TOHATSU OUTBOARD MOTOR

M90A

SERVICE MANUAL

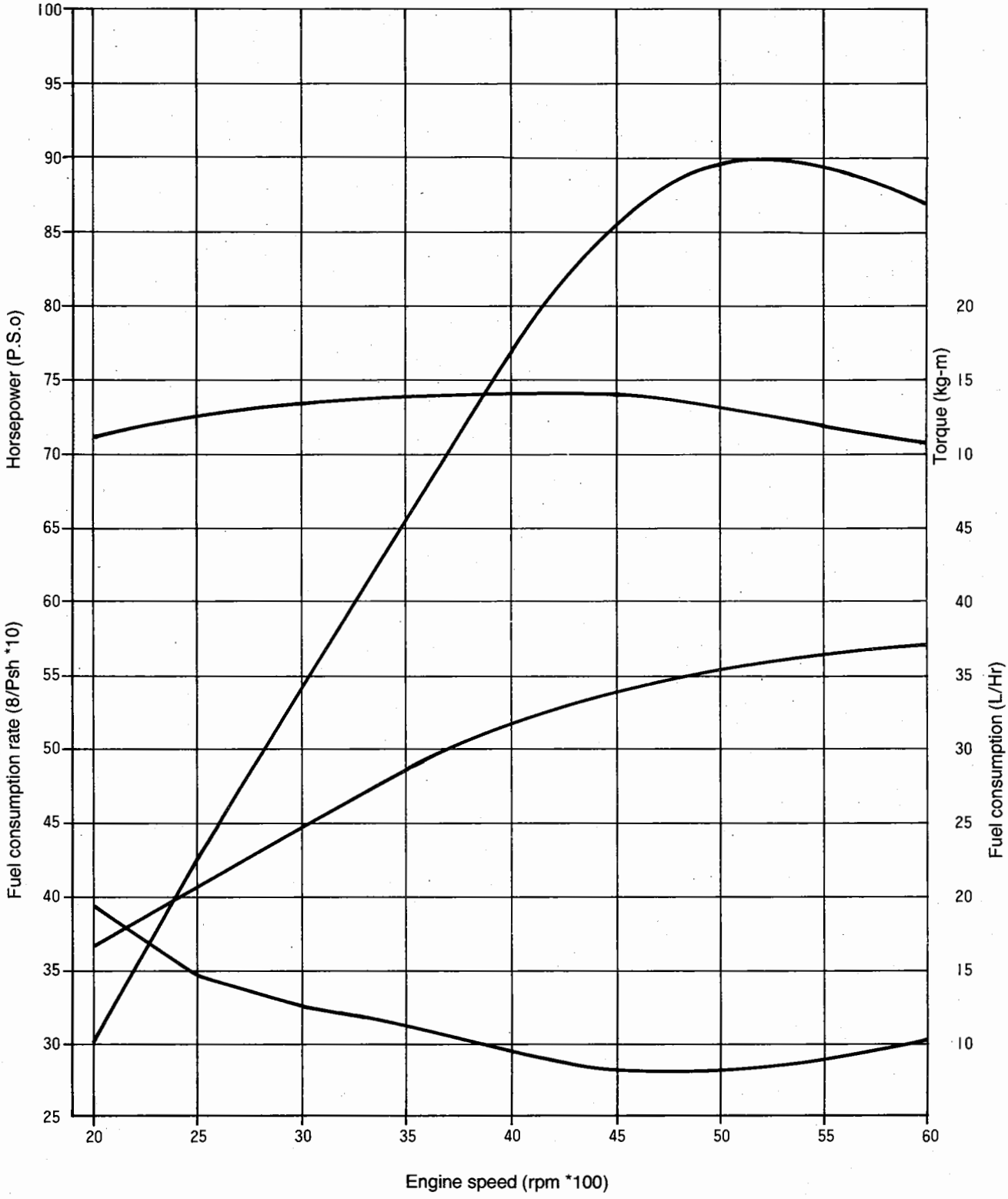
TABLE OF CONTENTS

1 SPECIFICATIONS

Name			M90A
Model			3B7
Dimensions		(mm)	Total length~Approx. 690 (27.1") Total width — Approx. 360 (14.1") Total height L — Approx. 1,435 (56.5") UL — Approx. 1,562 (61.5")
Outboard motor transom		(mm)	L: 517 (20.9") UL: 644 (25.3")
Weight		(kg)	L: Approx. 125 (275.6 lbs) UL: Approx. 127.5 (281 lbs)
Perform-ance:	Max. output	(PS)	90
	Full speed operation range	(rpm)	5,000~5,500
	Fuel oil consumption at full throttle	(L/Hr)	Approx. 36
Engine:	Cylinders		3
	Bore × stroke	(mm)	86 × 72.7
	Exhaust	(cc)	1,267
	Lubrication		Auto mixing or mixing
	Fuel		Unleaded gasoline, regular gasoline with 88 (A.K.I.) or over is recommended for easy starting and long life.
	Engine oil		Tohatsu Genuine 2-cycle Engine Oil Gold
	Mixing ratio		Auto mixing model: 50:1~120:1
			Hand mixing model: 50 : 1 (NOTE: After break-in running)
	Oil tank		Integral tank (capacity approx. 3.5L)
	Cooling		Forced cooling water (rubber impeller rotation)
	Cooling water temperature control		Thermostat (w/ pressure relief valve)
	Intake		Lead valve
	Exhaust		5-port Schnüle
	Starting		Electric starter (12V 1.0kW) and rope
	Ignition		Contact point less CD ignition magneto
	Alternator		12V 11A (12V 130W)
	Rectifier		Single phase full wave rectification w/ voltage regulator
	Spark plug		NGK B8HS-10 or Champion L78C10 (1mm gap)
	Carburetor		3-series
	Direction of engine revolution		Clockwise
	Ignition timing		ATDC5°~BTDC20°
	Trolling rpm		550~750
Lower unit	Tilt stages		5 (8°~24°)
	Tilt up angle		Approx. 76°
	Max. steering angle		Approx. 65° With drag link~Approx. 60°
	PTT assembly		Manifold type, 3 cylinders
	Shifting		Dog clutch (F-N-R)
	Gear ratio		13:26
	Exhaust		Through hub

Name		M90A
Others	Operation	Remote control Bar handle (EF model)
	Fuel tank (L)	24
	Standard propeller	L UL : A17
	Tachometer	Poles~4, 6, 12 switching type (M90A~6 poles) (EPTO model w/engine oil warning lamp)
	Trim meter	Standard on EPT model
	Remote control box	Modified RC3A : warning buzzer (engine oil, overheat, cooling water pressure) : neutral lock : neutral switch : safety switch : lever load adjuster : accessary terminal
	Safety functions:	High speed ESG (over-running prevention device) Low speed ESG Engine oil sensor (EPTO model) Overheating sensor Cooling water pressure sensor Shock absorber type PTT assembly w/ return function
Optional Parts	Propeller (no. blades × diameter × pitch, in inches):	A11 (3 × 14 × 9.4) A13 (3 × 13.6 × 12.4) A15 (3 × 13.5 × 14.6) A17 (3 × 13.5 × 15.7) A19 (3 × 12.9 × 17.6) A21 (3 × 12.6 × 19.9)
	Hour meter, fuel meter	
	Speedometer	50 MPH, 70 MPH
	Water pressure meter	
	Water temperature meter	
	Tachometer	4-, 6-, 12-pole switching w/ or w/o warning lamp
	Voltmeter	
	Drive cleaner kit	
	Tie-bar fit for two motor linkage	
	Twin control box	

M90A Engine Performance Curves



2 FEATURES

① 3-cylinder engine with extremely good balance makes for smooth running with low vibration and noise.

② Powerful engine as it is set for the maximum exhaust for a 90-horsepower class 3-cylinder outboard motor.
The engine's high speed performance is excellent, and there is high torque even for medium and low speeds, so acceleration is good and little decrease in speed even with heavy loads.

③ Tohatsu's original loop charge 5-port exhaust, the fine tuning of the exhaust system, a gear case with little hydrodynamic resistance, and the efficient propeller make for ultra low fuel consumption despite the highoutput.

④ The shape of the combustion chamber, the full recirculation system which also serves for lubrication, the high performance CD ignition with high energy even at low speeds, the exhaust bypass;, and the 3-seriescarburetor make stable slow operation over extended periods of time possible. The starting acceleration after slow operation is also fast and response is excellent.

⑤ The 2-cycle water cooled 3-cylinder engine which is extremely silent to begin with has a thorough noise-prevention structure so there is little noise both inside and outside the boat.

⑥ The rubber hardened barrel type vibration prevention rubber with an optimum shape has been arranged in the ideal position to thoroughly absorb vibration from low speeds through high speeds.

⑦ With the oil injection model, there is no need to take the trouble to mix oil to the gasoline.
The mixing ratio changes automatically depending on the requirements of the engine, whether in low speeds or high speeds, so oil consumption is low, increasing economy. The oil tank is handily located in the outboard motor, so supplying oil is easy. There is also a double lid consisting of a filler lid and tank cap, thereby preventing water or dirt from entering the oil tank. If any foreign substance should enterthe oil tank, there is a visible type large filter to prevent it from entering the oil pump or engine, thereby further increasing safety.
The oil tank has the maximum capacity for this class, so with the low fuel consumption operation is possible over long periods of time.

⑧ The power trim and tilt are joined together to form a single unit, so handling is extremely simple.
The manifold type 3-cylinder PTT assembly makes it possible to achieve the appropriate trim speed and fine trim adjustment is possible so the power of the outboard motor is used at its highest performance. The tilt up speed is fast and operability is excellent. This unit has a large capacity so running in shallow waters is easy, and there is a shock absorbing mechanism for reducing the shock should the gear case hit anything. After a shock is absorbed, an internal free piston is used to return automatically to the previous trim position. The trim meter is a standard on the PT model.

⑨ The drive shaft, propeller shaft, and bevel gear driving system has been given sufficient strength so that a stainless steel propeller can be used, so endurance is excellent.

⑩ There is a complete set of safety devices, including a neutral switch, safety switch, ESG (over-running prevention device), overheating buzzer, plus a water pressure sensor (buzzer) for warning in real timeshould the cooling water inlet be obstructed by plastic sheets, etc., and an oil level sensor (lamp and buzzer) for informing you when oil should be supplied. Furthermore, the low speed ESG in the ignition unit is automatically activated when the overheating sensor or water pressure sensor is activated, reducing the engine speed to approximately 3,2000 rpms, thereby protecting the engine.

3 CAUTIONS ON DISASSEMBLY AND ASSEMBLY

① Install the outboard motor securely on a work stand for repairs.
② Be careful not to damage the painted surfaces or the parting face of the cylinders and crank cases, etc.
③ After disassembly, replace the packing, gaskets, "O" rings, oil seals, spring pins, split pins and carburetor lock plates with new ones.
Replace deformed snap rings.
④ Always replace parts with Tohatsu Genuine parts, and use Tohatsu Genuine gear oil.
⑤ Use the proper special tools when necessary and perform operations appropriately.
⑥ Pay attention to the marks on the parts when disassembling, and give simple indications for non-marked parts to make assembly easier.
⑦ Clean disassembled parts and inspect for wear or damage.
⑧ When assembling, pay careful attention to details such as the fit of parts, centering precision, airtightness, obstruction of holes for supplying hole and grease, packing, wiring, and piping.
For parts in which many nuts and bolts are used, tighten the nuts and bolts at opposite angles uniformly, starting from those with larger diameters and ending with those with smaller diameters, from the inside to the outside to avoid looseness.
⑨ When inserting oil seals, be careful not to damage the lip and make sure the seal is in the proper direction.
Apply the specified grease to the lips.
⑩ When applying liquid packing material, be careful to use the proper thickness and quantity.
If the quantity is too high, the excess may come out or get into the case and cause adverse effects.
Read the directions carefully before using adhesives.

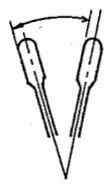
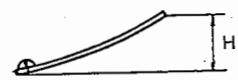
4 SERVICE DATA

(1) Standard Values

Part		Item	Standard Value, Type, Number, etc.
Engine	Piston	Max. diameter (external diameter measured 10mm above the lower edge of the piston skirt)	85.93±0.01 mm
		Piston clearance	0.08~0.13 mm
	Piston ring	Ring gap (top, second, and third)	0.25~0.40 mm
	Crank shaft	Deflection	Within 0.03mm with both ends supported
	Lead valve	Lift height	10.0~10.2 mm
	Connecting rod	Side gap of small end	0.2~0.55 mm
	Engine block	Compression pressure Measure after warming operation with throttle fully open Remove the three spark plugs	Approx. 8.2 kg/cm^2 (2799 lb/ft^2)
Fuel	Carburetor	Setting mark	M90AA
		Venturi diameter	30 mm
		Main jet (MJ)	#150
		Main air jet (MAJ)	#175
		Main nozzle (MN)	3.6 mm
		Slow jet (SJ)	#75
		Slow air jet (SAJ)	#80
		Pilot screw (P.S)	1 1/2 ±1/4 rotation return
		Float valve seat diameter	1.6 mm
		Oil surface (gauge: measure float center)	19.5±1.5 mm
		Air vent	Outer
		Choke valve leak hole (diameter)	Upper~6mm, center~3mm, lower~3mm
		Trolling rotation speed	550~750rpm
Cooling	Thermostat	Temperature control	Wax type w/ PRV (pressure relief valve)
		Valve operating start temperature	60°C
		Valve fully open temperature	70°C or greater
Driving	Bevel gear	Backlash (dial gauge reading)	0.08~0.16 mm (0.24~0.48 mm)

Part		Item	Standard Value, Type, Number, etc.
Electrical parts	Magneto	Ignition	CD ignition
		Ignition timing	ATDC5°±1° BTDC20°±1° (mechanical)
		Piston speed per second	2.67±0.27 mm (at BTDC20° ±1°)
		Spark performance	10mm or greater at 500 rpm (measured with Tohatsu Genuine spark tester)
		Spark plug	NGK B8HS10 CHAMPION L-78 (1mm gap)
		Plug gap	0.9~1.0 mm
		Lighting output	12V 130W
		Charging performance	3A or greater at 1,500 rpm 10±1A/5,500 rpm
		Lighting coil resistance	0.24±20%Ω
		Pulser coil resistance	196±15%Ω (between white/red, white/black, white/yellow-black)
		Charge coil resistance	205±15%Ω (between white/yellow~white/green)
		High speed ESG working revolution	5,900±250 rpm
		Low speed ESG working revolution	3,500±400 rpm
	Ignition coil	Primary coil resistance	0.22Ω±15% (between black/white-black)
		Secondary coil resistance	4.2kΩ±15% (between high voltage cord-black)
	Starter motor	Battery	12V—70AH
		Output	1.0 kW
		Clutch	Over-running clutch
		Brush length (wear limit)	14~15 mm (12 mm)
		Commutator undercut (wear limit)	0.5~0.8 mm (0.2 mm)
		Commutator external dimension (wear limit)	33 mm (32 mm)
	Rectifier	Conductive	One-direction only
	Fuse	Capacity	20A
	Water pressure sensor	Working water pressure	Switch off at 0.1 ±0.02kg/cm^2 or greater

(2) Repair Limits

Part	Repair Item	Repair Limits	correction Procedures/Precision
Spark Plug	Plug gap	1.2mm or greater	0.9~1.0mm (replace if electrode wear is extreme)
Water pressure sensor	Working water level	Cases other than when switch turns off at 0.1 ±0.01 kg/cm^2 when in pressurized state from pressure 0 (set pressure differs at depressurized state)	Gradually pressurize from pressure 0 and adjust the adjust screw so that the switch turns off at 0.1 ±0.02 kg/cm^2
Cylinder (cylinder head)	Parting faces of cylinder and cylinder head	When depth of scratch on contact surface or amount of distortion is 0.03 or greater	Repair on a fraise or surface table with 240 to 400 paper so that no gas leaks
	Scratches or wear of cylinder liner	When there are deep scratches or scuffing in the surface which slides against the piston which cannot be repaired with 400 to 600 paper and when the difference between the parts on the inside of the liner with maximum and minimum wear is of 0.06 or greater	Bore or hone 86.50 ±0.01mm, paying attention to the boat's chamfering, and if insufficient, chamfer. Use oversized piston and piston ring.
Piston ring	Ring gap	0.8mm or greater	Replace, but cylinder liner wear within service limits
Connecting rod	Inclination 	2mm or greater	Replace crank shaft assembly
Crank shaft	Crank shaft deflection	0.05mm or greater with both ends supported	Within 0.03mm with both ends supported
Lead valve stopper	Lift (H)	 Other than H = 10~10.2	Repair to H = 10~10.2
Lead valve	Lift, wear, damage	When lead valve tip is lifted, seat surface wear is great, or when there is damage	Replace entire set
Pump impeller, liner, guide plate	Wear, cracks	When there is wear, cracks, or damage to outer tips and upper and lower surface lips	Replace entire set
Oil seal	Irregular noise, damage	When there is wear, deterioration, damage of lip and when interference is worn to 0.5mm or less	Replace
Engine block	Compression pressure	When difference in compression pressure between cylinders is extremely high	Boring, honing, and oversized piston or replace
		When compression pressure is much higher than standard value	Piston crown, cylinder head carbon removal, exhaust bypass cleaning

(3) Places Where Sealing, Adhesive, and Lubrication Oil is Used

Place \ Sealing, Adhesive, Lubrication Oil	1342 Three bond	1303 B Three bond	G 17 Three bond	Three bond instant adhesive 1741	1104 I Three bond	Insulation grease	Heat resistant grease LT 2	Tohatsu Genuine grease	Cup grease	Tohatsu Genuine engine oil	Tohatsu Genuine gear oil	Silicon oilcompound KS 64	Mission oil automatic transmission		Remarks
Piston										○					Ring groove outer surface
Piston pin										○					Outer surface
Piston ring										○					
Cylinder liner										○					Inner wall
Small end bearing										○					Moving part
Big end bearing										○					Moving part
Main bearings										○					Moving part
Small end bearing washer										○					
Big end bearing washer										○					
Seal ring										○					
Main bearing upper oil seal									○						Lip
Crank case head "O" ring										○					
Lower crank shaft oil seal									○						Lip
Drive shaft oil seal									○						Lip
Drive gears, oil pump										○					
Driven gears, oil pump										○					
Cylinder crank case parting face					○										Care for thickness
Guide plate							○								Sliding part
Set ring		※ ○					○								Sliding part, ball joint
Spark plug cap												○			Spark plug insertion part, high tension cord
Advancer arm							○								Sliding part
Throttle cam							○								Sliding part
Clutch arm							○								Sliding part
Ball joint cap							○								Sliding part
Cable pin nut	○														Screw
Cable joint (clutch arm)								○							Sliding surface
Overheating sensor												○			Fill between sensor and cylinder head
Starter motor						Terminal ○		Apply lightly to pinion ○							
Solenoid switches (2) (starter motor)						○									Terminal
Solenoid switches (4) (PT/T)						○									Terminal

Place \ Sealing Adhesive Lubrication Oil	1342 Three bond	1303 B Three bond	G 17 Three bond	Three bond instant adhesive 1741	1104 I Three bond	Insulation grease	Heat resistant grease LT 2	Tohatsu Genuine grease	Cup grease	Tohatsu Genuine engine oil	Tohatsu Genuine gear oil	Silicon oilcompound KS 64	Mission oil automatic transmission		Remarks
Manual choke lever								○							Sliding part
Gear B nut	○								○						Screw, after thorough removal of grease
Propeller shaft housing									○						In-law portion
Propeller shaft housing O ring								○							
Propeller shaft oil seal								○							Lip
Propeller shaft								○							Spline
Propeller stopper								○							Tapered part
Propeller thrust holder															Spline
Lower water pump case									○						In-law portion
Lower water pump case "O" ring:									○						
Lower water pump case oil seal								○							Lip
Pump case bolt								○							Below neck
Water tube								○							Upper surface
Upper water tube seal rubber											○				Inner surface
Lower water tube seal rubber			Adhere to external case ○								inner surface ○				
Water tube guide rubber								○							Total surface
Pump case								○							Thinly on inner surface
Gear case plate screw	○														Screw
Exhaust housing grommet				○	or	○									Adhering surface
Idle port grommet				○	or	○									
Trim tab mounting bolt								○							
Drive shaft									○						Engine side, spline
Cam rod bushing									○						Total surface
Cam rod bushing O ring 1.9~6.8											○				
Cam rod bushing O ring 3.5~27.7									○						
Cam rod bushing stopper bolt									○						Below neck
Gear case internal lubricant oil											○				Approx. 830cc

Place \ Sealing / Adhesive / Lubrication Oil	1342 Three bond	1303 B Three bond	G 17 Three bond	Three bond instant adhesive 1741	1104 I Three bond	Insulation grease	Heat resistant grease LT 2	Tohatsu Genuine grease	Cup grease	Tohatsu Genuine engine oil	Tohatsu Genuine gear oil	Silicon oilcompound KS 64	Mission oil automatic transmission	□	Remarks
Gear case bolt									(O)						(Below neck)
Extension housing bolt									(O)						(Below neck)
Propeller shaft housing bolt									(O)						(Below neck)
Bracket bolt								O							Fill with grease and apply to inner surface
Bracket bolt cap								O							Inner surface
Stern bracket washer								(O)							(Both surfaces)
Swivel bracket								O							Fill interior with grease
Steering shaft								(O)							(Sliding surface)
Steering shaft bushing								(O)							(Sliding surface)
Steering shaft sealing								(O)							
Thrust plate								(O)							Sliding surface
Upper mounting bolt								(O)							(Outer surface)
Lower mounting bolt	O							(O)							Screw (outer surface)
Mounting bracket								O							Spline
Tilt stopper															Sliding part
								O							
Filler lid hinge								O							Sliding part
Hook lever								O							Sliding part
Hook lever bushing								O							Sliding part
Hook lever seal ring															Sliding part
Motor cover upper seal rubber													O		Adhering surface
Motor cover lower seal cover			O	or									O		Adhering surface
Filler lid seal rubber			O	or									O		
Shift assist holder								O							Sliding part and interior (small quantity)
P T/T trim receiver (H1220)								O							Head
P T/T cylinder upper pin								O							
P T/T assembly bolt								(O)							(Below neck)
P T/T sensor cam bolt	O														
P T/T switch (F type)											O				Switch lever base
P T/T oil												O			Specified product

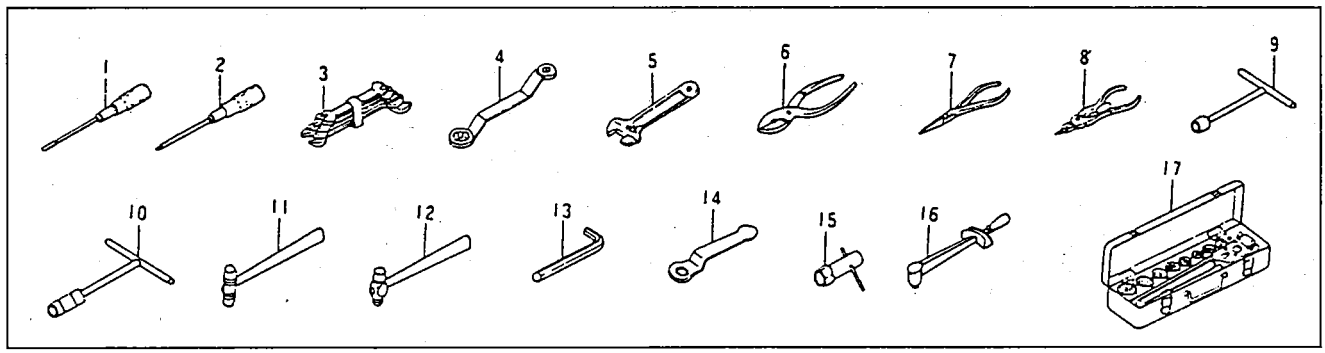
(4) Tightening torque

Item		Partial tightening torque		Final tightening torque	
		kg-m	lb-ft	kg-m	lb-ft
Cylinder head		1.3 ~ 1.7	9.39 ~ 12.29	3.0 ~ 3.5	21.68 ~ 25.29
Crank case M8		1.2 ~ 1.5	8.67 ~ 10.84	2.4 ~ 2.6	17.34 ~ 18.79
Crank case M10		1.7 ~ 2.3	12.29 ~ 16.62	3.8 ~ 4.2	27.46 ~ 30.35
Exhaust cover		0.6 ~ 0.8	4.34 ~ 5.78	1.3 ~ 1.5	9.39 ~ 10.84
Magneto nut				1.4 ~ 16	101.17 ~115.62
Spark plug				2.5 ~ 3.0	18.07 ~ 21.68
Engine mounting				2.4 ~ 2.6	17.34 ~ 18.79
Bevel gear B nut				1.0 ~ 12	72.27 ~ 86.72
Bracket nut				2.4 ~ 2.6	17.34 ~ 18.79
Mounting lever upper bolt				3.0 ~ 3.5	21.68 ~ 25.29
Mounting lever lower nut				3.0 ~ 3.5	21.68 ~ 25.29
Gear case mounting bolt M8				2.4 ~ 2.6	17.34 ~ 18.79
Gear case mounting bolt M10				3.8 ~ 4.2	27.46 ~ 30.35
Propeller nut				3.0 ~ 4.0	21.68 ~ 30.35
Other nuts and bolts	M 4			0.13 ~ 0.18	0.94 ~ 1.30
	M 5			0.27 ~ 0.36	1.95 ~ 2.60
	M 6			0.47 ~ 0.64	3.40 ~ 4.62
	M 8			1.14 ~ 1.54	8.24 ~ 11.13
	M 10			1.30 ~ 3.12	9.39 ~ 22.55

5 TOOLS AND MEASURING EQUIPMENT FOR DISASSEMBLY AND SERVICE

The following tools and measuring equipment are necessary for servicing Tohatsu outboard motors. Be sure to disassembly with the special tools when so indicated. For instructions on usage, refer to the section entitled "USE OFSPECIAL TOOLS".

(1) General Tools



①	Screwdriver	(200 mm)	⑤	Adjustable wrench	(300 mm)	⑫	Hammer	
		(150 mm)	⑥	Pliers		⑬	Hexagonal rod wrench	(6 mm)
		(100 mm)	⑦	Radio pliers				(8 mm)
②	Phillips screwdriver	(200 mm)	⑧	Clip pliers		⑭	Plug wrench	(21 mm)
		(150 mm)	⑨	T-shaped box wrench	(8 mm)	⑮	Plug wrench	(21 mm)
		(100 mm)			(13 mm)	⑯	Torque wrench	(500 kg-cm²)
③	Wrench set	(set of 6)			(17 mm)			(1,500 kg-cm²)
④	Off-set wrench	(10 × 13)	⑩	T-shaped universal wrench	(10 mm)	⑰	Box wrench set	
		(14 × 17)			(13 mm)			
		(21 × 23)	⑪	Plastic hammer				

(2) Compression gauge

(3) Test propeller

(4) Measuring tools

The following tools are all commercially available.

Tachometer	Tohatsu tachometer or a tachometer for 600~6,000rpm
Electric tester	(resistance × 1,000, 10kΩ AC voltage 30~300V, DC voltage 30V, internal voltage 3V or less)
Slide calipers	(JIS B 7507; M1 type slide calipers, 300mm)
Micrometer	(JIS B 7502; 0.01 scale, external micrometer)
Cylinder gauge	(JIS B 7515; 50~100mm cylinder gauge)
Ring gauge	(JIS B 7420; 86ø)
Dial gauge	(JIS B 7503; 0.01 scale, dial gauge)
Gap gauge	(JIS B 7524; measurable from 0.04~0.3)
V block	(JIS B 7540)
Surface plate	(JIS B 7513; 500 × 500)

Dial gauge magnet base or dial gauge stand

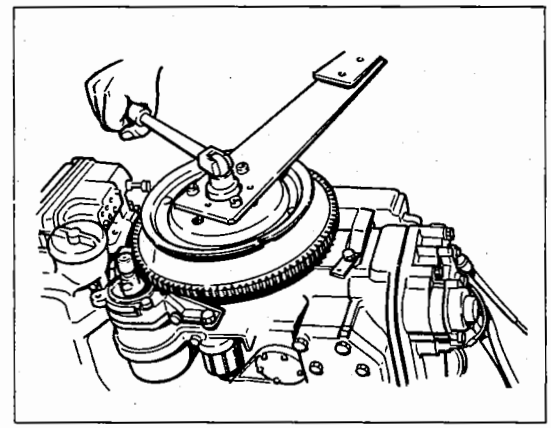
6 USE OF SPECIAL TOOLS

(1) Removal of flywheel

a. Removal of flywheel nut

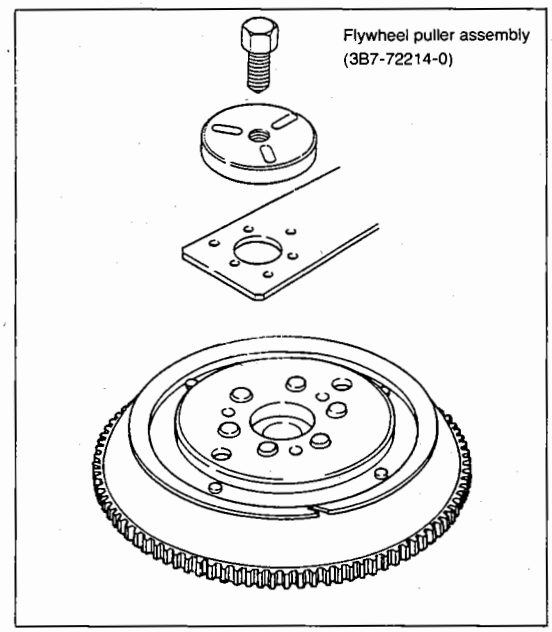
Fix the flywheel puller assembly with the hexagonal holed bolt (M8 × 25) and remove the magneto with socket wrench 27.

NOTE: Magneto nut is screwed clockwise.



b. Removal of flywheel

Install the flywheel puller assembly (3B7-72214-0) to the flywheel, tighten with a 19 socket wrench, and remove the flywheel.



(2) Installation of flywheel

To install the flywheel magneto, first check if the magneto key is inserted then install the flywheel, insert the magneto washer, and tighten the nut.

Install the flywheel puller assembly on the flywheel magneto and tighten with the specified torque (14 — 16 kg-m).

NOTE:

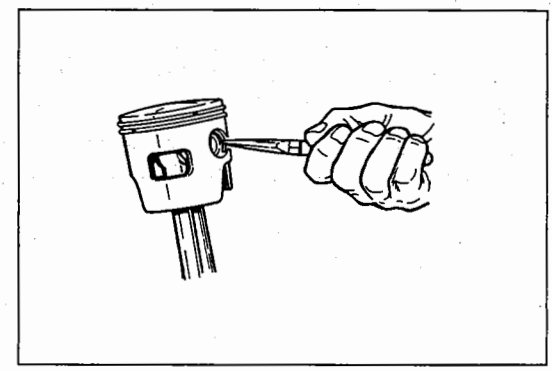
(i) Remove grease completely from the crank shaft and tapered part of the magneto.

(ii) Aplly oil to the screw portion properly.

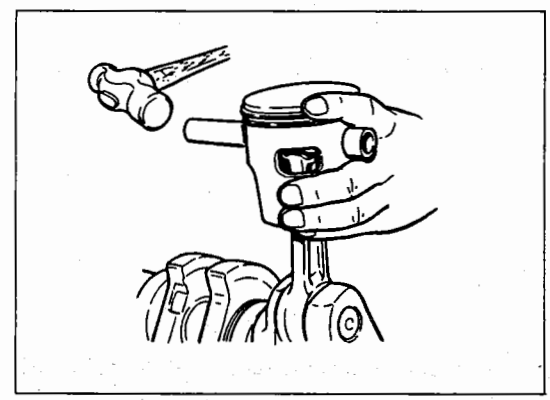
(3) Disassembly and assembly of piston pin

a. Disassembly

Remove the piston pin clips from both sides.



Place a piston pin tool (353-72215-0) against the piston pin and tap lightly with a hammer to remove.
Hold the piston by hand and be careful that the connecting rod does not get bent.
(Take care not to hit the small end bearing washer.)

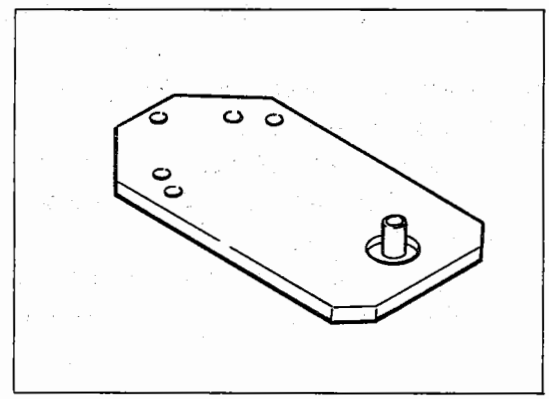


b. Assembly

To insert the piston pin, insert the small end bearing into the connecting rod, insert the side washers into both sides, lightly tap on the tip of the piston tool with a hammer to insert, and finally install the piston pin clips.
(Always use new piston pin clips.)

(4) Power head stand

(353-72247-0, common for M70A$_2$)
Use the power head stand when removing the power unit from the outboard motor and disassembling or assembling on a work table.
Secure the power head stand to the vice, set the cylinders engine installation surface on the stand and fix with M8 bolts.



(5) Spring pin tool

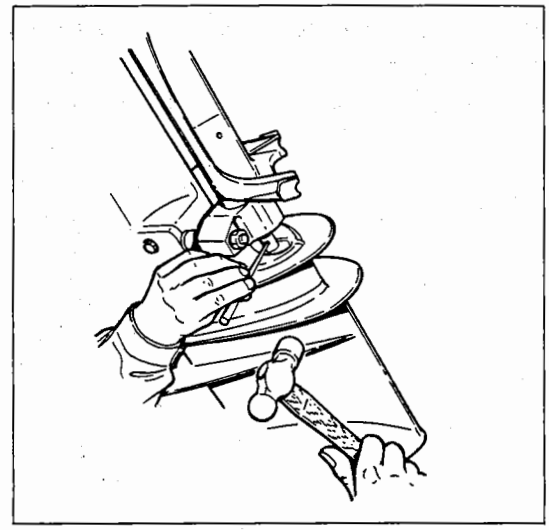
a. Use spring pin tool A (345-72227-0) to remove the spring pin.

b. Use spring pin tool B (345-72228-0) to insert the spring pin.

NOTE:

(i) Replace spring pins which have been removed with new ones.

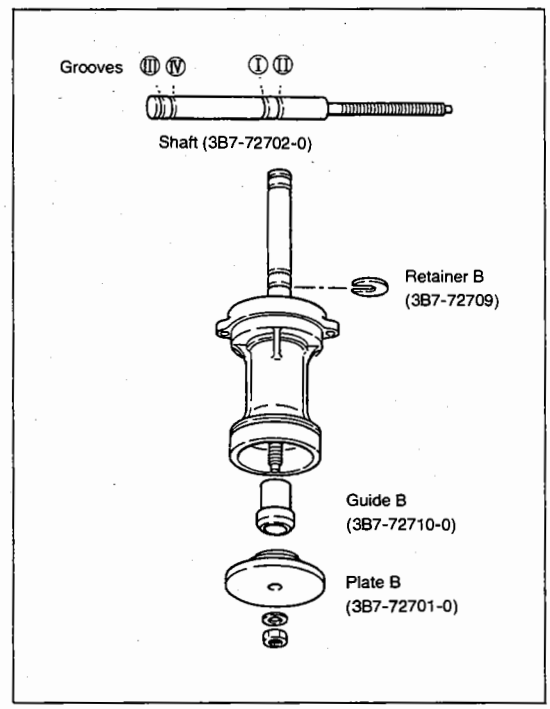
(ii) After mounting, set so that the pins protrude by same amount.



(6) Propeller shaft housing needle roller bearing puller

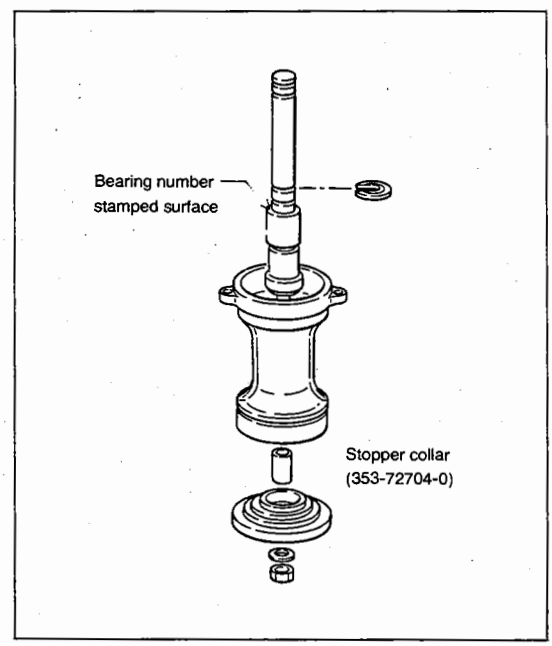
a. Removal of needle roller bearing

1) Remove the oil seal and propeller shaft housing.
2) Remove bearing C by heating the propeller shaft housing.
3) Insert the shaft (3B7-72702-0) into the needle roller bearing.
4) Attach retainer B (3B7-72709-0) to shaft groove (II). Set the V-shaped groove surface of retainer B on the bearing side.
5) Install guide B (3B7-72710) and plate B (3B7-72701-0) to the shaft and remove the needle roller bearing.



b. Installation of needle roller bearing

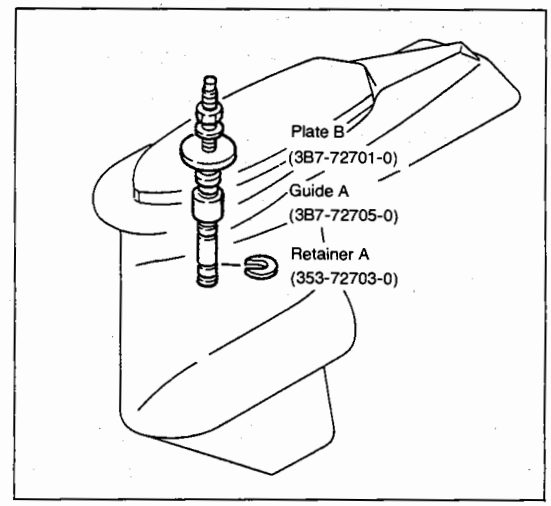
1) Attach retainer B to shaft groove (I).
2) Set the needle roller bearing, install guide B, and insert the propeller shaft housing from the propeller side.
3) Attach the stopper collar (353-72704-0) and plate B from the gear side of the propeller shaft housing.
4) Get the retainer direction from the stamp on the bearing.

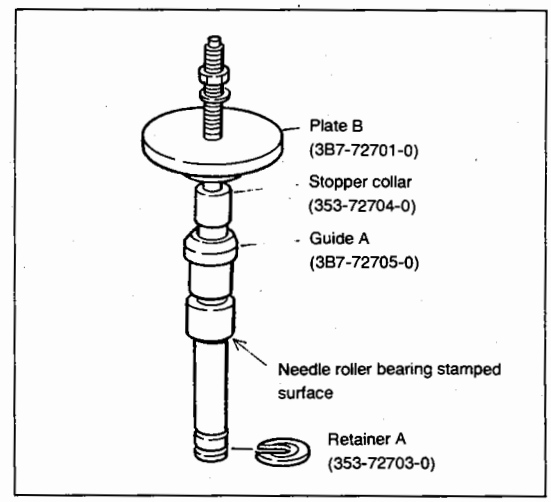


(7) Gear case needle roller bearing

a. Removal of needle roller bearing
   1) Install the drive shaft and water pump housing.
   2) Attach retainer A (3B7-72702-0) to groove (IV) of the shaft (353-72703-0) from the propeller shaft side.
   3) Attach guide A (3B7-72705-0) and plate B (3B7-72701-0) to the shaft from the water pump side.

b. Installation of needle roller bearing
   1) Insert the shaft from the water pump side.
   2) Attach the stopper collar (353-72704-0), guide A, and the needle roller bearing to the shaft from the propeller shaft side. Set the stopper collar from the water pump side. Set the stamped side of the needle roller bearing on the gear side.
   3) Set retainer A in groove (III) of the shaft. Set the V-shaped groove surface of retainer A on the bearing side.
   4) Set plate B from the water pump side.



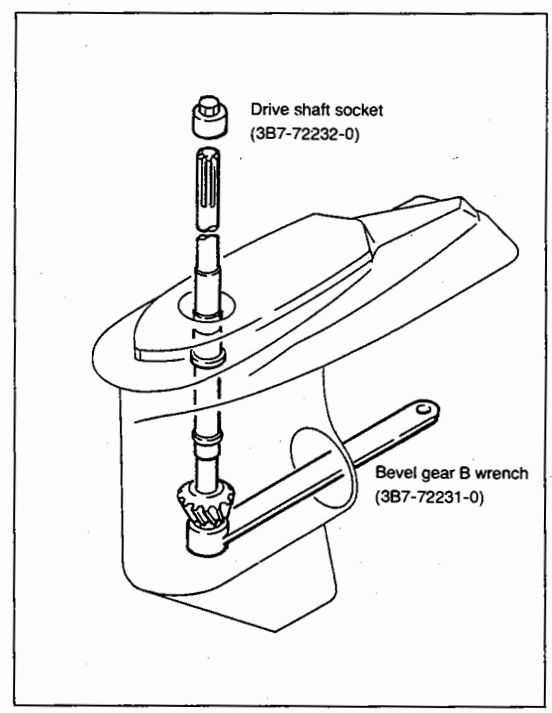


(8) Bevel gear B nut

a. Removal of bevel gear B nut
   Fix the bevel gear B nut in the gear case with the bevel gear B wrench and rotate the drive shaft socket attached to the spline of the drive shaft to remove.

b. Installation of bevel gear B nut
   1) Remove grease totally from the screw of the drive shaft and the bevel gear B nut.
   2) Apply screw lock (Three bond 1342) to the screw.
      NOTE: Do not apply more screw lock than necessary.
   3) Fix the bevel gear B nut with the wrench and tighten the drive shaft socket to the specified torque.

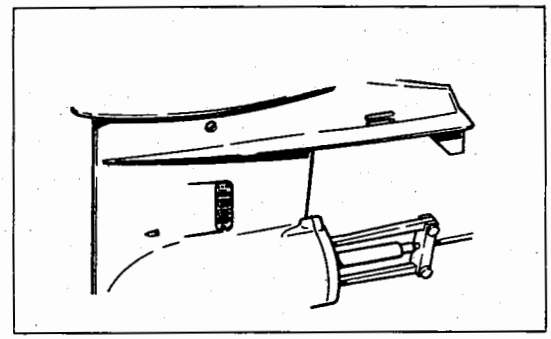
      Tightening torque: 10~12 kg-m



(9) Propeller shaft housing

a. Removal of propeller shaft housing

Remove the propeller shaft housing installation bolt, set the housing puller and tighten.



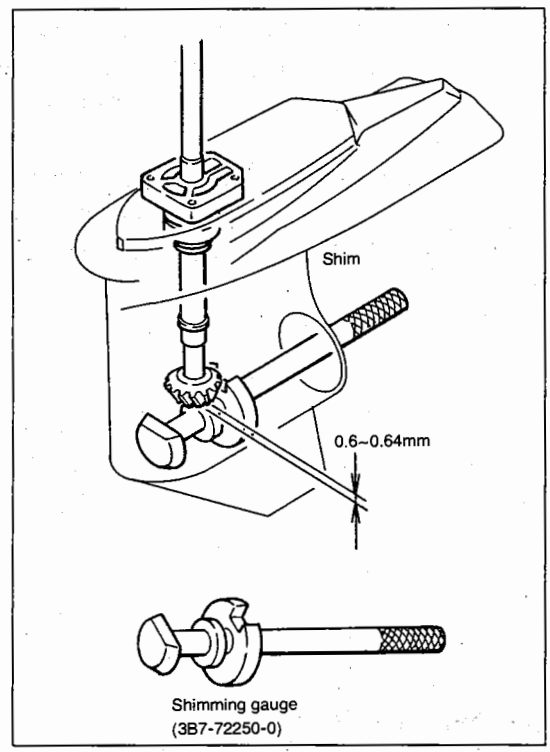
(10) Shimming gauge (3B7-72250-0)

a. Install the drive shaft assembly on the gear case. Install the lower pump case and fix. (Use M8 × 30 and plain washer 8.)

b. Install bevel gear B on the drive shaft with the nut (tightening torque: 10~12 kg-m).

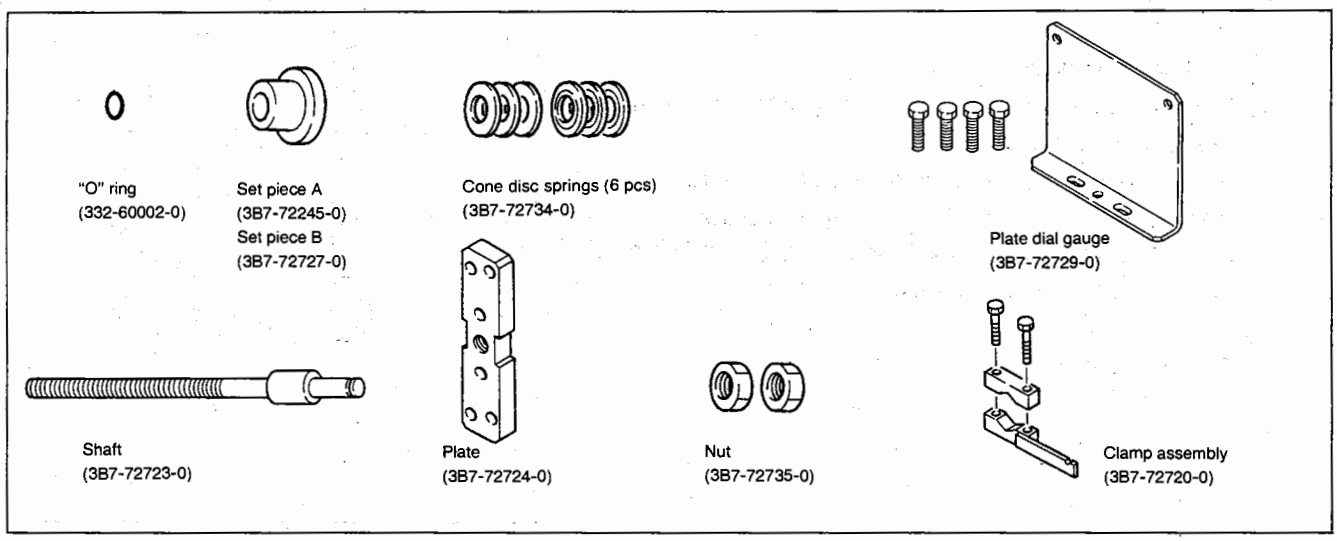
c. Insert the shimming gauge into the gear case and set so that the tapered surface of the gauge is in contact with the tapered surface of the bevel gear A bearing outer race.

d. Measure the gap between the gear B end and the shimming gauge with the thickness gauge.
(When measuring, lift the drive shaft upward to eliminate looseness.)
Gap: 0.6~0.64 mm
If the gap is not as specified, insert a shim into the bottom of the lower pump case to adjust.



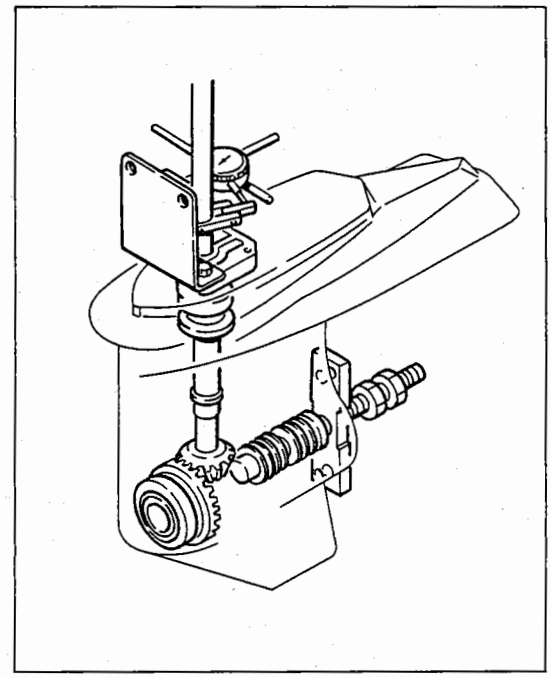
(11) Backlash

a. Backlash measuring tool



b. Measurement of backlash between gears A and B

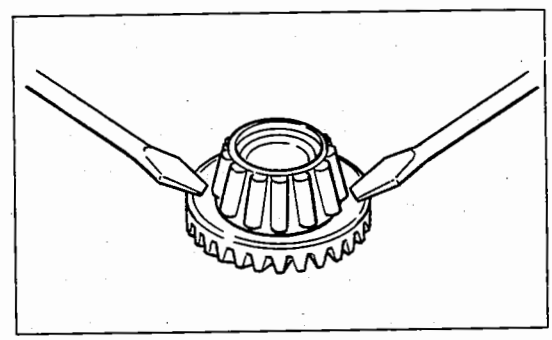
1) Determine the position of gear B.
2) Attach gear A and bearing A.
3) Insert the cone disk springs (3B7-72734-0) into the shaft (3B7-72723-0).
4) Insert the "O" ring (332-60002-0) into the shaft and insert the set piece A (3B7-72245-0).
5) Insert the shaft into the gear case and fix it with the plate (3B7-72724-0).
6) Tighten the shaft until the drive shaft begins to rotate.
7) Tighten the shaft 1/2 rotation more (180°) from where the drive shaft starts rotating.
8) Install the clamp assembly (345-72721-0) on the drive shaft. (Bring as near to possible to the lower pump case.)
9) Install the plate dial gauge (3B7-72729-0) on the gear case.
10) Set the dial gauge, lift the drive shaft upward, rotate, and read the deflection of the gauge.



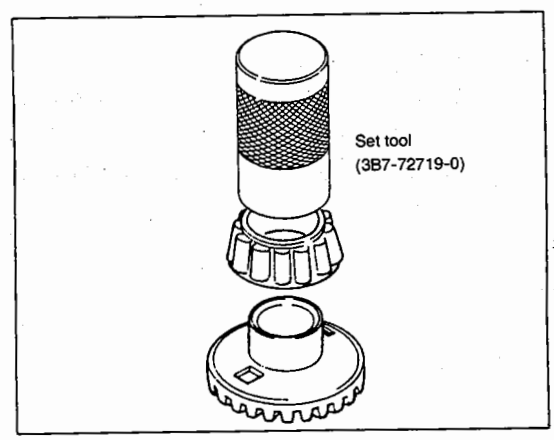
Proper dial gauge reading range: 0.24~0.48 mm

If the deflection is not within this range , insert a shim in gear A and adjust.
Refer to page 23, 24 for the shim selection.

When replacing the bevel gear A shim, insert screwdrivers into the notches of gear A to isolate gear A and the bearing section.

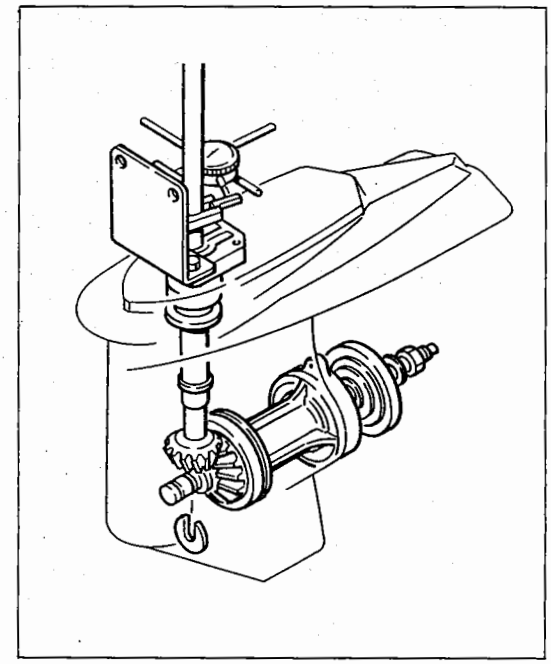


When inserting bearing A into gear A, use the set tool (3B7-72719-0) and press in with no inclination.



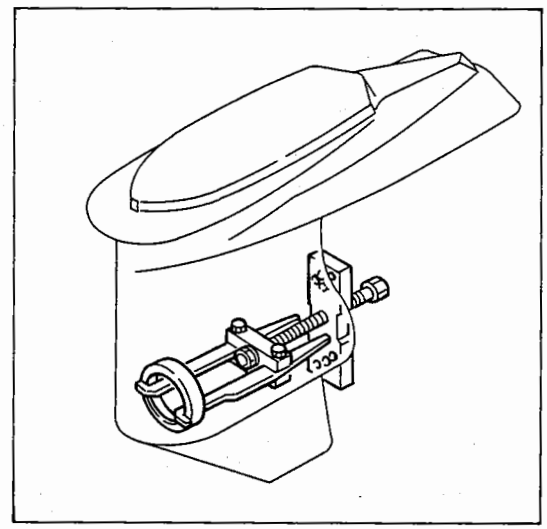
c. Adjustment of backlash between gears B and C

1) Determine the position of gear B.
2) Remove gear A.
3) Install gear C on the propeller housing and put the shaft through.
4) Insert set piece B into the shaft and insert retainer A into groove (IV).
   Face the side of set piece B with small steps and the side of retainer A without the V-shaped groove toward the propeller side.
5) Put plate B through the shaft.
   Set plate B with the side with small steps in the direction of the gear.
6) Insert the gear case and fix with the propeller shaft housing bolt.
7) Install the clamp assemblies on the drive shaft.
8) Tighten the nut on the shaft with your fingers.
9) Fix the clamp assemblies by hand and tighten the nut further approximately 1/4 revolution (90°).
10) Lift the drive shaft upward, rotate it both ways, and read the deflection on the dial gauge. Set the dial gauge against the notch on the clamp assembly.



Proper dial gauge reading range: 0.24~0.48 mm

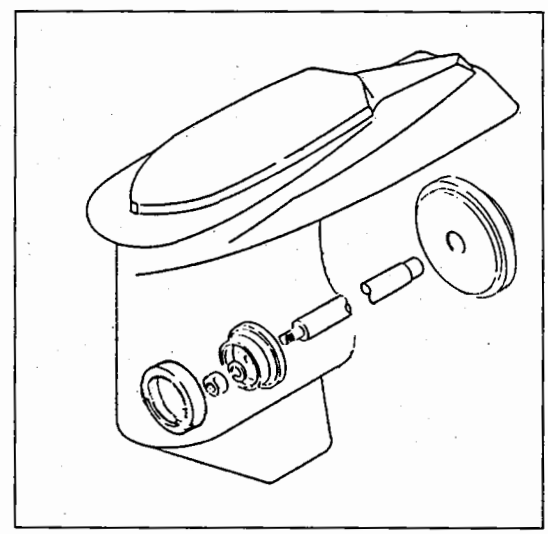
If the deflection is not within this range, insert a shim in gear C and adjust.



After adjusting the backlash, check for looseness in the forward/rear direction in the propeller shaft with the gear case assembly properly assembled.
The looseness should be within about 0.2~0.4 mm. Select one of the bevel gear C washers accordingly.
3 types of C washers: 2.8 t, 3.0 t, 3.2 t

d. Bearing outer race

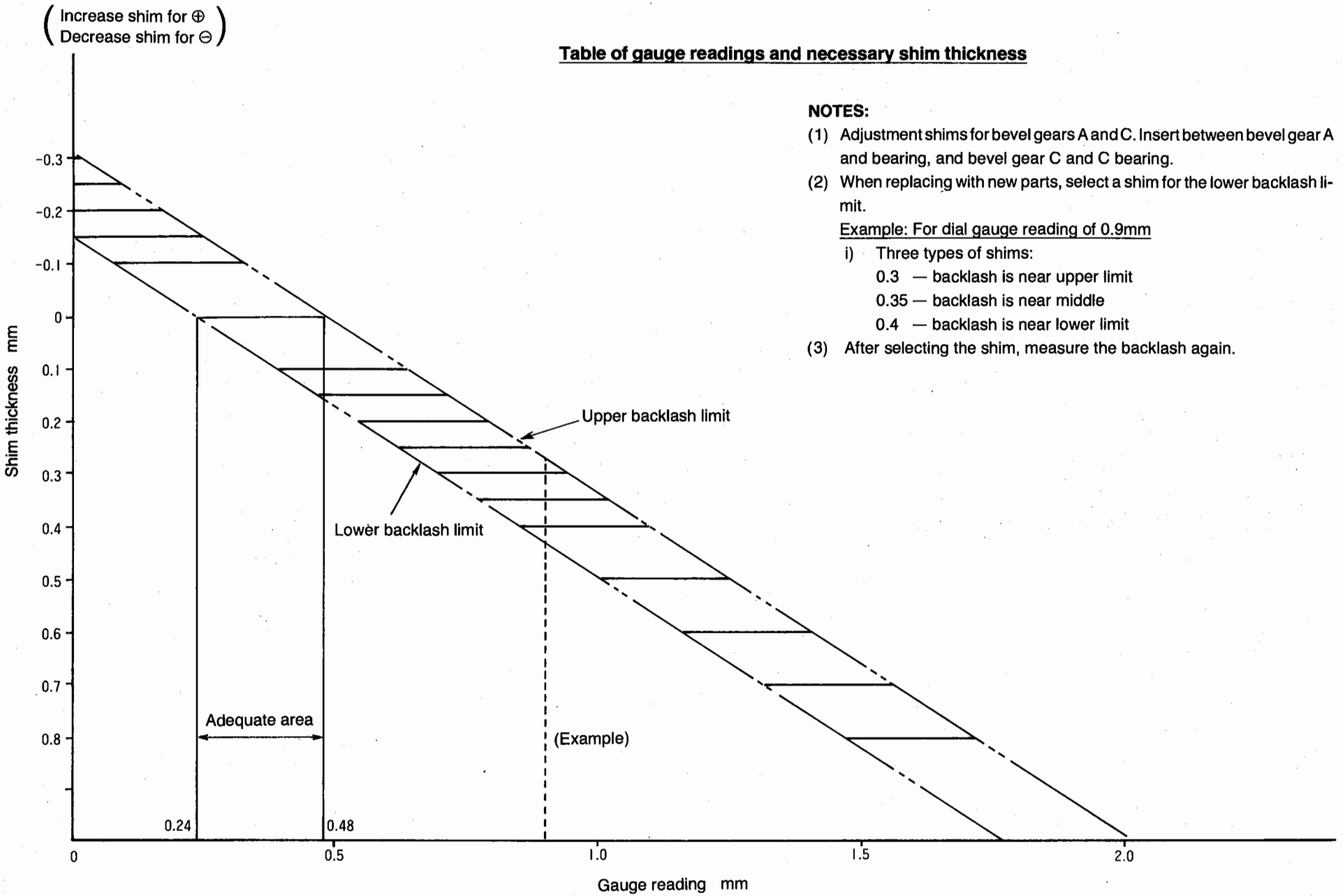
1) Removal of bevel gear A bearing outer race
2) Installation of bevel gear A bearing outer race
   Use the bearing tool kit to set the outer race in the gear case.



e. Adjustment shims table for backlash

Backlash gauge reading mm	Actual backlash mm	Necessary shim + increase − decrease mm
0 ~ 0.02	0 ~ 0.01	− 0.3
0 ~ 0.10	0 ~ 0.03	− 0.25
0 ~ 0.17	0 ~ 0.06	− 0.2
0.01 ~ 0.25	0.003 ~ 0.08	− 0.15
0.09 ~ 0.33	0.03 ~ 0.11	− 0.1
0.24 ~ 0.48	0.08 ~ 0.16	0
0.39 ~ 0.68	0.13 ~ 0.21	+ 0.1
0.47 ~ 0.71	0.16 ~ 0.24	+ 0.15
0.55 ~ 0.79	0.18 ~ 0.26	+ 0.2
0.62 ~ 0.86	0.21 ~ 0.29	+ 0.25
0.70 ~ 0.94	0.23 ~ 0.31	+ 0.3
0.78 ~ 1.02	0.26 ~ 0.34	+ 0.35
0.86 ~ 1.10	0.29 ~ 0.37	+ 0.4
1.01 ~ 1.25	0.34 ~ 0.42	+ 0.5
1.16 ~ 1.40	0.39 ~ 0.47	+ 0.6
1.32 ~ 1.56	0.44 ~ 0.52	+ 0.7
1.47 ~ 1.71	0.49 ~ 0.57	+ 0.8

Table of gauge readings and necessary shim thickness



NOTES:

(1) Adjustment shims for bevel gears A and C. Insert between bevel gear A and bearing, and bevel gear C and C bearing.

(2) When replacing with new parts, select a shim for the lower backlash limit.

Example: For dial gauge reading of 0.9mm

i) Three types of shims:
- 0.3 — backlash is near upper limit
- 0.35 — backlash is near middle
- 0.4 — backlash is near lower limit

(3) After selecting the shim, measure the backlash again.

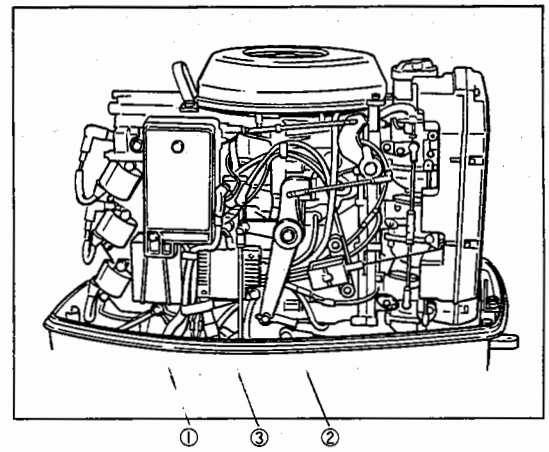
7 REMOVAL, DISASSEMBLY, AND ASSEMBLY OF POWER UNIT

(1) Removal of power unit

a. Remove the power cords.

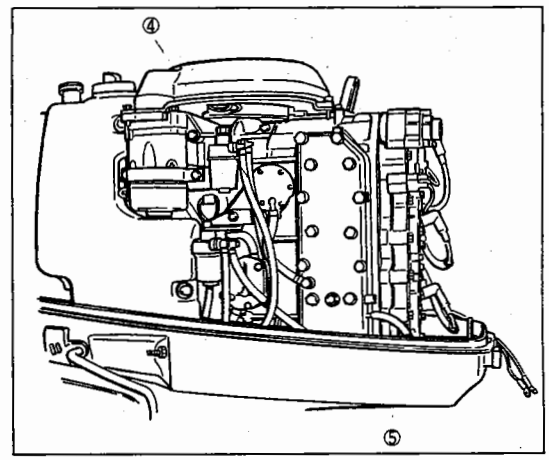
- Ground cord ①
- Battery cord ②
- Wire harness coupler ③

For the PT/T type, remove the 3 cords of the PT/T.

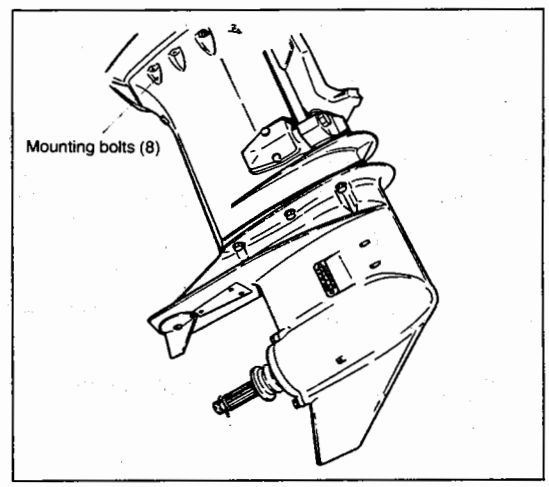


b. Removal of pipes

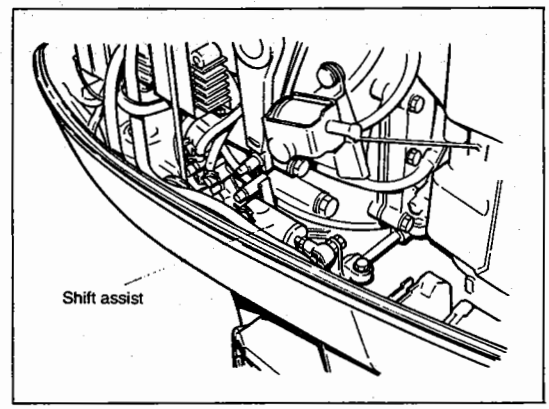
- Fuel oil pipe ④
- Pilot water check pipe ⑤



c. Remove the 8 drive shaft housing mounting bolts.

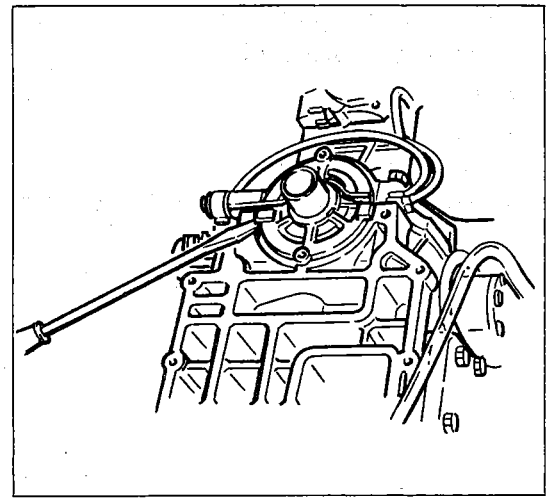


d. Disconnect the shift assist case.



(2) Crank case head, lower

Insert a screwdriver into the pinch groove and remove the lower crank case head.



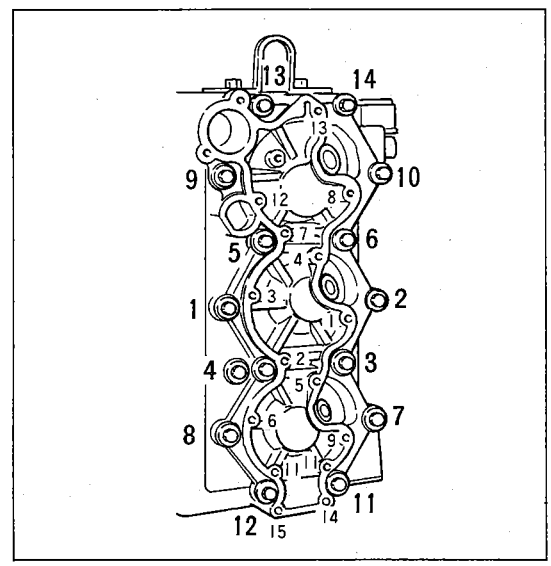
(3) When mount the crank case head, lower, pay attention to F & R mark.

(4) Cylinder head

Loosen the cylinder head bolts starting from the highest embossed number down.

Tighten the cylinder head bolts in the order of the embossed numbers.

Tightening torque for first time: 1.3~1.7 kg-m
Tightening torque for second time: 3.0~3.5 kg-m



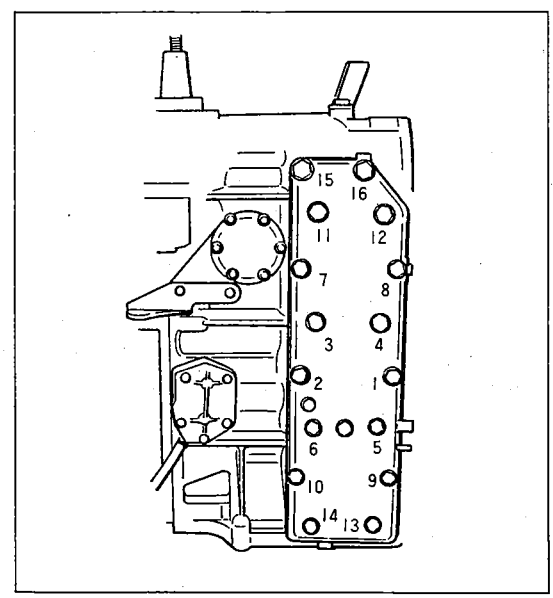
(5) Exhaust cover

Loosen the exhaust cover bolts starting from the highest embossed number down.

Set a screwdriver against the notch in the cover and remove.

Tighten the exhaust cover bolts in the order of the embossed numbers.

Tightening torque for first time: 0.6~0.8 kg-m
Tightening torque for second time: 1.3~1.5 kg-m



(6) Crank case

To remove the crank case, first loosen the M8 bolts in order starting from the ones furthest from the center of the crank case, then the M10 bolts in order starting from the ones furthest from the center of the crank case.

When tightening the crank case bolts, start from the M10 bolts nearest to the center level then tighten the M8 bolts nearest to the center level.

M10 bolt tightening torque

First time: 1.7~2.3 kg-m

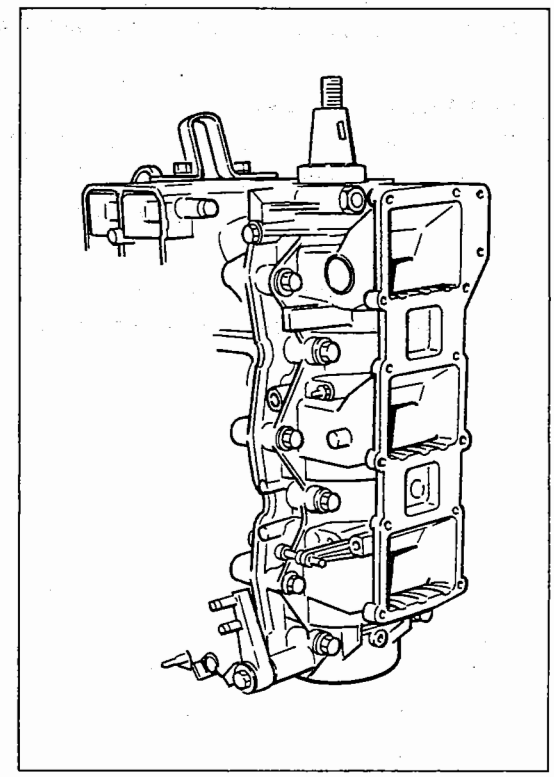
Second time: 3.8~4.2 kg-m

M8 bolt tightening torque

First time: 1.2~1.5 kg-m

Second time: 2.4~2.6 kg-m

NOTE: Pay attention to the position of the knock pin of the main bearing when assemblying the crank case.
The notches for the pins are located on either side of the crank case.
Pay attention to the knock position for the A bearing.

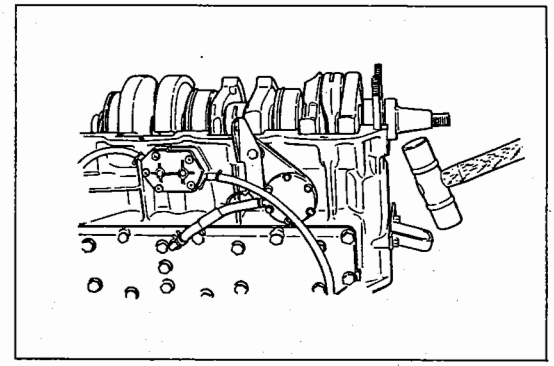


(7) Crank assembly

a. Hold both sides of the crank assembly by hand and lift the cylinders a little.

b. Lightly hit the cylinders and detach the crank assembly.

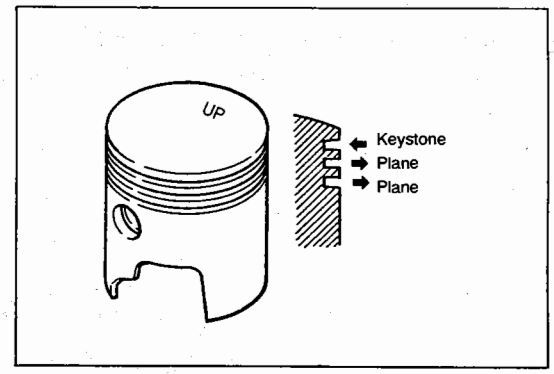
If the operator is removing the crank assembly alone, lightly tap the tapered part of the crank shaft with a soft hammer to loosen it and lift up the crank assembly.



(8) Piston

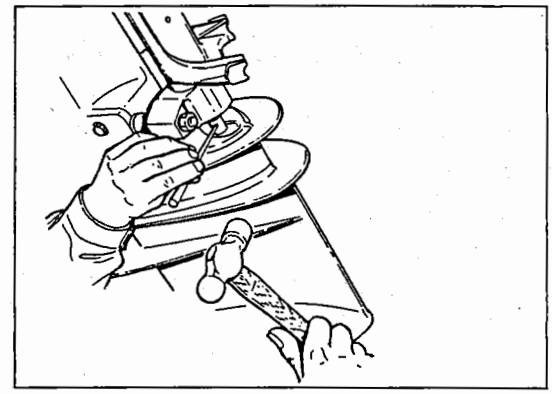
The top ring is of the keystone type, the second and the third rings are of the plane type. (2 piston rings were used on 1986 models.)

Be sure to assemble the piston with the UP mark on the top at the flywheel.



8 GEAR CASE

(1) Remove the spring pin of the shift cam shaft.

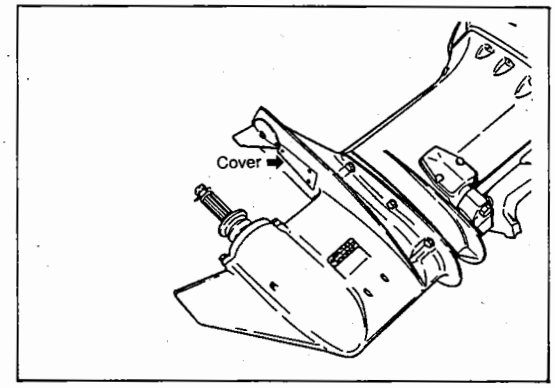


(2) Removal of gear case

a. Remove the gear case plate located under the cavitation plate and take out the internal coupling bolt.

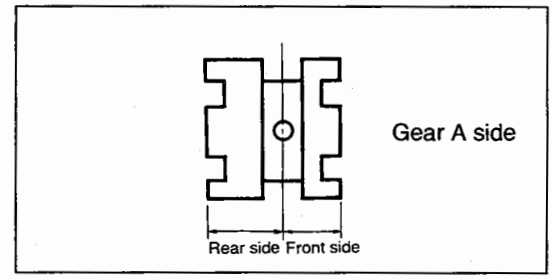
b. Remove the 6 gear case mounting bolts.

NOTE: To assemble, first install the bolt in the position of the B mark, decide the position of the gear case, then install the other bolts.



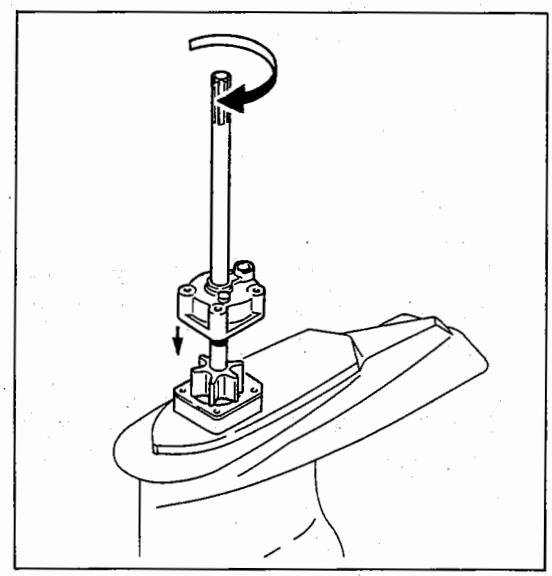
(3) Clutch

Install with the shortest distance from the center of the clutch pin to the tip of the claw facing the gear A side.

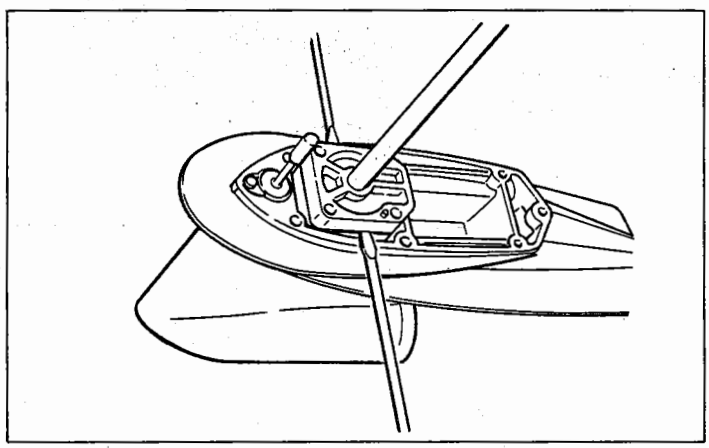


(4) Water pump

To install the water pump, rotate the drive shaft clockwise and set the upper water pump case to the impeller.
When the drive shaft is rotated counterclockwise, the impeller bends in the other direction and may be damaged.



Removal of lower water pump case
Insert a screwdriver into the notches on either side of the case to remove.

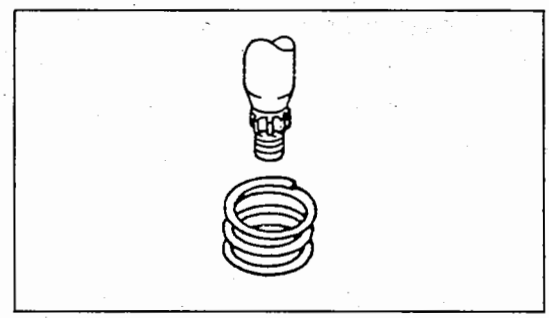


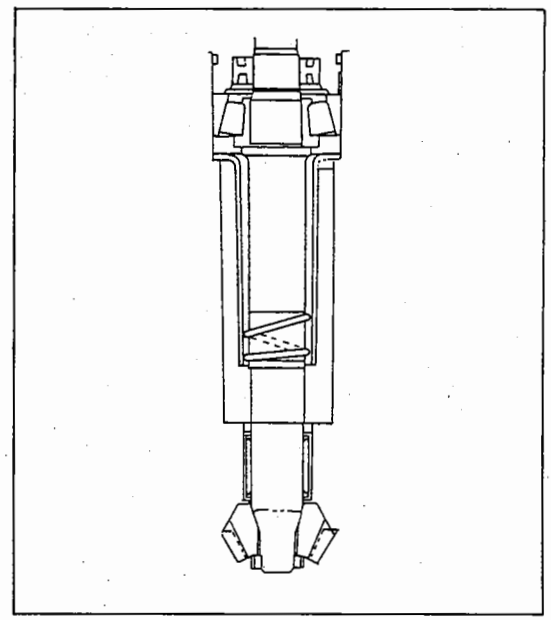
(5) Drive shaft spring

The drive shaft spring functions to supply lubricant oil to the tapered roller bearings under the water pump housing, lower.

Install the drive shaft spring with the open end of the spring on the gear side and the closed end on the bearing side.

Install the drive shaft spring in the specified position. If it is installed too high, the supply of oil to the bearings may be insufficient.

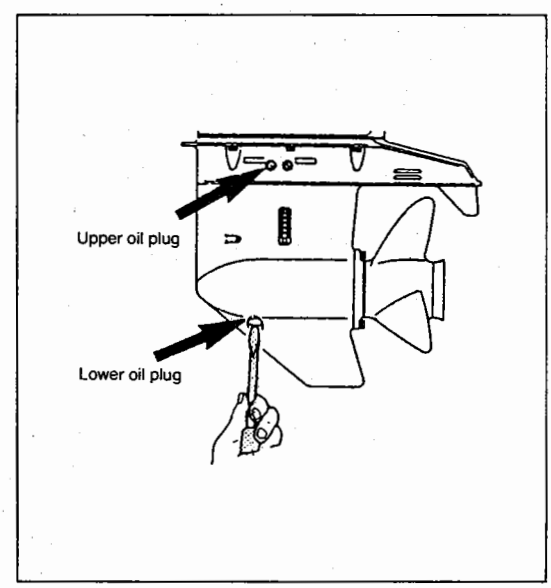




(6) Gear oil

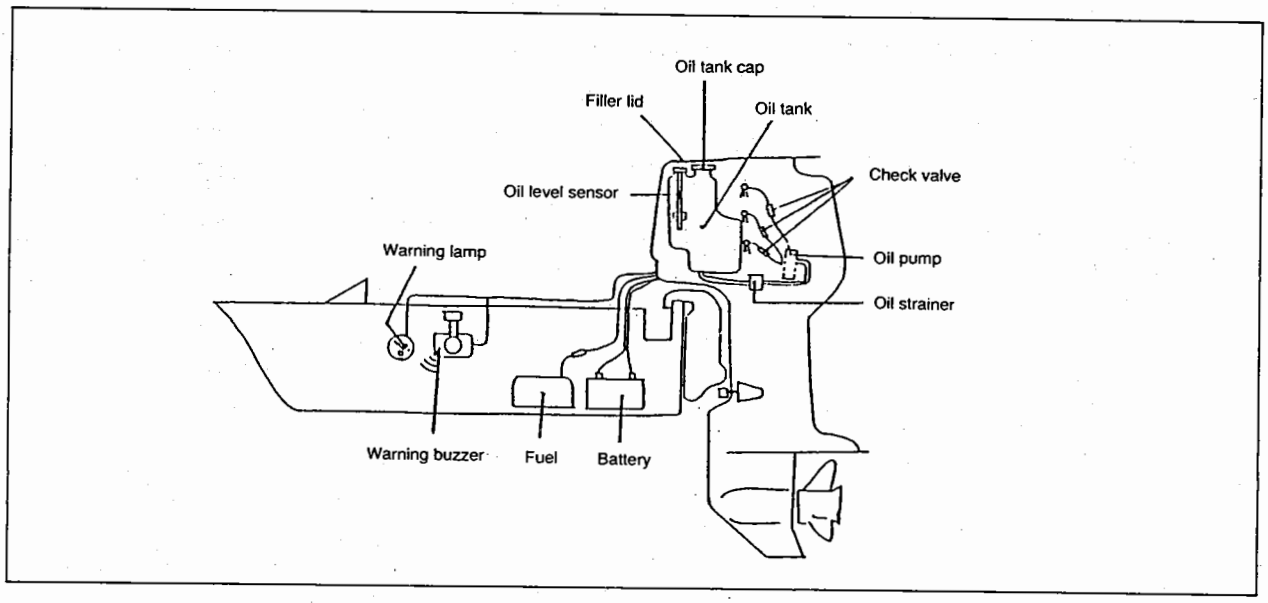
Remove the upper and lower oil plugs and let out the gear oil.

To replenish gear oil, remove the upper and lower oil plugs and insert the nozzle of the gear oil tube into the lower plug hole. When oil starts coming out of the upper plug hole, insert the plug and fasten.
Install the plug on the lower plug hole.



9 AUTO MIXING SYSTEM

(1) System makeup



(2) Function of system

This system feeds the engine oil and the fuel oil to the engine separately. The engine oil is automatically fed to the engine from the oil tank by the oil pump.

(3) Oil pump

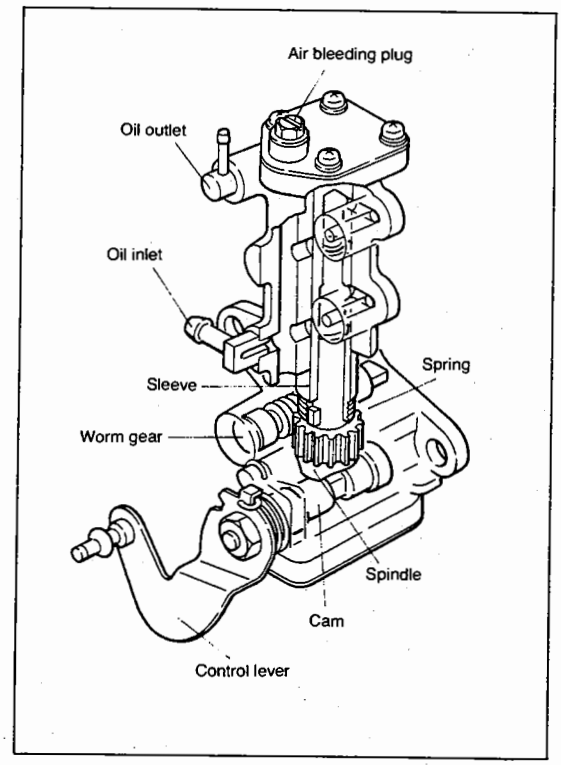
1) Structure

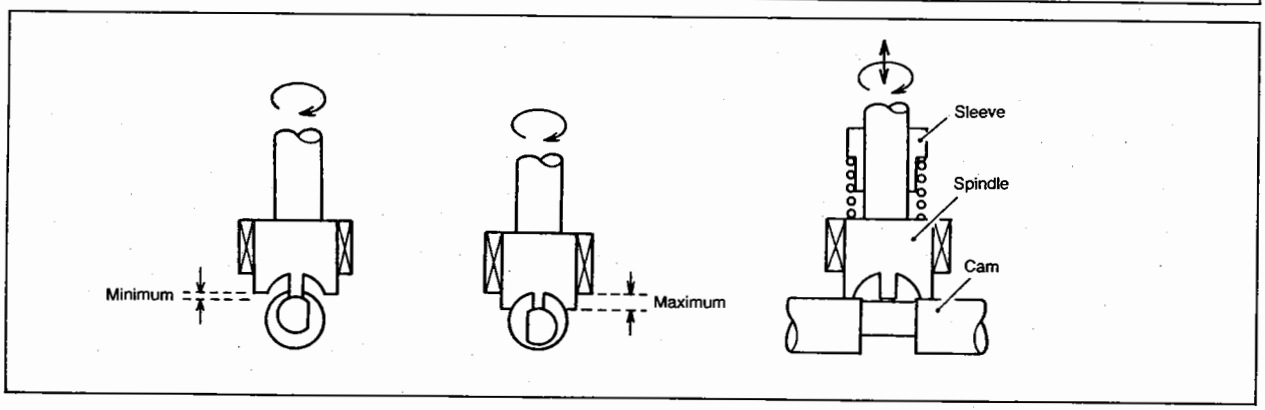
This is a plunger type oil pump.

The spindle is driven by a worm gear and the cam at the bottom of the spindle gear is linked to the piston and forces feeding.

The oil quantity is regulated by changing the stroke of the spindle with the cam which is linked to the control lever. (See diagram below)

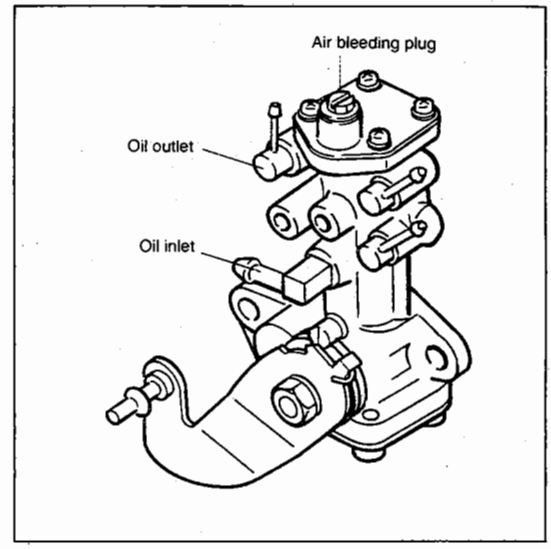
Furthermore, the rotation of the worm gear also changes according to the engine speed, so there is double control of the oil quantity.





(4) Air bleeding the oil system

Always bleed the air from the oil system for new outboard motors and after the motor runs cut of oil.



a. Bleeding of air between oil tank and oil pump
   1) Fill the oil tank with engine oil.
   2) Loosen the air bleeding plug.
   3) Bleed the air from the oil pipe and oil filter.
   4) Check that there is no more air, then reinstall the air bleeding plug.

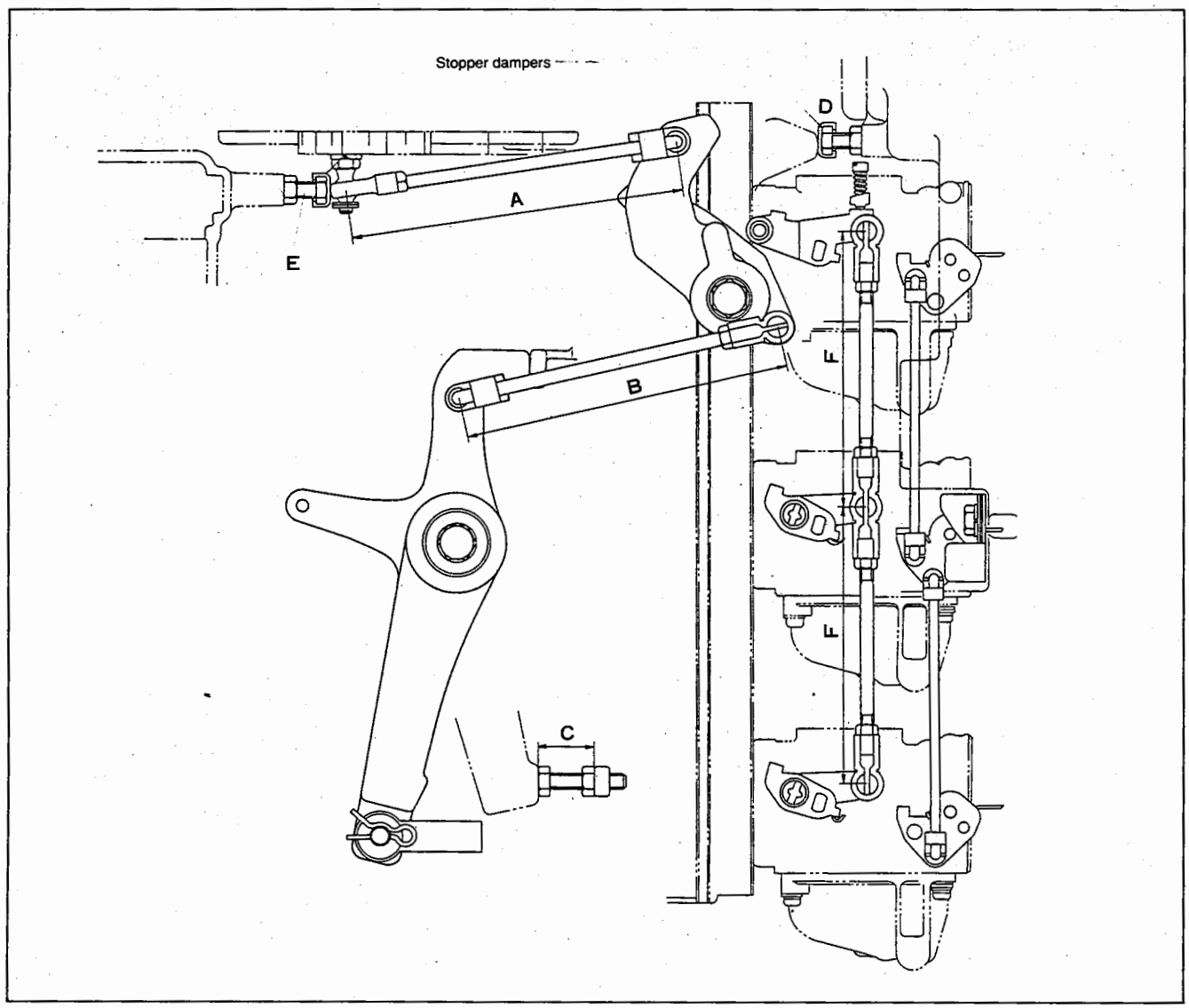
b. Bleeding of air between oil pump and intake manifold
   1) Start the engine and let it idle.
   2) Keep idling until there is no air left in the transparent oil pipe.

NOTE: When starting a new outboard motor, use engine oil with a 50:1 mixture in the fuel tank, aside from the engine oil in the oil tank.

(5) Cautions and inspection of auto mixing system

No.	Part	Caution/Inspection
1	Genuine oil	○ Use "Tohatsu engine oil Gold".
2	Oil pump "O" ring	○ Check the "O" ring upon assembly ○ Apply genuine oil
3	Oil pipe	○ Securely clip at place of insertion ○ Clamp at specified place ○ No bending or contact with sharp angles ○ No air
4	Oil tank cap	○ Check function of auto air vent
5	Oil link rod	○ Apply grease to ball joint ○ Check if clipped
6	Oil level sensor	○ Check function
7	Oil strainer	○ No water or dirt
8	Alarm device	○ Check that lamp lights ○ Check function of buzzer (also used as overheat buzzer)

10 LINK ADJUSTMENT

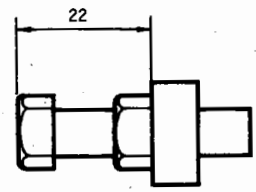


(1)

a. Length of links A and B
A (ignition timing link): 124 mm
B (throttle link): 131.5 mm
Check that the throttle is fully open when the advancer arm is at maximum speed. Use link B for fine adjustment.

b. High speed side stopper C length

C: 22 mm



c. Stopper D length
Control with stopper D to make BTDC 20° with ignition timing at throttle fully open.
Do not forget to install the stopper damper when adjusting.

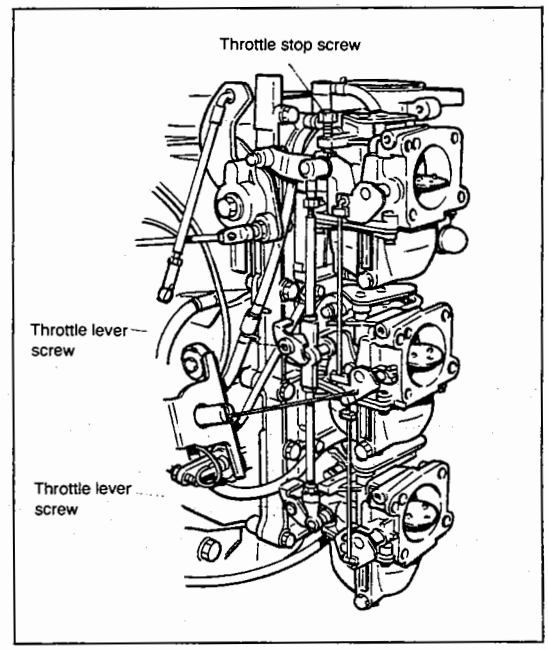
d. Stopper E
Control with stopper E to make ATDC 5° with ignition timing at fully closed throttle. Fine adjust with throttle link B so that the throttle is fully open when the advancer arm is in contact with C.

e. Shift link length F ... 80mm (distance between cap centers)

(2) Adjustment of carburetor

a. Throttle link rod F
F ... 110mm (distance between ball joint cap centers)
Apply grease to the ball joins.

b. Adjustment of synchronization
1) Turn the center and lower carburetor throttle lever screws clockwise to loosen. (Counterclockwise screwing screws)
2) Loosen the upper carburetor throttle stop screw sufficiently so that the throttle valve is fully closed.
3) Lightly press on the center carburetor throttle lever so that the butterfly valve is fully closed and turn the throttle lever screw counterclockwise to tighten.
4) Tighten the lower carburetor throttler lever screw in the same way.
5) Tighten the throttle stop screw and adjust so that the throttle opening is approximately 5°.



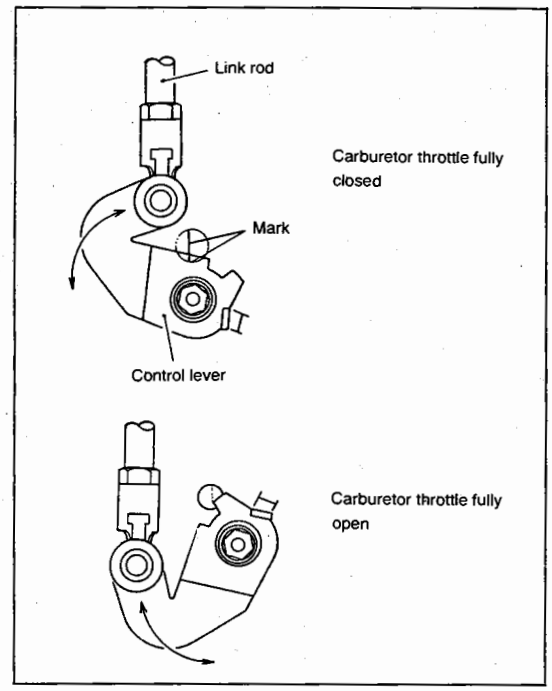
c. Adjustment of pilot screw
1) After thoroughly warming up, adjust the upper, center, and lower carburetors a little at a time to find the position where rotation increases the most when the pilot screw is returned 1 1/2 ±1/4 turns.
2) Return 1/8 turn further from the position in which rotation increases the most for when the engine is cold.
3) Adjust the throttle stop screw for the specified speed.
Specified trolleying speed: 550~750 rpm

Reference value
Idling speed: 850~1100 rpm

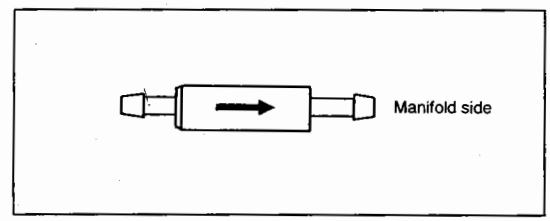
(3) Adjustment of oil pump aperture

a. Adjust the link rod length so that the cut angle part of the lever matches the mark on the ø7 boss when the carburetor throttle is fully open.

NOTE: Adjust the oil pump aperture after adjusting the carburetor and ignition timing.



b. Oil line check valves
There are check valves on the three oil lines between the oil pump and intake manifold.
Install with the arrow on the check valves facing the intake manifold. (The arrow mark indicates the direction of oil flow.)

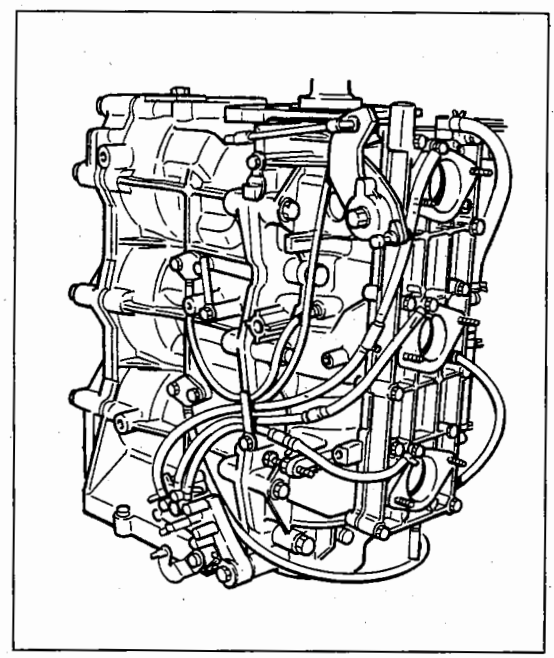


(4) Oil recirculation

Oil is recirculated uniformly to the cylinders to prevent mixed oil from stagnating, moving the stagnating mixed oil from the necessary places to improve lubrication.

Connect the recirculation hoses as follows:

# 1 Check valve	→ # 2 Crank case
# 2 Check valve	→ # 3 Crank case
# 3 Check valve	→ # 1 Upper part of crank case
# 3 Forward side of crank case	→ # 2 Intake manifold

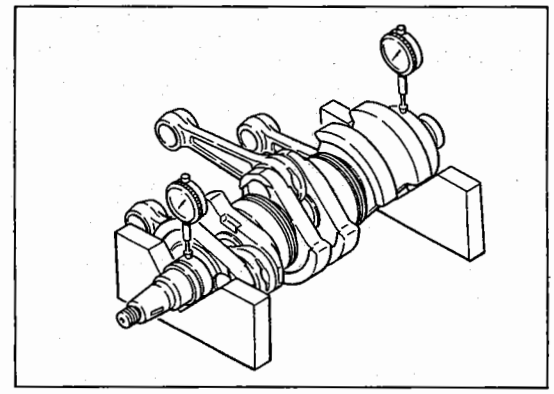


11 INSPECTION OF PARTS

(1) Crank shaft

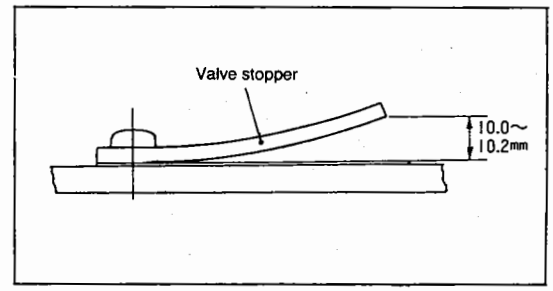
The crank shaft deflection should be within 0.03mm with both ends supported.

Measure with the bearings installed on both ends of the crank shaft.



(2) Lead valve

Adjust the lead valve stopper so that the lift height of the lead valve is 10.0~10.2mm.



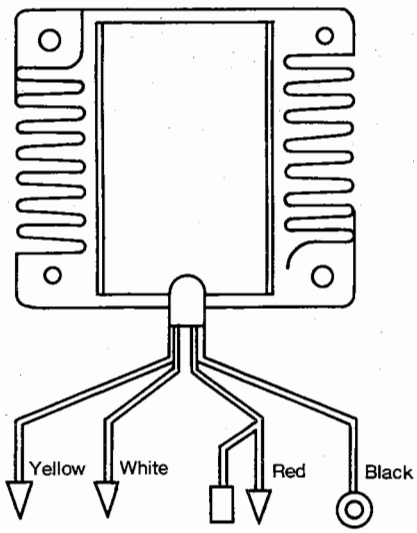
12 INSPECTION OF ELECTRICAL PARTS

(1) Measurement of coil resistance

To measure the coil resistance, connect the tester between the coil leads, and check the change in the resistance with tension is applied and released to the coil leads gently by hand.
If the resistance changes, the lead is about to break.

a. Alternator resistance	(between yellow and white leads)	0.24 ±20%Ω
b. Exciter coil resistance	(between white/yellow and white/green leads)	205 ±15%Ω
c. Pulser coil resistance	(between white/red or white/black or white/blue and black leads)	196 ±15%Ω
d. Ignition coil		
Primary coil resistance	(between black/white and black leads)	0.22 ±15%Ω
Secondary coil resistance	(between high voltage cord and black lead)	4.2 ±15%Ω

(2) Rectifier



Tester: HIOKI 3000

⊖ \ ⊕	Black	Red	White	Yellow
Black		Conductive	Conductive	Conductive
Red	Not conductive		Not conductive	Not conductive
White	Not conductive	Conductive		
Yellow	Not conductive	Conductive	Not conductive	

(3) CD unit

a. Cautions on handling CD unit
   1) Do not disconnect or short circuit the coil base lead wires or CD unit wires while the engine is running.
   2) Do not change the position of installation of the CD unit parts.
   3) Do not touch the spark plug or high voltage cord with your hand while the engine is running, as the voltage and current are high.
   4) When checking the spark of a spark plug, always keep the other two plugs in contact with the engine or the CD unit may be damaged.
   5) Disconnect the coil plate lead wires and CD unit wires when measuring the compression pressure.

b. Inspection of CD unit
   Use a radio circuit tester with an internal battery of 3V or less to measure the CD unit resistance.
   If a tester with a large battery capacity is used, the diodes in the CD unit may be damaged.

Standard Values for CD Unit Tester Check (±15%)

Tester: Tohatsu Genuine tester (HIOKI model 3000), range kΩ

Units: kΩ unless otherwise specified

Tester (black lead)	Tester (red lead)											
	B	SB	BR	W/Y	W/G	W/R	W/B	W/Bℓ	B/W①	B/W②	B/W③	
B		13	14	4.2	4.2	16	16	16	4.2	4.2	4.2	
SB	∞		∞	∞	∞	∞	∞	∞	∞	∞	∞	
BR	∞	∞		∞	∞	∞	∞	∞	∞	∞	∞	
W/Y	※	※	4.2		※	※	※	※	※	※	※	
W/G	.14	22	.70	.28		.45	.45	.45	.28	.28	.28	
W/R	∞	∞	∞	∞	∞		∞	∞	26	∞	∞	
W/B	∞	∞	∞	∞	∞	∞		∞	∞	26	∞	
W/Bℓ	∞	∞	∞	∞	∞	∞	∞		∞	∞	26	
B/W①	∞	∞	∞	∞	∞	∞	∞	∞		∞	∞	
B/W②	∞	∞	∞	∞	∞	∞	∞	∞	∞		∞	
B/W③	∞	∞	∞	∞	∞	∞	∞	∞	∞	∞		

Measure with the (B/Y) lead wires connected.

※ Needle shakes once the first time only, after returns to ∞.
From second time on, ∞.

· At first below indicated value, after stays at indicated value.

NOTE: The indicated values were measured with the Tohatsu specified radio circuit tester (HIOKI 3000) and may differ greater when tested with other testers.

Tester measurment range: × 1kΩ

Abbreviations:

B — black	W/Y — white/yellow	W/B — white/black
SB — sky blue	W/G — white/green	W/Bl — white/blue
BR — brown	W/R — white/red	B/W — black/white

(4) Starter motor

a. Brush and spring

1) Check the extent of wear of the brush.
If the brush length is 12mm or less, replace with a new one.

2) Check the insulation between brush holders.
If electricity is conducted, eliminate the cause and insulate or replace with a new one.

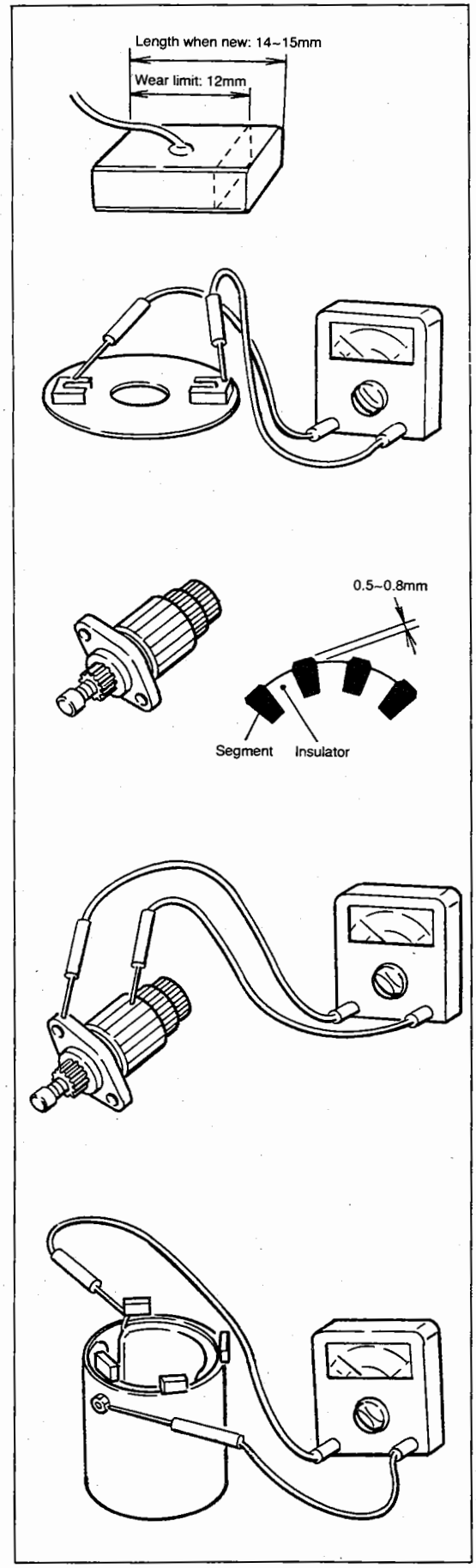
3) Brush spring tension
If the brush spring tension is reduced replace it with a new one.

b. Amateur

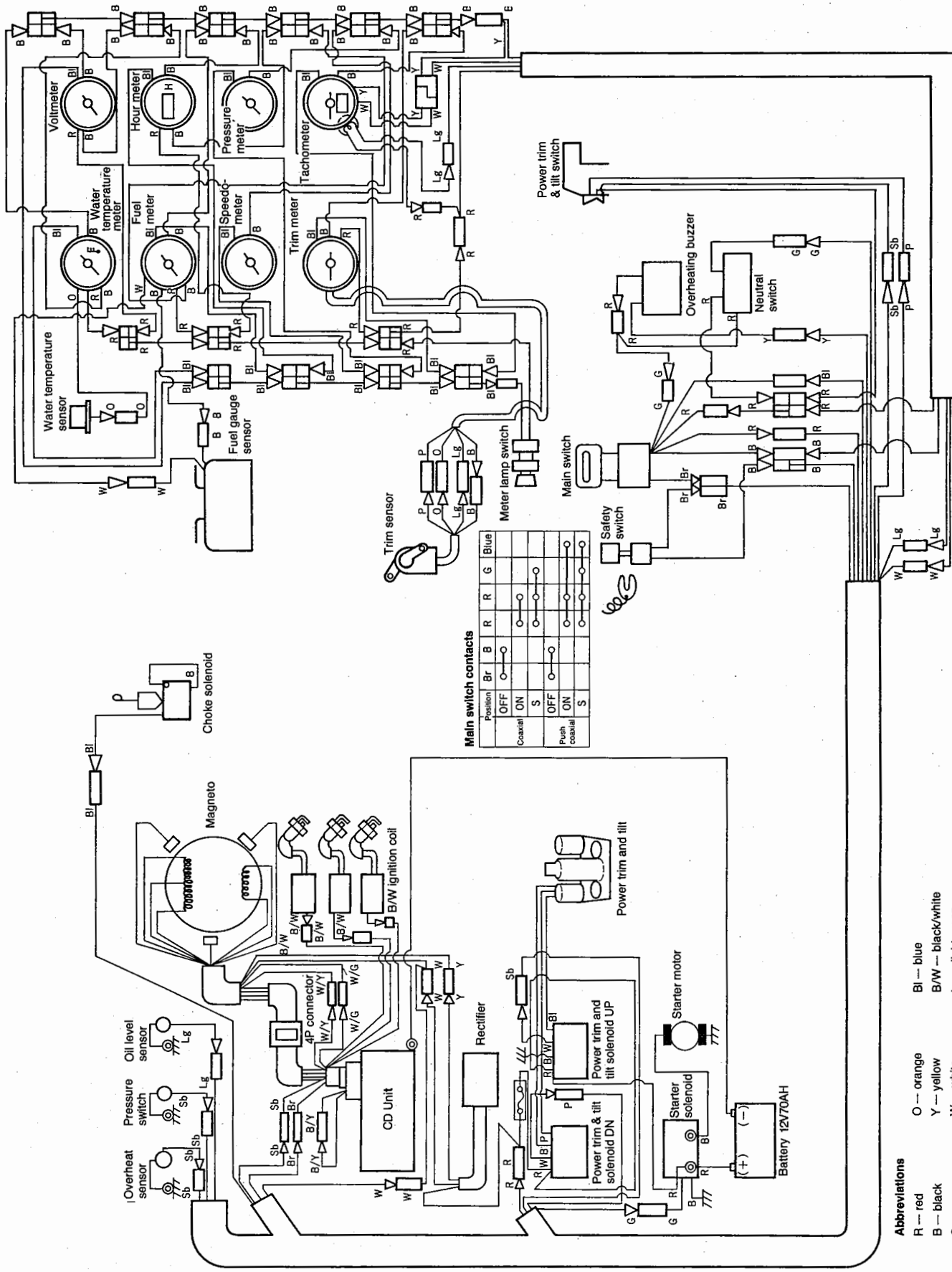
1) Measure the amateur insulator depth.
If the depth is less than 0.5 to 0.8mm, or if misshapen, repair with a hacksaw blade etc. to set to specified depth.
2) If the amateur has carbon or other dirt on it, use #500~#600 sandpaper to remove.
3) Check the amateur's insulation.
If electricity is conducted, replace the motor assembly.

c. Field coil

1) Check for damaged field coils.
Connect the tester to the coil terminals and check for conductivity.
2) Check for conductivity between the coil terminals and ground wire.
If conductive, insulation is defective, so replace with a new one.
3) Check for conductivity between the field coil terminals and yoke.
If conductive, insulation is defective, so replace with a new one.



13 ELECTRICAL WIRING DIAGRAM

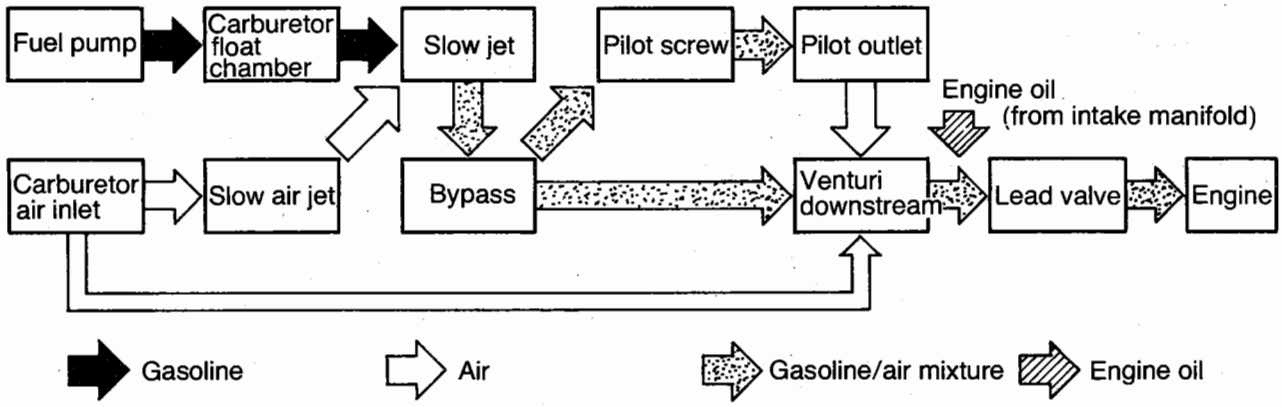


14 CARBURETOR

EPTO Model

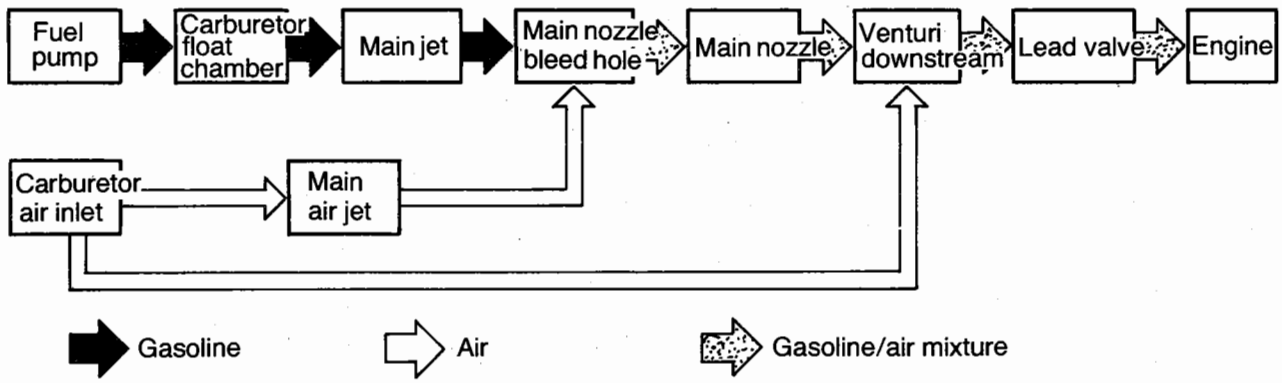
(1) Pilot system, slow system

Flow of fuel, mixture, and air for starting and idling



(2) Main system

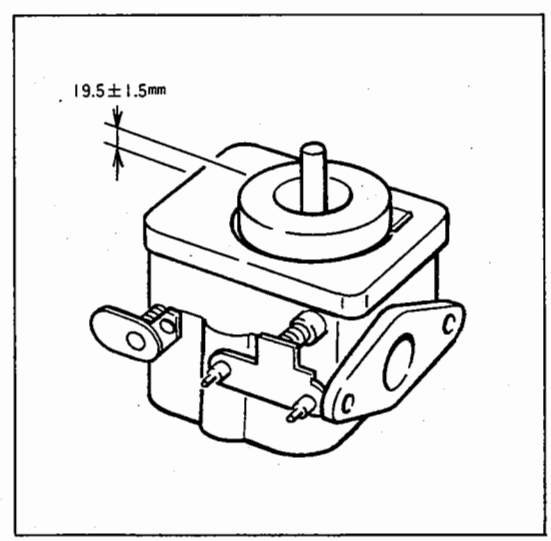
Flow of fuel and air at medium speeds and above



(3) Float height

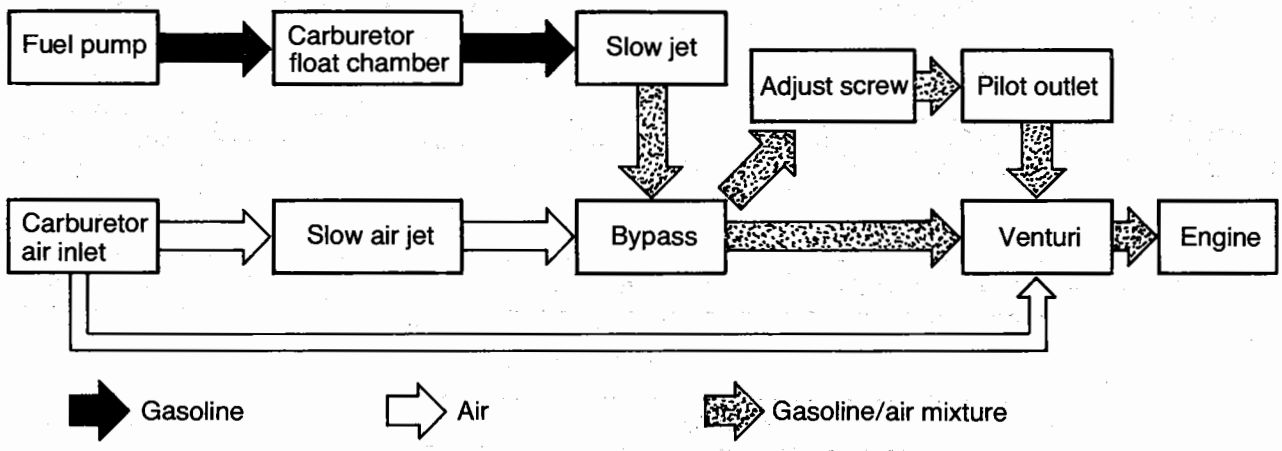
Measure the height for the center of the float from the float tip to the float chamber surface.

Standard float height 19.5±1.5 mm

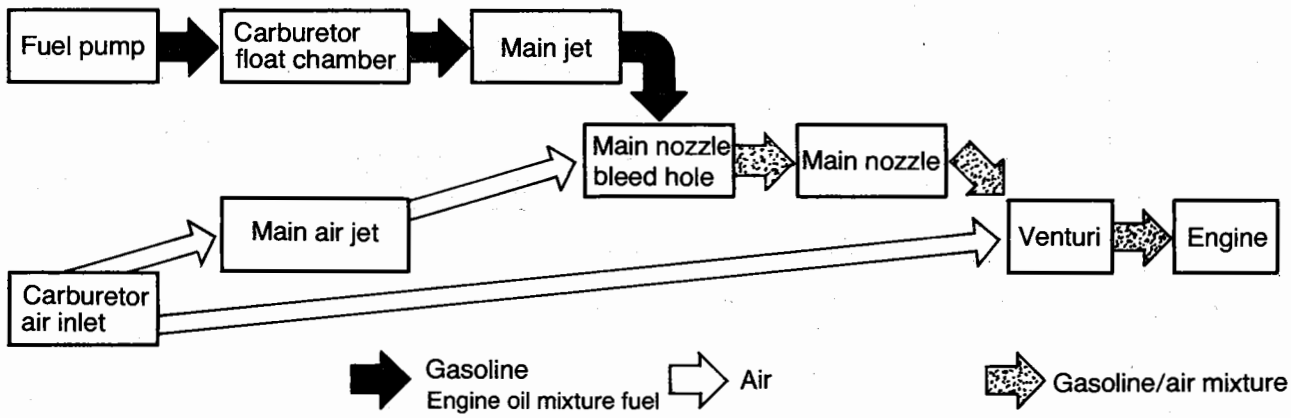


EPT, EFT, and EF Models

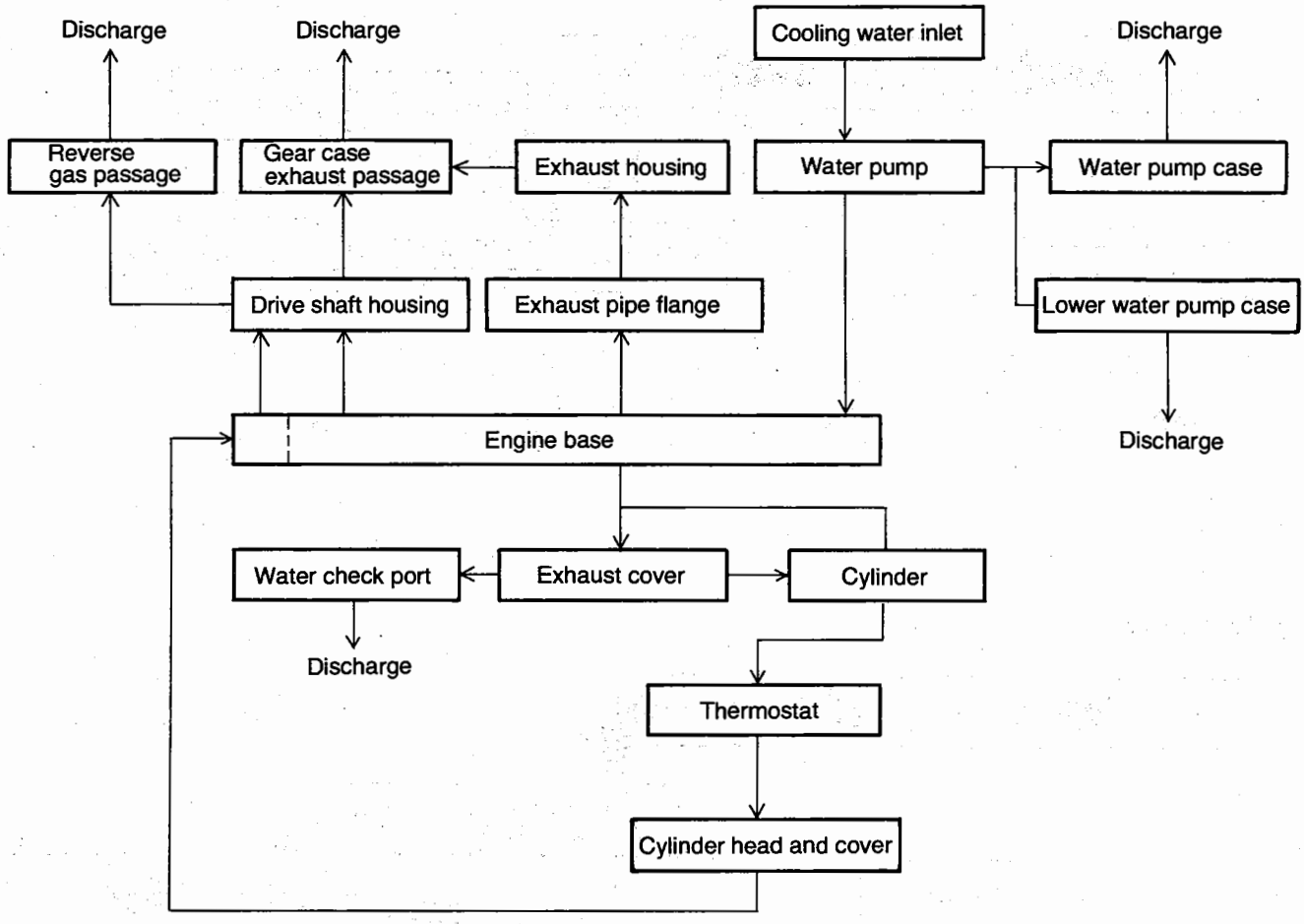
(1) Pilot system, slow system



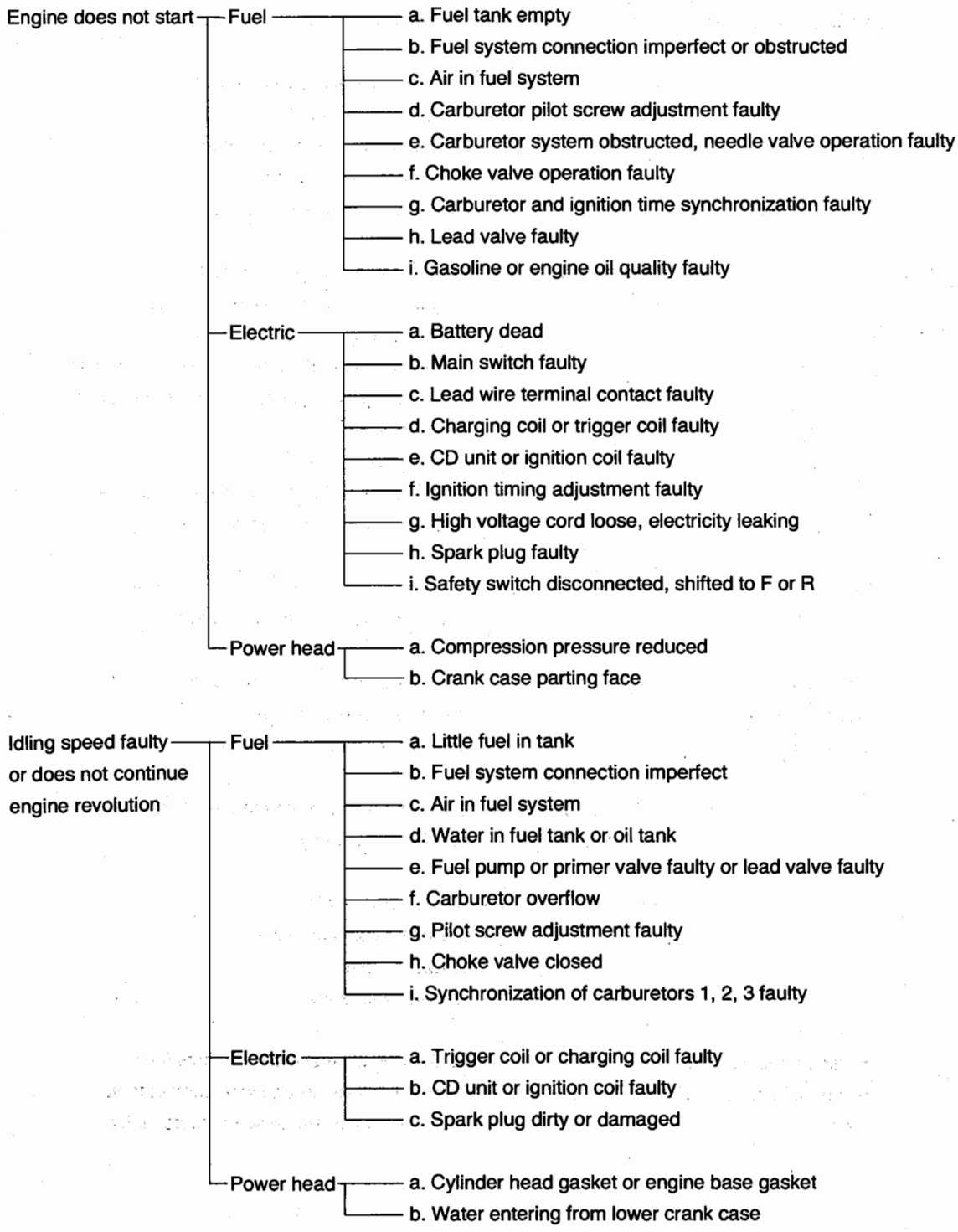
(2) Main system

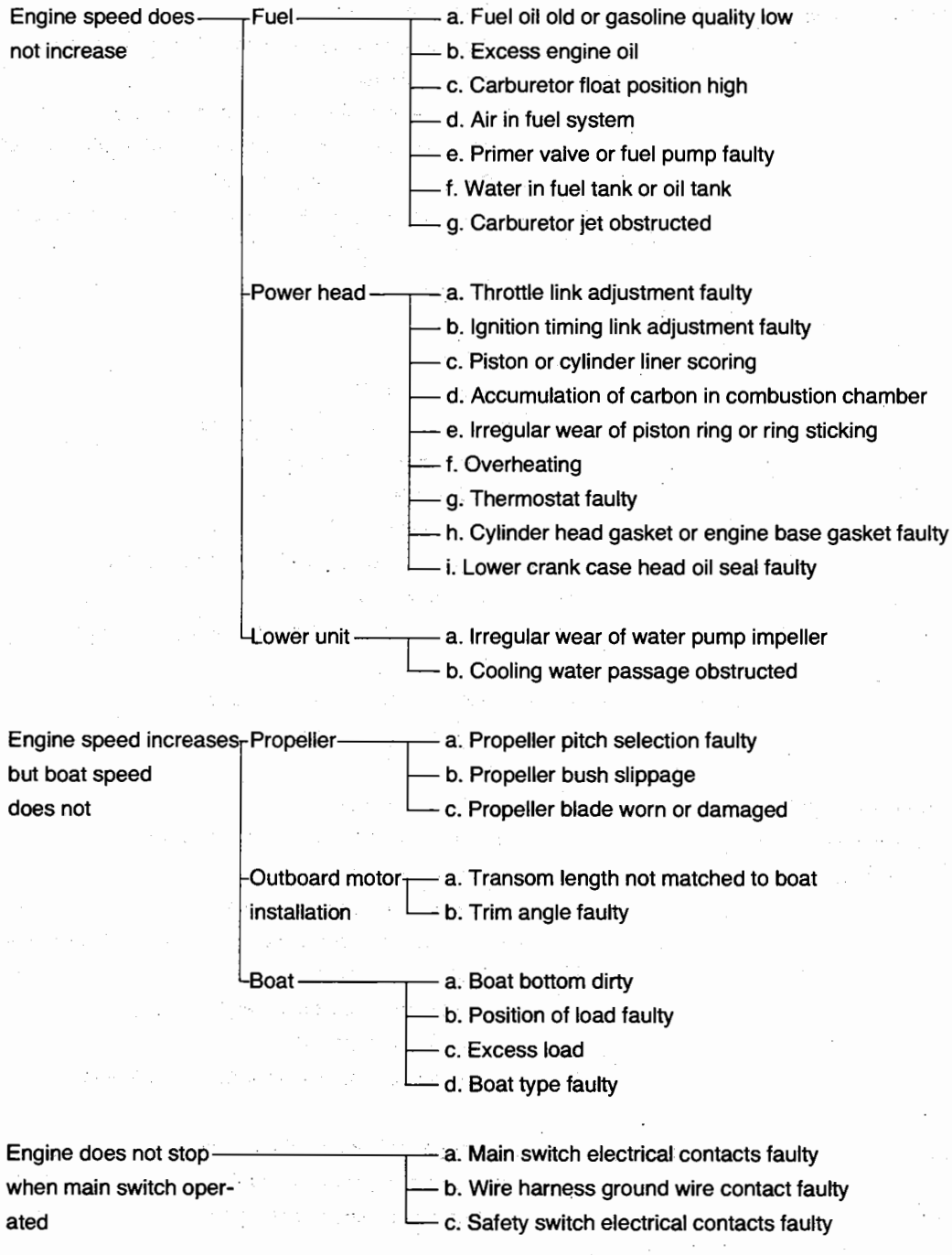


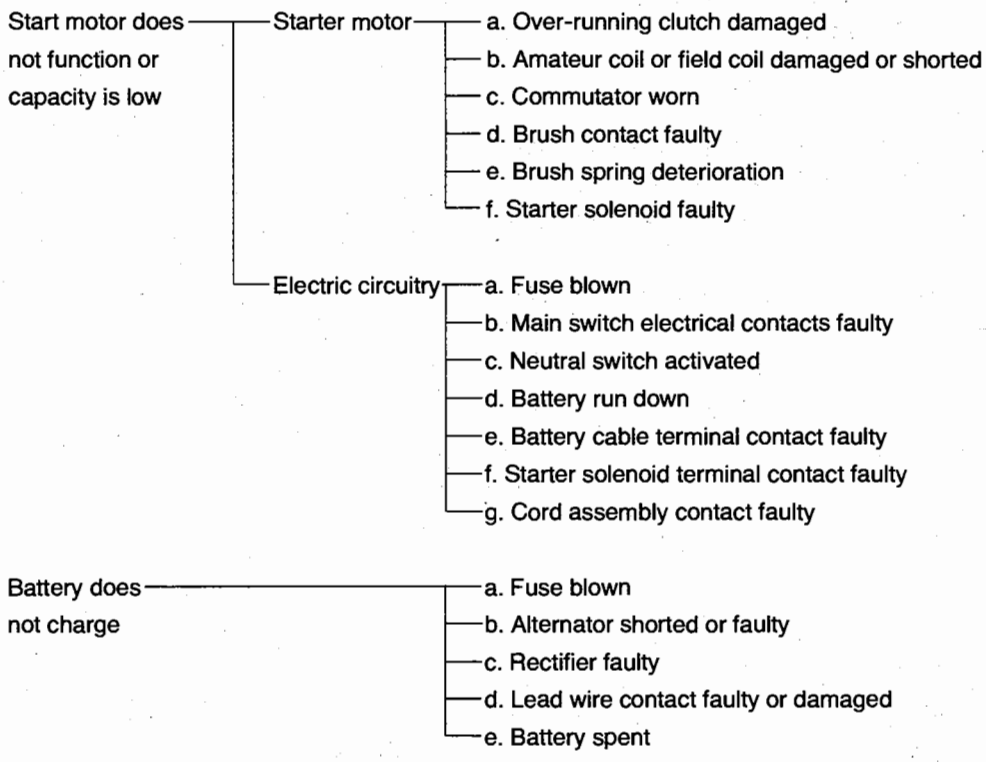
15 COOLING WATER



16 TROUBLESHOOTING




Engine speed does not increase
Fuel
a. Fuel oil old or gasoline quality low
b. Excess engine oil
c. Carburetor float position high
d. Air in fuel system
e. Primer valve or fuel pump faulty
f. Water in fuel tank or oil tank
g. Carburetor jet obstructed
Power head
a. Throttle link adjustment faulty
b. Ignition timing link adjustment faulty
c. Piston or cylinder liner scoring
d. Accumulation of carbon in combustion chamber
e. Irregular wear of piston ring or ring sticking
f. Overheating
g. Thermostat faulty
h. Cylinder head gasket or engine base gasket faulty
i. Lower crank case head oil seal faulty
Lower unit
a. Irregular wear of water pump impeller
b. Cooling water passage obstructed
Engine speed increases but boat speed does not
Propeller
a. Propeller pitch selection faulty
b. Propeller bush slippage
c. Propeller blade worn or damaged
Outboard motor installation
a. Transom length not matched to boat
b. Trim angle faulty
Boat
a. Boat bottom dirty
b. Position of load faulty
c. Excess load
d. Boat type faulty
Engine does not stop when main switch operated
a. Main switch electrical contacts faulty
b. Wire harness ground wire contact faulty
c. Safety switch electrical contacts faulty


Start motor does not function or capacity is low
Starter motor
a. Over-running clutch damaged
b. Amateur coil or field coil damaged or shorted
c. Commutator worn
d. Brush contact faulty
e. Brush spring deterioration
f. Starter solenoid faulty
Electric circuitry
a. Fuse blown
b. Main switch electrical contacts faulty
c. Neutral switch activated
d. Battery run down
e. Battery cable terminal contact faulty
f. Starter solenoid terminal contact faulty
g. Cord assembly contact faulty
Battery does not charge
a. Fuse blown
b. Alternator shorted or faulty
c. Rectifier faulty
d. Lead wire contact faulty or damaged
e. Battery spent

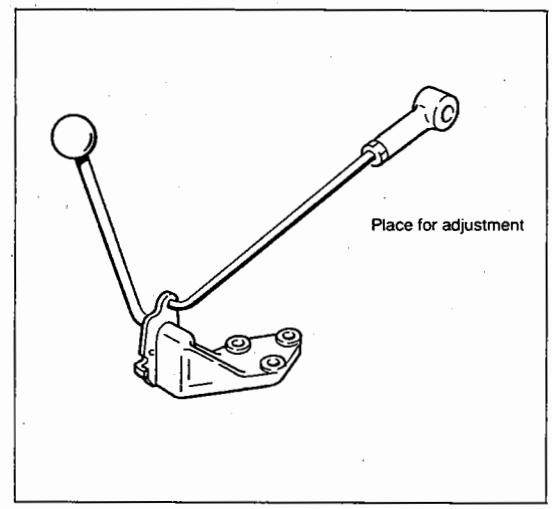
17 M90A EFT/ET MODELS

(1) Neutral switch

1) Place of installation — inside lower motor cover
2) Inspection of operation
   Check that the starter motor does not operate when the shift lever is in the F or R position.

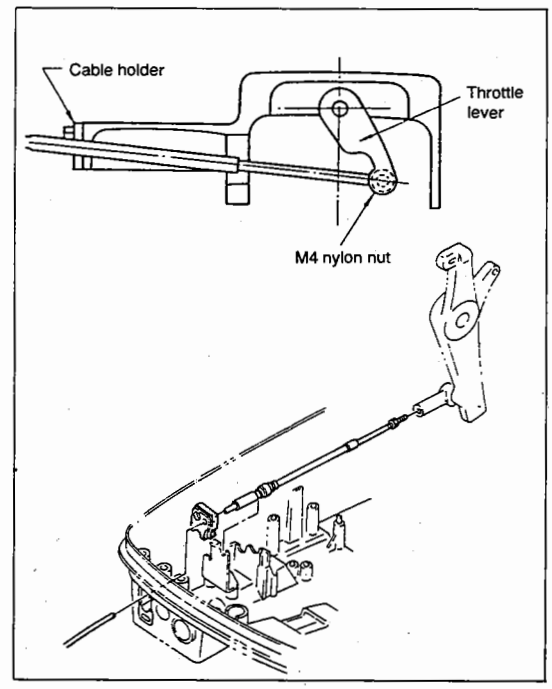
(2) Clutch lever

1) Distribute the clutch lever working length with the clutch in the N position and adjust the screwing depth of the cable joint so that the center hole in the clutch stopper plate and the center of the ball are matched.
2) Apply outboard motor oil to the grommet shift rod passing part, the stopper ball, and the holder.



(3) Bar handle type throttle cable

1) Pass the throttle cable through the handle and fix with the throttle cable holder.
2) Insert the tip of the throttle cable into the throttle lever and fasten with an M4 nylon nut. Tighten the nut enough so that the tip of the cable can rotate with no shaking.
3) Adjust the degree to which the cable joint on the cable tip is screwed in so that it touches the stopper when fully open. Next set to the slow side and check that there is leeway in the movement of the cable.



(4) Shock absorber, lower

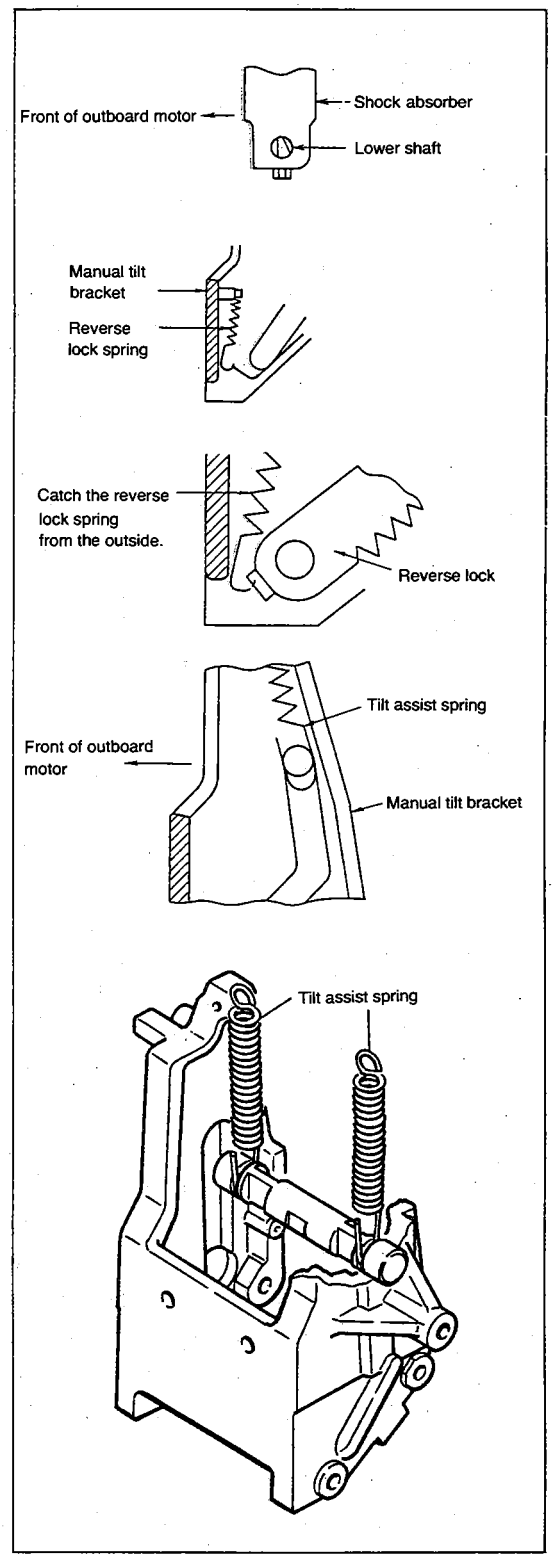
The lower shock absorber hook should be facing a certain direction. Set as shown in the diagram when installing on the manual tilt bracket.

(5) Reverse lock spring

Set the direction of the reverse lock spring as shown in the drawing.

(6) Tilt assist spring

Set so that the open part of the tilt assist spring is facing the front of the outboard motor.



18 PERIODIC INSPECTION OF THE OUTBOARD MOTOR

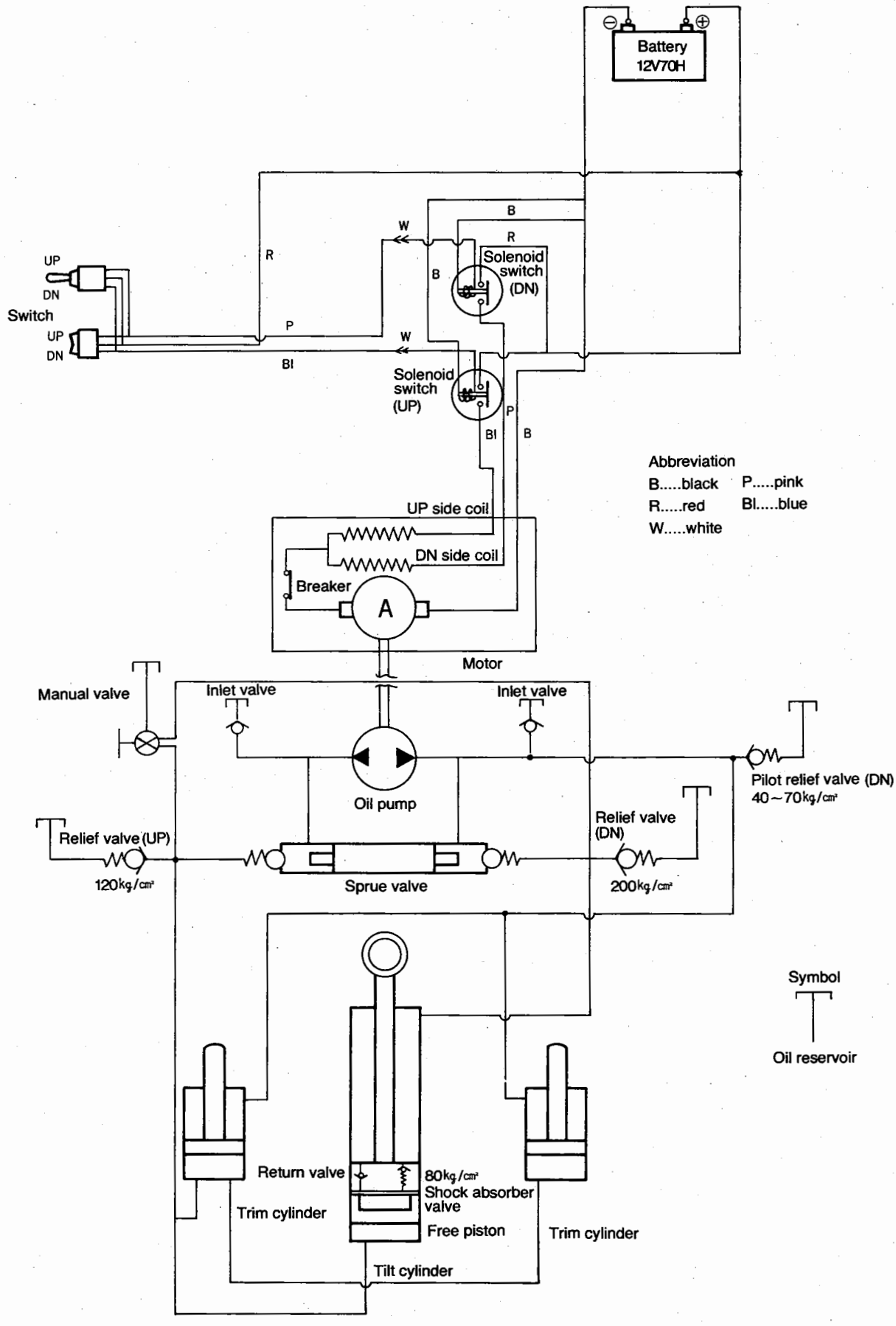
Inspection	Procedure	10 hours or 1 month	50 hours or 3 months	100 hours or 6 months	Remarks
1. Retightening of bolts and nuts	• Cylinder head, cylinder head cover, exhaust cover, carburetor, inlet manifold, crank case, oil pump, magnet nut, starter motor, drive shaft housing, gear case, propeller shaft housing, propeller nut, mounting rubber, etc.	○	○		Refer to tightening torque table for retightening torque.
2. Gear oil	• Check for water or metallic powder when replenishing or changing. • If amount of water or amount of oil replenished is irregularly high, inspect and repair the gear case.	○ Changing	○ Changing		Change oil every 200 hours, 1 year, or before prolonged storage Inspect before season
3. Spark plug	• Repair, clean, or replace if electrode wear causes gap to increase or carbon to adhere	○	○		NGK B8HS10 CHAMPION L78C Gap 0.9~1.0 mm
4. Fuel system	• Check fuel tank, fuel pipe, fuel filter, fuel connector, fuel pump. Also remove internal dirt and water, and check for fuel leakage, air intake, damage, insufficient clipping	○	○		Replace fuel pipe every 2 years
5. Carburetor	• Remove internal dirt and water and clean with washing liquid and air. • Check for wear of float valve.			○	If float valve wear is great, replace or repair with carburetor repair kit
6. Grease up	• Propeller shaft, bracket bolt, steering shaft, power TT steering upper pin, manual tilt mechanism, drag link, bar handle, sliding parts, manual clutch sliding parts, clutching mechanism, throttling mechanism, carburetor, ball joint cap, starter motor pin, hook lever, etc.		○		Refer to sealing, adhesive, and lubrication table
7. Compression pressure	• Measure the cylinder compression pressure with a compression gauge. Standard — approx. 8.2 kg/cm^2		○		Measure with throttle fully open after engine warmed

Inspection	Procedure	10 hours or 1 month	50 hours or 3 months	100 hours or 6 months	Remarks
8. Water strainer	• Remove dirt, shells, seaweed, etc. and clean	○			
9. Cooling water passage	• Remove incrustation and dirt from water pump, pump impeller, water pipe, cylinder, cylinder head, head cover, thermostat, exhaust cover, engine base, and exhaust pipe passages.			○	If water pump is damaged or worn, repair with repair kit
10. Carbon removal	• Cylinder head, piston crown, cylinder exhaust passage (including exhaust bypass), inner exhaust cover, engine base, exhaust pipe, piston ring groove.			○	Be careful not to scratch the surface of the cylinder head, piston crown, and ring groove
11. Electrical wiring	• Loose connections, damaged wires, damaged coating	○		○	
12. Ignition timing, throttle link mechanism	• When throttle fully closed: ATDC 5°±1° When throttle fully open: BTDC 20°±1° • Shaking in ball joint cap, looseness in lock nuts, bending of link rods, shaking of rod snaps	○		○	If there is shaking in the ball joint cap or rod snaps, replace
13. Idling adjustment	• After synchronization of 3-series carburetor for the first time, PS return 1 1/2 ±1/4 rotation, revolution when clutch at F, 550~700 rpms.	○	○		After warming up.
14. Power trim and tilt oil level	• Tilt up, set tilt stopper, remove oil plug, and check that oil is below oil plug hole. Check for leakage and/or damage to pipes. If level low, replenish with specified oil.	○		○	Oil (ATF oil) Example: Shell Dexron-II Esso ATF Mobil DTE#22, etc.
15. Function of power trim and tilt manual valve	• Loosen manual valve and check that tilting up and down are possible.		○		
16. Function of power trim and tilt	• Check function of trim, tilt, and shallow water running	Inspect each time used.			
17. Oil system	• Remove dirt and/or water from oil tank, oil pump, oil filter, and check valve. Check for oil leakage, damage, incomplete clipping.	○		○	Replace check valve every 2 years.

Inspection	Procedure	10 hours or 1 month	50 hours or 3 months	100 hours or 6 months	Remarks
18. Anode Trim tab Cylinder head Power trim and tilt	• Check for corrosion and wear. If wear is approximately 1/3, replace.	Inspect each time used.			Each year
19. Cooling water check	• Discharge of cooing water from inspection hole, plastic or dirt in cooling water inlet (water strainer).	Inspect each time used.			
20. Control box	• Function of key switch, safety switch, free accele lever, control lever, buzzer.	Inspect each time used.			With clutch in, switch on, and engine stopped, check function of buzzer.
21. Bar handle	• Throttle weight and shaking	Inspect each time used.			
22. Manual clutch	• Weight of operation, shaking Forward, neutral, reverse distribution				
23. Boat installation bolts	• Loose nuts and bolts	Inspect each time used.			
24. Drag link	• Loose nuts and bolts, shaking, grease	Inspect each time used.			

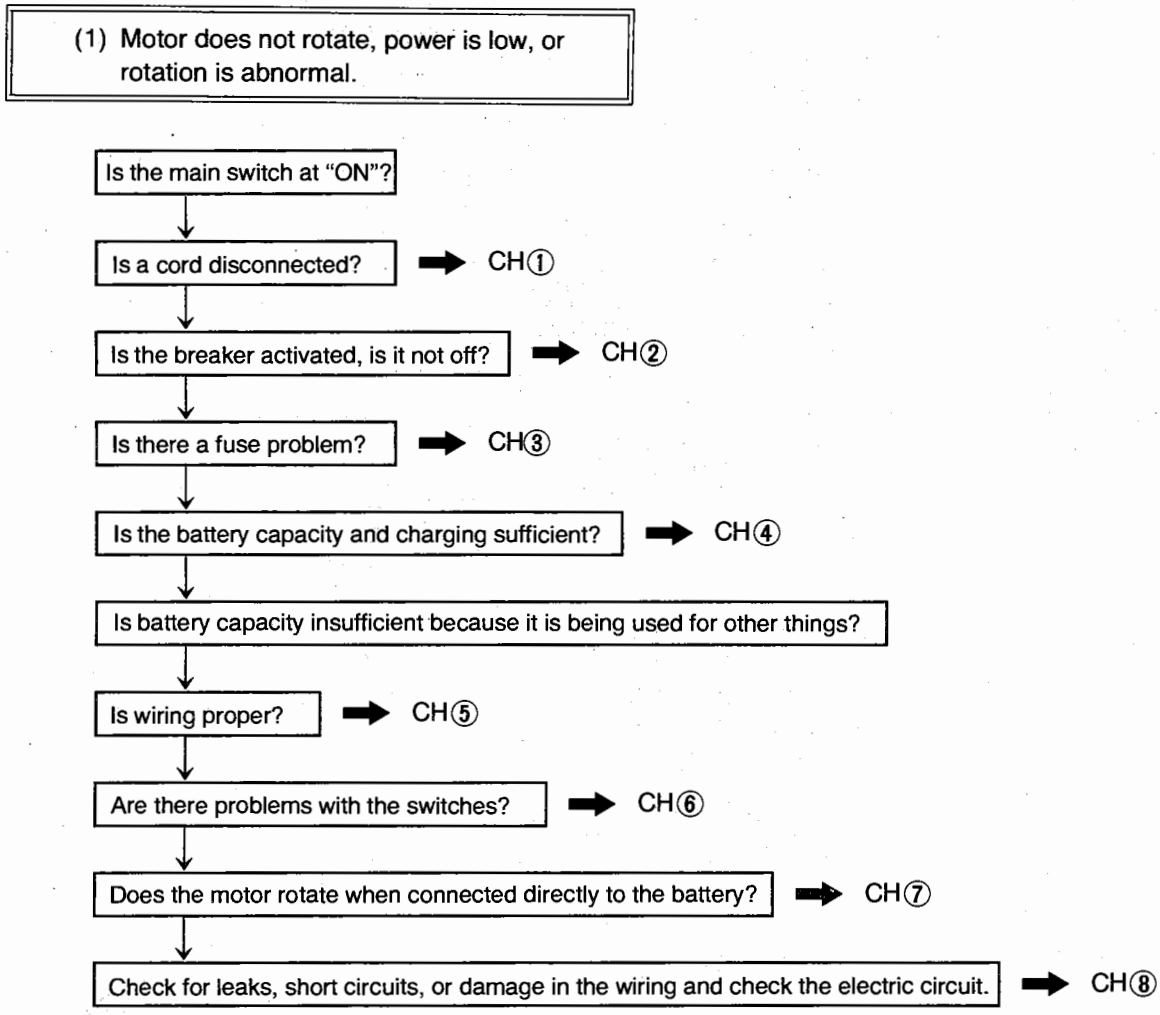
19 POWER TRIM AND TILT

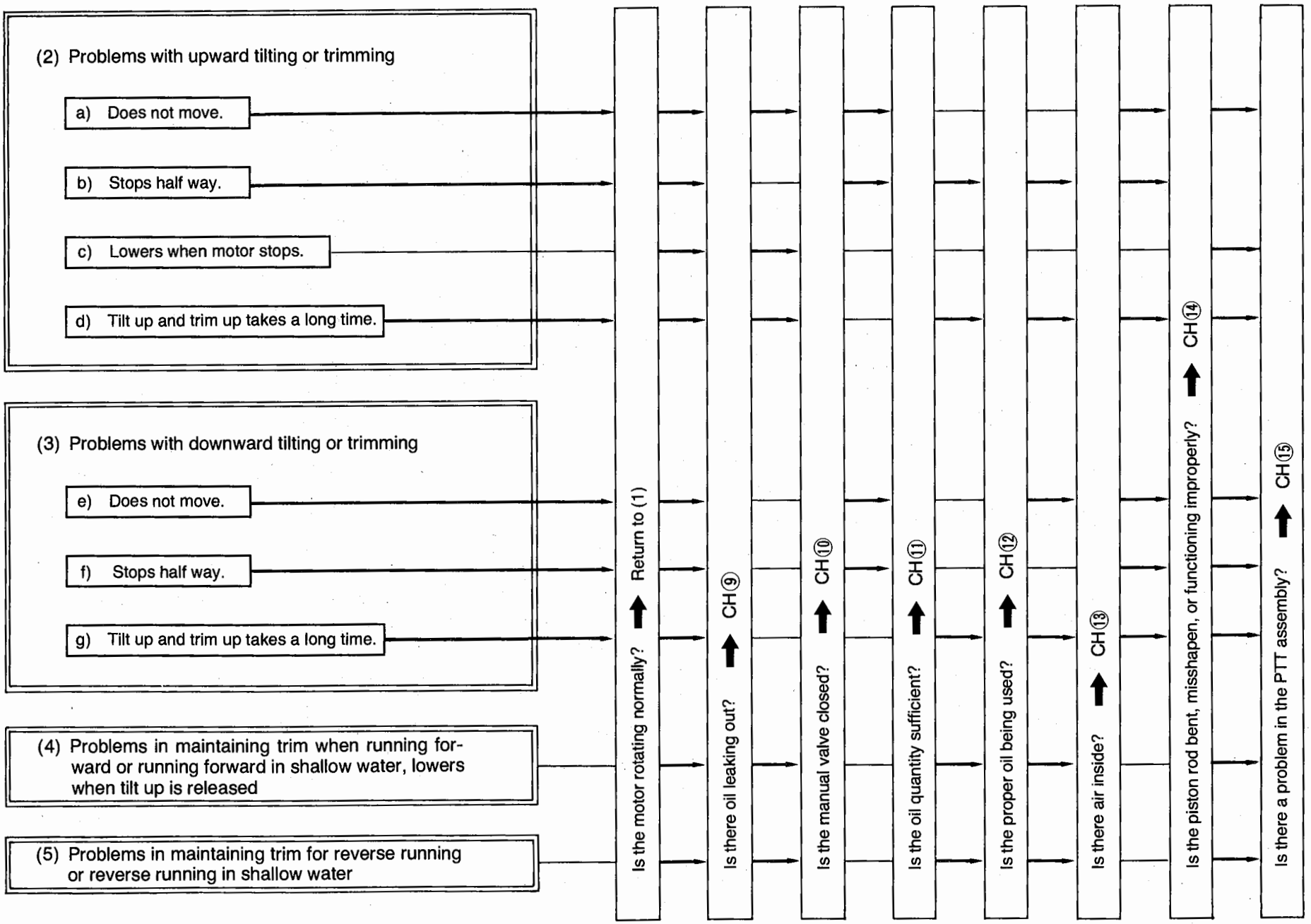
(1) Structural diagram



(2) Power trim and tilt troubleshooting

1) Description of problem and checks




(2) Problems with upward tilting or trimming
a) Does not move.
b) Stops half way.
c) Lowers when motor stops.
d) Tilt up and trim up takes a long time.
(3) Problems with downward tilting or trimming
e) Does not move.
f) Stops half way.
g) Tilt up and trim up takes a long time.
(4) Problems in maintaining trim when running forward or running forward in shallow water, lowers when tilt up is released
(5) Problems in maintaining trim for reverse running or reverse running in shallow water
Is the motor rotating normally?
Return to (1)
Is there oil leaking out?
CH⑨
Is the manual valve closed?
CH⑩
Is the oil quantity sufficient?
CH⑪
Is the proper oil being used?
CH⑫
Is there air inside?
CH⑬
Is the piston rod bent, misshapen, or functioning improperly?
CH⑭
Is there a problem in the PTT assembly?
CH⑮

2) Checks

CH① Is a cord disconnected?

- Is the battery cord connected to the battery?
- Are the cords connected securely?

CH② Is the breaker activated, is it not off?

- Touch the motor. If it is hot, the breaker may be activated. Let cool off for at least 3 minutes.

CH③ Is there a fuse problem?

- Open the engine cover and check the fuses in the electric bracket.

CH④ Is the battery capacity and charging sufficient?

- A battery of 12V, 70AH or greater should be used.
- Check the specific gravity of the battery electrolyte. If it is 1.22 (20°C) or less, charge.
- Operate the cell motor. If it rotates, OK.

CH⑤ Is wiring proper?

- Check for any mistakes using the wiring diagram.

CH⑥ Are there problems with the switches?

- Inspect the main switch ... Operate the other equipment (choke solenoid, cell motor, buzzer). If they operate properly, OK.
  Also use a tester to check the conductivity between the red lead wires. If electricity is conducted when the switch is on, OK.
- PTT switch ... Disconnect the white lead wire for the solenoid switch in the engine's electric bracket, and touch the terminal directly to the terminal board of the red cord. If the PTT assembly works, the PTT switch is defective (both up and down).
  Also use a tester to check the conductivity of the PTT switch.
  Press UP. If electricity is conducted between the red lead wire and the sky blue lead wire, OK.
  Press down. If electricity is conducted between the red lead wire and the pink lead wire, OK.
- Solenoid switch
  Disconnect the same white lead as above and touch it directly to the terminal board of the red cord. If a clicking sound is heard, OK.
  Next check the conductivity between board terminals. If electricity is conducted when the solenoid switch is on, OK. (NOTE: disconnect the red cord) If one side is judged OK, switch to the other.

CH⑦ Does the motor rotate when connected directly to the battery?

- Disconnect the PTT assembly blue and pink cords from the solenoid switch terminal board and touch the terminals separately to the red cord terminal. If it moves up when the blue terminal is touching and down when the pink terminal is touching, OK.
- Bring the PTT assembly cord through the engine cover and touch the terminals directly to the battery terminal. If the motor does not turn, it is defective.

CH⑧ Check for leaks, short circuits, or damage in the wiring and check the electric circuitry.

- Check the conductivity and for short circuits, especially for the cords.
- Also check for damage to cords for switches, etc.

CH⑨ Is there oil leaking out?

- Look outside to see if oil is leaking.
  Slight leaks are hard to find, so operate the PTT assembly and see if oil is floating on the water.
- If the oil tube nut is loose, retighten it.
  (Tightening torque: 1.14~1.54 kg-m 8.2~11.1 ft-Lbs)
- If oil is leaking from the PTT assembly or cylinder, there is breakage or assembly is wrong. Disassemble and inspect, and if necessary replace.

NOTE: Replace the O ring after disassembling the oil tube.

CH⑩ Is the manual valve closed?

- Try tightening the manual valve.
  Direction: clockwise Torque: 0.2 × 0.3 kg-m (17~26 inch-Lbs)

CH⑪ Is the oil quantity sufficient?

- Check the oil level.
  Proper oil level — bottom of oil plug hole when tilted up (all piston rods fully extended)

NOTE: When the quantity of oil is insufficient and oil is added, be sure to bleed the air then recheck the oil level.
Refer to CH⑬ for the air bleeding instructions.

- If tilting up is impossible when it is practically empty:
  Open the manual valve and tilt up manually, then apply the tilt stopper so that the engine it does not lower.
  Check for oil leakage.
  Replenish oil up to the bottom of the oil plug hole, operate the PTT assembly a little in the tilt up direction, and tilt up in steps while pouring in the oil. Close the manual valve to keep air out. When the motor is tilted up, release the tilt stopper, bleed the air, check the oil level, check the tilt up and down operations, and if necessary bleed the air and check the oil level.
- The normal total oil quantity is: 730 cc (24.6 fl-oz)
  NOTE: For PTT assembly position when supplying oil, see page 57.

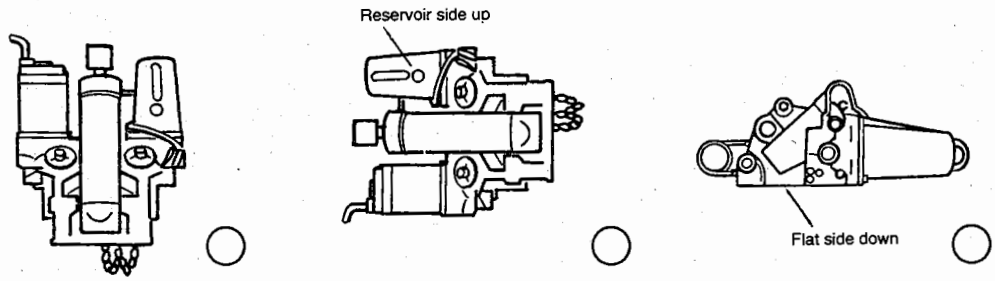
CH⑫ Is the proper oil being used?

- Only use the specified oil.
  (The oil used for this engine is Nihon Sekiyu AFT Dexron.)
  Specified oil: Automatic transmission fluid (conforming to GM standards)
  Mobil: Mobil DTE #22
  Mobil ATF 220
  Esso: Esso automatic transmission fluid
  Shell: Shell dextron II
  Shell terrace oil #22, K22

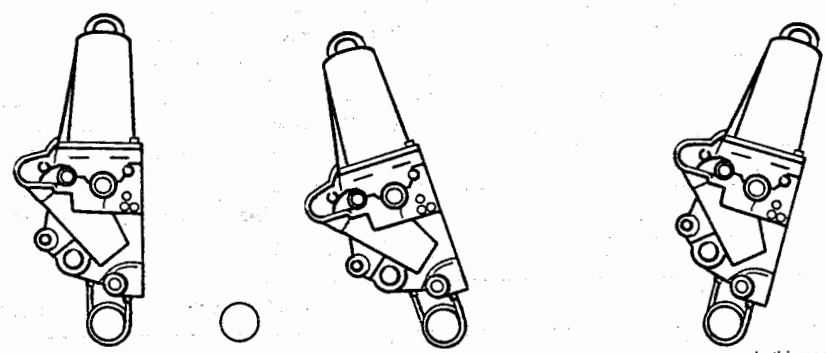
CH⑬ Is there air inside?

- If the PT/T assembly is operated with air inside, muffled sounds can be heard here and there so it is sometimes possible to tell this way.
- Air bleeding procedure (close the oil plug while bleeding air)
  Open the manual valve and repeatedly tilt up and down manually 4 times or more. Finally perform power tilt up and check the oil level.
- If air is deep inside
  This air cannot easily be bled at once, so wait several days then bleed it.
  NOTE: Be careful for standing position not to let air in.

The following shows a storing position in which air will not get it (with the opposite position, air will enter).



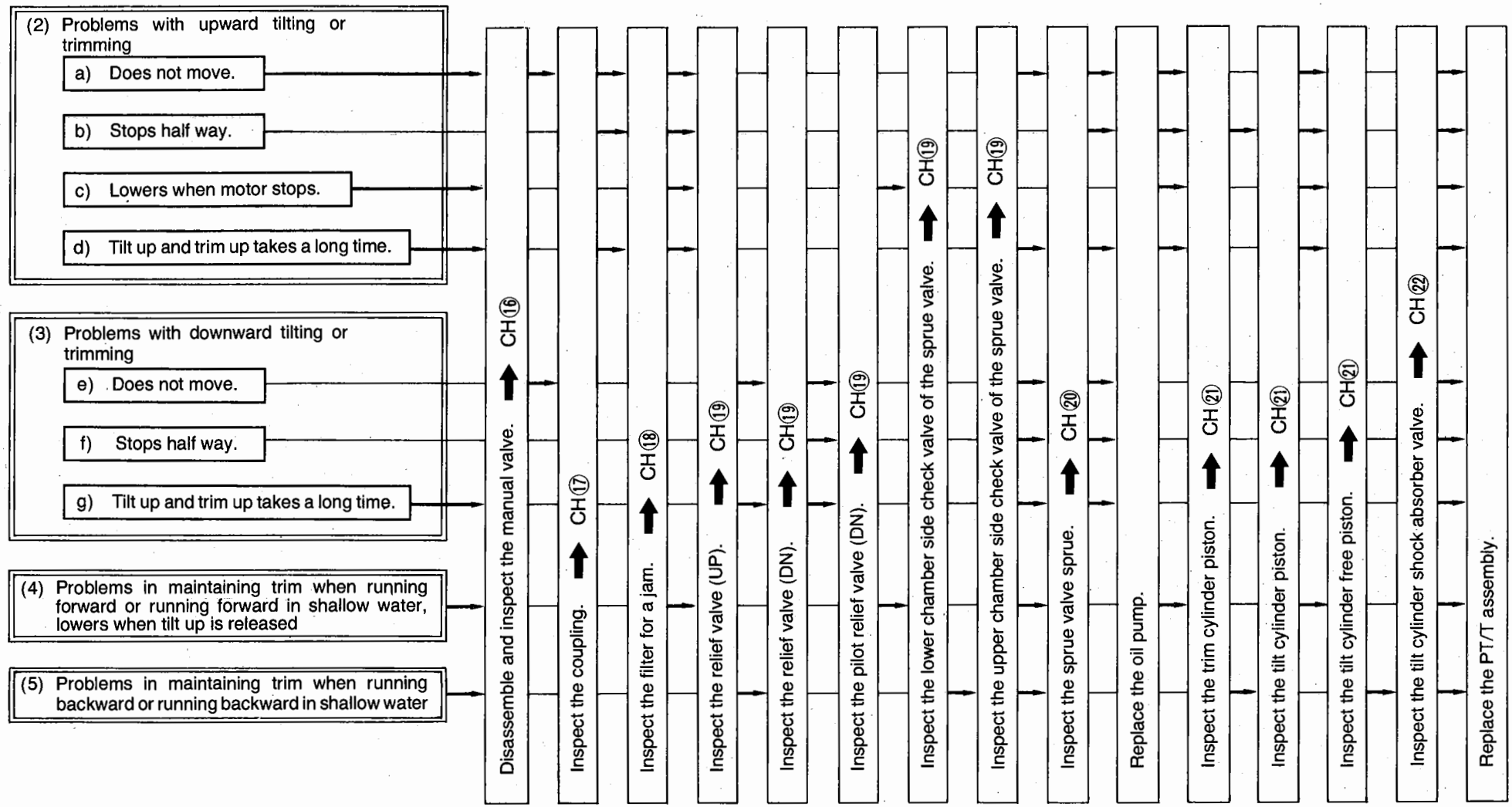
The position for replenishing oil in CH⑪ is as follows:



CH⑭ Is the piston rod bent, misshapen, or functioning improperly?

- Open the manual valve, tilt up and down manually, and check that operation is smooth.
- Check by sight.

CH⑮ Is there a problem in the PT/T assembly? .....The inspection differs according to the problem. Refer to the following.



NOTES:

1. Use the exclusive stand (special tool) when disassembling the PT/T assembly.
2. When disassembling, tilt up (with piston rod extended), open the manual valve, then leave for a while until the inner pressure reaches 0.
3. When removing parts, take care that oil does not squirt out into your eyes or onto your clothes.
4. Open the reservoir tank oil plug and remove the oil, then remove the motor and reservoir tank.

CH⑯ Disassemble and inspect the manual valve.

- Damage to manual valve end surface
- Damage to "O" ring
- Damage to seal washer (especially rubber seal)
- Damage to bottom surface of valve mounting hole

NOTE: Be careful that the seal washer is positioned properly when assembling.

CH⑰ Inspect the coupling.

Remove the motor and inspect the coupling.

- Is it disconnected?
- Is it damaged?

CH⑱ Inspect the filter for a jam.

Remove the motor and filter and clean.

CH⑲ Inspect the relief valves and check valves.

- Deterioration or bending of spring
- Damage to valve seat
- Damage or wear of valve (ball)
- Smooth operation ... Catching on dirt, etc. (push the ball by hand and check return)
- For the UP relief valve, also inspect for filter jam.
- Damage to "O" ring

CH⑳ Inspect the sprue valve sprue.

- Smooth operation (move by pushing lightly by hand)
- Damage or wear of backup ring

CH㉑ Inspect the cylinder pistons.

- Damage or wear of "O" ring and backup ring
- Damage to piston sliding surface of cylinder

CH㉒ Inspect the tilt cylinder shock absorber valve.

Disassembly the piston.

- Deterioration or damage to spring
- Damage to valve (ball)
- Damage to valve seat
- Catching on dirt

3) Cautions on disassembly and assembly

1. Cautions on disassembly and assembly of power trim and tilt assembly
   (1) Before disassembling, tilt up (with piston rod extended), open the manual valve, then leave for a while until the inner pressure reaches 0.
   (2) Open the oil plug and let the oil out.
   (3) When removing parts, be careful of squirting oil. Be especially careful of your eyes and your clothes.
   (4) Use the following special tools:
      • PTT stand (work stand)
      • Wrench, trim rod guide
      • Wrench, tilt rod guide
   (5) Before assembling, clean so that no dirt or foreign substances get inside.

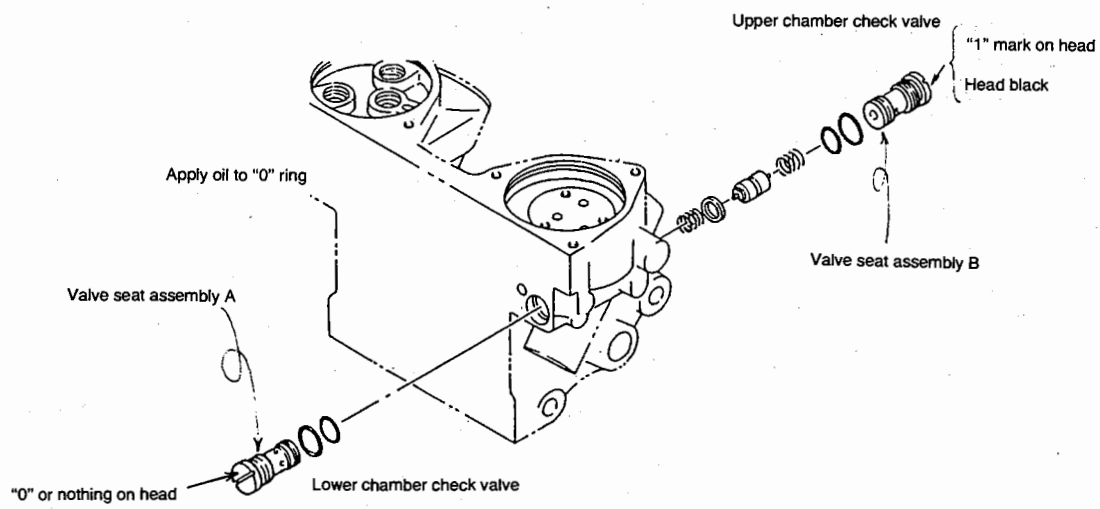
2. Assembly
   (1) Oil pump assembly (internal parts cannot be disassembled)
      Bolt tightening torque: 0.5~0.55 kg-m (43.4~47.7 in—LBS)
      "O" ring — apply oil

   (2) Relief valve (UP)
      Tightening torque: 1.2~1.4 kg-m (8.68~10.13 ft-Lbs)
      "O" ring — apply oil

   (3) Relief valve (DN)
      Tightening torque: 1.2~1.4 kg-m (8.63~10.13 ft-Lbs)
      "O" ring — apply oil

   (4) Pilot relief valve (DN)
      Tightening torque: 1.2~1.4 kg-m (8.68~10.13 fr-Lbs)
      "O" ring — apply oil

   (5) Sprue valve
      Apply oil to the outer surface and backup spring.
      There are two types of check valves, one for the upper chamber, the other for the lower chamber. Be careful not to confuse these. (See drawing below)
      Check valve tightening torque: 0.9~1.1 kg-m (6.51~7.96 ft-Lbs)



(6) Manual valve

Be careful to assemble the seal washer, spring, and inner collar in the correct order. (Refer to the parts list)
Assemble the seal washer in the correct direction (if tightened on its side it will break).

Tightening torque: 0.2~0.3 kg-m (17.4~26 inch-Lbs)
O ring — apply oil

(7) Piston sub assembly, trim

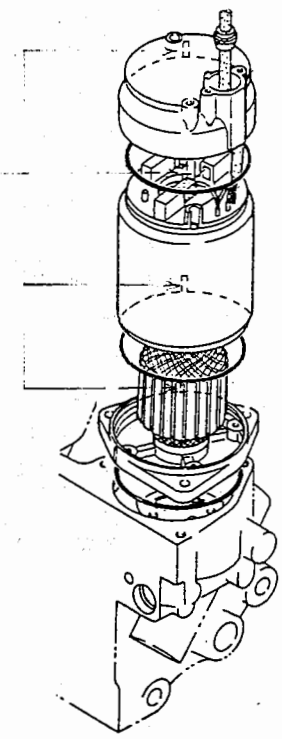
Apply oil to O ring, backup ring, and outer surface of piston

(8) Rod guide sub assembly, trim

Tightening torque: 7~9 kg-m (50.6~65.1 ft-Lbs)
O ring — apply oil
Oil seal — apply grease

(9) Cylinder assembly, tilt

Apply grease to shaft and outer surface of bushing.
Replace "O" ring and oil tube nut.
Screw in oil tube nut two or three turns with your fingers then tighten using the tool (using the tool from the beginning will make it crooked).
Oil tube nut tightening torque: 1.1~1.3 kg-m (7.96~9.40 ft-Lbs)
Apply oil to free piston "O" ring, backup ring, and outer piston surface.
Apply oil to piston rod assembly "O" ring and backup ring
Apply oil to rod guide "O" ring
Rod guide tightening torque: 8~12 kg-m (57.9~86.8 ft-Lbs)



(10) Motor

Through bolt tightening torque: 0.35~0.45 kg-m (30.3~39 in-Lbs)
Screw (for cord outlet seal plate) tightening torque: 0.35~0.45 kg-m (30.3~39 in-Lbs)
Line up marks when assembling amateur and yoke compressor
Bolt (for motor assembly) tightening torque: 0.5~0.7 kg-m (43.4~60.8 in-Lbs)

(11) Oil reservoir

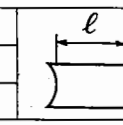
Bolt tightening torque: 0.5~0.7 kg-m (43.4~60.8 in-Lbs)
Apply oil to "O" ring
Oil plug tightening torque: 0.3~0.5 kg-m (26.0~43.4 in-Lbs)

(4) M90A Power Trim and Tilt Service Data

1. Pump assembly

Oil pump	Gear pump
Relief valve (UP) opening pressure	120~120 kg/cm^2 (1706~1991 psi)
Relief valve (DN) opening pressure	180~260 kg/cm^2 (2560~3697 psi)
Pilot relief valve (DN) opening pressure	40~70 kg/cm^2 (569~995 psi)
Sprue check valve upper chamber opening pressure	2.4 kg/cm^2 (34 psi)
Sprue check valve lower chamber opening pressure	1.2 kg/cm^2 (17 psi)
Oil capacity	730 cc (24.66 fl. oz)
Oil	Nippon Sekiyu ATF DEXRON
Oil filter	150-mesh

2. Motor

Rated time	60 sec	
Rated voltage	12V (DC)	
Output	0.3 kW	
Direction of rotation	Forward, reverse	
Breaker	DC sensor type	
Activation	40~120 sec (52 A)	
Reset	Within 35 sec.	
Commutator standard outer diameter	28 mm (1.102 inch)	
Usage limit	27 mm (1.063 inch)	
Brush standard dimensions (l on diagram)	11.5 mm (0.453 inch)	
Usage limit	5.5 mm (0.216 inch)	
Replacement dimensions	7.5 mm (0.295 inch)	
Amateur shaft core deflection standard value	0.15mm or less	
Usage limit	0.15mm or greater	
Field coil standard resistance	0.050 Ω (pink — blue)	

3. Trim cylinder

Piston diameter	38 mm (1.50 inch)
Piston rod diameter	16 mm (0.63 inch)
Stroke	69 mm (2.72 inch)

4. Tilt cylinder

Piston diameter	45 mm (1.77 inch)
Piston rod diameter	19 mm (0.75 inch)
Stroke	131 mm (5.16 inch)
Shock absorber valve opening pressure	65~95 kg/cm^2 (924~1351 psi)

5. Switch

Control box (P type)	Single pole double throw paddle locker switch (3 A)
Panel (F type)	Single pole double throw toggle switch (20 A)

6. Solenoid switches (UP and DN)

Rated voltage	12 V (DC)
Rated time	30 sec (at 100 A)
Excitation current	3 A or less
Excitation coil standard resistance	5.2 Ω

7. Tightening torques

Bolt, PTT	2.30~3.12 kg-m (16.6~22.6 ft-lbs)
Oil plug	0.3~0.5 kg-m (26~44 in-lbs)
Manual valve	0.2~0.3 kg-m (17~26 in-lbs)
Oil tube nut	1.1~1.3 kg-m (7.96~9.40 ft-lbs)
Motor	
Through bolt	0.35~0.45 kg-m (30.4~39 in-lbs)
Screw, seal plate (cord outlet)	0.35~0.45 kg-m (30.4~39 in-lbs)
Bolt, motor assembly	0.5~0.7 kg-m (43.4~60.8 in-lbs)
Bolt, oil reservoir	0.5~0.7 kg-m (43.4~60.8 in-lbs)
Pump	
Bolt, oil pump	0.5~0.55 kg-m (43.4~47.7 in-lbs)
Relief valve assembly (UP)	1.2~1.4 kg-m (8.68~10.13 ft-lbs)
Relief valve assembly (DN)	1.2~1.4 kg-m (8.68~10.13 ft-lbs)
Pilot relief valve assembly (DN)	1.2~1.4 kg-m (8.68~10.13 ft-lbs)
Sprue check valve assembly	0.9~1.1 kg-m (6.51~7.96 ft-lbs)
Rod guide, trim	7~9 kg-m (50.6~65.1 ft-lbs)
Rod guide, tilt	8~12 kg-m (57.9~86.8 ft-lbs)
(Nut, tilt piston rod)	8~12 kg-m (57.9~86.8 ft-lbs)
Switches	
Screw, PTT switch (P type)	0.05~0.08 kg-m (4.3~6.9 in-lbs)
Bolt, PTT switch (F type)	0.15~0.3 kg-m (13.0~26.0 in-lbs)

8. "O" rings (standard dimensions)

	Line diameter	Inner diameter
Oil plug	P-9	1.9—8.8 mm (0.075—0.346 inch)
Oil reservoir	A-03	1.78—69.6 mm (0.070—2.740 inch)
Motor assembly	A-03	1.78—69.6 mm (0.070—2.740 inch)
Motor	S-70	2.0—69.5 mm (0.079—2.736 inch)
Through bolt	P-5	1.9—4.8 mm (0.075—0.189 inch)
Pump assembly outlet passage	S-7	1.5—6.5 mm (0.059—0.256 inch)
Manual valve	S-10	1.5—9.5 mm (0.059—0.374 inch)
	P-18	2.4—17.8 mm (0.094—0.701 inch)
Relief valve assembly (UP)	S-11.2	1.5—10.7 mm (0.059—0.421 inch)
Relief valve assembly (DN)	P-9	1.9—8.8 mm (0.075—0.346 inch)
Pilot relief valve assembly (DN)	S-9	1.5—8.5 mm (0.059—0.335 inch)
Sprue check valve	P-18	2.4—14.8 mm (0.094—0.583 inch)
	S-14	1.5 —13.5 mm (0.059—0.531 inch)
Rod guide, trim	P-39	3.5—38.7 mm (0.138—1.524 inch)
	P-16	2.4—15.8 mm (0.094—0.622 inch)
Trim piston	P-32	3.5—31.7 mm (0.138—1.248 inch)
Rod guide, tilt	S-45	2.0—44.5 mm (0.079—1.752 inch)
Tilt piston	P-39	3.5—38.7 mm (0.138—1.524 inch)
Free piston	P-39	3.5—38.7 mm (0.138—0.524 inch)
Oil tube	P-5	1.9—4.8 mm (0.075—0.189 inch)

9. Spring (standard value)

	Line diameter — Outer diameter — Free length
Spring, brush	0.55—7—18.5 mm (0.0216—0.276—0.728 inch)
Spring, manual brush	1.2—11.5—6 mm (0.0472—0.453—0.236 inch)
Spring, sprue	1.0—10.2—10.5 mm (0.0394—0.402—0.413 inch)
Spring, relief valve (DN)	0.8—6.1—13 mm (0.0315—0.240—0.512 inch)
Spring, pilot relief valve	1.4—6.7—12.4 mm (0.0551—0.264—0.488 inch)
Spring, shock absorber valve	1.2—6.8—18 mm (0.0472—0.268—0.709 inch)
Spring, sprue	1.0—10.2—10.5 mm (0.0394—0.402—0.413 inch)

10. Steel ball (standard diameter)

	Diameter
Relief valve	5/32 inch (3.969 mm)
Pilot relief valve	1/8 inch (3.175 mm)
Shock absorber valve	3/16 inch (4.763 mm)

11. Spring seat (standard height)

Pilot relief valve (DN)	11.2 mm (0.441 inch)
Shock absorber valve	13 mm (0.512 inch)

12. Oil seal

	Inner diameter — Outer diameter — Thickness
Motor	8—18—4.5 mm (0.315—0.709—0.177 inch)
Dust seal, trim rod guide	15.2—24—4.5 mm (0.598—0.945—0.177 inch)
Dust seal, tilt rod guide	18.2—27—4.5 mm (0.717—1.063—0.177 inch)

13. Backup ring

	Inner diameter — Outer diameter — Thickness
Tilt piston	3.9—45—1.25 mm (1.535—1.772—0.0492 inch)
Free piston	3.9—45—1.25 mm (1.535—1.772—0.0492 inch)
Trim piston	3.2—38—1.25 mm (1.260—1.496—0.0492 inch)
Sprue valve	9—12—1.25 mm (0.354—0.472—0.0492 inch)

14. Seal washer

	Inner diameter — Outer diameter — Thickness
Manual valve	4.3—11.5—1.6 mm (0.169—0.453—0.063 inch)

15. Others

Inner collar (manual valve)	Thickness: 9.5 mm (0.374 inch)
Sprue	Total length: 26 mm (1.024 inch)

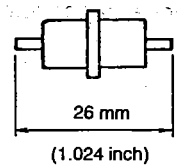
(I) Periodic Inspection

Inspection	Procedure	Period
1. Leakage of oil to exterior	o Inspect by sight o When small and difficult to judge, operate PTT assembly and judge by oil floating on water o If oil tube nut is loose, retighten (Torque: 1.1~1.3 kg-m) (7.96~9.40 ft-lbs)	o Upon purchase o 10 hours or 1 month o 50 hours or 3 months o Every 200 hours or 1 season
2. Damaged or misshapen oil tube	o Inspect by sight o For severe misshape or damage, replace	o Upon purchase o When occurs
3. Loose oil tube nut	o Retighten (Torque: 1.1~1.3 kg-m) (7.96~9.40 ft-lbs)	o Upon purchase o Every 200 hours or 1 season
4. PTT mounting bolt	o Retighten (Torque: 2.30~3.12 kg-m) (16.9~22.6 ft-lbs)	o Upon purchase o Every 200 hours or 1 season
5. Bent piston rod, bent upper cylinder pin, lost or misshapen E ring	o Inspect by sight	o Upon purchase o Every 200 hours or 1 season o After collision
6. Oil level Specified oil Air bleeding	o Oil level should be lower surface of oil plup hole when tilted up (piston rod fully extended) o After adding oil, bleed air then recheck oil level. see troubleshooting CH⑫ see troubleshooting CH⑫	o Upon purchase o 10 hours or 1 month o 50 hours or 3 months o Every 200 hours or 1 season
7. Manual valve operation	o Open manual valve and manual move up and down. **NOTE:** Tightening torque: 0.2~0.3 kg-m (17~26 in-lbs)	o Upon purchase o Every 200 hours or 1 season

(II) Disassembly and Inspection

Part	Inspection	Standard Value	Replacement Limit
1. Motor			
1) Amateur assembly	① Shaft core deflection	0.15 mm (0.0059 inch) or less	0.15 mm (0.0059 inch) or less
	② Commutator outer diameter	28 mm (1.102 inch)	27 mm (1.063 inch) or less
	③ Faulty coil insulation	With 500V megatester	Less than 1 MΩ
2) Yoke compressor	① Damaged field coil Standard resistance Blue terminal — + side brush Pink terminal — + side brush Blue terminal — pink terminal	 0.030 Ω 0.030 Ω 0.050 Ω	
	② Faulty thermal breaker (Conductivity at both ends)		Faulty conductivity
	③ Damaged ground cord Black terminal — (−) side brush		Faulty conductivity
	④ Insulation of cord and field coil Resistance between all terminals — yoke	0.1 MΩ or greater with 500V megatester	
3) Brush	① Brush wear	11.5 mm (0.453 inch)	7.5 mm (0.295 inch)
	② Damaged brush spring	Line diameter — outer diameter — free length 0.55—7—18.5mm (0.0216—0.276—0.728inch)	
4) O ring	Damaged	Line diameter — inner diameter 2.0—69.5 mm (0.075—2.736 inch)	
5) O ring through bolt	Damaged	Line diameter — inner diameter 1.9—4.8 mm (0.075—0.189 inch)	
2. Pump			
1) Filter B	○ Jam due to foreign substance ○ Damaged		

Part	Inspection	Standard Value	Replacement Limit
2) Coupling	Damaged		
3) "O" ring	Damaged	Line diameter — inner diameter 1.78—69.6 mm (0.070—2.740 inch) 1.5—6.5 mm (0.059—0.256 inch)	
4) Oil seal	Damaged or worn lip	Inner diameter — outer diameter — thickness 8—18—4.5 mm (0.315—0.709—0.177 inch)	
3. Manual valve			
1) Manual valve	Worn or damaged tip		
2) "O" ring	Damaged	Line diameter — inner diameter 1.5—9.5 mm (0.059—0.374 inch)	
3) "O" ring	Damaged	Line diameter — inner diameter 2.4—17.8 mm (0.094—0.701 inch)	
4) Washer, seal	• Damaged rubber lip • Worn plate	Inner diameter — outer diameter — thickness 4.3—11.5—1.6 mm (0.169—0.453—0.063 inch)	
5) Spring	Damaged, cracked	Line diameter — outer diameter — free length 1.2—11.5—6 mm (0.0472—0.453—0.236 inch)	
6) Collar, inner	Damaged, worn	Thickness 9.5 mm (0.374 inch)	
4. Relief valve (UP, DN, pilot — DN)			
1) Spring	Deterioration, damage	Line diameter — outer diameter — free length	
	UP	X—X—X 0.8—6.1—13 mm	
	DN	(0.0315—0.240—0.512 inch) 1.4—6.7—12.4 mm	
	Pilot DN	(0.0551—0.264—0.488 inch)	

Part	Inspection	Standard Value	Replacement Limit
2) Valve seat	Damaged		
3) Valve (ball)	Damaged or worn	Diameter	
	UP	×	
	DN	5/32 inch (3.969 mm)	
	Pilot DN	1/8 inch (3.175 mm)	
4) Filter (UP only)	Jammed		
5) "O" ring	Damaged	Line diameter — inner diameter 1.5—10.7 mm (0.059—0.421 inch) 1.9—8.8 mm (0.075—0.346 inch) 1.5—8.5 mm (0.059—0.335 inch)	
5. Sprue valve			
1) Valve seat Assembly A-B	• Deteriorated or damaged spring • Damaged valve seat • Damaged or worn valve (ball) • Smooth operation		
2) "O" ring	Damaged	Line diameter — inner diameter 2.4—14.8 mm (0.094—0.583 inch) 1.5—13.5 mm (0.059—0.531 inch)	
3) Spring	Damage or deterioration	Line diameter — outer diameter — free length 1.0—10.2—10.5 (0.0394—0.402—0.413 inch)	
4) Sprue	Bent or damaged projection		
5) Backup ring	Damaged or worn		

Part	Inspection	Standard Value	Replacement Limit
6. Reservoir tank			
1) "O" ring Oil plug	Damaged	Line diameter — inner diameter 1.9—8.8 mm (0.075—0.346 inch)	
2) "O" ring Reservoir tank		1.78—69.6 mm (0.070—2.740 inch)	
7. Tilt cylinder			
1) "O" ring Oil tube nut	Damaged	Line diameter — inner diameter 1.9—4.8 mm (0.075—0.189 inch)	Replace after disassembly
2) Rod guide Compressor			
a. "O" ring	Damaged or worn	Line diameter — inner diameter 2.0—44.5 mm (0.079—1.752 inch)	
b. Dust seal	Damaged or worn	Inner diameter — outer diameter — height 18.2—27—4.5 mm (0.717—1.063—0.177 inch)	
3) Piston rod assembly			
a. "O" ring	Damaged or worn	Line diameter — inner diameter 3.5—38.7 mm (0.138—1.524 inch)	
b. Backup ring	Damaged or worn	Inner diameter — outer diameter — thickness 39—38.7—1.25 mm (1.535—1.772—0.049 inch)	
c. Shock absorber	• Damaged seat surface • Deteriorated or damaged spring	Line diameter — outer diameter — free length 1.2—6.8—18 mm (0.0472—0.268—0.709 inch)	
	• Damaged or worn valve (ball)	Diameter 4.763 mm (3/16")	
4) Free piston			
a. "O" ring	Damaged or worn	Line diameter — inner diameter 3.5—38.7 mm (0.138—1.524 inch)	

Part	Inspection	Standard Value	Replacement Limit
b. Backup ring	Damaged or worn	Inner diameter — outer diameter — thickness 39—45—1.25 mm (1.535—1.772—0.049 inch)	
3. Trim cylinder 1) Rod guide sub assembly a. "O" ring	Damaged or worn	Line diameter — inner diameter 3.5—38.7 mm (0.138—1.524 inch) 2.4—15.8 mm (0.094—0.622 inch)	
2) Piston rod a. "O" ring	Damaged or worn	Line diameter — inner diameter 3.5—31.7 mm (0.138—1.248 inch)	
b. Backup ring	Damaged or worn	Inner diameter — outer diameter — thickness 32—38—1.25 mm (1.260—1.496—0.0492 inch)	

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