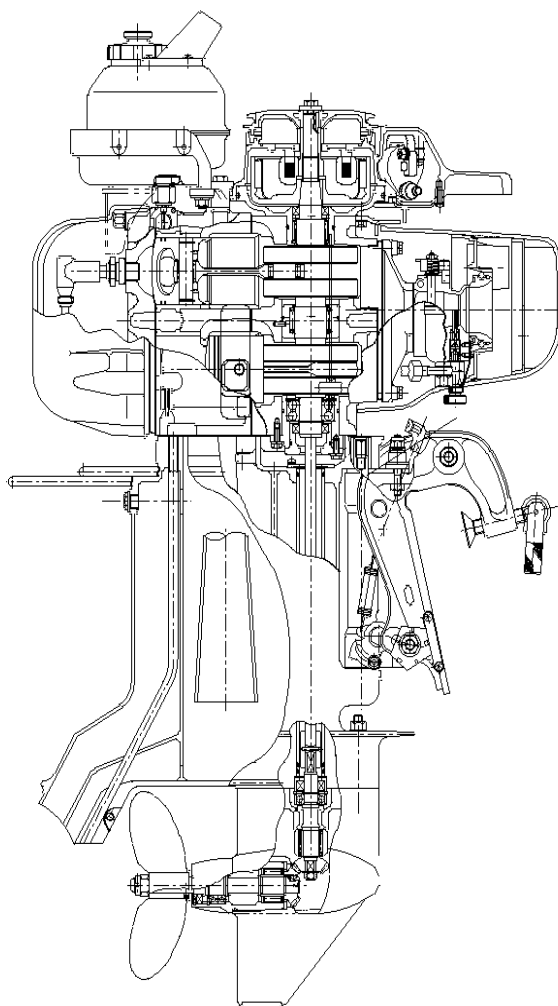




321

MANUAL



YAMATO MOTOR CO. LTD

<http://www.yamato-motor.co.jp>

INDEX

FORWARD	2
I GENERAL	3
II OPERATION OF MOTOR	4
1. Precautions prior to starting motor	4
2. How to start motor	4
3. If hull fails to plane	5
4. Things to observe and adjust during operation	5
5. How to stop motor	5
6. Care of motor after use	6
7. Submerged motor	6
III DISASSEMBLY, INSPECTION AND REASSEMBL	8
1. Power Unit	8
A. Disassembly	8
B. Inspection	9
C. Reassembly	9
2. Magneto	14
A. Disassembly	14
B. Reassembly	15
C. Specification	15
3. Carburetor	15
A. Disassembly	15
B. Inspection	18
C. Reassembly	18
4. Gear case	19
A. Disassembly	19
B. Inspection	20
C. Reassembly	20
IV TROUBLE SHOOTING	25
V CROSS SECTION OF MOTOR	26
VI PERFORMANCE CURVE	27
VII SPECIFICATION FOR MODEL 321	28

FORWARD

The Yamato model 321 is a 24.2 cubic inch / 396cc stock racing engine. Like its predecessors - the models 80, 102 and 202 - this motor was developed specifically for use in the multi-billion dollar parimutuel boat racing industry in Japan. These motors are required to run heats, day after day with perfect reliability at racing speeds. Therefore, like engines in commercial aircraft, they have been "overdesigned" in relation to the job they perform.

Essentially, this 33 h.p. engine is a strong twin which has been detuned by use of a low compression head, mild-port timing and one small carburetor. When putting out 33 h.p. at 6,800 rpm the 321 is just loafing. No wonder the Yamato has become the biggest and most popular class in UIM and APBA racing. Compared with other stock powerheads which vibrate, crack and fail at racing speed these engines are made virtually "Bullet Proof". Ask any racer that owns a model 80, 102 or 202. You too will be convinced that the model 321 is the best buy today on the motorboat racing scene.

I GENERAL

From the manufacturer of Yamato Motors, we sincerely thank you for selecting the Yamato model 321 racing outboard motor. To operate this outboard motor safely and efficiently, please read this instruction manual carefully. It will help you get a good understanding of the precautions in operation and how to service and maintain it for maximum performance, reliability and extended life.

As in most form of racing, there is risk which may bodily injury. Yamato Motor suggest that extreme caution be taken whenever you operate this motor. The Yamato Motor Co. cannot be responsible or liable for any mishaps that may occur while operating this motor.

II OPERATION OF MOTOR

II - 1 Precaution Prior to Starting Motor

- A. Check thumb screw handles to be sure it is tight.
- B. Check for oil in gear case.
- C. Check condition of high tension wires and spark plugs. Ensure it is firmly tightened.
- D. Check fuel in tank to be sure sufficient quantity remains for the anticipated run.
- E. Check for proper engine height and angle.
- F. Check steering system for proper installation and tightness.
- G. Check throttle system for tightness. Be sure it is free from binding and free to return to closed position.
- H. When the motor is cold, it is suggested that the motor be warmed up prior to launching. For safety sake, we suggest that the propeller be removed.

Caution: Remove spark plug wires whenever propeller is removed or installed.

II - 2 How to Start Motor

- A. Set fuel cock in vertical position, air vent (located on fuel cap) opened, main needle opened 1-1/2 turn, and spark plug wire attached to the appropriate plug.
- B. Check float pin. Approximately 5/16" should be protruding above carburetor float cover.
- C. Set timing handle about midway of travel.
- D. Pull choke lever (for cold motor only). See figure 1.
- E. On pre-heated motors, do not use choke. Instead, open throttle approximately 1/8 to 1/4.
However for cold motor DO NOT OPEN THROTTLE.
- F. Wrap starter rope 1-1/2 to 2 turns on starter pulley.
- G. Pull starter rope vigorously, repeat if necessary.
- H. As soon as motor starts, push choke in. See figure 2.
- I. If motor starts but stops immediately, it may or may not be necessary to reset choke.
- J. Repeat step G and H.

- K. After motor starts, shift timing handle all the way to the right (exhaust side).
- L. Increase motor RPM.
- M. For safety reasons, we suggest that the air idling screw be set all the way in and the throttle stop backed-off completely so that the motor will not continue to run if the driver is thrown out of the boat.

Figure 1

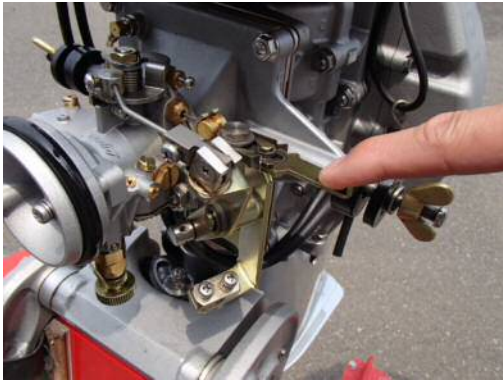
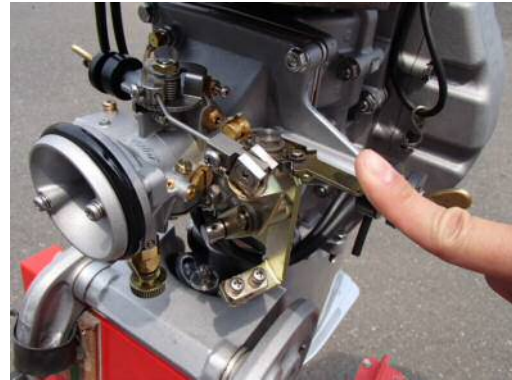


Figure 2



II - 3 If Hull Fails to Plane

- A. Stop motor after 30 seconds.
- B. Check transom height and angle.
- C. Check for foreign object around propeller and lower unit.
- D. Check for damaged around / or wrong propeller.
- E. Check motor. If motor lacks power, see trouble-shooting chart.

II - 4 Things to Observe and Adjust During Operation

- A. Be sure timing lever (Magneto #1) is in full advanced position.
- B. Open throttle for maximum power.
- C. Adjust high speed main needle (Carb #16) for maximum power.
- D. Check water outlet. Be sure it is not steaming.
- E. Check RPM (if tachometer is fitted). Do not exceed 8,000 rpm.
- F. Listen for any unusual noise.

II - 5 How to Stop Motor

- A. Release throttle lever.
- B. If kill-switch is installed, use it to stop motor.
- C. Alternate method of stopping motor is to shift timing lever toward the left (intake side).

II - 6 Care of Motor After Use

- A. Wipe spilled gasoline with clean rag.
- B. Wipe water, around powerhead.
- C. If motor has been used in salt water, flush motor internally as well as externally with fresh water.

CAUTION: Do not tip motor upside down. Water can enter the exhaust port and can cause serious damage.

- D. **CAUTION:** When laying motor on it's side, be sure the exhaust side faces down.

II - 7 Submerged Motor

- A. If motor, is submerged in water for any reason, take the following action immediately:

1. Remove propeller.
2. Remove spark plug and cylinder lead (remove cylinder head only when submerged at high speed). Cylinder head gasket is often blown due to hydraulic hammer. The gasket acts as a fuse which minimizes further internal damage.
3. Turn motor by hand. If complete revolution is possible without any bind, complete the following:
 - a. If motor has been submerged in salt water, flush motor with fresh water through carburetor while turning motor slowly.
Clean exterior parts with fresh water.
 - b. Remove starter pulley and coil plate assembly (see par III-2).
Flush with clean fresh water. Clean and dry all electrical parts.
Reinstall starter pulley only.
 - c. Drain fuel tank, fuel line and carburetor.
 - d. Set motor with cylinder head facing down.
 - e. Crank motor several times.
 - f. Turn motor so that exhaust-side is facing down.
 - g. Repeat step e.
 - h. Repeat step d.
 - i. Crank motor. Repeat step d thru h until all water is expelled.
 - j. Flush with fresh mixture of petrol and oil.
 - k. Repeat step d thru h until most of the petrol and oil mixture is expelled. Wipe all petrol and oil that may have spilled on motor.
 - l. Reassemble magnet assembly.
 - m. Attach high tension wires to spark plug. GROUND spark plug.

- n. Pull starter pulley and check spark plug. Both plugs must be firing.
- o. Reassemble (except propeller), refuel and run motor, for 30 seconds at intermediate speed.
- p. Replace propeller.

CAUTION : Remove spark plug wire when installing or removing propeller.

- q. Install on hull and run at least ten minutes at half throttle.

- 4. If motor binds when turned by hand, internal damage such as bent connecting rod, bent crankshaft, crankcase and/or fracture in cylinder may have occurred. Remove as much water as possible by following step 3-a thru 3-i. Wash and coat internal and external parts with oil. Complete disassembly is recommended.

III DISASSEMBLY, INSPECTION AND REASSEMBLY

III - 1 POWER UNIT

A. Disassembly

1. Remove Magneto assembly (see magneto section).
2. It is not necessary to remove fuel tank. However, for the beginner, it will be easier to work without it.
3. Remove carburetor.
4. Remove intake manifold assembly.
5. Remove reed valve assembly, exhaust flange, cylinder head.
6. Remove power unit by removing six 8mm nuts using 12mm box wrench or socket.
7. Separate power unit from lower unit.
8. Remove six 10mm nuts using 14mm box wrench to remove cylinder block.

CAUTION: Do not pry with screwdriver or other sharp tool.

9. Remove piston pin clips.
10. Remove piston pin.
11. Remove piston.
12. Remove three 6mm bolts holding lower bearing case assembly (P-25). It is not necessary to remove tail flange assembly except when replacing oil seal.
13. Remove flywheel and key.
14. Remove four 6mm bolts holding upper bearing case assembly (P-12).
15. Split crankcase by removing 8 nuts and 2 socket head bolts using 12mm socket.
16. Split crankcase assembly by tapping with soft hammer.

CAUTION: Do not pry with screwdriver or other sharp tool.

17. Remove crankshaft.
18. Inspect lower bearing assembly without removing from crankshaft. If bearing is defective, use special tool, Puller-bearing case lower, part #102-809-0080.

CAUTION: Remove clip (P-33) prior to removing lower bearing assembly.

19. Remove clip (p-10) which holds split sleeve, centre bearing (p-8).

CAUTION: Slight discoloration of center bearing is not detrimental to the life of this bearing.

20. Clean all parts in solvent. Scrape-off carbon and gasket residue.

B. Inspection

1. Slight scratches on cylinder wall is permissible. Hone if necessary.
2. Replace piston rings if gap exceeds 0.032" (0.8mm).
3. To check crankshaft, remove all bearings. Place "V" blocks on surface plate. Support crankshaft ends on "V" blocks. Check by placing dial indicator on center bearing surface while turning crankshaft. Maximum crankshaft deflection permissible 0.0032" (0.08mm).
4. Check upper and lower bearing for pits, excessive end play and wear.
5. Maximum bore wear 2.602" (66.08mm).
6. Minimum piston diameter 2.595" (65.92mm) measured at piston skirt, thrust side, 9/16" (14mm) above bottom

C. Reassemble in reverse order with the following precautions.

1. Lubricate all bearings.
2. When placing crankshaft in crankcase, be sure knock pin (p-11) fits into split sleeve of center bearing (p-8). Center bearing clip faces up. *See figure 5.*
3. After placing crankshaft in crankcase, install two 6mm bolts on upper bearing case assembly and one 6mm bolt on lower bearing case assembly on to crankcase. *See figure 3 and 4.*
4. Use gasket sealer to seal crankcase mating surfaces.
5. Install two remaining bolts to top and one to lower bearing case. Torque all 6mm bolts 5-7 ft lbs (70-100 Kg cm).
6. Install remaining 8mm nuts and two bolts on to crankcase. Torque all 8mm bolts and nuts 14-18 ft lbs (200-250 kg cm). *See figure 6.*
7. Install piston. Piston has, an arrow stamped on head. This arrow must be pointed up. Centre piston pin. Install piston clips.
8. Install piston rings. The side that faces cylinder head is marked with a "T".
9. Be sure that cylinder block and crankcase is flush at bottom. Torque cylinder to crankcase nut 22 - 25 ft lbs (300 - 350 kg cm). *See figures 7 and 8.*
10. Be certain that exhaust pipe is flush with lower unit. *See figure 9.*
11. Torque cylinder head 14 - 18 ft lbs (200 - 250 kg cm). *See figure 10 for proper sequence.*

CAUTION: It is of utmost importance that all bolts and nuts be torqued as specified. Over tightening can cause distortion with noticeable loss of power.

Figure 3

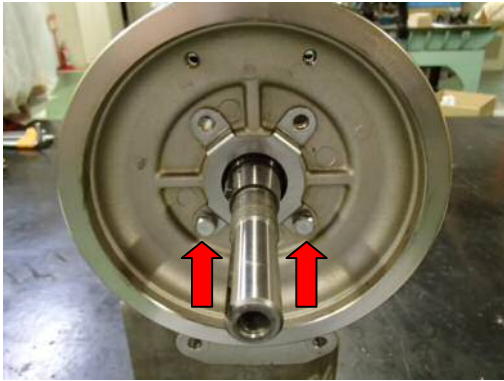


Figure 4

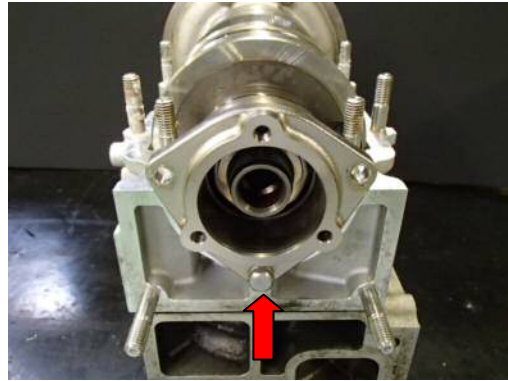


Figure 5

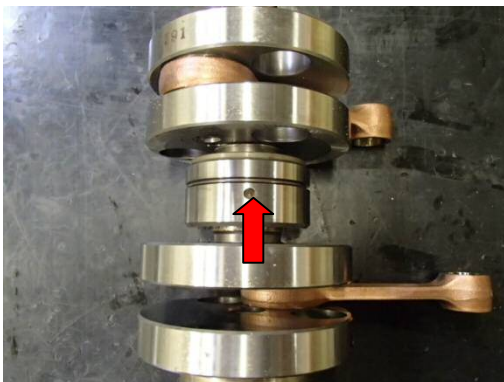


Figure 6

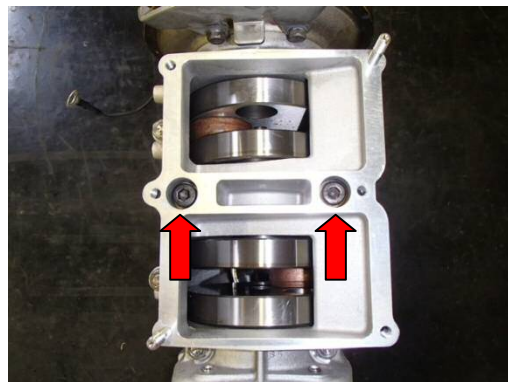


Figure 7

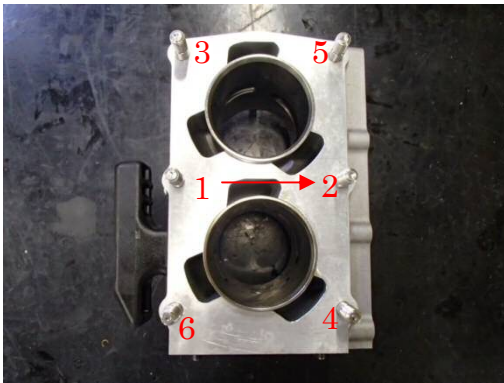


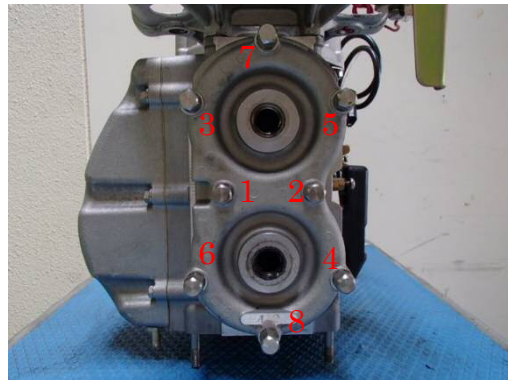
Figure 8



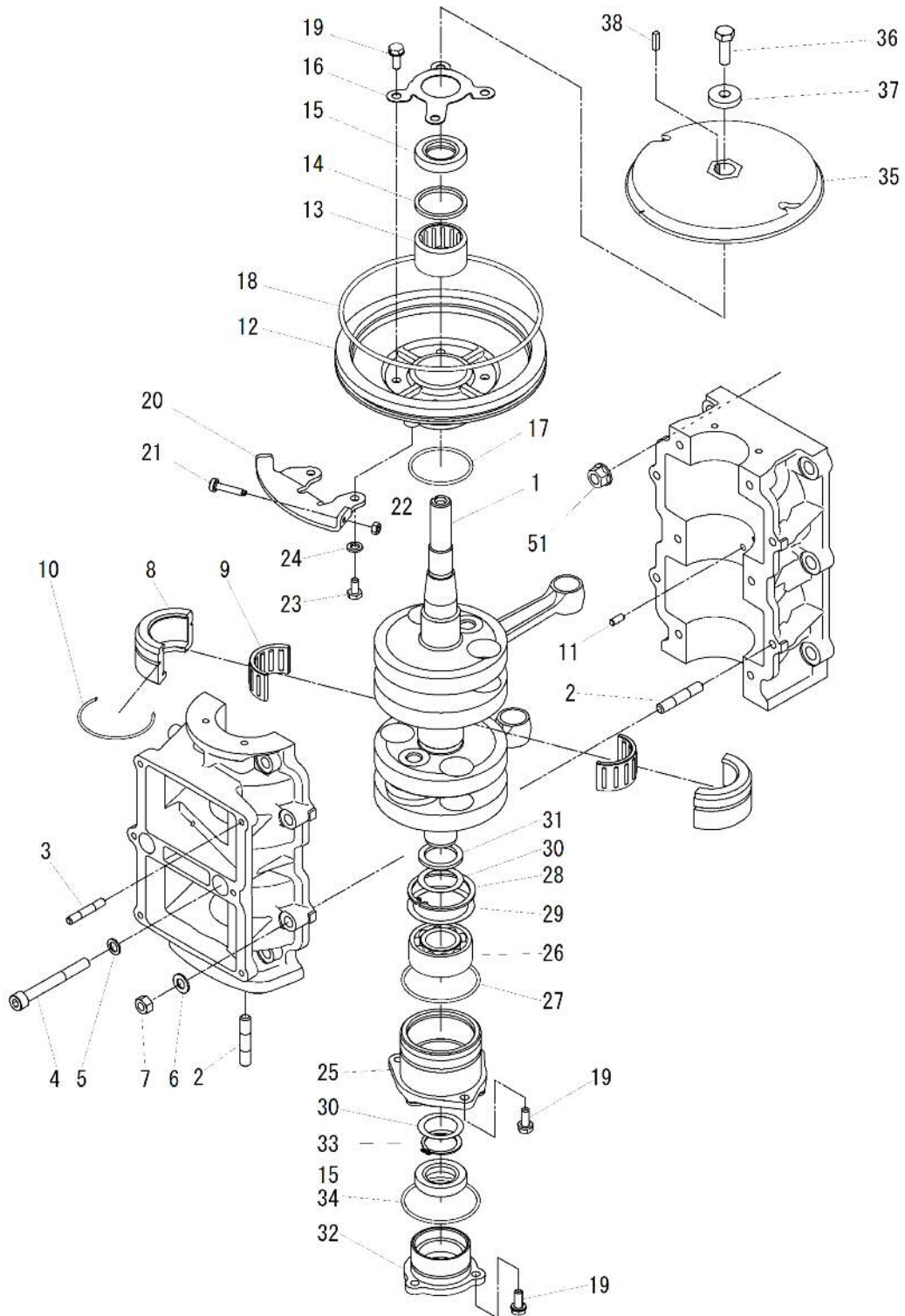
Figure 9



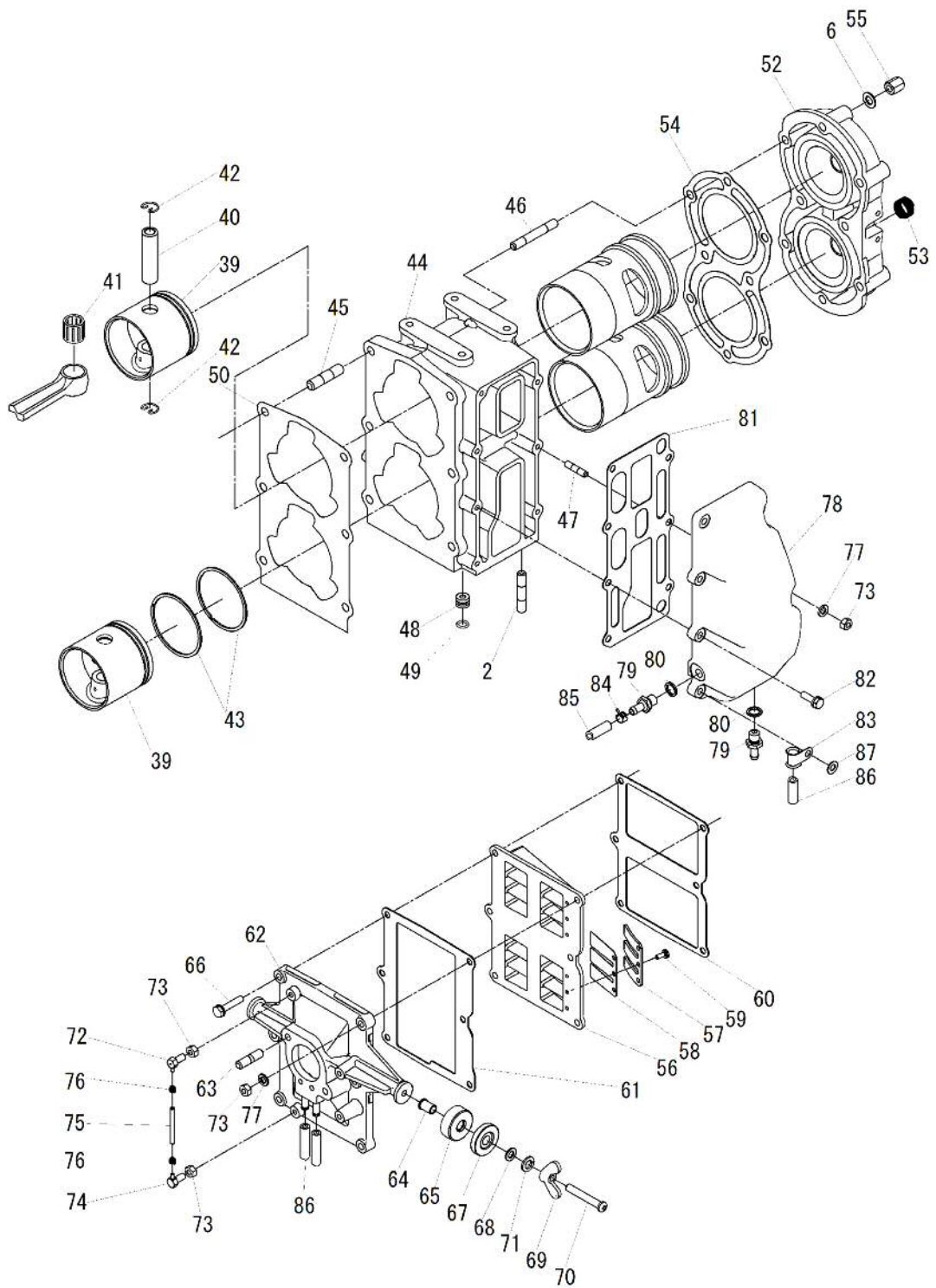
Figure 10



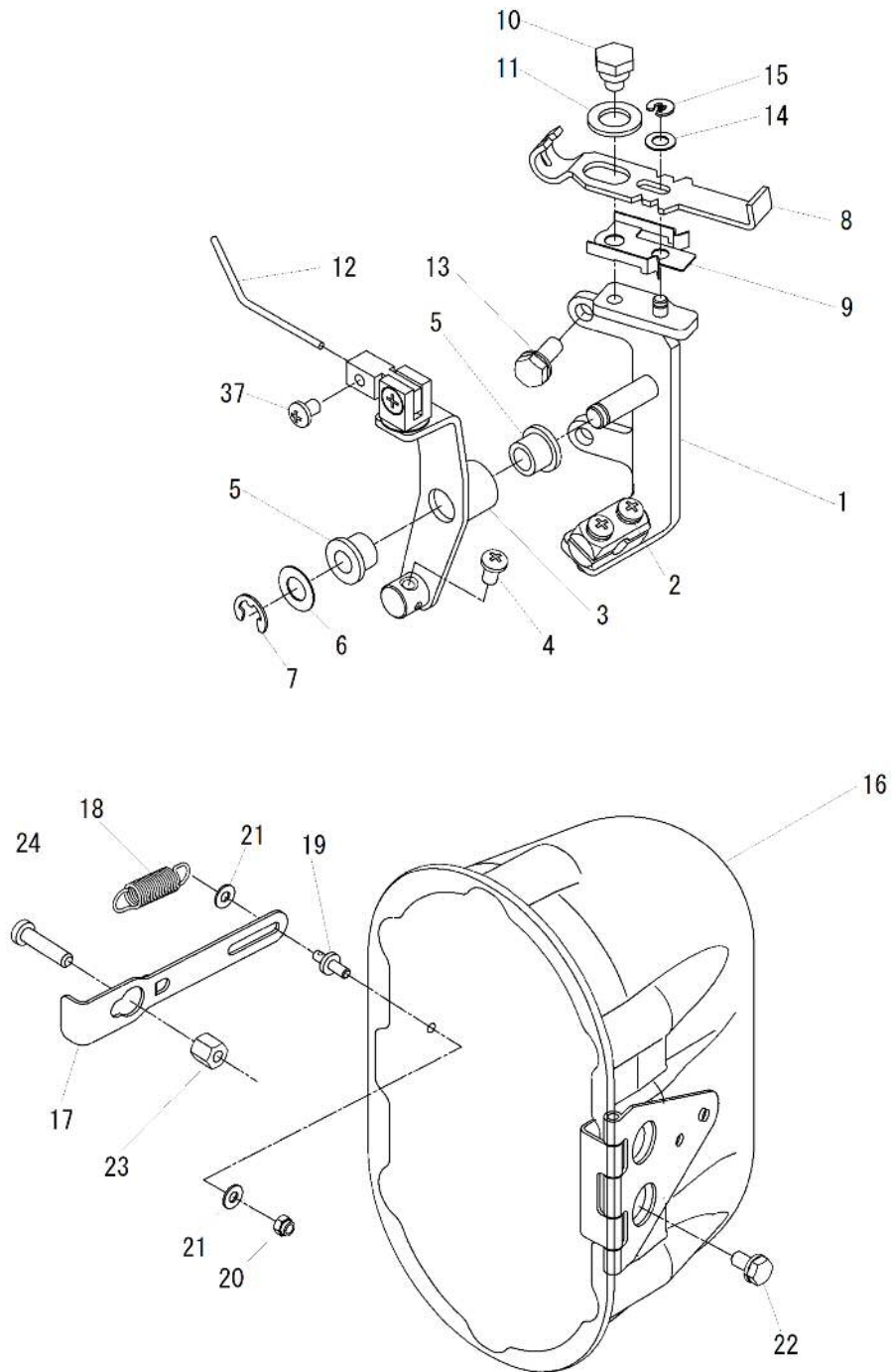
POWER UNIT GROUP



POWER UNIT GROUP



POWER ACCESSORY GROUP



III - 2 MAGNETO

A. Disassembly

1. Remove starter pulley bolt (p-36) and washer (P-37).
2. Remove starter pulley (p-35).
3. Remove key (P-38).
4. Remove four clamp plate nuts (M-41) washers (M-19) and clamp plates (M-40).
5. Remove coil plate assembly (M-1). Tap with soft hammer to lift up.
See figure 11.
6. Remove flywheel nut (M-44). Use special tool 102-809-0100. Clamp flywheel. *See figure 12.*
7. Remove flywheel (M-31) using special tool 102-809-0200.
See figure 13.
8. Clean all parts in solvent. Wipe dry or blow with air.

Figure 11



Figure 12



Figure 13



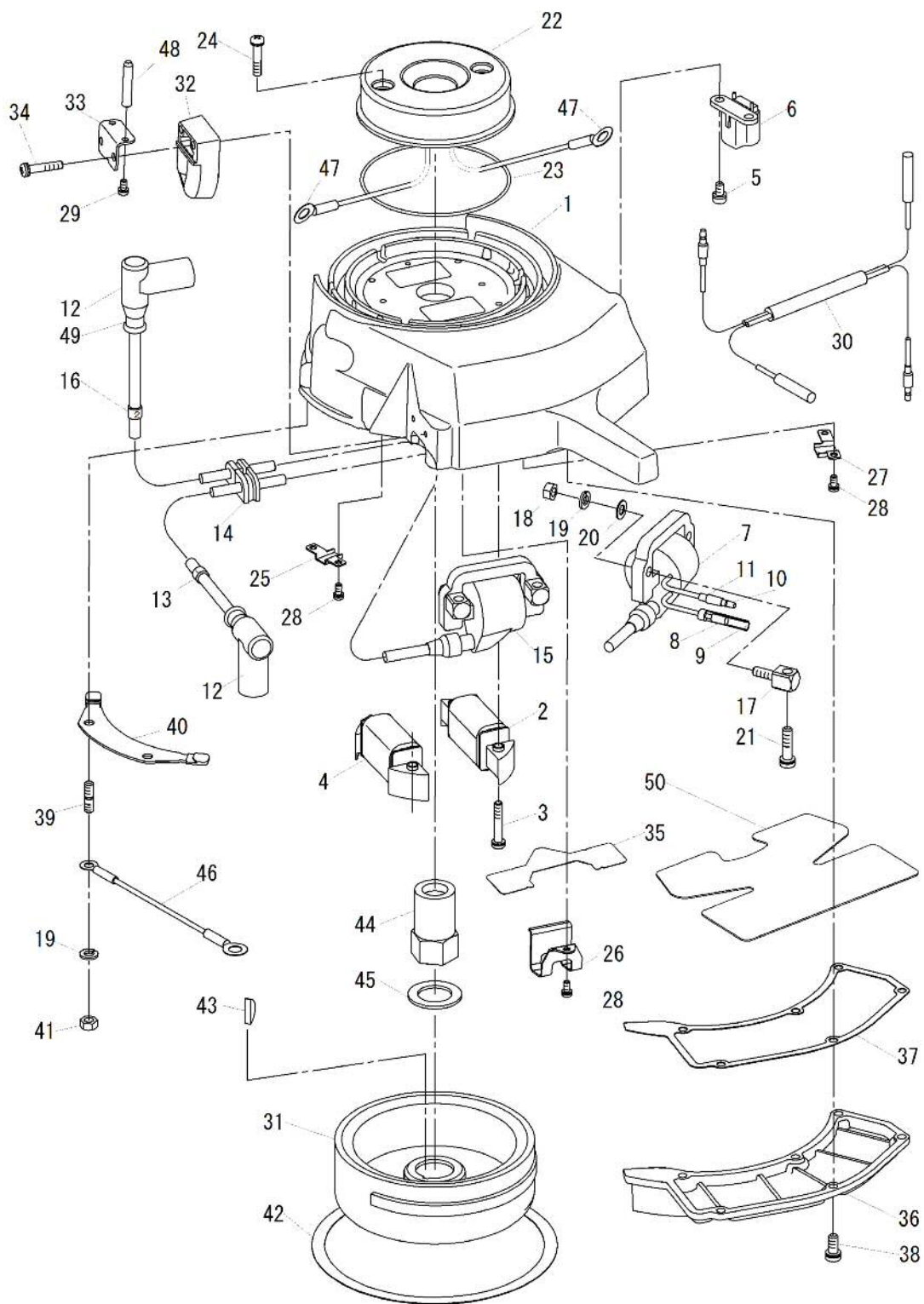
- B. Reassemble in reverse order with following precaution.
1. Lubricate inside of coil plate assembly with grease.
 2. Insure that flywheel key is seated properly.
 3. Use clamp flywheel - special tool 102-809-0100 - when tightening flywheel. Tighten 54 ~ 63Nm (550 - 650 Kg cm / 40 – 47 ft lbs).
 4. Clamp plate (M-40) has one side protruding. This side faces up.
 5. When setting ignition timing, spark advance lever can be adjusted by moving bolt (P-21). Use dial indicator thru spark plug hole. Rotate pulley to mark (red line) on coil plate assembly. Spark plug of #1 cylinder should spark when inscribed mark on pulley on coil plate assembly. See *figure 14*.

Figure 14



- C. Specification
1. Ignition timing when using dial indicator in spark plug hole 0.200 ~ 0.250 (5 ~ 6.6mm).
 2. Spark distance:
min 0.24 (6mm) / 500 rpm
min 0.40 (10mm) / 3000 rpm
 3. Fly wheel nut torque : 54 ~ 63 Nm (550 - 650 Kg cm / 40 ~ 47 ft bs)
 4. Pulley bolt torque : 20 ~ 24 Nm (200 - 250 Kg cm / 14 ~ 18 ft lbs)

MAGNETO GROUP



III - 3 CARBURETTOR

A. Disassembly

1. Remove 2 Phillip screws (C-4) from float cover.
2. Remove nut (C-10).
3. Remove banjo (C-9).
4. Float assembly can be removed from top.
CAUTION: Do not bend needle.
5. Remove spring plate (C-18).
6. Loosen holder (C-14).
7. Remove main needle assembly (C-17).
8. Remove plugs (C-32, 36) and pilot screw (C-38).
9. Remove jet (C-31, 34, 35).
10. Clean body and all parts in clean solvent.
11. If extremely corroded or dirty, soaking in commercial carburetor cleaner is recommended.

B. Inspection

1. Inspect float needle for straightness.
2. Inspect float needle contact.
3. Inspect all passage ways and jets for obstructions.

C. Reassemble in Reverse Order

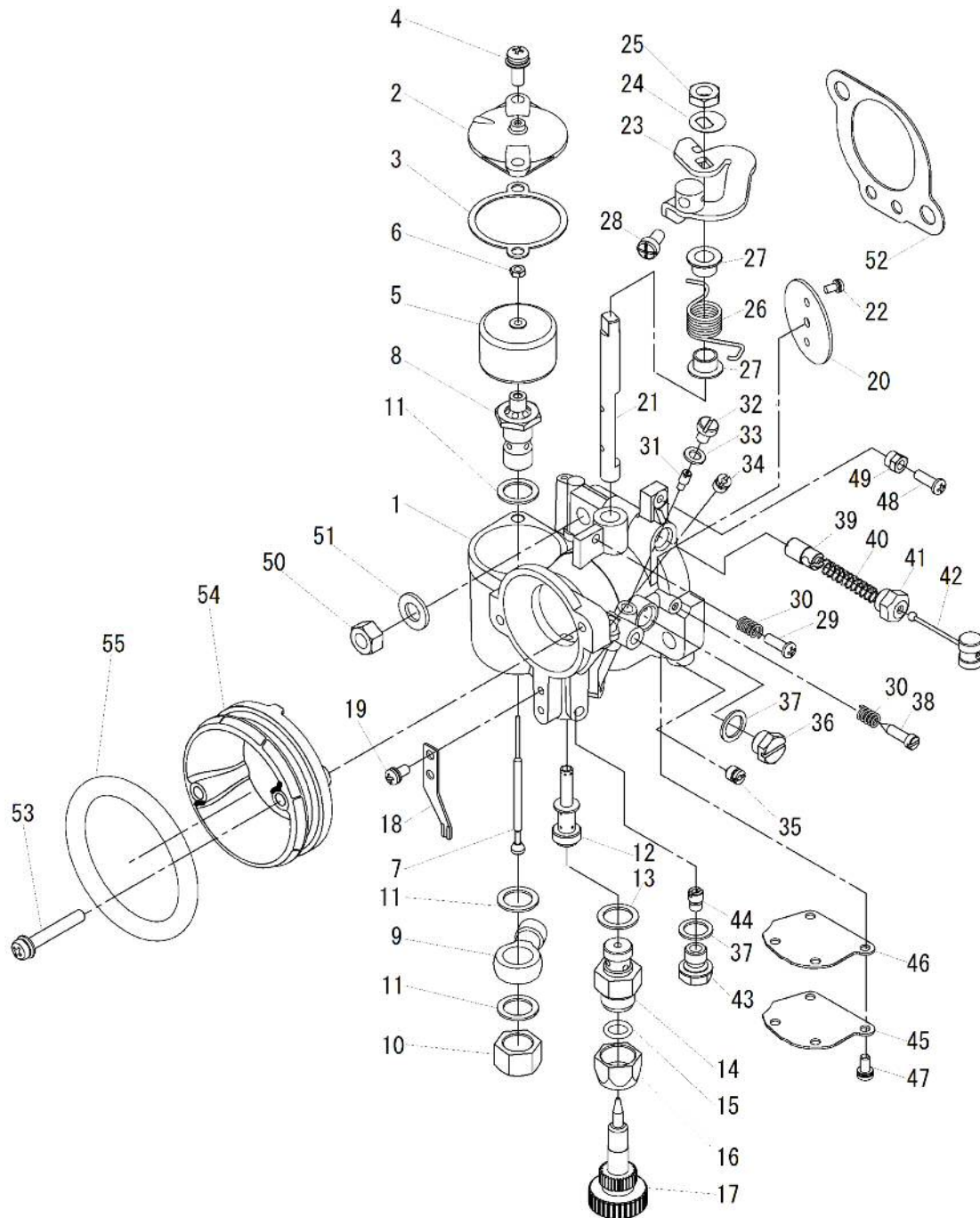
CAUTION:

1. Check throttle butterfly for smooth movement and proper return.
2. Set float level to 31mm. Measure from tip of float pin to top of float.
See figure 15.
3. Do not misplace main air jet, (C-34) and slow air jet (C-35). Main air jet has an I.D. of 0.59" (1.5mm). Slow air jet (C-35) has an I.D. of 0.036" (0.9mm) and is located behind above jet.
4. Adjust link bar (PA-12) only at closed throttle. Be sure throttle butterfly closes fully and smoothly.
5. Turn pilot screw clockwise to its full and reverse $1\frac{1}{4}$ turn for standard.

Figure 15



CARBURETTOR GROUP



III - 4 GEAR CASE

A. Disassembly

1. Using wrench, tail cap, special tool 102-801-3030, loosen tail cap (G-22).

CAUTION: LEFT HAND THREAD.

2. Remove tail cap and propeller shaft assembly by
 - a. Removing O-ring (G-30)
 - b. Removing clip (G-29)
 - c. Removing guard plate (G-28)
 - d. Removing oil seal (G-26)
 - e. Removing spacer (G-27)
 - f. Removing clip (G-16)
 - g. Using special tool, Bevel Puller, Part #102-809-0020, remove gear (G-18)
 - h. Remove thrust washer (G-20)
 - i. Remove gear key (G-19)
 - j. Slowly heat tail cap assembly 200 ~ 250°F(100-120°C)
 - k. Tap propeller shaft gently from gear end to remove propeller shaft with attached parts. *See figure16.*
3. Remove needle roller bearing (G-23).
4. Remove clip (G-16).
5. Remove two ball bearings (G-15).
6. Remove pinion gear nut (G-13) using 14mm box wrench.
7. Remove clip (G-10).
8. Clamp pinion shaft (G-5) in vice.
9. Tap gear case with plastic or rubber hammer to remove pinion shaft with parts attached.
10. Remove clip (G-8).
11. Remove ball bearing (G-7) by pressing.
12. Press needle roller bearing (G-2) down.
13. Clean all parts in solvent and dry with compressed air.
14. **CAUTION:** Do not spin bearing with compressed air.



figure16

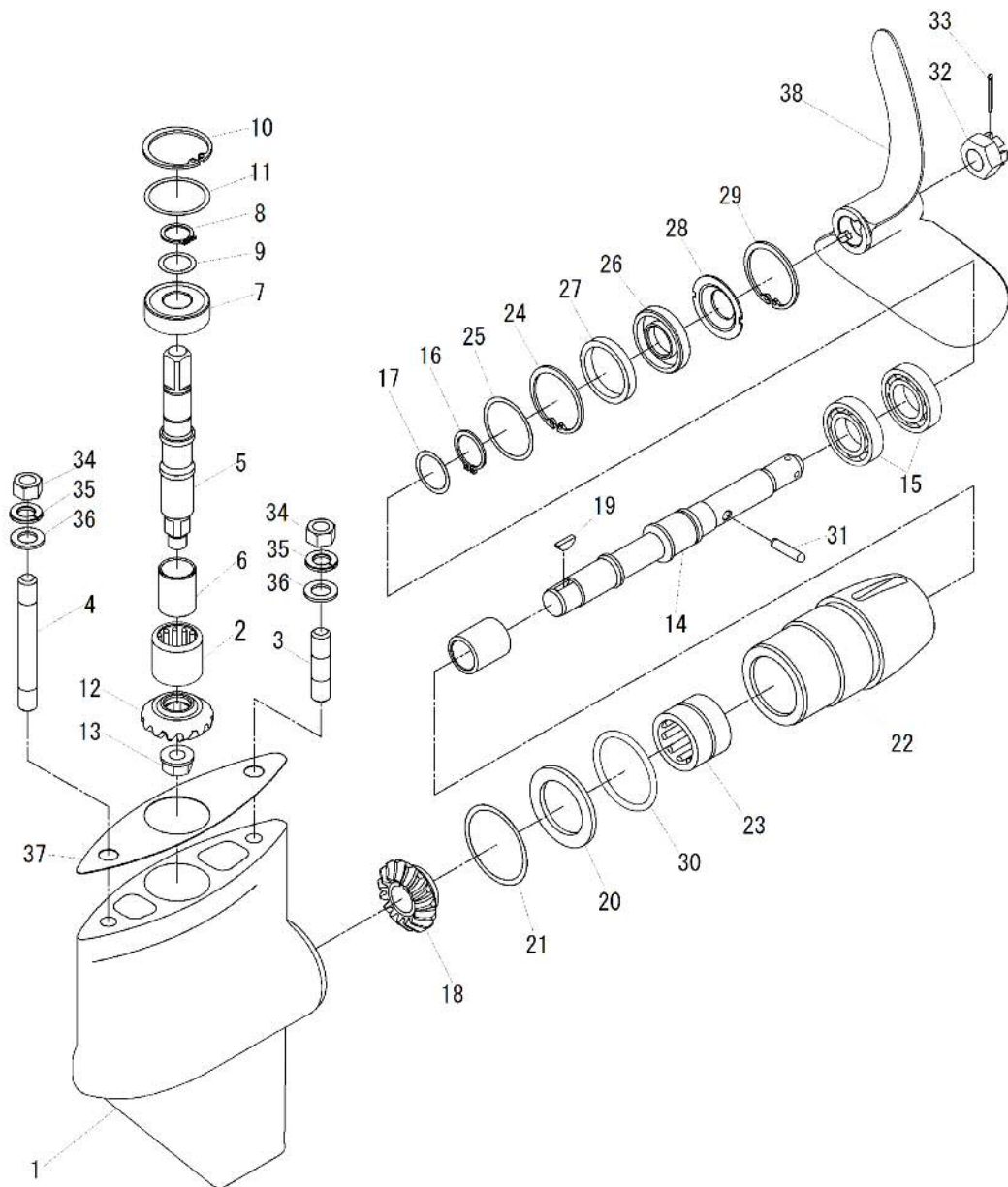
B. INSPECTION

1. When draining gear oil, check for water in gear case. If oil appears white, replace oil seals and O-ring.
2. Inspect gear for wear, pitting and full contact. If gears are not in full contact, shaft may be bent or shim adjustment is incorrect.
3. Check all bearings for wear.

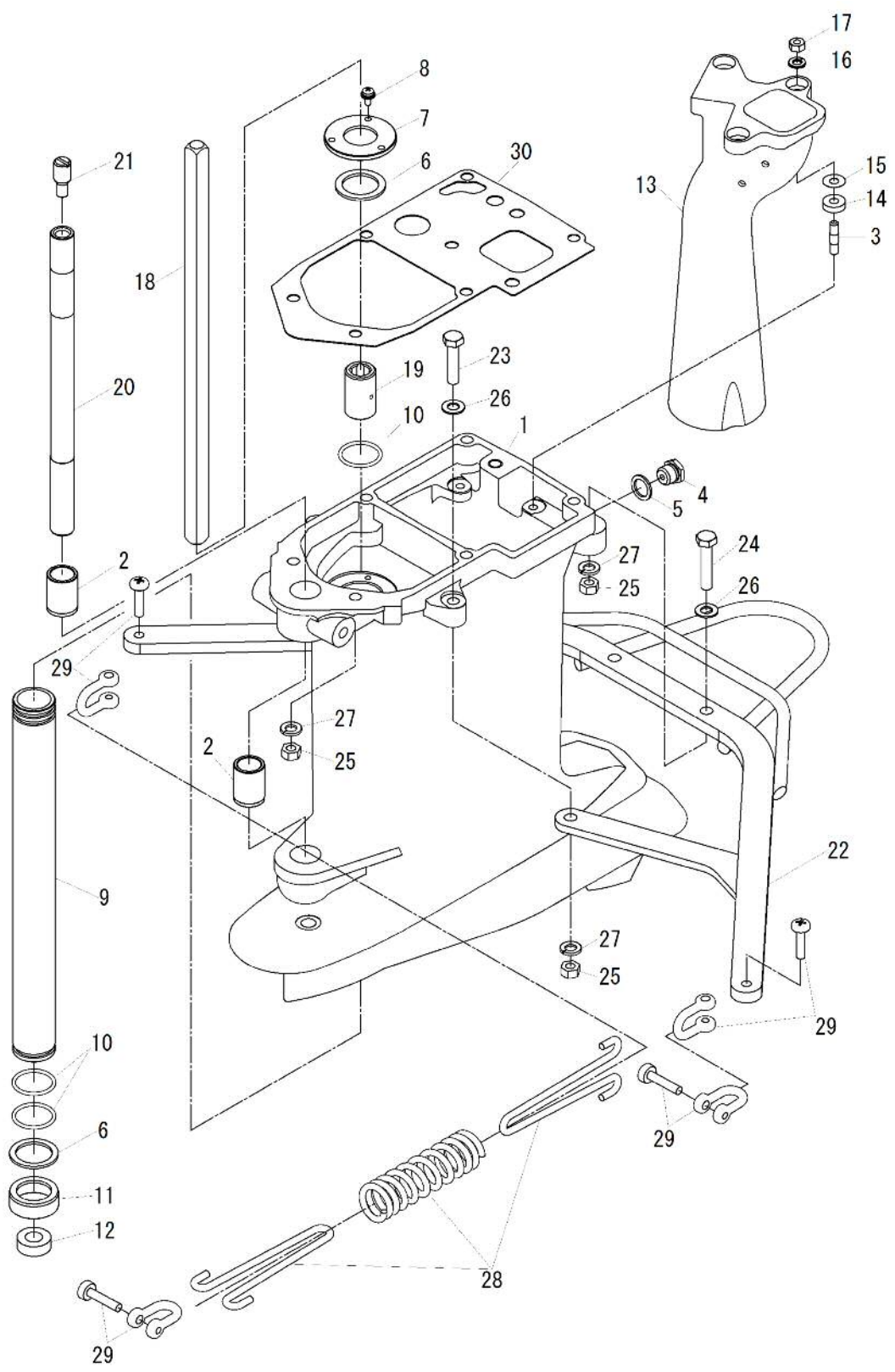
C. REASSEMBLY

1. Assemble in reverse order.
2. Press needle roller bearing (G-2) 1.614" (41mm from top of gear case housing).
3. Add or remove shim (G-9, 11) to adjust up and down movement of pinion shaft. There should be no bind and only a slight perceptible end play.
4. Back lash of gear should be between 0.004 to 0.006" / 0.1 to 0.15mm. Adjust by adding or removing shims (G-21).
5. Torque pinion shaft nut 22 - 25 ft lbs (300 - 350 Kg cm).
6. When replacing tail cap assembly, coat threads and body of tail cap with graphite grease.
7. Torque tail cap 50 - 55 ft lbs (700 - 750 Kg cm).
8. Fill gear case with a good quality gear oil (GO 90). Fill to boss located inside the gear case. Allow the oil to settle into the bearings. When the air bubbles stop refill to the boss. DO NOT OVERFILL.

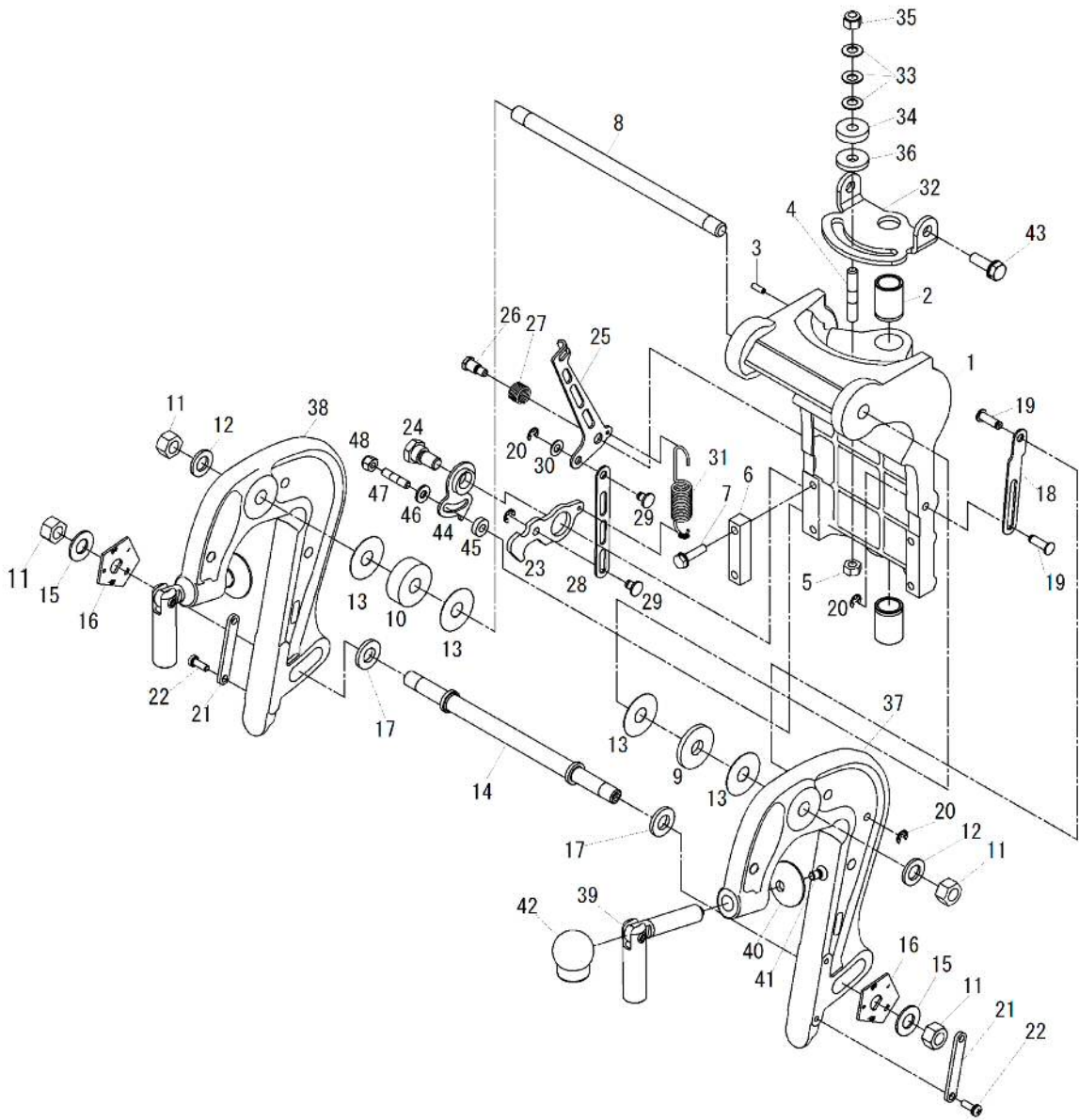
GEAR CASE GROUP



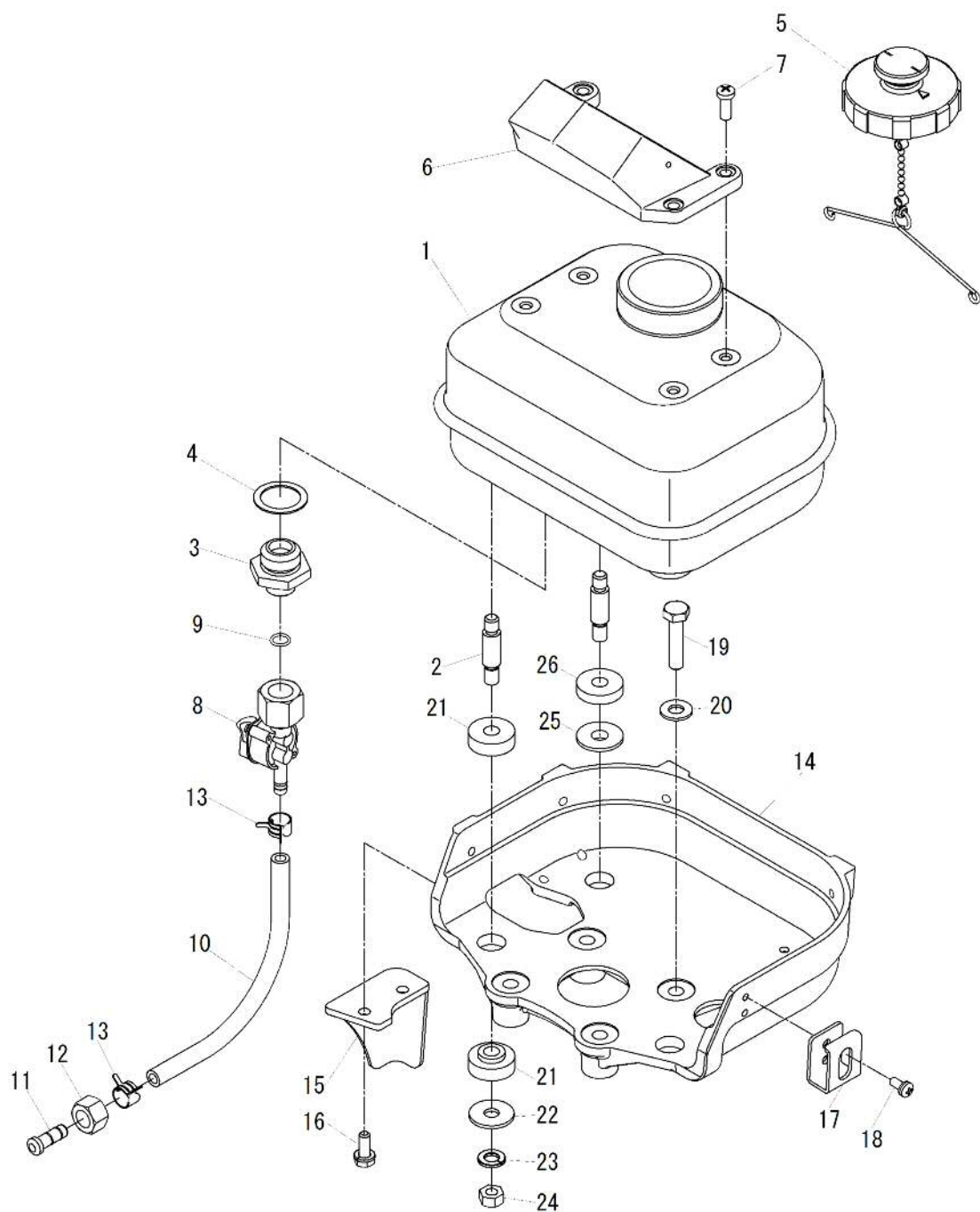
LOWER UNIT GROUP



LOWER UNIT GROUP



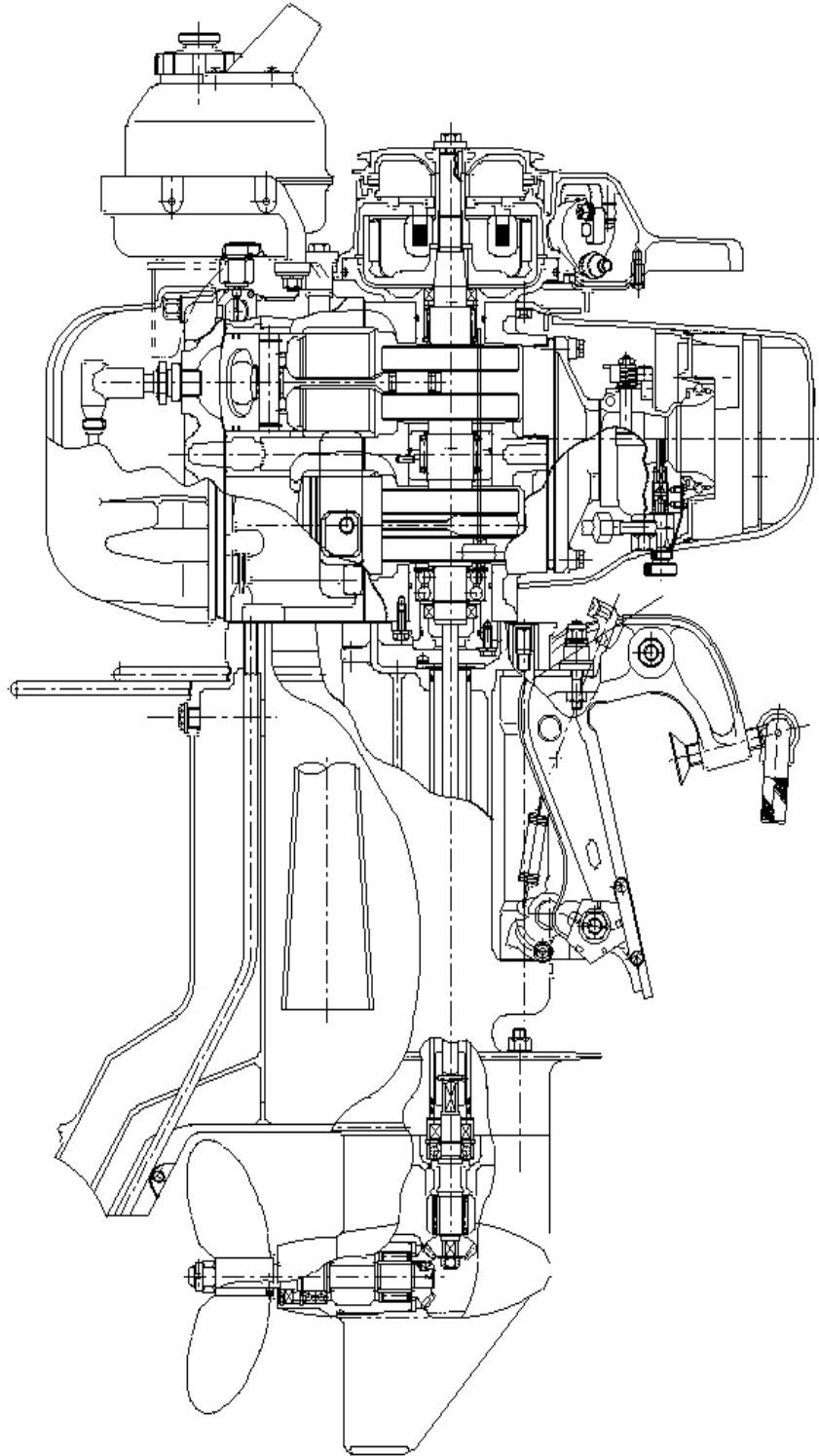
FUEL TANK GROUP



IV TROUBLE SHOOTING

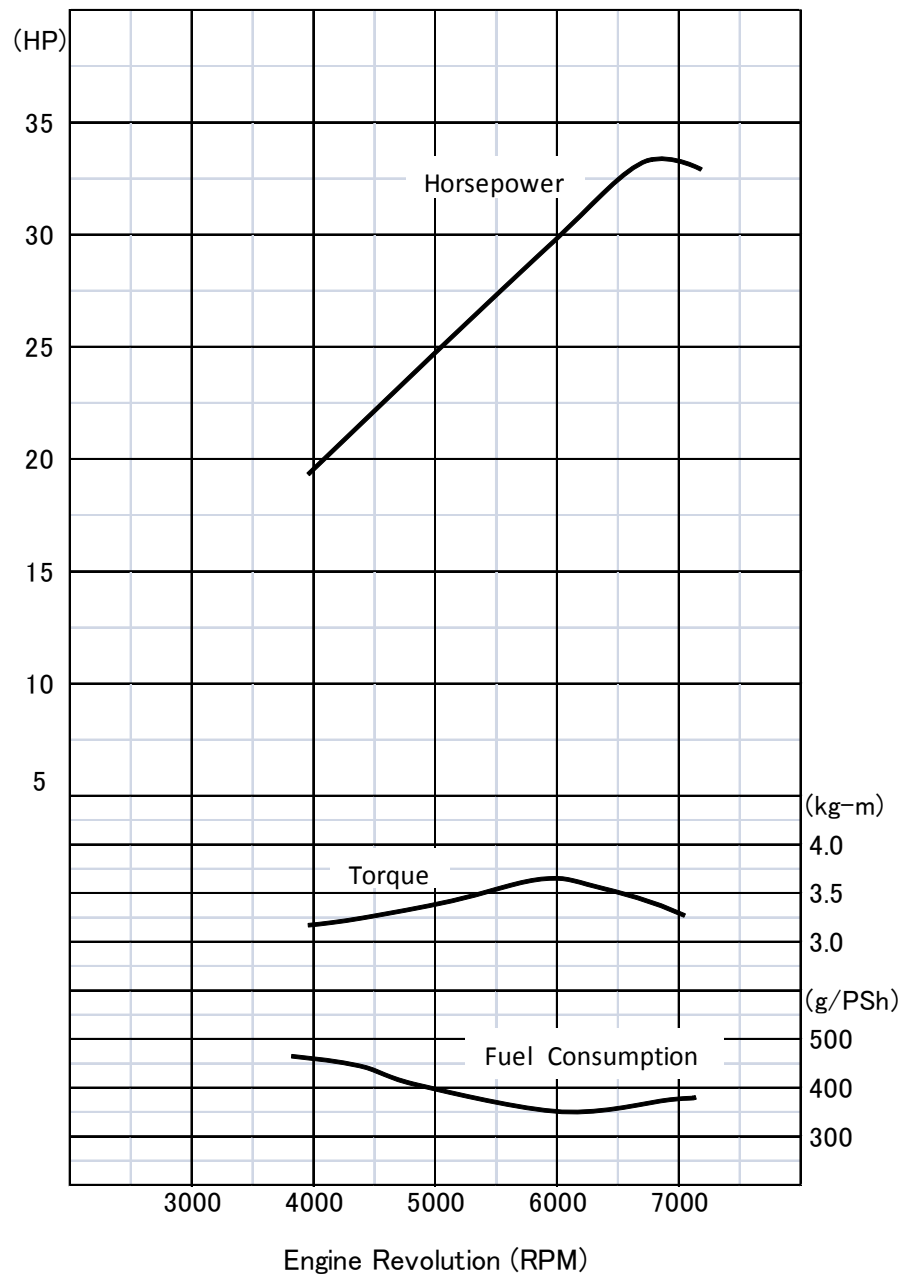
Boat dose not match motor	☆	☆☆				☆	☆		
Boat overloaded. Hull bottom coated withshell, Propeller pitch exessive, Bottom hooked		☆					☆		☆
Tilt angle incorrectly set		☆				☆	☆	☆	☆
Installation of motor low		☆					☆		
Installation of motor high		☆				☆		☆☆	☆
Propeller slips		☆				☆		☆	☆
Propeller pin sheared						☆		☆	☆
Propeller damaged or fouled withdebris or seaweed		☆			☆☆	☆	☆	☆	☆
Cavitation		☆				☆		☆	☆
Cooling water circuit clogged	☆	☆					☆	☆☆	☆
Water in fuel	☆	☆	☆	☆			☆		
Ignition of spark plug weak or intermittent	☆	☆	☆	☆	☆		☆		
Reverse connection of ignition cords			☆☆						
Wrong spark plug heat range	☆	☆					☆	☆	
Spark plug fouled	☆	☆	☆	☆	☆		☆		
Fuel, mixture too rich or too lean	☆☆	☆☆	☆	☆☆	☆		☆	☆	
High speed jet clogged or improperly sdj	☆☆	☆☆	☆	☆☆	☆		☆	☆	
Over choking			☆		☆				
Choking motor is necessary			☆						
Float chamber is not filled with fuel	☆	☆	☆	☆			☆		
Fuel line bent or cracked	☆	☆	☆	☆			☆		
Air vent of tank clogged or closed, fuel cock closed	☆	☆		☆☆			☆		
Fuel tank empty			☆	☆☆					
Fuel filter clogged	☆	☆	☆	☆			☆		
Timing lever in retarded position	☆☆	☆☆		☆			☆		
<div style="text-align: center;"> <div>Probable Cause</div> <div>Problem</div> </div>	Motor dose not develop full power	Lack of boat speed	Motor dose not start	Motor starts but does not continue to run	Motor vibrates excessively & RPM irregular	RPM too high	RPM too low	Over heating	Cooling water flow is insufficient

V CROSS SECTION OF MOTOR



VI PERFORMANCE CURVES

YAMATO 321 PERFORMANCE CURVES



VII SPECIFICATION FOR MODEL 321

Horse power	24 kW (33h.p.) at 6,800 rpm
Maximum Torque	3.7 kg cm / 26.8 ft lbs at 6,000 rpm
Bore X Stroke	66 mm×58 mm / 2.598×2.283
Piston Displacement	396. 9cc / 24.2 cubic inch
Piston Clearance	0.10~0.13 / 0.004 " ~0.005"
Cylinder	2
Port Timing - Intake	55 degree B.D.C
Port Timing - Exhaust	85 degree
Piston Clearance Volume	26 cc(1.58C.I.)
Induction System	Reed Valve, 1set
Cooling system	Ram water pressure (propeller)
Carburetor	One Ventury, 28mm
Ignition	Transistor Magneto
Flywheel weight	1.29 kg / 2.86 lbs.(Min)
Starting system	Manual (Rope)
Gear ratio	14:15
Fuel	Regular petro. Min. 86 Octane
Fuel tank capacity	2.3 Liter / 0.6 Gallon
Oil	2-cycle, water cooled
Fuel mixing ratio	30:1
Weight	42 kg / 92 lbs
Transom height	285 mm / 11.2 inches
Ignition timing	5.0~6.4 mm / 0.200"~0.250" B.T.D.C.
Spark plug	NGK
Spark plug gap	0.5 mm / 0.020"
Compression Ratio	8.6
Torque specification	6 mm 5.9~8.8 Nm (60~90 kg cm / 4.45~6.5 ft lbs) 8 mm 15~19.5 Nm (150~200 kg cm / 11~14 ft lbs) 10 mm 30~34 Nm (300~350 kg cm / 20~25 ft lbs)
Reed block	1 set Port size 29×13 mm (1.142×0.512)