of oil sump rear part (the gasket thickness may be 1.35-2.15 mm).

5. Measure the thickness of front gasket of the oil sump, its thickness should be more than that the clearance between oil sump and front section of master case within 0.2-0.3 mm.

6. Unscrew nuts, take off the washers, oil sump and rear flange gasket, then coat a yellow sealing compound on the selected front and rear flange gaskets, set it on case studs.

7. Mount the oil sump. Set four washers and four lock washers on fixing studs, uniformly tighten the four nuts.

CHAPTER VII

Probable troubles of the engine during starting and operation, causes for the troubles and remedy methods

Section I. Troubles at engine starting

1. Rotation of propeller by hand is difficult

Probable cause	Remedy
a. Remove antirust grease from engine incompletely.	Repeat degrease for engine.
b. Excessively heavier viscosity for oil (in winter).	Heat engine. Fill 2-3 lit. hot oil into case.
c. Accumulated oil or fuel in lower cylinders.	Unscrew front row spark plugs of the No. 4, 5, 6, 7, cylinder and oil draining plugs of the intake pipes of the No. 4, 5, 6, cylinders. Turn propeller through 3-4 revolutions. Drain out oil or fuel.
d. Excessively worn piston.	Replace the faulty piston.
e. Seizing of valve in guide.	Check valve, remedy the seizing.
f. Hydraulic impingement of engine makes bend of connecting rod.	Send it to factory for repair.

2. Without compression in the cylinder

Probable cause	Remedy
a. Close valve faultily.	Check the clearance between rocker pulley and valve stem crown, which should be 0.3-0.4 mm.
b. Fit of spark plug or starting valve is not complete.	Tighten the spark plug or the starting valve.
c. Piston ring is burnt, excessively worn or broken.	Remove the cylinder without compression. Replace defective parts.
d. Starting valve is damaged.	Replace the starting valve.

3. Engine fails in start

Probable cause	Remedy
a. Pressure in balloon too low.	Fill air into balloon for 40-50 kg/cm ² .
b. Leak in start system. Air pressure is lost.	Check start system for sealing. Remedy troubles.
c. Incorrect installation of distribution valve of the air start distributor.	Readjust the installation.
d. Worn working surface of air start distributor, air comes simultaneously into several cylinders.	Dismount the air start distributor, lap the working surface.
e. Incorrect installation of air tube.	Remount
f. Lack of fuel filled in engine.	Supplement to fill fuel through fuel injection system for engine.

Probable cause	Remedy
g. Too rich fuel filled in engine.	Make throttle at "Full open" position. Reversely rotate propeller 3-4 revolutions.
h. Clog in fuel injection system.	Check the fuel injection system. Remedy troubles.
i. Oil splashed or wet spark plug.	Unscrew spark plug. Wash it and dry it.
j. Lack of cylinder compression.	Dismount cylinder in order to check whether or not piston ring and piston is worn part, replace if necessary.
k. Starting coil is damaged. There is a short circuit in lead.	Check lead. Replace the starting coil.
l. Engine is overcooled (in winter).	Heat engine with heating equipment.
m. Charge of storage battery is not sufficient.	Replace storage battery.

4. The engine can start, but which after several popping will be stopped

Probable cause	Remedy
a. No fuel in the carburetor.	Unscrew the threaded plug of fuel chamber, check whether there is fuel in carburetor. Check whether fuel pump is well. Fuel inlet pipe should not leak fuel.

Probable cause	Remedy
b. Clog of air nozzle of carburetor.	Unscrew the air nozzle. Clean it and blow it dry.
c. Clog of strainer of carburetor.	Unscrew strainer and clean it.
d. There is water in fuel.	Drain out condensing water from fuel settler (depositing unit).
e. Clog of fuel pipe and strainer of fuel tank.	Blow fuel pipe throughly. clean strainer.
f. Incorrect installation angle of magneto.	Check and regulate installation angle.
g. Oil splashed contactor of magneto breaker.	Remove the oil and dirt on the contactor.
h. Outside the required clearance between contactor of magneto breaker.	Adjust clearance to 0.25-0.35 mm.
i. Incorrect connection on magneto distributor.	Check the wire for connection.

5. When start, the propeller turns reversely

Probable cause	Remedy
a. Improperly assembled air starting distributor.	Adjust air starting distributor.
b. Excessively big preignition angle.	Adjust preignition angle.
c. Incorrect connection of magneto.	Check distributor. Connect lead.

Section 2. Troubles at engine operation

1. There is interruption or vibration during engine operation

Probable cause	Remedy
a. Lead for ignition had damaged or incorrect connection with center electrode of spark plug.	Replace damaged wire. Check connection between the wire and the bent pipe of spark plug.
b. Incorrectly connected ignition wire.	Check and connect each lead correctly.
c. Defective or oil splashed spark plug.	Replace or clean spark plug.
d. Not close fit between valve and valve seat.	Check clearance between rocker pulley and air valve stem. Dismount cylinder if necessary, lap valve and valve seat.
e. Not close seal of air intake pipe.	Check sealing at flange of air intake pipe.
f. There is water in gasoline.	Drain off water from fuel settler.
g. Excessively lean or rich.	Adjust mixture ratio of mixture.
h. Too cold mixture	Heat
i. Freeze of carburetor throttle venturi tube or of copper bushing of fuel needle.	Check heating system of intake tube for work steadiness.
j. Rocker of carburetor high altitude governor stands in lean position.	Shift high altitude governor to "Full open" position.

Probable cause	Remedy
k. Clearance between contactors of magneto breaker don't meet specifications.	Adjust the clearance to 0.25-0.35 mm.
l. Loose set screw for magneto breaker or distribution brush.	Tighten the screw.
m. Lower fuel pressure or air clog	Regulate fuel pressure to 0.2-0.5 kg/cm ² . Remove fuel leak and air leak in fuel system.
n. Clog of fuel strainer and fuel pipe.	Check and clean complete fuel pipe and the fuel strainer.
o. Improper fix of engine on engine mount or in airplane.	Check fix of engine on engine mount and in airplane, and check damper.
p. Damaged balance of propeller or incorrect installation of propeller blade.	Balance propeller. Check installation and run out of propeller blade.

2. When pull to idle, engine will stop

Probable cause	Remedy
a. Improperly adjusted idle mixture.	Adjust mixture with the idle needle. Adjust main fuel needle if necessary.
b. Incorrectly regulated idle rotating speed.	Adjust opening of throttle by idle adjusting screw.
c. Air leak in intake system (Defective tighten of intake tube nut or without gasket at adapter).	Check tighten at each seal in air intake system, and check whether there is gasket.

3. Back fire of carburetor at idle rating

Probable cause	Remedy
a. Excessively opened throttle while starting (Particularly in cold weather).	Close throttle smaller.
b. Too lean mixture.	Make mixture to rich by idle needle.
c. Air leak in air intake system.	Check sealing at each connection in air intake system.
d. Excessive preignition angle of the magneto.	Decrease preignition angle.
e. Clog of carburetor strainer.	Check and clean carburetor strainer.
f. High altitude control lever of carburetor stands not in "Full open" position.	Regulate high altitude control lever to "Full open" position.
g. Lower fuel pressure	Adjust fuel pressure to 0.2-0.5 kg/cm ² .
h. Burnt or deformed valve.	Lap valve if it burns a little; replace it, if badly burnt.
i. Burnt or deformed valve seat.	Dismount defective cylinder, lap valve seat, if ineffective lapping in due to excessive damage, replace it.

4. Excessive rotating speed of idle

Probable cause	Remedy
a. Improper regulation of stop screw of idle rating of carburetor.	Adjust throttle open angle with idle stop screw.

Probable cause	Remedy
b. As incorrectly regulated length of control lever, it makes throttle to open excessively.	Adjust the length of the control lever.
c. Present gap in throttle controlling system of airplane.	Remedy the play.

5. Overheat of engine

Probable cause	Remedy
a. Improper circulation in oil system, too lower level of oil tank.	Check oil pressure, temperature, oil amount of oil tank and oil pump.
b. Clog of honey comb hole of oil radiator.	Clean and blow the honey comb hole throughout.
c. Oil freeze of oil radiator.	Heat the oil radiator.
d. Faulty oil return of engine (oil leak, clog and air clog in oil pump).	Check and clean all connections in returning pipe line. fill oil into oil pump, turn propeller to remove air in oil pipe line.
e. Too dirty oil.	Replace oil.
f. Too lean mixture.	Make the mixture rich.
g. Gas leaking into case.	Check cylinder compression. Replace worn piston ring.
h. Defective close of valve.	Check compression of each cylinder. If faulty compressoin is due to defective close of valve, should lap valve and valve seat or replace cylinders.

Probable cause	Remedy
i. Too big preignition angle.	Adjust preignition angle to $31^{\circ} \pm 1^{\circ}$ before TDC in compression stroke.
j. Air leak in air intake system.	Remedy air leak.
k. Damaged thermocouple or lead of it.	Replace defective parts.
l. Thermometer of cylinder head fell out.	Check or replace the meter.
m. Too long time at high pitch work of engine.	pull pitch change control lever to low pitch position.
n. Exhaust gas leaks, impinges on thermal electro-couple.	Remedy troubles. If gas will leak from a bushing of a spark plug, repair cylinders.
o. Exhaust gas leaks from main exhaust collector, impinges on cylinders.	Remedy gas leak.
p. No open of shutter	Open shutter.

6. Engine smoking

Probable cause	Remedy
a. Too rich mixture	Make mixture to lean.
b. Clog of fixed air nozzle.	Take off fixed air nozzle, clean and blow it.
c. Seizing, serious worn or broken the piston ring.	Check the compression of cylinder. Replace the trouble piston ring.
d. Burnt or worn piston.	Check cylinder compression, find out the trouble piston. Replace it if necessary.

Probable cause	Remedy
e. Excessively accumulated oil in case.	Check engine scavenge system and working condition of oil pump.

7. Too lower oil pressure

Probable cause	Remedy
a. Air clog of oil passage of oil pump. In winter oil is heavier. Clog of vent pipe of oil tank.	Remedy air clog. Heat the oil. Blow vent pipe of oil tank throughout.
b. Clogged strainer in oil passage from oil tank to engine.	Check oil passage, clean the oil strainer.
c. Seizing pressure regulating valve of oil pump, spring damaged.	Check pressure adjusted valve, replace defective parts.
d. Improper pressure regulating valve of oil pump.	Readjust the pressure regulating valve.
e. Excessively diluted oil.	Check dilution switch for oil leak, and replace oil.
f. Faulty oil pressure gage and its tube.	Check tube, replace pressure gage if necessary.
g. Too lower oil level of oil tank.	Fill oil sufficiently.
h. Oil bubble.	Clean oil system, replace oil.
i. Improper work of oil pump.	Unmount oil pump, remedy the trouble.
j. Oil overheat.	Check oil system.

8. The engine cannot reach to maximum rotating speed

Probable cause	Remedy
a. Excessive propeller pitch or improper adjusted governor.	Change propeller installation angle or adjust governor.
b. Improper connected tachometer or lead (The indicated rotation speed is not really).	Check connection of tachometer and its lead.
c. Overheat of engine.	Proceed analysis and remedy it according to the fifth item of this section.
d. Cloggy screen of carburetor.	Clean carburetor screen.
e. Not sufficient supplied fuel for carburetor.	Check fireproof switch. The switch should stand in full open position. Fuel screen should be clean.
f. Improper adjusted carburetor.	Check regulation of carburetor.
g. Too large or too small preignition angle of magneto.	Adjust installation angle of magneto.
h. Smaller clearance of magneto breaker. Burnt or dirty contactor.	Adjust contactor clearance and wipe clean contactor surface. If the surface is badly burnt, replace it.
i. Improper work of spark plug, oil splashed or wet.	Wipe spark plug clean. and then dry it, make a jump test, if it fails, replace it.
j. ignition system. failed	Check the spark plug, lead or magneto.
k. Air leak in air intake system.	Remedy air leak.
l. Not closely fitted valve. Clog or deformation.	Lap or replace the valve.

Probable cause	Remedy
m. Too large or too small valve clearance.	Adjust clearance to 0.3-0.4 mm.
n. Not full opened throttle or have presented gap in control system.	Remedy trouble in control system.

9. Propeller fails to obtain proper pitch

Probable cause	Remedy
a. Oil freeze in oil cylinder of propeller.	Unmount oil cylinder, drain frozen oil.
b. Improperly mounted propeller.	Check propeller assemble.
c. Incorrectly adjusted installation of governor.	Remount and adjust it.
d. Seizing oil distribution piston of governor, loose spring or it's break.	Check the oil distribution piston or replace governor.
e. Loose nipple of propeller shaft.	Tighten it with torque of 8-10 kg·m.

10. Dropping of rotating speed for single magneto exceeds tolerance

Probable cause	Remedy
a. Incorrect contactor clearance of magneto breaker. Dirt on contactor.	Adjust clearance to 0.25-0.35 mm. Wipe contactor clean.

Probable cause	Remedy
b. Incorrect preignition angle of magneto.	Check preignition angle. Adjust preignition angle according to upper limit if necessary.
c. Crack of magneto distribution brush.	Replace distribution brush.
d. Fuel lean	Regulate fuel consumption.
e. Improper work of spark plug, incorrect clearance of electrode wet, oil splashed, or accumulated carbon.	Adjust clearance between the spark plug and the electrode. Clean and dry the spark plug.
f. Air leak in air intake system.	Remedy air leak.

II. Compressor fails to make air pressure of board balloon

Probable cause	Remedy
a. Not closely for air tube connected in air system.	Tighten the nuts, replace the defective gasket. or washer.
b. Not close nipple of pressure valve.	Replace the gasket.
c. Not close of intake valve, piston valve and pressure valve.	Disassemble compressor. Check and clean valve. Lap it and make a close test if necessary.
d. elasticity of piston valve is lost.	Replace the spring.
e. Burnt piston or seizing and break of piston ring.	Clean the carbon deposit. Replace trouble parts.

12. When engine operates at high rotating speed, which will be "surge"

Probable cause	Remedy
a. small installation angle of magneto or improper pre-ignition unit of magneto.	<ol style="list-style-type: none"> 1. Check and adjust the preignition angle of magneto, it should be 31°. 2. Check the automatic advanced unit of magneto for flexibility. When turn distribution brush by hand, it may be spring back flexibly.
b. Due to storage or long periodic idle operation, accumulated oil in interior of piston of lower cylinder (the No. 5 and No. 6 cylinder), and on spark plug.	<ol style="list-style-type: none"> 1. Unmount the spark plug of the 4,5,6, cylinder and clean it, for long periodic storage engine. 2. Pay attention to burn out spark plug before take-off.

13. When engine turns for accelerating, which will be "short of breath"

Probable cause	Remedy
a. Lean at idle condition of the engine.	Regulate mixture of carburetor. Don't employ excessive lean at idle condition.
b. Lower temperature of cylinder head.	Should heat cylinder head to more than 140°C, before take off.
c. Lower temperature of air intake.	Air intake heating unit should be close, control should be flexible. Before take-off, maintaining the intake temperature is higher than 15°C.

Probable cause	Remedy
d. Too quick pushed throttle at accelerating.	Check the throttle control for flexibility. Idle stroke should not be excessive. Open throttle not too quickly at take-off, specially at less than 1400 rpm, it should be slow.

14. Hydraulic impingement

Probable cause	Remedy
a. While long periodic storage, oil flows into lower cylinder from clearance between the piston and cylinder wall.	Unscrew drain plug of the No. 4, 5, 6, cylinder air intake pipe, positively turn propeller, drain out accumulated oil, if more than two days of engine unwork or failure of trinal started engine.
b. Excessively high engine temperature at last engine stop or excessively long warming time in winter by heating furnace, oil becomes lighter, oil flows from case into cylinder combustion chamber.	While employ in summer, pay attention to the temperature of cylinder head at engine stop seriously, it is prohibited to exceed 165°C. While heating of engine in winter warming time should not be too long, outlet temperature of heating furnace should not exceed 180°C.
c. While apply oil dilution in winter, due to not mounting of restrict bowl in fuel line, make oil diluted too thin, the thin oil flows into lower cylinders.	As employ in winter, pay attention to check whether restrict bowl of fuel has been mounted in oil dilution line.

Probable cause	Remedy
d. Due to not complete degreasing of new mounted engine, preservative oil in cylinder has been not totally removed.	Before using the engine, make disgreasing according to specification. The sealing oil in upper cylinder must be drawn off by oil gun. Before start engine, unscrew oil draining plug of air intake pipe and front row spark plug of the 4,5,6, cylinder, positively turn propeller, drain accumulated oil.
e. While start engine, fill oil too much.	Before each starting of engine, turn propeller and fill oil according to specifications. If feel to turn propeller very heavy, unscrew air intake pipe drain plug and front row spark plug of the 4,5,6 cylinder, drain accumulated fuel and oil, pay attention to prohibit to reversely turn propeller for draining oil.
f. At application in summer due to clog leading from fuel tank to atmosphere hole and no lock of filling pump, make fuel vapor to flow into air intake pipe or cylinder through filling pump.	At application in summer, keep complete pass of hole that from fuel tank to atmosphere. After application of filling pump, lock handle.

15. Metal chips

Probable cause	Remedy
<p>Aluminum chips:</p> <p>a. Worn groove of piston ring, principally due to have much dust at air intake or due to excessive filled fuel at start, make dry friction.</p>	<p>Aluminum chips are piece form, its amount is more, it is easy discovered. While remedy it, clean oil system, replace trouble piston.</p>
<p>b. Worn rear cloggy block of piston and its cloggy hole, principally due to improper clamp of rear cloggy block or counter directional assemble.</p>	<p>Aluminum chips are thinner and shown starry, its amount is not too much, as the wear has reached to a certain degree, don't continue to develop. While remedy it, replace cloggy block. When install new cloggy block, pay attention that spherical end face should stand against cylinder wall.</p>
<p>c. Worn piston skirt, principally due to defective "running-in" while early application of new piston, and due to lack of oil for lubrication on skirt.</p>	<p>Aluminum chips show powder, excessively thin, as serious, the oil drained from oil sump shows grey-blue. As remedy it, replace it if the piston is badly worn, and proceed oil filling and "running-in" according to specification.</p>
<p>Copper chips:</p> <p>a. Worn bushing of cam disk.</p>	<p>As the bushing of cam disk is worn, there are many copper chips in oil sump, it shows piece form, and is rather big. Sometime, tin is separated from bronze, present small tin balls in oil sump. If the bushing of cam disk is badly worn, replace engine or send it to factory at once.</p>

Probable cause	Remedy
b. Worn guide sleeve of intake and exhaust valve.	After worn, there is more amount of copper chips in rocker chamber of that cylinder. In that case, replace the cylinder.
c. Worn bush of planetary gear.	Generally copper chips are very thin. Dismount case head and check. By the pin of planet gear collect many metal chips. After the bush is worn, generally send it to factory and replace it.
Steel chips: a. Steel chips retained in engine.	Size of metal chips is not same. If carefully observe, sometime detect cutting track of surface machine work, it is one piece or several pieces without other metal chips. After replacing oil, reduce or remove above appearance.
b. Bearing chipped off.	Very thin white steel of large quantity pieces defected in oil sump, it shows circle and has magnet. In that case, check it, replace chipped bearings.
c. Broken and worn piston ring.	The appearance: little amount of steel chips with magnet mixed in large quantity aluminum pieces. In that case, unassemble cylinder, replace defective piston ring.

Probable cause	Remedy
d. Other worn parts, for example broken gear, hydraulic impingement and so forth.	Steel chips seen in oil sump. According to form and size of steel chips and so on, and then determine the defective parts.

CHAPTER VIII

Conservation and its removal for engine

Section 1. Preservative oil

Name of oil material	Applications
Antirust grease No. 1.	For interior conservation of engine.
Antirust grease No. 217.	For interior or exterior conservation of engine.
Aviation oil (HH-20).	For short periodic conservation of engine interior, and long periodic conservation of interior of accessories.
Industrial vaseline.	For external conservation of engine.

Note:

1) All the oil material for conservation and its removal should meet regulations through chemical assaying.

2) Heat industrial vaseline and oil to 105-120°C, in order to proceed complete dewater, and then may be applied.

3) Using antirust grease No. 1 only after agitate it uniformly.

Section 2. Storage of engine installed on airplane

Engine installed on the airplane, that need to be

preserved more than seven days, according to period of preserving time and according to properly conserving method given and selected in this section, proceed conserving.

Caution:

1) In the rainy or snowy days prohibit to conserve and to remove antirust grease in the open.

2) Enter the conserving (or removal) date and period of engine, and its rusty condition in engine log book.

1. Conserving for 15 days.

a. Start and heat the engine. Run the engine at 1200-1400 rpm for 10-15 minutes. Stop the engine, cool the engine until the cylinder temperature is 30-70°C.

b. Unscrew the front row spark plugs, and make throttle in "Full open" position. Revolve propeller for 6-8 rev. in order to exhaust waste gas from cylinder.

c. Disassemble outlet duct connector of air compressor and then inject oil at 40-60°C temperature at intake valve. While filling oil, should turn propeller until oil flows from the pressure valve of the compressor.

d. As piston stands at BDC fill 100-150 g oil heated to 40-60°C through spark plug hole into each cylinder by oil gun, While filling oil, coat oil on exhaust valve seat, exhaust valve stem and mushroom, and then turn propeller for 2-3 rev. Having filled oil, set spark plug and outlet duct connector of compressor in original position.

e. Clog exhaust opening and case vent pipe with plug cover.

f. Wipe off dirt and dust from engine.

Note:

After 15 days conserving period of engine, if need continue to conserve for storage, conserve the engine again in accordance with the above requirements, but the conservation should not be more than twice.

2. Removal of antirust grease after 15 days conserving period.

Unmount the front row spark plug of cylinder No. 4, 5, 6, and oil draining threaded plug of the intake pipe, revolve propeller, drain off accumulated oil, and take off cloggy cover of exhaust opening and of case vent pipe.

3. Conservation for 30 days.

a. Drain off oil from oil tank radiator and oil sump, and then fill enough fresh oil into oil tank.

b. Finish the first-third item in conserving for 15 days of engine.

c. As piston stands at BDC inject 100-150 g oil heated 40-60°C through spark plug hole into each cylinder by oil gun, and then turn propeller for 2-3 rev.

d. Set the propeller at level position, repeated fill 100-150 g oil heated 40-60°C into each cylinder. After oil filling, set spark plug and outlet duct connector of compressor in original position.

e. Finish the 5th-6th item in conserving for 15 days of engine.

Note:

After 30 days period of conserving of engine, if need continue to preserve engine, at first, it is need to remove antirust grease from the engine in accordance with regulations, and after this conserve engine again according to above requirements, but the number of

reconservation should not exceed once.

4. Removal of antirust grease after 30 days conserving period.

a. Disassemble front row spark plug and oil draining threaded plug of intake pipe of cylinder No. 4, 5, 6, turn propeller in order to drain accumulated oil, and draw off oil from cylinder No. 1, 2,, 3, 7, 8, 9, by oil gun.

b. Inject 1.3-1.5 liter of fresh oil heated to 40-60°C into front and rear vent pipe of case respectively.

5. Conservation for 6 months

Caution:

If the conserving oil for engine interior is antirust grease, during conserving want to heat antirust grease No. 1 to 15-30°C, and to heat antirust grease No. 217 to 35-50°C. For the conserving of accessory interior, employ new dewatered aviation oil, during conserving must heat oil to 60-80°C.

a. Drain oil from oil tank, radiator and oil sump, and then fill enough oil into oil tank.

b. Start engine, run engine for 15-30 minutes at 1200-1400 rpm, until inlet temperature of oil is not less than 30°C, as oil return temperature is not less than 40°C, stop engine.

c. Unscrew front row spark plugs, set throttle in "Full open" position, turn propeller for 6-8 rev. in order to drain off the waste gas from the cylinder.

d. Drain oil from the case, and then inject antirust grease through front and rear vent pipe, until those are full, After have injected, turn propeller for 6-8 rev., after 20 minutes, drain off the oil completely.

e. Inject 200-300 g of antirust grease into each

cylinder respectively (While filling, piston should stand at BDC), and then turn propeller for 3-5 rev.

f. Disassemble the connector of the compressor outlet duct. fill oil through the inlet valve, simultaneously turn propeller until at pressure valve oil flows out. Then mount connector of outlet duct in original position.

g. Conserve the fuel pump: inject oil through inlet of the fuel pump, simultaneously turn the propeller until oil flows out from the outlet of the fuel pump.

h. Conserve the air starting distributor: unscrew flexible hose from union connector of air starting distributor, inject 15-20g oil through union connector by oil gun, simultaneously turn propeller for 2-3 rev..

i. Conserve carburetor

(1) Drain off deposit from the fuel chamber.

(2) Unscrew the upper oil draining threaded plug, set throttle in "Full open". Inject oil, with the pressure of not more than 0.5 kg/cm^2 , into inlet opening of the carburetor. While fill oil, open fuel valve by air stream, which comes from the air speed pipe and is not more than 0.5 kg/cm^2 . As oil flows out from the hole of upper oil draining threaded plug, install threaded plug and continue to fill oil, until oil flows out from main oil needle. Then move throttle for 2-3 times.

(3) Unscrew the lower oil draining threaded plug, drain oil from the fuel chamber, then remount the threaded plug.

(4) Paint a layer of antirust grease No. 217 or of industrial vaseline on exterior of carburetor.

j. Set propeller at level position, again fill 100-150g of antirust grease into each cylinder, after that prohibit

to turn propeller.

k. Unscrew propeller, clean propeller shaft and propeller hub spline, and wipe off rust on it, coat a layer of antirust grease No. 217 or industrial vaseline on propeller shaft and propeller hub spline, then install propeller. If preserve propeller individually, pack propeller shaft with wax paper.

1. Engine external conservation.

(1) Inspect external surface of engine. If the paint layer is chipped off, paint it again.

(2) Wipe off dirt and dust on external surface of engine, on the metal parts surface without protective layer paint a layer of antirust grease No. 217 or industrial vaseline.

m. Clog opening of exhaust pipe and vent pipe of case.

n. When engine is sent to factory for repair or individual storage, before pack it should be treated as follows:

(1) Dismount generator, pack it and set it in a special wooden box.

(2) Pack head part of propeller shaft, fuel pump and carburetor with wax paper and fasten it with thin line.

(3) Pack complete engine with wax paper, and fasten it with thin line.

6. Removal of antirust grease after 6 months period.

a. Unscrew the oil strainer of oil sump, spark plugs and oil draining threaded plug of intake pipe of cylinder No. 4, 5, 6. Turn propeller in order to drain

accumulated sealing oil, draw off oil from cylinder No. 1, 2, 3, 7, 8, 9, by oil gun, and then mount oil strainer of oil sump.

b. Inject 7-8 liters oil heated 80-100°C into case through front and rear vent pipe of case, and turn propeller for 6-8 rev., After 10 minutes, drain oil from case, and clean oil strainer of oil sump.

c. As piston stands at BDC, inject 150-200g oil heated 80-100°C through hole of spark plug into each cylinder by oil gun. Then turn propeller for 6-8 rev.

d. Draw off oil from cylinder No. 1, 2, 3, 7, 8, by oil gun, and then assemble spark plugs.

e. Removal of antirust grease for fuel pump: while revolve hand pump turn propeller shaft, wipe off oil from pump.

f. Removal of antirust grease for carburetor:

(1) Dismount and clean fuel strainer and air screen of carburetor.

(2) Disassemble upper draining threaded plug in fuel chamber. Then revolve wobble pump, and air stream with not more than 0.5 kg/cm² pressure induced from air speed pipe, make gasoline to flow in fuel chamber in order to wash out sealing oil from fuel chamber, until fresh gasoline flows out from upper oil draining threaded plug hole of fuel chamber, then install upper fuel draining threaded plug. Continue to rotate wobble pump and move throttle in order to clean fuel needle and sprayer

(3) Unscrew the lower draining threaded plug, drain gasoline from the fuel chamber.

g. Dismount the propeller, wipe off conservative oil. Then coat a layer of oil on the propeller shaft, the hub spline and on the rear cone, install the propeller. If preserve propeller individually, unpack fastened wax paper on propeller shaft, wipe off conserved oil, paint oil, and then install propeller.

h. Clean carbon deposit of spark plug and dry the all spark plugs.

Section 3. Removal of antirust grease for new engine in field

1. During removing the antirust grease from engine and accessories, the temperature should not be lower than 10°C.

2. The work for removing grease from the accessories proceeds in accordance with procedure about removal work after 6 months conserving period.

CHAPTER IX

Replacement of engine

Section I. Removal of engine from the airplane

1. Unscrew the propeller, union connector and adapter plug in propeller shaft, then install engine suspension collar.

2. Disconnect the control lever of air flap, remove air flap.

3. Take down the exhaust pipe and induction duct of carburetor.

4. Take down the control lever connected with carburetor and governor.

5. Disconnect fuel and oil tubes connected with engine.

6. Take down the tubes connected with air compressor and air starting distributor.

7. Disconnect the cable connected with magneto.

8. Disconnect the vent duct of the generator and its lead duct of measuring induction pressure, vent duct of rear vent pipe, flexible axle of tachometer, and high tension lead.

9. Unscrew spark plugs.

10. Place the suspender according to Fig. 16, suspend the engine by grab hook, the suspending capacity of which should be not less than 500kg, then take off the

bolts for connecting engine mount and fuselage, suspend engine to the ground.

11. Take off the diagonal struts, mount supporting rod for transporting engine, and then fix the engine on the bottom frame of engine box.

Note:

1) During removing of all ducts in order to avoid that dirt to drop into engine, it is necessary to mount cloggy plug or cloggy cover.

2) The engine sent to factory should be oil conserved for 6 months in accordance with regulations about conservation specified at chapter VIII.

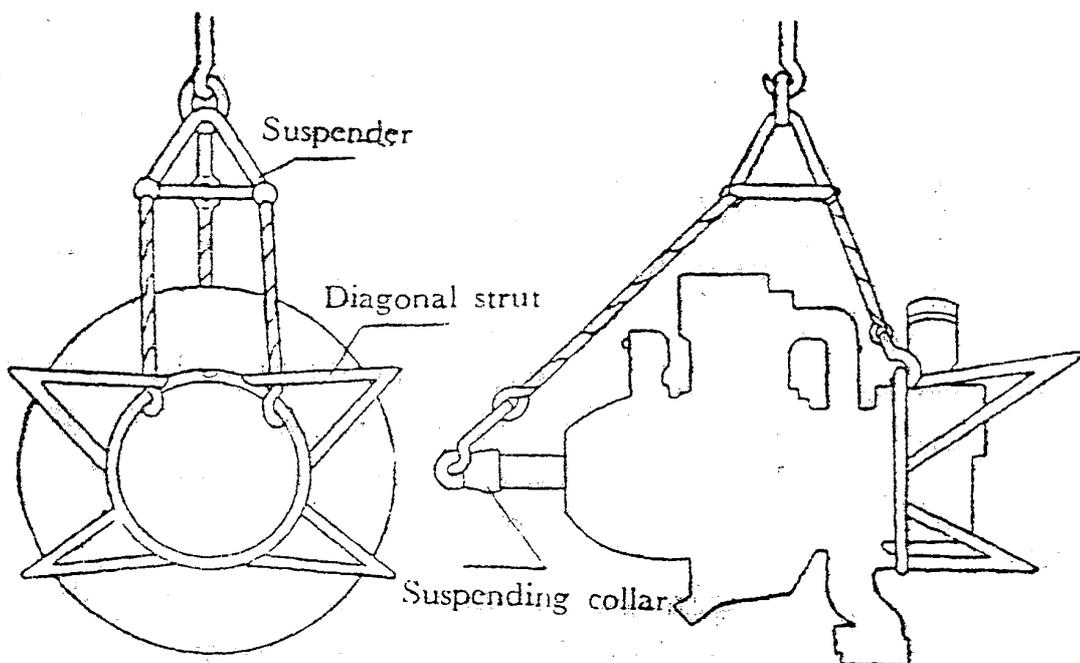


Fig. 16 Suspending position

Section 2. Installation of engine on airplane

1. Unpacking.

In packing box, except engine, there are addi-

tionally the following parts:

- a. Wooden box containing generator and spark plug.
- b. Box containing a set of spare parts.
- c. An engine log book and other documents.

Procedure of opening engine packing as follows:

- a. Inspect packing box and its stamp for good condition.
- b. Remove the stamp, take off the bolts for connecting box cover and frame, carefully suspend up box cover.
- c. Take off the wax paper from engine, check and count the engine, accessories, board tool, and spare parts. If there is defect or insufficiency in quantity, note case clearly and announce it to the factory.

2. Mount engine in airplane.

- a. Inspect engine log book, check serial numbers of engine and accessories.
- b. Set up the engine suspender according to Fig. 16, suspend the engine by a grab hook, then disassemble supporting rod for transporting engine, mount diagonal strut.
- c. Lift the engine and mount it on the airplane.
- d. Connect the duct for joining air compressor and starting distributor.
- e. Join the duct in gasoline and oil system.
- f. Connect the switch line of magneto and starting lead of left magneto.
- g. Connect the vent duct of rear vent pipe and the duct of measuring intake pressure.

h. Mount the vent pipe of generator, and connect the lead.

i. Assemble and adjust control lever for throttle, altitude and pitch change.

j. Coat lubricating grease No. 7007 on transmission mechanism of tachometer, and connect flexible axle.

k. Mount the spark plugs, and assemble thermocouple under rear row spark plug of cylinders No. 1, 4.

l. Connect the bent pipes of spark plug to each spark plug.

m. Mount the intake duct of carburetor, and connect the control lever for heating throttle.

n. Coat high temperature lubricating grease No. 4, on thread of nut for exhaust manifold, mount the exhaust manifold and fix it.

o. Assemble flaps and its control lever, and check open range of flap.

p. Mount adapter plug, union connector of propeller shaft, torque for tightening connector is 8-10 kg. m.

q. Fill gasoline, oil in airplane for starting.

CHAPTER X

Engine tools

1. Description:

Engine tools are provided in three forms:

a. Board tools are provided by 1:1, which is prepared for postflight checking and daily maintenance.

b. Special tools are provided by 1:4, which are prepared for remedy engine troubles.

c. Tools for periodic inspection are provided according to the air base. Which are prepared for remedy engine troubles and periodic inspection.

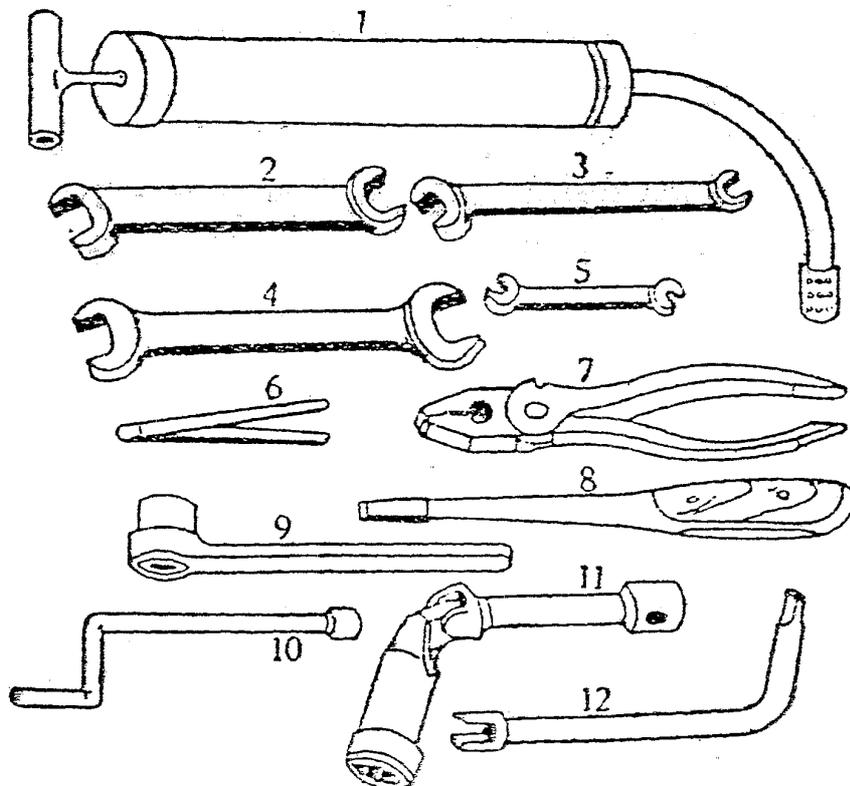


Fig. 17 Engine board tools

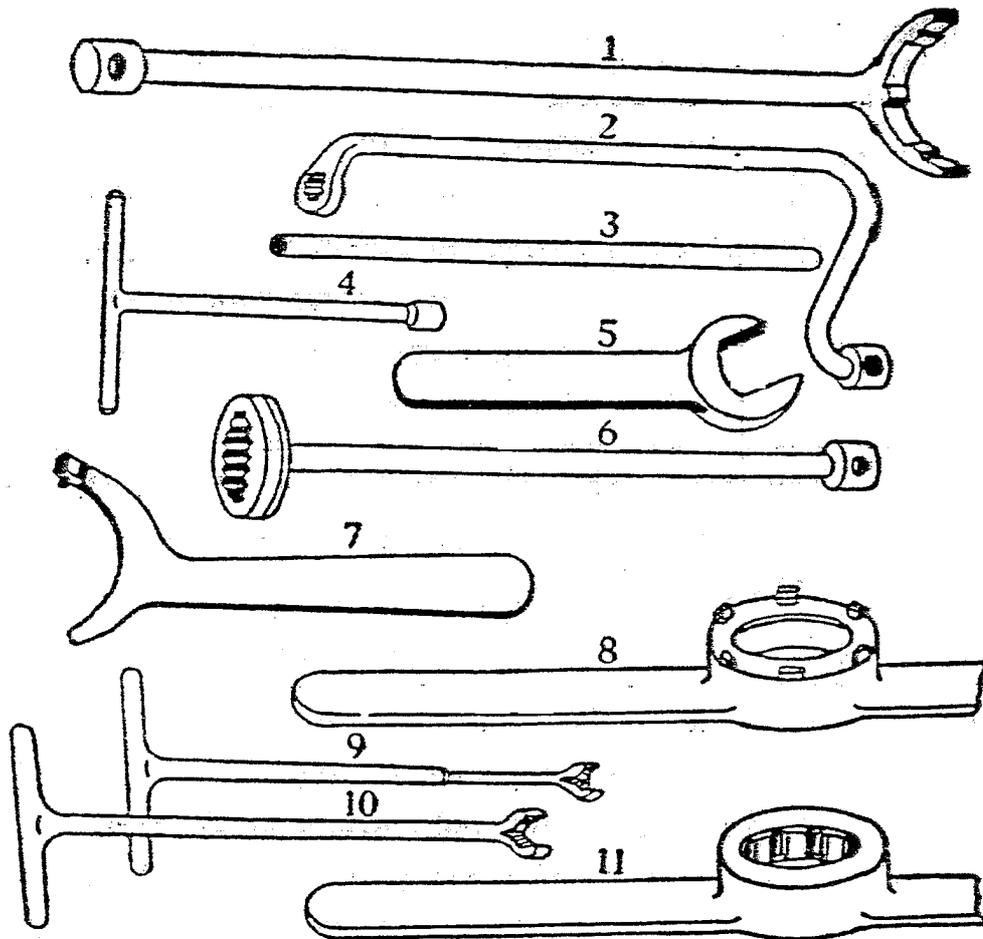


Fig. 18 Special tools of engine

2. Board tools (Fig. 17)

Order number	Number of tool	Name of tool	Purpose
1	H6. G. 819	Oil gun	For conservation of engine and its removing.
2	H6. G. 001	Flat nose spanner (17×19mm.)	Screw and unscrew of following parts: nut of pressure regulating valve and its cover of oil pump, strainer of oil line of governor. pipe adapter nut of pressure valve of air compressor, and connecting nut of fuel injecting pipe, tighten bent pipe and flexible pipe of ignition lead, nut of induction pipe of air starting distributor and nut of inlet and outlet flexible pipe of gasoline pump

Order number	Number of tool	Name of tool	Purpose
3	H6. G. 002	Flat nose spanner (11×14mm.)	Employ for oil draining threaded plug of lower inlet pipe, and for fixing nuts of governor, oil pump, oil sump, compressor, vacuum pump, gasoline pump and carburetor.
4	H6. G. 003	Flat nose spanner (19×22mm.)	Employ for nut of inlet pipe of carburetor, cover nut of scavenge oil pipe of oil pump and nut of oil pressure pipe nipple.
5	H6. G. 004	Flat nose spanner (7×9mm.)	Fix nut of air starting distributor, transmission box of governor, clamp of starting guide, vent pipe of supercharger and speed reducer and guide sleeve of tappet
6	H6. G. 801	filler	Check gap between valve stem and rocker pulley
7	H6. G. 826	plier.	Lock a bolt and a nut, put a split pin
8	H6. G. 827	Screw driver	Adjust pressure regulating valve of oil pump, tightening push stem sleeve, injecting pipe, magneto cover, ignition cable and clamp of starting guide
9	H6. G. 802	Spanner for lock nut of rocker adjustable screw	Secure the adjustable screw of valve rocker

Order number	Number of tool	Name of tool	Purpose
10	H6. G. 803	Box spanner (11mm)	Screw and unscrew fix nuts of inlet pipe, injecting pipe, and oil collector
11	H6. G. 804	Spanner of spark plug. (22mm)	Assemble and disassemble of spark plug
12	H6. G. 805	Spanner of adjustable screw of valve rocker	Regulate clearance between valve stem and rocker pulley, assemble and disassemble rocker chamber cover

3. Special tools (Fig. 18)

Order number	Number of tool	Name of tool	Purpose
1	H6. G. 806	Spanner of nut of inlet pipe	Screwing and unscrewing of inlet pipe.
2	H6. G. 808	Spanner of fix nut of cylinder (14mm)	For fixing cylinder
3	H 6. G. 005	Spanner stem (12×350mm)	Employ it together with spanner of inlet pipe nut and of cylinder nut
4	H6. G. 809	Box spanner (7mm)	Fix starting air tube screw
5	H6. G. 006	Short spanner for fixing cylinder nut. (14mm.)	Mount and unmount fix nut of cylinder and magneto

Order number	Number of tool	Name of tool	Purpose
6	H6. G. 810	Spline box spanner (36mm)	Assemble and disassemble strainers of oil sump and inlet oil.
7	H6. G. 811	Spanner of inlet and outlet air pipe nut	Mount and dismount inlet and outlet air pipe
8	H6. G. 812	Spanner of thrust bearing nut	Tighten nut of thrust bearing for propeller shaft
9	H6. G. 813	End spanner (11mm)	Fix air deflector, disassemble compressor
10	H6. G. 814	End spanner (14 mm)	Fix adapter seat of carburetor, vacuum pump, magneto and carburetor
11	H6. G. 815	Spanner of propeller shaft sleeve groove	Fix propeller shaft

4. Tools for periodic inspection which contains board tools, special tools and the following several special tools (Fig. 19)

Order number	Number of tool	Name of tool	Purpose
1	H6. G. 007	Clamping strip of piston ring	As install a cylinder, clamp rings
2	H6. G. 817	TDC indicator	Mount magneto and air starting distributor.

Order number	Number of tool	Name of tool	Purpose
3	H6. G. 008	Flat opening spanner (36×41mm.)	Fix cable nut
4	H6. G. 816	Fixture for fixing air starting distributor	Mount air starting distributor
5	H6. G. 009	Piston pin punch	Disassemble piston (while piston pin plug has tightness)
6	H6. G. 824	Timer (containing pointer unit and scale)	Assemble magneto and air starting distributor

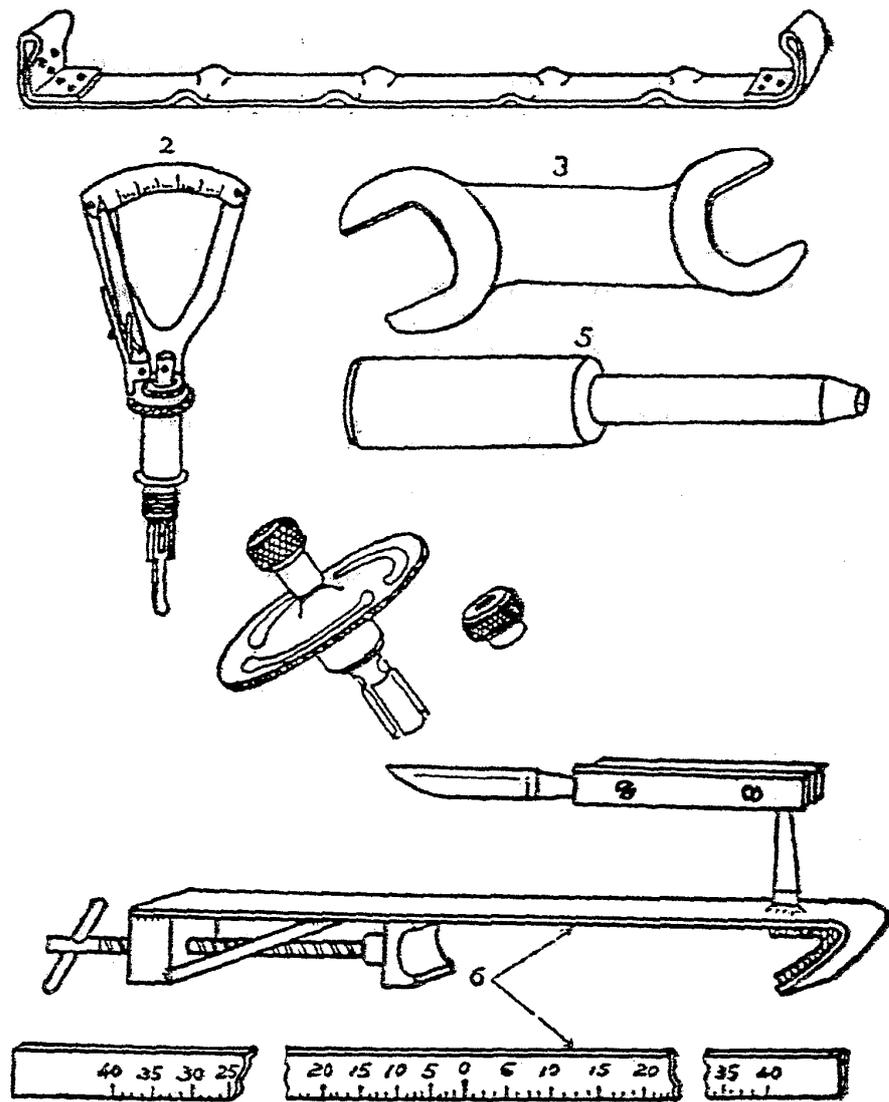


Fig. 19 Tools for periodic inspection

牡丹号：

8893

其余：

2666