TOHATSU OUTBOARD MOTOR

M8B

SERVICE MANUAL

JULY 1987

CONTENTS

1. SPECIFICATIONS

Model	M8B
Overall length, mm	Approx. 780
Overall width, mm	Approx. 320
Overall height, mm	S: Approx. 980, L: Approx. 1,107, XL: 1,234
Transom height, mm (in)	S: 435 (17), L: 562 (22), XL: 689 (27)
Weight (S), kg (lb)	S: 25 (55), L: 26 (57), XL: 27 (59)
Bore x stroke, mm	50 x 43
No. of cylinders	2
Piston displacement, cc (in^3)	169 (10.3)
Max. output, PS/rpm	8/5,000
Full-throttle speed range, rpm	4,500 to 5,500
Full-throttle fuel oil consumption, l/h	4.3
Lubrication system	Mixed gasoline (gasoline 50 : oil 1)
Cooling system	Forced water cooling (rubber impeller) type
Cooling water temp. control	Thermostat (pressure relief valve)
Starting system	Recoil hand starter (electric starter: optional)
Ignition system	Flywheel magneto (C.D. ignition system)
Lighting	12 V, 80 W (optional)
Spark plug	NGK BP7HS-10 or Champion L82YC, gap: 1 mm
Carburetor	Keihin Kikaki
Engine rotation	Clockwise
Clutch	Dog clutch (forward, neutral and reverse)
Reduction ratio	13 : 27
Maximum tilt angle	75°
Maximum steering angle	130°
Tilt stages and angle	6 stages, 4°–24°
Shallow water angle	32.5°
Control	Handle girp (remote control: optional)
Fuel tank	13 liters (separate)
Transom thickness, mm	30–55
Standard propellers (pitch)	S: 8.5, L: 7.5, UL: 7.5
Optional components	Propeller 6.5 (3 x 216 x 165—No. of propeller blades x dia. x pitch) for heavy duty Electric starter Remote control (cable length 2–6 m) Alternator (12 V, 80 W) Rectifier kit Safety switch Vertical starter Tachometer Chrome-plated water pump kit Neutral starter Oversized piston and ring (0.5 mm) Test propeller

2. FEATURES

(1) Compact, modular design and simple, functional styling allow for the lightest weight (25 kg: transom S) in this class without sacrificing excellent durability.
(2) Easy-to-use engine with excellent torque characteristic from low to high speed, thanks to ample engine displacement.
(3) Small control force of the recoil starter thanks to high performance C.D. ignition and carburetor, and low compression ratio engine, thus ensuring easy starting at any atmospheric temperature.
(4) Neutral start mechanism for safe operation.
(5) High stability at low speeds for long, continuous operation, allowing smooth acceleration from low speed through the use of the C.D. ignition with high-output, throttle-interlocked ignition advancer, fully sealed reed valve and special recirculation system.
(6) Applicable to all types of boats due to the 6-stage adjustable tilt mechanism, three transom heights and multi-step splash plate.
(7) Easy installation and removal of the motor using the tilt handle and side handles on both sides of the lower motor cover.
(8) Light steering and straight cruising due to well weight distribution; and a wide 130° steering angle allowing comfortable, sharp turning.
(9) Reverse lock interlocked with the clutch lever can be automatically applied when reversed.
(10) Shallow water cruising is possible tnanks to shallow water cruise device that also serves as a tail stopper.
(11) Solid block shock-absorbing rubber for easy installation and complete shock absorption.
(12) Simple construction with a small number of parts and less adjusting points for easy, simple inspection and servicing.
(13) Electric starter is mountable.
(14) Alternator with large capacity of 12 V, 80 W is mountable.
(15) Greatly reduced fuel consumption through newly developed engine and the gear case with less flow resistance.

3. DISASSEMBLY AND SERVICING

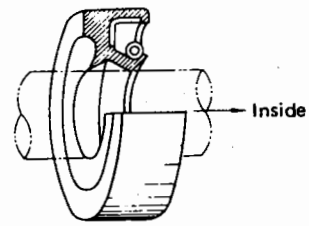
1 General Disassembly and Servicing Notes

(1) Securely fix the motor to the work bench.
(2) Be careful not to damage painting and joints of the cylinder and crankcase.
(3) Replace packings, gaskets, O-rings, oil seals, springs, slit pins, etc. with new ones when reassembling. Also, replace deformed snap rings with new ones when deformed.
(4) Be sure to use genuine Tohatsu parts when replacing, and use genuine Tohatsu oil.
(5) Use special tools when necessary.
(6) When disassembling, pay attention to mating marks on the parts, and make simple marks for convenience of reassembly.
(7) It is recommended to temporarily put small parts, bolts and nuts, washers and the like in position after removing, eliminating the fear of missing.
(8) Thoroughly clean the removed parts with oil or washing liquid and check them for wear and damage.
(9) When assembling, pay due attention to engagement, alignment, air tightness, lubrication, greasing, oil hole clog, packing, wirings, pipings, etc.

When tightening bolts on the cylinder and crankcase, tighten them diagonally and uniformly in order from larger diameter to smaller diameter, and from inside to outside, avoiding uneven tightening of them. (Reverse the above-mentioned procedure to remove.) To install oil seals, do not damage their lips on the shaft, and pay attention to their upper and lower sides. Also, apply the specified grease to the lips of oil seals. When applying liquid packing agent, read its instruction manual thoroughly and pay due attention to its coating thickness. If the agent is applied excessively, it will flow out and enter the case. If bolts and nuts are corroded and difficult to remove, spray screw-loosening agent (3M "Three Loosen") or the like, and wait for five minutes to loosen it. For detailed service information, refer to the tables tabulated later.

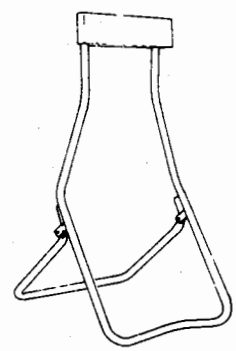
Bolts and nuts, washers, etc. are indicated in this manual as follows.

H620:	Hexagonal bolt, 6 mm dia. x 20 mm long
H6:	Hexagonal bolt, 6 mm dia.
N6:	Hexagonal nut (type 3), 6 mm dia.
W6:	Washer, 6 mm dia.
SW6:	Spring washer, 6 mm dia.
P620:	Pan head screw, 6 mm dia. x 20 mm long
F620:	Flat head screw, 6 mm dia. x 20 mm long



Ordinary oil seal installation direction

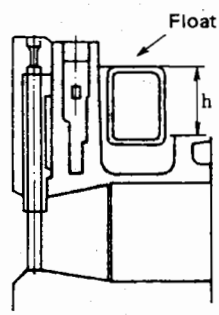
Fig.1.1



Work bench for display and servicing

Fig.1.2

2 Service Data

	Component	Description	Reference value	Repair or replacement limit
Engine	Piston	Clearance between piston and cylinder (min. clearance in direction normal to pin at 10 cm from piston skirt bottom)	0.02 – 0.05 mm (0.0008 – 0.0020 in)	0.15 mm (0.006 in) or more
		Clearance between piston pin and its hole	Tight 0.001 – Loose 0.008 mm (0.00004 – 0.00032 in)	0.05 mm (0.0020 in) or more
	Piston ring	Clearance at mating position	0.18 – 0.33 mm (0.0071 – 0.0130 in)	0.8 mm (0.031 in) or more
		Clearance between piston ring and ring groove (top and second)	0.01 – 0.05 mm (0.0004 – 0.0020 in)	0.08 mm (0.0031 in) or more
	Crankshaft	Deviation of centerline of rotating crankshaft	0.05 mm (0.0020 in) or less	0.05 mm (0.0020 in) or less
	Reed valve	Lift (valve stopper tip height)		
	Connecting rod	Side gap at large end	0.2 – 0.4 mm (0.008 – 0.016 in)	0.6 mm (0.024 in) or more
	Oil seal	Crankshaft lip		Replace in case of lip breakage, hardening, damage, or tightening allowance of 0.5 mm (0.020 in) or less on shaft
Fuel System	Carburetor  Fig.2.1	Main jet (M.J.)	#98	
		Slow jet (PS)	#48	
		Pilot screw return (PS)	1-3/8±1/4	
		Oil level (height from float chamber mating surface to float)	h=14±2 mm	
Cooling System	Thermostat	Type	Wax type	
		Operating temperature (start of open)	50.5° – 53.5°C	
		Operating temperature (fully open)	65°C	
	Water pump	Liner, guide plate		Replace when impeller sliding portion is worn excessively.
		Impellers		Replace when projections at tips are worn or cracked.

	Component	Description	Reference value	Repair or replacement limit
Electric Devices	**Magneto**	Ignition timing: Full throttle position of throttle grip Full close of throttle grip	 (BTDC 24°/5000 rpm) (ATDC 4°/700 rpm)	
	Coil plate	Clearance between bearing and crankcase slide portion	0.034 – 0.084 mm (0.0013 – 0.0033 in)	0.18 mm (0.0071 in) or more
	Spark plug	Type Spark plug gap	NGK BP7HS10 or Champion L82YC 0.9 – 1.0 mm (0.035 – 0.039 in)	 1.2 mm (0.047 in) or more
Others	**Bevel gear A**	Clearance between inside diameter of bush and propeller shaft	0.03 – 0.058 mm (0.0012 – 0.0023 in)	0.1 mm (0.0047 in) or more
	Propeller shaft housing	Clearance between inside diameter of bush and propeller shaft	0.06 – 0.09 mm (0.0024 – 0.0035 in)	0.15 mm (0.0059 in) or more
	Bevel gear B	Backlash between bevel gears A and B	[0.14 – 0.42 mm (0.0055 – 0.0165 in)] * 0.05 – 0.15 mm (0.0020 – 0.0059 in)	[0.84 mm (0.0331 in) or more] * 0.3 mm (0.012 in) or more
	Needle roller bearing	Drive shaft bearing		Replace in case of abnormal wear
	Oil seal	Drive shaft oil seal, propeller shaft oil seal, lower pump case oil seal		Replace in case of lip breakage, hardening, damage, or tightening allowance of 0.5 mm (0.020 in) or less on shaft
	Propeller 8.5	Outside diameter 216 mm (8.5 in) Pitch 216 mm (8.5 in)		Replace depending on wear (outside diameter), bend and damage.
	Propeller 7.5	Outside diameter 216 mm (8.5 in) Pitch 190 mm (7.5 in)		Replace depending on wear (outside diameter), bend and damage.
	Propeller 6.5	Outside diameter 216 mm (8.5 in) Pitch 165 mm (6.5 in)		Replace depending on wear (outside diameter), bend and damage.

*Dial reading by using backlash measuring tool

Oversize piston: When 0.5 mm oversized piston and ring are used, finish the bore of the cylinder to dimension of 50.50 to 50.51 mm

3 Sealer, Adhesive and Lubricant Applying Points

Component	Three Bond 1342	Three Bond 1303B	Three Bond G17	Flash Setting Three Bond 1741	Three Bond 1104-1	Three Bond 1107	Low temp. resistant grease LT2 (NIPPECO LT2)	Genuine Tohatsu grease	Cup grease	Genuine Tohatsu engine oil	Genuine Tohatsu gear oil	Remarks
Pipe nipple		●										Press fit
Piston										●		Ring groove, skirt
Piston pin										●		
Piston ring										●		
Cylinder liner										●		Inside wall
Main bearing										●		Rotating parts of bearing
Big end bearing										●		Ditto
Small end bearing										●		Ditto
Mating surfaces of cylinder/ crankcase					●							Coat thickness
Crankshaft and upper oil seal									●			Lip
Crankshaft and central oil seal										●		Lip
Crankshaft and lower oil seal									●			Lip
Drive shaft oil seal									●			Lip
Magneto coil plate							●					Bearing and sliding surface
Screws and lower set plate	●											Thread
Starter case							●					
Starter spring							●					
Friction spring							●					
Bolts and starter shaft	●											Thread
Carburetor							●					Lever sliding portion
Advancer lever							●					Sliding portion
Throttle drum							●					Sliding portion
Throttle arm							●					Sliding portion
Starter lock								●				Sliding portion
Starter lock cam								●				Sliding portion
Throttle wire								●				
Ball joint		●										Thread
Engine base packing						●						Upper and lower sides
Propeller shaft housing									●			Fitting portion
Propeller shaft O-ring									●			
Propeller shaft oil seal									●			Lip
Lower pump case oil seal									●			Lip

Component	Three Bond 1342	Three Bond 1303B	Three Bond G17	Grease (molybdenum)	Adhesive 17A	Flash Setting Three Bond 1741	Three Bond 1104-1	Three Bond 1107	Low temp. resistant grease LT2	Genuine Tohatsu grease	Cup grease	Genuine Tohatsu engine oil	Genuine Tohatsu gear oil	Remarks
Pump case bolt	●													Thread
Water pipe seal rubber (lower)													●	Inside
Water pipe seal rubber (upper)													●	Inside
Exhaust pipe bolt	●													Thread
Cam rod bush													●	Full circumference
Cam rod bush O-ring A										●				
Cam rod bush O-ring B										●				
Gear case lubricant													●	320 cc
Stern bracket plate										●				
Clamp screw										●				Thread
Tilt stopper bush										●				Sliding surface
Bracket shaft										●				Sliding surface
Bracket shaft bush										●				Sliding surface
Thrust plate										●				Sliding surface
Bracket shaft O-ring										●				Sliding surface
Bracket friction plate										●				
Bracket friction bolt										●				Thread
Reverse lock link joint										●				Sliding surface
Swivel bracket										●				Internal grease filling
Grip										●				Sliding portion
Steering handle bush										●				Sliding portion
Steering handle washer										●				Sliding portion
Steering handle wave washer										●				Sliding portion
Throttle shaft bush										●				Sliding portion
Shift lever shaft oil seal										●				Lip
Shift lever shaft bush										●				Sliding portion
Shift rod lever										●				Sliding portion
Shift lever stopper										●				Sliding portion
Shift rod										●				Insert portion of shift rod lever
Upper motor cover seal rubber					●									Adhering portion
Starter seal rubber					●									Adhering portion
Choke rod grommet										●				Inside
Throttle shaft										●				Sliding portion
Hook lever bush										●				Sliding portion
Hook lever seal ring										●				Sliding portion

Component	Three Bond 1342	Three Bond 1303B	Three Bond C17	Grease (molybdenum)	Three Bond 1104-1	Three Bond 1107	Low temp. resistant grease LT2	Genuine Tohatsu grease	Cup grease	Genuine Tohatsu engine oil	Genuine Tohatsu gear oil	Remarks
Drive shaft				●								Spline crankshaft side
Propeller shaft								●				Propeller insert portion
Drive shaft guard pipe			●									Grommet

4 Tightening Torques

No.	Part	Thread dimensions mm	Tightening torque kg.m (lb.ft, N.m)	Tightening condition
1	Magneto nut	12	5 – 6 (36.1 – 43.3, 0.51 – 0.61)	
2	Cylinder head bolt	6	0.8 – 1.0 (5.8 – 7.2, 0.08 – 0.1)	
3	Crankcase bolt	6	1.2 – 1.4 (8.6 – 10.1, 0.12 – 0.14)	
4	Exhaust cover bolt	6	0.8 – 1.0 (5.8 – 7.2, 0.08 – 0.1)	
5	Inlet manifold bolt	6	1.2 – 1.4 (8.6 – 10.1, 0.12 – 0.14)	Tightened with crankcase
6	Exhaust pipe bolt	6	0.7 – 0.9 (5.1 – 6.5, 0.07 – 0.09)	
7	Spark plug	14	2.5 – 3.0 (18.1 – 21.7, 0.26 – 0.31)	
8	Bracket nut	8	1.2 – 1.5 (8.6 – 10.8, 0.08 – 0.15)	
9	Gear case	6	0.8 – 1.0 (5.8 – 7.2, 0.08 – 0.1)	
10	Propeller shaft housing	6	0.8 – 1.0 (5.8 – 7.2, 0.08 – 0.1)	
11	Drive shaft housing bolt	6	0.8 – 1.0 (5.8 – 7.2, 0.08 – 0.1)	
12	Ball joint	5	0.2 – 0.3 (1.4 – 2.2, 0.02 – 0.03)	Apply Three Bond 1342
13	Switch case nut	20	Tighten ¾ turn after contact with tightening surface	
14	Other bolts and nuts	4 5 6	0.15 – 0.20 (1.08 – 1.44, 0.02) 0.25 – 0.35 (1.81 – 2.5, 0.03 – 0.04) 0.50 – 0.65 (3.61 – 4.7, 0.05 – 0.07)	

5 Tools and Meters Required for Disassembly and Servicing

The following tools and meters are required for disassembling and servicing Tohatsu's outboard motor. Be sure to use special tools when specified in this manual. Refer to "How to Use Special Tools" explained later.

(1) General Tools

1.	Straight-edge screwdrivers	200 mm 150 mm 100 mm
2.	Phillips screwdrivers	200 mm 150 mm 100 mm
3.	Wrenches	6
4.	Box wrenches	10 x 13 mm 17 x 21 mm 21 x 23 mm
5.	Adjustable wrench	300 mm
6.	Pliers	
7.	Long nose pliers	
8.	Cutting pliers	
9.	T-type box wrenches	10 mm 13 mm 17 mm
10.	T-type universal wrenches	10 mm 13 mm
11.	Plastic hammer	
12.	Hammer	
13.	Hexagonal bar wrenches	8 mm 10 mm
14.	Box wrench	21 mm
15.	Spark plug wrench	21 mm
16.	Torque wrench	500/1500 kg.cm
17.	Box wrench set	

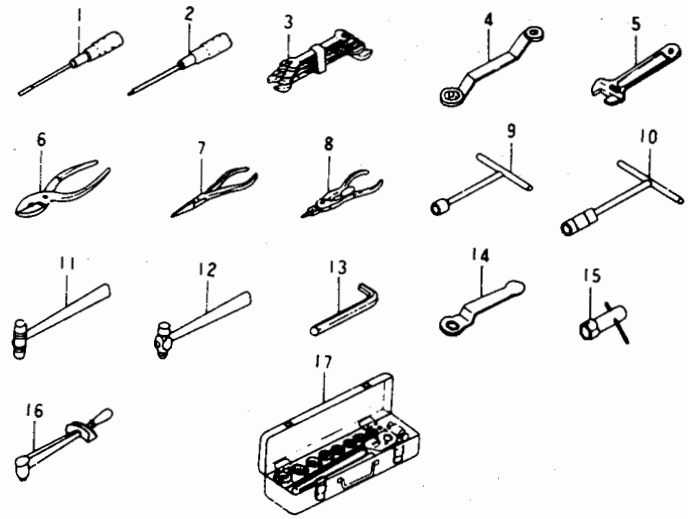


Fig.5.1

(2) Compression gauge

(3) Test propeller

(4) Meters and measuring tools

Use the following commercial meters and measuring tools.

Tachometer	600–6,000 rpm, or Tohatsu tachometer
Tester	Resistor x 1,000, 10 kohms, 30–300 VAC, 30 VDC, 3 V or less built-in battery.
Slide calipers	300 mm slide calipers
Micrometer	0.01 mm graduation, outside diameter measuring micrometer
Cylinder gauge	50–100 mm cylinder gauge
Ring gauge	55 mm diameter
Dial gauge	0.01 mm graduation dial gauge
Filler gauge	0.03–0.3 mm measurable
V-block	
Surface plate	500 x 600 mm

Magnet base for dial gauge or dial gauge stand

6 How to Use Special Tools

(1) Flywheel magneto puller (336-72214-1)

1. Disassembly

Fix tools A and B to the flywheel magneto with bolt D, then remove the magneto nut with 19 mm socket wrench. (Nut is right-hand thread). (Fig.6.1)

Screw tool C in tool B, then tighten tool C with a 24 mm socket wrench to remove the flywheel.

NOTE: Tighten three bolts (Fig.6.2)

2. Assembly

When attaching the flywheel, confirm that the magneto key is attached, then tighten the magneto washer and nut. Attach tools A and B to the flywheel, then tighten them with a torque wrench with the specified torque.

Tightening torque: 5 – 6 kg.m
36.1 – 43.2 lb.ft
0.51 – 0.61 N.m

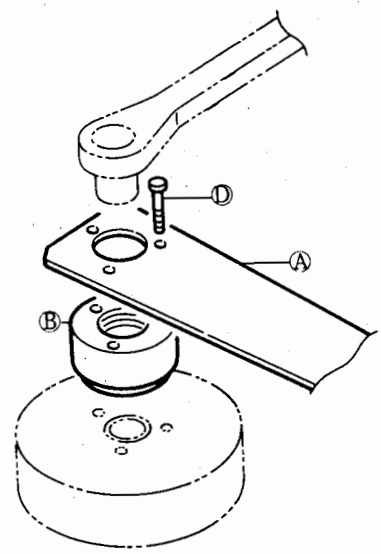


Fig.6.1

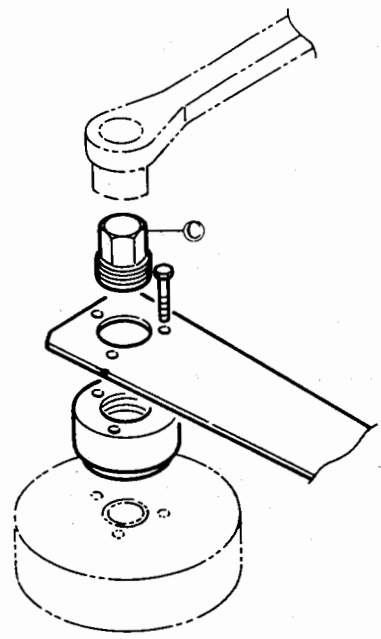
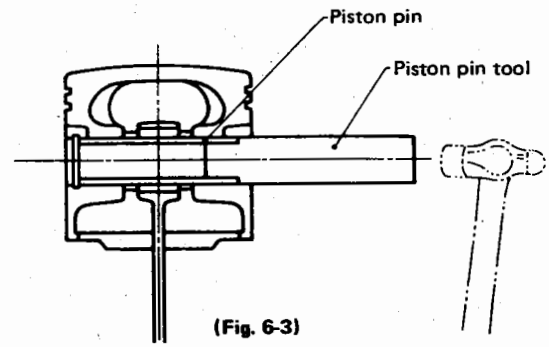


Fig.6.2

(2) Piston pin tool (332-72215-0)

Remove the piston pin clip, insert the piston pin tool into the piston pin hole, then remove the piston pin by gently tapping the piston pin tool end with a hammer. In this case, withdraw the piston pin while holding piston to avoid bending rod (Fig.6.3).



(Fig. 6-3)

(3) Drive shaft bearing tool assembly (332-72256-0)

1. Disassembly

Mount the guide on the drive shaft as shown in Fig.6.4, then insert it into the hole to drop the lower bearing from the drive shaft.

2. Assembly

Mount the lower bearing and guide on the drive shaft, then insert them into the hole by hammering until clearance H becomes zero, as shown in Fig.6.5.
NOTE: Do not deform the gear case by hammering.

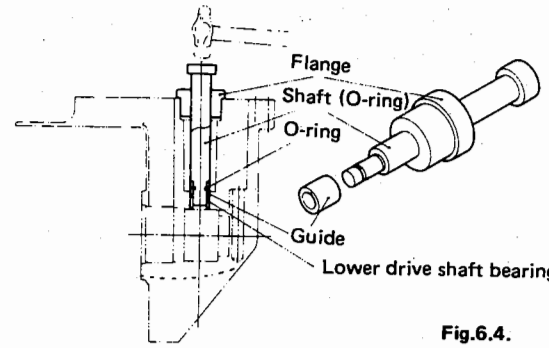


Fig.6.4.

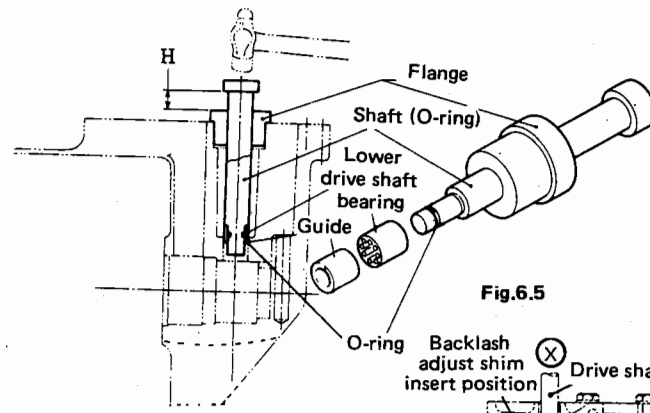


Fig.6.5

(4) Backlash measuring tool

1. Measuring method
   a. Fix the skeg portion of the gear case with a vice.
   b. Assemble as shown in Fig.6.6.
   c. Pull out the drive shaft by hand in the direction of (X).
   d. Insert a straight-edge screwdriver into the slot at the end of shaft B, then tighten a regular 6 mm nut to fix the shaft into bevel gear A.
      NOTE: Do not tighten the regular 6 mm nut excessively, and never tighten it when the shaft is not inserted into the bevel gear A.
      Then set a dial gauge on (A)-portion.
   e. Push the arm in the direction of (B) manually to fix bevel gear B.
   f. While pressing shaft A in the direction of (Z), turn it to read the dial gauge. In this case, press the arm in the direction of B.
   g. Adequate reading range of the dial gauge is 0.14 to 0.42 mm. Use adjust shims when necessary.
      Two adjust shims (0.1 and 0.15 mm thick) are provided.

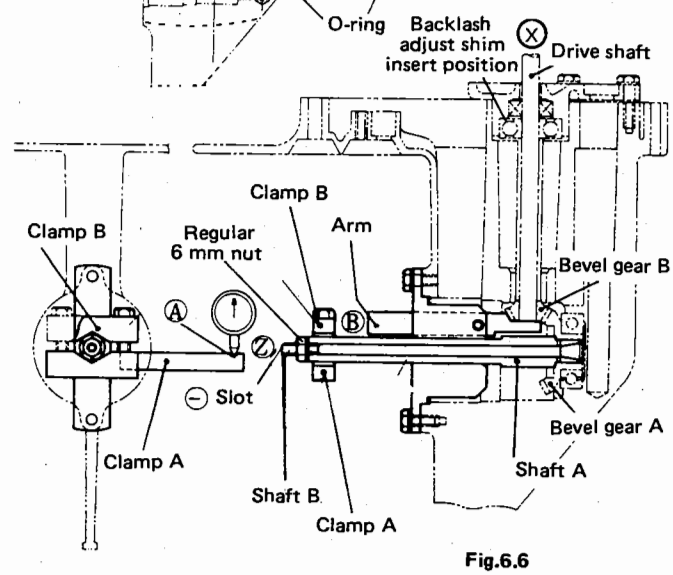


Fig.6.6

2. Disassembly

Loosen the regular 6 mm nut, then gently tap the slot portion of shaft B in the direction of (Z) to disengage bevel gear A and shaft A.

(5) Spring pin tool

Use special tools for clutch pin and clutch cam pin, which are both spring pins.

- Use special tools to remove and attach the clutch pin as shown in Fig.6.7.
- Use special tools to remove and attach the clutch cam pin as shown in Fig.6.8.

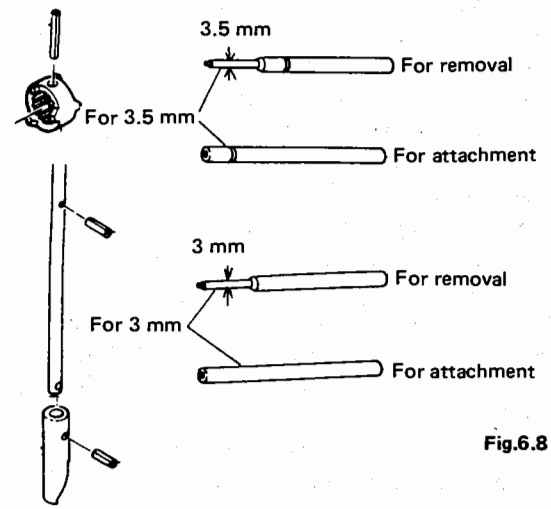


Fig.6.8

7 Removal and Disassembly of Power Unit

Remove the power unit from the outboard motor for inspection and servicing of the engine. Note that the cylinder head, recoil starter, magneto, carburetor, etc. can be inspected and serviced without detaching the power unit.

(1) Power unit removal

1. Disconnect the wire from the stop switch.
2. Remove the starter lock rod (option).
3. Remove the throttle wire from the throttle drum.
4. Remove the choke rod and fuel pipe from the carburetor.
5. Remove the drive shaft housing bolt (H635-6), then pull out the power unit upward.

(2) Power unit disassembly

1. Crankcase head removal:

Remove crankcase head bolts (H620-2), then remove crankcase head gasket.

2. Recoil starter removal:

Remove recoil starter bolts (H620-3), recoil starter assembly, crank pulley bolts (H612-3), and crank pulley in this order.

3. C.D. unit removal:
   - Remove the plug cap from the plug.
   - Disconnect the coupler between C.D. unit and coil plate.
   - Remove C.D. unit bolts (H620 and H635), then remove the C.D. unit.
4. Remove the spark plugs.
5. Flywheel magneto removal:
   - Remove the flywheel by using the special tool (flywheel magneto tool).

     NOTES: 1. Refer to Item "How to Use Special Tools".
     2. Magneto nut is right-hand threaded.
   - Remove the ball joint cap on the advancer link rod from the ball joint on the coil plate.
   - Remove the upper set plate screw (P510-3), then remove the upper set plate.
   - Remove the coil plate by pulling it up.
   - Remove the lower set plate screw (F612-4), then remove the lower set plate.
6. Carburetor removal:
   - Remove the throttle link rod.
   - Remove the carburetor bolts (H685-2), then remove the air silencer and carburetor.
7. Cylinder head removal
   - Remove the cylinder head bolts (H630-11), then remove the cylinder head. After that, take out the thermostat.
   - Loosen the bolts in reverse order of the tightening procedure, starting with No. 11.
8. Exhaust cover removal
   - Remove the exhaust cover bolts (H625-7), then remove the outer and inner exhaust covers.

     NOTE: When removing the exhaust cover, widen the groove on mating surface with a straight edge screwdriver, avoiding damage to and deformation of the seal.
9. Inlet manifold and reed valve
   - Remove the crankcase bolts (H675-6, H650-2 and H630-2), then remove the inlet manifold and reed valve assembly.

     NOTE: When the inlet manifold, reed valve assembly and crankcase are removed, sealer is peeled off the mating faces because they are tightened together. Therefore, remove the crankcase, clean the mating faces, and apply sealer for reassembly.
   - Remove throttle drum holder screws from the inlet manifold, then remove the advancer lever and throttle drum. The advancer lever and throttle drum can be separated into upper and lower portions, respectively.
10. Crankcase removal
    - Remove the crankcase by widening the two grooves provided between the crankcase and the cylinder, by inserting a straight-edge screwdriver into the two grooves.
    - Remove the crankshaft assembly from the cylinder.

      NOTE: If the crankshaft assembly is worn out or deformed, replace it with a new one as a unit.
11. Crankshaft and piston
    - Remove the piston pin clip.
    - Remove the piston pin from the connecting rod by using the piston pin tool (special tool).
    - Remove the small end bearing.
    - Remove the piston ring (#1 and #2 piston rings are common, plain types).

8 Parts Inspection

Refer to the service data as a guideline for repair and replacement.

Component	Inspection item	What to do
Cylinder head	1. Carbon deposit in combustion room. 2. Distortion of installing surface. 3. Corrosion of parting face of cylinder head. 4. Clogging of cooling water system.	1. Clean. 2. Correct (Rub it on the surface plate with #200 sandpaper). 3. Correct or replace when necessary. 4. Clean.
Cylinder	1. Carbon deposit at air exhaust port. 2. Deposits inside water jacket. 3. Wear of cylinder bore: Measure inside diameter of cylinder with cylinder gauge, and measure clearance between piston and cylinder bore. (Fig.8.1) 4. Seizure. 5. Scoring in cylinder.	1. Clean. 2. Clean. 3. If wear exceeds the specified, replace it with a new one, or drill and hone finish. Oversized piston is 0.5 mm. 4. Replace, or use oversize piston after boring. 5. Repair depending on conditions (Use #400 to #600 sandpaper).
Piston	1. Carbon deposited to piston head and ring groove. 2. Scoring on sliding surface. 3. Measure piston ring and piston ring groove (Fig.8.2). 4. Measure piston pin hole diameter. 5. Measure outside diameter of piston skirt at 100 mm from bottom in exhaust direction (Fig.8.3).	1. Clean. 2. Repair depending on conditions (Use #400 to #600 sandpaper). 3. Replace if specified clearance is exceeded. 4. Replace if specified diameter is exceeded. 5. Replace if specified diameter is exceeded.
Piston ring	1. Measure clearance at mating face (Fig.8.4). If ring gauge is not available, measure at the lower portion of the less worn cylinder bore.	1. Replace if specified clearance is exceeded.
Crankshaft	1. Alignment of centerline of rotating crankshaft, with main bearings supported with V-blocks at both ends. 2. Bent connecting rod. 3. Side gap at large end.	1. Repair or replace with a new one if deflection exceeds the specified. (See Fig.8.5 and Fig.8.6) 2. Replace if specified bending is exceeded. 3. Replace if specified gap is exceeded.
Reed valve	1. Height of valve stopper. 2. Crack and damage of reed valve. 3. Deformation of valve seat surface.	1. Adjust. (Fig.17.1) 2. Replace. 3. Replace.
Thermostat	1. Operational check of thermostat. 2. Fatigue or deformation of spring.	1. Replace if operation is faulty. 2. Replace.

Operational (open/close) check of thermostat

1. Replace thermostat with a new one if its valve opens at ordinary temperature.
2. Measure the valve-open temperature by submerging the thermostat in water and increasing water temperature gradually.
3. Measure the lift of the open-valve after placing the thermostat in water at about 65°C for about five minutes, because the thermostat has time delay. (Refer to Service Data).

• Checking the Power Unit Parts

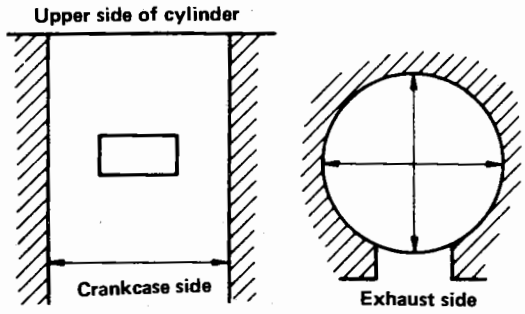


Fig.8.1 Cylinder bore measuring points and directions

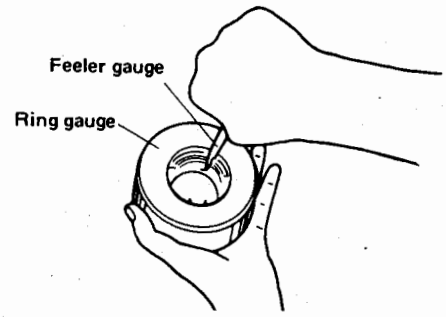


Fig.8.4 Piston ring mating clearance measurement

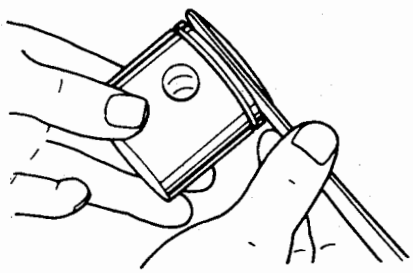


Fig.8.2 Piston ring groove measurement

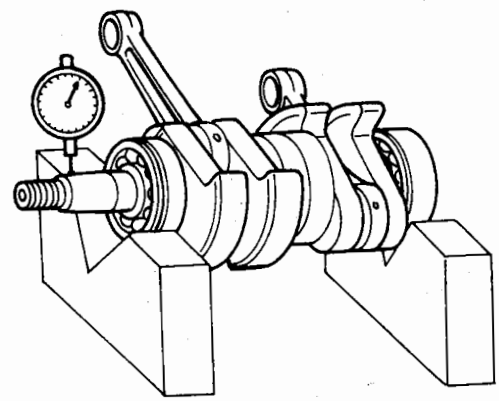


Fig.8.5 Alignment of centerline of rotating crankshaft

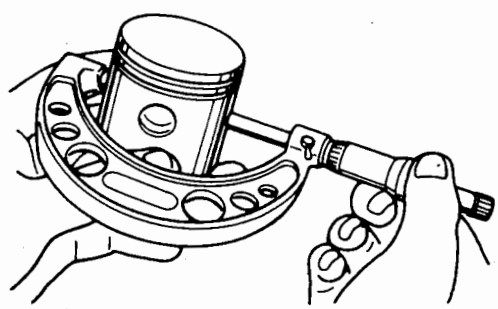


Fig.8.3 Piston diameter measurement

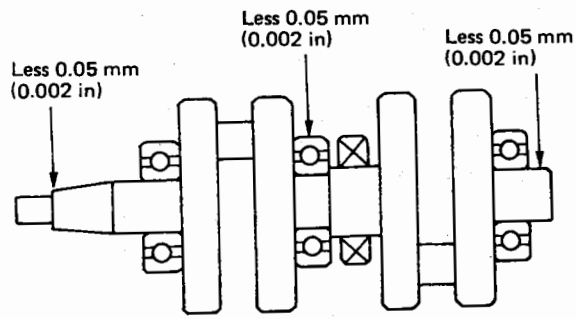


Fig.8.6 Measuring positions of alignment of centerline of rotating crankshaft

9 Power Unit Assembly

Assemble the power unit in reverse order of the disassembling procedure paying attention to the following points.

- Observe the General Assembly and Servicing Notes described in Item 3, 1).
- Perform inspection and checks according to Service Data in Item 3, 2).
- Carefully use the specified sealer, adhesive or lubricant according to the table in Item 3, 3).

(1) Piston assembly:

1. Mount the small end bearing on the small end of the connection rod, and insert the piston pin into the piston on one side by tapping lightly, connect the piston to the connecting rod and insert the piston pin by hammering lightly, using the piston pin tool (special tool).

NOTE: Assemble the piston so that "UP" mark is positioned on the magneto side of the crankshaft.

2. Insert the piston pin clip into the piston pin clip hole of the piston securely.

NOTE: When reassembling, use a new piston pin clip.

3. Mount the piston ring on the piston aligning it with its lock hook position.

(2) Crankshaft:

1. Fit the main bearing by pressing the inner race.
2. Press the main bearing so that the knocks approach the connection rod as shown in Fig.9.1. Also, confirm that the knocks have been press fit securely.
3. Attach the crankshaft oil seals in the position shown in Fig.9.1.
4. Apply genuine Tohatsu engine oil to the sliding and rotating portions.

(3) Attaching the crankshaft assembly to the cylinder and assembling the crankcase:

1. Mount upper crankshaft oil seal on the crank.
2. Confirm that the mating faces of the cylinder and crankcase are free from fins, irregularities, foreign matter, etc.
3. Confirm that the cut portion of the piston ring aligns with the lock hook position on the piston, then insert the piston into the cylinder.
4. When attaching the crankshaft assembly to the cylinder, press the upper crankshaft oil seal to the upper stopper and the central crankshaft oil seal to the thrust plate, then confirm that they are not deformed. Attach the main bearing so that its knocks are inserted in the specified grooves.

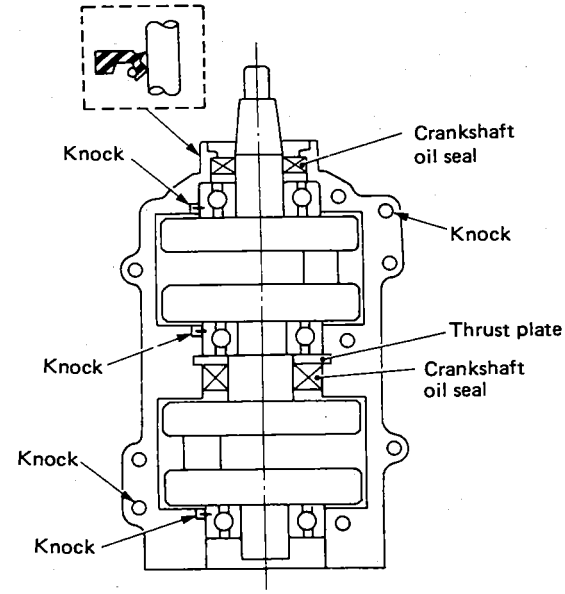


Fig.9.1

5. Confirm that the cylinder crankcase is provided with two knocks, degrease it, and apply packing agent (Three Bond 1104) to both sides of the cylinder crankcase.

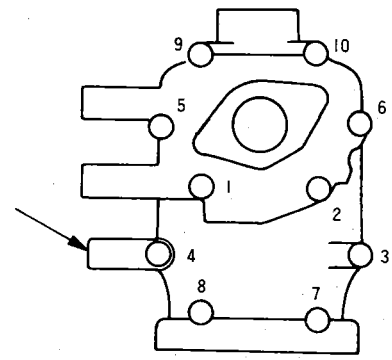


Fig.9.2

6. Tighten the crankcase bolts (H675-6, H650-2 and H630-2) with the specified torque. A clamp band is set at No. 4.

Tightening torque: 1.2 to 1.4 kg.m

NOTE: Do not mix crankcase bolts (high tensile bolts) with other bolts. Tighten bolts in the order shown in Fig.9.2.

7. Fix the starter brackets L and R with bolts (H623-4).

(4) Exhaust cover assembly:

Tighten the bolts with the specified torque in a few steps in the order marked on the cover. Use a clamp band at No. 7.

Tightening torque: 0.8 to 1.0 kg.m

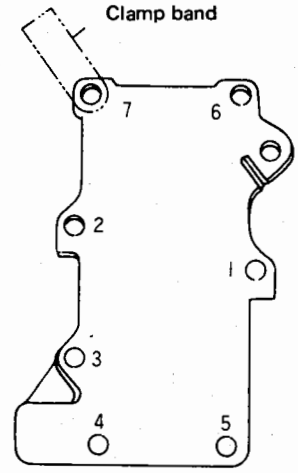


Fig.9.3

(5) Cylinder head assembly:

Tighten the bolts (H630-11) with the specified torque in a few steps in the order of the numbers raised on the upper surface of the cylinder head cover.

Tightening torque: 0.8 to 1.0 kg.m

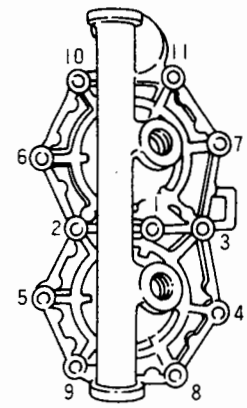


Fig.9.4

(6) Magneto assembly:

1. Attach the lower set plate.

Tighten screws (flat head F612-4) after applying adhesive (Three Bond 1342).

2. When attaching the coil plate to the cylinder crankcase, apply antifreeze grease to the respective sliding portions.

3. Attach the coil plate to the cylinder case, then fix the upper set plate with screws (pan head screw P510-3).

4. Degrease the taper portions of the crankshaft and flywheel completely, insert the magneto key in the crankshaft, then attach the flywheel while keeping the magneto key in position, avoiding its dropping.

5. Tighten the magneto nut (right-hand thread) with the specified torque.

Specified torque: 5 to 6 kg.m

6. When attaching the C.D. unit, arrange the lead wire on the high voltage side after passing on the rear side of the C.D. unit, and fix the ground cable with bolt (H635), spacer and washer as shown in Fig.9.5.

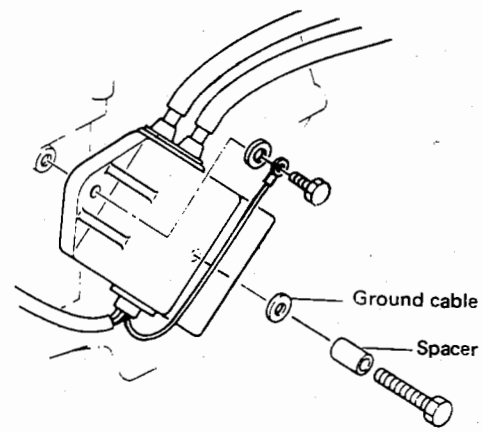


Fig.9.5

(7) Attaching the carburetor:

1. Assemble the throttle drum, throttle arm and advancer lever as shown in Fig.9.6. Attach the rod snap (3 mm diameter - B) to the throttle arm and the rod snap (5 mm diameter) to the advancer lever. Insert this subassembly into the bearing at the inlet mainifold. Fix the throttle drum holder with screws (pan head P520-2). Apply antifreeze grease to the bearing portion.
2. Insert the air silencer spacer into the air silencer at the joint between the air silencer and the carburetor, insert bolts (H685-2) and washers into the air silencer and carburetor in this order to fasten them to the inlet manifold. At this time, confirm that the carburetor gasket is located and secured in position.
3. Attach the rod snap (3 mm diameter-B) to the throttle lever at the carburetor, then connect the throttle lever to the throttle arm through the throttle link rod.
4. Attach the nut (M5) and ball joint cap to the advancer link rod, then connect the advancer lever to the ball joint at the coil plate.

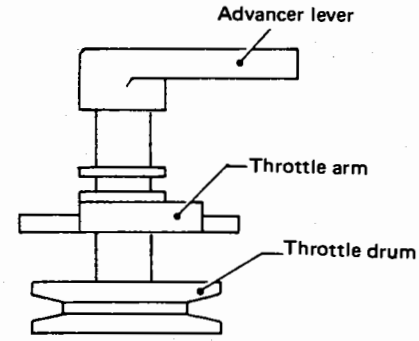


Fig.9.6

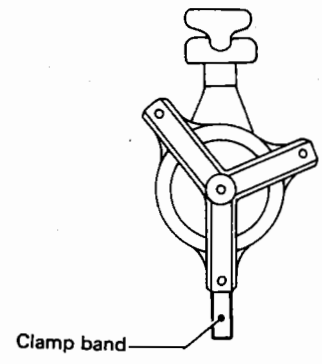


Fig.9.7

(8) Attaching the recoil starter

1. Fix the crank pulley to the magneto flywheel with bolts (H612-3).
2. Attach the recoil starter with bolts (H620-3). At this time, use a clamp band at the stay on the cylinder head side of the recoil starter.

(9) Attaching the crankcase head

Attach oil seals in the positions shown in Fig.9.8. Use two oil seals (12-28-5) in which spacer (22-27.5-1) must be provided.
Attach the crankcase head with bolts (H620-2).

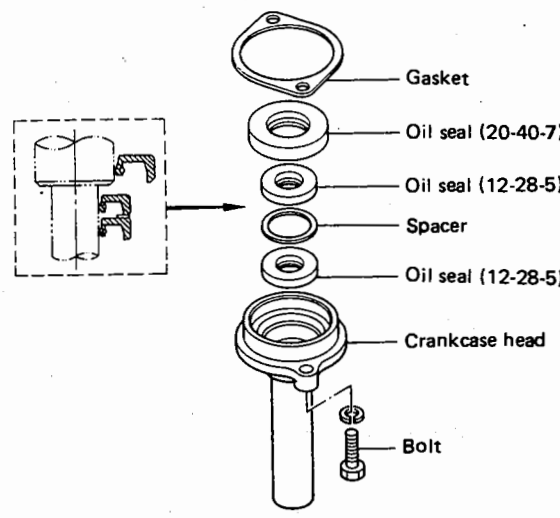


Fig.9.8

(10) Wiring:

1. Wire according to the diagram, and secure them well with clamps, etc.
2. Avoid sharp bending and folding and contact with other parts that could cause damage or wire breakage.
3. Fix the wiring with the clamp associated with the crankcase as shown in Fig.9.9. At this time, it is required that the coil plate lead wire has sufficient length to allow free movement of the coil plate.
4. Fix the high-voltage cord for the lower cylinder with clamps provided on the exhaust cover and recoil starter as shown in Fig.9.10.

Fix the high-voltage cord for the upper cylinder with the clip in the position shown in Fig.9.10.

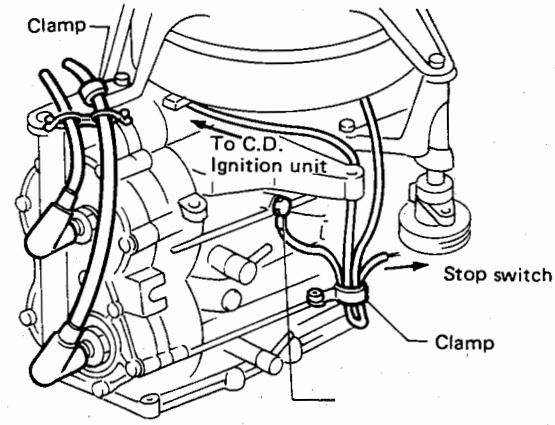


Fig.9.9

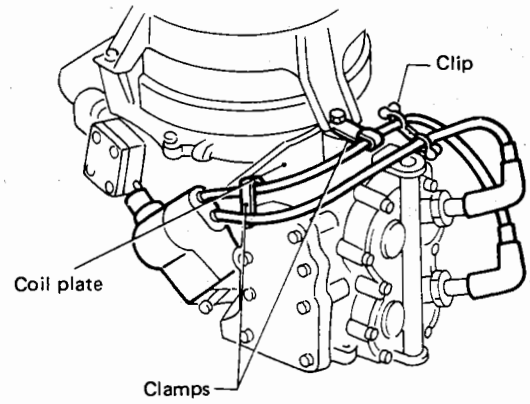


Fig.9.10

(11) Throttle mechanism

1. Adjust the throttle and spark timing advance angle after attaching the power unit to the lower unit.
2. Adjust the position of the ball joint cap on the advancer link rod so that the coil plate turns counterclockwise to contact with the stopper when the throttle valve is closed fully by moving the advancer lever manually.
3. Mount the throttle wire on the throttle drum, and screw the nuts in the throttle wire mount of the lower motor cover. Be sure to correct the wire installation position shown in Fig.9.11.
4. Adjust the position of the nuts provided at the throttle wire mount so that the magneto coil plate turns counterclockwise and contacts with the stopper when the handle grip is turned counterclockwise fully, and the magneto coil plate turns clockwise and contacts with the stopper when the handle grip is turned clockwise fully.

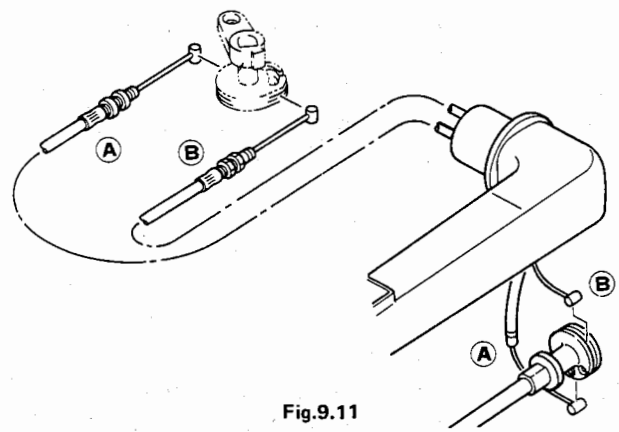


Fig.9.11

(12) Fuel pipe and lubrication tube

1. Fuel piping
   a. Locate a grommet around the central position of the fuel pipe B (110 mm long).
   b. Do the fuel piping as shown in Fig.9.12, and locate the fuel pipe B between the C.D. Ignition unit and the crankcase.

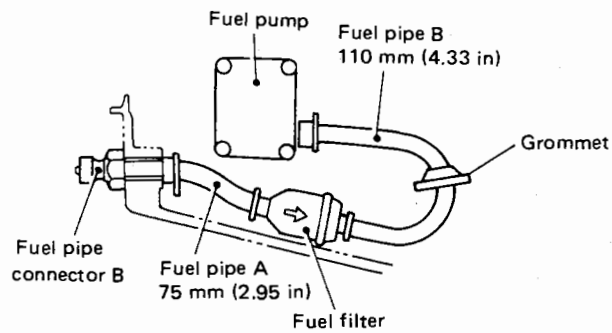


Fig.9.12

2. Lubrication piping
   a. Connect lubrication pipes (250 mm long) between the check valve at the lower cylinder and the nipple at the upper cylinder, and lubrication pipe (120 mm long) between the check valve at the upper cylinder and the nipple at the lower crankcase.

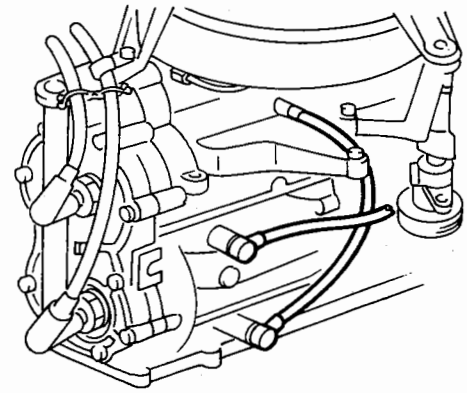


Fig.9.13

(13) Choke

1. Apply genuine Tohatsu grease to the interior of the choke rod grommet.
2. Insert the choke rod into the rod snap (3 mm diameter-B) on the choke lever at the carburetor.
3. Confirm that the choke valve is fully closed when pulling out the choke rod completely, and opened fully when depressing it to its original position.

(14) Spark plug

1. Confirm that the gap of the spark plug is adequate (0.9 to 1.0 mm), then install it on the cylinder head. When installing a new plug, rotate it more about 3/4 turn with a plug wrench after seating it on its mounting seat.

Tightening torque: 2.5 – 3.0 kg.m
18.1 – 21.7 lb.ft
0.26 – 0.31 N.m

10 Gear Case Disassembly

(1) Gear case removal:

1. Remove the lower spring pin from the shift rod joint with the special tool. (Fig.10.1)

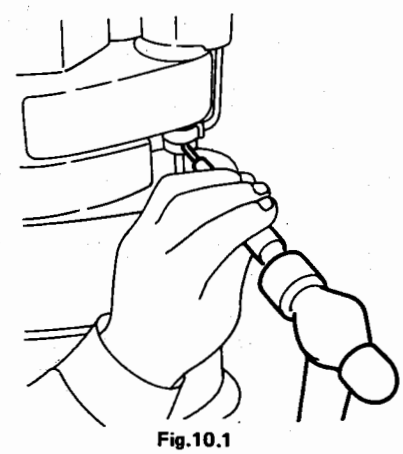


Fig.10.1

2. Remove the gear case bolts (H635-4), and withdraw the gear case assembly downward. (Fig.10.2)

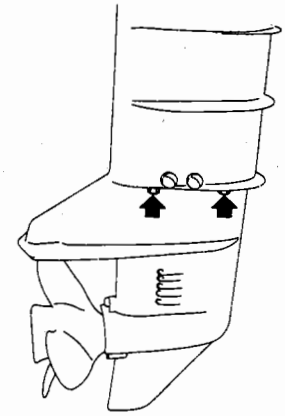


Fig.10.2 Gear case bolts removal

(2) Propeller removal:

1. Remove the split pin from the propeller nut.
2. Remove the propeller nut, washer, propeller and thrust holder from the propeller shaft in this order.

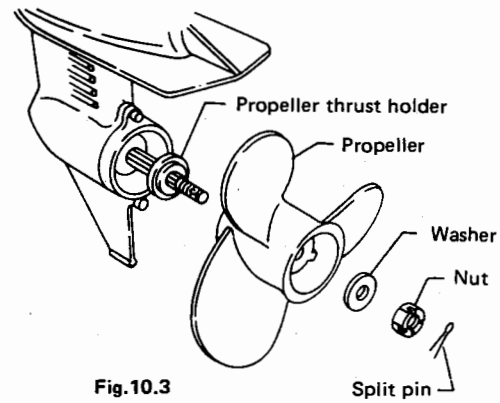


Fig.10.3

(3) Propeller shaft and clutch disassembly:

1. Remove oil plugs from upper and lower gear cases, then drain gear oil.
2. Remove the propeller shaft housing, propeller shaft and bevel gear C by removing propeller shaft housing bolts (H620-2). (Fig.10.4)

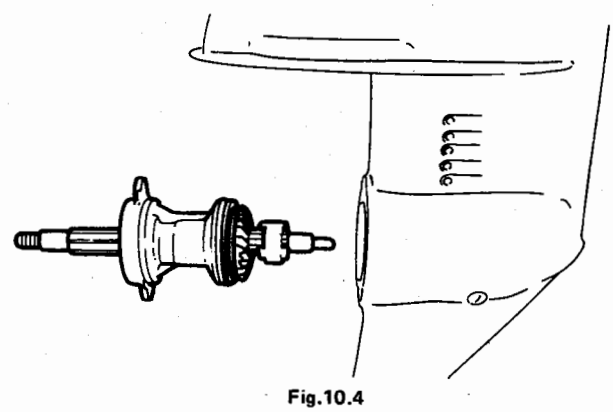


Fig.10.4

3. Withdraw the clutch pin while pressing the push rod lightly.

NOTES:
1. Be sure that the push rod and clutch spring are ejected when removing the clutch pin.
2. Use the special tool to remove the clutch pin. (Fig.10.5)

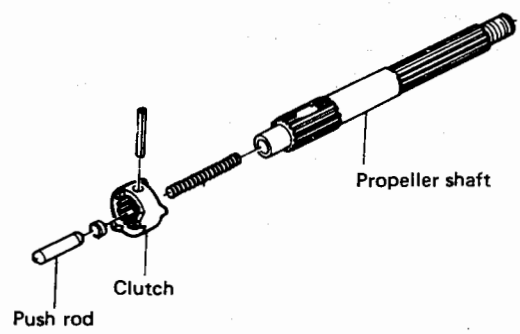


Fig.10.5

(4) Water pump case disassembly:

1. Remove the pump case by removing the pump case bolts (H650-4). (Fig.10.6)

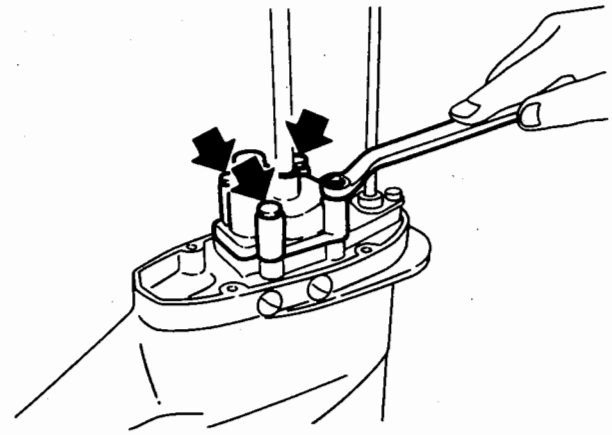


Fig.10.6

2. Remove the water pump impeller, pump impeller key, pump case gasket, water pump guide plate and pump plate gasket in this order. (Fig.10.7)

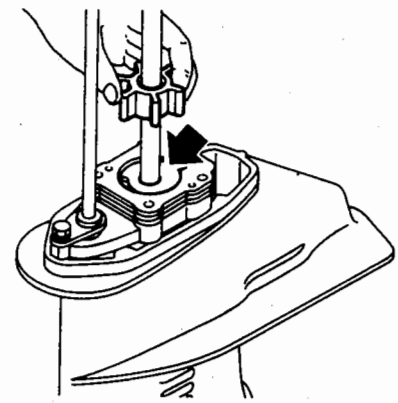


Fig.10.7

(5) Cam rod, drive shaft and bevel gear removal:

1. Remove the cam rod bushing stopper bolt (H625-1), and remove the cam rod bushing stopper. (Fig.10.8)

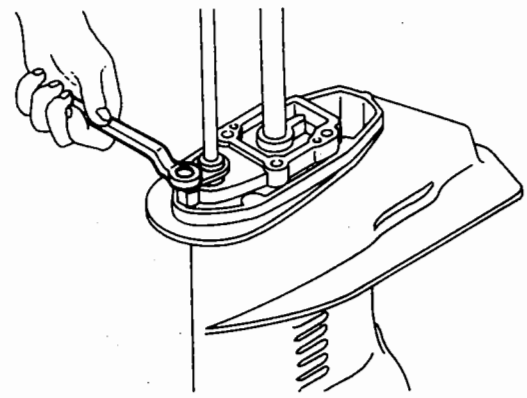
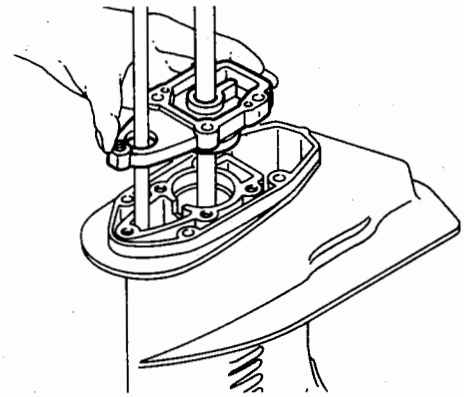


Fig.10.8

2. Remove the lower pump case, cam rod and drive shaft as a unit.



3. Remove the bevel gear B. (Fig.10.10)

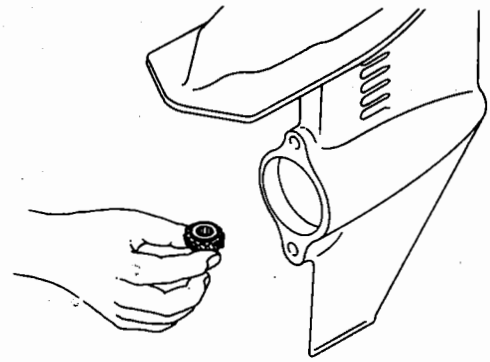


Fig.10.10

4. Remove the bevel gear A. (Fig.10.11)

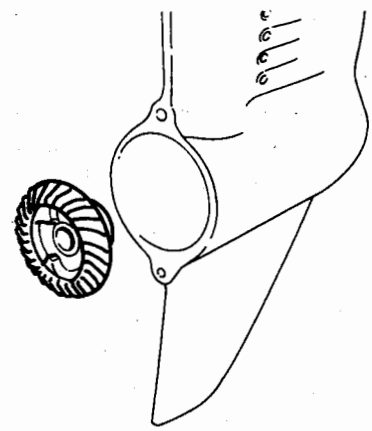


Fig.10.11

11 Gear Case Inspection

Component	Inspection item	What to do
Bevel gears A, B, C and clutch	○ Wear of bevel gear A and C	Replace.
	○ Wear of clutch	Replace.
	○ Enmeshing of tooth surfaces of bevel gears A, B and C	Replace depending on conditions.
	○ Wear of bearings for bevel gears A and C	Replace depending on conditions.
Propeller shaft	○ Wear at bearing part	Replace depending on conditions.
	○ Wear between spline portion and clutch	Replace depending on conditions.
Drive shaft	○ Bent of drive shaft	Replace depending on conditions.
	○ Wear of needle roller rotating portion	Replace depending on conditions.
	○ Wear of spline portion	Replace depending on conditions.
Water pump	○ Damage of pump impeller	Replace.
	○ Wear and deformation of pump case liner	Replace.
	○ Wear of water pump guide plate	Replace.
Anode	○ Waste of gear case anode	Replace.
Propeller shaft housing	○ Wear of bearing portion	Replace.

12 Gear Case Assembly

Assemble the gear case in the reverse order of the disassembly procedure, paying attention to the following points.

(1) Clutch

1. Mount the clutch on the propeller shaft, and confirm that they can operate smoothly with less loose movement.
2. Using the special tool, fix the clutch cam on the cam rod with a new spring pin (3ø x 10 mm). At this time, do not let the spring pin protrude from the clutch cam as illustrated in Fig.12.1.
3. Apply genuine Tohatsu grease to all O-rings inside and outside the cam rod bush.
4. Connect the cam rod, then confirm that it moves up and down smoothly.

Do not let the pin protrude from the clutch.

Fig.12.1

(2) Bevel gears

1. Press the bearing into the bevel gear A by pressing its outer race.
2. Be sure to measure the backlash between bevel gears A and B, by using the special tool. Adequate backlash is 0.05 mm to 0.15 mm [measuring tool reading: 0.14 to 0.42 mm (0.0055 to 0.017 in)]. Insert the

adjust shim between the lower pump case and upper drive shaft bearing when necessary.
Two adjust shims (0.1 and 0.15 mm thick) are available.

3. Press the drive shaft bearing into the gear case by using the special tool.

(3) Propeller shaft housing

1. Press the bearing into the bevel gear C by pressing its outer ring.
2. Insert the propeller shaft oil seal into the propeller shaft housing.
3. Apply genuine Tohatsu grease to the oil seal lip.
4. When inserting the oil seal, be sure that its steel plate portion is directed toward the gear case as shown in Fig.12.2.
5. Apply genuine Tohatsu grease to the O-ring and in lower portion when inserting the propeller shaft housing into the gear case.

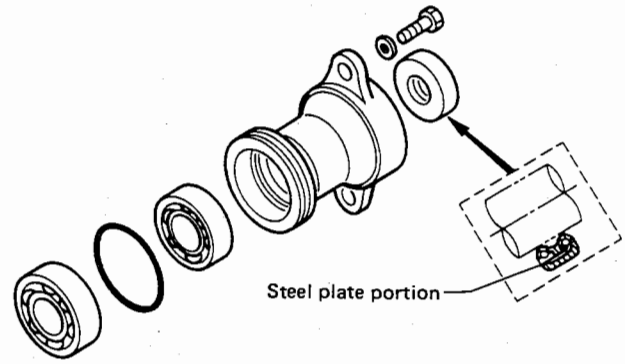


Fig.12.2

(4) Propeller

1. Apply genuine Tohatsu grease to the propeller shaft spline when fixing the propeller on the propeller shaft.

(5) Water pump

1. Apply genuine Tohatsu grease to the oil seal lip, then insert the oil seal into the lower pump case.
2. In this case, be careful that the oil seal steel plate portion is directed toward the gear case as shown in Fig. 12.3.
3. When inserting the pump case liner into the pump case, be sure to engage its projection correctly. (Fig. 12.4.)
4. Stick the impeller key in the key-attaching position on the drive shaft, using genuine Tohatsu grease.
5. Install the pump impeller making sure to engage it with the impeller key. In this case, be sure that the pump impeller blades are curved in the rotating direction of the drive shaft (clockwise direction seen from the engine), avoiding reverse rotation.
6. Align the knock holes of the water pump guide plate, pump guide plate gasket and pump case gasket.
7. Apply genuine Tohatsu grease to the bolts (H650-4), then tighten them.

At the same time, tighten the cam rod bush stopper bolts (H625) uniformly.

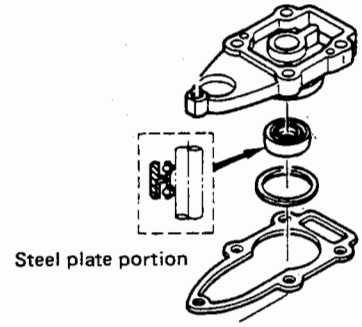


Fig.12.3

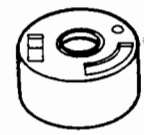


Fig.12.4

(6) Gear oil filling capacity

About 320 cc (genuine Tohatsu gear oil)

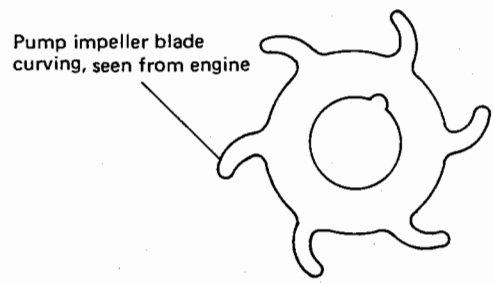
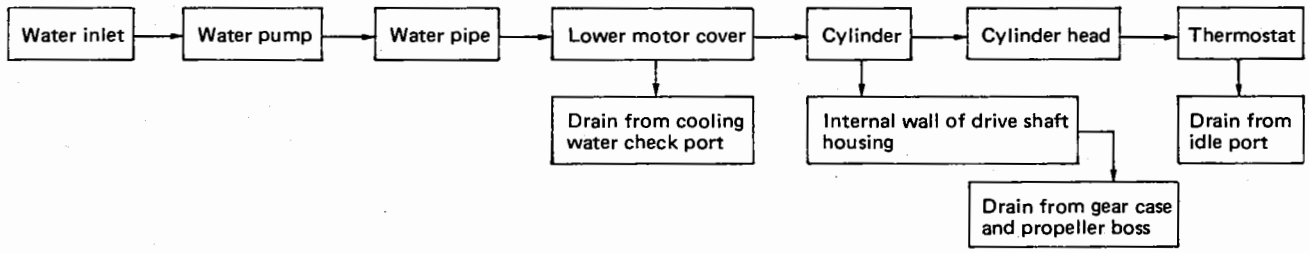


Fig.12.5

(7) Cooling water circulation system



(8) Gear case assembly drawing

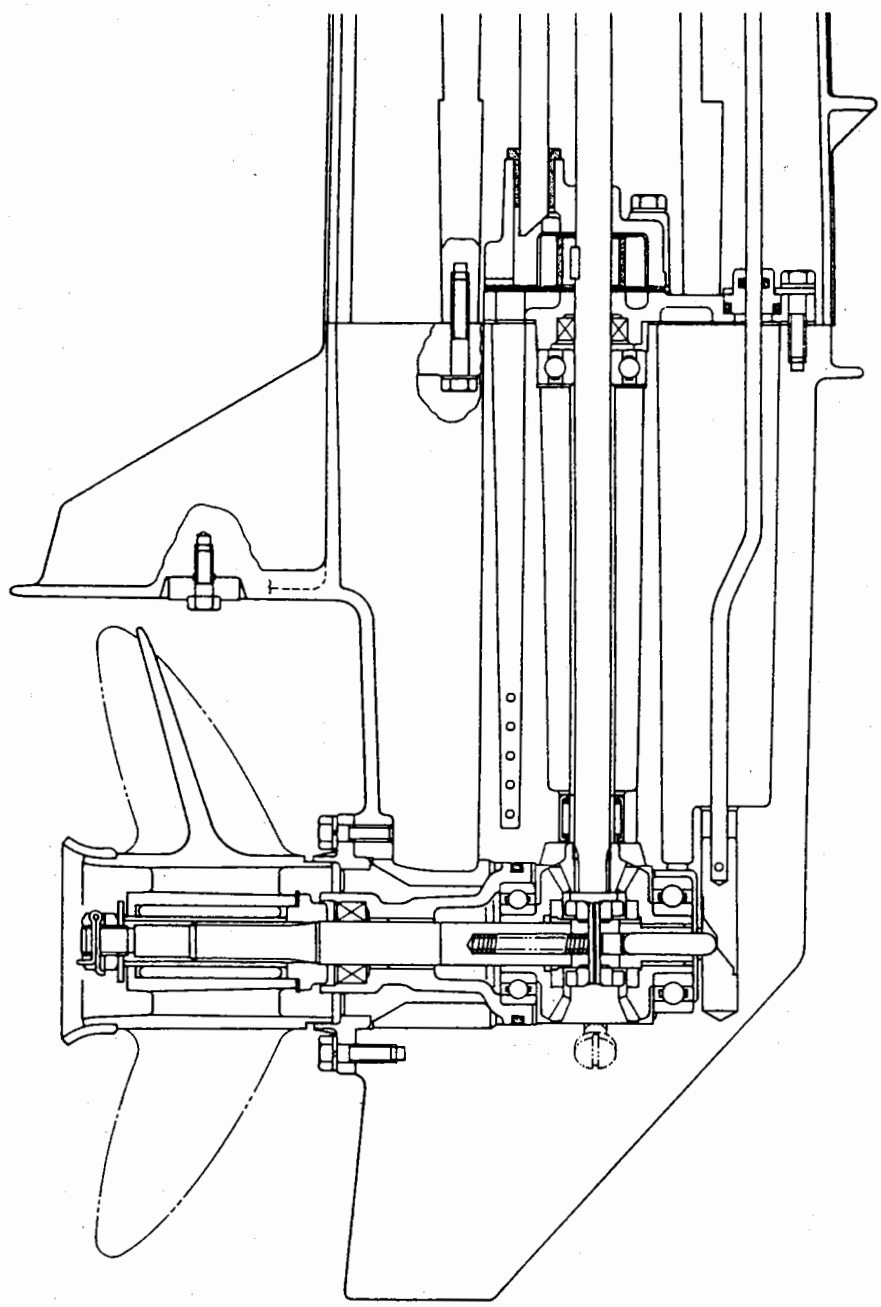


Fig.12.6

1 Lower Motor Cover and Drive Shaft Housing Disassembly

(1) Lower motor cover removal

1. Remove the spring pin from the upper portion of the shift rod joint by using the special tool. (Fig.13.1)
2. Remove the throttle wire together with the throttle wire grommet from the lower motor cover.
3. Remove the lower motor cover bolts (H620-2), then pull out the lower motor cover while holding its both edges.

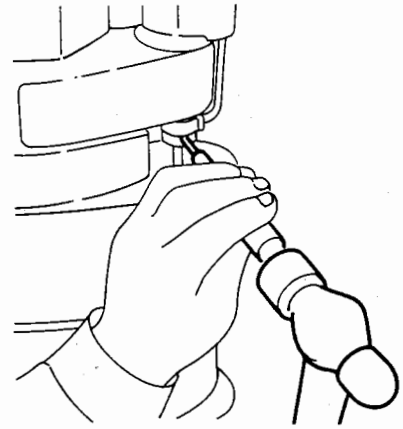


Fig.13.1

(2) Exhaust pipe removal

1. Remove the exhaust pipe bolts (H618-4), and remove the exhaust pipe.

(3) Drive shaft housing removal

1. Remove the mount bracket bolts (H640-2), then remove mount brackets A and B.
2. Remove the lower mount rubber and thrust plate.
3. Liberally apply soapsuds to the upper mount rubber, then remove the drive shaft housing from the steering bracket. In this case, the stern bracket clamp screw must be tightened securely to the working stand.

(4) Shift lever removal

1. Remove the shift lever stopper bolt (H610), then remove the shift lever stopper.
2. Remove the snap retainer, and pull out the shift lever.

14 Motor Cover and Drive Shaft Housing Assembly

Perform assembly in reverse order of the disassembly procedure, paying attention to the following points.

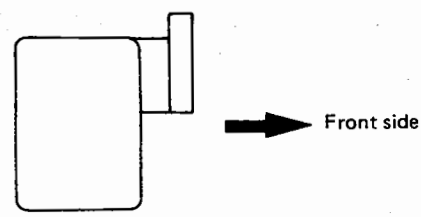


Fig.14.1

(1) Drive shaft housing

1. When installing the upper mounting rubber, pay attention to its installation directions as shown in Fig. 14.1.

2. When installing the drive shaft housing on the steering bracket, liberally apply soapsuds to the mounting rubber attaching position on the steering bracket for smooth sliding, and press down the drive shaft housing until the bottom of the upper mounting rubber reaches the bottom of the steering bracket attaching portion, while moving the drive shaft housing horizontally.
3. Install the lower mounting rubber front so that its mark "⇑" is directed upward.

(2) Lower motor cover assembly

1. Apply Three Bond 1342 to the exhaust pipe bolts (H618-4), then tighten them with the specified torque.

Specified torque: 0.7 – 0.9 kg.m
5.06 – 6.50 lb.ft
0.07 – 0.09 N.m

(3) Shift lever assembly

1. Apply genuine Tohatsu grease to the sliding portions of the shift lever oil seal, shift lever shaft bush and shift rod lever, then assemble them.
2. Using the special tool, insert the spring pin into the shift rod joint, avoiding that the spring pin does not extrude from the shift rod joint.
3. Clutch adjustment:

Adjust the clutch after assembling the lower unit.

a. Loosen the shift lever stopper bolt (H610).
b. Fully move the shift lever to Reverse position, then tighten the shift lever stopper bolt. After tightening, check the shift lever for movement.

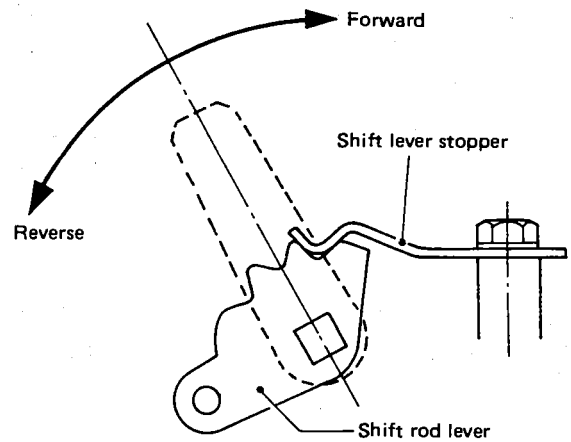


Fig.14.2

15 Steering Handle and Bracket Disassembly

(1) Steering shaft assembly

1. Pull out the steering shaft assembly upward.
2. Remove the thrust plate, O-ring and steering shaft bushing.

(2) Steering handle

1. Remove the throttle shaft supporter, pull out the drum from the throttle shaft, and disconnect and pull out the throttle wire from the handle.
2. Remove the nuts (N6-2) securing the handle and pull out the handle from the steering bracket.
3. Remove the screw (flat head F518) from the grip, then remove the grip from the handle.
4. Remove the throttle shaft from the handle.

(3) Stern bracket

1. Remove the thrust rod.
2. Remove the bracket distance plate screw (flat head F612), then remove the bracket distance plate.
3. Remove the bracket bolts, then remove the left and right brackets.

(4) Swivel bracket

1. Remove the tilt stopper set plate, then remove the tilt stopper.
2. Remove the E-ring from the reverse lock shaft, then remove the shaft and reverse lock.
3. Remove the friction bolt and friction plate.

b. Do not bend or touch the reed valve unnecessarily. If the valve stopper is dropped or bent, the opening of the reed valve will be changed, adversely affecting the engine output and life of the reed valve.

c. The reed valve will be cracked as a result of improper selection of the proper or excessive speed operation due to cavitation. So, adequate transom height must be selected and the full-throttle speed range (4500 to 5500 rpm) must be met.

16 Steering Handle and Bracket Assembly

Perform assembly in reverse order of the disassembling procedure, paying attention to the following points.

(1) Two types of reverse locks, each being interlocked with the shift lever, are available depending on the reverse lock installation position.

a. When the reverse lock link is jointed to hole-A, the reverse lock is locked only when the shift lever is in the reverse position. (Factory set position)

b. When the reverse lock link is jointed to hole-B, the reverse lock is locked when the shift lever is in reverse and neutral positions.

(2) Apply genuine Tohatsu grease to sliding positions of the grip, throttle shaft bush and throttle shaft, then assemble them.

(3) Assemble the throttle shaft and grip as illustrated.

(4) Apply genuine Tohatsu grease to the tilt stopper bush and coil spring, then assemble them.

(5) Apply genuine Tohatsu grease to the stern bracket washer, then tighten the bracket bolts and nuts with the specified torque.

(6) Install the bracket assembly to the drive shaft housing and grease up to grease nipples on the swivel bracket.

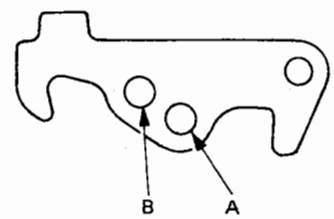


Fig.16.1

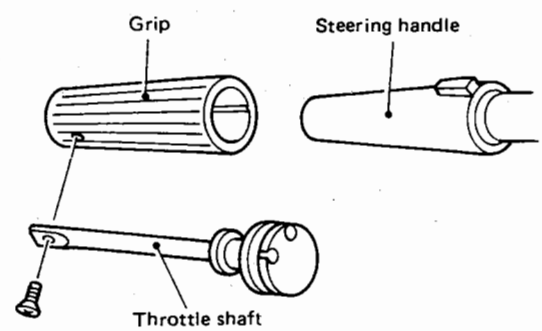


Fig.16.2

17 Construction and Disassembly/Assembly of Other Units

(1) Reed Valve

The reed valve, made of a thin 0.2 mm special elastic stainless steel, is actuated according to the change in pressure, suction inertia, etc. in the crank case. Therefore, pay attention when handling the reed valve.

1. Reed valve inspection
   a. Dimensions of reed valve
      Valve stopper lift: 5.0 to 5.2 mm (0.2 in)
      Gap between reed valve end
      and valve seat: 0.2 mm (0.0078 in) or less
2. Assembling notes on the reed valve:
   a. Both surfaces of the reed valve are different, so align the notches on the reed valve and valve stopper when assembling as shown in Fig.17.3.
   b. Reed valve screws are coated with adhesive and included in the reed valve seat. When installing the reed valve, tighten new reed valve screws with the specified torque. Never employ the used reed valve screws, because their adhesive effect has been lost which could lead to trouble, such as disengagement during operation.
      Specified torque: 0.07 – 0.09 kg.m
      0.51 – 0.65 lb.ft
      0.007 – 0.009 N.m
   c. Confirm that the clearance between the reed valve and the valve seat is 0.2 mm (0.0078 in) or less after assembly.

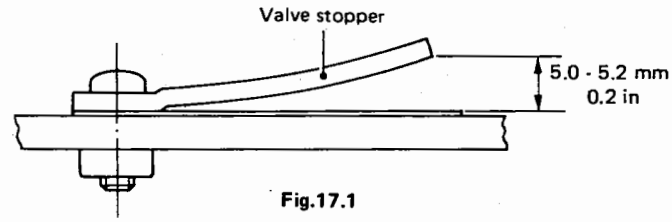


Fig.17.1

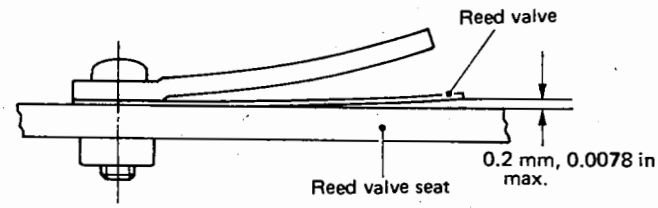


Fig.17.2

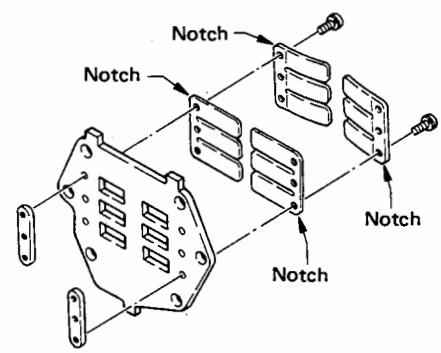


Fig.17.3

(2) Recoil Starter

1. Recoil starter and starter lock (option)

The recoil starter is designed to automatically wind up the starter rope by recoiling force of the flat spiral spring.

When pulling the recoil starter handle, the ratchet comes out and engages with the starter pulley to turn the crankshaft for engine starting.

After the engine starts, or when the rope is released,

this engagement is also released automatically. The starter lock (optional) is interlocked with the shift lever, so the starter is locked except when the shift lever is at the neutral position, disenabling starting.

a. Disassembly

- Disengage the rope from the starter handle, hold the starter case and reel, and turn the reel to release the starter spring
- Remove the starter shaft bolts, and remove the friction plate, friction spring, ratchet and return spring.
- Slowly lift and remove the reel while turning it in rope winding direction.

CAUTION: Be careful of ejection of the starter spring.

b. Assembly

Perform assembly in reverse order of the disassembly procedure, paying attention to the following points.

- When setting the starter spring to the starter spring case, direct the hook at the end of the spiral spring to the right side, and hook it to the opening on the exterior of the starter spring case.
- To wind the starter spring, turn the reel in the roll pull-out direction (counterclockwise). Finally set the reel so that it can turn ¼ to 1¼ turns further when the rope is pulled out entirely.
- Apply antifreeze grease to moving parts of the starter spring, starter shaft bolts and friction plate.
- Tighten the starter shaft bolt with the torque of 0.35 – 0.40 kg.m, 2.53 – 2.89 lb.ft, 0.036 – 0.04 N.m
- Apply Three Bond 1342 to the thread of the starter shaft bolt.

c. Starter lock

After assembling the outboard motor, confirm that the starter is disenabled at positions other than neutral position, by moving the shift lever actually.
Install the starter lock rod so that its larger bent portion is positioned on the shift lever side as shown in Fig.17.4

Never deform the starter lock rod; otherwise, the desired operation cannot be achieved.

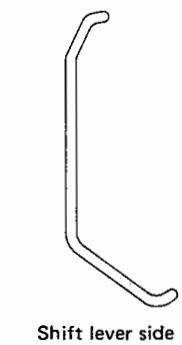


Fig.17.4

(3) Carburetor

The fuel and air systems are divided into the pilot line and main line.

1. Pilot line (Fig.17.5 to Fig.17.7)

The pilot line consists of the slow jet (SJ), slow air jet (SAJ), pilot outlet (PO), bypass (BP) and pilot adjust screw (PS).

When the opening of the throttle valve is small, the fuel passes through path A and is measured at the slow air jet (SAJ) and mixed with the fuel, which is measured by the slow air jet (SAJ) at the path B, and then ejected from the bypass (BP) or the pilot outlet (PO) to the engine.

In the idling mode, the air is also sucked into the bypass (BP), and mixed fuel is mainly ejected from the pilot outlet (PO). When the throttle valve is opened further, negative pressure applied to the pilot line is increased, and the mixed fuel is also ejected from the bypass (BP).

When the throttle is opened, the air volume is increased and the pressure drop increases. As a result, the fuel is sucked from the main jet (MJ) and ejected from the main nozzle.

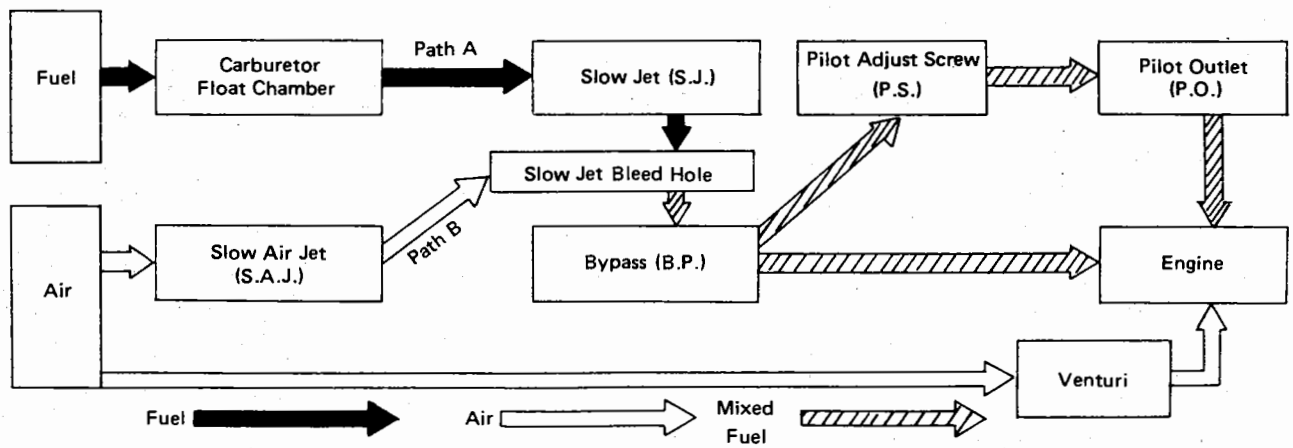


Fig.17.5

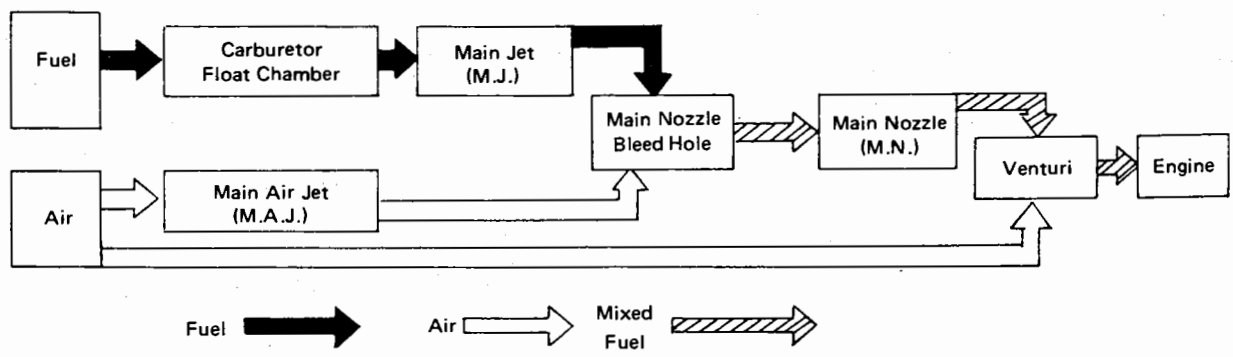


Fig.17.6

2. Main line (Fig.17.6, Fig.17.7 and Fig.17.8)

The main line consists of the main jet (MJ), main nozzle (MN) and main air jet (MAJ).

When the opening of the throttle valve is increased, the pilot line becomes almost inoperative. When the throttle valve is opened greatly, the air volume is increased and the air flow velocity is increased at the venturi, thus increasing the pressure drop at the tip of the main nozzle (MN) and sucking an increased volume of the fuel for ejection. The fuel is measured at the main jet (MJ), and the air is sucked at the main air jet (MAJ) and fed to the bleed holes of the main nozzle (MN) where the air and fuel, measured at the main jet (MJ), are mixed. As a result, adequately mixed fuel is ejected from the tip of the main nozzle (MN) and then mixed with main air to be supplied to the engine.

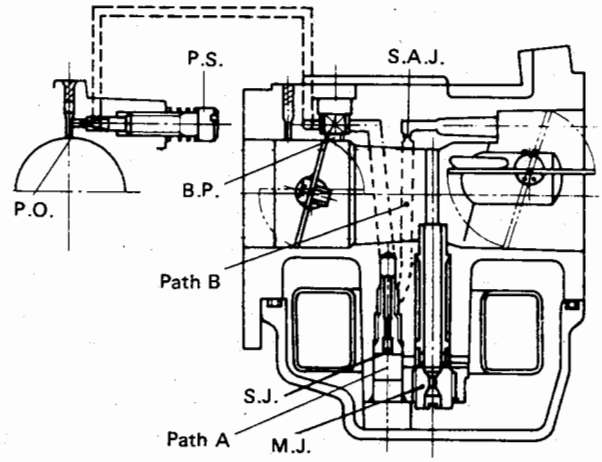


Fig.17.7

3. Float unit

The float unit, consisting of the float, float valve, special clip, valve seat, etc., always maintains the oil level constant for generating the mixture of the fuel and air required by the engine.

The fuel goes into the float chamber through the valve seat, and the float rises when the oil level reaches the predetermined level. As a result, the float valve contacts tightly with the valve seat, thus shutting off the flow of the fuel. When the fuel is consumed and the oil level is lowered again, the float is also lowered, separating from the valve seat. As a result, the fuel goes into the float chamber and repeats the above-mentioned operation, thus maintaining the oil level constant at all times.

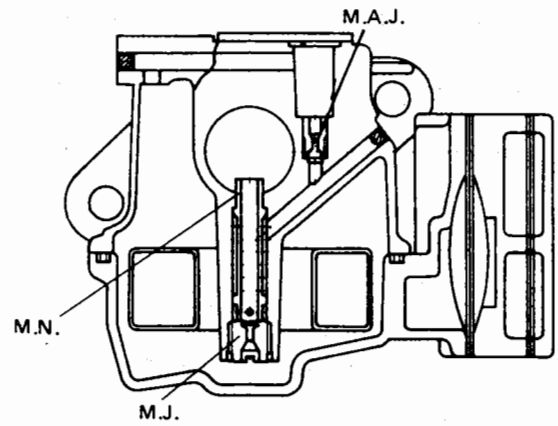
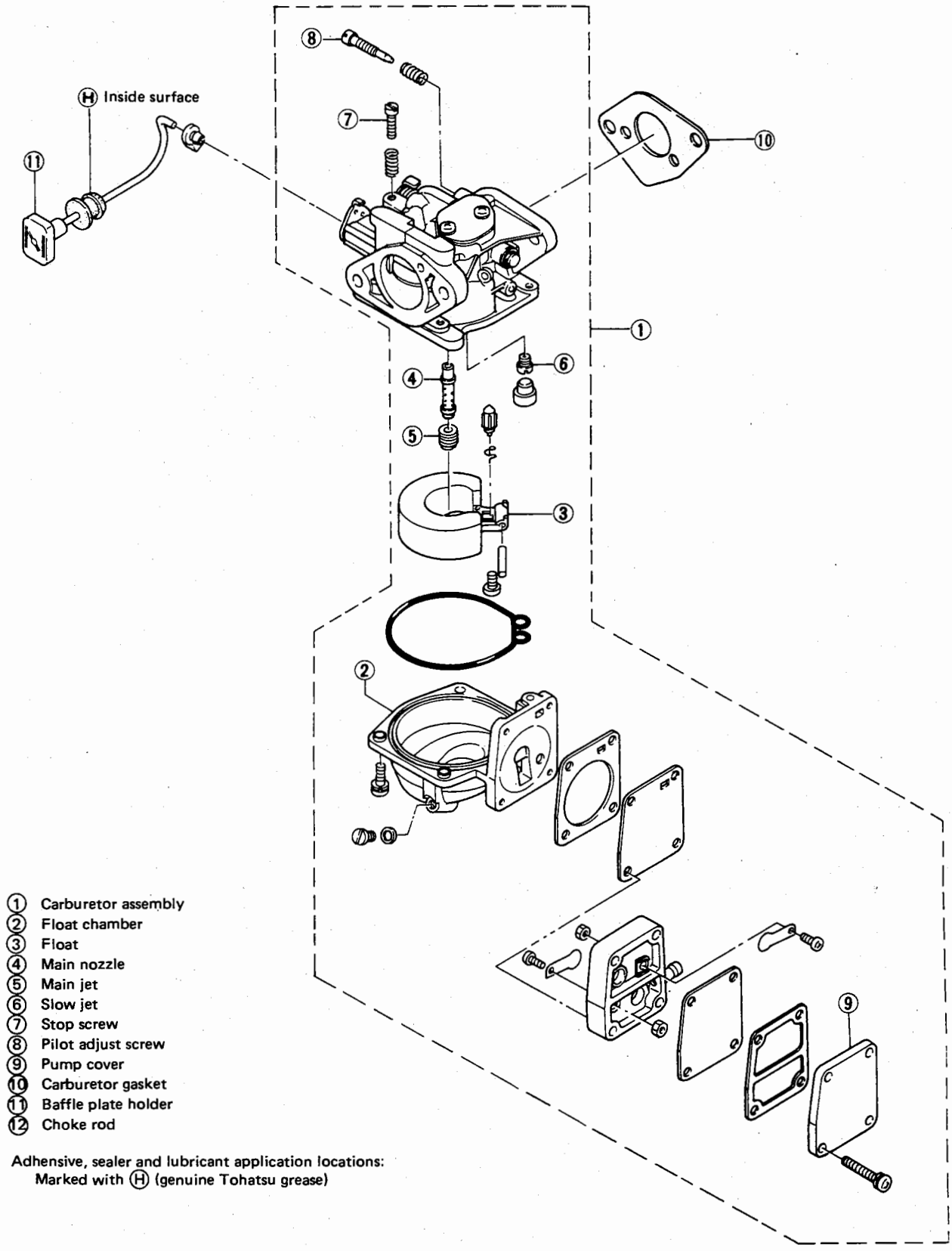


Fig.17.8

CARBURETOR



① Carburetor assembly
② Float chamber
③ Float
④ Main nozzle
⑤ Main jet
⑥ Slow jet
⑦ Stop screw
⑧ Pilot adjust screw
⑨ Pump cover
⑩ Carburetor gasket
⑪ Baffle plate holder
⑫ Choke rod

Adhensive, sealer and lubricant application locations:
Marked with Ⓗ (genuine Tohatsu grease)

Fig.17.9

4. Fuel pump

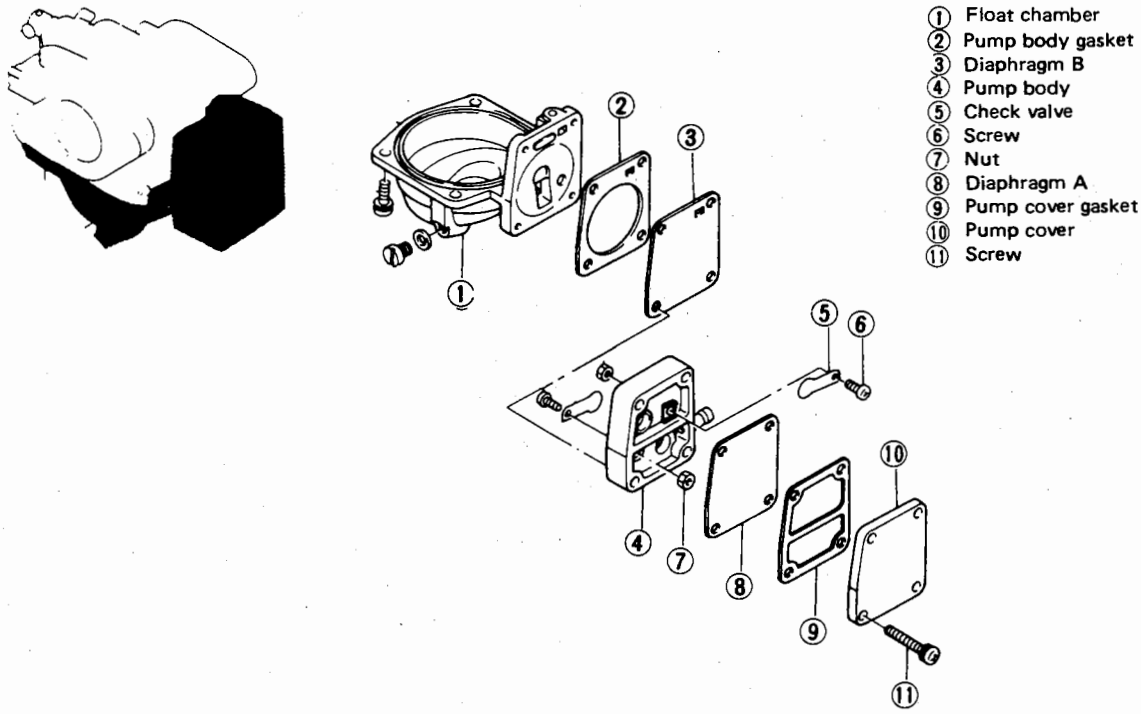


Fig.17.10

5. Carburetor setting

6. Inspection

Refer to Service Data on page 5.

Inspection Item	What to do
1. Oil leakage from fuel pipe joint.	○ Replace pipe.
2. Loose movement of throttle valve shaft, choke valve shaft.	○ Replace depending on conditions.
3. Idling speed: ○ Adjust idling speed after warm up operation. Clutch ON: About 700 to 800 rpm Clutch OFF: About 900 to 950 rpm (reference).	○ Tighten the pilot adjust screw (PS) slightly, loosen it for the standard setting as specified, and set the specified RPM by regulating the throttle and stop screw while monitoring the engine speed with a tachometer. Then, set the pilot adjust screw (PS) to the best position where the engine speed is highest in the range of about ±¼ turn of the reference position. After that, set the specified speed with a throttle stop screw. ○ Replace the pilot adjust screw (PS) with a new one if its tip is worn heavily. ○ Set with the clutch ON.
4. Fuel pump ○ Warped and damaged diaphragm, and deformed fixing hole.	○ Replace when necessary.
5. Damage of packings, and gas leakage.	○ Replace when necessary (carburetor and fuel pump).
6. Water and foreign matter deposits.	○ Drain water and remove dirt from fuel filter, float chamber, etc.

(4) Electric units

Construction and servicing of the C.D. magneto

Unlike the conventional magneto using a contact breaker (point), the secondary ignition voltage generating system on the C.D. magneto functions to charge AC current generated by the magneto in the capacitor at the C.D. unit, and apply electric energy from the capacitor to the primary ignition coil through signal voltage at the magneto synchronous with the sparking timing so as to obtain high voltage at the secondary coil. In other words, this unit incorporates the electric switch (thyristor SCR) which is actuated by signal voltage to allow stable, high-performance secondary sparking.

Operating principle is as follows:

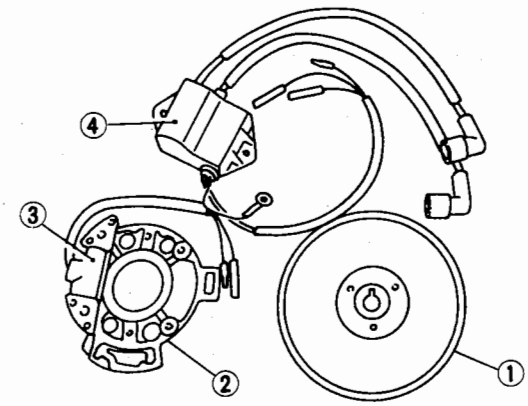
AC voltage is generated at the exciter coil due to change in the magneto rotational speed when the flywheel turns.

AC voyage is charged at the capacitor C by a positive current (marked with ←).

When negative voltage is generated at the exciter coil, the current (marked with ←--) flows through SCR, and turns SCR on. As a result, the charge at the capacitor C is supplied to the primary side of the ignition coil, inducing a high voltage at the secondary side.

The magneto is of simultaneous multi-cylinder ignition type and can make ignition at both cylinders at the same time. However, the ignition is caused only in compression stroke (TDC side). This means the ignition is caused in one cylinder at each sparking timing: the other cylinder is not ignited, although sparking is caused at the same time.

The C.D. magneto can be separated into three components: (1) the flywheel having magnetic steel and pole shoes; (2) the coil plate having various coils, capacitor, SCR and ignition coil; and (3) the C.D. unit incorporating diode.



① Flywheel cup
② Coil plate assembly
③ Exciter coil
④ C.D. Ignition unit

Fig.17.11

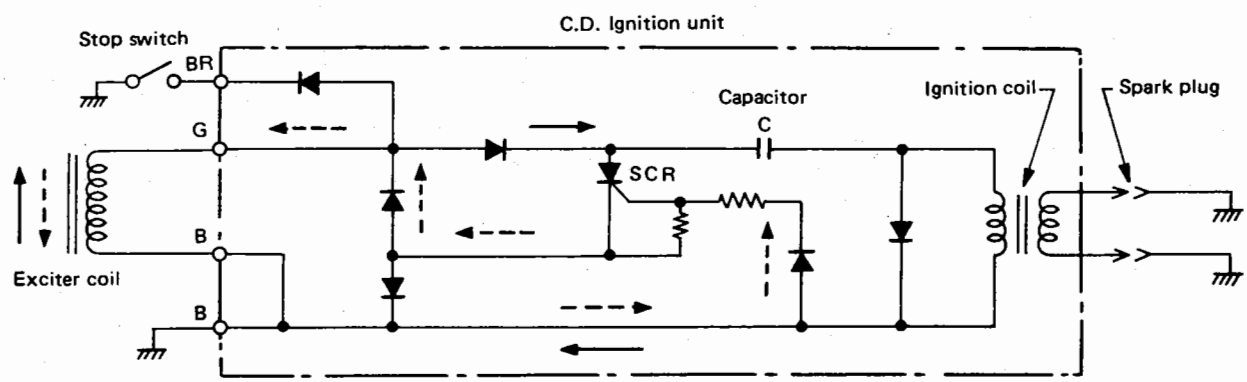


Fig.17.12

1. Flywheel
   a. Construction
      The flywheel is made of cast iron and is of pan shape into which the high-performance ferrite magnet and pole shoe are fixed positively with screws and adhesive. Four poles are arranged radially and magnetized. The boss is located at the center of the flywheel, and has a key groove for convenience of positioning the crankshaft. The flywheel is plated for protection against corrosion.
   b. Inspection and servicing
      The flywheel requires no special servicing. However, a complete cleaning of oil, grease and foreign matter from the tapered boss before installing the flywheel to the crankshaft is required.
      Tightening torque of nuts on
      flywheel: 5 – 6 kg.m
      36.1 – 43.3 lb.ft
      0.51 – 0.61 N.m

2. Coil plate
   a. Construction
      The coil plate incorporates the exciter coil fixed on the base plate which is die cast with aluminum alloy and functions to charge the capacitor and generate signals at sparking timing.
   b. Inspection and servicing
   - Coil inspection
     C.D. ignition wiring diagram is shown for convenience of checking coils.

Disconnect the coupler from between the coil plate and C.D. Ignition unit, and measure the resistance between the lead wires of the exciter coil in the coil plate with a tester to check if the coil is sound or not. If the measured resistance is greatly different from the following value, the coil in question is most likely defective.

Resistance between green and black lead wires of the exciter coil: 280 ohms

NOTE: The resistance of the coil normally deviates ±15% to ±20% due to the deviation of the coil diameter, etc.

When measuring the resistance of the coil, check the coil lead wire and coil itself for breakage and disconnection. That is, connect a tester between the coil lead wires, and check whether the tester reading is changed or not when the coil lead wires are pulled lightly by hand or twisted at the lead wire outlet and coil winding. If the tester reading is changed, the coil is most likely disconnected or broken.

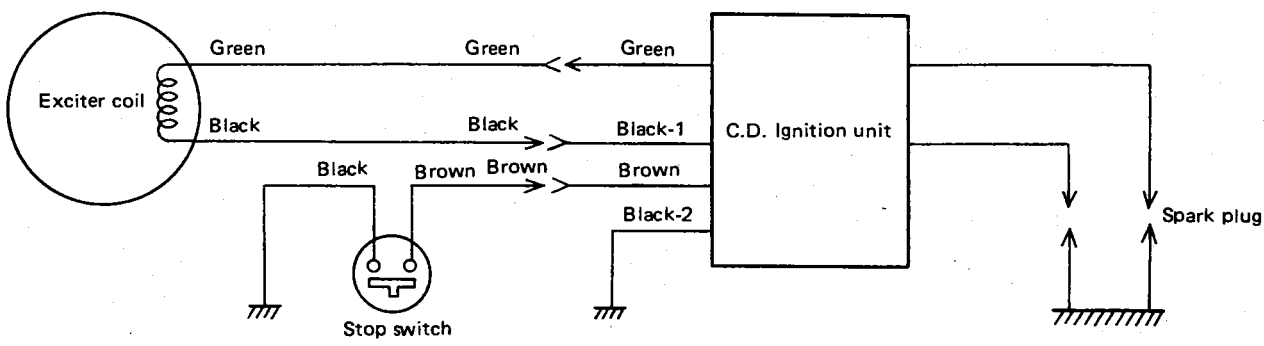


Fig.17.13

3. C.D. Ignition Unit

a. Construction

The C.D. Ignition unit incorporates one PCB on which a diode rectifying the current generated by the magneto, a capacitor charging the aforesaid current, a thyristor serving as a breaker, a zener diode controlling thyristor, a resistor, etc. are provided as well as the ignition coil in a black resin case which is filled with resin for protection against water and vibration.

b. Inspection and servicing

Measure the resistance of the C.D. Ignition unit with a circuit tester (with internal battery of 3 V or less) for a radio set to check if the C.D. Ignition unit is sound or not. Never use a megger (insulation resistance meter) or battery-powered instrument because the C.D. Ignition unit will be damaged.

When the resistance of the capacitor is measured with a tester, its pointer swings far instantly and returns to the original position, since the resistance becomes infinity when connected to the tester. Also, when the tester terminals are connected reversely (with reversed terminal polarity) or when the resistance range is switched to measure a sound diode, the resistance value is varied greatly. In short, inspection is made through the use of the above-mentioned phenomena. The following table shows reference resistance values when measuring with a tester for a radio set connected between lead wires of the C.D. Ignition unit. Therefore, if any measured data do not meet the table, the C.D. Ignition unit in question is most likely defective.

The resistance selection range of a tester has x1 kohrm graduation. However, the graduation figures are not indicated because the resistance values will be changed according to the type of tester.

Tester terminal and lead wire identification		Tester terminals (+)			
		Green	Brown	Black-1	Black-2
Tester terminals (−)	Green		Conducted	Pointer swings once, then ∞	Pointer swings once, then ∞
	Brown	∞		∞	∞
	Black-1	Conducted	Conducted		0
	Black-2	Conducted	Conducted	0	

4. Ignition coil

a. Construction

One ignition coil is incorporated in the C.D. Ignition unit case. One lead wire on the primary side of the ignition coil is connected to the capacitor, and the other is connected to the ground cable.

b. Inspection and servicing

Inspect the ignition coil by measuring the resistance with a circuit tester for a radio set.

Disconnect electric circuit between the C.D. Ignition unit and coil plate, and disconnect the high-voltage wire for the C.D. Ignition unit from the spark plug.

Measure the resistance between the two high-voltage terminals for the resistance of the secondary coil. The ignition coil is defective if the measured resistance is far less the value described below.

The construction of the ignition coil does not allow direct measurement of the primary coil resistance, but the two lead wires of the primary coil can be determined unbroken, when the resistance of the secondary coil meets the following value.

Reference resistance value: 2.6 kΩ between the high-voltage terminals of the secondary coil.

NOTE: The resistance of a coil will normally deviate in the range of ±15% to ±20% due to the deviation of coil diameter, etc.

5. Stop switch

Inspection and servicing

NOTE: If the insulation resistance between the contacts of the stop switch is reduced, ignition performance—particularly starting performance—will be adversely affected.

To measure the insulation resistance between the contacts of the stop switch, disconnect the connection (2-pole coupler) between the C.D. Ignition coupler and stop switch, then measure the resistance between the two poles of the coupler on the switch side. The insulation resistance must be 2 MΩ (2,000 kΩ) or more when measured at the maximum value of the resistance selection range when using a tester, and 1 MΩ or more when using a 500 V megger. If the measured resistance insulation is lower than the aforesaid values, remove and disassemble the switch, and clean the contacts and the interior of the switch case. Also, occasionally check the waterproof case for a crack resulting from age, etc. If a crack is found, replace the case with a new one.

6. C.D. Ignition unit operating notes

a. Never disconnect the wiring of the magneto and C.D. Ignition unit, and never short circuit them when the engine runs: otherwise, the C.D. Ignition unit will be damaged.

b. Do not reposition parts of the C.D. Ignition unit. They are located in positions determined with thermal and vibration conditions in mind.

c. Never touch directly the ignition plug and high-voltage cord when the engine runs, because the secondary voltage and current of the C.D. Ignition unit are both high.

d. When checking the sparking of the ignition plug, be sure to contact both the spark plugs with the engine. If only one of the both makes contact, the C.D. Ignition unit will be damaged.

e. When measuring the compression pressure, observe the procedure described in Item 4, but disconnect the 3P coupler.

(5) Propeller

A variety of propellers are available.

a. Selection of propellers

If a boat is provided with an inadequate propeller, operating efficiency is reduced and engine trouble will be caused. In other words, matching the propeller and boat is of prime importance. It is recommended to select a propeller that can rotate in the recommended speed range, achieving high operating efficiency. Otherwise (for example, running out of the recommended speed range), operating efficiency will be reduced, vibration and noise will be increased, parts will be damaged, or cavitation will be caused.

If the rotating speed is lower than the recommended range, overloading will occur damaging the parts.

b. Recommended speed range:
4500 to 5000 rpm

c. Propeller selection graph (see Fig.17.14)

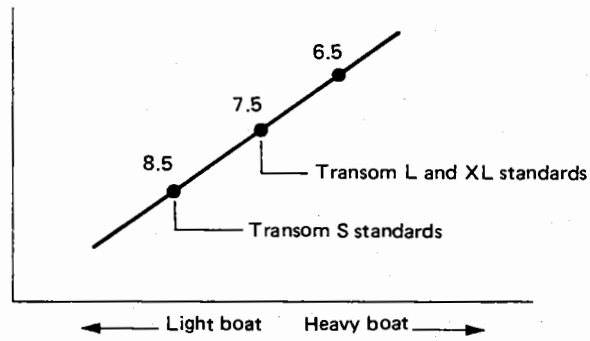


Fig.17.14

(6) Inspection and Check after Assembly

(Test running and adjusting procedures in water tank after final assembly)

1. Water tank for running test and propeller test:

In running test in a water tank, it is required that the test propeller runs to load the engine properly.

a. Test propeller

- Used for break-in running of a new outboard motor.
- Used for operational testing of an outboard motor after being serviced.

b. Water tank

- The water tank must meet the dimensions shown in Fig.17.16.
- When fixing two or more motors in a water tank, the water tank is required to be separated by bulkhead according to the number of motors, each compartment satisfying the dimensions shown in Fig.17.16.
- Be careful to keep water temperature below 25°C during continous running: otherwise, seizure will be caused. It is desirable to use cooling equipment or overflow equipment to allow cool water flow.
- Always use new, clean water: otherwise, carbon contained in the used, contaminated water will adhere to the internal wall of the cooling system on the motor, greatly reducing cooling efficiency.
- Keep the water tank in well ventilated environment by using air exhaust equipment to prevent the carburetor from sucking the exhaust gas from the motor.

b. Test propeller dimensions
Outside diameter: 164 mm
Width: 12 mm

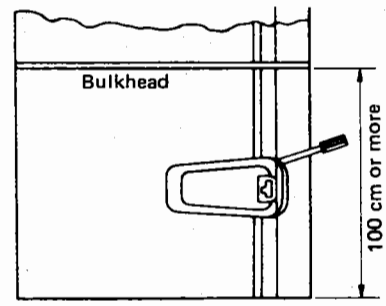
2. Using the test propeller in the water tank

a. Position the engine at the center of the mount board, then fix it securely with a clamp screw handle.

b. Set the motor perpendicular to water level by relocating the thrust rod.

c. Determine water level so that no cavitation is caused in full-throttle mode. That is, 26 cm from the motor-fixing board for transom S, 39 cm for transom L, and 51.5 cm for transom XL.

d. Use the specified test propeller for power absorption. In test running in the water tank with the test propeller fixed to the motor, it is acceptable that the engine runs at 4,800 rpm or higher when the carburetor throttle valve is opened fully.



Water level Transom S: 26 cm
Transom L: 39 cm
Transom XL: 51.5 cm

Fig.17.15

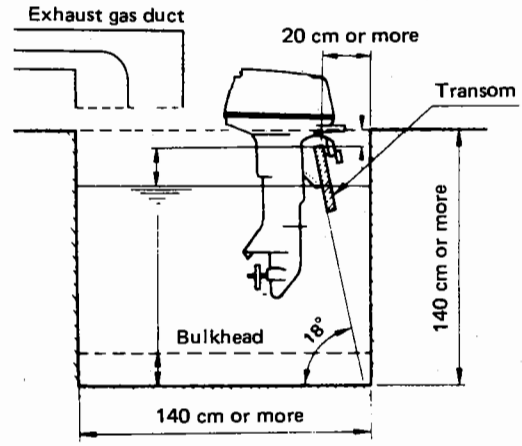


Fig.17.16

Outer diameter: 164 mm
Width: 12 mm

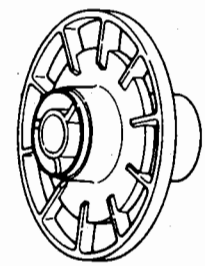


Fig.17.17

3. Fuel
   a. Use the fuel tank associated with the outboard motor.
   b. Use a mixture of gasoline and genuine Tohatsu oil at a 20:1 ratio for break-in running (when replacing the engine parts).

4. Inspection and adjustment after assembly

After assembling the engine and lower unit, perform the inspection under the following points.

   a. Check items before test running
   - Fuel piping conditions
   - Clutch adjustment
   - Electric wirings, connections and clamps
   - Operation of and locking with reverse lock

   b. Check items during test running

   Start the engine and check the following items in the idling mode.
   - Fuel leak from crankcase joint
   - Cooling water leak from cylinder head joint
   - Cooling water from engine-fixing position
   - Abnormal sound
   - Idling speed (750 ±50 rpm) and stability
   - Operation of stop switch
   - Operation of clutch
   - Engine running in gradual acceleration mode
   - Discharge of cooling water from check port

5. Break-in running

When replacing the piston, piston ring, piston pin, crankshaft, cylinder or bevel gear bearing, perform break-in running to smoothen sliding surfaces of the parts in question.

   a. Using the slow stop screw on the carburetor, adjust so that the minimum engine speed becomes 750±50 rmp with the clutch ON (forward run mode).
   b. Perform break-in running at low and intermediate speeds for about 10 hours while loaded.

   Check items during break-in running:
   - Check for abnormal sound and vibration.
   - Check for water or gas leakage from mating joints.
   - Check if cooling water is discharged from check port.

6. After break-in running
   a. After the engine is warmed up sufficiently, adjust so that the minimum engine speed is 750±50 rpm once again with the clutch ON (forward run mode), using the slow stop screw on the carburetor.

      In this condition, adjust the pilot adjust screw (PS) at the carburetor. (The position where maximum engine speed can be achieved is most desirable: adjustment is required within the range of 1-1/8 to 1-5/8 return). After setting the pilot adjust screw (PS) to the best position, adjust it again so that the minimum engine speed becomes 750±50 rpm with the clutch ON (forward run mode) using the slow stop screw.
   b. With the clutch ON, measure the engine speed when turning the handle grip to the full throttle position. (In this case, the engine speed is required to be 4,800 rpm or higher).

7. Engine stopping
   a. Turn the handle grip to the slow speed, move the shift lever to neutral position, then keep the stop switch depressed until the engine stops completely.
   b. Close the cock on the fuel tank, tighten the air vent screw on the fuel tank cap, then disconnect the fuel connector.
   c. When removing the outboard motor from a boat, lift the motor upward, and completely drain water from the gear case before laying it down.
   d. When carrying the motor, be sure to keep the engine higher than the propeller.
   e. Rest the motor on the ground with the handle facing upward; otherwise, water enters the cylinder.

8. Inspection after removal from boat
   a. Check the gear case, propeller shaft housing (oil seal and O-ring) and oil plugs for gear oil leakage.
   b. Check the cylinder, crankcase, cylinder head, spark plugs and carburetor for gas and water leakage.
   c. Check bolts and nuts for loosening and missing.
   d. Check painting for peeling.
   e. Retightening:
   - Cylinder head bolts
   - Carburetor bolts
   - Drive shaft housing bolts
   - Other loosened bolts

18 Periodic Inspection

Inspection items	Inspection intervals	Description	Remarks
Tightening of bolts and nuts	10 operating hrs. (new machine)	Cylinder head, exhaust cover, carburetor, inlet manifold, crankcase, recoil starter, drive shaft housing, mounting rubber, gear case, propeller shaft housing, etc.	See "Tightening Torque" list in page 10.
Gear oil	Change after 10 hrs. (new machine). Refill every 50 hrs. Change every 200 hrs., after off-season storage or before new season.	Change or refill. Check the propeller shaft oil seal for crack, wear and water entry.	Tohatsu gear oil #80, about 320 cc
Spark plug*	Every 50 hrs.	Check for gap (resulting from worn electrode), carbon deposit and fouling. Remedy, clean or replace if deposited or fouled.	NGK BP7HS-10 or Champion L82YC Gap: 0.9 - 1.0 mm
Fuel system*	Every 50 hrs.	Check fuel tank, fuel pipe, fuel filter, fuel pump, carburetor, float chamber for dirt, clogging and damage.	Removal of dirt and water, fuel leakage and air suction.
Greasing*	Every 50 hrs.	Propeller shaft, shift lever, hook lever, choke link, shift lever stopper, throttle shaft, handle, grip, bracket shaft, bracket bolt, clamp screw, tilt stopper, reverse lock, throttle link, starter lock, recoil starter and carburetor.	
Compression pressure	Every 100 hrs.	Measure compression pressure in the cylinder. (Make measurement after warm-up operation)	Standard: 4 kg/cm^2
Cooling water path	Every 100 hrs.	Remove deposit and dirt from water path in pump, water pipe, cylinder and cylinder head.	Overheating due to insufficient volume of cooling water resulting from clog.
Carburetor	Every 100 hrs.	Disassemble the carburetor, and clean dirt from its inside with washing liquid and air.	Poor operation at idling, low, intermediate and high speeds.
Carbon cleaning	Every 200 hrs. or annually	Clean away carbon in combustion chamber, air exhaust path and piston head.	Use of Tohatsu oil
Anode*	Every use	Check for wear and corrosion.	
Propeller*	Every use	Remedy or replace damaged or deformed propellers.	
Starter rope	Before cruising	Check for wear and breakage.	
Cooling water check	Every use	Check if water is discharged from check port and exhaust port. Check water inlet for clogging.	Cleaning
Clutch operation*	Every use	Positioning and adjustment	
Reverse lock*	Every use	Operational check	
Handle*	Every use	Steering feel (light/heavy). Throttle handling (light/heavy).	Sliding adjustment
Electric wiring*	Every 100 hrs.	Check connections for looseness, breakage and flaw.	
Throttle wire	Every 100 hrs.	Adjust length of wire.	
Throttle link	Every 100 hrs.	Check ball joint cap for loose movement. Check for bending of rod.	

NOTE: Please instruct users to inspect the items marked with * by themselves.

19 Troubleshooting

Troubles / Possible causes	Engine fails to start	Engine starts but stops soon	Poor idling	Poor acceleration	Engine speed abnormally high	Engine speed abnormally low	No acceleration	Engine overheating
Empty fuel tank	○	○						
Incorrect connection of fuel system	○	○	○	○		○	○	○
Air entry in fuel line	○	○	○	○		○	○	○
Deformed or damaged fuel pipe	○	○	○	○		○	○	○
Fuel tank cap or air vent screw left open	○	○	○	○		○	○	○
Clogged fuel filter, fuel pump or carburetor	○	○	○	○		○	○	○
Poor quality of engine oil			○	○		○	○	○
Poor quality of gasoline	○		○	○		○	○	○
Excessive oil in mixture			○	○		○	○	
Insufficient oil in mixture						○	○	○
Excessive supply of fuel	○			○				
Poor carburetor adjustment	○	○	○	○		○	○	○
Broken recirculation pipe	○	○	○	○			○	○
Spark plugs other than specified		○	○	○		○	○	○
Dirt or bridge on spark plugs	○	○	○	○		○	○	
Defective spark plug	○	○	○	○		○	○	
No circulation or insufficient cooling water						○	○	○
Faulty thermostat			○					○
Cavitation				○	○		○	○
Improper selection of propeller				○	○	○	○	○
Damaged or bent propeller				○	○	○	○	○
Improper position of thrust rod				○	○		○	
Unbalanced load position on boat				○	○	○	○	
Transom too high or too low				○	○	○	○	○
Short-circuited stop switch	○					○	○	
Improper adjustment of throttle link	○		○	○		○	○	
Inadequate ignition timing	○	○	○	○		○	○	○
Discharged or blown fuse	○							

4. OPTIONAL EQUIPMENT

1 Remote Control

The Tohatsu Remote Controller RC3D features a single-lever design to fully exhibit the original high performance of the outboard motor. It also features superior durability and water resistance.

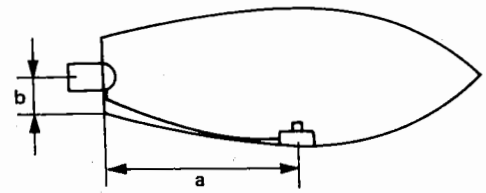


Fig.1.1 Simplified method of measuring the remote control cable length (a + b) + 300

1) The Tohatsu Remote Controller RC3D is available as a kit. The kit includes a remote-control box assembly fitted with a safety switch assembly, a mounting parts assembly, and screws. Measure the mounting length of the remote controller and the length necessary to allow the engine to swing. Then prepare a control cable and stop cable best suited for the size of the boat. (Fig.1.1)
2) Before installing the remote controller, check the contents of the kit.

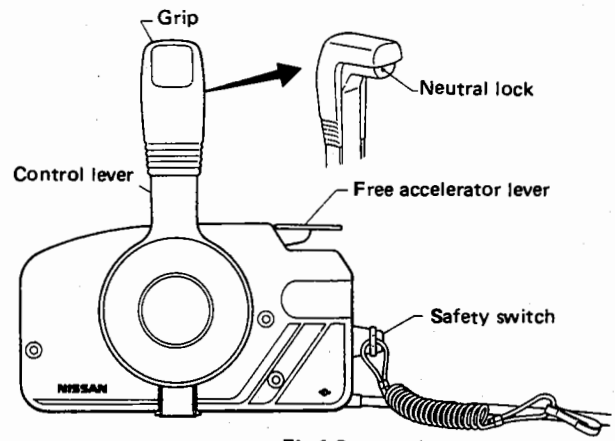


Fig.1.2

3) Mounting location (operator side of the boat)
   (1) Mount the control box to the right of the operator. (Fig.1.3)
   (2) Secure the box with the attached screws so that control lever can be operated easily.
   (3) Secure the remote control cable to the boat, avoiding sharp bends.

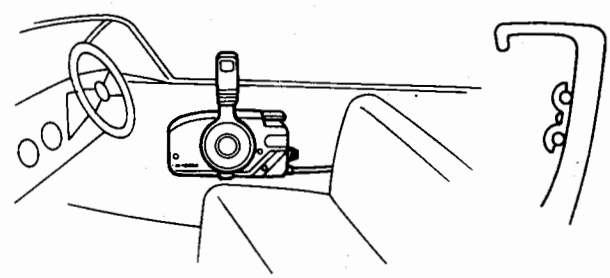
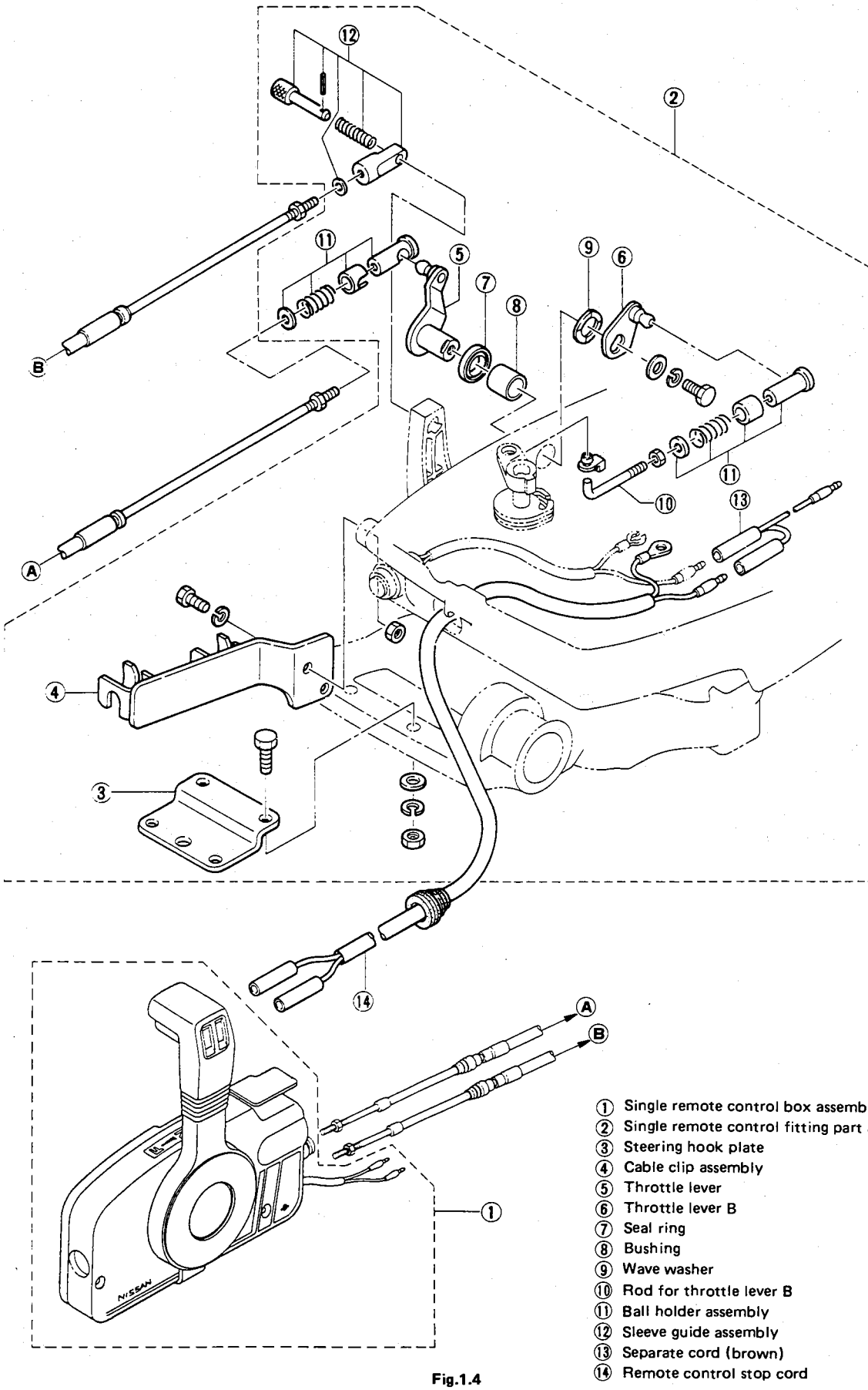


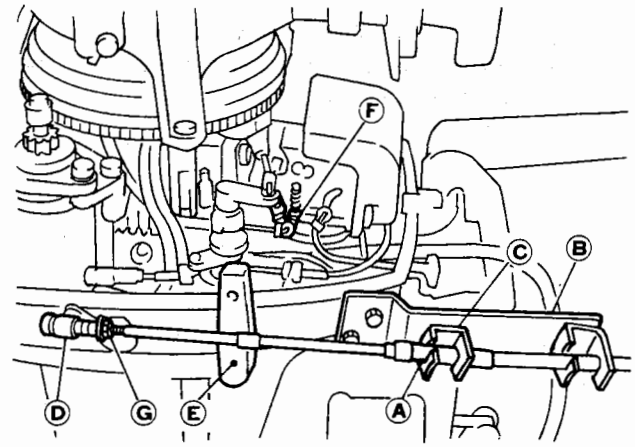
Fig.1.3



① Single remote control box assembly
② Single remote control fitting part assembly
③ Steering hook plate
④ Cable clip assembly
⑤ Throttle lever
⑥ Throttle lever B
⑦ Seal ring
⑧ Bushing
⑨ Wave washer
⑩ Rod for throttle lever B
⑪ Ball holder assembly
⑫ Sleeve guide assembly
⑬ Separate cord (brown)
⑭ Remote control stop cord

Fig.1.4

4) Reassembly (engine side)
   (1) Remove the throttle shaft grommet.
   (2) Install the seal ring and bushing to the throttle lever. Position the throttle lever in the lower motor cover at the throttle shaft, and tighten throttle lever B with the bolt (H612). Apply a coat of Tohatsu grease to the frictional surfaces of the lever.
   (3) Attach the snap rod to the throttle drum. Then connect throttle lever B to the throttle drum using the rod (for throttle lever B) assembled with a ball joint cap.
   (4) While manually turning the throttle drum, adjust the length of the rod (for throttle lever B) so that the carburetor throttle valve opens and closes properly.
   (5) Secure the cable clip assembly to the lower motor cover using bolts (H616) and nuts.
   (6) Install the sleeve guide assembly to the remote control cable (on the clutch side) and the holder cap assembly to the remote control cable (on the throttle side).
   - To distinguish the throttle side remote control cable from the clutch-side cable, proceed as follows:
     Move the remote control lever (at the remote control box) to "N" (Neutral) and operate the free accelerator lever to determine which inner cable lengthens and shortens. The side on which the inner cable moves in this way is the "throttle" side.
   (7) Position outer groove Ⓐ of the remote control outer cable (on the throttle side) in holder Ⓒ on the rear of cable clip assembly. Ⓑ Attach cable holder cap Ⓓ to the throttle lever ball joint. Set shift lever Ⓔ to "N" (Neutral) and screw the cable holder cap so that carburetor throttle lever Ⓕ is at the fully closed position. Then securely tighten lock nut Ⓖ.
   (8) Position outer groove (A) of the remote control outer cable (on the clutch side) in front holder (C) of cable clip assembly (B). Set shift lever (D) to "N" (Neutral). Align hole (E) used to install the shift lever with sleeve guide (H) of the cable end, and insert the guide lock pin (F) into hole (E) in the shift lever. Here, make adjustment by turning the sleeve guide (G). Lock the lock pin by burning it 90°.
   (9) Wiring connections to the safety switch (in the remote control box)
   (Refer to the block diagram on page 50.)
   Connect the separate cord (brown) between the stop switch and CD unit lead wires using a coupler. Connect the safety switch to the coupler using the remote control stop cord.



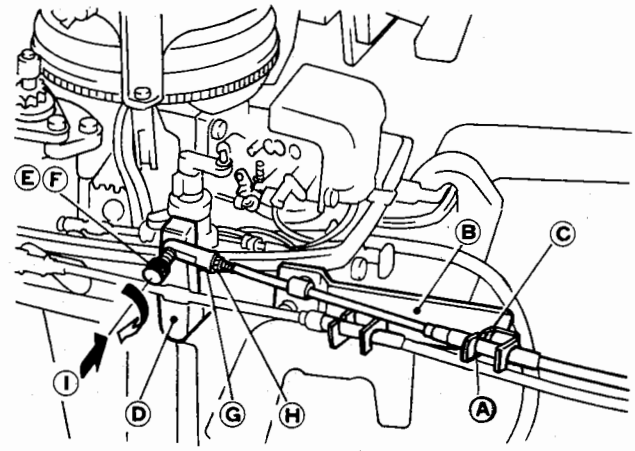


Fig.1.6

2 Alternator

1) Using the Flywheel Magneto Tool, remove the flywheel.
2) Secure the alternator with panhead screws (P628) furnished as accessory parts. Ensure that the diagonal dimension "d" (Fig. 2.1) is within $119.1^{+0}_{-0.2}$ mm ($4.689^{+0}_{-0.008}$ in).

   Tightening torque:
   4.4 – 5.4 N·m
   (0.45 – 0.55 kg-m, 3.3 – 4.0 ft-lb)
3) Route the lead wire along the outside of the guide as shown, and fasten together with the exciter coil lead wires.

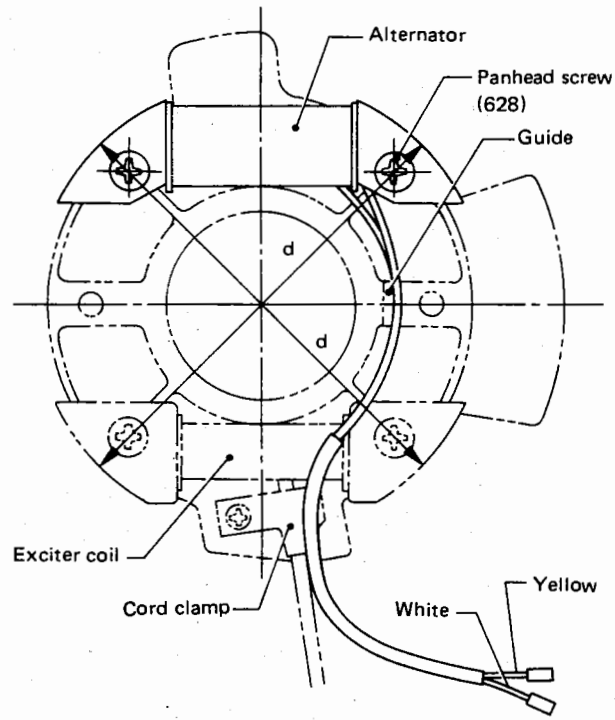


Fig.2.1

3 Light Extention Cord

When illuminating only the light bulb (without installing the battery), connect the light extension cord directly to the bulb.

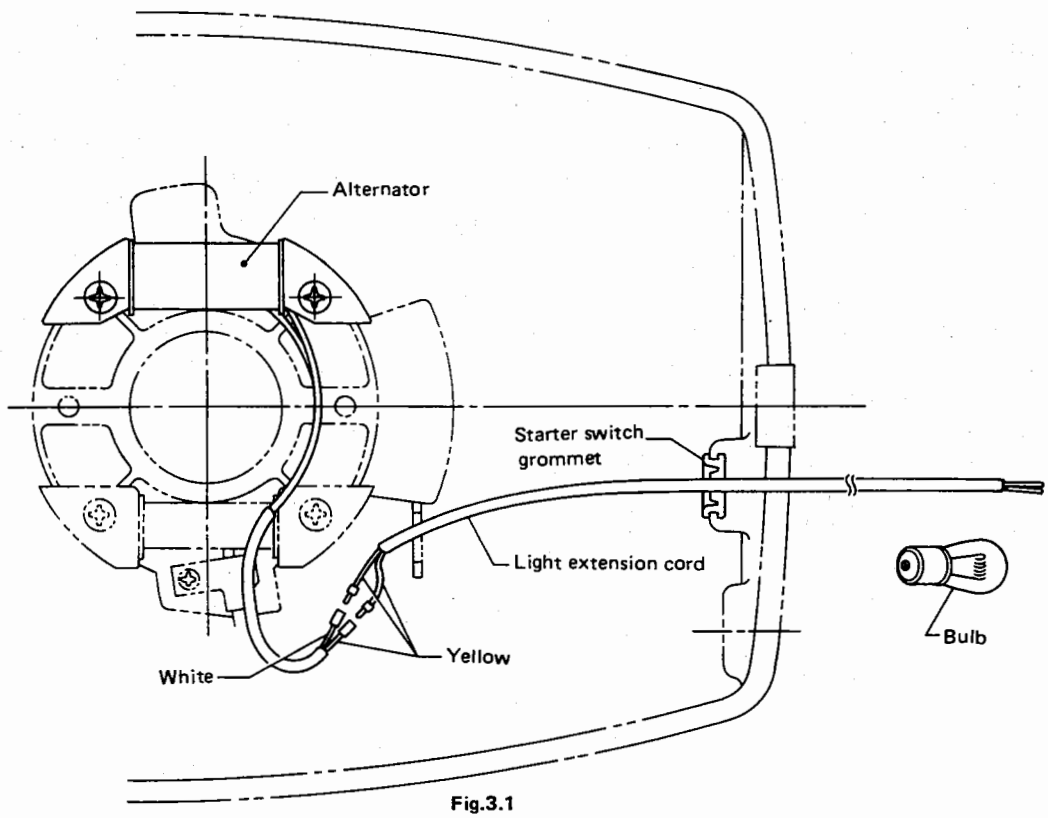


Fig.3.1

4 Tachometer Lead Wires

When a tachometer is to be installed, use the tachometer lead wires. If these lead wires are used in conjunction with the light extension cord or rectifier kit, use the separate cord.

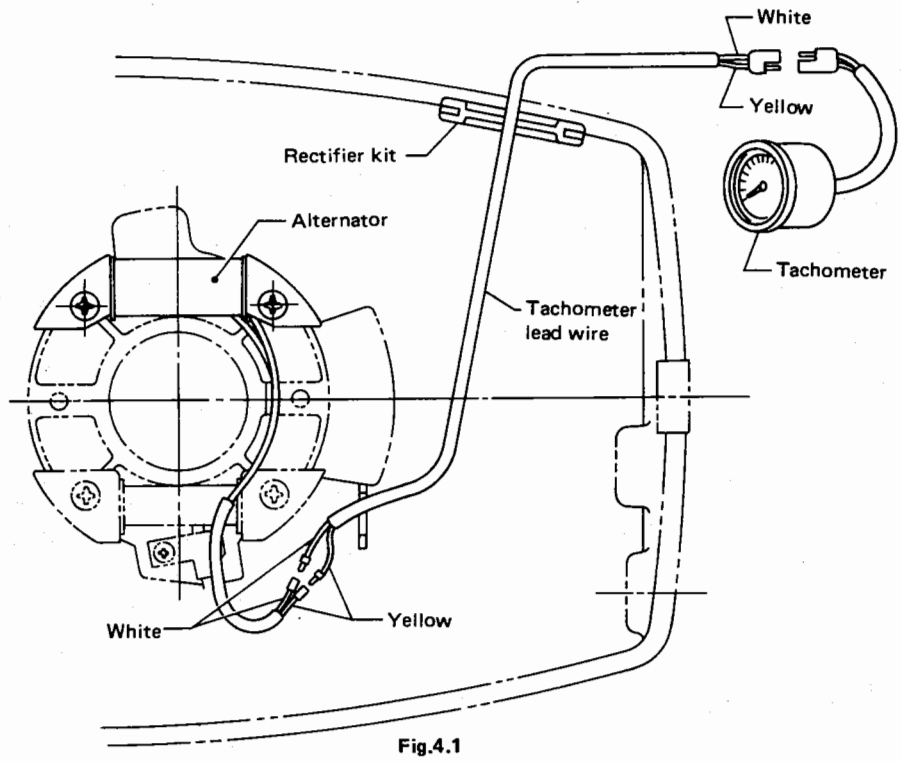
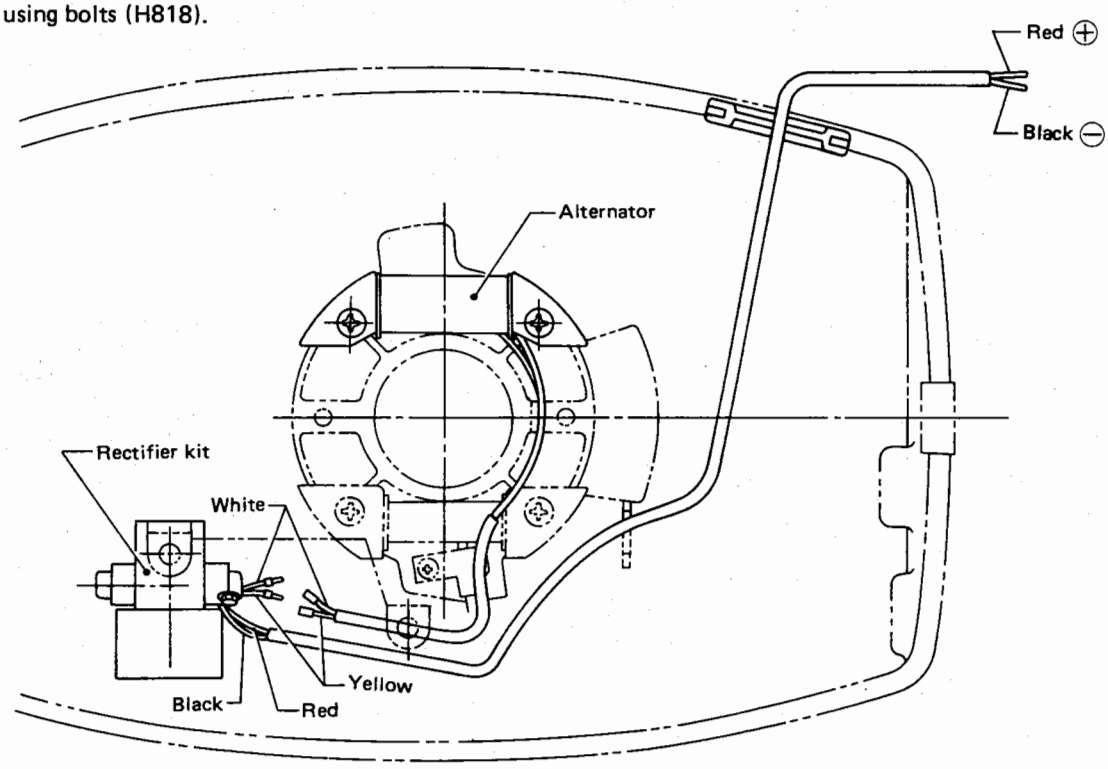


Fig.4.1

5 Rectifier Kit

Install the rectifier kit on the boss of the electric starter bracket using bolts (H818).



(Fig. 5-1)

6 Safety Switch

Remove the stop switch and install the safety switch in its place. The wiring need not be changed.

7 Vertical Starter

1) Drill 6.2-mm dia. holes on the starter case.
2) Install a seal on the vertical starter.
3) Install the vertical starter on the starter case using bolts (H654) and nuts.

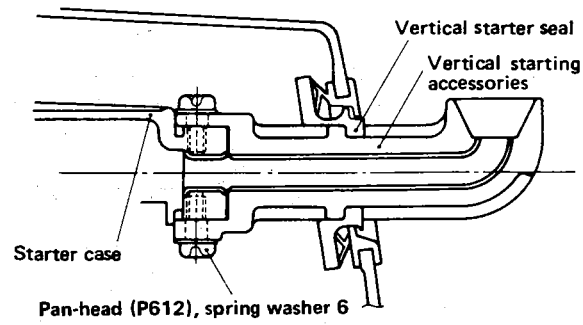


Fig.7.1

8 Electric Circuit (Standard)

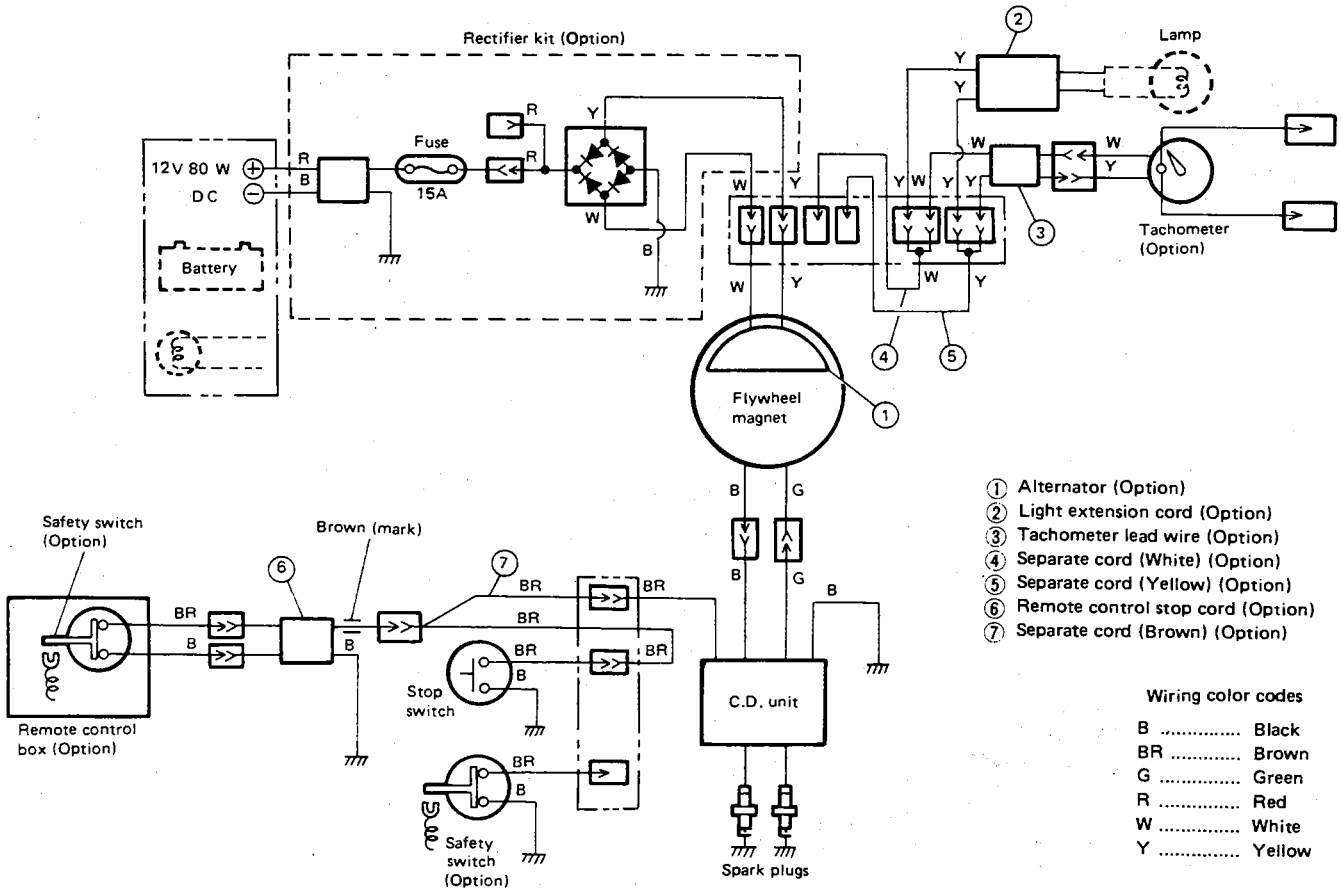


Fig.8.1

9 Electric Circuit (for F-type Electric Starter Specifications)

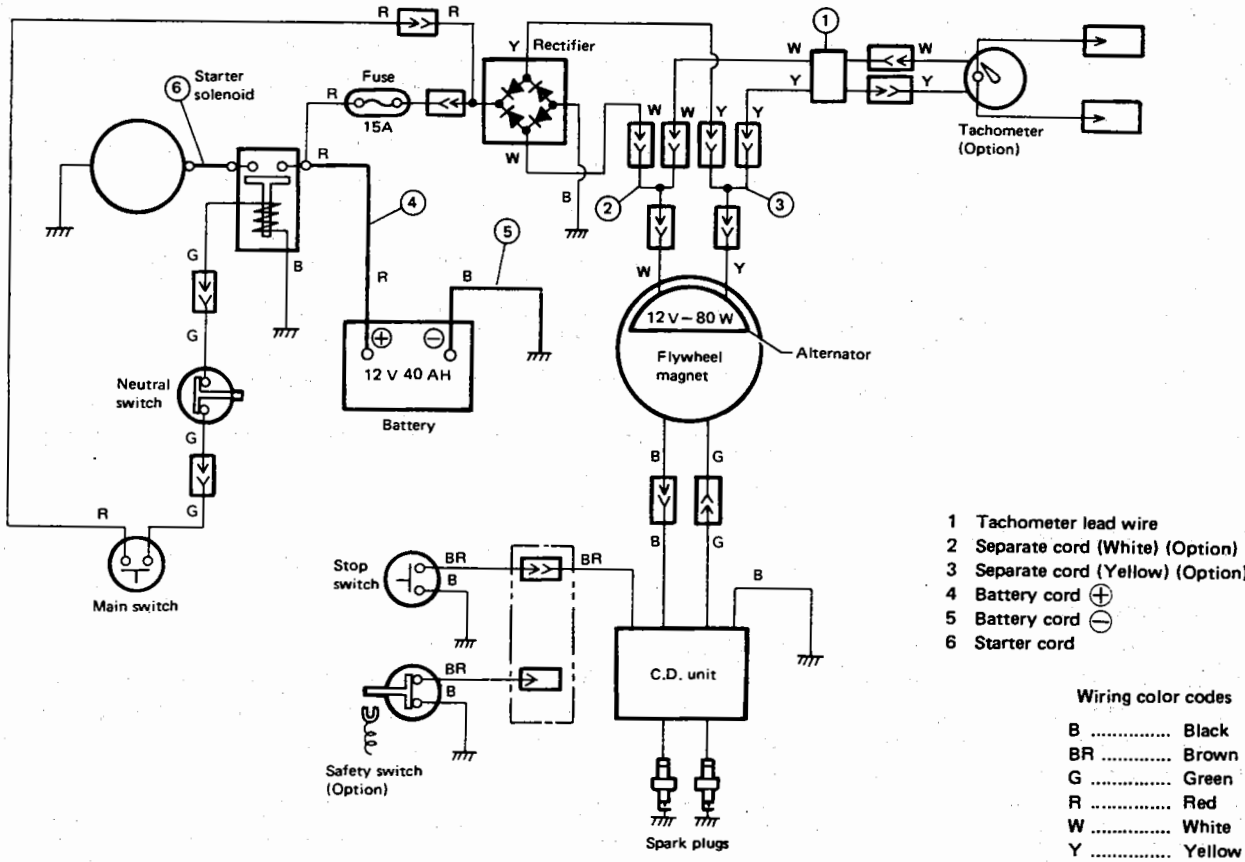


Fig.9.1

10 Troubleshooting

Problems which can occur in the starter motor and associated parts are listed in the following table. Before checking or repairing parts, set the clutch lever to Neutral.

Probable cause	Remedy
When main switch is turned ON, starter does not start or runs too slowly.	
(1) Loose or rusty battery terminals	Clean and repair.
(2) Discharged or dead battery	Recharge or replace.
(3) Poor main switch contact	Replace.
(4) Poor contact of starter terminal	Repair.
(5) Poor starter brush pressure (worn bruch/weak spring) or carbon accumulation	Replace or clean.
(6) Faulty starter solenoid (broken coil winding, poor point contact)	Replace or clean.
(7) Improper wiring of starting circuit	Repair.
(8) Field coil or armature coil grounded	Replace.
(9) Faulty neutral switch	Replace.
Starter runs but pinion does not engage ring gear.	
(1) Worn starter pinion end	Replace.
(2) Faulty starter (idling of over-running clutch or improper sliding of splines)	Replace.
Starter does not stop.	
(1) Failure of starter switch to return	Replace.
(2) Faulty starter solenoid (seized contacts)	Replace.

Checks after eliminating problems

1) Check electrical wiring, couplers and clamps for abnormalities.
2) Check the battery installation and electrolyte level, and plugs for deterioration or damage.
3) Run the starter motor to check if the pinion gear properly engages the ring gear (with clutch set in Neutral).

11 Periodic Inspection

Point to check	Service interval	Checking procedure
Condition of pinion engagement	Every 3 months	Run the starter motor to check switch operation, engagement of pinion gear, engine operation, etc.
Battery	Every 3 months	① Check electrolyte level. If close to low mark, add distilled water to upper mark through six plug openings.
	Every 3 months	② Check specific gravity of electrolyte. If it is below 1.20 at 20°C (68°F), charge battery to 1.25 – 1.27.
	Before day's operation	③ Check battery for improper installation, cracks or damage.
	Before day's operation and every 3 months thereafter	④ Check terminals for looseness or corrosion. If corroded, clean and apply grease or petroleum jelly.
Wiring harnesses	Before day's operation	① Check harnesses for damage and clamps for looseness. ② Check couplers for looseness.

12 Inspection and Service

(1) Starting system

When the main switch is pressed, current flows from the battery to the starter solenoid coil through the switch, energizing the iron core in the coil. The iron core then attracts the contact so that the motor terminal of the starter solenoid and the negative terminal are connected electrically.

Thus, a large current flows from the battery to the starter motor through the starter solenoid so that the starter motor runs.

Part to check	Inspection item	Service item	Standard value (Remedy)
Starter motor	(1) Brush height	Brush	7 mm (0.28 in) [If below 4 mm (0.16 in), replace brush.]
	(2) Check operation of brush.	Brush spring	4.32 N (0.44 kg, 0.97 lb)
	(3) Brush spring pressure (Using a spring scale, measure spring load just as the spring moves away from brush.)		20 mm (0.79 in) [Below 19.7 mm (0.776 in)]
	(4) Worn commutator	Commutator OD	
Starter solenoid	(1) Check coil for discontinuity. (2) Check insulation between starter and battery terminals. (3) Check for burned contact or poor continuity.		

(2) Battery

Part to check	Service standard	Remedy
Specific gravity of electrolyte in each cell	Standard value: 1,260 [at 20°C (68°F)] Repair limit: 1,200 [at 20°C (68°F)]	Charge battery if specific gravity is below 1,200.

Note: Measure specific gravity of battery electrolyte as corrected at 20°C (68°F). Correct specific gravity must be determined by the following equation:

Converted specific gravity = Measured S.G. + (Measured electrolyte temperature – 20) x 0.0007

(3) Rectifier and fuse

Names of parts	Inspection item	Remedy
Rectifier	Continuity and insulation test (Refer to Fig.12.1 for test methods.)	Replace if faulty.
Fuse	Visually check blown fuse. (Use a circuit tester if necessary.)	Replace if faulty.

(4) Main switch

Names of parts	Inspection item	Remedy
Main switch	Continuity and insulation tests (Refer to Fig.12.2 for test methods.)	Replace if faulty.
Neutral switch	Continuity and insulation tests (Refer to Fig.12.3 for test methods.)	Replace if faulty.

Checking the rectifier

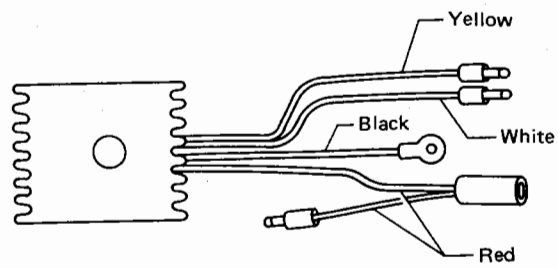


Fig.12.1

Tester (+) terminal \ Tester (−) terminal	Black (Black/White)	Yellow	White (Yellow)	Red (Yellow)
Black (Black/White)		No continuity	No continuity	No continuity
Yellow	Continuity established		No continuity	No continuity
White (White)	Continuity established	No continuity		No continuity
Red (Yellow)	Continuity established	Continuity established	Continuity established	

Attach test leads of a circuit tester to terminals ① and ② of the main switch. If the tester indicates "infinity" (∞ ohms), the main switch is in good condition.
While attaching test leads of a circuit tester to terminals ① and ② of the main switch, press main switch ③. If the tester indicates "0" ohms, the main switch is in good condition.

Checking the main switch

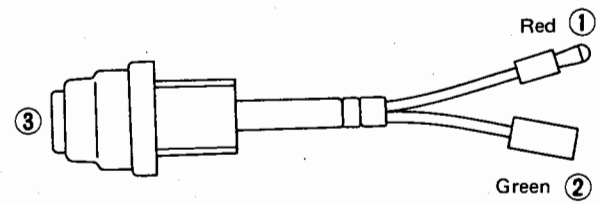


Fig.12.2

Attach test leads of a circuit tester to terminals ① and ② of the neutral switch. If the tester indicates "infinity", the neutral switch is in good condition. While attaching test leads of a circuit tester to terminals ① and ② of the neutral switch, press switch ③. If the tester indicates "0" ohms, the switch is in good condition (continuity is established).

Checking the neutral switch

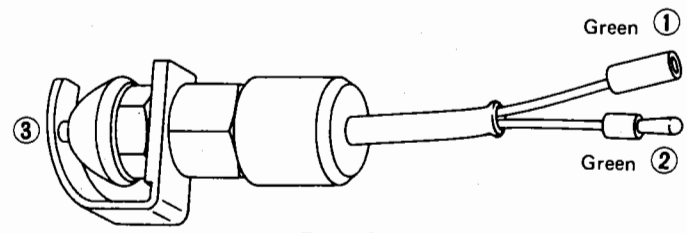


Fig.12.3

Attach test leads of a test (x 1Ω) to terminals ① and ② of the starter solenoid. If the tester indicates 3 ohms, the starter solenoid is in good condition. If the tester indicates "infinity" or "0 ohms", the starter solenoid is defective.

Starter solenoid

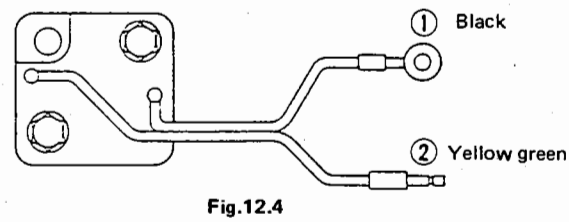


Fig.12.4

13 Electric Starter

(1) General

The electric starter consists of three major systems:

a) Engine starting system – Starter motor, starter solenoid, neutral switch and main switch.
b) Power source – Battery (optional).
c) Charging system – Rectifier and fuse.

(2) Components of the electric starter kit

An electric starter kit (F type) designed for industrial use is available.

It is suitable for use with Japanese fishing boats and is designed to start the engine on the outboard side using a bar handle.

Names of parts	Q'ty	Remarks
Starter motor	1	12 V, 0.4 kW
Starter solenoid	1	Hitachi A104-103
Starter cord	1	Starter solenoid – starter motor
Battery cable ⊕	1	Starter solenoid – battery
Battery cable ⊖	1	Ground – battery
Neutral switch	1	
Actuator/neutral switch	1	
Main switch	1	
Flywheel cup	1	W/ring gear
Alternator*	1	12 V, 80 W
Rectifier*	1	Stanley Electric DE 4204
Fuse	1	15 A
Battery	1	Optional (12 V, 40 W recommended)
Cord clamp	3	For 8 mm (0.31 in) dia. x 1; for 6 mm dia. (0.24 in) x 2

Notes: (1) The above table lists major components of the electric starter kit. For bolts used with these parts, refer to the parts list in the kit. An asterisk "*" refers to optional parts. Refer to items 2) and 5) in section 4.
(2) Power to operate lights is available from the battery.

(3) Installation

1) Refer to the parts list in the electric starter kit and wiring diagrams and connect all wiring.
2) Remove the recoil starter assembly.
3) Remove the magneto flywheel.
4) Install alternator Ⓐ. (Refer to page 48.) (Fig.13.1)
5) Remove the engine from the lower motor cover.
6) Install main switch Ⓑ and neutral switch Ⓒ on the lower motor cover. (Fig.13.2)

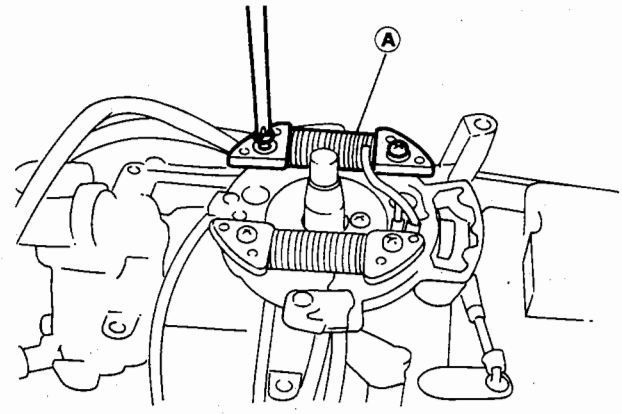


Fig.13.1

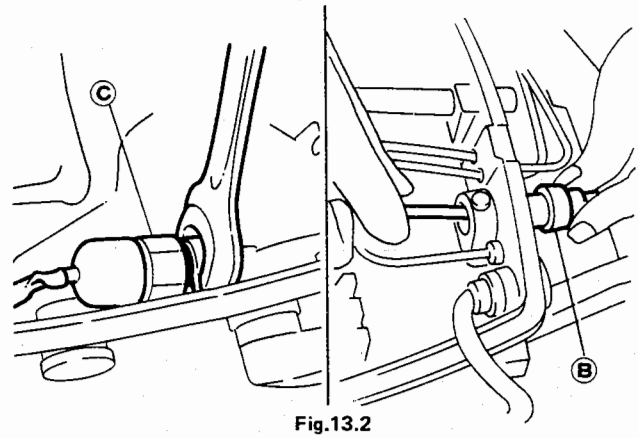


Fig.13.2

After installing the actuator, bend its tip for contact with the slot drum.

Fig.13.3

7) Clamp the magneto exciter lead wires (green Ⓓ and black Ⓔ) and alternator lead wires (yellow Ⓕ and white Ⓖ).
Lead wires Ⓓ through Ⓖ must be fastened with clamp Ⓗ on the crankcase. These lead wires must be routed loosely because they move together with the coil plate. (Fig.13.4)

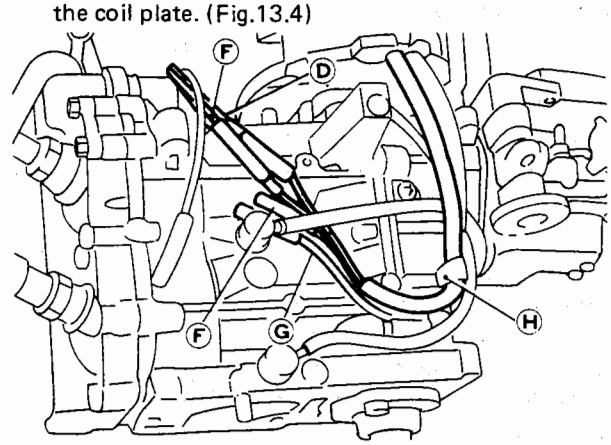


Fig.13.4

8) Install the engine in the lower motor cover. (Fig.13.5)

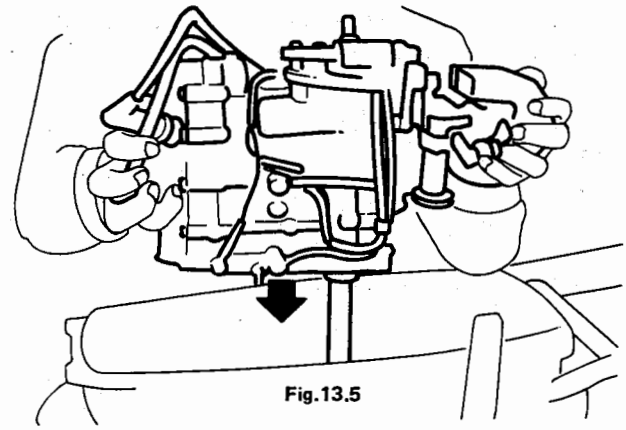
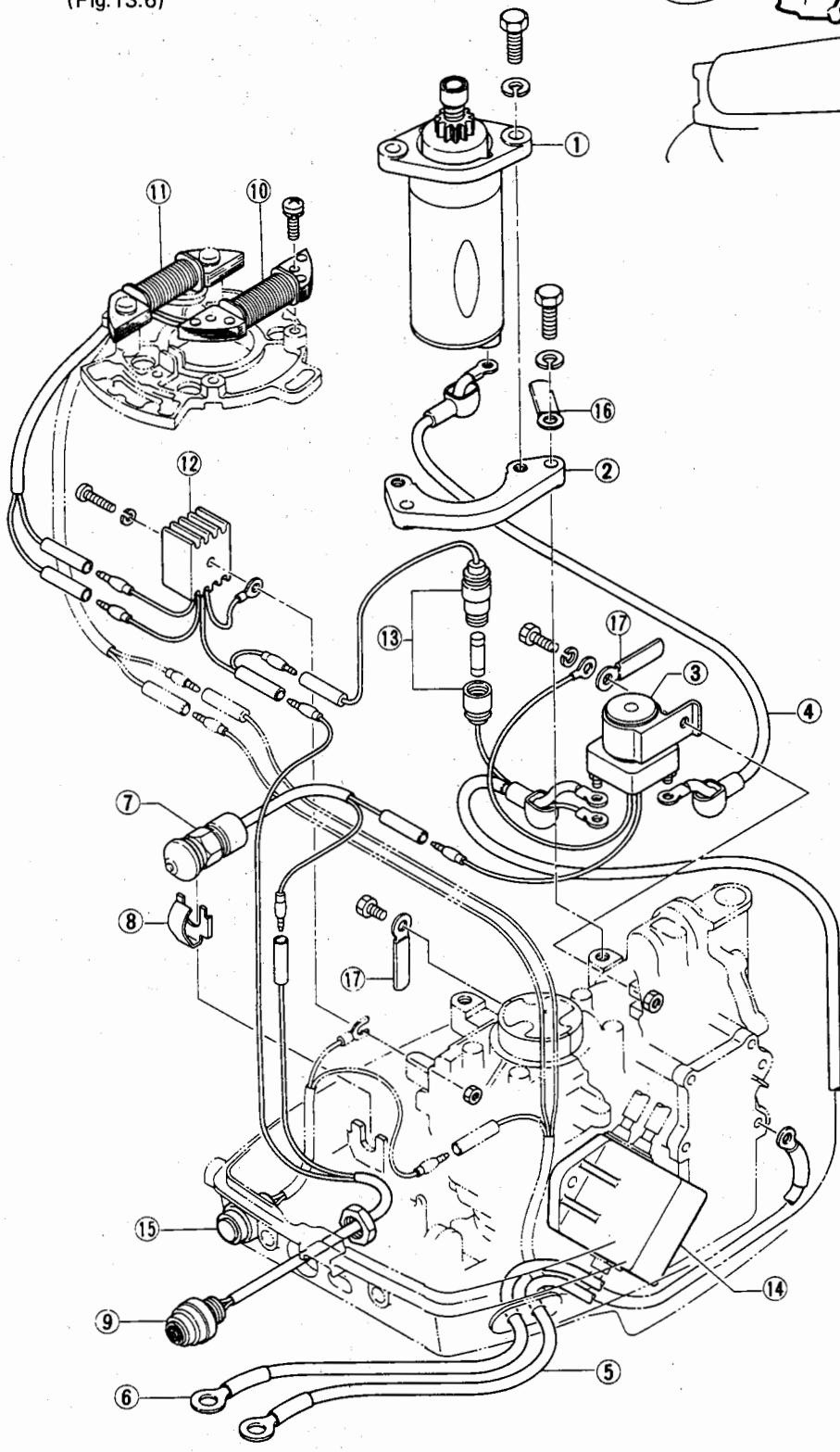


Fig.13.5

9) Make wiring connections using the following figure and the wiring diagram on pages 50 and 51. (Fig.13.6)



① Starter motor
② Starter motor bracket
③ Starter solenoid
④ Starter cord
⑤ Battery cord ⊕
⑥ Battery cord ⊖
⑦ Neutral switch
⑧ Actuator
⑨ Main switch
⑩ Alternator
⑪ Exciter coil
⑫ Rectifier
⑬ Fuse
⑭ CD unit
⑮ Stop switch
⑯ Cord clamp (φ8)
⑰ Cord clamp (φ6)

Position the following lead wires as a unit in the concave section of the cylinder. (Fig.13.7)

Name of lead wire	
• Magneto exciter coil lead wire (D) • DC unit lead wire (B) (green-black) • Stop switch lead wires (A) and (C) • Alternator lead wire (E) • Neutral switch lead wire (F)	Connected portion

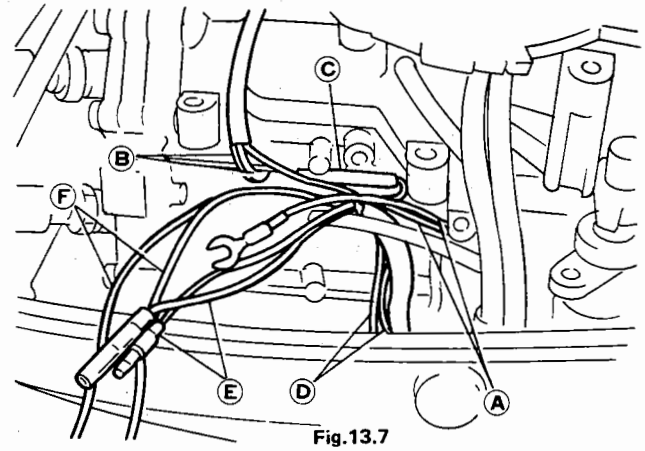


Fig.13.7

10) Install rectifier (G).
To install, face the cord side down and secure rectifier (G) to the crankcase using panhead screws (H) (P520) and nuts. Secure the ground lead wires (black) of the rectifier and stop switch to the back of the rectifier. Route rectifier lead wires (I) (yellow and white) as shown in the figure, connect to alternator lead wires (9) and (E), and secure them together with ground cable (black) of the stop switch, by clamps (J). (Fig.13.8)

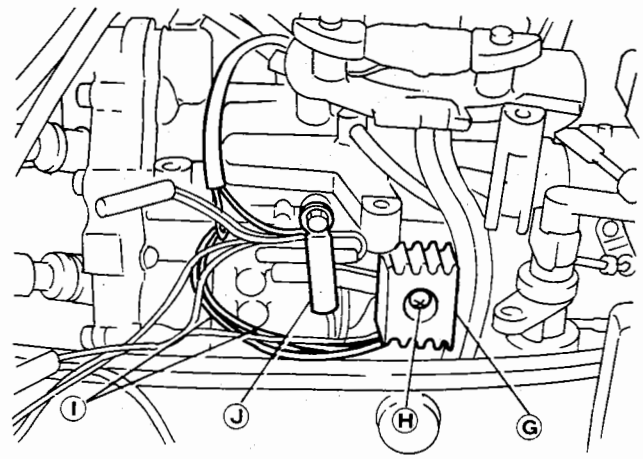


Fig.13.8

12) Starter solenoid cords
Connect battery cables (+) and (−).
- Pass battery cables (+) ((K) -red) and (−) ((L) -black) through the front and rear grommets in the lower motor cover. (Refer to Fig.13.6.)
  Route the cable (+) ((K) -red) along guide (M) and to the cylinder head.
- Secure the cable (−) ((L) -black) to the #1 bolt on the exhaust cover.
- Route the cable (+) ((K) -red) to area close to starter solenoid (M). Install starter terminal cap (P) on both the cable and fuse lead wire terminal (N). Then temporarily tighten the cable at the starter solenoid.
- Connect capped starter cord (P) to the terminal of starter (Q). (Fig.13.9 and Fig.13.10)

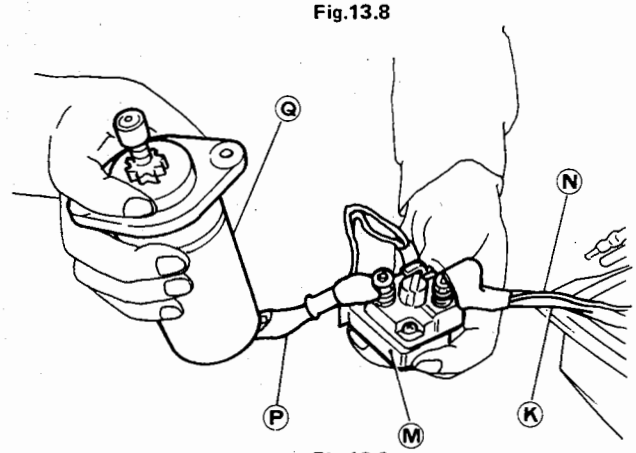


Fig.13.9

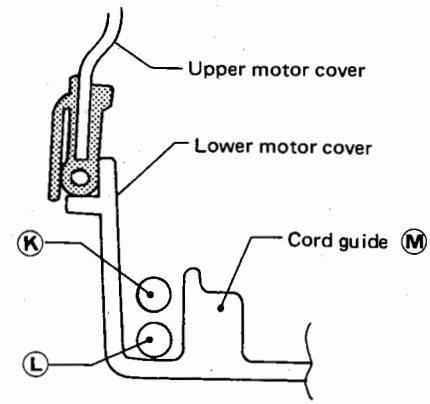


Fig.13.10

12) install starter motor bracket Ⓐ together with 8 mm (0.31 in) dia. cord clamp Ⓒ using the two bolts (B) (H825).
- Attach the lead wires of the main switch, neutral switch and rectifier to cord clamp Ⓒ.

Ⓓ . . . . . Boss used to install starter solenoid (Fig.13.11)

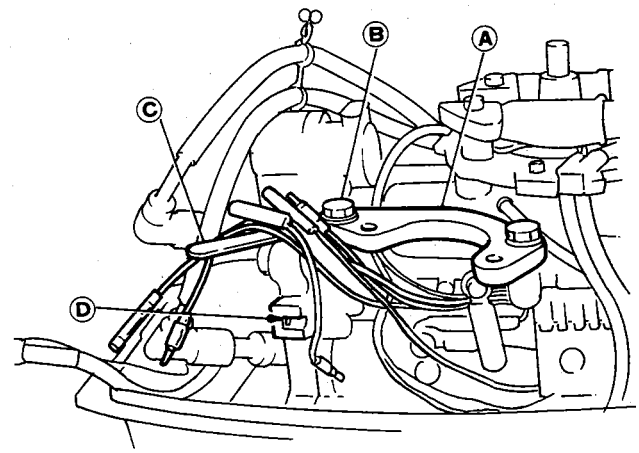


Fig.13.11

13) Align starter solenoid Ⓔ and starter motor Ⓕ with their mounting holes, and remove the solenoid and motor. Tighten terminal nuts firmly.
Install the starter terminal cap and starter solenoid using bolts Ⓖ (H618) and nuts. Also install the starter motor using the two bolts Ⓗ (H825).
- Secure the 6 mm (0.24 in) dia. fuse clamp Ⓘ and ground lead wire Ⓙ to starter solenoid Ⓔ.
- Using a clamp, secure fuse Ⓚ with its connector facing upward.
- Check that all lead wires are connected in the proper positions. Then secure them as a unit using an 8 mm (0.31 in) dia. clamp Ⓛ.

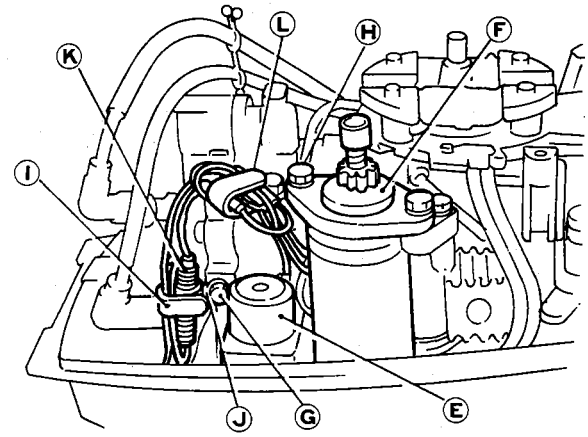


Fig.13.12

14) Installation of the magneto recoil starter
- Install flywheel cup Ⓐ equipped with the ring gear.
- Install recoil starter assembly Ⓑ.

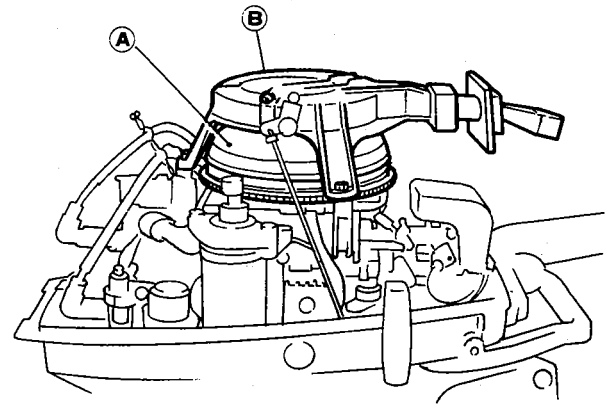


Fig.13.13

(4) Precautions during installation of the electric starter kit

1) Always use starter terminal caps when connecting the starter cord and battery cable (+) to their terminals.
2) Clean the contact surfaces of the ground cord and battery cable (—) for good grounding.
3) Do not clamp cords and cables too tightly on the hull; take into account marginal length required for swinging and tilting the engine.
4) After completing all wiring connections, recheck that all lead wires are properly connected. Use the wiring diagram as a guide.

(5) Precautions during test run

1) Check that the battery (12 V - 40 Ah) is charged completely.
2) Connect the red positive battery cable (+) and black negative cable (—) to their respective battery terminals, in that order. Be sure to install the cap cover on the positive cable.
3) Check that the motor starts only when the clutch lever is moved to "N" (Neutral).
4) Do not run the starter motor for more than 5 seconds at a time. Wait at least 5 seconds before trying it again. Continued starting operation may degrade the performance of the solenoid, battery, etc.
5) When installing the battery, secure it firmly so that it will not tilt from vibration during operation.
6) Check that cords and cables are not pinched or rubbed by adjacent parts when the steering wheel is turned.

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