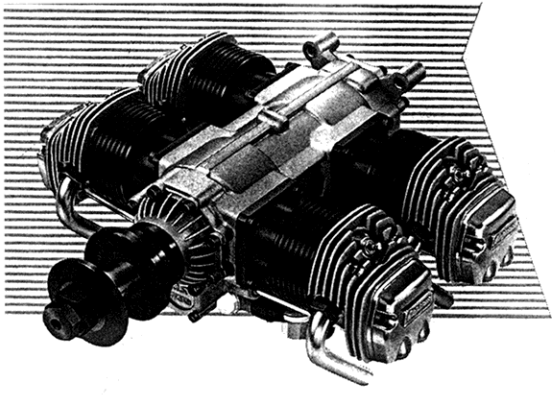
O.S.

FF-320 〈Pegasus 320〉

FOUR STROKE CYCLE ENGINE

OWNER'S
INSTRUCTION MANUAL



O.S. ENGINES MFG.CO.,LTD.

IMPORTANT: Before attempting to operate your engine, please read through this instruction booklet so as to familiarize yourself with the controls and other features of the engine. Also, pay careful attention to the recommendations contained in the "Safety Instructions and Warnings" leaflet enclosed.

Closely following the design of a typical full-size light aircraft engine, the O.S. FF-320 (PEGASUS 320) is a horizontally-opposed four-cylinder overhead-valve four-stroke engine of 53.04 cc (3.24 cu.in) total displacement. It was designed to meet the requirements of those whose interests lie in the field of large radio-controlled aircraft and who demand the high standards of refinement and realism that are not found in single-cylinder two-stroke engines based on chainsaw and other light commercial power-units. Production of the FF-320 was preceded by an exhaustive programme of research, development and prototype testing.

The FF-320 has earned high praise from leading engine experts for its all-round excellence of design, construction and performance, including its outstandingly smooth running qualities, ease of operation and exceptional throttle response.

TOOLS AND ACCESSORIES

The following tools and accessories are supplied with your FF-320.

1. Radial Motor Mount Set
   - Radial Motor Mount (fitted to the engine). . 1
   - Engine Fixing Screws (fitted to the engine) . 4
   - Mount Fixing Screws (M5 x 25) 4
   - Lock Washers (ø5) 4
   - Blind Nuts (M5) 4
   - Hexagonal (Allen) key (4.0 mm) 1
2. Set of leads for wiring glow plugs
   - Leads for glow plug with snap-on connectors 4
   - Lead for earth (ground) 1
3. Valve Adjusting Tool Kit (in plastic case)
   - Feeler gauge 0.04 mm 1
   - Feeler gauge 0.10 mm 1
   - Hexagonal (Allen) Key (1.5 mm) 1
   - Special Offset Wrench (5 mm) 1
4. Needle-valve extension cable
   - Extension cable 1
   - Knob for needle-valve extension 1
   - Hook for needle-valve extension 1
5. Choke valve rod 1
6. Woodruff key (spare) 1
7. Hexagonal (Allen) key (2.0 mm) 1
   - Hexagonal (Allen) key (2.5 mm) 1
   - Hexagonal (Allen) key (3.0 mm) 1
8. Wrench (5 – 5.5 mm) 1
   - Wrench (5 – 6 mm) 1
   - Wrench (7 – 8 mm) 1
   - Wrench (10 – 12 mm) 1
   - Wrench (14 – 17 mm) 1
9. Screwdriver for mixture control adjustment 1
10. Drain plug 1
11. Propeller Washer Set for Scale Model . . 1

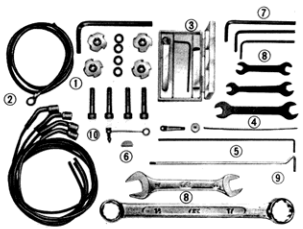


Photo 1

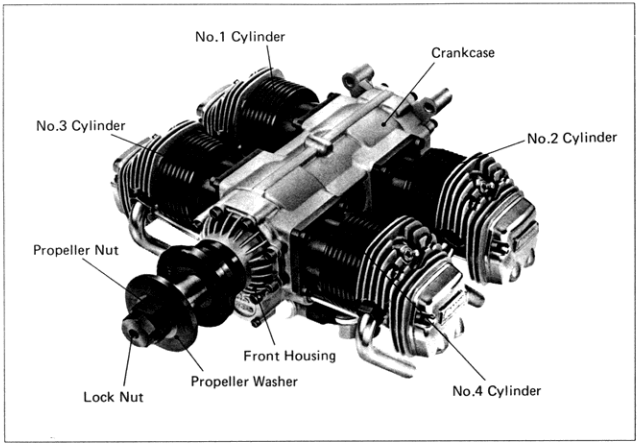


Photo 2

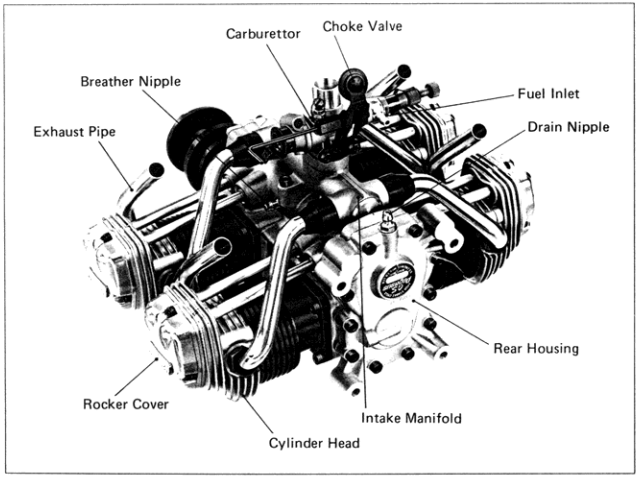


Photo 3

INSTALLATION

- The FF-320 is equipped with a strong cast aluminum radial-type mount to enable it to be bolted securely to the firewall (front bulkhead) of the aircraft.
- It is essential that the firewall is strong and rigid (e.g. at least 15 mm thick) and firmly integrated with the structure of the aircraft.
- In the interests of scale appearance, the engine should be installed with the carburettor below the crankcase so that the exhaust pipes point downwards.

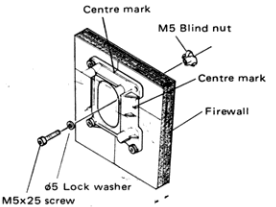


Fig. 1

Needle-valve extension

The needle-valve supplied with this engine is designed to incorporate an extension so that, when the engine is enclosed within the fuselage, the needle-valve may be adjusted from the outside. An L-shaped rod, of 1.6—1.8 mm dia. and appropriate length, should be inserted into the needle's centre hole and secured by tightening the set-screw in the needle-valve knob with the small Allen key provided. For longer extension, it is recommended to use the extension cable supplied with the engine, together with the knob and support hook also supplied.

Do not use an excessively long unsupported extension as this may vibrate and cause the needle-valve setting to vary or even damage the needle-valve thread. Always provide a suitable support at the outer end.

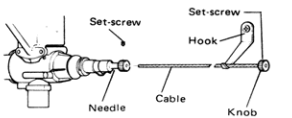


Fig. 2

Note: Do not reverse the carburettor in order to reverse the needle-valve location, otherwise the engine may not run properly.

Choke valve

The choke valve operating lever can be located right or left by reversing the hexagon nut and cap screw.

- Unscrew the cap screw while holding the hexagon nut with 6 mm wrench supplied, and re-fit the lever to required location.
- If the rod supplied is too long, reduce it to required length.
- A needlessly lengthy rod may vibrate. The rod should be as short as possible or have its outer end supported.

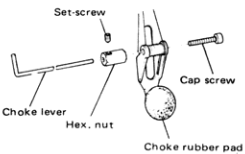


Fig. 3

Fuel inlet

The fuel inlet nipple on the carburettor can be adjusted to the most suitable position for connecting to the fuel delivery tube from the tank. Slacken the needle-valve holder with the 8mm wrench provided, reset the inlet nipple at the required angle and re-tighten.

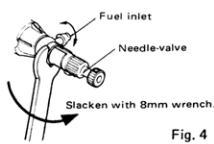


Fig. 4

Exhaust pipe adjustment
The direction of the exhaust pipes may be altered in accordance with individual installation requirements. The angle is easily adjusted by loosening the nut that secures the exhaust pipe to the cylinder head. Use the 12mm wrench supplied.

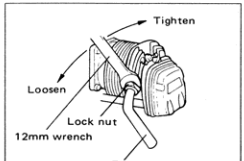


Fig. 5

Carburettor cleanliness

- It is recommended that the fuel is passed through a filter when the tank is filled and that a good in-line filter is installed between the fuel tank and carburettor.
- Occasionally remove the needle-valve holder from the carburettor and rinse out the locations shown in Fig. 6 and Fig. 7 with methanol or fuel. Be careful not to lose the gasket when removing the needle-valve holder from the carburettor.

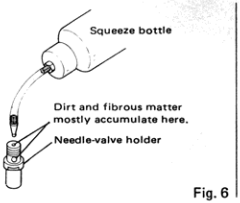


Fig. 6

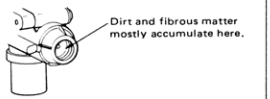


Fig. 7

PROPELLER

The choice of propeller depends on the size and weight of the model and on the type of flying envisaged. Determine the best size after practical experiment. As a starting point, choose a propeller by referring to the data on page 16.

For safety, keep your face and other parts of the body well away from the path of the propeller when starting the engine, or when adjusting the needle-valve while the engine is running, as the propeller arc is very wide with the large size propellers used on this engine (dia. 46cm – 56cm or 18in. – 22in.). Also, refer to the "Safety Instructions and Warnings" leaflet enclosed.

Use well balanced propellers only. An unbalanced propeller causes vibration and loss of power. Make sure that the prop has no nicks, splits or cracks or any other sign of wear or damage.

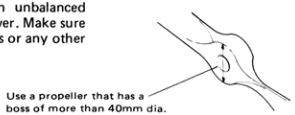


Fig. 8

Fixing the propeller
It is recommended to use the Safety Propeller Locknut Assembly supplied with the engine to prevent the propeller from fracturing or flying off, even if it loosens. Tighten the propeller nut securely. Installation procedure is as follows:

1. Ream the propeller centre hole to 12mm. Make sure that the propeller is properly balanced.
2. Fit the propeller nut and washer to propeller, screw onto shaft and tighten firmly with 17 mm wrench supplied.
3. Finally, insert the Safety Propeller Locknut. Tighten locknut firmly (but not with excessive force) using 14 mm wrench.

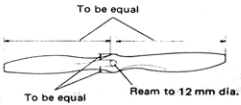


Fig. 9

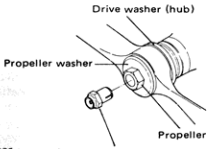
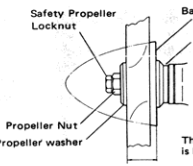


Fig. 10



The Safety Propeller Locknut can be used provided that the width is between 21.5mm and 26mm.

Fig. 11

Note: Make a habit of always checking the tightness of the propeller before starting the engine. Remember that, especially with wooden propellers, there is a tendency for the material to shrink, or for it to be reduced by the serrated face of the drive hub. Retighten the propeller nut if necessary after loosening the Safety Propeller Locknut. The locknut should be tightened firmly after retightening the propeller nut.

GLOWPLUG HEATING

Glowplug

Four O.S. Type "F" glowplugs are fitted to the FF-320. The O.S. Type "F" glowplug has been designed especially for four-stroke engines and is recommended for the best all-round performance with this engine.

Note: If you use glowplugs other than Type "F", the same type of glowplug should be fitted to each cylinder. Please observe that the special snap-on connectors supplied with this engine do not fit most other makes of plug.

Glowplug battery

It is necessary to use a glowplug battery of fairly large capacity (10 Ah or more) as this is required to heat four glowplugs simultaneously. A heavy-duty 1.5-volt dry battery or (preferably) 1.2-volt Ni-Cd battery may be used. A 2-volt lead-acid cell (accumulator) may also be used but only if provision is made for reducing the voltage at the plugs since these are nominally rated at 1.5-volt. See notes below.

The four glowplug leads supplied with the engine should be brought together (Fig. 14) and connected to a conveniently located common external point on the fuselage. This can either be a terminal with a separate terminal for the earth (ground) lead (Fig. 15) or a suitable socket or jack with connections for both glowplug and earth (ground) leads (Fig. 16). Note that the earth (ground) lead supplied is much heavier (2.0 mm^2 multi-strand copper core) than the plug leads as this has to have the capacity to carry the current for all four plugs. Similar wire should be used if a single lead is employed to extend the glowplug leads (Fig. 14).

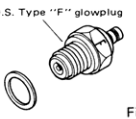


Fig. 12

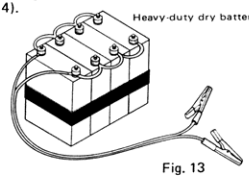


Fig. 13

- **Heavy-duty 1.5-volt dry battery**
  Use at least four heavy-duty cells wired in parallel (Fig. 13) and with short heavy leads (to minimize voltage drop) to the connection point on the fuselage. The disadvantage of dry cells is that they cannot be recharged when their power diminishes and makes the engine difficult to start.
- **Ni-Cd (nickel-cadmium) 1.2-volt rechargeable battery**
  Use a 10-Ah cell, or 8 to 10 1.2-Ah cells (as commonly used for electric-powered R/C cars) wired in parallel and with short heavy leads (to minimize voltage drop) to the connection point on the fuselage.
- **Lead-acid 2-volt rechargeable cell**
  A lead-acid cell of 10-Ah (preferably greater) capacity is required. However, in this case, it is necessary to reduce the applied voltage at the glowplugs to approximately 1.5 volt. The recommended method is to insert a suitable resistor in *each* individual plug lead. It is possible, of course, to use a rheostat attached to the 2-volt cell, or to use extra long leads (at least 2 metres) to obtain the required voltage drop. However, the disadvantage of this method is that if one glowplug should fail or become disconnected, voltage to the other three will be increased with the risk of burning out their elements.

Glowplug leads

- The plug leads are fitted with special snap-on connectors that ensure firm contact with O.S. plugs. They are a "click" fit and are not suitable for use with most other makes of glowplug.
- The earth (ground) lead is fitted with a terminal lug which should be connected to the engine by means of one of the mounting screws.
- Make sure that no part of the wiring touches the cylinder head or cooling fins.
- Keep wiring away from the fuel tank where it might cause a fire in the event of a short-circuit.

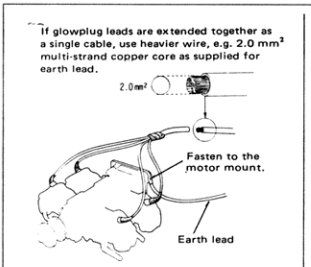


Fig. 14

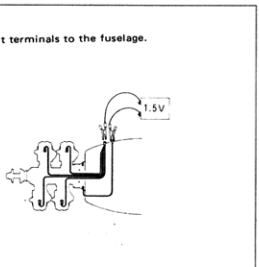


Fig. 15

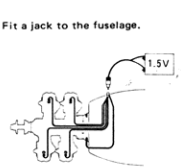


Fig. 16

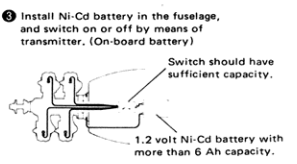


Fig. 17

Glowplug re-heat

Under normal conditions, the FF-320 will idle sufficiently slowly with the throttle closed to permit a safe landing approach. However, if conditions (atmospheric, fuel, tank location etc.) are unfavourable, there may be a tendency for one cylinder to cease firing if the engine is throttled down to a very low idling speed. This can be prevented by installing a small on-board Ni-Cd battery which will automatically re-heat the glowplugs when the engine is throttled down to idling speed (Fig. 17). A suitable switch should be installed so that it is actuated by the throttle servo only when the engine is throttled down. Safe idling speeds of less than 1,800 rpm may be obtained in this way and without undue drain on the battery.

FUEL AND LUBRICATION

Fuel

The FF-320 runs on standard commercially available model glowplug engine fuel. Fuels containing castor-oil and/or synthetic lubricants are acceptable but, for the best performance and reliability, a fuel shown below is recommended. For consistent performance and long life of the engine, it is advisable to use good quality fuel containing AT LEAST 18% lubricant castor-oil if possible, until a total of one to two hours running time has been accumulated including the running-in period.

Nitromethane	7 – 10%
Lubricant	18 – 20%
Methanol	75 – 70%

Generally, a fuel containing a lower lubricant content improves the running characteristics of a four stroke engine slightly, but it may also shorten engine life.

Lubrication

All parts of the FF-320 are automatically lubricated by the oil content of the fuel mixture.

- The crankcase breather hole is located at the side of the engine and is fitted with a brass nipple. (See Photo 3 on page 3.) Fit a length of silicone tubing of approx. 2.5–3 mm I.D. to this nipple to conduct away the small amount of oil that escapes through the breather.
- At the conclusion of the flying session, drain out the excess oil in the crankcase by removing the drain plug. While running the engine, the drain plug should always be fitted. (See Photo 4 and Fig. 18.)
- Make a habit of draining out the excess oil in the crankcase at the end of each flying session. Leaving contaminated oil in the crankcase for a long time will cause rust. Also, residual castor-oil will tend to solidify and lock the engine. Inject corrosion-inhibiting oil into the crankcase to neutralize the effects of any remaining contaminants.

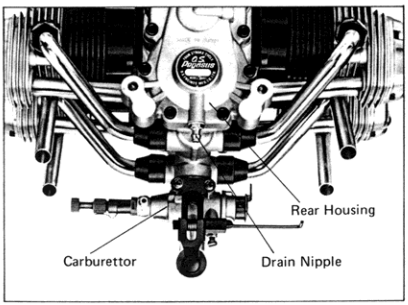


Photo 4

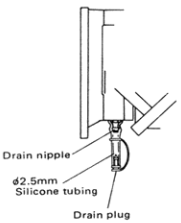


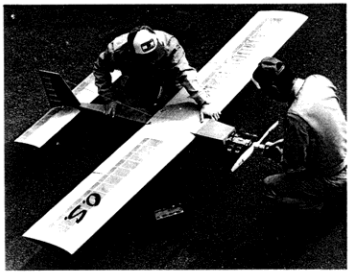
Fig. 18

STARTING

Precautions

For safety, please observe the following instructions before starting the engine.

- Read and follow the "Safety Instructions and Warnings" leaflet enclosed before starting the engine.
- Start the engine by turning the propeller counter-clockwise (i.e. normal running direction).
- Do not start the engine with the throttle fully opened, otherwise the model will tend to move forward suddently due to the strong thrust of the propeller. Hold both wings of the model when starting the engine.
- Do not carry out carburettor adjustments (except needle-valve adjustment) while engine is running.
- It is preferable to use a high-torque electric starter, although hand-starting is quite easy.



Be sure to call assistant's attention when opening or closing the throttle.

Photo 5

Starting procedure is as follows:

1) Open the needle-valve 3 to 3-½ turns from the fully closed position (Fig. 19).

2) Make sure that the glowplugs are not connected to the battery. Do not heat the glowplugs while priming. (Fig. 20)

Fig. 19

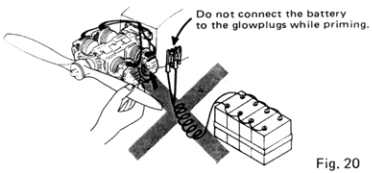


Fig. 20

3) Open the throttle valve fully, close the choke valve and turn the propeller counter-clockwise through three revolutions. (Figs. 21 & 22)

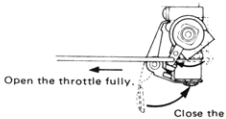


Fig. 21

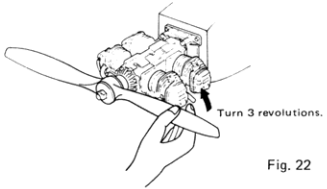


Fig. 22

- If very strong compression is felt when trying to turn the propeller counter-clockwise, too much fuel has been drawn into the engine. In this case, do not use force, but release the choke valve and turn the propeller **clockwise** slowly to eject excess fuel through exhaust pipes.
- Warning! Never close the choke valve when applying the starter. Such an action will cause an excess quantity of fuel to be drawn into the cylinder and result in hydraulic lock that may damage the engine. (Fig. 23)
- Excess fuel in the carburettor may drip into the engine compartment when the choke valve is reopened. Therefore, it is advisable to drill a drain hole in the bottom of the engine bay or cowling and to apply fuelproof paint to the surrounding surfaces to prevent fuel from penetrating the airframe structure.

4) Release the choke control and immediately turn the propeller counter-clockwise several times so that fuel is drawn well into the cylinders (Fig. 24).

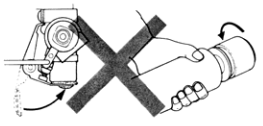


Fig. 23

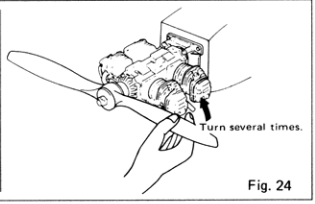


Fig. 24

5) Set the throttle valve approximately ¼ open from the fully closed position. (Fig. 25).

6) A. Starting with an electric starter (Fig. 26)
- Make sure that the direction of rotation of the starter is correct.
- Connect the glowplug battery.
- Apply the electric starter.

B. Hand Starting
For safety be sure to use a heavily padded glove or a "chicken stick".
- The propeller should be fixed in such a way that it is positioned horizontally as compression is felt.
- Connect the glowplug battery.
- Swing the propeller smartly counter-clockwise from the centre of the right blade.

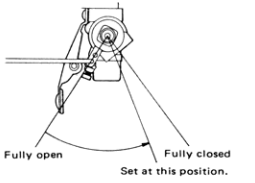


Fig. 25

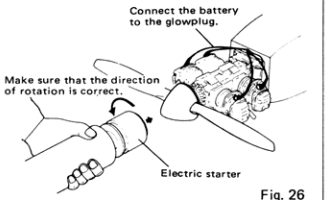


Fig. 26

7) When the engine starts, open the throttle valve fully and keep it running initially (approx. 10 seconds), with original needle-valve setting.

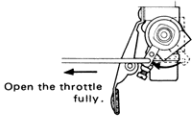


Fig. 27

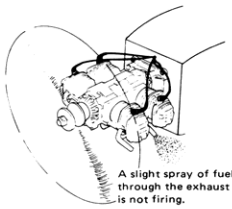


Fig. 28

8) Make sure that all four cylinders are firing
   - The engine is running properly if white smoke is emitted through all four exhaust pipes. A slight spray of fuel will be discharged through the exhaust pipe of any cylinder that is not firing.
   - If a cylinder ceases firing, reduce the throttle setting to approximately ¼ open from the fully closed position and re-connect the glowplug battery. Revolutions will increase when all cylinders are firing steadily.

9) Now disconnect the glowplug battery.

10) Adjust the needle-valve, bearing in mind the following points.
   - Abrupt adjustment of the needle-valve may cause the engine to stop, especially when it is new and insufficiently run-in.
   - As the speed of the engine does not instantly change with needle-valve readjustment, small movements, with pauses between, are necessary to arrive at the optimum setting.

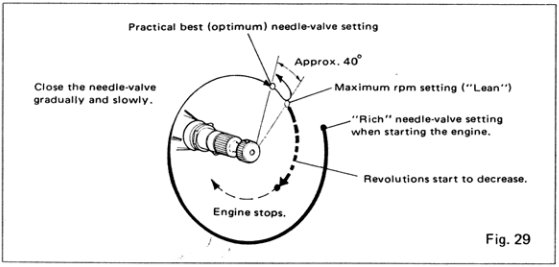


Fig. 29

Re-starting the engine when warm

To re-start the engine when warm, simply re-energise the plugs and reapply the starter with the throttle in the idling position. If the engine does not start, disconnect the battery from the glowplugs and re-prime by closing the choke valve while rotating the propeller twice with the throttle open. Initially, the high temperature inside the combustion chambers may turn the liquid fuel into gas and emit it through the exhaust pipes. Therefore, repeat the priming procedure once or twice until the cylinders become cool enough for restarting.

RUNNING-IN ("Breaking-in")

All internal-combustion engines benefit, to some degree, from extra care when they are run for the first few times - known as running-in or breaking-in. This is because the working parts of a new engine take a little time to settle down after being subjected to high temperatures and stress. However, because O.S. engines are made with the aid of the finest modern precision machinery and from the best and most suitable materials, only a very short and simple running-in procedure is required and can be carried out with the engine installed in the model. Obtain an 18x12 or 20x10 propeller for running-in.

Running-in procedure is as follows:
Start the engine and run it for about 10 seconds with the needle-valve set for 5,800~6,300 r.p.m., then open the needle-valve to reduce speed to approximately 5,000 r.p.m. and run for 20 seconds at this cooler setting. Keep the throttle fully open, using only the needle-valve to reduce speed. Repeat this procedure, alternately running the engine fast and slow with the needle-valve, but gradually extending the short period of high speed running until a total of at least 10 minutes running time has been accumulated. Following the initial break-in of 10 minutes on the ground, run-in for a further period in the air. For the first flights, have the needle-valve set as rich as possible, consistent with adequate take-off power and, if necessary, readjust the throttle trim on the transmitter so that the engine does not stop when the throttle is fully closed.
With each successive flight, close the needle-valve slightly, until, at the end of 10 flights, the needle-valve is set for maximum power. The carburettor can now be adjusted for optimum throttle performance following the instructions given in the next section.

THROTTLE VALVE ADJUSTMENT

The carburettor of your FF-320 has been factory set for the approximate best result with the fuel tank located in the normal position (i.e. close to the back of the engine and where the level of the needle-valve is at 2/3 height of the tank), but the setting may, in some cases, vary slightly in accordance with fuel and climatic conditions. Remember, also, that, while the engine is being run-in and the needle-valve is set on the rich side, the carburettor cannot be expected to show its best response. Therefore, it is recommended that you first run the engine with the throttle settings as received. After the engine has been run-in, check the operation of the throttle according to the following chart.
Re-adjust the controls only when necessary.

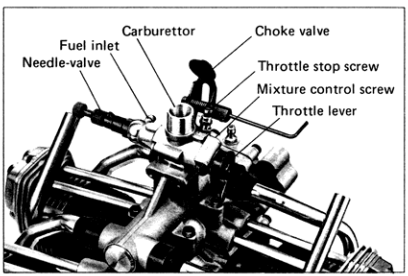


Photo 6

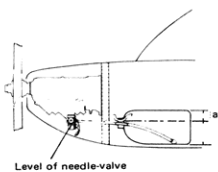
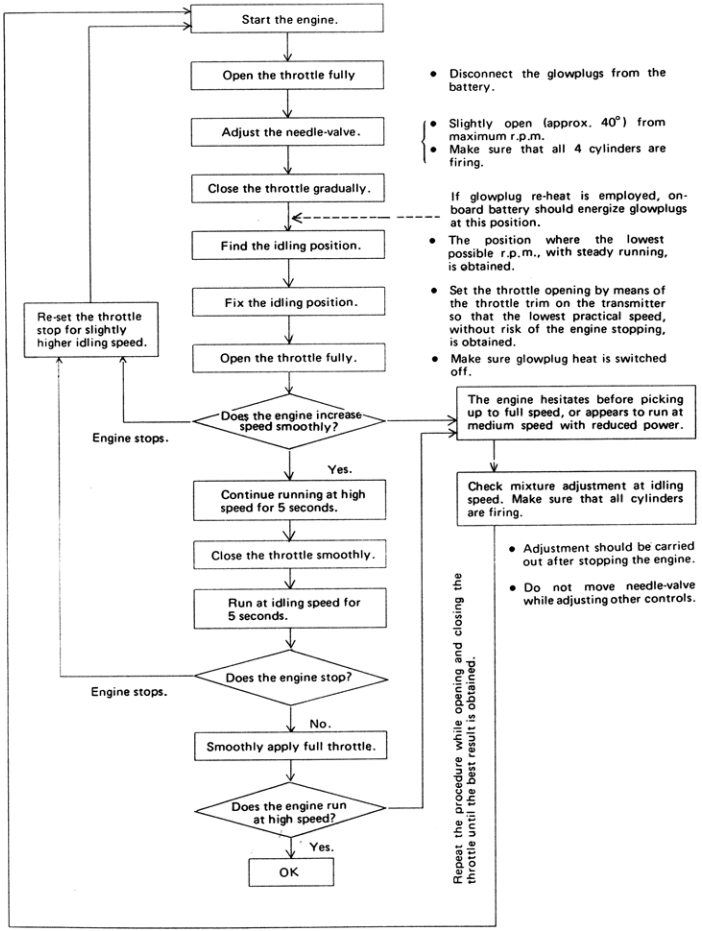


Fig. 30



Attention: Do not leave the battery connected while adjusting the carburettor.

Adjusting the mixture control valve

The special O.S. carburettor fitted to the FF-320 controls the amount of fuel admitted according to the throttle opening and thereby maintains the correct mixture strength at all speeds from idle to full power. The mixture control valve is factory set but should be rechecked, after the engine has been run-in, as follows.

1) Start the engine, warm it up, then close the throttle. Allow it to idle for a few moments then reopen the throttle for full power.

2) If, at this point, the engine hesitates, puffing out a good deal of smoke, before picking up to full speed, it is probable that the idling mixture is too rich. In this case, it will be necessary to turn the Mixture Control Screw in the reverse direction from the + mark (i.e. clockwise) to weaken the mixture. About 1/12 turn (30°) should be sufficient (Fig. 31).

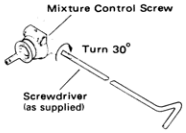


Fig. 31

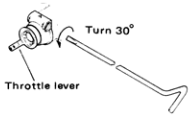


Fig. 32

3) Alternatively, if the engine stops or is slow to pick up speed, without smoking or a strong exhaust note, it is probable that the idling mixture is too lean. In this case, it will be necessary to turn the Mixture Control Screw in the direction of the + mark (i.e. counter-clockwise) approximately 1/12 turn (30°) (Fig. 32).

4) Thirdly, if revolutions increase but the engine appears to run with reduced power, it is probable that one of the cylinders has ceased firing. You may detect this by the difference in exhaust note and revolutions compared with previous full-throttle running. The cutting out of the cylinder may be caused by the idling speed being set too low or the idling mixture being too rich.

In the case of the idling speed being too low, re-set the idling position a little higher by means of the throttle trim on the transmitter. In the case of the idling mixture being too rich, turn the Mixture Control Screw in the reverse direction of the + mark about 1/12 turn (30°). Normal safe idling speeds are in the region of 1,800 to 2,000 r.p.m..

Note: As this is four-cylinder four-stroke-cycle engine, firing strokes occur every half revolution (180°), that is, two firings take place every one complete revolution. Therefore, at first you may have an impression that the engine is idling at higher r.p.m. than actual running r.p.m. It is recommended to check the engine r.p.m. with a tachometer.
Changing the make of glowplug or fuel may sometimes require re-adjustment of the carburettor throttle.

Realignment of mixture control screw

In the course of making carburettor adjustments, it is just possible that the Mixture Control Screw setting may be upset. Its basic setting can be re-established as follows:

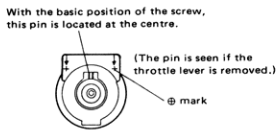


Fig. 33

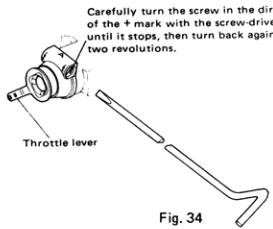


Fig. 34

Note: If an on-board glowplug re-heat system is fitted, mixture adjustment at idling speed should be carried out with this in operation.

FLIGHT

Checking before flight

- Make sure that all four cylinders are firing.
- Make sure that the engine runs steadily at idling speed.
- Make sure that the engine is fully warmed up.
- It is necessary to warm up the engine as with a full-size aircraft or automobile. Do not attempt to take-off immediately after the engine has been started. Allow the engine to run at full throttle for at least 10 seconds before releasing the model.

CARE AND MAINTENANCE

To ensure that you obtain long life and peak performance from your engine, observe the following.

1) Avoid running the engine under dusty conditions. If necessary, lay a sheet of plywood or hardboard in front and under the nose of the model when starting the engine.
2) Foreign matter in the fuel can cause the carburettor jet to be partially clogged. Therefore:
   - rinse out the fuel tank with methanol or fuel before installing it
   - fit a fuel filter in the fuel delivery tube between tank and carburettor
   - fit a fuel filter to pump inlet of the manual or electric fuel pump
   - do not leave your fuel container open needlessly
   - check filters periodically and clean them when necessary
3) Do not close the needle-valve to too "lean" a setting. This will cause the engine to overheat and slow down and also will generate much nitromethane oxide due to extremely high temperature which will cause internal rusting of the engine. Always adjust the needle-valve very slightly to the "rich" side of the peak r.p.m. setting.
4) Clean the exterior of the engine with a clean cotton cloth. If this is not done, oil and dirt will burn onto the outside of the engine each time it is run and the engine will soon become blackened.
5) If the engine is not in use for a while (more than two months) remove the glowplugs and rinse out the interior with kerosene (not gasoline), by rotating the crankshaft. Shake out residue, then inject corrosion-inhibiting oil (preferably) or light machine-oil through glowplug holes and breather nipple, again rotating the shaft to distribute the protective oil to all working parts. (Fig. 35)

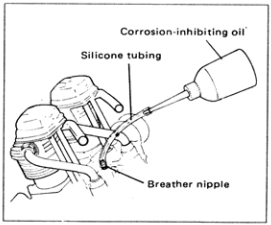


Fig. 35

VALVE CLEARANCE ADJUSTMENT

Valve clearances are correctly set before the FF-320 leaves the factory and, in normal use, will seldom require adjustment. However, if, after a considerable amount of running time has accumulated, a loss of power is detected, or if the engine has to be disassembled or repaired as a result of a crash, valve clearances should be checked and readjusted as necessary. For checking and adjusting the valve clearances, a valve adjusting tool kit is supplied with the engine.

Note: Valve clearances of this engine must be checked and re-set WHEN THE ENGINE IS COLD.

1) Remove the rocker cover from each cylinder head by unscrewing two socket-head cap-screws from the rocker box on top of the cylinder head with Allen key supplied.

2) Remove all the glowplugs except the one fitted to the cylinder that you want to check.

Note: Each glowplug should be re-fitted to the original cylinder.
You may start to check and adjust with any cylinder.

3) Turn the propeller until compression is felt, then turn it one quarter revolution and stop. Both valves should now be closed in that cylinder.

4) The required valve clearance is between 0.04 mm and 0.10 mm (0.0015 to 0.004 inch) measured between the valve stem and rocker arm. Use the 0.04 mm and 0.10 mm feeler gauges to check clearances.
Usually, the 0.04 mm feeler will pass through the gap: 0.10 mm gauge should not.

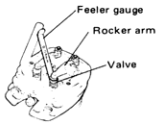


Fig. 36

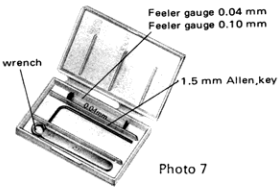


Photo 7

If the gap is found to be too small or too large, re-set the valve clearance as follows.

1) Carefully slacken the locknut on one rocker arm with the special offset wrench supplied. (Approx. ¼ to ½ turn. See Fig. 37.)

2) Turn adjusting screw approx. ½ turn counter-clockwise to open gap with 1.5 mm Allen Key supplied. (See Fig. 38.)

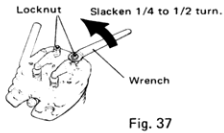


Fig. 37

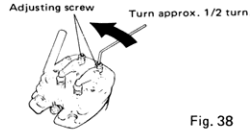


Fig. 38

3) Insert 0.04 mm feeler between valve stem and rocker arm, and gently turn adjusting screw clockwise between finger and thumb until it stops. (See Fig. 39.)

4) Re-tighten the locknut while holding adjusting screw with the Allen key. (See Fig. 40.)

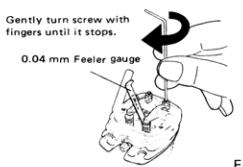


Fig. 39

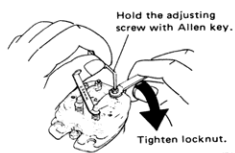


Fig. 40

5) Remove 0.04 feeler, rotate prop through exactly two turns and re-check gap. If the valve clearance is correctly adjusted, check the other valve and adjust if necessary. Then replace rocker over and remove glowplug.

6) Fit glowplug to the next cylinder to be checked and repeat steps 1 to 5 above.

7) Check the other two cylinders and adjust, if necessary, in the same way.

REFERENCE

The choice of propeller used on this engine depends on the size and weight of the model and on the type of flying envisaged. Determine the best size after practical experiment among 18x10–14, 20x8–10 and 22x8 propellers. Typical r.p.m. obtained with various "Zinger" maple wood props are as follows:

Fuel containing 10% Nitromethane and 20% lubricant used.

Propeller (in.)	r.p.m.
Zinger 18×10	7,800–8,000
Zinger 18×12	7,000–7,200
Zinger 18×14	6,500–6,700
Zinger 20×8	7,600–7,800
Zinger 20×10	6,700–6,900
Zinger 22×8	6,600–6,800

PROPELLER WASHER SET FOR SCALE MODEL

If you prefer to use the standard propeller nut and six screws to fit the propeller to obtain more scale-like appearance, accessory Scale Propeller Washer Set (propeller nut, propeller washer and six screws) is available.

Choose a propeller that has a boss at least as large as the diameter of the drive hub so that it is not weakened when drilled for six retaining screws. If the propeller boss is small and the propeller nut or screws are inadequately tightened, this can (due to detonation or "knocking" if the engine is run too lean or under too heavy a load) cause the propeller to split and fly off. Obviously, this can be very dangerous. Therefore, choose a propeller that has a large boss and secure the prop nut and screws as follows.

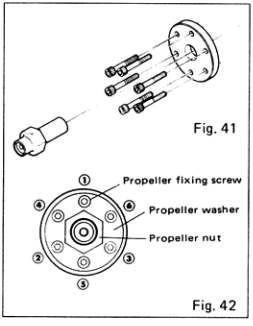


Fig. 41

Fig. 42

1) Drill holes through the propeller boss to align precisely with the holes in the prop-washer fitted to the engine.

Important Note: Holes must be exactly parallel to the shaft hole and exactly sized to accept the 3 mm screws.

2) Fit propeller and prop washer to shaft. Insert screws through washer and prop and into drive hub and fit prop-nut.

3) Tighten prop-nut, then tighten screws progressively and evenly in the order shown in the sketch.

4) Repeat the above procedure several times to make sure that the prop is really secure.

Regardless of the type of propeller fixing used, make a habit of always checking the tightness of the propeller before starting the engine.
Remember that, especially with wooden propellers, there is a tendency for the material to shrink, or for it to be reduced by the serrated face of the drive hub.

When removing the propeller from the engine between flying sessions, it is recommended to withdraw it complete with drive washer, instead of removing the six retaining screws. Be careful not to lose the Woodruff key at this time.
(One spare Woodruff key is supplied with the engine.)

SPECIFICATIONS

Displacement	13.26cc×4 (0.81cu.in.×4)
Bore	27.7mm (1.09in.)
Stroke	22.0mm (0.866in.)
Practical R.P.M.	1,800–8,500r.p.m.
Weight	2,190g (77.31oz.) (including motor mount)

PARTS LIST

Code No.	Description	Code No.	Description
46401000	Crankcase	46160000	Valve Assembly
46401610	Front Housing	45361000	Rocker Arm Assembly (1 pc.)
46401810	Rear Housing	45961400	Rocker Support Assembly
46402100	Crankshaft No.1	46462000	Camshaft
46402200	Crankshaft No.2	45564000	Cam Follower (2 pcs.)
46402300	Coupling Collar	45566000	Push Rod (2 pcs.)
46103100	Cylinder Liner	45566100	Push Rod Cover Ass'y (2 pcs.)
45903200	Piston	46481000	Carburettor Complete
46103300	Cylinder Jacket	46184000	Choke Valve Assembly
45403400	Piston Ring	46468000	Intake Manifold Assembly
46404030	Cylinder Head (w/valve ass'y)	46168500	Manifold Boots (2 pcs.)
46404120	Cylinder Head	46468100	Intake Pipe (right) (1 pc.)
46404200	Rocker Cover	46468200	Intake Pipe (left) (1 pc.)
46105000	Connecting Rod Assembly	46469000	Exhaust Pipe (1 pc.)
45906000	Piston Pin	22681953	Breather Nipple (w/washer)
46408000	Drive Washer	24025923	Drain Nipple (w/washer)
45508200	Woodruff Key	71615009	Glowplug Type F (w/washer)
46109400	Propeller Spacer	71910000	Radial Motor Mount
46410100	Lock Nut	71516010	Screwdriver for mixture control adjustment
46414010	Head Gasket Set	72200060	Valve Adjusting Tool Kit
46120000	Thrust Washer	72200070	Booster Cable Set
26731002	Crankshaft Bearing No.1	72200080	Needle-valve Extension Cable
22130004	Crankshaft Bearing No.2	46471000	Drain Plug
46030008	Crankshaft Bearing No.3	46409000	Scale Propeller Washer Set
46031005	Camshaft Bearing (front)	*71521000	Long Socket Wrench (w/plug grip)
22631019	Camshaft Bearing (rear)	*72403050	Super Filter (large)
46431100	Camshaft Bearing Spacer		

* Optional extra parts

The specifications are subject to change without notice for improvement.