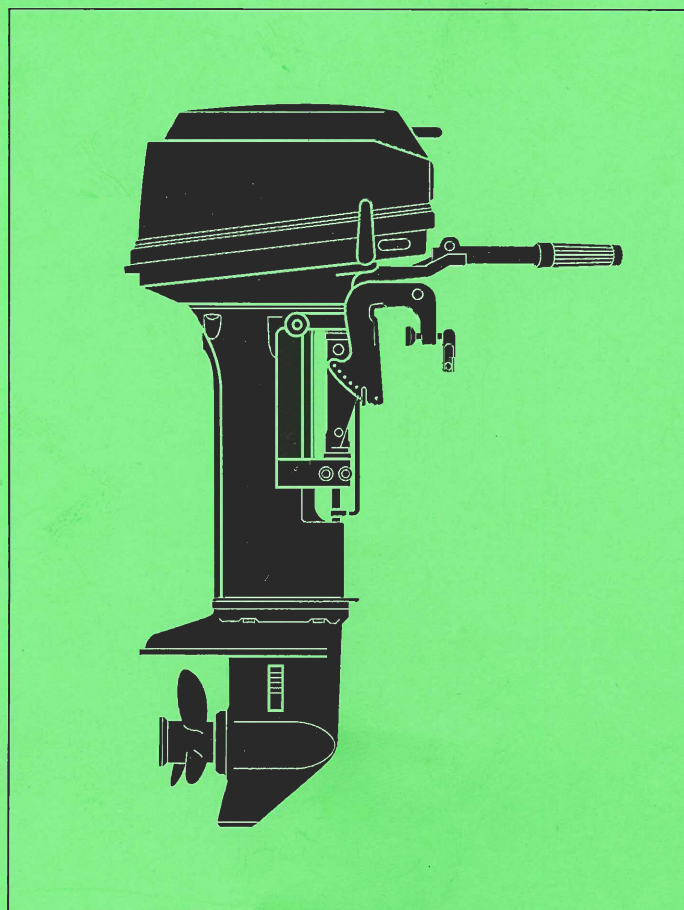


TOHATSU
OUTBOARD

**SERVICE
MANUAL**



9.9•15•18



TOHATSU CORPORATION

CONTENTS

CHAPTER 1 SPECIFICATIONS

Specifications	1-2
Disassembly, Maintenance and Repair	1-6

CHAPTER 2 SERVICE DATA

Service Data and Maintenance Standards	2-2
Periodic Inspection	2-8
Table of Sealants, Adhesives, Lubricating Oils and Usage Locations	2-9
Table of Tightening Torques	2-12
Tools and Instruments Required for Disassembly, Maintenance and Repair	2-13
How To Use Special Tools	2-14

CHAPTER 3 POWER UNIT

Removal of Power Unit	3-2
Removal of Accessories	3-4
Engine Disassembly	3-10
Engine Assembly	3-14
Installation and Adjustments of Accessories	3-18
Recoil Starter	3-23

CHAPTER 4 LOWER UNIT

Disassembly of Gear Case	4-3
Disassembly of Lower Unit Motor Cover and Drive Shaft Housing	4-12
Disassembly of Steering System, Handle and Bracket	4-21
Assembly of Steering System, Handle and Bracket	4-23

CHAPTER 5 CARBURETOR

Outline of Operation	5-2
----------------------------	-----

CHAPTER 6 ELECTRICAL SYSTEM

Coil Plate and Coils	6-2
CD Unit	6-3
Ignition Coil/Stop Switch	6-5
Electric Starter	6-6
Electric Circuit	6-7
Inspection of Parts Related to Electric Starter	6-9

CHAPTER 7 REMOTE CONTROL

Remote Control	7-3
----------------------	-----

CHAPTER 8 INSPECTIONS, ADJUSTMENTS AND TRIALS

Inspections and Adjustments After Final Assembly	8-3
Troubleshooting	8-4

CHAPTER 1

SPECIFICATIONS

SPECIFICATIONS 1

Specifications

Model Name		9.9C	9.9CEF	9.9CEP	15C	
Dimensions	Length	mm	869		565	869
	Breadth	mm	345		290	345
	Height	mm	(S) 1,052 approx. (L) 1,179 approx. (LL) 1,255 approx. (UL) 1,306 approx.			
	Outboard motor transom length	mm	S:435 L:562 LL:638 UL:689			
	Weight	kg	37	39	38.5	37
Performance	Maximum output	PS	9.9			15
	Range of rpm at wide-open-throttle	rpm	4,500 ~ 5,300			4,750 ~ 5,500
	Fuel consumption at wide-open-throttle	L/Hr	5.5			7.3
Engine	Number of cylinders		2			
	Bore × stroke	mm	55 × 52			
	Displacement	CC	247			
	Fuel		Minimum 87 octane			
	Engine oil		TCW-3			
	Lubricating system		Gasoline-engine oil mixture			
	Mixing ratio		50 parts of gasoline : 1 part of oil			
	Cooling system		Forced water-cooling system (rubber impeller rotary system)			
	Cooling water temperature regulation		Thermostat (with pressure release valve)			
	Intake system		Reed valve system			
	Exhaust system		Reverse scavenging system			
	Starting system		Recoil starter	Electric starter		Recoil starter
	Ignition system		Magneto energized CD ignition			
	Alternator		12V-80W			
	Rectifier		—	12V-6A		—
	Spark plug		NGK B7HS-10 or Champion L82 (gap 1mm)			
	Carburetor		TK carburetor			
	Direction of rotation of engine		Right hand			
	Ignition timing		ATDC 3° ~ BTDC 22°			
	Idling rpm	rpm	600 ~ 700			
Lower Unit	Number of tilt adjustments		6 positions			
	Tilt-up angle		70°			
	Maximum steering angle		80°			
	Tilt angle when running in shallow water		32°			
	Clutch system		Dog clutch type (F-N-R)			
	Gear ratio		13 : 24			
	Gear oil		Specified gear oil (GL5 SAE#80 to 90), 370cc approx.			
	Exhaust system		Through-hub exhaust			

15CEF	15CEP	18D	18DEF	18DEP
869	565	869		565
345	290	345		290
Height (S) 1,052 approx. (L) 1,179 approx. (LL) 1,255 approx. (UL) 1,306 approx.				
S:435 L:562 LL:638 UL:689				
39	38.5	37	39	38.5
15		18		
4,750 ~ 5,500				
7.3		8.5		
2				
55 × 52		60 × 52		
247		294		
Minimum 87 octane				
TCW-3				
Gasoline-engine oil mixture				
50 parts of gasoline : 1 part of oil				
Forced water cooling system (rubber impeller rotary system)				
Thermostat (with pressure release valve)				
Reed valve system				
Reverse scavenging system				
Electric starter		Recoil starter	Electric starter	
Magneto energized CD ignition				
12V-80W				
12V-6A		—	12V-6A	
NGK B7HS-10 or Champion L82 (gap 1mm)				
TK carburetor				
Right hand				
ATDC 3 ° ~ BTDC 22°		ATDC 3° ~ BTDC 25°		
600 ~ 700				
6 positions				
70°				
80°				
32°				
Dog clutch type (F-N-R)				
13 : 24				
Specified gear oil (GL5 SAE#80 to 90) 370cc approx.				
Through-hub exhaust				

SPECIFICATIONS 1

Model Name		9.9C	9.9CEF	9.9CEP	15C
Others	Steering	Tiller handle		Remote control	Tiller handle
	Fuel tank (plastic)	25L (portable)			
	Standard propeller (No. of blades × diameter × pitch)	Transom S : 8.5 (3 × 234 × 224)			
		Transom L : 8 (3 × 234 × 199)			
		Transom LL : 8 (3 × 234 × 199)			
		Transom UL: 7 (3 × 234 × 174)			
	Remote control box	—		STD	—
	Safety features	Neutral start system			
Throttle opening regulation device during reverse operation					
Optional Parts	Propeller (No. of blades × diameter × pitch)	6 (3 × 234 × 155)			
		7 (3 × 234 × 174)			
		8 (3 × 234 × 199)			
		8.5 (3 × 234 × 224)			
		9 (3 × 234 × 231)			
		10 (3 × 234 × 250)			
	Electric starter kit	P type/F type			
	Remote control box	RC type			
	Remote control cable				
	Rectifier kit	For manual type			
	Lighting plug socket/plug				
	Stop switch with rope				
	Tachometer	Tachometer lead wire to be arranged for separately			
Separate cords	For simultaneous usage of lighting devices and tachometer				

15CEF	15CEP	18D	18DEF	18DEP
Tiller handle	Remote control	Tiller handle		Remote control
25L (portable)				
Transom S : 8.5 (3 × 234 × 224)		Transom S : 9 (3 × 234 × 231)		
Transom LL : 8 (3 × 234 × 199)		Transom L : 8.5 (3 × 234 × 224)		
Transom LL : 8 (3 × 234 × 199)		Transom LL : 8.5 (3 × 234 × 224)		
Transom LL : 7 (3 × 234 × 174)		Transom UL : 8 (3 × 234 × 199)		
—	STD	—		STD
Neutral start system				
Throttle open regulation device during reverse operation				
6 (3 × 234 × 155)				
7 (3 × 234 × 174)				
8 (3 × 234 × 199)				
8.5 (3 × 234 × 224)				
9 (3 × 234 × 231)				
10 (3 × 234 × 250)				
P type/F type				
RC type				
For manual type				
Tachometer lead wire to be arranged for separately				
For simultaneous usage of lighting devices and tachometer				

Disassembly, Maintenance and Repair

Precautions during work

General precautions for assembly/disassembly are given below.

1. Place the motor on a suitable stand that will safely support the motor during maintenance operations.
2. Avoid damage to the mating surfaces of the crankcase and cylinder assembly. Do not use a sharp metal scraper to clean this area. Protect painted surfaces from damage.
3. Replace gaskets, O rings, seals, cotter pins, and spring pins when removed during repairs.
4. Use only genuine replacement parts and accessories.
5. Use special tools for specific repairs.
6. Find matching marks on parts removed for repair, if these marks are not present make your own. This will make assembly quicker and easier.
7. Keep all parts, screws, nut, washers, etc., removed from motor separated for easy identification during assembly.
8. Wash parts in cleaning solvent (always use rubber gloves) before inspection for wear and damage.
9. During assembly all parts should be carefully inspected for alignment, function. Use recommended lubrication products where they apply.
 - (1) Follow torque sequences when tightening any bolt. First lightly torque the bolt in sequence then torque to final specification.
 - (2) Using a lubricant, carefully assemble seals to avoid damage to the seal lips. Be sure seal lips are facing the correct direction.
 - (3) Use the correct type and amount of sealing product on the metal to metal surfaces. Use a small quantity to avoid sealant entering crankcase.
 - (4) Use care when removing rusted or frozen bolts. Penetrating solvents are available to ease removal.
 - (5) For details of inspection, maintenance and repair values, tightening torque for various parts, locations where sealing material, adhesive, and grease, etc., are to be used, refer to the corresponding table.
 - (6) Bolts, nuts, and washers are indicated by the symbols below.

H820 – Hexagonal bolt	Diameter 8	Length 20
N8 – Normal hexagonal bolt	Diameter 8	
L8 – Hexagonal lock nut (3 types)	Diameter 8	
W6 – Flat washer	Diameter 6	
SW6 – Spring washer	Diameter 6	
Screw 620 – Round head screw	Diameter 6	Length 20

10. Work carefully during maintenance and repair to avoid injuries and accidents.

CHAPTER 2

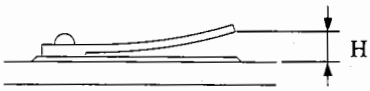
SERVICE DATA

Service Data and Maintenance Standards

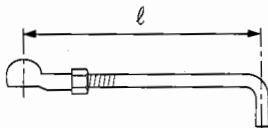
	Part	Item	Standard Values
Engine-related Items	Cylinder head	<ol style="list-style-type: none"> Carbon deposits on the inside surface of the combustion chamber Mounting surface distorted Corrosion of mating surfaces. Cooling water passages plugged 	
	Cylinder	<ol style="list-style-type: none"> Carbon deposits near the exhaust port Residue in the water jacket Measure the inside diameter using cylinder gauge, then measure the clearance between the cylinder and the piston. (See Fig. 3-1) Seizure Minor scores in cylinder liner Scores and wear of cylinder liner Cylinder and mating surfaces of cylinder head 	<ol style="list-style-type: none"> Piston clearance from 0.0019mm to 0.0035mm
	Piston	<ol style="list-style-type: none"> Maximum diameter The location for measurement of diameter is at a position 12mm above the lower end of the piston skirt (in the exhaust direction) (See Fig. 3-3) Piston clearance Carbon deposits on the piston crown and the ring groove Scratches on the sliding surfaces Measurement of clearance between piston ring and ring groove (See Fig. 3-2) Measurement of diameter of hole for piston pin 	<ol style="list-style-type: none"> <div>18D 59.95mm ~ 59.97mm</div> <div>15C/9.9C 54.95mm ~ 54.97mm</div> <div>Piston clearance 0.05mm ~ 0.09mm</div> <div>Top 0.03mm ~ 0.07mm</div> <div>Second 0.02mm ~ 0.06mm</div> Clearance with pin Tight 0.01mm to loose 0.009mm
	Piston ring	<p>End gap</p> <p>Top Second</p> <p>Note: Measurement of end gap (See Fig. 3-4) If a ring gauge is not available, measure the gap at the lower part of the cylinder bore with the least wear.</p>	<p>0.20mm ~ 0.40mm 0.20mm ~ 0.40mm</p>
	Crankshaft	<ol style="list-style-type: none"> Crankshaft deflection (The main bearings at both ends of the crankshaft are to be supported on V-blocks) (See Fig. 3-5 and Fig. 3-6) Side gap of big end (See Fig. 3-7) 	<ol style="list-style-type: none"> 0.05mm or less 0.20mm to 0.40mm

Repair Limits	Measures
2. When the score depth or distortion is 0.03mm or greater	<ol style="list-style-type: none"> 1. Clean and remove deposits. 2. Repair (set sand paper of grade #240 ~ #400 or above and repair the surface by rubbing). 3. Repair or replace according to the degree of wear. 4. Clean and remove foreign matter.
3. 0.15mm or greater 6. If a score with large depth or scarfing is detected in the sliding surfaces of the piston, and if it is not possible to repair the flaw using #400 to #600 paper, and if the difference between maximum and minimum wear is 0.06mm or greater 7. When the flaw depth or distortion of the mating surfaces is 0.03mm or greater	<ol style="list-style-type: none"> 1. Clean and remove the deposits. 2. Clean and remove the residue. 3. If the wear is greater than the requirements, replace or perform boring and finish by honing. For oversized piston, the clearance is 0.05mm. 4. Replace or use an oversized piston after boring. 5. Repair using sand paper of #400 to #600. 6. Bore and hone to a diameter of 60.5 ± 0.01 (18D) or 55.5 ± 0.01 millimeter (15C/99C), carefully checking the chamfered part of the port and chamfering the inadequately-chamfered part. 7. Repair using #240 to #400 paper on the milling cutter or surface plate ensuring that gas does not leak.
1. 0.15mm or greater 4. Top 0.10mm or greater Second 0.09mm or greater. 5. 0.03mm or greater	<ol style="list-style-type: none"> 1. Replace if outside the range of requirements. 2. Clean and remove carbon deposits. 3. Repair if necessary (sand paper #400 to #600). 4. Replace if outside the range of requirements. 5. Replace if outside the range of requirements.
0.08mm or greater	Replace with a new piston ring. However, the wear in the cylinder liner should be within the repair limits.
1. 0.05mm or greater 2. 0.6mm or greater	<ol style="list-style-type: none"> 1. Repair or replace if outside the range of requirements. 2. Replace if outside the range of requirements.

SERVICE DATA 2

	Part	Item	Standard Values
Engine-related Items	Reed valve	1. Height of valve stopper (H) 2. Reed valve cracked or damaged 3. Deformation of valve seat surface Rise, wear or damage	 H=6.0mm to 6.2mm
	Engine block	Compressive pressure Measure after fully opening the throttle after warming up (remove both spark plugs). Disable ignition	18D 7.5kg/cm ² 15C/99C 8.0kg/cm ²
Fuel-related Items	Carburetor	Setting mark Venturi diameter Main jet (MJ) Main air jet (MAJ) Main nozzle inside diameter (MN) Slow jet (SJ) Slow air jet (SAJ) Throttle opening (at W.O.T.) Pilot screw (PS) Oil level (from flange surface to float bottom surface) Air vent Idling rpm	3G2 0 ø 22 #116 #100 ø 4mm #60 #130 18D/15C 72° 9.9C 53° 1×1/2±1/4 rotation reversed 14.5mm ±1mm ø 4.5mm 950 ~ 1000rpm
Electrical Items	Magneto	Ignition timing Ignition occurs Sparking sequence Spark plug Plug gap Lighting output Charging ability Lighting coil resistance Yellow - white wire Pulser coil resistance Blue - black wire Exciter coil resistance Red - black wire	18D Throttle fully closed ATDC3°±1° Throttle fully open BTDC25°±1° 15C/9.9C Throttle fully closed ATDC3°±1° Throttle fully open BTDC22°±1° Greater than 500rpm/10mm (measurement using specified spark tester) 1-2 NGK B7HS10 CHAMPION L82C (gap 1.0mm) 0.9mm ~ 1.0mm 12V/80W 1500rpm 5500rpm, greater than 5A 0.3Ω 38Ω 210Ω

Repair Limits	Measures
<p>H = outside the range 6.0 ~ 6.2</p> <p>When the reed valve tip is raised, seat is worn, or damaged.</p>	<ol style="list-style-type: none"> 1. Repair or replace 2. Replace 3. Replace <p>Replace with a new set of items.</p>
<p>When the difference in compression between cylinders is greater than 10%.</p> <p>When the compression is abnormally higher than the standard value.</p>	<p>Perform boring, honing and fit an oversized piston, or replace with a new part.</p> <p>Remove carbon from piston crown and cylinder head, and clean the exhaust bypass.</p>
	<p>Oil level: Repair or replace with a new part if the level is outside the range of standard values.</p>
<p>Spark gap 1.2mm or greater</p>	<p>Adjust the side electrode.</p> <p>However, if the wear in the electrode is excessive, replace it.</p>

	Part	Item	Standard Values
Electrical Items	Ignition coil	<ul style="list-style-type: none"> Primary coil resistance (terminal to ground) Secondary coil resistance (between high voltage cables) 	0.25Ω 5,100Ω
	CD unit		
	Starter motor	Battery Output Clutch <ul style="list-style-type: none"> Brush length (wear limit) Brush spring (standard force) Commutator (wear limit) 	Greater than 12V-40AH 12V-0.4KW Over-running switch 7.5mm (4.5mm) 0.5kg 20mm (19.7mm)
	Rectifier	Continuity	In one direction only
	Fuse	Capacity	15A
Cooling-related Items	Thermostat	1. Switching of thermostat 2. Permanent set or deformation of spring	<ul style="list-style-type: none"> Temperature at start of operation 52°C±2°C Temperature when valve is fully open 65°C±2°C Lift when valve is fully open Greater than 3mm
	Pump impeller Pump case liner Guide plate	Wear, crack	
Throttle Angle-related Items	Link adjustments	See Page 3-21 <ul style="list-style-type: none"> Length of link (2) 72mm Length of link (3) 75mm 	
	Anode	1. Anode on the engine side 2. Gear case anode 3. Mounting bracket anode	
Lower Unit	Propeller shaft	<ul style="list-style-type: none"> Bearing damaged Oil seal damaged 	
	Bevel gear	See Page 2-19 Backlash between bevel gears A and B	0.08mm to 0.13mm
	Oil seals	Wear, damage	

Thermostat switching test

1. If the valve is even slightly open at normal temperature, replace the thermostat.
2. Immerse the thermostat in water, raise the water temperature gradually and check the valve opening temperature.
3. Since there is a time delay in the thermostat, maintain a temperature of about 65°C for approximately 5 minutes and measure the lift of the valve.

Repair Limits	Measures
	If wear in the brush or commutator exceeds the limit, replace with a new item.
	<ol style="list-style-type: none"> 1. Replace after testing (see below). 2. Replace
In case of wear, crack or damage to tip diameter or lips of the upper or lower surface	Replace with a new set.
	<ol style="list-style-type: none"> 1. Replace if wear is excessive. 2. Same as above 3. Same as above
0.15mm or greater at the propeller stopper	Replace with a new item.
0.15mm or greater	Adjust or replace with a new item.
If the lips have deteriorated, degraded or damaged, and if wear is such that the tightening allowance is less than 0.5mm.	Replace with a new item.

Periodic Inspection

Item to be Inspected	Inspection Period	Inspection Procedure	Remarks
Excessive tightening of bolts and nuts	After 10 hours for new items	Cylinder head, exhaust cover, carburetor, inlet manifold, crankcase, recoil starter, drive shaft housing, mounting bracket, gear case, propeller shaft, housing, others	Refer to "Table of tightening torques".
Gear oil	Replace after 10 hours if new Replenish oil after every 50 hours After 200 hours or after long term storage, replace before the season starts	Replenish or replace at periods mentioned in the column on the left. Inspect the propeller shaft and oil seal for cracks, wear and water penetration.	Use about 370cc of recommended oil (GL5, SAE#90 to SAE#90).
* Spark plug	Every 50 hours or 6 months	If the clearance increases (greater than 1.2mm) or carbon deposits or dirt accumulates because of wear of the electrodes, repair, clean or replace the spark plug.	Gap STD 0.9mm to 1.0mm
*Fuel system	Every 50 hours or 6 months	Clean and check fuel tank, fuel pipe, fuel filter, fuel pump, carburetor, float chamber for dirt and damage.	Remove dirt and water. Fuel leaks Air intake
* Grease-up	Every 50 hours or 6 months	Propeller shaft, gear shift lever shaft, choke link mechanism, gear shift lever stopper, throttle shaft, handle, grip, bracket shaft, bracket bolts, clamp screws, tail stopper, reverse locking mechanism, throttle link mechanism, starter locking mechanism, recoil starter, carburetor	
Compressive pressure	Every 100 hours or 12 months	Measure the compressive pressure on the cylinder (measure after warming up).	
Cooling water passages	Every 100 hours or 12 months	Remove scales and dirt in the cooling water passages of pump, water pipe, cylinder, and cylinder head. Inspect or replace impeller.	Overheating occurs if cooling water quantity is inadequate.
Carburetor	Every 100 hours or 12 months	Disassemble the carburetor, remove dirt from internal parts, clean using cleaning oil or gasoline, and blow air.	Malfunction at low/medium/high speed and idling operation.
Carbon cleaning	Every 200 hours or 12 months	Removal of carbon from fuel chamber, exhaust passages, exhaust bypass, piston head and ring groove.	
* Anode	When used	Check for corrosion and wear.	Replace if necessary after checking the condition.
* Propeller	When used	Repair or replace damaged or deformed propeller.	
* Starter rope	When used	Check for wear and cuts.	
* Starter motor	When used	Check rotating condition.	If unsatisfactory, check battery.
* Cooling water check	When used	Check drainage of cooling water at the inspection port and drain outlet. Check for plastic scraps or dirt in the water inlet.	Remove
* Clutch operation	When used	Check adjustments cables	
* Reverse operation	When used	Operation	
* Handle	When used	Check whether steering is easy or hard. Check whether throttle operation is easy or hard.	Adjust sliding surfaces.
* Electric wiring	Every 100 hours or 6 months	Looseness, breaks, damage to connectors	
Throttle link mechanism	Every 100 hours or 6 months	Play, looseness in ball joint cap, and bend in rod	

(Remarks) Give instructions to ensure that users strictly follow the inspection procedures for items marked "*" in the extreme left column.

Table of Sealants, Adhesives, Lubricating Oils and Usage Locations

Engine-related items	Three Bond 1322	Three Bond 1373 B	Three Bond 1361 B	Three Bond 1342	Three Bond G17	Instantaneous Adhesive Three Bond 1741	Three Bond 1104I	Three Bond 1107	Cold-resistant Nippeico LT2	Specified grease	Cup grease	TCW-3 engine oil	Specified gear oil	Remarks
Piston												○		Ring groove, piston, piston hole, periphery
Piston pin												○		Periphery
Piston ring												○		
Cylinder liner												○		Inside wall
Main bearing												○		Bearing moving parts
Big end bearing												○		Bearing moving parts
Small end bearing												○		Bearing moving parts
Labyrinth packing												○		Groove part
Cylinder crank case mating surface						○								Take care to maintain thickness of coating
Labyrinth packing screw				○										Threaded part
Crankshaft upper oil seal											○			Lips
Crankshaft lower oil seal											○			Lips
Drive shaft oil seal											○			Lips
Magneto base "O" ring												○		
Magneto base									○					Periphery of bearing
Guide plate									○					Sliding surfaces
Setting ring									○					Sliding surfaces
Starter shaft									○					Ratchet guide B groove, bearing periphery
Starter spring									○					
Ratchet shaft bush									○					
Starter shaft nut				○										Threaded part
Flange assembly of carburetor				○										
Carburetor									○					Lever sliding parts
Air silencer screw				○										Threaded part
Advancer arm									○					Sliding parts
Advancer arm shaft		○												Threaded part on the screw side
Starter lock										○				Sliding parts
Starter locking cam										○				Sliding parts
Throttle stopper										○				Sliding parts
Ball joint B		○												Threaded part
Engine base packing								○						Both sides

SERVICE DATA 2

Engine-related items	Three Bond 1322	Three Bond 1373 B	Three Bond 1361 B	Three Bond 1342	Three Bond G17	Instantaneous Adhesive Three Bond 1741	Three Bond 1104I	Three Bond 1107	Cold-resistant Nippeico LT2	Specified grease	Cup grease	Specified engine oil	Specified gear oil	Remarks
Bevel gear B nut		○												After thoroughly de-greasing the threaded part
Propeller shaft housing											○			Spigot
Propeller shaft "O" ring											○			
Propeller shaft oil seal													○	Lips
Lower pump case oil seal													○	Lips
Lower pump case "O" ring											○			
Lower pump case											○			Spigot
Propeller shaft housing bolts	○													Threaded part
Pump case bolts														Threaded part
Water pipe lower seal rubber													○	Inside surface
Water pipe upper seal rubber													○	Inside surface
Water pipe guide rubber													○	Complete
Exhaust pipe bolts		○												Threaded part
Reverse locking bolts				○										Threaded part
Upper mounting rubber bolts				○										Threaded part
Drive shaft housing bolts											○			Threaded part
Gear case bolts											○			Threaded part
Water intake port cover bolts				○										Threaded part
Cam rod bush stopper bolts										○				Threaded part
Cam rod bush													○	All around
Cam rod bush "O" ring A													○	
Cam rod bush "O" ring B													○	
Gear case lubricating oil													○	370cc
Upper mounting rubber										○				Outer and inner periphery
Bracket conical collar										○				Periphery
Clamp screw										○				Threaded part
Tilt stopper bush										○				Sliding surfaces
Steering shaft										○				Sliding surfaces
Steering shaft bush										○				Sliding surfaces
Thrust plate										○				Sliding surfaces
Bracket shaft "O" ring										○				Sliding surfaces
Steering friction plate										○				

Engine-related items	Three Bond 1322	Three Bond 1373 B	Three Bond 1361 B	Three Bond 1342	Three Bond G17	Instantaneous Adhesive Three Bond 1741	Three Bond 1104I	Three Bond 1107	Cold-resistant Nippeico LT2	Specified grease	Cup grease	Specified engine oil	Specified gear oil	Remarks
Steering friction bolts										<input type="radio"/>				Threaded part
Reverse lock link collar										<input type="radio"/>				Sliding surfaces
Reverse lock link joint										<input type="radio"/>				Sliding surfaces
Swivel bracket										<input type="radio"/>				Grease packed inside
Grip										<input type="radio"/>				Sliding parts
Steering handle collar										<input type="radio"/>				Sliding parts
Throttle shaft bush										<input type="radio"/>				Sliding parts
Universal pinion										<input type="radio"/>				Sliding parts
Throttle shaft supporter										<input type="radio"/>				Sliding parts
Gear shift lever shaft oil seal										<input type="radio"/>				Lips
Gear shift lever shaft bush										<input type="radio"/>				Sliding Parts
Gear shift lever stopper plate										<input type="radio"/>				Sliding parts
Gear shift lever stopper										<input type="radio"/>				Sliding parts
Shift lever pin										<input type="radio"/>				Sliding parts
Motor cover upper seal rubber						<input type="radio"/>								Adhesive parts
Starter seal rubber						<input type="radio"/>								Adhesive parts
Choke rod										<input type="radio"/>				Sliding parts
Choke lever										<input type="radio"/>				Sliding parts
Hook lever bush										<input type="radio"/>				Sliding parts
Hook lever sealing ring										<input type="radio"/>				Sliding parts
Drive shaft											<input type="radio"/>			Spline crankshaft side
Propeller shaft										<input type="radio"/>				Propeller insertion part
Drive shaft guard pipe					<input type="radio"/>									Grommet
Air silencer gasket							<input type="radio"/>							Both sides
Air silencer bolts				<input type="radio"/>										
Float chamber nipple				<input type="radio"/>										
Primary nipple				<input type="radio"/>										
Rectifier screws (electric starter)				<input type="radio"/>										Threaded part

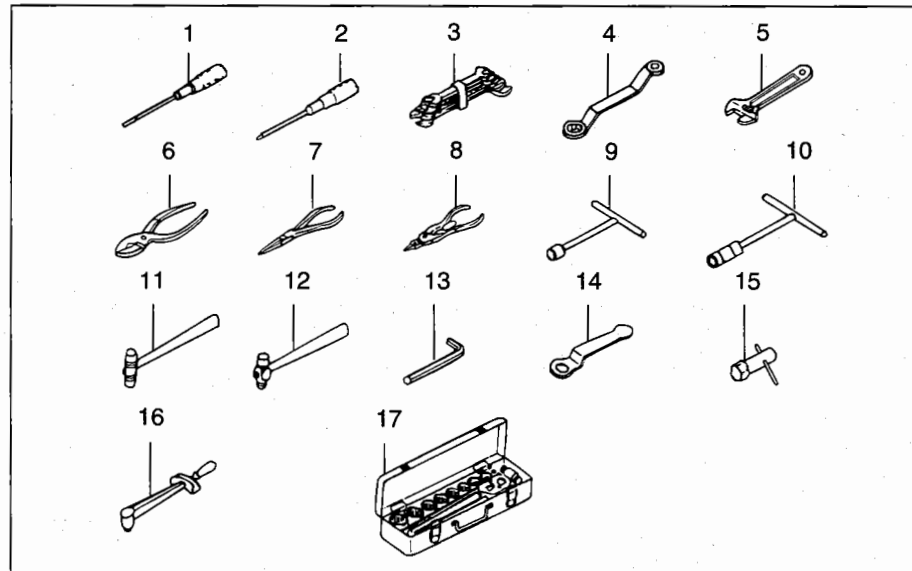
Table of Tightening Torques

No.	Item	Screw Dimension (mm)	Tightening Torque (kg-m)	Tightening Conditions
1	Magneto nut	16	7 ~ 9	
2	Cylinder head bolt	8	2.4 ~ 2.6	Tighten after running-in
3	Crank case bolt	8	2.4 ~ 2.6	
4	Exhaust cover bolt	6	0.8 ~ 1.0	
5	Inlet manifold bolt	6	0.8 ~ 1.0	
6	Advancer arm nut	8	Adjustment	
7	Exhaust pipe bolt	6	0.7 ~ 0.9	Apply Three Bond 1373B
8	Spark plug	14	2.4 ~ 2.6	
9	Bracket nut	8	1.5 ~ 2.0	Type I bracket bolt
		7/8 (inch)	9 ~ 10	Type II bracket bolt
10	Reverse lock bolt	8	1.8 ~ 2.0	Apply Three Bond 1342
11	Upper mounting rubber bolts	10	2.3 ~ 3.2	Apply Three Bond 1342
12	Drive shaft housing bolt	8	1.8 ~ 2.0	Tighten after running-in Apply the specified grease
13	Ball joint B	6	0.3 ~ 0.5	Apply Three Bond 1373B
14	Handle friction adjusting nut	6	Adjustment	
15	Bevel gear B nut	10	3.0 ~ 3.5	Apply Three Bond 1373B
16	Others	4	0.13 ~ 0.18	
		5	0.27 ~ 0.36	
		6	0.47 ~ 0.64	
		8	1.14 ~ 1.54	
		10	2.30 ~ 3.12	
17	Stop switch	16	0.3 ~ 0.4	
18	Stop switch with rope	16	0.2 ~ 0.25	
19	Neutral switch (type F)	12	0.3 ~ 0.35	

Tools and Instruments Required for Disassembly, Maintenance and Repair

The tools and instruments described below are necessary for the maintaining and repairing outboard motors. Where the use of special tools is recommended in this text, make sure you use these special tools for disassembly/assembly. For usage methods, please refer to "How to use special tools."

(1) General tools



(Fig. 2-1)

- | | | | |
|----------------------------|-----------|-------------------------------|----------------------|
| 1. Flat-tipped screwdriver | (200mm) | 8. Cutting pliers | |
| " | (150mm) | 9. T-shaped box wrench | (10mm) |
| " | (100mm) | " | (13mm) |
| 2. Phillips screwdriver | (200mm) | " | (17mm) |
| " | (150mm) | 10. T-shaped universal wrench | (10mm) |
| " | (100mm) | " | (13mm) |
| 3. Set of wrenches | (6 nos.) | 11. Plastic hammer | |
| 4. Box end wrench | (10 × 13) | 12. Hammer | |
| " | (17 × 21) | 13. Allen wrench | (8mm) |
| " | (21 × 23) | " | (10mm) |
| 5. Adjustable wrench | (300mm) | 14. Plug wrench | (21mm) |
| 6. Pliers | | 15. Plug wrench | (21mm) |
| 7. Thin-nose pliers | | 16. Torque wrench | (500kg-cm) (1,500kg) |
| | | 17. Set of socket wrenches | |

(2) Compression gauge

(3) Dynamometer

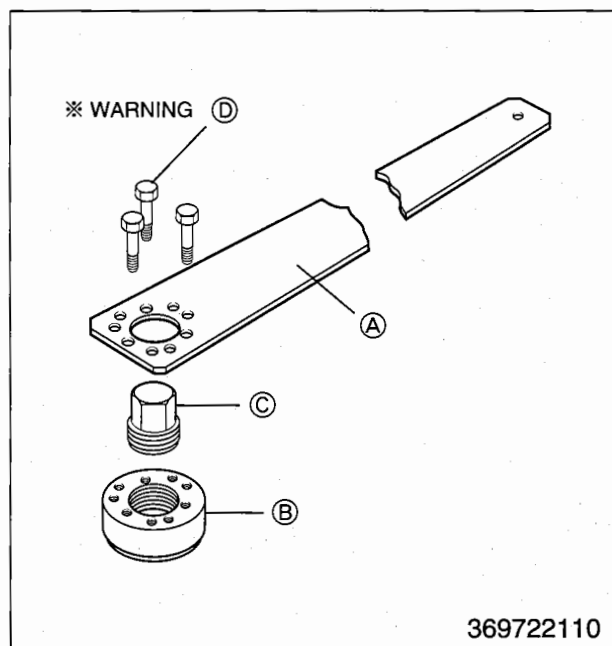
(4) Measuring tools

Use the measuring tools listed below, commonly available in the market.

Tachometer	600rpm to 6,000rpm
Tester	(resistance × 1,000 10 k-ohms AC voltage 30 to 300V, DC voltage 30V, built-in battery less than 3V)
Calipers	(JIS B 7507; M1 type Calipers 300mm)
Micrometer	(JIS B 7502; minimum scale reading 0.01, outside micrometer)
Cylinder gauge	(JIS B 7515; 50mm to 100mm cylinder gauge)
Ring gauge	(JIS B 7420; dia. 55, dia. 60)
Dial gauge	(JIS B 7503; minimum scale reading 0.01 dial gauge)
Feeler gauge	(JIS B 7524; capable of measurements from 0.03 to 0.3)
V Block	(JIS B 7540)
Surface plate	(JIS B 7513; 500 × 500)
Dial gauge with magnetic base or dial gauge stand	

How To Use Special Tools

Flywheel magneto tool



Bolts will hit coils if too long.

1. Disassembly

Secure the tools (A) and (B) on the flywheel magneto using the bolts (D). Remove the magneto nut using a 24mm socket wrench. (nut has left-hand thread) Next, insert the tool (C) in the tool B. Tighten the tool (C) using the 24mm socket wrench to remove the flywheel magneto.

2. Assembly

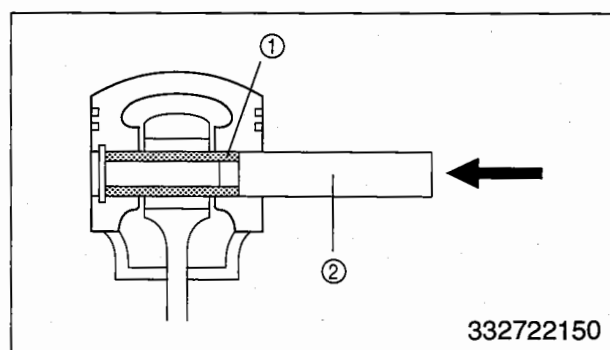
When installing the flywheel, make sure that the magneto key has been assembled, then tighten the magneto washer and nut. Mount the tools (A) and (B) on the flywheel and tighten to the specified torque using a torque wrench.

Tightening torque: 7 ~ 9 kg-m

CAUTION

- Thoroughly degrease the crankshaft and magneto taper.
- Lubricate the threads in (B) and (C) periodically.
- ※ Warning: when using a flywheel puller, be sure to use the correct bolts for the tool. If the bolts are too long they will damage the lighting and exciter coils.

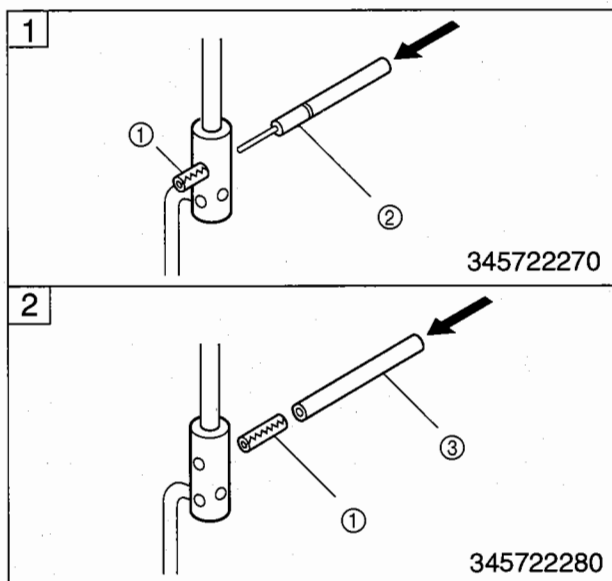
Piston pin tool



- ① Piston pin
- ② Piston pin tool

- Remove the piston pin clip. Insert the tip of the piston pin tool (2) in the hole of the piston pin (1) and lightly tap the end of the tool in the direction of the arrow with a hammer. Hold the piston with your hand to prevent applying a bending force on the connecting rod and carefully pull out the piston pin.

Spring pin tool

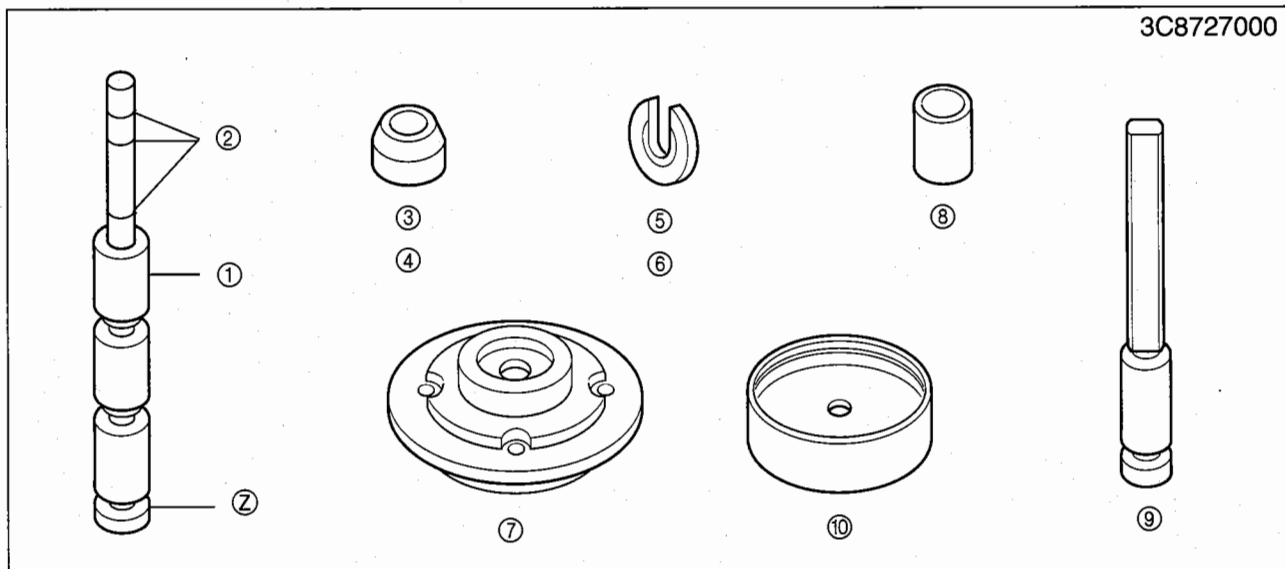


- ① Spring pin
- ② Spring pin tool A
- ③ Spring pin tool B

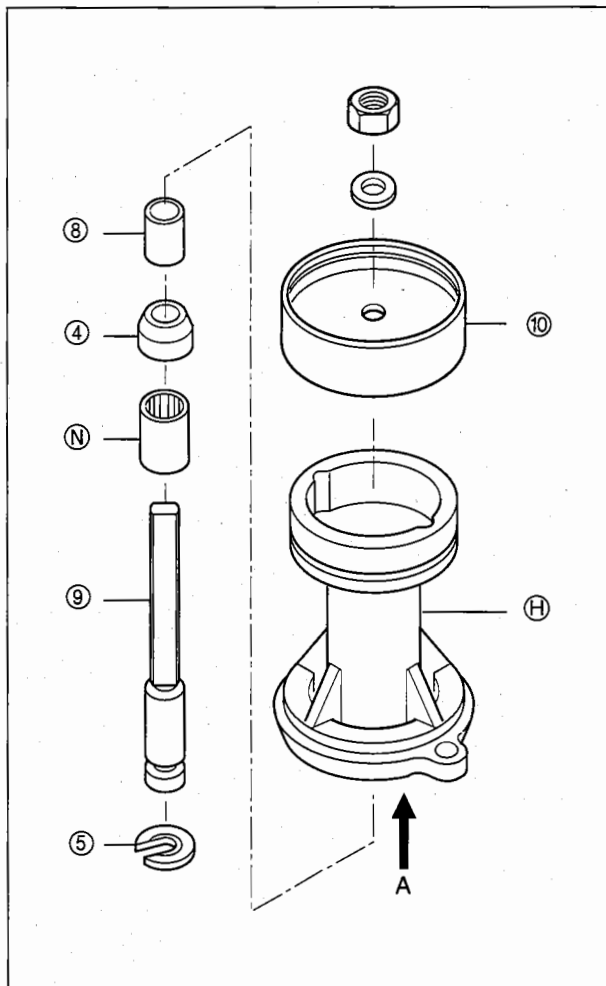
1. To remove the spring pin from the shift rod joint
 - Insert the tip of the spring pin tool A ② in the hole of the spring pin ①, tap the tool lightly with a hammer in the direction of the arrow and remove it.
(This tool may be used for removing spring pins at other locations also.)
2. To insert the spring pin in the shift rod joint
 - Insert the spring pin ① in the hole of the spring pin tool B ③. Align the front end of the spring pin with the spring pin hole of the clutch lever joint, and tap the end face lightly with a hammer in the direction of the arrow, to insert the spring pin. (This tool may be used for inserting spring pins at other locations also.)

Needle roller bearing tool

- ④ Guide B (inside diameter 17)



- ① Shaft A
- ② Engraved lines
- ③ Guide A (inside diameter 16)
- ④ Guide B
- ⑤ Retainer A (dia. 23.5)
- ⑥ Retainer B (dia. 24.5)
- ⑦ Flange A
- ⑧ Shaft stopper
- ⑨ Shaft B
- ⑩ Flange B



- ⑤ Retainer A (dia. 23.5)
- ⑧ Shaft stopper
- ⑨ Shaft B
- ⑩ Flange B
- Ⓜ Propeller shaft housing
- Ⓝ Needle roller bearing

(1) Needle roller bearing in propeller shaft housing

1. Press-fit

Insert the retainer A ⑤ (outside diameter 23.5) in the groove of shaft B ⑨, then place the needle roller bearing ③, guide B ④, shaft stopper ⑧ on top of it.

CAUTION

Make sure you set the tapered end of guide B, end face of needle roller bearing with no characters written on it, and the face with the V-groove of retainer A, so that they all face the threaded end of the shaft.

Insert the assembly you have just set into the propeller shaft housing ②, in the direction of the arrow A shown in the figure on the left. Assemble flange B ⑩ as shown in the figure, and tighten the assembly with the nut/washer so that it is firmly secured.

2. Removal

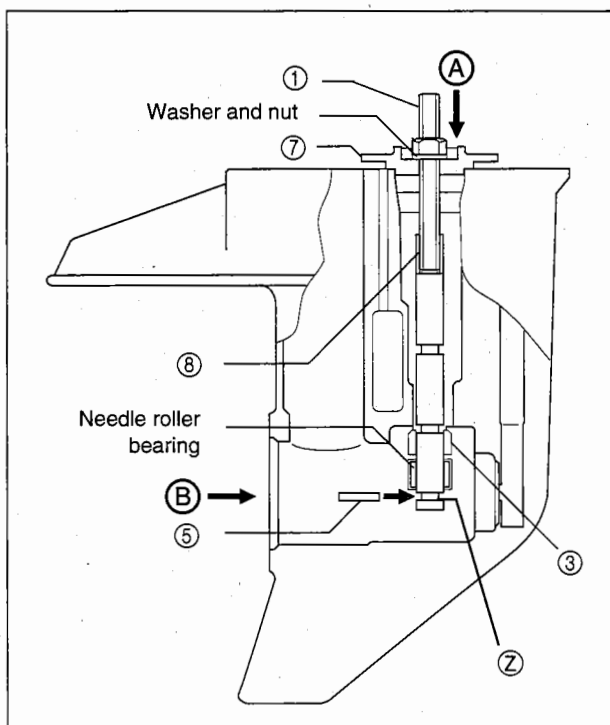
To remove the needle roller bearing, set only the retainer A in the groove of shaft B, similar to the press-fitting procedure, and insert it in the direction of the arrow shown in the figure. (Make sure that the oil seal of the propeller shaft housing has been removed before you start removing the needle roller bearing.)

Then set the flange B as shown in the figure, and tighten using the nut/washer until the needle roller bearing is removed. (Use the propeller shaft housing spigot of diameter 65.5 in the hole of flange B, and make sure that the center of the hole of flange B is not displaced from the center of the shaft.)

CAUTION

Do not re-use a needle roller bearing, which has been removed.

- ① Shaft A



- ③ Guide A (inside diameter 16)
- ⑤ Retainer A (dia. 23.5)
- ⑦ Flange A
- ⑧ Shaft stopper

(2) Needle roller bearing of gear case

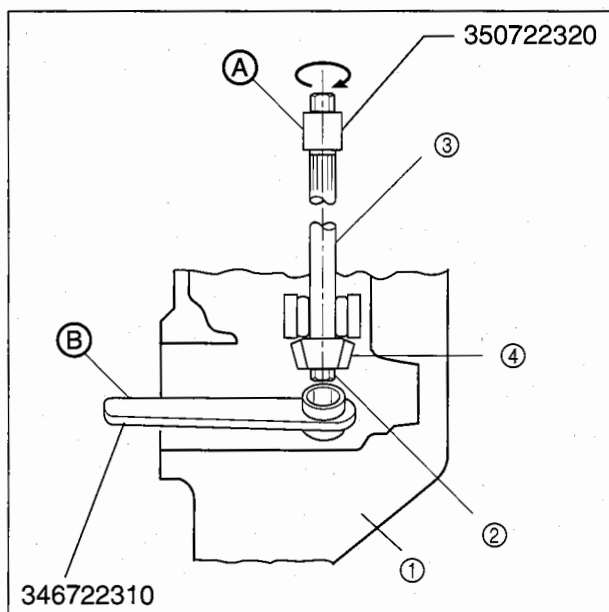
1. Press-fit

Insert the shaft A① in the direction of the arrow ① in the gear case. Insert the guide A③ and needle bearing in order, in the direction of arrow ② in the shaft A, and set the retainer A⑤ (outside diameter 23.5) in the groove of ②. (Make sure that the larger diameter step in guide A, the end face of the needle roller bearing with no characters, and the V-groove of retainer A are all facing the threaded side of the shaft.) Then set the shaft stopper ⑧ and flange A⑦ in order, so that the shaft passes through from the side ① in the direction of the arrow ① shown in the figure on the left. Insert flange A in the spigot (hole for lower pump case), support the diameter of flange A with your hand, set the washer and nut and tighten the nut so that the shaft is firmly secured. The press-fit of the needle bearing is complete at this step. (Flange A has many steps; use the part with dia. 43, having a hole for the lower pump case and a spigot.) Now, if you loosen the nut and remove the retainer A, the tool can be disassembled.

2. Removal

Insert the shaft A in the direction of the arrow ①, similar to the press-fit procedure. Insert the retainer A in the groove of ② of the shaft A from the direction of the arrow ②. Set flange A only so that the shaft passes through it, and secure it similar to the press-fit procedure. Set the nut and washer and tighten the nut until the needle roller bearing can be removed.

Socket and wrench for bevel gear B nut



- ① Gear case
- ② Bevel gear B nut
- ③ Drive shaft
- ④ Bevel gear B

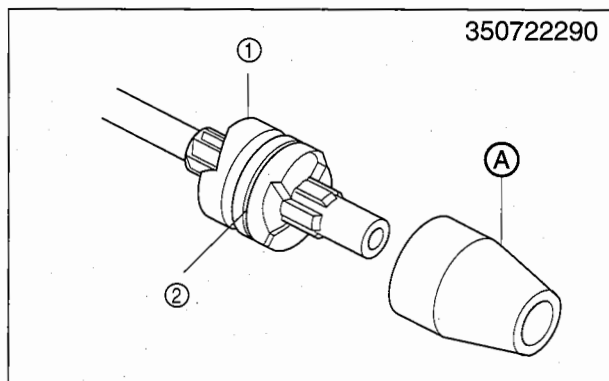
- Secure the bevel gear B nut ② in the gear case ① using tool ③. Tighten the tool A, inserted in the spline on the engine side of drive shaft ③, to the specified torque.

CAUTION

The threaded part of the bevel gear B nut and drive shaft must be completely degreased before applying a coating of thread locking agent (Three Bond 1373-B). Do not apply an excessive amount of locking agent.

Tightening torque: 3.0 ~ 3.5 kg-m

Clutch pin snap tool



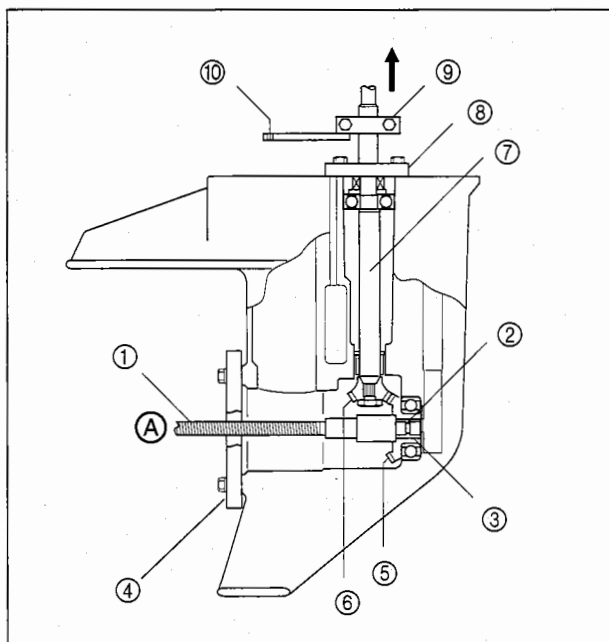
- ① Clutch
- ② Groove marked on the forward side

- Install the clutch spring, clutch spring bushing clutch and clutch pin on the propeller shaft. Fit tool ① on the propeller shaft, so that the clutch pin snap spreads out gradually along the tapered part, insert it in the groove and install it.

CAUTION

Do not re-use a snap ring that has been removed.

Backlash measuring tool



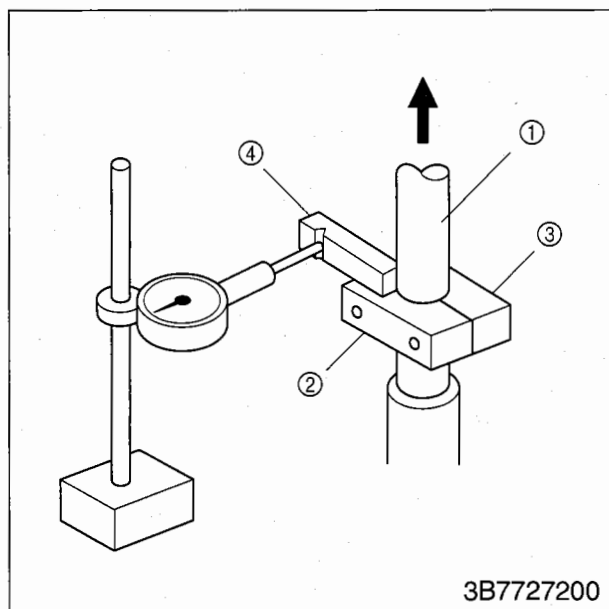
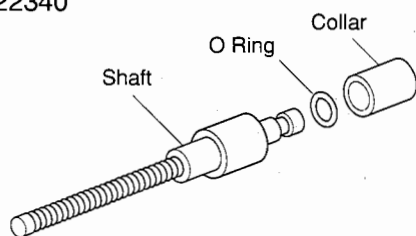
- ① Shaft
- ② "O" ring
- ③ Collar
- ④ Plate
- ⑤ Bevel gear A
- ⑥ Bevel gear B
- ⑦ Drive shaft
- ⑧ Lower pump case
- ⑨ Clamp A/B
- ⑩ V-groove

1. To measure the backlash between bevel gears A and B, first remove the propeller shaft housing and the propeller shaft bevel gear C from the gear case. Fit the O-ring ② and the collar ③ in the groove at the front end of the shaft ①, and screw-in the plate ④ on the threaded part of the shaft. Insert the collar side of the shaft in the bearing of bevel gear A ⑤, and fit the plate on the gear case.

If the threaded portion of ④ is small, the shaft presses against the bevel gear A and the plate cannot be fitted completely, therefore, make sure the threading on ④ is adequate.

Using a screw driver on the ⊖ slot on the end face of the shaft, screw-in the shaft and secure it so that the bevel gear A does not rotate. (Take care to avoid excessive tightening.)

3C8722340



- ① Drive shaft
- ② Clamp A
- ③ Clamp B
- ④ Groove D

2. Mount clamps A ② and B ③ on the drive shaft ①. Pull up the drive shaft in the direction of the arrow while turning it and read the deflection at the notch D ④ on the dial gauge.

Correct backlash : 0.08 ~ 0.13 (mm)

Types of adjusting shims : 0.1, 0.15, 0.3, 0.5 (mm)

3B7727200

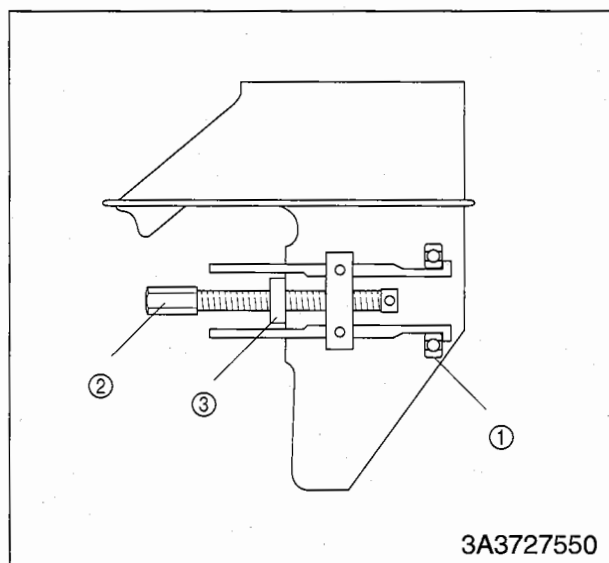
SERVICE DATA 2

The relation between dial gauge reading and required shim thickness is shown in the table below.

Before adjustment		After adjustment	
Gauge reading (M)	Backlash (B)=H/4.70	Required shim thickness	Correct backlash
0.38 ~ 0.61	0.08 ~ 0.130	0	0.05 ~ 0.13
0.62 ~ 0.84	0.131 ~ 0.178	0.1	0.05 ~ 0.13
0.55 ~ 1.06	0.179 ~ 0.226	0.2	0.05 ~ 0.13
1.07 ~ 1.29	0.227 ~ 0.274	0.3	0.05 ~ 0.13
1.30 ~ 1.51	0.275 ~ 0.322	0.4	0.05 ~ 0.13
1.52 ~ 1.74	0.323 ~ 0.370	0.5	0.05 ~ 0.13

Take the following precautions during measurements:

- Make sure that the shaft to which the bevel gear is attached, does not rotate more than the backlash amount even if the drive shaft is lightly rotated.
- Confirm that the drive shaft bearing B is secured only to the lower pump case. Clamps A and B must be fitted as close to the lower pump case as possible.
- After securing the gear case and the dial gauge, pull up the drive shaft while rotating it and take the dial gauge reading. The measurements should be made such that play does not occur in other parts (deflection of drive shaft, play between drive shaft and bearing).



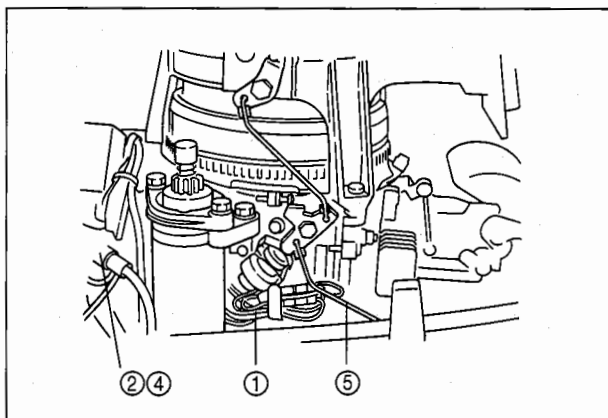
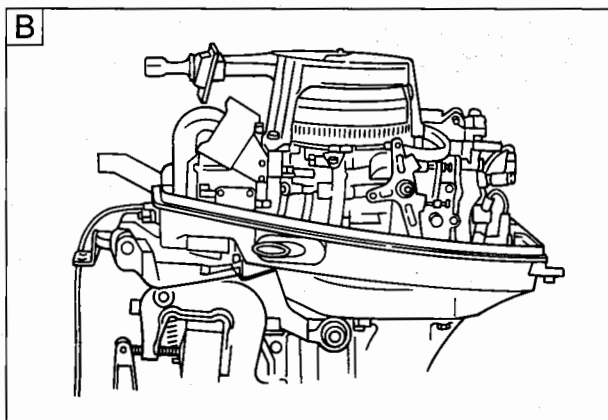
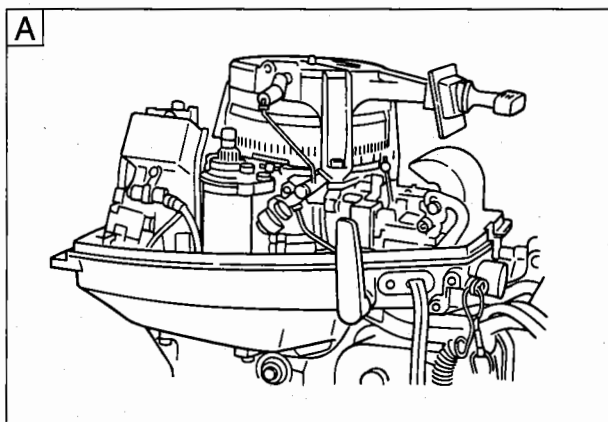
Bevel gear A bearing puller

- ① Bevel gear A bearing
- ② Hexagonal part
- ③ Plate

- To remove the bevel gear A bearing ①, set the puller in the gear case as shown in the figure on the left, and tighten the hexagonal part ② using a wrench.
- Plate ③ contains many holes. Use the holes for the mounting bolts of propeller shaft housing which match the pitch and fit the plate.
- Do not re-use bearings.

CHAPTER 3

POWER UNIT



Removal of Power Unit

- Ⓐ External view of type EF power unit Right side
- Ⓑ External view of type EF power unit Left side

CAUTION

Specifications for assembly and disassembly of outboard motors are explained taking type EF as the basis and a type I bracket (See Fig. 4-22).

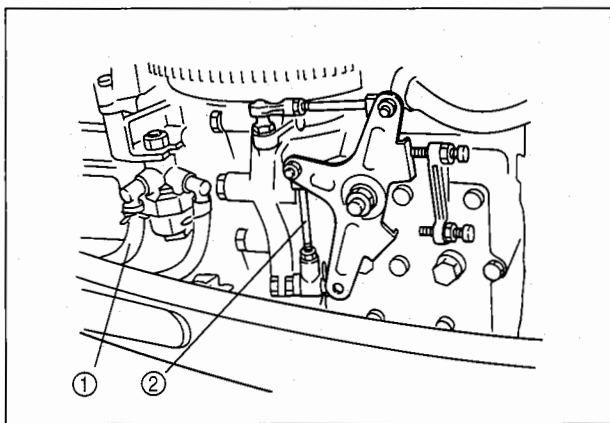
Inspection and maintenance of the engine must be performed after removing the power unit from the outboard motor. However, inspection and maintenance of the following parts can be performed without removing the power unit from outboard motor:

- Recoil starter
- Magneto
- Starter motor
- Starter solenoid
- Neutral switch
- Carburetor
- Thermostat

Removal of power unit

- ① Stop switch lead wire
- ② Battery cable ⊕
- ③ Battery cable ⊖
- ④ Fuse lead wire
- ⑤ Throttle stopper link

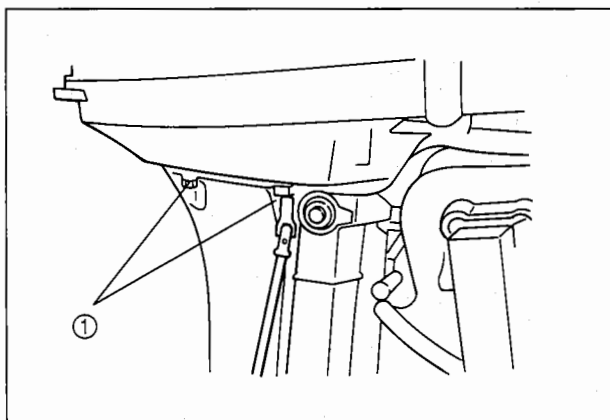
1. Make sure that the cables connecting the battery are disconnected, then disconnect the following wires:
 - Stopper switch lead wires (brown) (black) ①
 - Battery cable ⊕ ②
 - Battery cable ⊖ ③
 - Fuse lead wire (red) ④
2. Remove the following:
 - Throttle stopper link ⑤



- ① Fuel pipe
- ② Rod joint (advancer arm side)

3. Remove the following:

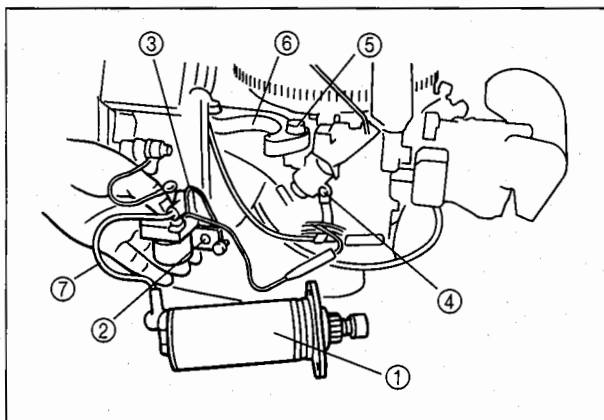
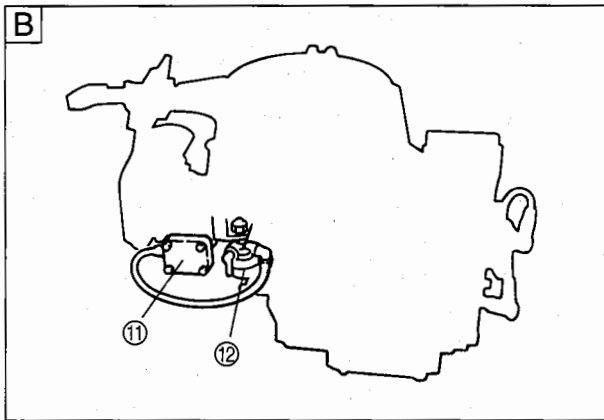
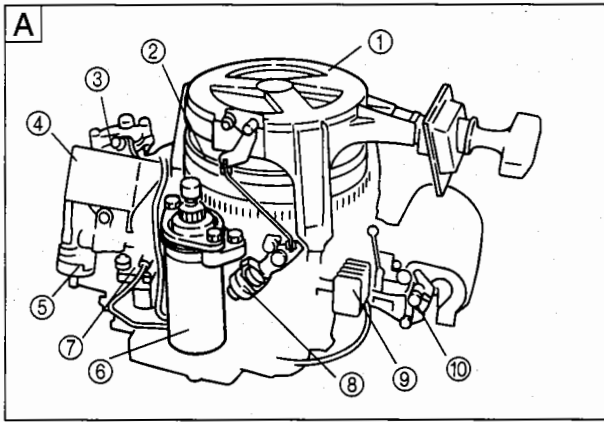
- ① Engine bolts



- Power unit assembly
(Pull up the unit vertically and remove it.)

CAUTION

- A plug type connection is used between the choke rod and choke lever. Do not forget to connect these during assembly.
 - To disconnect choke rod and choke lever first, either remove the air silencer from the carburetor or remove the carburetor assembly from the engine.
 - When removing the carburetor, make sure you remove the fuel pipe and lubrication tube first.
-



Removal of Accessories

The power unit is fitted with the accessories listed below.

- A** Power unit Right side
- B** Power unit Left side
- ① Recoil starter
- ② Magneto assembly
- ③ Thermostat
- ④ CD unit
- ⑤ Ignition coil
- ⑥ Starter motor
- ⑦ Starter solenoid
- ⑧ Neutral switch
- ⑨ Rectifier
- ⑩ Carburetor
- ⑪ Fuel pump
- ⑫ Fuel filter

Removal of starter motor

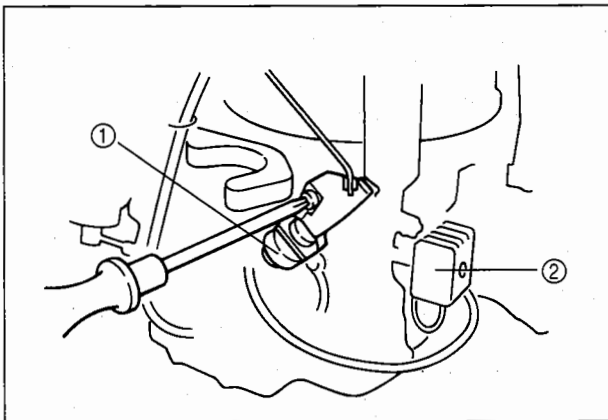
- ① Starter motor
- ② Starter solenoid bolt
- ③ Starter solenoid ground lead wire
- ④ Clamp
- ⑤ Starter motor bracket bolts (H830-2)
- ⑥ Starter motor bracket
- ⑦ Starter motor lead wire

1. Remove the following:
 - Starter motor bolts (H830-2)
 - Starter motor ①
 - Starter solenoid bolt ② (H618-1)
(Simultaneously remove the starter solenoid ground lead wire ③)

CAUTION

- When removing the starter motor, remove the starter solenoid without removing the starter motor lead wire, then remove the starter motor.
- Pay special attention to the direction of installation of the starter motor on the starter solenoid side when removing the starter motor lead wire.

2. Disconnect the following:
 - Neutral switch lead wire (green)

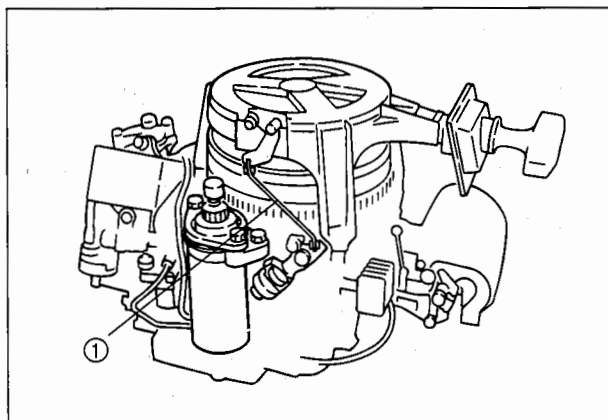
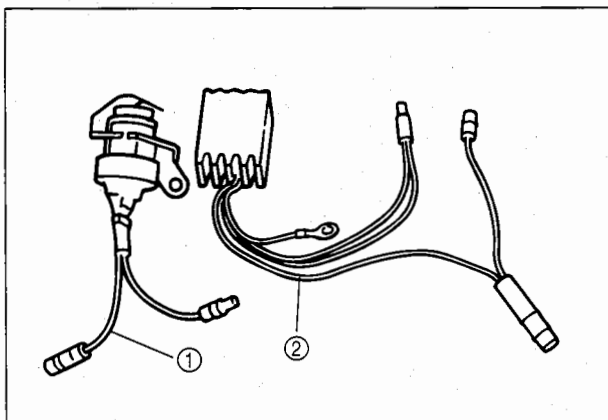


① Neutral switch

② Rectifier

3. Remove the following:

- Neutral switch screws (+ pan head screws 612-2)
- Neutral switch ① (EF type)
- Rectifier screw (+ pan head screw 525-1)
- Rectifier ②

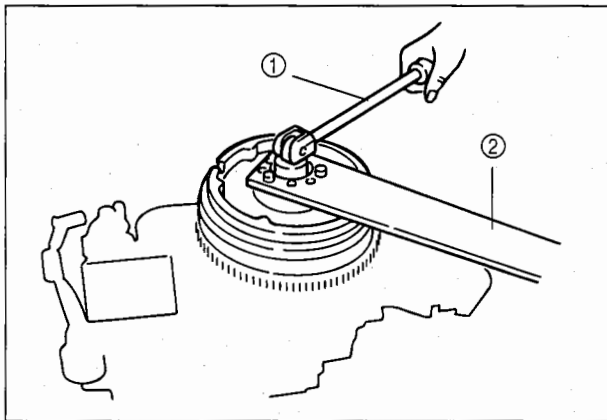


Removal of recoil starter

① Starter locking link

1. Remove the following:

- Starter locking link ①
- Recoil starter bolts (H620-3)
- Recoil starter assembly



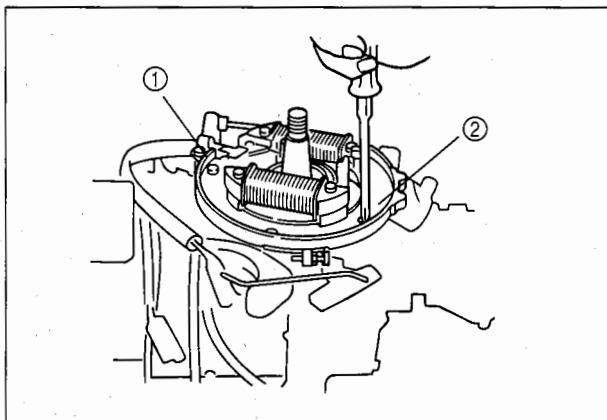
Removal of flywheel magneto

1. Remove the following:
 - Flywheel magneto nut (left-hand thread) (24mm)
 - Flywheel magneto

- ① Wrench
- ② Flywheel magneto tool

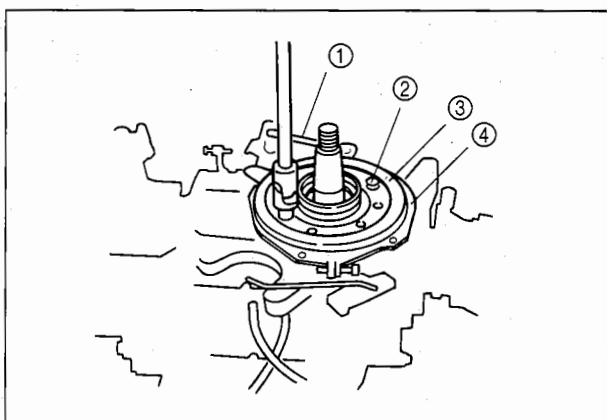
CAUTION

Remove the flywheel using the flywheel tool.



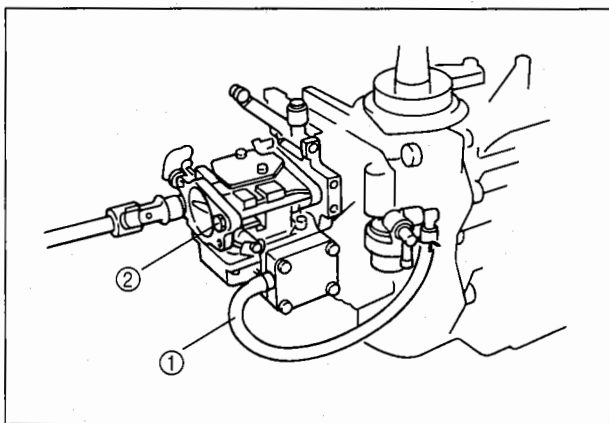
- ① Coil plate screw
- ② Coil plate

2. Disconnect the following:
 - Flywheel magneto lead wire
3. Remove the following:
 - Magneto lead wire clamp
 - Coil plate screw ① (+ pan head screw 610-4)
 - Coil plate ②



- ① Advancer link rod B
- ② Guide plate bolts
- ③ Guide plate
- ④ Setting ring

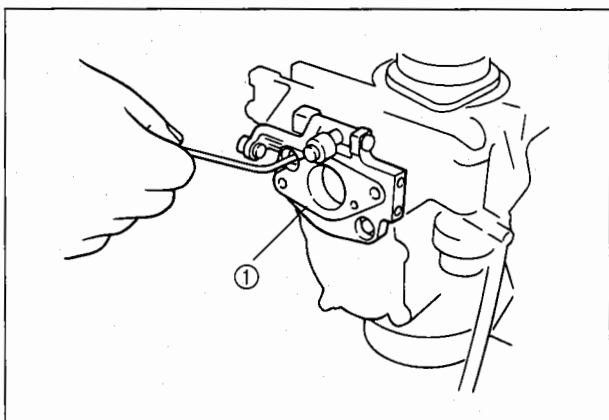
4. Remove the following:
 - Advancer link rod B ①
 - Guide plate bolts ② (H620-2)
 - Guide plate ③
 - Setting ring ④



Removal of carburetor

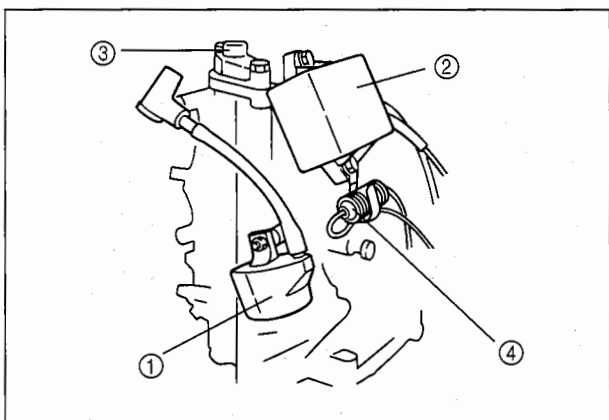
- ① Fuel tube B
- ② Carburetor bolts

1. Remove the following:
 - Air silencer screws (pan head screw 512-2)
 - Air silencer
 - Fuel tube B ①
 - Carburetor bolts ② (H680-2)
 - Carburetor



- ① Carburetor flange assembly

2. Remove the following:
 - Carburetor flange assembly ①



Removal of CD unit and ignition coil

- ① Ignition coil
- ② CD unit
- ③ Thermostat cap
- ④ Fuse

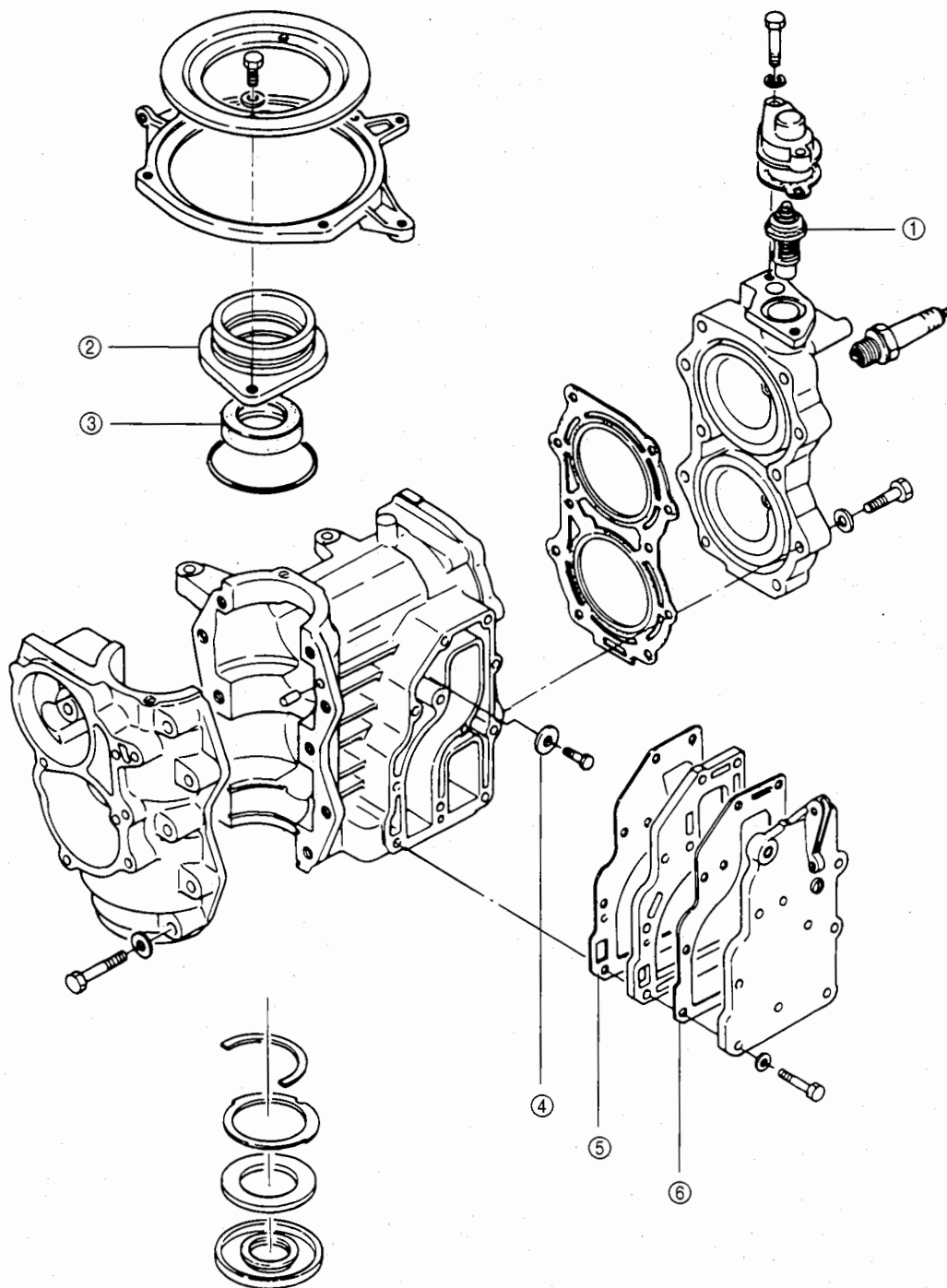
1. Remove the following:
 - Ignition coil bolts (H620-1, H650-1)
 - Ignition coil ①
 - CD unit bolts (H618-2)
 - CD unit ②

Removal of thermostat

1. Remove the following:
 - Thermostat cap bolts (H623-2)
 - Thermostat cap ③
 - Gasket
 - Thermostat
 - Fuse ④

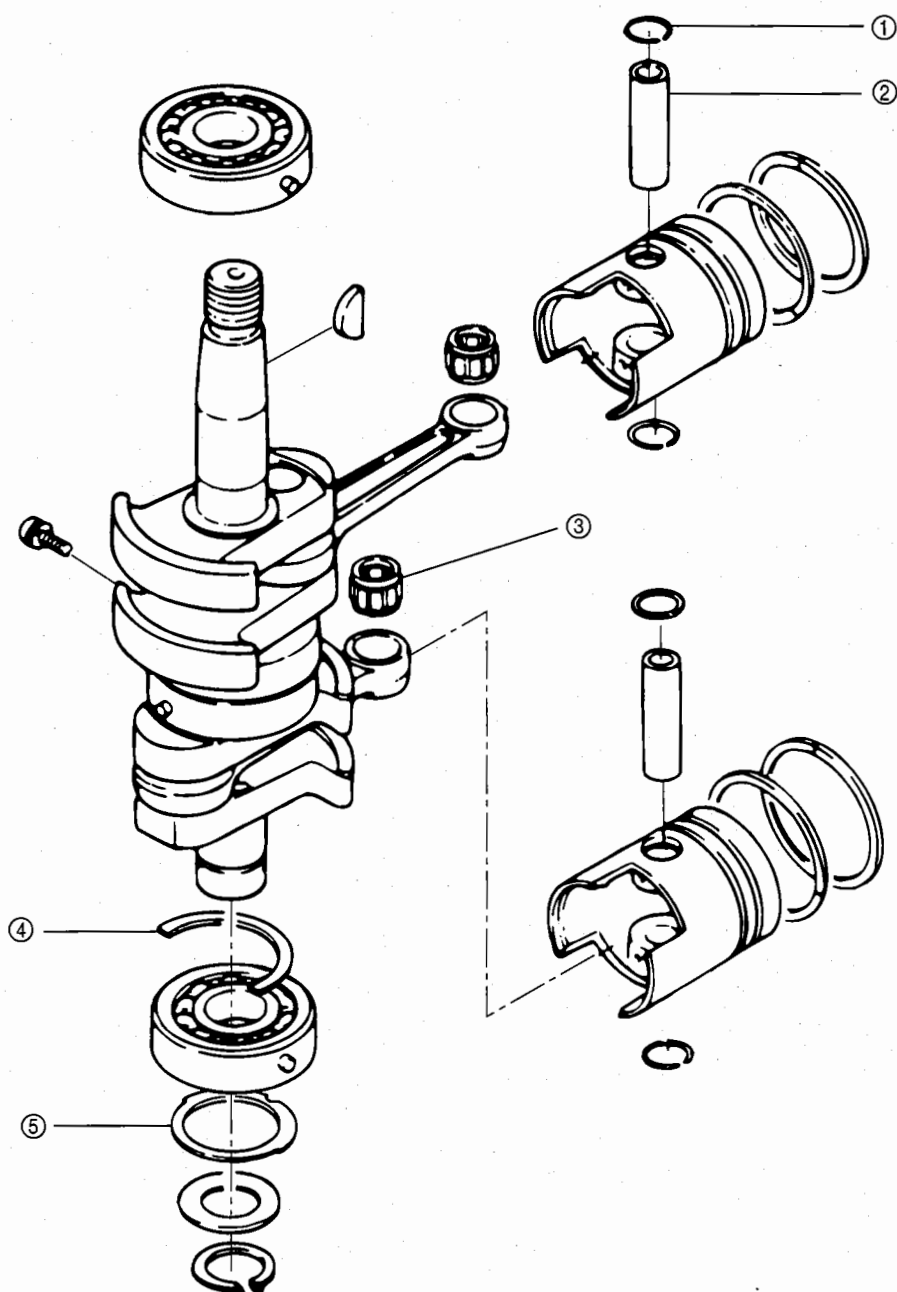
Cylinder and crank case assembly

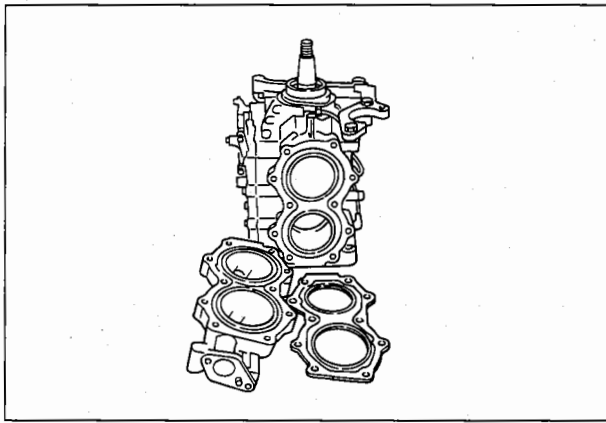
- ① Thermostat
- ② Magneto base
- ③ Upper oil seal
- ④ Engine anode
- ⑤ Exhaust cover inner gasket
- ⑥ Exhaust cover outer gasket



Piston and crank shaft

- ① Piston pin clip
- ② Piston pin
- ③ Small end bearing
- ④ Upper thrust plate
- ⑤ Lower thrust plate





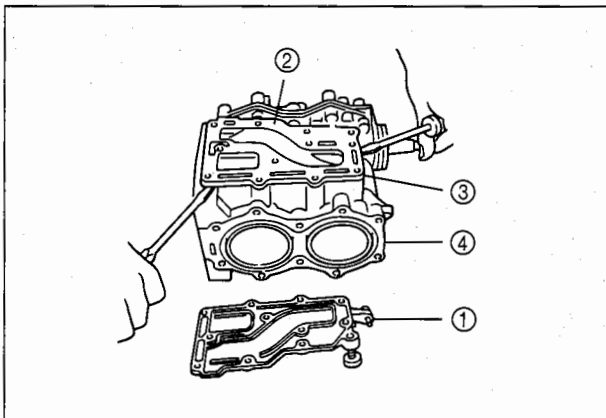
Engine Disassembly

Removal of cylinder head

1. Remove the following:
 - Cylinder head bolts (H840-10)
 - Cylinder head

CAUTION

These bolts are tempered (T mark), therefore, make sure they are not mixed with other ordinary bolts.



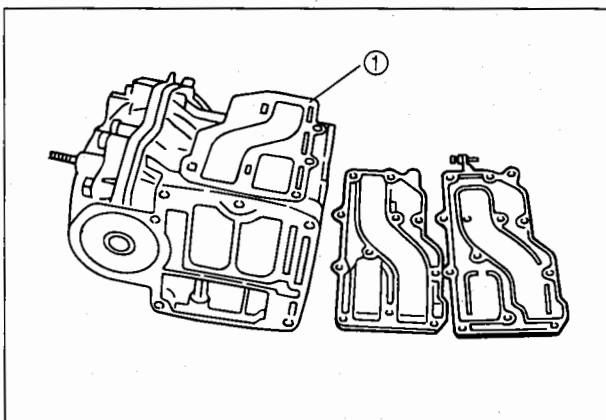
Removal of exhaust cover and engine anode

- ① Outer exhaust cover
- ② Outer gasket
- ③ Inner exhaust cover

1. Remove the following:
 - Exhaust cover bolts (H625-11)
 - Outer exhaust cover ①
 - Outer gasket ②
 - Inner exhaust cover ③

CAUTION

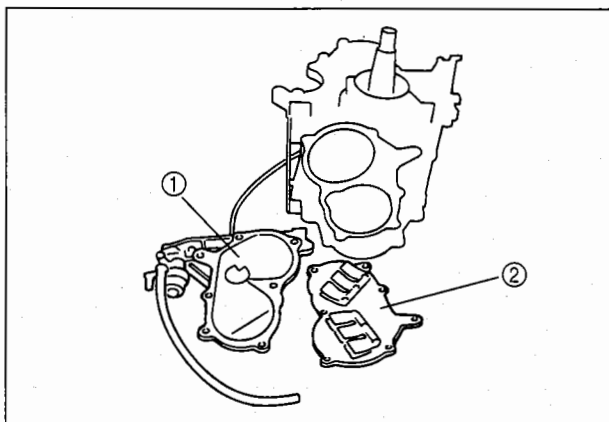
When removing the inner exhaust cover, make use of the grooves on both sides to pry the cover from the cylinder ④. Take care to avoid scratching the mating surfaces.



- ① Inner gasket

2. Remove the following:
 - Inner gasket ①
 - Engine anode

(Remove the gasket from the water jacket in the exhaust cover.)



Removal of inlet manifold and reed valve

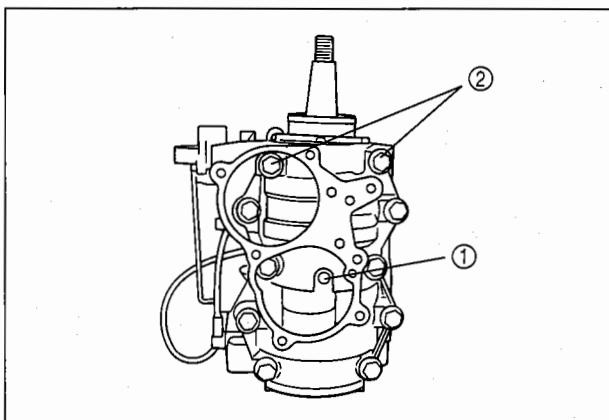
- ① Inlet manifold
- ② Reed valve assembly

1. Remove the following:

- Inlet manifold bolts (H635-2, H628-3) and nuts (6-2)
- Inlet manifold ①
- Reed valve assembly ②

CAUTION

Bolts are of two types. Take care to prevent mixing of these bolts with other bolts.



Removal of crank case and crankshaft

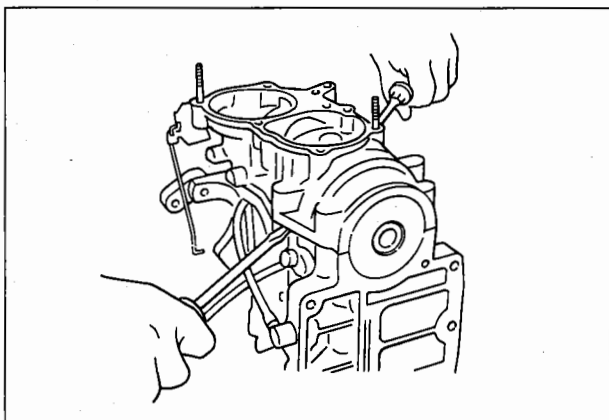
- ① Labyrinth screw
- ② Crank case bolts

1. Remove the following:

- Labyrinth screw ① (pan head screw 516)
- Crank case bolts ② (H845-10)

CAUTION

Crankcase bolts are tempered bolts, therefore, do not mix them with other bolts.

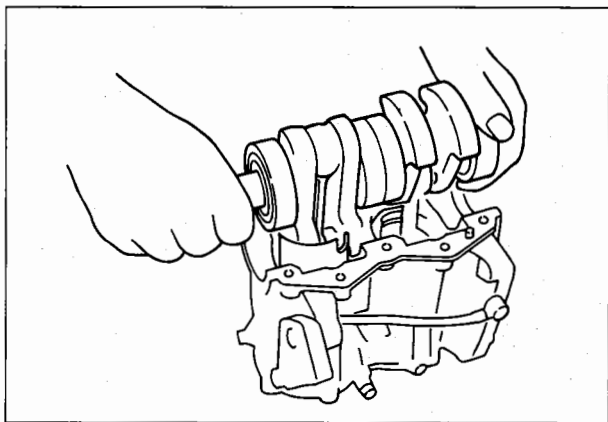


2. Remove the following:

- Crank case
- Magneto base
(Remove from the magneto shaft.)

CAUTION

When removing the crank case, use the grooves on both sides and pry the crank case from the cylinder. Take care to avoid scratches on the mating surfaces.



3. Remove the following:

- Crank shaft assembly

CAUTION

- Confirm the positions of the knock plate and thrust plate.
 - Do not disassemble/assemble the crank shaft assembly. (To replace the crank shaft, replace the entire assembly.)
-

Removal of piston

1. Remove the following:

- Piston pin clip
- Piston pin
- Piston
- Small end bearing
- Piston ring

CAUTION

Remove the piston pin using the piston pin tool.

18D

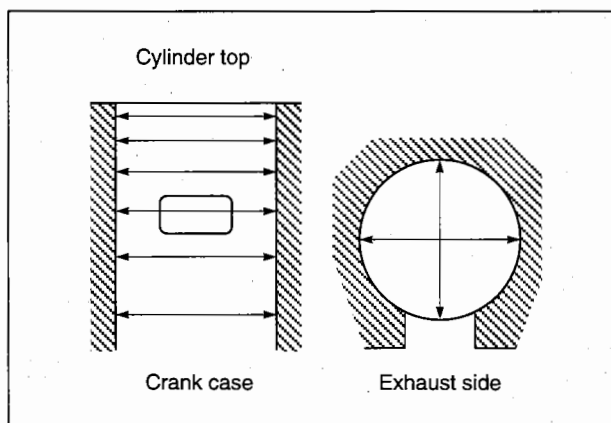
Top ring: Plain ring (square)

Second ring: Plain ring (square)

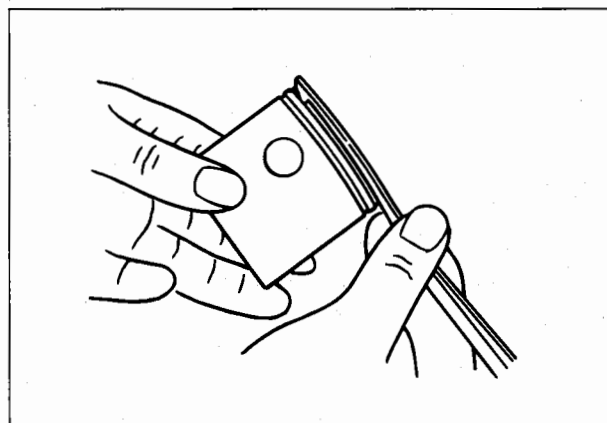
15D/9.9C

Top ring: Plain ring (barrel face)

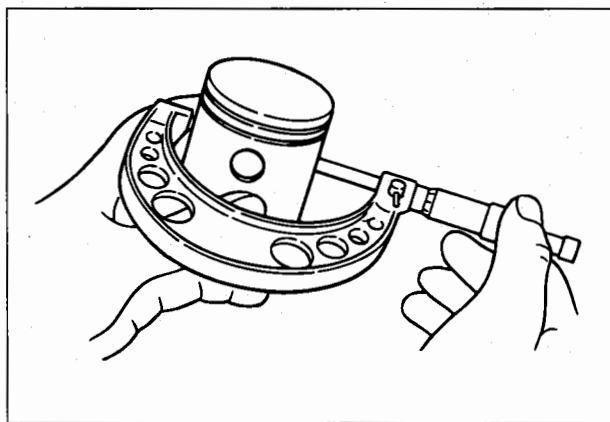
Second ring: Plain ring (square)



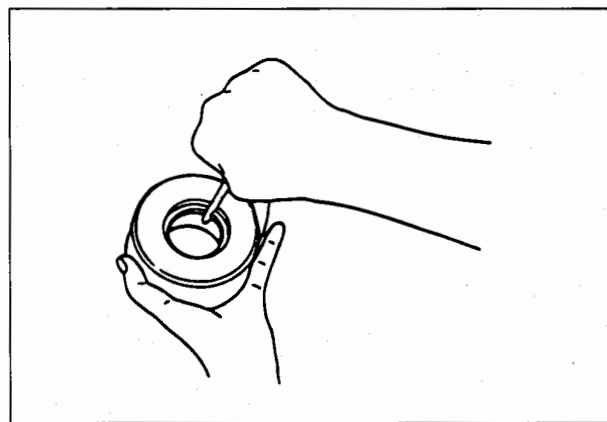
(Fig. 3-1) Position and direction of cylinder inside diameter measurements



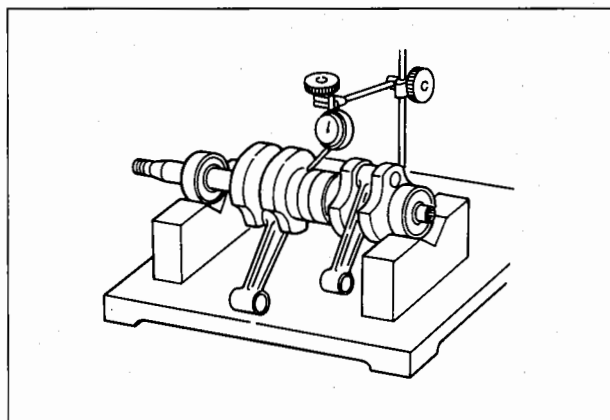
(Fig. 3-2) Piston ring groove measurement



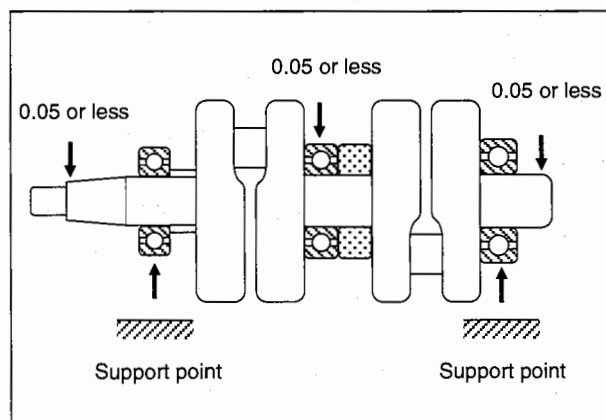
(Fig. 3-3) Measurement of piston diameter



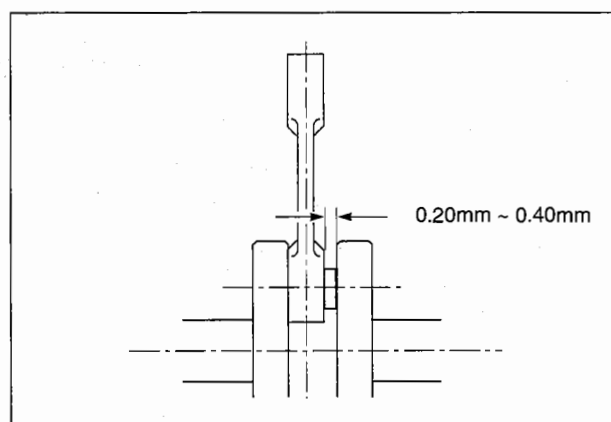
(Fig. 3-4) Measurement of end gap



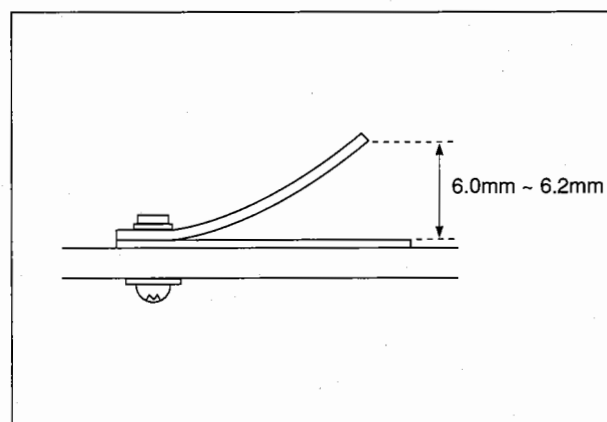
(Fig. 3-5) Crank shaft deflection measurement



(Fig. 3-6) Locations for measurement of crank shaft deflection



(Fig. 3-7) Side clearance of connecting rod

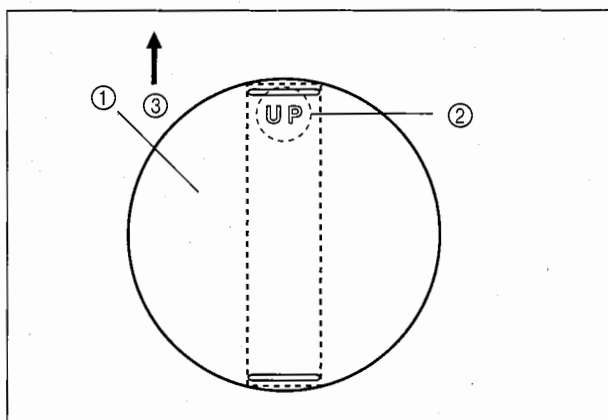


(Fig. 3-8) Measurement of lift height

Engine Assembly

Reverse the procedure for disassembling the engine taking the precautions listed below, for assembling the engine.

- Engine assembly should only be performed in a clean area. All parts should be completely washed and lubricated. Cylinder liners should be washed with soap and water, dried, and coated with outboard oil (TCW-3).
- Adhere to the precautions during work.
- Check and inspect according to Service Data.
- Always use sealants, adhesives or lubricating oils referring to the "Table of sealants, adhesives and lubricating oils and usage locations."

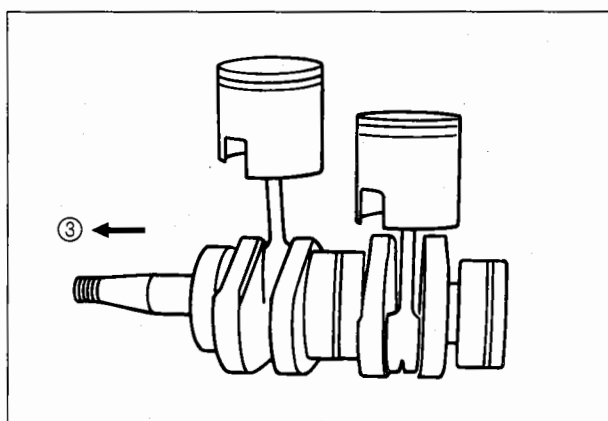


Installing the piston

- ① Piston
- ② UP mark
- ③ Magneto side

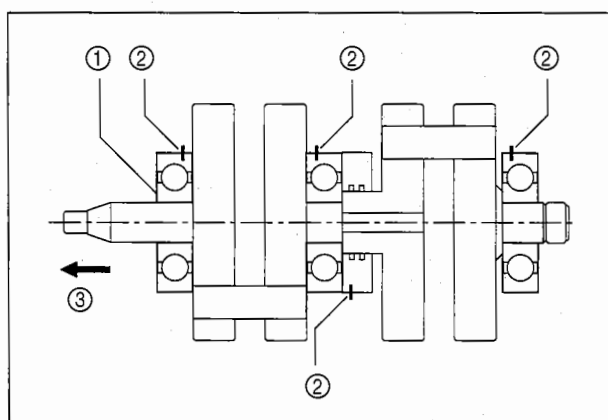
1. Install the following:

- Small end bearing
- Piston
- Piston pin
- Piston pin clip
- Piston ring



CAUTION

- Make sure you install the piston ① so that the UP mark ② is on the magneto side ③ of the crank shaft.
- Fit the piston pin using the piston pin tool.
- Always use a new piston clip and fit it firmly in the groove of the piston hole.
- Fit the piston ring to suit the closed gap of the rotation-locking knock in the piston.

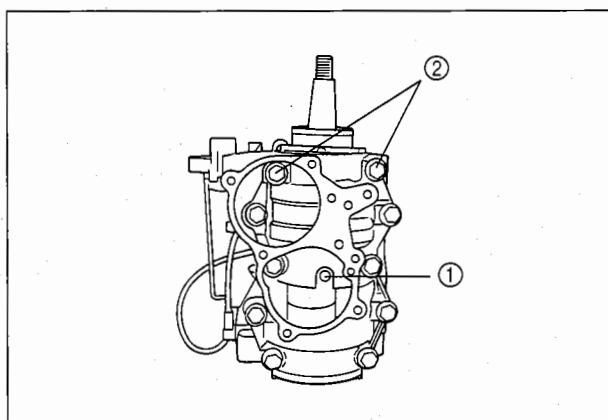
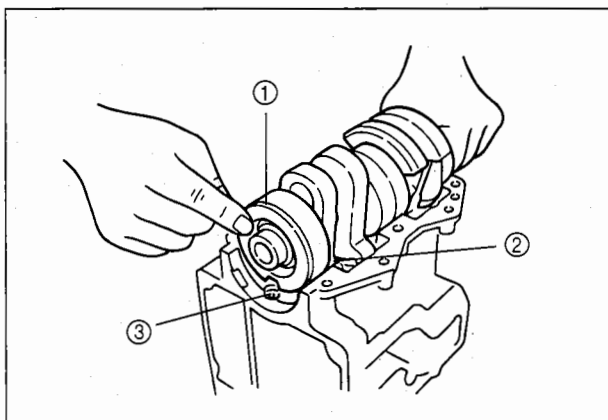
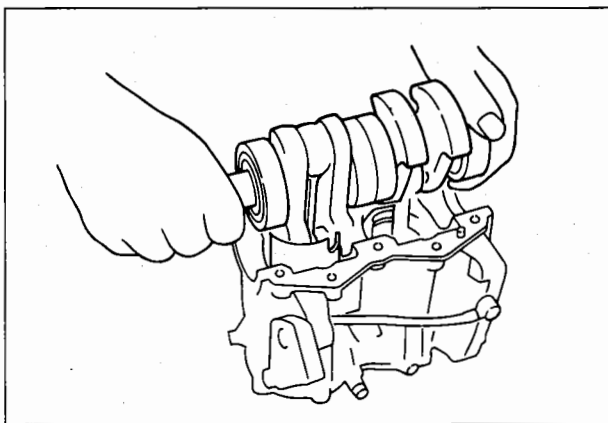


Installing the crank shaft and crank case

- ① Inner race
- ② Knock
- ③ Magneto side

Before installing the crank shaft:

- Thoroughly clean the main bearing with cleaning solvent and remove traces of dirt and metal scraps, blow air and dry it.
- Press-fit the bearing by pressing the inner race ①.
- Check positions of locating pins ② on the main bearing and labyrinth packing and confirm that the pin is press-fit firmly.
- Lubricate all sliding parts and rotating parts with engine oil.



Assembly procedure:

- Place the cylinder so that the crank shaft case side is facing you.
- Align the piston ring gap with piston alignment pin position and insert the pistons one by one in the cylinder.
- When both pistons have been inserted, push the crank shaft in the cylinder with both ends of the crank shaft horizontal.

- ① Lower thrust plate
- ② Upper thrust plate
- ③ Lubricating hole

- Insert the lower thrust plate ① firmly in the groove of the cylinder case.
- Insert the upper thrust plate ② aligning the notch with the lubricating hole ③ of the insertion groove.
- Press-fit the upper crank shaft oil seal with lips coated with grease, in the magneto base.
Insert the magneto base O-ring into the crank shaft magneto side.

CAUTION

Align each main bearing and labyrinth packing with the specified hole in the cylinder and the notch in the crank case.

- ① Labyrinth screw
- ② Crank case bolt

2. Install the following:
 - Crank case (apply sealant)
 - Labyrinth screw ① (temporarily tightened) (Three Bond 1342 applied)
 - Crank case bolts ② (H845-10)

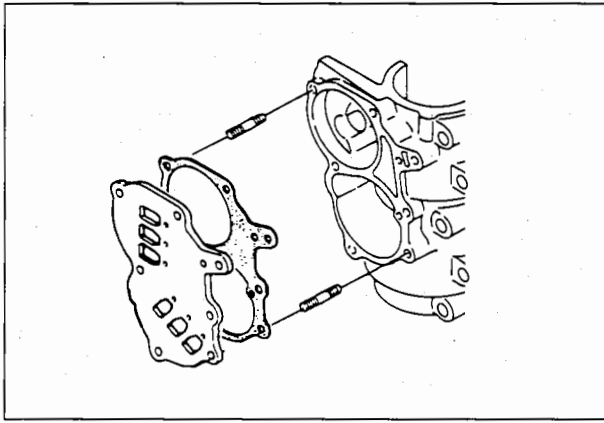
Crankcase tightening torque: 2.4 ~ 2.6 kg-m

- Labyrinth screw (tightened)

Labyrinth screw torque: 0.27 ~ 0.36 kg-m

CAUTION

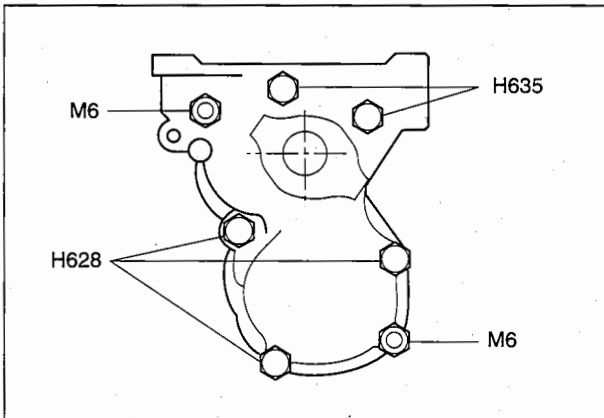
- Confirm that there are no burrs, protrusions, or foreign matter on the cylinder mating surfaces when installing the crank case.
- Rotate crankshaft during assembly to insure there is no binding.
- Since the guide plate is to be tightened together with the setting ring, insert the setting ring under the guide plate and tighten during the installation of the magneto base.



Installation of reed valve and inlet manifold

1. Install the following:

- Gasket
- Reed valve assembly
- Gasket



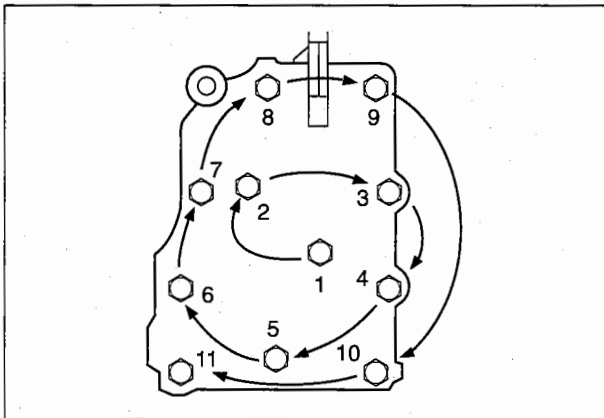
2. Install the following:

- Inlet manifold
- Inlet manifold bolts (H635-2, H628-3) and nuts (6-2)

Tightening torque: 0.8 ~ 1.0 kg-m

CAUTION

- Install bolts and nuts according to the positions and types shown in the figure.
- Do not mix these bolts with other bolts as these are tempered bolts.



Installation of exhaust cover and engine anode

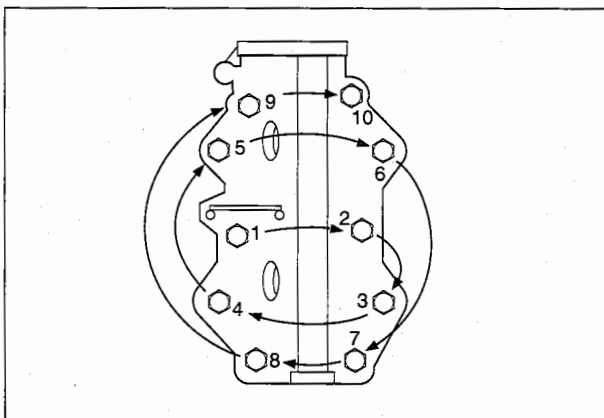
1. Install the following:

- Engine anode
- Gasket (inner and outer)
- Exhaust cover (inner and outer)
- Exhaust cover bolts (H625-11)

Tightening torque: 0.8 ~ 1.0 kg-m

CAUTION

Install the bolts according to the numerical sequence shown in the figure after dividing the bolts into two or three lots.



Installation of cylinder head

1. Install the following:

- Cylinder head gasket
- Cylinder head
- Cylinder head bolts (H840-10)

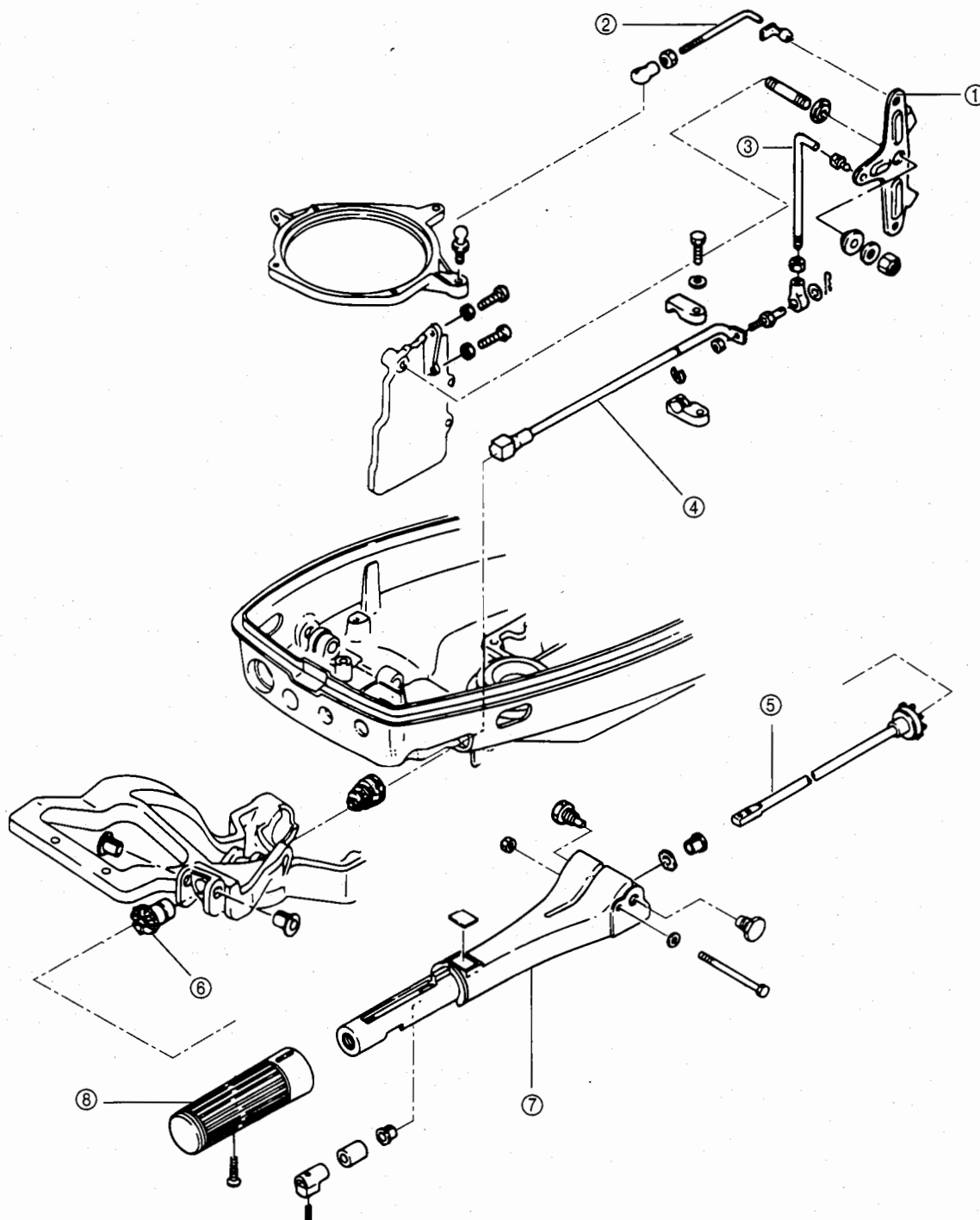
Tightening torque: 2.4 ~ 2.6 kg-m

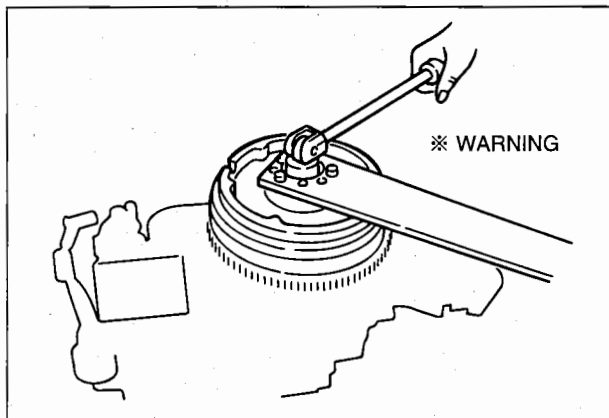
CAUTION

- Divide the bolts into two or three lots and install them according to the cylinder head numerical sequence.
- Since these bolts are tempered bolts (T mark) do not mix them with other bolts.
- After running-in, tighten the bolts to the specified torques.

Throttle mechanism and bar handle

- ① Advancer arm
- ② Advancer link rod
- ③ Link rod 5-65L
- ④ Throttle shaft B
- ⑤ Throttle shaft A
- ⑥ Universal pinion
- ⑦ Steering handle
- ⑧ Grip





Installation and Adjustment of Accessories

Install accessories taking the precautions specified for each item, by reversing the removal procedure.

Installation of flywheel magneto

1. Install the following:

- Coil plate
- Guide plate

CAUTION

- Apply cold-resistant grease (Nippeico LT2) on all sliding surfaces before inserting the coil plate in the guide plates and fitting it to the setting ring.
- After installation, confirm that the rotation is smooth and there is no play.

※ Warning: when using a flywheel puller be sure to use the correct bolts for the tool. If the bolts are too long they will damage the lighting and exciter coils.

2. Install the following:

- Flywheel magneto
- Flywheel magneto nut (left-handed thread)

Tightening torque: 7 ~ 9 kg-m

CAUTION

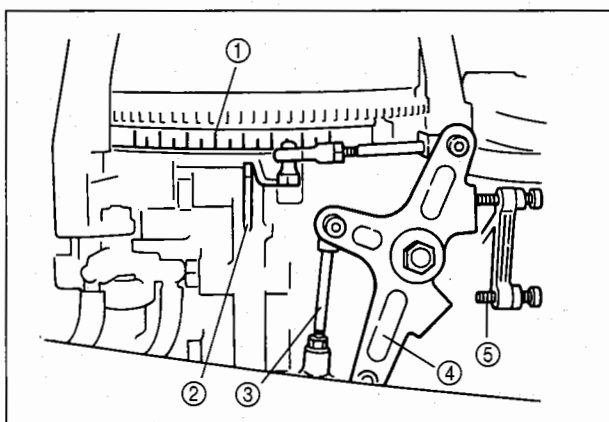
- Secure the magneto lead wire to the setting ring using the magneto lead wire clamp A. Make sure that the lead wire does not touch the flywheel yet allows full movement of magneto plate.
- Before installing the flywheel magneto, make sure the tapered part of the crankshaft is completely degreased.
- Use the flywheel magneto tool to tighten the magneto tightening nut.
- Refer to the wiring diagram to route wiring. Avoid unnecessary bends and contact with other parts. Secure the wires firmly using clamps.
- Always use the specified tools for connecting the connector lead wire. Make firm connections and support the connector using the connector holder.

Installation of fuel lines

• Install the following:

- Fuel pipes
- Lubrication tubes
- Fuel filter
- Plate washers (above and below the fuel filter mount)
- Air silencer

Apply thread locking agent (Three Bond 1342) on the screw thread.



CAUTION

- Insert pipes and tubes firmly in the nipples and secure them using clamps (clips).
Take care to avoid unnecessary lengths and bends in pipes, and contact with other parts.
 - Make sure there is no accumulation of water and dirt in the fuel filter.
-

Adjustment of throttle mechanism

- ① Timing mark
 - ② Ignition timing inspection line
 - ③ Link rod 5-65L
 - ④ Advancer arm
 - ⑤ Stopper bolt
-

CAUTION

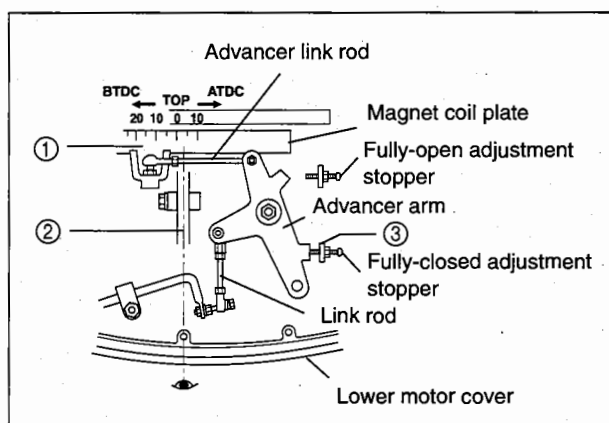
- Make this adjustment only after fitting the power unit to the lower unit.
 - Apply the specified grease on sliding parts and ball joints of the advancer arm bush.
-

Procedure for adjusting ignition timing when opening the throttle fully:

- Rotate the throttle grip fully toward the FAST side until the grip stops.
 - Adjust using the link rod 5-65L ③ so that the timing mark ① 25° (22° for 15C/9.9C) of the magneto coil plate and the ignition timing inspection line ② (crankcase mating surface) coincide.
 - Adjust the stopper bolts so that the advancer arm ④ touches the stopper bolt ⑤ (fully-open adjustment).
-

CAUTION

- Make sure that the carburetor throttle lever is fully open during the fully-open adjustment.
 - Look vertically down on the crankcase when adjusting the timing mark.
-



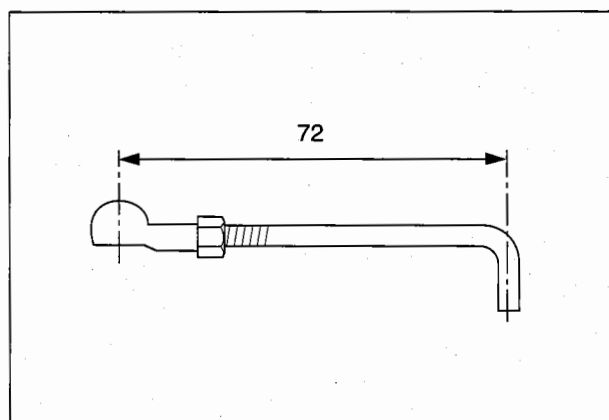
- ① Timing mark
- ② Ignition timing inspection line
- ③ Stopper bolt

Procedure for adjusting ignition timing when the throttle is fully closed:

- Rotate the throttle grip fully toward the SLOW side.
- Adjust the stopper bolts at the position where the timing mark ① $0 \sim -2^\circ$ A.T.D.C of the magneto coil plate and the ignition timing inspection line ② (crankcase mating surface) coincide so that the advancer arm touches the stopper bolt ③ (fully closed adjustment).

CAUTION

Make sure that the carburetor throttle lever is fully closed during the fully closed adjustment.



CAUTION

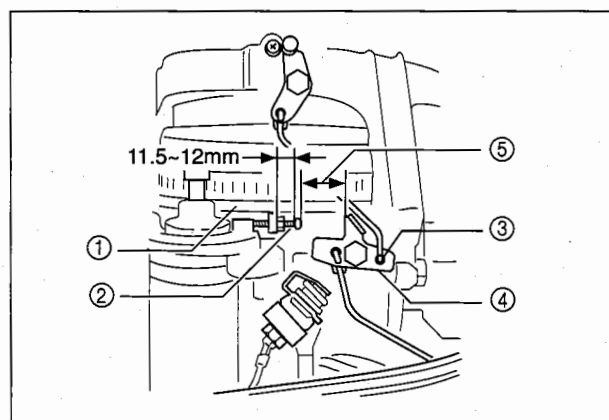
Adjust the advancer arm link rod as shown in the figure when you adjust the ignition timing.

Procedure for adjusting sliding motion of the advancer arm:

- Using the M8 nylon nut of the advancer arm, adjust so that the throttle grip can be operated lightly and the grip does not return to its original position when you release your hand.

CAUTION

After making adjustments, confirm that the advancer arm moves firmly and smoothly. Always tighten the adjusting nut after adjustments.



- ① Magneto stater
- ② Adjusting screw
- ③ Throttle stopper
- ④ Position of throttle stopper during reverse operation
- ⑤ Range of throttle stroke during reverse operation

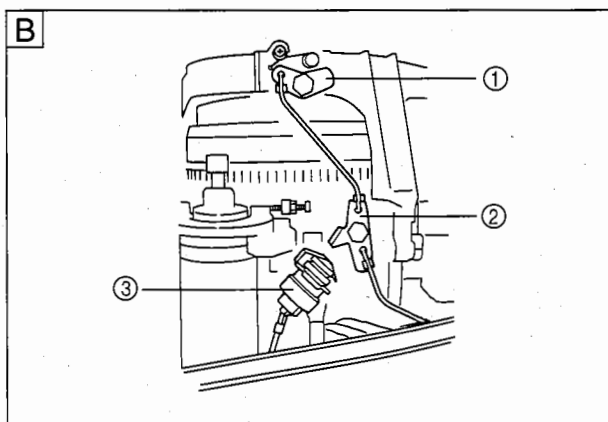
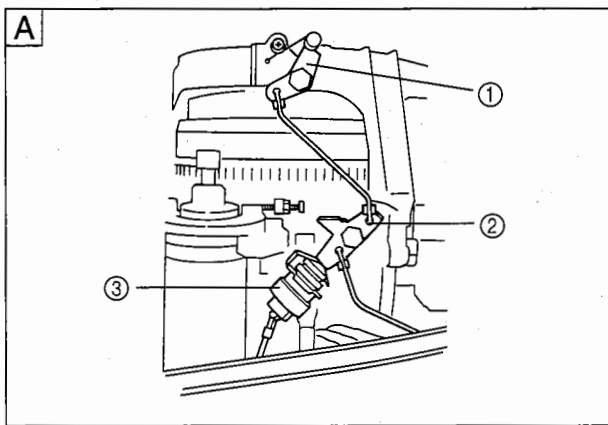
Procedure for adjusting opening of throttle toward the reverse side:

During reverse operation, the engine rpm is regulated by the adjusting screw ② of magneto stater ① and the throttle stopper ③.

- Rotate the adjusting screw and adjust so that the height is 11.5 mm \sim 12 mm.

CAUTION

Make this adjustment after operating the gear shift lever toward the reverse side.



- Ⓐ At neutral position
- Ⓑ At forward position
- ① Starter locking cam
- ② Throttle stopper
- ③ Neutral switch

Procedure for inspecting starter locking cam:

- Perform the F-N-R operation of the gear shift lever and confirm that the RE coil starter is locked at a position other than neutral position. (M, EF, EP type)
- Turn on the main switch and confirm that the starter motor does not operate. (EF, EP type)
- Confirm that the throttle stopper ② is positioned between the starter locking cam ① and the clutch stopper plate. Also confirm the reverse throttle opening limit when operating the shift lever.

CAUTION

- Perform this inspection after F-N-R position adjustments.
- Apply the specified grease on the starter locking cam and sliding parts of throttle stopper bearing.

Standards for engine oil and O-ring

Part Name	Dimensions
Upper crankshaft oil seal	25 × 45 × 8
Magnet base O-ring	ø 2 × ø 55.5

Installation of starter motor

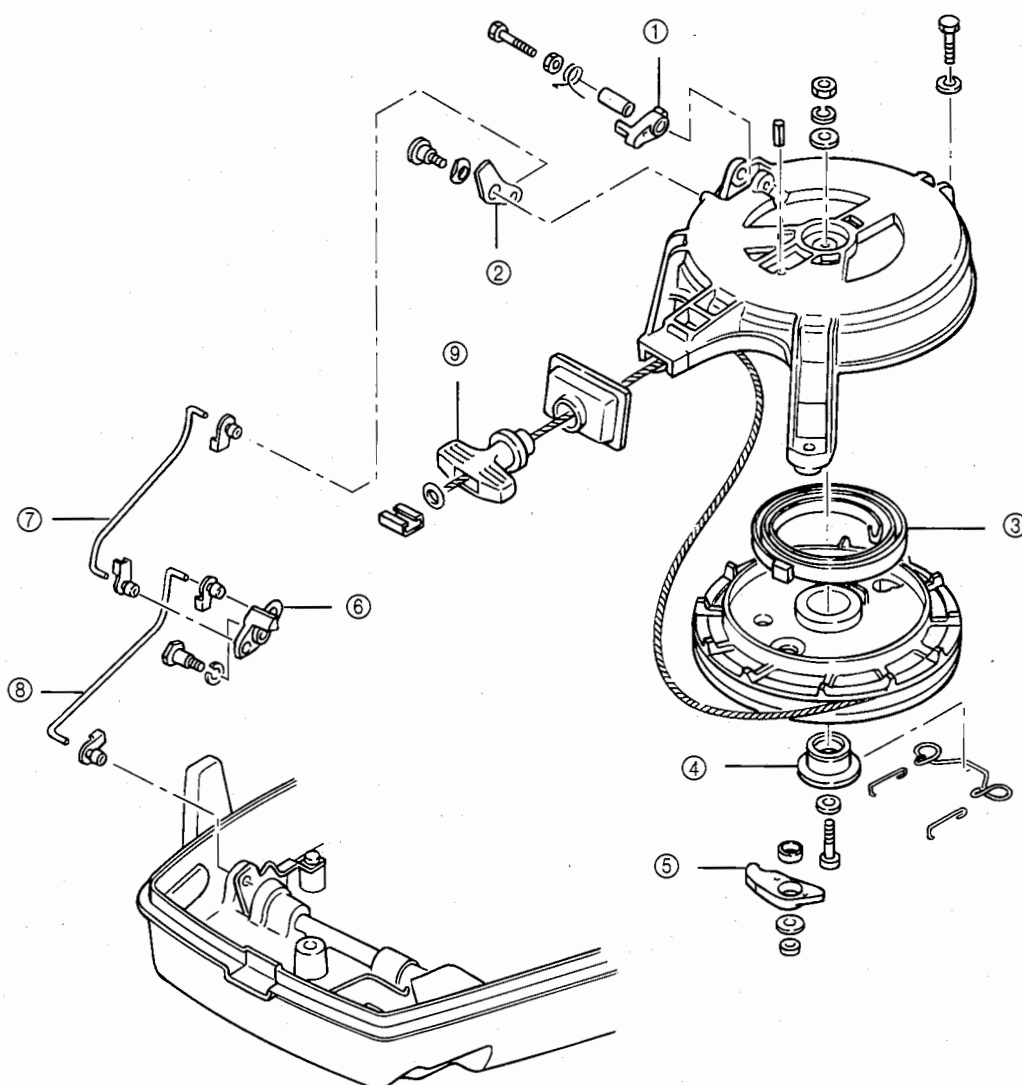
Take the following precautions during installation, and follow the removal procedure in the reverse order:

CAUTION

- Always use terminal caps for terminal contacts of starter motor lead wire, battery ⊕ terminal, and lead wire.
- Insert the connectors for all lead wires firmly, make sure they are waterproof and secure firmly using clamps.
- Install the ground lead wires and battery ⊖ lead wires after removing paint and oil sticking to the wires, and make sure that the ground connection is done properly.
- When securing the battery ⊕, ⊖ lead wires and wire harness to the hull, make sure you take into account the length required for the steering angle of the engine.
- After installation is completed, refer to the wiring circuit diagram, and reconfirm that there is no mistake in connections and installation.

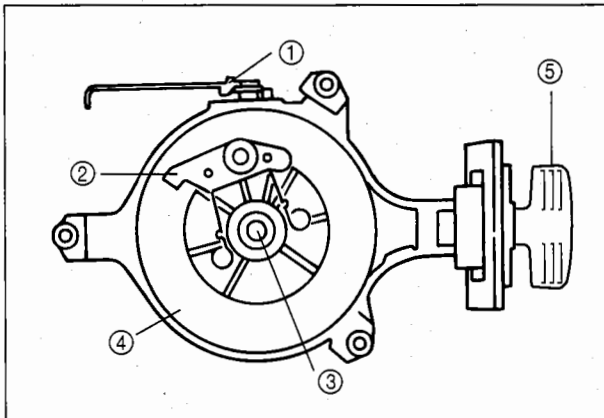
Recoil starter and starter lock

- | | |
|-----------------------|-------------------------|
| ① Starter lock | ⑥ Throttle stopper |
| ② Starter locking cam | ⑦ Starter locking link |
| ③ Starter spring | ⑧ Throttle stopper link |
| ④ Starter shaft | ⑨ Starter handle |
| ⑤ Ratchet | |



Recoil Starter

The recoil starter automatically rewinds the starter rope onto the starter reel. When the starter is pulled pawls move into position and engage the flywheel and the crankshaft will rotate. When the engine starts the pawls retract. The starter locking mechanism interlocks with the shift lever. When the lever is in neutral the rewind starter will engage. When the shift lever is in forward or reverse the rewind starter is locked to prevent starting in gear.



Disassembly of recoil starter

- ① Starter locking cam
- ② Ratchet
- ③ Bolt
- ④ Reel
- ⑤ Starter handle

1. Remove the following:
 - Starter locking cam shaft
 - Starter locking rod
2. Remove the following:
 - Starter handle

CAUTION

After removing the starter handle from the rope, tie a knot in the rope so that the rope does not get entangled.

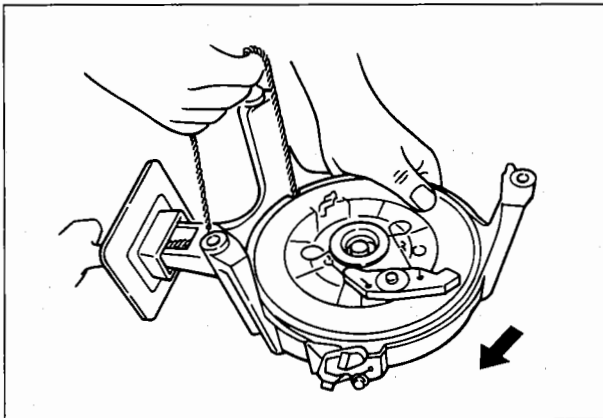
3. Rewind the reel and slacken the recoil starter spring.

Procedure for rewinding:

Grip the rope and wind the rope on the concave part of the reel circumference for about 3 turns, while holding the reel.

CAUTION

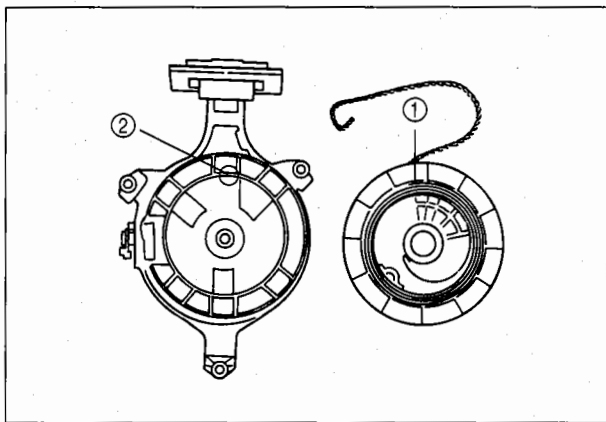
Make sure the spring is completely slack.



4. Remove the following:
 - Ratchet E ring (d=5)
 - Ratchet
(with ratchet guides A, B)
 - Starter shaft bolt (H635)
 - Starter shaft
 - Reel

CAUTION

- Remove the starter shaft bolt after loosening the nut at the center of the starter shaft.
- Remove the reel with the rope wound on it so that the internal starter spring is not displaced.



Recoil starter assembly

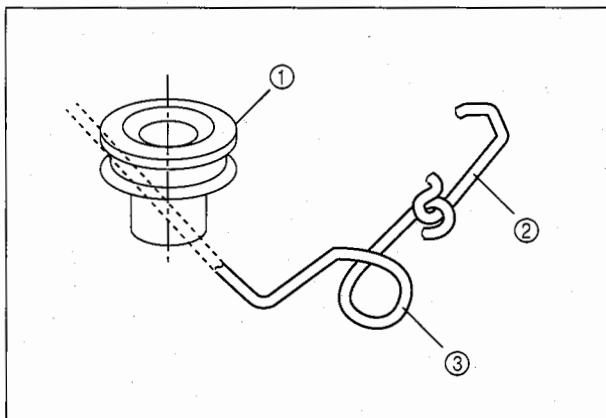
Assemble the recoil starter taking the precautions described below, by reversing the procedure for disassembly.

1. Install the following:

- Reel
(with starter spring)

CAUTION

- Apply cold-resistant grease Nippeco LT2 on the starter spring.
- Wind the starter rope fully on the reel in the clockwise direction looking at the reel from the starter spring side, and allow the end to protrude from the notched part of the reel.
- Attach the hook ① at the end of the periphery of the starter spring while inserting it in the starter case pin ②.



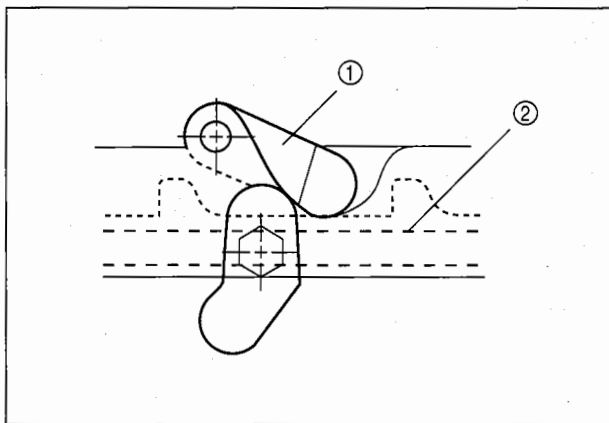
- ① Starter shaft
- ② Ratchet guide A
- ③ Ratchet guide B

2. Install the following:

- Starter shaft
- Starter shaft bolt (H635)
- Starter shaft nut
(apply Three Bond 1342)
- Ratchet
- Ratchet E ring (d=5)

CAUTION

- Install the following after applying cold-resistant grease Nippeco LT2:
 - Starter shaft
 - Ratchet
 - Ratchet bush
- Take care to avoid making a mistake in the direction of mounting of starter guides A and B.
- Do not use unnecessary force when installing the ratchet E ring.



- ① Starter lock
- ② Reel

3. Install the following:

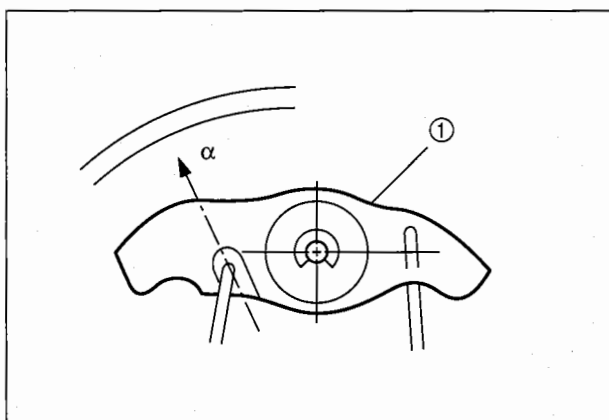
- Starter locking rod
- Starter locking cam shaft
- Starter handle

How to apply initial load on the starter spring:

- Make sure there is no load on the starter spring.
- Hold the end of the rope, rotate the reel 3 times in the counterclockwise direction, and attach it to the starter handle.

CAUTION

Using the knot on the starter rope (handle side), adjust so that the pawl of the starter lock ① rests in the concave part of the reel ②.



- ① Ratchet

Checking the force acting on the ratchet:

Check that the ratchet ① operates when an initial load of 300g to 500g is applied on the ratchet in the direction α .

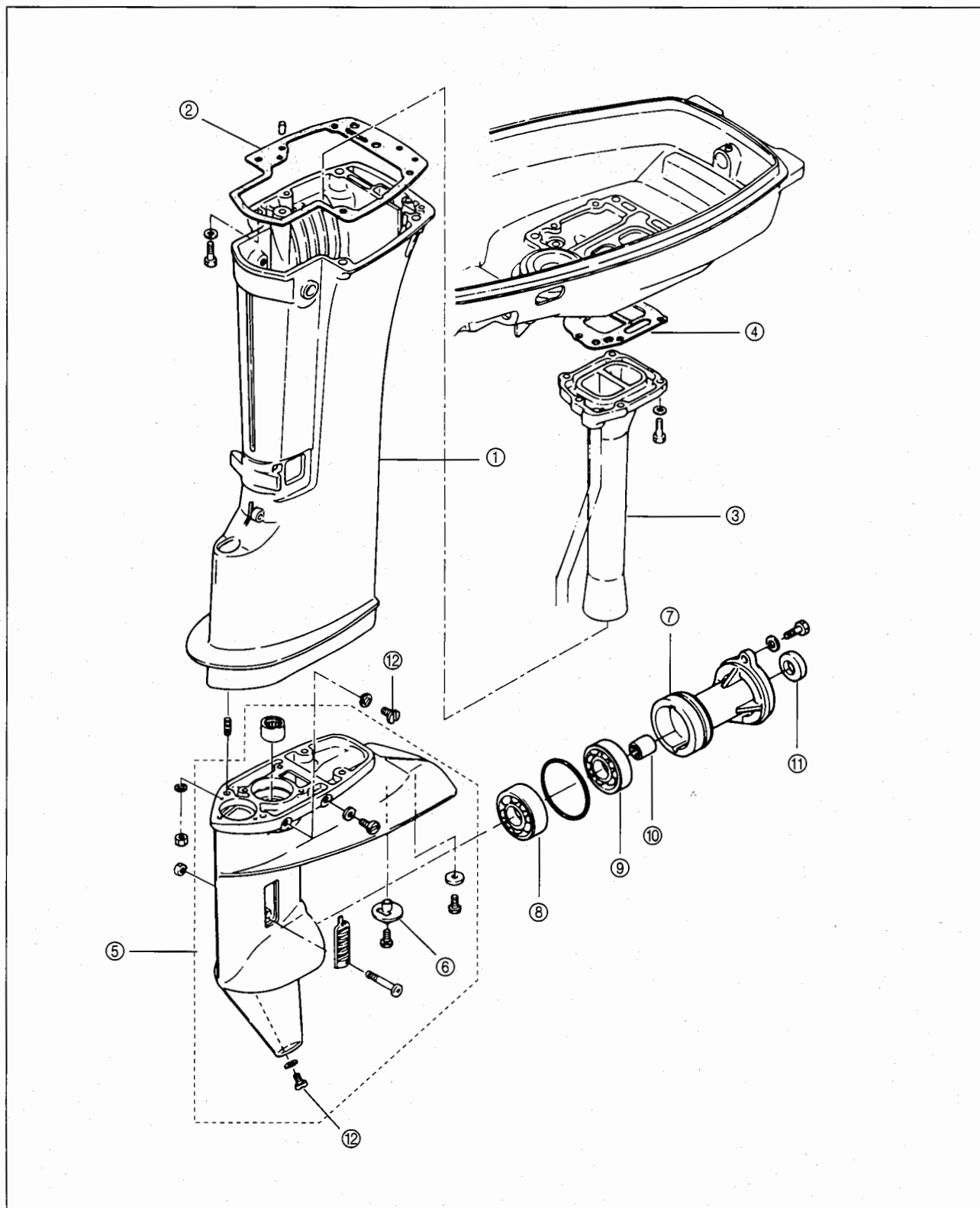
(Set the ratchet face upward, apply grease and then measure the force.)

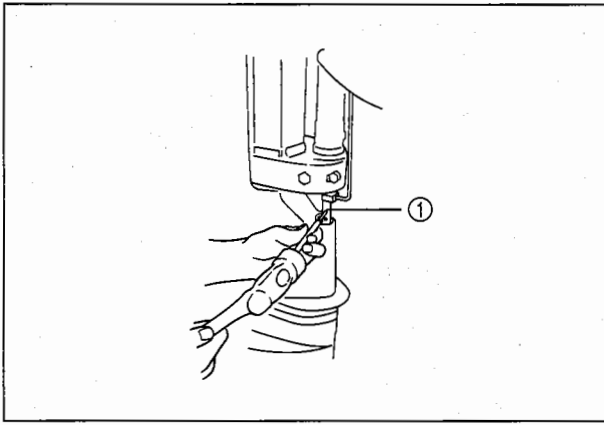
CHAPTER 4

LOWER UNIT

Drive shaft housing and gear case

- | | |
|-----------------------|----------------------------|
| ① Drive shaft housing | ⑦ Propeller shaft housing |
| ② Gasket | ⑧ Bevel gear A bearing |
| ③ Exhaust pipe | ⑨ Bevel gear C bearing |
| ④ Gasket | ⑩ Needle bearing |
| ⑤ Gear case assembly | ⑪ Propeller shaft oil seal |
| ⑥ Sub-water strainer | ⑫ Oil plug |





Disassembly of Gear Case

Removal of gear case

- ① Shaft rod joint

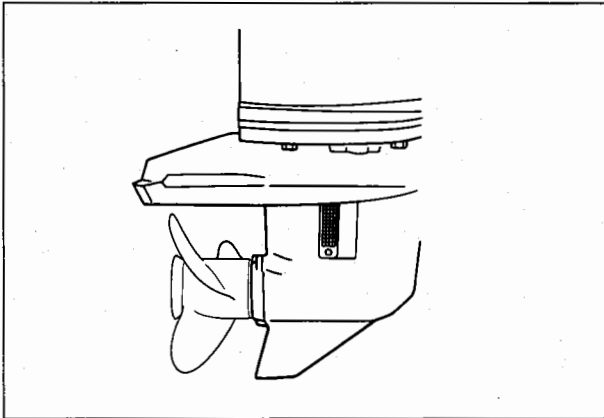
The gear case can be removed without removing the power unit from the outboard motor.

1. Remove the following:

- Spring pin
(Remove the spring from the upper side of gear shift rod joint ①.)

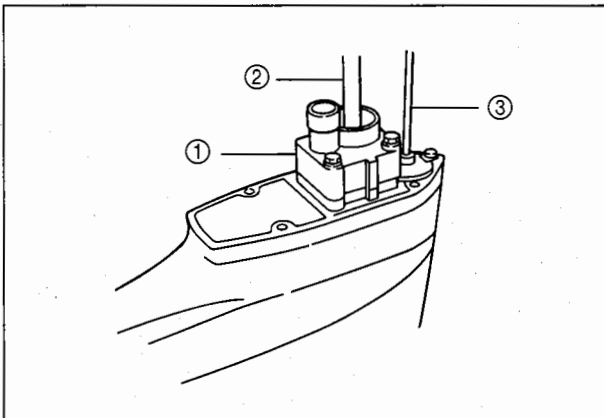
CAUTION

Remove the spring pin using the spring pin tool.



2. Remove the following:

- Gear case nuts (plain 8-4)
- Gear case assembly
(Pull out the assembly from the bottom.)



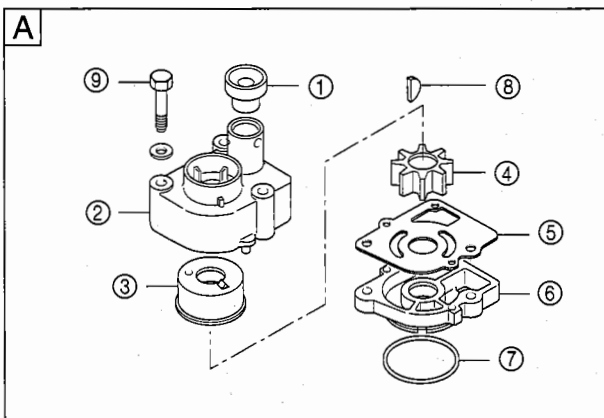
Disassembly of water pump case

- ① Water pump case
- ② Drive shaft
- ③ Cam rod

1. Drain the gear oil. (Refer to oil plug, Page 4-6.)

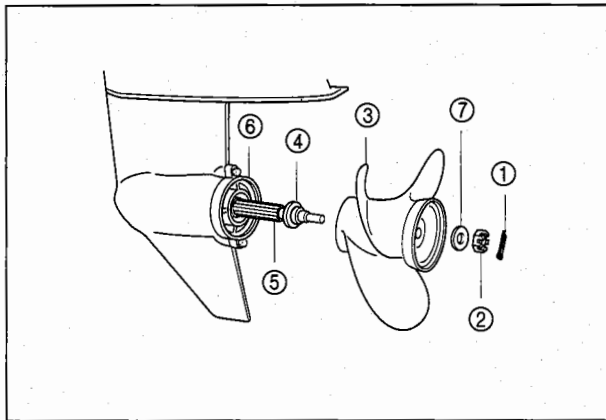
2. Remove the following:

- Water pump case bolts (H652-3)
- Water pump case ①
- Pump impeller (Pull out from the top.)
- Pump impeller key
- Lower pump case



A Water pump assembly

- ① Lower water pipe grommet
- ② Water pump case
- ③ Pump case liner
- ④ Pump impeller
- ⑤ Water pump guide plate
- ⑥ Lower water pump case
- ⑦ O-ring
- ⑧ Pump impeller key
- ⑨ Pump case bolt

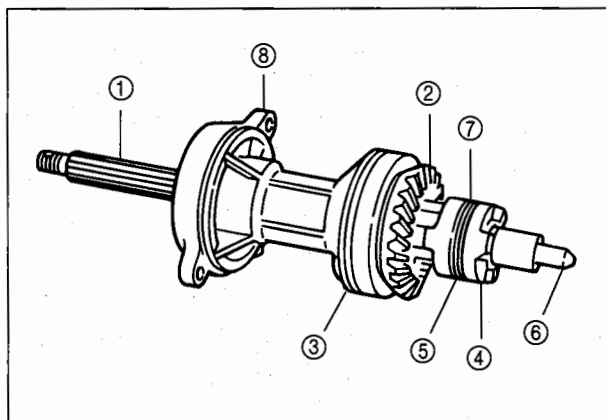


Removal of propeller

- ① Split pin
- ② Propeller nut
- ③ Propeller
- ④ Thrust holder
- ⑤ Propeller shaft
- ⑥ Propeller shaft housing
- ⑦ Washer

1. Remove the following:

- Split pin ①
- Propeller nut ②
- Washer ⑦
- Propeller ③
- Thrust holder ④



Disassembly of propeller shaft and clutch

- ① Propeller shaft
- ② Bevel gear C
- ③ O-ring
- ④ Clutch
- ⑤ Clutch pin snap
- ⑥ Push rod
- ⑦ Clutch pin
- ⑧ Pull-out groove

1. Remove the following:

- Propeller shaft housing bolts (H625-2)
- Propeller shaft housing (propeller shaft ① with bevel gear C ②)
- Propeller shaft

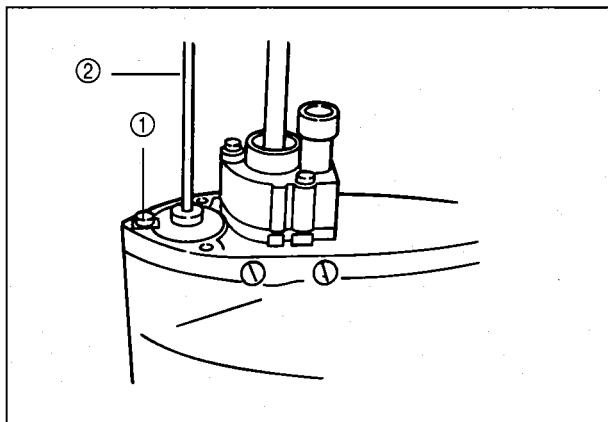
2. Remove the clutch pin snap ⑤ from the peripheral groove of the clutch ④, and pull out the clutch pin ⑦ while pushing the push rod ⑥ lightly.

CAUTION

Take care when you pull out the clutch pin because the push rod, clutch spring holder, and clutch spring are likely to fly out.

3. Remove the following:

- Clutch
- Push rod
- Clutch spring holder
- Clutch spring



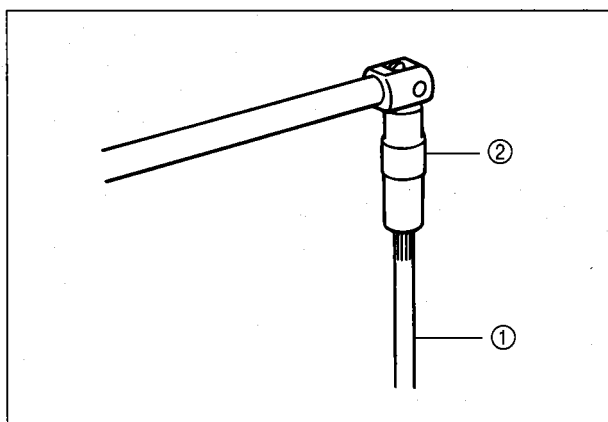
Removal of clutch cam and cam rod

- ① Cam rod push stopper bolt
- ② Cam rod

1. Remove the following:
 - Cam rod push stopper bolt ① (H512)
 - Cam rod ② (Pull out from the top.)
2. Remove the following:
 - Clutch cam spring pin
 - Cam rod spring pin
 - Clutch cam
 - Cam rod bush (Remove from the cam rod.)

CAUTION

Use the spring pin tool to remove the spring pin.



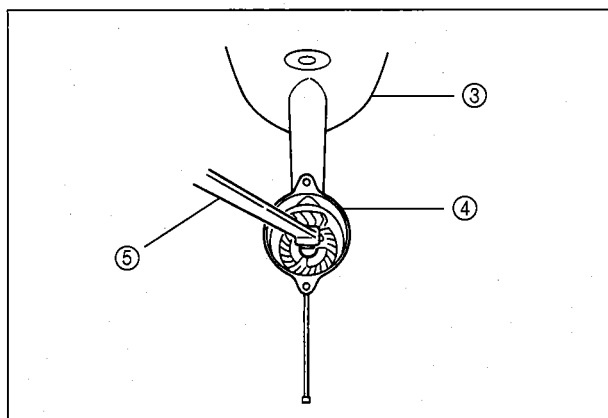
Removal of bevel gear and drive shaft

- ① Drive shaft
- ② Bevel gear B nut socket
- ③ Gear case
- ④ Bevel gear B
- ⑤ Bevel gear B nut wrench

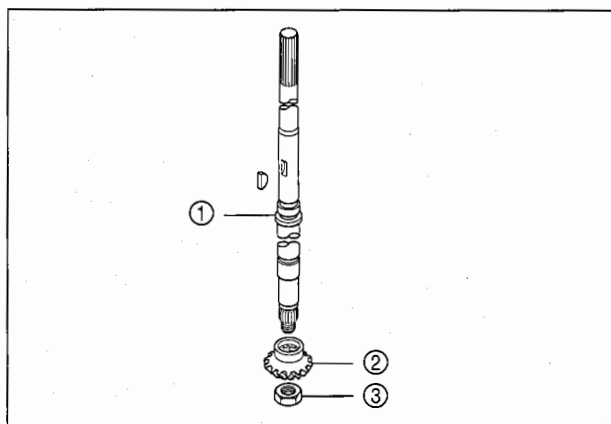
1. Remove the following:
 - Bevel gear B nut
 - Bevel gear B
 - Drive shaft
 - Bevel gear A
 - Bevel gear A bearing
 - Bevel gear C

Removal procedure:

- Insert the bevel gear B socket nut ② in the spline of the drive shaft ①.
- Set the bevel gear B nut wrench ⑤ on the bevel gear B ④ nut on the gear case ③.
- Secure the bevel gear B nut, loosen the bevel gear B nut socket, then remove the bevel gear B nut and bevel gear B.
- Hold the drive shaft, tap the gear case flange surface lightly with a plastic hammer, pull out the drive shaft, and then remove the bevel gear A.
- Remove the bevel gear A bearing using the bevel gear A bearing puller.
- Remove the bevel gear C from the propeller shaft housing.



Inspection items		
Bevel gears A, B, C and clutch	<ul style="list-style-type: none"> • Wear and damage to pawls of bevel gears A and C • Wear and damage to clutch pawl • Contact of tooth faces of bevel gears A, B and C • Wear in bearings for bevel gears A and C 	Replace Replace Replace if necessary Replace if necessary
Propeller shaft	<ul style="list-style-type: none"> • Play between the clutch and meshing part (spline) 	Replace if necessary
Drive shaft	<ul style="list-style-type: none"> • Misalignment of drive shaft • Wear in spline, and at seal and bearing surface • Contact of needle roller 	Repair or replace Replace if necessary Replace if necessary
Water pump	<ul style="list-style-type: none"> • Wear in pump impeller • Wear and deformation of pump case liner • Wear in pump guide plate • Wear and crack in the rib of pump case lower oil seal 	Replace Replace Replace if necessary Replace if necessary



Gear case assembly

Take the precautions described below and reverse the procedure for disassembly.

Installation of bevel gear and drive shaft

- ① Drive shaft
- ② Bevel gear B
- ③ Bevel gear B nut

1. Install the following:
 - Bevel gear A bearing

CAUTION

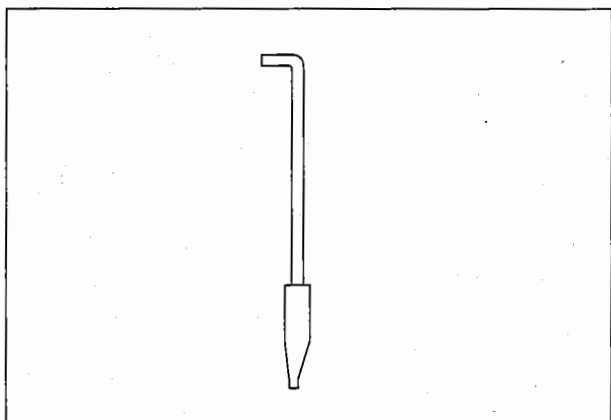
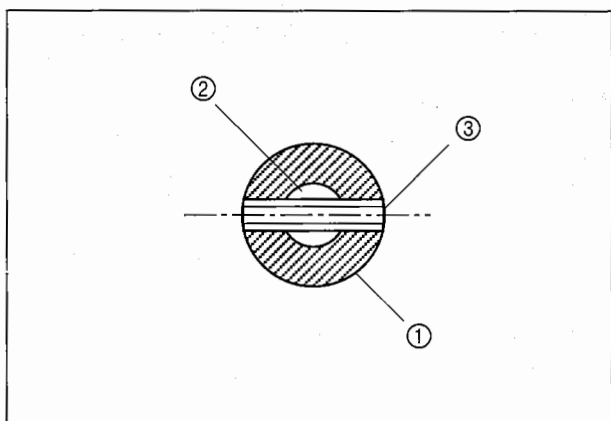
To press-fit the bearing, press the outer race.

2. Assemble the following:
 - Bevel gear B nut

Tightening torque: 3.0 ~ 3.5 kg-m

CAUTION

- Make sure you completely degrease the threaded part of the bevel gear B nut and drive shaft, apply Three Bond 1373 and then tighten the nut.
- To tighten the nut, use the bevel gear B nut socket and bevel gear B nut wrench.



Installation of clutch cam and cam rod

- ① Clutch cam
- ② Clutch cam rod
- ③ Clutch cam spring pin

1. Install the following:
 - Cam rod O-ring A and B
 - Cam rod bush
 - Clutch cam ①
(Install the cam on the clutch cam rod ②.)
 - Clutch cam spring pin ③ (ø 3 × 12 ℓ)

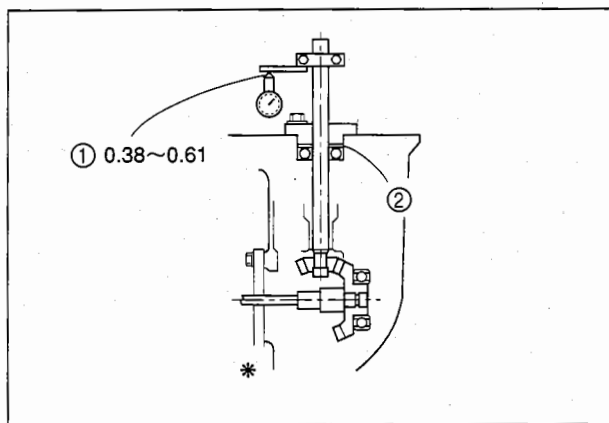
CAUTION

- Apply gear oil to the O rings inside and outside the cam rod bush before installation.
- Do not re-use the spring pin.
- Press-fit the spring pin using the spring pin tool and make sure it does not fly from the clutch cam periphery.

2. Install the following:
 - Cam rod
 - Cam rod bush stopper bolt (H512)
(Apply the specified grease.)

CAUTION

After installation, check that the cam rod moves up and down smoothly.



Backlash adjustment between bevel gears A and B

- ① Measuring position (dial gauge reading)
- ② Location for inserting adjusting shim

1. Measure the following: (Refer to Page 2-19, 2-20.)

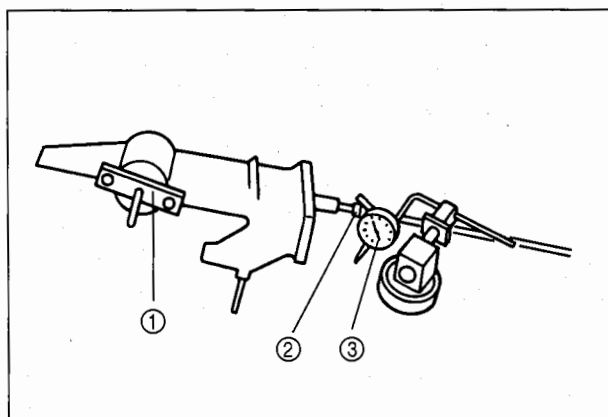
- Backlash between bevel gears A and B

Backlash: 0.08 mm ~ 0.13 mm

* Dial gauge reading of 0.38 to 0.61 is equivalent to 0.08 to 0.13 in the gear pitch diameter.

CAUTION

Use the backlash measuring tool.



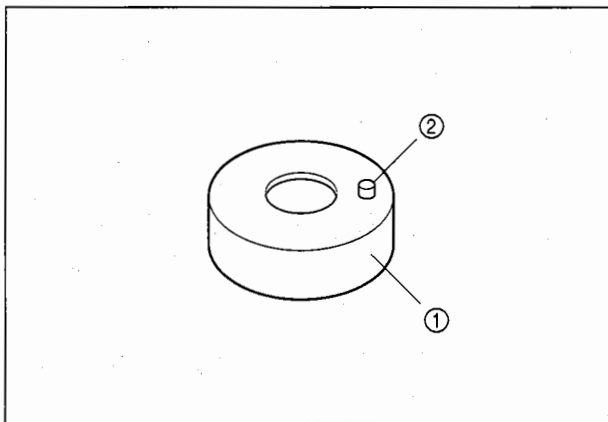
- ① Backlash measuring tool
- ② Cramp
- ③ Dial gage

2. Adjust the following:

- Backlash between bevel gears A and B

Adjusting procedure:

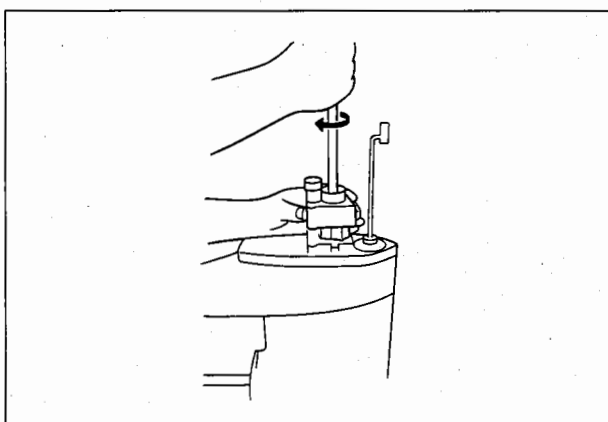
- Use adjusting shims between the pump case and drive shaft bearing.



Assembly of water pump case

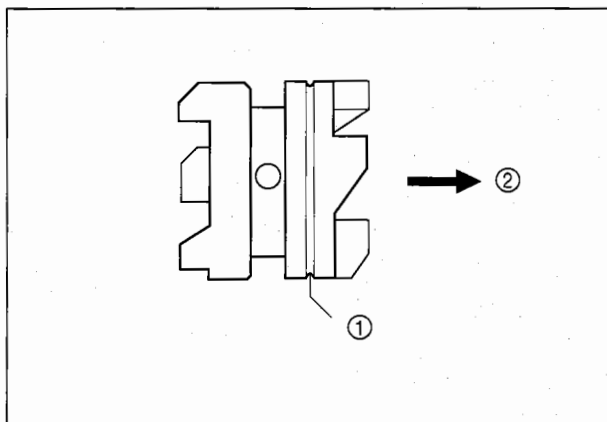
- ① Pump case liner
- ② Pump case protrusion

1. Install the following:
 - Oil seal (13.8×26×9.5) (Apply gear oil.)
 - O-ring (Apply cup grease.)
 - Lower pump case
 - Pump impeller key
 - Pump case liner
 - Water pump case
 - Water pump case bolts (H652-3)
- (Apply the specified grease.)



CAUTION

- Take care to prevent damage to the oil seal when installing the lower pump case on the drive shaft.
 - Install the pump impeller key with the large chamfer directed upward.
 - Insert the pump case liner in the pump impeller while rotating the drive shaft clockwise when looking from the engine side and install the pump case.
- (Make sure that the blades of the pump impeller are not reversed.)



Assembly of propeller shaft and clutch

- ① Groove
- ② Bevel gear A side

CAUTION

Before installing the clutch and the propeller shaft, make sure that motion in the vertical direction is smooth and without any play.

1. Install the following:

- Clutch
- Clutch pin
- Clutch pin snap

CAUTION

- Install the clutch so that the side with the groove ① faces the side with bevel gear A ②.
- Do no re-use the clutch pin snap.
Also, assemble the clutch pin snap using the clutch pin snap tool.

2. Install the following:

- Propeller shaft oil seal (17-30-9)
(Apply cup grease.)
- Needle bearing
(Install in the propeller shaft housing.)
- Ball bearing
(Install on the bevel gear C side.)
- Propeller shaft housing
- Propeller shaft housing bolts (H625-2)
(Apply Three Bond 1332.)

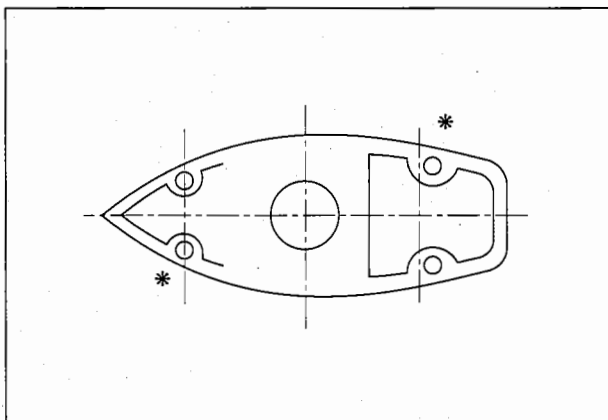
CAUTION

- Press-fit the needle bearing using the needle roller bearing tool.
- Install the propeller housing after applying gear oil on the O-ring and spigot.

Use a pressure and vacuum tester to insure repairs were completed correctly. Perform the pressure test at 6 to 7 PSI. Draw 3 to 5 inches of mercury for the vacuum test. Rotate the shafts, move the shift shaft up and down, there should be no leakage. If leakage occurs put the gearcase in water the bubbles will show you where the leak is coming from.

3. Inject gear oil.

**Gear oil: Approx. 370 cc (specified gear oil)
(GL5-sas ± 80 - 90)**



Propeller installation

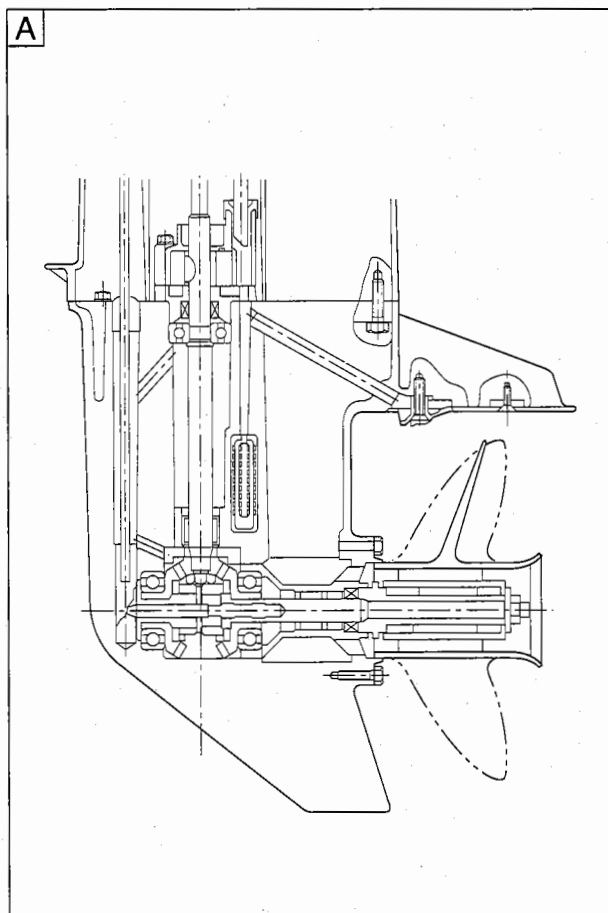
1. Install the following:
 - Propeller (Apply the specified grease on the propeller shaft.)

Installation of gear case

1. Install the following:
 - Gear case assembly
 - Gear case nut
 (Apply the specified grease.)

CAUTION

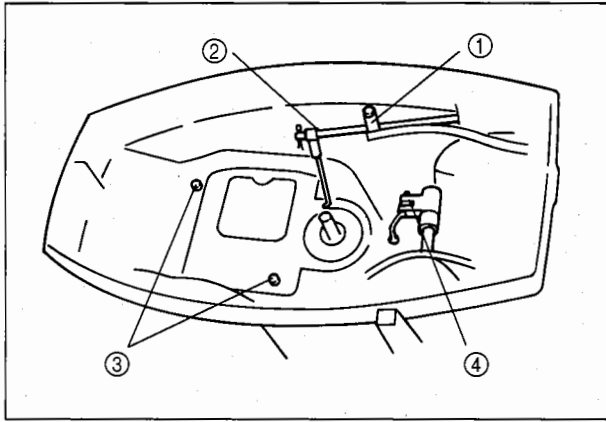
- Insert the water pipe after applying oil on the water pipe seal rubber, so that there is no displacement or deformation of the seal rubber.
- Tighten the gear case nut from the positions marked '*' in the figure.
- Tighten the engine bolts after running-in.



Standards for oil seals and O rings for gear case

A Gear case assembly drawing

Part name	Dimensions
Propeller shaft housing O-ring	$\phi 2.4 \times \phi 59.6$
Propeller shaft oil seal	$17 \times 30 \times 9$
Lower pump case O-ring	$\phi 3.5 \times \phi 36$
Lower pump case oil seal	$13.8 \times 26 \times 9.5$
Cam rod O-ring A	$\phi 2.4 \times \phi 5.8$
Cam rod O-ring B	$\phi 3.5 \times \phi 36$



Disassembly of Lower Motor Cover and Drive Shaft Housing

Removal of lower motor cover

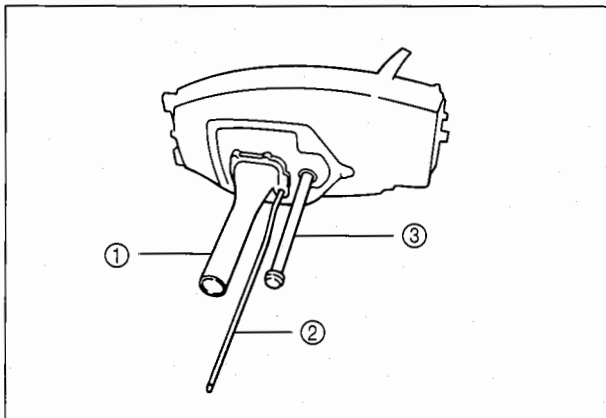
- ① Throttle shaft supporter
- ② Throttle shaft
- ③ Lower motor cover bolts
- ④ Gear shift rod lever pin

1. Remove the following:

- Throttle shaft supporter ①
- Throttle shaft ②
- Lower motor cover bolts ③ (H620-2)
- Lower motor cover
(with exhaust pipe, water pipe, drive shaft guard pipe fitted)

CAUTION

If the gear case assembly has been fitted to the drive shaft housing, remove the gear shift rod lever pin ④ or the spring pin of the gear shift rod joint (upper side) first, then remove the lower motor cover.

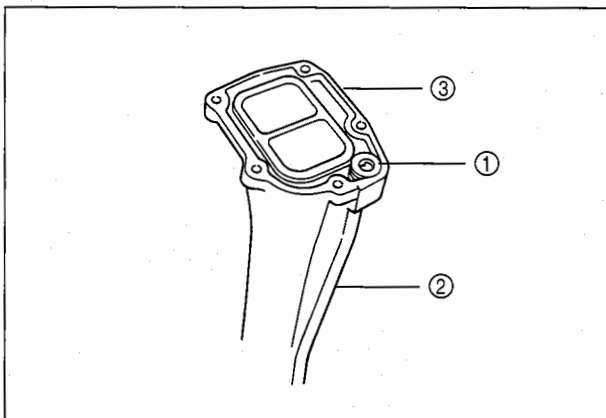


Removal of exhaust pipe and water pipe

- ① Exhaust pipe
- ② Water pipe
- ③ Drive shaft guard pipe

1. Remove the following:

- Exhaust pipe bolts (H625-5)
- Exhaust pipe ①



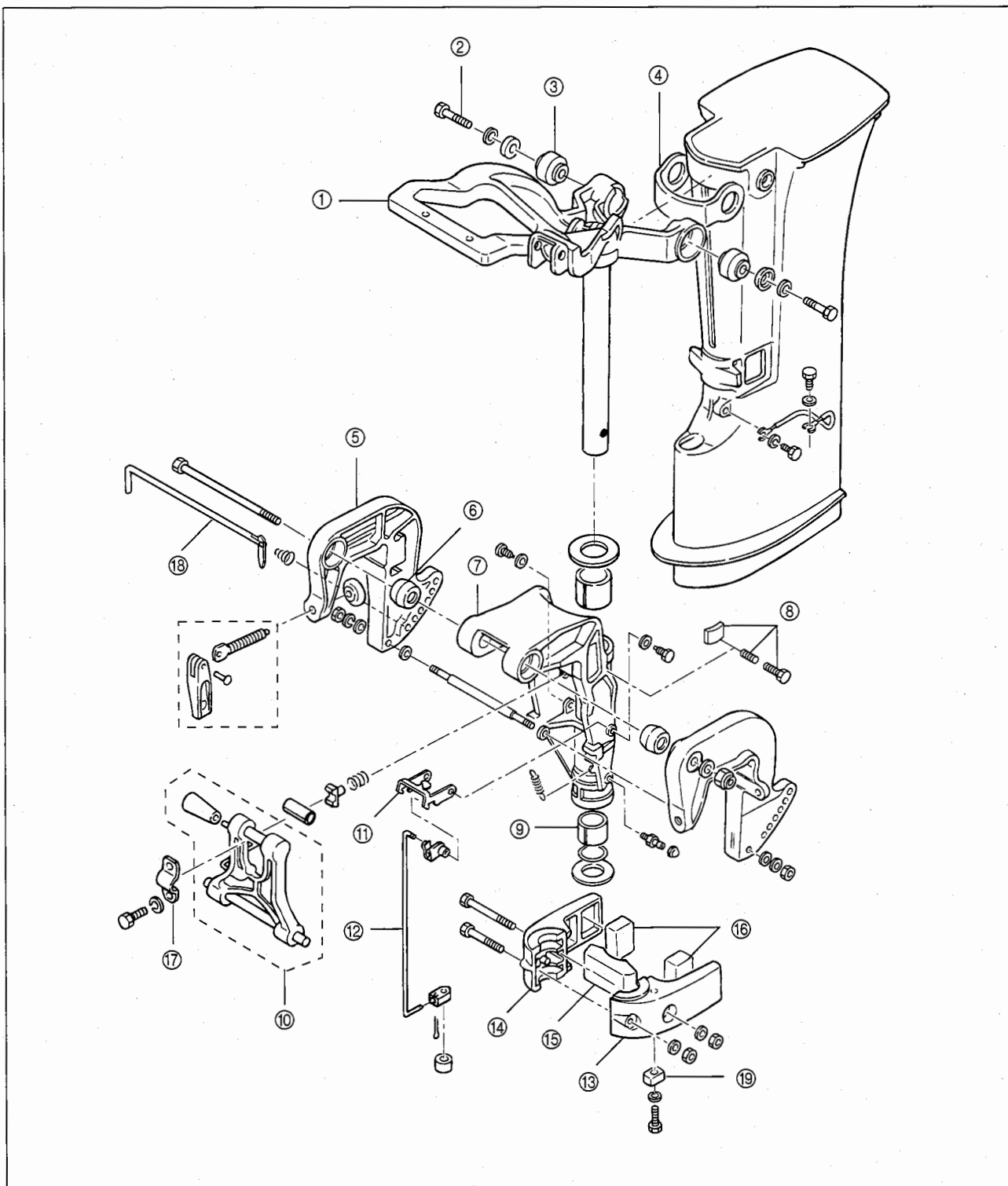
- ① Water pipe stopper
- ② Water pipe
- ③ Exhaust pipe

2. Remove the following:

- Water pipe stopper ①
- Water pipe ②
(Remove from the exhaust pipe ③.)

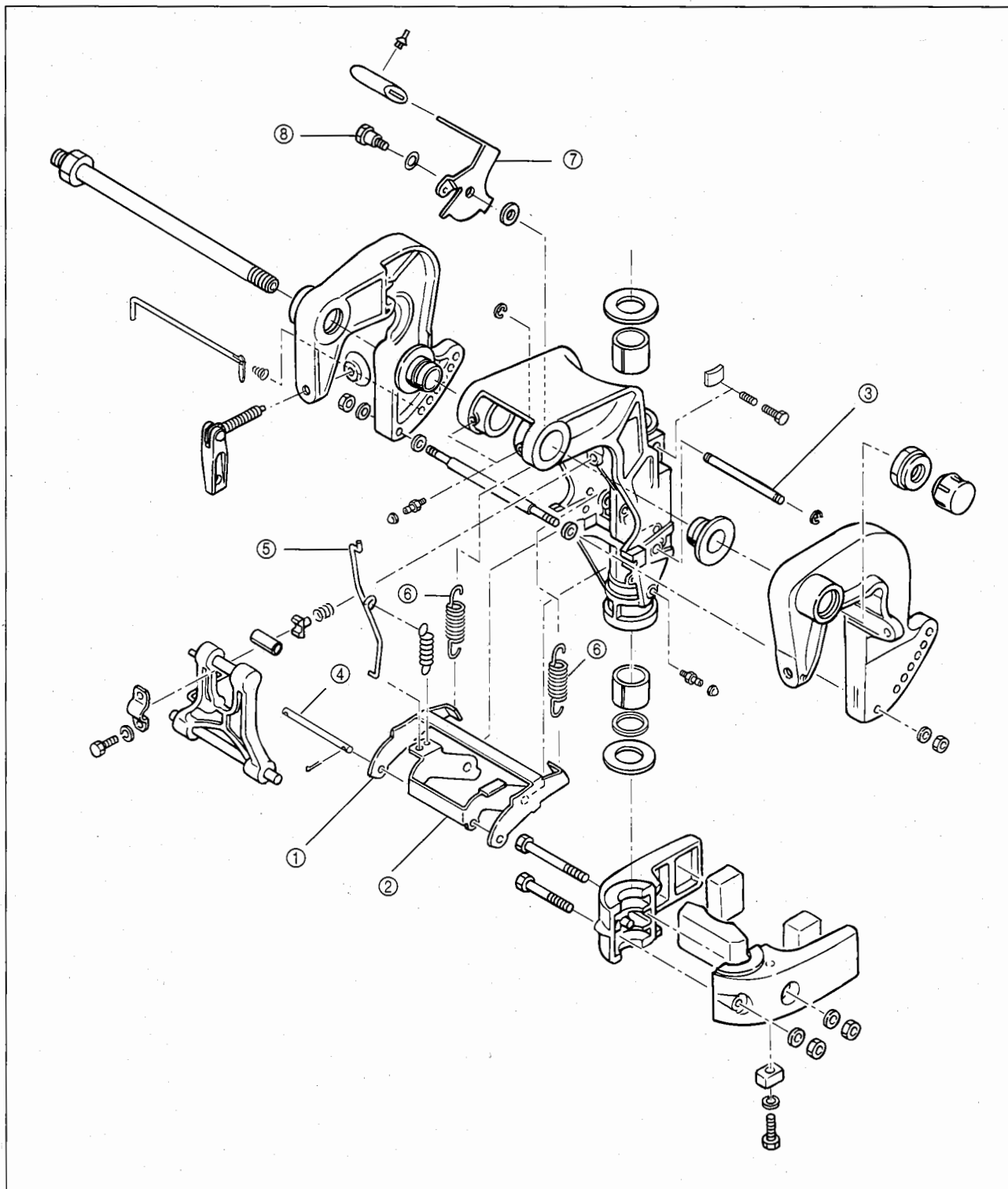
Bracket and reverse lock (Type I)

- | | | |
|---------------------------|--------------------------|--------------------------------|
| ① Steering shaft assembly | ⑧ Friction bolt assembly | ⑮ Lower, side mounting rubber |
| ② Bolt | ⑨ Bracket shaft bush | ⑯ Lower, front mounting rubber |
| ③ Upper mounting rubber | ⑩ Tilt stopper | ⑰ Tilt stopper setting plate |
| ④ Damper rubber | ⑪ Reverse lock | ⑱ Thrust rod |
| ⑤ Stern bracket | ⑫ Reverse locking ring | ⑲ Anode |
| ⑥ Conical collar | ⑬ Mounting bracket L | |
| ⑦ Swiveling bracket | ⑭ Mounting bracket R | |



Bracket and reverse lock (Type II)

- | | |
|---------------------------|-------------------------------|
| ① Reverse lock | ⑤ Reverse locking link |
| ② Reverse locking arm | ⑥ Reverse locking spring |
| ③ Reverse locking bracket | ⑦ Reverse locking lever |
| ④ Reverse locking rod | ⑧ Reverse locking lever shaft |



A Stern bracket (Type I)

- ① Swiveling bracket
- ② Stern bracket R
- ③ Stern bracket L
- ④ Distance piece
- ⑤ Bracket bolts
- ⑥ Conical collar
- ⑦ Thrust rod
- ⑧ Tilt stopper
- ⑨ Reverse lock
- ⑩ Reverse locking bolts
- ⑪ Friction plate

Disassembly of stern bracket

1. Remove the following:
 - Thrust rod
 - Distance piece nut
 - Bracket bolts and nuts
 - Nylon nuts on the stern bracket L side (Type II only)
 - Bracket bolts
 - Brackets (R, L)
 - Bushing (Type II only)

Disassembly of swiveling bracket

(Type I bracket)

1. Remove the following:
 - Tilt stopper setting plate
 - Tilt stopper
 - Reverse locking spring
 - Reverse locking bolts
 - Reverse lock
 - Friction bolts
 - Friction plate

B Stern bracket (Type II)

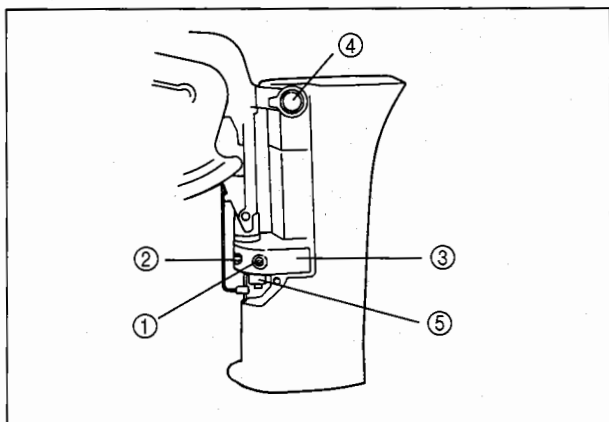
- ① Swiveling bracket
- ② Stern bracket R
- ③ Stern bracket L
- ④ Distance piece
- ⑤ Bracket bolts
- ⑥ Bushing
- ⑦ Thrust rod
- ⑧ Tilt stopper
- ⑨ Reverse lock
- ⑩ Reverse locking bracket
- ⑪ Friction plate
- ⑫ Reverse locking arm
- ⑬ Spring reverse lock
- ⑭ Reverse locking link
- ⑮ Reverse locking lever

(Type II bracket)

1. Remove the following:
 - Tilt stopper setting plate
 - Tilt stopper
 - Reverse locking lever shaft
 - Reverse locking lever
 - Reverse locking link
 - Spring reverse lock
 - Reverse locking assembly
 - Friction bolts
 - Friction plate
2. Disassemble the following:
 - Reverse locking assembly

Disassembly procedure:

- Remove the reverse locking shaft E ring, and pull out the reverse locking shaft.
- Remove the reverse locking shaft and the reverse lock.

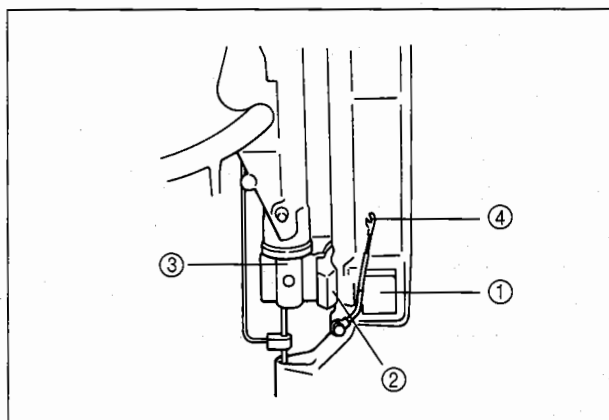


Disassembly of drive shaft housing

- ① Mounting bracket bolt A
- ② Mounting bracket bolt B
- ③ Mounting brackets R, L
- ④ Upper mounting rubber bolts 4
- ⑤ Anode

1. Remove the following:

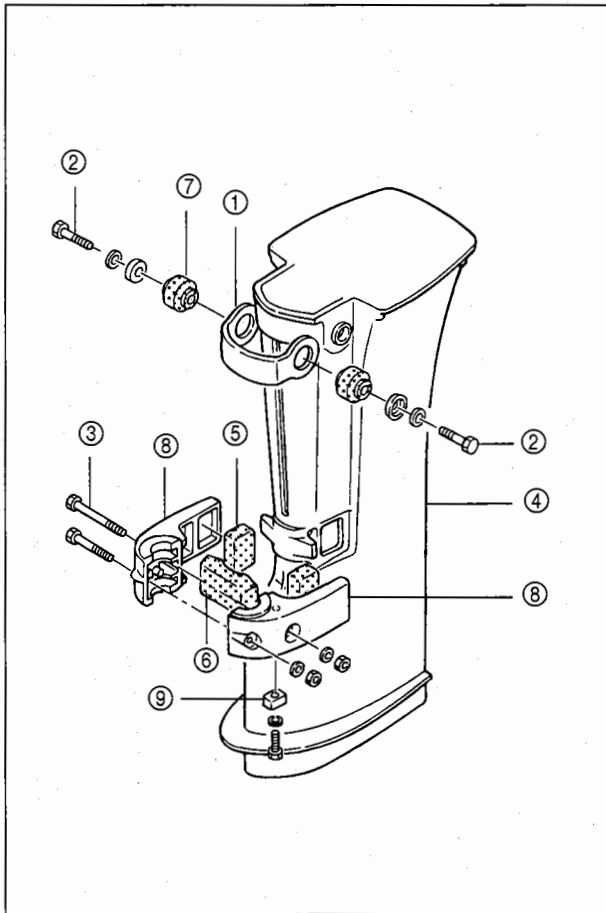
- Mounting bracket bolt A ① (H885)
- Mounting bracket bolt B ② (H852)
- Mounting brackets R, L ③
- Upper mounting rubber bolts ④ (H1045-2)
- Drive shaft housing
(Remove from the steering.)



- ① Lower, side mounting rubber
- ② Lower, front mounting rubber
- ③ Steering shaft
- ④ Ground wire

CAUTION

- When removing the mounting bracket, make sure the lower, side mounting rubber ① (2 nos.), lower, front mounting rubber ② (1 no.) and the thrust plate do not fall.
- When removing the drive shaft housing, make sure the damper rubber does not fall.



Drive shaft housing and mounting bracket

- ① Damper rubber
- ② Mounting rubber upper bolt
- ③ Mounting bracket bolts A
- ④ Drive shaft housing
- ⑤ Lower, side mounting rubber
- ⑥ Lower, front mounting rubber
- ⑦ Upper mounting rubber
- ⑧ Mounting bracket
- ⑨ Anode

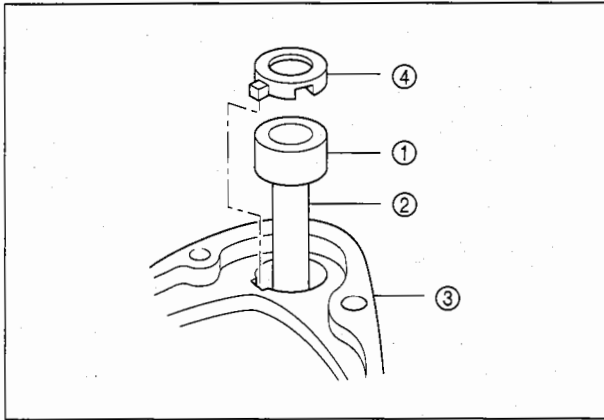
Assembly of lower motor cover and drive shaft housing

Take precautions for each item to be assembled and follow the disassembly procedure in reverse.

Assembly of drive shaft housing

1. Install the following:
 - Upper mounting rubber
(Apply the specified grease on the inner diameter of bush and periphery of rubber.)
 - Upper mounting rubber bolts
(Apply Three Bond 1342.)

Tightening torque: 2.3 ~ 3.2 kg-m



Installation of exhaust pipe and water pipe

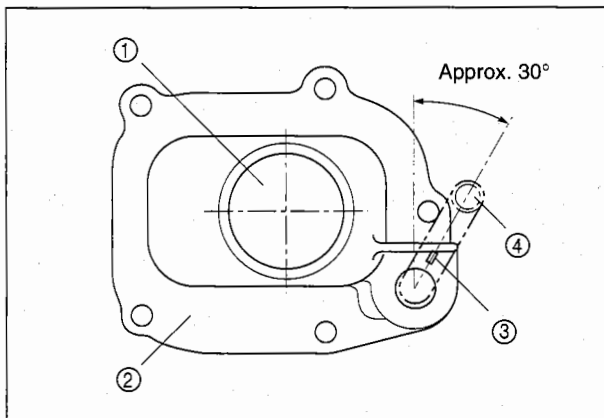
- ① Water pipe seal rubber
- ② Water pipe
- ③ Exhaust pipe
- ④ Exhaust pipe stopper

1. Install the following:

- Water pipe seal rubber ①
(Apply oil on the inner surface.)
- Water pipe ②
(Fit the exhaust pipe ③.)
- Water pipe stopper ④

CAUTION

Align the front end of the water pipe, coincide the protruding part of the water pipe stopper with the hollow part of the exhaust pipe and install the water pipe.



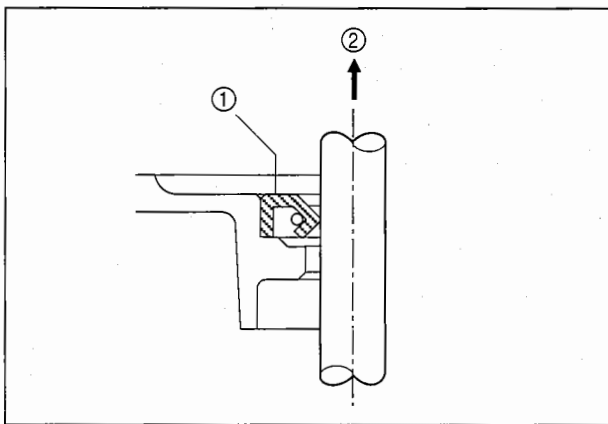
- ① Exhaust pipe (exit side)
- ② Exhaust pipe flange
- ③ Water pipe aligning mark
- ④ Water pipe entrance

2. Install the following:

- Exhaust pipe gasket
- Exhaust pipe
- Exhaust pipe bolts (H625-5)
(Apply Three Bond 1373B.)

Tightening torque: 0.7 ~ 0.9 kg-m

- Upper grommet of drive shaft guard pipe
(Apply the specified grease on inner surface.)



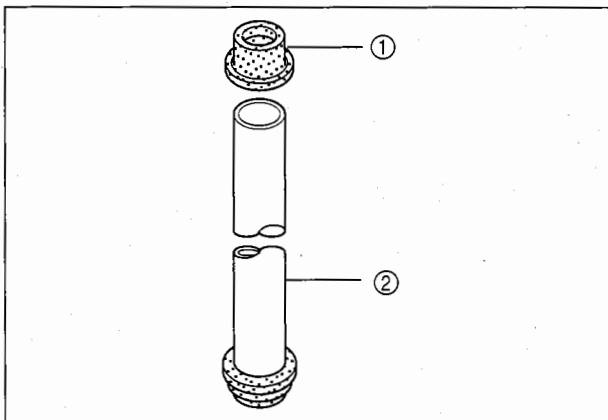
Installation of lower motor cover

- ① Drive shaft oil seal
- ② Engine side

1. Install the following:
 - Drive shaft oil seal ① (12.8 × 25 × 7)
(Apply cup grease.)

CAUTION

Install the lower motor cover in the direction shown in the figure.

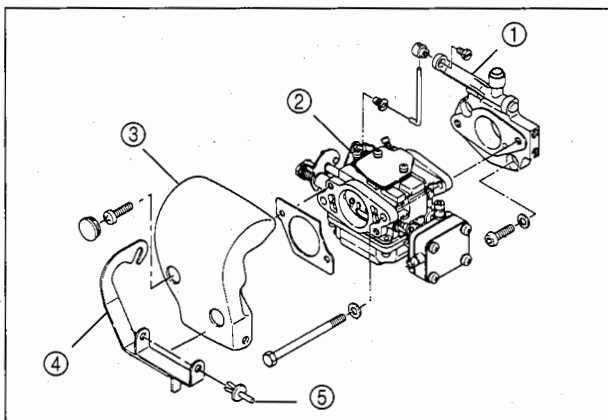


2. Install the following:
 - Lower motor cover

- ① Upper grommet
- ② Drive shaft guard pipe

CAUTION

- Make sure the drive shaft guard pipe is fitted to the lower motor cover before assembling the lower motor cover.
- Take care to prevent damage to the oil seal from the drive shaft.
- Assemble the lower motor cover after confirming that the drive shaft guard pipe has been inserted in the upper grommet.



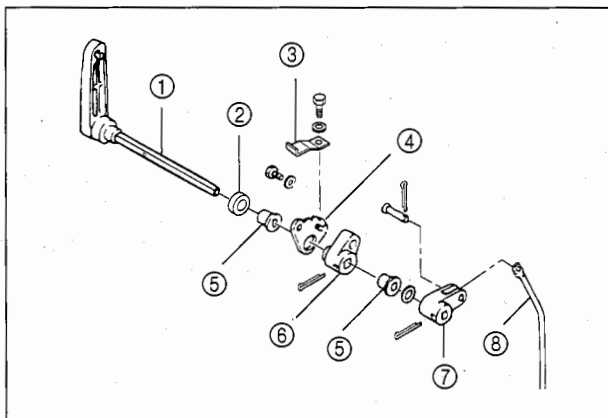
Installation of choke lever

1. Install the following:
 - Choke rod bush
(Apply the specified grease on the inner surface.)
 - Choke lever

- ① Flange ass'y carburetor
- ② Carburetor
- ③ Air silencer
- ④ Choke lever
- ⑤ Pin choke lever

CAUTION

- The choke lever must be inserted in the slit of the choke rod.
- Make sure that the choke valve is fully closed when you pull the choke rod fully to the front.
- Make sure that the choke rod operates smoothly.



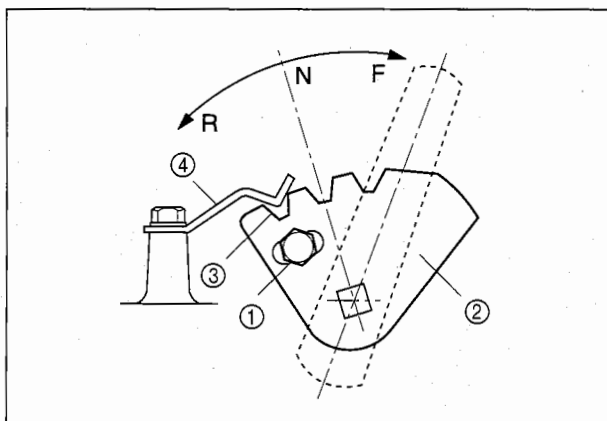
Assembly of gear shift lever

- ① Gear shift lever
- ② Oil seal (10 × 20 × 4.5)
- ③ Gear shift lever stopper
- ④ Gear shift lever stopper plate
- ⑤ Gear shift lever shaft bush
- ⑥ Gear shift lever adjuster
- ⑦ Gear shift rod lever
- ⑧ Gear shift rod

1. Assemble the following:
 - Shift lever assembly

CAUTION

- Assemble after applying the specified grease to the following parts:
 - Shift lever shaft oil seal
 - Shift lever shaft bush
 - Shift lever stopper plate
 - Shift lever stopper
- Install the spring pin for the shift lever rod joint using the spring pin tool. Since both ends have been pressed in to prevent the pin from being removed, use a center punch to widen the ends.



Shift lever adjustments

- ① Shift lever stopper plate bolt (H616)
- ② Shift lever stopper plate
- ③ F side groove
- ④ Shift lever stopper

1. Adjust the following:
 - Shift lever

Adjustment procedure:

- Move the shift lever fully toward the F side.
- Loosen the shift lever stopper bolt ① and adjust so that the F groove ③ of shift lever stopper plate ② is fully inserted in the shift lever stopper ④.
- Tighten the shift lever stopper plate bolt.

CAUTION

After adjustments, operate the F-N-R shift and confirm that the standard angles are obtained.

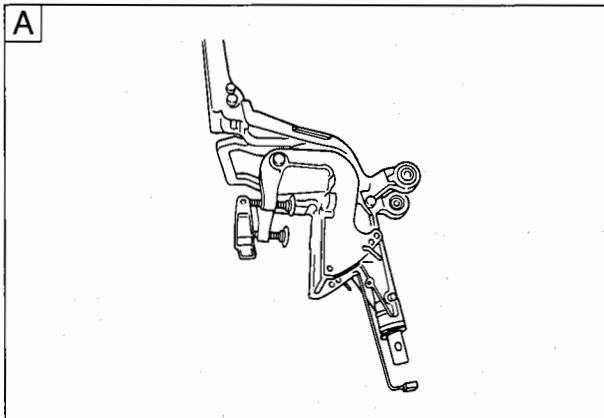
Standards for oil seals of lower motor cover and drive shaft housing

Part name	Dimensions
Drive shaft oil seal	12.8 × 25.7
Hook lever seal ring	13.8 × 22 × 3.7
Shift lever oil seal	14 × 20 × 4.5

Installation of motor cover

CAUTION

- Apply the specified grease on the lips of the hook lever bush and hook lever seal ring.
 - When installing the upper motor cover, make sure that the lower motor cover does not bind on the seal rubber.
-

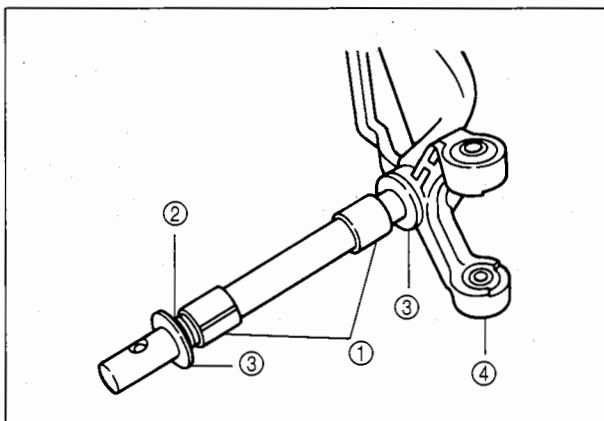


Disassembly of Steering System, Handle and Bracket

Removal of steering shaft assembly

A Steering assembly (Type I bracket)

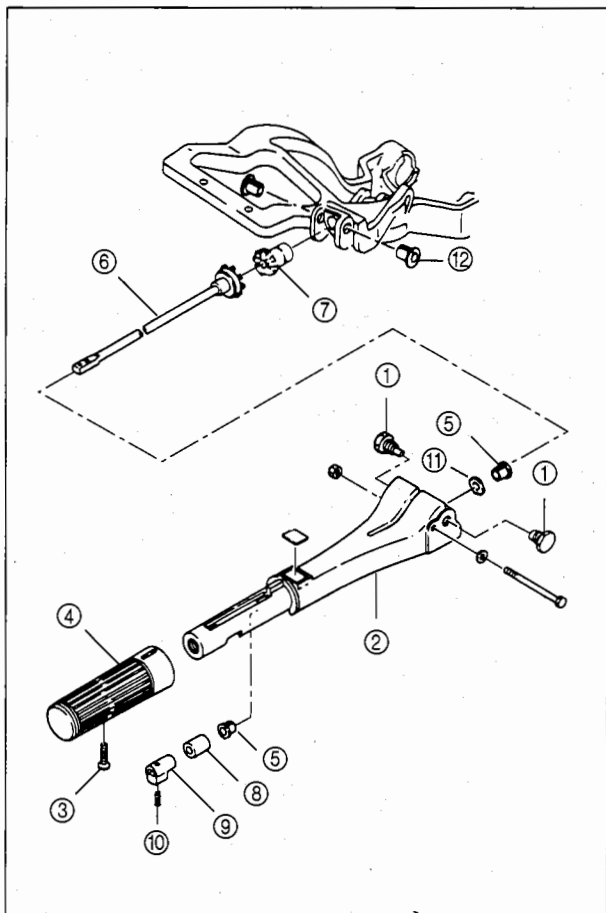
1. Remove the following:
 - Bracket shaft O-ring
 - Steering shaft assembly



Disassembly of steering system

- ① Bracket shaft bush
- ② O-ring
- ③ Thrust plate
- ④ Steering assembly

1. Remove the following:
 - Bracket shaft bush ①
 - O-ring ②
 - Thrust plate ③
 - Steering assembly ④



Removal of steering handle

- ① Steering handle bolt
- ② Steering handle
- ③ Grip screw
- ④ Grip
- ⑤ Throttle shaft bush
- ⑥ Throttle shaft A
- ⑦ Universal pinion
- ⑧ Throttle shaft rubber
- ⑨ Throttle shaft spacer
- ⑩ Spring pin
- ⑪ Wave washer d=10
- ⑫ Handle collar

1. Remove the following:
 - Steering handle bolt ①
 - Steering handle ②
 - Grip screw (pan head 518) ③
 - Grip ④
 - Throttle shaft bush ⑤
 - Throttle shaft A ⑥
 - Universal pinion ⑦
 - Throttle shaft rubber ⑧
 - Throttle shaft spacer ⑨
 - Spring pin ($\varnothing 3 \times 10 \ell$) ⑩
 - Wave washer d=10 ⑪
 - Handle collar ⑫

CAUTION

Pull the universal pinion from the steering shaft assembly.

Assembly of Steering System, Handle and Bracket

Take the necessary precautions for each item and reverse the disassembly procedure for assembly.

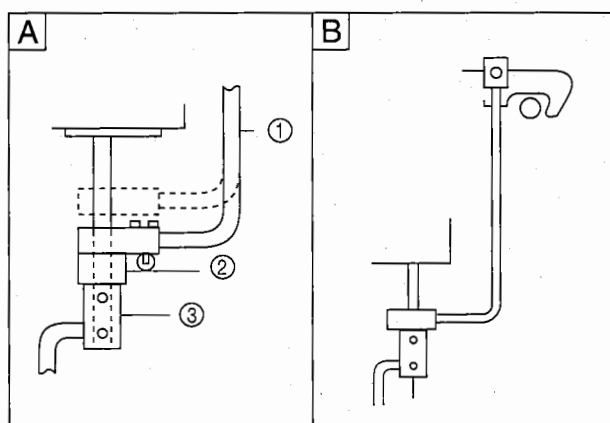
Assembly of stern bracket

1. Install the following:
 - Reverse lock
 - Tilt stopper
 - Bracket
 - Bracket bolts and nuts

Tightening torque:	Type I	1.5 ~ 2.0 kg-m
	Type II	9.0 ~ 10.0 kg-m

CAUTION

- Apply Three Bond 1342 on the reverse locking bolt (Type I) and tilt stopper setting plate bolts.
- After applying the specified grease assemble the following:
 - Clamp screw
 - Tilt stopper bush
 - Bracket conical collar (Type I)
 - Bracket spring (Type II)
 - Bracket bolts
- Apply grease using a grease nipple on the spring and bracket bolts after assembly.
- Tighten and adjust the bracket friction bolts so that the steering is not stiff while running and the boat maintains a straight-line course even if you release your hand from the handle.



Adjustments of reverse lock

Type I

- ① Reverse locking link
- ② Reverse locking link spacer
- ③ Gear shift rod joint
- Ⓐ Released at N
- Ⓑ Locked at N

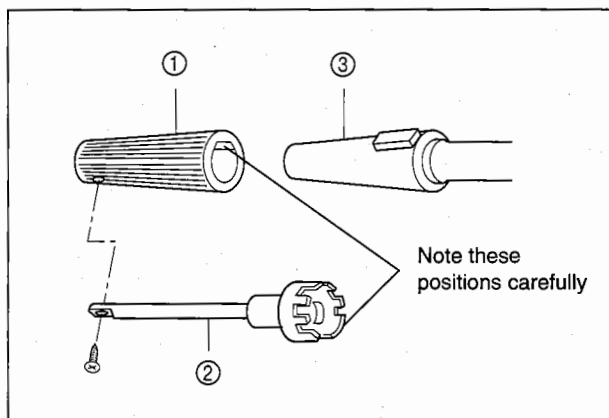
The position of the reverse locking link has been adjusted so that the reverse lock is released when the gear shift is at N (Neutral).

To adjust so that reverse lock is applied when the gear shift is at N (Neutral), remove the reverse locking link spacer.

Type II (adjustments not necessary)

Reverse lock is automatically initiated when you tilt down the outboard motor while moving the reverse lock lever to the lock side.

Move the reverse lock lever toward the release side to tilt up the outboard motor.



Installation of steering handle

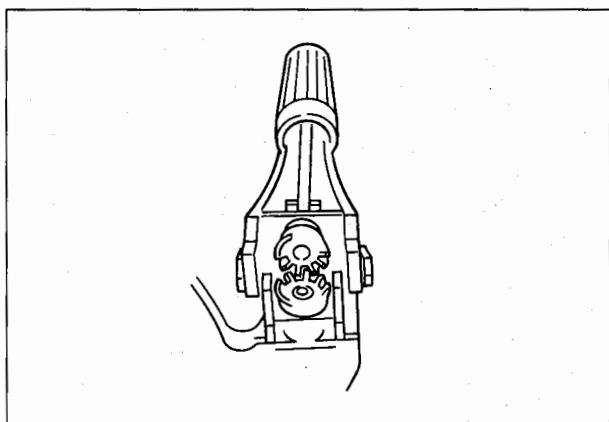
- ① Grip
- ② Throttle shaft A
- ③ Steering handle

Follow the precautions for assembly and reverse the procedure used for disassembly.

1. Install the following:
 - Universal pinion (Apply the specified grease.)
 - Throttle shaft A
 - Throttle shaft bush (Apply the specified grease.)
 - Grip (Apply the specified grease.)

CAUTION

- Apply the specified grease on sliding surfaces of the throttle shift supporter before assembly.
- When installing the grip, make sure that the relative positions of the steering shaft A and the grip are as shown in the figure, and then assemble the grip.



Assembling the steering system

1. Install the following:
 - Steering assembly
 - Steering shaft assembly

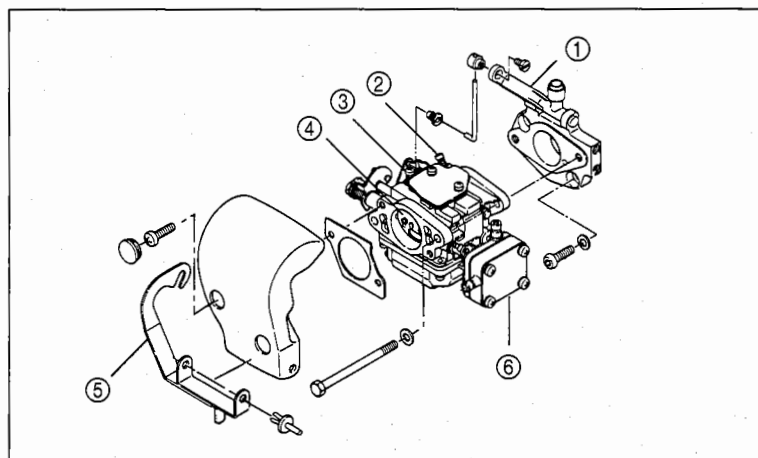
CAUTION

- Adjust the handle friction adjusting bolt so that the handle does not topple down due to its own weight when it is placed in the raised position. Make sure you do not tighten the bolt excessively.
- After correctly fitting the bracket assembly in the drive shaft housing, charge the specified grease using the grease nipple provided in the swiveling bracket.

CHAPTER 5

CARBURETOR

The carburetor is integral with the fuel pump and is fitted to the engine through the inlet manifold. The fuel pump is a diaphragm type pump that delivers fuel using the crankcase pressure and vacuum.



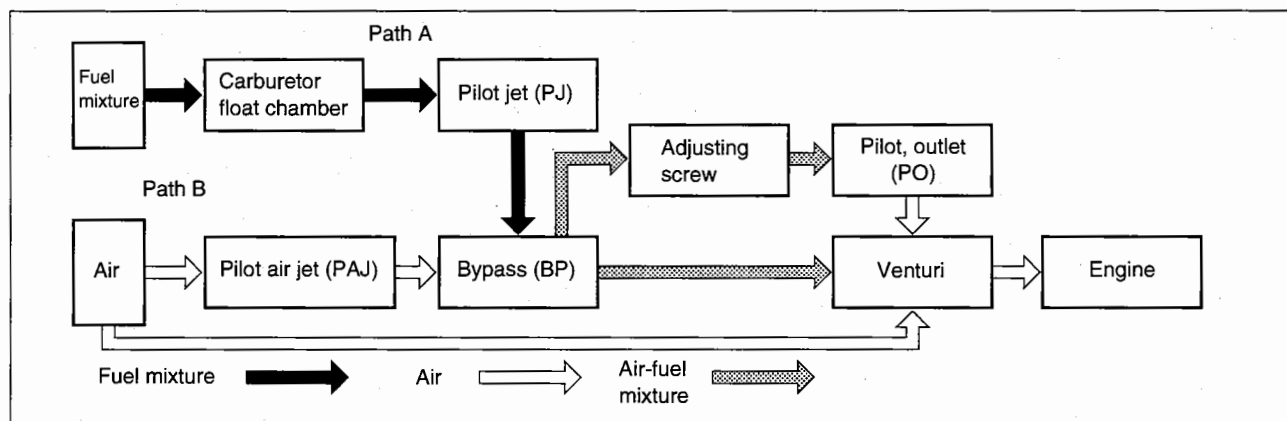
- ① Throttle lever
- ② Pilot screw
- ③ Throttle stop screw
- ④ Choke valve
- ⑤ Choke lever
- ⑥ Fuel pump

Outline of Operation

This two staff carburetor utilities a pilot system and a main system.

Pilot system (Fig. 5-1)

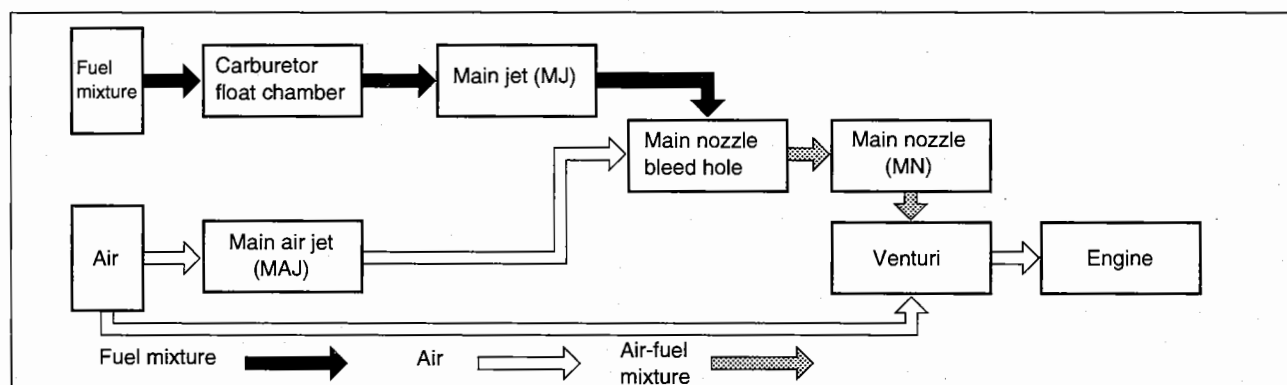
Flow of fuel mixture during start and idling/slow operation



(Fig. 5-1)

Main system (Fig. 5-2)

Flow of fuel mixture for operations above medium speed



(Fig. 5-2)

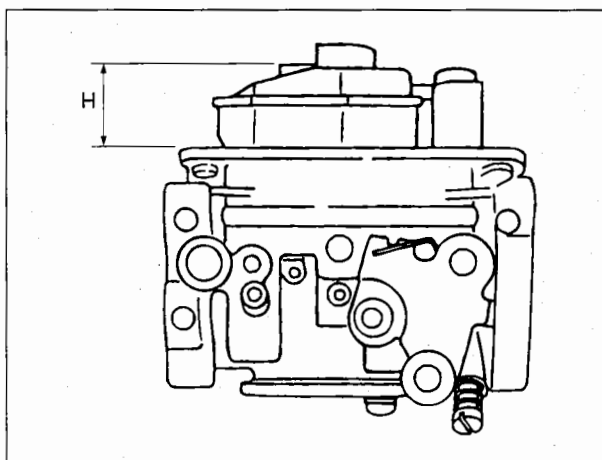
Float system (Fig. 5-3)

Consists of a hinged float, float valve, valve seat, etc..

The float height (H) is measured by inverting the carburetor.

Standard float height: $14.5 \pm 1.0\text{mm}$

Measure the height from the front end of the float on the opposite side of the float valve to the mating surface of the float chamber.



(Fig. 5-3)

Carburetor setting

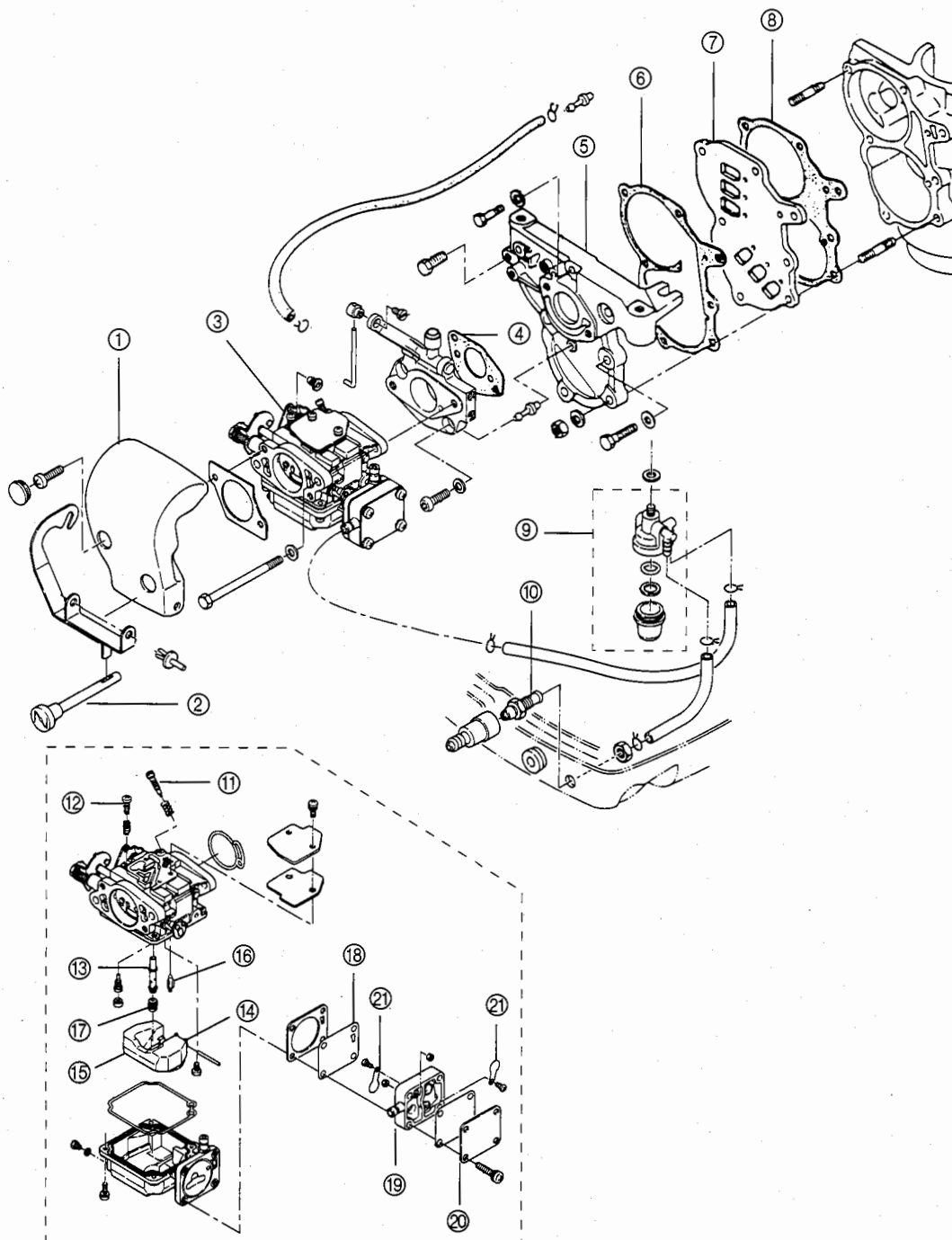
Please refer to the Service Data Section.

Inspections

Inspection Item	Measures
1. Fuel leak from the fuel pipe joint	<ul style="list-style-type: none">• Replace the pipe.
2. Play in throttle valve shaft or choke valve shaft	<ul style="list-style-type: none">• Replace if necessary.
3. Idling rpm <ul style="list-style-type: none">• Adjust after warming up the engine. <div>Clutch off 950 ~ 1000rpm</div> <div>Clutch in 600 ~ 700rpm</div>	<ul style="list-style-type: none">• Loosen the pilot screw slightly and set it at the standard position. Rotate the throttle stopper screw while observing the engine rpm on the tachometer, and set it at the specified rpm. Then adjust the pilot screw by rotating it around the reference position by $\pm 1/4$ turn so that the engine rpm is raised to the most ideal position, and again set it at the specified rpm using the throttle stopper screw.• If the tip of the pilot screw is worn out excessively, replace it.
4. Fuel pump <ul style="list-style-type: none">• Sag and damage to diaphragm and deformation of mounting hole	<ul style="list-style-type: none">• Replace if necessary.
5. Damage to packing and leakage of gas	<ul style="list-style-type: none">• Replace if necessary (carburetor/fuel pump).
6. Accumulation of water or foreign matter	<ul style="list-style-type: none">• Drain water from fuel filter and float chamber, and remove dirt.

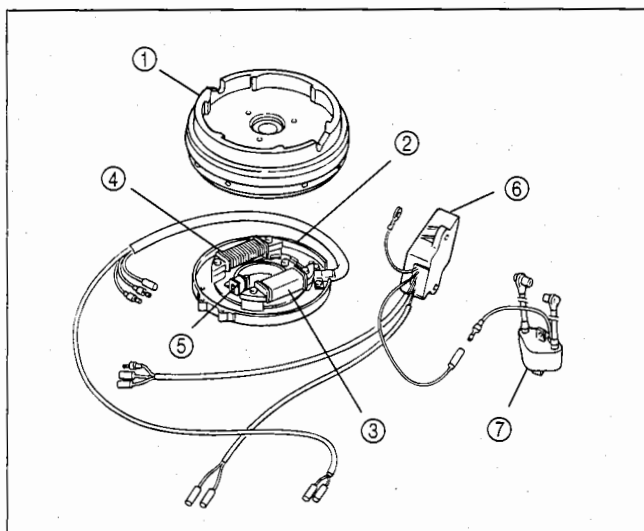
Inlet (carburetor with reed valve/fuel pump)

- | | | |
|-----------------------|------------------------|---------------|
| ① Air silencer | ⑧ Gasket B | ⑮ Float |
| ② Choke rod | ⑨ Fuel filter assembly | ⑯ Float valve |
| ③ Carburetor assembly | ⑩ Fuel connector B | ⑰ Main jet |
| ④ Carburetor gasket | ⑪ Pilot screw | ⑱ Diaphragm |
| ⑤ Inlet manifold | ⑫ Throttle stop screw | ⑲ Pump body |
| ⑥ Gasket A | ⑬ Main nozzle | ⑳ Pump cover |
| ⑦ Reed valve assembly | ⑭ Float hinge | ㉑ Check valve |



CHAPTER 6

ELECTRICAL SYSTEM



Flywheel magneto and CD unit

- ① Flywheel
- ② Coil plate assembly
- ③ Exciter coil
- ④ Alternator coil (Lighting coil)
- ⑤ Pulser coil
- ⑥ CD unit
- ⑦ Ignition coil

CD magneto construction and maintenance

Configuration

The CD ignition is divided into the following main components: flywheel, with magnetic pole pieces, coil plate for mounting coils, CD unit containing diodes, and ignition coil.

Flywheel

Inspection and maintenance

Completely degrease the tapered part of the boss to remove all traces of oil or foreign matter before re-installation. Align the position of the key and mount the flywheel firmly on the crank shaft.

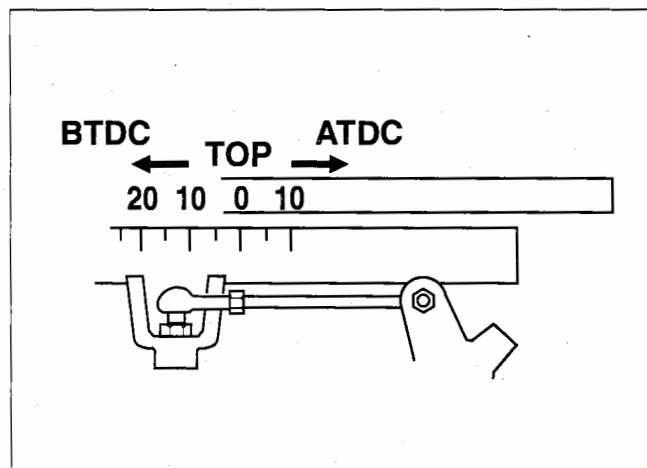
Flywheel nut tightening torque: 7.0 ~ 9.0 kg-m

Coil Plate and Coils

Pulser coil(s) signals C-D unit when to fire.

Exciter coil supplies energy to C-D unit.

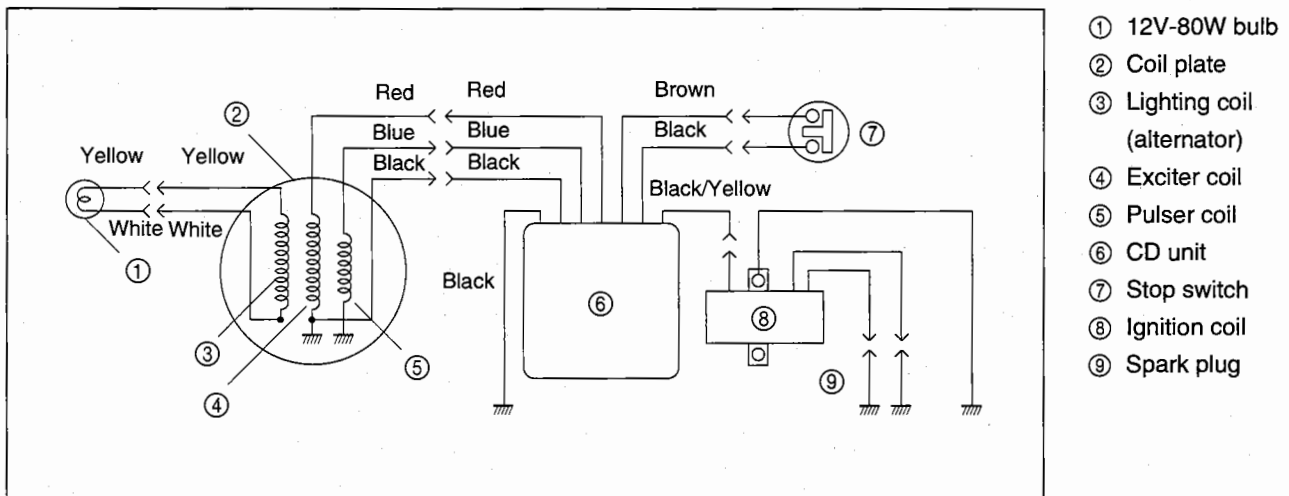
The lighting coil (alternator) is rated at 12V-80W but if a starter motor is installed in the outboard motor, it can be used as the charging coil for the battery.



(2) Inspection and maintenance

① Inspection of coils

For inspection of various parts, please refer to the CD ignition connection diagram.



Remove the connectors connecting the coil plate and the CD unit. Measure the resistance of coils between the coil wires using an ohms meter. If the measured resistance differs widely from the resistance values given here, the coil is defective.

Reference resistance values:

Exciter coil	210Ω	(Between lead wire Red and coil plate)
Pulser coil	38Ω	(Between lead wire Blue and coil plate)
Alternator	0.3Ω	(Between lead wires Yellow and White)

CAUTION

Due to variation in the diameter of the coil wire, etc, even with a correct coil the resistance may vary by $\pm 15\%$ to 20% .

Check for breaks in the coil lead wires and internal connections of coils during resistance measurement. Inspection methods include connecting the tester between the coil lead wires, pulling the coil lead wires lightly, applying voltage, applying a twisting force on the lead wire with the fingers on the lead wire take-off port and coil turns, measuring the resistance value and checking for changes in the resistance value. If the resistance value changes, there is an incomplete connection.

② Checking the ignition timing

If the timing mark of the crank case mating surface (ignition timing inspection line) coincides with the timing mark of the coil plate when the throttle is fully open at (BTDC) $25^\circ(18D)$ and $22^\circ(15C/9.9C)$, then the ignition timing is correct.

CD Unit

Inspection and maintenance

- ① For inspection of the CD unit, measure the resistance value with the specified circuit tester. If the conditions fall outside the range of the items indicated on the test table, the CD unit will be judged defective.

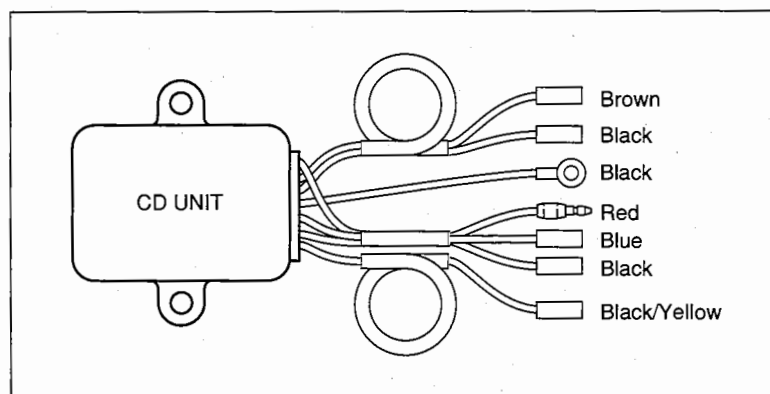
Procedure for testing CD unit:

(1) Tester used: HIOKI 3030 Range: 1k Ω range

(2) Precautions

- Use a ohms meter (battery power 3 V or less).
- Since the measurements are made through the diode, the indicated values may vary depending on the range or voltage of the tester.
- This check is only a yardstick.
- The CON display shows condenser characteristics. The pointer swings once and returns to its original position.

(3) CD unit terminals



Test check table

Tester - / +	Brown Stop	Black Stop	Black (LA106) Ground	Red Exciter	Blue Pulser	Black Ground	Black/Yellow Ignition coil
Brown Stop		OFF (∞)	OFF (∞)	OFF (∞)	OFF (∞)	OFF (∞)	OFF (∞)
Black Stop	ON (about 12k Ω)		ON (0 Ω)	ON (about 4k Ω)	OFF (∞)	ON (0 Ω)	CON
Black (LA016) Ground	ON (about 12k Ω)	ON (0 Ω)		ON (about 4k Ω)	OFF (∞)	ON (0 Ω)	CON
Red Exciter	ON (about 4k Ω)	ON (about 1M Ω)	ON (about 1M Ω)		OFF (∞)	ON (about 1M Ω)	CON
Blue Pulser	ON (about 48k Ω)	ON (about 10k Ω)	ON (about 10k Ω)	ON (about 21k Ω)		ON (about 10k Ω)	CON
Black Ground	ON (about 12k Ω)	ON (0 Ω)	ON (0 Ω)	ON (about 4k Ω)	OFF (∞)		CON
Black/Yellow Ignition coil	CON (very small)	CON (very small)	CON (very small)	CON (very small)	OFF (∞)	CON (very small)	

- Before measuring the CON display part, short the Black-Yellow wire and Black wire (LA106). LA106 refers to the ground terminal.
- The locations indicating "(very small)" in the CON display means that the deflection of the pointer is extremely small, therefore, observe the deflection carefully during measurements.

Ignition Coil

Inspection and judgement

Measure the resistance using a circuit tester and check the coil.

If the measured value differs widely from the values given below, the ignition coil is defective.

Reference resistance values:		
Primary coil	Terminal-ground of Black/Yellow wire:	0.25Ω
Secondary coil	Between high voltage wires on the #1 and #2 sides:	5.10kΩ

- DVA or peak voltage test sequences
All tests are conducted while cranking the motor over. Results are minimum readings. If minimum readings are found the part tested is marginal.
C-D unit voltage output to ignition coil test must be performed with all ignition system circuits connected and spark gap tester connected to ignition coil secondary (spark plug wires).
Adjust test meter volt setting to the appropriate setting for the part being tested.
Peak volt readings can also be taken while the engine is running.
- M-9.9-C, M-15-C, M18-D test sequences:
Exciter coil test: Red meter lead to red exciter coil lead, black meter lead to black to black coil plate lead. The result should be 130 volts minimum. (if minimum volts are seen the part is marginal)
Pulser coil test: Red meter lead to blue pulser lead, black meter lead to black coil plate lead. Result should be 3 volts minimum (if 3 volts is the result the part is marginal)
C-D unit test: Insert the red tester lead into the bullet connector of the ignition coil primary wire (black/yellow) and the result should be 130 volts minimum. (this value should not diminish)

Stop Switch

Inspection and maintenance

CAUTION

If the insulation resistance between the stop switch contacts, the incasases ignition system will be adversely affected and engine starting ability will deteriorate.

To measure the resistance between the stop switch contacts, remove the connecting wires (2-pole coupler) between the CD unit and stop switch and measure the resistance between the two poles of the coupler on the switch side.

If the insulation resistance is smaller than the above values, remove the switch, disassemble it, and clean the internal parts of the contact and switch case. Also, check for cracks due to aging of the waterproof cover. In case of cracks, replace with a new waterproof cover.

Inspection of connecting wires and contacts

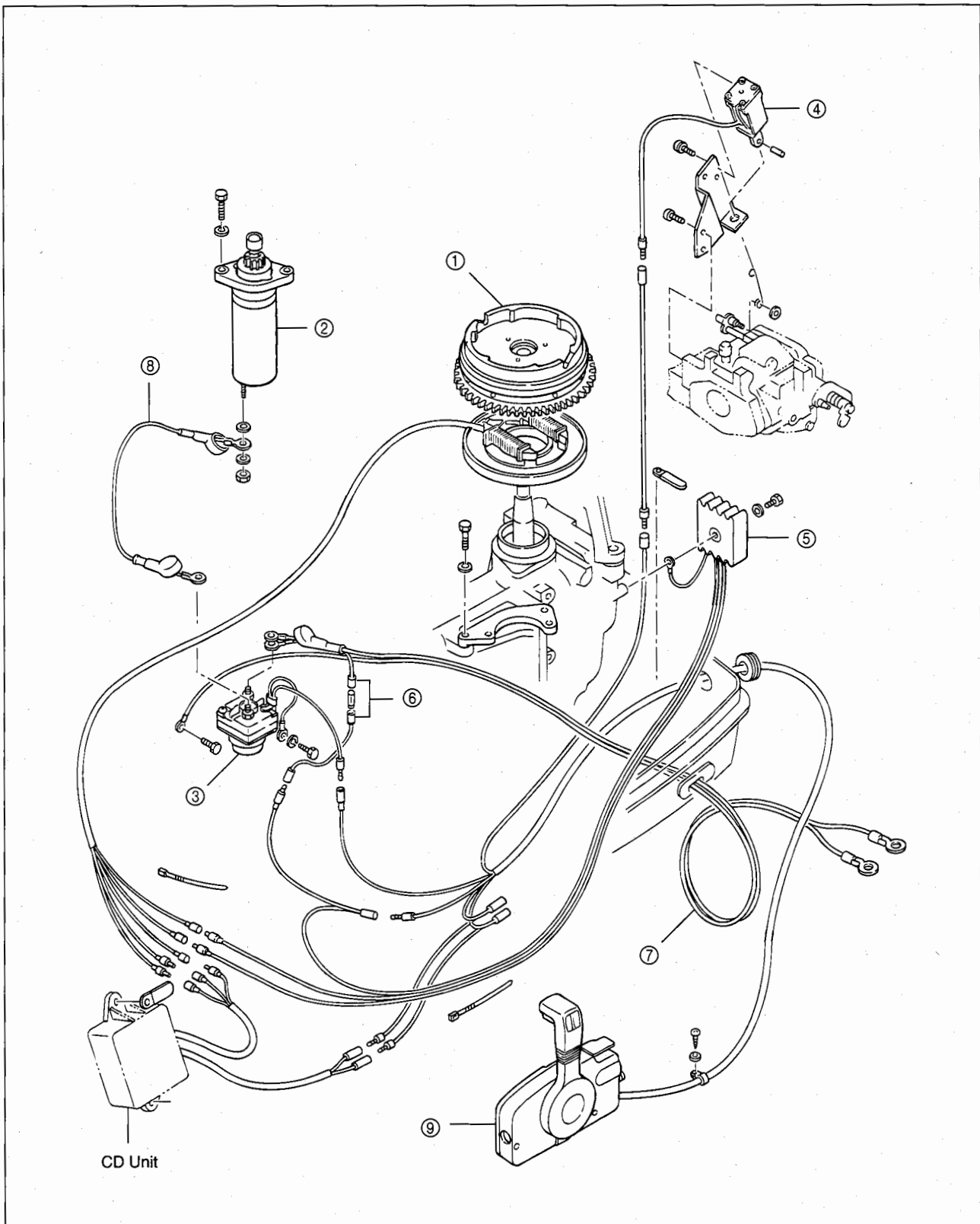
Check for looseness in the mounting bolts of coupler parts and CD unit.

Precautions in handling the CD magneto

- (1) Take special care to avoid removing the connecting wires or shorting wires of the magneto and CD unit when the engine is being operated, otherwise, the CD unit may be damaged.
- (2) Do not change the mounting positions of the CD magneto parts.
The CD unit has been installed after selecting a position that is ideal considering heat dissipation and vibrations, therefore, do not change the position.
- (3) Do not touch the spark plug or high voltage cables during engine operation.
The CD magneto should not be touched directly with your hand as both the secondary voltage and current use high voltages.
- (4) When inspecting the spark from the spark plug, always bring both spark plugs in contact with the engine unit. Bringing only one spark plug in contact with the engine unit may damage the CD unit.
- (5) Use a procedure similar to (4) when measuring the compressive pressure but remove the connector between the magneto and CD unit before the measurement.
- (6) Precautions in handling the flywheel
 - Never subject the outside surface of the flywheel to impact, such as striking it with a hammer when installing or removing the engine.
 - Use the specified tools when removing the engine.
 - Do not drop the flywheel. If it falls, do not use it.

Electric Starter

- ① Flywheel cap (with ring gear)
- ② Starter motor
- ③ Starter solenoid
- ④ Choke solenoid
- ⑤ Rectifier
- ⑥ Fuse wire assembly
- ⑦ Battery lead wire
- ⑧ Starter motor lead wire
- ⑨ Remote control box assembly

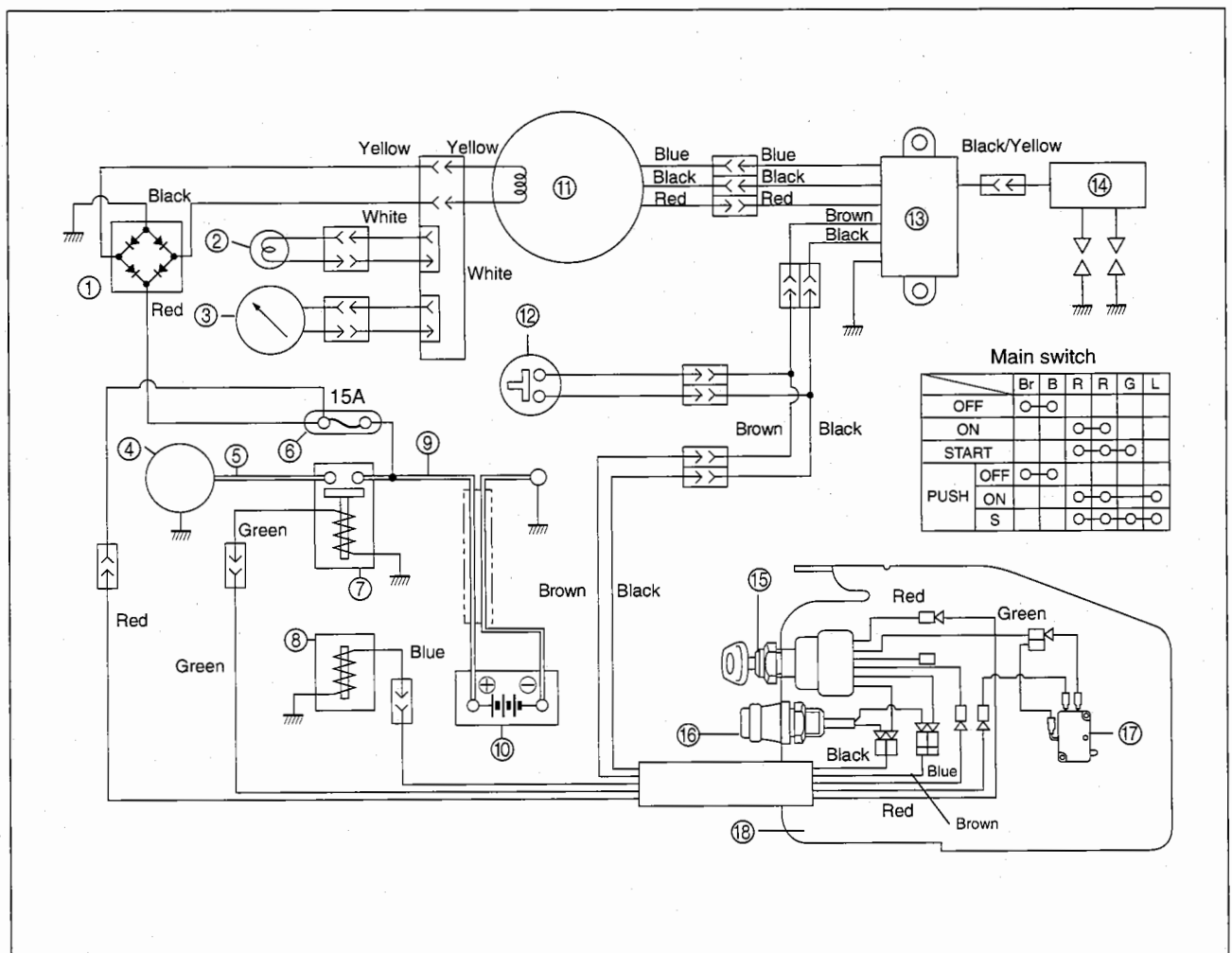


Precautions during tests and trials

1. Make sure that the battery (capacity greater than 12V-40Ah) is fully charged.
2. Connect the battery \oplus lead wire and then the battery \ominus lead wire. Fit the cap on the \oplus side.
3. Move the shift lever to "Neutral" and "Forward/Reverse," and check the action of the neutral switch. (Confirm that the starter motor does not operate when the shift lever is at a position other than "Neutral.")
4. Operate the starter 3 to 5 seconds each time you start the engine. Never operate it for a long period because this may lead to deterioration in the performance of solenoid and battery.
5. If you fit the battery on the hull, make sure that it is secured firmly and there is no chance of a fall due to vibrations when the boat is underway.
6. Make sure the lead wire does not get caught or is not subjected to chafing when operating the steering handle.

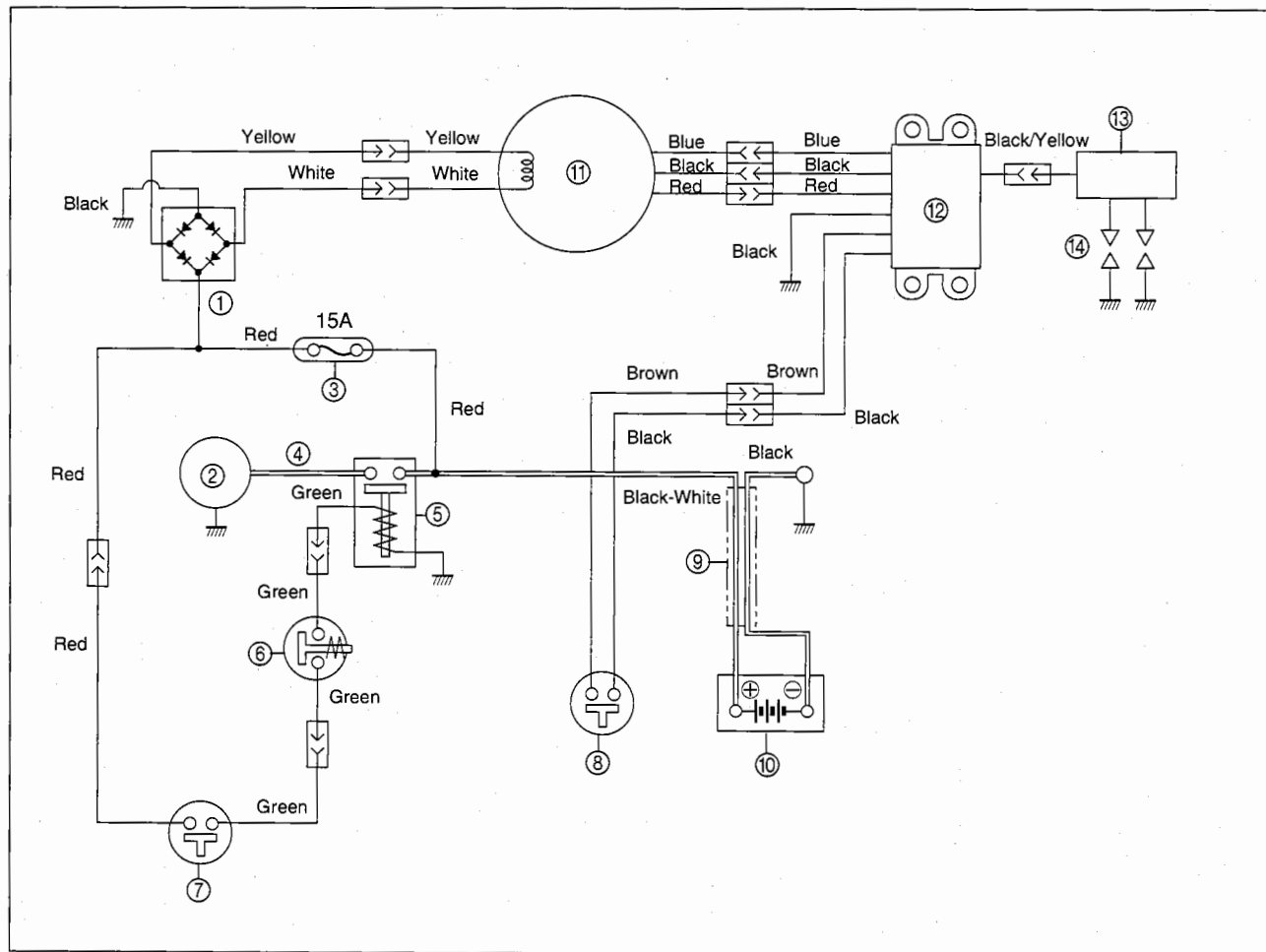
- | | |
|---------------------------|-------------------------|
| ① Rectifier | ⑩ Battery |
| ② Lamp 12V-80W (OP) | ⑪ Magneto |
| ③ Tachometer (OP) | ⑫ Stop switch |
| ④ Self-starting motor | ⑬ CD unit |
| ⑤ Starter motor lead wire | ⑭ Ignition coil |
| ⑥ Fuse | ⑮ Main switch |
| ⑦ Starter solenoid | ⑯ Stop switch with rope |
| ⑧ Choke solenoid | ⑰ Neutral switch |
| ⑨ Battery lead wires | ⑱ Remote control box |

Electric circuit (EP type)



- | | |
|---------------------------|----------------------|
| ① Rectifier | ⑧ Stop switch |
| ② Starter motor | ⑨ Battery lead wires |
| ③ Fuse | ⑩ Battery |
| ④ Starter motor lead wire | ⑪ Magneto |
| ⑤ Starter solenoid | ⑫ CD unit |
| ⑥ Neutral switch | ⑬ Ignition coil |
| ⑦ Main switch | ⑭ Spark plug |

Electric circuit (EF type)



Inspection of Parts Related to Electric Starter

Items related to starter motor (check with the shift lever at neutral position)

Predicted causes of fault	Measures
Electric starter does not rotate or rotation is slow.	
(1) Looseness or wear in battery contacts	Clean, repair
(2) Battery excessively discharged or battery life reached	Charge or replace
(3) Defective contact in main switch	Replace
(4) Defective contact of starter terminal	Repair
(5) Defective contact pressure of starter brush (Brush worn or spring defective) and dirt	Replace or clean
(6) Fault in starter solenoid	Replace
(7) Continuity defect in wire of starting circuit	Repair
(8) Grounding of field coil or armature coil	Replace
(9) Fault in neutral switch	Replace
The starter operates but the pinion does not engage with the ring gear.	
(1) Starter pinion is worn out.	Replace
(2) Fault in starter	Replace
Starter continues to operate and does not stop.	
(1) Starter switch return motion is defective.	Replace
(2) Fault in starter solenoid (Internal contacts are stuck)	Replace

Inspection after mounting or repair of starter motor accessories

- (1) Check for faults in wiring of electric circuits, couplers and clamps.
- (2) Check the mounting, liquid level and plugs of battery.
- (3) Start the starter motor and confirm that the pinion gear engages with the ring gear. (Start the starter motor after setting the shift at "neutral.")

Periodic inspection

Inspection Location	Inspection Period	Inspection Procedure
Status of engagement of pinion	Every 3 months	Operate the starter motor and check the working of switches, engagement of pinion gear, and smooth rotation of engine.
Battery	Every 3 months	① Check the amount of liquid in the battery. If the volume is close to the minimum level, remove the six caps and replenish distilled water until the upper level is reached.
	Every 3 months	② Measure the specific gravity of the battery liquid. Fully charged: 1.25 to 1.27 (20°C). Charging is required when the specific gravity is less than 1.20.
	When used	③ Battery mounting condition, cracks, damage
	Before use and every 3 months	④ Check the tightening of terminals and condition of wear. If there is wear, clean the terminals, and apply grease or vaseline on the terminal after cleaning.
Wire harness	When used	① Check for looseness of clamps and damage. ② Check for looseness of coupler.

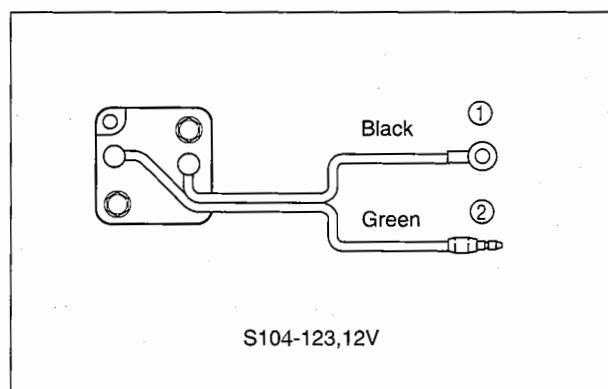
WARNING: Never charge the battery while connected to motor.
Never charge the battery while in the boat.

Inspection and maintenance

1. Starting system

If the main switch key is rotated to the START position, (press the working main switch knob), current flows through the battery and main switch to the starter solenoid. The iron core is magnetized because of the current, and the armature adheres to the iron core, and the terminals of the solenoid on the motor side and the battery side become connected. This results in high amperage flowing directly from the battery to the starter motor through the solenoid, which rotates the motor.

Inspection Location	Inspection Item	Maintenance Item	Standard Value and Measures	
Starter motor	(1) Check the height of the brush.	Brush height	7.5mm	Replace if brush height is less than 4.5mm.
	(2) Confirm whether the brush slides into the holder easily.			
	(3) Pressure of brush spring (measure the instantaneous load when the brush spring separates from the brush, using a spring balance)	Pressure on brush spring	0.5kg	
	(4) Wear in commutator	Commutator diameter	20mm	19.7mm or less.
Starter solenoid	(1) Check for coil disconnection. (2) Check the insulation between starter and battery terminals. (3) Check for burn-out of armature and continuity defects.			



Check the starter solenoid

Measure the resistance between ① and ② of the starter solenoid. (Tester - X1Ω) If the value indicated on the tester is 3Ω, the starter solenoid is normal. If the pointer swings excessively or does not swing at all, the starter solenoid is defective.

2. Battery

Inspection Item	Maintenance Standards	Measures
Specific gravity of each battery	Standard value : 1.260 (20°C) Correction limit : 1.200 (20°C)	Charge the battery if the specific gravity is below the limit.

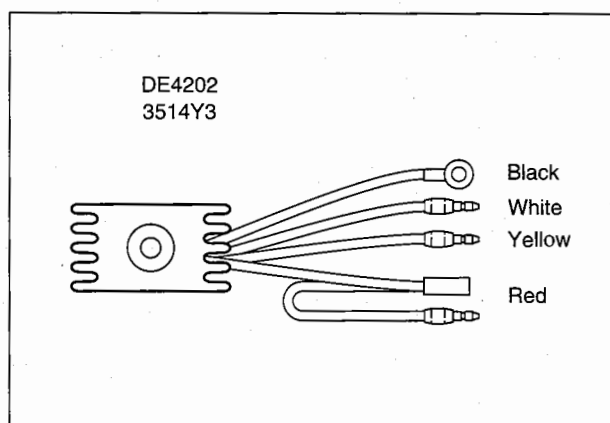
CAUTION

The specific gravity of a battery at 20°C is taken as the standard value. The conversion is given by the following equation:

$$\text{Converted specific gravity (20°C)} = \text{Measured specific gravity} + (\text{Measured temperature} - 20) \times 0.0007$$

3. Rectifier and fuse

Part Name	Inspection Item	Measures
Rectifier	Continuity and insulation	Replace in case of a fault.
Fuse	Check whether the fuse has blown. (Visual check or tester)	Replace if defective.



Complete check of rectifier (361-76060-0)

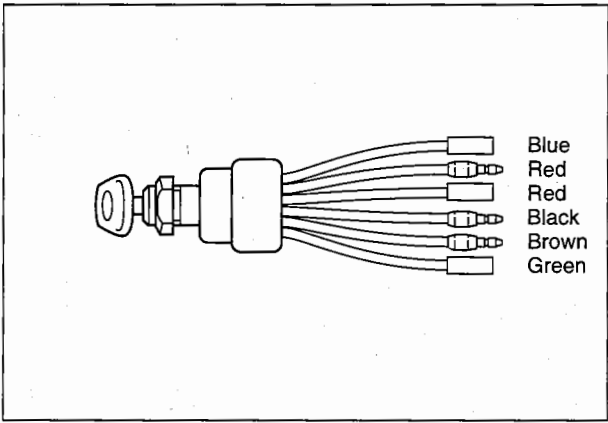
Continuity check

Check continuity between terminals. If the condition is as shown in the table below, the rectifier is normal.

	Red	B	R	W	Y
Black					
B			ON	ON	ON
R		OFF		OFF	OFF
W		OFF	ON		OFF
Y		OFF	ON	OFF	

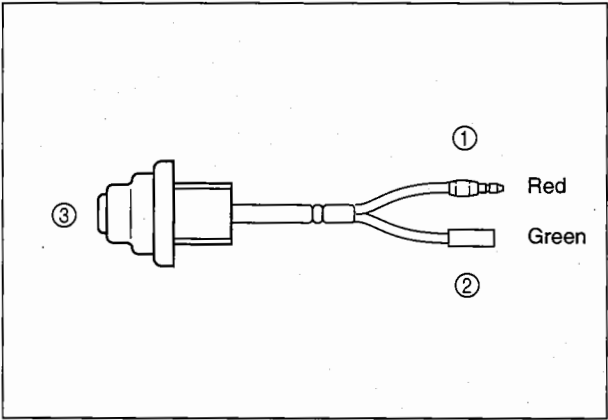
4. Main switch, choke solenoid, neutral switch and wire harness

Part Name	Inspection Item	Measures
Main switch (Type EP, EF)	Continuity and insulation	Replace in case of a fault.
Choke solenoid	Test the operation	Replace in case of a fault.
Neutral switch for industrial use	Continuity and insulation	Replace in case of a fault.
Wire harness	Damage to sheathing	Replace or repair (insulation) if necessary. Cover damaged part with tape.



Main switch (Type EP) check

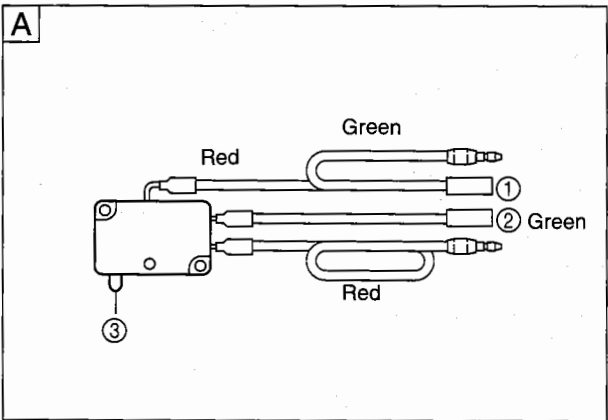
Key position	Color	Brown	Black	Red	Red	Green	Blue
	OFF						
PUSH	ON						
	START						
	OFF						
PUSH	ON						
	START						



Main switch (Type EF) check

Check continuity between ① and ② using a tester. If there is no continuity, then the main switch is normal.

After checking for continuity between ① and ②, press ③. If there is continuity, the switch is normal.

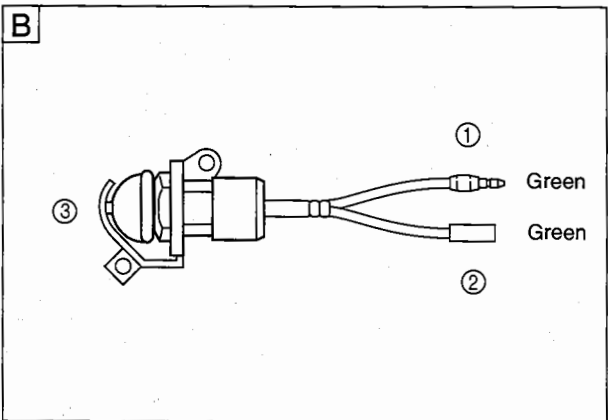


Neutral switch check

- A Type EP
- B Type EF

Check continuity between ① and ② using a tester. If there is no continuity, the switch is normal.

After checking for continuity between ① and ②, press ③. If there is continuity, the switch is normal.

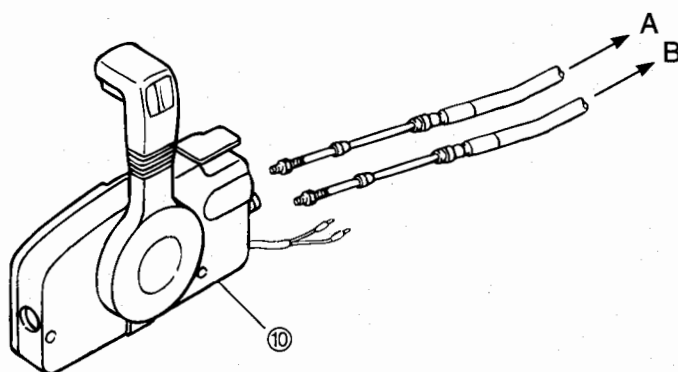
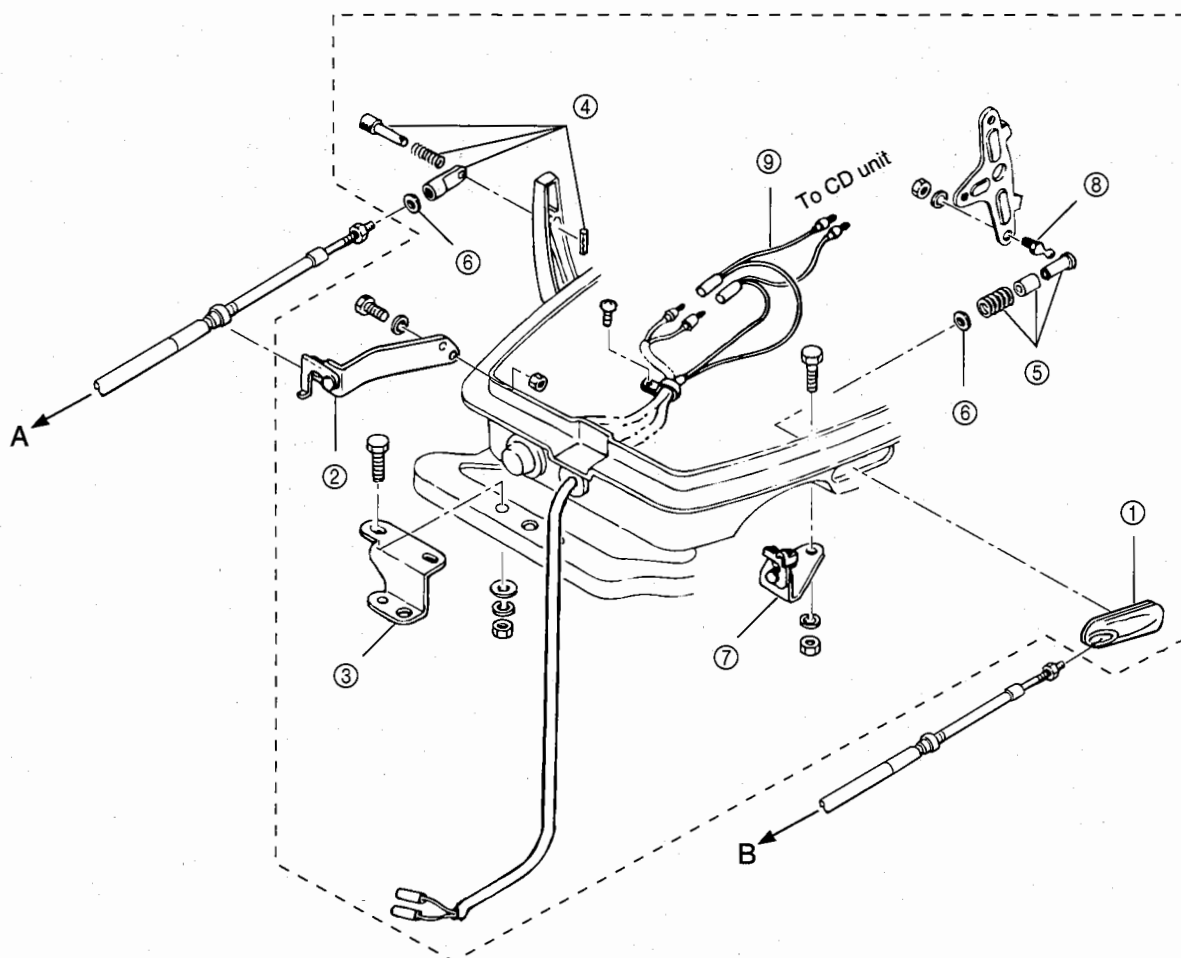


CHAPTER 7

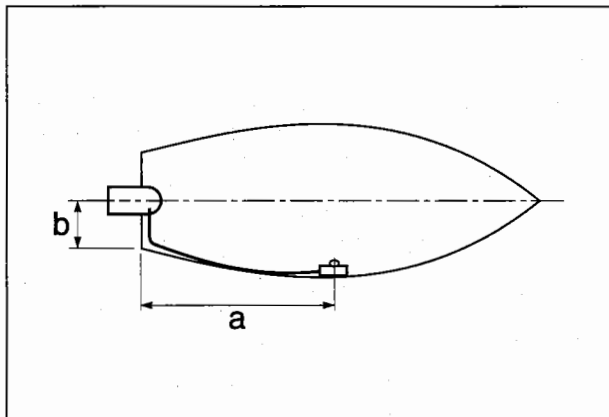
REMOTE CONTROL

Engine side mounting kit for remote control

- ① Throttle cable grommet
- ② Shift cable clip assembly
- ③ Steering hook plate
- ④ Sleeve B guide assembly
- ⑤ Holder cap assembly
- ⑥ Washer
- ⑦ Cable clip assembly
- ⑧ Ball joint
- * ⑨ Remote control stop lead wire
- * ⑩ Remote control box assembly
- *: Manual type (Option)



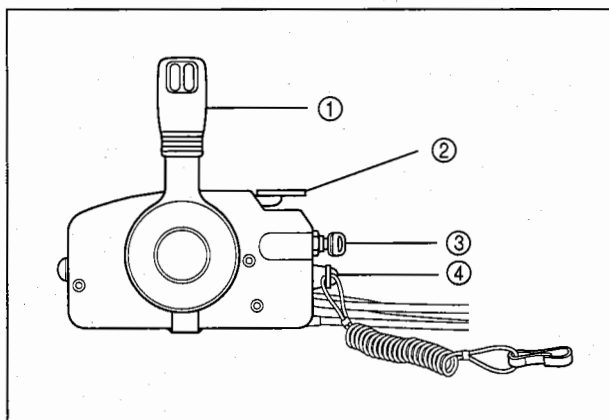
Remote Control



The cable assembly, the main switch, and the stop switch assembly are already installed in the remote control box of Type EP remote control. Measure the required length considering the length required for mounting the remote control box and the swing of the engine, and arrange for a remote control cable that suits the hull on which it is to be fitted.

Measurement reference for remote control cable length: $a+b$

For the manual type, arrange for parts on the engine side required for the remote control in addition to the remote control box. (Refer to Page 7-4 Engine side mounting tools for remote control.)



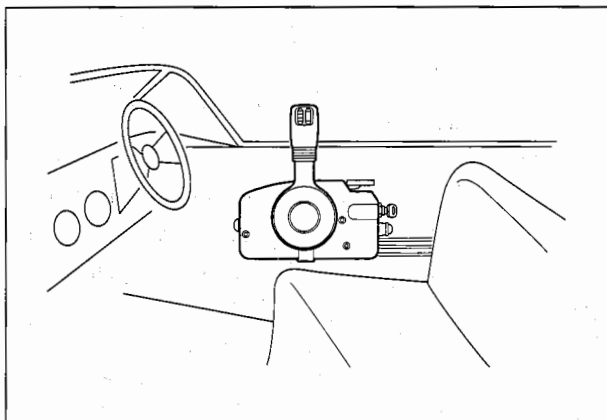
EP Type

- ① Control lever
- ② Free accelerator cable
- ③ Main switch
- ④ Stop switch

Installation of remote control cables

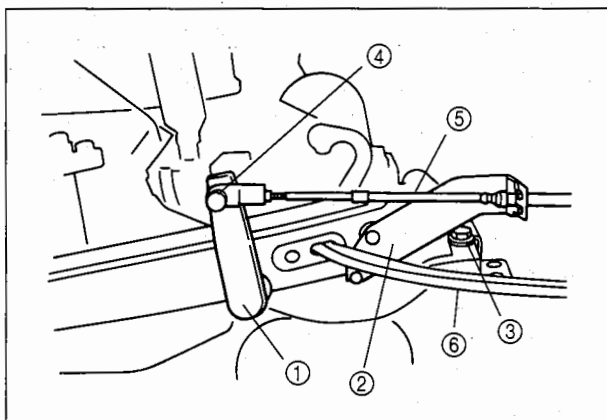
The remote control cables are to be installed in the remote control box. For details, please refer to the remote control instruction manuals. However, take the following precautions when installing the cables:

1. Arrange for two cables, one for the gear shift and one for the throttle. Cables of lengths from 7 feet up to a maximum of 30 feet at intervals of 1 foot are available.
2. When fitting the terminal eye to the end of the cable, make sure that a screw-in length of more than 11 mm is available in the terminal eye, and then secure it firmly using a lock nut. Apply the specified grease on the terminal eye.
3. Remove the rear panel of the remote control box. Insert the groove on the outer cable in the mouth of the remote control box, insert the shift cable in the shift arm (arm that does not move even if the free accelerator cable is operated), the throttle cable in the throttle arm and secure these cables with the E ring. Insert the supplied grommet in the outer cable groove between the shift cable and the throttle cable.



Control box installation (driver's side)

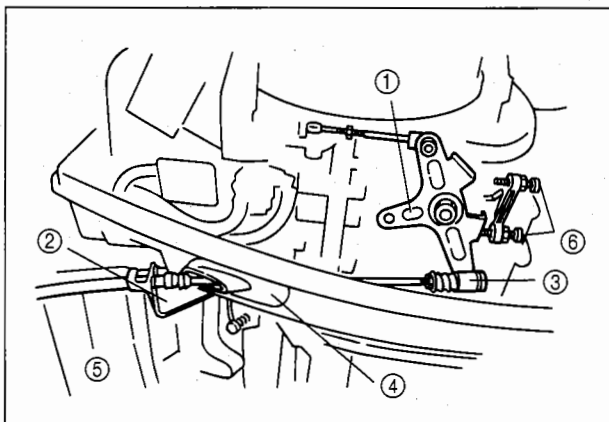
1. Install the remote control box to the right of the driver's seat.
2. Install the box using the supplied screws and nuts so that the control lever can be operated without hitting the boat.
3. Secure the remote control firmly to the hull so that bends are minimum.



Installation of remote control cables at engine

- ① Gear shift lever
- ② Clutch cable clip assembly
- ③ Steering hook plate
- ④ Sleeve B guide assembly
- ⑤ Shift side remote control cable
- ⑥ Battery lead wire

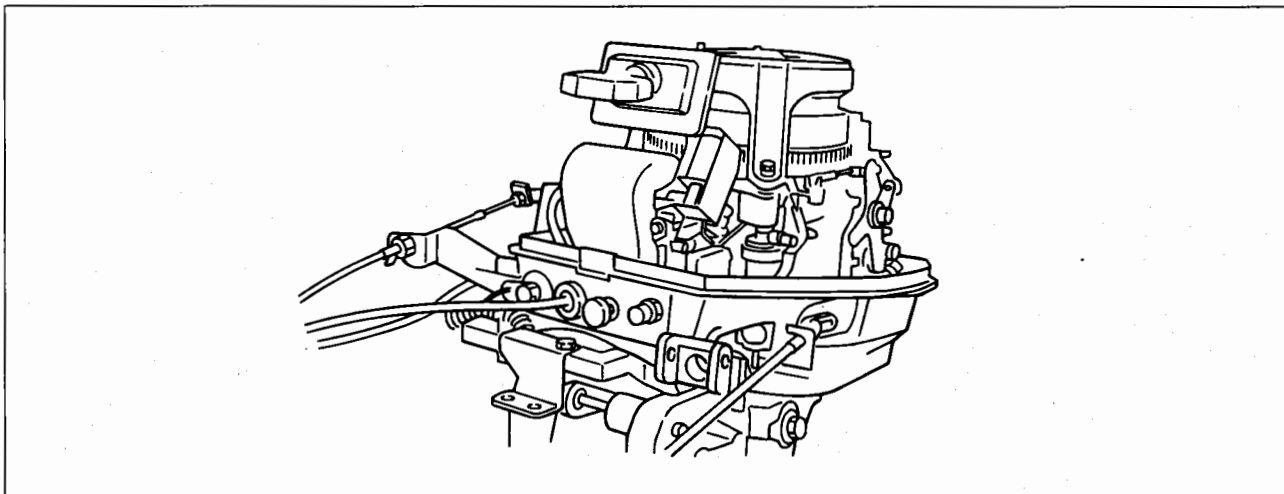
1. Install the attaching kit parts on the engine for remote control box cable connections. Remove the link rod (5-65L) of the advancer arm and fit the ball joint at the lower part of the advancer arm. Apply Three Bond 1373 on the threaded part of the ball joint.
2. Secure the throttle cable clip assembly at the left bottom side of the lower motor cover and the gear shift lever clip on the right side using bolts.
3. Fit the sleeve B guide assembly to the remote control cable on the shift side and secure it using a nut.
4. Insert the sleeve B guide lock pin in the gear shift lever mounting hole, and rotate it by 90° to lock it. Insert the grooved part of the outer cable in the shift cable clip and secure it.



- ① Advancer arm
- ② Cable clip assembly
- ③ Holder cap assembly
- ④ Grommet throttle cable
- ⑤ Throttle cable
- ⑥ Throttle stop screw

5. After inserting the cable grommet in the remote control cable on the throttle side, fit the holder cap assembly and secure it with the nut.
 - To distinguish throttle side and shift side of the remote control cables, set the control lever at N (Neutral) and operate the free accelerator lever. The side where the inner cable is pulled up, is the throttle side.
6. Insert the throttle side cable through the left side of the lower motor cover, and fit the holder cap at the front end of the cable to the ball joint. After inserting the grooved part of the outer cable in the cable clip assembly and fitting the clip, install the grommet on the lower motor cover.
7. Adjust by screwing the sleeve B and holder cap so that the throttle is at the fully closed position when the control lever is at position N.

Remote control installed



CHAPTER 8

**INSPECTIONS,
ADJUSTMENTS AND TRIALS**

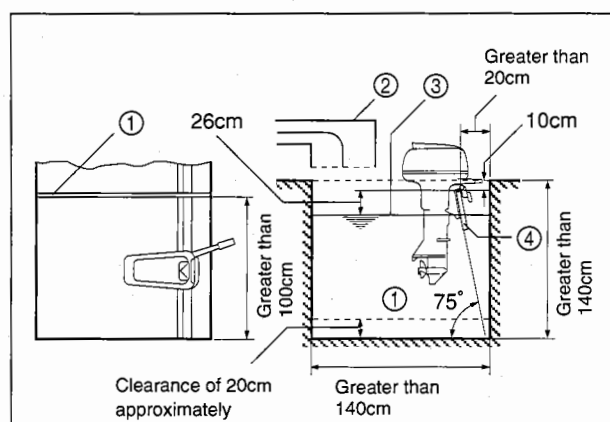
The propeller has the role of supplying the force to propel the boat. There are various types of propellers for different applications.

	Name	10	9	8.5	8	7	6
	Dimensions Number of blades×D×P	3×234×250	3×234×231	3×234×224	3×234×199	3×234×174	3×234×155
18D	Specifications	For light loads Optional	Standard propeller for S transom	Standard propeller for L/LL transom	Standard propeller for UL transom	For heavy loads (Optional)	For specially heavy loads (Optional)
15C	Specifications	For light loads Optional	For light loads Optional	Standard propeller for S transom	Standard propeller for L/LL transom	Standard propeller for UL transom	For heavy loads (Optional)
9.9C	Specifications	For light loads Optional	For light loads Optional	Standard propeller for S transom	Standard propeller for L/LL transom	Standard propeller for UL transom	For heavy loads (Optional)

Note: This table is given only for guidance. Always select a propeller for the specified range of engine rpm and speeds.

Testing tank and Dynamometer

Dynamometer has been manufactured with the aim of checking adjustments and operation of new outboard motors after breaking-in and readjustments of the outboard motors.



Conditions and precautions for testing tank

- ① Partition plate ----- for testing two outboard motors in tank
- ② Ventilation duct
- ③ Water level
- ④ Transom board

- Maintain the minimum dimensions of the tank shown in the figure.
- If more than two outboard motors are installed in the tank, secure the partition plate so that the minimum dimensions shown in the figure for each outboard motor are maintained.

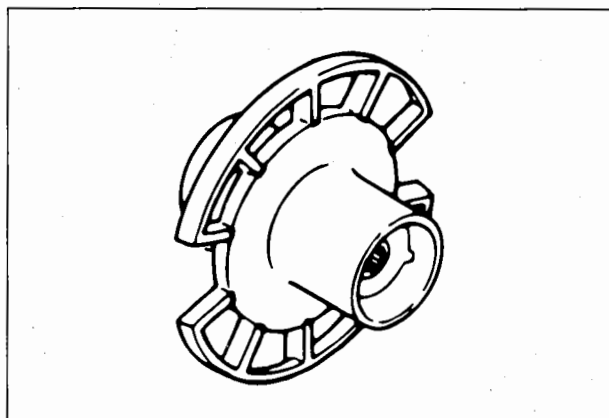
- Continuous usage raises the temperature of water in the tank and may lead to seizure of the engine. Therefore, make sure the temperature in the tank does not exceed 25°C. If possible, cooling equipment or overflow device may be installed.
- If water in the tank has become dirty after testing many motors, and the same water is used, the carbon in the water may adhere to the cooling system of the outboard motor and degrade the cooling ability, therefore, always use clean and fresh water.
- Continuous usage causes exhaust gases to collect around the outboard motor, which may suck air containing exhaust gases into the carburetor. This may stop its operation, therefore, install forced ventilation equipment to remove exhaust gases and always maintain the area around the outboard motor in a well-ventilated condition with no accumulation of exhaust gases.
- Since water may splash out during the tests, maintain the heights of water tank and water level shown in the figure.

Adjustments and operational checks of outboard motor

- When the handle grip is opened fully while running in the tank mentioned in the previous section, and if the engine rotating speed is greater than the value shown in the table, regardless of the transom length, attainment of the specified output is confirmed.

However, the output is determined at standard conditions of temperature and pressure (20°C, 760mmHg, humidity 65%), and varies depending on these conditions, therefore, the values are to be taken only for guidance.

Use a tachometer with good accuracy for measuring the rpm.



Model	Diameter (mm)	Breadth (mm)	Speed of rotation (rpm)
18D	180	12	5300
15C	180	12	5000
9.9C	180	12	4500

- Perform idling adjustments of the engine with the clutch at "Neutral." This is because the resistance of the Dynamometer and propeller varies, and the water level of the tank remains constant, regardless of the length of the transom.

Inspections and Adjustments After Final Assembly

After assembling the engine and lower unit, inspect the following items:

☐ Items to be checked before tests and trials

- Status of pipes in the fuel system
- Clutch adjustments
- Status of electric wiring, connections and clamps
- Engagement and operation of reverse lock

☐ Items to be checked during tests and trials

Start the engine and check the following items during idle running:

- Fuel leaks from mating surfaces of crankcase
- Fuel leaks from mounting surface of intake manifold
- Cooling water leaks from mating surfaces of cylinder head
- Cooling water leaks from engine mounting surfaces
- Cooling water leaks from exhaust cover mounting surfaces
- Abnormal noise
- Rpm and stability during idling operation (Clutch-in 600 to 700rpm)
- Operation of stop switch
- Clutch operation
- Status of engine rotation at acceleration/deceleration
- Cooling water discharge status (Cooling water is being discharged from the inspection hole and drain hole)

☐ Tightening after tests and trials

Always tighten with the specified torque (Refer to Table of tightening torques in the chapter on disassembly and maintenance).

☐ Running-in

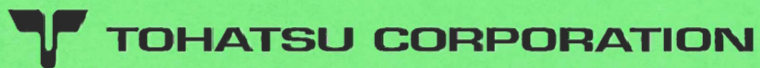
After replacing piston, piston ring, piston pin, crankshaft, cylinder or bevel gear bearing parts, perform running-in of the replaced part to ensure perfect fit of the mating surfaces.

CAUTION

- Ratio of gasoline and specified engine oil is 20 : 1 (during replacement of engine parts)
- Operating time: More than 10 hours
- Speed of rotation: Do not open the throttle fully immediately after starting the engine. First run at low speed and medium speed.

Troubleshooting

	Defective engine start	Engine starts but stops immediately	Idling Speed incorrect	Poor acceleration	Engine rpm excessively low	Engine rpm excessively high	Speed is low	Engine is overheated	Predicted causes
Fuel system	<input type="radio"/>	<input type="radio"/>							Fuel tank is empty
	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>		<input type="radio"/>	<input type="radio"/>	Fuel system connections are incomplete
	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>		<input type="radio"/>	<input type="radio"/>	Air is sucked into the fuel system
	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>		<input type="radio"/>	<input type="radio"/>	Twist in the fuel pipe
	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>		<input type="radio"/>	<input type="radio"/>	Fuel tank cap vent or cock is closed
	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>		<input type="radio"/>	<input type="radio"/>	Dirt accumulation in fuel filter, fuel pump or carburetor
	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>		<input type="radio"/>		Excessive oil during mixing
	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>		<input type="radio"/>	<input type="radio"/>	Carburetor adjustments are defective
	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>			<input type="radio"/>	<input type="radio"/>	Lubrication tube is cut or damaged
	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>					Check valve operation is defective
	<input type="radio"/>		<input type="radio"/>	<input type="radio"/>			<input type="radio"/>	<input type="radio"/>	Poor quality gasoline has been used
	<input type="radio"/>			<input type="radio"/>					Excessive fuel intake
			<input type="radio"/>	<input type="radio"/>	<input type="radio"/>		<input type="radio"/>	<input type="radio"/>	Poor quality engine oil has been used
								<input type="radio"/>	Insufficient oil during mixing
Electrical system	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>		<input type="radio"/>	<input type="radio"/>	Spark plug other than specified spark plug (B7HS10) used
	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>		<input type="radio"/>		Dirt or bridging of spark plug
	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>		<input type="radio"/>		No spark or weak spark generated
	<input type="radio"/>		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>		<input type="radio"/>		Defective adjustment of throttle link mechanism
	<input type="radio"/>		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>		<input type="radio"/>		Defective adjustment of ignition timing
	<input type="radio"/>								Shorting of engine stop switch
Others				<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Propeller selection is inappropriate
			<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Damage, deformation or slip of propeller
				<input type="radio"/>		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Thrust rod position is incorrect
				<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Unbalance in loading position
				<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Transom is too high or too low
						<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Cooling water does not rise or insufficient
			<input type="radio"/>			<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Thermostat is defective
				<input type="radio"/>		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Cavitation



TOHATSU CORPORATION

Address: 4-9, 3-chome, Azusawa, Itabashi-ku, TOKYO 174, Japan

Cable: "TOHATSU TOKYO"

Facsimile: TOKYO (03) 3969-7885

Phone: TOKYO (03) 3966-3117

Printed in Japan
95.01.CR200