PREFACE

This manual covers the construction, function and servicing procedure of the Honda BF35A•45A outboard motors. Careful observance of these instructions will result in better, safer service work.
Illustrations in this manual are based primarily on the BF45A LRT.

HONDA MOTOR CO., LTD.
SERVICE PUBLICATIONS OFFICE

CONTENTS

Date of Issue Oct. 1990

SPECIFICATIONS

SPECIFICATIONS

DIMENSIONS AND WEIGHTS

Unit: mm (in)

Model	BF35A					BF45A		
Description code	BSAG (Short type), BLAG (Long type)					BSAF (Short type), BLAF (Long type)		
Type	SH	LH	LR	LRT	SR	SR	LR	LRT
Overall length	*1: 725 (28.5) *2: 1,059 (41.7)		685 (27.0)					
Overall width	370 (14.6)							
Overall height	1,255 (49.4)	1,360 (53.5)			1,255 (49.4)	1,360 (53.5)		
Dry weight	89 kg (196.2 lb)	91 kg (200.7 lb)	90 kg (198.5 lb)	92 kg (202.9 lb)	88 kg (194.0 lb)	90 kg (198.5 lb)	92 kg (202.9 lb)	
Operating weight (incld. oil)	91.5 kg (201.8 lb)	93.5 kg (206.1 lb)	92.5 kg (204.0 lb)	94.5 kg (208.4 lb)	90.5 kg (200.0 lb)	92.5 kg (204.0 lb)	94.5 kg (208.4 lb)	

*1: With handlebar raised
*2: With handlebar extended

FRAME

Model	BF35A					BF45A		
Type	SH	LH	LR	LRT	SR	SR	LR	LRT
Transom height	416 mm (16.4 in)	521 mm (20.5 in)			416 mm (16.4 in)	521 mm (20.5 in)		
Transom angle	5 stage adjustment (11.5°, 15.5°, 19.5°, 23.5°, 27.5°)							
Tilting angle	73°							
Swivel angle	37.5° right and left							
Trim angle	—			0–20°	—			0–20°

Model	BF35A					BF45A		
Type	SH	LH	LR	LRT	SR	SR	LR	LRT
Shaft Length	S	L	L	L	S	S	L	L
Tiller Handle	H	H						
Remote Control			R	R	R	R	R	R
Gas Assisted Tilt	GAT	GAT	GAT		GAT	GAT	GAT	
Power Tilt/Trim				T				T
Tachometer				*				*
Trim meter				*				*

*: Standard Equipment
- According to Shaft Length
  S: Short Shaft
  L: Long Shaft
- According to Control System
  H: Tiller Handle Control
  R: Remote Control
- According to tilt system
  GAT: Gas-assisted Tilt (with gas damper assist function)
  T: Power trim & tilt (with hydraulic assist function)

ENGINE

Model	BF35A	BF45A
Type	4-stroke, O.H.C, 3-cylinder	
Displacement	808 cm³ (49.4 cu in)	
Bore x stroke	70 x 70 mm (2.8 x 2.8 in)	
Rated power *1	35 HP (26.1 kw)/4,600—5,600 min⁻¹ (r.p.m.)	45 HP (33.6 kw)/5,000—6,000 min⁻¹ (r.p.m.)
Maximum torque	6.0 kg-m (43.4 ft-lb) 3,500 min⁻¹ (r.p.m.)	6.05 kg-m (43.8 ft-lb) 4,500 min⁻¹ (r.p.m.)
Compression ratio	9.2 : 1	
Fuel consumption ratio [g/PS·hr]	210	
Cooling system	Forced water circulation by impeller pump with thermostat	
Ignition system	CDI	
Ignition timing	5—32° B.T.D.C.	
Spark plug	DR7EA (NGK), X22ESR-U (NIPPONDENSO)	
Carburetor	Horizontal type, butterfly valve (3 carburetor)	
Lubrication system	Pressure lubrication by trochoid pump	
Lubrication capacity	2.4 ℓ (2.54 US qt, 2.11 Imp qt)	
Starter system	Electric starter	
Stopping system	Grounding of primary circuit	
Fuel	Regular automotive gasoline (86 pump octane; unleaded preferred)	
Fuel tank capacity	25 ℓ (6.6 US gal, 5.5 Imp gal)	
Fuel pump	Mechanical plunger type	
Exhaust system	Underwater type	
Recommended oil	SAE 10 W—30/40	

*1: Full throttle r.p.m. range.

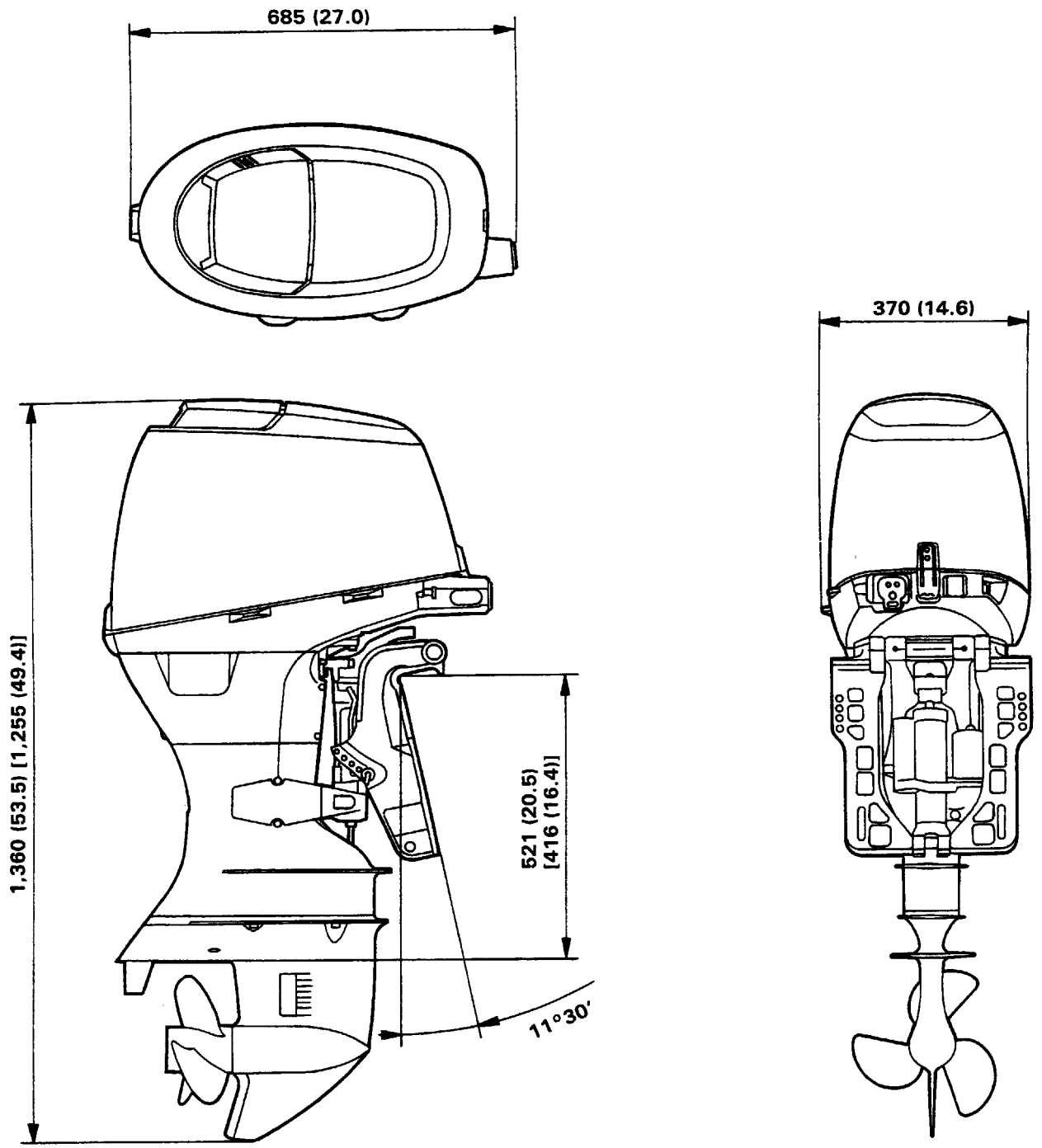
LOWER UNIT

Clutch	Dog clutch (Forward—Neutral—Reverse)
Gear ratio	0.48 (26/33 x 14/23)
Reduction	Spiral bevel
Gear case oil capacity	0.52 ℓ (0.550 US qt, 0.458 Imp qt)
Propeller No. of blades-Dia. x Pitch	3-286 x 330 mm (11-1/4 x 13.0 in)
Propeller rotating direction	Clockwise (viewed from rear)
Propeller driving system	Spline

DIMENSIONAL DRAWINGS

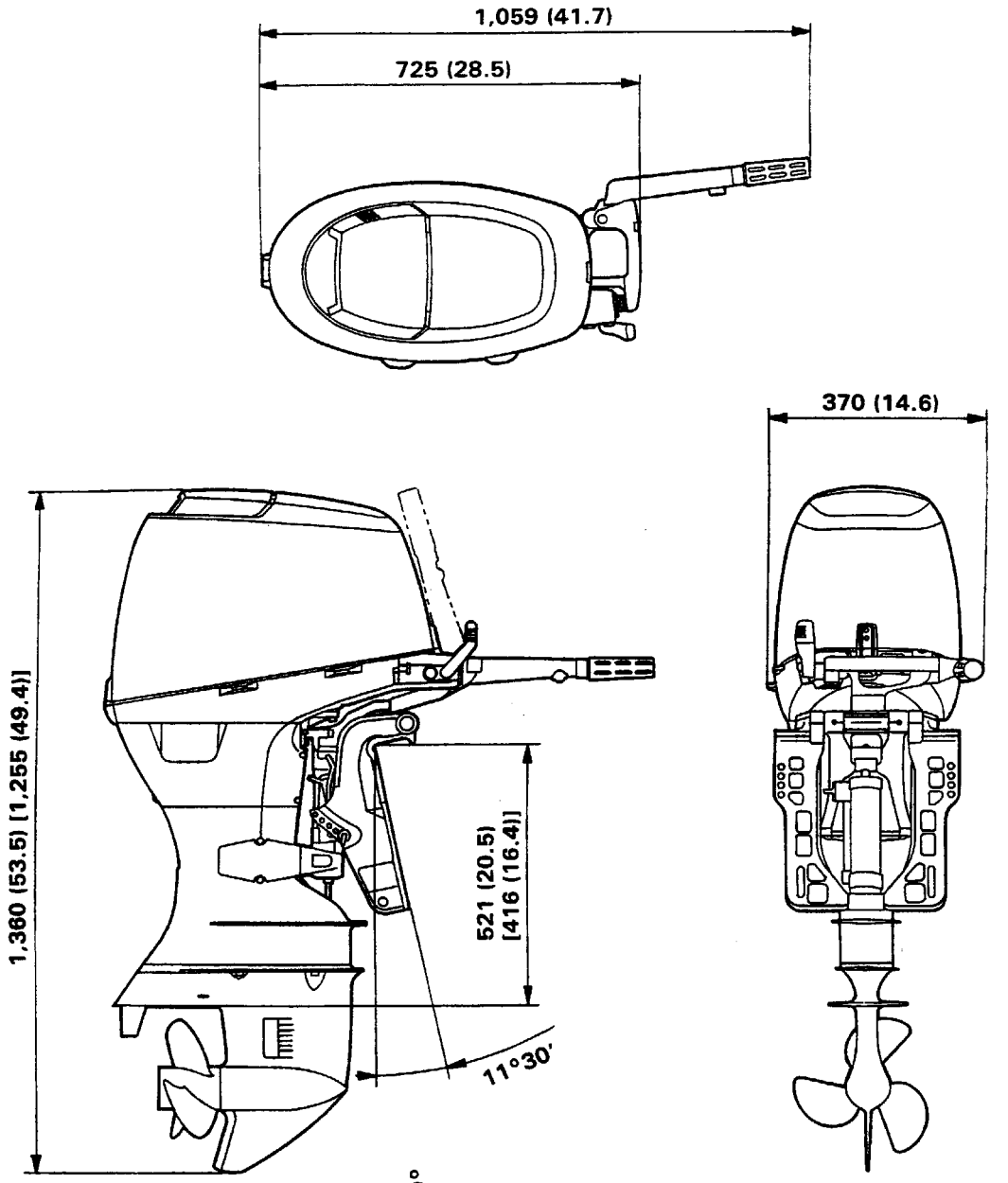
Unit: mm (in)

Remote control type
[ ]: Short shaft type

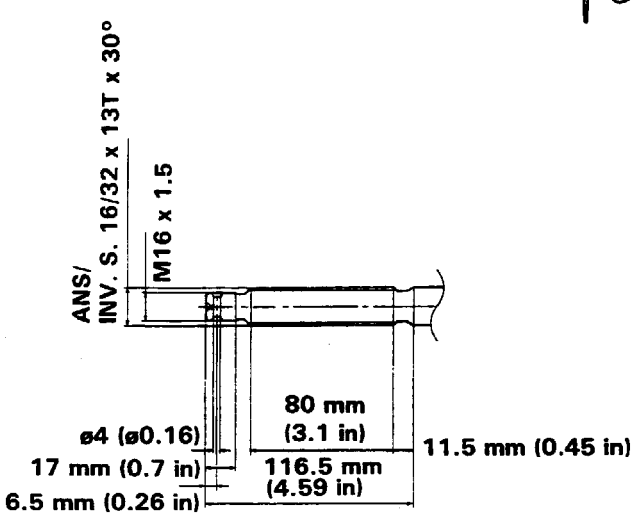


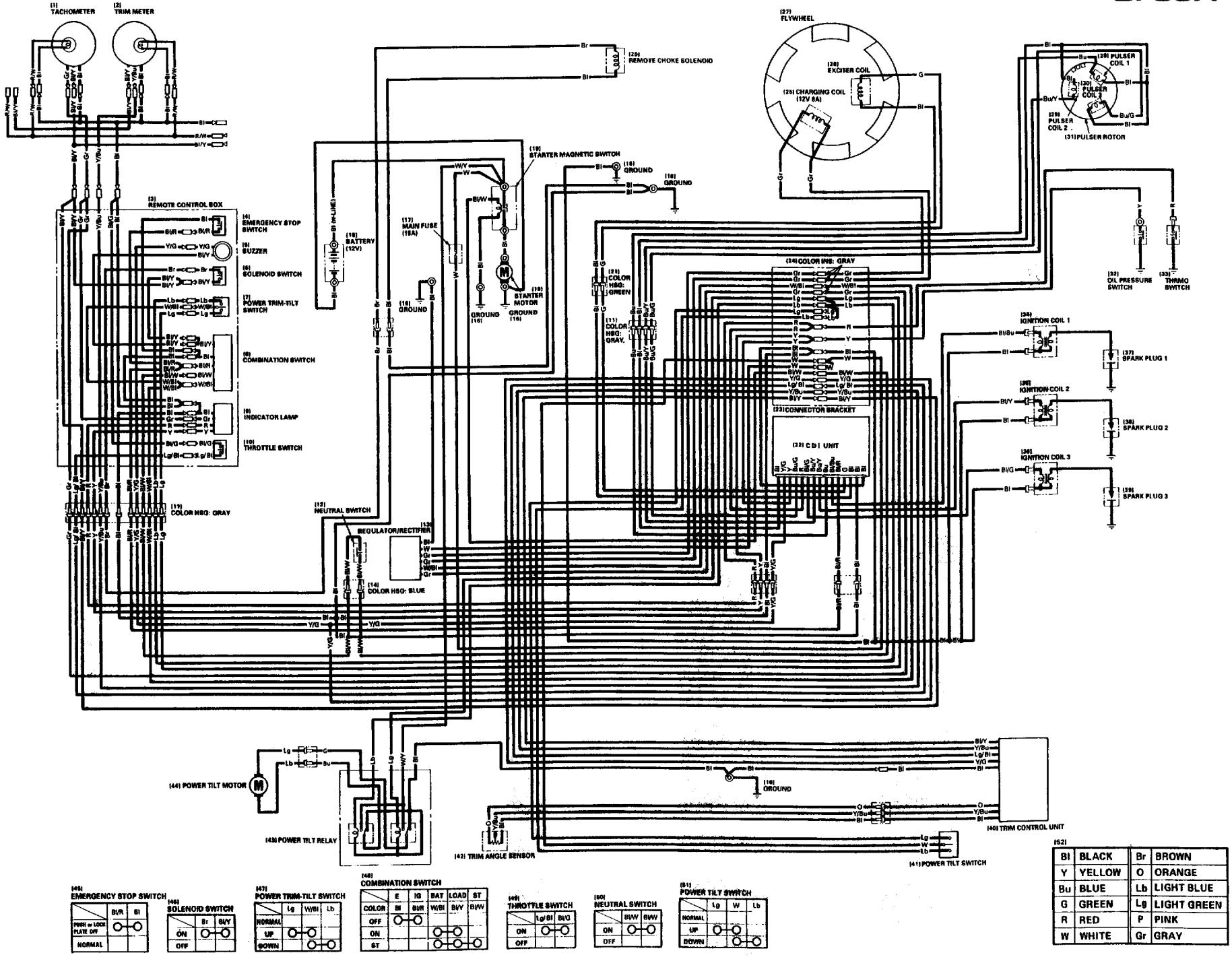
Tiller handle type
[ ]: Short shaft type

Unit: mm (in)

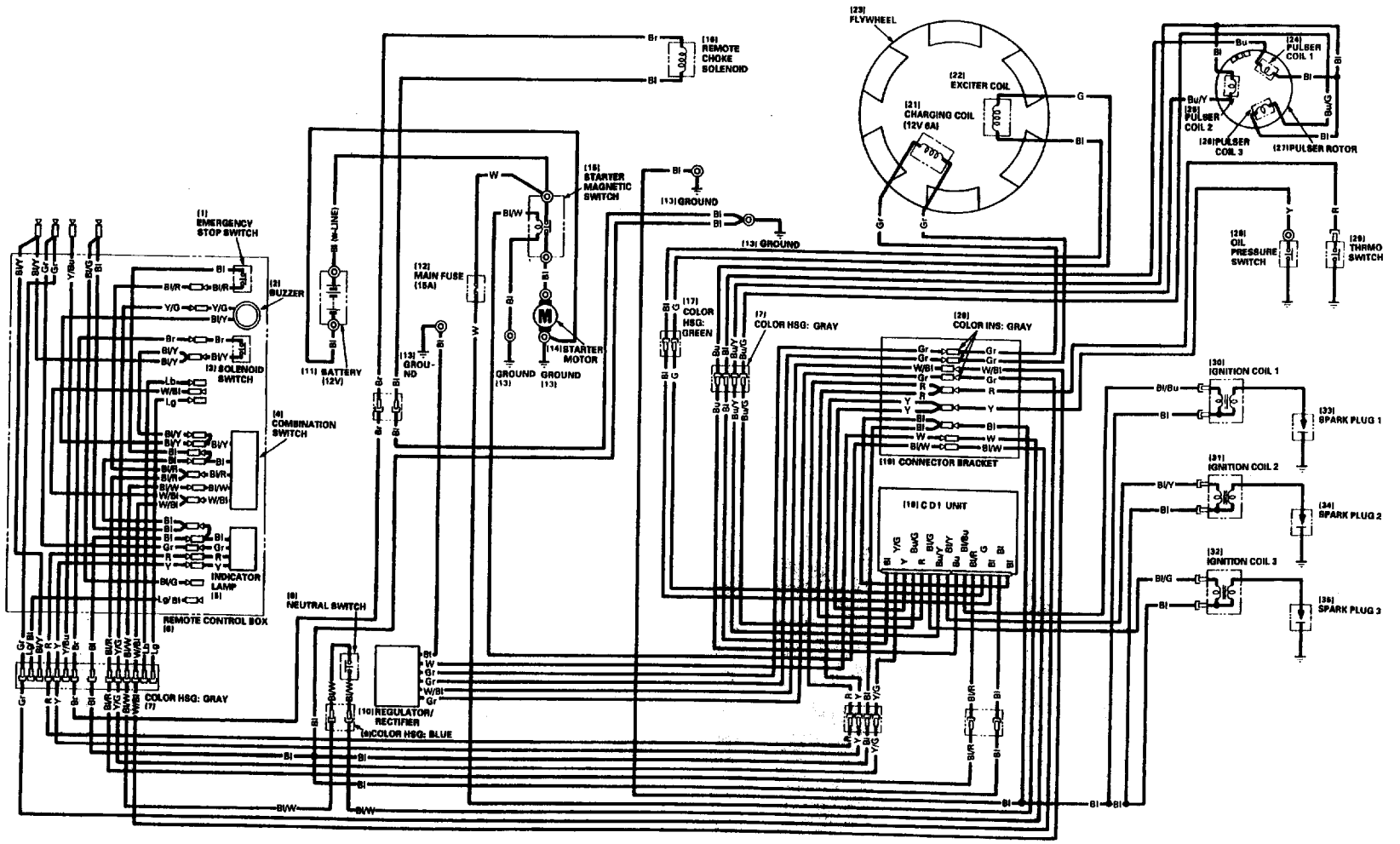


PROPELLER SHAFT




[1] TACHOMETER
[2] TRIM METER
[3] REMOTE CONTROL BOX
[4] EMERGENCY STOP SWITCH
[5] BUZZER
[6] SOLENOID SWITCH
[7] POWER TRIM-TILT SWITCH
[8] COMBINATION SWITCH
[9] INDICATOR LAMP
[10] THROTTLE SWITCH
[11] COLOR HSG: GRAY
[12] NEUTRAL SWITCH
[13] REGULATOR/RECTIFIER
[14] COLOR HSG: BLUE
[15] BATTERY (12V)
[16] GROUND
[17] MAIN FUSE (15A)
[18] GROUND
[19] STARTER MAGNETIC SWITCH
[20] REMOTE CHOKE SOLENOID
[21] COLOR HSG: GREEN
[22] CDI UNIT
[23] CONNECTOR BRACKET
[24] COLOR HSG: GRAY
[25] EXCITER COIL
[26] CHARGING COIL (12V 6A)
[27] FLYWHEEL
[28] PULSER COIL 1
[29] PULSER COIL 2
[30] PULSER COIL 3
[31] PULSER ROTOR
[32] OIL PRESSURE SWITCH
[33] THRMO SWITCH
[34] IGNITION COIL 1
[35] IGNITION COIL 2
[36] IGNITION COIL 3
[37] SPARK PLUG 1
[38] SPARK PLUG 2
[39] SPARK PLUG 3
[40] TRIM CONTROL UNIT
[41] POWER TILT SWITCH
[42] TRIM ANGLE SENSOR
[43] POWER TILT RELAY
[44] POWER TILT MOTOR
[45] EMERGENCY STOP SWITCH
[46] SOLENOID SWITCH
[47] POWER TRIM-TILT SWITCH
[48] COMBINATION SWITCH
[49] THROTTLE SWITCH
[50] NEUTRAL SWITCH
[51] POWER TILT SWITCH
[52]
BI BLACK
Br BROWN
Y YELLOW
O ORANGE
Bu BLUE
Lb LIGHT BLUE
G GREEN
Lg LIGHT GREEN
R RED
P PINK
W WHITE
Gr GRAY

Remote control type



[36] EMERGENCY STOP SWITCH

	Bl/R	Bl
PUSH or LOCK PLATE OFF		
NORMAL	○	○

[37] SOLENOID SWITCH

	Br	Bl/Y
ON	○	○
OFF		

[38] COMBINATION SWITCH

	E	IG	BAT	LOAD	ST
COLOR	Bl	Bl/R	W/Bl	Bl/Y	Bl/W
OFF	○	○			
ON			○	○	
ST			○	○	○

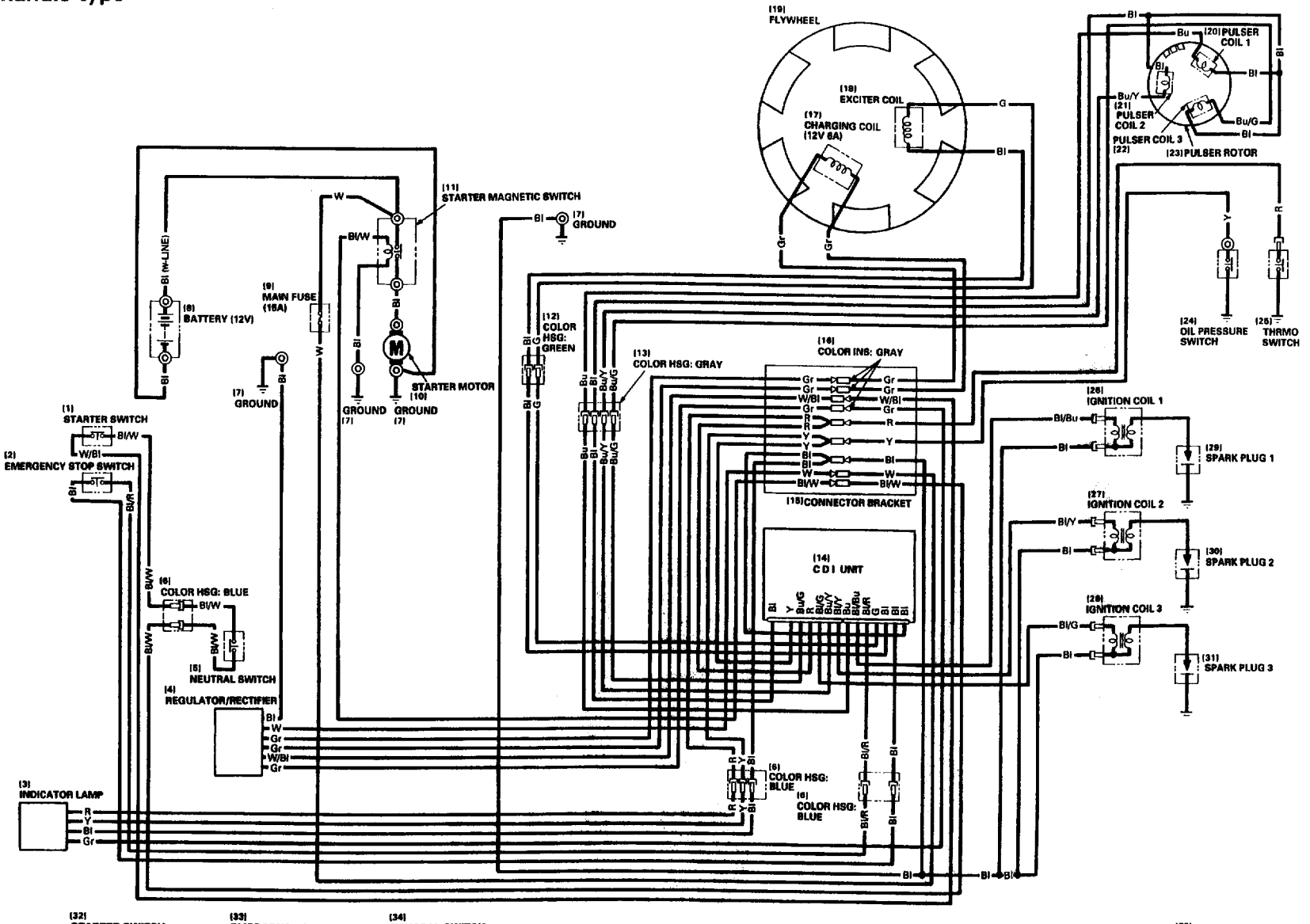
[39] NEUTRAL SWITCH

	Bl/W	Bl/W
ON	○	○
OFF		

[40]

Bl	BLACK	Br	BROWN
Y	YELLOW	O	ORANGE
Bu	BLUE	Lb	LIGHT BLUE
G	GREEN	Lg	LIGHT GREEN
R	RED	P	PINK
W	WHITE	Gr	GRAY

Tiller handle type



[32] STARTER SWITCH

	W/Bl	Bl/W
PUSH	○	○
NORMAL		

[33] EMERGENCY STOP SWITCH

	Bl/R	Bl
PUSH or LOCK PLATE OFF	○	○
NORMAL		

[34] NEUTRAL SWITCH

	Bl/W	Bl/W
ON	○	○
OFF		

[35]

Bl	BLACK	Br	BROWN
Y	YELLOW	O	ORANGE
Bu	BLUE	Lb	LIGHT BLUE
G	GREEN	Lg	LIGHT GREEN
R	RED	P	PINK
W	WHITE	Gr	GRAY

SERVICE INFORMATION

GENERAL SAFETY

Pay attention to these symbols and their meanings:

⚠WARNING **Indicates a strong possibility of severe personal injury or death if instructions are not followed.**
CAUTION: Indicates a possibility of personal injury or equipment damage if instructions are not followed.

⚠WARNING

- **Stop the engine, and remove the spark plug caps and ignition key before servicing the outboard motor.**
- **If the motor must be running to do some work, make sure the area is well ventilated. Never run the engine in a closed area; the exhaust contains poisonous carbon monoxide gas.**
- **Gasoline is extremely flammable and is explosive under certain conditions. Do not smoke or allow flames or sparks in your working area.**

CAUTION

- **Keep away from rotating or hot parts and high voltage wires when the engine is run with the engine cover off.**

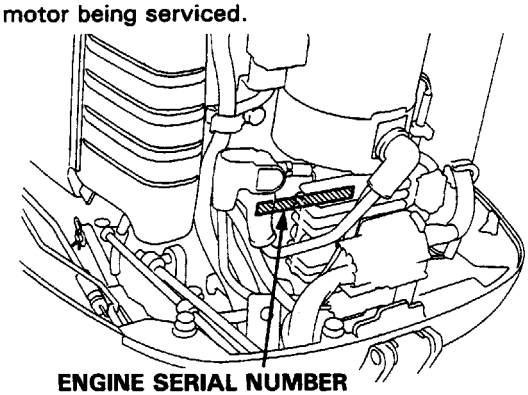
SERVICE RULES

1. Use genuine Honda or Honda-recommended parts and lubricants or their equivalents. Parts that do not meet Honda's design specifications may damage the unit.
2. Use the special tools designed for the product.
3. Install new gaskets, O-rings, etc. when reassembling.
4. When torquing bolts or nuts, begin with larger-diameter or inner bolts first and tighten to the specified torque diagonally, unless a particular sequence is specified.
5. Clean parts in cleaning solvent upon disassembly. Lubricate any sliding surfaces before reassembly.
6. After reassembly, check all parts for proper installation and operation.
7. Many screws used in this machine are self-tapping. Be aware that cross-threading or overtightening these screws will strip the female threads and ruin the hole.
8. Use only metric tools when servicing this unit. Metric bolt, nuts and screws are not interchangeable with nonmetric fasteners. The use of incorrect tools and fasteners will damage the unit.
9. Follow the instructions represented by these symbols when they are used:

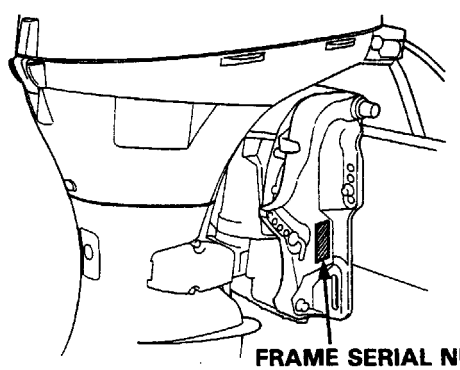
OIL : Apply oil S.TOOL : Use special tool GREASE : Apply grease
O x O (O) : Indicates the type, length, and number of the flange bolt used.
: Indicates the reference page.

SERIAL NUMBER LOCATION

The engine serial number is stamped on the crankcase and the frame serial number is located on the R. stern bracket. Always specify these numbers when inquiring about the engine or when ordering parts in order to obtain the correct parts for outboard motor being serviced.



ENGINE SERIAL NUMBER



FRAME SERIAL NUMBER

MAINTENANCE STANDARDS

BF35A

ENGINE

Unit: mm (in)

Part	Item		Standard	Service limit
Engine	Idle speed		950 ± 50 min⁻¹ (rpm)	—
	Cylinder compression		15 ± 1 kg/cm² (212 ± 14 psi) at 500 min⁻¹ (rpm)	—
Carburetor	Main jet		#102	—
	Pilot screw opening		2-1/8 turns out	—
	Float height		14 (0.6)	—
Spark plug	Gap		0.6–0.7 (0.024–0.028)	—
Valves	Valve clearance	IN	0.13–0.17 (0.005–0.007)	—
		EX	0.21–0.25 (0.008–0.010)	—
	Stem O.D.	IN	5.480–5.490 (0.2157–0.2161)	5.45 (0.215)
		EX	5.460–5.470 (0.2150–0.2154)	5.42 (0.213)
	Guide I.D.	IN/EX	5.500–5.512 (0.2165–0.2170)	5.53 (0.218)
	Seat width	IN	1.25–1.55 (0.049–0.061)	2.0 (0.08)
		EX	1.25–1.55 (0.049–0.061)	2.0 (0.08)
	Spring free length	IN/EX	36.9 (1.45)	35.4 (1.39)
	Stem-to-guide clearance	IN	0.010–0.032 (0.0004–0.0013)	0.06 (0.0024)
		EX	0.030–0.052 (0.0012–0.0020)	0.10 (0.004)
Rocker arm	Rocker arm I.D.		14.010–14.028 (0.5516–0.5523)	14.05 (0.553)
	Rocker arm shaft O.D.		13.976–13.994 (0.5502–0.5509)	13.95 (0.549)
	Rocker arm shaft-to-rocker arm clearance		0.016–0.052 (0.0006–0.0020)	0.07 (0.003)
Piston	Skirt O.D.		69.970–69.990 (2.7547–2.7555)	69.910 (2.7524)
	Piston-to-cylinder clearance		0.010–0.045 (0.0004–0.0018)	0.09 (0.0035)
	Pin hole I.D.		18.002–18.008 (0.7087–0.7090)	18.012 (0.709)
	Pin O.D.		17.994–18.000 (0.7084–0.7086)	17.954 (0.7068)
	Pin-to-pin hole clearance		0.002–0.014 (0.0001–0.0005)	0.04 (0.0016)
Piston ring	Ring side clearance	Top	0.040–0.065 (0.0016–0.0026)	0.1 (0.004)
		Second	0.015–0.045 (0.00059–0.0018)	0.1 (0.004)
		Oil	0.055–0.140 (0.0022–0.0055)	0.15 (0.006)
	Ring end gap	Top	0.15–0.3 (0.006–0.012)	0.8 (0.03)
		Second	0.3–0.45 (0.012–0.018)	0.95 (0.037)
		Oil	0.2–0.7 (0.0079–0.028)	1.0 (0.04)
	Ring width	Top	0.990–1.025 (0.0390–0.0404)	0.96 (0.038)
		Second	1.190–1.225 (0.0469–0.0482)	1.160 (0.0457)
Cylinder/ cylinder head	Cylinder sleeve I.D.		70.0–70.015 (2.7559–2.7565)	70.06 (2.758)
	Distortion of cylinder head		0.05 (0.0019)	0.1 (0.004)
	I.D. of camshaft journal		23.0–23.021 (0.9055–0.9063)	23.05 (0.908)

Unit: mm (in)

Part	Item		Standard	Service limit
Connecting rod	Small end I.D.		18.016–18.034 (0.7093–0.7100)	18.05 (0.711)
	Big end oil clearance		0.016–0.040 (0.0006–0.0016)	0.05 (0.0019)
	Big end axial clearance		0.05–0.2 (0.0019–0.0079)	0.3 (0.012)
	Connecting rod bearing oil clearance		0.020–0.038 (0.0008–0.0015)	0.08 (0.003)
Crankshaft	Journal O.D.	Main	39.982–40.006 (1.5741–1.5750)	39.95 (1.572)
		Pin	37.976–38.0 (1.4951–1.4961)	37.94 (1.494)
	Crankshaft main bearing oil clearance		0.020–0.038 (0.0008–0.0015)	0.05 (0.0019)
	Crankshaft side clearance		0.05–0.3 (0.0019–0.012)	0.45 (0.018)
Camshaft	Shaft axial clearance		0.03–0.11 (0.0012–0.0043)	0.3 (0.012)
	Shaft runout		0.03 (0.0012) Max.	0.05 (0.0019)
	Journal O.D.		22.959–22.980 (0.9039–0.9047)	22.93 (0.903)
	Cam height	IN	34.928–35.248 (1.3751–1.3877)	34.708 (1.3665)
		EX	34.973–35.293 (1.3769–1.3895)	34.753 (1.3682)
	Shaft oil clearance		0.020–0.065 (0.0008–0.0026)	0.08 (0.003)
Oil pump	Body I.D.		50.15–50.18 (1.974–1.975)	50.20 (1.976)
	Inner rotor-to-outer rotor clearance		0.15 (0.006) Max.	0.20 (0.0079)
	Outer rotor-to-body clearance		0.15–0.22 (0.006–0.009)	0.26 (0.0102)
	Outer rotor height		16.98–17.0 (0.6685–0.6693)	16.93 (0.667)
	Pump body depth		17.02–17.05 (0.670–0.671)	17.09 (0.673)
	Pump end clearance		0.02–0.07 (0.0008–0.0028)	0.1 (0.004)
Ignition coil	Resistance	Primary coil	0.19–0.23 Ω	—
		Secondary coil	2.8–3.4 kΩ	—
Charging coil	Resistance		0.20–0.26 Ω	—
Exciter coil	Resistance		168–227 Ω	—
Pulser coil	Resistance		288–352 Ω	—

FRAME

Part	Item		Standard	Service limit
Vertical shaft	Shaft O.D. (at needle bearing)		22.217–22.230 (0.8747–0.8752)	22.196 (0.8739)
Bevel gear	Gear I.D.	Forward	19.000–19.021 (0.7480–0.7489)	19.04 (0.750)
		Reverse	22.05–22.30 (0.868–0.878)	22.35 (0.880)
Propeller shaft	Shaft O.D.	Front	18.967–18.980 (0.7467–0.7472)	18.946 (0.7459)
		Rear	20.9–21.2 (0.82–0.83)	20.85 (0.821)
	Shaft O.D. (at needle bearing)		22.007–22.020 (0.8664–0.8669)	21.99 (0.866)

BF45A

ENGINE

Unit: mm (in)

Part	Item		Standard	Service limit
Engine	Idle speed		950 ± 50 min^{-1} (rpm)	—
	Cylinder compression		15 ± 1 kg/cm^2 (212 ± 14 psi) at 500 min^{-1} (rpm)	—
Carburetor	Main jet		#125	—
	Pilot screw opening		2-1/8 turns out	—
	Float height		14 (0.6)	—
Spark plug	Gap		0.6—0.7 (0.024—0.028)	—
Valves	Valve clearance	IN	0.13—0.17 (0.005—0.007)	—
		EX	0.21—0.25 (0.008—0.010)	—
	Stem O.D.	IN	5.480—5.490 (0.2157—0.2161)	5.45 (0.215)
		EX	5.460—5.470 (0.2150—0.2154)	5.42 (0.213)
	Guide I.D.	IN/EX	5.500—5.512 (0.2165—0.2170)	5.53 (0.218)
	Seat width	IN	1.25—1.55 (0.049—0.061)	2.0 (0.08)
		EX	1.25—1.55 (0.049—0.061)	2.0 (0.08)
	Spring free length	IN/EX	36.9 (1.45)	35.4 (1.39)
	Stem-to-guide clearance	IN	0.010—0.032 (0.0004—0.0013)	0.06 (0.0024)
		EX	0.030—0.052 (0.0012—0.0020)	0.10 (0.004)
Rocker arm	Rocker arm I.D.		14.010—14.028 (0.5516—0.5523)	14.05 (0.553)
	Rocker arm shaft O.D.		13.976—13.994 (0.5502—0.5509)	13.95 (0.549)
	Rocker arm shaft-to-rocker arm clearance		0.016—0.052 (0.0006—0.0020)	0.07 (0.003)
Piston	Skirt O.D.		69.970—69.990 (2.7547—2.7555)	69.910 (2.7524)
	Piston-to-cylinder clearance		0.010—0.045 (0.0004—0.0018)	0.09 (0.0035)
	Pin hole I.D.		18.002—18.008 (0.7087—0.7090)	18.012 (0.709)
	Pin O.D.		17.994—18.000 (0.7084—0.7086)	17.954 (0.7068)
	Pin-to-pin hole clearance		0.002—0.014 (0.0001—0.0005)	0.04 (0.0016)
Piston ring	Ring side clearance	Top	0.040—0.065 (0.0016—0.0026)	0.1 (0.004)
		Second	0.015—0.045 (0.00059—0.0018)	0.1 (0.004)
		Oil	0.055—0.140 (0.0022—0.0055)	0.15 (0.006)
	Ring end gap	Top	0.15—0.3 (0.006—0.012)	0.8 (0.03)
		Second	0.3—0.45 (0.012—0.018)	0.95 (0.037)
		Oil	0.2—0.7 (0.0079—0.028)	1.0 (0.04)
	Ring width	Top	0.990—1.025 (0.0390—0.0404)	0.96 (0.038)
		Second	1.190—1.225 (0.0469—0.0482)	1.160 (0.0457)
Cylinder/ cylinder head	Cylinder sleeve I.D.		70.0—70.015 (2.7559—2.7565)	70.06 (2.758)
	Distortion of cylinder head		0.05 (0.0019)	0.1 (0.004)
	I.D. of camshaft journal		23.0—23.021 (0.9055—0.9063)	23.05 (0.908)

Unit: mm (in)

Part	Item		Standard	Service limit
Connecting rod	Small end I.D.		18.016—18.034 (0.7093—0.7100)	18.05 (0.711)
	Big end oil clearance		0.016—0.040 (0.0006—0.0016)	0.05 (0.0019)
	Big end axial clearance		0.05—0.2 (0.0019—0.0079)	0.3 (0.012)
	Connecting rod bearing oil clearance		0.020—0.038 (0.0008—0.0015)	0.08 (0.003)
Crankshaft	Journal O.D.	Main	39.982—40.006 (1.5741—1.5750)	39.95 (1.572)
		Pin	37.976—38.0 (1.4951—1.4961)	37.94 (1.494)
	Crankshaft main bearing oil clearance		0.020—0.038 (0.0008—0.0015)	0.05 (0.0019)
	Crankshaft side clearance		0.05—0.3 (0.0019—0.012)	0.45 (0.018)
Camshaft	Shaft axial clearance		0.03—0.11 (0.0012—0.0043)	0.3 (0.012)
	Shaft runout		0.03 (0.0012) Max.	0.05 (0.0019)
	Journal O.D.		22.959—22.980 (0.9039—0.9047)	22.93 (0.903)
	Cam height	IN	34.928—35.248 (1.3751—1.3877)	34.708 (1.3665)
		EX	34.973—35.293 (1.3769—1.3895)	34.753 (1.3682)
	Shaft oil clearance		0.020—0.065 (0.0008—0.0026)	0.08 (0.003)
Oil pump	Body I.D.		50.15—50.18 (1.974—1.975)	50.20 (1.976)
	Inner rotor-to-outer rotor clearance		0.15 (0.006) Max.	0.20 (0.0079)
	Outer rotor-to-body clearance		0.15—0.22 (0.006—0.009)	0.26 (0.0102)
	Outer rotor height		16.98—17.0 (0.6685—0.6693)	16.93 (0.667)
	Pump body depth		17.02—17.05 (0.670—0.671)	17.09 (0.673)
	Pump end clearance		0.02—0.07 (0.0008—0.0028)	0.1 (0.004)
Ignition coil	Resistance	Primary coil	0.19—0.23 Ω	—
		Secondary coil	2.8—3.4 kΩ	—
Charging coil	Resistance		0.20—0.26 Ω	—
Exciter coil	Resistance		168—227 Ω	—
Pulser coil	Resistance		288—352 Ω	—

FRAME

Unit: mm (in)

Part	Item		Standard	Service limit
Vertical shaft	Shaft O.D. (at needle bearing)		22.217—22.230 (0.8747—0.8752)	22.196 (0.8739)
Bevel gear	Gear I.D.	Forward	19.000—19.021 (0.7480—0.7489)	19.04 (0.750)
		Reverse	22.05—22.30 (0.868—0.878)	22.35 (0.880)
Propeller shaft	Shaft O.D.	Front	18.967—18.980 (0.7467—0.7472)	18.946 (0.7459)
		Rear	20.9—21.2 (0.82—0.83)	20.85 (0.821)
	Shaft O.D. (at needle bearing)		22.007—22.020 (0.8664—0.8669)	21.99 (0.866)

TORQUE VALUES

Item		Thread Dia. (mm) and pitch (length)	Torque values		
			N·m	kg-m	ft-lb
• ENGINE					
Crankcase bolt	*1	M8 x 1.25	28	2.8	20.2
		M6 x 1.0	11	1.1	8.0
Oil filter cartridge		M20 x 1.5	8	0.8	5.6
Water jacket cover bolt		M6 x 1.0	12	1.2	8.7
Thermostat cover bolt		M6 x 1.0	12	1.2	8.7
Cylinder head bolt	*1	M10 x 1.25	38	3.8	27.5
		M8 x 1.25	27	2.7	19.5
Cylinder head cover bolt		M6 x 1.0	12	1.2	8.7
Fuel pump bolt		M6 x 1.0	10	1.0	7.2
Camshaft holder bolt		M6 x 1.0	14	1.4	10.1
		M6 x 1.0	12	1.2	8.7
Throttle cam		M6 x 1.0	12	1.2	8.7
Choke arm bolt		M6 x 1.0	12	1.2	8.7
Intake manifold bolt, nut		M6 x 1.0	12	1.2	8.7
Carburetor bolt		M6 x 1.0	10	1.0	7.2
Connecting rod nut		M8 x 0.75	28	2.8	20.2
Primary drive gear nut		M22 x 1.25	92	9.2	66.5
Valve adjusting nut		M7 x 0.75	23	2.3	16.6
Oil drain bolt		M12 x 1.5	23	2.3	16.6
Exhaust pipe bolt		M6 x 1.0	10	1.0	7.2
		M8 x 1.25	21	2.1	15.2
Oil pan bolt		M6 x 1.0	10	1.0	7.2
Oil pump bolt		M6 x 1.0	13	1.3	9.4
Fuel strainer retainer bolt		M6 x 1.0	13	1.3	9.4
Timing pulley bolt		M48 x 1.5	130	13.0	94.0
Timing belt tensioner bolt		M10 x 1.25	45	4.5	32.5
Timing belt adjusting spring bolt		M6 x 1.0	12	1.2	8.7
Flywheel bolt		M10 x 1.0	66	6.6	47.7
Pulser rotor bolt		M10 x 1.25	57	5.7	41.2
Oil pressure switch		PT 1/8	9	0.9	6.5
Thermo switch		M16 x 1.5	12	1.2	8.7
Starter magnetic switch (switch side)		M6 x 1.0	5	0.5	3.6
(starter motor side)		M8 x 1.25	7	0.7	5.1
CDI unit bolt		M6 x 1.0	5	0.5	3.6
Remote choke solenoid body stay bolt (Remote control type only)		M6 x 1.0	9	0.9	6.5

*1: Tighten the crankcase bolts to 28 N·m (2.8 kg-m, 20.2 ft-lb) and the cylinder head bolts to 38 N·m (3.8 kg-m, 27.5 ft-lb) first, then tighten them $90^{\circ}{}^{+30}_{0}$ further.

Item	Thread Dia. (mm) and pitch (length)	Torque values		
		N·m	kg-m	ft-lb
• GEAR CASE				
Pinion gear nut	M12 x 1.25	75	7.5	54.2
Gear case end nut	M80 x 1.5	70^{+30}_{0}	$7.0^{+3.0}_{0}$	$50.6^{+21.7}_{0}$
Gear case bolt	M10 x 1.25	35	3.5	25.3
	M8 x 1.25	22	2.2	15.9
Oil check bolt	M8 x 1.25	6.5	0.65	4.7
Drain plug bolt	M8 x 1.25	6.5	0.65	4.7
Flushing bolt	M8 x 1.25	6.5	0.65	4.7
Sensor nipple	M8 x 1.0	3	0.3	2.2
Impeller housing bolt	M6 x 1.0	11	1.1	8.0
• EXTENSION/MOUNT				
Extension case bolt	M8 x 1.25	22	2.2	15.9
Lower mount rubber nut	M12 x 1.25	55	5.5	40.0
Lower mount housing bolt	M8 x 1.25	22	2.2	15.9
Drain plug cover bolt	M6 x 1.0	6.5	0.65	4.7
Upper mount rubber nut	M10 x 1.25	45	4.5	32.5
• STERN BRACKET				
Stern bracket nut (L. side)	7/8—14 UNF	17.5	1.75	12.7
(R. side)	7/8—14 UNF	32.5	3.25	23.5
	M10 x 1.25	35	3.5	25.3
• FRAME/ELECTRICAL				
Emergency stop switch nut	M16 x 1.0	1.5	0.15	1.1
Starter switch nut (Tiller handle type only)	M16 x 1.0	1.5	0.15	1.1
Tilt handle nut (Tiller handle type only)	M6 x 1.0	6.5	0.65	4.7
Neutral switch nut	M20 x 1.0	2.5	0.25	1.8
Under cover screw	M5 x 0.8	3	0.3	2.2

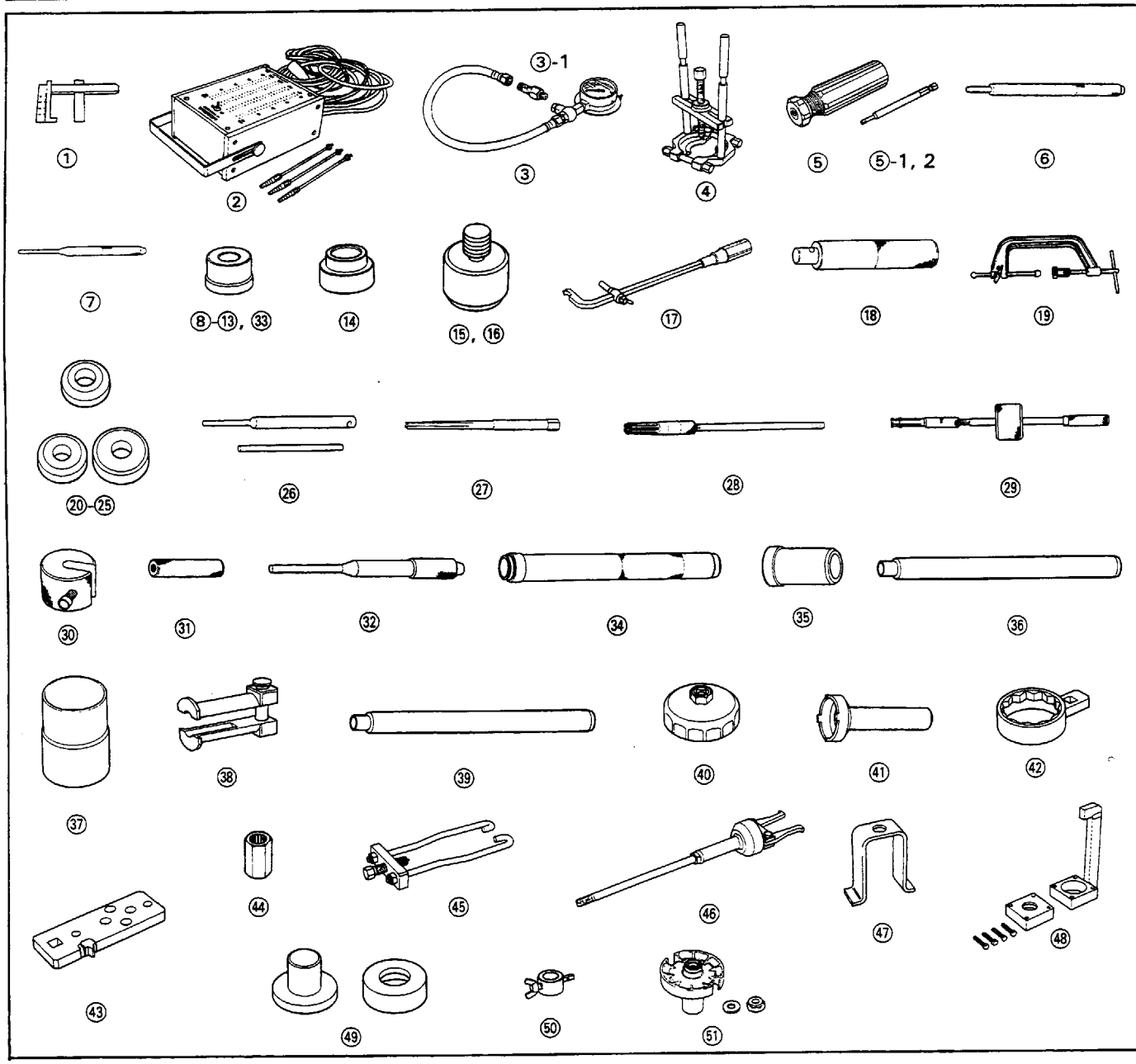
STANDARD TORQUE VALUES

Item	Thread Dia.	Torque values		
		N·m	kg-m	ft-lb
Bolt and nut	5 mm	5	0.5	3.6
	6 mm	10	1.0	7.2
	8 mm	21	2.1	15.2
	10 mm	35	3.5	25.3
	12 mm	55	5.5	40.0
Flange bolt and nut	6 mm (SH Flange bolt)	9	0.9	6.5
	6 mm	12	1.2	8.7
	8 mm	27	2.7	19.5
	10 mm	35	3.5	25.3
	12 mm	60	6.0	43.4
Screw	5 mm	4	0.4	2.9
	6 mm	9	0.9	6.5

SPECIAL TOOLS

Tool name	Tool number	Application
1. Float level gauge	07401—0010000	Inspection for carburetor float level
2. Vacuum 4ch tester set	07404—0030001	Carburetor vacuum pressure inspection
3. Oil pressure gauge	07506—3000000	Inspection for oil pressure
3-1 -attachment	07406—0030000	
4. Universal bearing puller	07631—0010000	Vertical shaft, gear case inner race removal
5. Torx bit handle	07703—0010300	Handle for 5-1, 5-2
5-1. -screw T20H	07703—0010400	Fuel pump disassembly/reassembly
5-2. -screw T30H	07703—0010600	Diaphragm adjustment
6. Valve guide driver, 5.5 mm	07742—0010100	Valve guide removal/installation
7. Pin driver, 2.5 mm	07744—0010100	2.5 x 12 mm, 2.5 x 18 mm, 2.5 x 20 mm spring pin removal/installation
8. Attachment, 32 x 35 mm	07746—0010100	22 x 35 x 7 mm water seal installation
9. Attachment, 37 x 40 mm	07746—0010200	Gear case inner race, 25 x 40 x 7 mm water seal installation
10. Attachment, 42 x 47 mm	07746—0010300	6005 bearing, vertical shaft outer race installation
11. Attachment, 52 x 55 mm	07746—0010400	6205 bearing installation
12. Attachment, 62 x 68 mm	07746—0010500	Gear case outer race installation
13. Attachment, 24 x 26 mm	07746—0010700	7/8 x 1-1/8 x 1 mm needle bearing removal/installation, 6007 bearing, 17 x 26 x 7 mm water seal installation
14. Inner driver, 35 mm	07746—0030400	6007 bearing, gear case inner race installation
15. Pilot, 25 mm	07746—0040600	6205, 6005 bearing installation
16. Pilot, 22 mm	07746—0041000	7/8 x 1-1/8 x 1 mm, 22 x 28 x 20 mm needle bearing removal/installation
17. Oil seal driver	07748—0010001	Oil seal, water seal removal
18. Handle A	07749—0010000	Driver for 8, 9, 10, 11, 13 and 33
19. Valve spring compressor	07757—0010000	Valve cotter removal/installation
20. Valve seat cutter, 45° ϕ29	07780—0010300	Valve seat reconditioning EX
21. Valve seat cutter, 45° ϕ33	07780—0010800	Valve seat reconditioning IN
22. Valve seat cutter, 32° ϕ30	07780—0012200	Valve seat reconditioning EX
23. Valve seat cutter, 32° ϕ33	07780—0012900	Valve seat reconditioning IN
24. Valve seat cutter, 60° ϕ30	07780—0014000	Valve seat reconditioning EX
25. Valve seat cutter, 60° ϕ37.5	07780—0014100	Valve seat reconditioning IN
26. Cutter holder, 5.5 mm	07781—0010101	Valve seat reconditioning
27. Valve guide reamer	07984—2000001	Valve guide reaming
28. Bearing remover, 35 mm	07936—3710400	6007 bearing removal
29. Bearing remover, 25 mm	07936—ZV10000	6205, 6005 bearing removal
30. Remover weight	07741—0010201	Constituents of Bearing remover, 35 mm and Bearing race puller (above item 28 and 46).
31. Remover handle	07936—3710100	
32. Pin driver, 4 mm	07944—9350200	4 x 20 mm, 4 x 25 mm Spring pin removal/installation (Tiller handle type only)
33. Attachment, 28 x 30 mm	07946—1870100	22 x 28 x 20 mm needle bearing removal/installation, 17 x 30 x 7 mm water seal installation
34. Stem race driver	07946—GC40000	Vertical shaft inner race installation
35. Bearing driver	07946—KM40701	22 x 28 x 20 mm needle bearing removal/installation
36. Handle	07946—MJ00100	Reverse gear removal
37. Base	07965—SD90100	Reverse gear removal/installation
38. Remover attachment, 22 mm	07GMD—KT70200	Reverse gear removal

Tool name	Tool number	Application
39. Handle	07949—3710001	7/8 x 1-1/8 x 1 mm needle bearing removal/installation, gear case outer race installation
40. Oil filter wrench	07HAA—PJ70100	Oil filter replacement
41. End nut wrench	07LPA—ZV30100	Gear case end nut removal/installation
42. 56 mm lock nut wrench	07LPA—ZV30200	Pulser rotor, 45 mm lock nut removal/installation
43. Ring gear holder	07LPB—ZV30100	Flywheel, 22 mm lock nut removal/installation
44. Vertical shaft holder	07LPB—ZV30200	Vertical shaft lock nut removal/installation
45. Propeller shaft holder	07LPB—ZV30300	Forward gear backlash inspection
46. Bearing race puller	07LPC—ZV30100	Vertical shaft, gear case outer race removal
47. Propeller shaft remover	07LPC—ZV30200	Propeller shaft holder assembly removal
48. Vertical shaft gauge	07LPJ—ZV30100	Vertical shaft shim adjustment
49. Bearing height gauge	07LPJ—ZV30200	Forward gear shim adjustment
50. Backlash inspection attachment	07LPJ—ZV30300	Forward gear backlash inspection
51. Test propeller	07LPZ—ZV30100 07LPZ—ZV50100	For test operation in water tank.



TROUBLESHOOTING

ENGINE

A. HARD STARTING

Check the fuel level in the fuel tank.
- No fuel in the tank → • Add fuel and restart the engine.
- Fuel OK →

Loosen the carburetor drain screw to see if there is fuel in the float bowl.
- Fuel flow restricted → • Check for collapsed or pinched fuel line. • Check for clogged fuel tank breather hole: Close the tank and open the vent knob, listen for hiss. • Check for air leaks past the primer bulb. • Squeeze the primer bulb and be sure that the fuel is reaching the carburetor. • Check for clogged fuel filter and connector. • Check fuel connectors.
- Fuel flows freely. →

Remove the spark plug and check for wet fouled electrode.
- Dry → • Fuel pump faulty • Check for clogged carburetor port/nozzle.
- Wet with fuel → • Clean and reinstall the plug, then restart the engine. • If excessively wet, check the carburetor for flooding. If flooding, drain the carburetor and prime again.

Attach the plug cap and ground the electrode.
Pull the recoil starter and check for sparks.
CAUTION: Do not check near the plug hole.
- No or weak spark → • Ignition system faulty (P. 12-14)
- Good spark →

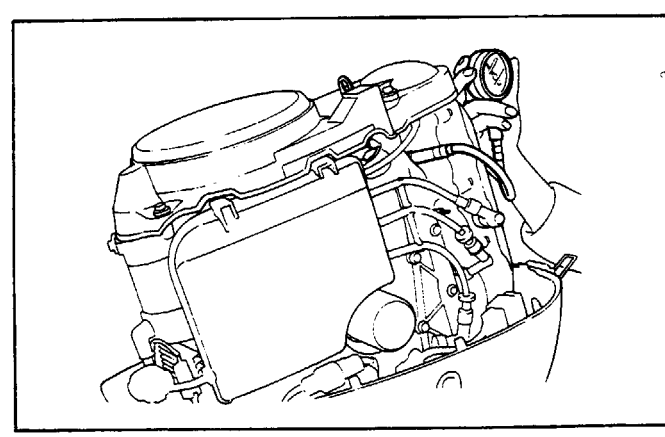
Attach the compression gauge to the plug hole.
Turn the starter switch on and check for cylinder compression.
- Low compression → • Check for valve clearance. • Check for loose cylinder head. • Check for damaged cylinder head gasket, valve, or valve seat. • Check for worn piston ring, piston, or cylinder.
- Compression OK →

Reinstall the spark plug and restart the engine.

• CYLINDER COMPRESSION TEST

1) Remove the all spark plugs.
2) Shift into neutral gear and open the throttle fully.
3) Install a compression gauge in one of the spark plug holes.
4) Operate the starter motor until the highest reading is obtained.
5) Install the compression gauge in the other spark plug hole and repeat the step 3).

Cylinder compression	15 ± 1 kg/cm² (212 ± 14 psi) at 500 min⁻¹ (r.p.m.)



6) Check the compression on all cylinders.

B. IGNITION SYSTEM

Hard starting

↓

Perform the spark test.
Spark plug gap: 0.6—0.7 mm (0.024—0.028 in)

↓ No spark

Check again with the new spark plugs.

↓ Sparks

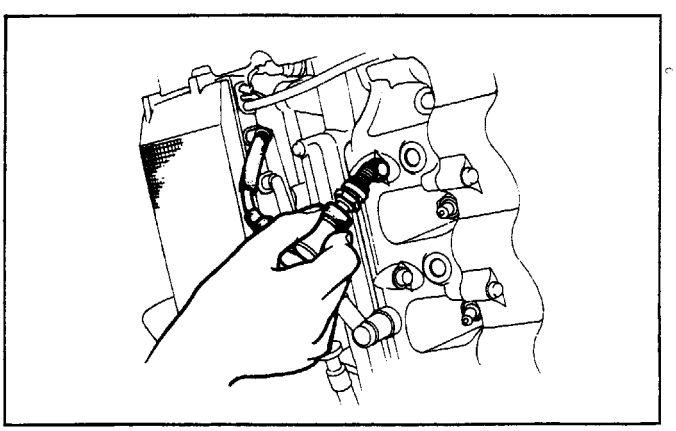
Replace the spark plugs.

No spark →

- Check the emergency engine stop switch hook installation.
- Disconnect the emergency engine stop switch wire (black/red) and recheck.
  - Sparks → Emergency engine stop switch faulty. • Replace.
- Disconnect the green and black wire of the exciter coil and measure the resistance between the wires.
  Resistance: 168—227 Ω
  - Out of spec. → Exciter coil fautly. • Replace.
- Disconnect the black and blue wire of the pulser coil and measure the resistance between the wires.
  Resistance: 288—352 Ω
  - Out of spec. → Pulser coil faulty. • Replace.
- Check the ignition coil (each unit) resistance.
  Primary: 0.19—0.23 Ω
  Secondary: 2.8—3.4 kΩ
  - Out of spec. → Ignition coil faulty. • Replace.
- Check the resistance between the CDI unit terminals (P. 16-17)
  - Faulty → • Replace the CDI unit.
- Bring a screwdriver close to the flywheel magnet and check for magnetic force.
  - No magnetic force → Replace the flywheel.

SPARK TEST

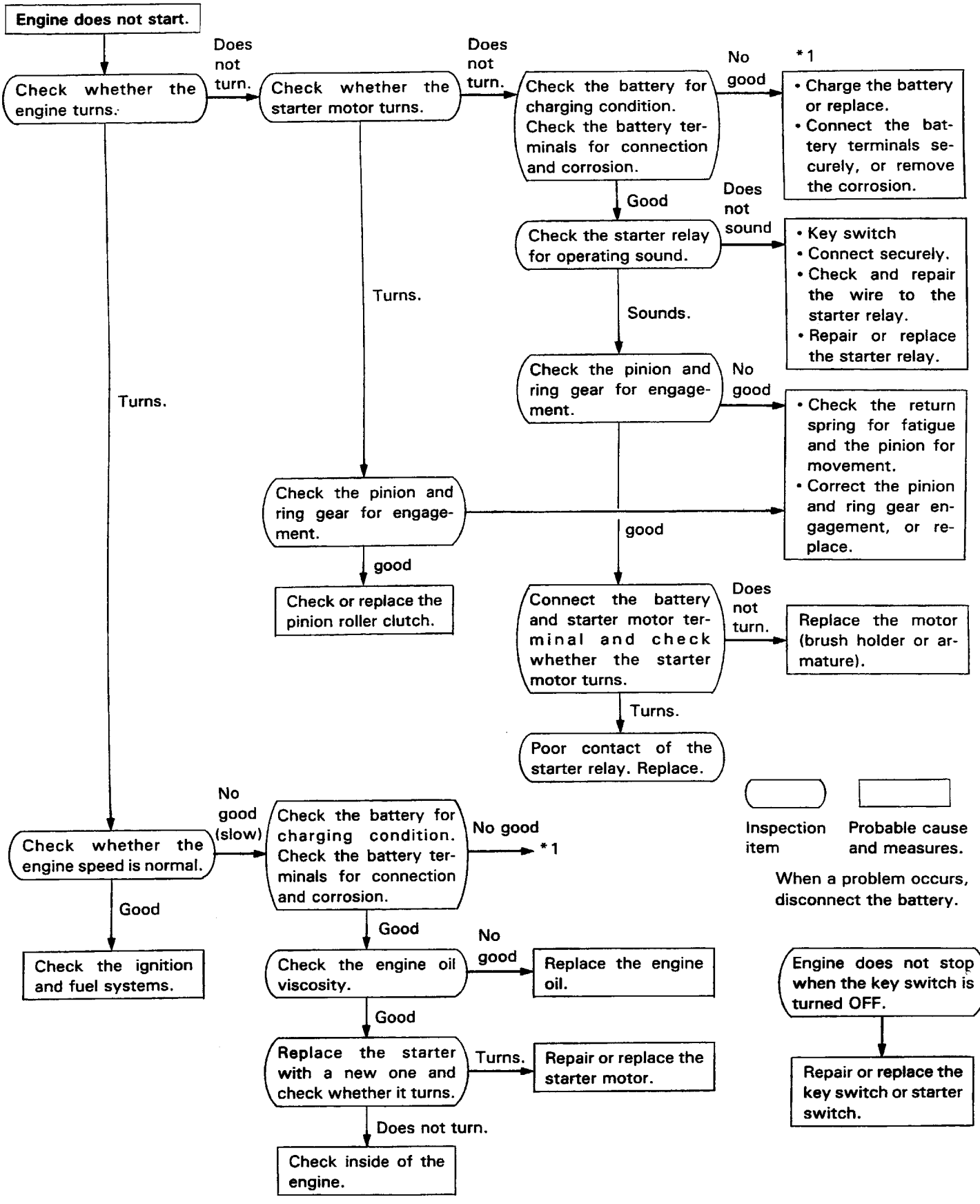
1) Remove the spark plug caps and spark plugs.
2) Attach the removed plug to the plug cap and ground the negative (−) terminal of the plug (threads) to the cylinder head cover bolt.
3) Turn the starter switch on and check to see if sparks jump across the electrodes.
4) Repeat steps 2) through 3) for another spark plug test.



⚠WARNING

- **Never hold the spark plug wire with wet hands while performing this test.**
- **Make sure that no fuel is spilled on the engine and that the plug is not wet with fuel.**
- **To avoid fire hazards, do not allow sparks near the plug hole.**

C. STARTER MOTOR



D. ENGINE DOES NOT RUN SMOOTHLY

Engine starts but stops soon. Poor idle performance.

1) Wet fouled spark plug caused from excessive choke application → Start the engine with the choke fully open and the throttle fully closed.
2) Faulty spark plug → Clean, adjust, or replace.
3) Carburetor synchronization misadjusted → Adjust properly.
4) Carburetor pilot screw/stop screw misadjusted → Adjust properly.
5) Carburetor slow circuit clogged with dirt → Overhaul.
6) Overflowed carburetor → Drain the carburetor and prime again. If still not good, overhaul the carburetor.
7) Secondary air sucked caused from damaged carburetor insulator gasket → Replace.

Engine speed does not increase.

1) Choke not returned properly → Return.
2) Throttle cable misadjusted → Adjust properly.
3) Propeller mismatched → Select correct propeller.
4) Engine overheats, engine oil pressure drops abnormally. (Warning system functions.)
5) Faulty spark plug → Clean, adjust, or replace.
6) Clogged fuel filter → Replace.
7) Water/dirt in carburetor → Drain the carburetor. Overhaul if it is still no good.
8) Incorrect valve timing → Reinstall the timing belt.

Engine speed does not decrease.

1) Acceleration/deceleration system misadjusted → Readjust properly.
2) Clogged dash pot check valve → Replace.
3) Throttle cable stuck with salt → Replace.
4) Carburetor throttle shaft not move smoothly. → Replace.

Excessive engine speed, engine speed fluctuates.

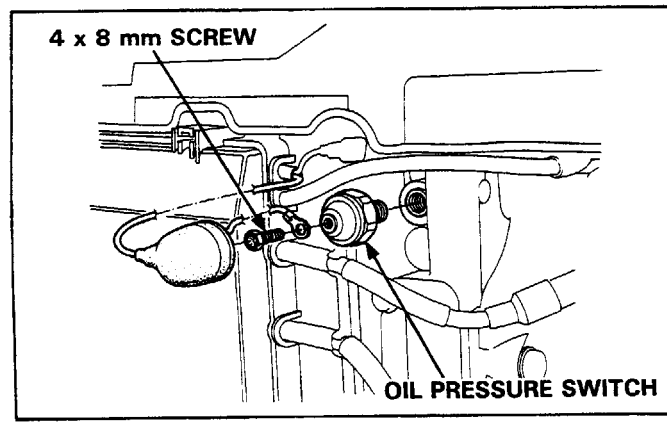
1) Mismatched propeller → Select correct propeller.

(Rev-limiter functions when over-revving.)

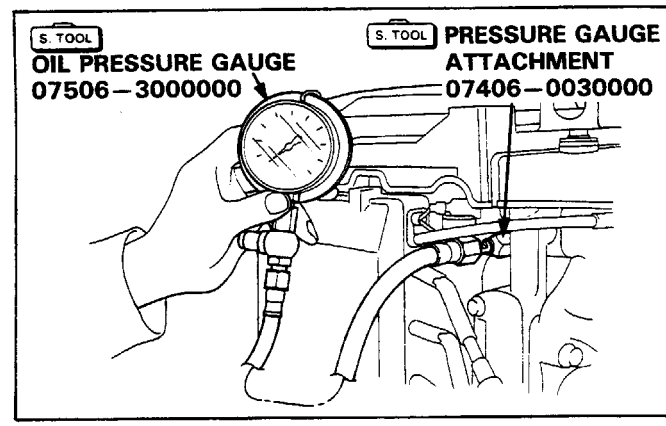
2) Propeller excessively worn → Replace.
3) Propeller damper rubber slippery → Replace.
4) Improperly installed outboard engine (incorrect transom height, tilt angle, etc.) → Adjust properly.

• **OIL PRESSURE TEST**

1) Check the engine oil level (P. 3-2).
2) Remove the 4 x 8 mm screw and oil pressure switch.



3) Install the pressure gauge attachment (special tool) on the oil pressure gauge that has a scale calibrated to a maximum of 7—10 kg/cm² (99.6—142.2 psi) scale and on the outboard motor.



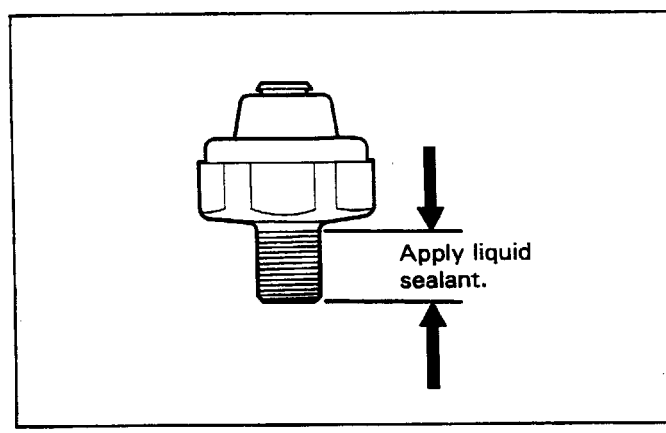
CAUTION

- **Tighten the gauge attachment to 9 N·m (0.9 kg-m, 6.5 ft-lb).**
- **Overtightening will damage the threads.**

4) Remove the propeller and set the outboard motor in a water tank or apply water to the outboard motor with the rinsing plug, and start the engine.
5) Measure the oil pressure when its temperature reaches 80°C (216.0°F)

Oil pressure [Engine speed 950 ± 50 min^{-1} (rpm) in neutral]	1.5 kg/cm² (21.3 psi) min.

6) If the oil pressure is less than the specification, check the oil pump rotors and body for wear.
7) Clean the oil pressure switch threads and apply liquid sealant (THREE BOND 1215 or equivalent) to the threads. Tighten the oil pressure switch to the specified torque.

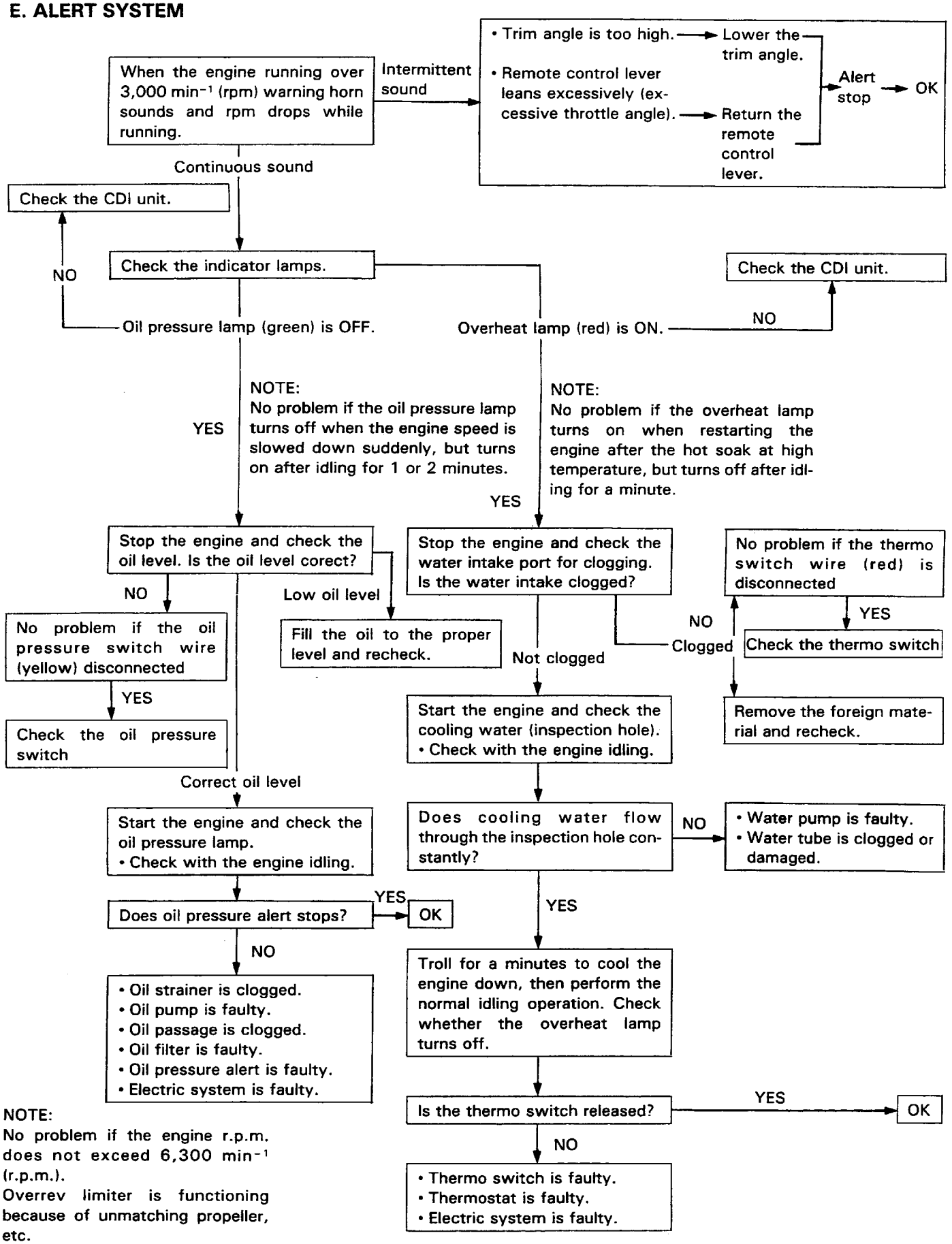


TORQUE: 9 N·m (0.9 kg-m, 6.5 ft-lb)

CAUTION

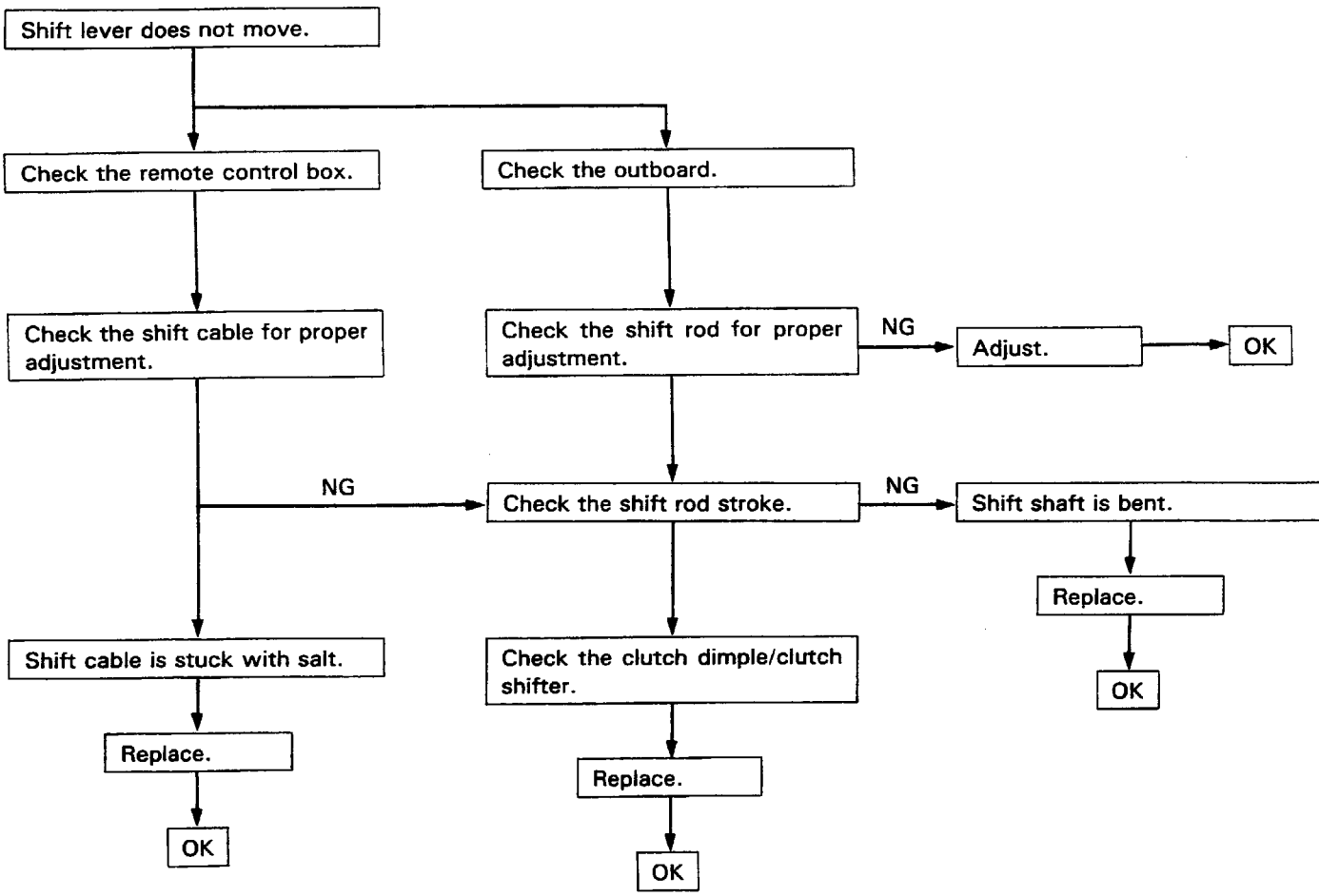
- **Be sure to use a torque wrench to tighten the switch.**
- **Overtightening will damage the starter case.**

E. ALERT SYSTEM

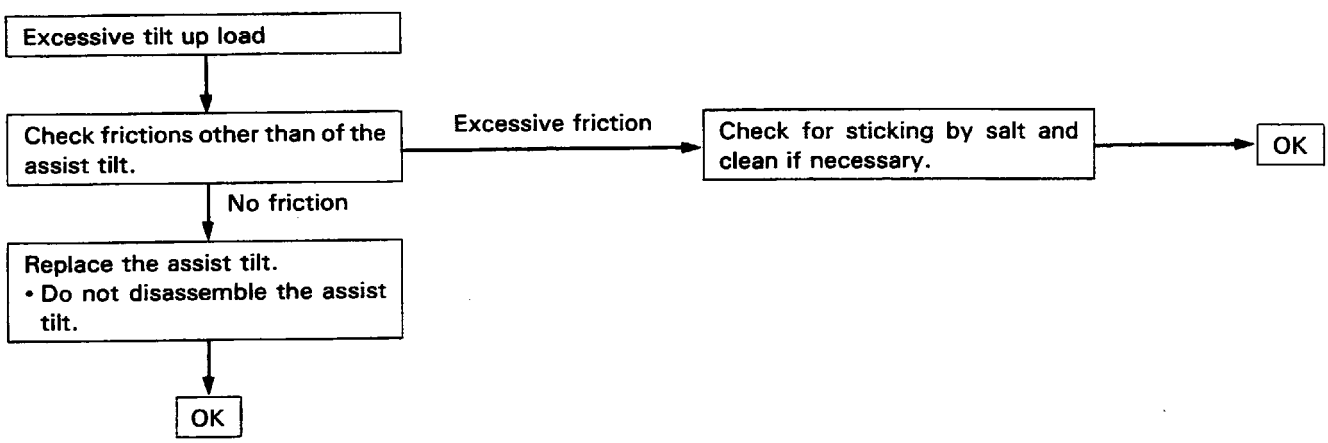


NOTE:
No problem if the engine r.p.m. does not exceed 6,300 min⁻¹ (r.p.m.).
Overrev limiter is functioning because of unmatching propeller, etc.

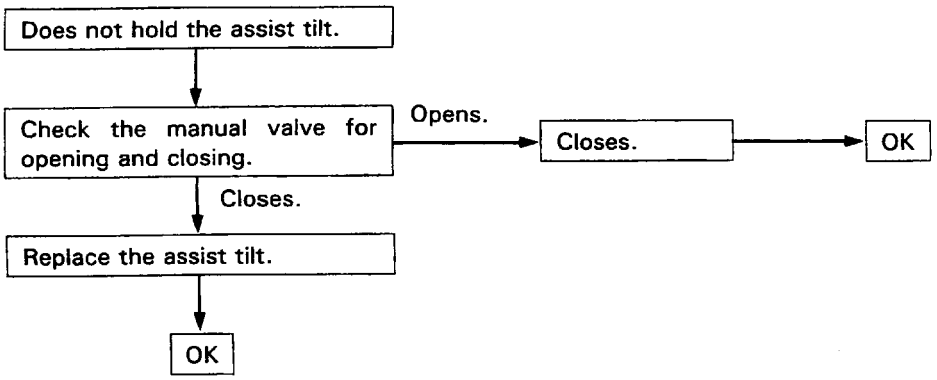
F. SHIFT LEVER



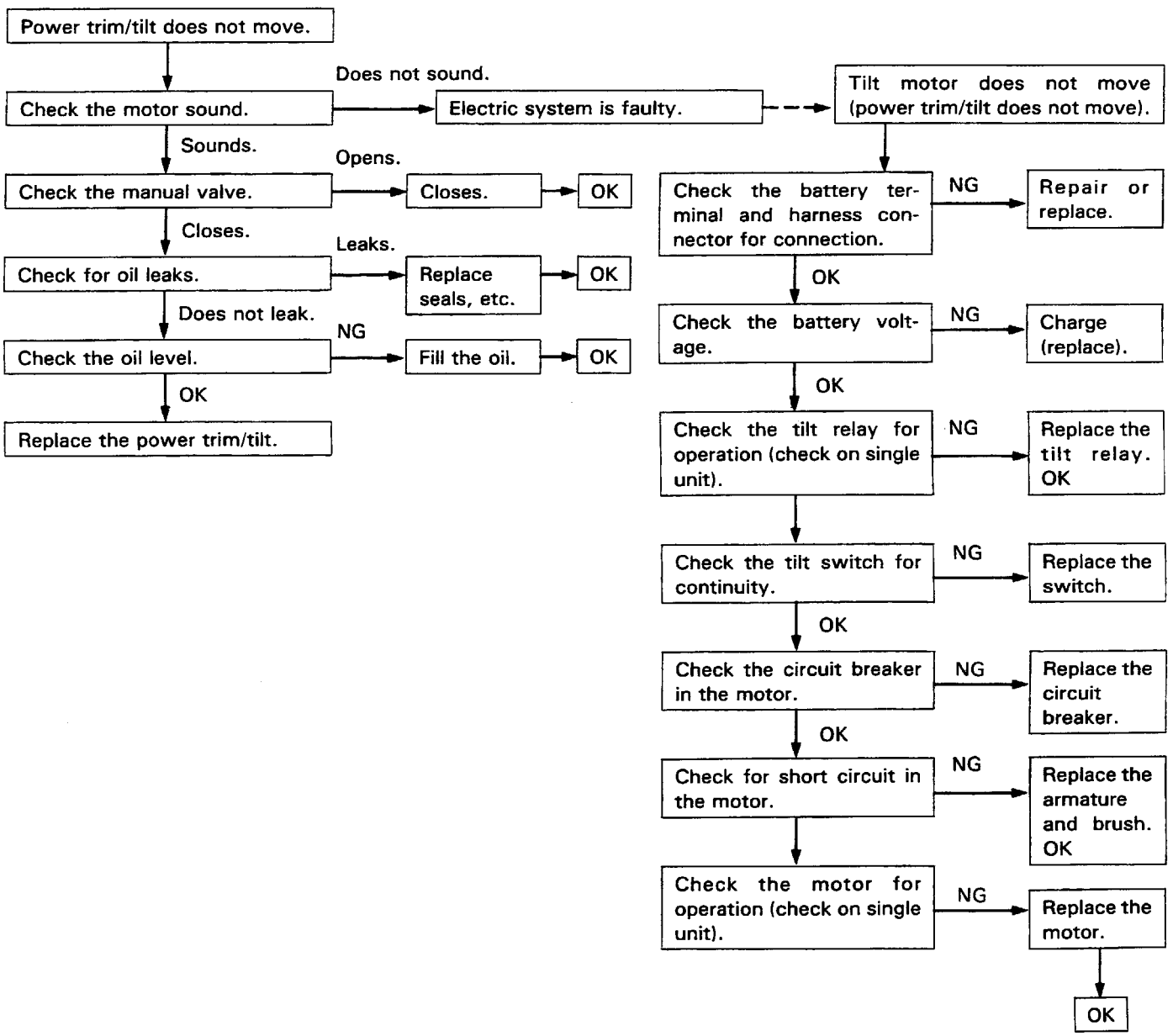
G. ASSIST TILT LOAD (Gas assisted type)



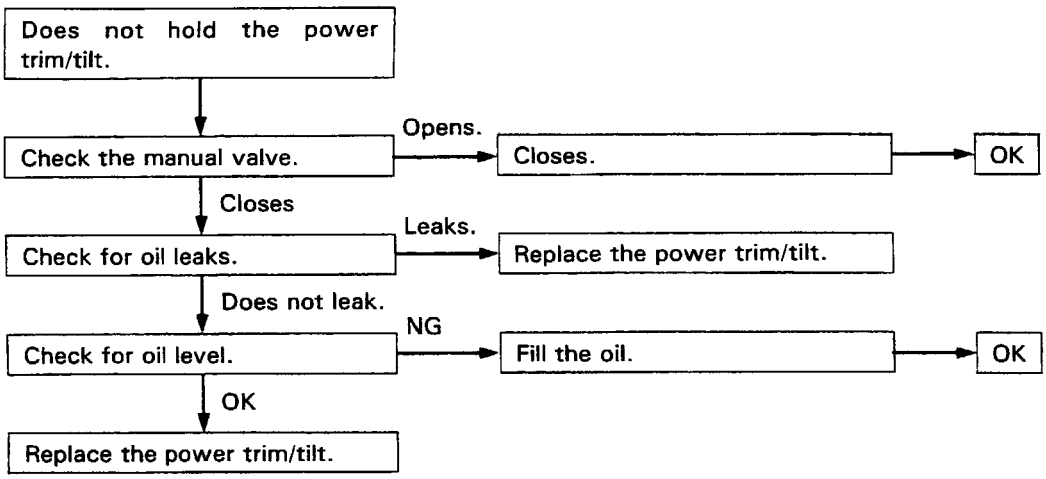
H. DOES NOT HOLD THE ASSIST TILT (Gas assisted type)



I. POWER TRIM & TILT DOES NOT MOVE (Power trim & tilt type)

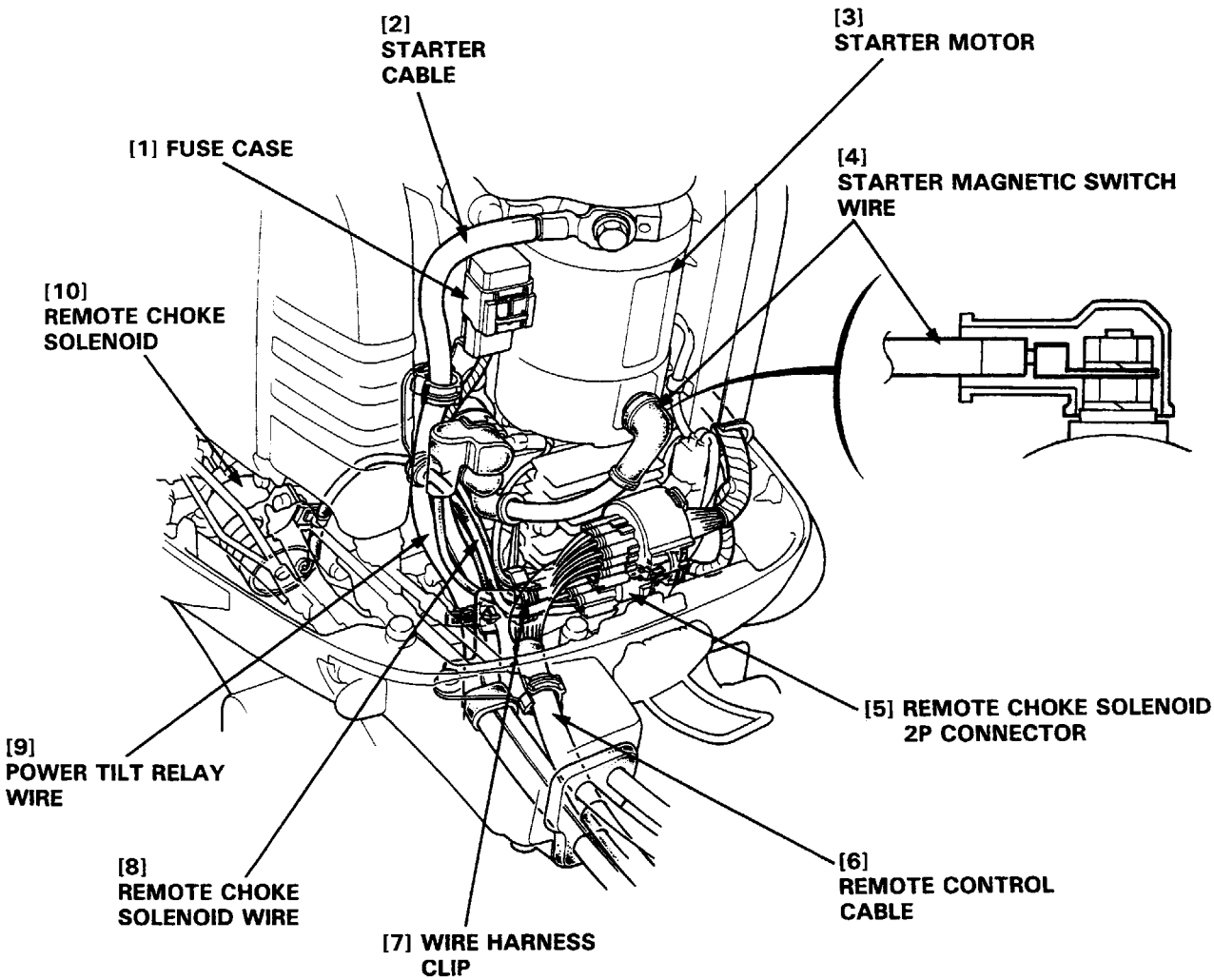


J. DOES NOT HOLD THE POWER TRIM & TILT (Power trim & tilt type)

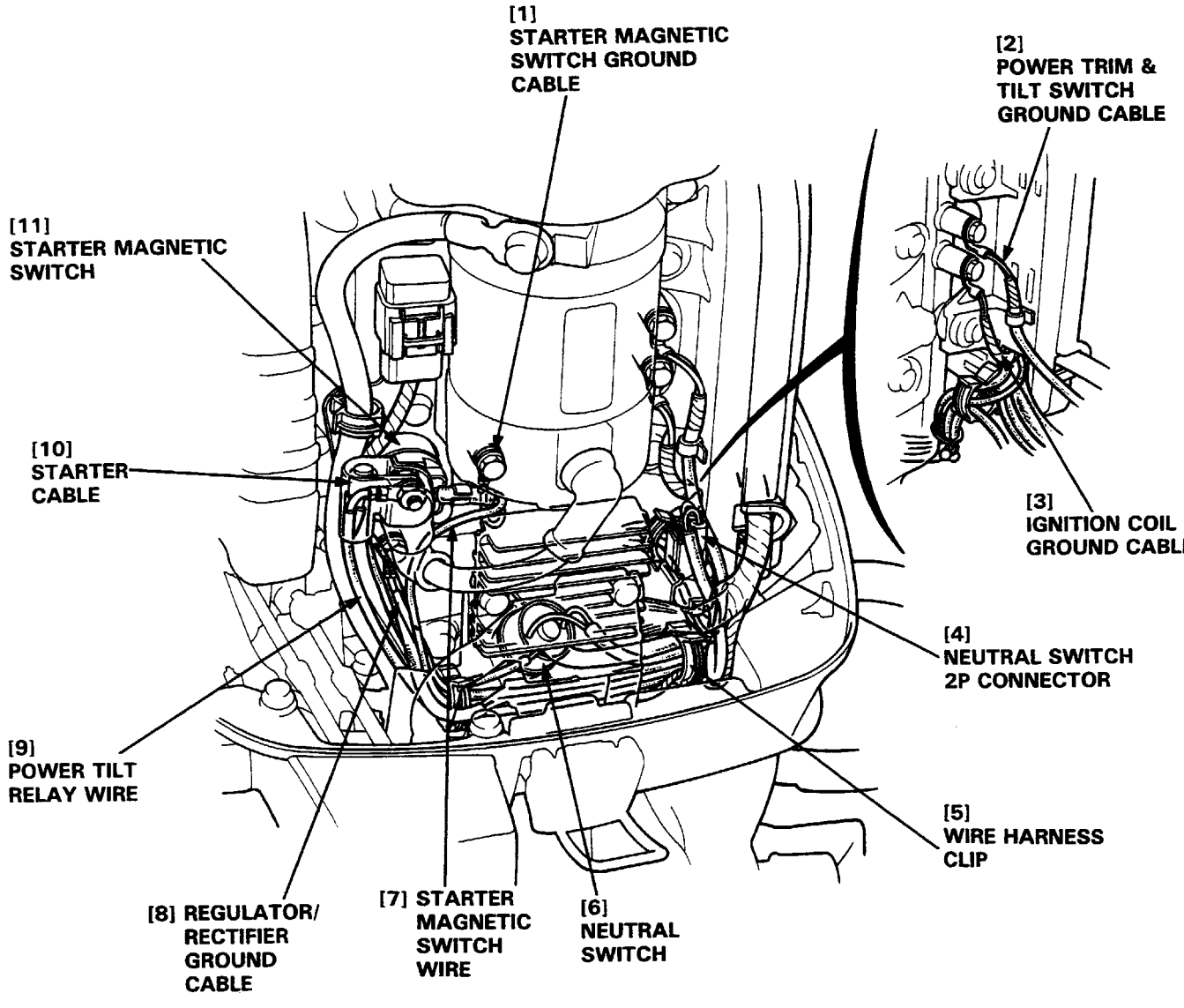


CABLE/HARNESS ROUTING

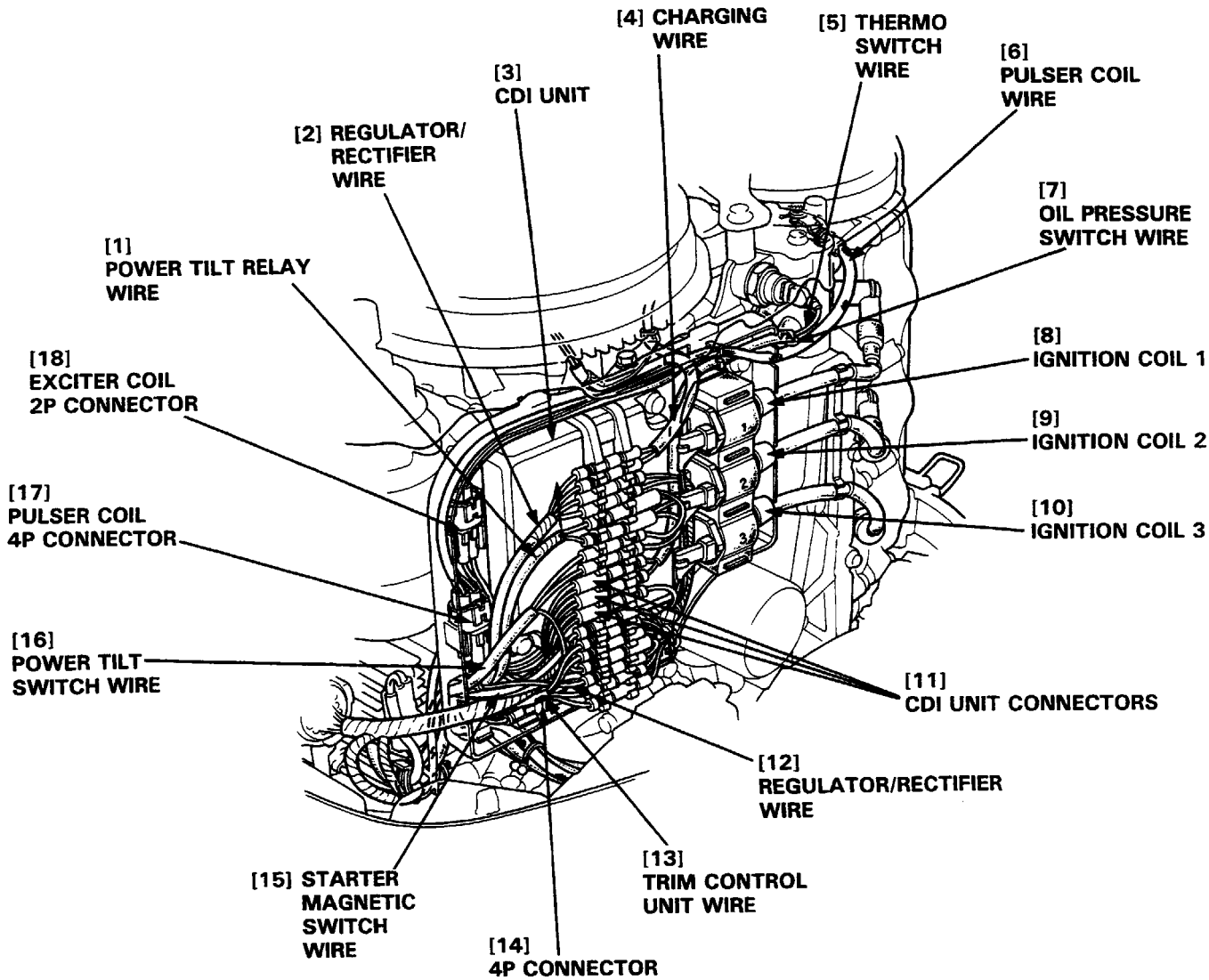
(Remote control/Power trim & till type)

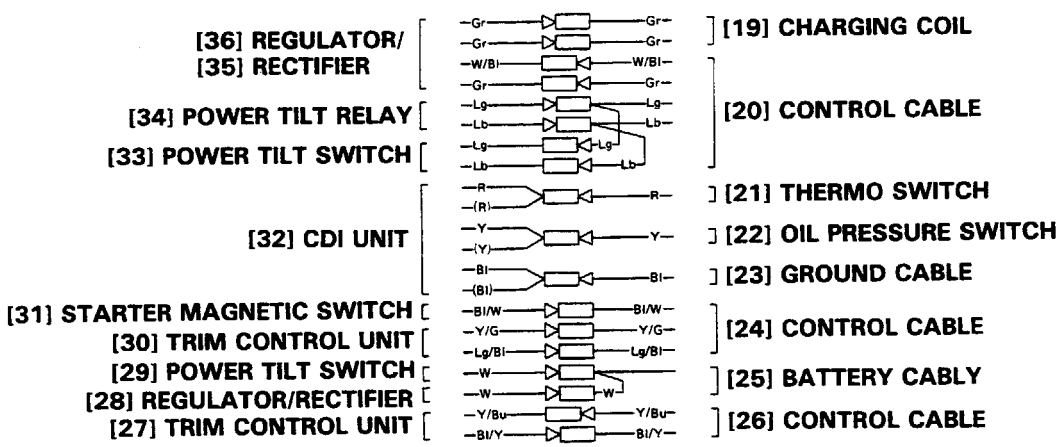


(Remote control/Power trim & tilt type)

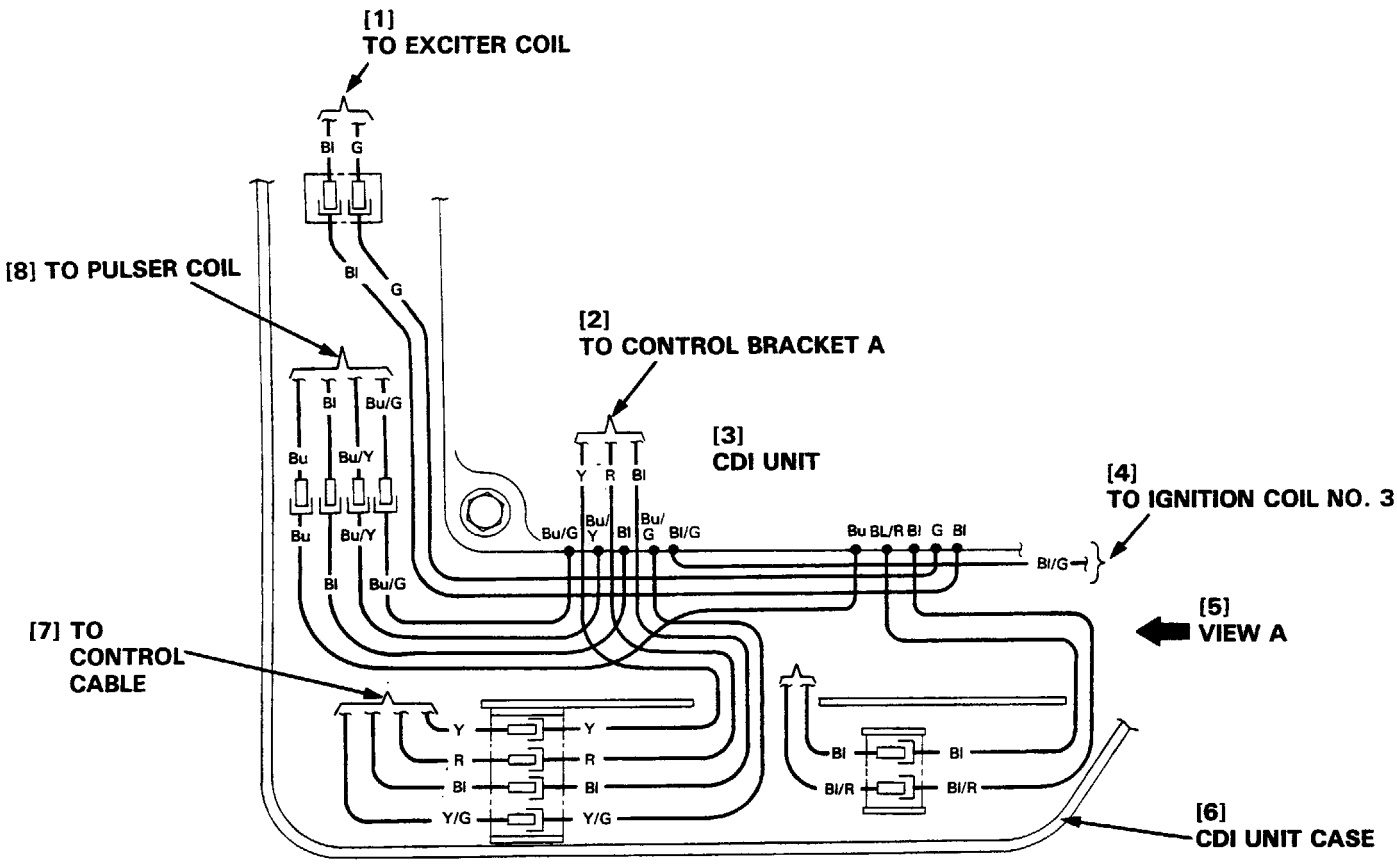


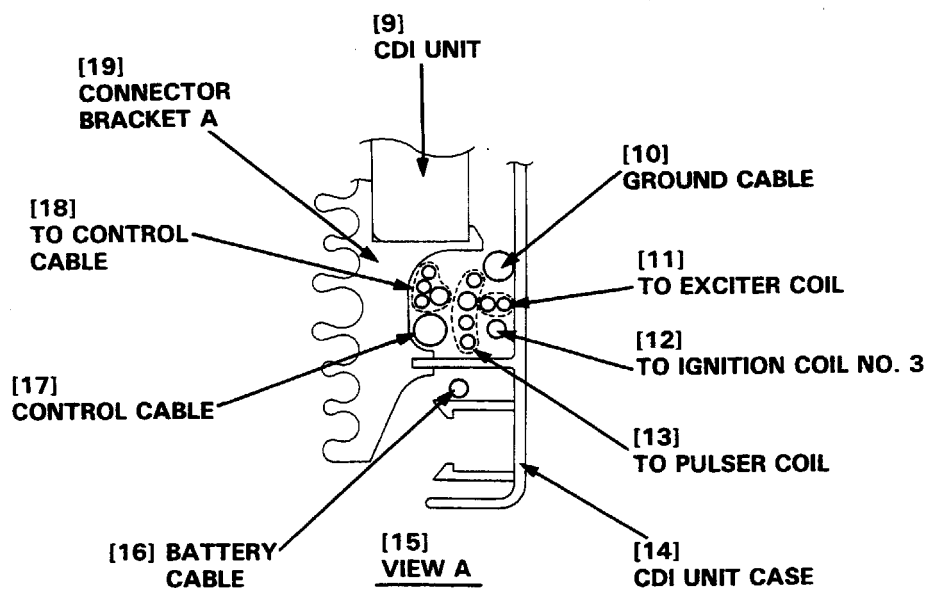
(Remote control/Power trim & tilt type)



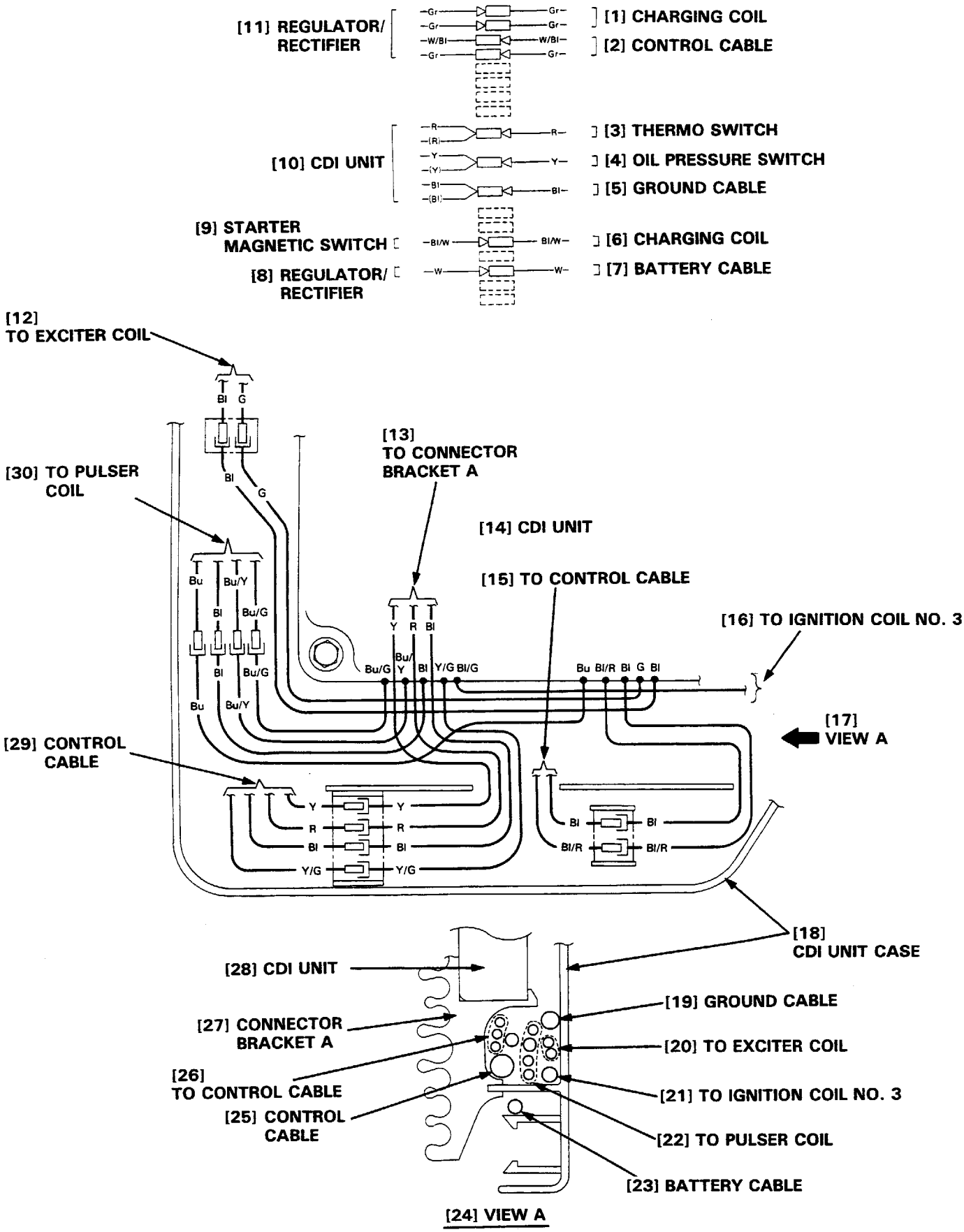


(Remote control/Power trim & tilt type)

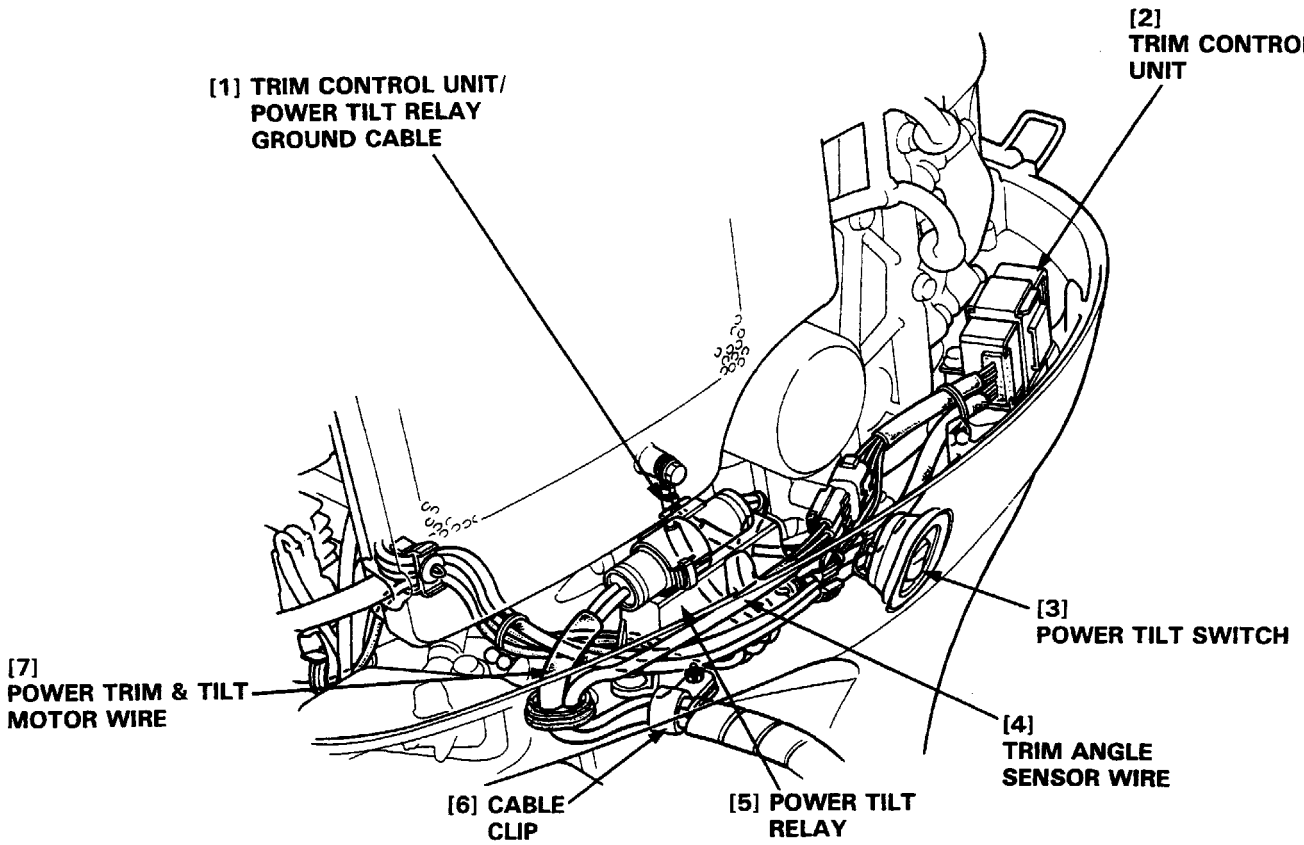




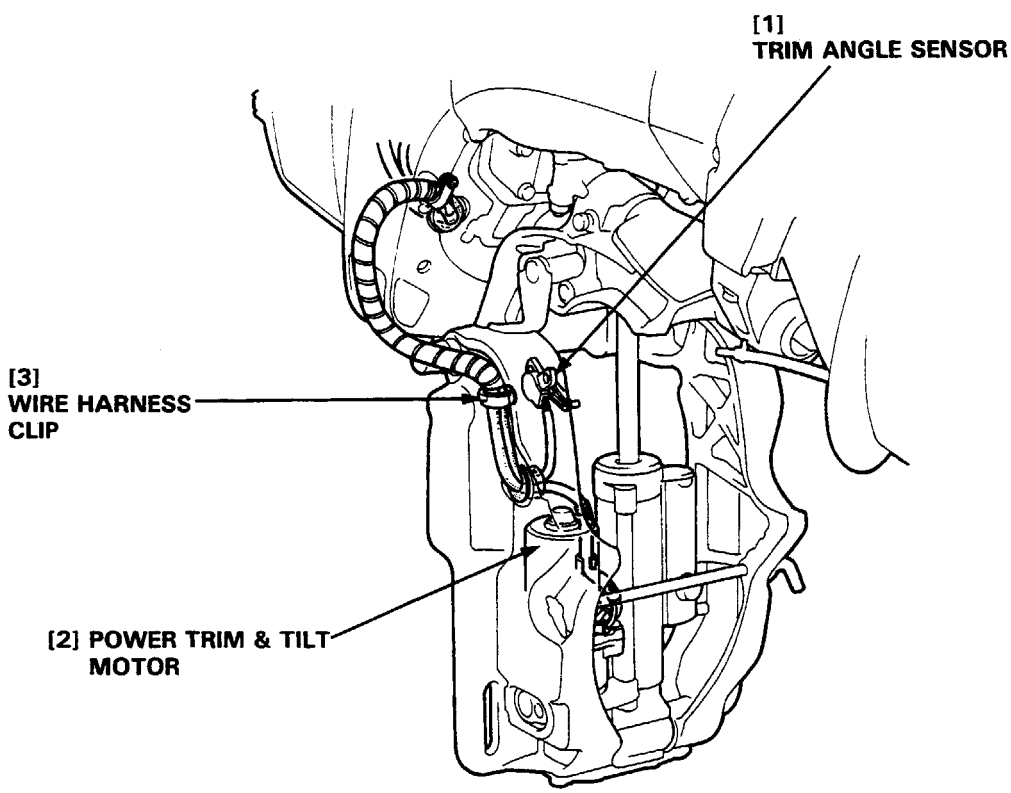
(Remote control/Gas assisted type)



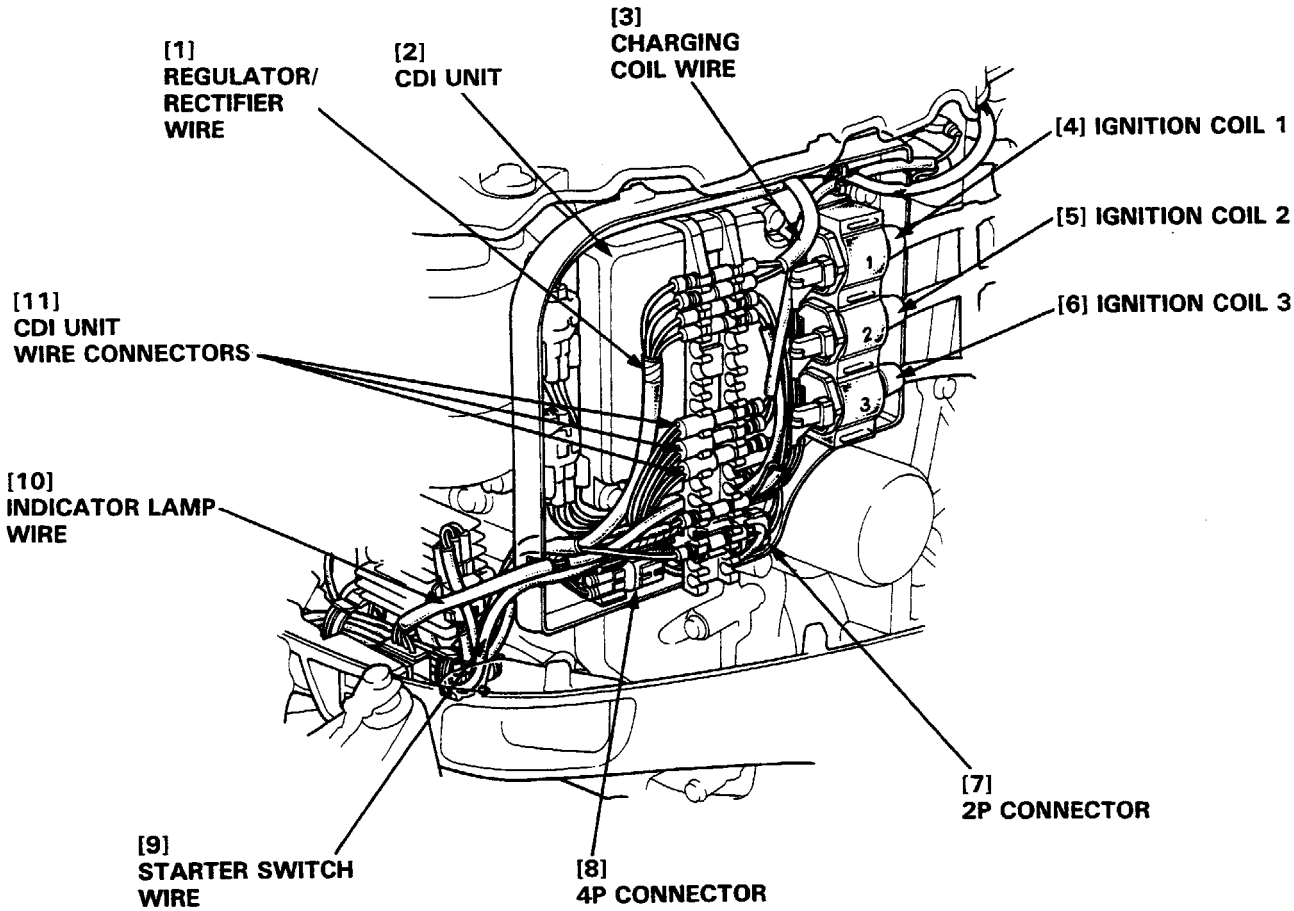
(Remote control/Power trim & tilt type)

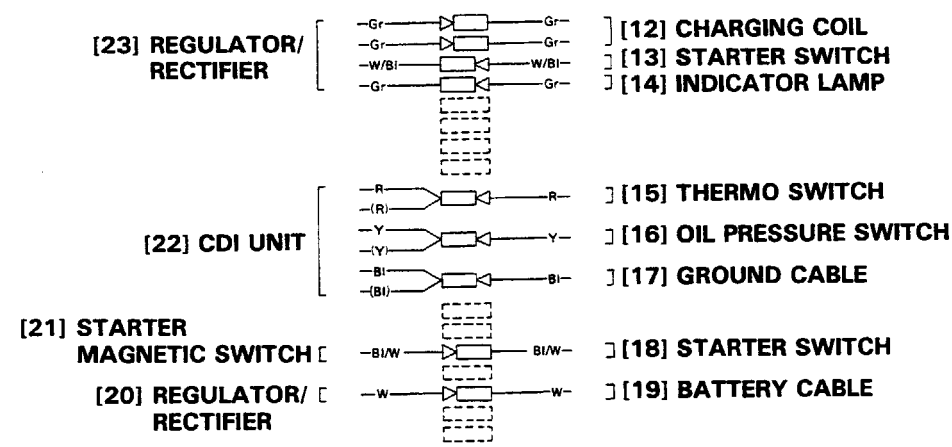


(Power trim & tilt type)

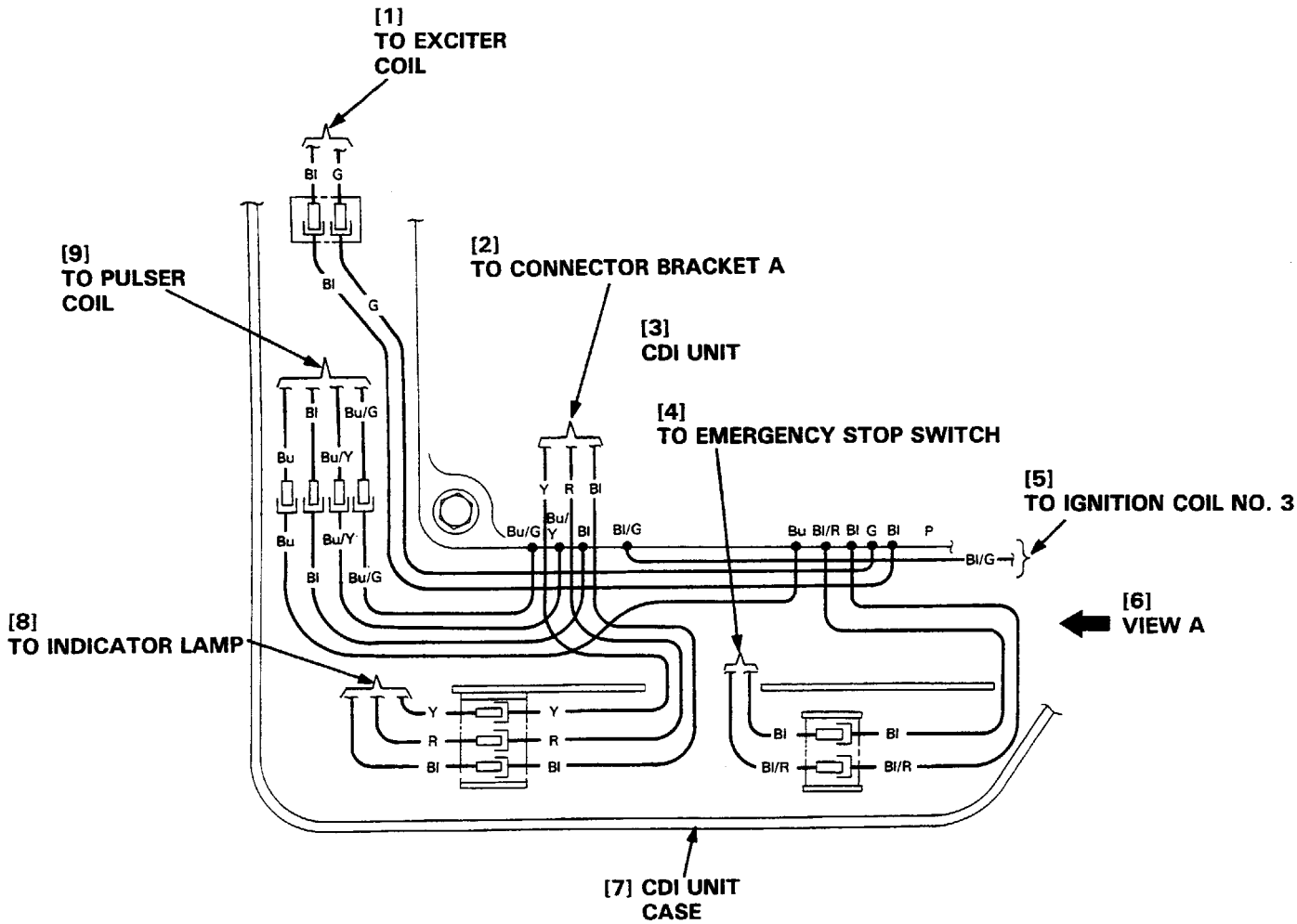


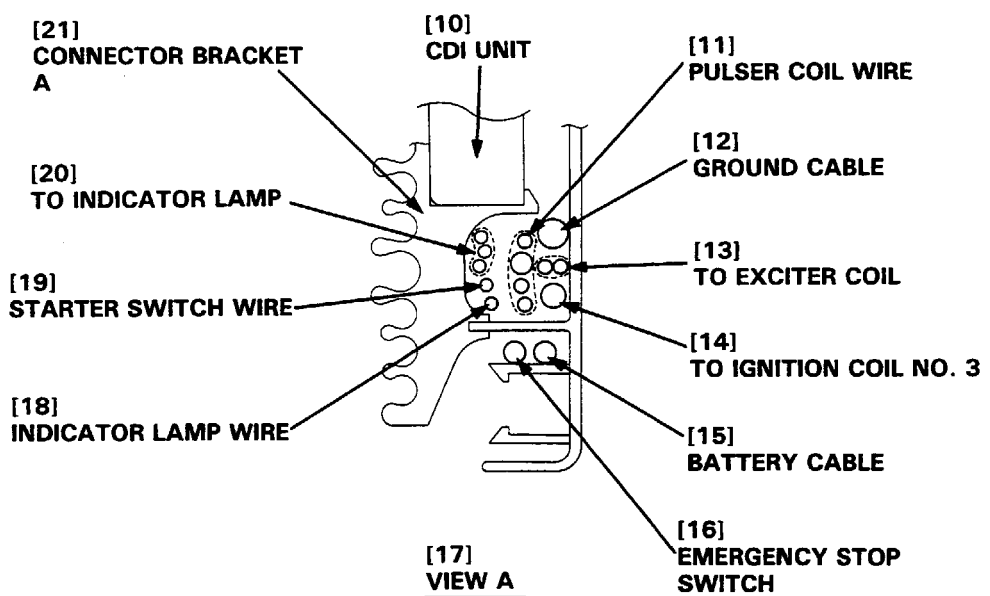
(Tiller handle type)



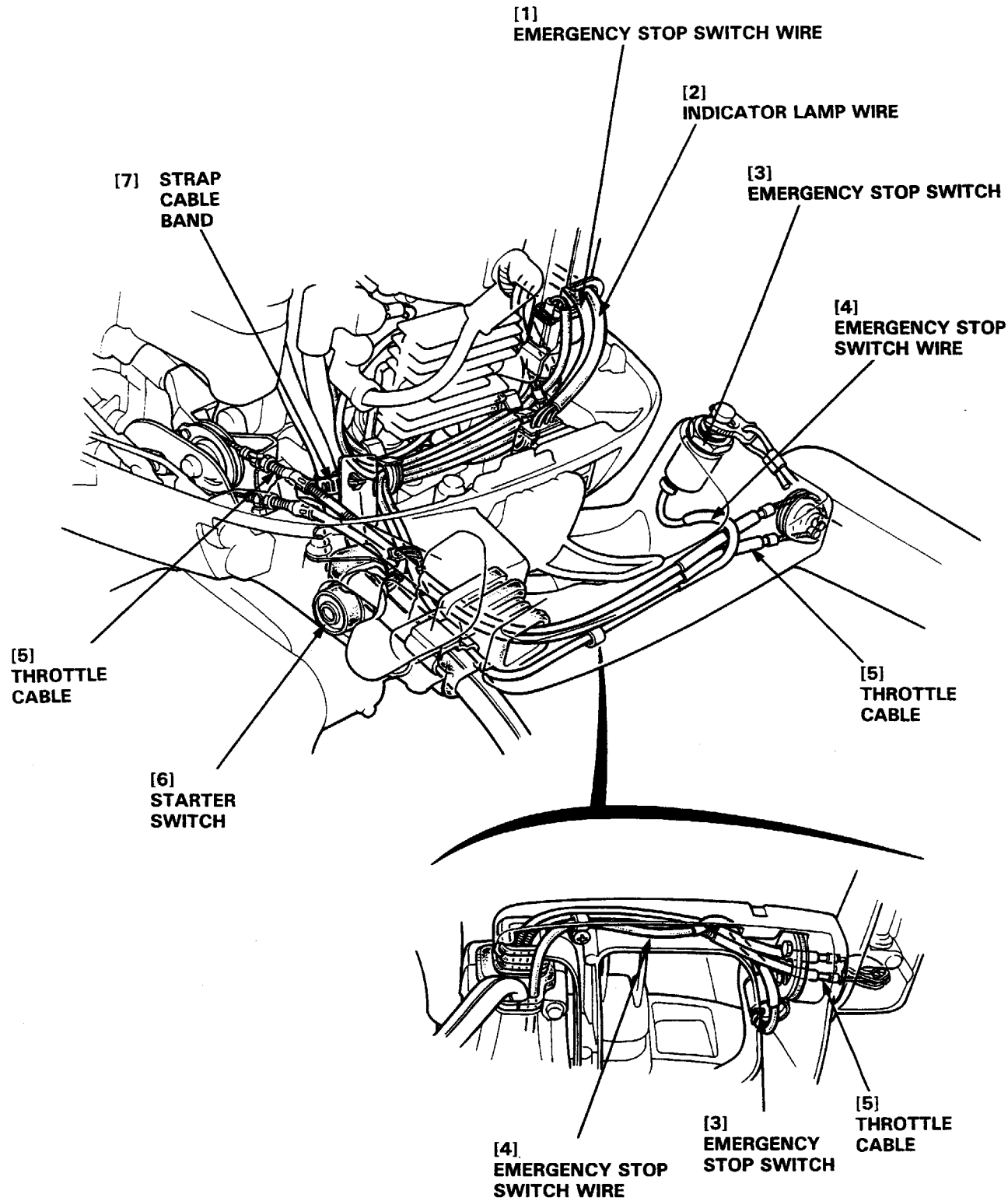


(Tiller handle type)

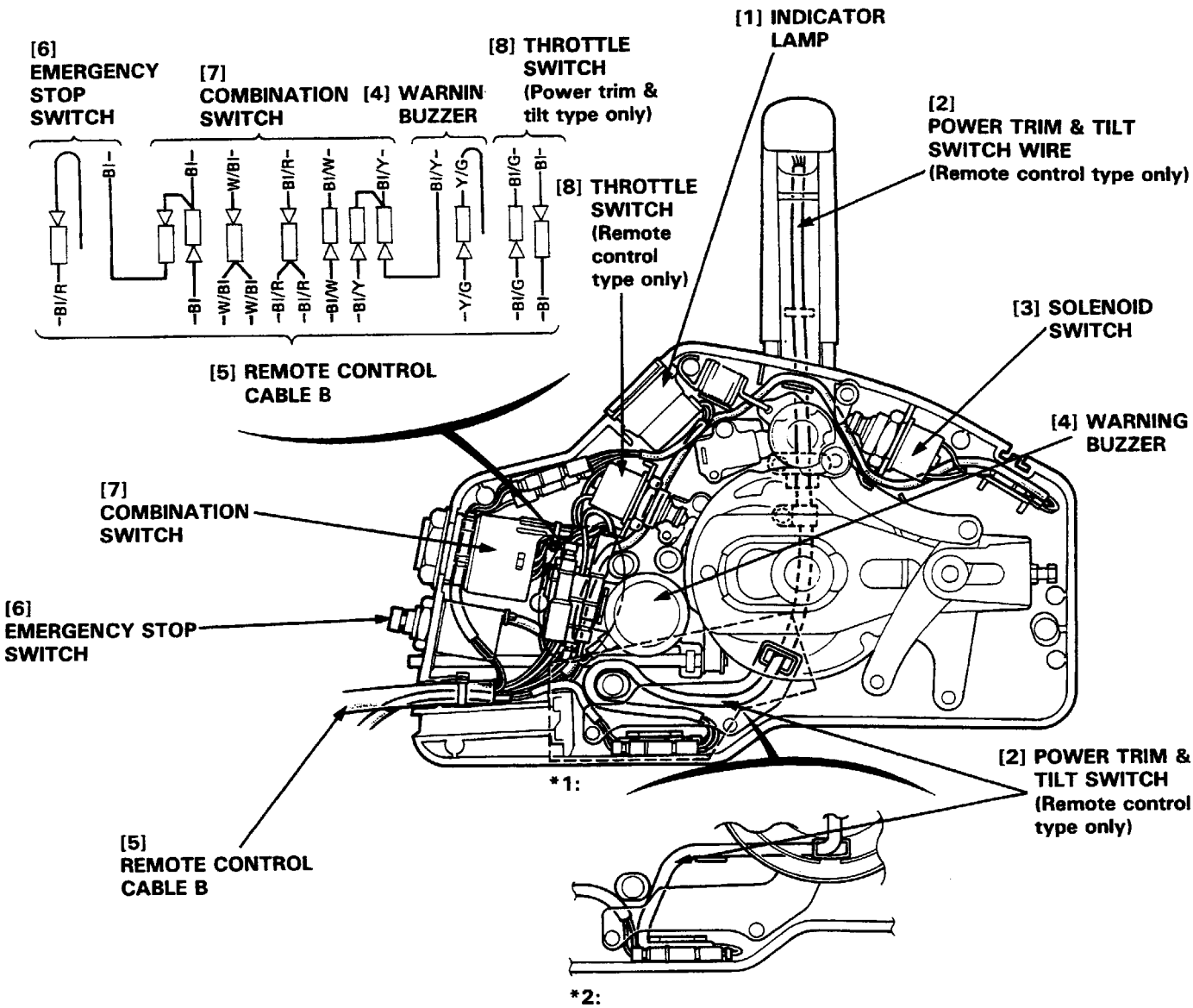




(Tiller handle type)

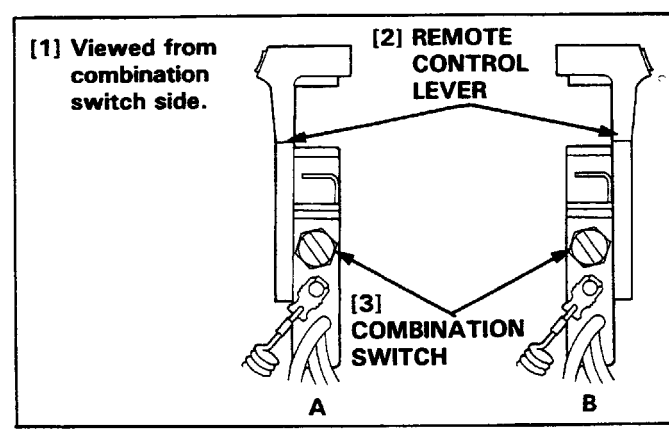


(Remote control type)

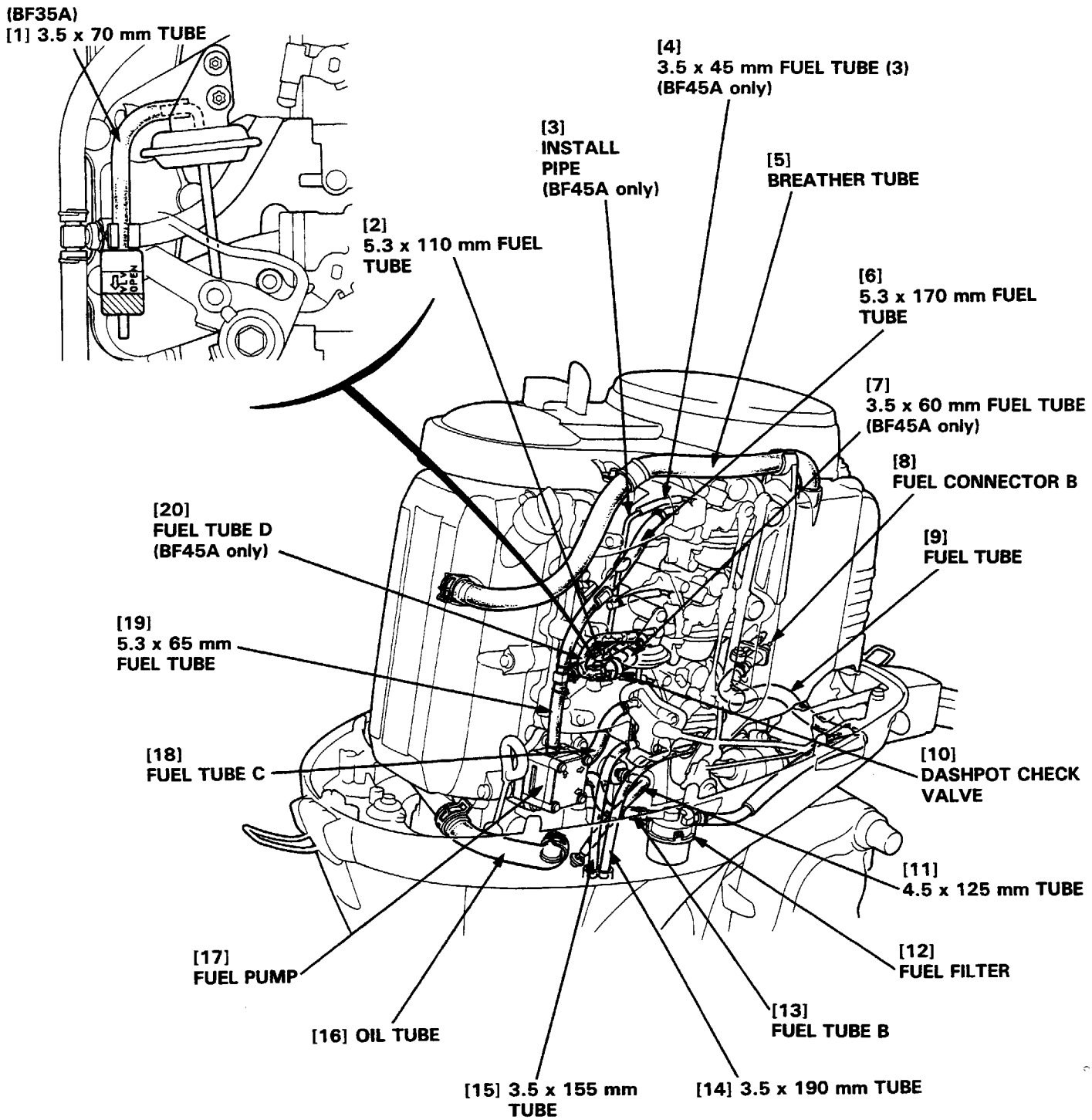


*1: Power trim/tilt switch wire routing with remote control lever set as shown by A.

*2: Power trim/tilt switch wire routing with remote control lever set as shown by B.

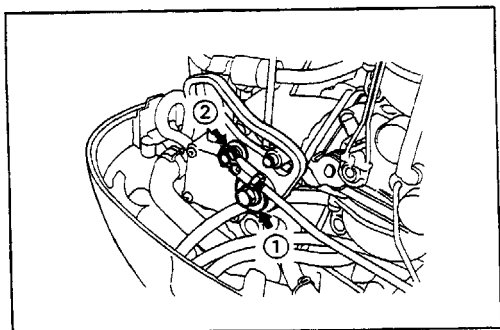


TUBE ROUTING

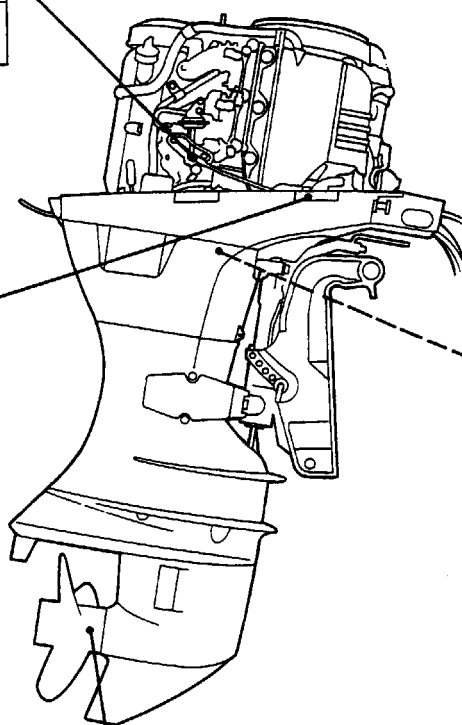


LUBRICATION

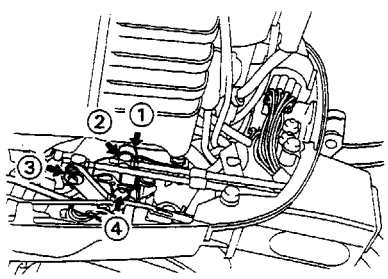
Wipe the outside of the engine with a cloth dipped in oil.
Apply marine anticorrosion grease to the following parts:



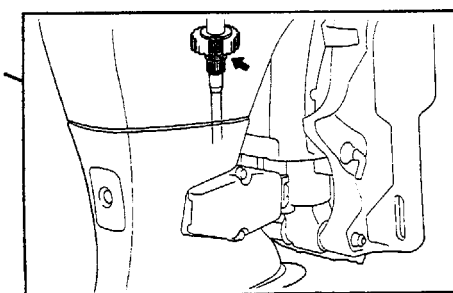
① THROTTLE CAM/OPENER CAM
② LINKAGE PIVOT



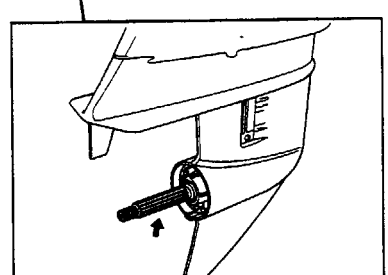
(Remote control type only)



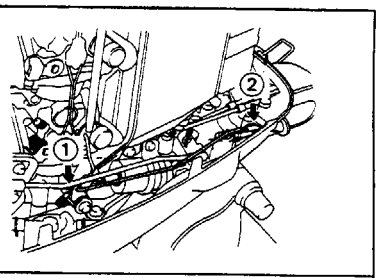
① CLICK SPRING
② SHIFT PIVOT
③ THROTTLE ARM
④ SHIFT LINK B



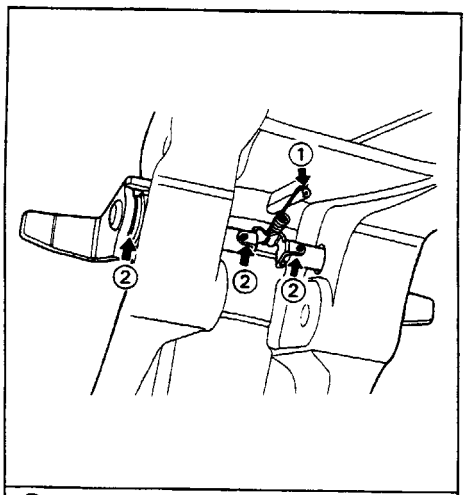
VERTICAL SHAFT



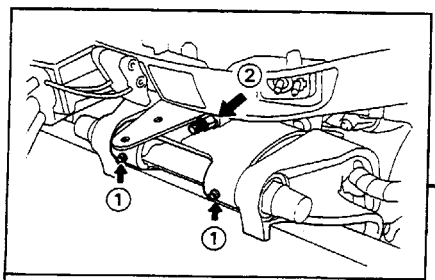
PROPELLER SHAFT



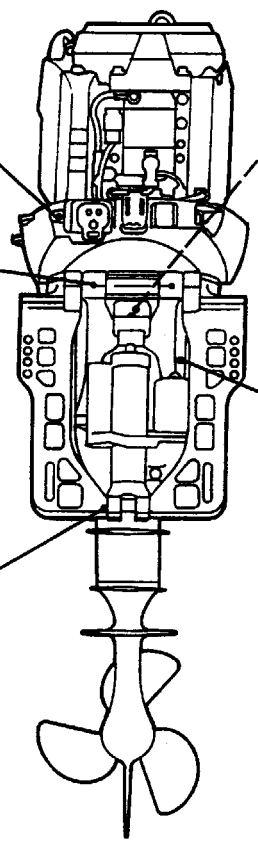
① CHOKE ARM A, B
② CHOKE KNOB

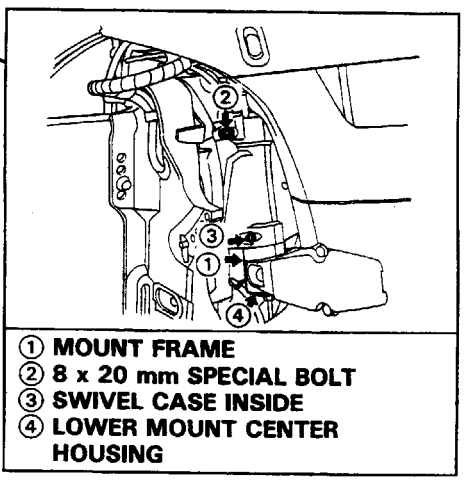


① TILT STOPPER SPRING
② TILT STOPPER



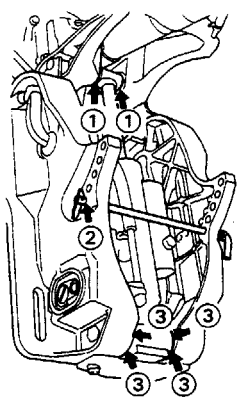
① TILTING SHAFT
② 10 mm SELF-LOCKING NUT
(Remote control type only)





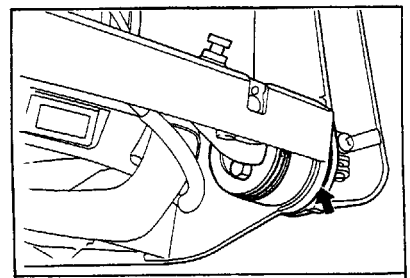
① MOUNT FRAME
② 8 x 20 mm SPECIAL BOLT
③ SWIVEL CASE INSIDE
④ LOWER MOUNT CENTER HOUSING

(Power trim & tilt/Gas assisted type only)

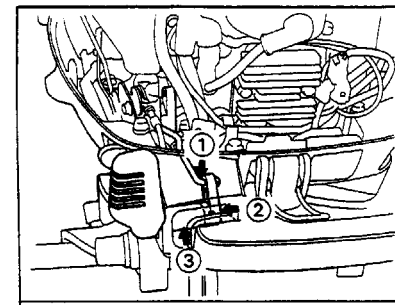


① CYLINDER UPPER PIN
② ADJUSTING ROD
③ LOWER CYLINDER BUSHING

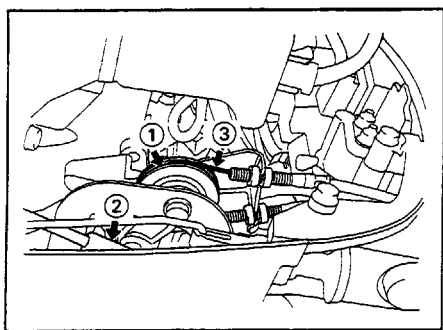
(Tiller handle type only)



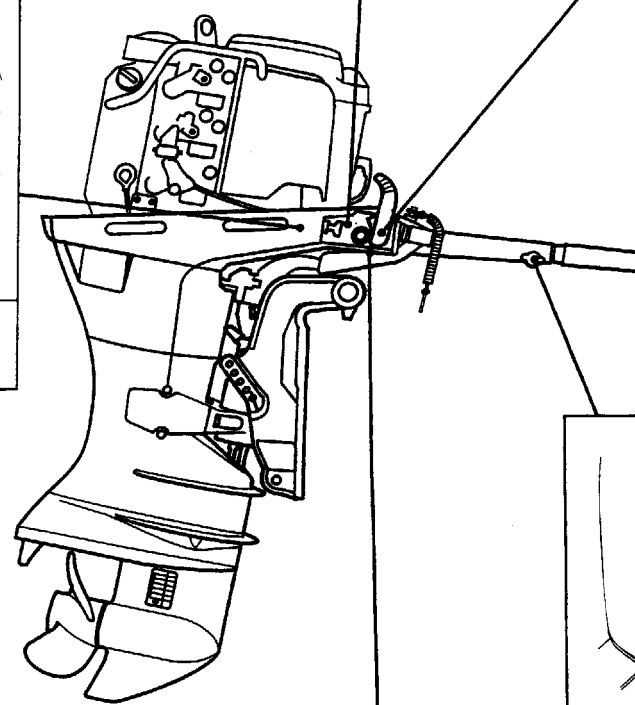
HANDLEBAR

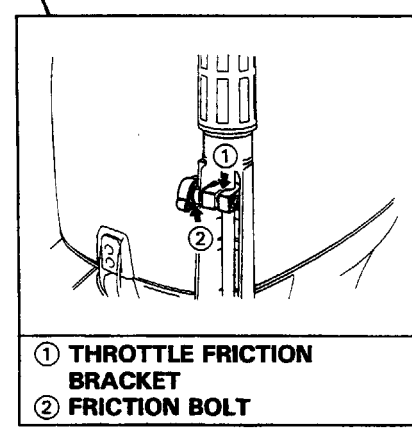


① LINK ROD
② SHIFT LINK A
③ SHIFT LEVER

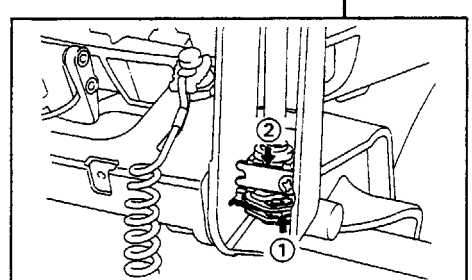


① THROTTLE ARM
② THROTTLE ROD
③ THROTTLE CABLE





① THROTTLE FRICTION BRACKET
② FRICTION BOLT



① THROTTLE REEL
② THROTTLE REEL PLATE

MAINTENANCE SCHEDULE

ITEM / REGULAR SERVICE PERIOD (2) Perform at every indicated monty or operating hour interval, whichever comes first.		EACH USE	FIRST MONTH OR 20 HRS	EVERY 6 MONTHS OR 100 HRS	EVERY YEAR OR 200 HRS	EVERY 2 YEARS OR 400 HRS	Refer to page
Engine oil	Check level	O					3-2
	Change		O		O		
Gear case oil	Check level and Check for water contamination			O			3-4
	Change		O		O		
Engine oil filter	Change					O	3-3
Timing belt	Check-Readjust				O		3-16
Carburetor linkage	Check		O	O			3-11
Idling	Readjust		O	O			3-8
Valve clearance	Check-Readjust		O		O		3-5
Spark plugs	Check-clean		O		O		3-4
Propeller and split pin	Check	O					11-2
	(Replace if necessary)			O			
Lubrication	Grease		O(1)	O(1)			2-33
Fuel tank and tank filter	Clean				O		3-7
Fuel strainer	Check			O			3-8
	Change					O	
Thermostat	Check				O		8-3
Fuel	Check	O					5-12
	(Replace if necessary)					O	
Battery fluid	Check-refilling	O					——
Cable connection	Check-tightness		O	O			
Bolts and Nuts	Check-tightness		O	O			——

NOTE:
(1) Lubricate more frequency when used in salt water.
(2) For professional commercial use, log hours of operation to determine proper maintenance intervals.

MAINTENANCE

ENGINE OIL

a. INSPECTION

⚠WARNING

- **Used motor oil may cause skin cancer if repeatedly left in contact with the skin for prolonged periods. Although this is unlikely unless you handle used oil on a daily basis, it is still advisable to thoroughly wash your hands with soap and water as soon as possible after handling used oil.**

NOTE

- Draining can be performed rapidly and completely when the engine is still warm.
- Place the shop towel under the oil filter when removing the oil filter.

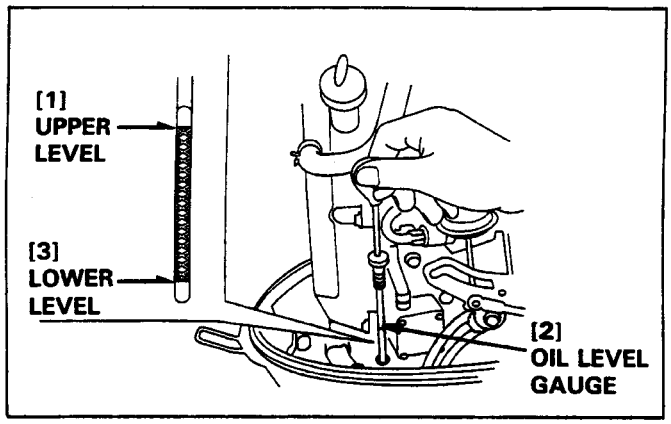
1) Remove the engine cover and oil level gauge.
2) Insert the oil level gauge into the oil filler neck.
3) Check the oil level shown on the oil level gauge; if near or below the lower level mark, fill to the upper level mark with the recommended oil.

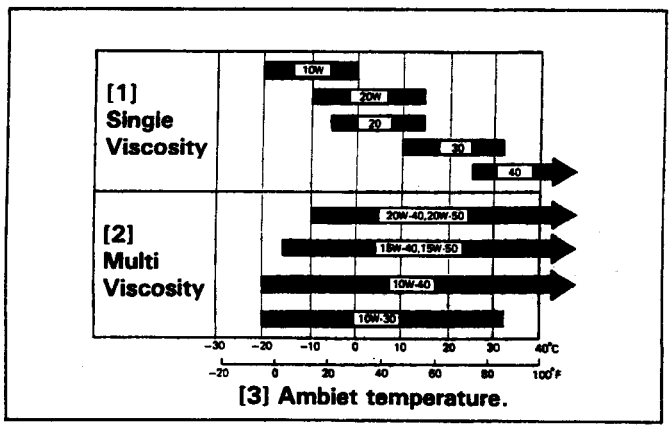
Engine oil capacity	2.0 ℓ (2.11 US qt, 1.76 Imp qt)

Recommended engine oil	SAE10W-30/40 engine oil or equivalent, API Service classification SG, SF/CC, CD

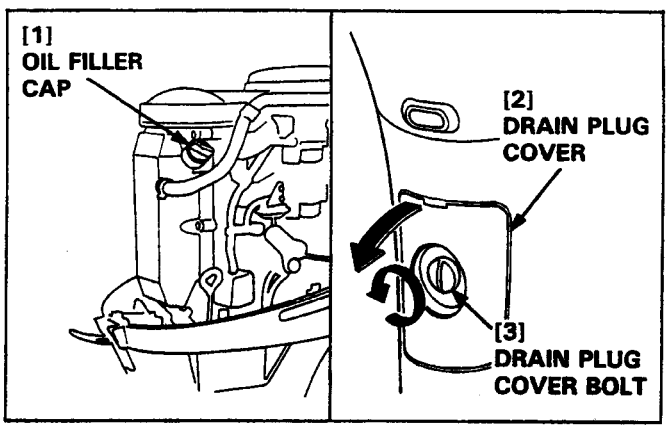
NOTE

- When a new oil filter has been installed,recheck the engine oil level after running the engine for a few minutes.





[3] Ambiet temperature.



b. OIL CHANGE

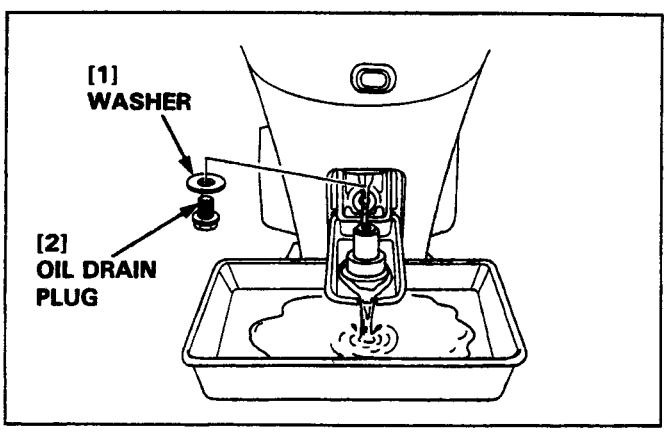
1) Remove the oil filler cap, drain plug cover and oil drain plug. Drain the oil into a suitable container.
2) Retighten the oil drain plug.

   TORQUE: 23 N·m (2.3 kg-m, 16.6 ft-lb)

3) Refill to the upper level mark on the oil level gauge with the recommended oil.
   Tighten the oil filler cap securely.
4) Tighten the drain plug cover bolt.

   TORQUE: 6.5 N·m (0.65 kg-m, 4.7 ft-lb)

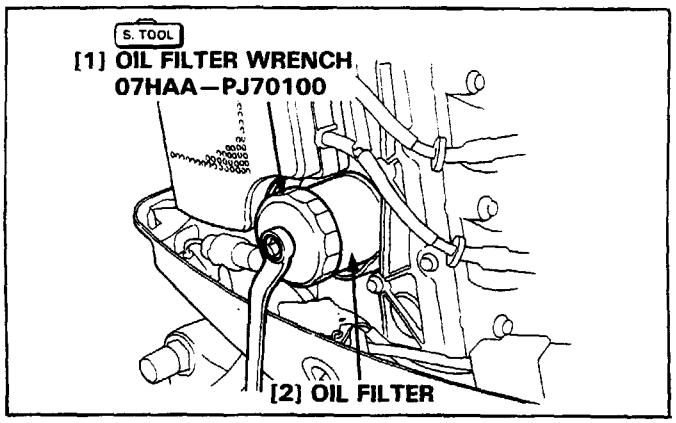
5) Install the engine cover.



OIL FILTER

1) Remove the engine cover.
2) Drain the engine oil (P. 3-2).
3) Attach the oil filter wrench to the oil filter and remove the oil filter.

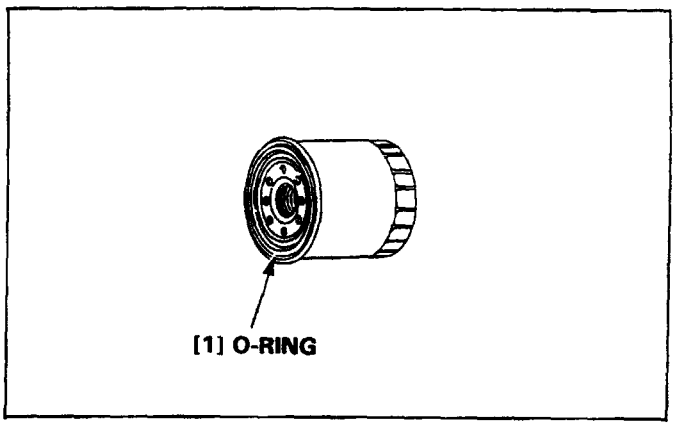
TOOL:
OIL FILTER WRENCH **07HAA—PJ70100**



4) Clean the installation section of a new cartridge and apply a light coating of engine oil to the O-ring, screw on and tighten the cartridge by hand.
5) Use the oil filter wrench to tighten to the torque.

TORQUE: 8 N·m (0.8 kg-m, 5.6 ft-lb)

6) Fill with the specified capacity of engine oil and run the engine for a few minutes. At that time, check for oil leaks from the oil filter cartridge.

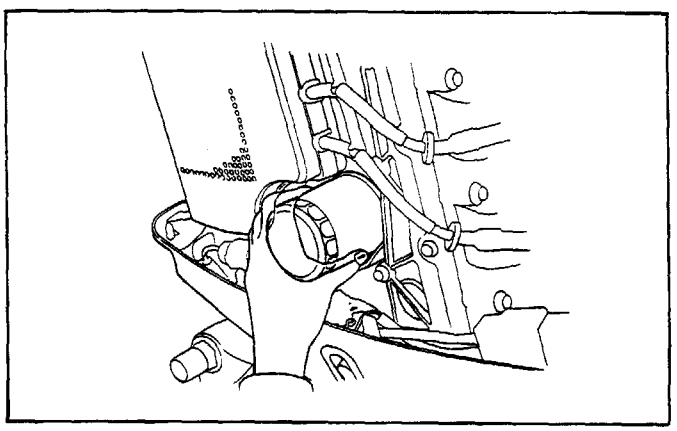


Oil capacity	2.0 ℓ (2.11 US qt, 1.76 Imp qt) with oil filter cartridge replacement: 2.2 ℓ (2.32 US qt, 1.93 Imp qt)

After stopping the engine, check the engine oil amount and fill with oil if necessary.

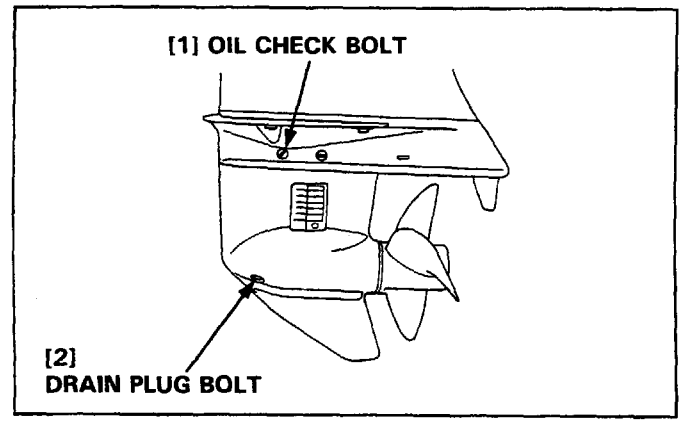
NOTE

- Before replacing the oil filter, place a wipe cloth under the filter to trap oil leakage.
- Replace the oil filter as an assembly cartridge.



GEAR OIL

1) GEAR OIL LEVEL CHECK
   Check the oil level when the engine is in the vertical position.
   Remove the oil check bolt and see if oil flows out. If no oil comes out, fill through the drain plug bolt hole until the oil starts to flow out through the oil check bolt hole.
2) GEAR OIL REPLACEMENT
   Remove the oil check bolt and drain plug bolt to drain the oil.
   Inject oil through the drain plug bolt hole until it starts flowing out through the oil check bolt hole. Reinstall and tighten the oil check bolt and drain plug bolt securely.

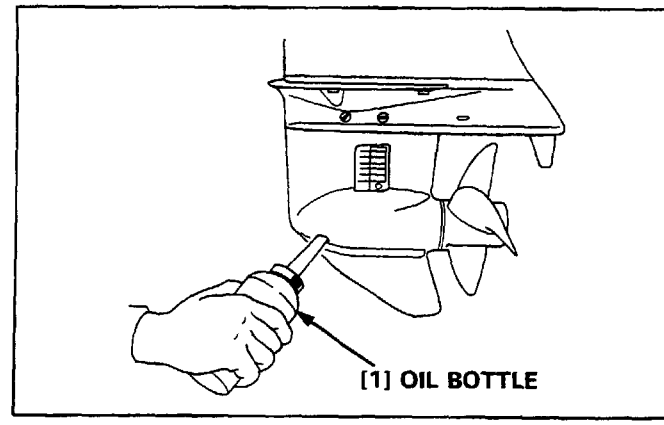


Gear oil capacity	0.52 ℓ (0.550 US qt, 0.458 Imp qt.)

Recommended gear oil	SAE #90 Hypoid gear oil or equivalent, API Service Classification (GL-4 or GL-5)

NOTE

- Be sure that the water is not mixed with the gear oil. If the water is mixed in the oil, check the gasket and water seal for damage and check the gear case for tightening.



SPARK PLUGS

1) Remove the engine cover and spark plug caps.
2) Clean any dirt from around the spark plug bases.
3) Use a spark plug wrench to remove the spark plugs.
4) Visually inspect the spark plug. Discard the plugs if the insulators are cracked or chipped.
5) Remove carbon or other deposits with a stiff wire brush.
6) Measure the plug gap with a wire-type feeler gauge.

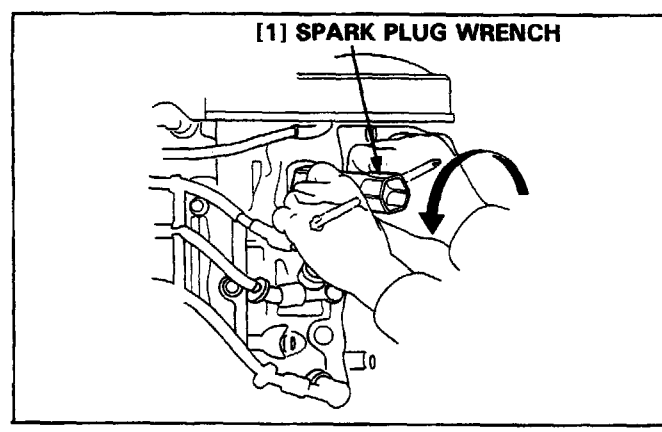
Spark plug gap	0.6—0.7 mm (0.024—0.028 in)

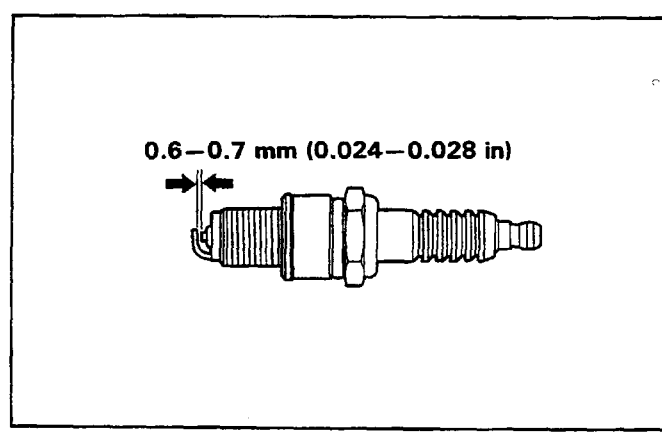
Recommended spark plug	DR7EA (NGK) X22ESR-U (ND)

   If necessary, adjust the gap by bending the side electrode.
7) Make sure the sealing washer is in good condition.
8) Install the plug fingertight to seat the washer, then tighten with a plug wrench (an additional 1/2 turn if a new plug) to compress the sealing washer. If you are reusing a plug, tighten 1/8-1/4 turn after the plug seats.

CAUTION

- **The spark plug must be securely tightened. An improperly tightened plug can become very hot and possibly damage the engine.**
- **Never use spark plug with an improper heat range.**

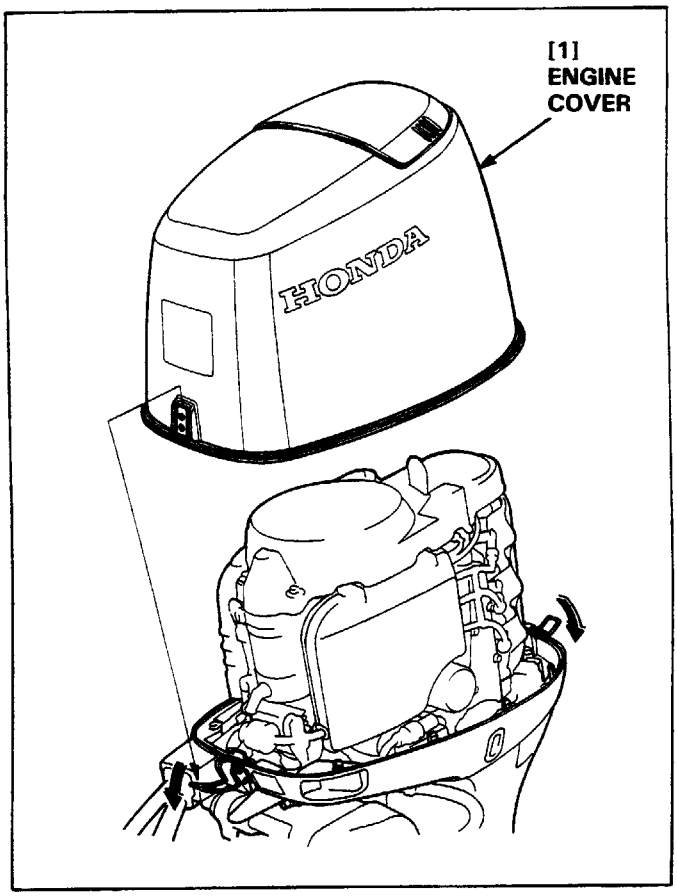




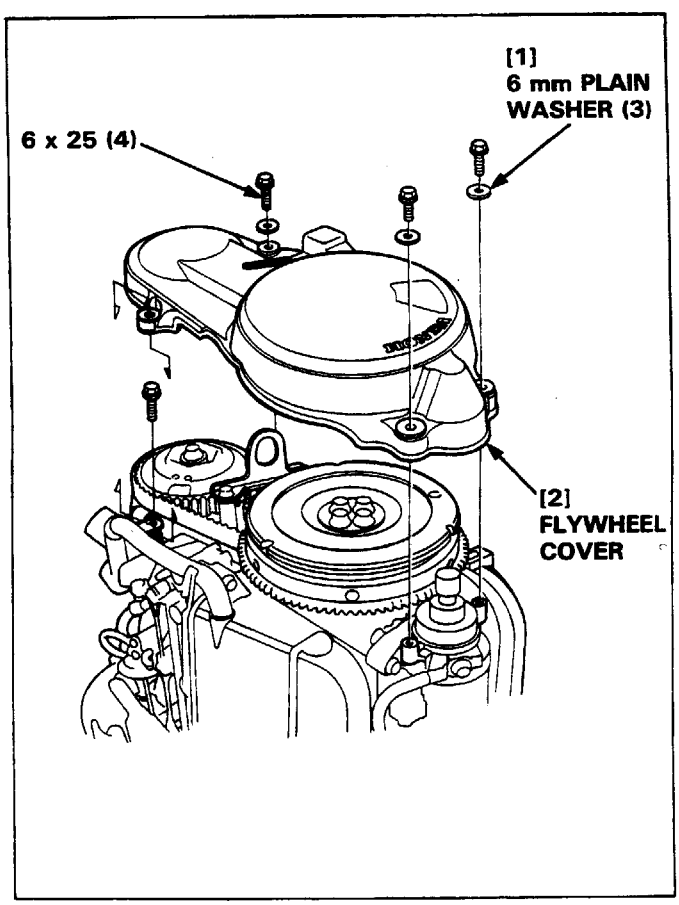
VALVE CLEARANCE

Valve clearance inspection and adjustment must be performed with the engine cold.

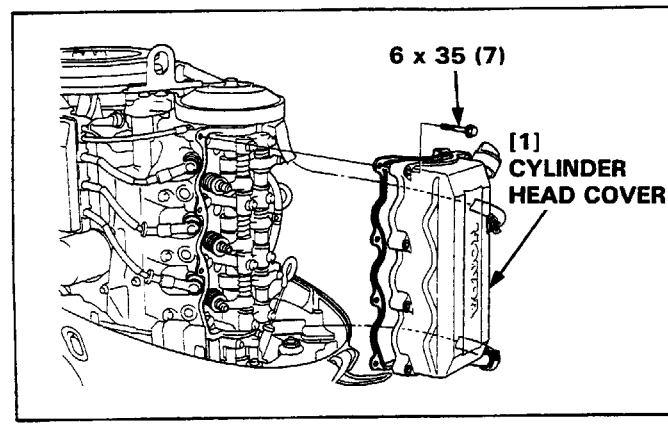
1) Remove the engine cover.



2) Move the shift lever to "N" position.
3) Remove the four 6 x 25 mm flange bolts and three 6 mm plain washers from the flywheel cover.
4) Remove the flywheel cover.



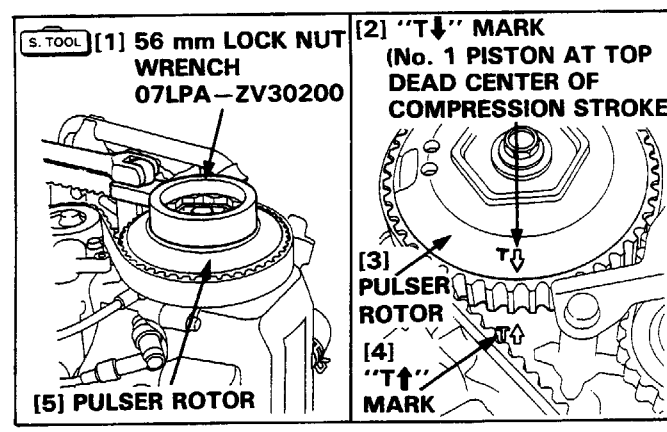
5) Remove the seven 6 x 35 mm flange bolts and cylinder head cover.

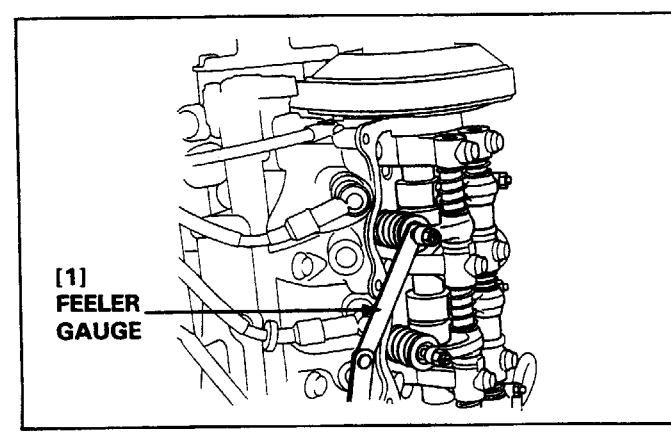


6) Attach the special tool to the pulser rotor as shown, and align the "T▼" mark on the pulser rotor with the "T▲" mark on the cylinder head.
Be sure that the "T" mark on the flywheel aligns with the "▮" mark on the engine hanger mounting boss this time (which indicates that the No. 1 piston is at the top dead center of its compression stroke). With the No. 1 piston at the top dead center of the compression stroke, measure the intake and exhaust valve clearances.

Valve clearance	IN	0.13—0.17 mm (0.005—0.007 in)
	EX	0.21—0.25 mm (0.008—0.010 in)

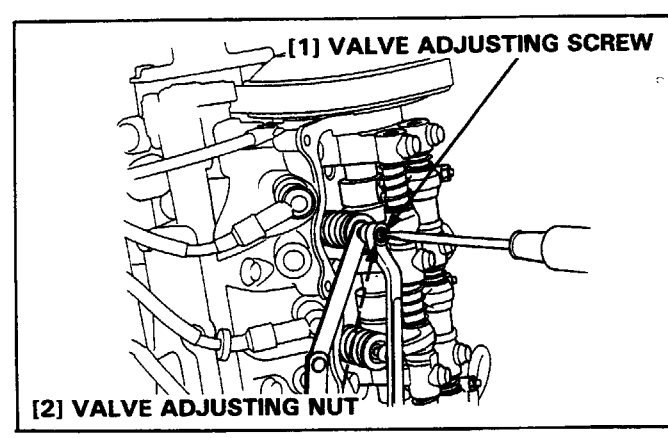
TOOL:
56 mm Lock nut wrench 07LPA—ZV30200



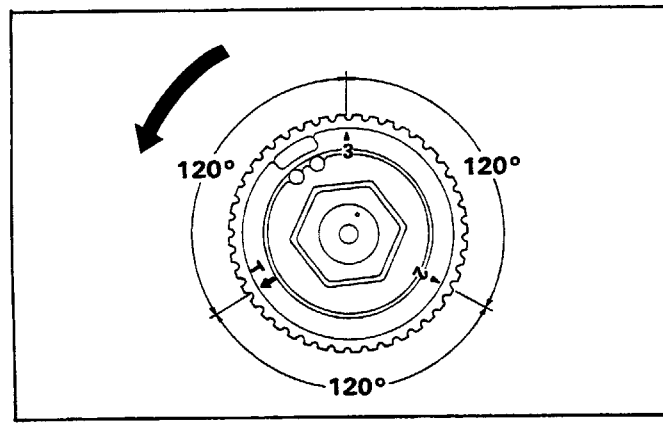


7) Loosen the valve adjusting screw lock nut and turn the adjusting screw to obtain the specified intake and exhaust valve clearance.
8) Hold the adjusting screw, and tighten the lock nut.
9) Recheck valve clearance after tightening the lock nut.

TORQUE: 23 N·m (2.3 kg-m, 16.6 ft-lb)



10) After adjusting the intake and exhaust valve clearances of the No. 1 cylinder, turn the pulser rotor 120° further and align the "2▲" mark with the "T⬆" mark on the cylinder head (which indicates that the No. 2 piston is at the top dead center of its compression stroke), then adjust the intake and exhaust valve clearances.
Finally, turn the pulser rotor 120° further and align the "3▲" mark with the "T⬆" mark on the cylinder head (which indicates that the No. 3 piston is at the top dead center of compression stroke), then adjust the intake and exhaust valve clearances.



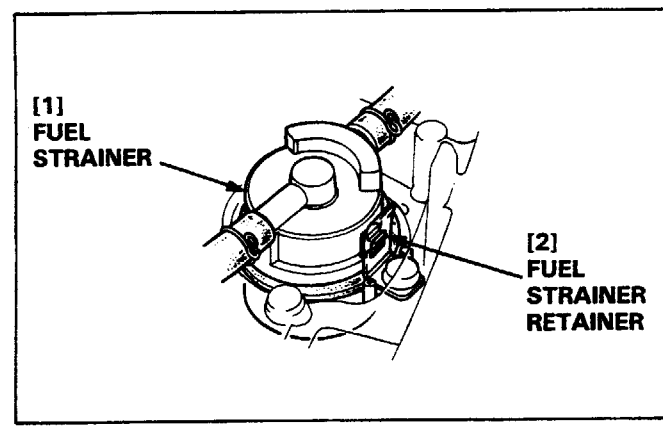
FUEL STRAINER

⚠ WARNING

- **Gasoline is extremely flammable and explosive under certain conditions. Do not smoke or allow flames or sparks in the area.**

• Inspection

1) Turn the fuel knob at the fuel tank to the "OFF" position and remove the engine cover.
Pull the choke knob.
2) Pull the fuel strainer retainer toward you and remove the fuel strainer.
3) Check the fuel strainer for cloggings with water and dirt.

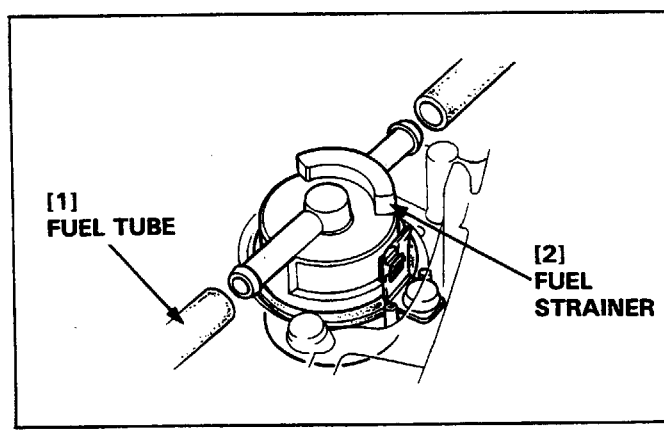


• Replacement

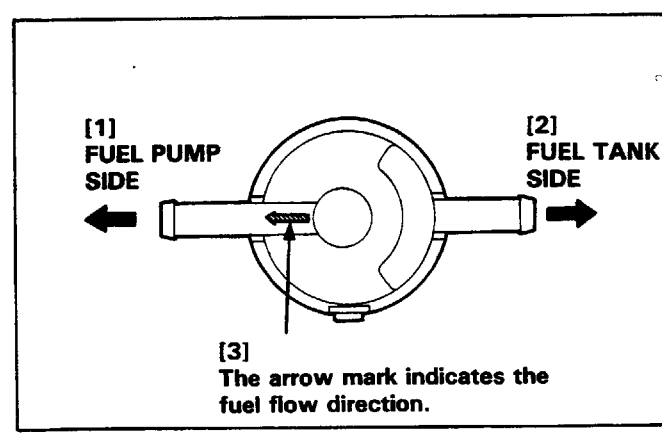
1) Remove the fuel strainer from the engine under case.
2) Disconnect the fuel tube from the fuel strainer with care not to leak the gasoline, and replace with a new fuel strainer.

NOTE

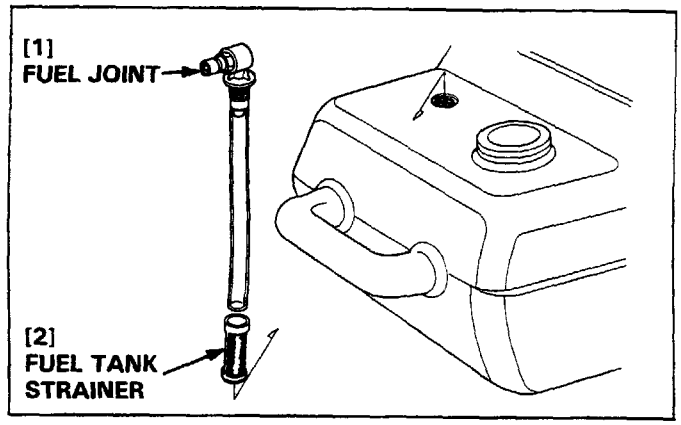
- Before removing the fuel strainer, place clamps on the fuel tube on each side of the fuel strainer to prevent fuel leakage.



3) Install the new fuel strainer, so that arrow mark "⬅" points the fuel pump side.
4) Connect the fuel line to the fuel tank, pump the primer bulb, and check for leaks.



FUEL TANK STRAINER

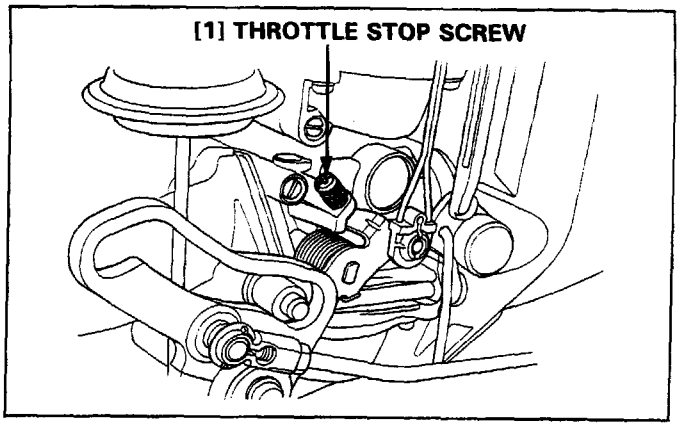


⚠ WARNING

- **Gasoline is flammable and is explosive under certain conditions. Do not smoke or allow flames or sparks near the outboard motor while draining fuel.**
- **Always work in a well-ventilated area.**
- **Be sure that any fuel drained from the outboard motor is stored in a safe container.**

1) Drain the fuel tank.
2) Remove the fuel joint and fuel tank strainer.
   Remove dust and foreign matter from the fuel tank strainer, and check for tears.

CARBURETOR



Idle Speed

With no load (Shift lever in neutral)

1) Remove the propeller, and place the outboard motor in a water tank with the water level at least 4 inches above the anti-cavitation plate.
   A water tank is not required if a hose is connected from a water faucet to the outboard motor, using a hose joint (optional part).
   Remove the engine cover.

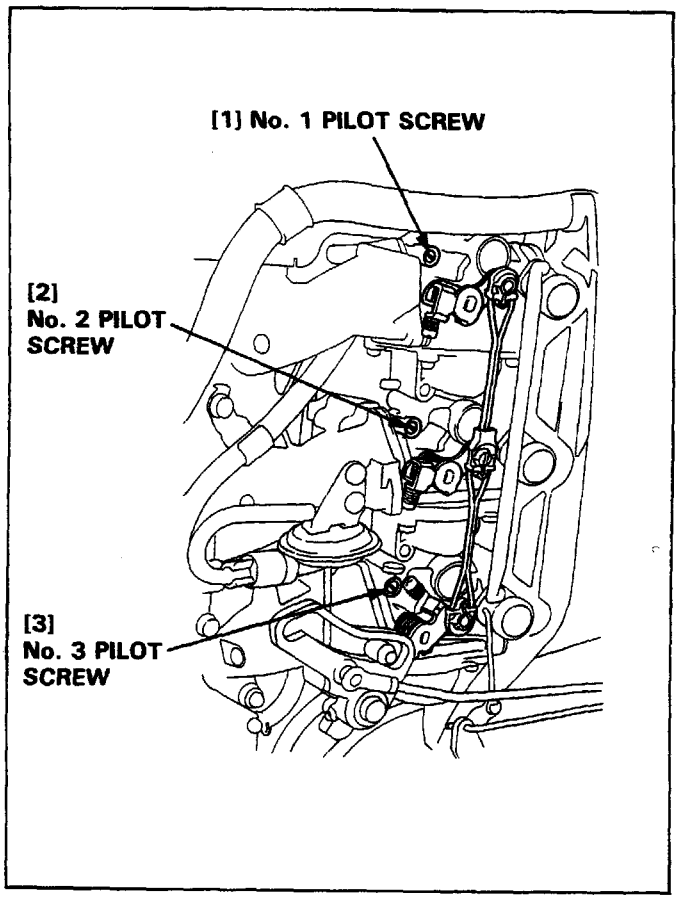
CAUTION

- **Running the engine without water can cause serious engine damage due to overheating. Be sure that water flows from the water check hole while the engine is running. If not, stop the engine and determine the cause of the problem.**
- **Keep clear of moving parts.**

2) After the engine speed has stabilized, turn and adjust the throttle stop screw to achieve the specified idle speed.

Specified idle speed (Shift lever in neutral)	950 ± 50 min^{-1} (r.p.m.)

If the idle speed does not stabilize, perform the carburetor synchronization adjustment (page 3-9).



Pilot screws

If the pilot screws setting needs adjustment:

1) Tighten the pilot screw of each cylinder as full as they go, then back them off by 2-1/8 turns.

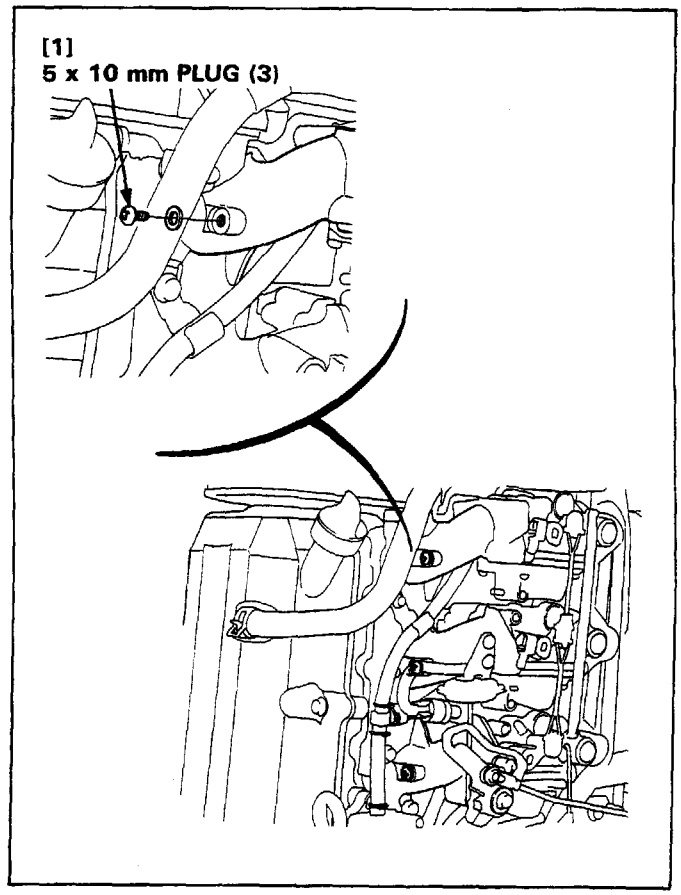
Standard pilot screw setting	2-1/8 turns out

2) Turn the throttle stop screw to obtain the specified idle speed.
3) Turn the pilot screw of the No. 3 carburetor 1/8 turns per time until the highest idle speed can be obtained.
   This is the standard carburetor.
   Perform the same adjustment on the No. 1 and No. 2 carburetors.
4) Lightly snap the engine several times, and turn the throttle stop screw to adjust the idle speed to the specified speed.

CARBURETOR SYNCHRONIZATION

Start the engine and allow it to warm up to normal operating temperature.

1) Place the outboard motor on a level surface and move the shift lever to "N" position.
2) Remove the three 5 x 10 mm plugs from the intake port of each cylinder.



3) Attach the vacuum gauge adapters to each plug holes. Connect the vacuum gauge tubes to the adapters.

NOTE

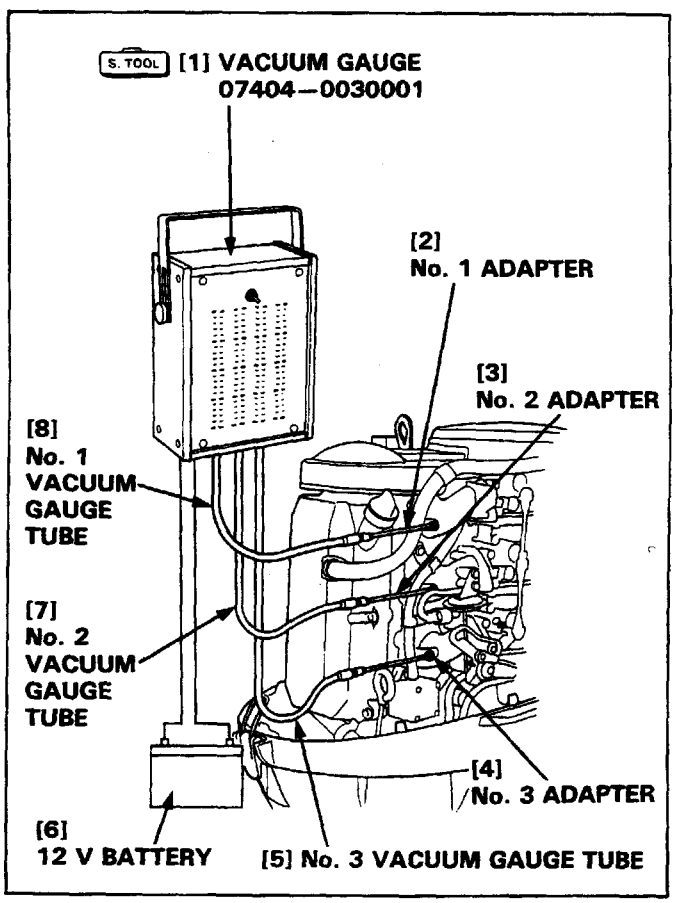
- Connect the vacuum gauge No. 1 tube to the No. 1 carburetor adaptor, vacuum gauge No. 2 tube to the No. 2 carburetor adaptor, and the No. 3 tube to the No. 3 carburetor adaptor properly.

TOOL:
Vacuum gauge **07404—0030001**

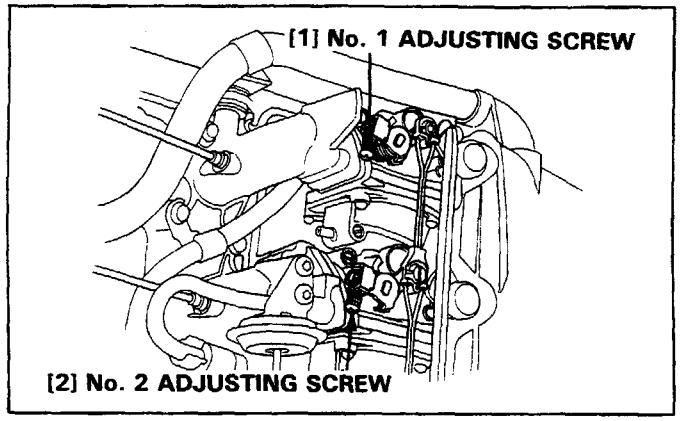
4) Start the engine and check the standard idle speed (page 3-8).
5) Check that the vacuum gap between the cylinders is 20 mmHg or below.

Vacuum gap	20 mmHg less than

6) If the vacuum gap is more than 20 mmHg, adjust as follows.



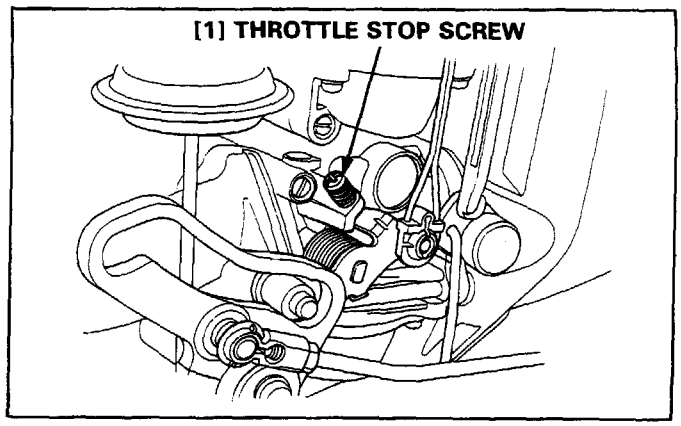
7) With the vacuum of the No. 3 carburetor being the standard, turn the No. 1 and No. 2 carburetor adjusting screws so that the vacuum gap between the No. 1 and No. 2 carburetors is 20 mmHg or below.
Snap the engine several times and be sure that the vacuum of the No. 1 and No. 2 carburetors is the same as that of the No. 3 carburetor.



NOTE

- The less the vacuum gap is, the more the idle speed stabilizes.

8) Remove the special tool from the intake manifold and install the 5 x 10 mm plugs.
9) After adjustment, readjust the idling speed by turning the No. 3 carburetor throttle stop screw (page 3-8).



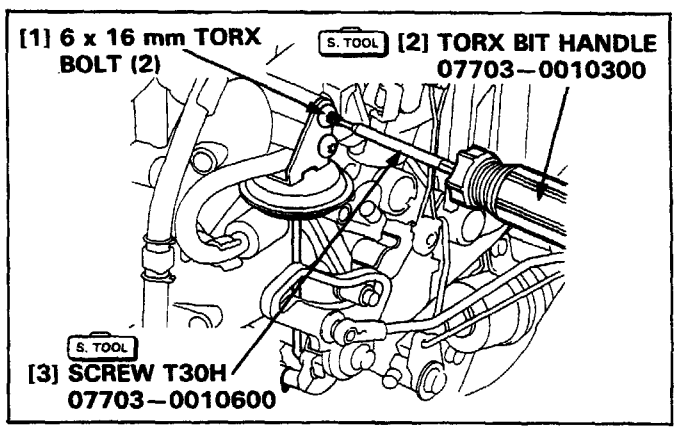
ACCELERATION DEVICE/DIAPHRAGM ADJUSTMENT

Adjust the acceleration device/diaphragm after adjusting the idling speed.

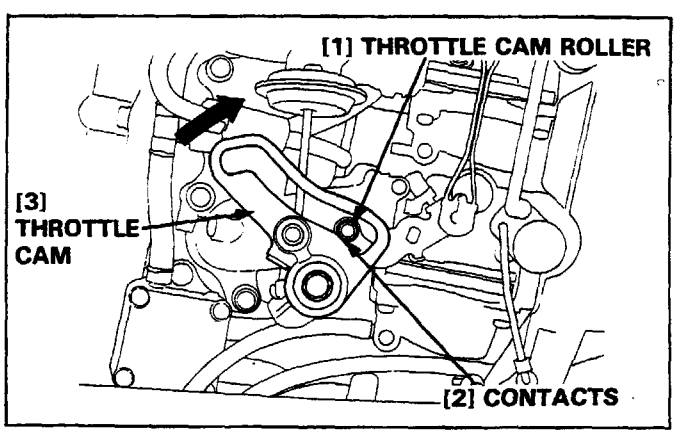
1) Loosen the 6 x 16 mm torx bolts using the special tools.

TOOLS:

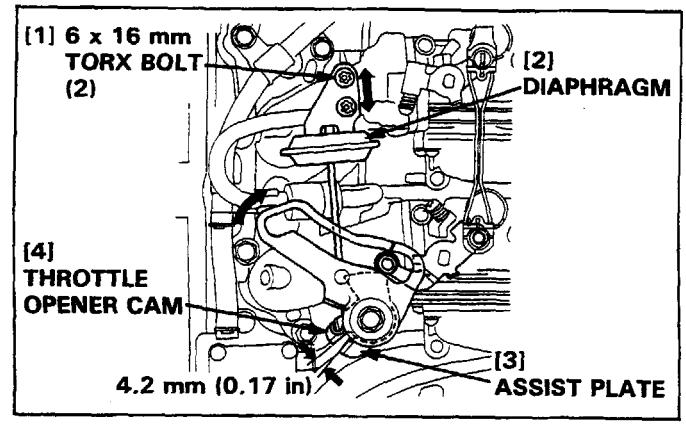
Torx bit handle	**07703–0010300**
Screw T30H	**07703–0010600**



2) Remove the throttle rod from the throttle cam.
3) Move the throttle cam in the direction pointed by arrow until it contacts the throttle arm roller.

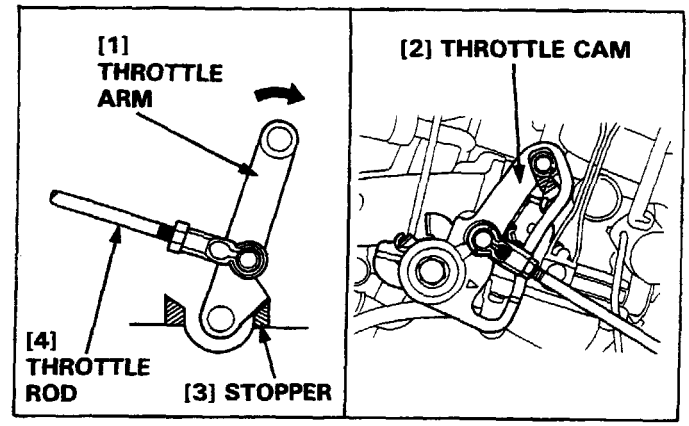


4) Move the diaphragm up and down slowly until the clearance between the assist plate and throttle opener cam is 4.2 mm (0.17 in). While holding the clearance, tighten the 6 x 16 mm torx bolts using the special tool.
Attach the throttle rod to the throttle cam.

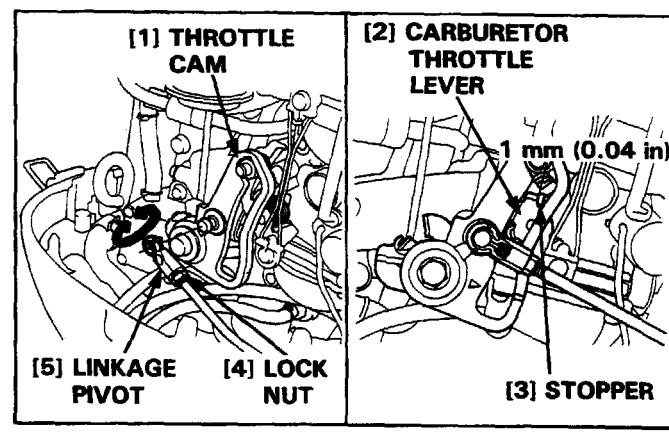


THROTTLE ADJUSTMENT (REMOTE CONTROL TYPE)

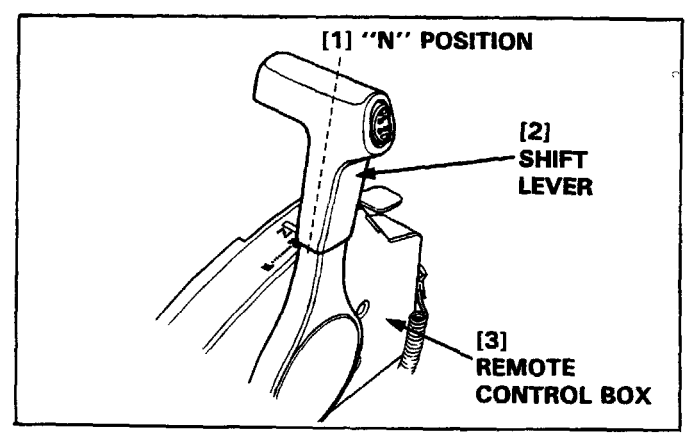
Throttle rod length adjustment:
1) Move the throttle arm to the fully open position and be sure that the arm contacts the full open position stopper.
2) Check that the throttle cam is at the full open position, too.
3) If either the throttle arm does not contact the stopper or the throttle cam is not at the full open position, adjust as follows.



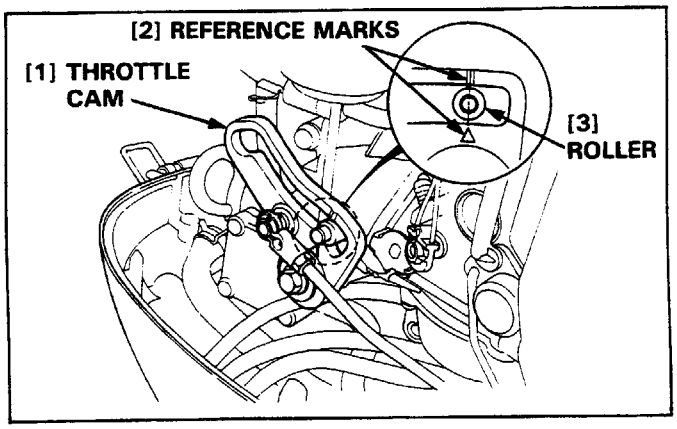
4) Loosen the linkage pivot lock nut, detach the linkage pivot from the throttle cam, and adjust by turning the pivot.
Tighten the lock nut securely.
5) After adjustment, move the carburetor throttle lever to the fully open position and be sure that there is clearance of 1 mm (0.04 in) or less between the carburetor throttle lever and the fully open position stopper.
6) If the clearance is more than 1 mm (0.04 in), readjust by turning the linkage pivot.



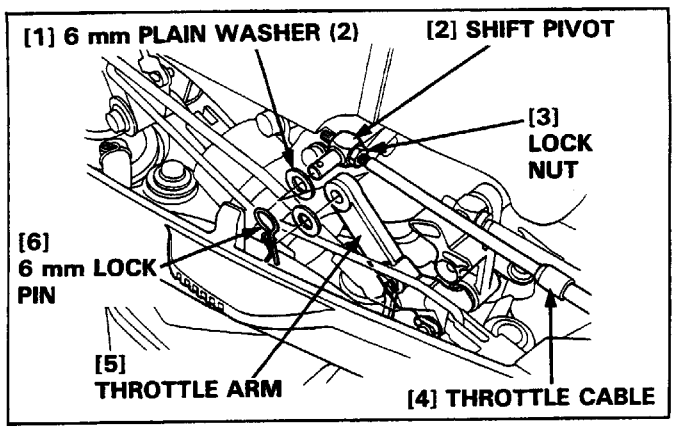
Remote control cable length adjustment:
Remote control cable length adjustment must be performed after adjusting the throttle rod.
1) Move the remote control shift lever to the "N" position.



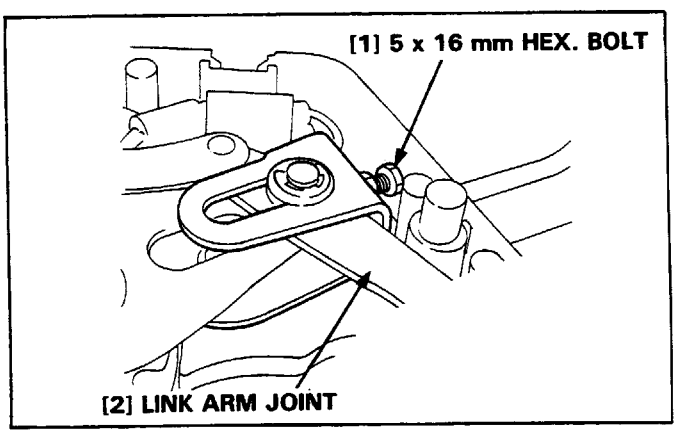
2) Check that the two reference marks on the throttle cam align with the center of the roller.
If they do not align, adjust as follows.



3) Remove the 6 mm lock pin and 6 mm plain washers from the shift pivot, and detach the shift pivot from the throttle arm.
4) Loosen the shift pivot lock nut and adjust by turning the shift pivot.
After adjustment, tighten the lock nut and attach the shift pivot to the throttle arm.

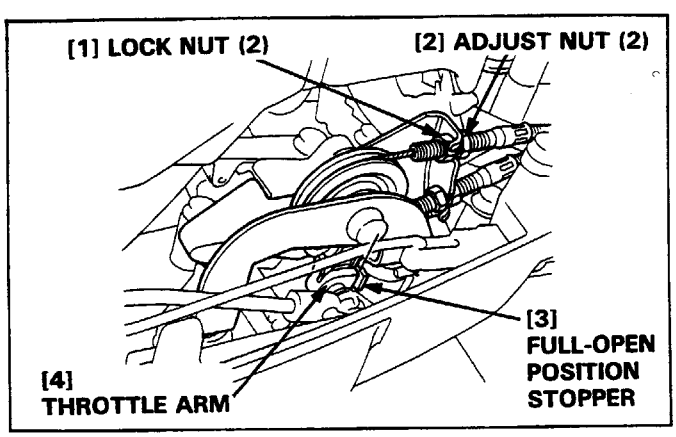


5) Remove the remote control housing B and C (P. 14-4).
6) Move the remote control shift lever to the full open position and be sure that the link arm joint is in contact with the 5 x 16 mm hex. bolt.
If it is not, tighten the 5 x 16 mm hex. bolt until it contacts the link arm joint.



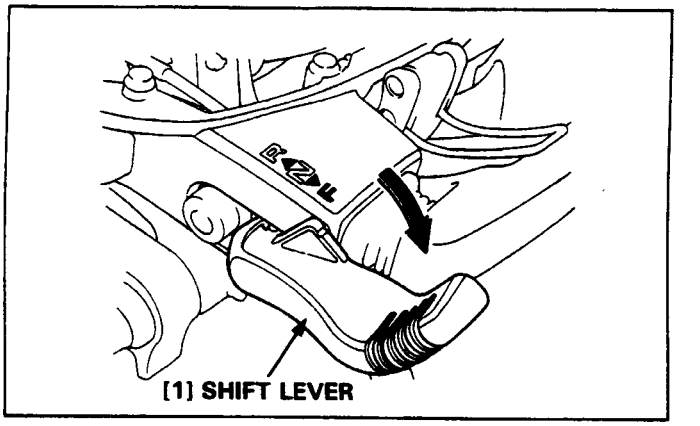
THROTTLE ADJUSTMENT (TILLER HANDLE TYPE)

Throttle cable adjustment:
1) Move the throttle grip to the full open position and be sure that the throttle arm contacts the stopper of the throttle cable bracket.
2) If the throttle arm does not contact the stopper, loosen the cable lock nut and adjust by turning the adjusting nut.

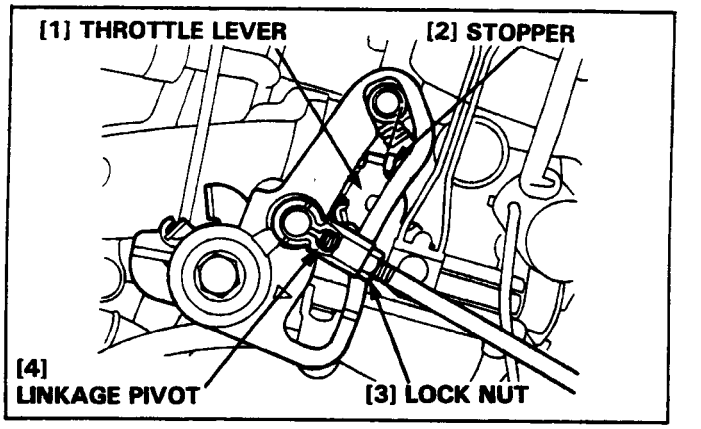


Throttle rod length adjustment:
The throttle rod length adjustment must be performed after adjusting the throttle cable.

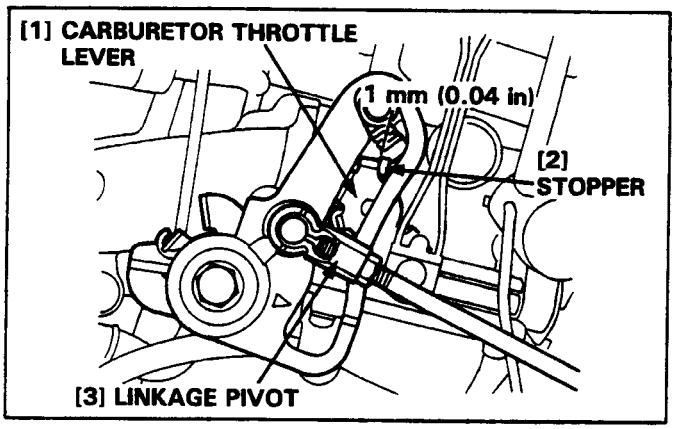
1) Move the shift lever to the "F" position.
2) Turn the throttle grip to the full-open position, and confirm that the throttle arm contacts the full-open position stopper of the throttle cable bracket. (P. 3-12)



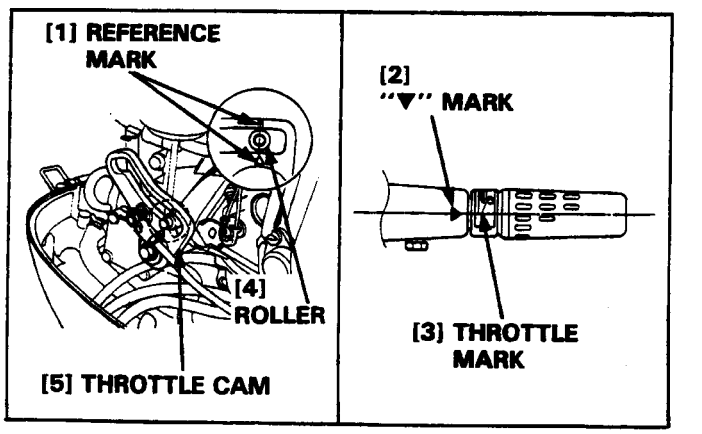
3) Be sure that the carburetor throttle lever contacts the full open position stopper on the carburetor side.
4) If the carburetor throttle lever does not contact the stopper, loosen the lock nut and adjust the throttle rod length by turning the linkage pivot.
After adjustment, tighten the lock nut securely.



5) Check that the throttle lever moves the entire range from the fully open position to the fully closed position without binding.
Then, move the carburetor throttle lever to the fully open position and be sure that there is clearance of 1 mm (0.04 in) or less between the throttle lever and the full open position stopper.
6) If the clearance is more than 1 mm (0.04 in), readjust by turning the linkage pivot.

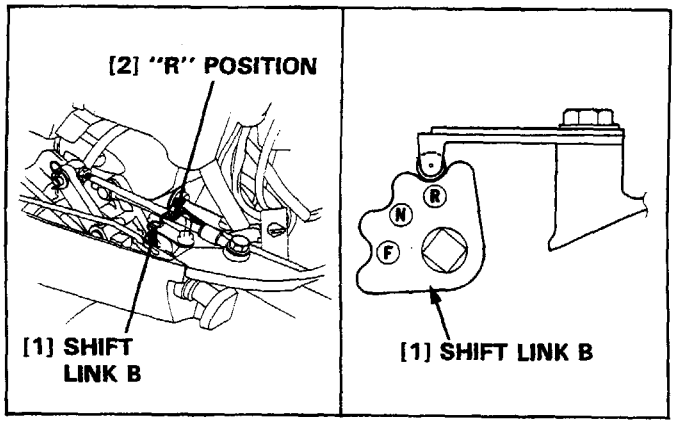


7) Turn the throttle grip to the fully closed position and align the "▼" mark on the steering handle with the throttle mark idle position. Be sure that the two reference marks on the throttle cam align with the center of the roller.
If they do not align, loosen the lock nut on the closed position side and adjust by turning the adjusting nut.
8) After the adjustment turn the throttle grip and make sure that the carburetor throttle lever moves over the entire range, from the fully-closed to the fully-open position without binding.

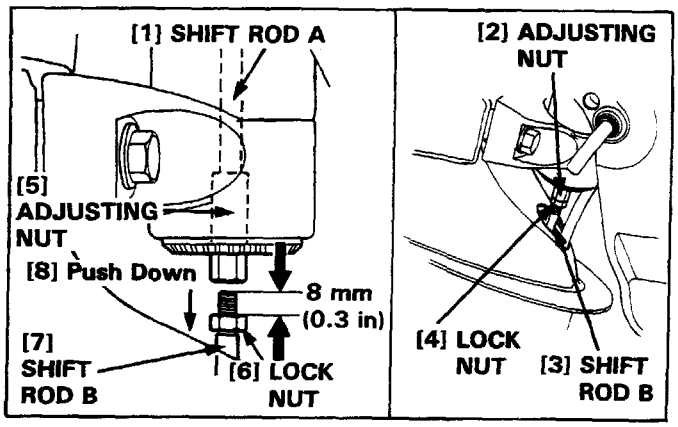


SHIFT ROD ADJUSTMENT

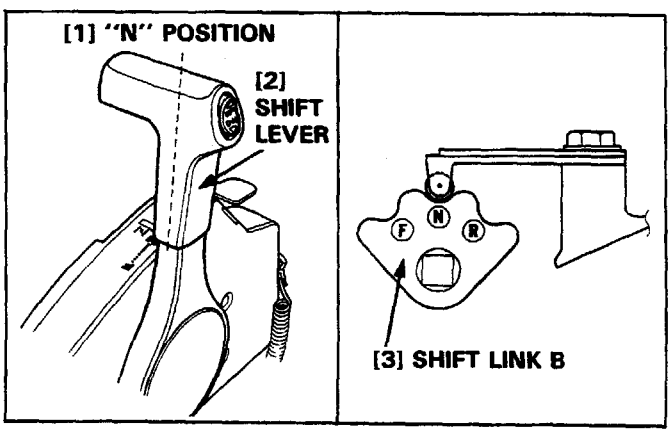
1) Move the shift lever to the "R" position and be sure that the shift link B is in the "R" position, too.
If either or both the shift link B or/and shift lever is/are not in the "R" position, adjust as follows.



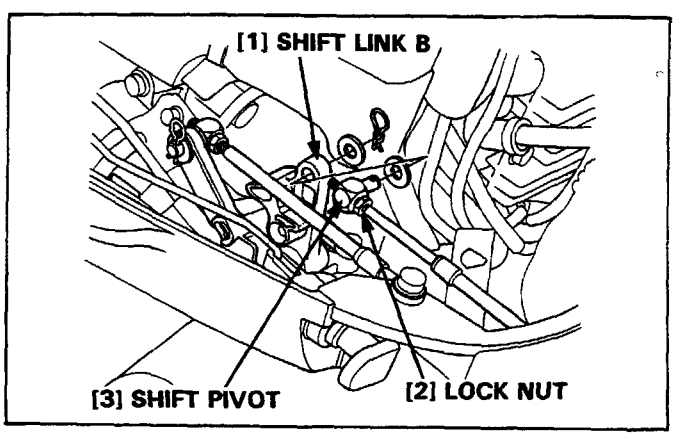
2) Move the shift lever to the "N" position.
3) Loosen the lock nut and adjusting nut interconnecting the shift rod A and B, and disconnect the shift rod A from the shift rod B. Move the shift lever to the "R" position.
4) With the shift rod B lowered to the lowermost position, turn the adjusting nut and insert the shift rod B into the adjusting nut until the length from the lock nut end to the tip of the shift rod B is 8 mm (0.3 in), then tighten the lock nut.
After adjustment, be sure that the shift lever moves to each position smoothly.



Remote control cable adjustment [Shift side]:
(Remote control type only)
If the shift link B of the remote control type (LR/LRT types) does not operate properly after adjusting the shift rod, perform the following adjustment.
1) Disconnect the shift side remote control cable from the shift link B.
2) Move the shift lever to the "N" position. Be sure that the shift link B is in the "N" position, too.

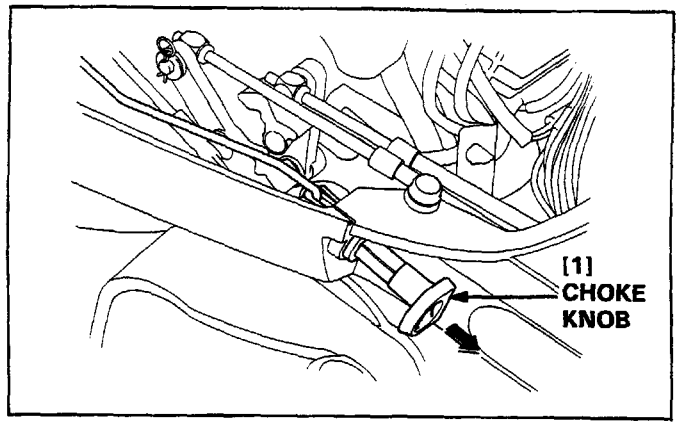


3) Loosen the shift pivot lock nut and turn the shift pivot so that it attaches to the shift link B smoothly. Tighten the lock nut after adjustment.
Install the shift pivot on the shift link B and move the shift lever. Be sure that the shift link B moves to each position smoothly.

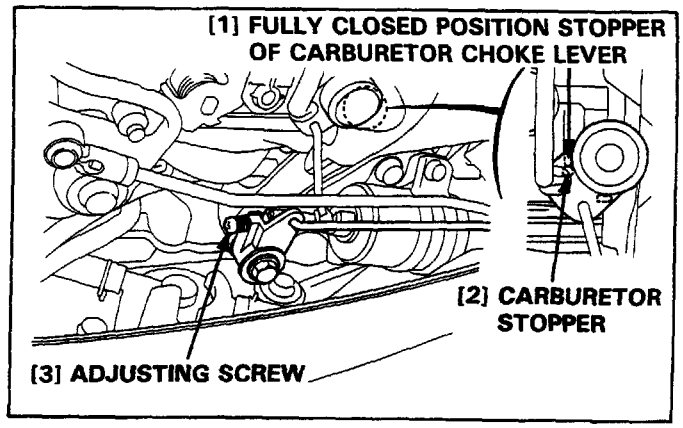


CHOKE KNOB ROD ADJUSTMENT

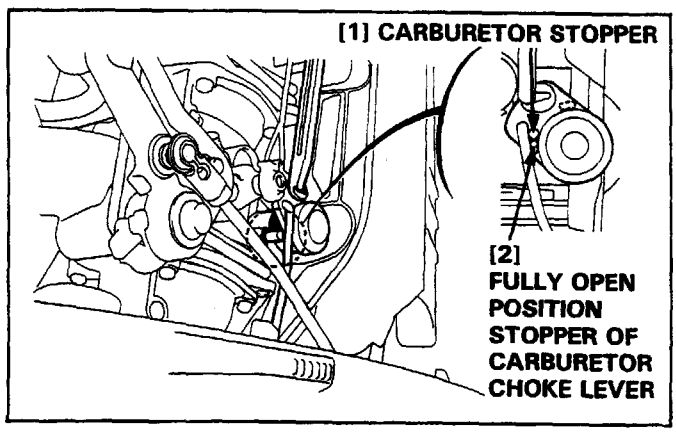
1) Pull the choke knob fully (i.e. to the fully closed position).



2) Check that the carburetor stopper is in contact with the fully closed position stopper of the carburetor choke lever. If they are not, turn the adjusting screw until they contact.



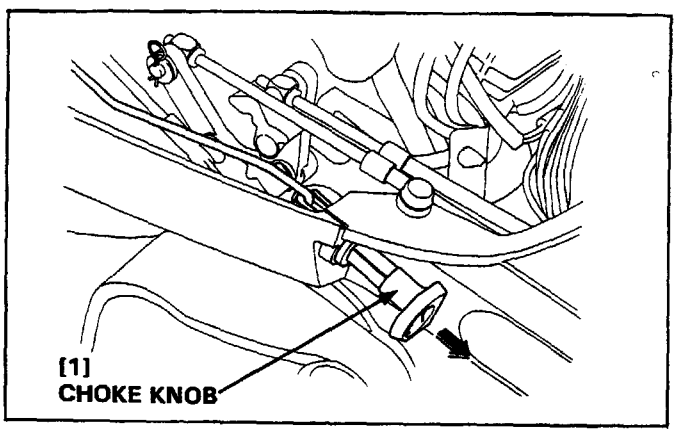
3) After adjustment, push the choke knob fully (i.e. to the full open position) and be sure that the carburetor stopper is in contact with the full open position stopper of the carburetor choke lever.



REMOTE CHOKE SOLENOID ADJUSTMENT (REMOTE CONTROL TYPE)

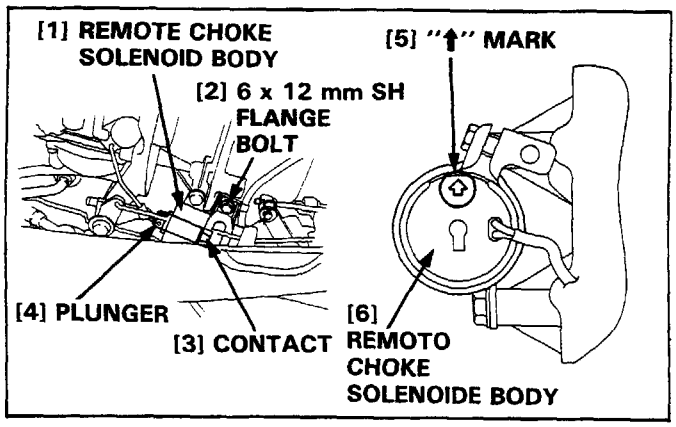
Perform the remote choke solenoid adjustment after adjusting the choke rod.

1) Turn the combination switch to the "ON" position.
2) Move the idle lever and check the remote choke solenoid for proper operation.
   If it does not operate properly, adjust as follows.
3) Pull the choke knob fully (i.e. to the fully closed position).



4) Loosen the 6 x 12 mm SH flange bolt on the solenoid body stay.
   Check that the "⬆" mark on the reverse side of the remote choke solenoide body is pointing up.
5) Push the plunger to the right and determine the position where it stops. Then, move the solenoid body until it contacts the plunger.
6) Tighten the 6 x 12 mm SH flange bolt to the specified torque.

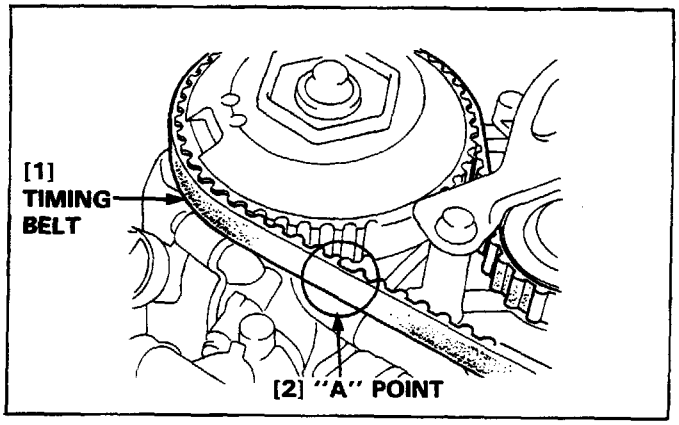
TORQUE: 9 N·m (0.9 kg-m, 6.5 ft-lb)



TIMING BELT

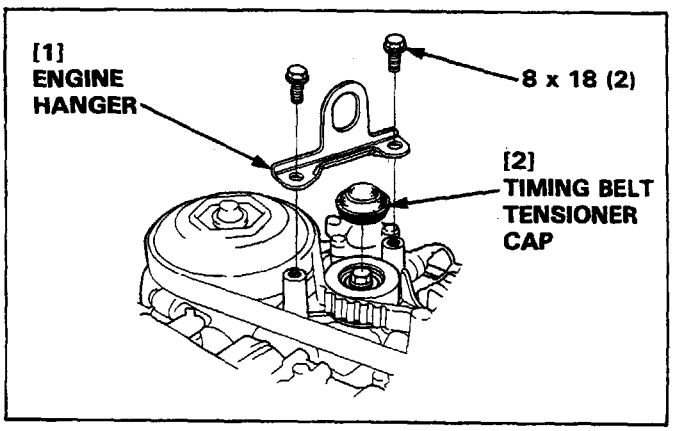
a. INSPECTION

1) Remove the engine cover and timing belt cover.
2) Check to see whether the "A" point of the timing belt is not damaged or worn, and replace the timing belt if necessary.



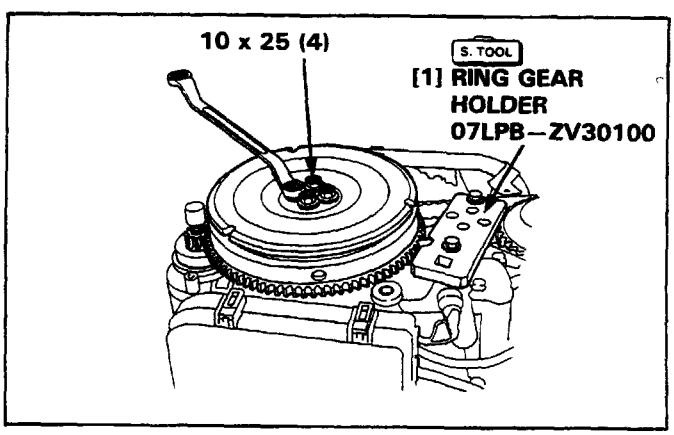
b. REPLACEMENT

1) Remove the 8 x 18 mm flange bolts and engine hanger.
2) Remove the timing belt tensioner cap.

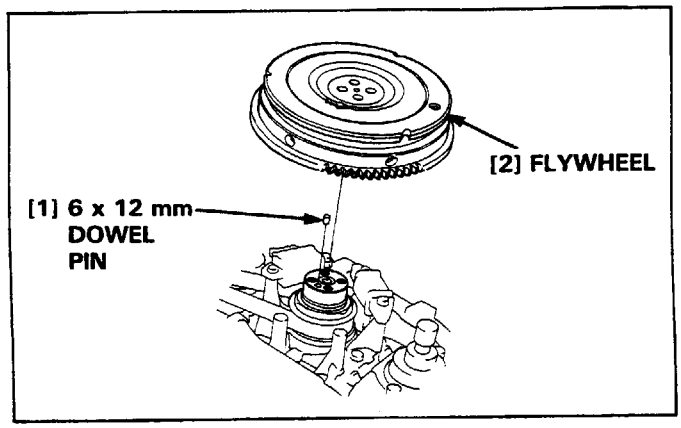


3) Attach the special tool to the engine hanger installation section and remove the four 10 x 25 mm flange bolts from the flywheel.

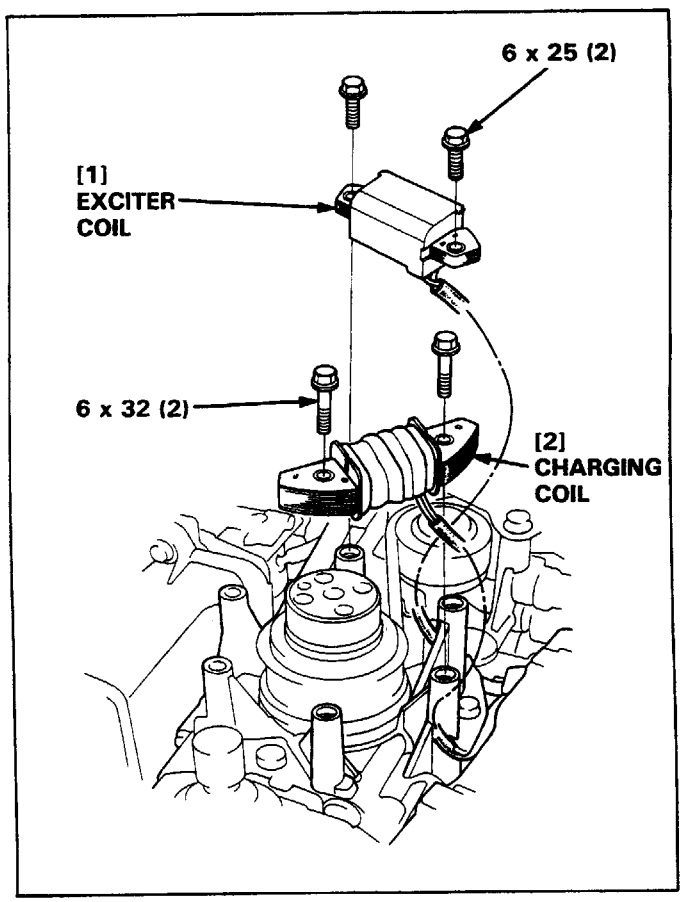
TOOL:
Ring gear holder **07LPB—ZV30100**



4) Remove the flywheel and 6 x 10 mm dowel pin.



5) Disconnect the exciter coil and charging coil.



6) Loosen the 10 x 38 mm flange bolt which is tightening the timing belt tensioner, then retighten the 10 x 38 mm flange bolt while pushing the belt tensioner in the direction of the arrow.

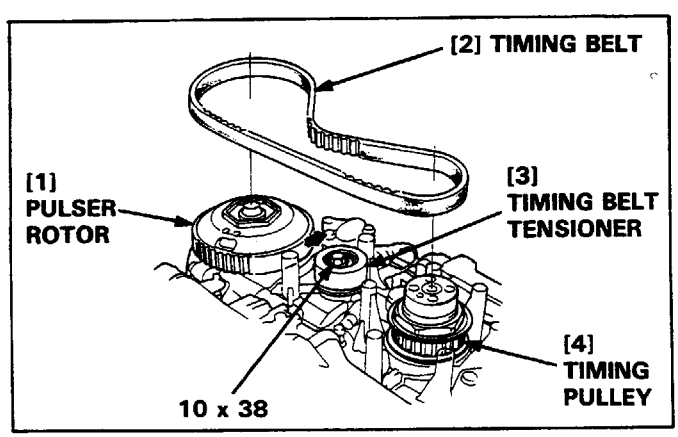
CAUTION

- **Do not remove the timing belt with force using a driver, etc.**

7) Remove the timing belt from the pulser rotor first, then remove the timing belt from the timing pulley.

NOTE

- Take care not to contaminate the removed timing belt with oil or grease.
  Do not bend the timing belt. Keep the removed timing belt by hanging it on the wall.



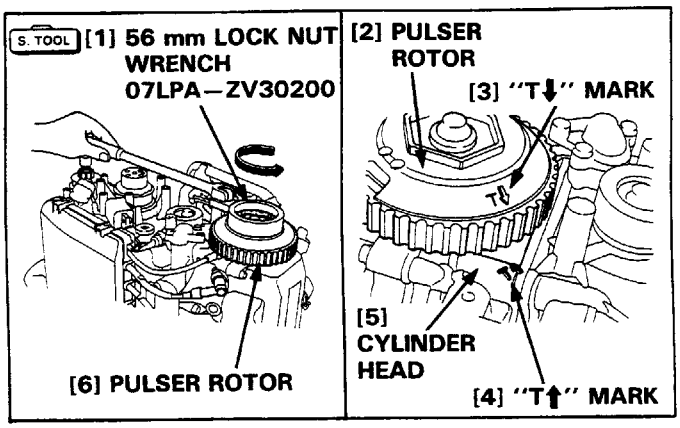
c. INSTALLATION

1) Set the special tool on the pulser rotor as shown, and turn the pulser rotor until the "T⬇" mark on the pulser rotor aligns with the "T⬆" mark on the cylinder head.

CAUTION

- **Do not turn the pulser rotor clockwise.**

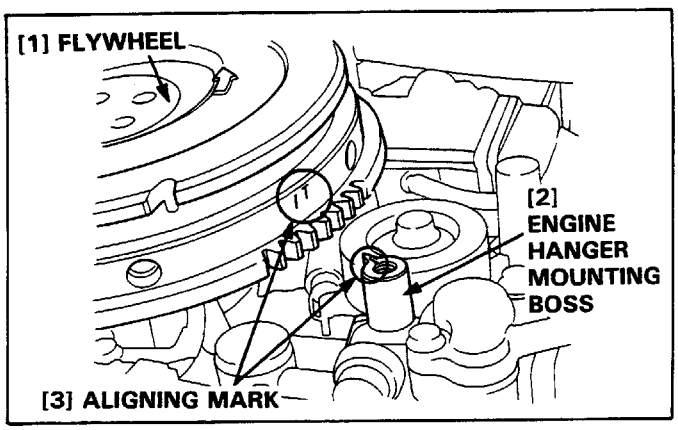
TOOL:
56 mm lock nut wrench **07LPA—ZV30200**



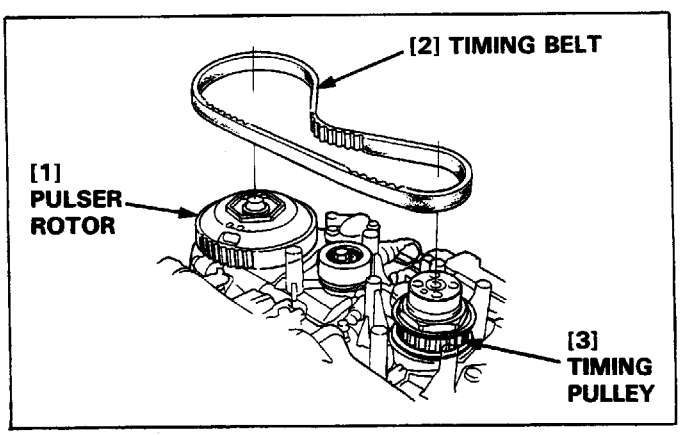
2) Set the 6 x 10 mm dowel pin and flywheel on the crankshaft and loosely tighten the four 10 x 25 mm flange bolts.
3) Turn the flywheel counterclockwise and align the "T" mark on the flywheel with the "I" mark on top of the engine hanger mounting boss.

CAUTION

- **Be sure to turn the flywheel in the direction of the arrow. Do not turn it in the reverse direction.**



4) Remove the flywheel with care not to move the marks out of alignment.
5) Install the new timing belt in the reverse order of removal with care not to move the aligning marks out of position. After installation, adjust the timing belt tension.



d. ADJUSTMENT

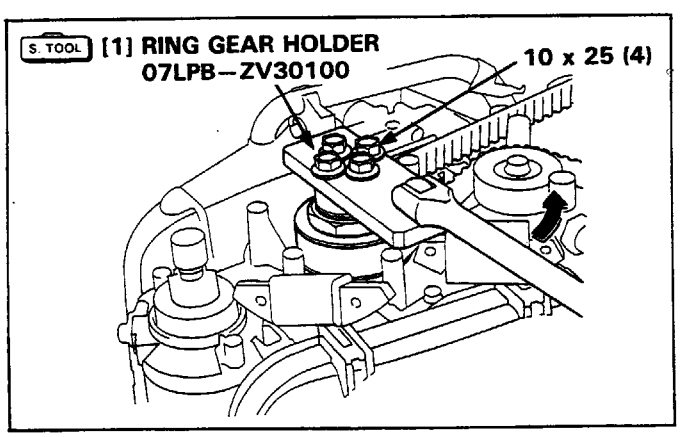
1) Set the 6 x 10 mm dowel pin and flywheel on the crankshaft, and be sure that the mark on the pulser rotor is aligned with that on the cylinder head and the mark on the flywheel is aligned with that on the cylinder barrel.
Remove the flywheel and 6 x 10 mm dowel pin.
Loosen the 10 x 38 mm flange bolt.

2) Using the 10 x 25 mm flange bolt (i.e. flywheel mounting bolt), install the special tool on the crankshaft and turn the crankshaft two turns counterclockwise from the alignment position with the pulser rotor.

CAUTION

- **Do not turn the flywheel clockwise.**

TOOL:
Ring gear holder: **07LPB—ZV30100**



3) Then turn the crankshaft counterclockwise by 3 teeth of the pulse rotor.

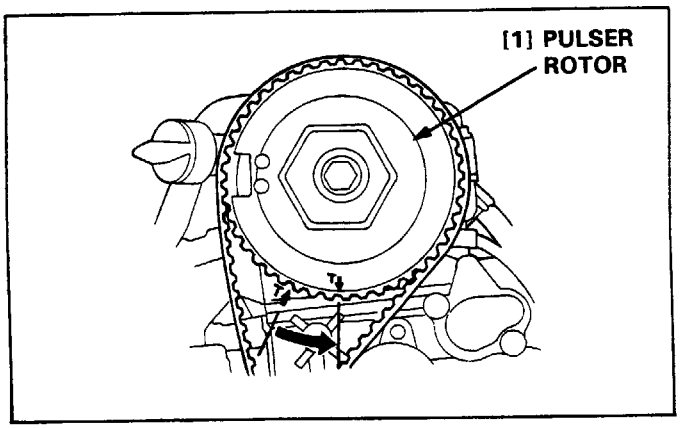
NOTE

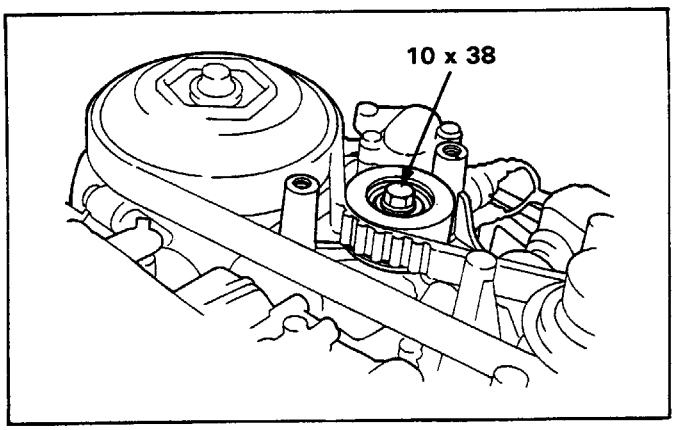
- The timing belt tensioner is autopmatically adjusted. Do not push the tensioner against the belt by hand.

4) Tighten the 10 x 38 mm flange bolt to the specified torque.

TORQUE: 45 N·m (4.5 kg-m, 32.5 ft-lb)

After adjustment, install the following parts.
- Exciter coil, charging coil, flywheel (page 6-2).
- Engine hanger, timing belt tensioner cap (page 6-3).
- Flywheel cover (page 6-2).
- Engine cover (page 4-2).

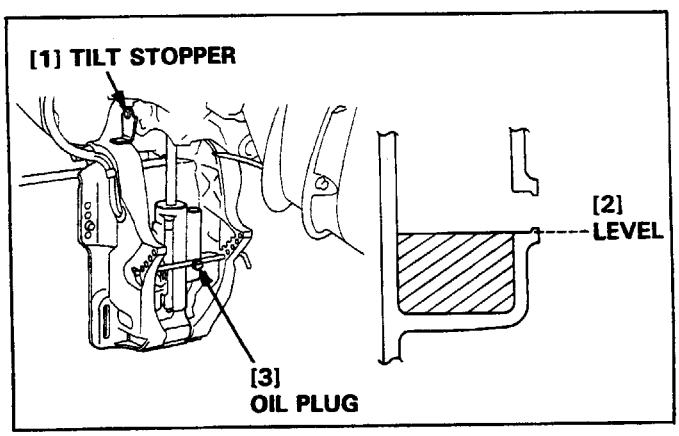




POWER TILT OIL (POWER TRIM & TILT TYPE)

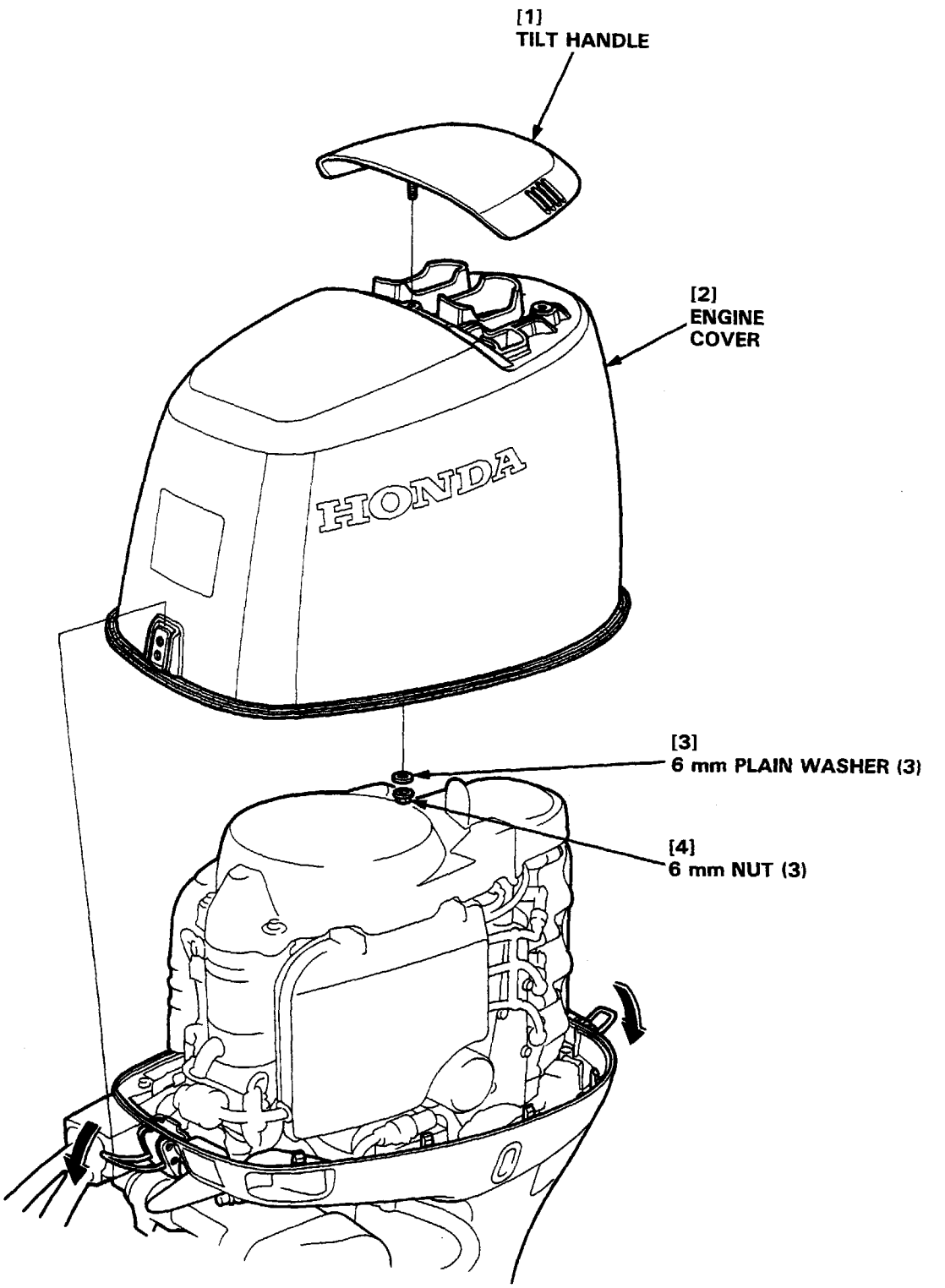
1) Tilt up the outboard to the uppermost position and lock it with the tilt stopper.
2) Remove the oil plug from the power tilt assembly and be sure that the oil level is up to the oil filler port.
   If the oil level is low, add the oil up to the filler port.

Recommended oil	ATF (Automatic Transmission Fluid)



ENGINE COVER/THROTTLE/ CHOKE

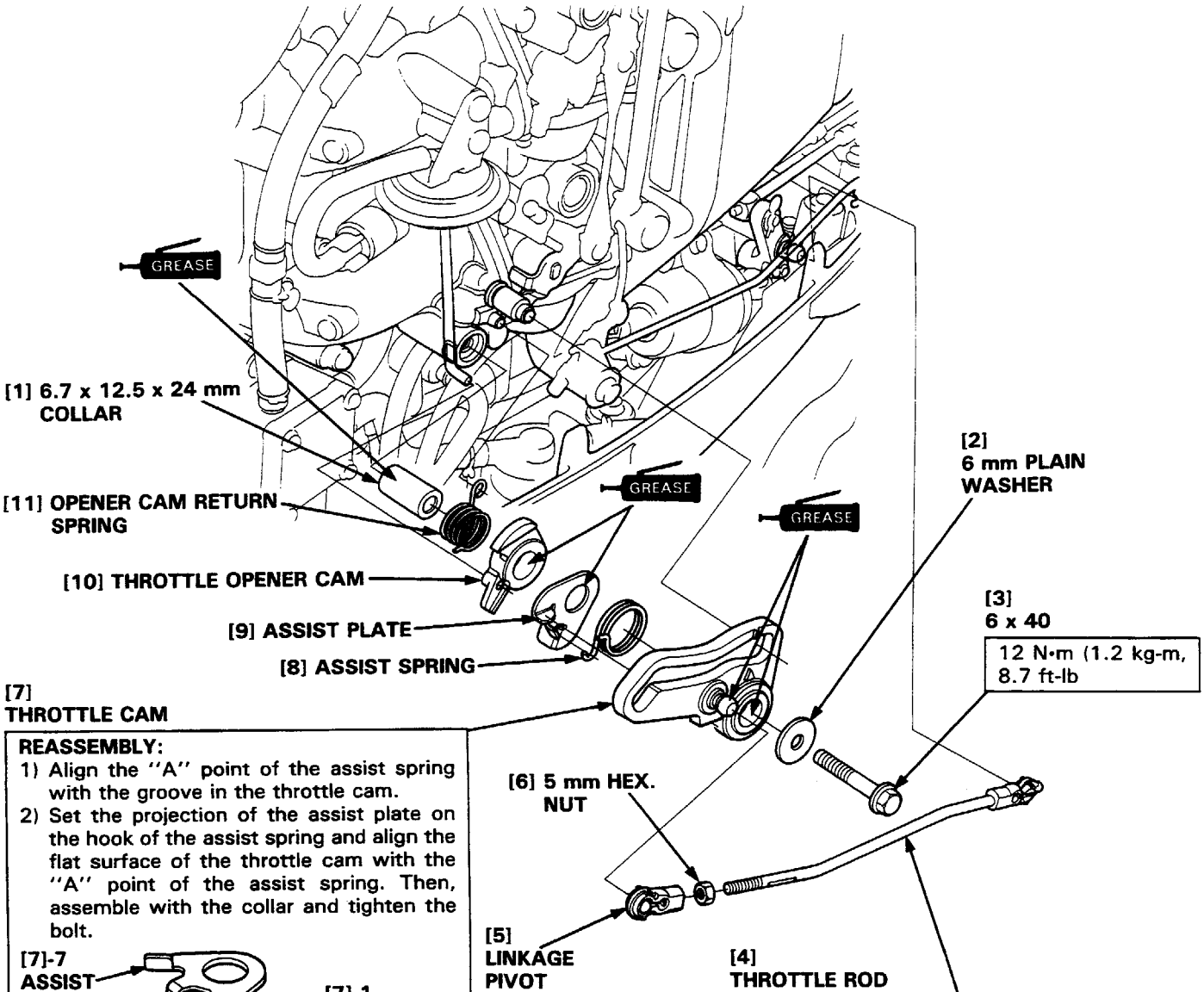
ENGINE COVER



THROTTLE CAM

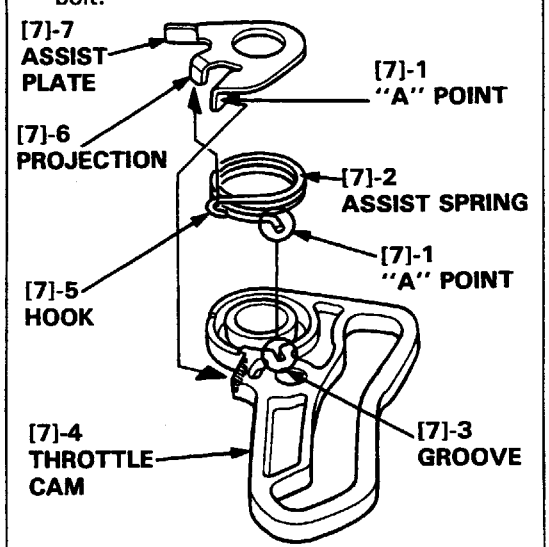
a. DISASSEMBLY/REASSEMBLY

1) Remove the engine cover (P. 4-2).



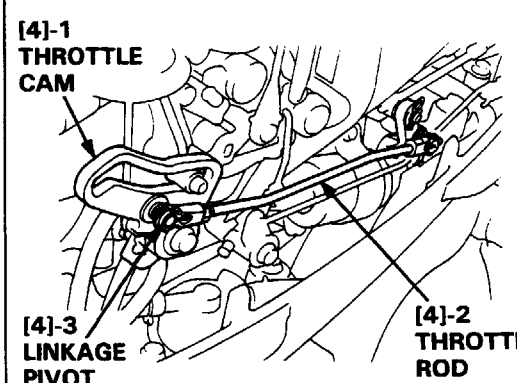
REASSEMBLY:

1) Align the "A" point of the assist spring with the groove in the throttle cam.
2) Set the projection of the assist plate on the hook of the assist spring and align the flat surface of the throttle cam with the "A" point of the assist spring. Then, assemble with the collar and tighten the bolt.



REASSEMBLY

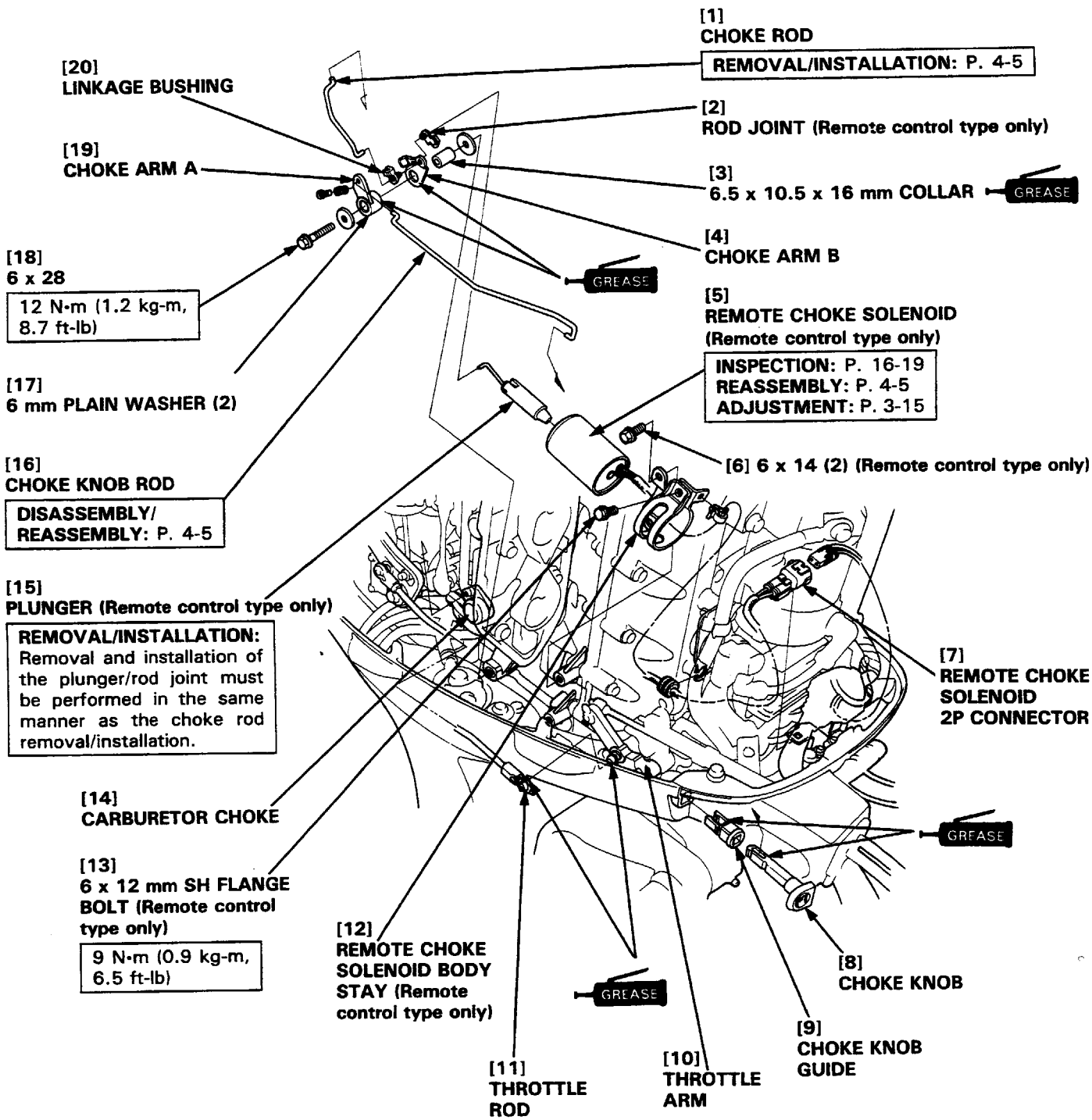
Install the throttle rod with the linkage pivot facing the throttle cam.



CHOKE KNOB ROD

a. DISASSEMBLY/REASSEMBLY

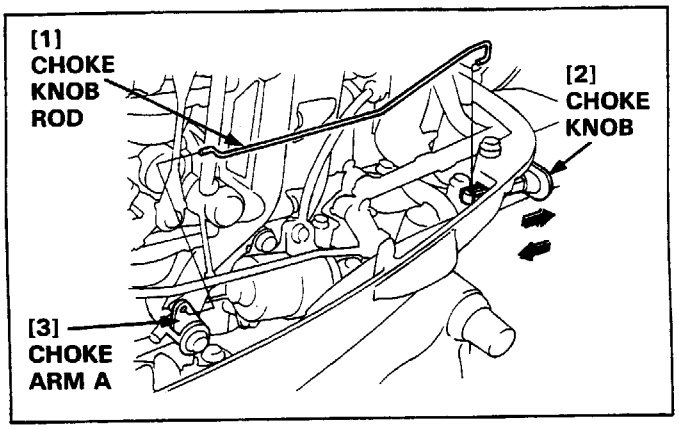
1) Remove the engine cover (P. 4-2) and silencer cover (P. 5-2).
2) Disconnect the throttle rod from throttle arm.
3) Disconnect the remote choke solenoid 2P connector (Remote control type only).



• CHOKE KNOB ROD

DISASSEMBLY/REASSEMBLY:

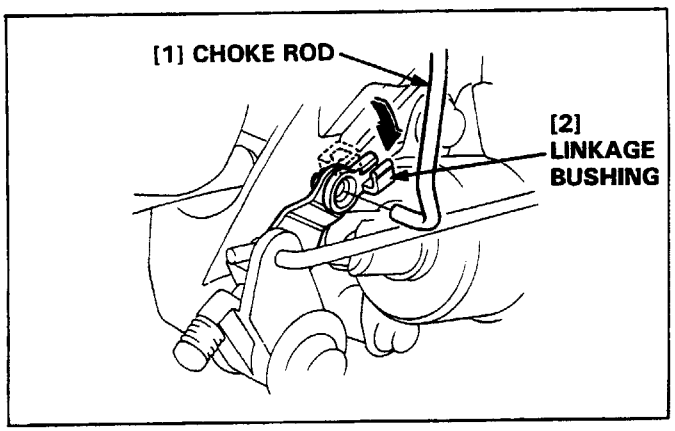
1) Pull the choke knob, then push it while holding the choke knob rod. Pull up the choke knob rod and disconnect it from the choke knob and choke arm A.
2) To reinstall the choke knob rod, set it on the choke arm A, push the choke knob, and connect the choke knob rod to the choke knob. Pull the choke knob as full as it goes.



• CHOKE ROD

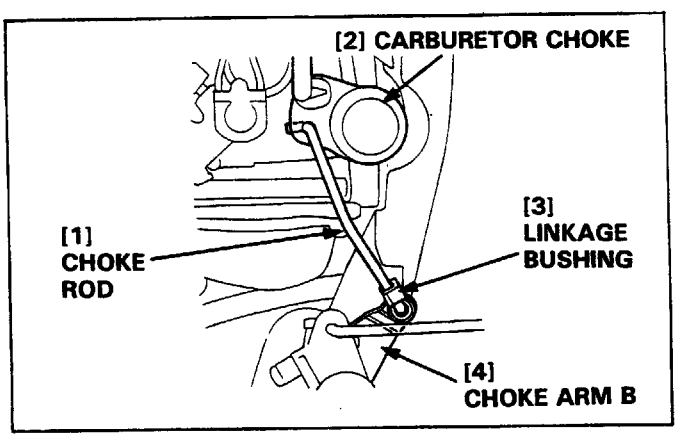
DISASSEMBLY:

Hold the choke rod and push down the linkage bushing to remove it from the rod.



REASSEMBLY:

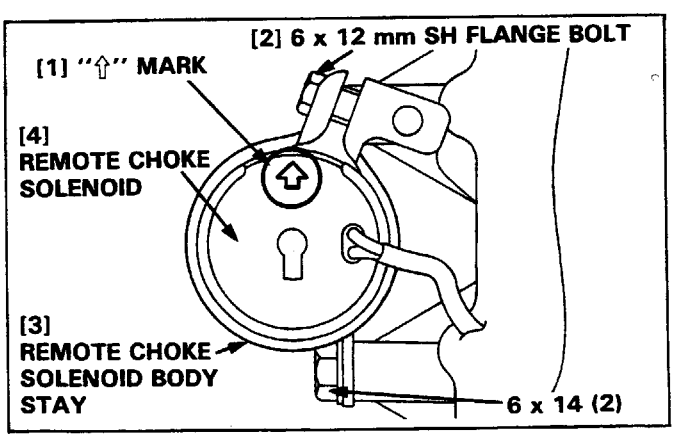
1) Connect the choke rod to the carburetor choke, then connect it to the choke arm.
   Be sure that the choke rod is connected as shown.
2) Push the linkage bushing up and set the linkage bushing on the choke rod.



• REMOTE CHOKE SOLENOID (Remote control type only)

REASSEMBLY:

1) Set the solenoid body stay on the engine and tighten with the two 6 x 14 mm flange bolts.
2) Set the remote choke solenoid on the solenoid body stay with the "⇧" mark on the reverse side of the remote choke solenoid pointing up, then loosely tighten it with the 6 x 12 mm SH flange bolt.
3) Connect the plunger rod to the choke arm B and clamp it with the rod joint.
4) Adjust the remote choke solenoid following the step 5 and the subsequent steps of the remote choke solenoid adjustment (P. 3-15).

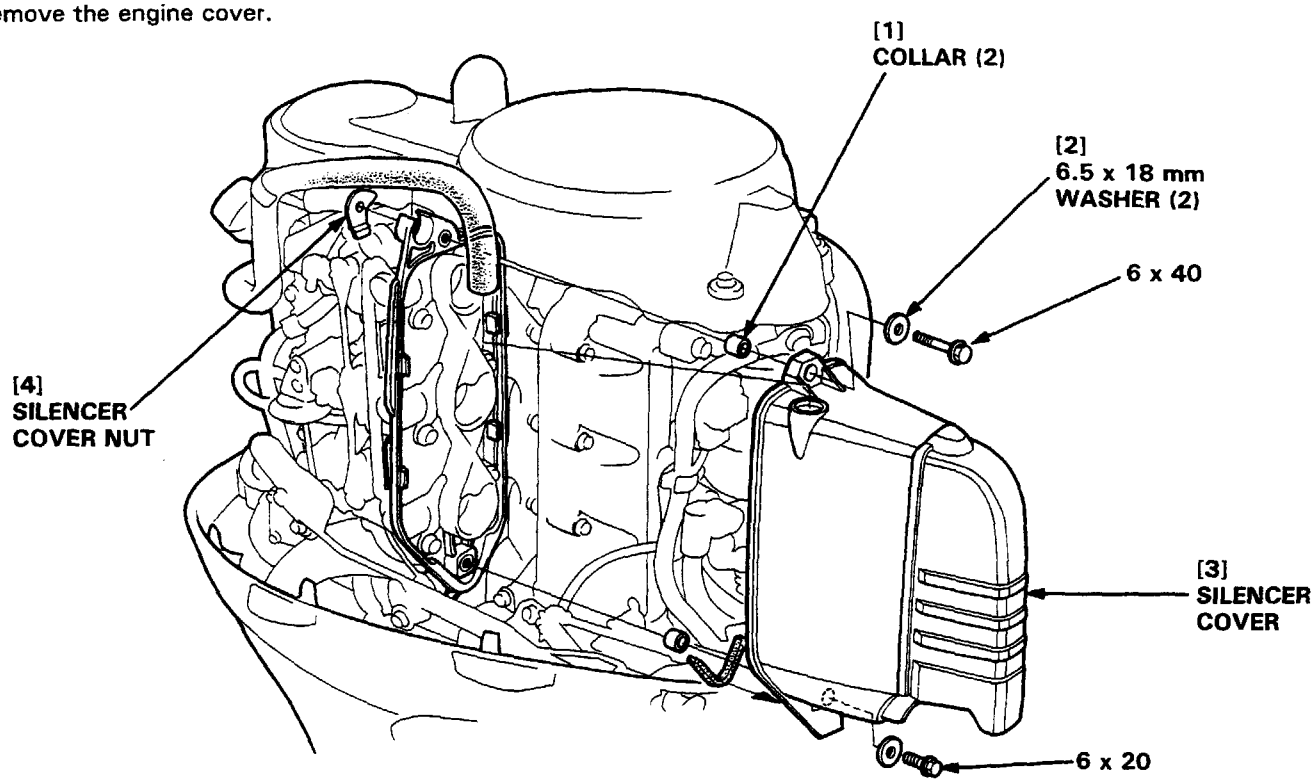


FUEL SYSTEM

SILENCER COVER

a. DISASSEMBLY/REASSEMBLY

1) Remove the engine cover.



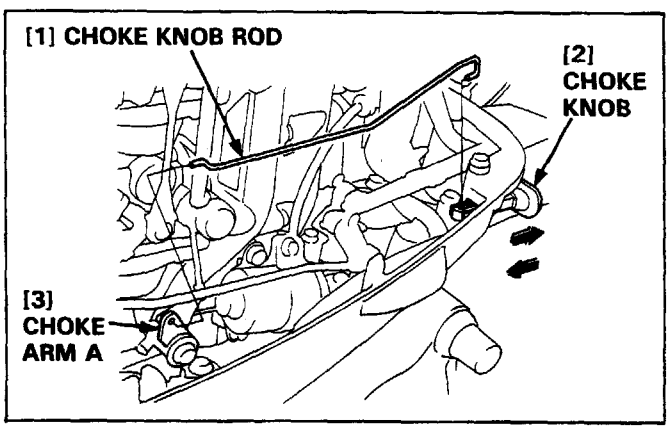
CARBURETOR

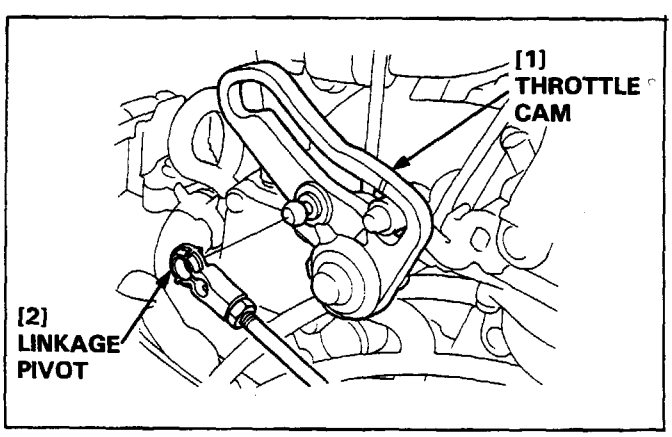
a. REMOVAL/INSTALLATION

⚠WARNING

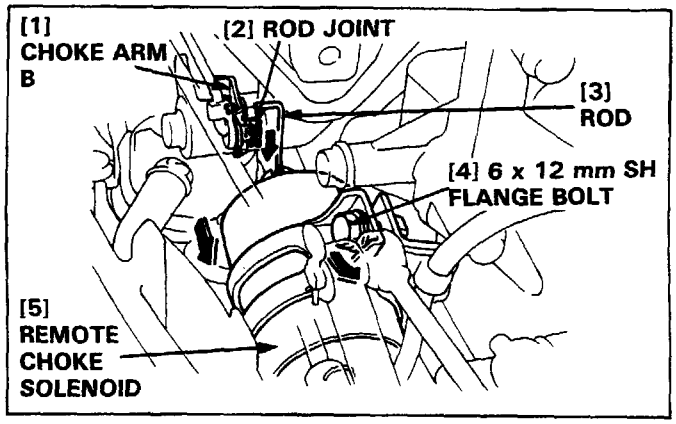
- **Remove the drain screws and drain the carburetor before removing.**
- **Gasoline is extremely flammable and is explosive under certain conditions. Do not smoke or allow flames or sparks in the area.**

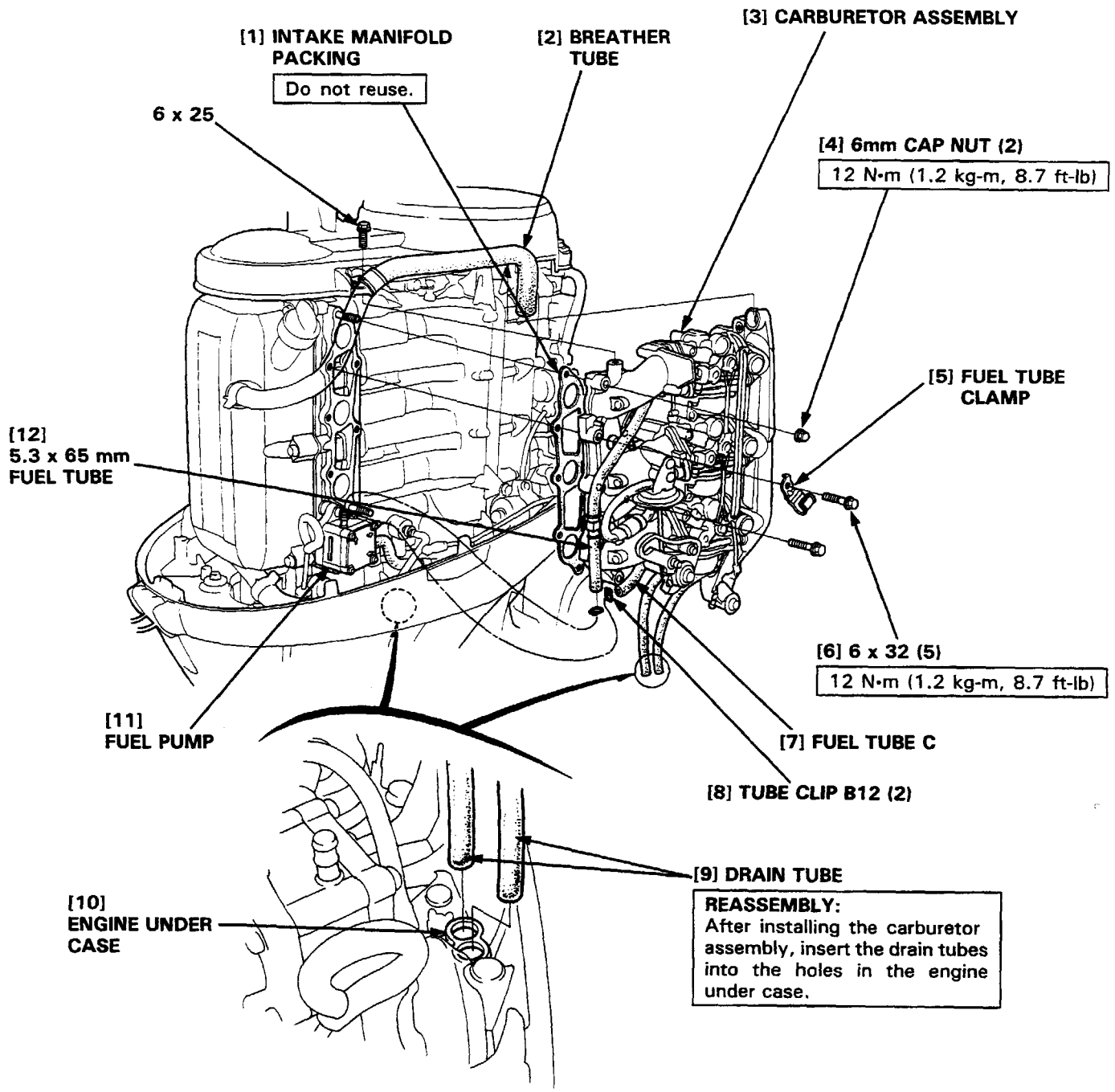
1) Remove the silencer cover (see above).
2) Pull the choke knob, then push it while holding the choke knob rod. Pull up the choke knob rod and disconnect it from the choke knob and choke arm A.
3) Remove the linkage pivot from the throttle cam.





4) Loosen the 6 x 12 mm SH flange bolt (Remote control type only).
5) Slide the remote choke solenoid rearward, detach the rod joint from the plunger rod, and remove the rod from the choke arm B (Remote control type only).
6) Disconnect the breather tube. Disconnect the fuel tube C and 5.3 x 65 mm fuel tube.
   Remove the 6 x 25 mm flange bolt, five 6 x 32 mm flange bolts and the two 6 mm cap nuts.
   Remove the carburetor assembly from the engine.





b. DISASSEMBLY/REASSEMBLY

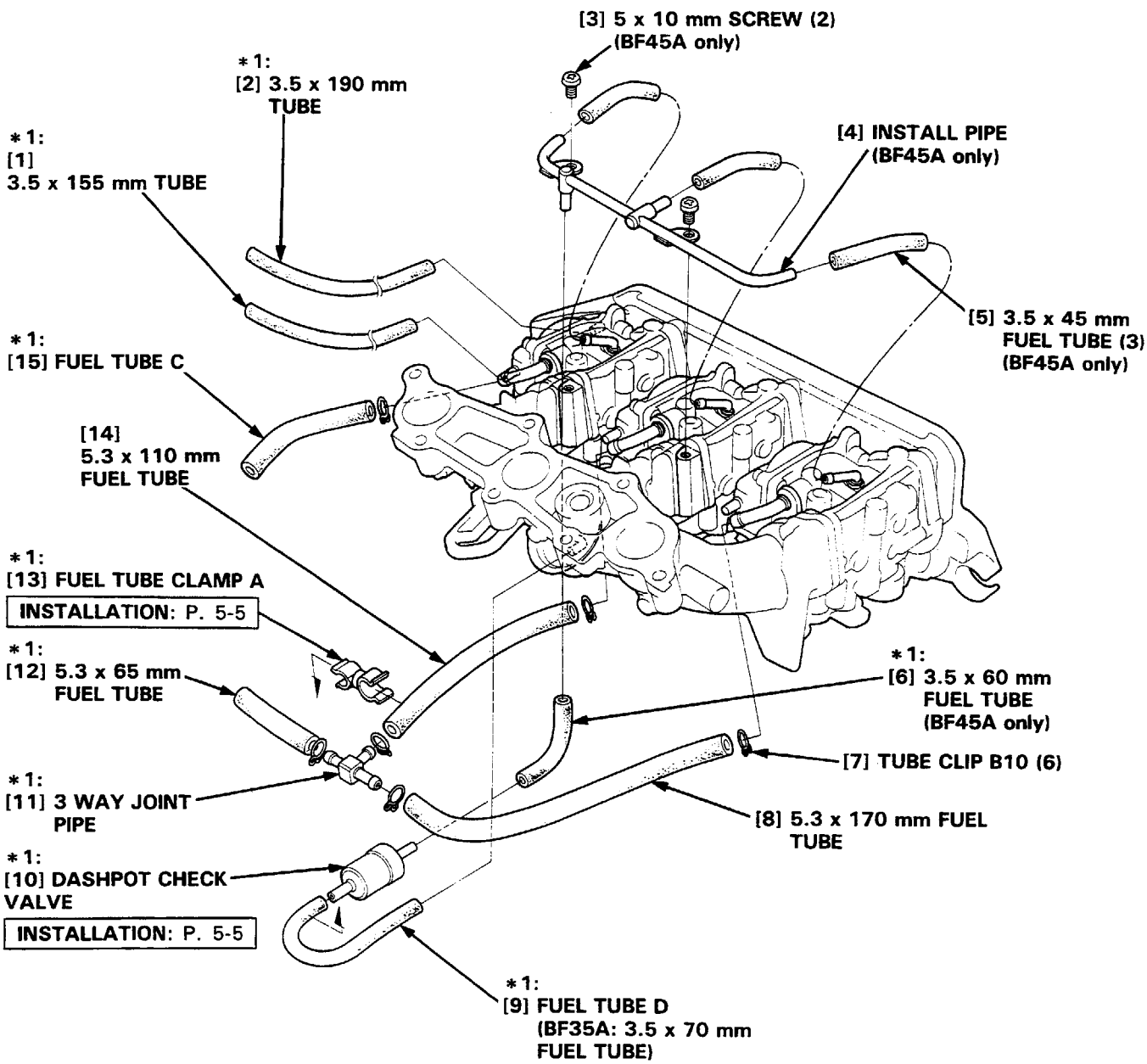
• FUEL LINE

NOTE

- Before installing the fuel tubes, check for deterioration or damage. Replace if necessary.

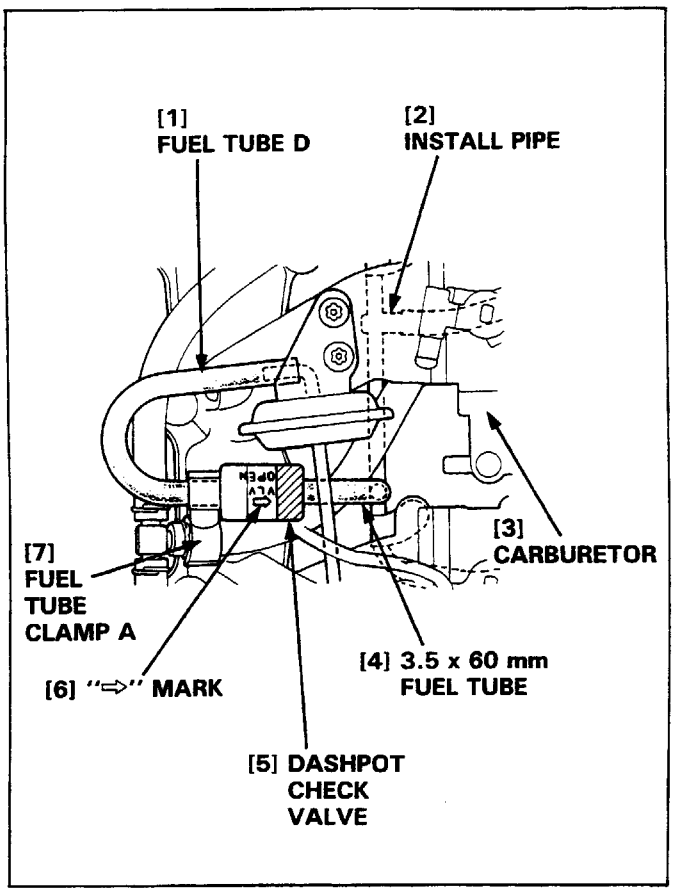
1) Remove the carburetor assembly (p. 5-3).

Parts marked with "*1:" can be disassembled and reassembled with the carburetor mounted on the frame.

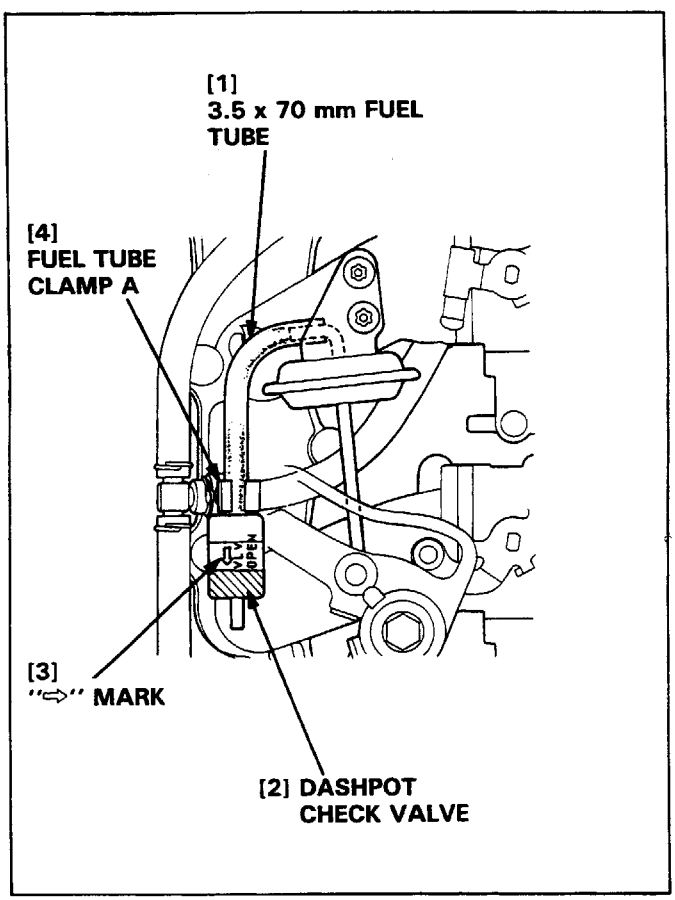


• DASHPOT CHECK VALVE/FUEL TUBE CLAMP A INSTALLATION

BF45A:
Install the dashpot check valve so that "⇨" mark is toward the carburetor side.
Clamp the fuel tubes with the fuel tube clamp A as shown.



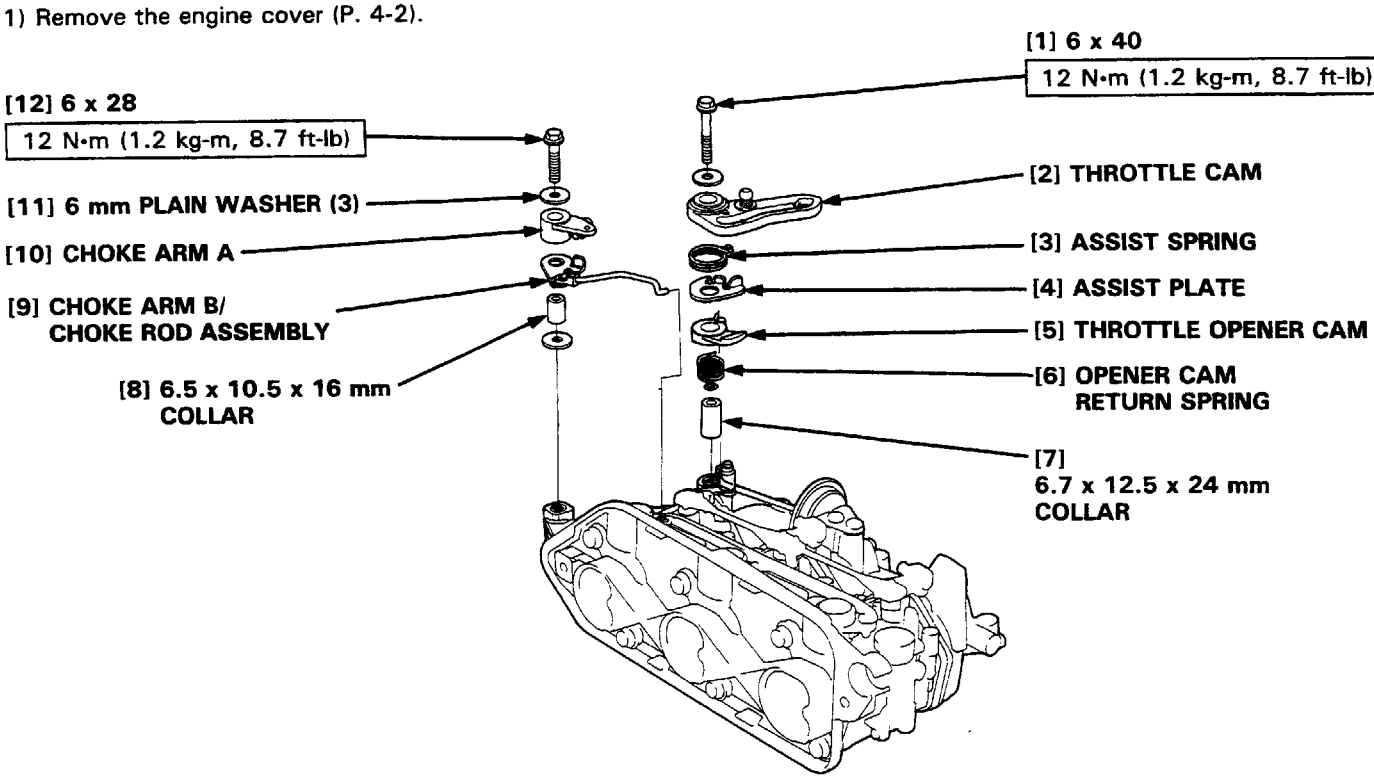
BF35A:
Install the dashpot check valve so that "⇨" mark is toward the engine under cover side.
Clamp the fuel tubes with the fuel tube clamp A as shown.



• THROTTLE CAM/CHOKE ARM

• The throttle cam/chock arm can be disassembled and reassembled with the carburetor mounted on the frame.

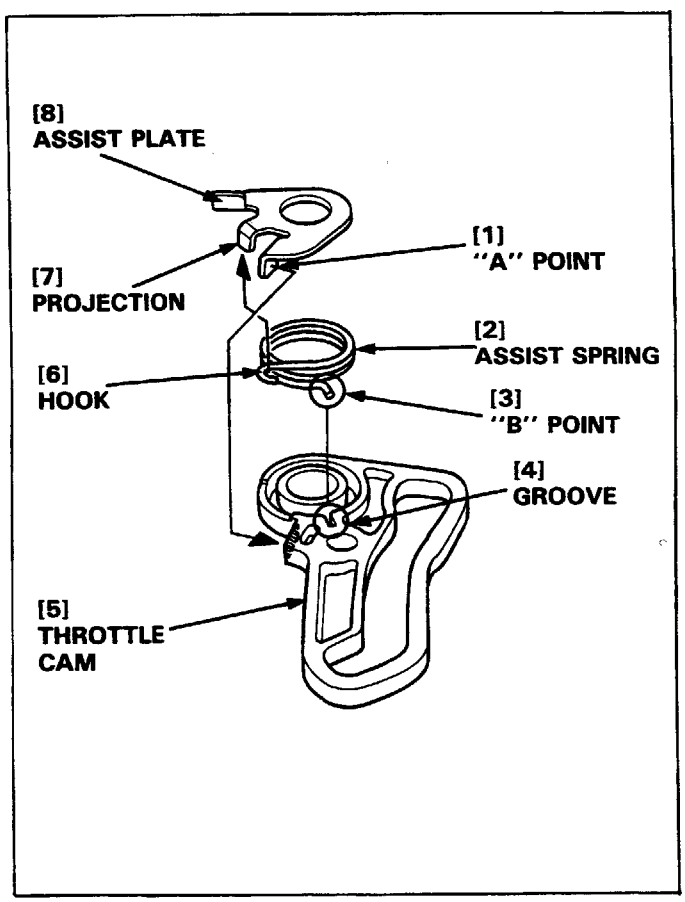
1) Remove the engine cover (P. 4-2).



• THROTTLE CAM

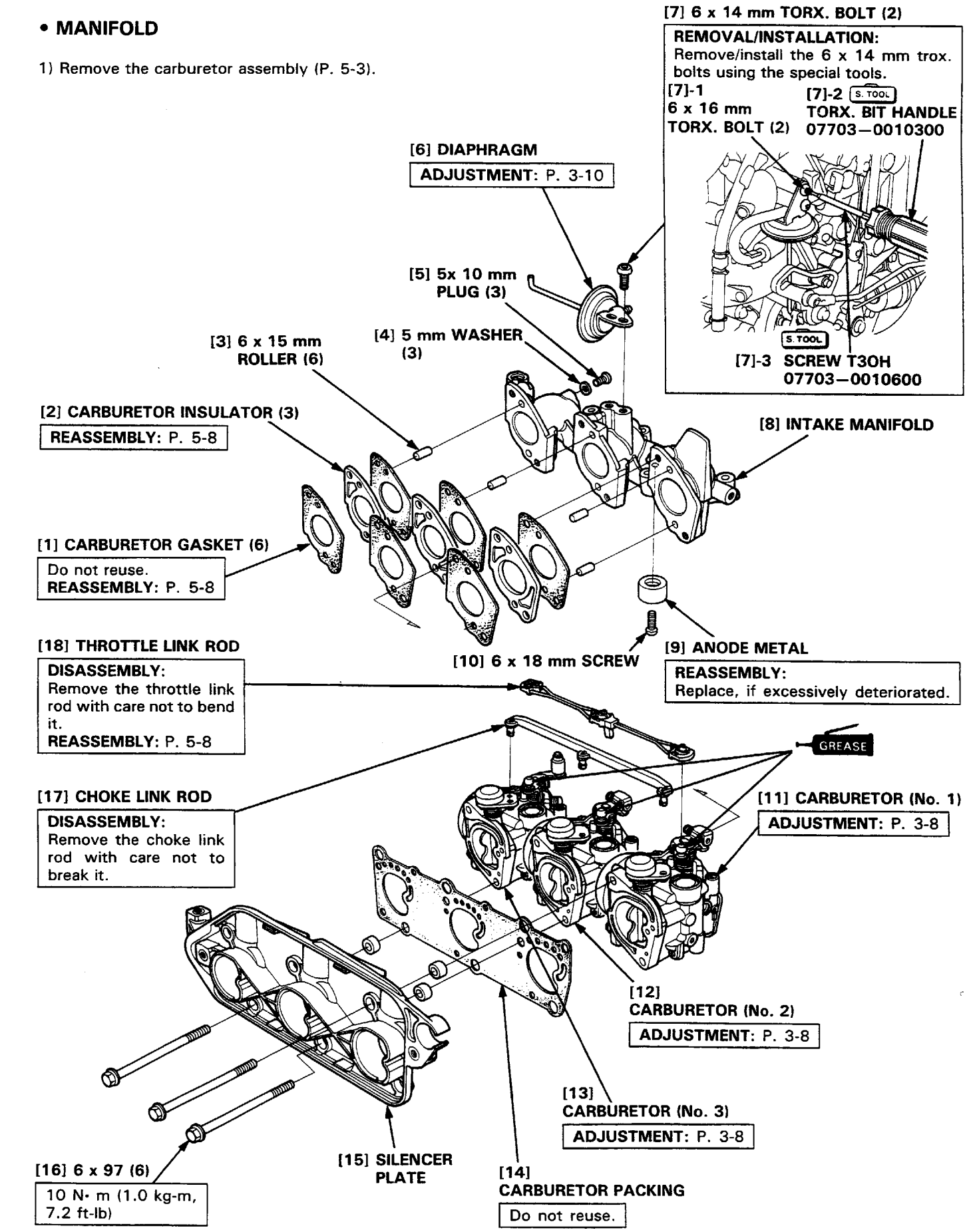
REASSEMBLY:

1) Align the "A" point of the assist spring with the groove in the throttle cam.
2) Set the projection of the assist plate on the hook of the assist spring and align the flat surface of the throttle cam with the "B" point of the assist plate. Then, assemble with the collar and tighten the bolt.

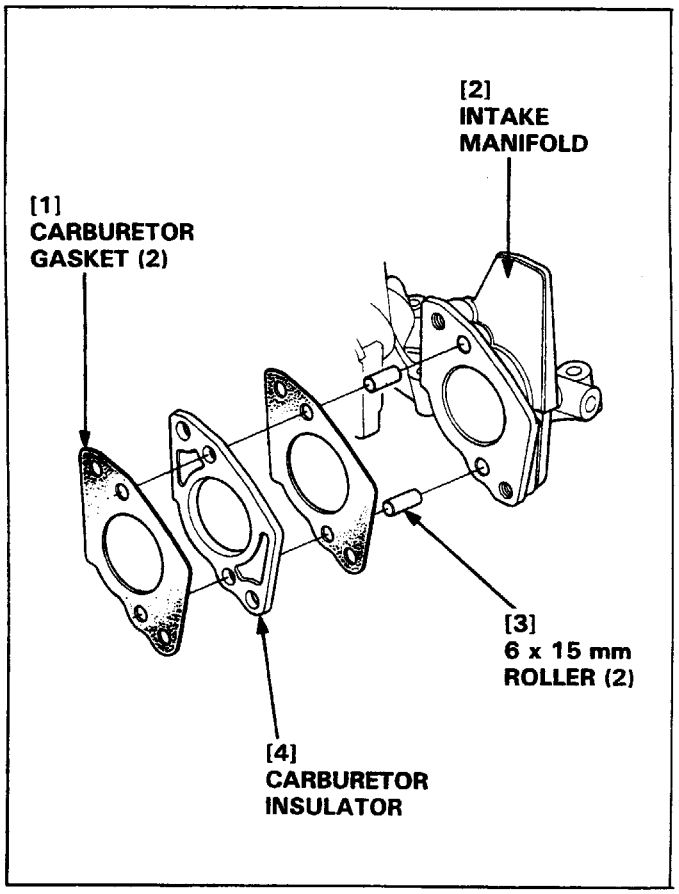


• MANIFOLD

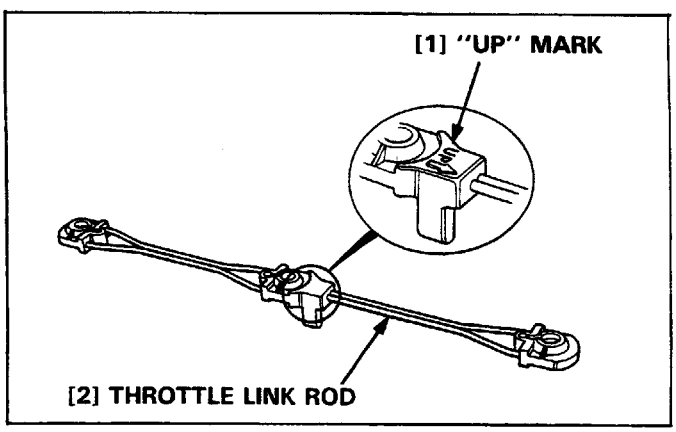
1) Remove the carburetor assembly (P. 5-3).



• **CARBURETOR GASKET/INSULATOR**
REASSEMBLY:
Note the installation direction.



• **THROTTLE LINK ROD**
REASSEMBLY:
Install the throttle link rod with the "UP" mark at the center of the rod facing up.

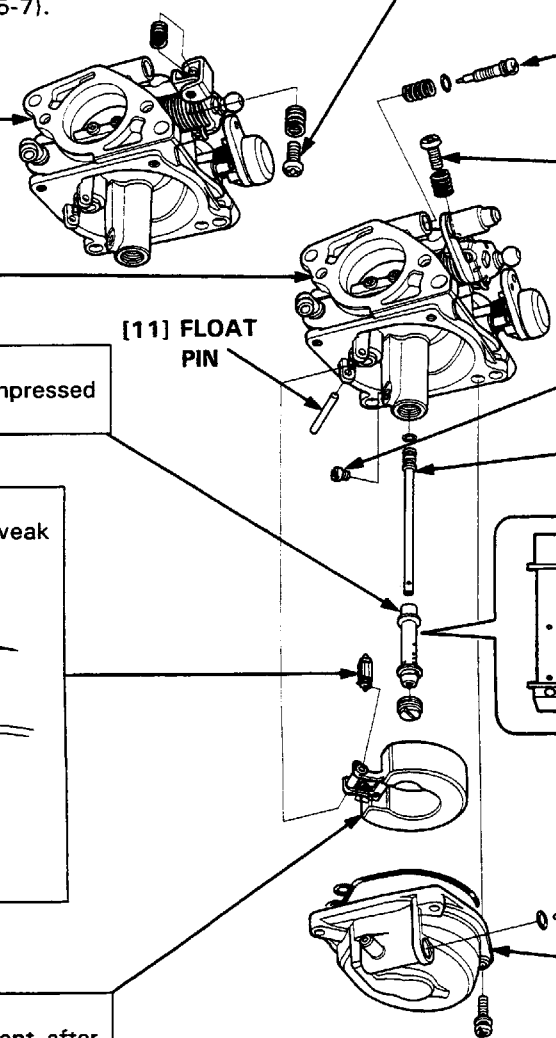


• CARBURETOR

⚠ WARNING

- **Remove the drain screw and drain the carburetor before disassembling.**
- **Gasoline is extremely flammable and is explosive under certain conditions. Do not smoke or allow flames or sparks in the area.**

1) Remove the manifold (P. 5-7).



[1] THROTTLE STOP SCREW
ADJUSTMENT: P. 3-8

[2] PILOT SCREW
REASSEMBLY:
Inspect for wear or damage before installation.
ADJUSTMENT: P. 3-8

[3] THROTTLE STOP SCREW
ADJUSTMENT: P. 3-8

[4] MAIN JET (BF35A: #102, BF45A: #125)
REASSEMBLY:
Clean thoroughly with compressed air before installation.

[5] JET SET
REASSEMBLY:
Clean thoroughly with compressed air before installation

[6] DRAIN SCREW

[7] FLOAT CHAMBER
REASSEMBLY:
Install so that the drain screw faces to the pilot screw side.

[8] FLOAT
REASSEMBLY:
Check for smooth movement after installation.

[9] FLOAT VALVE
REASSEMBLY:
Check for worn valve or weak spring before installation.

[9]-1 FLOAT VALVE

[9]-2 FLOAT

[10] MAIN NOZZLE
REASSEMBLY:
Clean thoroughly with compressed air before installation.

[11] FLOAT PIN

[12] CARBURETOR BODY #3

[13] CARBURETOR BODY #1,2

c. INSPECTION

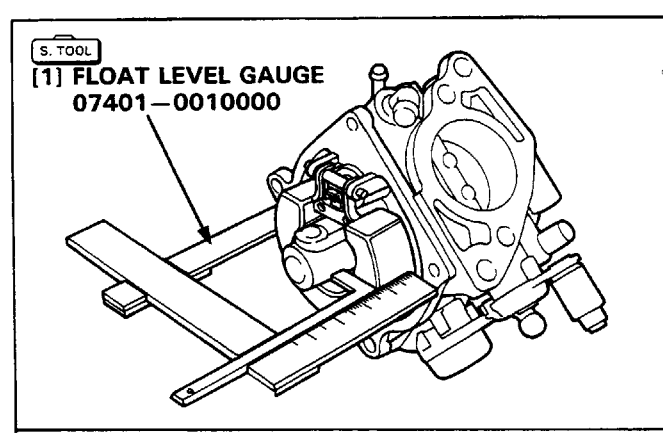
• FLOAT LEVEL HEIGHT

With the carburetor in an upright position, measure the distance between the float top and the carburetor body when the float just contacts the float valve.

Standard float height	14 mm (0.6 in)

If the hight is out of specification, replace the float.

Check the float operation.



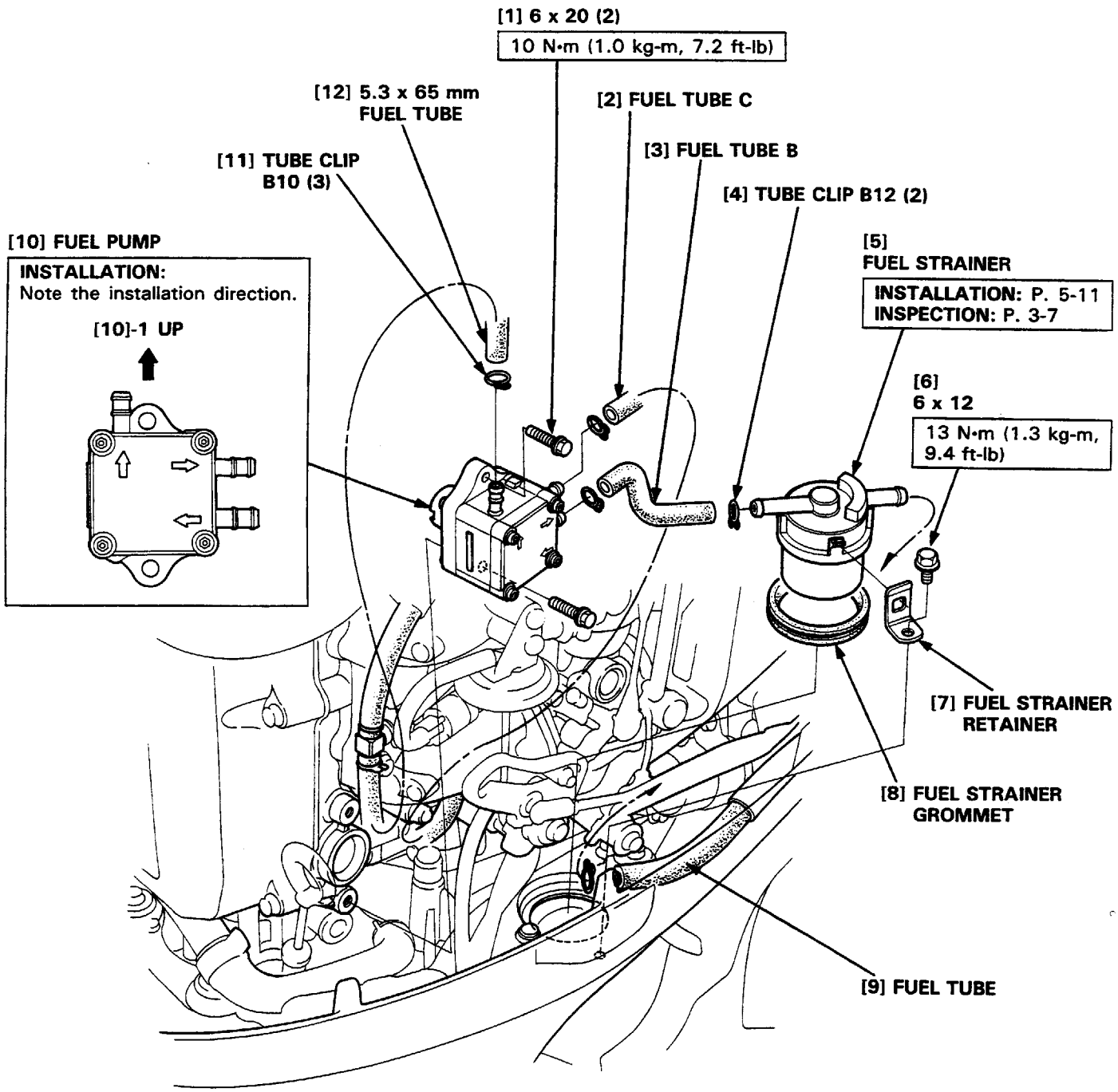
FUEL PUMP/FUEL STRAINER

a. DISASSEMBLY/REASSEMBLY

NOTE

- Before installing the fuel tubes, check for deterioration or damage. Replace if necessary.

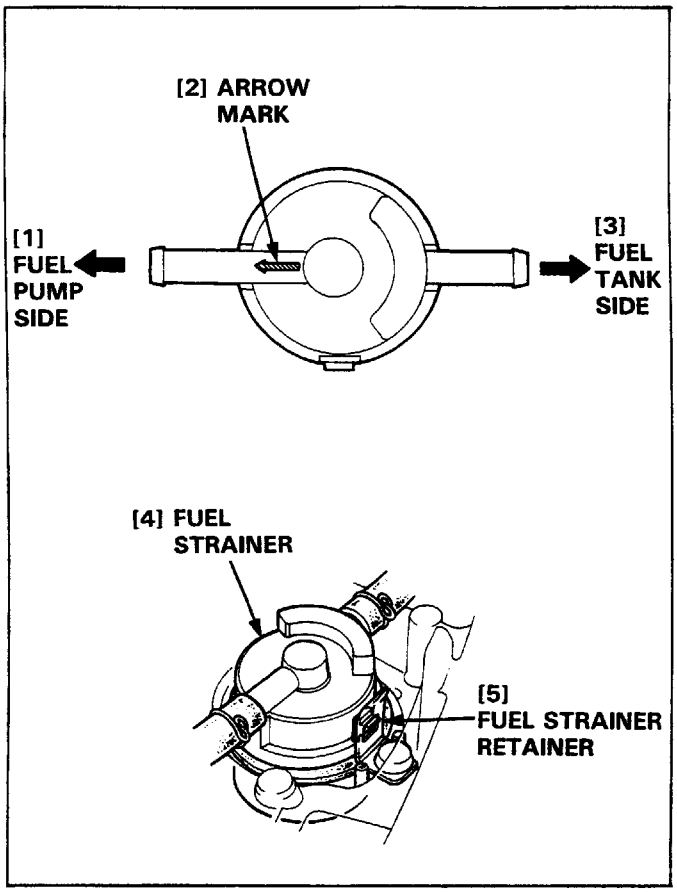
1) Remove the engine cover.



• **FUEL STRAINER**

INSTALLATION:

Install the fuel strainer so that "⇦" mark is on the fuel pump side and align the projection on the fuel strainer with the hole in the retainer securely.



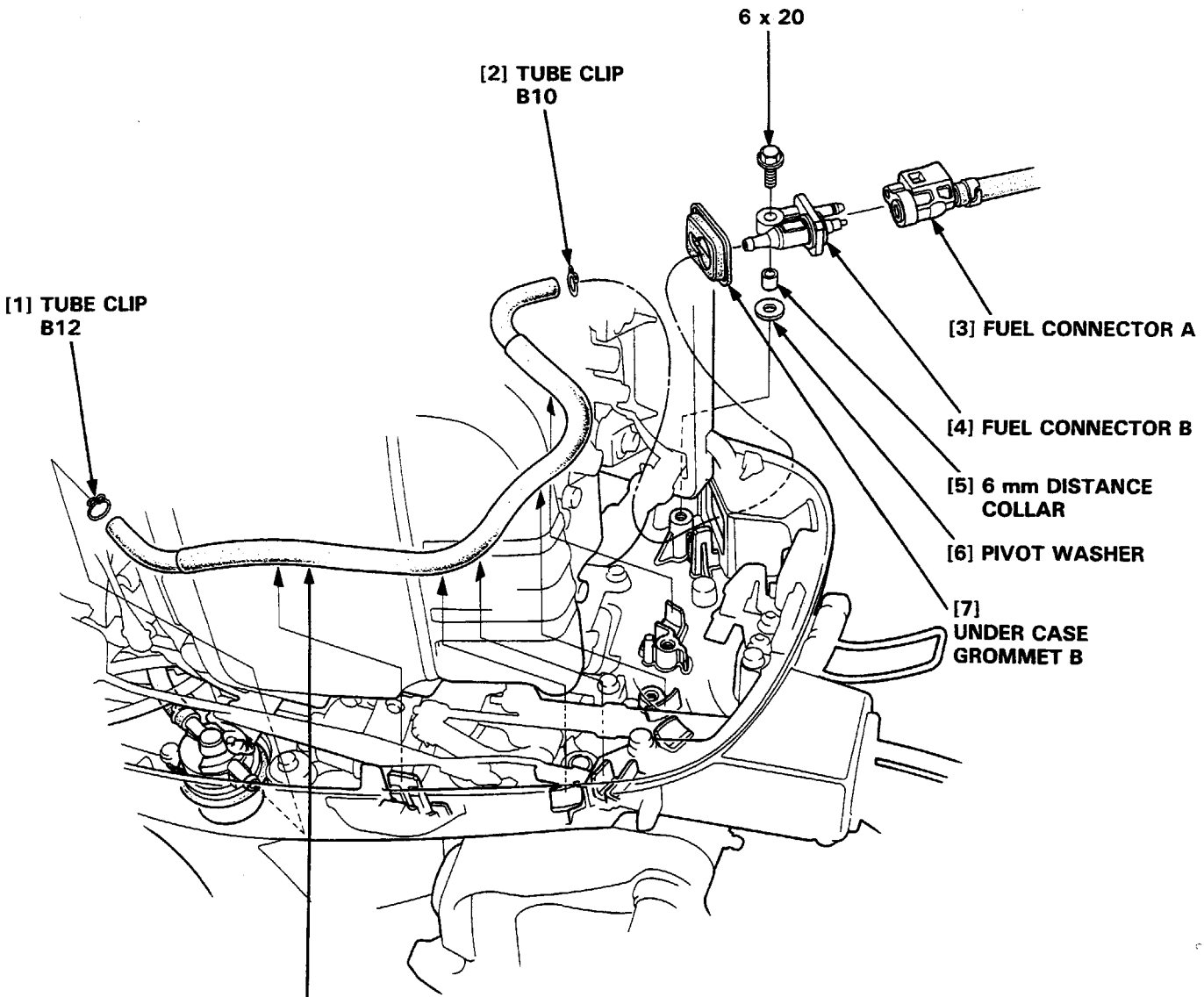
FUEL TUBE

a. DISASSEMBLY/REASSEMBLY

NOTE

- Before installing the fuel tubes, check for deterioration or damage. Replace if necessary.

1) Remove the starter motor (P. 16-7).
2) Remove the electric parts (P. 16-12).



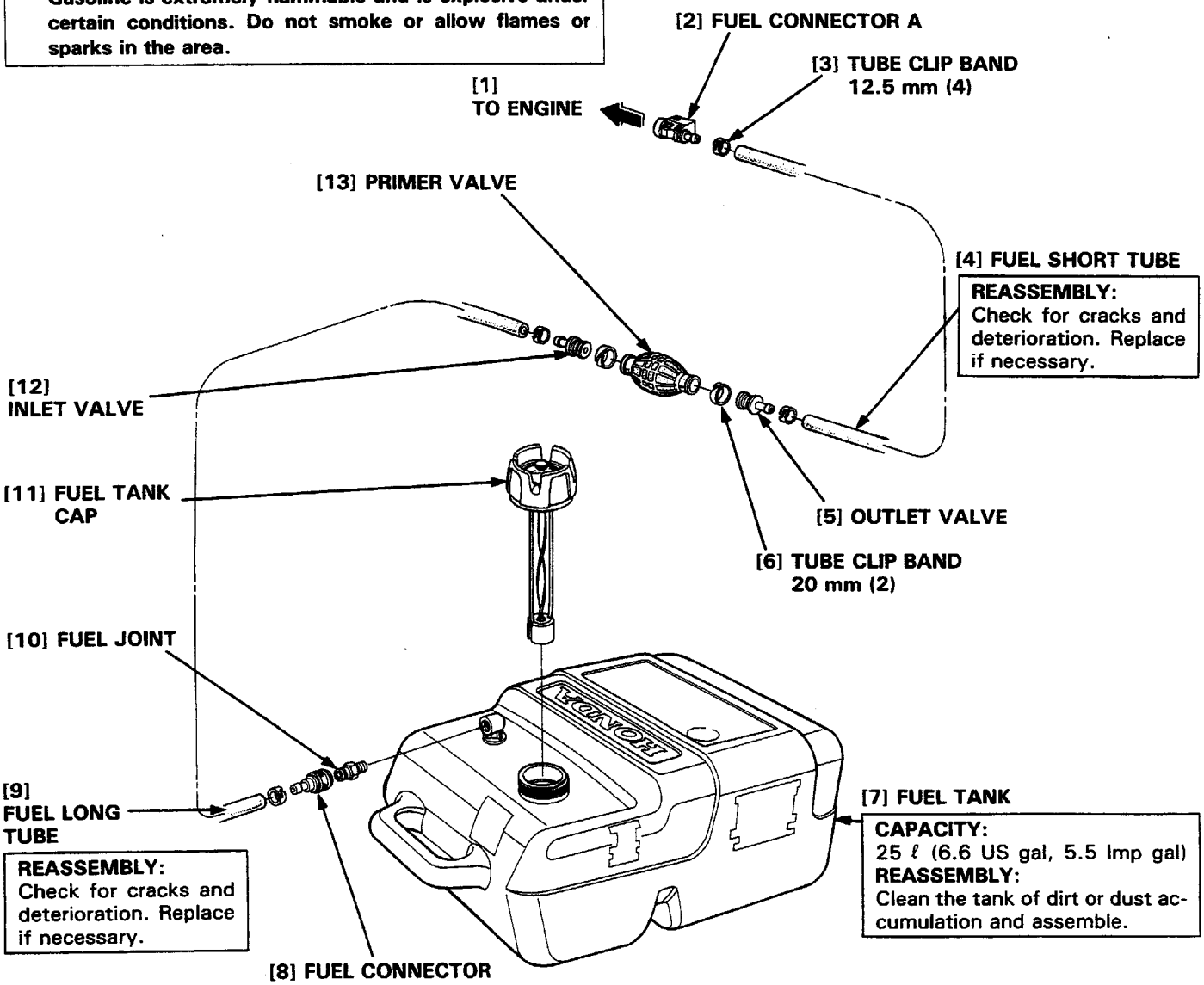
INSTALLATION:
Install the fuel tube to the groove of the engine under case securely.

FUEL TANK (MODEL WITH FUEL TANK)

a. DISASSEMBLY/REASSEMBLY

⚠ WARNING

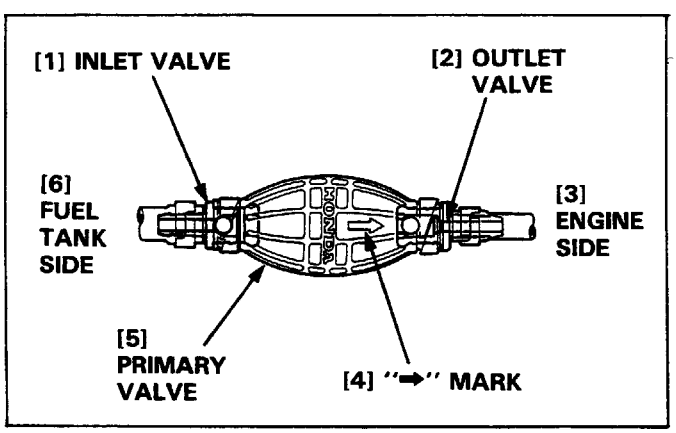
- **Before disassembly, drain the fuel tank and fuel line completely.**
- **Gasoline is extremely flammable and is explosive under certain conditions. Do not smoke or allow flames or sparks in the area.**



• INLET/OUTLET VALVE INSTALLATION

Install with care not to interchange the inlet valve with the outlet valve.

Install the primary valve so that "⬅" mark is on the engine side.



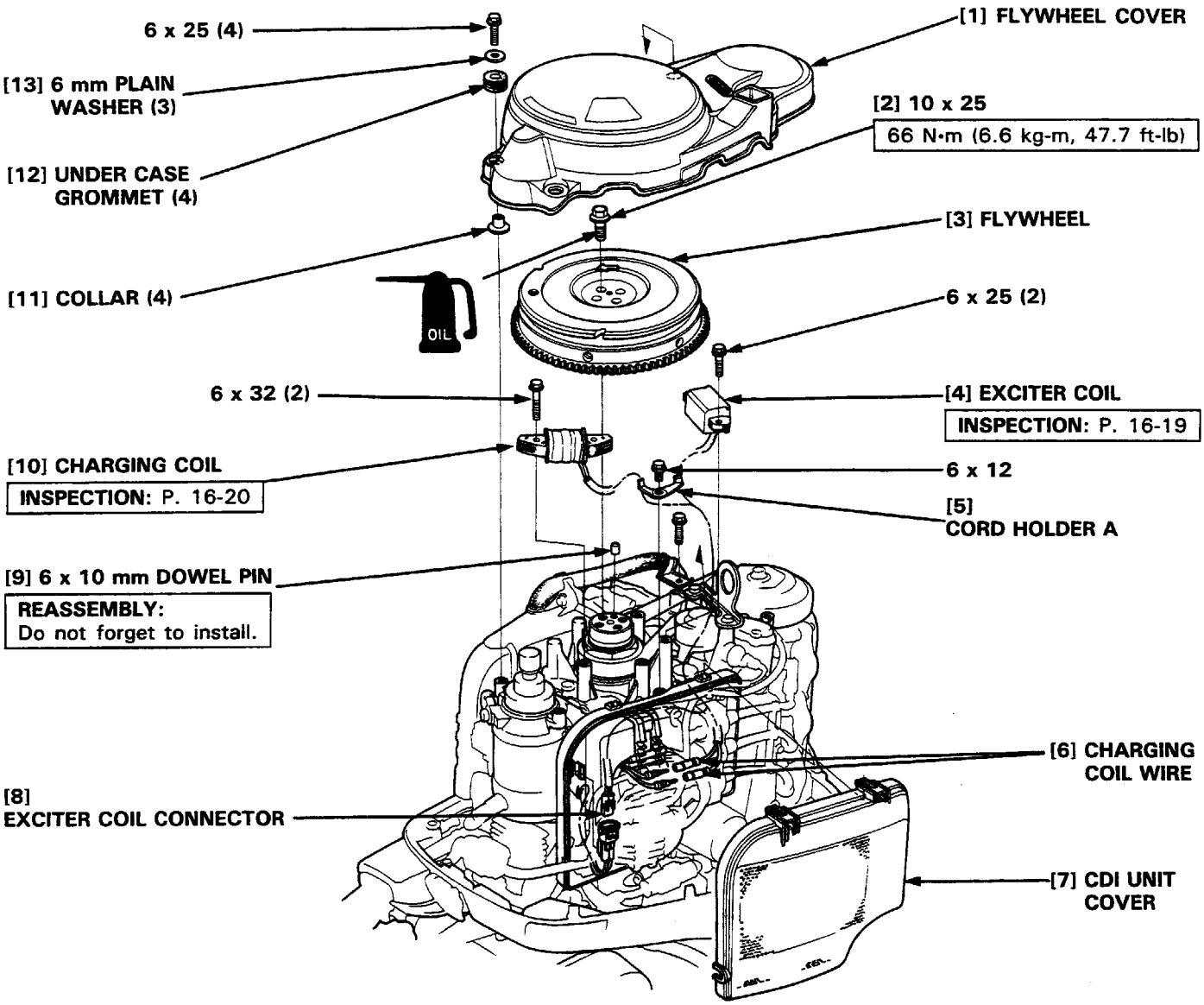
FLYWHEEL/TIMING BELT

FLYWHEEL

SHOP MANUAL NEWS

a. DISASSEMBLY/REASSEMBLY

1) Remove the engine cover and the CDI unit cover, and disconnect the charging coil wires and the exciter coil connector.

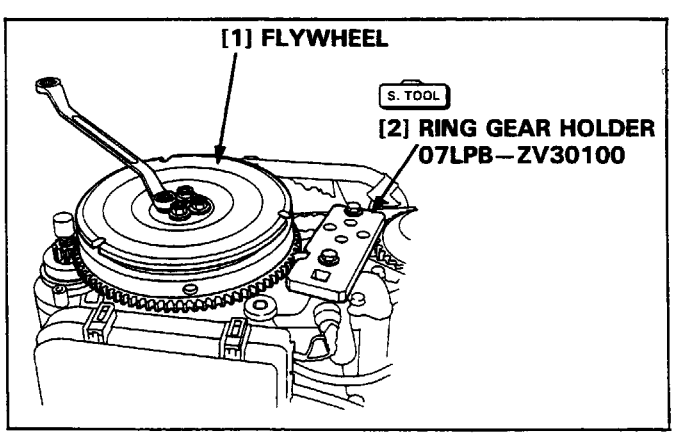


• FLYWHEEL REMOVAL/INSTALLATION

Do not hit the flywheel with a hammer.
Remove/install the flywheel using the special tool.

TOOL:

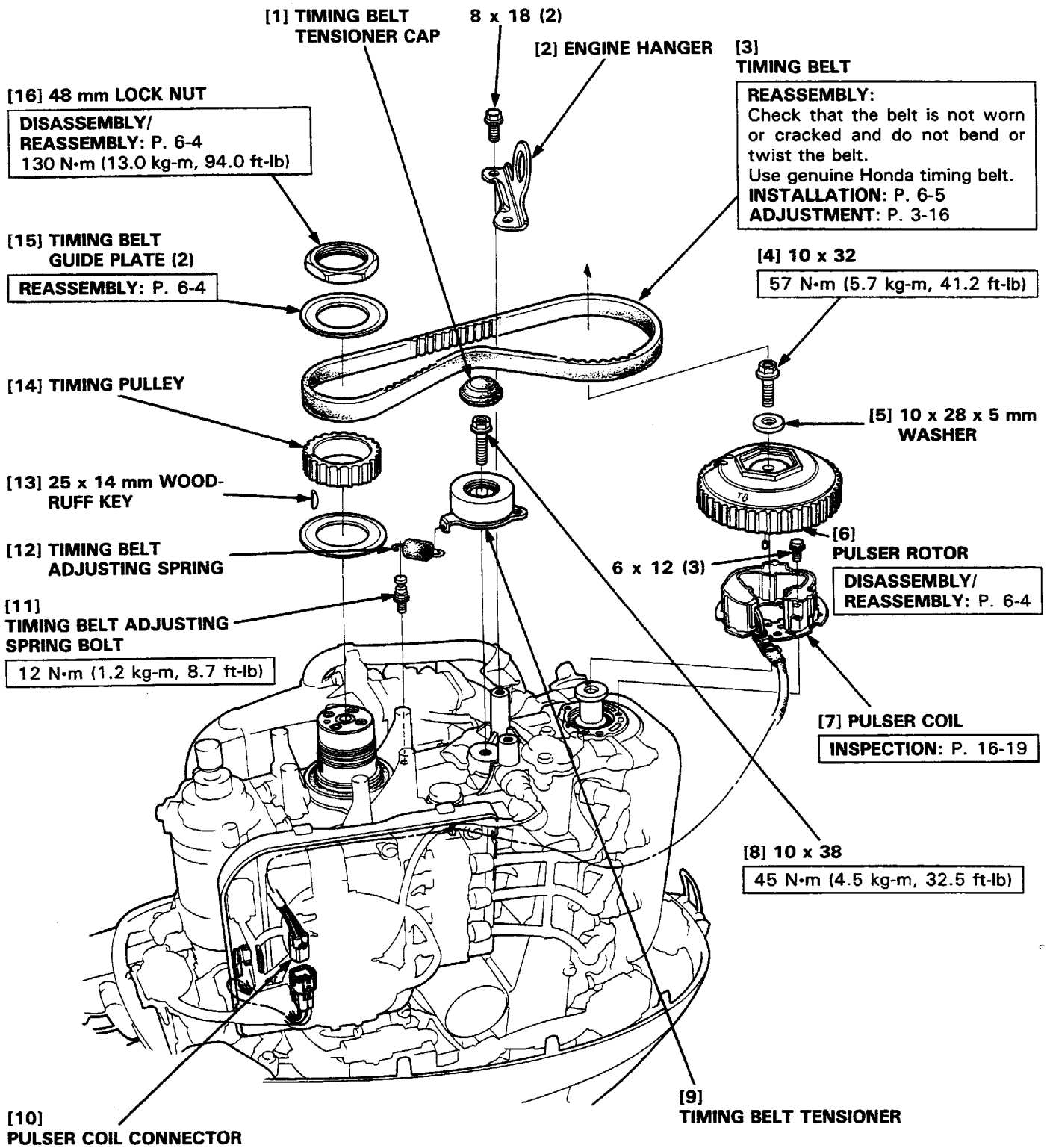
Ring gear holder	**07LPB—ZV30100**



TIMING BELT/PULLEY

a. DISASSEMBLY/REASSEMBLY

1) Remove the flywheel (P. 6-2) and disconnect the pulser coil connector.

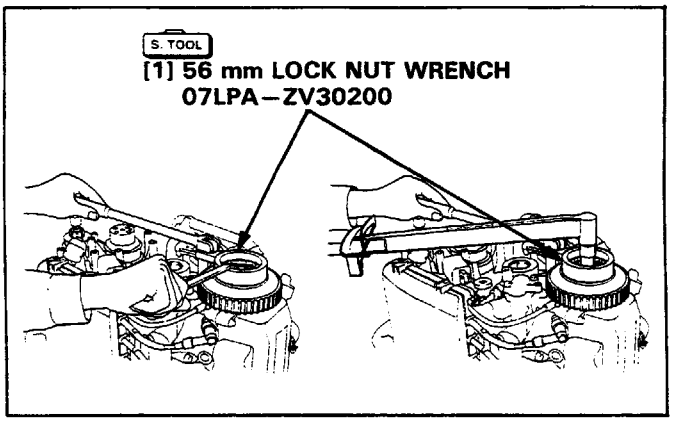


• PULSER ROTOR

Remove/install the pulser rotor using the special tool.

TOOL:
56 mm Lock nut wrench 07LPA—ZV30200

TORQUE: 57 N·m (5.7 kg-m, 41.2 ft-lb)

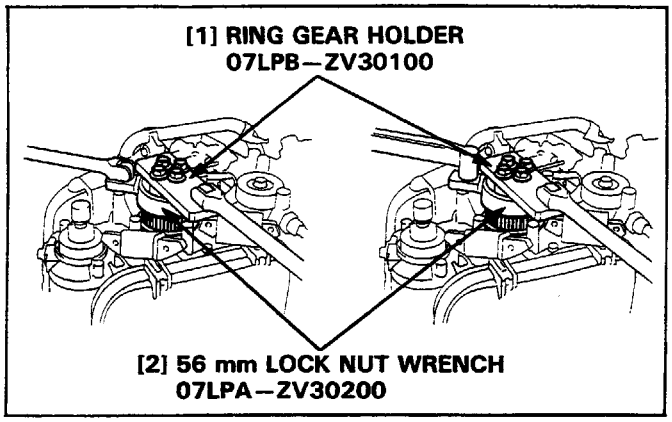


• 48 mm LOCK NUT

Remove/install the 48 mm lock nut using the special tools.

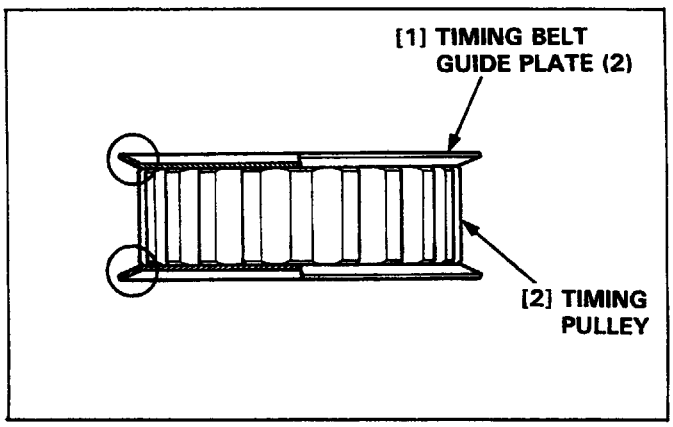
TOOLS:
56 mm lock nut wrench 07LPA—ZV30200
Ring gear holder 07LPB—ZV30100

TORQUE: 130 N·m (13.0 kg-m, 94.0 ft-lb)



• TIMING BELT GUIDE PLATE

Install with the curved surfaces toward the timing pulley.



• TIMING BELT

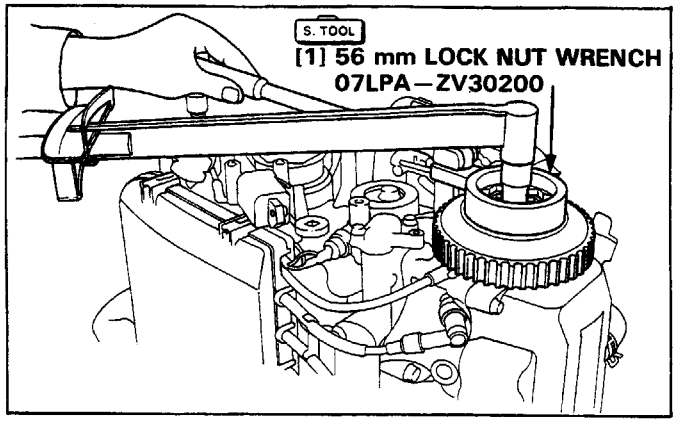
INSTALLATION:

1) Set the pulser rotor over the camshaft and tighten the 10 x 32 mm flange bolt using the special tool as shown.

TORQUE: 57 N·m (5.7 kg-m, 41.2 ft-lb)

TOOL:

56 mm lock nut wrench	**07LPA-ZV30200**



2) Install the timing belt guide plate, 25 x 14 mm woodruff key, and the timing pulley on the crankshaft (page 6-3).
3) Attach the special tool to the pulser rotor, and align the "T⬇" mark on the pulser rotor with the "T⬆" mark on the cylinder head by turning the pulser rotor counterclockwise (in the normal rotating direction of the camshaft).

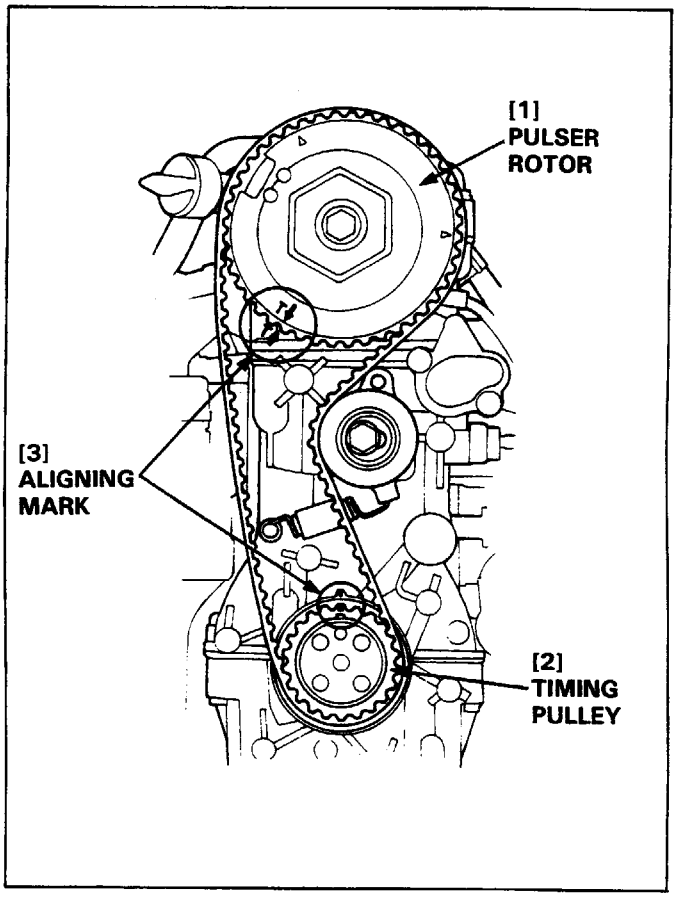
CAUTION

- **Do not rotate the pulser rotor clockwise.**

4) Align the "●" mark on the timing pulley with the "I" mark on the cylinder block.
5) Move the timing belt tensioner to the position of slackening the belt and install the belt on the timing pulley side first, then install on the pulser rotor.

NOTE

- Install the timing belt with care not to move the marks out of alignment.



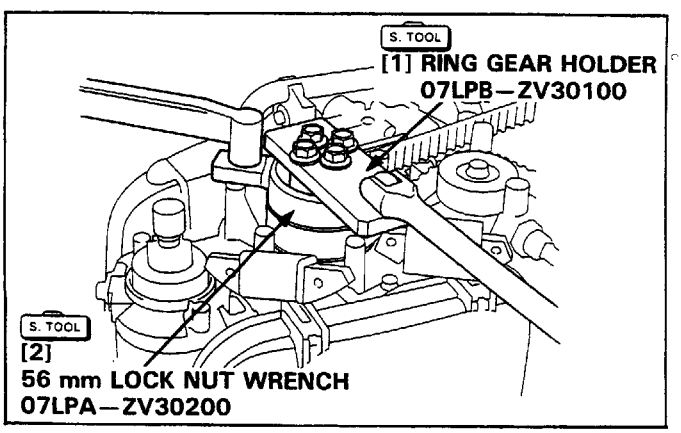
6) After installing the timing belt, check each mark for proper alignment.
Install the timing belt guide plate and 48 mm lock nut on the crankshaft. Note the installation direction of the timing belt guide plate.
7) Tighten the 48 mm lock nut using the special tool with care not to move the marks out of alignment.

TORQUE: 130 N·m (13.0 kg-m, 94.0 ft-lb)

TOOLS:

56 mm lock nut wrench	**07LPA—ZV30200**
Ring gear holder	**07LPB—ZV30100**

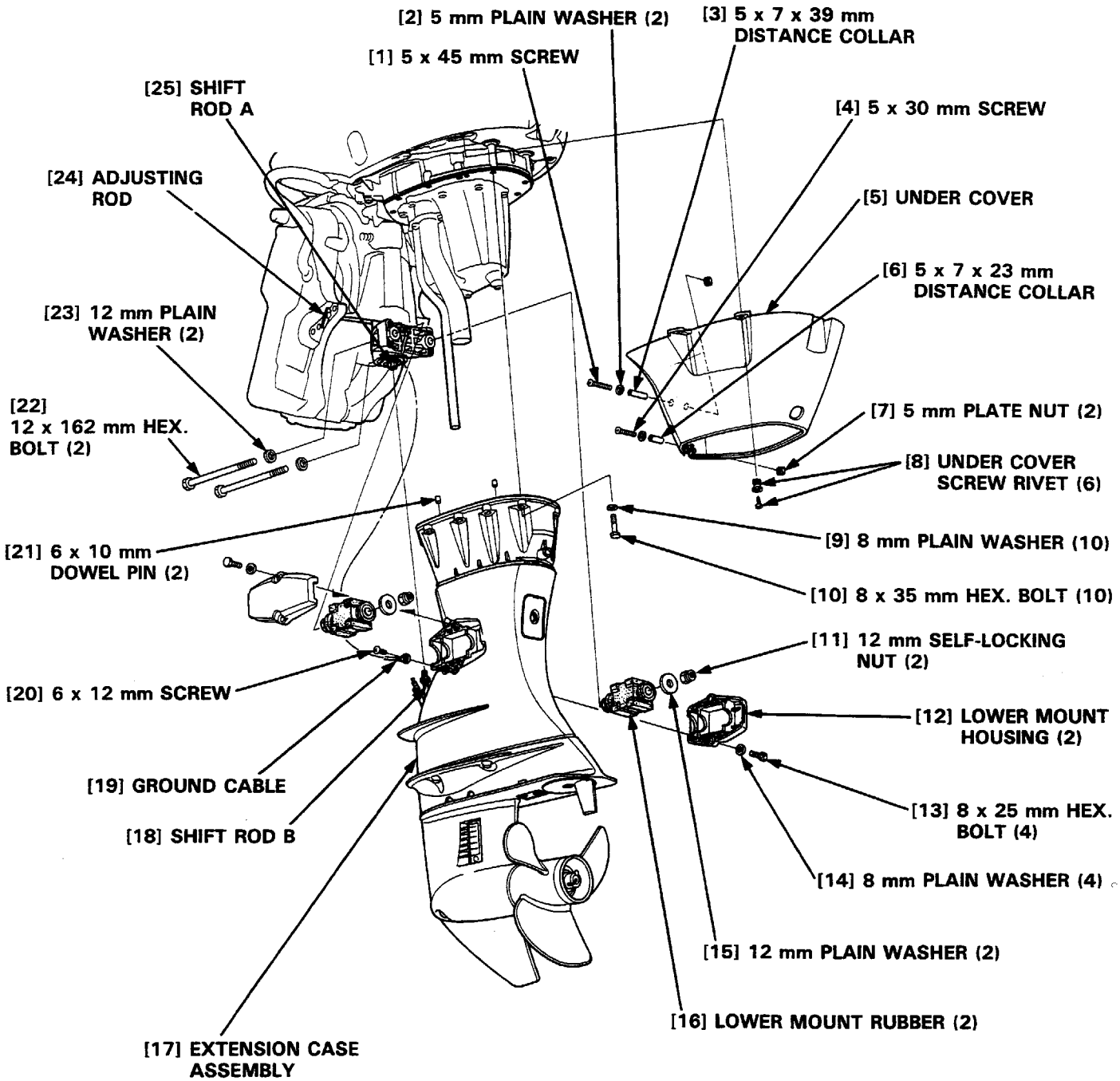
8) After tightening the lock nut, adjust the timing belt tension (page 3-16).



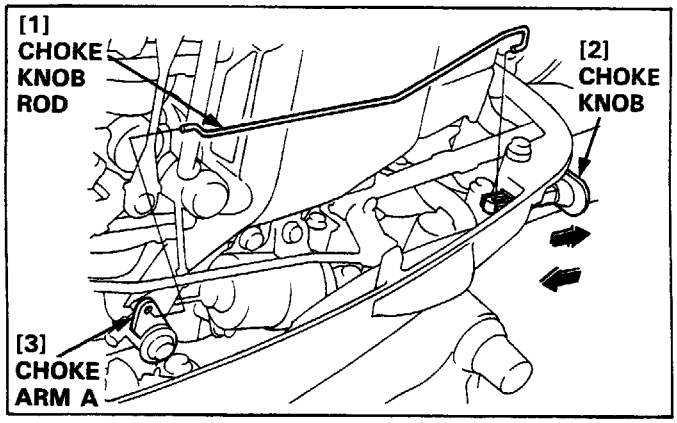
ENGINE REMOVAL/ INSTALLATION

REMOVAL

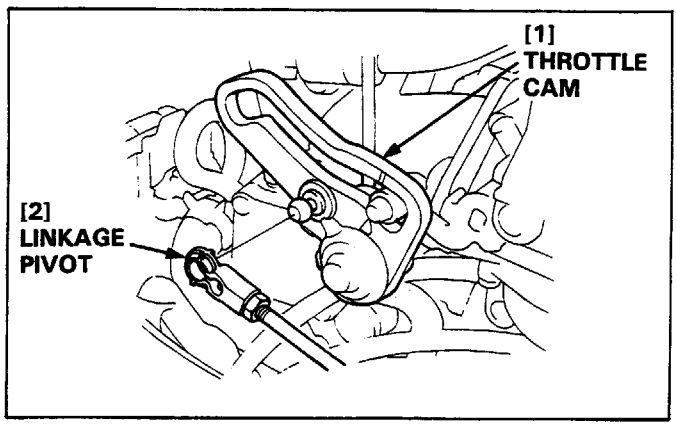
1) Set the adjusting rod in the second hole from the rear of the stern bracket as shown.
2) Move the shift lever to the "N" position, loosen the lock nut and adjusting nut connecting the shift rod A and B, and disconnect the shift rods.
3) Remove the four 8 x 25 mm hex. bolts and the left/right lower mount housings, and disconnect the ground cable from the left side of the extension case assembly.
4) Remove the two 12 x 162 mm hex. bolts and the left/right lower mount rubbers
5) Remove the 5 x 30 mm/5 x 45 mm screws, six screw rivets and the under cover.
6) Remove the ten 8 x 35 mm hex. bolts and the extension case assembly.
7) Remove the oil pan (P. 12-2).



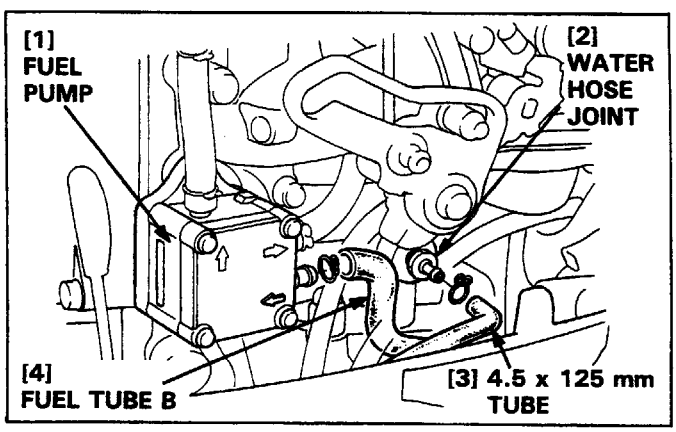
8) Remove the engine cover.
9) Pull the choke knob, then push it while holding the choke knob rod. Pull up the choke knob rod and disconnect it from the choke knob and choke arm A.



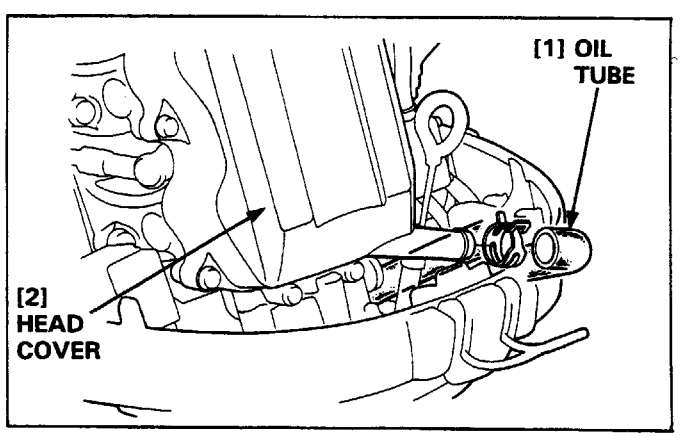
10) Remove the linkage pivot from the throttle cam.



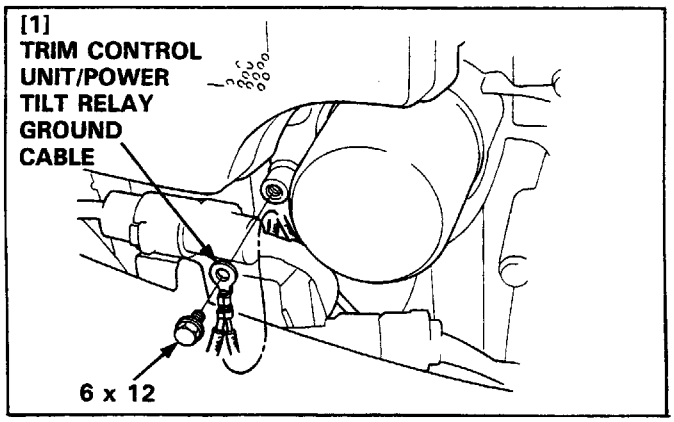
11) Disconnect the fuel tube B and the 4.5 x 125 mm tube from the fuel pump and the water hose joint.



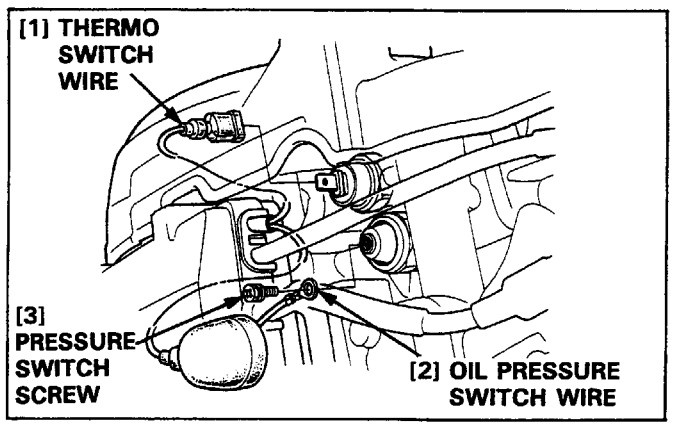
12) Disconnect the oil tube from the head cover.



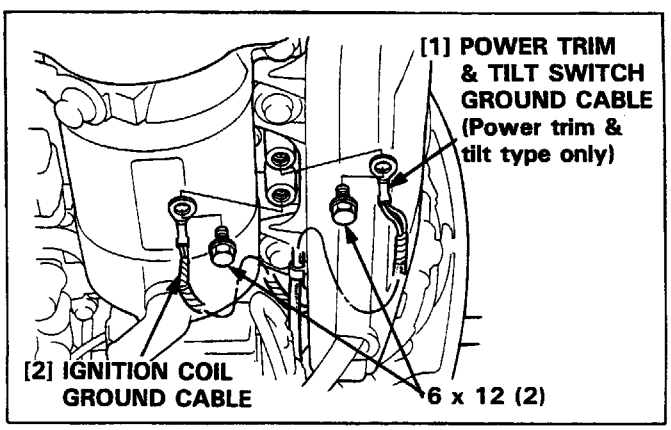
13) Remove the 6 x 12 mm flange bolt and disconnect the ground cable of the trim control unit and the power tilt relay from the cylinder block. (Remote control type only)



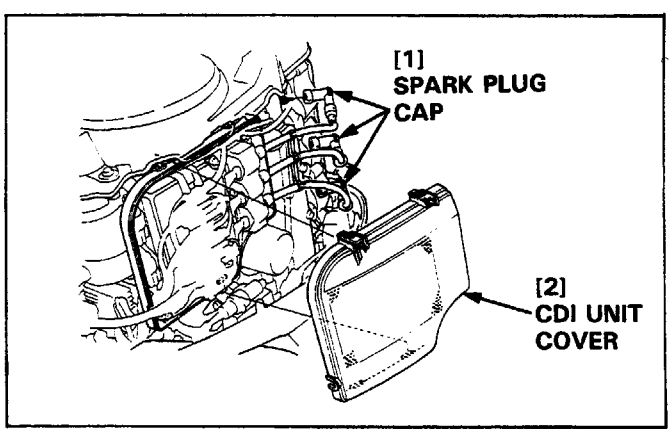
14) Remove the pressure switch screw and disconnect the oil pressure switch wire and the thermo switch wire.



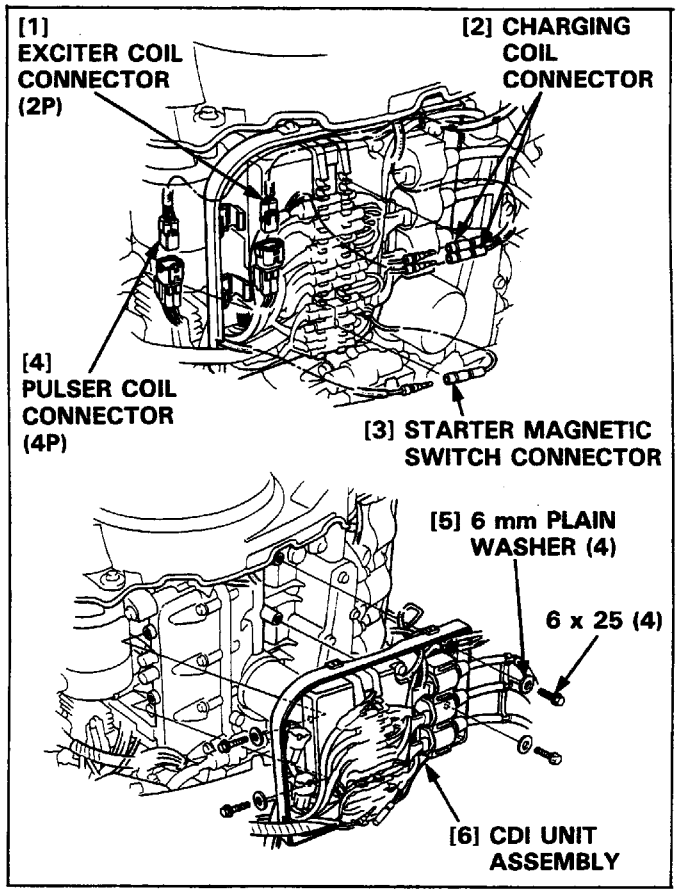
15) Remove the two 6 x 12 mm flange bolts and disconnect the ground cables of the ignition coil and the power trim & tilt switch. (Power trim & tilt type only)



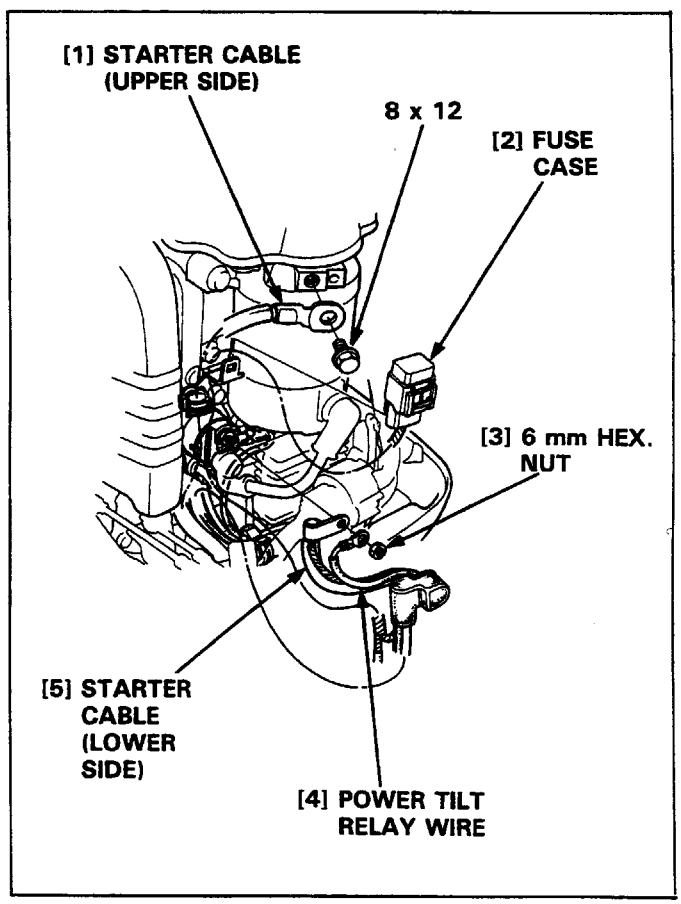
16) Remove the spark plug caps and the CDI unit cover.



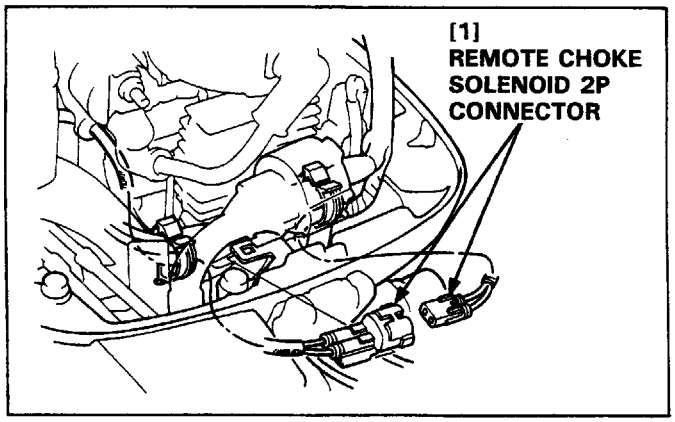
17) Disconnect the starter magnetic switch connector, exciter coil connector, charging coil connectors and the pulser coil connector.
18) Remove the four 6 x 25 mm flange bolts and the CDI unit assembly.



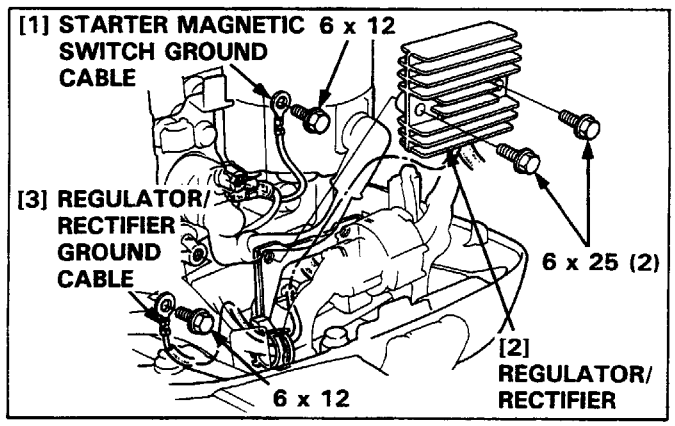
19) Remove the 8 x 12 mm flange bolt and the 6 mm hex. nut and disconnect the starter cable (upper side) and the power tilt relay wire/starter cable (lower side).
Remove the fuse case.



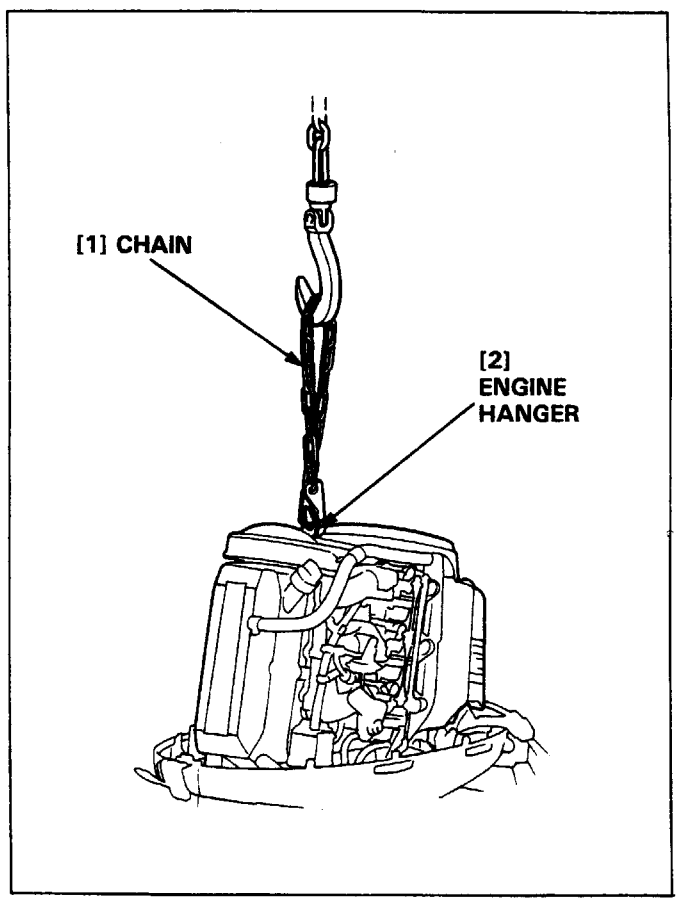
20) Disconnect the remote choke solenoid 2P connector. (Remote control type only)



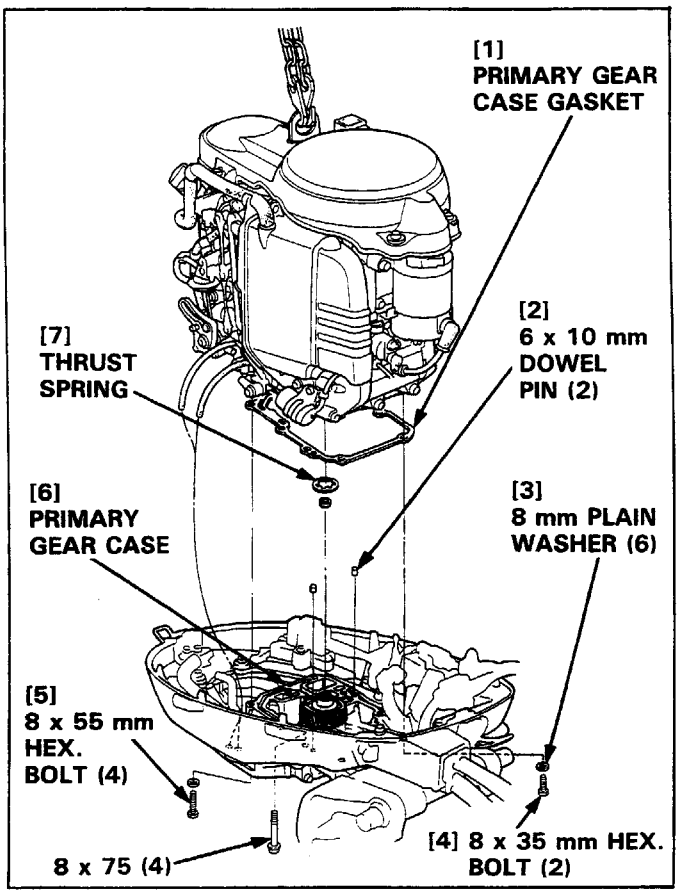
21) Remove the two 6 x 25 mm flange bolts and the regulator/rectifier.
Remove the two 6 x 12 mm flange bolts and disconnect the ground cables of the starter magnetic switch and the regulator/rectifier.



22) Set the chain to the engine hanger.



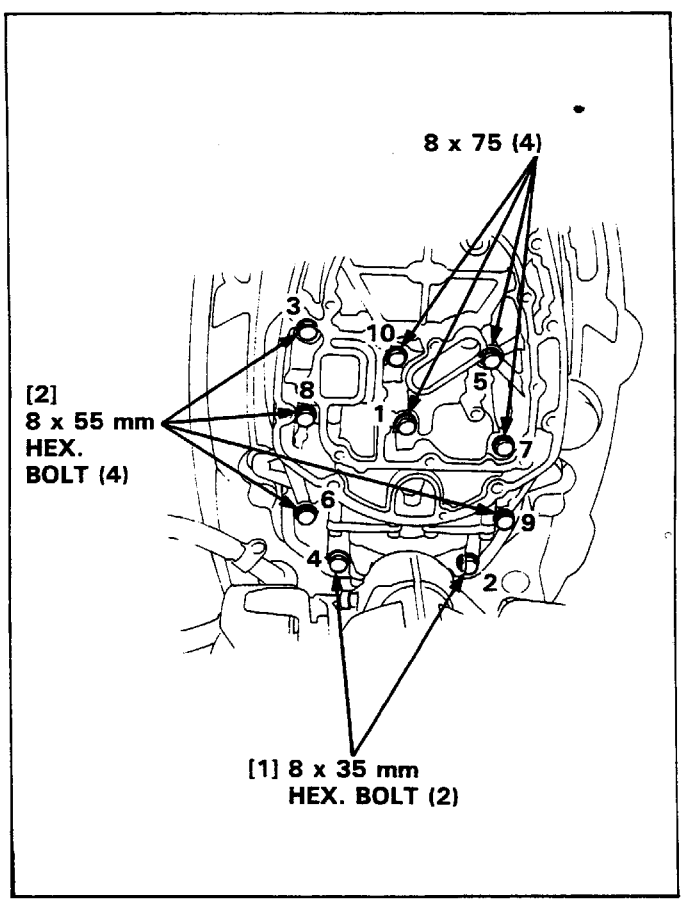
23) Remove the four 8 x 75 mm flange bolts, four 8 x 55 mm hex, bolts and two 8 x 35 mm hex. bolts, and remove the engine from the primary gear case.



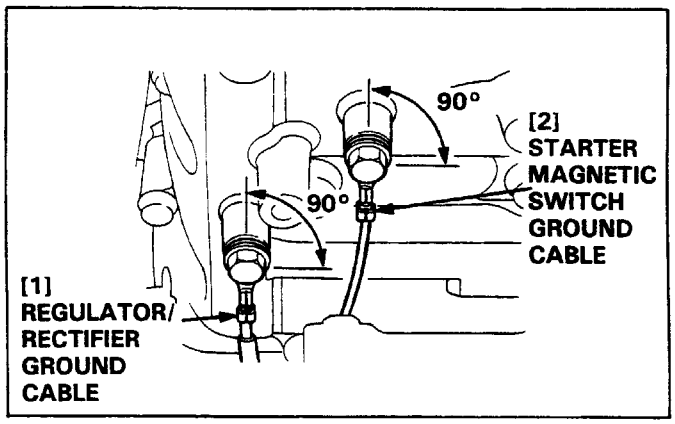
INSTALLATION

Installation procedures are the reverse of removal but care must be taken during the following.

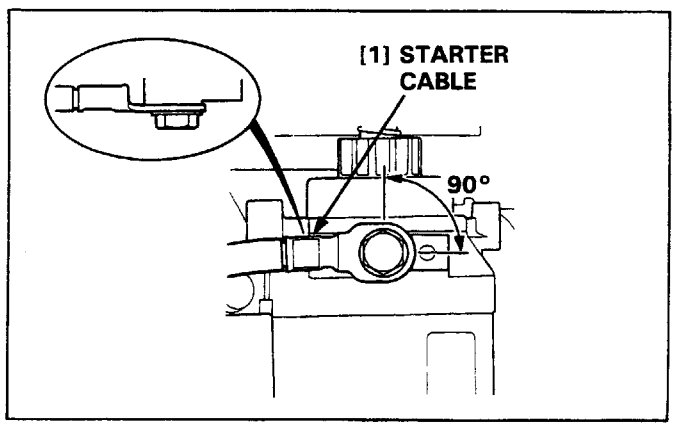
1) Note the engine mounting bolts installation location and tighten the ten bolts in the numbered sequence shown in the drawing.



2) Connect the regulator/rectifier and the starter magnetic switch ground cables at the angle of 90° from the horizontal line as shown.

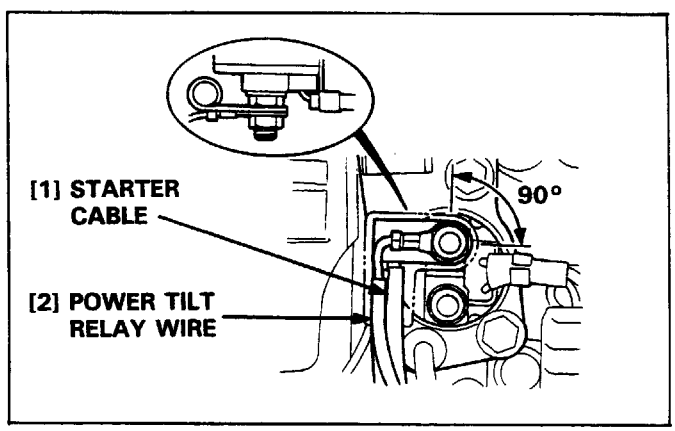


3) Connect the starter cable at the angle of 90° from the vertical line as shown.

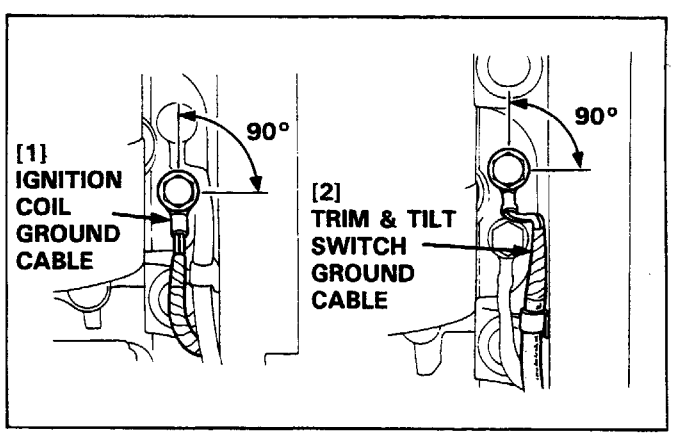


4) Connect the starter cable and the power tilt relay wire at the angle of 90° from the vertical line as shown.

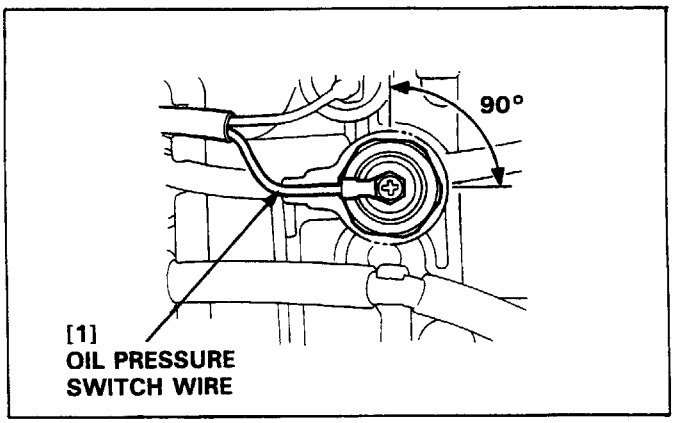
TORQUE: 5 N·m (0.5 kg-m, 3.6 ft-lb)



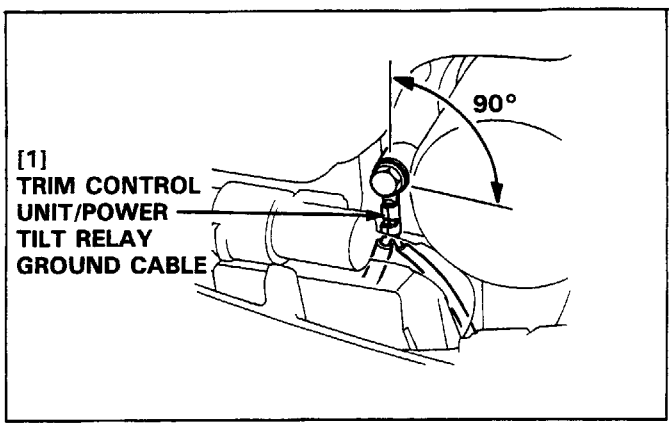
5) Connect the ignition coil ground cable and the power trim & tilt switch ground cable at the angle of 90° from the horizontal line as shown.



6) Connect the oil pressure switch wire at the angle of 90° from the vertical line as shown.

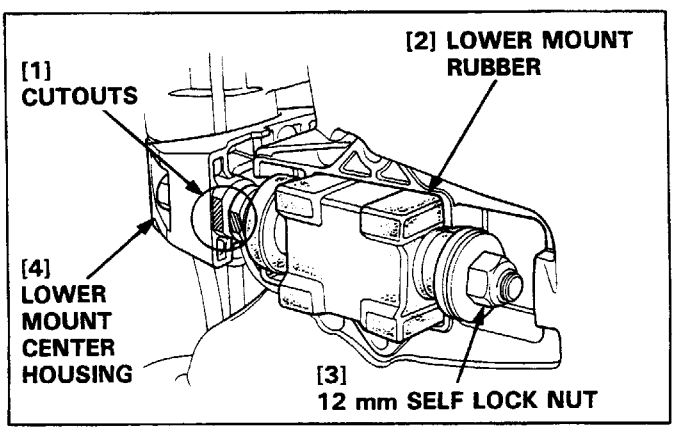


7) Connect the trim control unit/power tilt relay ground cable at the angle of 90° from the horizontal line as shown. (Remote control type only)



8) Align the cutouts on the lower mount rubber and the lower mount center housing for installation, and tighten the self lock nut securely.

TORQUE: 55 N·m (5.5 kg-m, 40.0 ft-lb)



TORQUE: Oil pan bolt
10 N·m (1.0 kg-m, 7.2 ft-lb)
Extension case bolt
22 N·m (2.2 kg-m, 15.9 ft-lb)
Lower mount housing bolt
22 N·m (2.2 kg-m, 15.9 ft-lb)

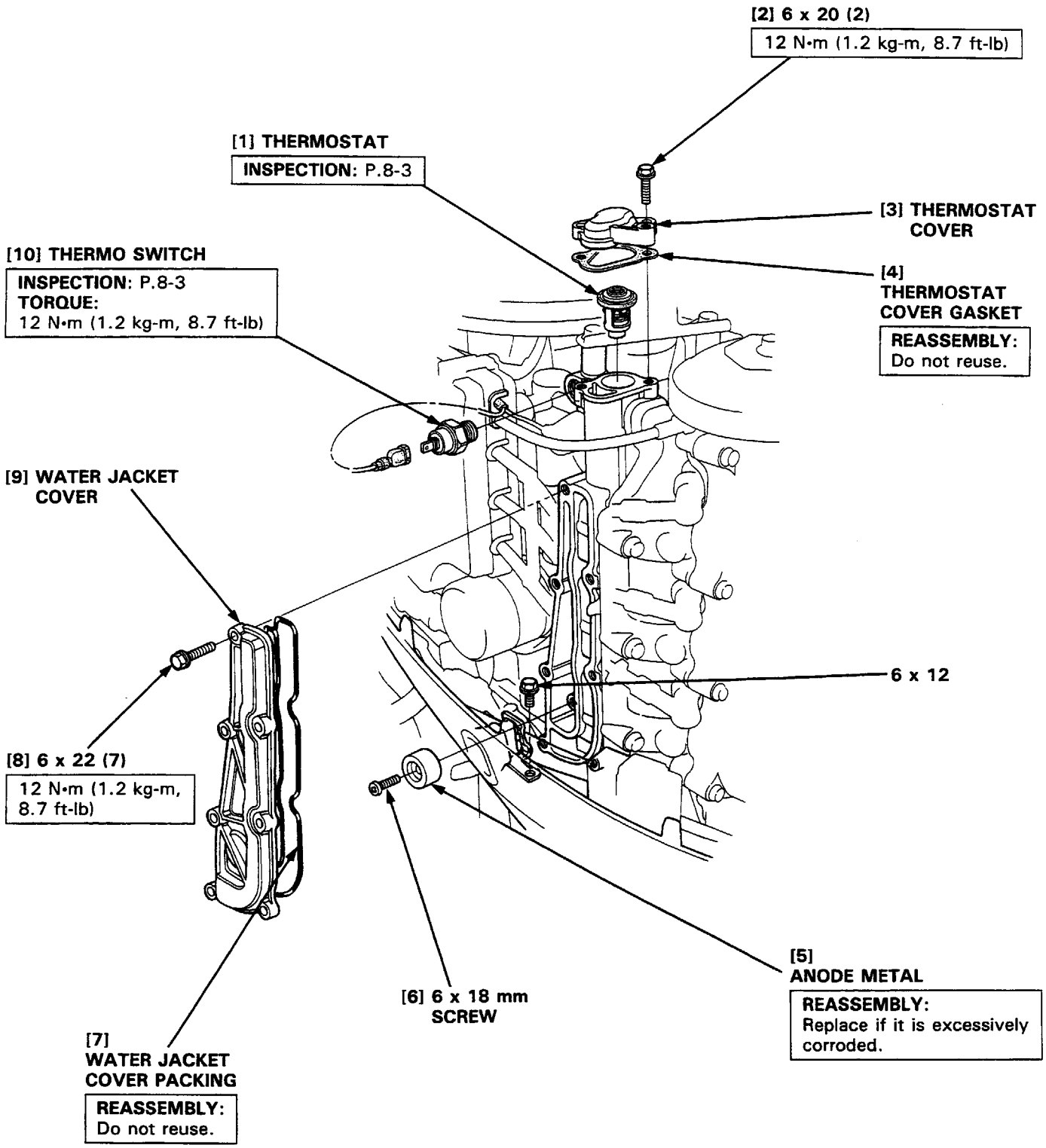
After installation, adjust the followings:
- Shift rod (P. 3-14)

WATER JACKET COVER/ THERMOSTAT/THERMO SWITCH

WATER JACKET COVER/THERMOSTAT/THERMO SWITCH

a. DISASSEMBLY/REASSEMBLY

1) Remove the engine cover.



b. INSPECTION

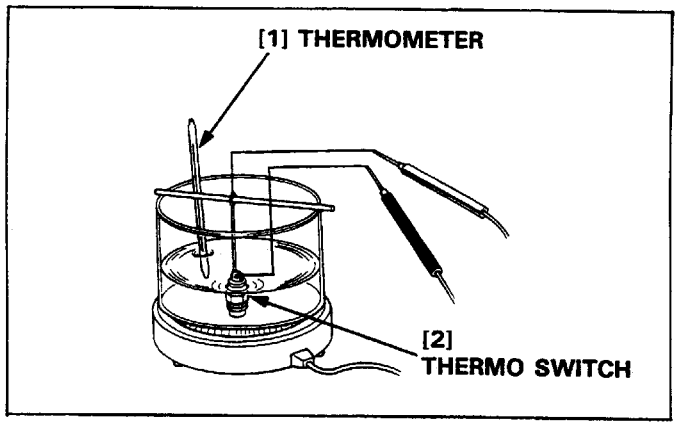
● THERMO SWITCH

1) Suspend the thermo switch in a container of coolant or oil. Be sure the switch does not touch the container.
2) Heat the liquid and note its temperature when the thermo switch closes and there is continuity between the thermo switch lead and body.

NOTE

• Don't allow the thermometer to touch the container.

Continuity (ON)	90 ± 2°C min.
No continuity (OFF)	3—7°C below the temperature when continuity exists.



● THERMOSTAT

1) Immerse the thermostat in water.
2) Heat the water and observe the operation of the thermostat as the water temperature increases.
3) Measure the water temperature when the thermostat starts opening.

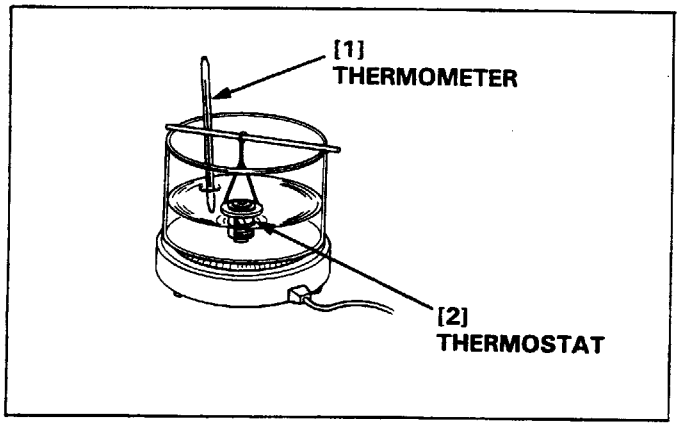
NOTE

• Don't let the thermometer or the thermostat touch the container; this may cause a false reading.

4) Measure lift height when fully open.

Start opening	52°C (126°F)
Fully open	62°C (144°F)

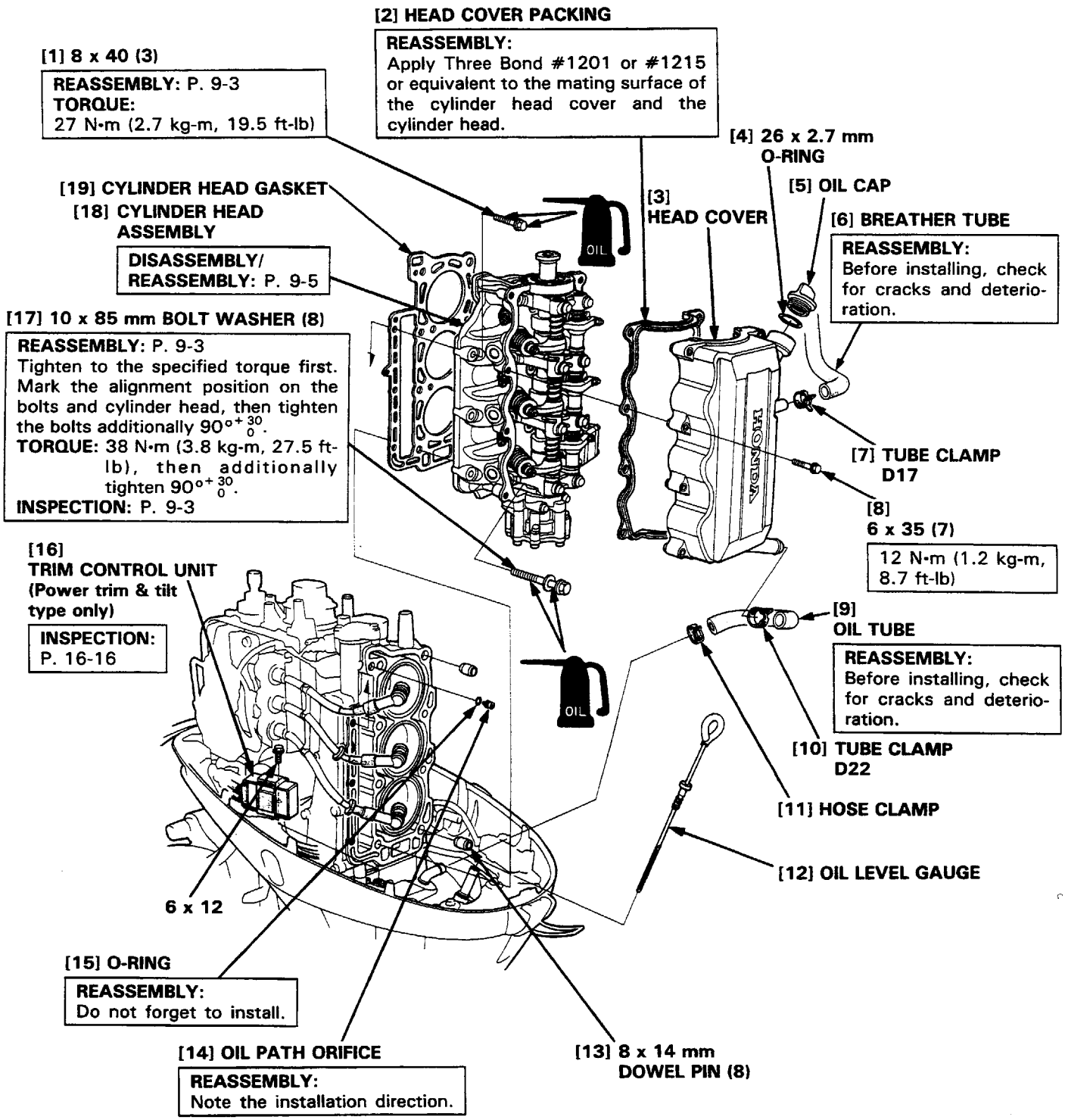
Lift height	More than 3.0 mm (0.12 in)



CYLINDER HEAD/VALVES/ OIL PUMP

REMOVAL/INSTALLATION

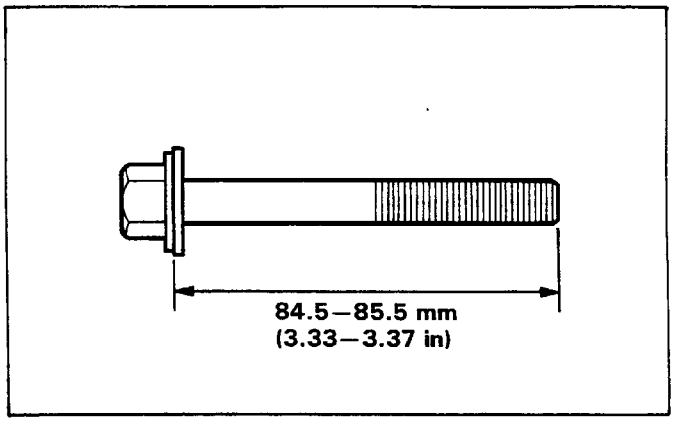
1) Remove the engine cover and the flywheel cover (P. 6-2).
2) Remove the pulser rotor and the pulser coil (P. 6-2).
3) Disconnect the breather tube from the silencer cover and the fuel tubes from the fuel pump (P. 7-2).
4) Remove the choke knob rod, linkage pivot and the carburetor assembly (P. 5-2 and 5-3).



• INSPECTION

10 x 85 mm BOLT WASHER
Measure bolt length. If not within service limit, replace the bolt.

STANDARD	SERVICE LIMIT
84.5–85.5 mm (3.33–3.37 in)	86.9 mm (3.42 in)

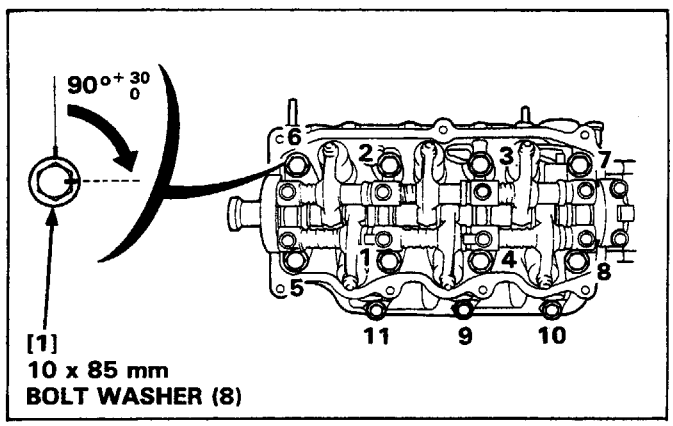


10 x 85 mm BOLT WASHER/8 x 40 mm FLANGE BOLT

REASSEMBLY:
Tighten the eight 10 x 85 mm bolt washers and the three 8 x 40 mm flange bolts to the specified torque in the numbered sequence shown in the drawing. After tightening the 10 x 85 mm bolt washers to the specified torque, mark the alignment position on the bolt washers and cylinder head, then tighten the bolt washers additionally $90°^{+30}_{0}$.

TORQUE:
10 x 85 mm bolt washer
38 N·m (3.8 kg-m, 27.5 ft-lb) then additionally tighten $90°^{+30}_{0}$.

8 x 40 mm flange bolt
27 N·m (2.7 kg-m, 19.5 ft-lb)

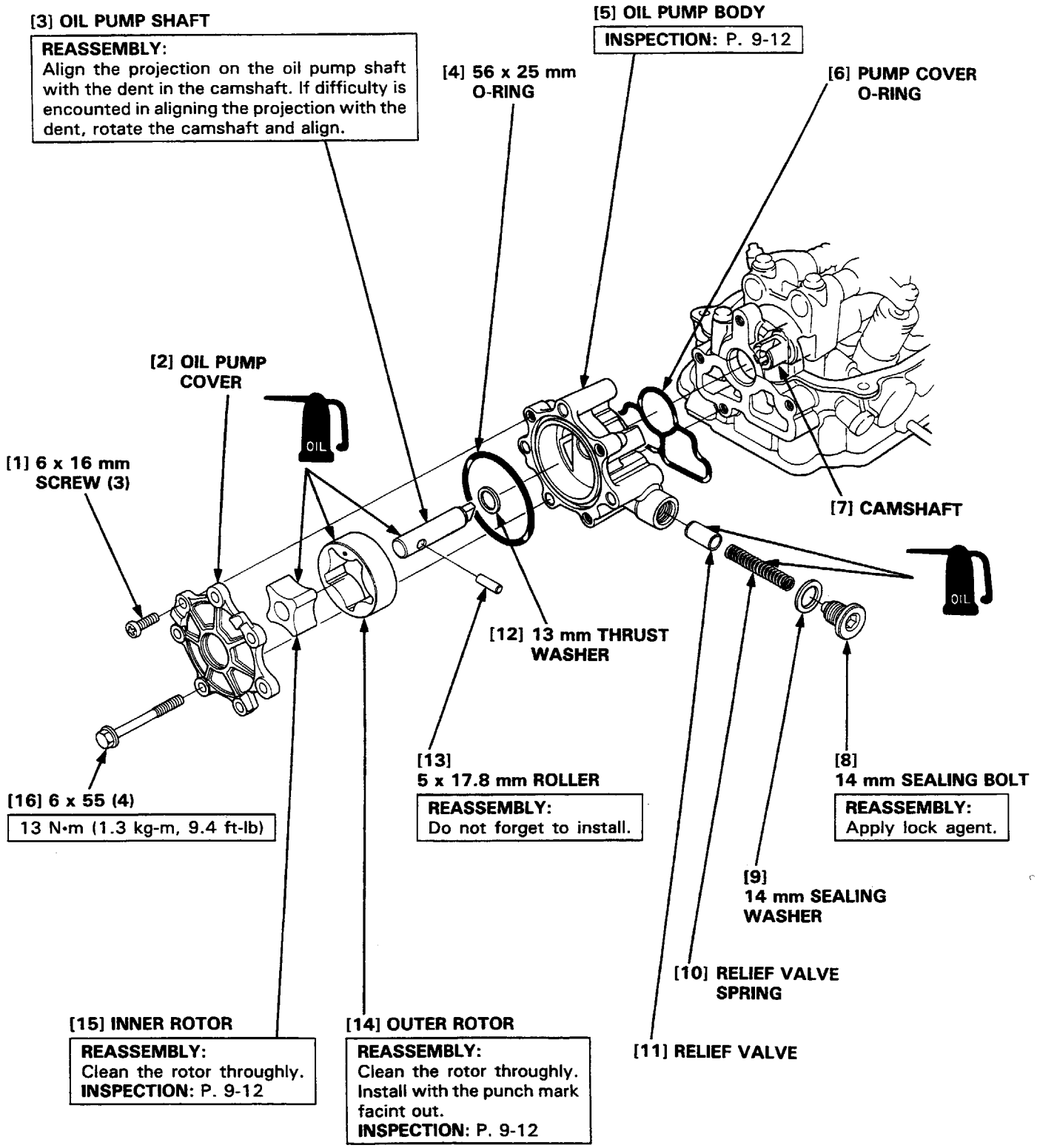


OIL PUMP

1) Remove the cylinder head assembly (P. 9-2).

NOTE

- After assembling the oil pump and before installing it on the cylinder head, pour approximately 5 cc (0.3 cu in) of oil into the oil pump body.

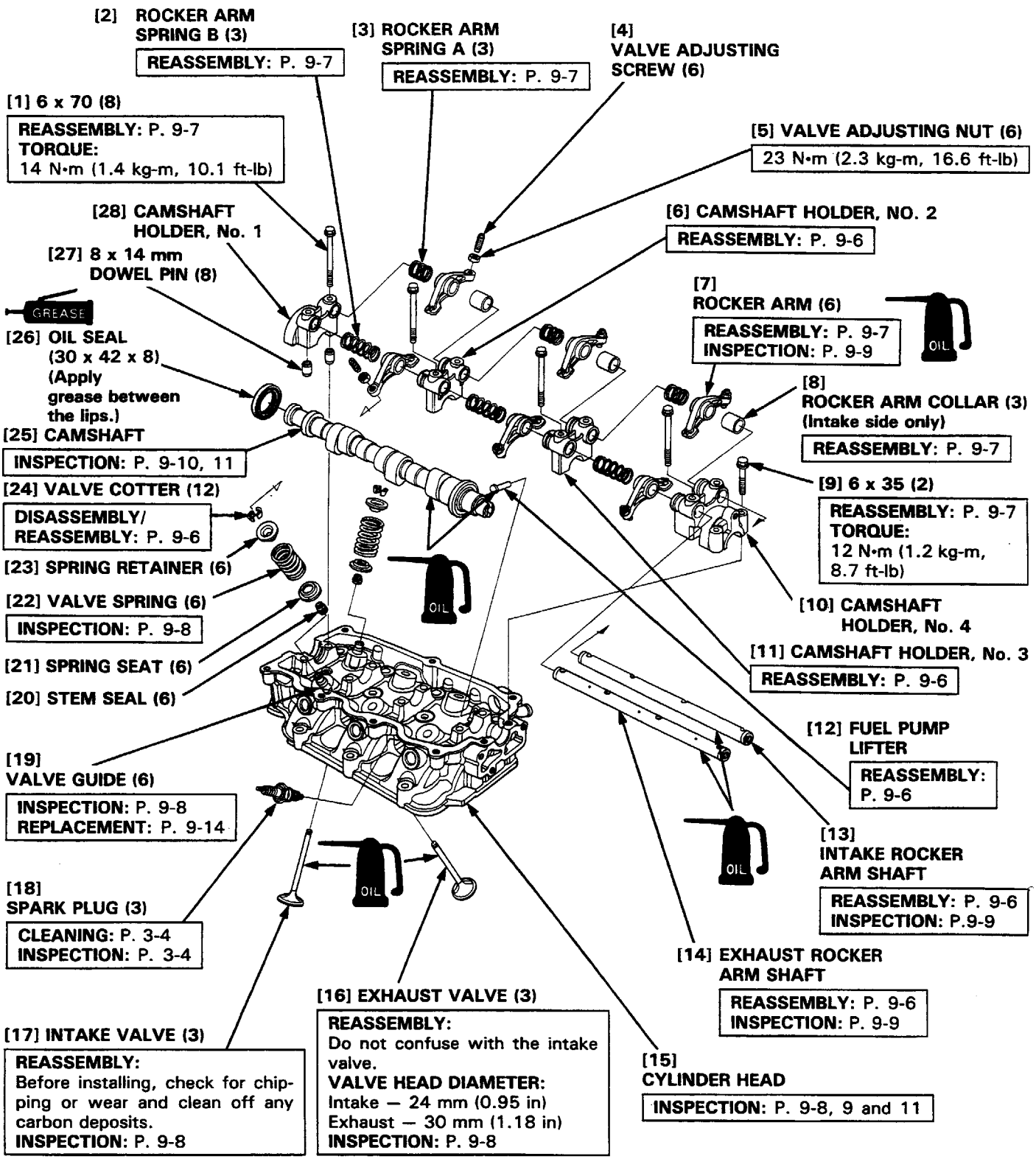


DISASSEMBLY/REASSEMBLY

1) Remove the cylinder head assembly (P.9-2).

NOTE

- Before installing the No. 1 and No. 4 cam holders, apply Three Bond #1141 or equivalent to the installation surfaces.

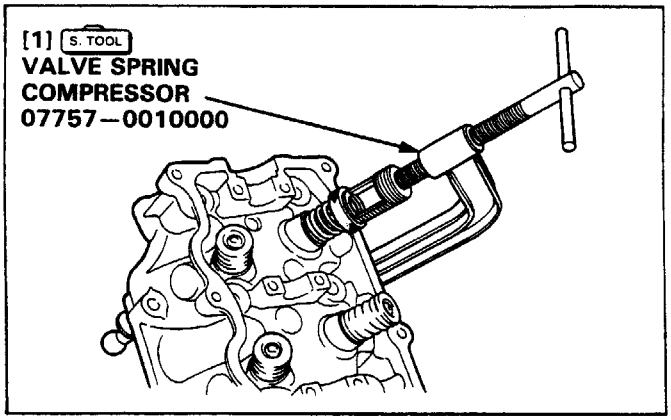


• VALVE COTTER

DISASSEMBLY/REASSEMBLY:
Use the special tool to compress the spring and install the cotters.
Make sure the cotters seat in the groove properly.

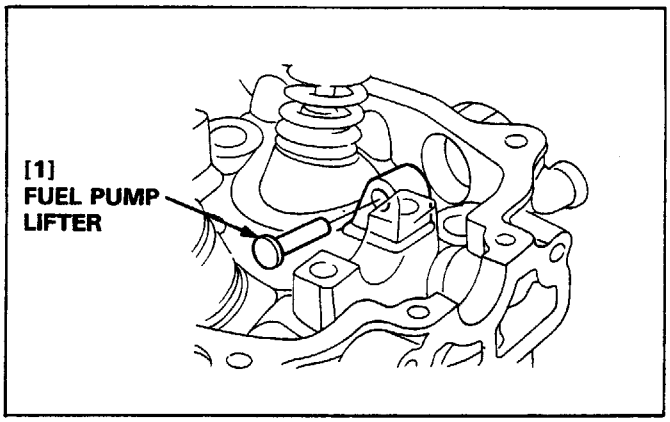
TOOL:

Valve spring compressor	**07757—0010000**



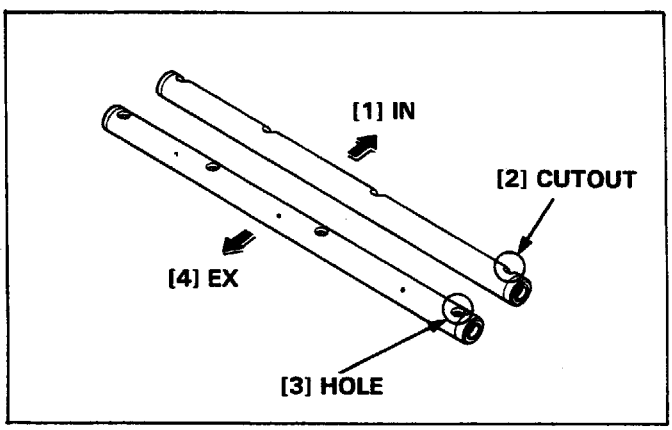
• FUEL PUMP LIFTER

REASSEMBLY:
Install the fuel pump lifter from inside of the cylinder head. Do not forget to install.



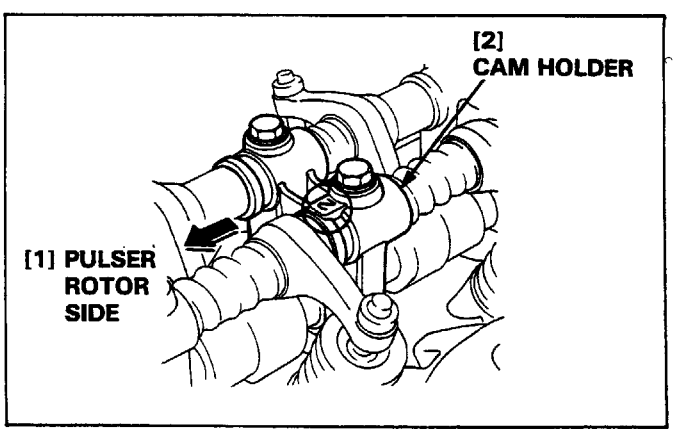
• ROCKER ARM SHAFT

REASSEMBLY:
Take care not to interchange the exhaust side rocker arm shaft with that of the intake side. Install the rocker arm shaft that has the hole in it on the exhaust side and the rocker arm shaft with the cutout in it on the intake side.



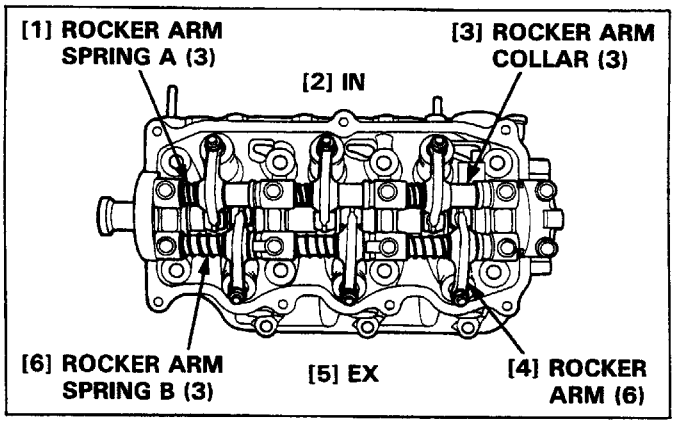
• CAM HOLDER, No. 2/No. 3

REASSEMBLY:
Install with the number of cam holder facing the pulser rotor side.



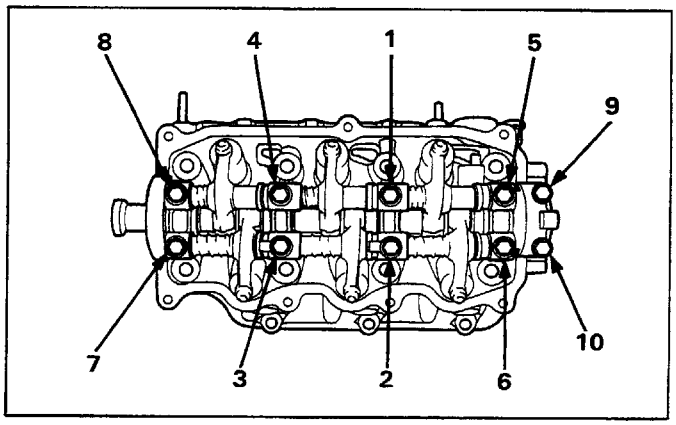
• ROCKER ARM/ROCKER ARM SPRING/ROCKER ARM COLLAR

REASSEMBLY:
Note the installation direction as shown.



• 6 x 70 mm/6 x 35 mm FLANGE BOLT

REASSEMBLY:
Tighten the eight 6 x 70 mm/two 6 x 35 mm flange bolts to the specified torque in the numbered sequence shown in the drawing.



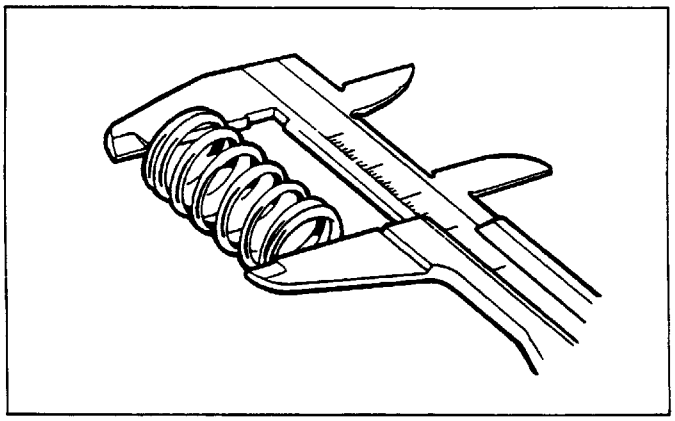
INSPECTION

• VALVE SPRING FREE LENGTH

Measure the free length of the valve springs.

	STANDARD	SERVICE LIMIT
IN/EX	36.9 mm (1.45 in)	35.4 mm (1.39 in)

Replace the springs if they are shorter than the service limit.

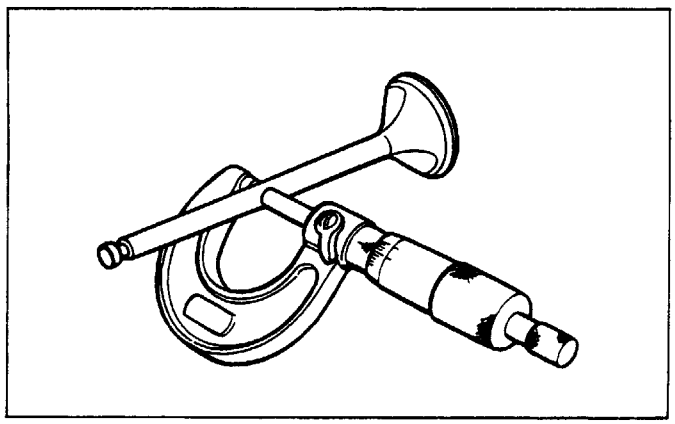


• VALVE STEM O.D.

Inspect each valve for face irregularities, bending or abnormal stem wear. Replace the valve if necessary.
Measure and record each valve stem O.D.

	STANDARD	SERVICE LIMIT
IN	5.480—5.490 mm (0.2157—0.2161 in)	5.45 mm (0.215 in)
EX	5.460—5.470 mm (0.2150—0.2154 in)	5.42 mm (0.213 in)

Replace the valves if their O.D. is smaller than the service limit.



• VALVE GUIDE I.D.

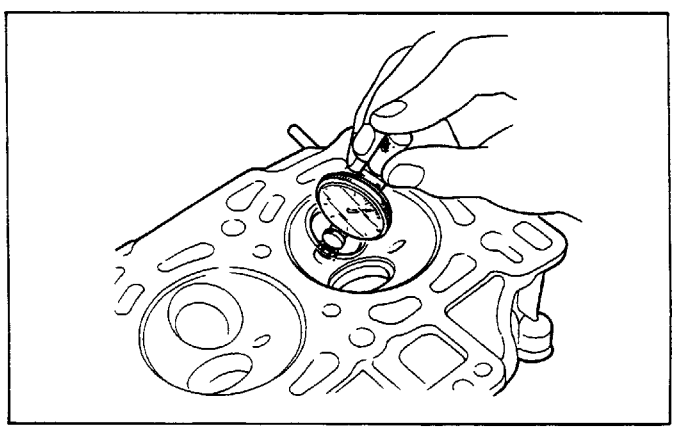
NOTE

- Ream the valve guides to remove any carbon deposits before measuring.

Measure and record each valve guide I.D.

	STANDARD	SERVICE LIMIT
IN/ EX	5.500—5.512 mm (0.2165—0.2170 in)	5.53 mm (0.218 in)

Replace the guides if they are over the service limit.



• GUIDE-TO-STEM CLEARANCE

Subtract each valve stem O.D. from the corresponding guide clearance.

	STANDARD	SERVICE LIMIT
IN	0.010—0.032 mm (0.0004—0.0013 in)	0.06 mm (0.0024 in)
EX	0.030—0.052 mm (0.0012—0.0020 in)	0.10 mm (0.004 in)

If the stem-to-guide clearance exceeds the service limit, determine if the new guide with standard dimensions would bring the clearance within tolerance. If so, replace any guide as necessary and ream to fit. If the stem-to-guide clearance exceeds the service limit with new guides, replace the valves as well.

NOTE

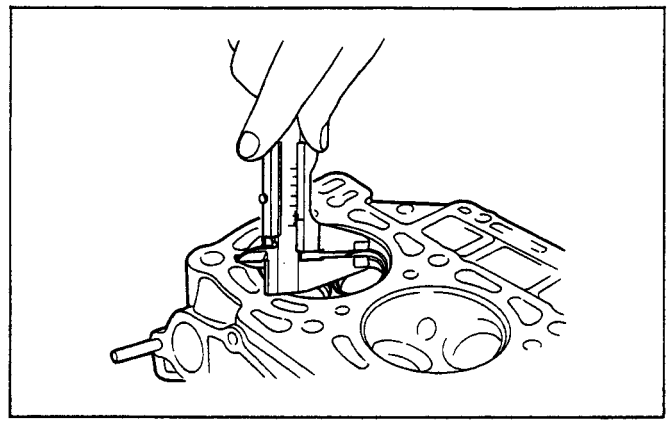
- Recondition the valve seats whenever the valve guides are replaced.

• VALVE SEAT WIDTH

Measure the valve seat width.

	STANDARD	SERVICE LIMIT
IN/ EX	1.25—1.55 mm (0.049—0.061 in)	2.0 mm (0.08 in)

If the valve seat width is under the standard, or over the service limit, recondition the valve seat. See page 9-15.

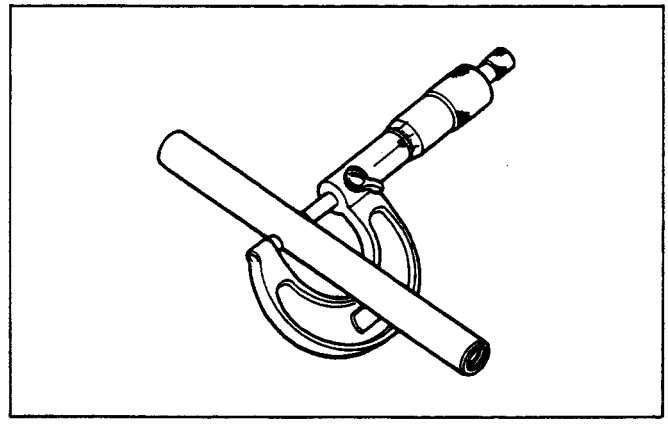


• ROCKER ARM SHAFT O.D.

Measure the O.D. of the rocker arm shaft.

STANDARD	SERVICE LIMIT
13.976—13.994 mm (0.5502—0.5509 in)	13.95 mm (0.549 in)

Replace the rocker arm shaft if its O.D. is smaller than the service limit.

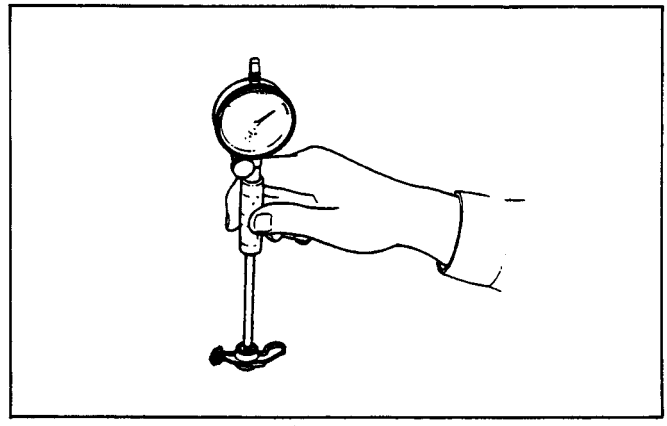


• ROCKER ARM I.D.

Measure the I.D. of the rocker arm.

STANDARD	SERVICE LIMIT
14.010—14.028 mm (0.5516—0.5523 in)	14.05 mm (0.553 in)

Replace the rocker arms if their I.D. is larger than the service limit.
Also check the rocker arm slipper surface for any wear or scraches.



• ROCKER ARM SHAFT-TO-ROCKER ARM CLEARANCE

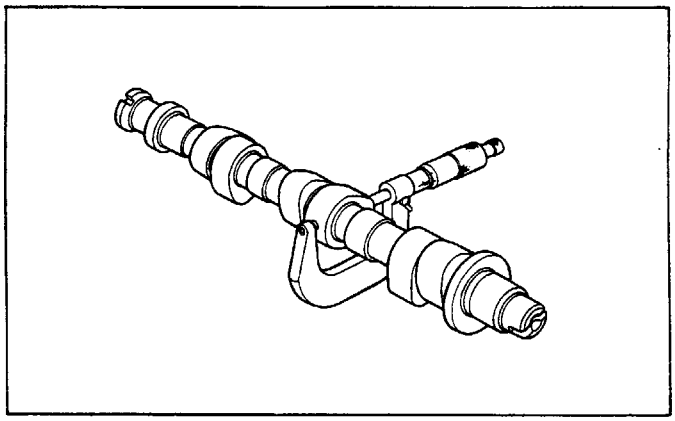
STANDARD	SERVICE LIMIT
0.016—0.052 mm (0.0006—0.0020 in)	0.07 mm (0.003 in)

• CAM HEIGHT

Measure the cam height.

	STANDARD	SERVICE LIMIT
IN	34.928–35.248 mm (1.3751–1.3877 in)	34.708 mm (1.3665 in)
EX	34.973–35.293 mm (1.3769–1.3895 in)	34.753 mm (1.3682 in)

Replace the camshaft if the cam height is lower than the service limit.

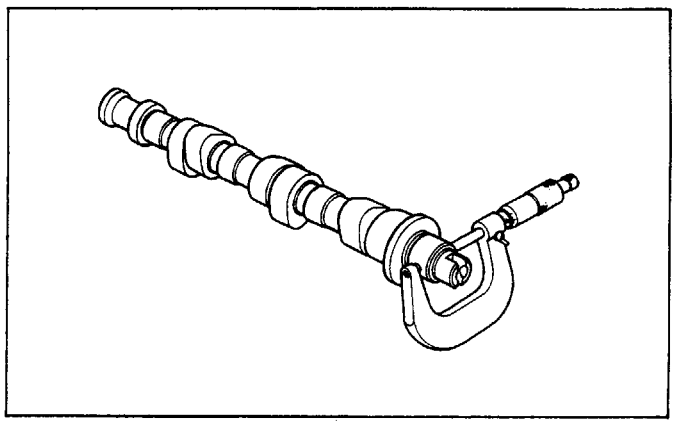


• CAMSHAFT JOURNAL O.D.

Measure the camshaft O.D.

STANDARD	SERVICE LIMIT
22.959–22.980 mm (0.9039–0.9047 in)	22.93 mm (0.903 in)

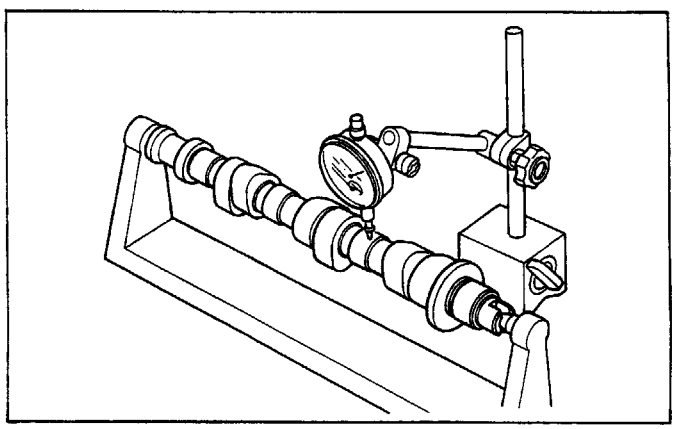
Replace the camshaft if its O.D. is smaller than the service limit.



• CAMSHAFT RUNOUT

STANDARD	SERVICE LIMIT
0.03 mm (0.0012 in) Max.	0.05 mm (0.0019 in)

Camshaft runout is half of maximum gauge reading.

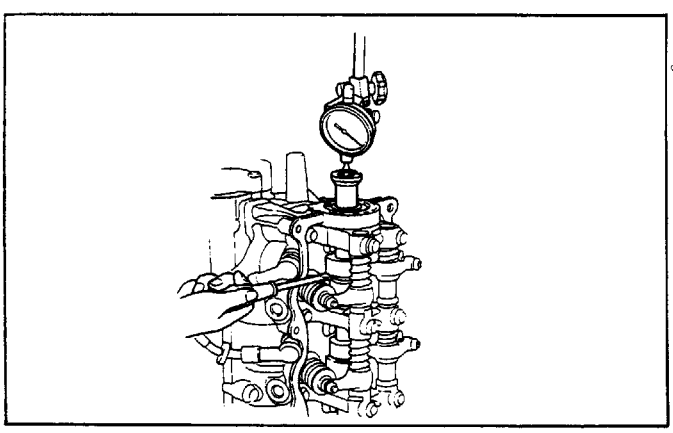


• CAMSHAFT AXIAL CLEARANCE

Measure the camshaft axial runout before removing the cylinder head from the cylinder block.
Loosen the valve adjusting lock nuts and back off the valve adjusting screws before inspection.

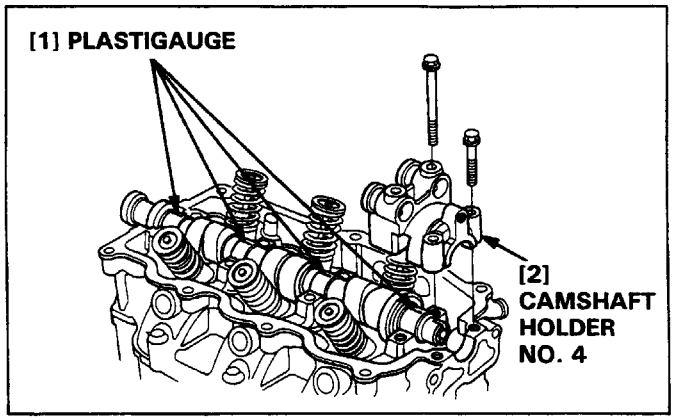
STANDARD	SERVICE LIMIT
0.03–0.11 mm (0.0012–0.0043 in)	0.3 mm (0.012 in)

Install the new camshaft and recheck the axial clearance.
If it exceeds the service limit, replace the cylinder head.



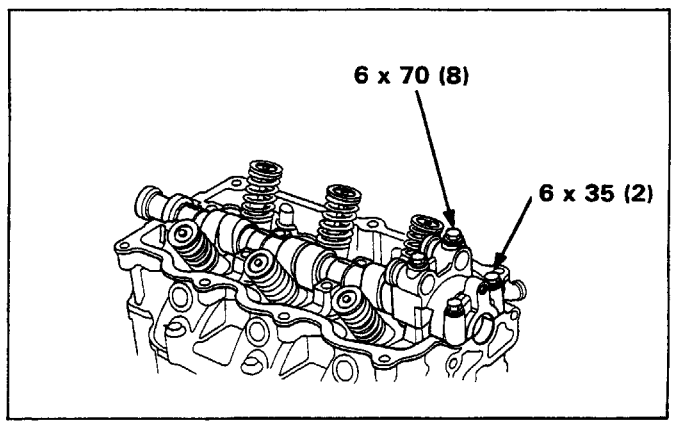
• CAMSHAFT OIL CLEARANCE

1) Set plastigauge axially on each camshaft journal.
2) Install the camshaft holders, No. 1, 2, 3 and 4, and each 8 x 14 mm dowel pins.



3) Tighten the 6 x 70 mm flange bolts and 6 x 35 mm flange bolts to the specified torque.

TORQUE:
6 x 70 mm flange bolts
14 N·m (1.4 kg-m, 10.1 ft-lb)
6 x 35 mm flange bolts
12 N·m (1.2 kg-m, 8.7 ft-lb)



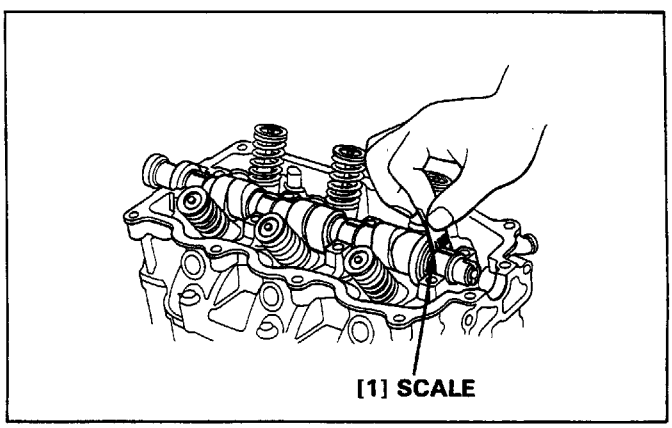
CAUTION

- **Do not rotate the shaft while tightening bolts. Tighten inner bolts first, then outer side with the same torque value.**

4) Remove the camshaft holder No. 1, 2, 3 and 4, and check the width of each plastigauge using a scale. Measure the width at its widest point.

STANDARD	SERVICE LIMIT
0.020—0.065 mm (0.0008—0.0026 in)	0.08 mm (0.003 in)

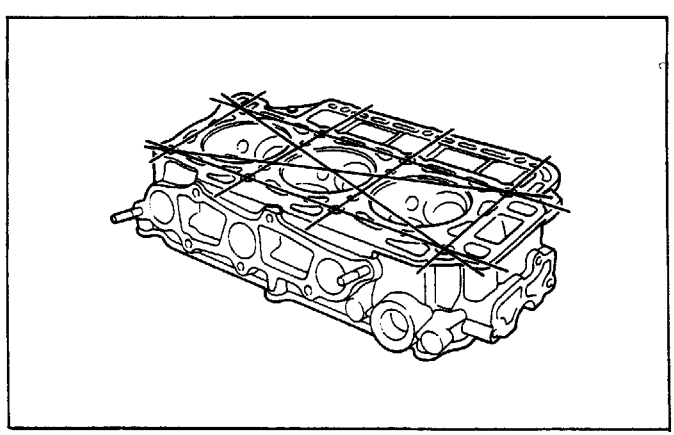
5) Replace the camshaft if the oil clearance exceeds the service limit.
6) Install a new camshaft and measure the oil clearance. if the oil clearance still exceeds the service limit, replace the cylinder head.



• CYLINDER HEAD

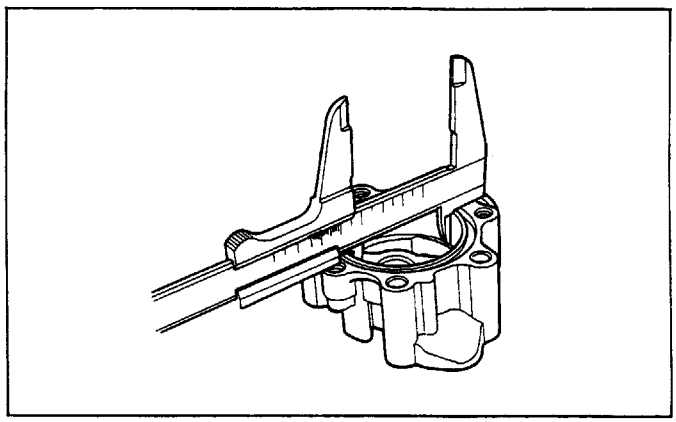
Remove carbon deposits from the combustion chamber. Clean off any gasket material from the cylinder head surface.
Check the spark plug holes and valve areas for cracks. Check the cylinder head for warpage with a straight edge and a feeler gauge.

Service limit	0.1 mm (0.004 in)



• **PUMP BODY I.D.**

STANDARD	SERVICE LIMIT
50.15—50.18 mm (1.974—1.975 in)	50.20 mm (1.976 in)

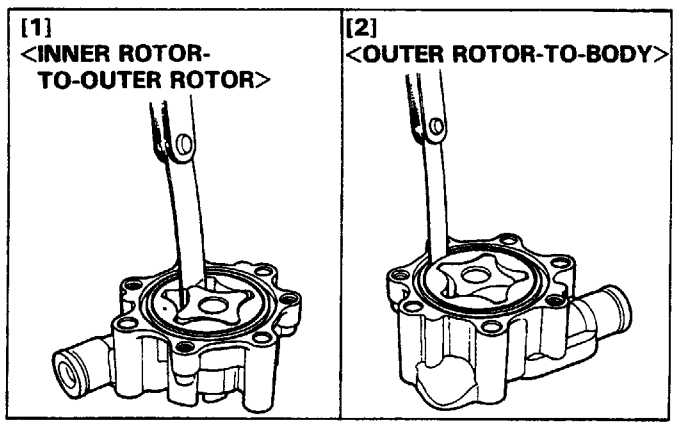


• **INNER ROTOR-TO-OUTER ROTOR CLEARANCE**

STANDARD	SERVICE LIMIT
0.15 mm (0.006 in) Max.	0.20 mm (0.0079 in)

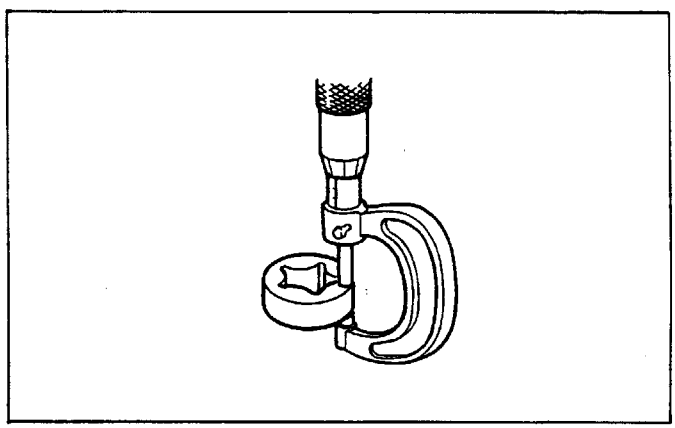
• **OUTER ROTOR-TO-BODY CLEARANCE**

STANDARD	SERVICE LIMIT
0.15—0.22 mm (0.006—0.009 in)	0.26 mm (0.0102 in)



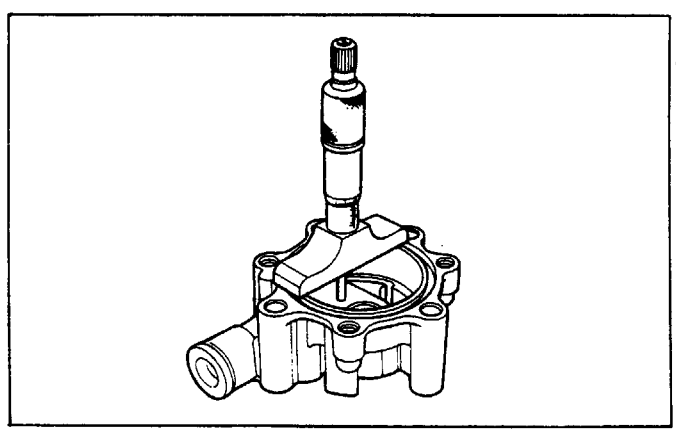
• **OUTER ROTOR HEIGHT**

STANDARD	SERVICE LIMIT
16.98—17.0 mm (0.6685—0.6693 in)	16.93 mm (0.667 in)



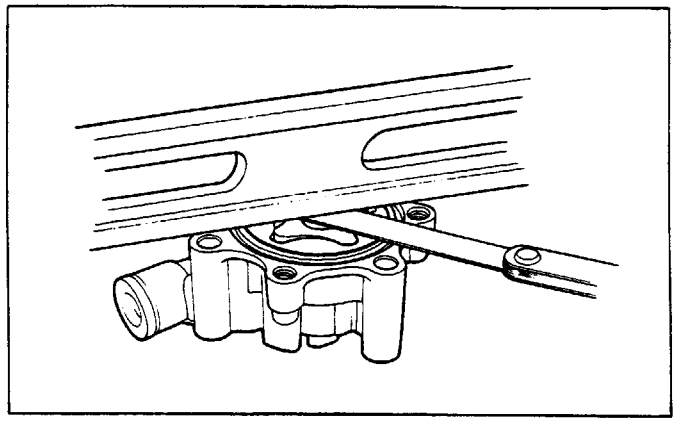
• **PUMP BODY DEPTH**

STANDARD	SERVICE LIMIT
17.02—17.05 mm (0.670—0.671 in)	17.09 mm (0.673 in)



• **PUMP END CLEARANCE**

STANDARD	SERVICE LIMIT
0.02—0.07 mm (0.0008—0.0028 in)	0.1 mm (0.004 in)

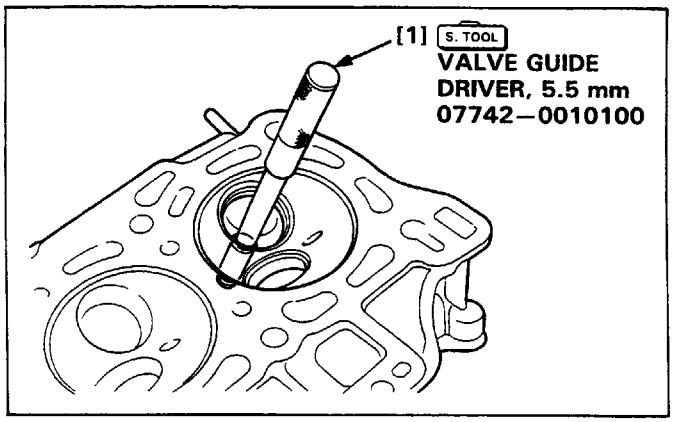


VALVE GUIDE REPLACEMENT

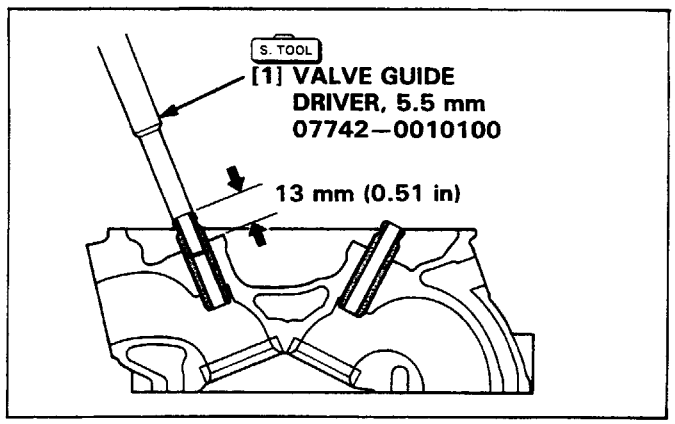
1) Chill the replacement valve guides in the freezer section of a refrigerator for about an hour.
2) Drive the valve guide out of the combustion chamber side using a valve guide driver (special tool).

CAUTION

- **When driving the valve guides out, be careful not to damage the head.**



3) Remove the new valve guides from the refrigerator one at a time as needed.
4) Install the new valve guides from the valve spring side of the cylinder head. Drive each valve guide as shown.
5) After installation, inspect the valve guide for damage. Replace the guide if damaged.

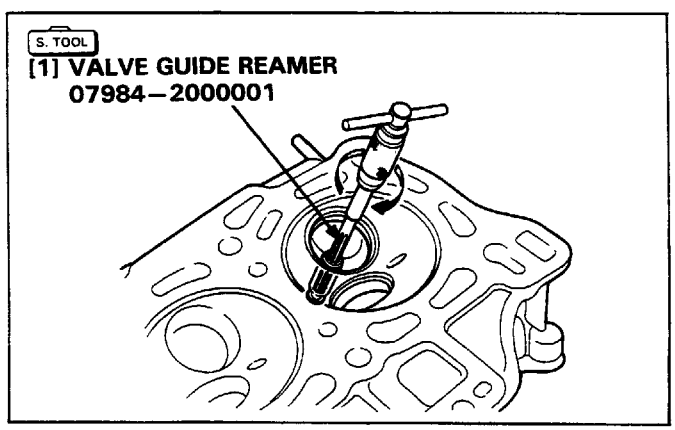


• VALVE GUIDE REAMING

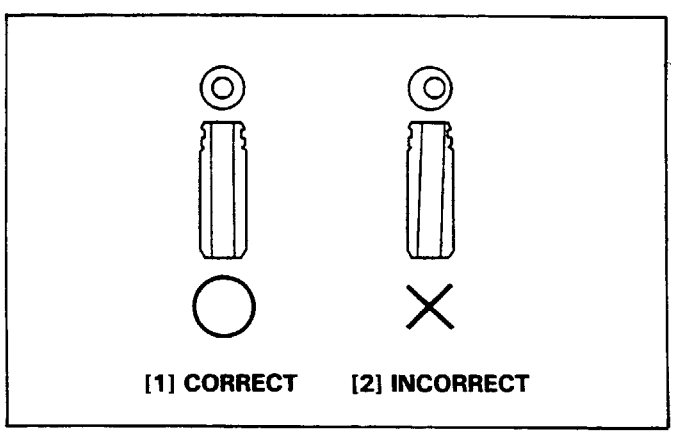
NOTE

- For best results, be sure the cylinder head is at room temperature before reaming valve guides.

1) Coat the reamer and valve guide with cutting oil.
2) Rotate the reamer clockwise through the valve guide the full length of the reamer.
3) Continue to rotate the reamer clockwise while removing it from the valve guide.



4) Throughly clean the cylinder head to remove any cutting residue.
5) Check the valve guide bore; it should be straight, round and centered in the valve guide, insert the valve and check operation. If the valve does not operate smoothly, the guide may have been bent during installation. Replace the valve guide if it is bent or damaged.
6) Check the Valve Guide-to-Stem Clearance. See page 9-8.

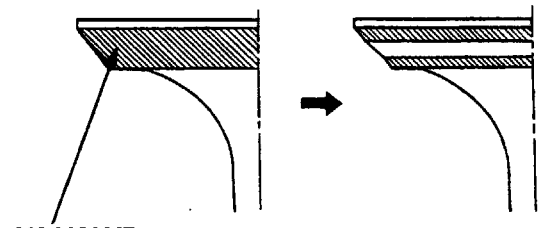


VALVE SEAT RECONDITIONING

1) Thoroughly clean the combustion chambers and valve seats to remove carbon deposits. Apply a light coat of Prussian Blue compound or erasable felt-tipped marker ink to the valve faces.
2) Insert the valves, and then lift them and snap them closed against their seats several times. Be sure the valve does not rotate on the seat. The transfered marking compound will show any area of the seat that is not concentric.

NOTE

- Follow Valve Seat Cutter Manufacturer's Instructions.

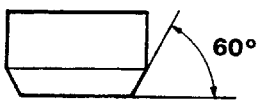


[1] VALVE FACE

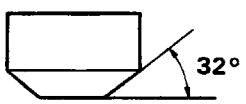
3) Using a 45° cutter, remove enough material to produce a smooth and concentric seat. Turn the cutter clockwise, never counterclockwise. Continue to turn the cutter as you lift it from the valve seat.

S. TOOL [1] CUTTER HOLDER
07781–0010101

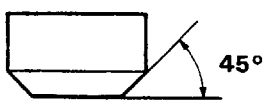
S. TOOL [2] VALVE SEAT CUTTERS



[3] IN: 07780–0014100
ϕ37.5
EX: 07780–0014000
ϕ30.0



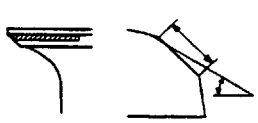
[4] IN: 07780–0012900
ϕ33.0
EX: 07780–0012200
ϕ30.0



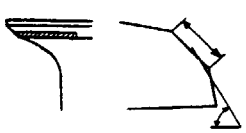
[5] IN: 07780–0010800
ϕ33.0
EX: 07780–0010300
ϕ29.0

4) Use the 30°–32° and 60° cutters to narrow and adjust the valve seat so that it contacts the middle of the valve face. The 30°–32° cutter removes material from the top edge. The 60° cutter removes material from the bottom edge. Be sure that the width of the finished valve seat is within specification.

[1] CONTACT TOO HIGH



[2] CONTACT TOO LOW



• VALVE SEAT WIDTH

STANDARD	SERVICE LIMIT
1.25—1.55 mm (0.049—0.061 in)	2.0 mm (0.08 in)

5) Make a light pass with 45° cutter to remove any possible burrs at the edges of the seat.

6) After resurfacing the seats, inspect for even valve seating. Apply Prussian Blue compound or erasable felt-tipped marker ink to the valve faces. Insert the valves, and then lift them and snap them closed against their seats several times. Be sure the valve does not rotate on the seat. The seating surface, as shown by the transfered marking compound, should have good contact all the way around.

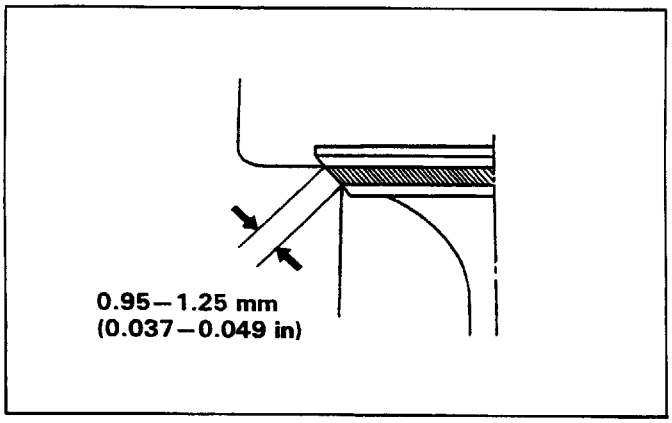
7) Lap the valves into their seats, using a hand valve lapper and lapping compound (commercially available).

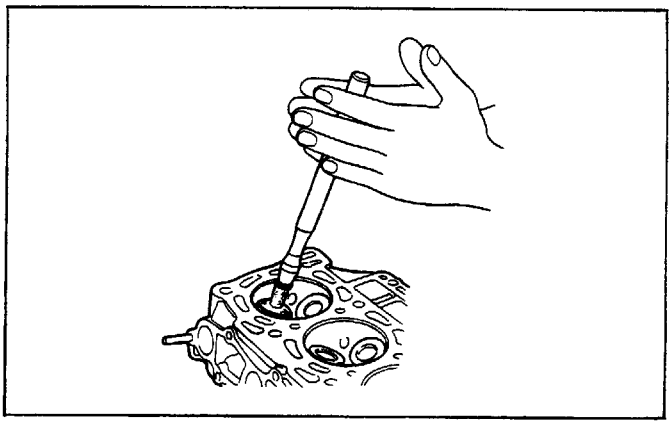
CAUTION

- **To avoid severe engine damage, be sure to remove all lapping compound from the engine before reassembly.**

NOTE

- Check valve clearance after reassembly.



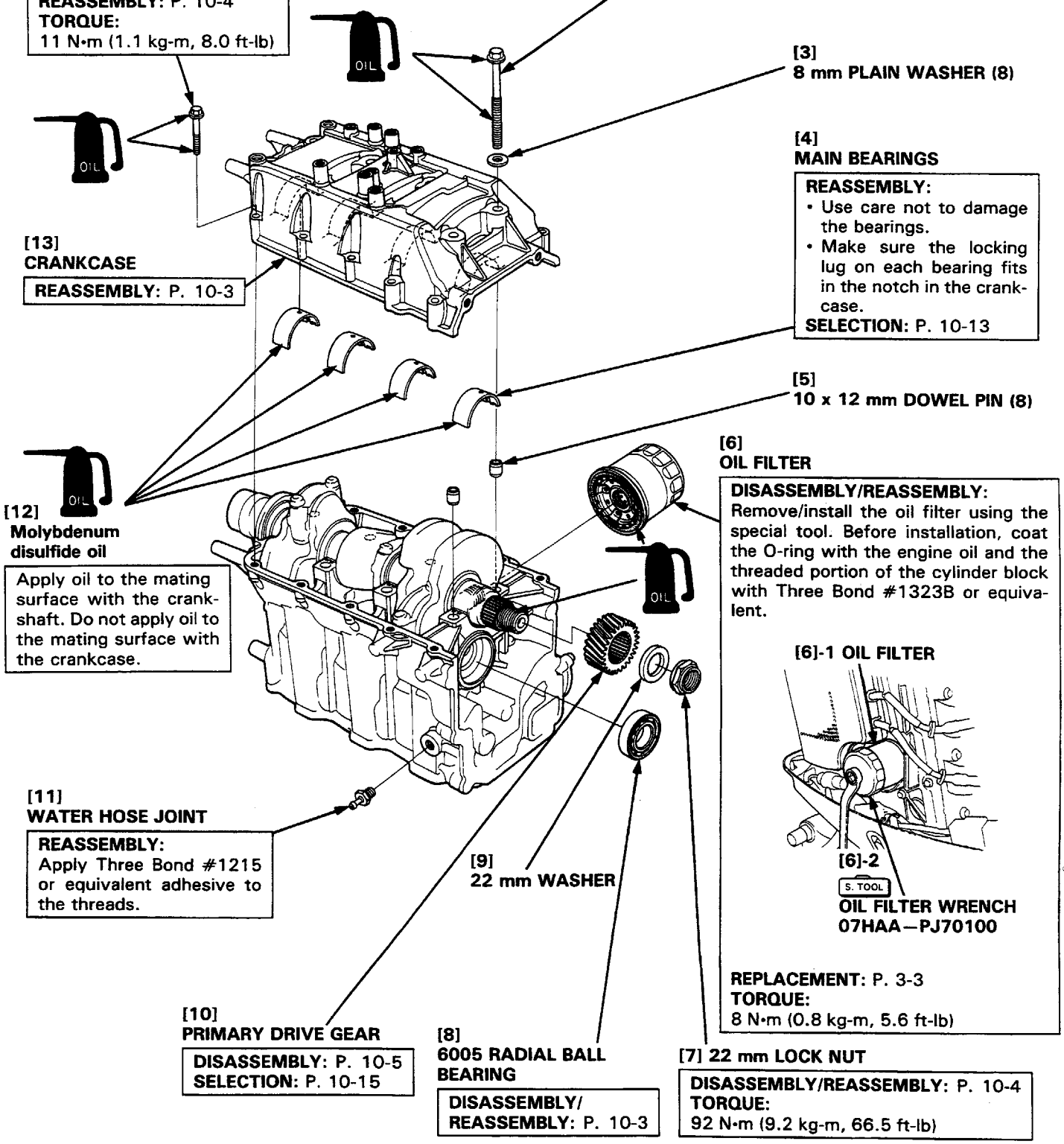


CRANKCASE/CYLINDER BLOCK/CRANKSHAFT/ PISTON

CRANKCASE

a. DISASSEMBLY/REASSEMBLY

1) Remove the engine (P.7-2)
2) Remove the cylinder head (P.9-2)



[1]
6 x 40 (10)

REASSEMBLY: P. 10-4
TORQUE:
11 N·m (1.1 kg-m, 8.0 ft-lb)

[2]
8 x 95 (8)

REASSEMBLY: P. 10-4
Apply locking agent and tighten to the specified torque. Mark the alignment position on the bolts and crankcase, then additionally tighten $90°^{+30}_{0}$.
TORQUE: 28 N·m (2.8 kg-m, 20.2 ft-lb), then additionally tighten $90°^{+30}_{0}$.
INSPECTION: P.10-3

[3]
8 mm PLAIN WASHER (8)

[4]
MAIN BEARINGS

REASSEMBLY:
- Use care not to damage the bearings.
- Make sure the locking lug on each bearing fits in the notch in the crankcase.

SELECTION: P. 10-13

[5]
10 x 12 mm DOWEL PIN (8)

[6]
OIL FILTER

DISASSEMBLY/REASSEMBLY:
Remove/install the oil filter using the special tool. Before installation, coat the O-ring with the engine oil and the threaded portion of the cylinder block with Three Bond #1323B or equivalent.

[6]-1 OIL FILTER

[6]-2
S. TOOL
OIL FILTER WRENCH
07HAA—PJ70100

REPLACEMENT: P. 3-3
TORQUE:
8 N·m (0.8 kg-m, 5.6 ft-lb)

[7] **22 mm LOCK NUT**

DISASSEMBLY/REASSEMBLY: P. 10-4
TORQUE:
92 N·m (9.2 kg-m, 66.5 ft-lb)

[8]
6005 RADIAL BALL BEARING

DISASSEMBLY/ REASSEMBLY: P. 10-3

[9]
22 mm WASHER

[10]
PRIMARY DRIVE GEAR

DISASSEMBLY: P. 10-5
SELECTION: P. 10-15

[11]
WATER HOSE JOINT

REASSEMBLY:
Apply Three Bond #1215 or equivalent adhesive to the threads.

[12]
Molybdenum disulfide oil

Apply oil to the mating surface with the crankshaft. Do not apply oil to the mating surface with the crankcase.

[13]
CRANKCASE

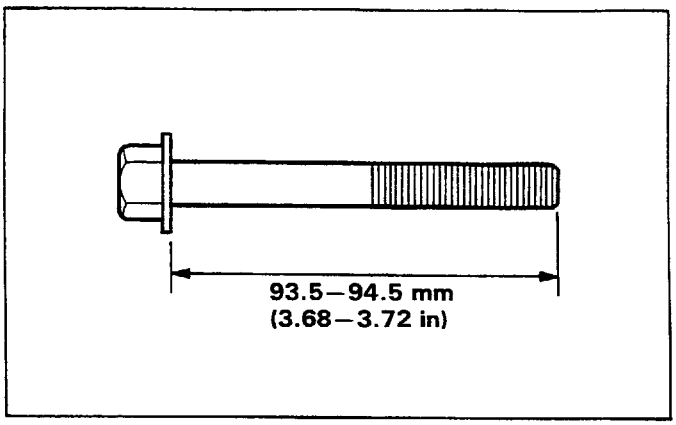
REASSEMBLY: P. 10-3

b. INSPECTION

• 8 x 95 mm FLANGE BOLT

Measure bolt length. If not within service limit, replace the bolt.

STANDARD	SERVICE LIMIT
93.5–94.5 mm (3.68–3.72 in)	95.4 mm (3.76 in)

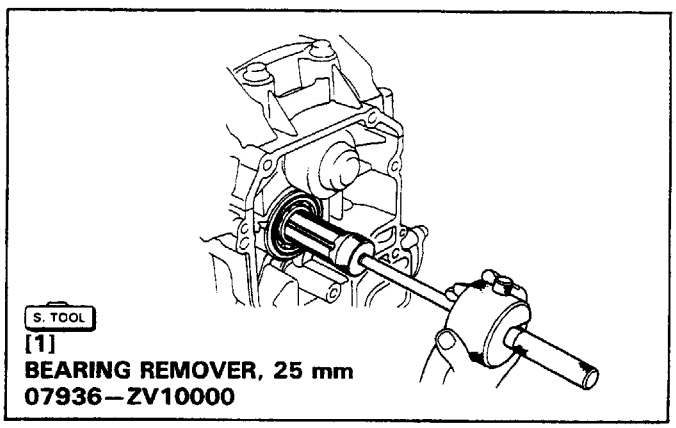


• 6005 RADIAL BALL BEARING

DISASSEMBLY:
Remove the 6005 radial ball bearing using the special tool.

TOOL:

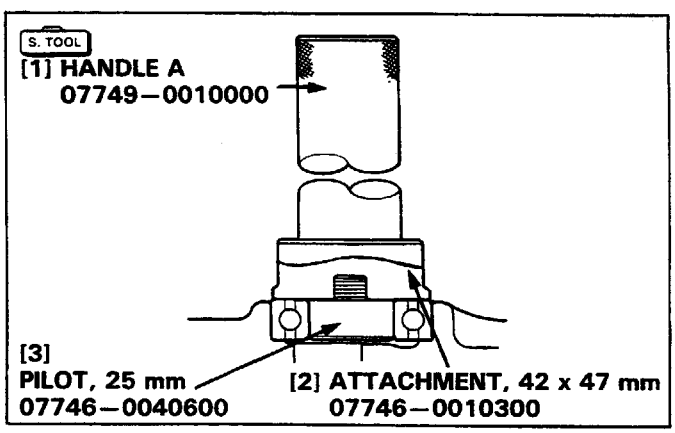
Bearing remover, 25 mm	**07936–ZV10000**



REASSEMBLY:
Install the 6005 radial ball bearing using the special tools.

TOOLS:

Handle A	**07749–0010000**
Attachment, 42 x 47 mm	**07746–0010300**
Pilot, 25 mm	**07746–0040600**

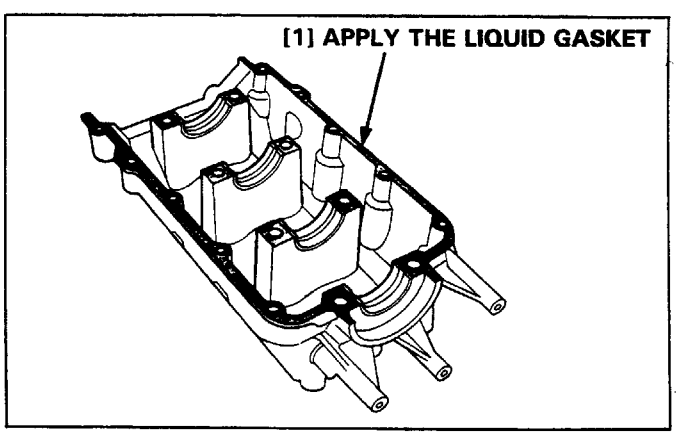


• CRANKCASE

REASSEMBLY:
Before installation, apply Three Bond #1141C or equivalent to the position shown in the drawing.

CAUTION

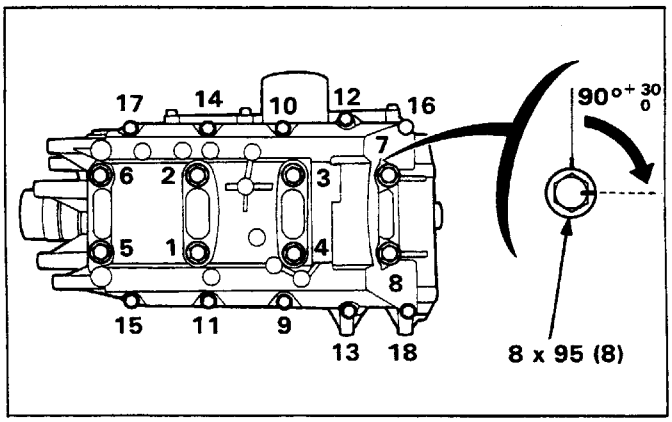
- **Do not apply the liquid gasket to the crankshaft journal and the bolt hole.**



• 8 x 95 mm/6 x 40 mm FLANGE BOLT

REASSEMBLY:
Tighten the eight 8 x 95 mm flange bolts and the ten 6 x 40 mm flange bolts to the specified torque in the numbered sequence shown in the drawing. After tightening the 8 x 95 mm flange bolts to the specified torque, mark the alignment position on the bolts and crankcase, then tighten the bolts additionally $90°^{+30}_{0}$.

TORQUE: 8 x 95 mm flange bolt 28 N·m (2.8 kg-m, 20.2 ft-lb), then additionally tighten $90°^{+30}_{0}$.
6 x 40 mm flange bolt
11 N·m (1.1 kg-m, 8.0 ft-lb)

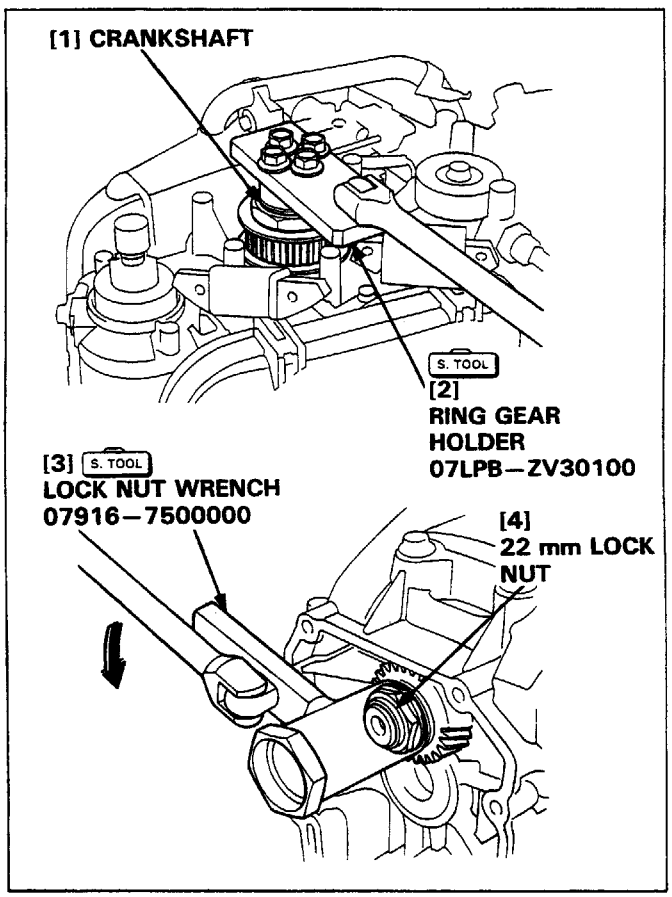


• 22 mm LOCK NUT

DISASSEMBLY/REASSEMBLY:
1) Hold the crankshaft using the special tool when removing/installing the 22 mm lock nut.
2) Remove the 22 mm lock nut by using the following special tools.

TOOLS:

Lock nut wrench	**07916—7500000**
Ring gear holder	**07LPB—ZV30100**

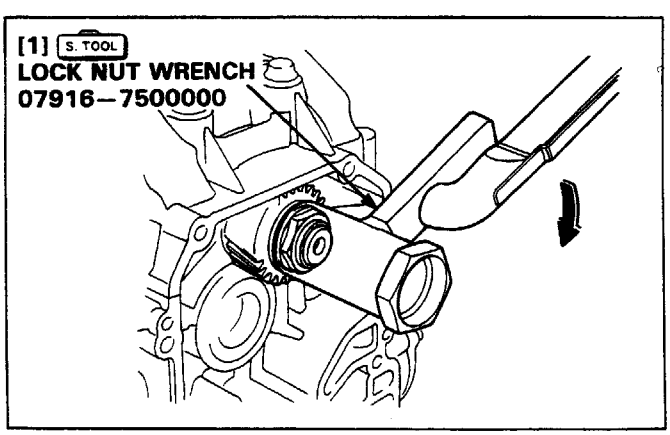


3) On installation, replace the lock nut with a new one. Install the 22 mm lock nut using the special tool.

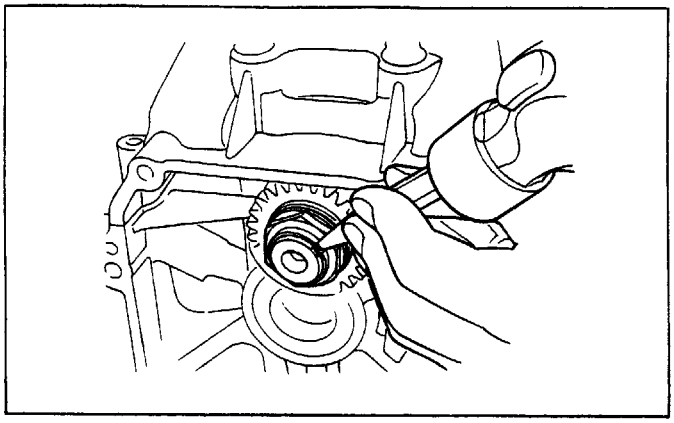
TOOL:

Lock nut wrench	**07916—7500000**

TORQUE: 92 N·m (9.2 kg-m, 66.5 ft-lb)

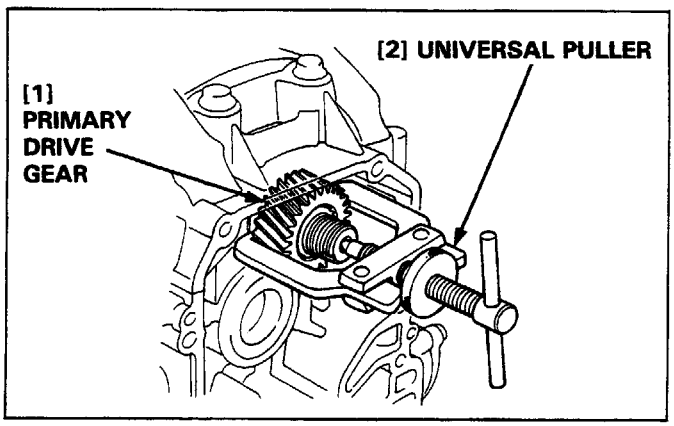


4) After installation, stake the lock nut by using the dent in the crankshaft.



• PRIMARY DRIVE GEAR

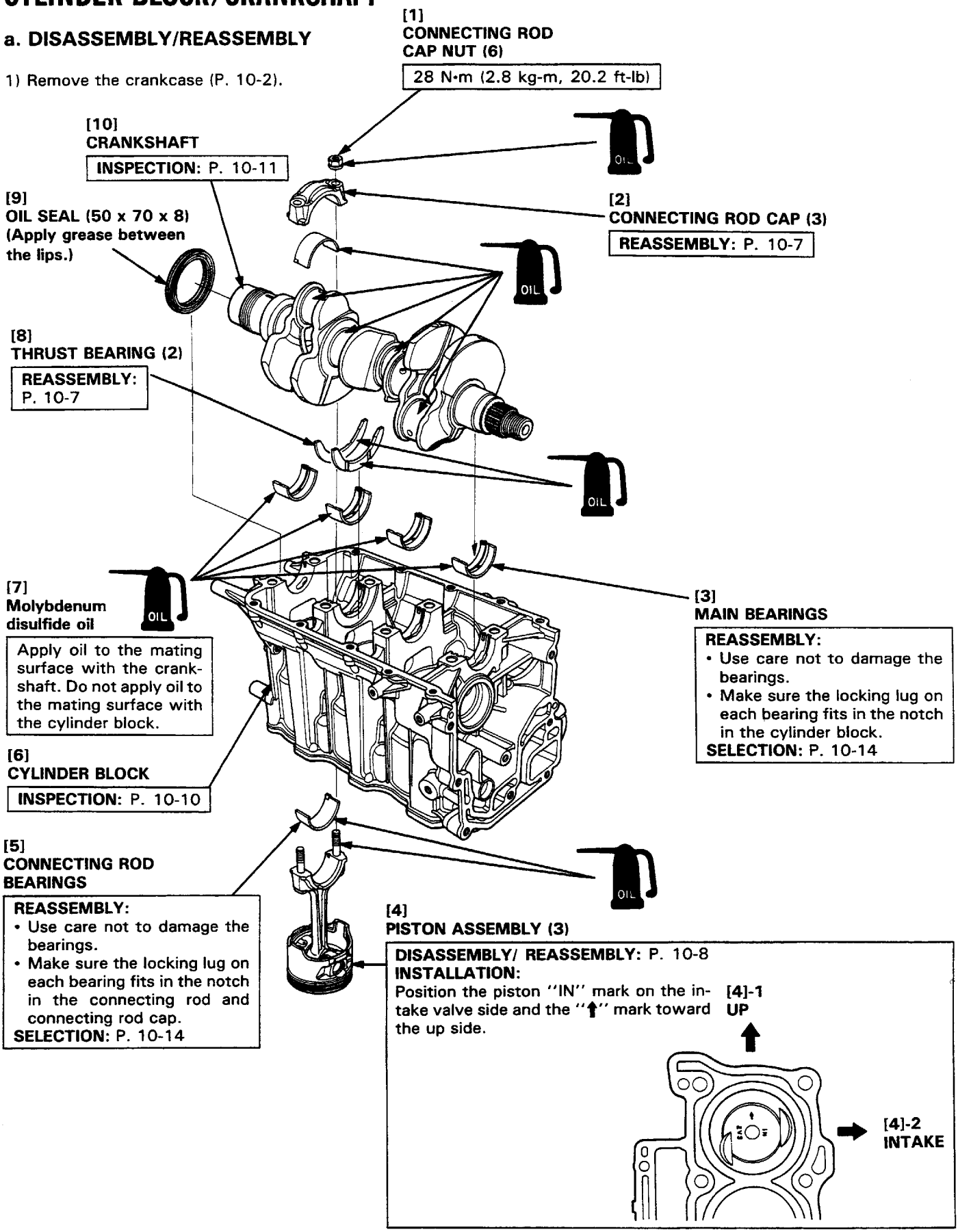
DISASSEMBLY:
Remove the primary drive gear using the universal puller.



CYLINDER BLOCK/CRANKSHAFT

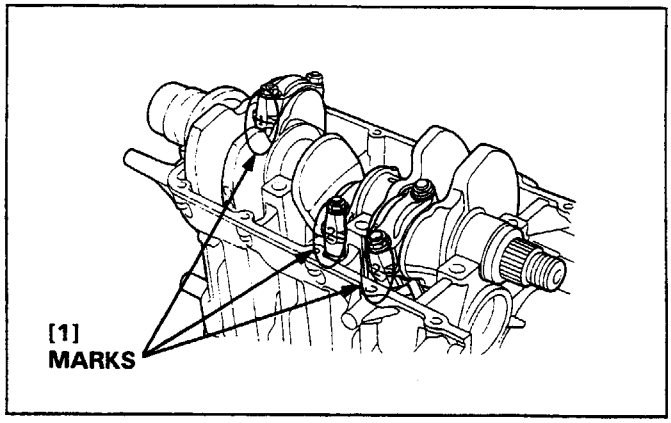
a. DISASSEMBLY/REASSEMBLY

1) Remove the crankcase (P. 10-2).



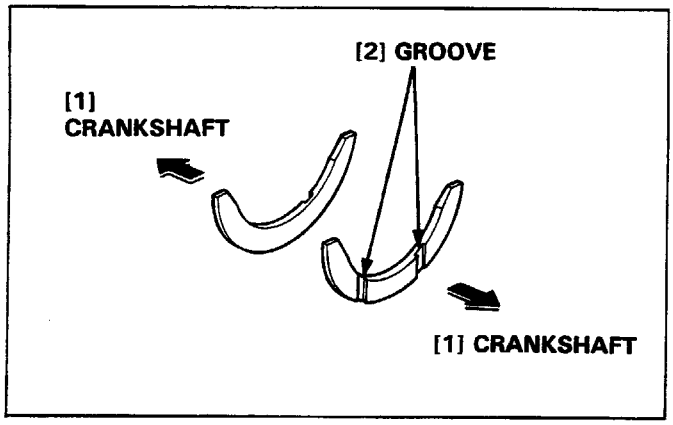
• CONNECTING ROD CAP

REASSEMBLY:
Install the connecting rod caps aligning the marks of the connecting rods and caps.



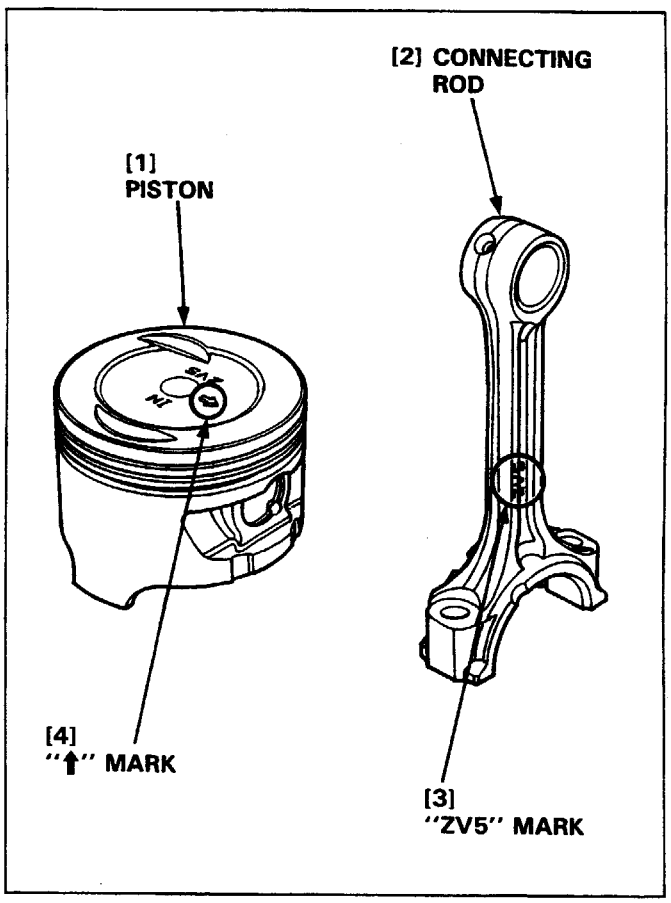
• THRUST BEARING

REASSEMBLY:
Install with the grooved side toward the crankshaft.



• PISTON/CONNECTING ROD

REASSEMBLY:
Assemble so that "⬆" mark on the piston points in the same direction as "ZV5" mark on the connecting rod.

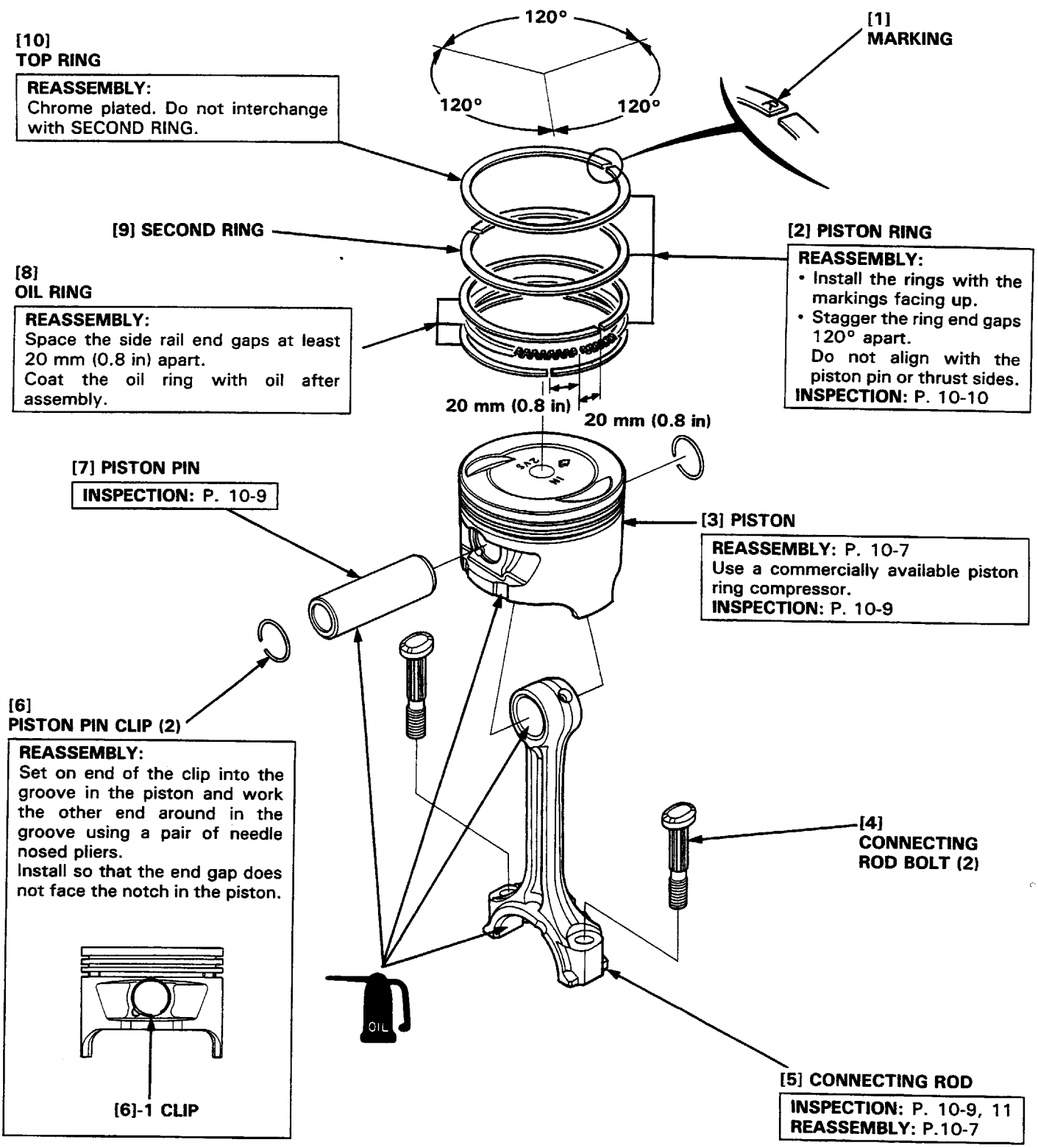


PISTON

a. DISASSEMBLY/REASSEMBLY

NOTE

- After installing pistons and connecting rods in the cylinder block, secure the rods to the crankshaft.



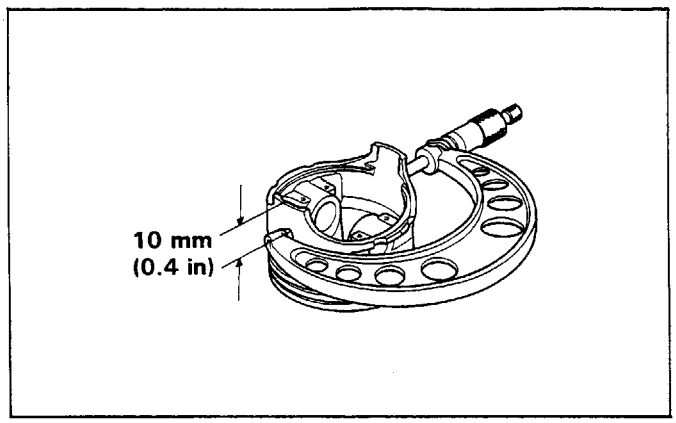
INSPECTION

For pistons, crankshaft, and cylinder inspection, measure the following. If needed, replace them.

• PISTON SKIRT O.D.

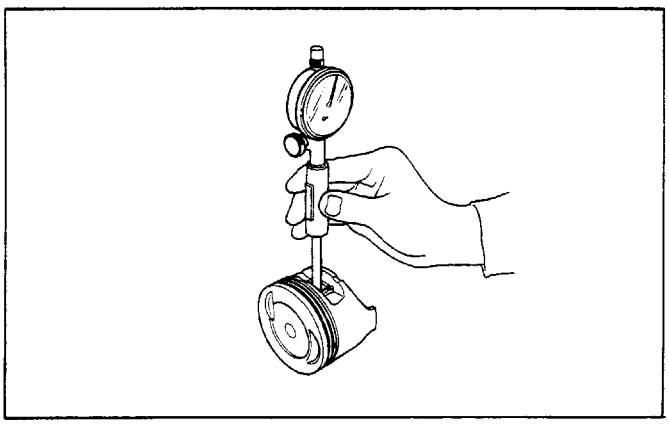
Measure and record the piston O.D. at a point 10 mm (0.4 in) from the bottom, and 90° to the piston pin bore.

STANDARD	SERVICE LIMIT
69.970—69.990 mm (2.7547—2.7555 in)	69.910 mm (2.7524 in)



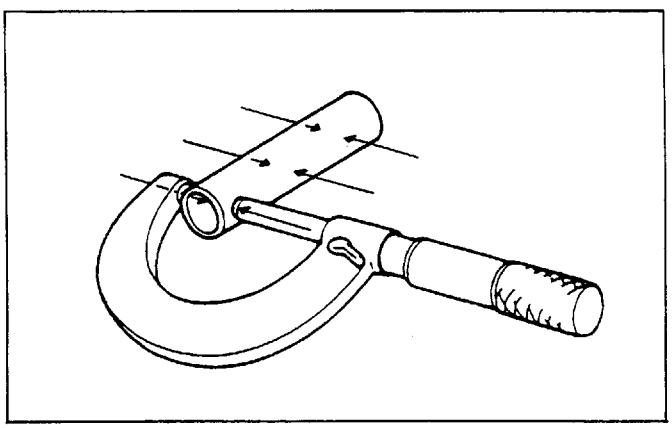
• PISTON PIN HOLE I.D.

STANDARD	SERVICE LIMIT
18.002—18.008 mm (0.7087—0.7090 in)	17.96 mm (0.707 in)



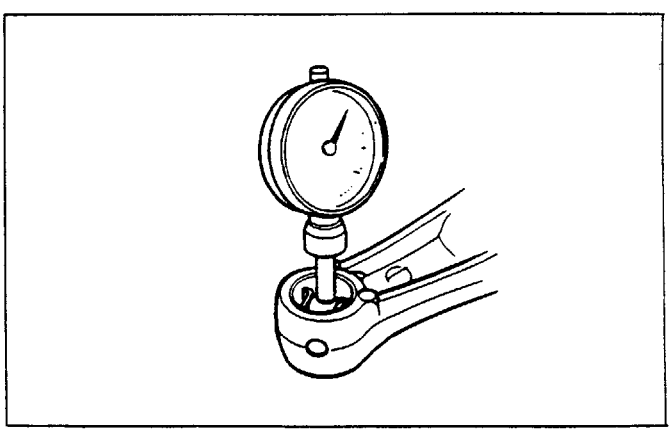
• PISTON PIN O.D.

STANDARD	SERVICE LIMIT
17.994—18.000 mm (0.7084—0.7086 in)	17.954 mm (0.7068 in)



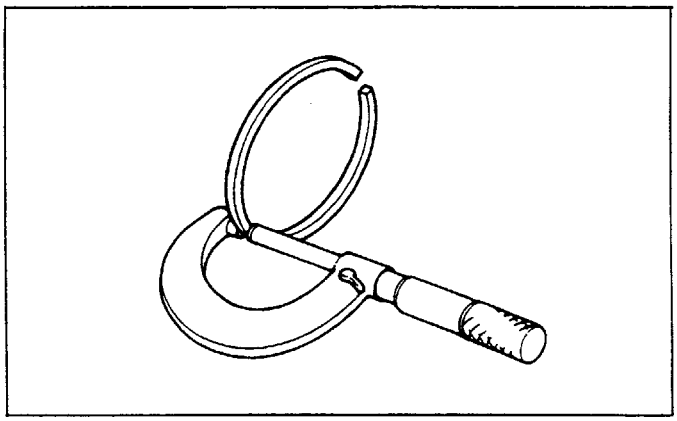
• CONNECTING ROD SMALL END I.D.

STANDARD	SERVICE LIMIT
18.016—18.034 mm (0.7093—0.7100 in)	18.05 mm (0.711 in)



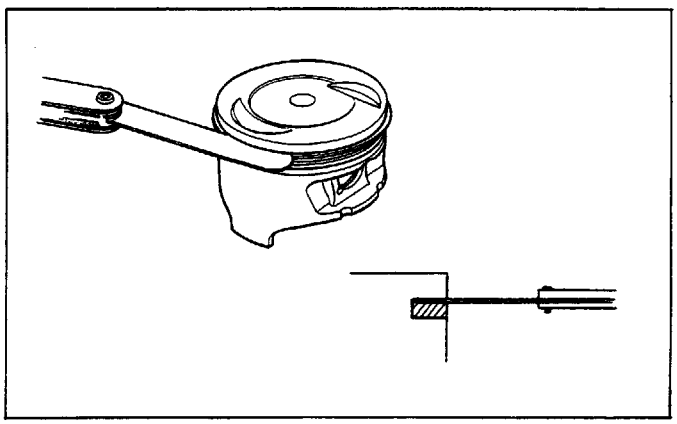
• PISTON RING WIDTH

	STANDARD	SERVICE LIMIT
TOP	0.990—1.025 mm (0.0390—0.0404 in)	0.96 mm (0.038 in)
SECOND	1.190—1.225 mm (0.0469—0.0482 in)	1.160 mm (0.0457 in)



• PISTON RING SIDE CLEARANCE

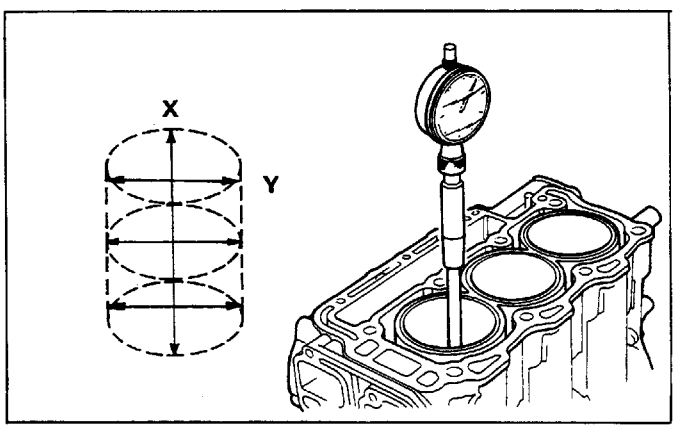
	STANDARD	SERVICE LIMIT
TOP	0.040—0.065 mm (0.0016—0.0026 in)	0.1 mm (0.004 in)
SECOND	0.015—0.045 mm (0.00059—0.0018 in)	0.1 mm (0.004 in)
OIL	0.055—0.140 mm (0.0022—0.0055 in)	0.15 mm (0.006 in)



• CYLINDER I.D.

Measure and record the cylinder I.D. at three levels in both X and Y axis. Take the maximum reading to determine the cylinder wear.

STANDARD	SERVICE LIMIT
70.0—70.015 mm (2.7559—2.7565 in)	70.06 mm (2.758 in)

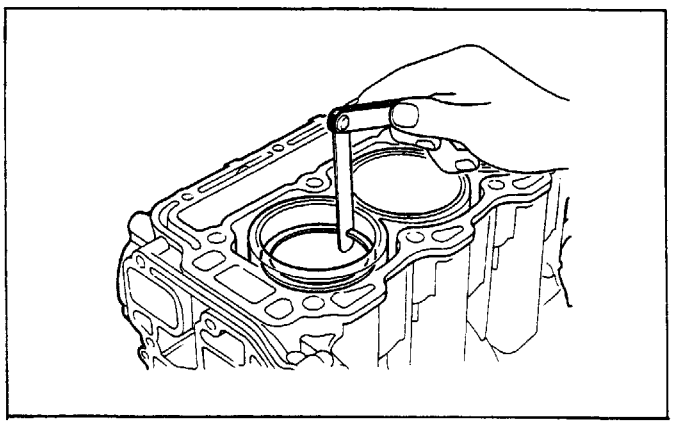


• PISTON-TO-CYLINDER CLEARANCE

STANDARD	SERVICE LIMIT
0.010—0.045 mm (0.0004—0.0018 in)	0.09 mm (0.0035 in)

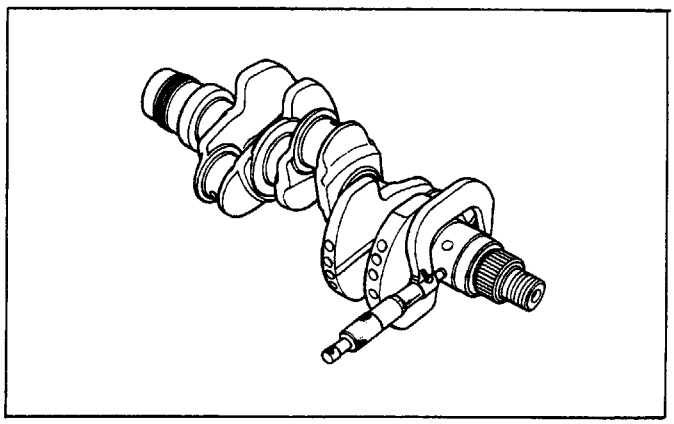
• PISTON RING END GAP

	STANDARD	SERVICE LIMIT
TOP	0.15—0.3 mm (0.006—0.012 in)	0.8 mm (0.03 in)
SECOND	0.3—0.45 mm (0.012—0.018 in)	0.95 mm (0.037 in)
OIL	0.2—0.7 mm (0.0079—0.028 in)	1.0 mm (0.04 in)



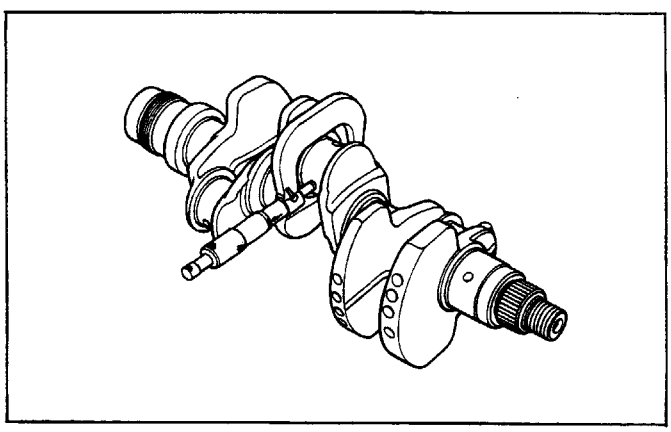
• CRANKSHAFT MAIN JOURNAL O.D.

STANDARD	SERVICE LIMIT
39.982—40.006 mm (1.5741—1.5750 in)	39.95 mm (1.572 in)



• CRANKPIN O.D.

STANDARD	SERVICE LIMIT
37.976—38.0 mm (1.4951—1.4961 in)	37.94 mm (1.494 in)



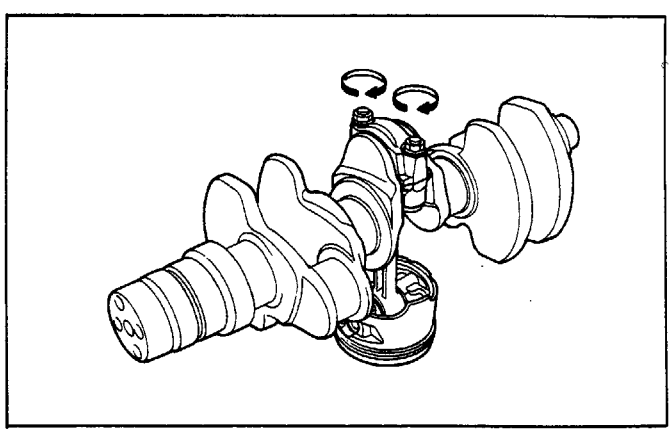
• CONNECTING ROD BIG END OIL CLEARANCE

1) Clean all oil from the crankpin and connecting rod bearing surfaces.
2) Place a piece of plastigauge on the crankpin, install the connecting rod and cap and tighten the nuts.

TORQUE: 28 N·m (2.8 kg-m, 20.2 ft-lb)

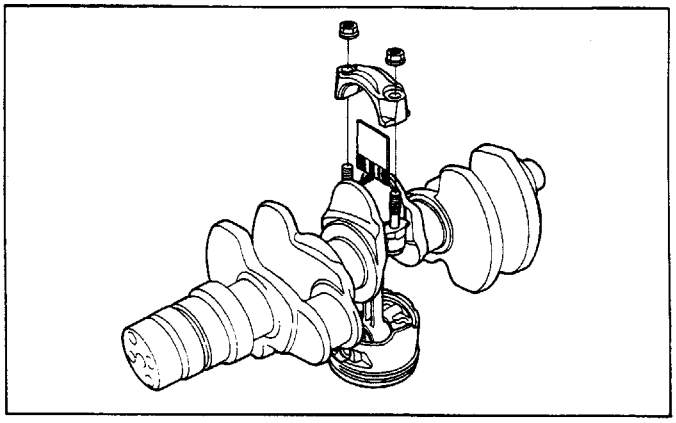
NOTE

- Do not rotate the crankshaft while the plastigauge in place.



3) Remove the connecting rod and measure the plastigauge.

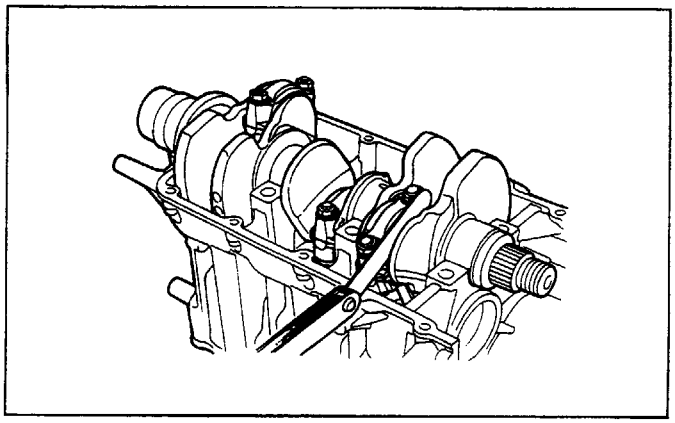
STANDARD	SERVICE LIMIT
0.020—0.038 mm (0.0008—0.0015 in)	0.08 mm (0.003 in)



• CONNECTING ROD BIG END AXIAL CLEARANCE

Measure the clearances with a feeler gauge.

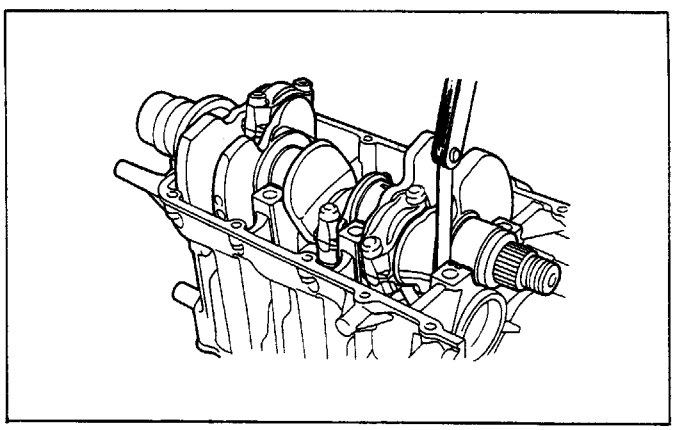
STANDARD	SERVICE LIMIT
0.05—0.2 mm (0.0019—0.0079 in)	0.3 mm (0.012 in)



• CRANKSHAFT SIDE CLEARANCE

Measure the clearances with a feeler gauge.

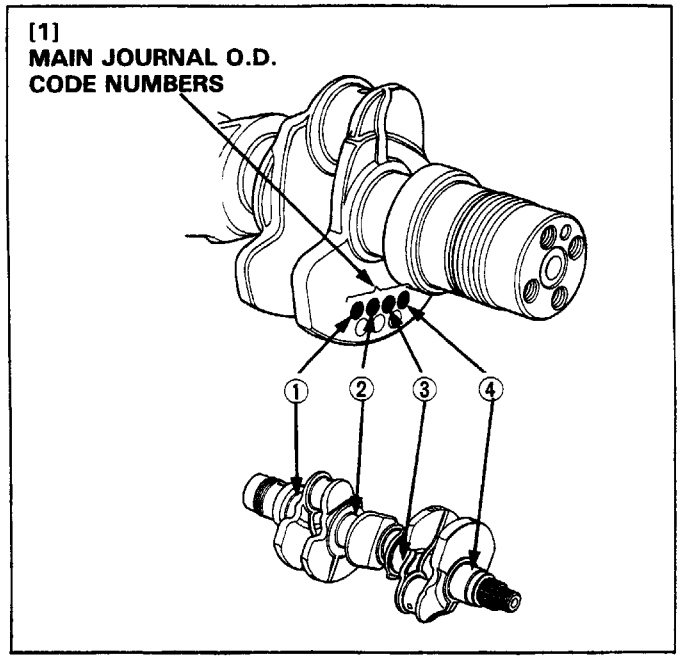
STANDARD	SERVICE LIMIT
0.05—0.3 mm (0.0019—0.012 in)	0.45 mm (0.018 in)



BEARING SELECTION

a. MAIN BEARING

1) Record the crankshaft main journal O.D. code numbers (or measure the main journal O.D.).

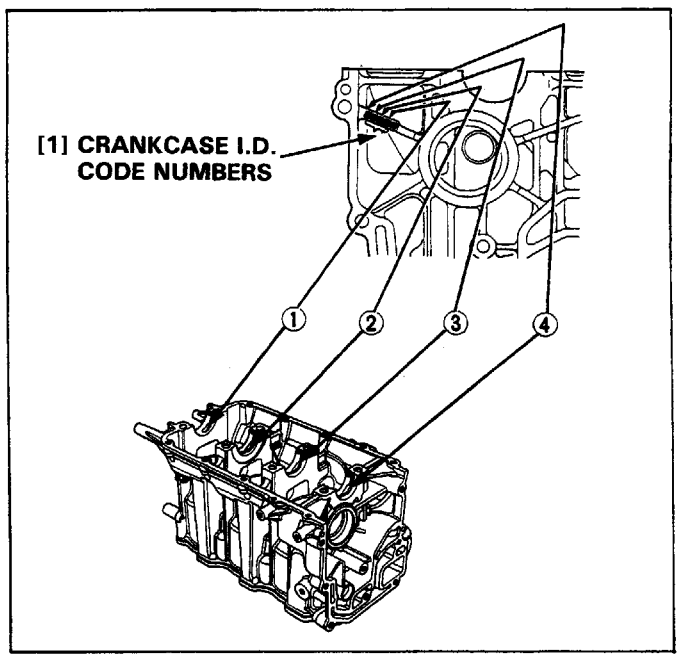


2) Record the crankcase I.D. code numbers.

NOTE

- Numbers on the crankcase are the codes for main journal I.D.s from front to rear.

3) Cross reference the case and journal codes to determine the replacement bearing color code.

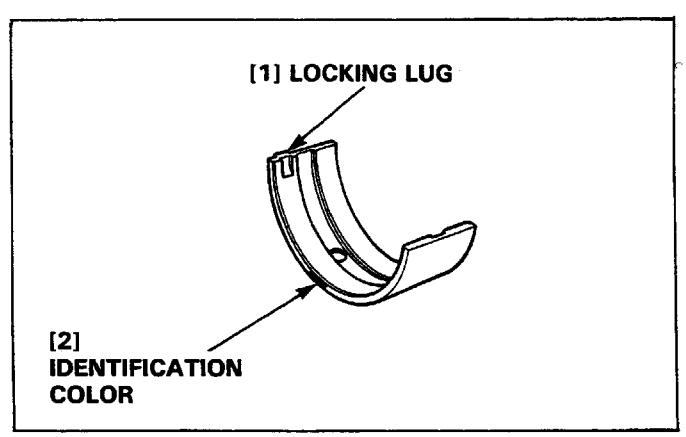


STANDARD OIL CLEARANCE	0.020—0.038 mm (0.0008—0.0015 in)

Unit: mm (in)

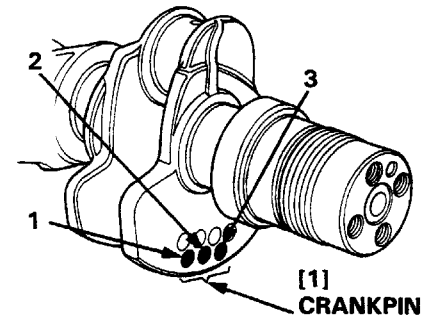
Crankcase I.D. 44ø / Crankshaft O.D. 40ø		Mark A	Mark B	Mark C	Mark D
		0—Less than 0.006(0.0002)	0.006(0.0002)—Less than 0.012(0.0005)	0.012(0.0005)—Less than 0.018(0.0007)	0.018(0.0007)—Less than 0.024(0.0009)
Mark 1	Less than 0.006(0.0002)—0	RED	PINK	YELLOW	GREEN
Mark 2	Less than 0—-0.006(-0.0002)	PINK	YELLOW	GREEN	BROWN
Mark 3	Less than -0.006(-0.0002)—-0.012(-0.0005)	YELLOW	GREEN	BROWN	BLACK
Mark 4	Less than -0.012(-0.0005)—-0.024(-0.0009)	GREEN	BROWN	BLACK	BLUE

REASSEMBLY:
Make sure the locking lug on each bearing fits in the notch in the bearing saddle.
Be careful not to damage the bearings.

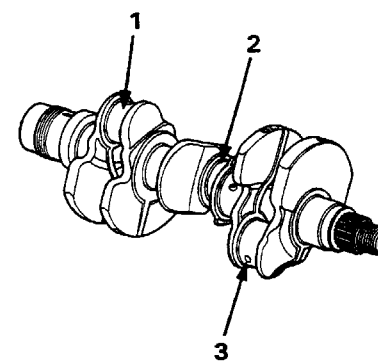


b. CONNECTING ROD BEARING

1) Record the crankpin O.D. code letters (or measure the crankpin journal O.D.)



[1] CRANKPIN O.D. CODE LETTERS

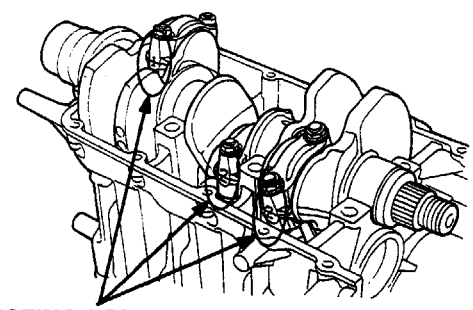


2) Record the connecting rod I.D. code letters or measure the I.D. with the bearing cap installed without bearing inserts.

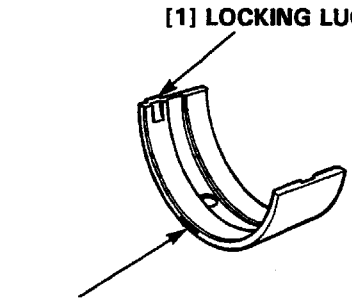
3) Cross-reference the crankpin and rod codes to determine the replacement bearing color.

Unit: mm (in)

Crank pin O.D. 38φ / Connecting rod I.D. 41φ		Mark A	Mark B	Mark C	Mark D
		Less than 0– -0.006(-0.0002)	Less than -0.006(-0.0002)– -0.012(-0.0005)	Less than -0.012(-0.0005)– -0.018(-0.0007)	Less than -0.018(-0.0007)– -0.024(-0.0009)
Mark 1	0–Less than 0.006(0.0002)	RED	PINK	YELLOW	GREEN
Mark 2	0.006(0.0002)– Less than 0.012(0.0005)	PINK	YELLOW	GREEN	BROWN
Mark 3	0.012(0.0005) Less than 0.018(0.0007)	YELLOW	GREEN	BROWN	BLACK
Mark 4	0.018(0.0007)– Less than 0.024(0.0009)	GREEN	BROWN	BLACK	BLUE



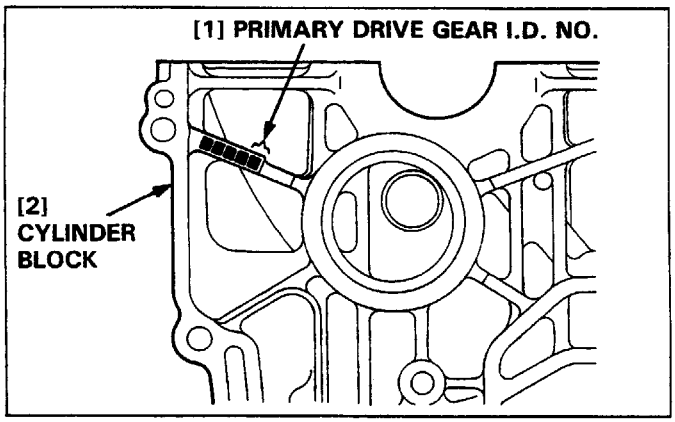
[1] CONNECTING ROD I.D. CODE LETTERS



REASSEMBLY:
Be careful not to damage the bearings.
Make sure the locking lug on each bearing fits into the notch in the connecting rod.

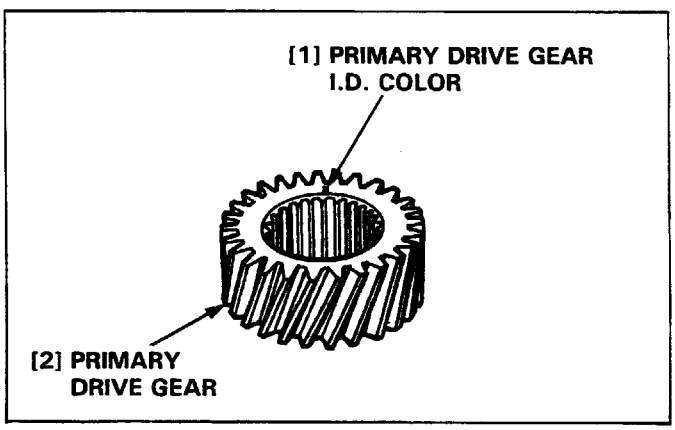
c. PRIMARY DRIVE GEAR

1) Record the right end number of the primary drive gear I.D. number.



2) Determine the primary drive gear I.D. color and select the proper primary drive gear by referring to the primary drive gear I.D. number.

Primary drive gear I.D. No.	Primary drive gear I.D. color	Primary drive gear part No.	Parts name
1	YELLOW	23413-ZV5-000	Primary drive gear C
2	BLUE	23412-ZV5-000	Primary drive gear B
3	WHITE	23411-ZV5-000	Primary drive gear A

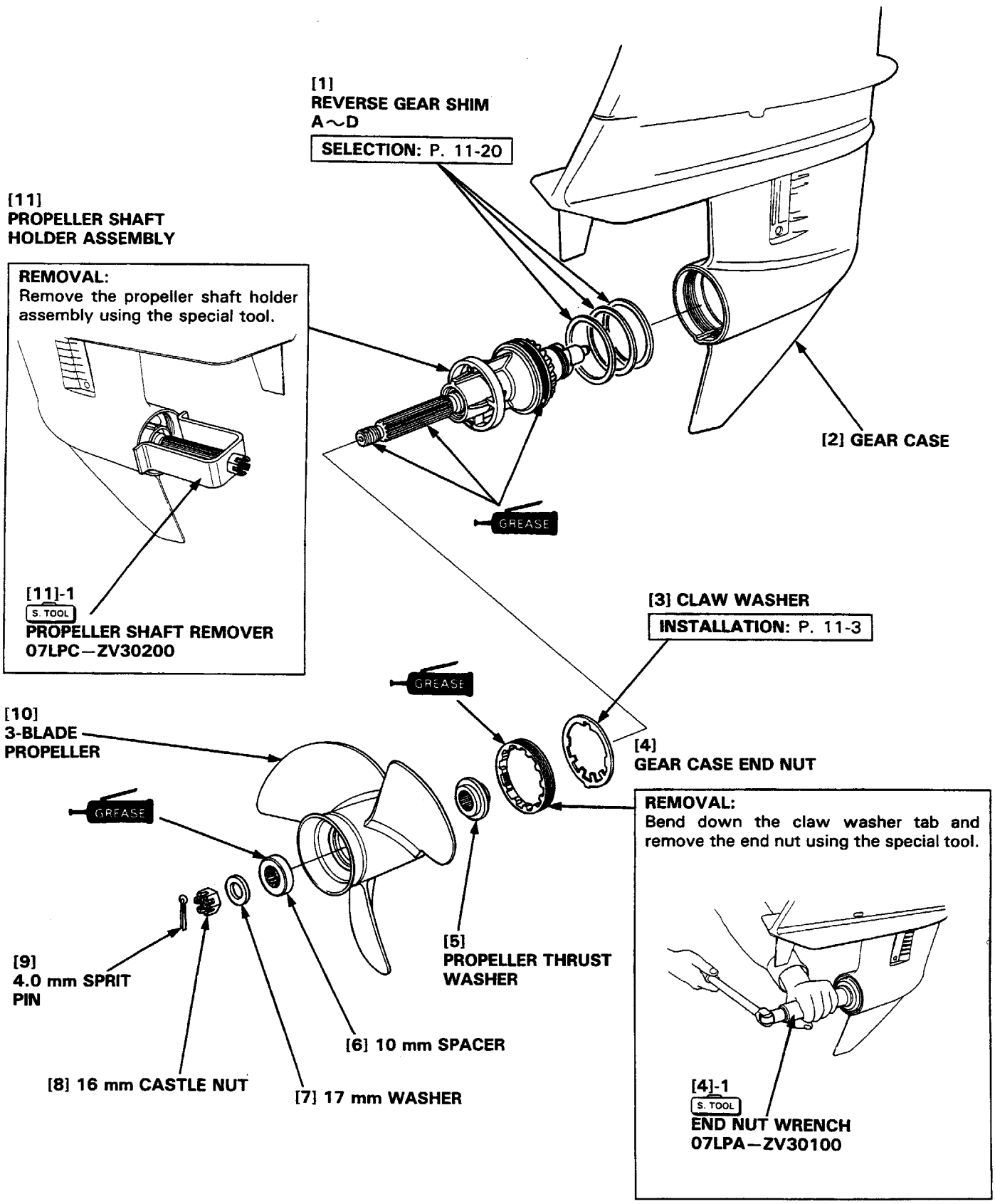


PROPELLER/GEAR CASE/ EXTENSION CASE

1

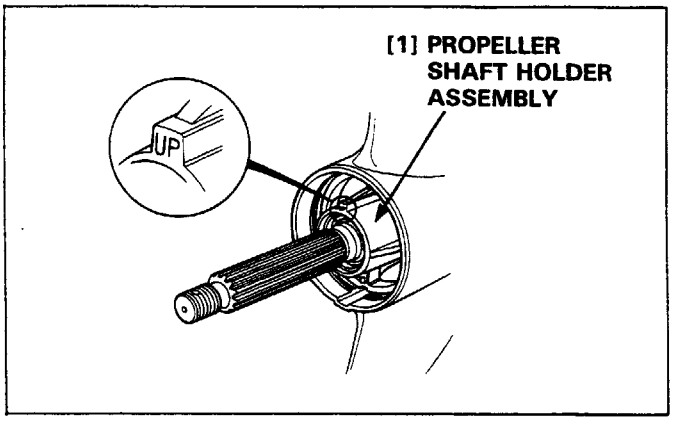
PROPELLER/PROPELLER SHAFT HOLDER ASSEMBLY

a. REMOVAL

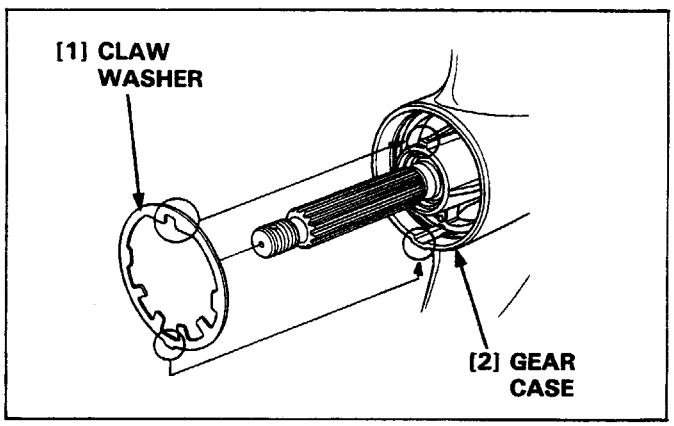


b. INSTALLATION

1) Install the propeller shaft holder assembly with the "UP" mark facing upward.



2) Install the claw washer and by aligning it cutout and the tab of with the projection and the groove of the gear case.



3) Apply grease to the end nut. Set the gear case end nut in the gear case with the "OFF" mark on the gear case end nut facing out.
Turn the end nut counterclockwise when the end nut contacts the threaded portion in the gear case, then tighten the nut by turning it clockwise by hand.

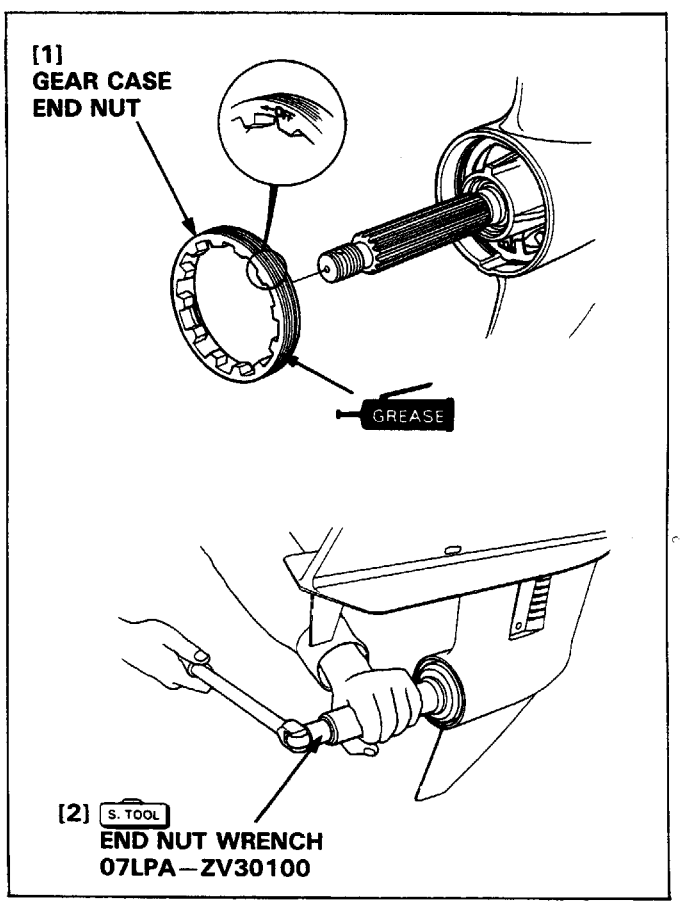
NOTE

- Tighten the end nut with care not to ruin the threads.

Tighten the nut as full as it goes by hand, then tighten it further to the specified torque of 70 $^{+30}_{0}$ N·m (7,0 $^{+3.0}_{0}$ kg-m, 50.6 $^{+21.7}_{0}$ ft-lb) using the special tool.

TOOL:

End nut wrench	**07LPA—ZV30100**

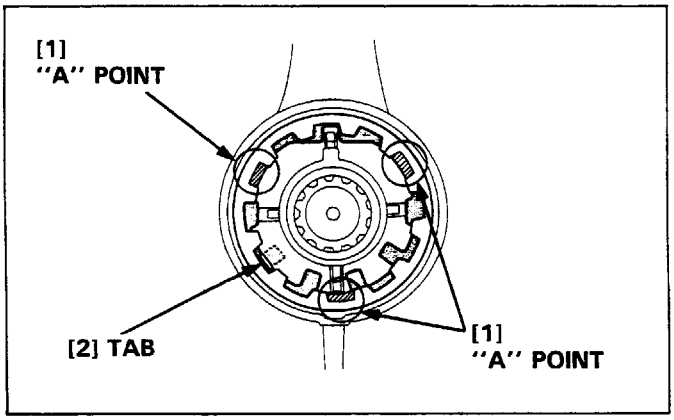


4) Check to see whether the claw washer tab and the end nut groove are aligned. If not, tighten the end nut until they are aligned. (Do not exceed the torque of 100 N·m (10.0 kg-m, 72.3 ft-lb) this time.)

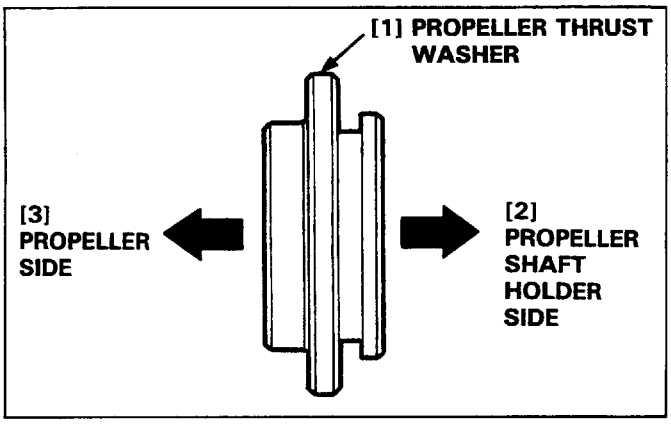
5) With the claw washer tab and end nut groove aligned, bend the tab to stake.

NOTE

- Bend up the claw washer tab at one place except the "A" points.

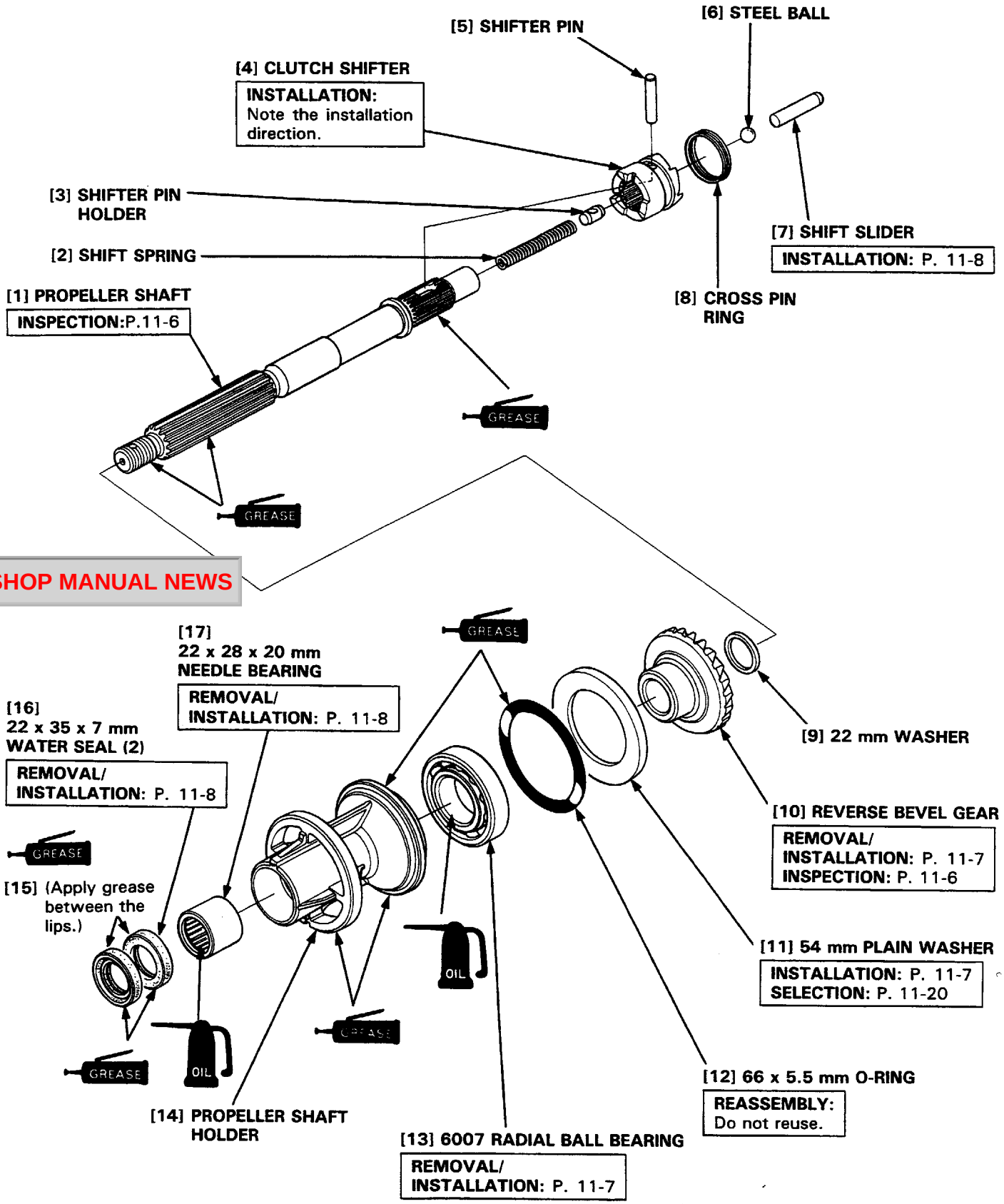


6) Install the propeller thrust washer as shown.



PROPELLER SHAFT/PROPELLER SHAFT HOLDER

a. DISASSEMBLY/REASSEMBLY

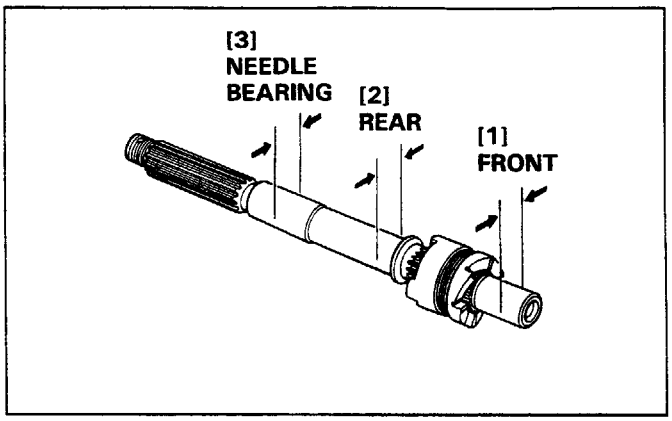


SHOP MANUAL NEWS

b. INSPECTION

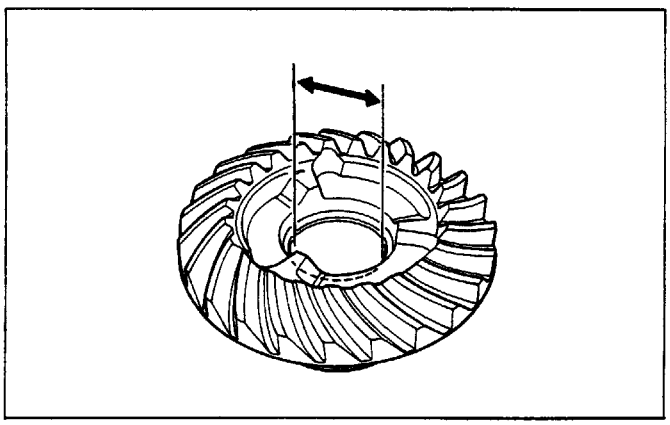
• PROPELLER SHAFT O.D.

	STANDARD	SERVICE LIMIT
Front	18.967—18.980 mm (0.7467—0.7472 in)	18.946 mm (0.7459 in)
Rear	20.9—21.2 mm (0.82—0.83 in)	20.85 mm (0.821 in)
At needle bearing	22.007—22.020 mm (0.8664—0.8669 in)	21.99 mm (0.866 in)



• REVERSE BEVEL GEAR I.D.

STANDARD	SERVICE LIMIT
22.05—22.30 mm (0.868—0.878 in)	22.35 mm (0.880 in)



• REVERSE BEVEL GEAR/6007 RADIAL BALL BEARING

REMOVAL:

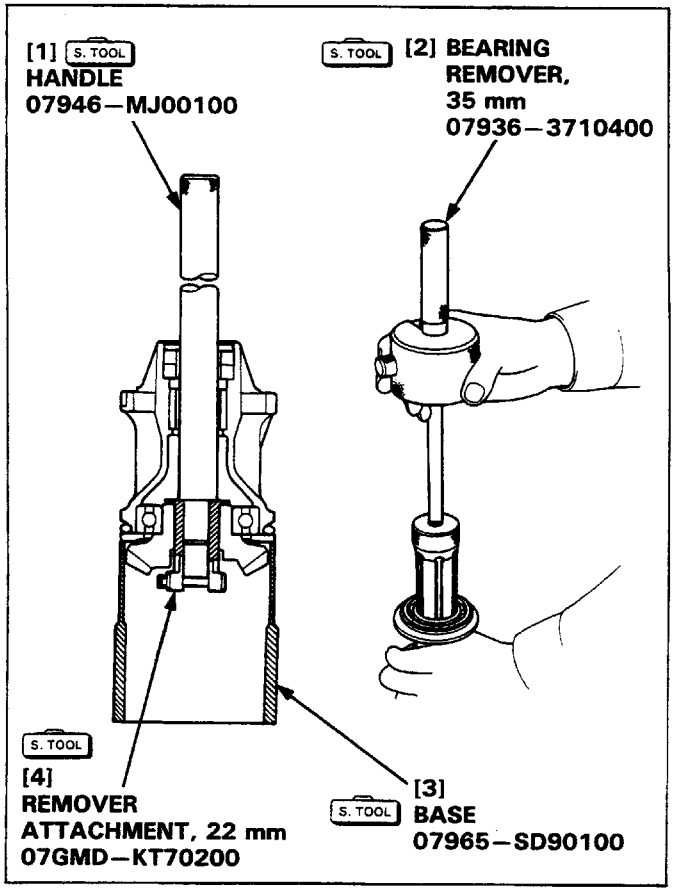
1) Remove the reverse bevel gear using a hydraulic press and the special tools.
2) Remove the bearing using the special tools.

CAUTION

- **Remove the reverse bevel gear using the hydraulic press. Never remove it by striking with a hammer.**

TOOLS:

Handle	**07946—MJ00100**
Remover attachment, 22 mm	**07GMD—KT70200**
Base	**07965—SD90100**
Bearing remover, 35 mm	**07936—3710400**
Remover weight	**07741—0010201**
Remover handle	**07936—3710100**



INSTALLATION:

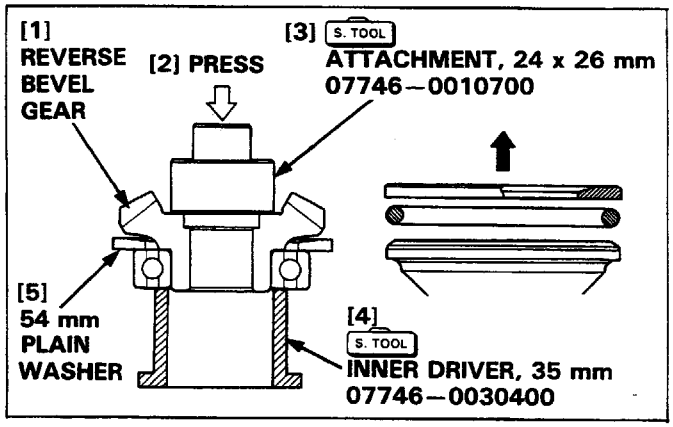
1) Install the reverse bevel gear and plain washer on the bearing using the special tools. Note the installation direction of the plain washer.
2) Set the O-ring on the bearing/gear assembly of the above step 1, and install the bearing/gear assembly on the propeller shaft holder using the special tools and the hydraulic press.

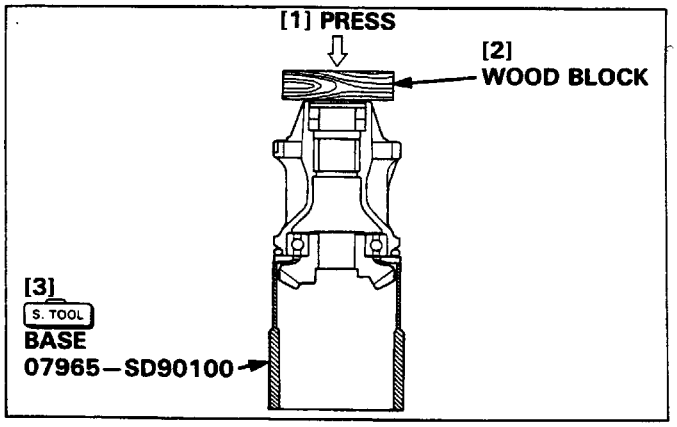
CAUTION

- **Install the bearing/gear assembly using the hydraulic press. Never install it by striking with a hammer. Take care not to damage the O-ring.**

TOOLS:

Inner driver, 35 mm	**07746—0030400**
Attachment, 24 x 26 mm	**07746—0010700**
Base	**07965—SD90100**



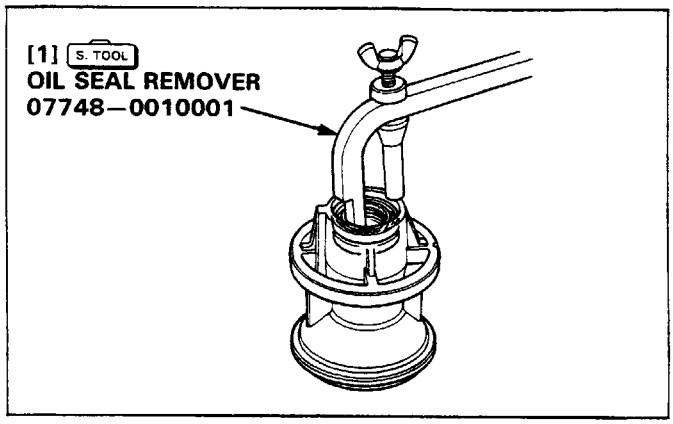


• 22 x 35 x 7 mm WATER SEAL

REMOVAL/INSTALLATION:
Remove/install the water seals using the special tools.

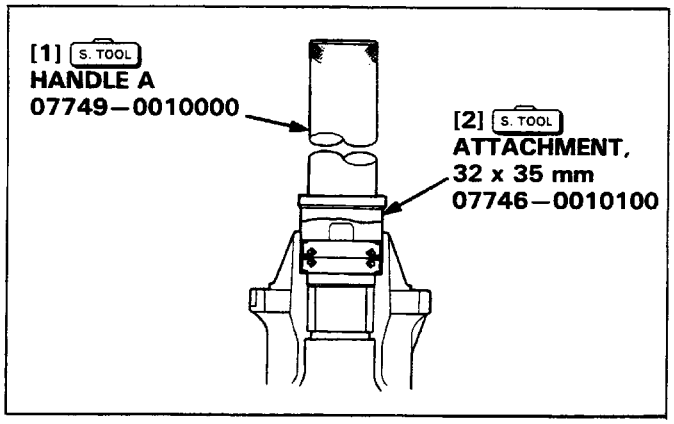
TOOLS:

Oil seal remover	**07748—0010001**
Handle A	**07749—0010000**
Attachment, 32 x 35 mm	**07746—0010100**



NOTE

- Install the water seals in the direction as shown.



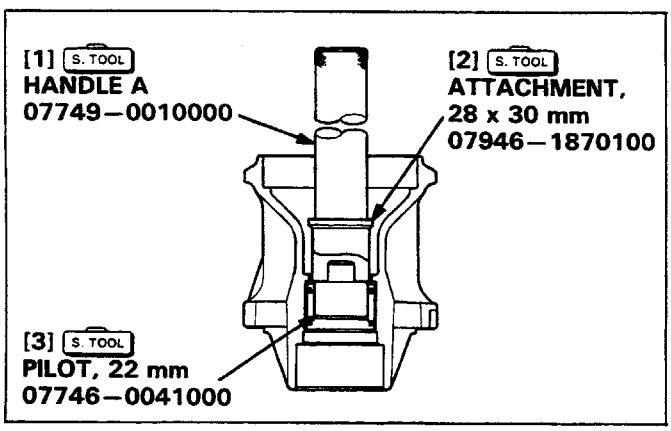
• 22 x 28 x 20 mm NEEDLE BEARING

REMOVAL:
Attach the special tools to the gear case side and drive out the needle bearing.

INSTALLATION:
Drive in the needle bearing from the propeller side using the special tools.

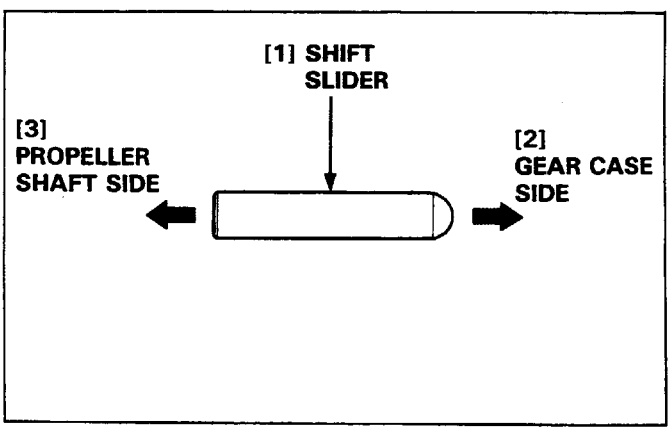
TOOLS:

Handle A	**07749—0010000**
Attachment, 28 x 30 mm	**07946—1870100**
Pilot, 22 mm	**07746—0041000**



• SHIFT SLIDER

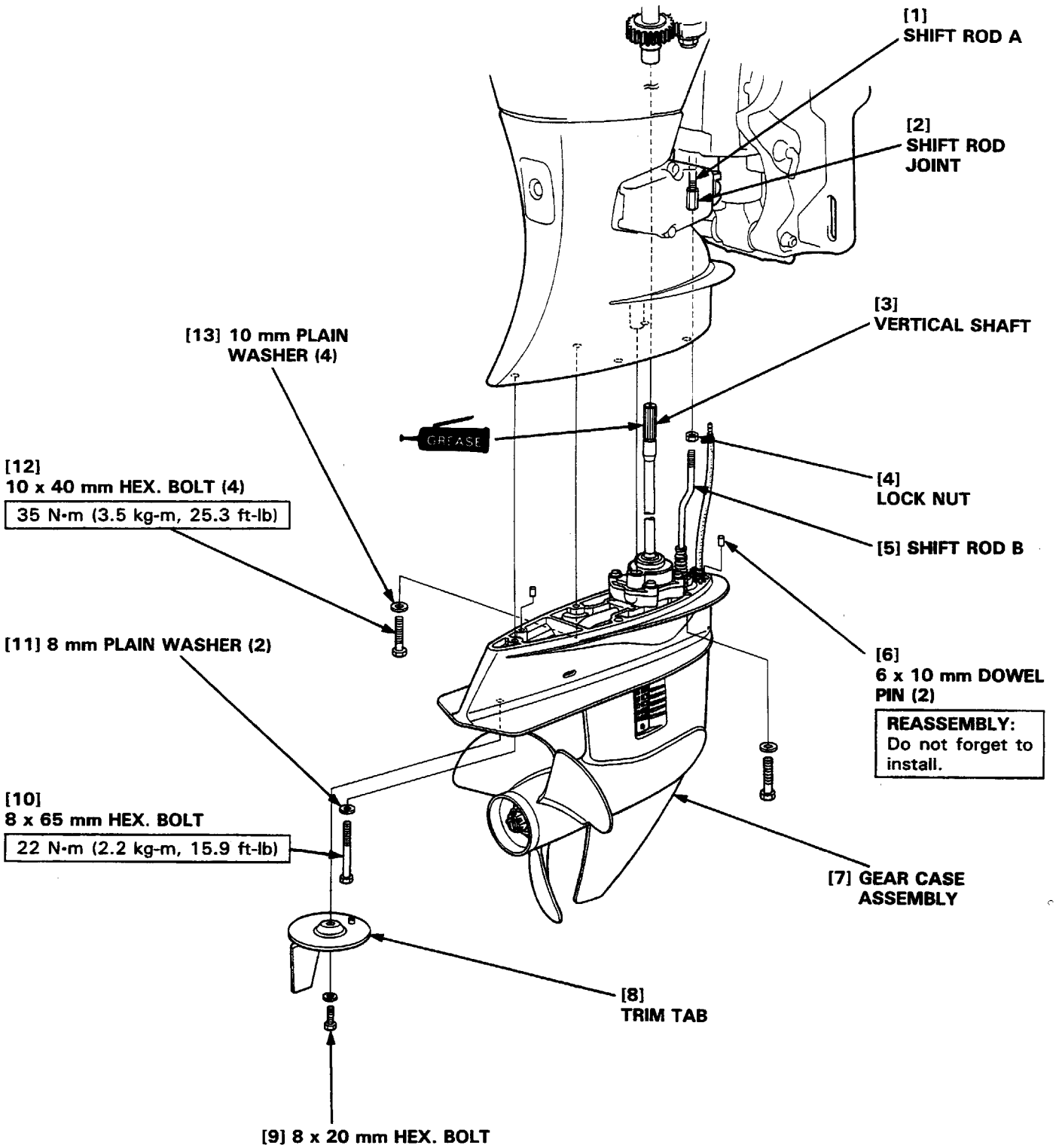
INSTALLATION:
Note the installation direction.



GEAR CASE ASSEMBLY

a. REMOVAL/INSTALLATION

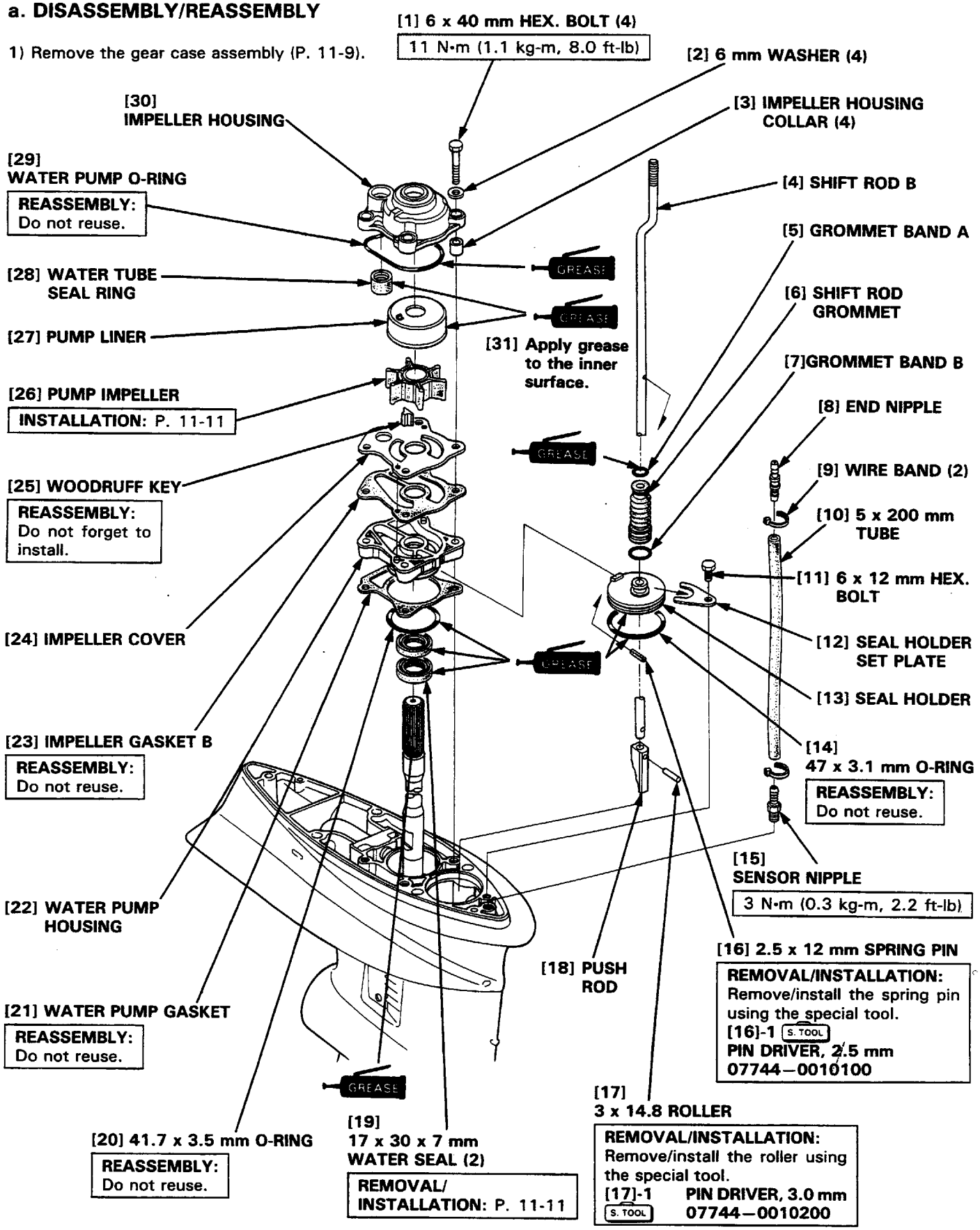
1) Move the shift lever to the "N" position, loosen the lock nut and adjusting nut connecting the shift rod A and B, and disconnect the shift rods.



WATER PUMP

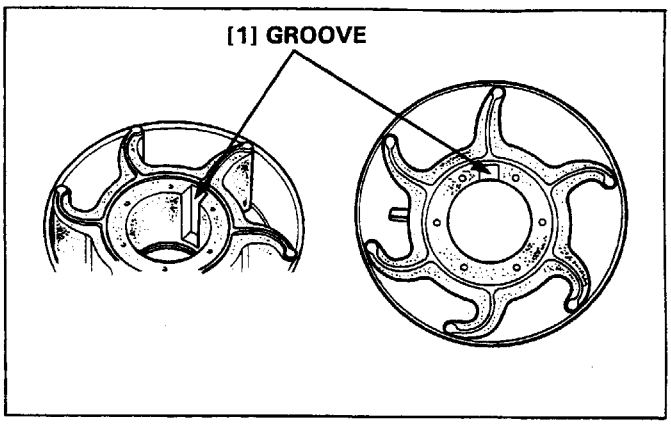
a. DISASSEMBLY/REASSEMBLY

1) Remove the gear case assembly (P. 11-9).



• IMPELLER

INSTALLATION:
Check the impeller for wear or cracks.
Install the impeller by turning it counterclockwise with the side where the groove reaches to the end toward up.



• 17 x 30 x 7 mm WATER SEAL

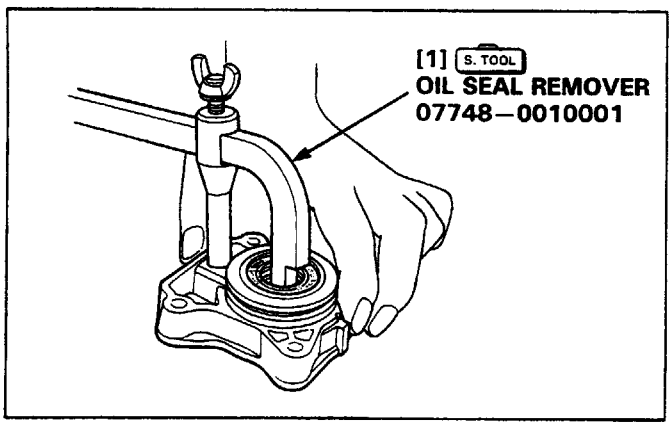
REMOVAL/INSTALLATION:
Remove/install the water seals using the special tools.

TOOLS:

Oil seal remover	**07748–0010001**
Handle A	**07749–0010000**
Attachment, 28 x 30 mm	**07946–1870100**

NOTE

- Install the water seals in the direction as shown.



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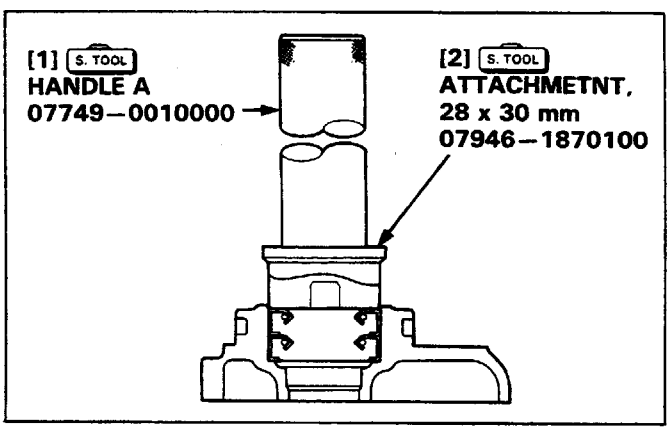
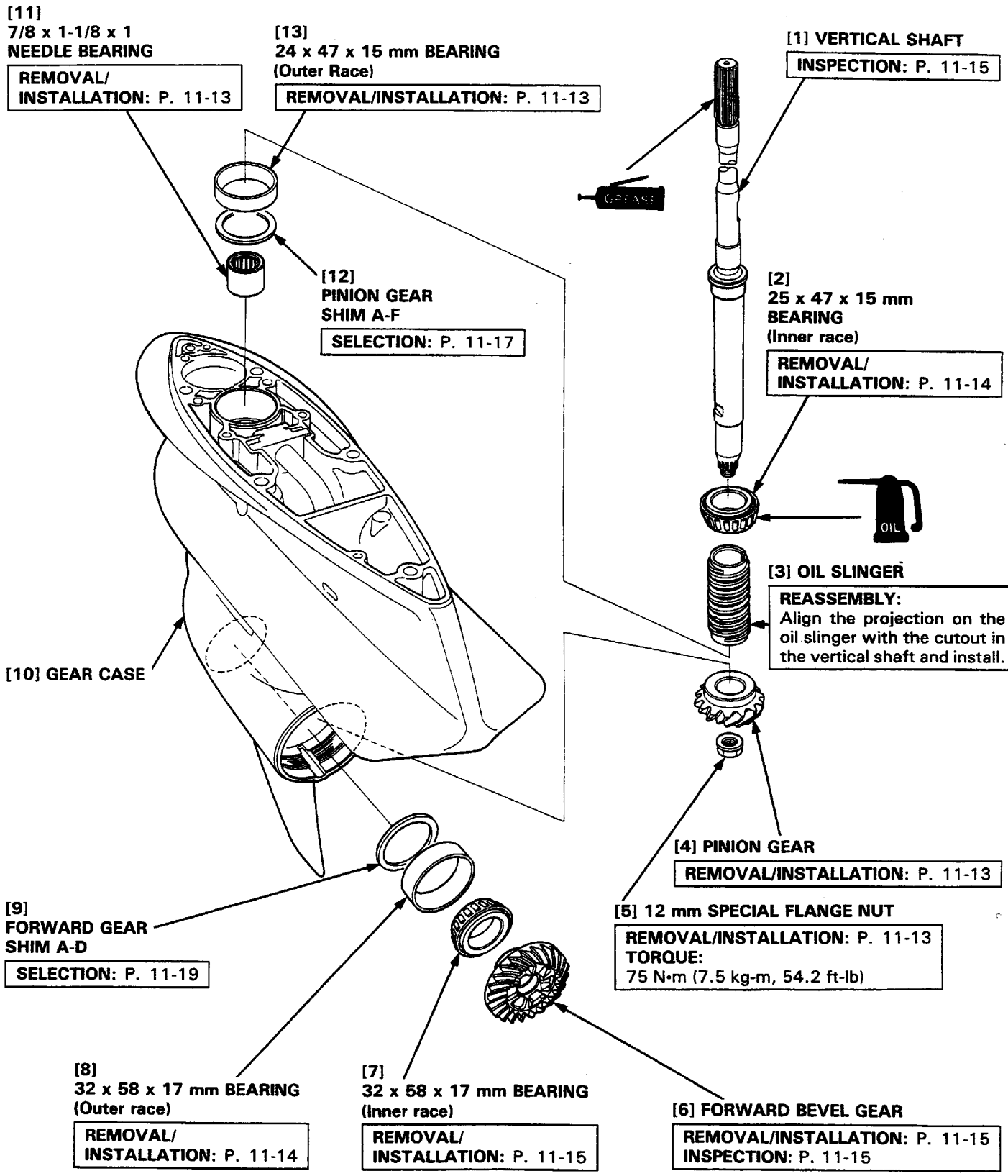


VERTICAL SHAFT/BEVEL GEAR

a. DISASSEMBLY/REASSEMBLY

1) Remove the gear case assembly (P. 11-9) and the propeller shaft holder assembly (P. 11-2).



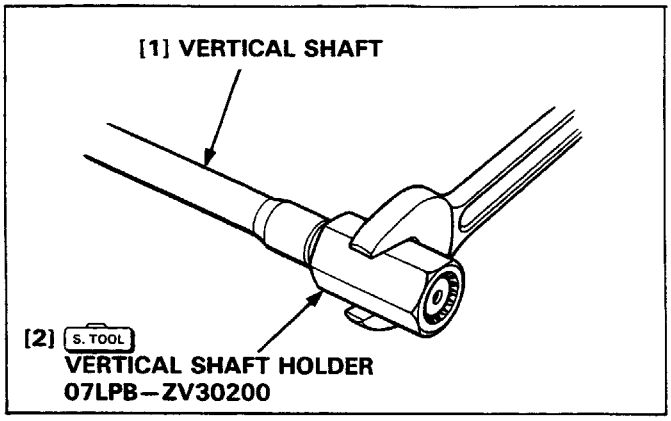
• 12 mm SPECIAL FLANGE NUT

REMOVAL/INSTALLATION:

Remove/install the 12 mm special flange nut by holding the vertical shaft with the special tool.

TOOL:

Vertical shaft holder	**07LPB—ZV30200**



• 7/8 x 1-1/8 x 1 NEEDLE BEARING

REMOVAL/INSTALLATION:

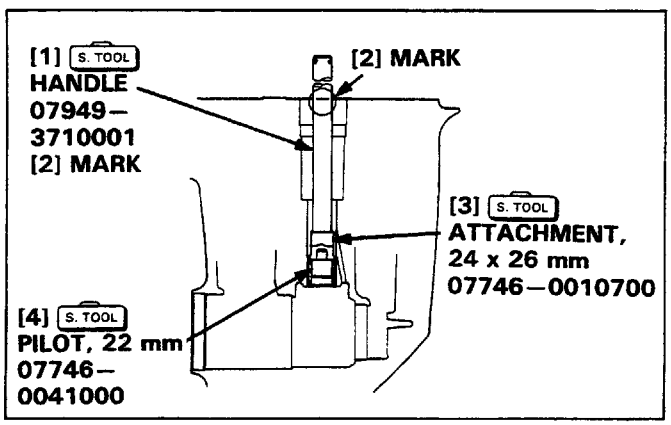
Remove/install the needle bearing using the special tools.

NOTE

- Mark the gear case upper surface position on the handle (special tool) before removing the bearing. Drive in the bearing to the marked position and install the bearing so that the bottom surface of the bearing is flush with the bottom surface of the gear case.

TOOLS:

Handle	**07949—3710001**
Attachment, 24 x 26 mm	**07746—0010700**
Pilot, 22 mm	**07746—0041000**



• 25 x 47 x 15 mm BEARING (Outer race)

REMOVAL/INSTALLATION:

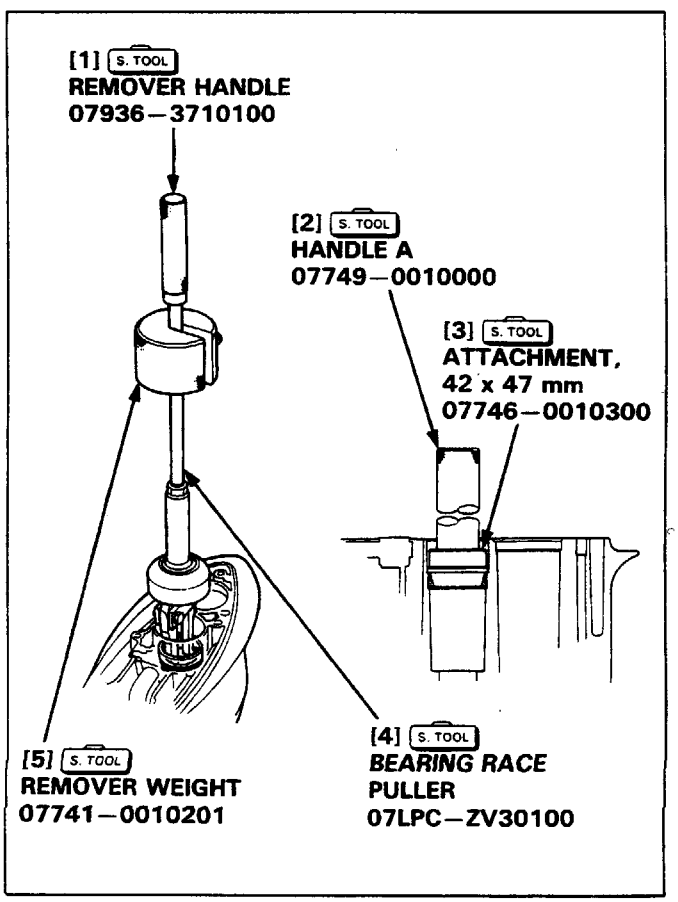
Remove/install the bearing (outer race) using the special tools.

NOTE

- Drive in the bearing with the larger I.D. side toward out.

TOOLS:

Bearing race puller	**07LPC—ZV30100**
Remover weight	**07741—0010201**
Remover handle	**07936—3710100**
Handle A	**07749—0010000**
Attachment, 42 x 47 mm	**07746—0010300**



• 32 x 58 x 17 mm BEARING (Outer race)

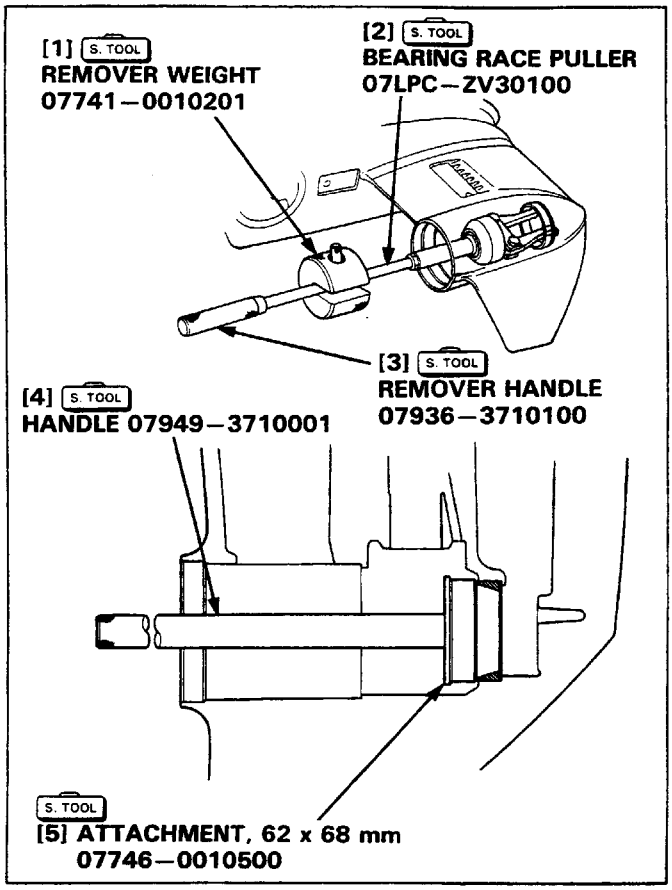
REMOVAL/INSTALLATION:
Remove/install the bearing (outer race) using the special tools.

NOTE

- Drive in the bearing with the larger I.D. side toward out.

TOOLS:

Bearing race puller	**07LPC—ZV30100**
Remover weight	**07741—0010201**
Remover handle	**07936—3710100**
Handle	**07949—3710001**
Attachment, 62 x 68 mm	**07746—0010500**



• 25 x 47 x 15 mm BEARING (Inner race)

REMOVAL:
Set the 12 mm special flange nut on the pinion gear installation section of the vertical shaft, set the special tool as shown, and remove the bearing (inner race) using the hydraulic press.

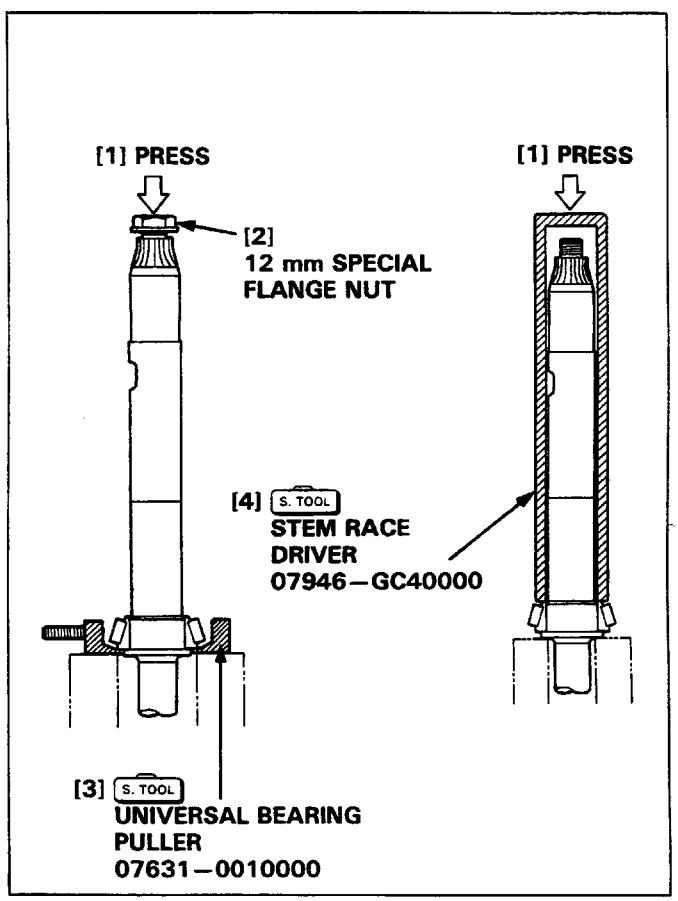
TOOL:

Universal bearing puller	**07631—0010000**

INSTALLATION:
Install the bearing (inner race) using the special tool.

TOOL:

Stem race driver	**07946—GC40000**

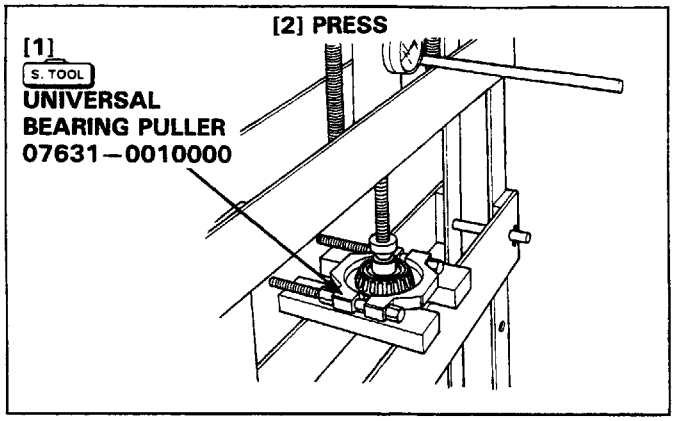


• **32 x 58 x 17 mm BEARING (Inner race)**

REMOVAL:
Set the special tool as shown and remove the 32 x 58 x 17 mm bearing using the hydraulic press.

TOOL:

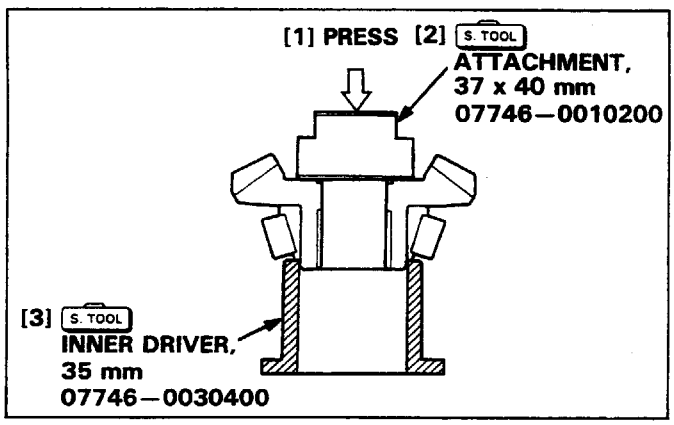
Universal bearing puller	**07631—0010000**



INSTALLATION:
Set the special tools as shown and install the 32 x 58 x 17 mm bearing using the hydraulic press.

TOOLS:

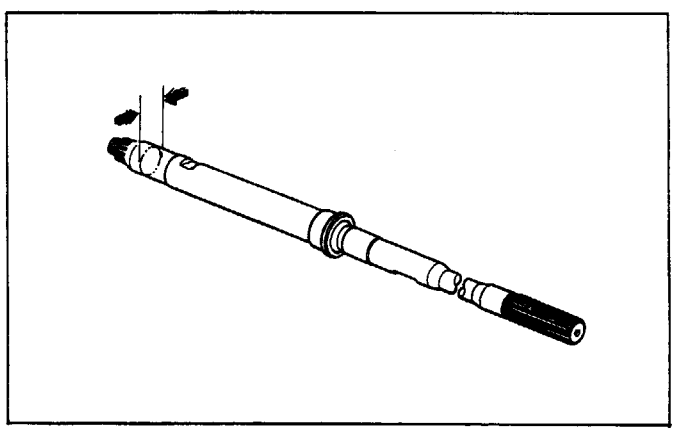
Inner driver, 35 mm	**07746—0030400**
Attachment, 37 x 40 mm	**07746—0010200**



b. INSPECTION

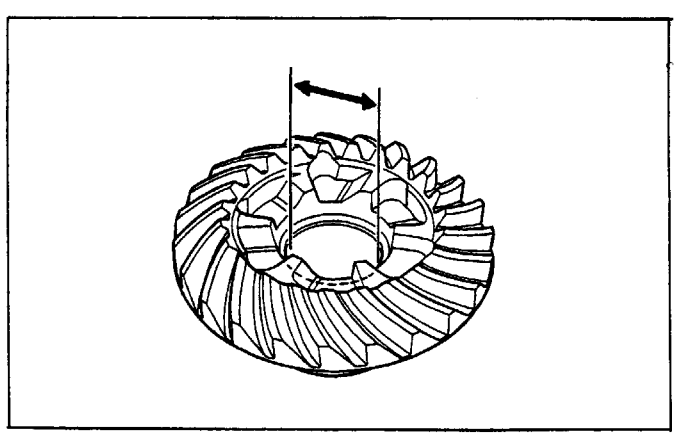
• **VERTICAL SHAFT O.D. (at needle bearing)**

STANDARD	SERVICE LIMIT
22.217—22.230 mm (0.8747—0.8752 in)	22.196 mm (0.8739 in)



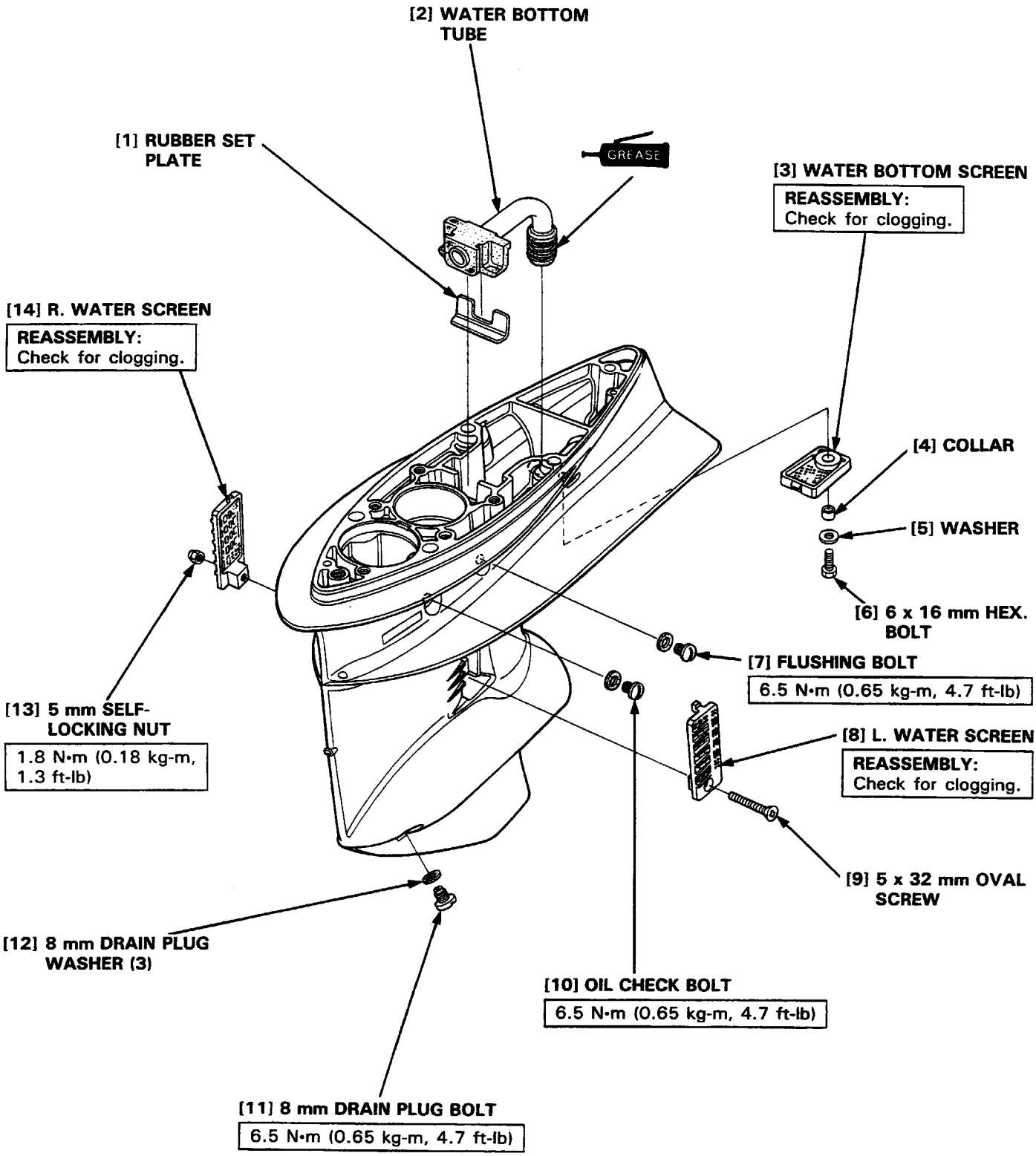
• **FORWARD BEVEL GEAR I.D.**

STANDARD	SERVICE LIMIT
19.000—19.021 mm (0.7480—0.7489 in)	19.04 mm (0.750 in)



WATER SCREEN

a. DISASSEMBLY/REASSEMBLY



SHIM SELECTION

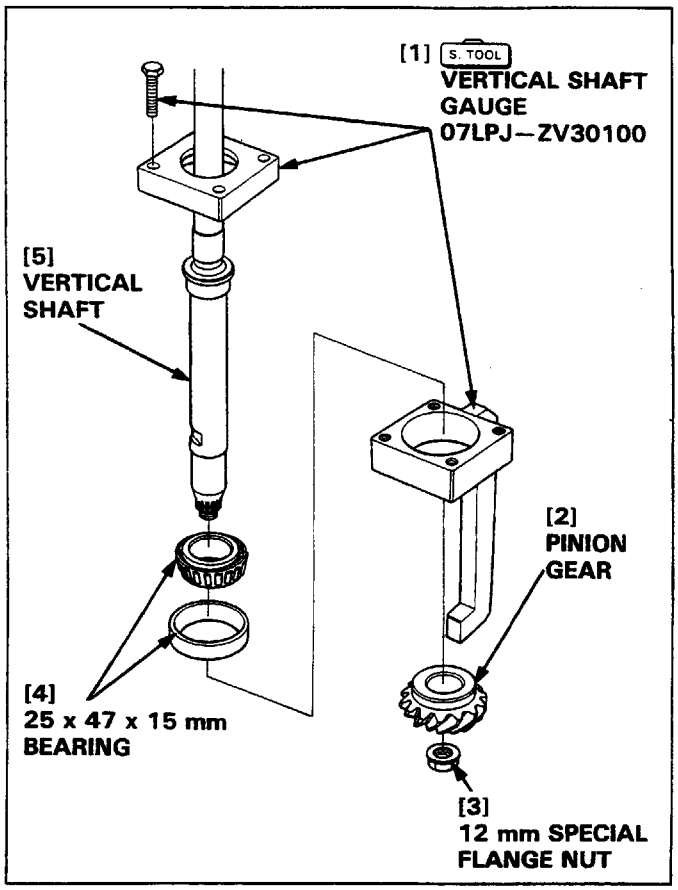
• PINION GEAR SHIM

1) Install the 25 x 47 x 15 mm bearing and pinion gear over the vertical shaft and tighten the 12 mm special flange nuts.

TORQUE: 75 N·m (7.5 kg-m, 54.2 ft-lb)

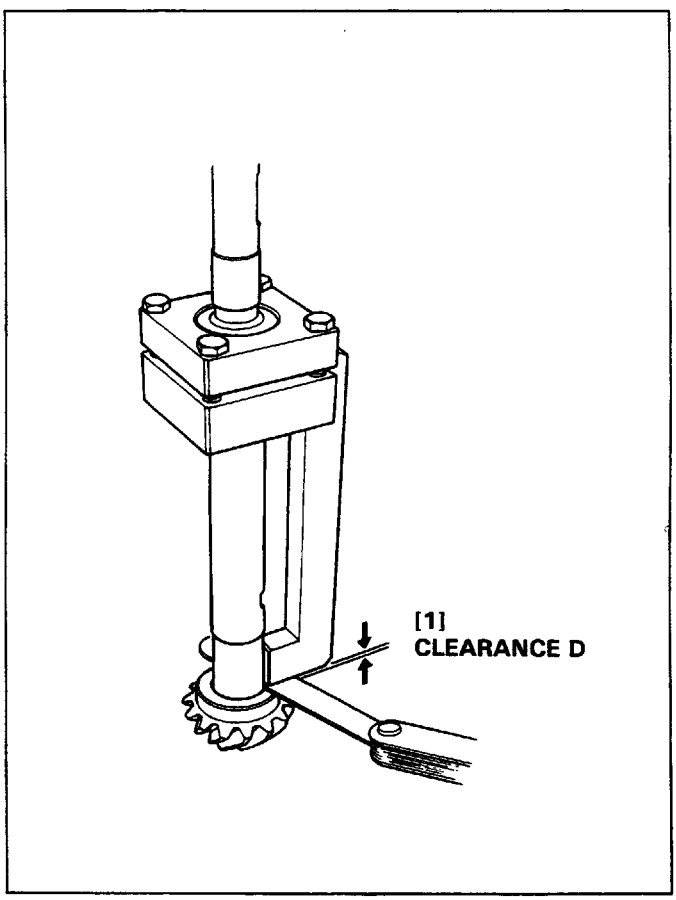
2) Attach the special tool to the vertical shaft as shown.

TOOL:
Vertical shaft gauge **07LPJ—ZV30100**

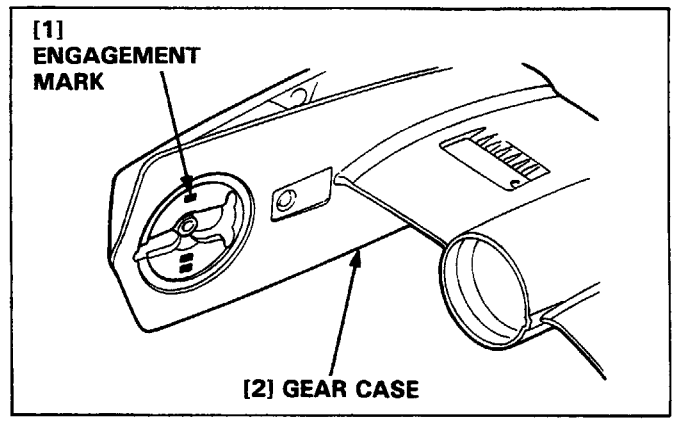


3) Measure the clearance between the pinion gear and vertical shaft gauge (clearance D) as shown, then obtain the calculation value in the following formula.

Formula:
Clearance D − 0.5 = calculation value
Example:
When the clearance D is 0.3;
0.3 − 0.5 = −0.2
Therefore, calculation value is −0.2 mm (−0.008 in).



4) Cross reference the calculation value and engagement mark located on the trim tab installation section of the gear case, and select the shim of the appropriate thickness from the shim selection table.



- **Shim type table**

Parts name	Parts number	Thickness
Gear shim A	90518−ZV5−000	0.10 mm (0.0039 in)
Gear shim B	90519−ZV5−000	0.15 mm (0.0060 in)
Gear shim C	90520−ZV5−000	0.30 mm (0.0118 in)
Gear shim D	90521−ZV5−000	0.50 mm (0.0197 in)

- **Shim selection table**

Unit: mm (in)

[1] Engagement mark on gear case	[2] Calculation value: −0.45 (−0.018) – −0.40 (−0.016)	−0.40 (−0.016) – −0.35 (−0.014)	−0.35 (−0.014) – −0.30 (−0.012)	−0.30 (−0.012) – −0.25 (−0.010)	−0.25 (−0.010) – −0.20 (−0.008)	−0.20 (−0.008) – −0.15 (−0.006)	−0.15 (−0.006) – −0.10 (−0.004)	−0.10 (−0.004) – −0.05 (−0.002)	−0.05 (−0.002) – 0
A	0.35 (0.014)	0.40 (0.016)	0.45 (0.018)	0.50 (0.020)	0.55 (0.022)	0.60 (0.024)	0.65 (0.026)	0.70 (0.028)	0.75 (0.030)
B	0.30 (0.012)	0.35 (0.014)	0.40 (0.016)	0.45 (0.018)	0.50 (0.020)	0.55 (0.022)	0.60 (0.024)	0.65 (0.026)	0.70 (0.028)
C	0.25 (0.010)	0.30 (0.012)	0.35 (0.014)	0.40 (0.016)	0.45 (0.018)	0.50 (0.020)	0.55 (0.022)	0.60 (0.024)	0.65 (0.026)
D	0.20 (0.008)	0.25 (0.010)	0.30 (0.012)	0.35 (0.014)	0.40 (0.016)	0.45 (0.018)	0.50 (0.020)	0.55 (0.022)	0.60 (0.024)
E	0.15 (0.006)	0.20 (0.008)	0.25 (0.010)	0.30 (0.012)	0.35 (0.014)	0.40 (0.016)	0.45 (0.018)	0.50 (0.020)	0.55 (0.022)
F	0.10 (0.004)	0.15 (0.006)	0.20 (0.008)	0.25 (0.010)	0.30 (0.012)	0.35 (0.014)	0.40 (0.016)	0.45 (0.018)	0.50 (0.020)

Unit: mm (in)

[1] Engagement mark on gear case	[2] Calculation value: 0 – 0.05 (0.002)	0.05 (0.002) – 0.10 (0.004)	0.10 (0.004) – 0.15 (0.006)	0.15 (0.006) – 0.20 (0.008)	0.20 (0.008) – 0.25 (0.010)	0.25 (0.010) – 0.30 (0.012)	0.30 (0.012) – 0.35 (0.014)	0.35 (0.014) – 0.40 (0.016)	0.40 (0.016) – 0.45 (0.018)
A	0.80 (0.031)	0.85 (0.033)	0.90 (0.035)	0.95 (0.037)	1.00 (0.039)	1.05 (0.041)	1.10 (0.043)	1.15 (0.045)	1.20 (0.047)
B	0.75 (0.030)	0.80 (0.031)	0.85 (0.033)	0.90 (0.035)	0.95 (0.037)	1.00 (0.039)	1.05 (0.041)	1.10 (0.043)	1.15 (0.045)
C	0.70 (0.028)	0.75 (0.030)	0.80 (0.031)	0.85 (0.033)	0.90 (0.035)	0.95 (0.037)	1.00 (0.039)	1.05 (0.041)	1.10 (0.043)
D	0.65 (0.026)	0.70 (0.028)	0.75 (0.030)	0.80 (0.031)	0.85 (0.033)	0.90 (0.035)	0.95 (0.037)	1.00 (0.039)	1.05 (0.041)
E	0.60 (0.024)	0.65 (0.026)	0.70 (0.028)	0.75 (0.030)	0.80 (0.031)	0.85 (0.033)	0.90 (0.035)	0.95 (0.037)	1.00 (0.039)
F	0.55 (0.022)	0.60 (0.024)	0.65 (0.026)	0.70 (0.028)	0.75 (0.030)	0.80 (0.031)	0.85 (0.033)	0.90 (0.035)	0.95 (0.037)

- **How to read shim selection table**

When the engagement mark on the gear case is B and the calculation value is −0.2 mm (−0.008 in) or more, the shim thickness is 0.55 mm (0.022 in). (See Example 1 below.)
When the calculation value is less than −0.2 mm (−0.008 in), the shim thickness is 0.50 mm (0.020 in). (See Example 2 below.)

[1] Example 1: Unit: mm (in)

	[2] Calculation value			
				[3] −0.20 mm (−0.008 in) or above to less than −0.15 mm (−0.006 in)
A				
B				0.55 (0.022)

[4] Example 2: Unit: mm (in)

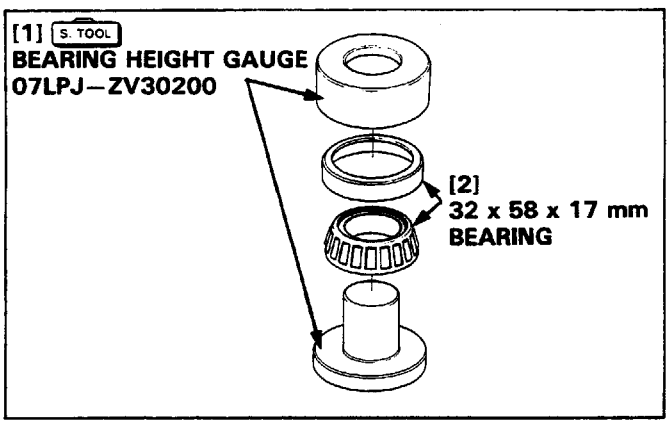
	[2] Calculation value				
			[5] −0.25 mm (−0.010 in) or above to less than −0.20 mm (−0.008 in)		
A					
B			0.50 (0.020)		

• **Shim combination**
To bring the total thickness of the shim to 0.55 mm (0.022 in), the correct combination of the gear shims should be four gear shims A and one gear shim B, or the combination of one gear shim A, B, and C respectively.

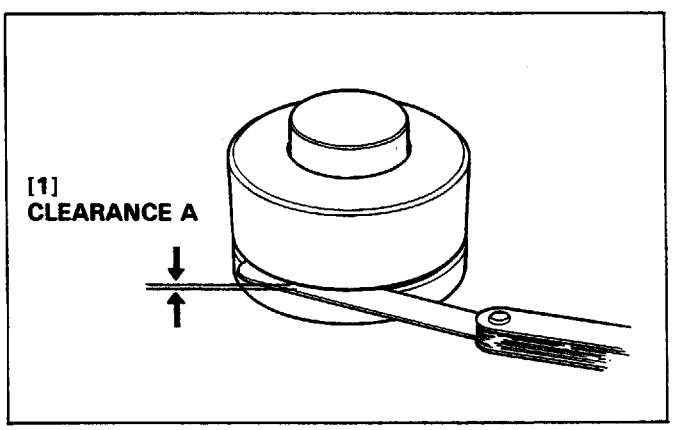
• FORWARD GEAR SHIM

1) Set the 32 x 58 x 17 mm bearing on the special tool as shown.

TOOL:
Bearing height gauge **07LPJ–ZV30200**



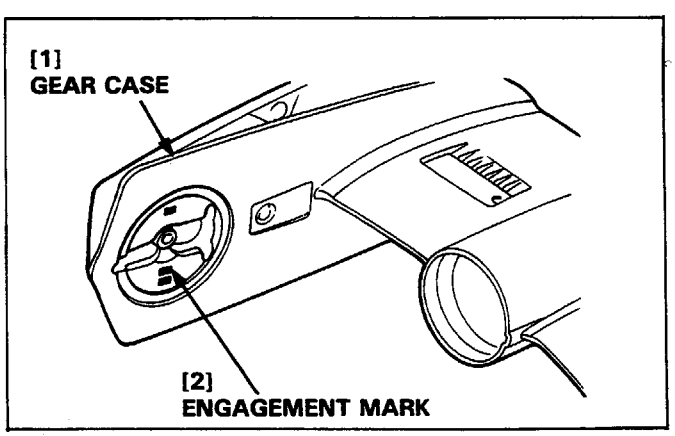
2) Measure the clearance between the upper and lower part of the special tool (clearance A) using a feeler gauge.
3) Obtain the calculation value by subtracting 0.5 mm (0.02 in) from the measured clearance A.
Example:
When the clearance A is 0.3 mm (0.012 in);
0.3 – 0.5 = –0.2
Therefore, the calculation value is –0.2 mm (–0.008 in).



4) Cross reference the calculation value and engagement mark located on the trim tab installation section of the gear case, and select the shim of the appropriate thickness from the shim selection table.

• **Shim type table**

Parts name	Parts number	Thickness
Forward gear shim A	90528–ZV5–000	0.10 mm (0.0039 in)
Forward gear shim B	90529–ZV5–000	0.15 mm (0.0060 in)
Forward gear shim C	90530–ZV5–000	0.30 mm (0.0118 in)
Forward gear shim D	90531–ZV5–000	0.50 mm (0.0197 in)



• **Shim selection table**

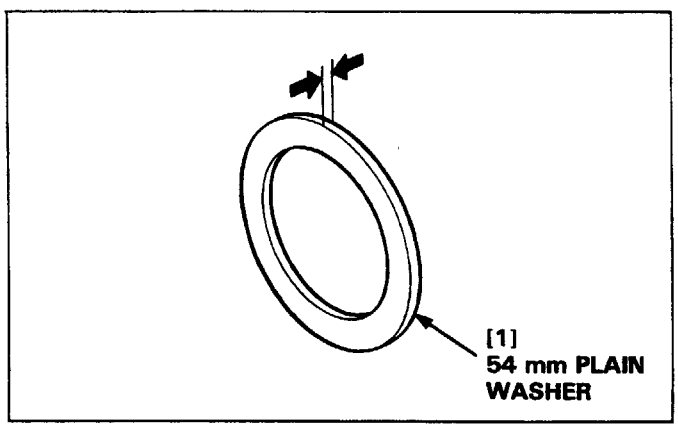
Unit: mm (in)

[1] Engagement mark on gear case	[2] Calculation value							
	0.20 (0.008) – 0.15 (0.006)	0.15 (0.006) – 0.10 (0.004)	0.10 (0.004) – 0.05 (0.002)	0.05 (0.002) – 0	0 – −0.05 (−0.002)	−0.05 (−0.002) – −0.10 (−0.004)	−0.10 (−0.004) – −0.15 (−0.006)	−0.15 (−0.006) – −0.20 (−0.008)
1	0.40 (0.016)	0.45 (0.018)	0.50 (0.020)	0.55 (0.022)	0.60 (0.024)	0.65 (0.026)	0.70 (0.028)	0.75 (0.030)
2	0.35 (0.014)	0.40 (0.016)	0.45 (0.018)	0.50 (0.020)	0.55 (0.022)	0.60 (0.024)	0.65 (0.026)	0.70 (0.028)
3	0.30 (0.012)	0.35 (0.014)	0.40 (0.016)	0.45 (0.018)	0.50 (0.020)	0.55 (0.022)	0.60 (0.024)	0.65 (0.026)
4	0.25 (0.010)	0.30 (0.012)	0.35 (0.014)	0.40 (0.016)	0.45 (0.018)	0.50 (0.020)	0.55 (0.022)	0.60 (0.024)
5	0.20 (0.008)	0.25 (0.010)	0.30 (0.012)	0.35 (0.014)	0.40 (0.016)	0.45 (0.018)	0.50 (0.020)	0.55 (0.022)
6	0.15 (0.006)	0.20 (0.008)	0.25 (0.010)	0.30 (0.012)	0.35 (0.014)	0.40 (0.016)	0.45 (0.018)	0.50 (0.020)

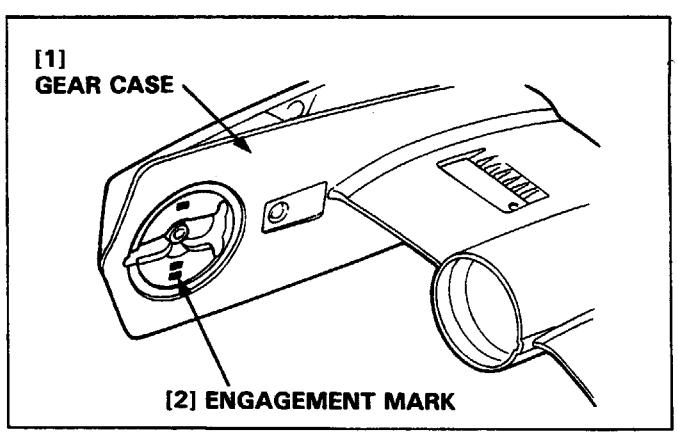
Refer to pages 11-18 and 19 for how to read shim selection table and shim combination.

• REVERSE GEAR SHIM

1) Measure the thickness of the 54 mm plain washer using a micro-meter.
   The calculation value can be obtained by subtracting 4 mm (0.2 in) from the washer thickness.
   Example:
   When washer thickness is 3.8 mm (0.15 in);
   3.8 – 4 = −0.2
   Therefore, the calculation value is −0.2 mm (−0.008 in).



2) Cross reference the washer thickness and engagement mark located on the trim tab installation section of the gear case, and select the shim of the appropriate thickness from the shim selection table.



• **Shim type table**

Parts name	Parts number	Thickness
Reverse gear shim A	90538–ZV5–000	0.10 mm (0.0039 in)
Reverse gear shim B	90539–ZV5–000	0.15 mm (0.0060 in)
Reverse gear shim C	90540–ZV5–000	0.30 mm (0.0118 in)
Reverse gear shim D	90541–ZV5–000	0.50 mm (0.0197 in)

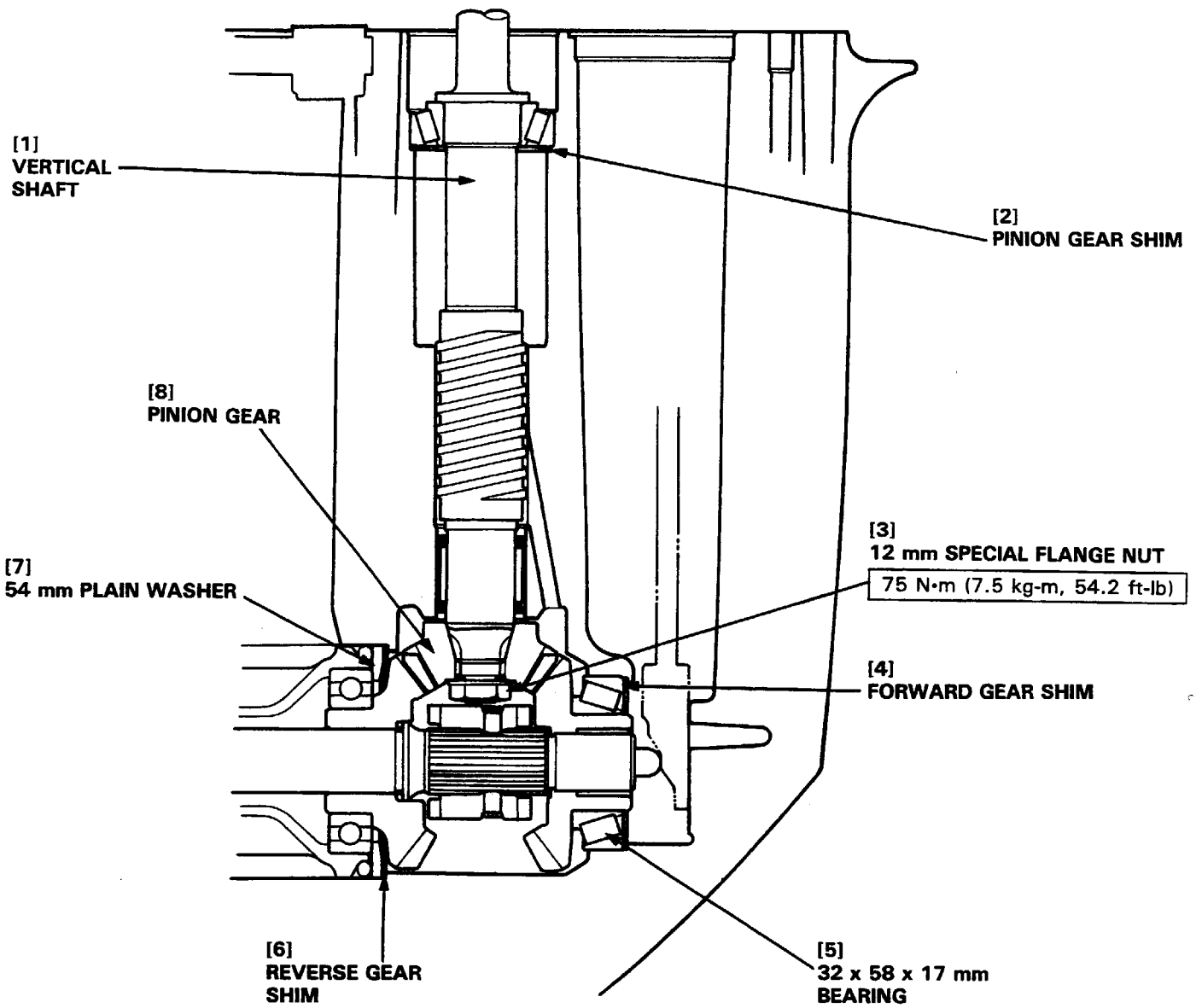
• **Shim selection table**

Unit: mm (in)

[1] Engagement mark on gear case	[2] Calculation value											
	0.30 (0.012)– 0.25 (0.010)	0.25 (0.010)– 0.20 (0.008)	0.20 (0.008)– 0.15 (0.006)	0.15 (0.006)– 0.10 (0.004)	0.10 (0.004)– 0.05 (0.002)	0.05 (0.002)– 0	0– –0.05 (–0.002)	–0.05 (–0.002)– –0.10 (–0.004)	–0.10 (–0.004)– –0.15 (–0.006)	–0.15 (–0.006)– –0.20 (–0.008)	–0.20 (–0.008)– –0.25 (–0.010)	–0.25 (–0.010)– –0.30 (–0.012)
A	0.40 (0.016)	0.45 (0.018)	0.50 (0.020)	0.55 (0.022)	0.60 (0.024)	0.65 (0.026)	0.70 (0.028)	0.75 (0.030)	0.80 (0.031)	0.85 (0.033)	0.90 (0.035)	0.95 (0.037)
B	0.35 (0.014)	0.40 (0.016)	0.45 (0.018)	0.50 (0.020)	0.55 (0.022)	0.60 (0.024)	0.65 (0.026)	0.70 (0.028)	0.75 (0.030)	0.80 (0.031)	0.85 (0.033)	0.90 (0.035)
C	0.30 (0.012)	0.35 (0.014)	0.40 (0.016)	0.45 (0.018)	0.50 (0.020)	0.55 (0.022)	0.60 (0.024)	0.65 (0.026)	0.70 (0.028)	0.75 (0.030)	0.80 (0.031)	0.85 (0.033)
D	0.25 (0.010)	0.30 (0.012)	0.35 (0.014)	0.40 (0.016)	0.45 (0.018)	0.50 (0.020)	0.55 (0.022)	0.60 (0.024)	0.65 (0.026)	0.70 (0.028)	0.75 (0.030)	0.80 (0.031)
E	0.20 (0.008)	0.25 (0.010)	0.30 (0.012)	0.35 (0.014)	0.40 (0.016)	0.45 (0.018)	0.50 (0.020)	0.55 (0.022)	0.60 (0.024)	0.65 (0.026)	0.70 (0.028)	0.75 (0.030)
F	0.15 (0.006)	0.20 (0.008)	0.25 (0.010)	0.30 (0.012)	0.35 (0.014)	0.40 (0.016)	0.45 (0.018)	0.50 (0.020)	0.55 (0.022)	0.60 (0.024)	0.65 (0.026)	0.70 (0.028)

Refer to pages 11-18 and 19 for how to read shim selection table and shim combination.

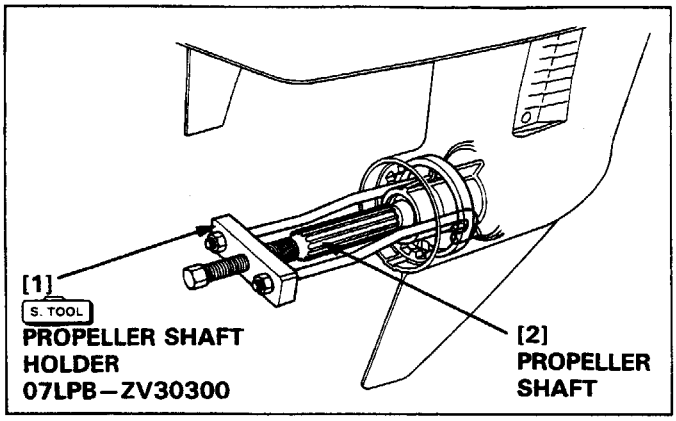
SHIM POSITION



BACKLASH ADJUSTMENT

• FORWARD GEAR

After selecting the shim(s), remove the water pump and water screen (see page 11-10 and 16) and install the following parts on the gear case securely.
— Vertical shaft/bevel gear (page 11-12)
— Propeller shaft/propeller shaft holder (page 11-5)
— Propeller/propeller shaft holder assembly (page 11-2)



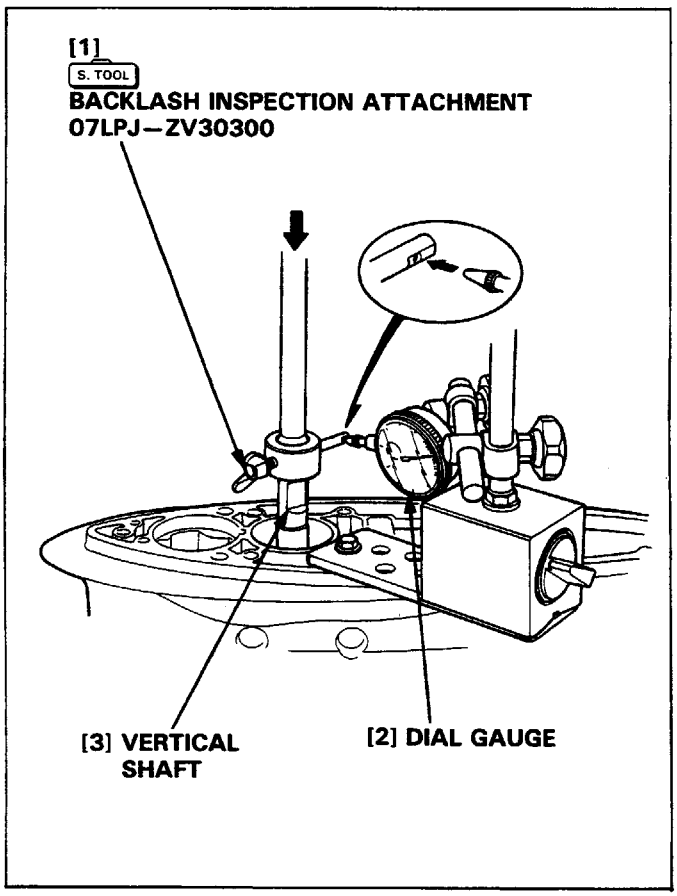
1) Hold the propeller shaft securely with the special tool as shown.
TOOL:
Propeller shaft holder **07LPB–ZV30300**

2) Set the special tool on the vertical shaft as shown and attach the tip of the dial gauge to the special tool.
TOOL:
Backlash inspection attachment **07LPJ–ZV30300**

3) Turn the vertical shaft right and left while pressing it down with approximately 5 kg (11.0 lb) of force and measure the backlash.

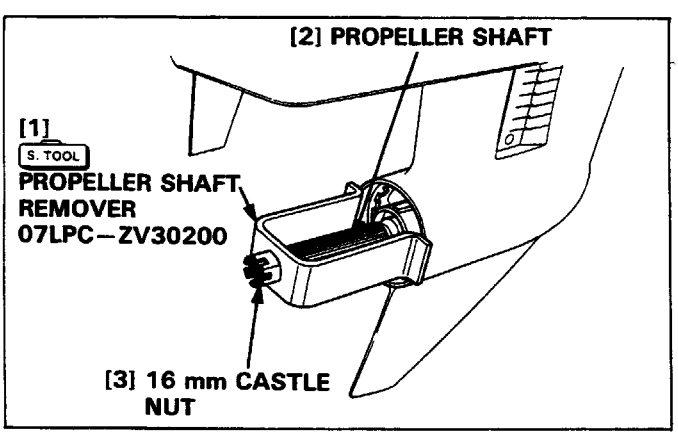
Standard	0.11–0.34 mm (0.0043–0.0134 in)

4) If the backlash is too large, increase the forward gear shim thickness and recheck the backlash.
If the backlash is too small, decrease the forward gear shim thickness and recheck the backlash.



• REVERSE GEAR

1) Hold the propeller shaft securely with the special tool and 16 mm castle nut as shown.
TOOL:
Propeller shaft remover: **07LPC–ZV30200**

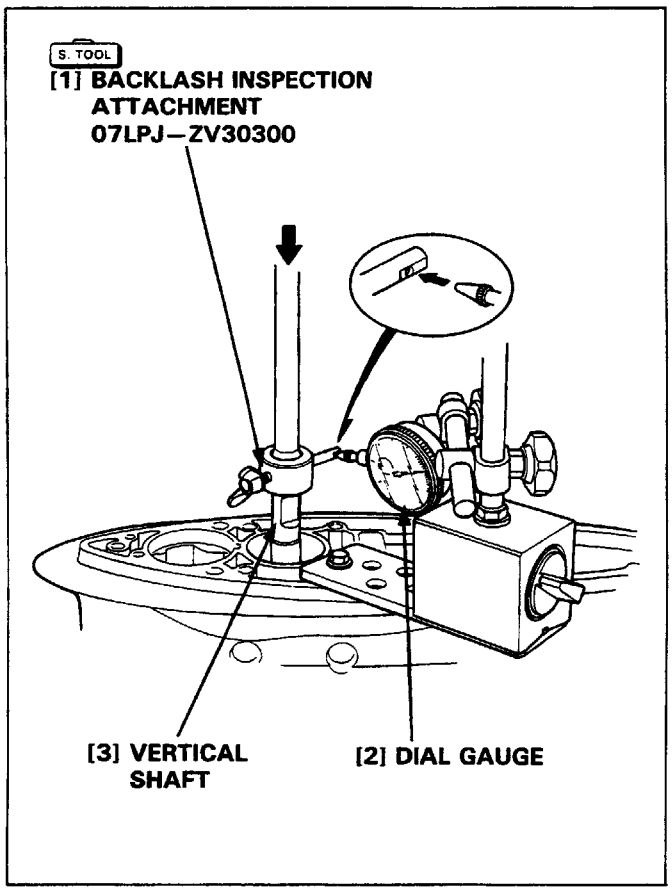


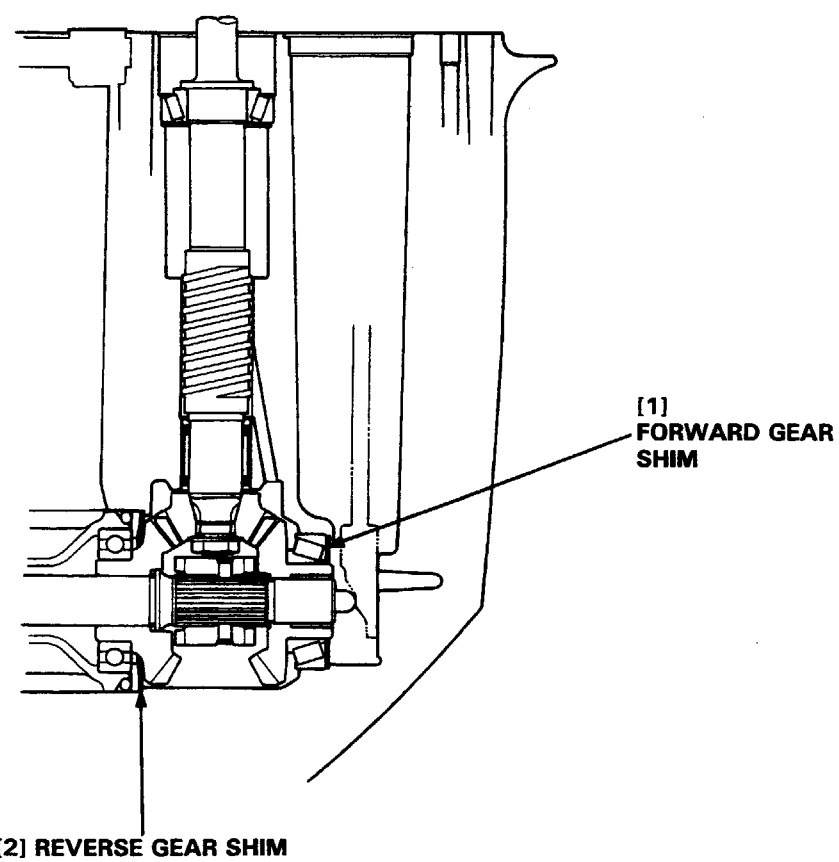
2) Set the special tool on the vertical shaft as shown and attach the tip of the dial gauge to the special tool.
TOOL:
Backlash inspection attachment **07LPJ—ZV30300**

3) Turn the vertical shaft right and left while pressing it down with approximately 5 kg (11.0 lb) of force and measure the backlash.

Standard	0.11—0.34 mm (0.0043—0.0134 in)

4) If the backlash is too large, increase the reverse gear shim thickness and recheck the backlash.
If the backlash is too small, decrease the reverse gear shim thickness and recheck the backlash.



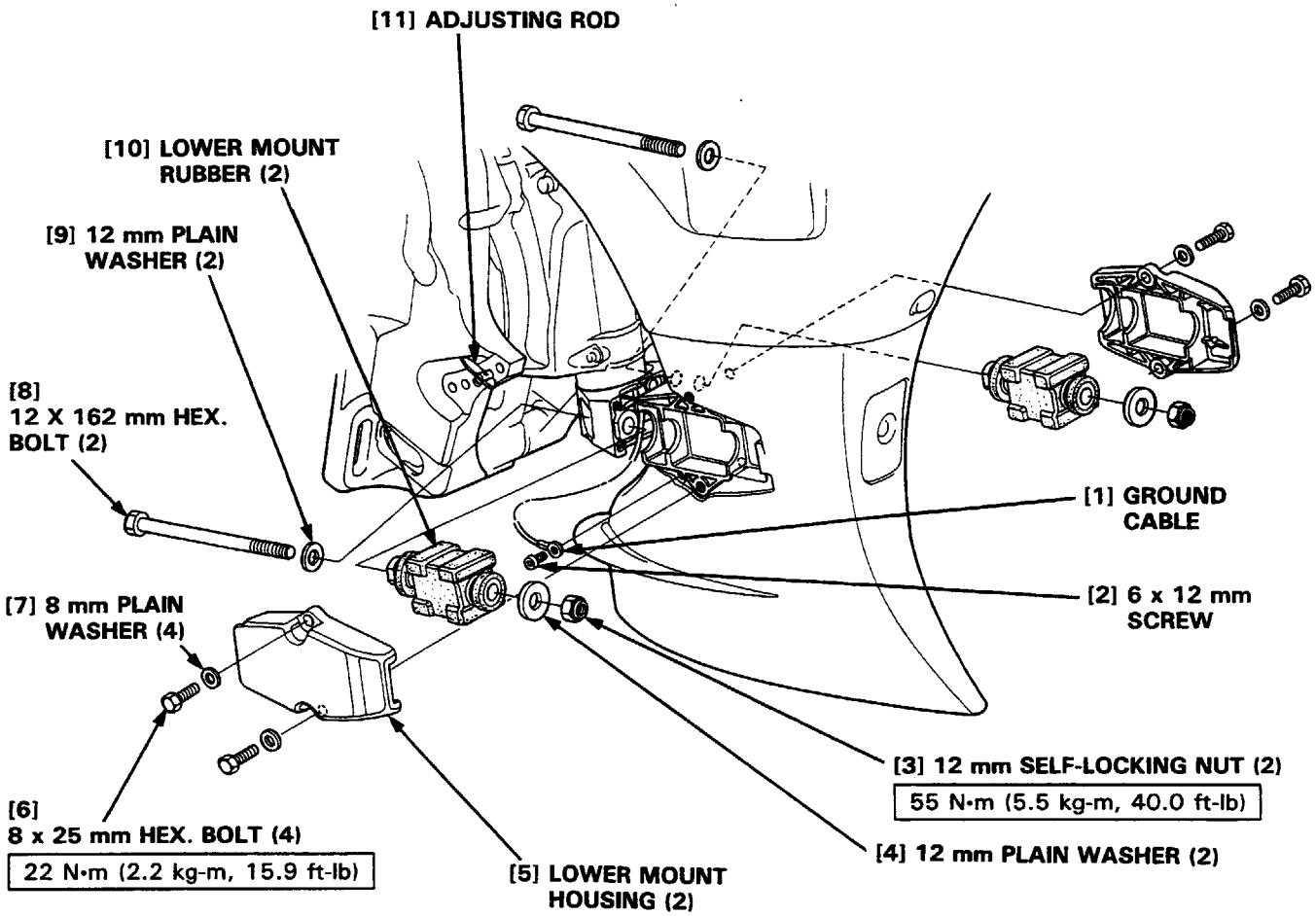


EXTENSION CASE/UNDER COVER

a. DISASSEMBLY/REASSEMBLY

• LOWER MOUNT RUBBER

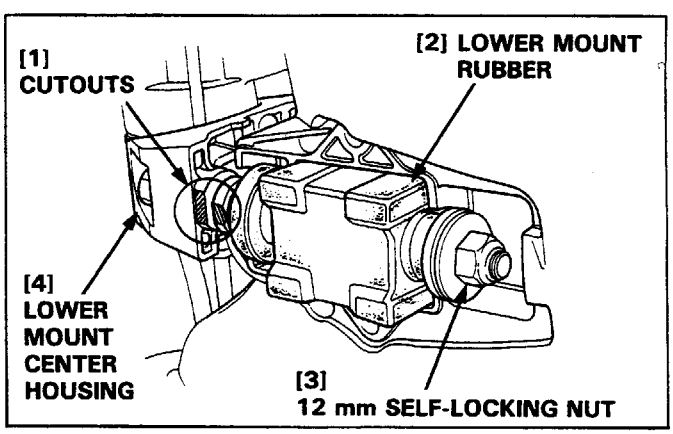
1) Remove the gear case assembly (P. 11-9).
2) Set the adjusting rod in the second hole from the rear as shown.



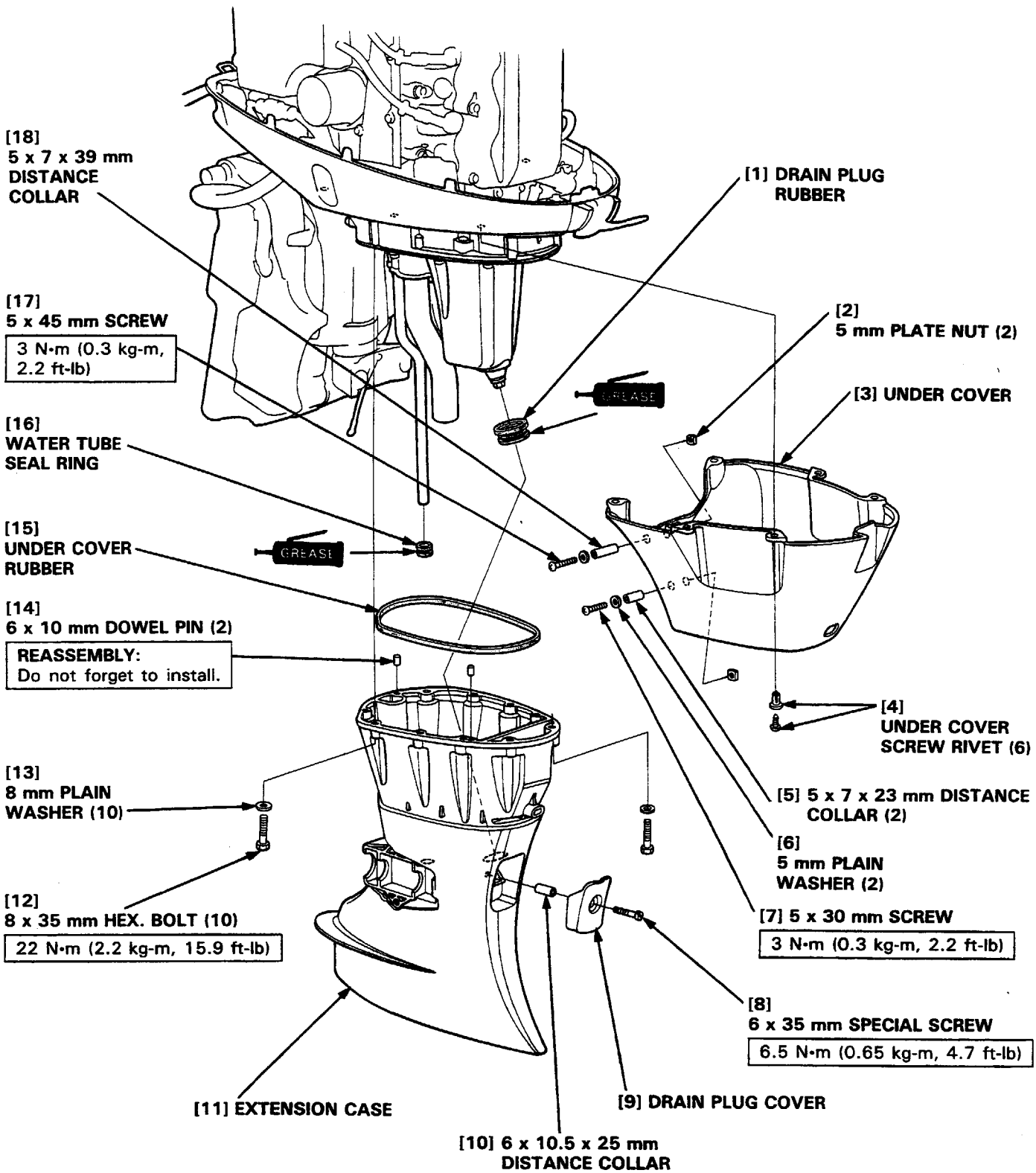
• LOWER MOUNT RUBBER

INSTALLATION:
Install the lower mount rubber by aligning its cutout with the cutout in the lower mount center housing, then tighten the self-locking nut securely.

TORQUE: 55 N·m (5.5 kg-m, 40.0 ft-lb)



• EXTENSION COVER/UNDER COVER



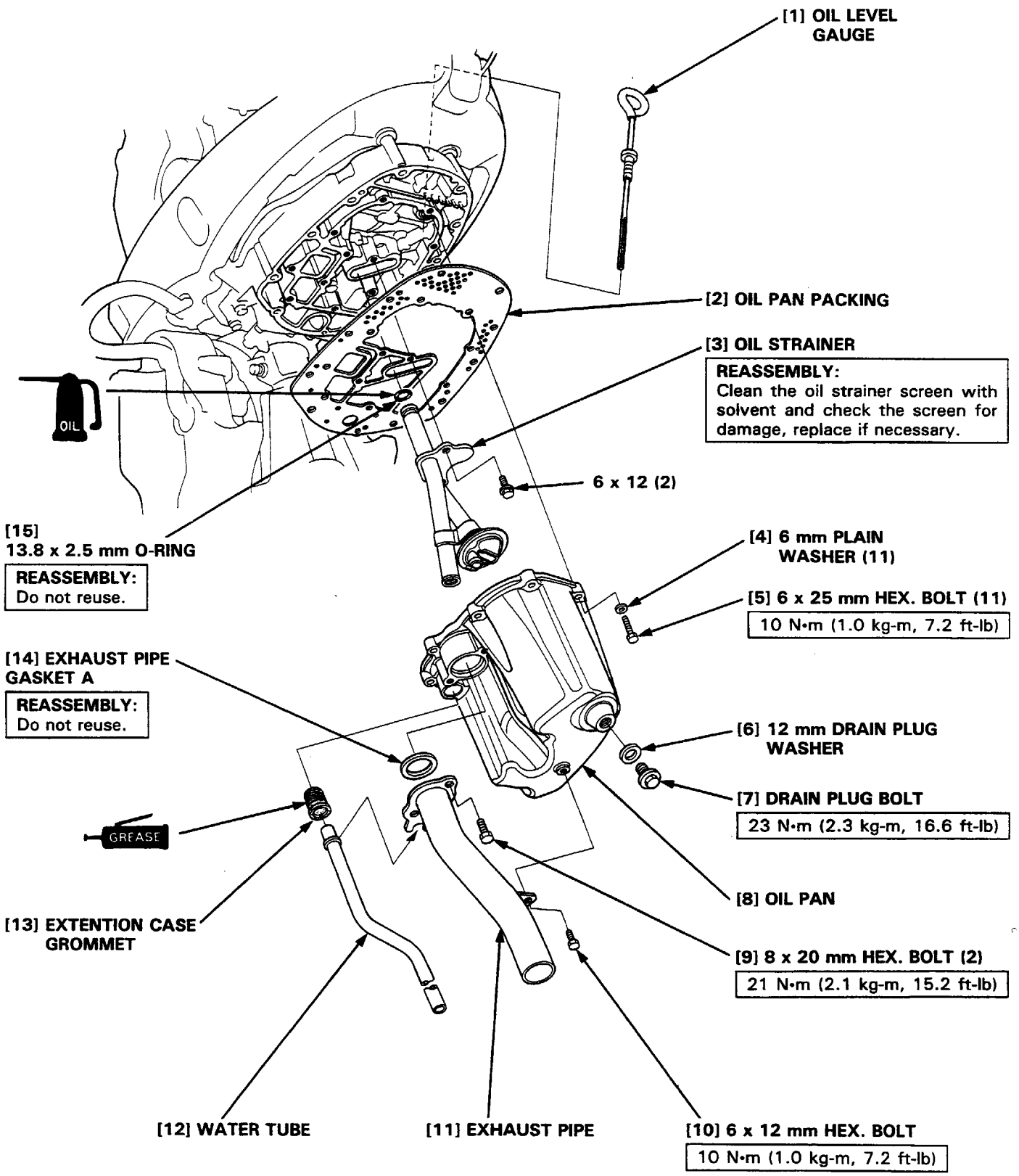
OIL PAN/PRIMARY GEAR CASE/SWIVEL CASE

1

OIL PAN/MUFFLER

a. DISASSEMBLY/REASSEMBLY

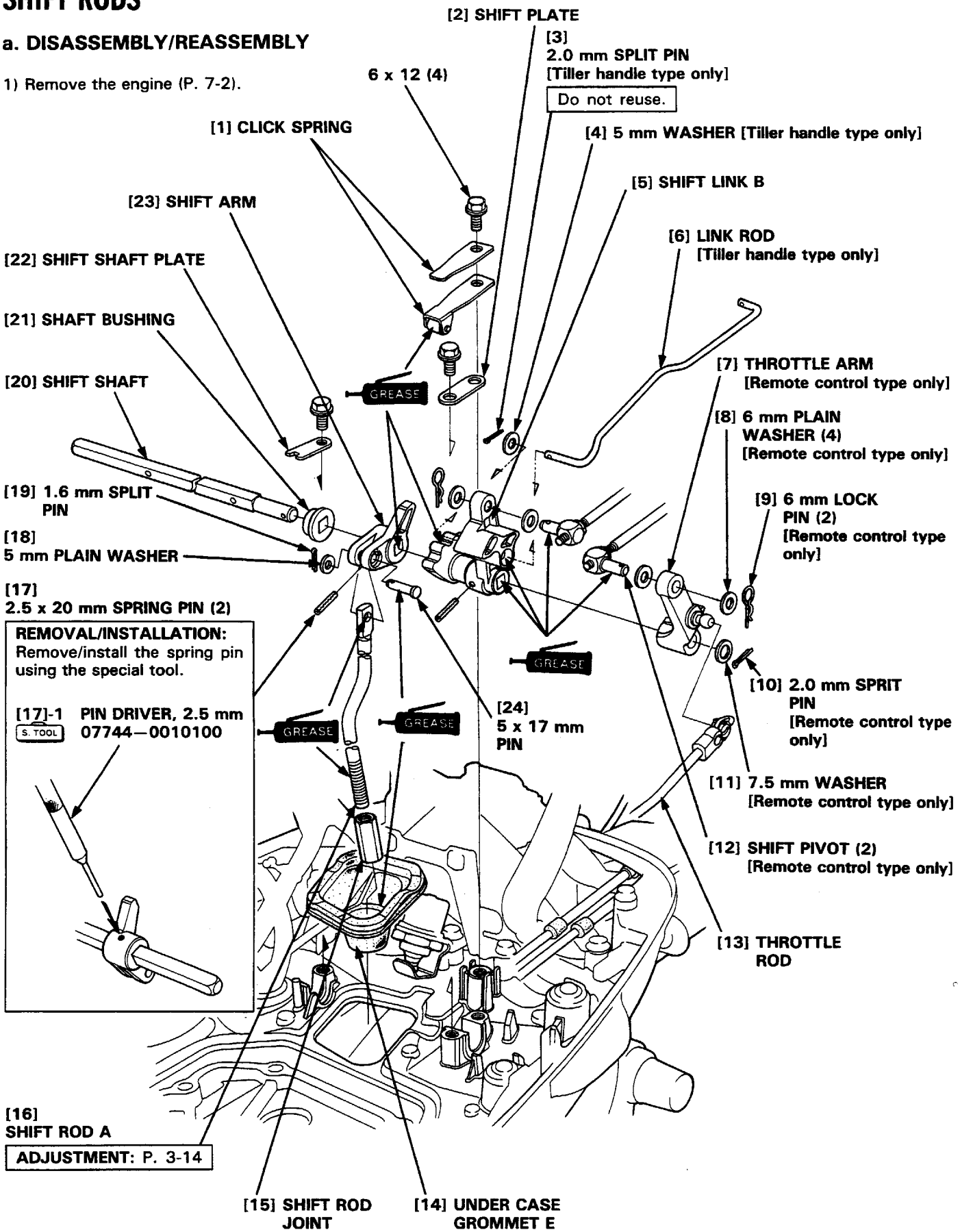
1) Remove the extension case assembly (P. 7-2).



SHIFT RODS

a. DISASSEMBLY/REASSEMBLY

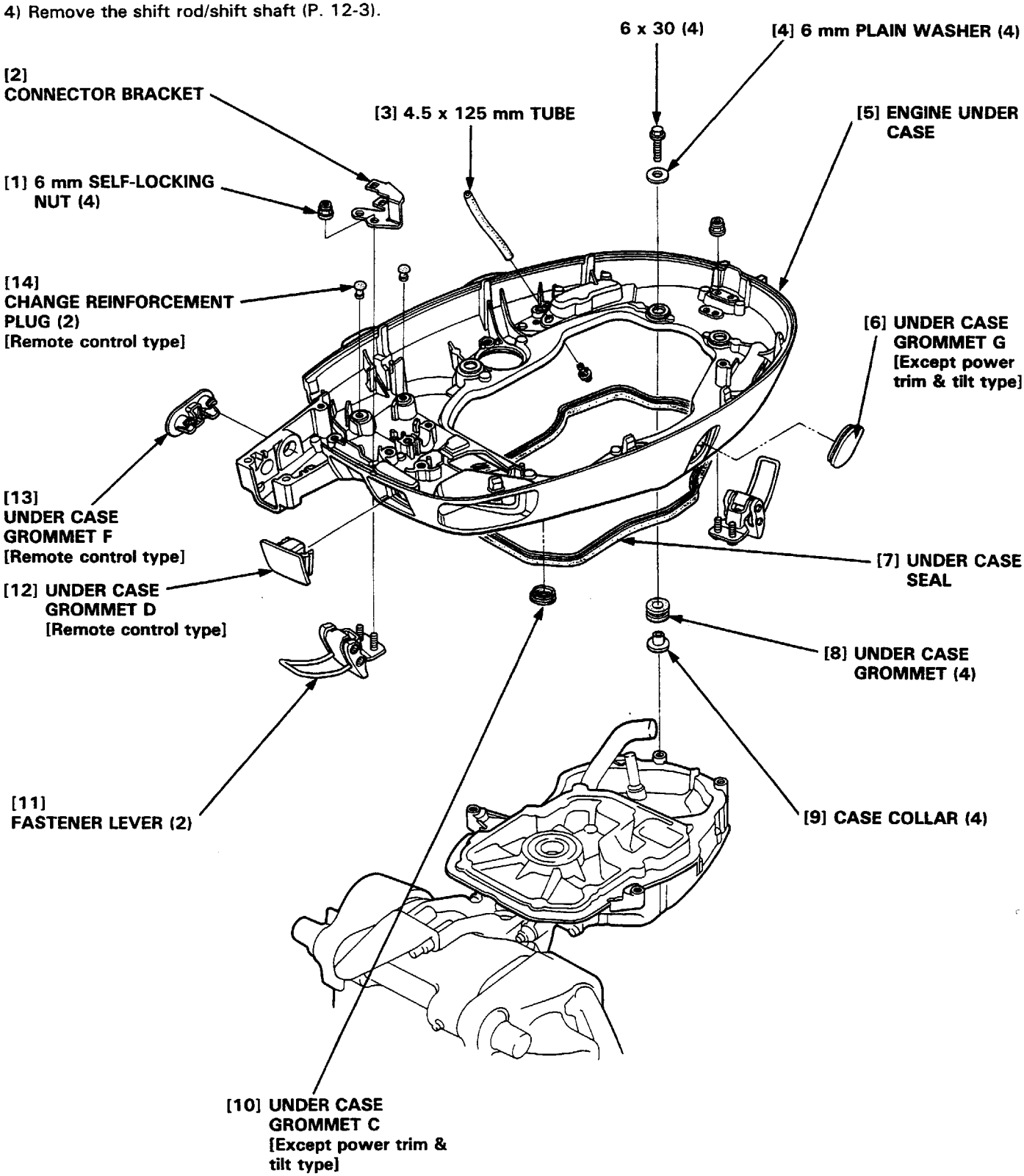
1) Remove the engine (P. 7-2).



ENGINE UNDER CASE

a. DISASSEMBLY/REASSEMBLY

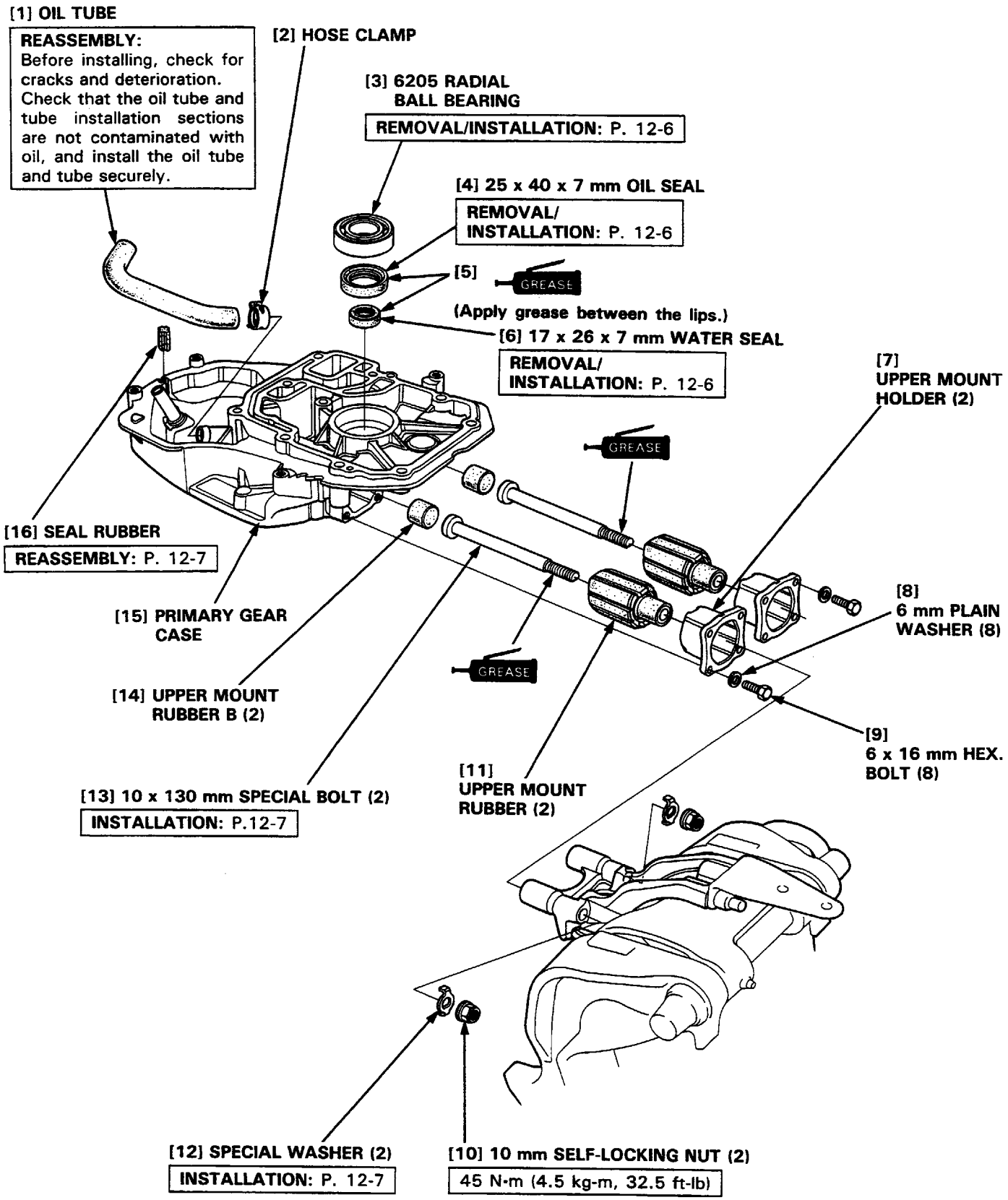
1) Remove the engine (P. 7-2).
2) Remove the handlebar (P. 15-5) [Tiller handle type only]
3) Remove the electric parts (P. 16-12).
4) Remove the shift rod/shift shaft (P. 12-3).



PRIMARY GEAR CASE

a. DISASSEMBLY/REASSEMBLY

1) Remove the engine under case (P. 12-4).

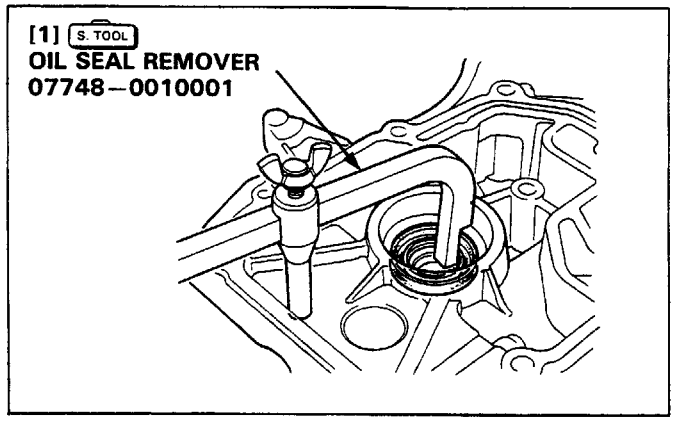


• 25 x 40 x 7 mm OIL SEAL/17 x 26 x 7 mm WATER SEAL

REMOVAL:
Remove the oil seal/water seal by using the special tool as shown.

TOOL:

Oil seal remover	**07748—0010001**



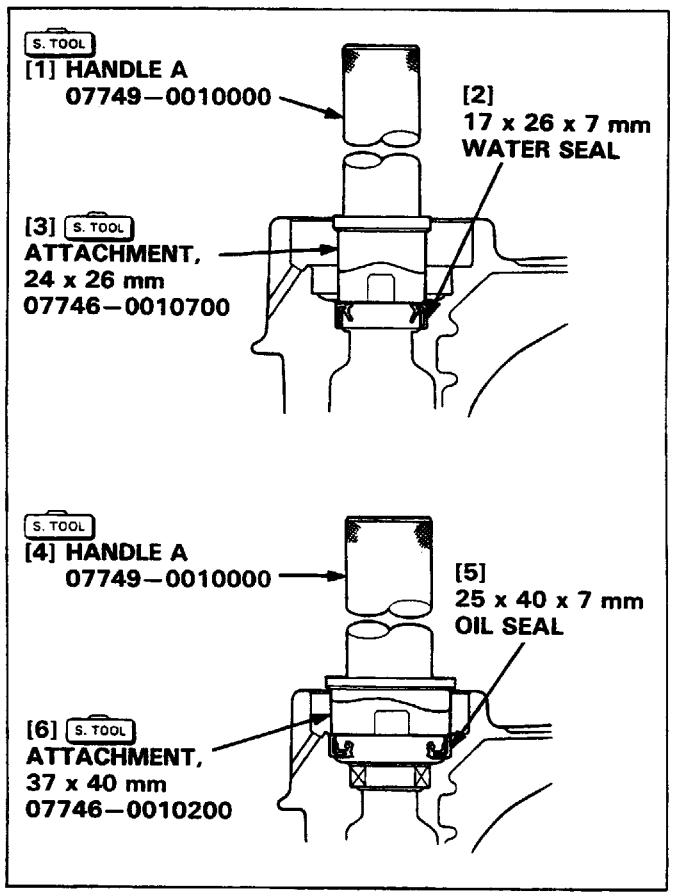
INSTALLATION:
Drive the oil seal/water seal into the primary gear case by using the special tools as shown.

TOOLS:

17 x 26 x 7 mm WATER SEAL	
Handle A	**07749—0010000**
Attachment, 24 x 26 mm	**07746—0010700**
25 x 40 x 7 mm OIL SEAL	
Handle A	**07749—0010000**
Attachment, 37 x 40 mm	**07746—0010200**

NOTE

- Install the oil seal and water seal in the direction as shown.

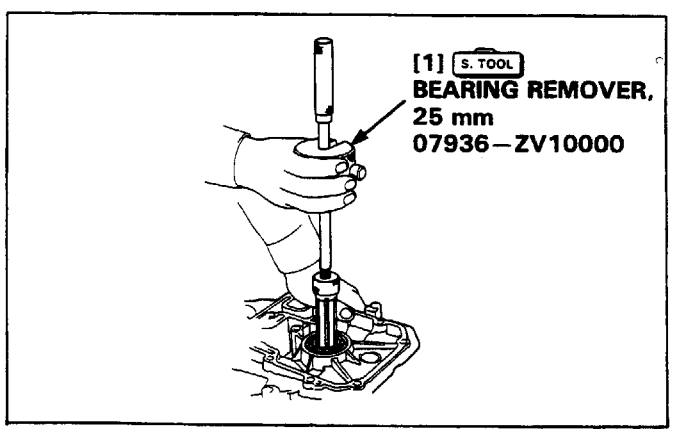


• 6205 RADIAL BALL BEARING

REMOVAL:
Remove the bearing by using the special tool as shown.

TOOL:

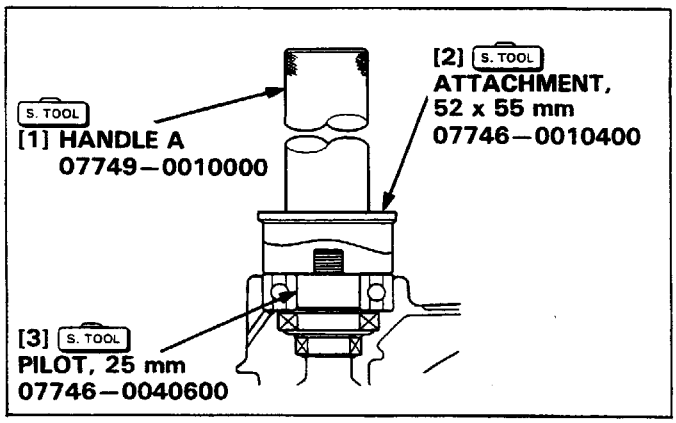
Bearing remover, 25 mm	**07936—ZV10000**



INSTALLATION:
Drive the bearing into the primary gear case using the special tools as shown.

TOOLS:

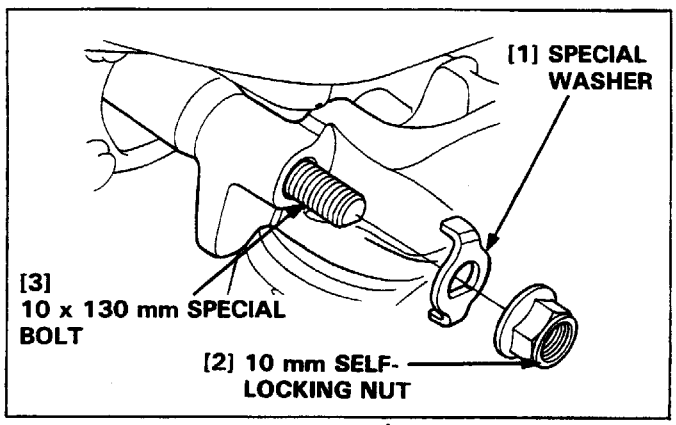
Handle A	**07749–0010000**
Attachment, 52 x 55 mm	**07746–0010400**
Pilot, 25 mm	**07746–0040600**



• 10 x 130 mm SPECIAL BOLT/SPECIAL WASHER

INSTALLATION:
Install the 10 x 130 mm special bolt/special washer with the cutout toward down and tighten the 10 mm self-locking nut.

TORQUE: 45 N·m (4.5 kg-m, 32.5 ft-lb)

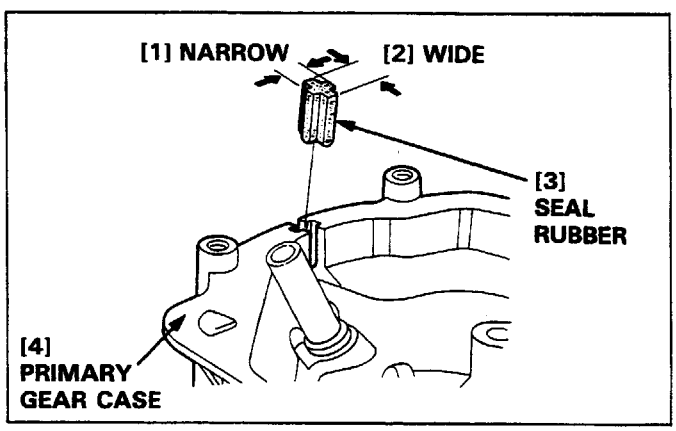


• SEAL RUBBER

REASSEMBLY:
Install the seal rubber in the primary gear case with the narrower side facing the front as shown.

NOTE

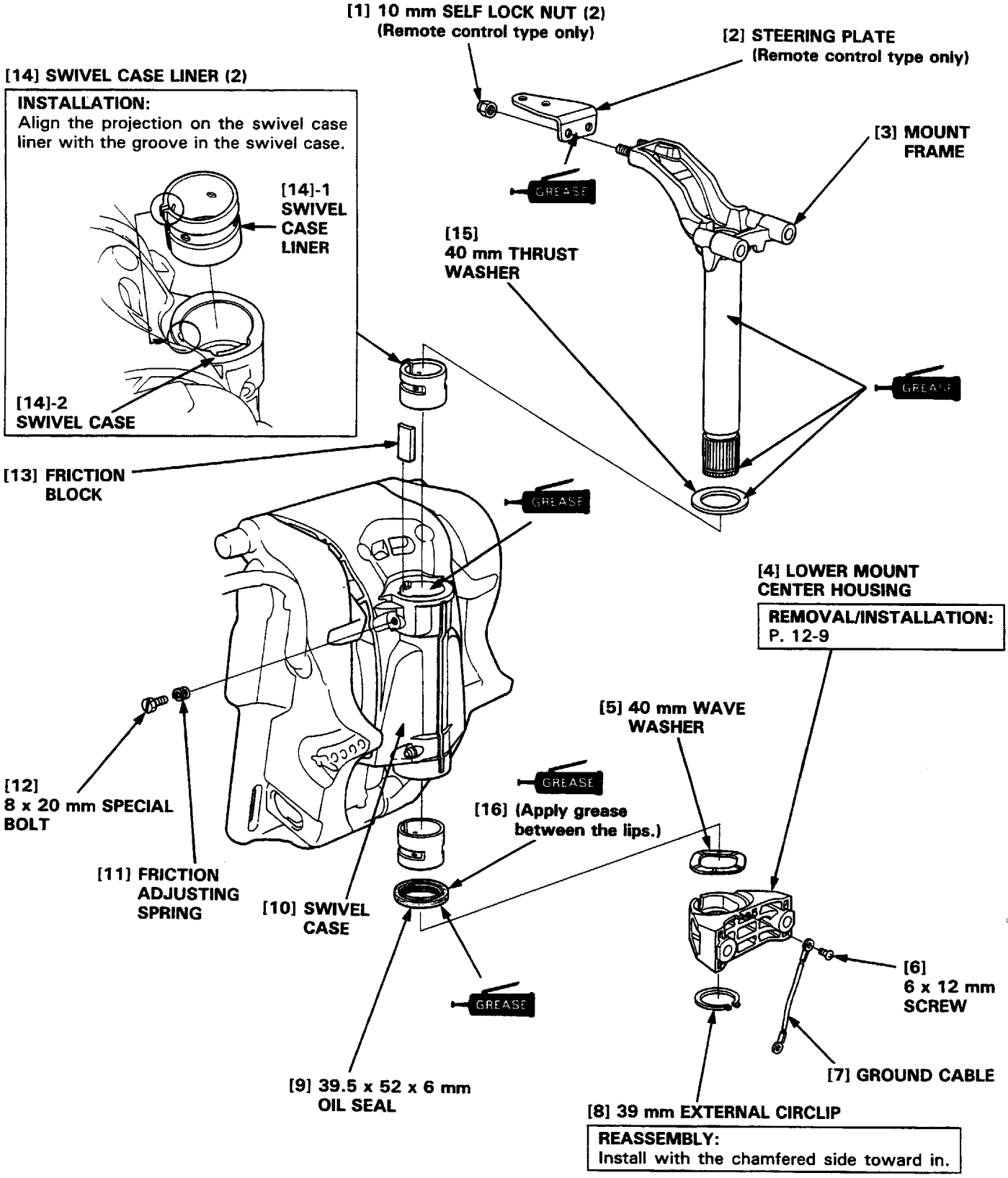
- Install the seal rubber with the narrower side facing the front, or the water can enter the primary gear case.



MOUNT FRAME

a. DISASSSEMBLY/REASSEMBLY

1) Remove the primary gear case (P. 12-5).



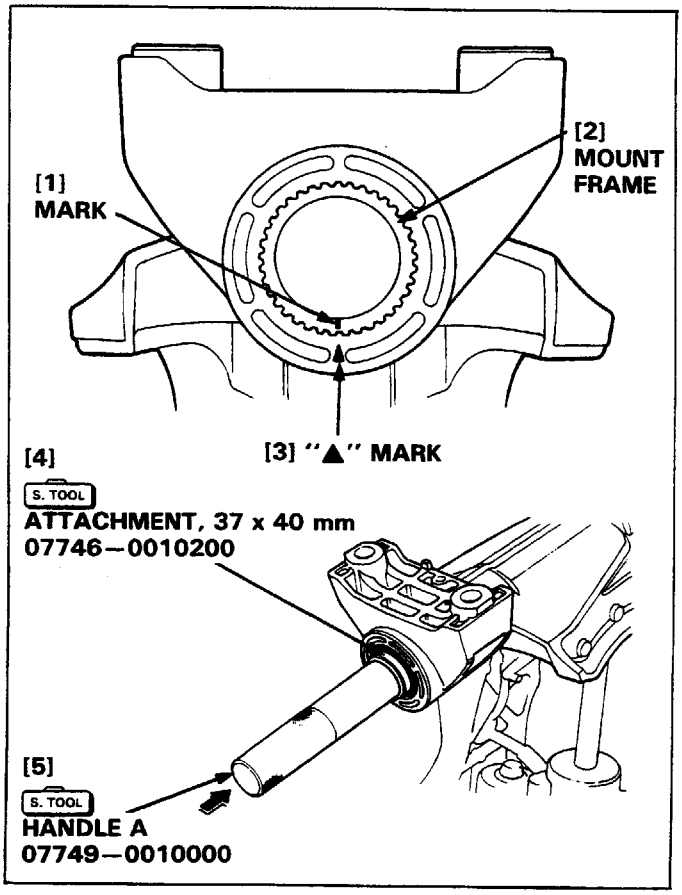
• LOWER MOUNT CENTER HOUSING

REMOVAL:

1) Remove the 39 mm external circlip.
2) Mark the mount frame so that it aligns with the "▲" mark on the lower mount center housing.
3) Drive the mount frame out of the lower mount center housing using the special tools.

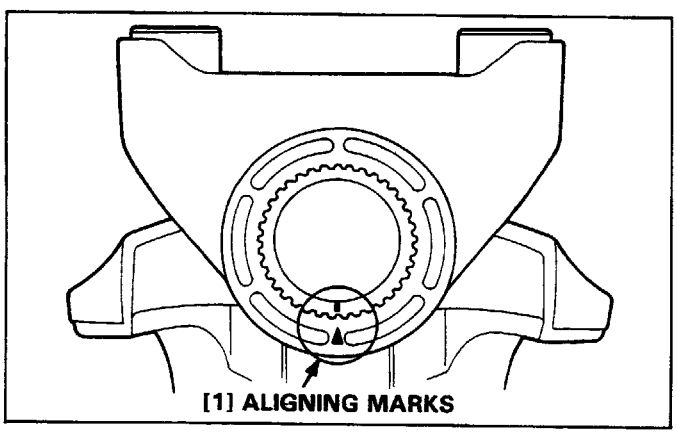
TOOLS:

Handle A	**07749–0010000**
Attachment, 37 x 40 mm	**07746–0010200**



INSTALLATION:

1) Install the mount frame on the swivel case.
2) Align the mark on the mount frame, which was marked on disassembly, with the "▲" mark on the lower mount center housing, and assemble them.

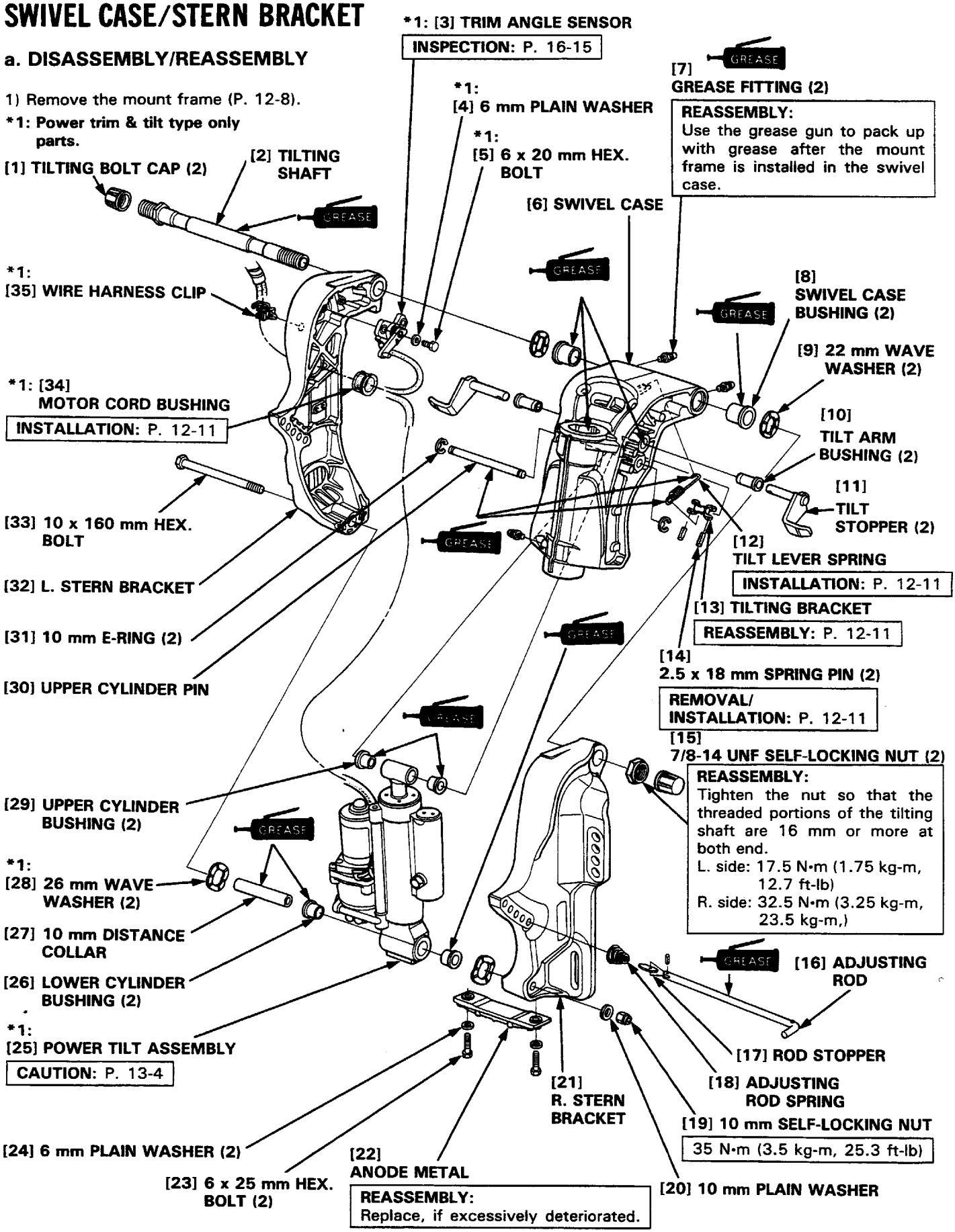


SWIVEL CASE/STERN BRACKET

a. DISASSEMBLY/REASSEMBLY

1) Remove the mount frame (P. 12-8).

*1: Power trim & tilt type only parts.



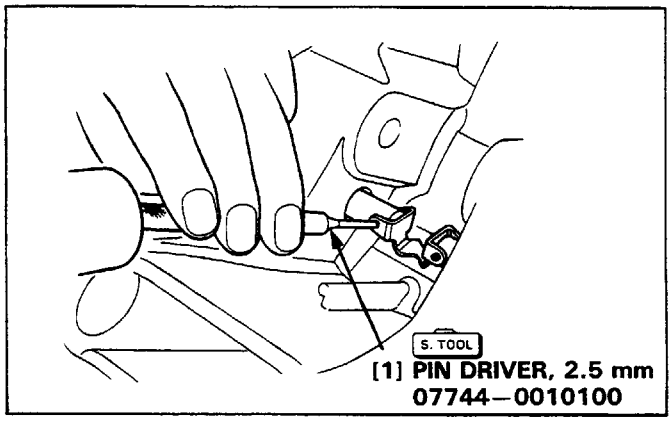
• 2.5 x 18 mm SPRING PIN

REMOVAL/INSTALLATION:

Remove/install the 2.5 x 18 mm spring pin by using the special tool.

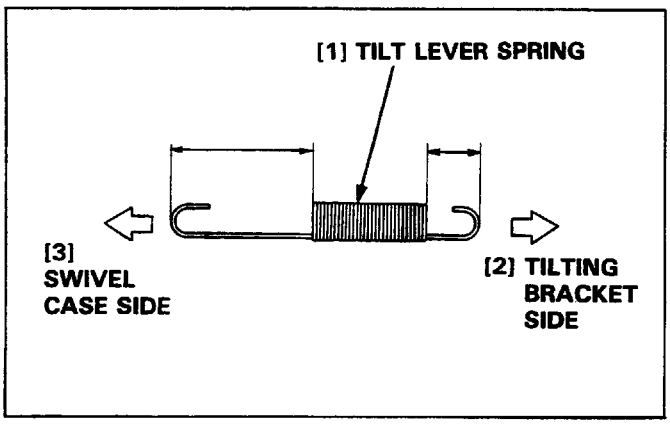
TOOL:

Pin driver, 2.5 mm	**07744—0010100**



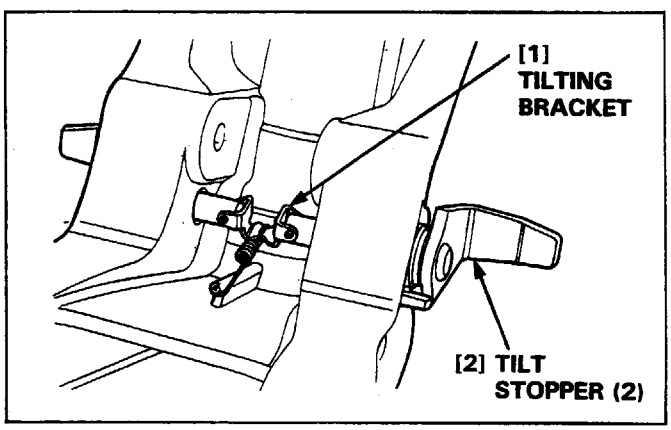
• TILT LEVER SPRING

INSTALLATION:
Install the shorter side of the hook so that it faces toward the tilting bracket.



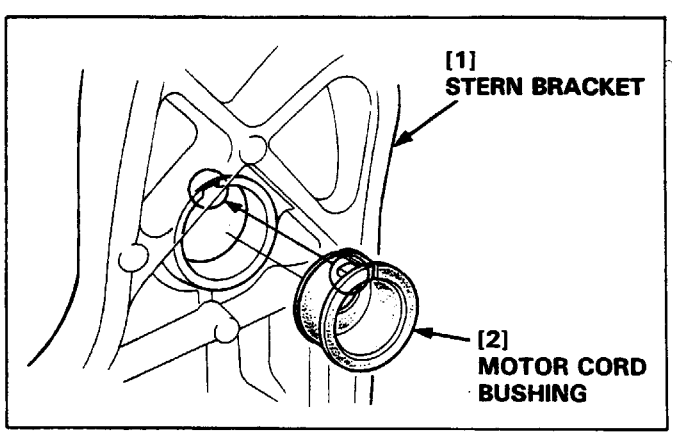
• TILTING BRACKET/TILT STOPPER

INSTALLATION:
Note the installation direction.



• MOTOR CORD BUSHING

INSTALLATION:
Align the projection on the motor cord bushing with the groove in the stern bracket.



GAS ASSISTED/POWER TILT

GAS ASSISTED ASSEMBLY (GAS ASSISTED TYPE)

a. DISASSEMBLY/REASSEMBLY

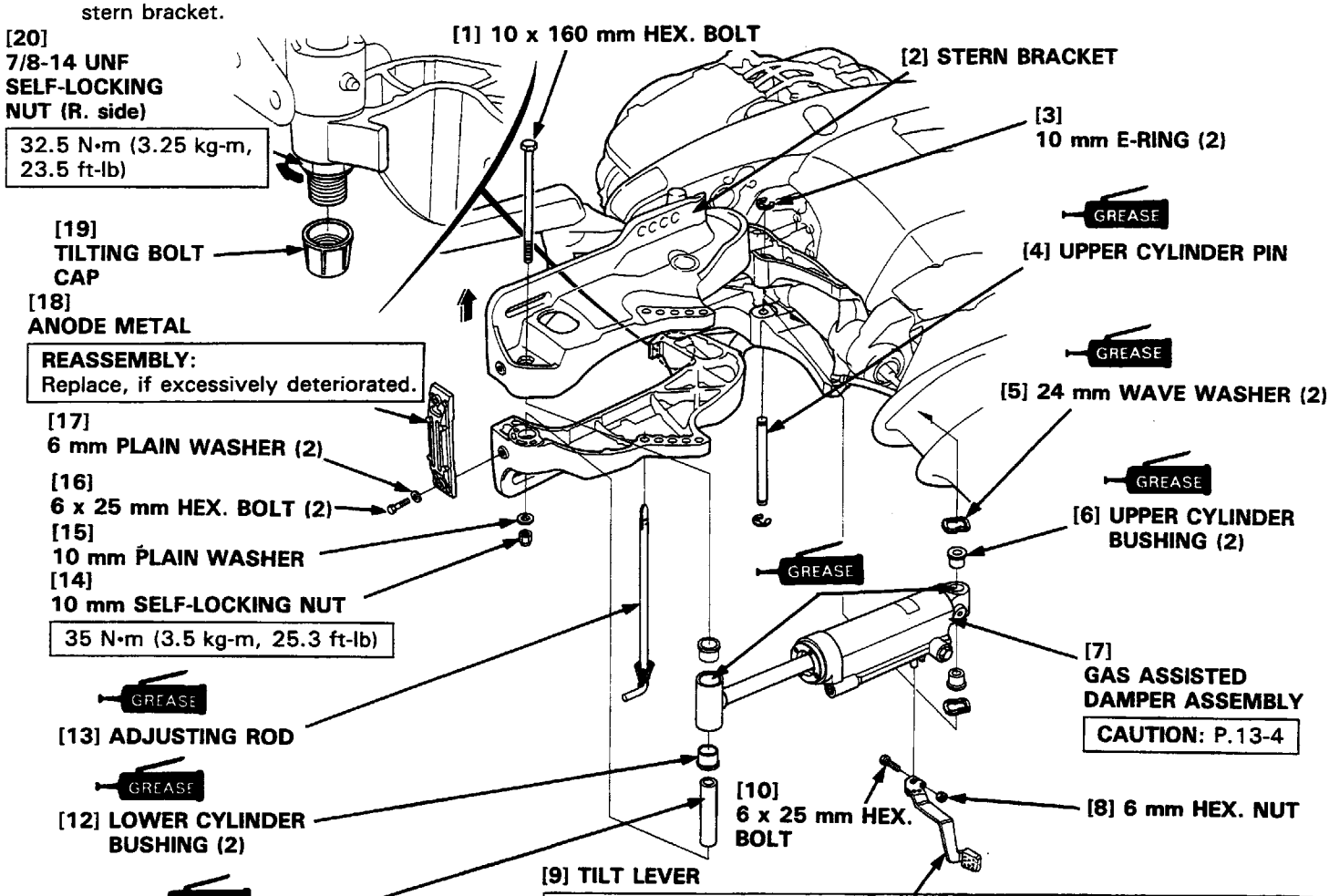
⚠ WARNING

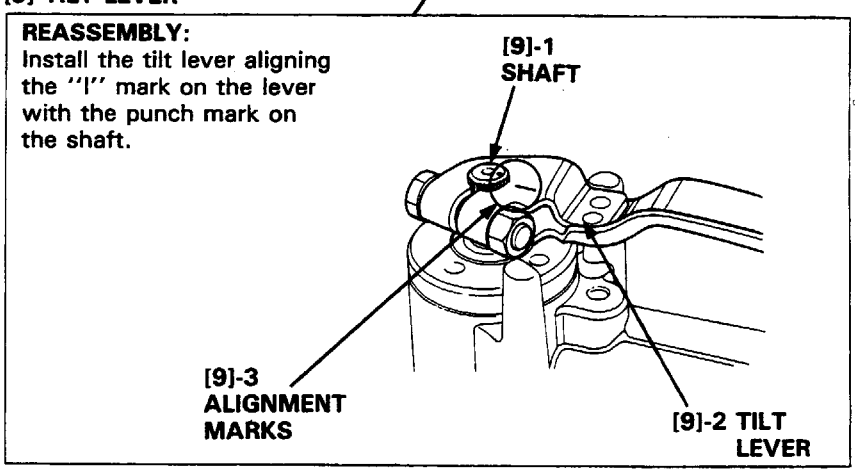
- **Do not disassemble the gas assisted damper assembly as it is filled with the high pressure gas.**

NOTE

- Disassembly/reassembly of the gas assisted assembly must be performed with the outboard motor laying on its right side. Raise the outboard motor to the uppermost position.

1) Remove the gas assisted damper assembly by removing the tilting bolt cap, loosening the self locking nut, and lifting the stern bracket.





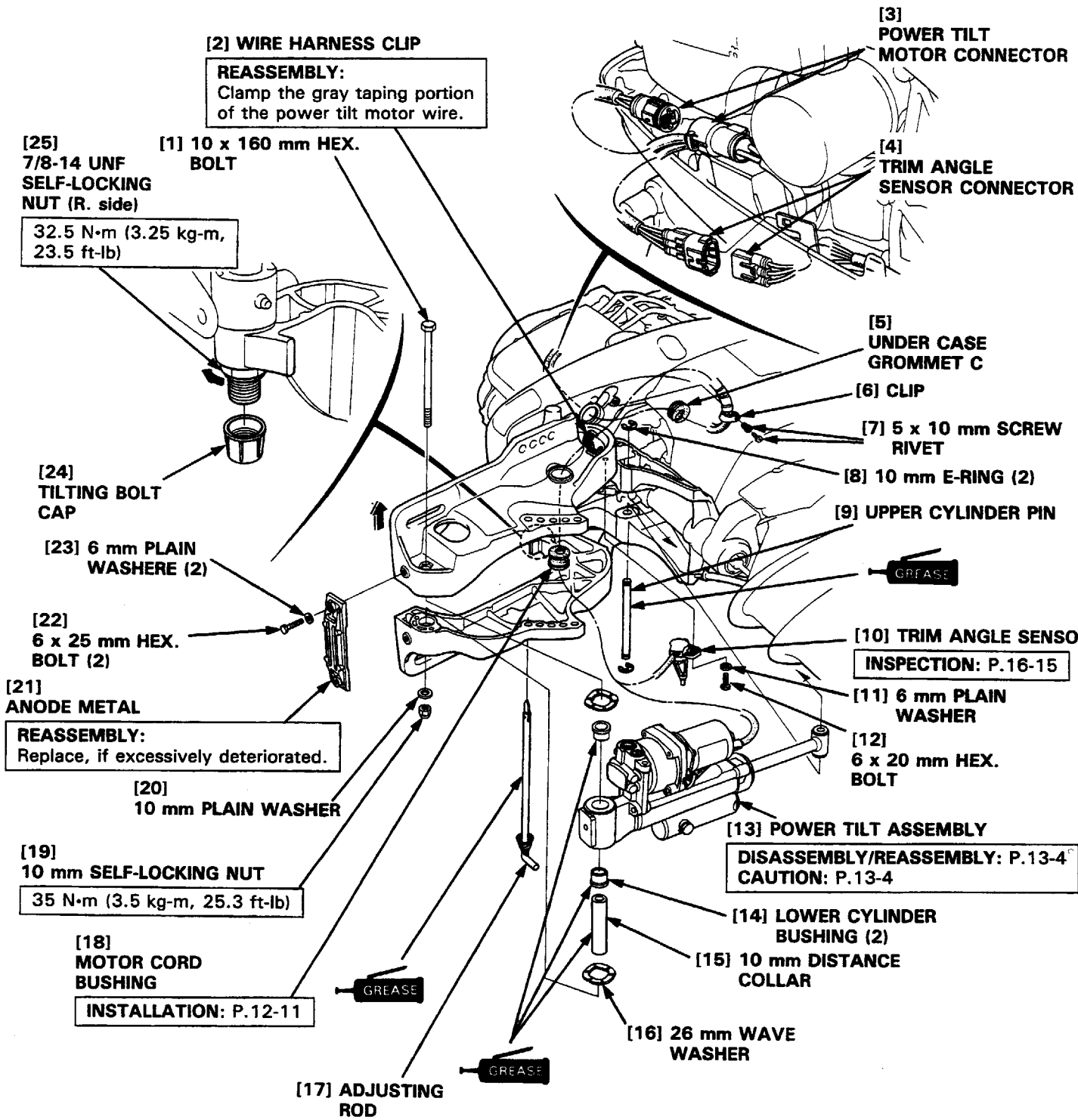
POWER TILT ASSEMBLY (POWER TRIM & TILT TYPE)

a. DISASSEMBLY/REASSEMBLY

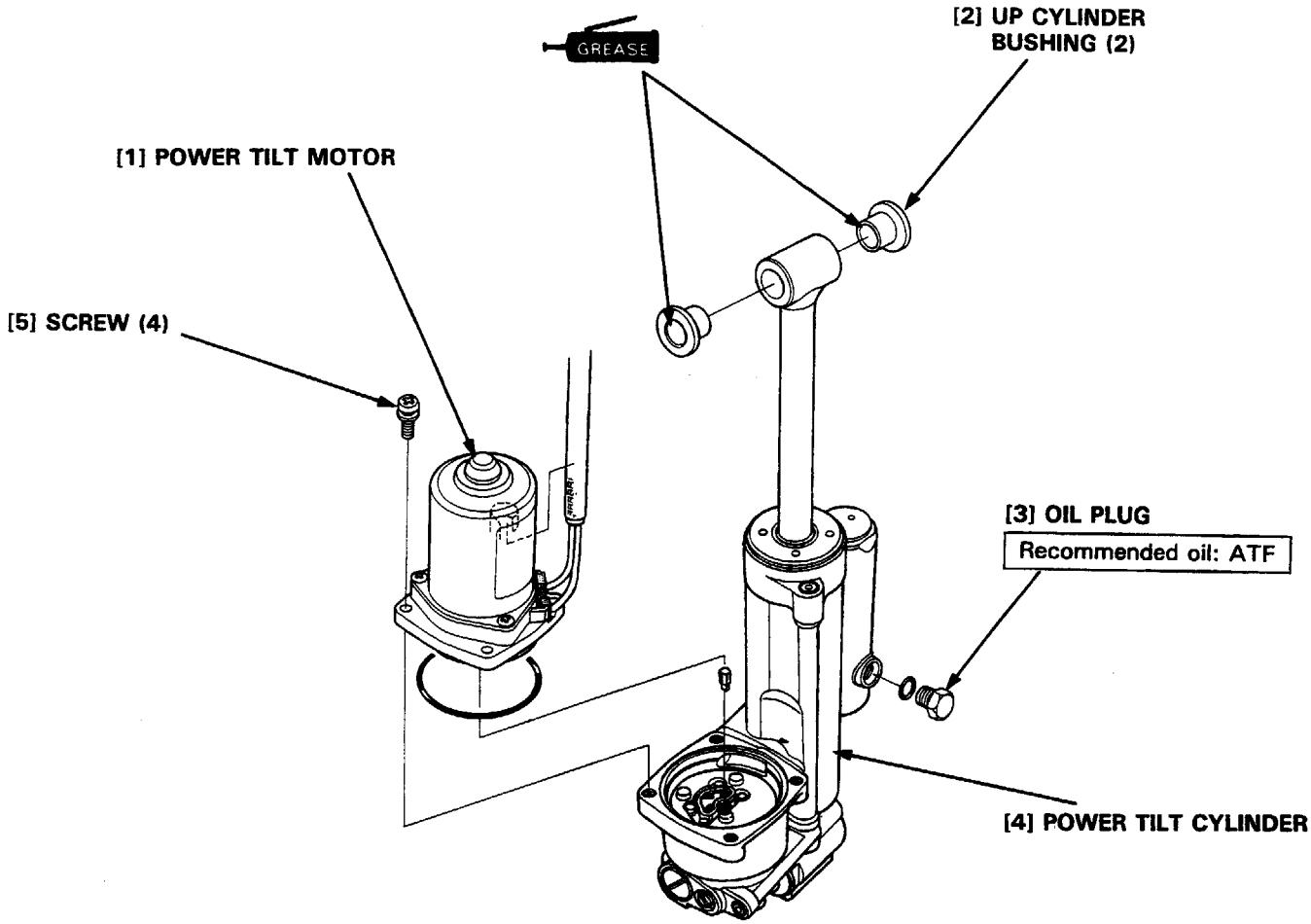
NOTE

- Disassembly/reassembly of the power tilt assembly must be performed with the outboard motor laying on its right side. Raise the outboard motor to the uppermost position.

1) Disconnect the trim angle sensor connectors and the power tilt motor connectors.
2) Remove the power tilt assembly by removing the tilting bolt cap, loosening the self lock nut, and lifting the stern bracket.



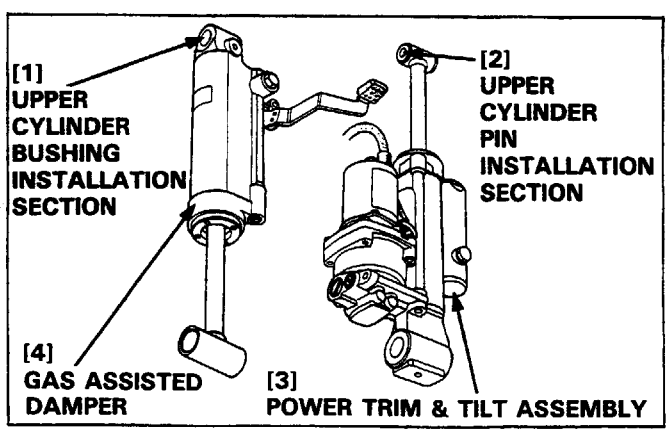
• POWER TILT ASSEMBLY



• GAS ASSISTED DAMPER/POWER TILT ASSEMBLY

CAUTION

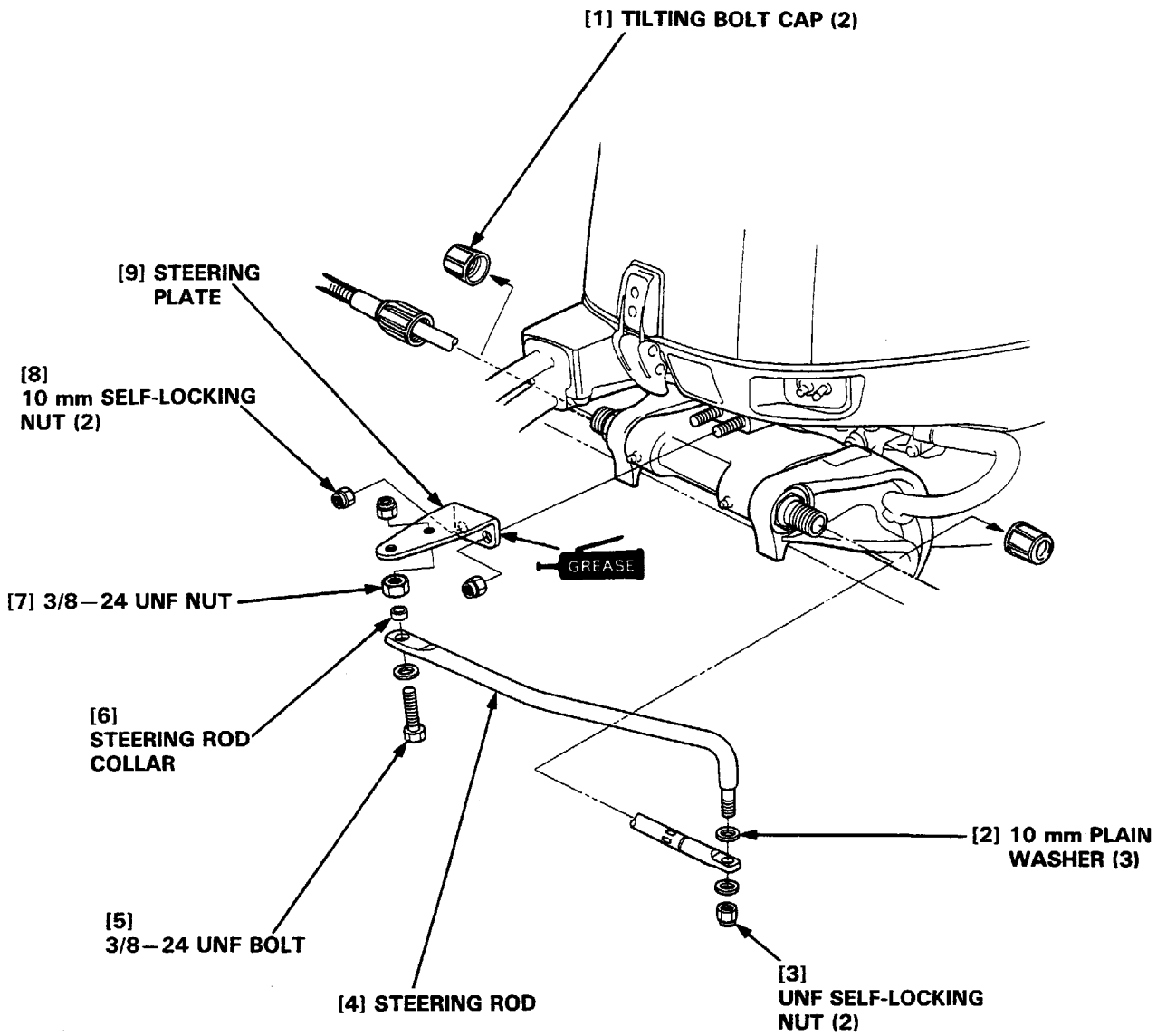
- Store the gas assisted damper assembly vertically with the upper cylinder bushing installation section toward up, as shown. Never store it horizontally or with the 10 mm distance collar installation section toward up.
  Store the power tilt assembly vertically with the upper cylinder pin installation section toward up, as shown. Never store it horizontally or with the 10 mm distance collar installation section toward up.



STEERING ROD/REMOTE CONTROL BOX (REMOTE CONTROL TYPE ONLY)

STEERING ROD

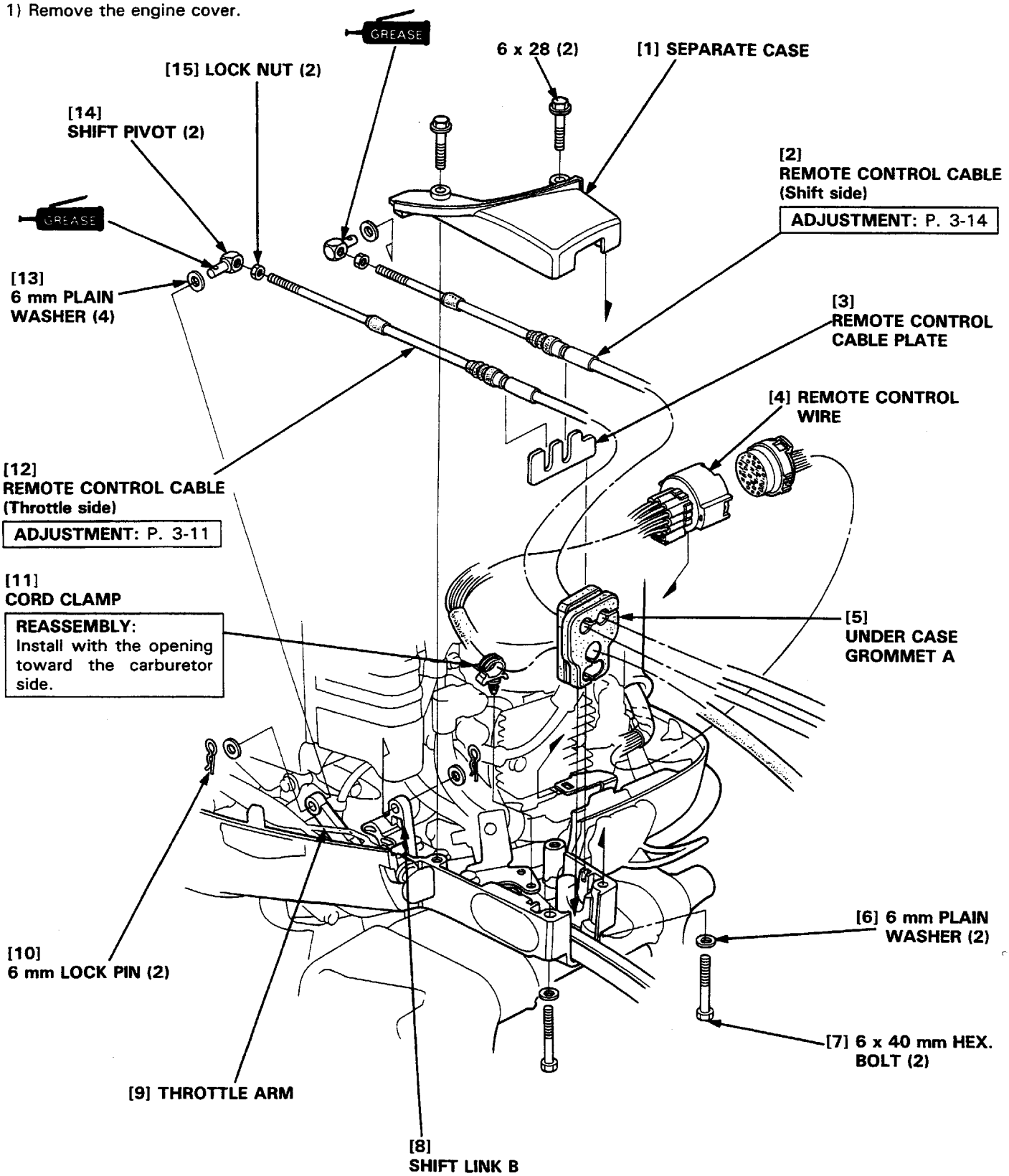
a. DISASSEMBLY/REASSEMBLY



REMOTE CONTROL CABLE

a. DISASSEMBLY/REASSEMBLY

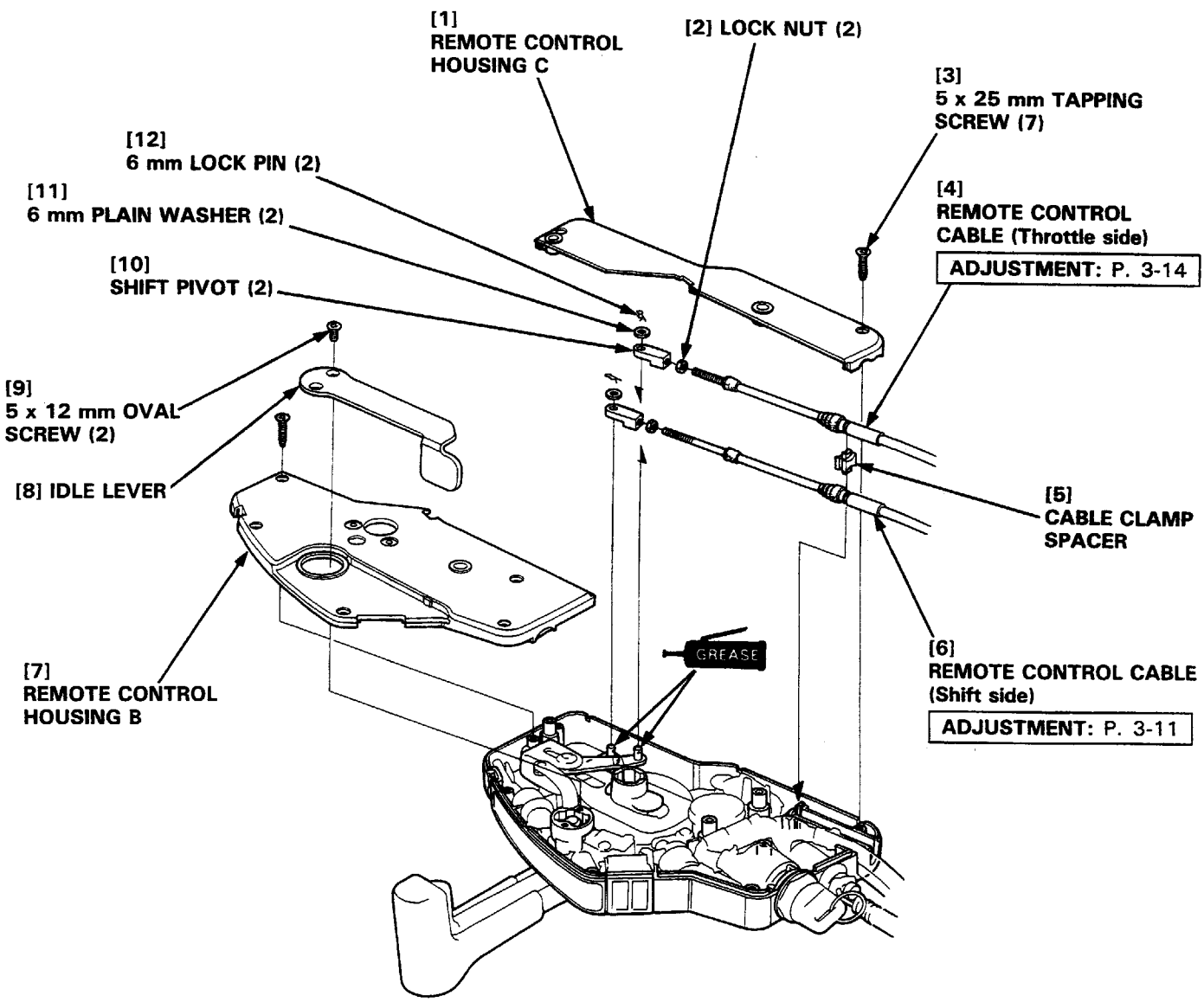
1) Remove the engine cover.



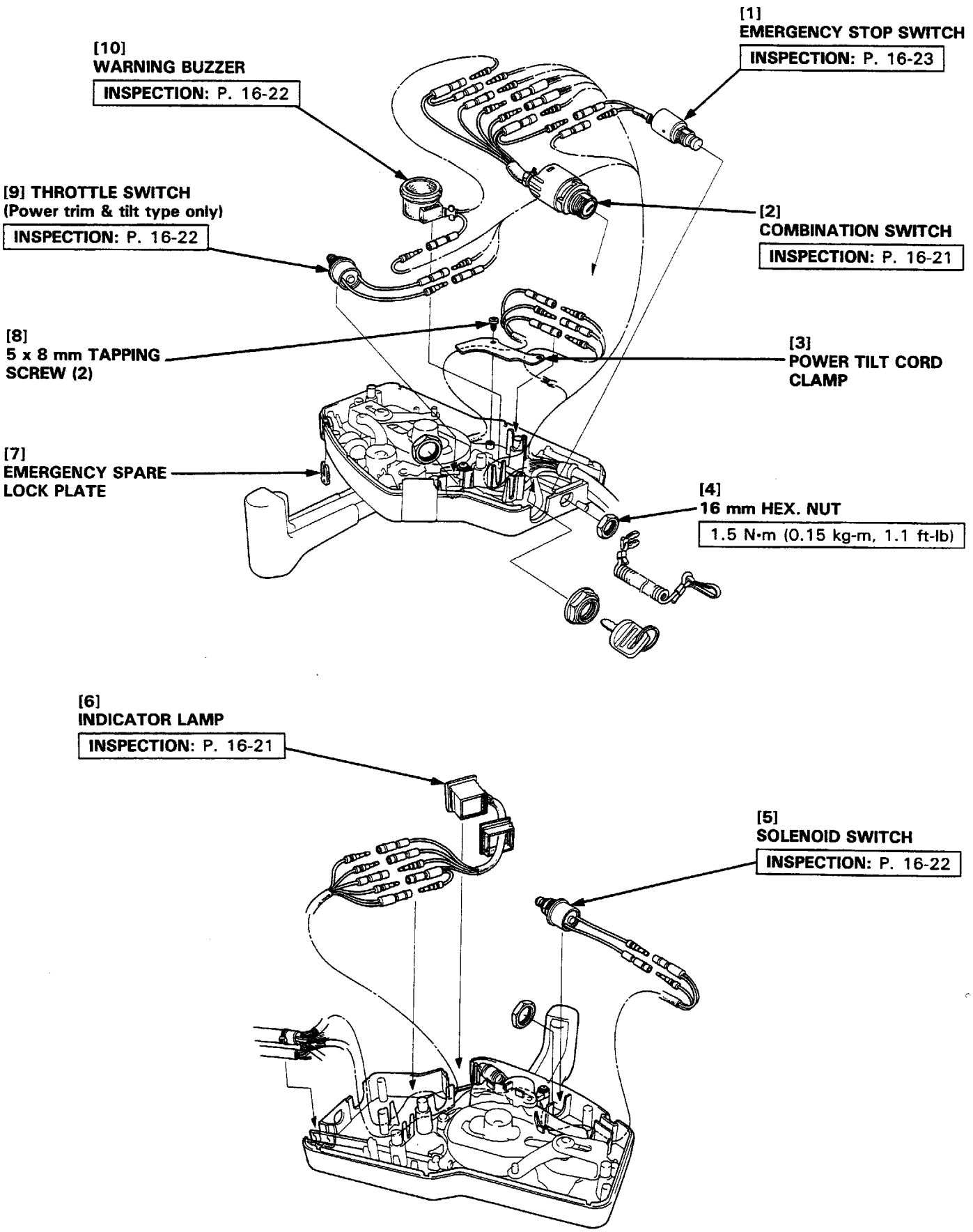
REMOTE CONTROL BOX

a. DISASSEMBLY/REASSEMBLY

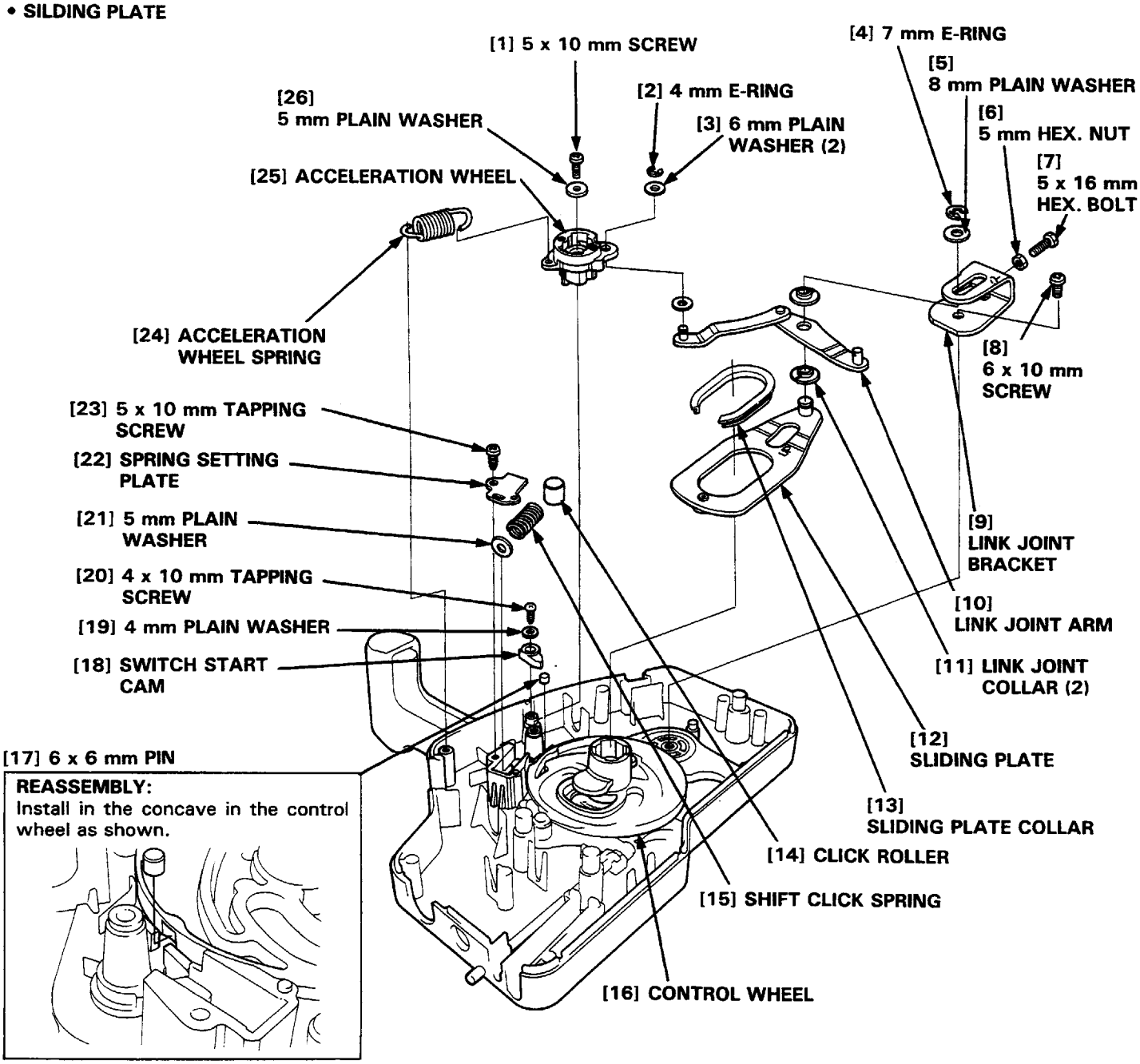
• REMOTE CONTROL CABLE



• ELECTRIC COMPONENTS



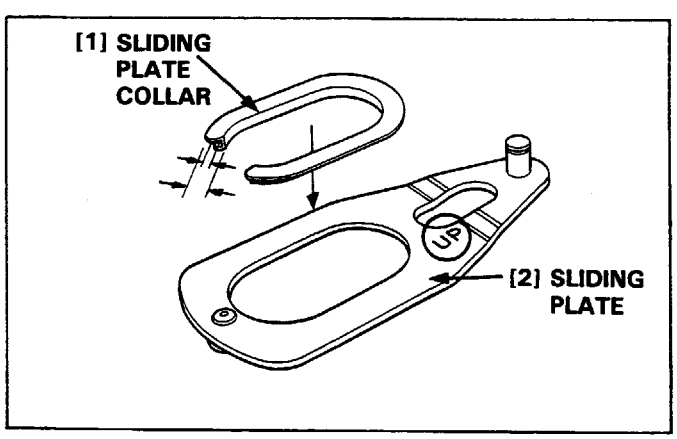
• SILDING PLATE



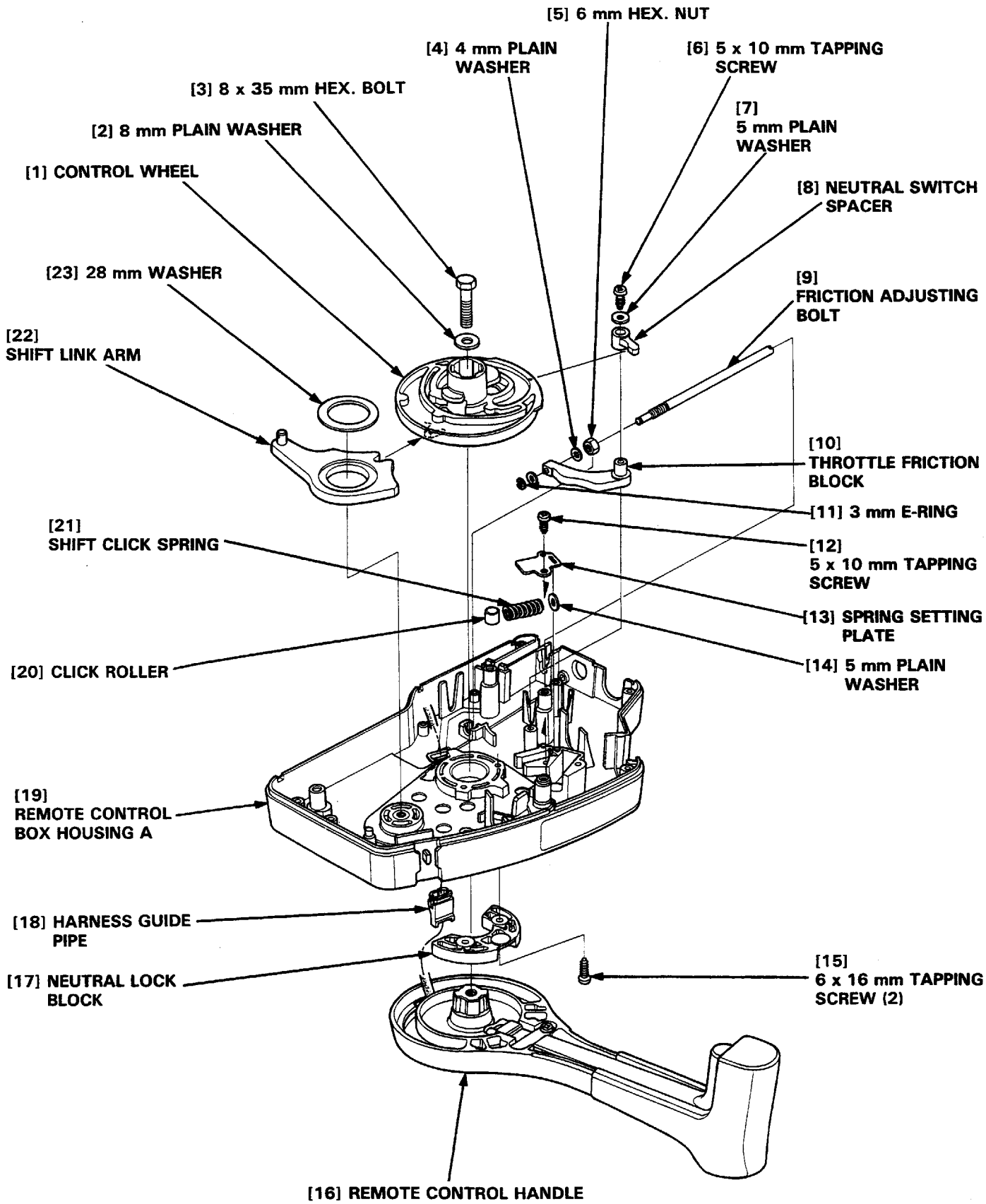
REASSEMBLY:
Install in the concave in the control wheel as shown.

• **SLIDING PLATE/COLLAR INSTALLATION**

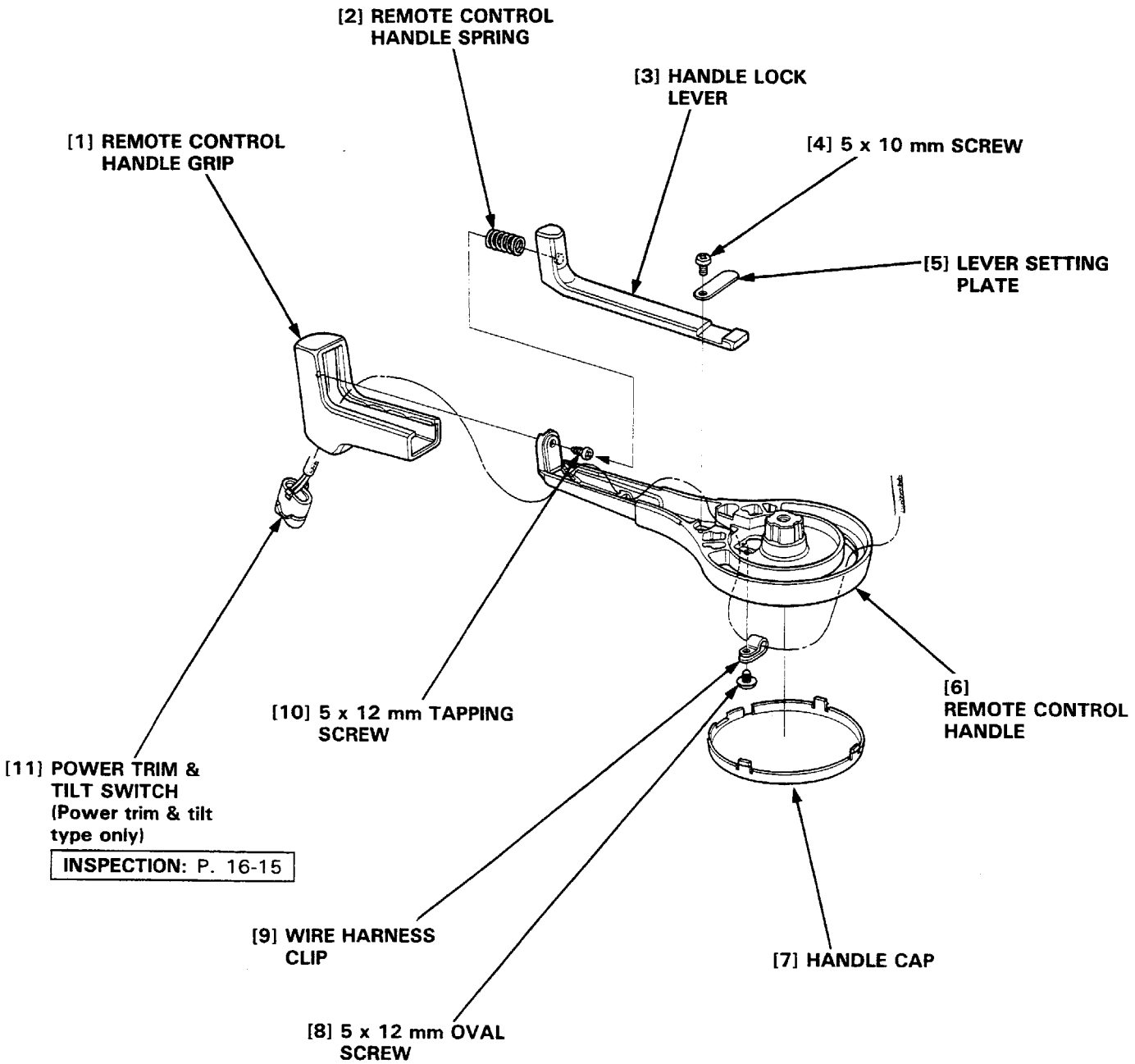
Install the sliding plate with the "UP" mark toward up. Attach the sliding plate collar to the sliding plate with its opening toward the opposite from the "UP" mark side of the sliding plate and the wide lip toward up.



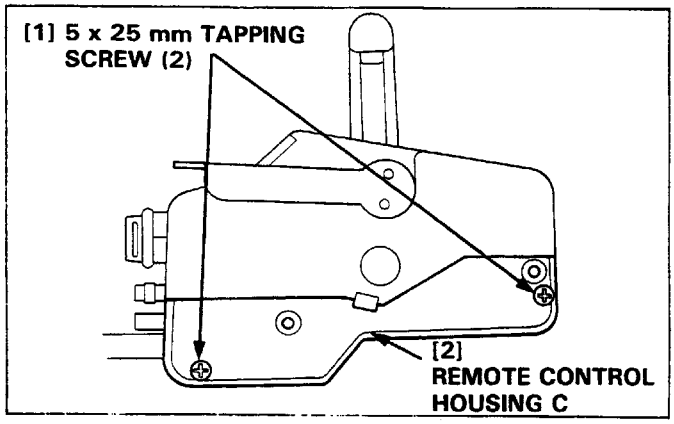
• REMOTE CONTROL HANDLE



• REMOTE CONTROL HANDLE



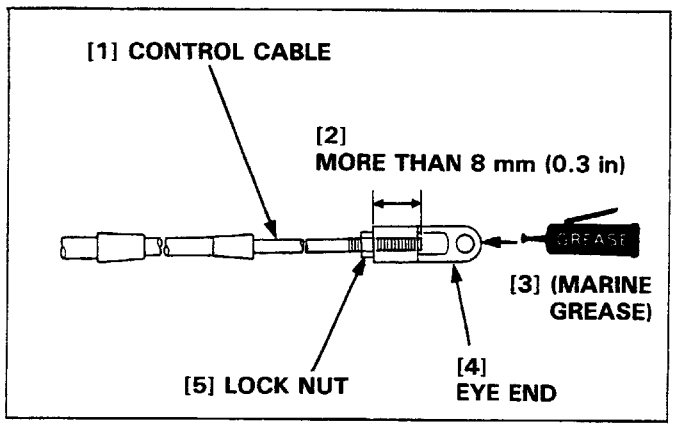
REMOTE CONTROL CABLE INSTALLATION



- **REMOTE CONTROL BOX SIDE**

1) Remove the two screws and housing C.

2) Screw the lock nuts and eye ends more than 8 mm (0.3 in) onto the thread of the remote control cable and tighten the lock nut securely to hold the pivot. Apply marine grease to the hole of the eye end.



3) Install the shift control cable by aligning the groove of the control cable with the cable guide plate. Then connect the eye end to the shift arm pin using the two washers and 6 mm lock pin.

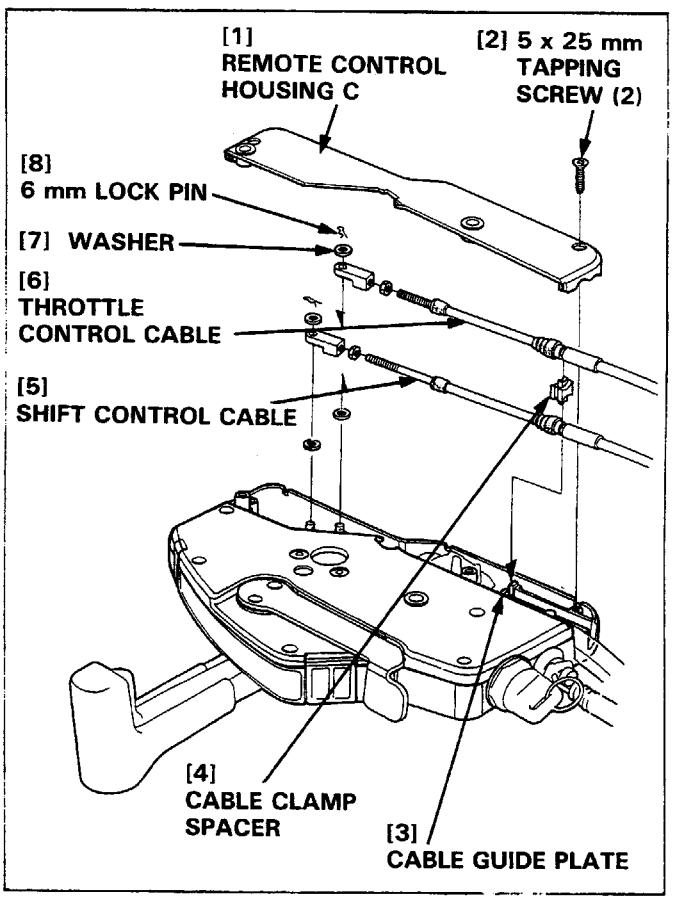
4) Install the cable clamp spacer and throttle control cable by aligning the groove with the cable guide plate. Then connect the eye end to the throttle arm pin using the two washers and 6 mm lock pin.

NOTE

- Make sure to insert the two washers and secure them with the 6 mm lock pins.

5) Reinstall the housing C and tighten the screws.

TORQUE: 2 N·m (0.2 kg-m, 1.4 ft-lb)

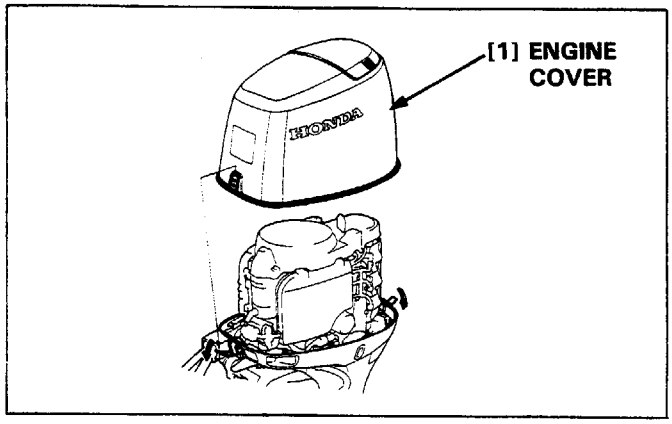


• **OUTBOARD MOTOR SIDE**

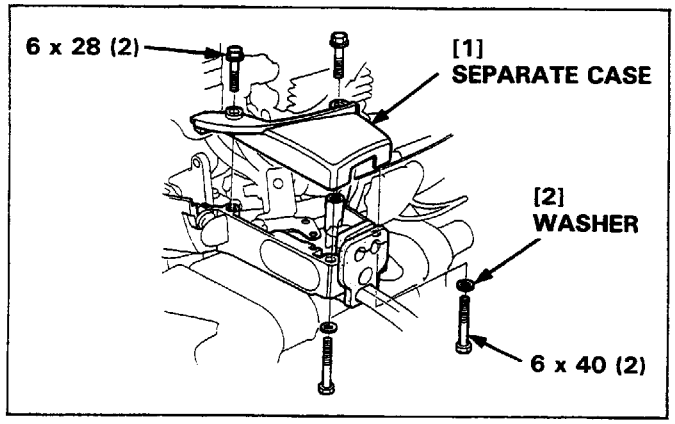
NOTE

- After installing the control cable to the remote control box, install the control cable to the outboard motor.
- Connect the control cable to the outboard motor with the remote control lever in "N" position and free acceleration lever in fully closed position (idle).

1) Remove the engine cover.

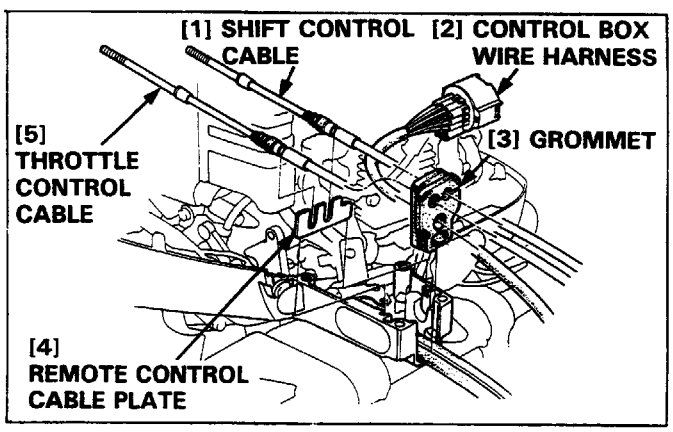


2) Remove the four bolts, two washers, and separate case.

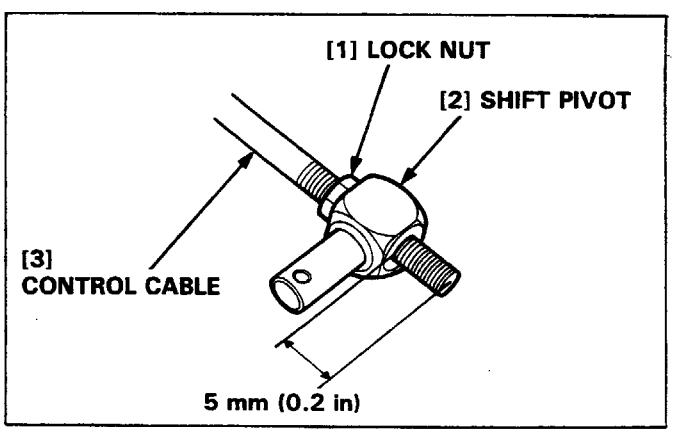


3) Pass the control box wire harness and control cables through the grommet as shown.

4) Attach the cable plate to the control cables by aligning the groove with the cable plate, and then install them to the case.



5) Screw the shift pivot onto the threaded portion of the throttle and shift cable as shown.



6) Make sure that the shift link on the outboard motor side is in the neutral position (N), and that the control lever at the remote control box side is in the neutral position (N).

7) Apply marine grease to the pins of the shift pivot.

8) Connect the control cables to the shift link and throttle arm using 6 mm washers and lock pins as shown. Tighten the lock nuts securely.

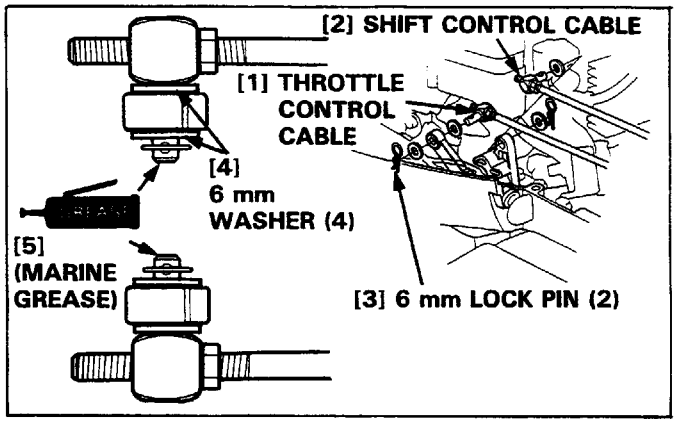
NOTE

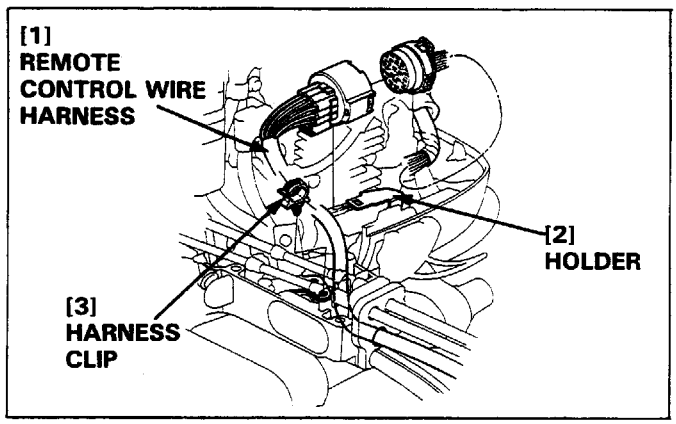
- Use the 6 mm washers on both side of the arm as shown.
- If the holes in the shift link and the pivot pin do not align, adjust by turning the shift pivot in or out, as required.

9) Connect the remote control wire harness to the outboard motor side wire harness and set the connector to the holder.

10) Secure the remote control wire harness with the harness clip.

11) Reinstall the separate case and tighten the bolts securely.





CONTROL CABLE LENGTH ADJUSTMENT

• THROTTLE CONTROL CABLE

1) Disconnect the throttle control cable from the throttle arm.

2) Move the throttle arm to the fully-open position until it touches the stopper and check that the carburetor throttle lever touches the stopper at the fully-open position.

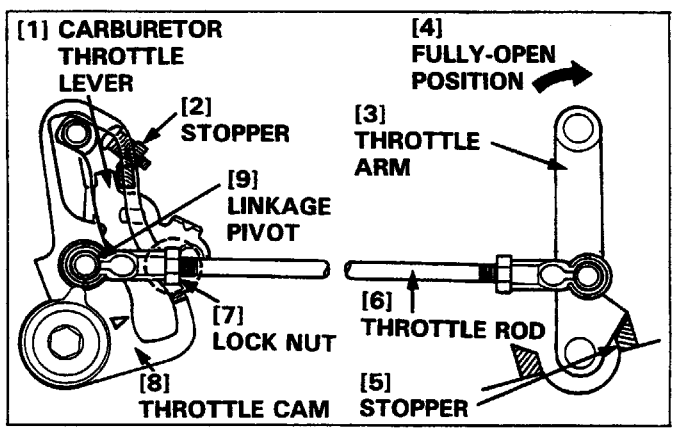
3) If no, disconnect the throttle rod from the throttle cam, loosen the lock nut and adjust the rod length by turning the linkage pivot.

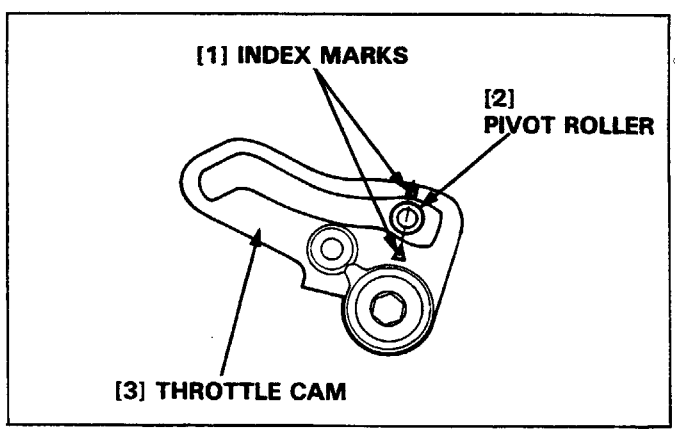
4) After adjustment tighten the lock nut securely and connect the throttle rod to the throttle cam.

5) Reconnect the throttle control cable to the throttle arm and set to remote control lever to the "N" position.

6) Check that the center of the pivot roller aligns with the index marks on the throttle cam.

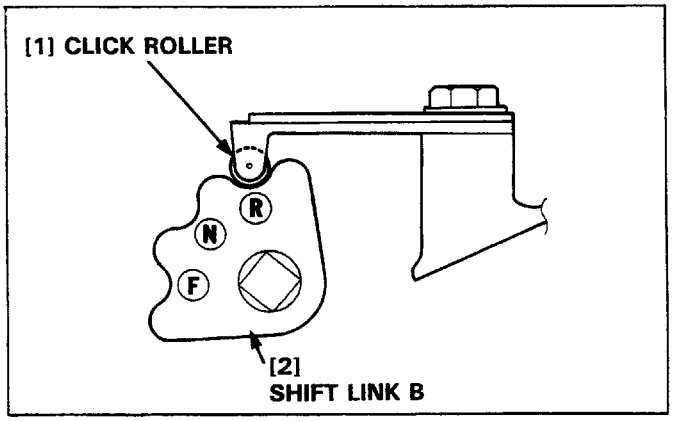
7) If no, disconnect the throttle control cable, loosen the lock nut and turn the pivot shaft.





8) After adjustment tighten the lock nut securely and reconnect the throttle control cable.

9) Move the remote control lever and check that control lever moves smoothly and that the carburetor throttle lever moves smoothly without binding from the fully-open to the fully-closed position.



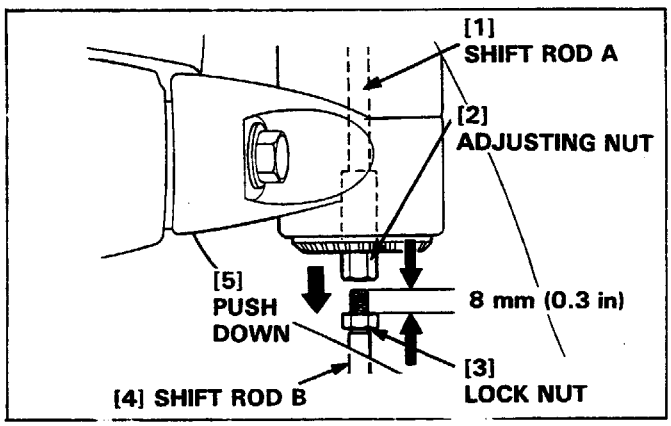
• **SHIFT CONTROL CABLE**

1) Disconnect the shift control cable from the shift arm. Set the shift in "R" and visually inspect that the click roller is in the center of the groove on the shift link B at the (R) mark.

2) If no, loosen the lock nut and turn the adjusting nut, separate the shift rods A and B.

3) Push the shift rod B to its lowest position. Turn the lock nut until the distance from top of the shift rod B is 8 mm (0.3 in) and then turn the adjusting nut of shift rod B in as required.

4) Tighten the lock nut securely.



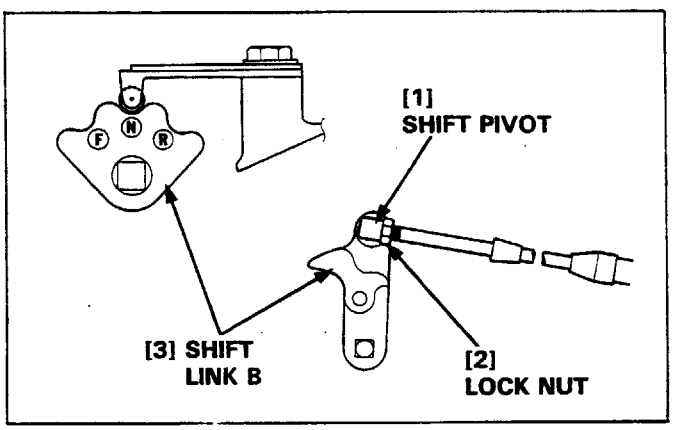
5) Reconnect the shift control cable and set the remote control lever to the neutral position (N).

6) Check that the click roller sits in the (N) groove of the shift link B.

7) If no, disconnect the shift pivot, loosen the lock nut, and turn the shift pivot as required.

8) Tighten the lock nut securely and reconnect the shift pivot.

9) After the adjustment ensure that the shift lever operates correctly.



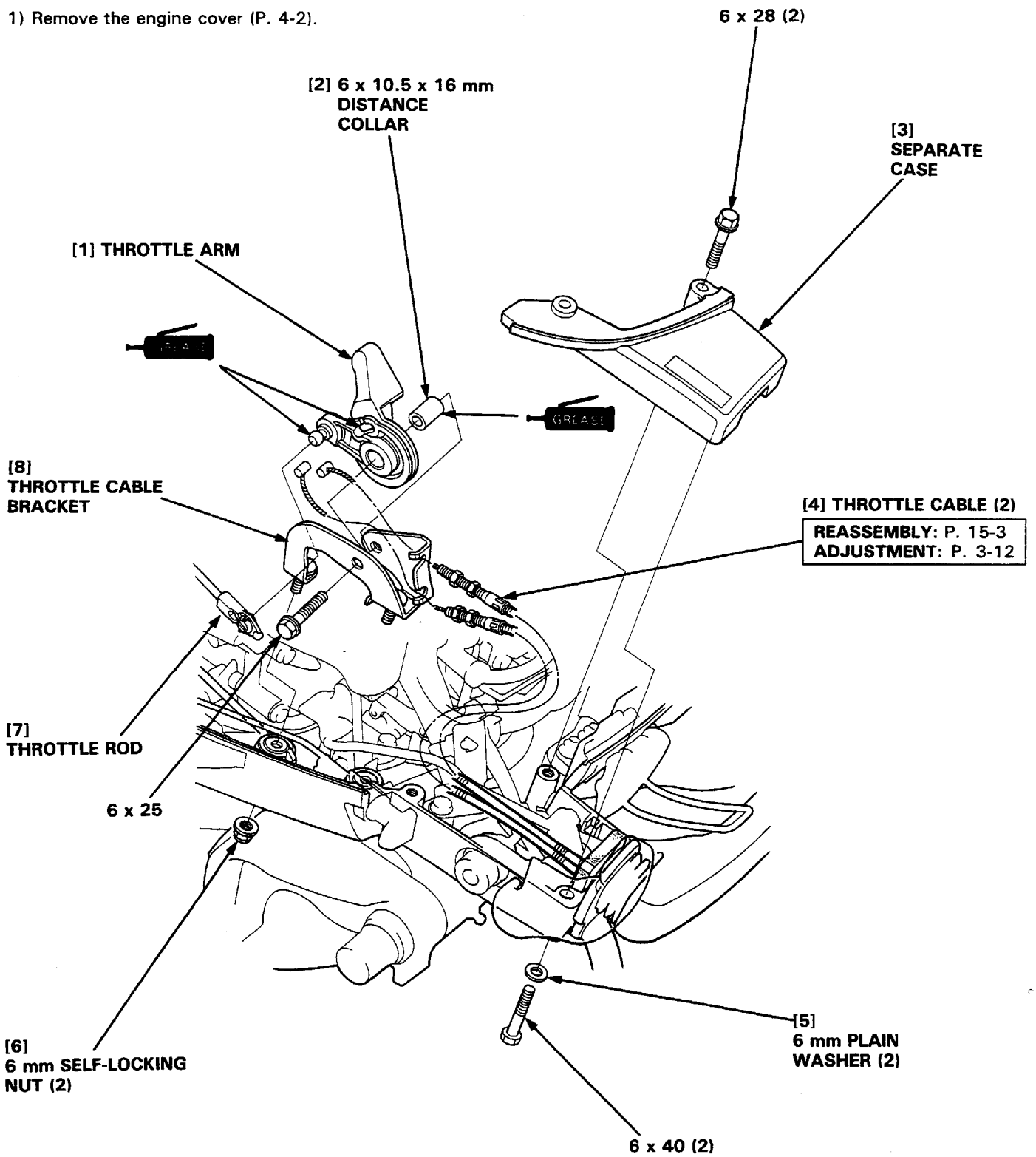
10) Reinstall the outboard motor cover.

THROTTLE BRACKET/SHIFT LEVER/HANDLEBAR (TILLER HANDLE TYPE ONLY)

THROTTLE BRACKET

a. DISASSEMBLY/REASSEMBLY

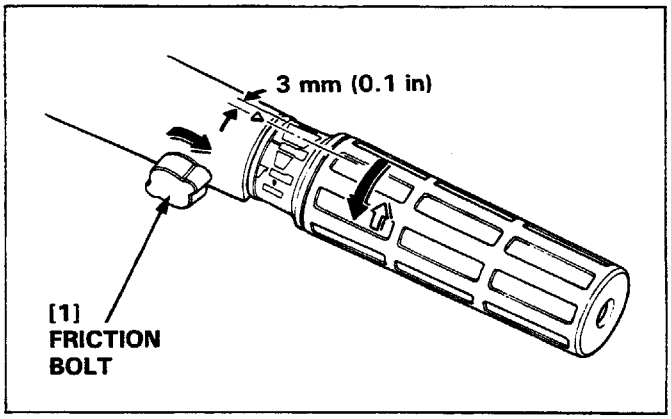
1) Remove the engine cover (P. 4-2).



• THROTTLE CABLE

REASSEMBLY:

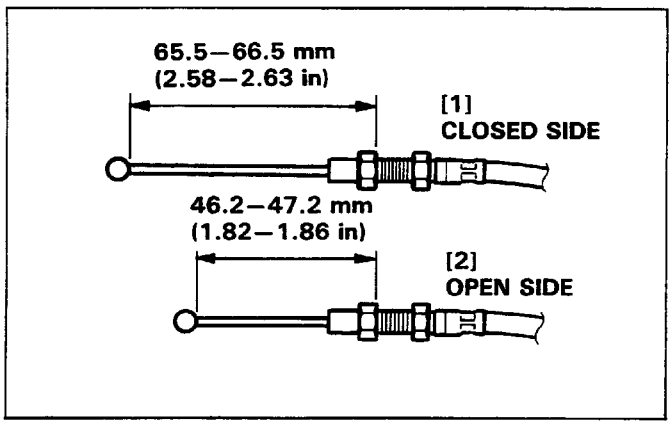
1) Turn the throttle grip to the full open position, then back it off 3 mm (0.1 in) from the fully open position and tighten the friction bolt.



2) Adjust the closed side and open side of the throttle cables to the length shown in the drawing.

NOTE

- Before adjusting the throttle cable length, be sure that the throttle cables are connected to the outboard motor securely (page 15-6).



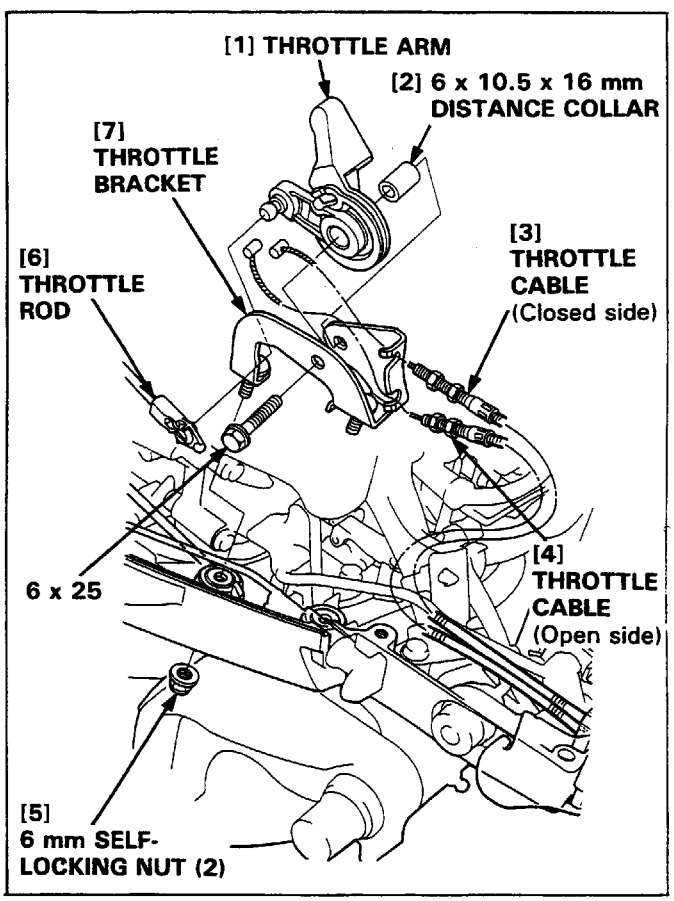
3) Connect the throttle cables to the throttle arm.

4) Connect the throttle cables to the throttle bracket.

NOTE

- Connect the throttle cables to the throttle bracket with care not to change the length of the cables.

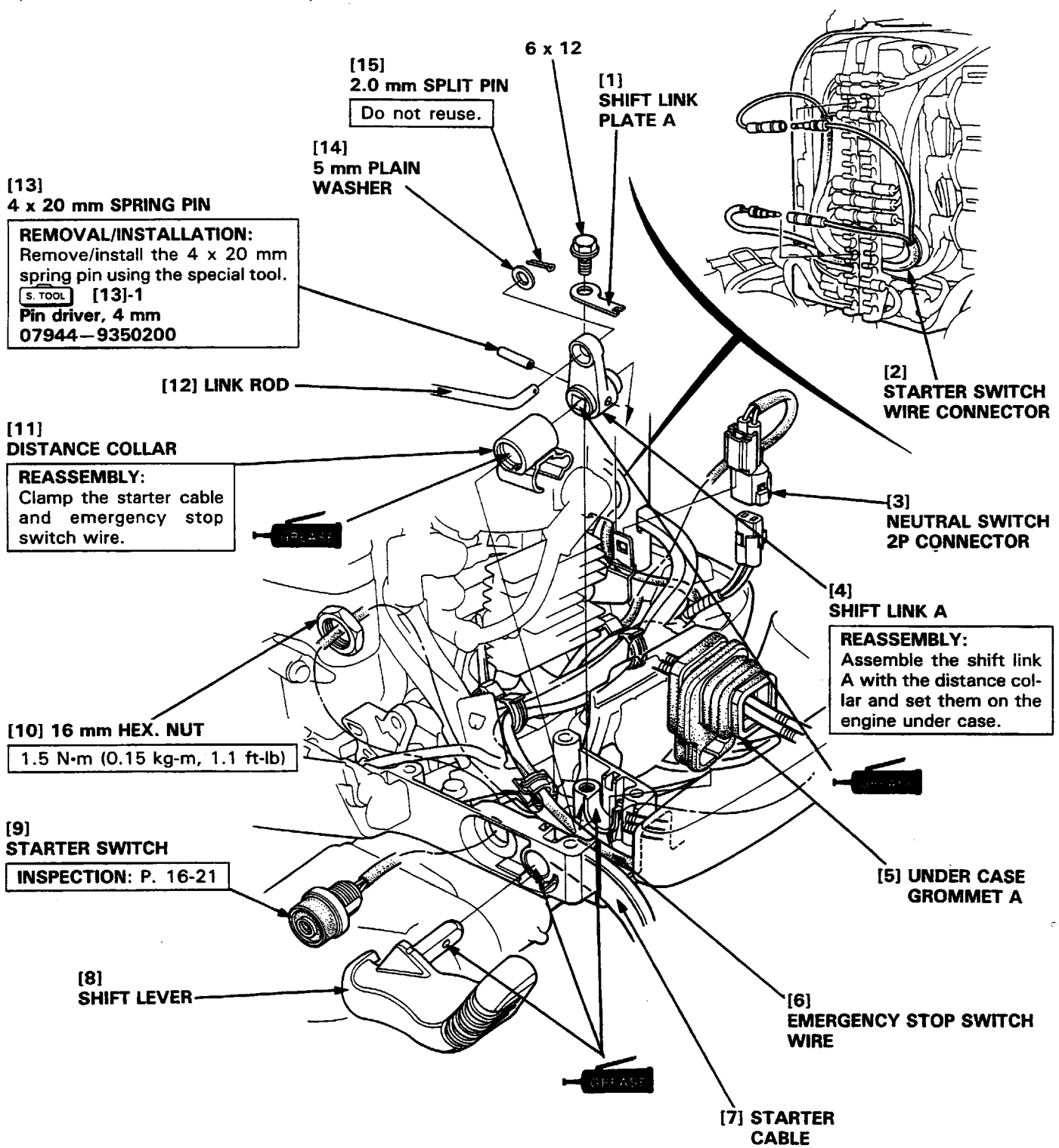
5) Loosen the friction bolt and install the 6 x 10.5 x 16 mm distance collar on the throttle cam.
6) Install the throttle cam on the throttle bracket and tighten the 6 x 25 mm flange bolt.
7) Install the throttle bracket on the engine under case and tighten the 6 mm self-locking nuts.
   Install the throttle rod.
8) After installing the throttle bracket, adjust the throttle (P. 3-12).



SHIFT LEVER

a. DISASSEMBLY/REASSEMBLY

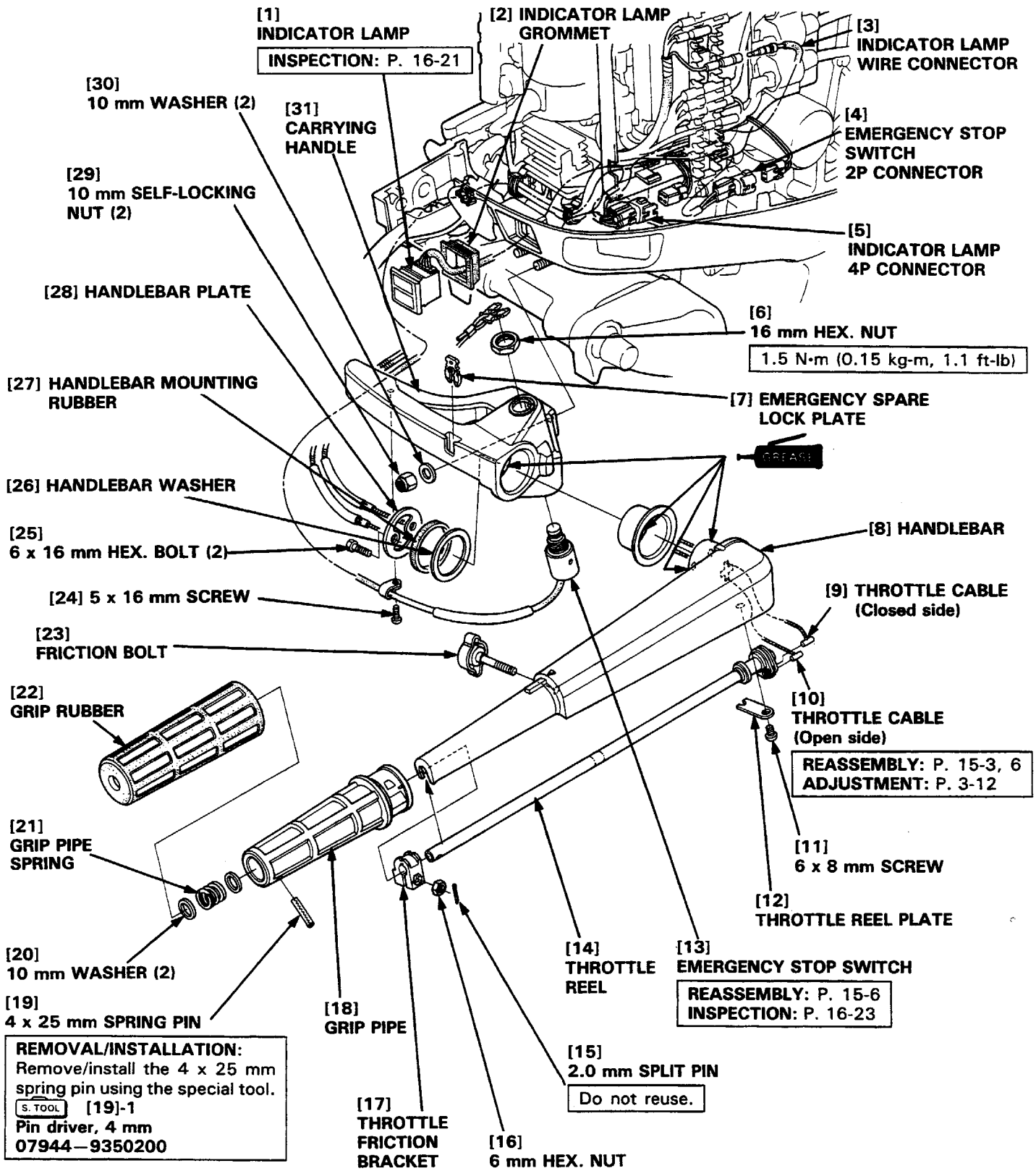
1) Remove the engine cover and separate case (P. 15-2)
2) Remove the CDI unit cover and disconnect the starter switch wire connectors.
3) Remove the throttle cable bracket (P. 15-2)
4) Move the shift lever to the "R" position.



HANDLEBAR

a. DISASSEMBLY/REASSEMBLY

1) Remove the shift lever (P. 15-4)
2) Disconnect the indicator lamp 4P connector, wire connector and emergency stop switch 2P connector.

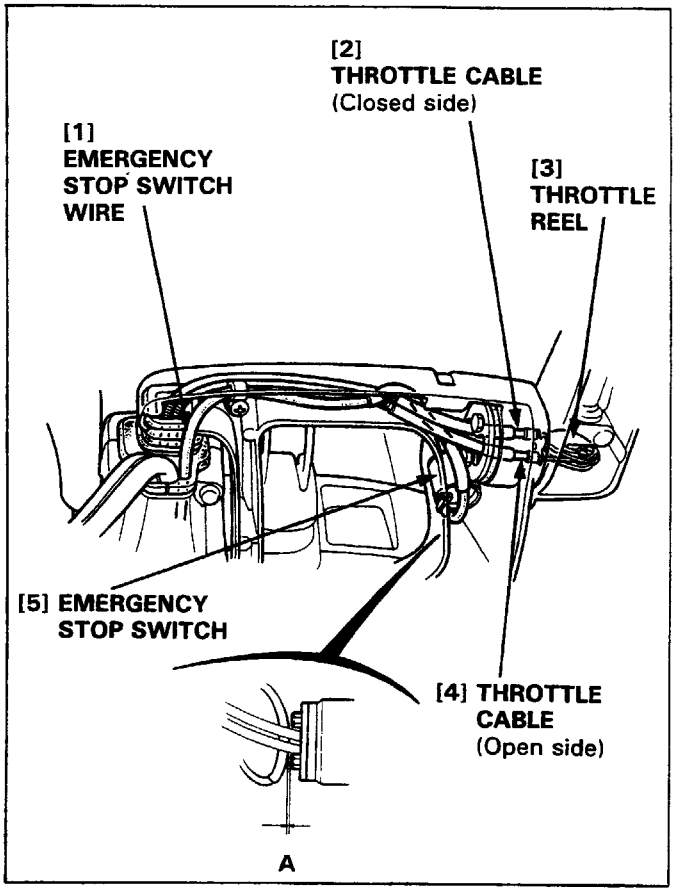


• EMERGENCY STOP SWITCH/ THROTTLE CABLE

REASSEMBLY:
Connect the open side and closed side of the throttle cables to the throttle reel as shown.
Route the emergency stop switch wire as shown.

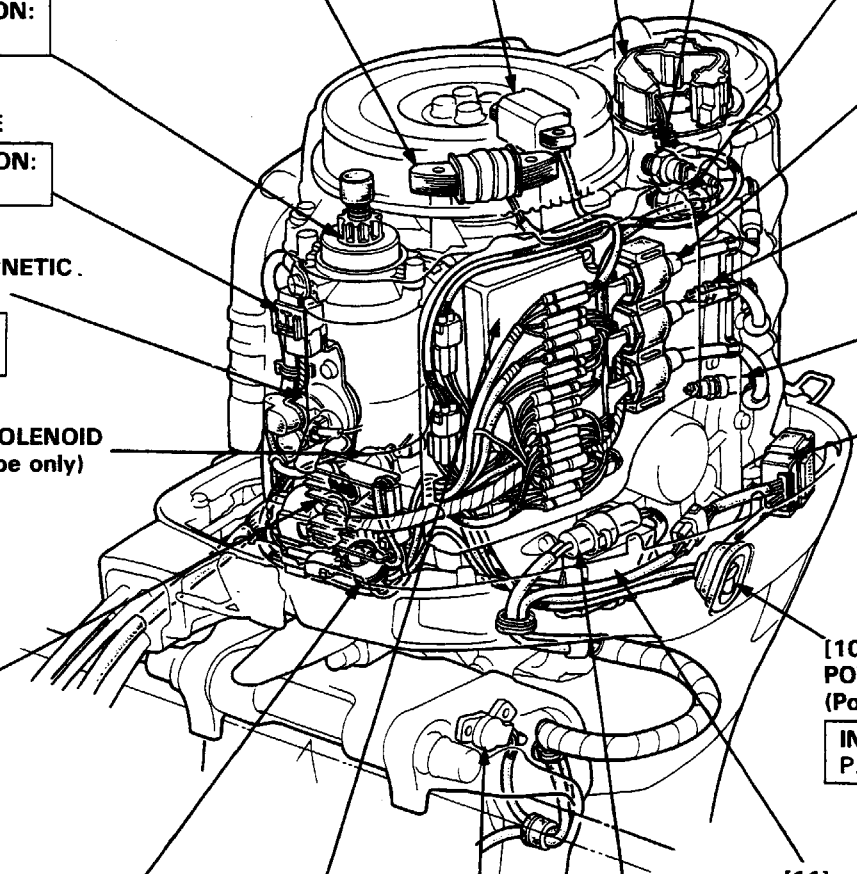
NOTE

- Move the handlebar up and down and be sure that the clearance between the emergency stop switch wire and bolt (A in the drawing) is 1 mm or more.



ELECTRICAL EQUIPMENT

COMPONENT LOCATION



[1]
CHARGING COIL
INSPECTION: P. 16-20

[2]
EXCITER COIL
INSPECTION: P. 16-19

[3]
PULSER COIL
INSPECTION: P. 16-19

[4]
THERMO SWITCH
INSPECTION: P. 8-3

[5]
OIL PRESSURE SWITCH
INSPECTION: P. 16-19

[6]
IGNITION COIL
INSPECTION: P. 16-20

[7]
SPARK PLUG
INSPECTION: P. 3-4

[8]
SPARK PLUG CAP
INSPECTION: P. 16-21

[9]
TRIM CONTROL UNIT
(Power trim & tilt type only)
INSPECTION: P. 16-16

[10]
POWER TRIM & TILT SWITCH
(Power trim & tilt type only)
INSPECTION: P. 16-15

[11]
POWER TILT RELAY
(Power trim & tilt type only)
INSPECTION: P. 16-14

[12]
POWER TILT MOTOR CONNECTOR
(Power trim & tilt type only)
INSPECTION: P. 16-22

[13]
TRIM ANGLE SENSOR
(Power trim & tilt type only)
INSPECTION: P. 16-15

[14]
CDI UNIT
INSPECTION: P. 16-17 and 18

[15]
NEUTRAL SWITCH
INSPECTION: P. 16-13

[16]
REGULATOR/ RECTIFIER
INSPECTION: P. 16-14

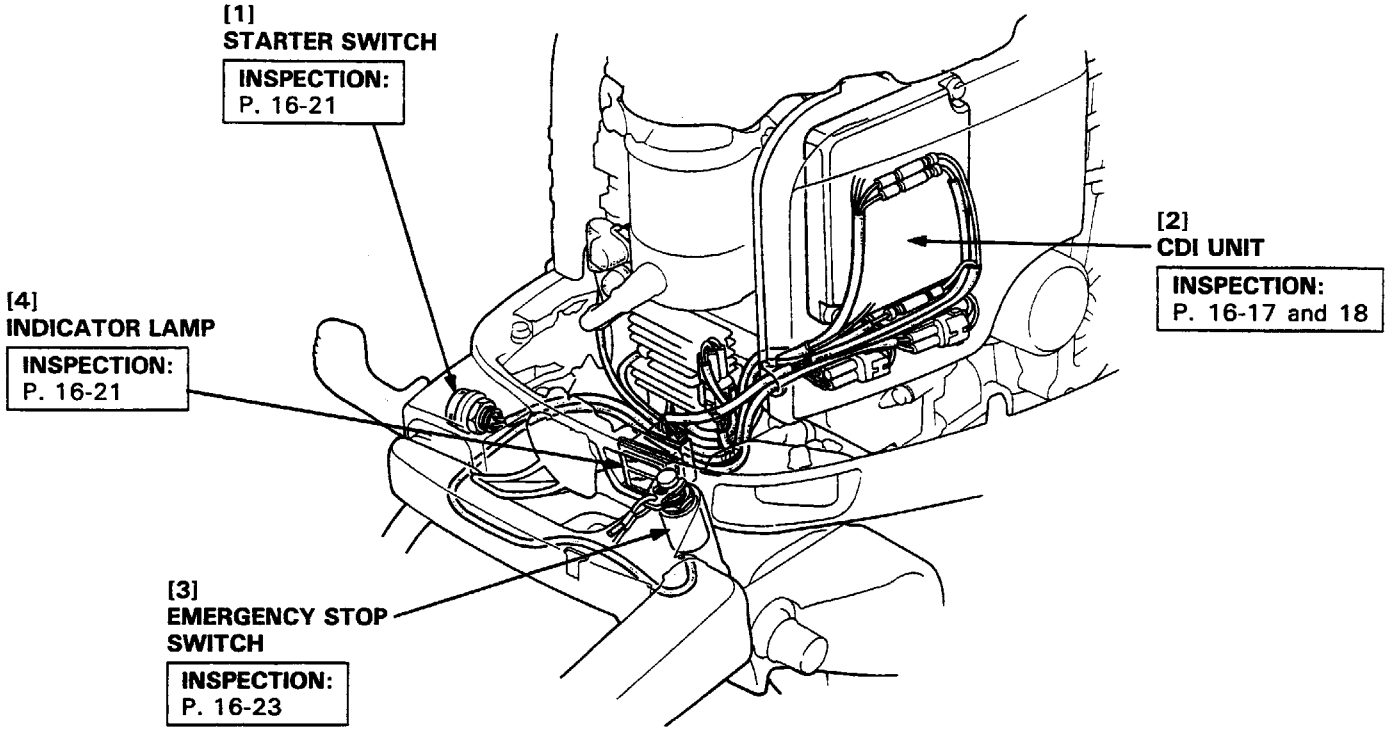
[17]
REMOTE CHOKE SOLENOID
(Remote control type only)
INSPECTION: P. 16-19

[18]
STARTER MAGNETIC SWITCH
INSPECTION: P. 16-13

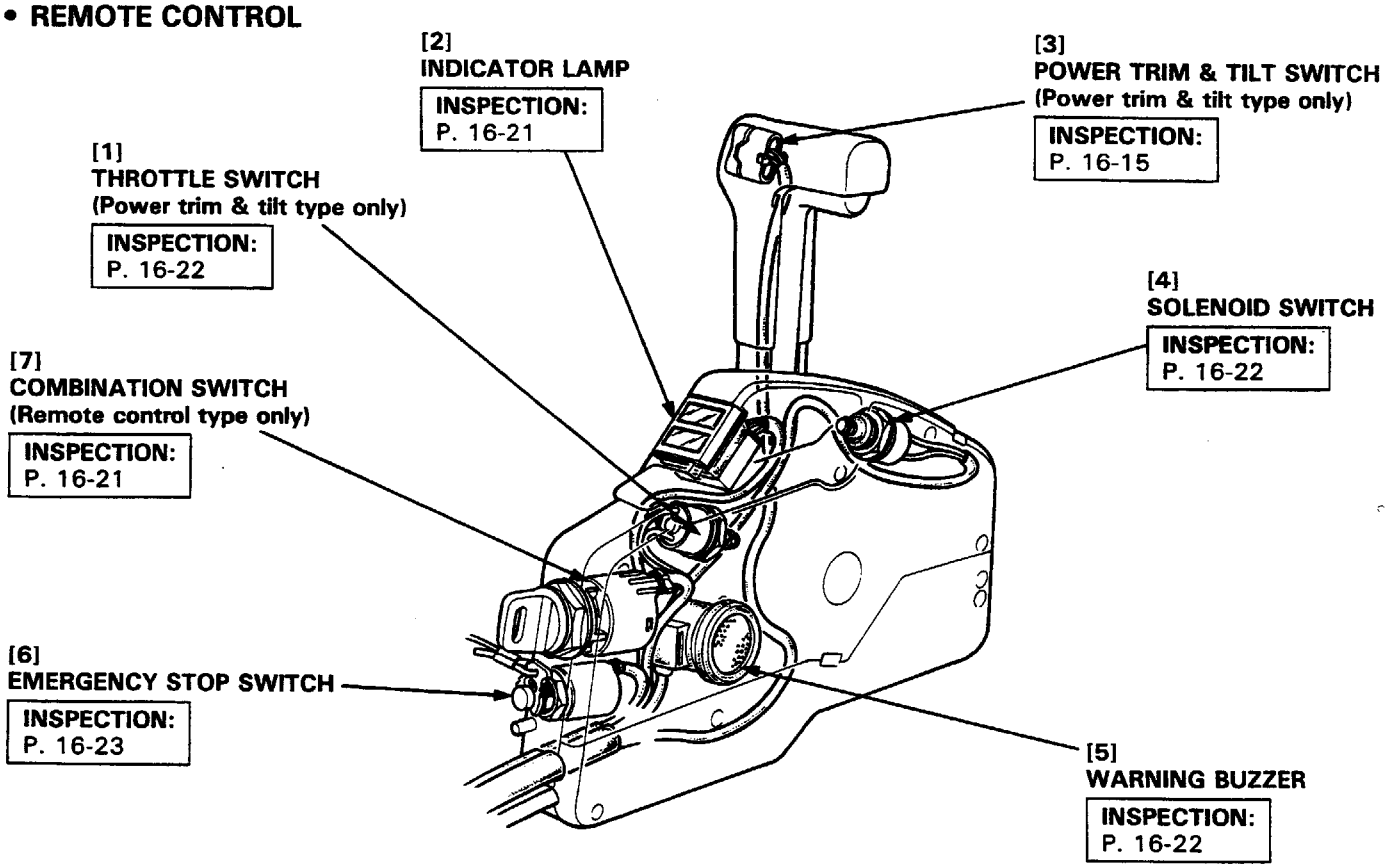
[19]
FUSE CASE
INSPECTION: P. 16-13

[20]
STARTER MOTOR
INSPECTION: P. 16-9

• TILLER HANDLE TYPE



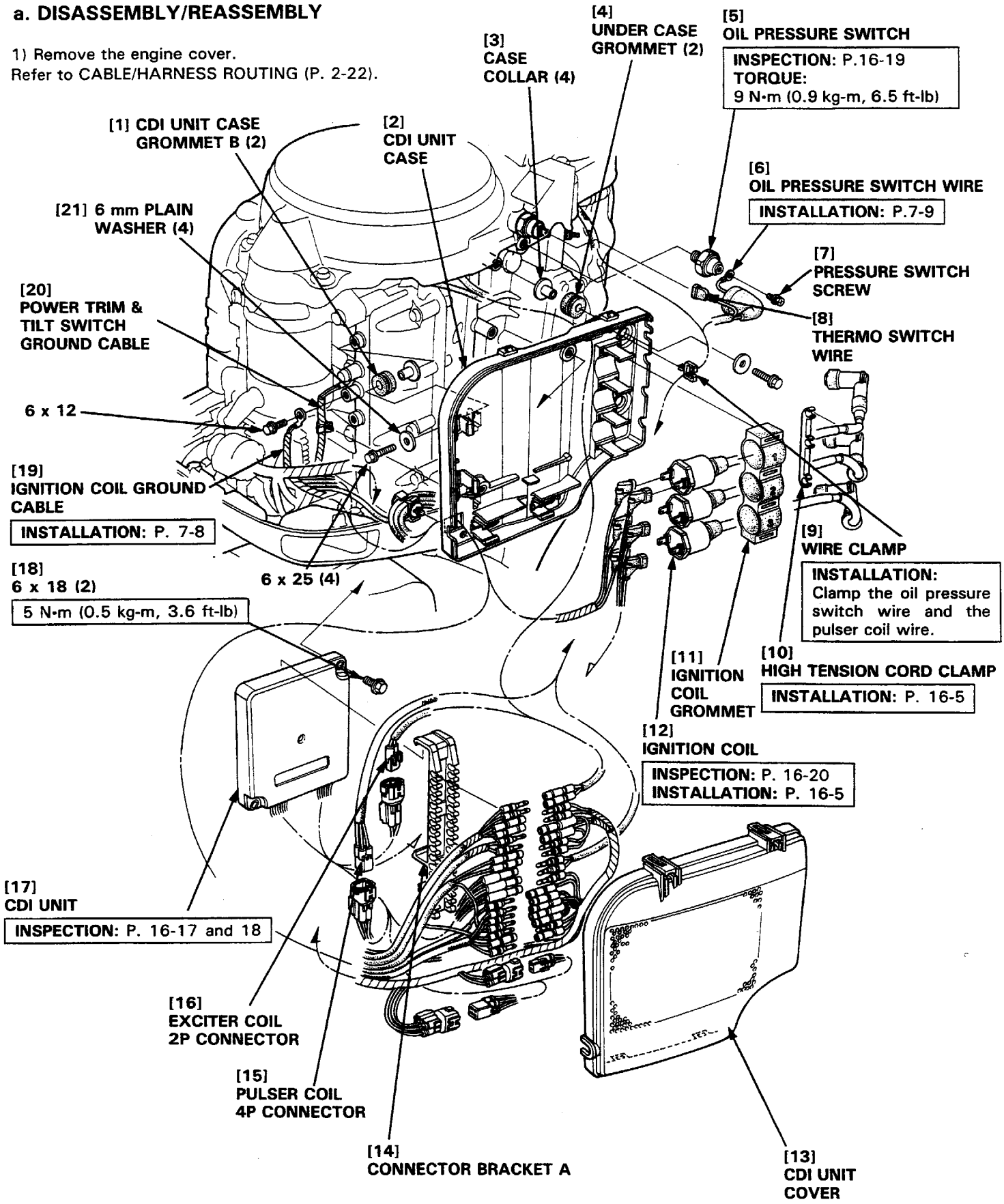
• REMOTE CONTROL



CDI UNIT/IGNITION COIL

a. DISASSEMBLY/REASSEMBLY

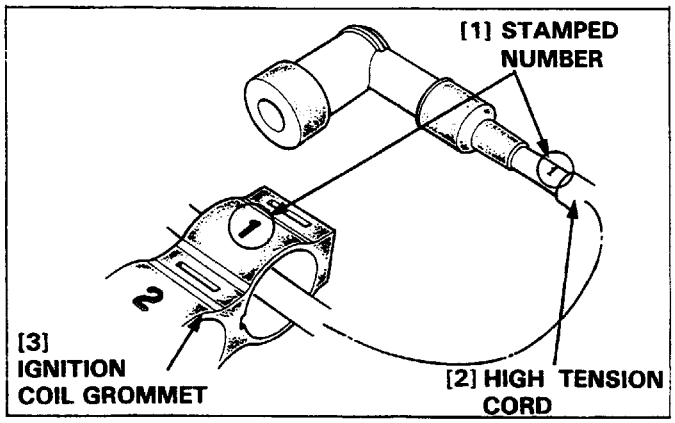
1) Remove the engine cover.
Refer to CABLE/HARNESS ROUTING (P. 2-22).



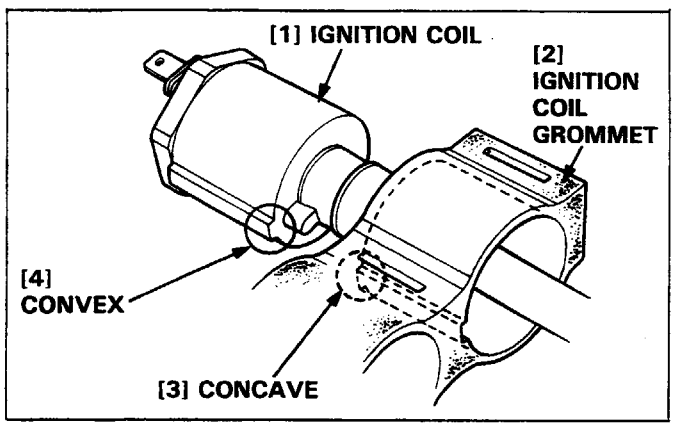
b. INSTALLATION

• **IGNITION COIL**

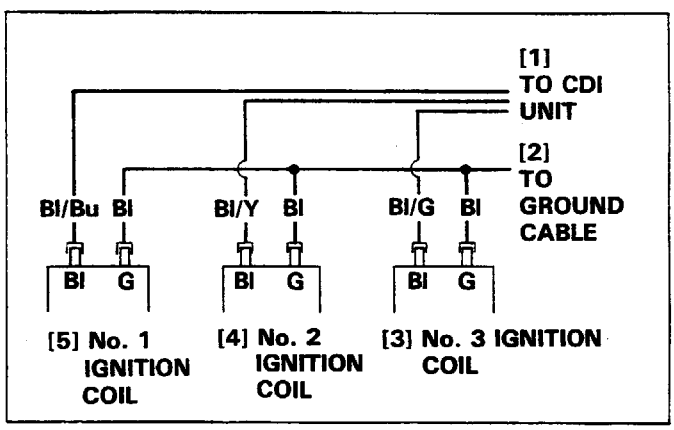
1) Cross-reference the number stamped on the high tension cord and the number on the ignition coil grommet, and pass the ignition coil through the grommet stamped with the same number.



2) Align the concave in the ignition coil grommet with the convex of the ignition coil, and assemble the ignition coil with the ignition coil grommet securely.

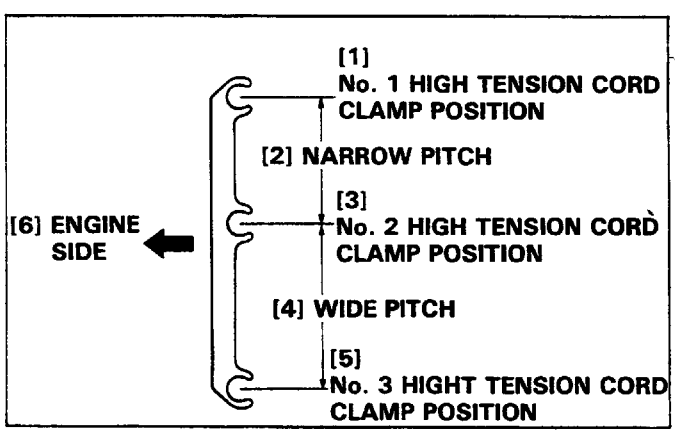


3) Connect the ignition coil wires to ignition coils as shown.



• **HIGH TENSION CORD CLAMP**

Set the high tension cord clamp with the narrow pitch side toward up and the flat side toward the engine as shown, and tighten the No. 1, No. 2 and No. 3 high tension cords in descending order securely.

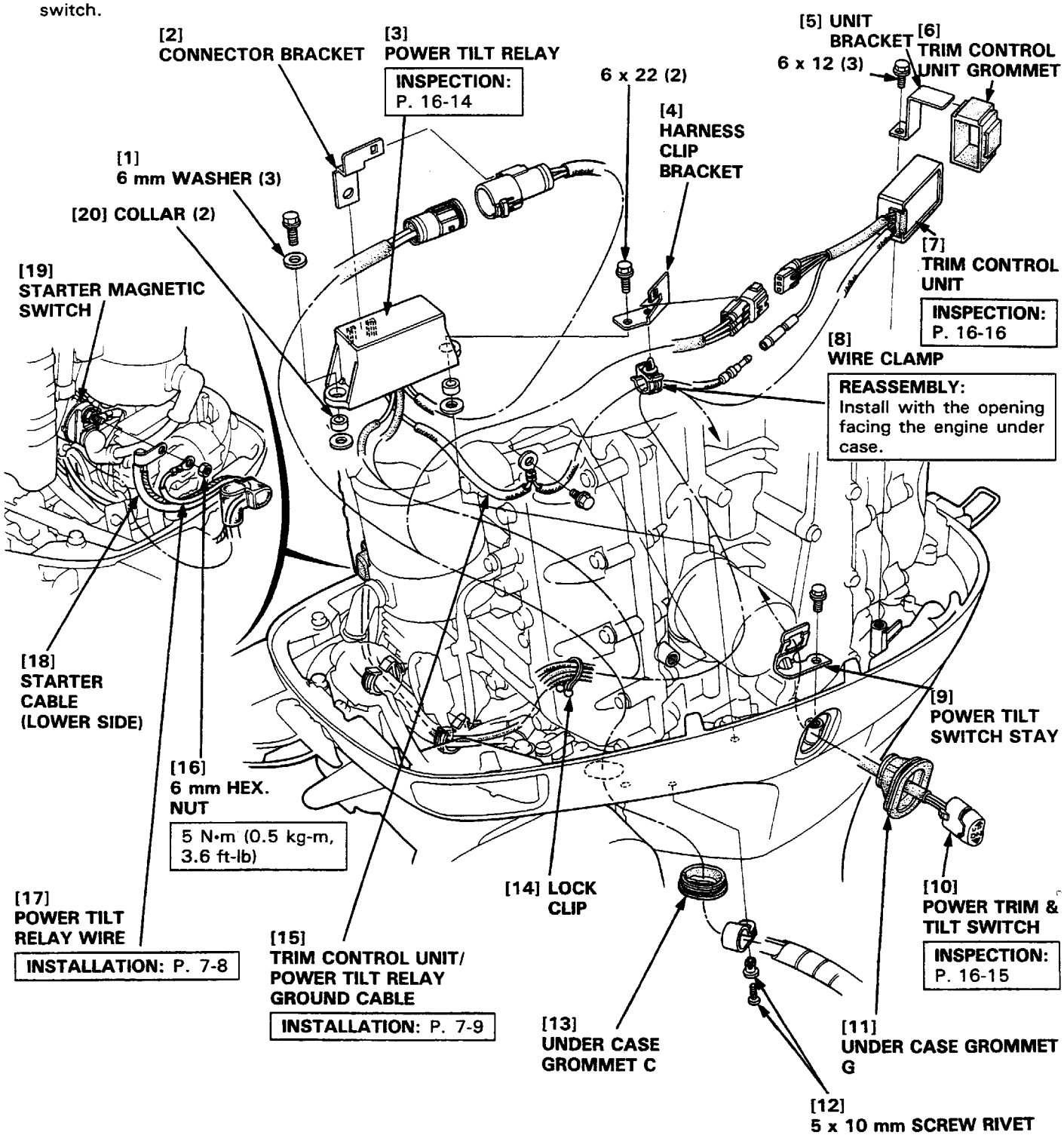


POWER TILT RELAY/TRIM CONTROL UNIT (POWER TRIM & TILT TYPE ONLY)

a. DISASSEMBLY/REASSEMBLY

- Disassembly/reassembly of the power tilt relay/trim control relay can be performed without removing the CDI unit cover. Just remove the following parts.

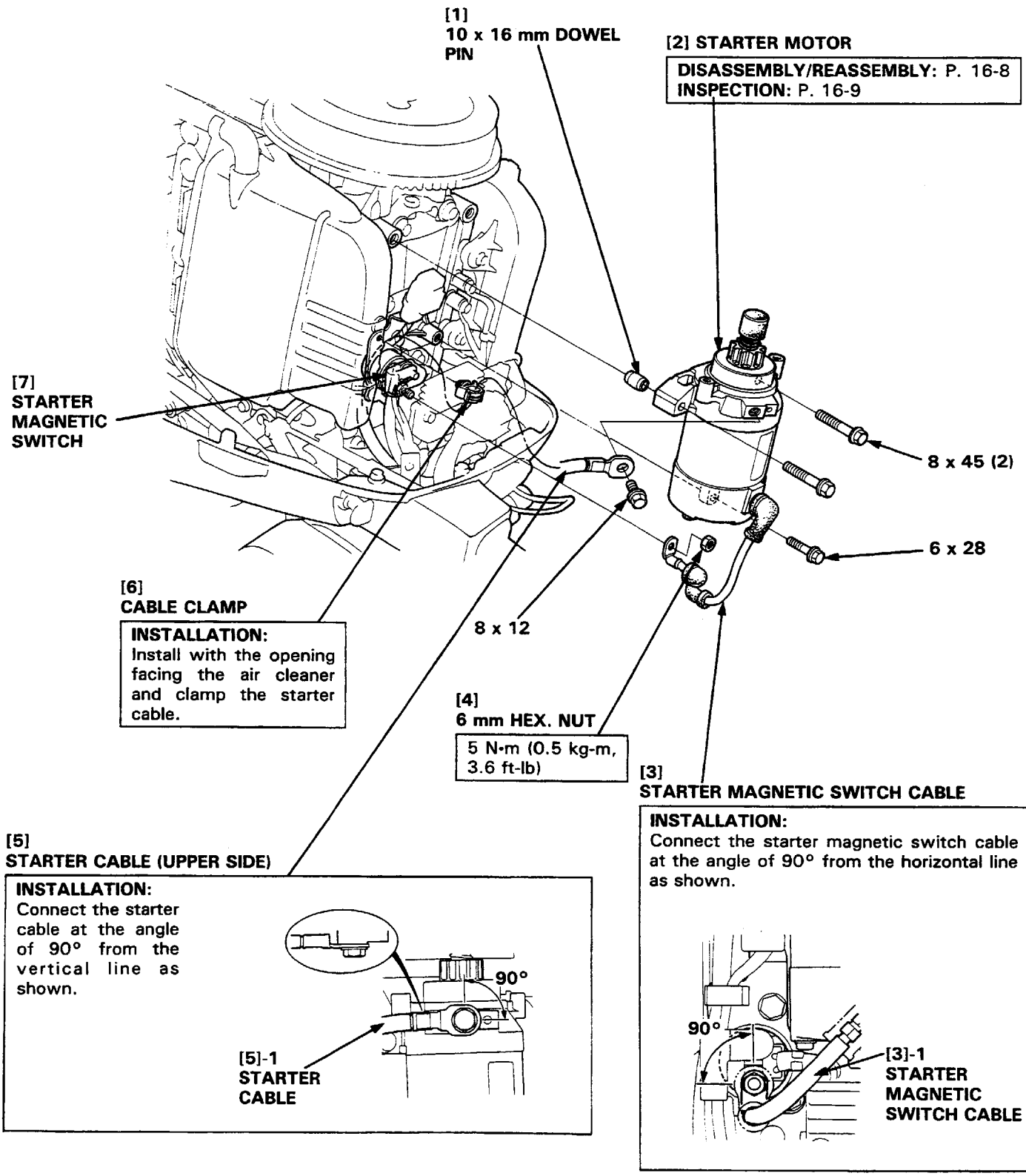
1) Remove the engine cover.
2) Remove the 6 mm hex. nut and disconnect the power tilt relay wire/starter cable (lower side) from the starter magnetic switch.



STARTER MOTOR

a. REMOVAL/INSTALLATION

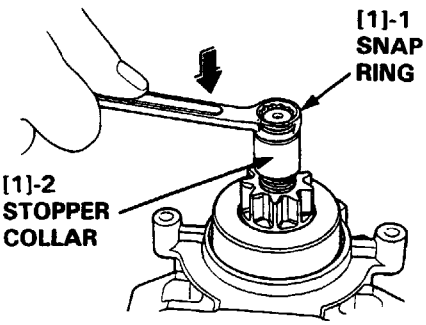
1) Remove the engine cover and flywheel cover.



b. DISASSEMBLY/REASSEMBLY

[1] SNAP RING

DISASSEMBLY:
Hold the armature upright, place an offset wrench over the stopper piece and push the stopper piece down exposing the snap ring. Remove the snap ring; then remove the stopper piece and clutch.



REASSEMBLY:
Check for smooth movement in axial direction by rotating the clutch. Check the gear teeth for wear or damage; replace if necessary.
Also, check the flywheel ring gear teeth if the pinion gear teeth are damaged.

[3] OVERRUNNING CLUTCH
INSPECTION: P. 16-10

[4] 6003 BALL BEARING

[5] FRONT COVER
INSTALLATION: P. 16-11

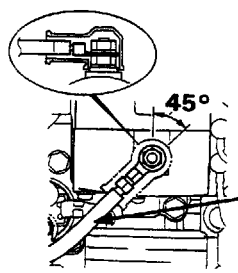
[2] STOPPER COLLAR

GREASE

[6] WASHER (2)

[7] STARTER MAGNETIC SWITCH CABLE

REASSEMBLY:
Connect the starter magnetic switch cable at the angle of 45° from the vertical line as shown.



[17] ARMATURE

INSPECTION: P. 16-9
REASSEMBLY:
Visually inspect the commutator surface for dust, rust or other damage. If necessary, wipe it with a clean lint-free cloth. If rusted or damaged, dress with a fine emery cloth.

GREASE

[8] 8 mm FLANGE NUT (2)
7 N·m (0.7 kg-m, 5.1 ft-lb)

[9] BOLT SCREW (2)

[16] O-RING
Do not reuse

[10] 4 mm SCREW (2)

[11] REAR COVER
INSTALLATION: P. 16-11

[15] YOKE

REASSEMBLY:
Make sure that there is no obstruction on the magnets.

[12] M BUSHING

REASSEMBLY:
Apply an adhesive (Cemedain #575 or equivalent) to the mating surface with the rear cover.

[14] CARBON BRUSH SPRING (3)

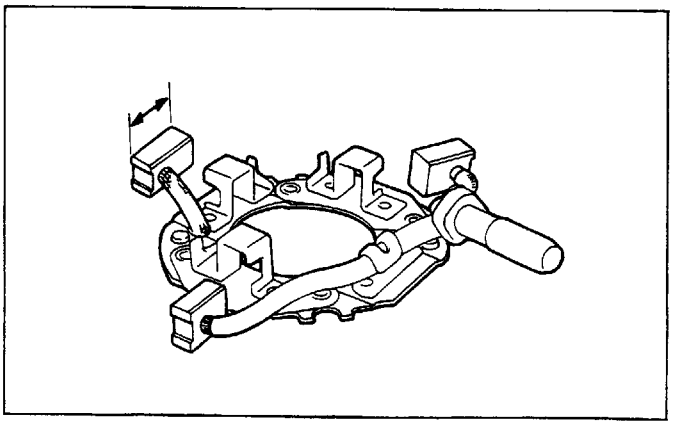
[13] BRUSH HOLDER
INSPECTION: P. 16-9

c. INSPECTION

• BRUSH LENGTH

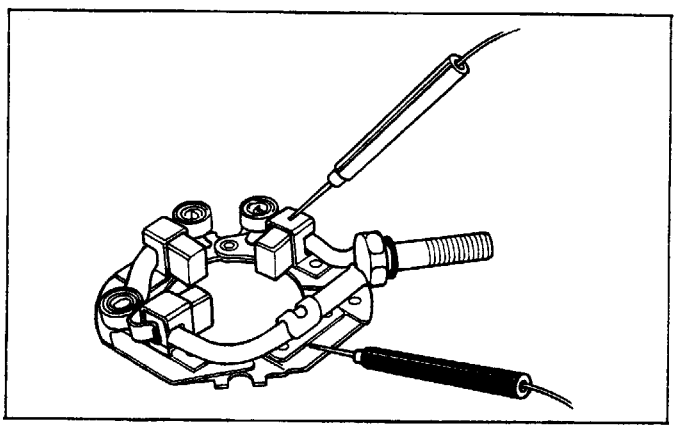
Measure the brush length.
If brush length is less than standard, replace the brush holder.

STANDARD	SERVICE LIMIT
16 mm (0.6 in)	12 mm (0.5 in)



• BRUSH INSULATION

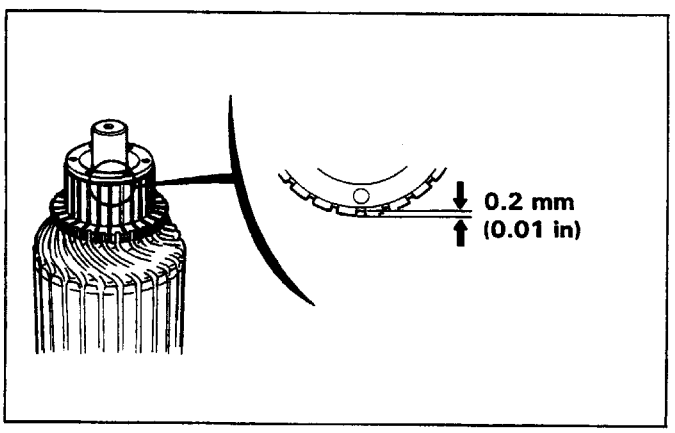
Check for continuity between the brushes.
There should be no continuity.



• MICA DEPTH

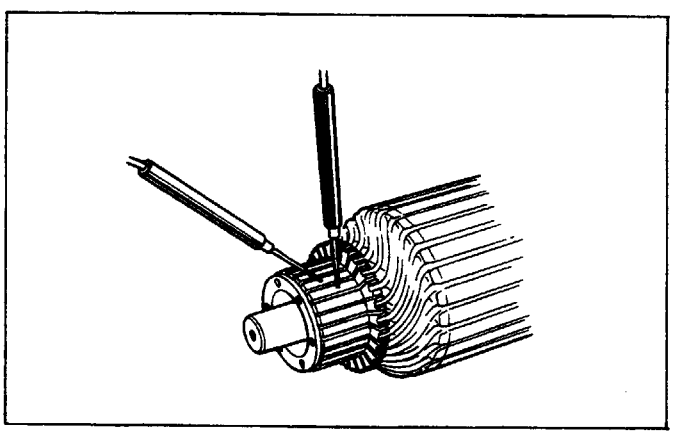
If the grooves are clogged or mica depth is less than the service limit, recut the grooves using a hacksaw blade or a small file.

SERVICE LIMIT	0.2 mm (0.01 in)

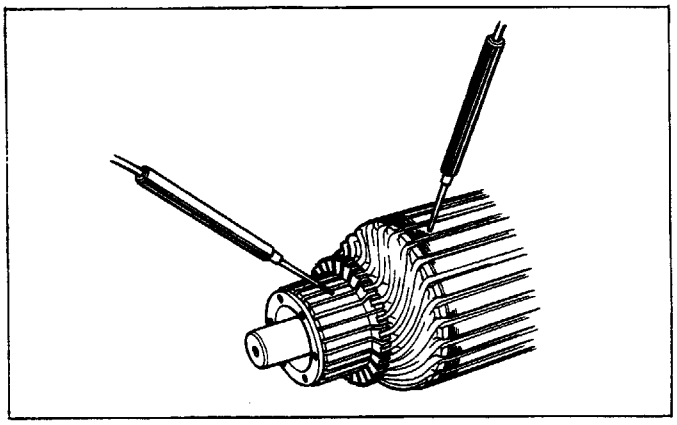


• ARMATURE

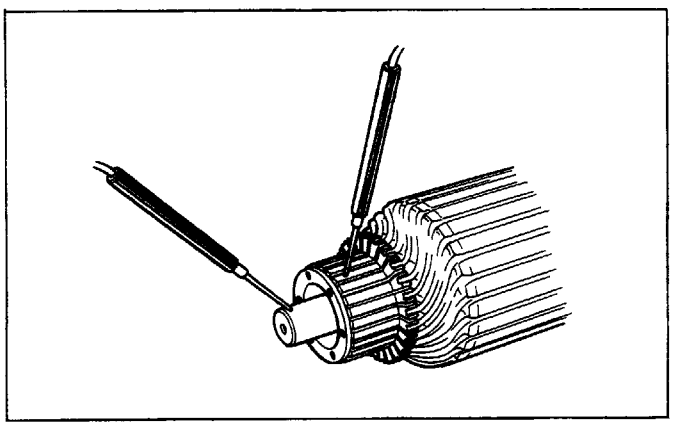
CONTINUITY CHECK—SEGMENTS
Check for continuity between each segment. If an open circuit exists between any two segments, replace the armature.



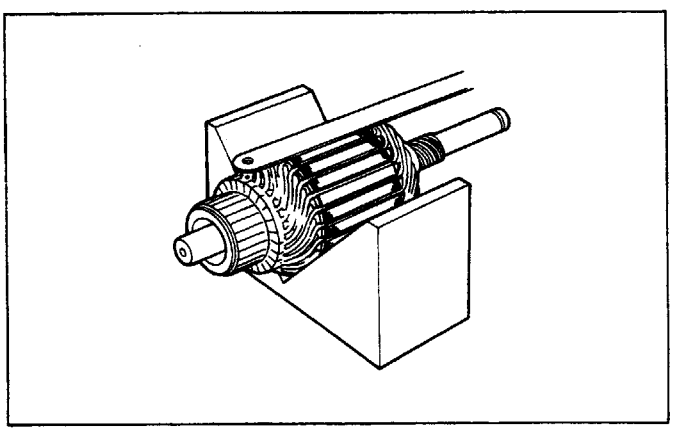
SHORT CIRCUIT TEST—CORE-TO-COMMUTATOR
Check for continuity between the commutator and armature coil core.
If continuity exists, replace the armature.



SHORT CIRCUIT TEST—SHAFT-TO-COMMUTATOR
Check for continuity between the commutator and amature shaft.
If there is continuity, replace the armature.

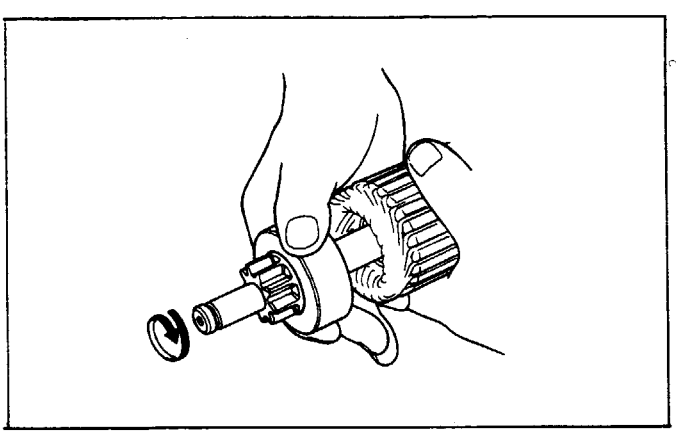


SHORT CIRCUIT TEST—ARMATURE
Place the armature in an armature tester (commercially available).
Hold a hacksaw blade close to the armature core. If the blade is attracted to the core or vibrates when the core is turned, the armature is shorted. Replace the armature.



• OVERRUNNING CLUTCH

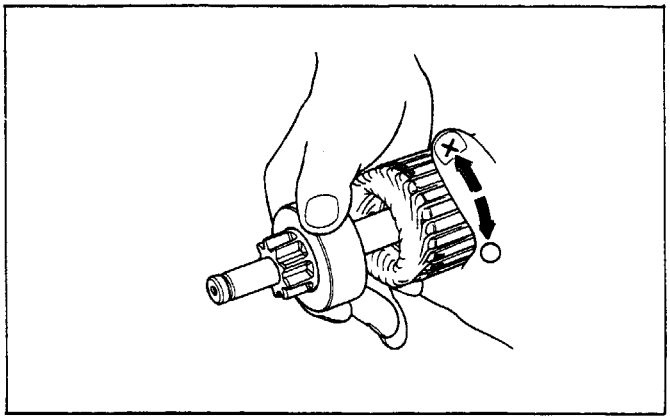
1) Check the overrunning clutch for smooth axial movement. Apply oil or replace the overrunning clutch if necessary.



2) Check the clutch movement by holding the rotor and turning the clutch. The clutch should turn freely counterclockwise and should not turn clockwise.
3) Check the pinion gear for wear or damage and replace if necessary.

NOTE

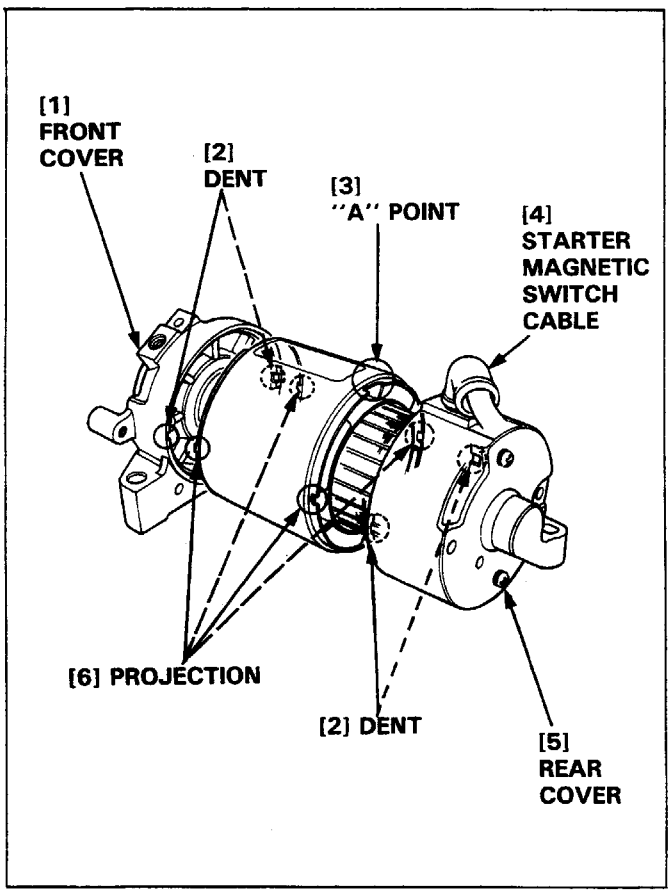
- If the pinion gear is worn or damaged, the flywheel ring gear must be inspected.



d. INSTALLATION

• FRONT COVER/YOKE/REAR COVER

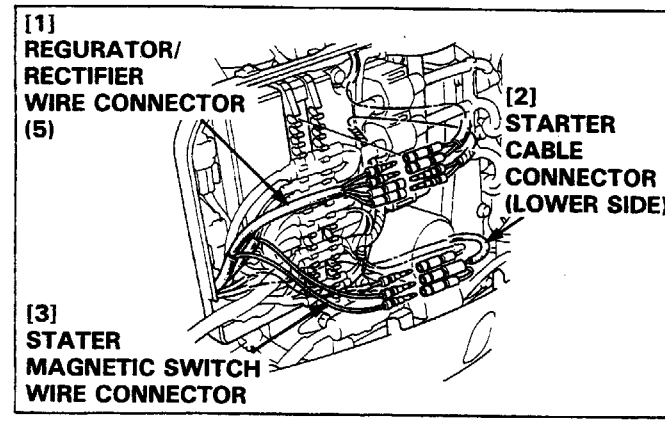
1) Align the projections on the yoke with the dents in the rear cover, and assemble the yoke and rear cover with the "A" point on the yoke facing the starter magnetic switch cable.
2) Assemble the yoke and front cover by aligning the dents in the front cover with the projections on the yoke.



ELECTRIC PARTS

a. DISASSEMBLY/REASSEMBLY

1) Remove the engine cover.
2) Remove the starter motor (P. 16-7).
3) Remove the CDI unit cover and disconnect the starter magnetic switch wire connector, starter cable (lower side) connector and regurator/rectifier wire connectors.
4) Disconnect the 14P connector and remote choke solenoid 2P connector. (Remote control type only).



[1] FUSE CASE
INSPECTION: P. 16-13

[2] BLADE TYPE FUSE [15A] (2)
INSPECTION: P. 16-13

[3] FUSE CASE COVER

[4] REGULATOR/ RECTIFIER BRACKET

[5] NEUTRAL SWITCH 2P CONNECTOR

6 x 12 (8)

[6] WIRE HARNESS CLIP (2)
REASSEMBLY: Install with the opening facing up.

[7] REGULATOR/RECTIFIER
INSPECTION: P. 16-14

6 x 25 (2)

[8] REGULATOR/RECTIFIER GROUND CABLE
INSTALLATION: P. 7-8

[9] NEUTRAL SWITCH
INSPECTION: P. 16-13

[10] NEUTRAL SWITCH BRACKET

[11] NEUTRAL SWITCH PLATE

[12] 14P CONNECTOR

[13] REMOTE CHOKE SOLENOID 2P CONNECTOR

[14] POWER TRIM & TILT SWITCH GROUND CABLE
INSTALLATION: P. 7-8

[15] CABLE CLIP BRACKET

[16] STARTER CABLE
REASSEMBLY: Set the starter cable on the engine under case so that the starter motor grommet is under the cable clip bracket.

[17] CABLE CLAMP

[18] STRAP BAND
REASSEMBLY: After tightening the band, cut off the excess of 15 mm (0.6 in) from end of the band.

[19] 6 mm HEX. NUT
5 N·m (0.5 kg-m, 3.6 ft-lb)

[20] POWER TRIM RELAY WIRE
INSTALLATION: P. 7-8

[21] STARTER CABLE (Lower side)
INSTALLATION: P. 7-8

[22] STARTER MAGNETIC SWITCH
INSPECTION: P. 16-13

[23] STARTER MAGNETIC SWITCH GROUND CABLE
INSTALLATION: P. 7-8

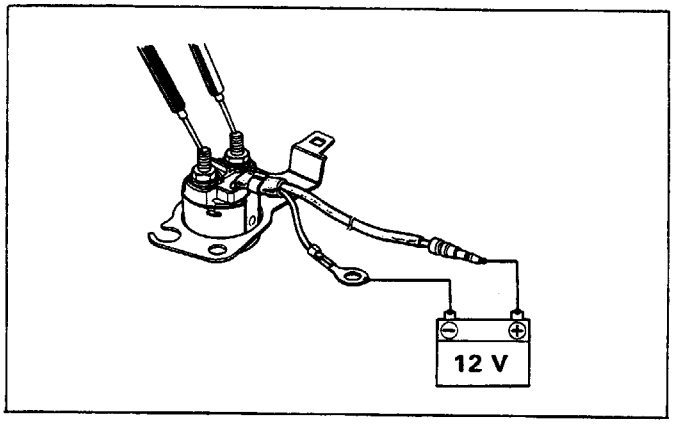
INSPECTION

• STARTER MAGNETIC SWITCH ASSEMBLY

NOTE

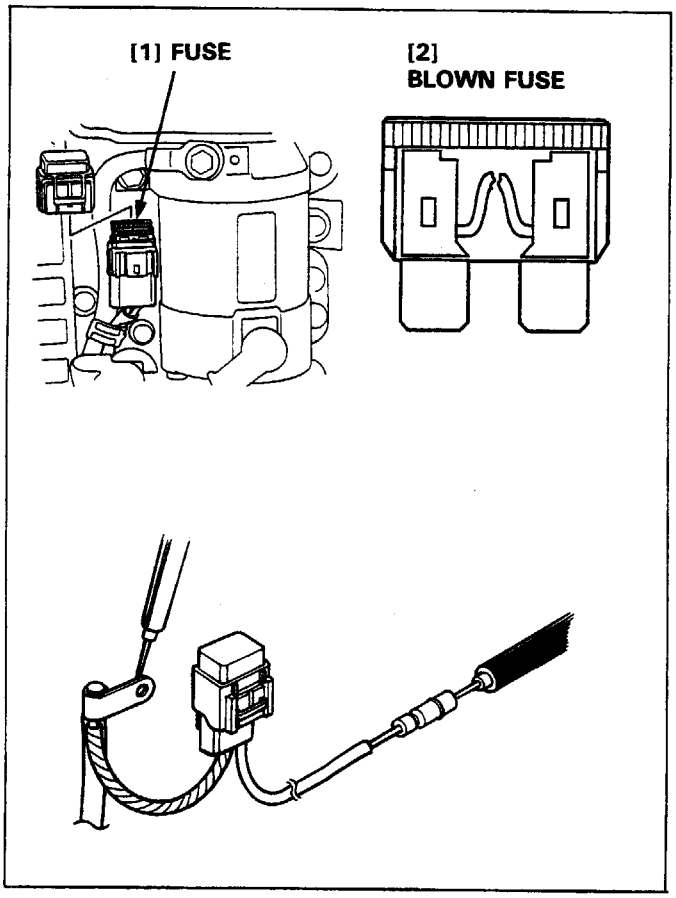
- Be sure the battery is in good condition before performing this test.

Connect the black/white wire of the starter switch to the positive (+) terminal of the battery and black wire to the negative (−) terminal and check for continuity. There should be continuity between the terminals.
And then there should be no continuity when disconnecting the battery.



• FUSE/FUSE CASE

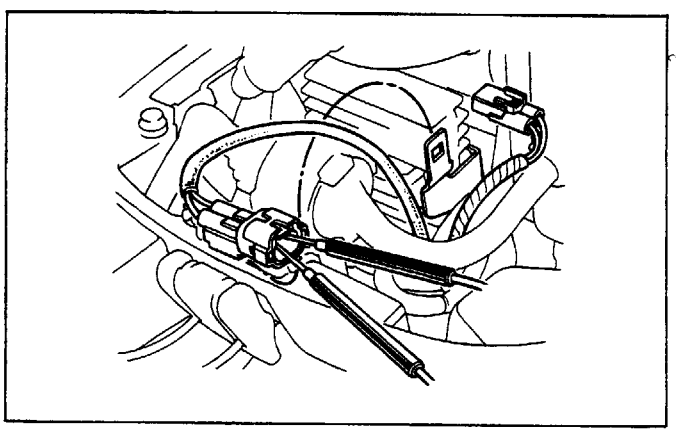
Check the fuse for continuity.
Connect the fuse to the fuse case and check the case for continuity.



• NEUTRAL SWITCH

Attach the tester leads to the two terminals at the neutral switch and check for continuity. There should be continuity when the switch knob is pushed.

SWITCH PUSHED (Shift lever to "F" or "R")	CONTINUITY
SWITCH RELEASED (Shift lever to "N")	NO CONTINUITY



• REGULATOR/RECTIFIER

Measure the resistance between the connectors.
Replace the regulator if the measurement is out of the specified range shown in the table below.

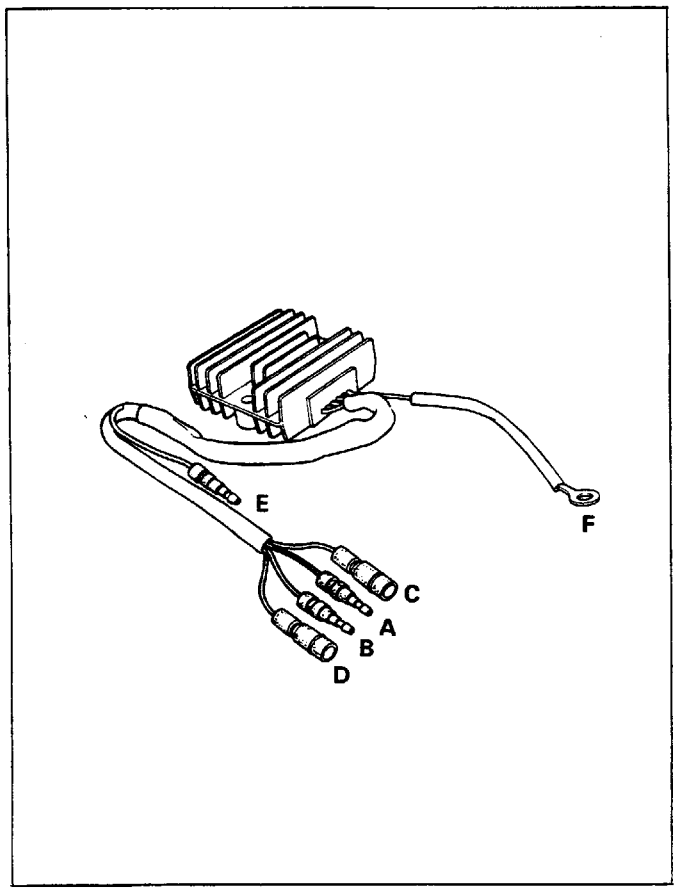
(Ω)

TESTER (+) / TESTER (−)		Gr A	Gr B	W/Bl, W D/E	Bl F
Gr	A		∞	∞	∞
Gr	B	∞			∞
W/Bl, W	D/E	1k—200k	1k—200k		500—100k
Bl	F	500—50k	100—50k	∞	

Check the regulator/rectifier for continuity.
The regulator/rectifier is normal if there is continuity between C and A, or C and B.

NOTE

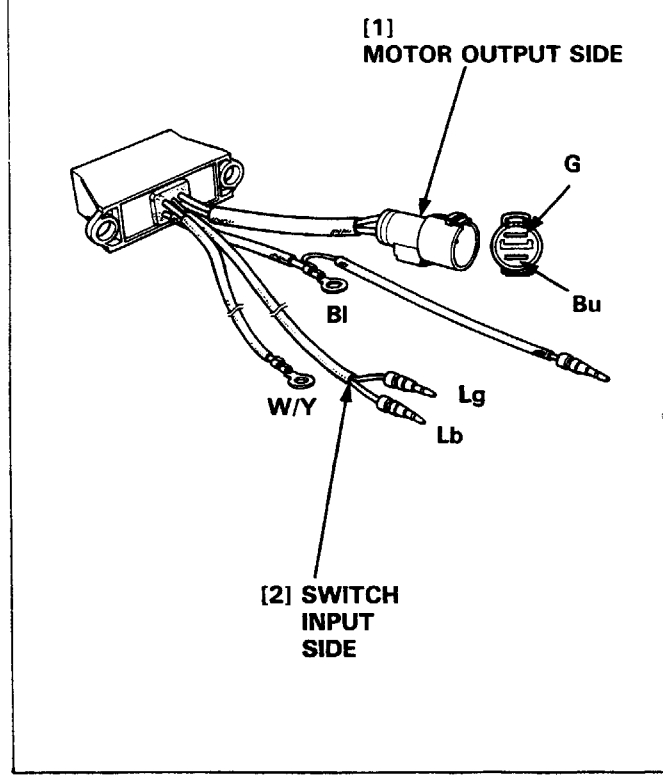
- RECOMMENDED MULTITESTERS:
  TH—5H (KOWA Analogue type)
  SP—10D (SANWA Analogue type)
- Select the following range.
  Kowa: R x 100 Ω
  Sanwa: kΩ



• POWER TILT RELAY (Power trim & tilt type only)

Check the continuity and resistance between the terminals shown in the table below.

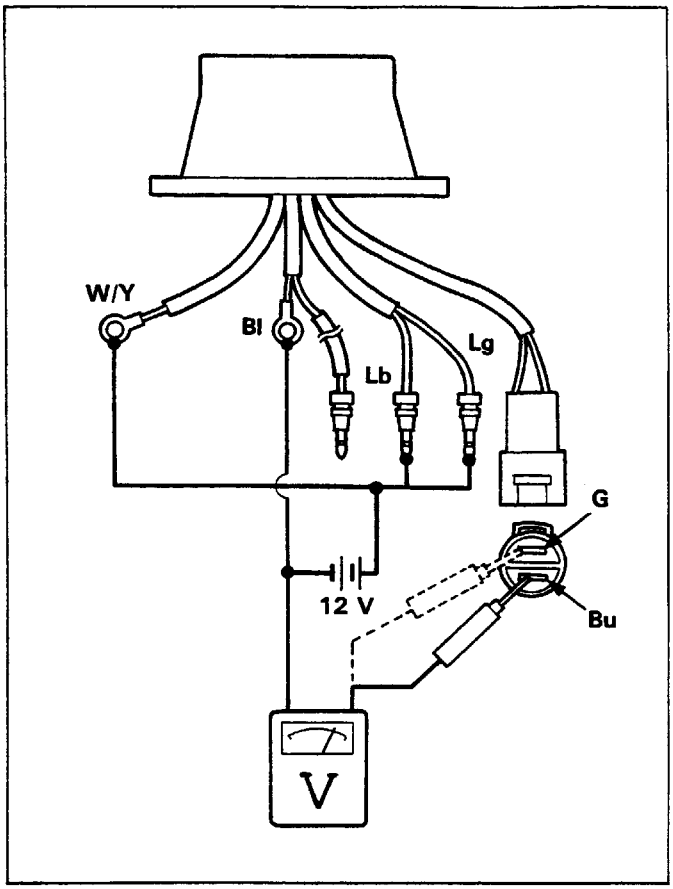
Between G (motor output side) and Bl	Continuity
Between Bu (motor output side) and Bl	Continuity
Between Lg (switch input side) and Bl	90—120 Ω
Between Lb (switch input side) and Bl	90—120 Ω
Between W/Y and Bl	No continuity



NOTE

• Be sure the battery is in good condition before performing this test.

Check that there is battery voltage between the ground cable Bl and the motor output side G and Bu in the circuit shown to the right.

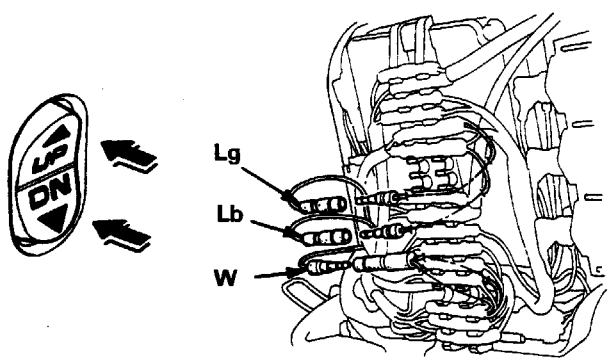


• POWER TRIM & TILT SWITCH (Power trim & tilt type only)

Attach the tester lead to each terminal and check for continuity. There should be continuity between the terminals marked with circle in the table below.

Remote control side connector color	Lg	W/Bl	Lb
Engine under case side connector color	Lg	W	Lb
UP	○	○	
DOWN		○	○

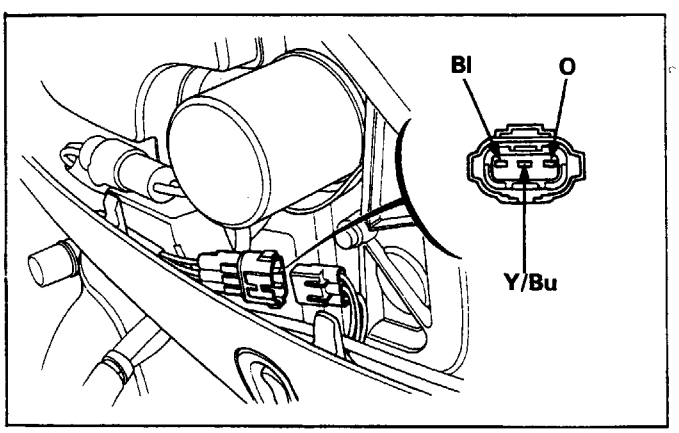
[1] ENGINE UNDER CASE SIDE



• TRIM ANGLE SENSOR

Attach the tester leads to the trim angle sensor connector and measure the resistance.

Resistance between O and Bl	4–6 kΩ
Resistance between Y/Bu and Bl	2.7–4.3 kΩ

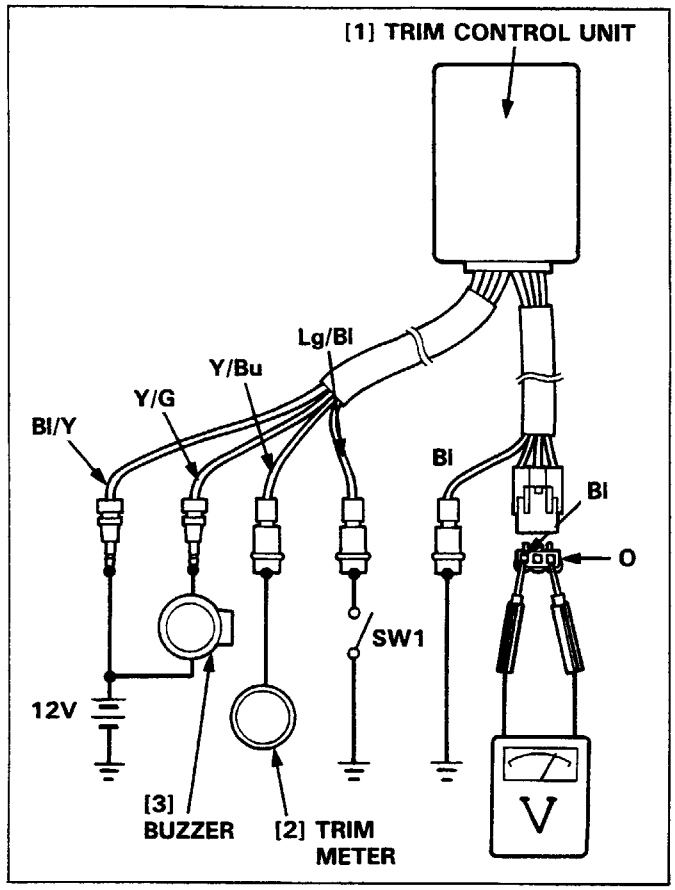


• TRIM CONTROL UNIT (Power trim & tilt type only)

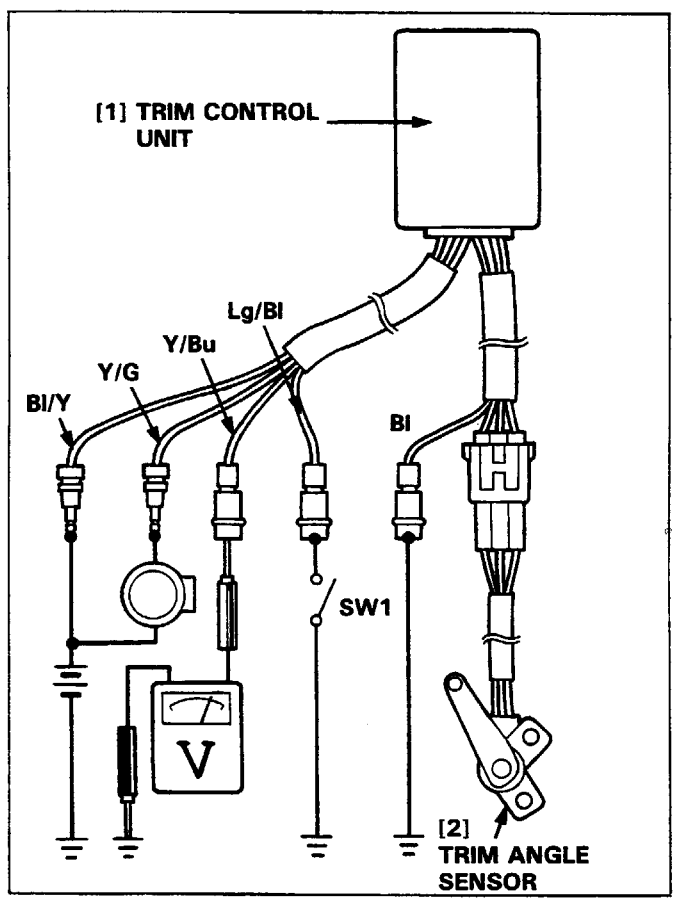
NOTE

- Be sure the battery is in good condition before performing this test.

1) Check that there is 5 ± 0.1 V of voltage between the O and Bl terminals in the circuit shown to the right.

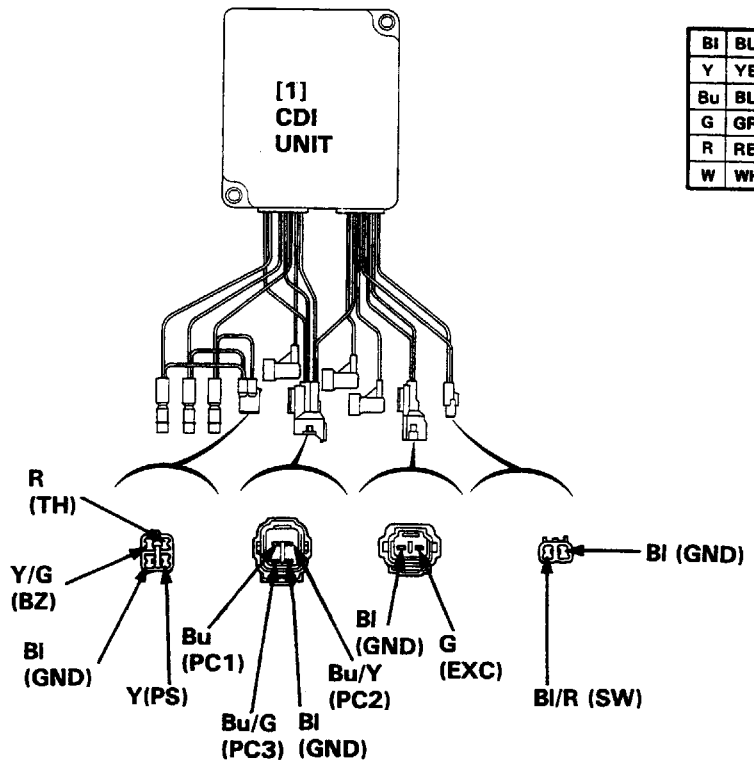


2) Turn the angle sensor until voltage between Y/Bu and Bl is 3.05 volts. Be sure that the buzzer sounds intermittently when the switch 1 is turned OFF. Check also that the buzzer stops sounding when the switch 1 is ON.



• CDI UNIT (Except tiller handle type)

Measure the resistance between the CDI unit terminals and be sure that measurements conform to the ranges shown in the table below.



Bl	BLACK	Br	BROWN
Y	YELLOW	O	ORANGE
Bu	BLUE	Lb	LIGHT BLUE
G	GREEN	Lg	LIGHT GREEN
R	RED	P	PINK
W	WHITE	Gr	GRAY

(KΩ)

COLOR	Tester(−) / Tester(+)	PC1	PC2	PC3	EXC	SW	IG1	IG2	IG3	PS	TH	GND	BZ
Bu	PC1		10−500	10−500	10−500	∞	∞	∞	∞	∞	∞	3−300	∞
Bu/Y	PC2	10−500		10−500	10−500	∞	∞	∞	∞	∞	∞	3−300	∞
Bu/G	PC3	10−500	10−500		10−500	∞	∞	∞	∞	∞	∞	3−300	∞
G	EXC	10−500	10−500	10−500		∞	∞	∞	∞	∞	∞	0.5−50	∞
Bl/R	SW	20−500	20−500	20−500	0.5−50		∞	∞	∞	∞	∞	0.5−50	∞
Bl/L	IG1	∞	∞	∞	∞	∞		∞	∞	∞	∞	∞	∞
Bl/Y	IG2	∞	∞	∞	∞	∞	∞		∞	∞	∞	∞	∞
Bl/G	IG3	∞	∞	∞	∞	∞	∞	∞		∞	∞	∞	∞
Y	PS	10−500	10−500	10−500	10−500	∞	∞	∞	∞		∞	0.5−50	∞
R	TH	3−300	3−300	3−300	3−300	∞	∞	∞	∞	∞		0.5−50	∞
Bl	GND	3−300	3−300	3−300	3−300	∞	∞	∞	∞	∞	∞		∞
Y/G	BZ	10−500	10−500	10−500	10−500	∞	∞	∞	∞	∞	∞	0.5−500	

TESTER (−) / TESTER (+)	PC.E	EXC.E.	IND.E.	SW.E.
GND	Continuity	Continuity	Continuity	Continuity

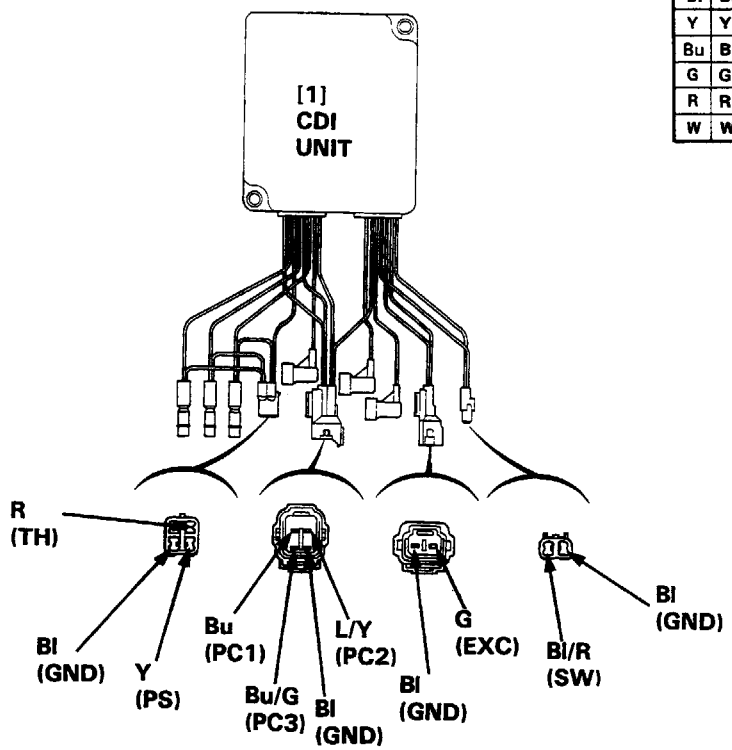
NOTE

- RECOMMENDED MULTITESTERS:
  TH−5H (KOWA Analogue type)
  SP−10D (SANWA Analogue type)
- Select the following range.
  Kowa: R x 100 Ω
  Sanwa: kΩ

• CDI UNIT (Tiller handle type only)

Measure the resistance between the CDI unit terminals and be sure that measurements conform to the ranges shown in the table below.

Bl	BLACK	Br	BROWN
Y	YELLOW	O	ORANGE
Bu	BLUE	Lb	LIGHT BLUE
G	GREEN	Lg	LIGHT GREEN
R	RED	P	PINK
W	WHITE	Gr	GRAY



(KΩ)

COLOR	Tester(−) / Tester(+)	PC1	PC2	PC3	EXC	SW	IG1	IG2	IG3	PS	TH	GND
Bu	PC1		10—500	10—500	10—500	∞	∞	∞	∞	∞	∞	3—300
Bu/Y	PC2	10—500		10—500	10—500	∞	∞	∞	∞	∞	∞	3—300
Bu/G	PC3	10—500	10—500		10—500	∞	∞	∞	∞	∞	∞	3—300
G	EXC	10—500	10—500	10—500		∞	∞	∞	∞	∞	∞	0.5—50
Bl/R	SW	20—500	20—500	20—500	0.5—50		∞	∞	∞	∞	∞	0.5—50
Bl/L	IG1	∞	∞	∞	∞	∞		∞	∞	∞	∞	∞
Bl/Y	IG2	∞	∞	∞	∞	∞	∞		∞	∞	∞	∞
Bl/G	IG3	∞	∞	∞	∞	∞	∞	∞		∞	∞	∞
Y	PS	10—500	10—500	10—500	10—500	∞	∞	∞	∞		∞	0.5—50
R	TH	3—300	3—300	3—300	3—300	∞	∞	∞	∞	∞		0.5—50
Bl	GND	3—300	3—300	3—300	3—300	∞	∞	∞	∞	∞	∞	

TESTER (−) / TESTER (+)	PC.E	EXC.E.	IND.E.	SW.E.
GND	Continuity	Continuity	Continuity	Continuity

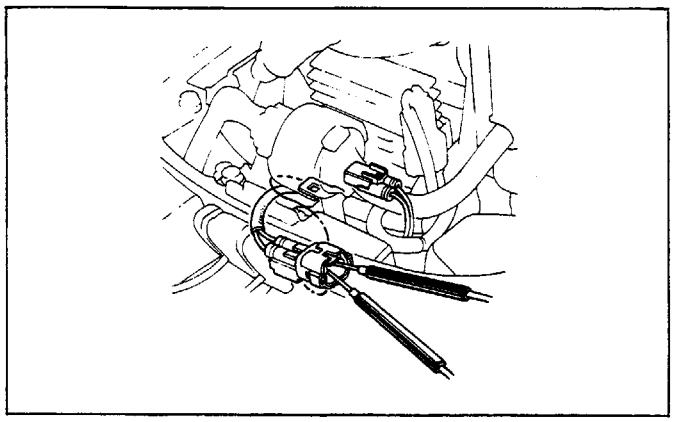
NOTE

- RECOMMENDED MULTITESTERS:
  TH—5H (KOWA Analogue type)
  SP—10D (SANWA Analogue type)
- Select the following range.
  Kowa: R x 100 Ω
  Sanwa: kΩ

• REMOTE CHOKE SOLENOID (Remote control type only)

Measure the resistance between the terminals.

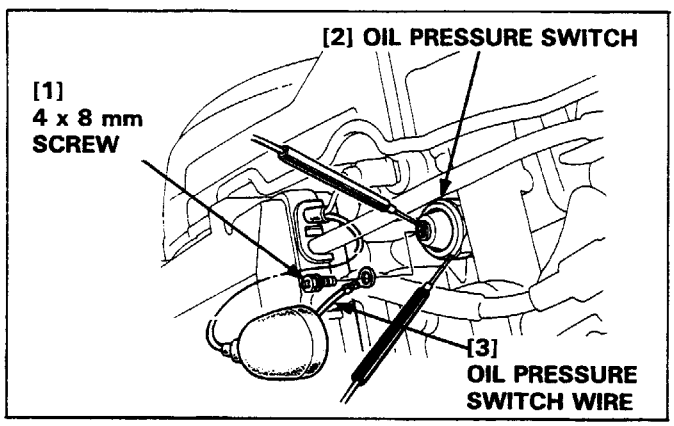
Resistance	2.8 – 3.4 Ω



• OIL PRESSURE SWITCH

1) Remove the oil pressure switch wire.

2) Attach the tester leads to the terminal joint and switch body and check for continuity. There should be continuity.



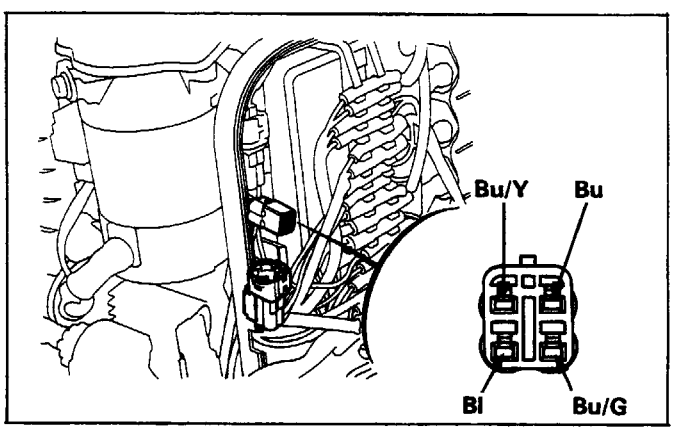
• PULSER COIL

NOTE

- It is not necessary to remove the coil:
  Remove the engine cover and disconnect the pulser coil connector from the right side of the engine (P. 6-3).

Attach the tester lead to each terminal and measure the resistance between the terminals.

	PC1 (Bu)	PC2 (Bu/Y)	PC3 (Bu/G)
GND (Bl)	288–352 Ω	288–352 Ω	288–352 Ω



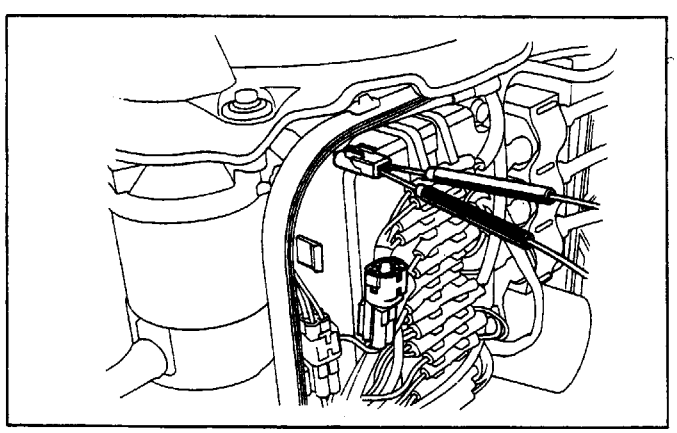
• EXCITER COIL

NOTE

- For exciter coil replacement, see page 6-2.

Measure the resistance between each terminal of the exciter coil with the tester.

Resistance	168–227 Ω



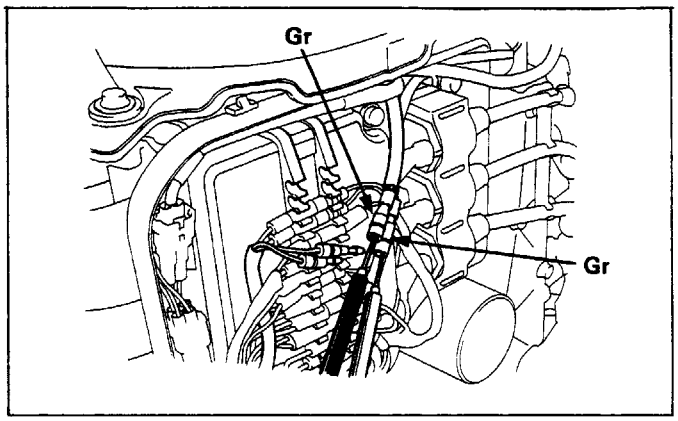
• CHARGING COIL 12V-6A

NOTE

- It is not necessary to remove the coil:
  Remove the engine cover and disconnect the charging coil connector from the right side of the engine (P. 6-2).

Measure the resistance between each terminal of the charging coil with the tester.

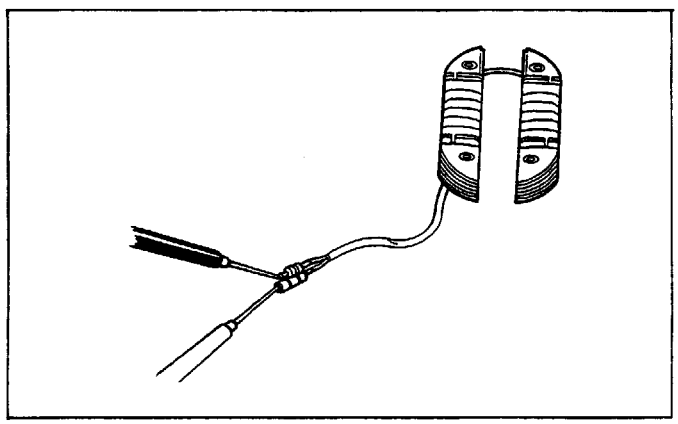
Resistance	0.20—0.26 Ω



• CHARGING COIL 12V-10A (OPTIONAL)

Measure the resistance between each terminal of the charging coil kit with the tester.

Resistance	0.17—0.23 Ω



• IGNITION COIL

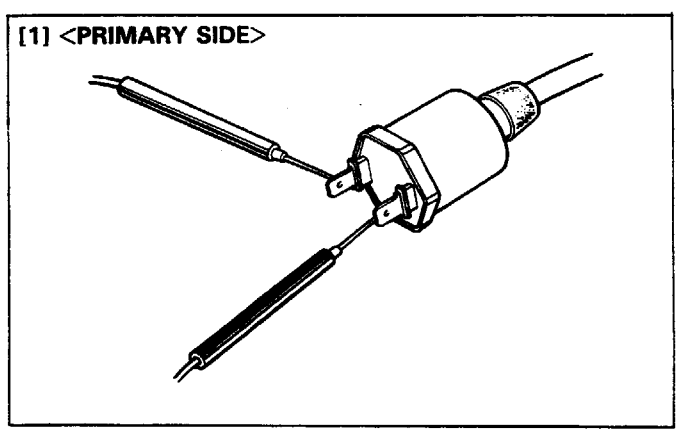
NOTE

- For ignition coil replacement, see page 16-4.

<Primary side resistance>
Measure the resistance of the primary coil between the two terminals at the ignition coil.

Resistance	0.19—0.23 Ω

[1] <PRIMARY SIDE>



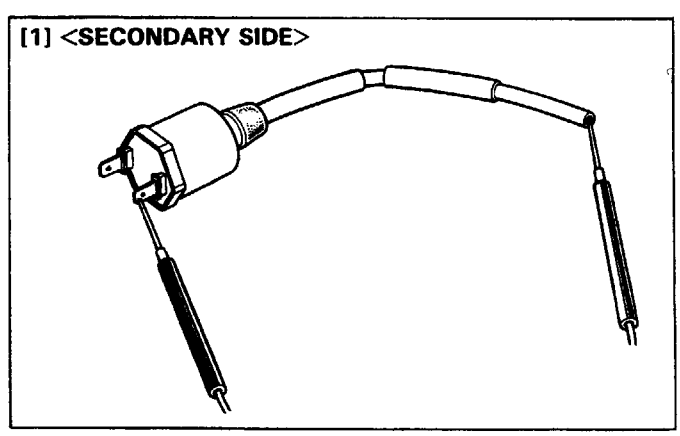
<Secondary side resistance>
Remove the spark plug cap and measure the resistance of the secondary coil between the plug wire and the green terminal.

Resistance	2.8—3.4 kΩ

NOTE

- A false reading will result if the spark plug cap is not removed.

[1] <SECONDARY SIDE>



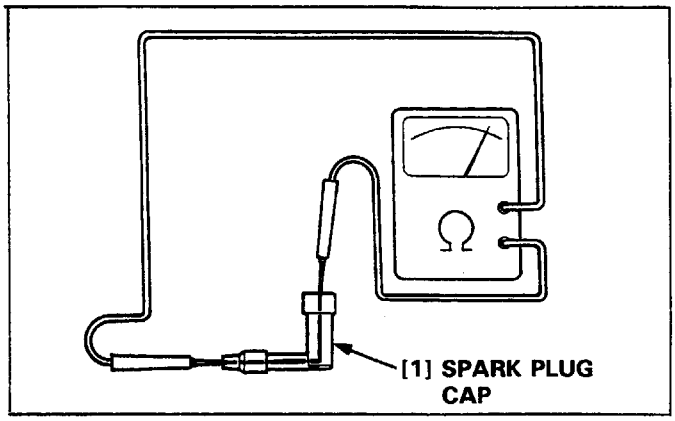
• SPARK PLUG CAP

Measure the resistance of the spark plug cap by touching one test lead at the wire end of the cap, and the other at the spark plug end.

Resistance	7.5—12.5 kΩ

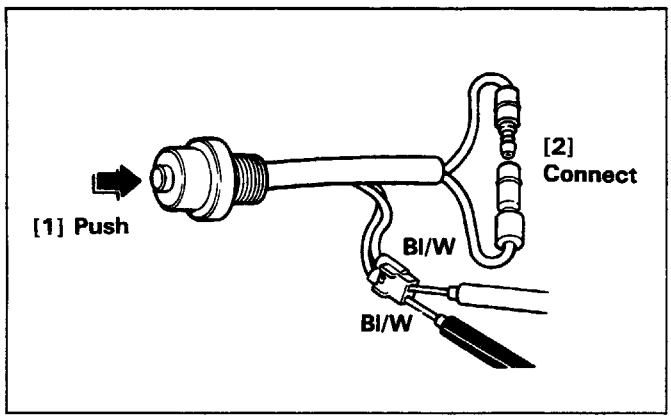
NOTE

- RECOMMENDED MULTITESTERS:
  TH—5H (KOWA Analogue type)
  SP—10D (SANWA Analogue type)



• STARTER SWITCH (Tiller handle type only)

Connect the starter switch 2P connector, attach the tester leads to the 2P connector terminal joints, and push the starter switch knob. The switch is normal if there is continuity when the knob is pushed.

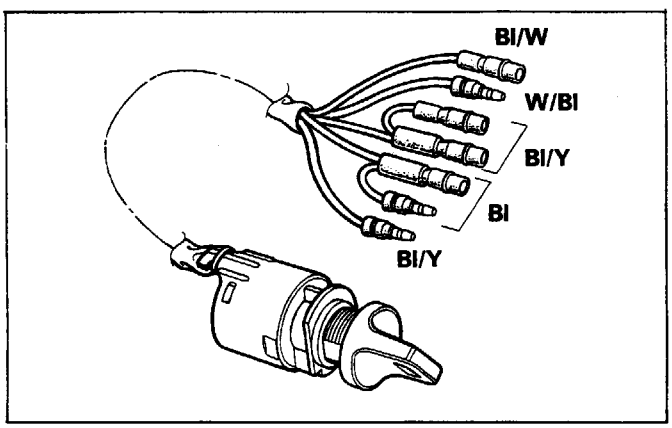


• COMBINATION SWITCH

Check for continuity between the terminals with the switch in each position.

Position \ Color	E (Bl)	IG (Bl/R)	BAT (W/Bl)	LO (Bl/Y)	ST (Bl/W)
OFF	O—O				
ON			O—O		
START			O—O	O	O

O—O: Continuity



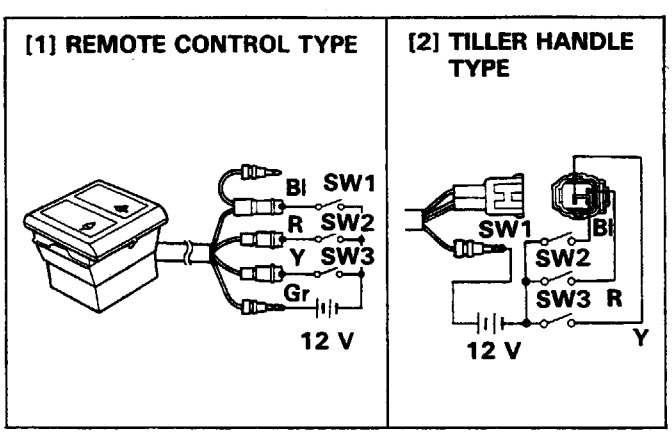
• INDICATOR LAMP

NOTE

- Be sure the battery is in good condition before performing this test.

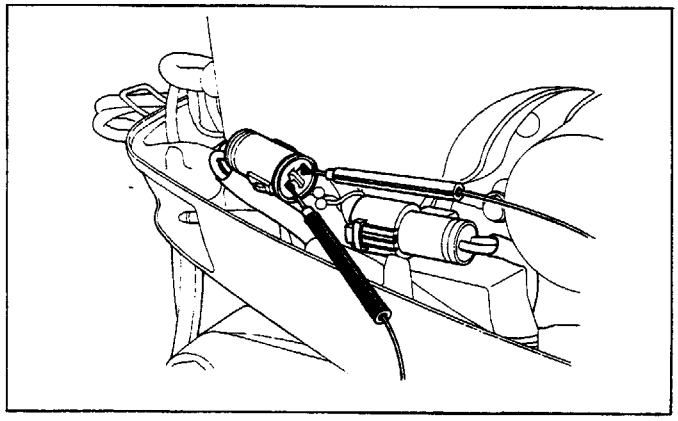
Apply 12V of voltage to the Br terminal and connect the switches 1, 2, and 3 to the Bl, R, and Y terminals respectively.

When SW1 is ON: The green lamp should turn on.
When SW1 and SW3 are ON: The green lamp should go off.
When SW2 is ON: The red lamp should turn on.



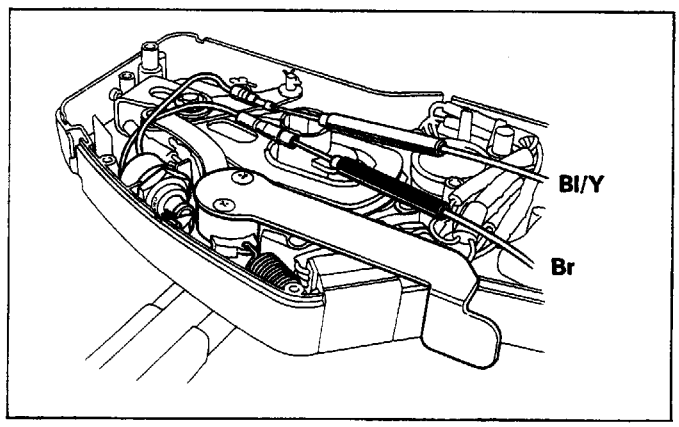
• POWER TILT MOTOR (Power trim & tilt type only)

Check for continuity between the terminals.



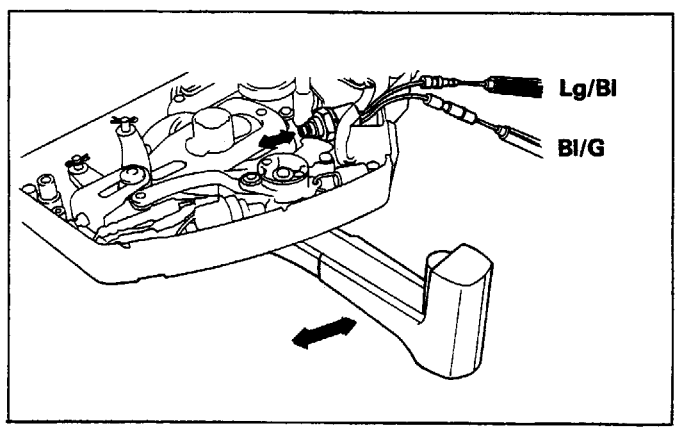
• SOLENOID SWITCH (Remote control type only)

Attach the tester leads to the two terminals at the solenoid switch and check for continuity. There should be continuity when the switch knob is pushed.



• THROTTLE SWITCH (Power trim & tilt type only)

Attach the tester leads to the two terminals at the throttle switch and check for continuity. There should be continuity when the switch knob is pushed.

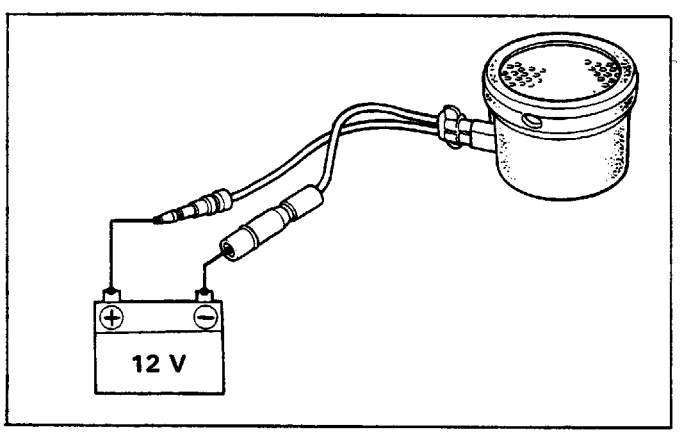


• WARNING BUZZER (Remote control type only)

NOTE

- Be sure the battery is in good condition before performing this test.

Connect the black/yellow terminal of the warning buzzer to the positive (+) terminal of the 12V battery and the yellow/green terminal to the negative (−) terminal of the battery.
The warning buzzer should sound.



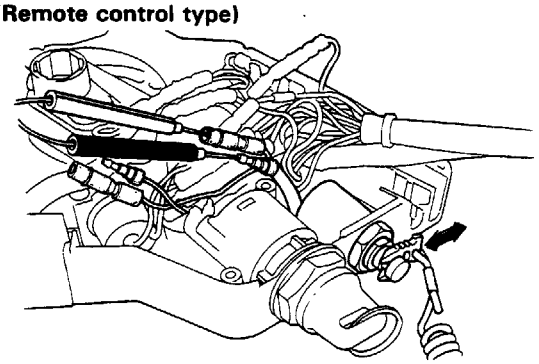
• EMERGENCY STOP SWITCH

Attach the tester leads to the two terminals of the emergency stop switch and check for continuity.

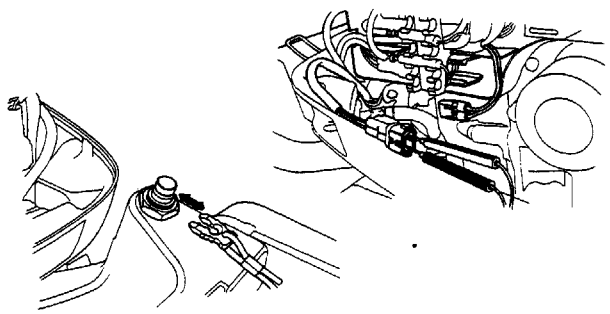
Switch clip	Continuity
Yes	No
No	Yes

In case that the switch clip is set, there should be continuity when the button is pushed.

[1] (Remote control type)



[2] (Tiller handle type)



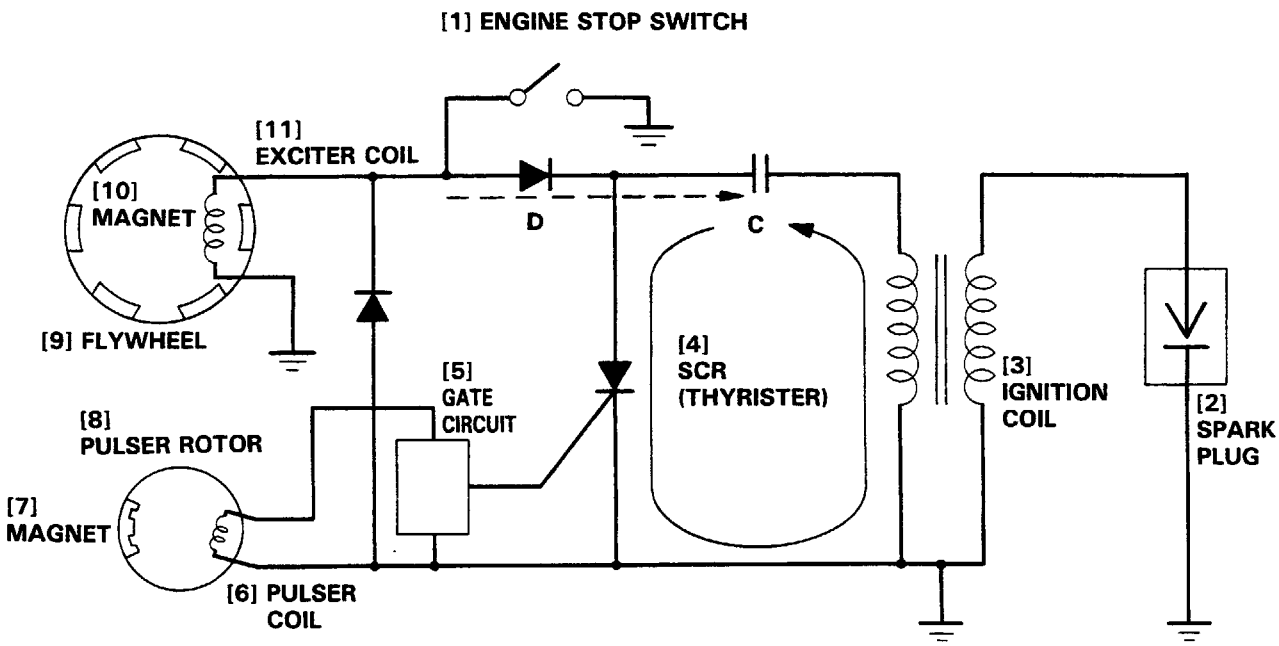
OPERATION

ELECTRICAL SYSTEM

~1. Electronic advance CDI system

The BF35A • 45A is equipped with the electronic advance maintenance free CDI system which is excellent in sparking performance and has no mechanical contact.

<Basic circuit diagram (for one cylinder)>



<Operation>

1) When the flywheel rotates, the electric power generated at the exciter coil is rectified by the diode (D) and charged into the ignition condenser (C) (shown by the broken line in the above diagram). The thyrister (SCR) is OFF this time.

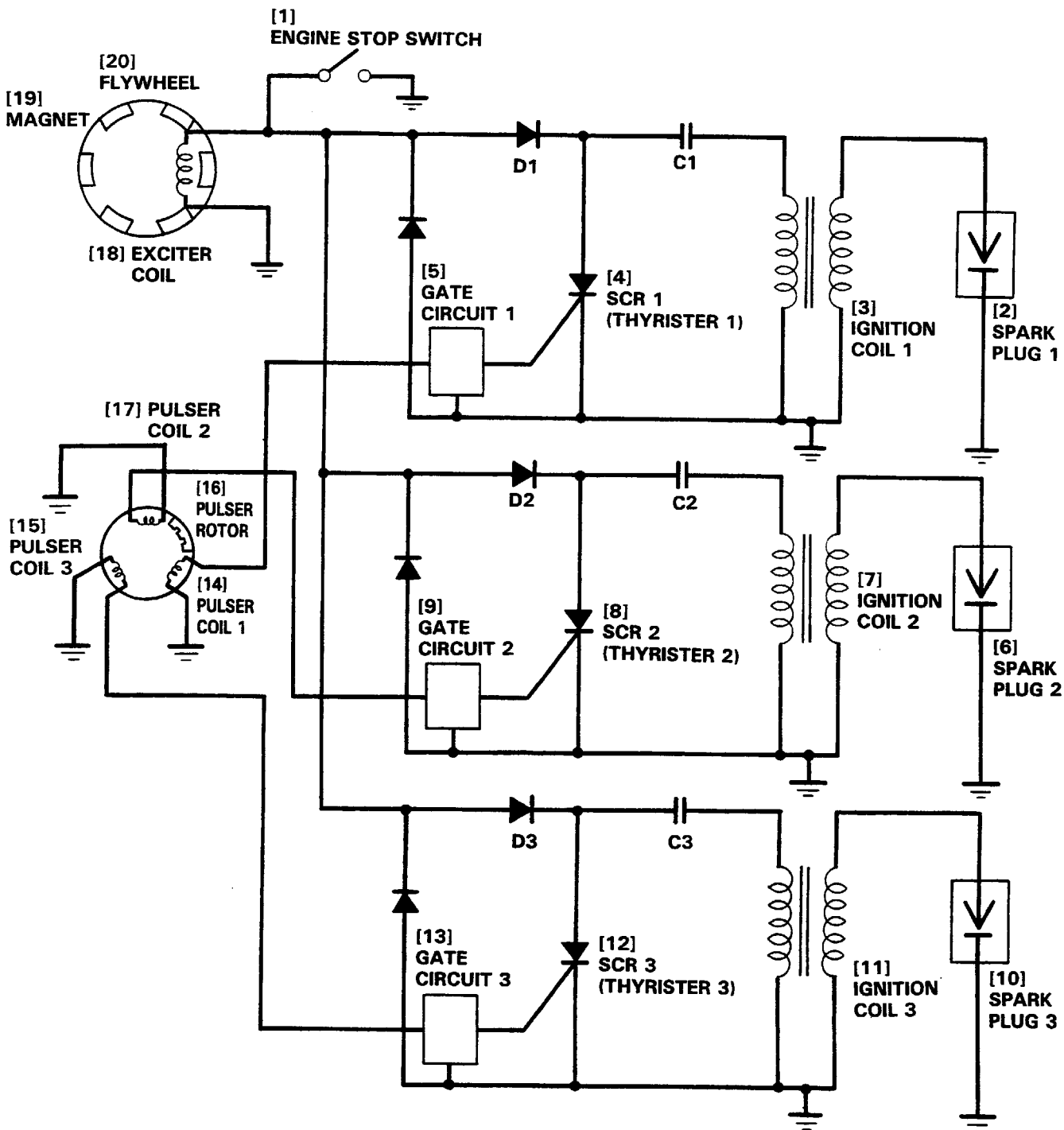
2) When the magnet on the pulser rotor passes the pulser coil, the electric pulser coil signal is emitted by the magnetic force. This signal passes the gate circuit, turns ON the thyrister, and discharges the electric charge from the condenser. When the discharged current flows through the ignition coil primary circuit, high voltage is generated in the secondary circuit and the spark plug sparks (shown by the solid line in the above diagram).

3) Spark advance
The BF35A • 45A is equipped with the electronic advance spark system, which advances the ignition timing when the gate circuit turns ON the thyrister according to the engine speed to obtain the high speed power.

<3 cylinder ignition system>

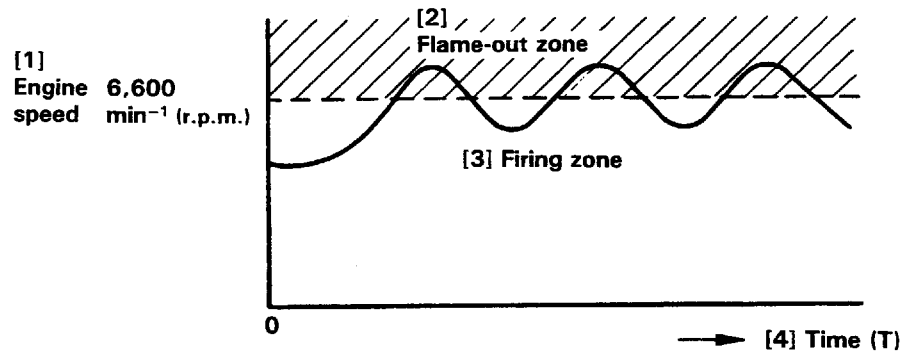
This system is equipped with the three ignition condensers and an independent ignition system is provided for each cylinder.

- **Basic circuit diagram**

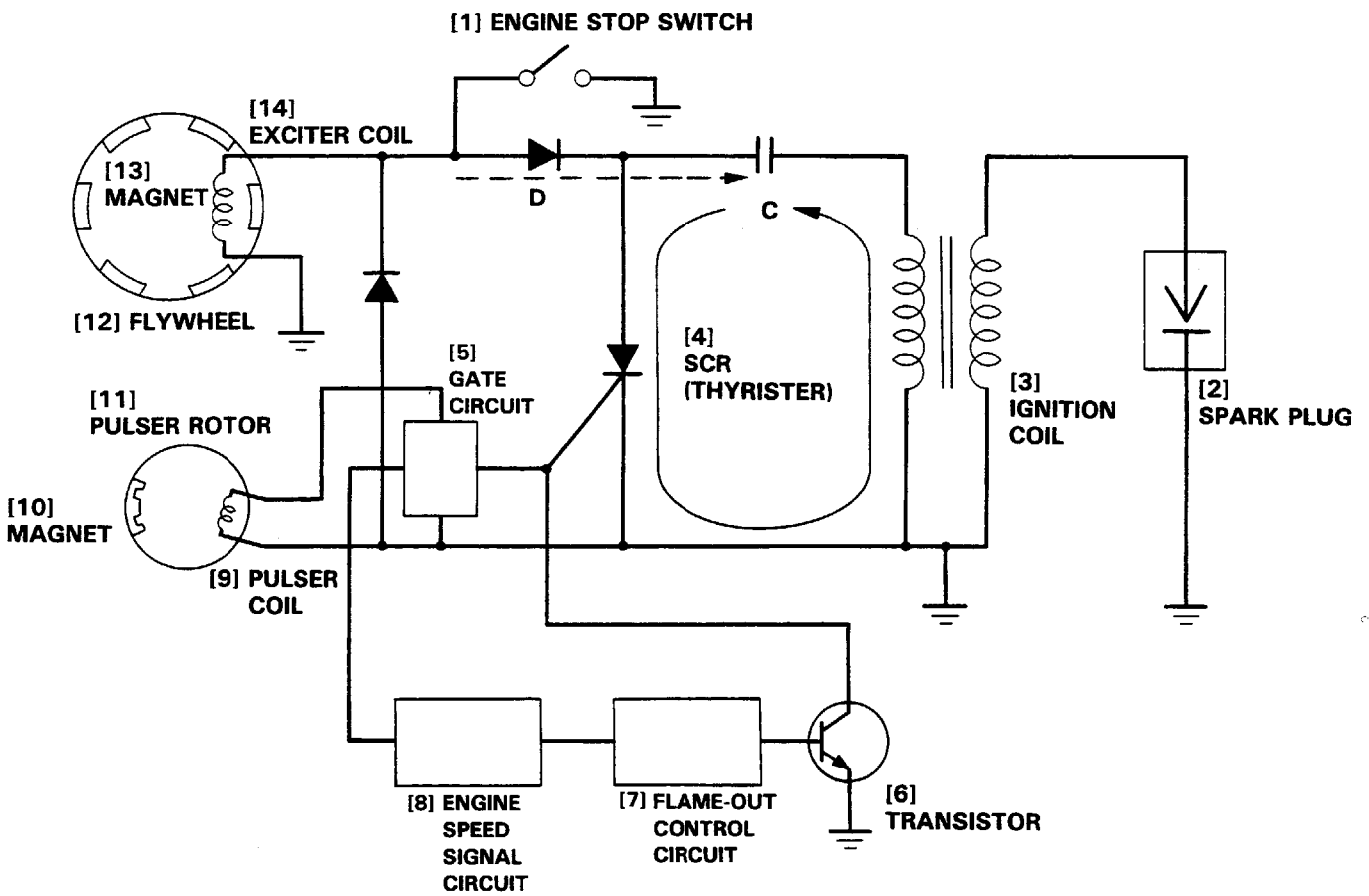


~2. Overrev limiter

The overrev limiter is provided in the CDI unit circuit to prevent the overrevving of the engine.
Set speed of overrev limiter: 6,600 ± 200 min^{-1} (r.p.m.).



<Basic circuit diagram (for one cylinder)>



<Operation>

1) Getting the engine speed signal from the pulser coil gate circuit, the flame-out control circuit detects whether it is over or below the set speed.

2) When the speed is over the set speed, the transistor (TR) turns ON and short circuits the thyrister (SCR) trigger signal to the ground to flame out.

*The above procedures are performed to flame out the No. 2 and No. 3 cylinders.
Stable engine speed while under way is thereby obtained.

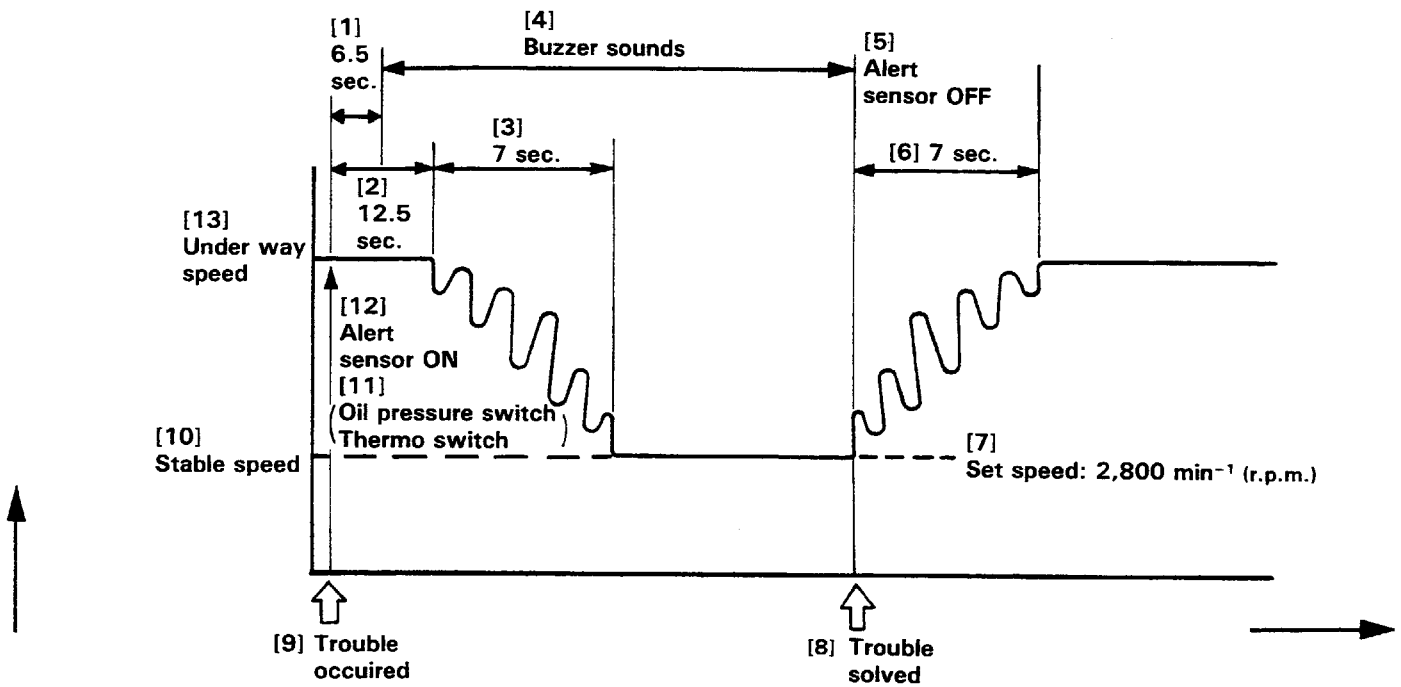
~3. Overheat/oil pressure alert system

The BF35A • 45A is equipped with the overheat/oil pressure alert system which protects the engine by controlling the engine speed in the CDI circuit when the engine is overheated or oil pressure drops.

<Principal operation>

When a trouble occurs, the system slows down the engine speed gradually, as a sharp drop of the engine speed is very dangerous for the operator as if the boat is braked suddenly. When the trouble is solved, it also increases the engine speed slowly and gradually. The system is provided with the indicator lamps and buzzuer sound (remote control type) to indicate the cause of trouble to the operator.

1) Engine speed control



Engine speed down boat slows down

Firing and flaming out is repeated electrically to control the engine speed.

1. Engine speed: below the stable speed
   When the engine speed is below the stable speed, it increases to the stable speed according to the throttle angle.

2. Engine speed: above stable speed
   The engine speed slows down gradually from the under way speed and stabilizes at the stable speed (approximately 2,800 r.p.m.). Then the engine speed does not increase regardless of the throttle angle.

2) Warning system

The warning system sets the time of the timer before the engine speed control is started and notifies the operator of the oil pressure switch/thermo switch operation with the indicator lamps (LED).

Item	Color of the lamp	When faulty
Oil pressure switch	Green	OFF
Thermo switch	Red	ON

<Detection>

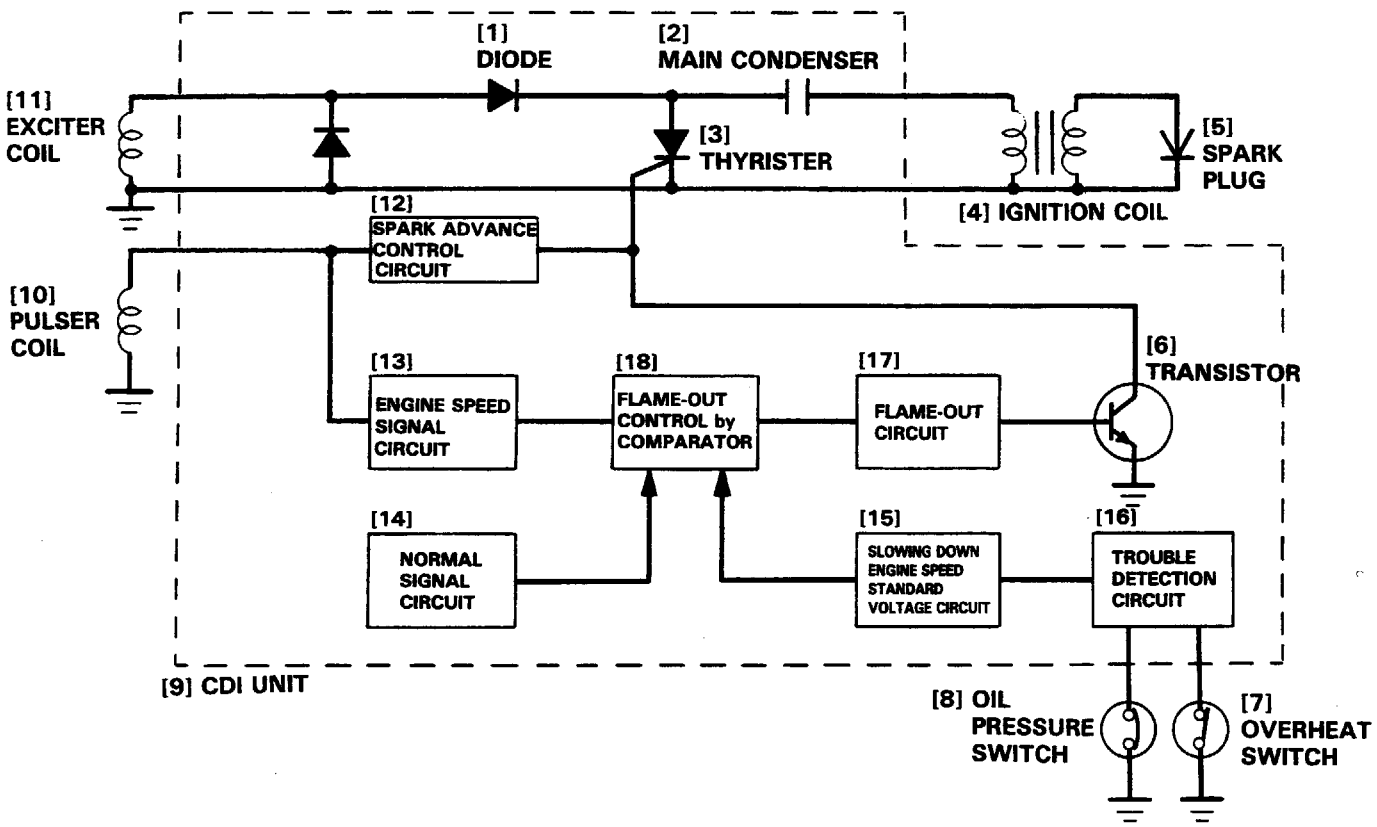
Thermo switch: ON when temperature is above the set temperature

Oil pressure switch: ON when oil pressure is below the set pressure

- If the product is the steering handle type, the indicator lamps are installed on the outboard.
- If the product is the remote control type, the operator does not notice the trouble easily before the engine speed control is started, as he must frequently turns back while driving if the indicator lamps are mounted on the outboard. Therefore, the indicator lamps are mounted on the remote control box and the buzzer in the remote control box sounds after the indicator lamps turn ON (OFF).

<Unit alert system operation (for one cylinder)>

1) Basic circuit diagram



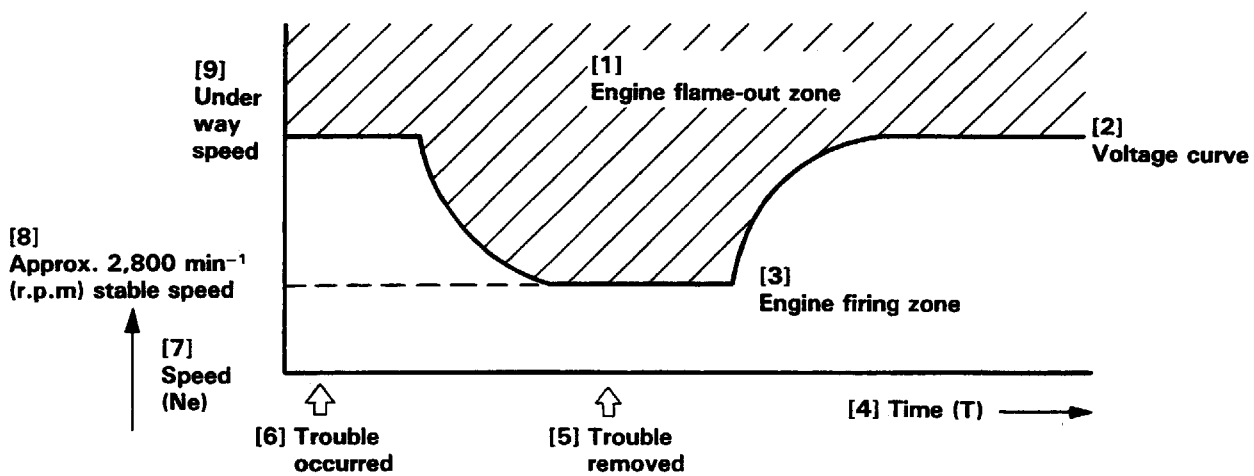
2) Operation

1. When the oil pressure switch or thermo switch detects the trouble signal, the comparator circuit compares the condenser discharged voltage curve of the slowing down engine speed standard voltage circuit with the engine speed voltage signal and detects whether the speed is above or below the specified speed.

2. Getting the signal from the comparator, the flame-out circuit turns ON/OFF the transistor (TR) and controls the thyrister gate.

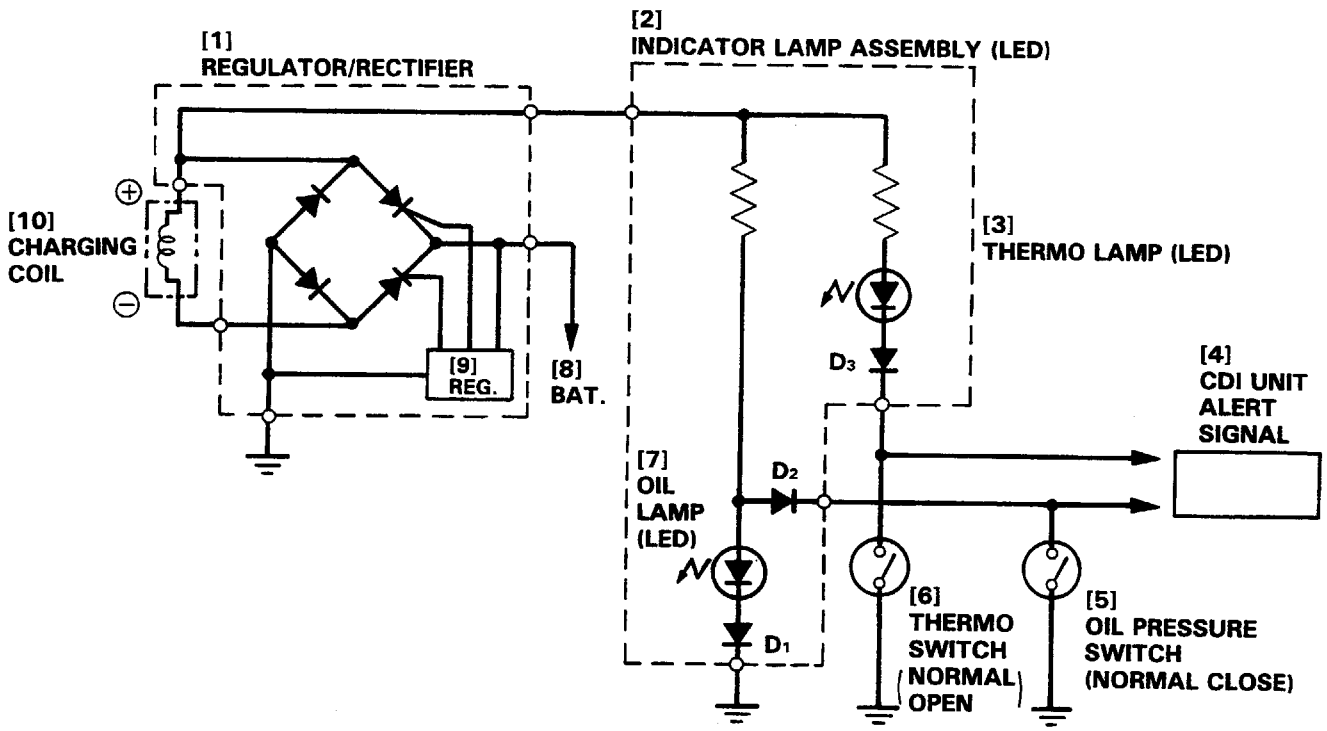
3. The slowing down engine speed standard voltage stabilizes at the preset stable engine speed and flaming-out and firing are repeated at this stable engine speed.

4. After the trouble to the oil pressure switch or thermo switch is removed and trouble signal stops, the unit alert system repeats the above 1 and 2.



<Alert indicator lamp circuit>

1) Basic circuit diagram



2) Operation

1. The direct current supplied from the charging coil and rectified to the half wave by the rectifier flows to the thermo lamp and oil lamp to light.
2. The thermo switch turns ON when the temperature is above the set temperature and the current flows through the lamp circuit to light. The alert ON signal is sent to the CDI unit when the thermo switch is ON.
3. The oil pressure switch turns OFF and the current flows to the oil lamp when the oil pressure is applied to the engine while running. When the oil pressure drops below the set pressure, the switch turns ON, the current flows through the diode D2 to the oil pressure switch, and the current to the oil lamp is shut off to turn the lamp OFF. The alert ON signal is sent to the CDI unit when the switch is ON.

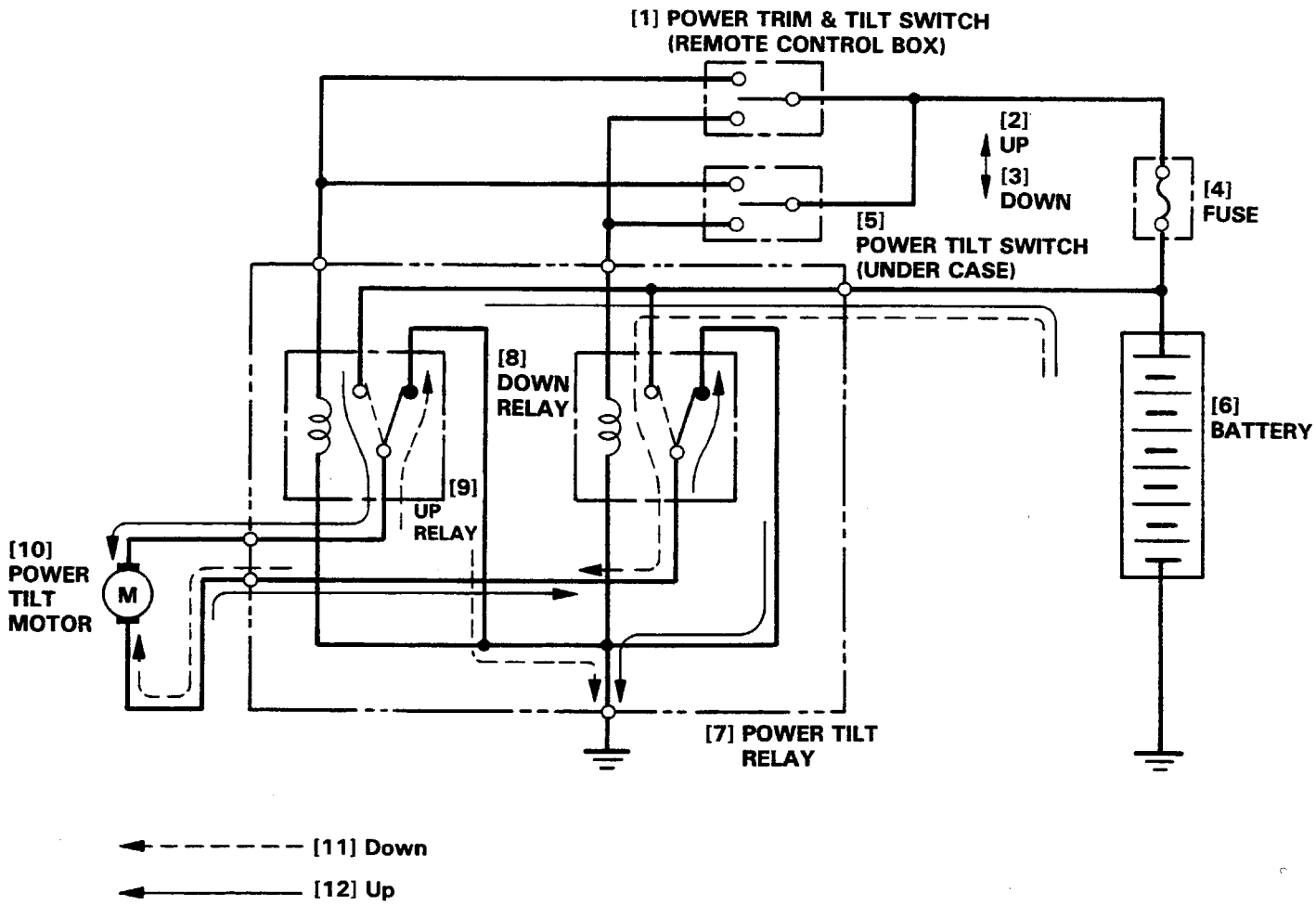
POWER TRIM & TILT SYSTEM

The BF35A•45A has a type equipped with the power trim & tilt system which hydraulically raises/lowers the outboard by simply pressing on the switch.

~1. Power trim & tilt motor drive system

The power trim & tilt switch and power tilt switch are installed on the control knob of the remote control box and on the left side of the outboard under case. Press on the either one of these switches, and the relay activates and controls the rotating direction of the motor, and the outboard is raised/lowered by the hydraulic cylinder.

<Basic circuit diagram>



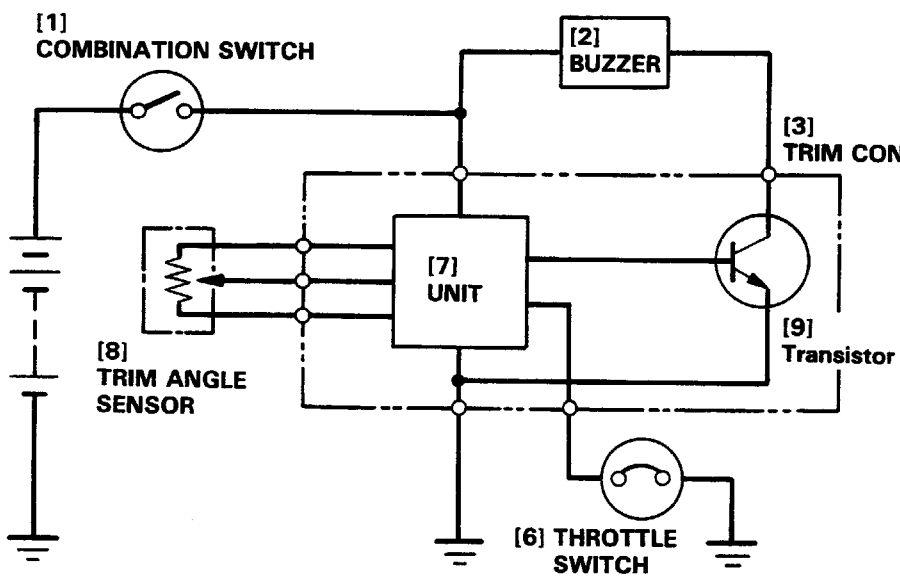
<Operation>

1) Turning the power trim & tilt switch or power tilt switch ON to the UP side, the UP relay in the power tilt relay activates, contact point moves in the direction shown by the solid line and arrow, electric current flows in the direction shown by the broken line and arrow, and the motor rotates in the normal direction.
2) Turning the switch ON to the DOWN side, the relay in the power tilt relay activates, contact point moves in the direction shown by the dot line and arrow, and the motor rotates in the reverse direction.

~2. Power trim warning system

The BF35A • 45A is equipped with the warning system which sounds when the trim angle exceeds 20° so that the power trim can be used at the safe cruising angle. However, as the power tilt is used for the maintenance and cruising in shallows, the warning buzzer does not sound when the throttle angle is below the set angle with the shift lever in neutral, reverse, or forward position.

<Basic circuit diagram>



[4]
Installation position
1. **Trim angle sensor: stern bracket**
2. **Throttle switch: remote control box**
3. **Trim control unit: inside of under case**
4. **Buzzer: remote control box**
5. **Combination switch: remote control box**

[5] ON when the throttle angle is below the set value with the shift lever in neutral, reverse, forward position.

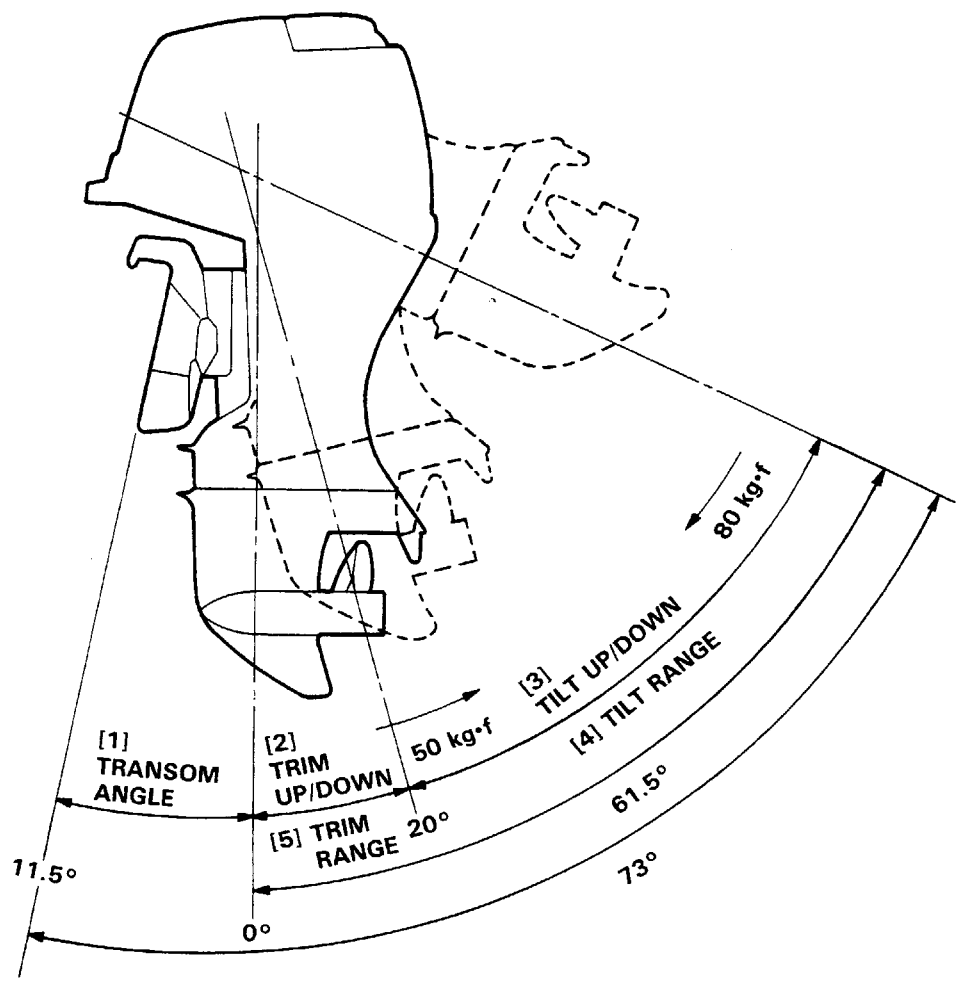
<Operation>

1) Trimming when the throttle switch is OFF (i.e. over the certain set throttle angle with the shift lever in forward position and/or reverse position). The unit detects the voltage when the trim angle sensor exceeds the certain set angle, turns the transistor ON and OFF at regular intervals, and sounds the buzzer intermittently.
2) Tilting when the throttle switch is ON (i.e. under the certain set throttle angle with the shift lever in neutral, reverse, and/or forward position). The buzzer does not sound independently of the trim angle sensor.

*The buzzer also functions for the oil pressure alert system. When the power trim warning system and the oil pressure alert system operate simultaneously, the buzzer sounds continuous beep for the alert of the oil pressure.

POWER TRIM & TILT FUNCTION

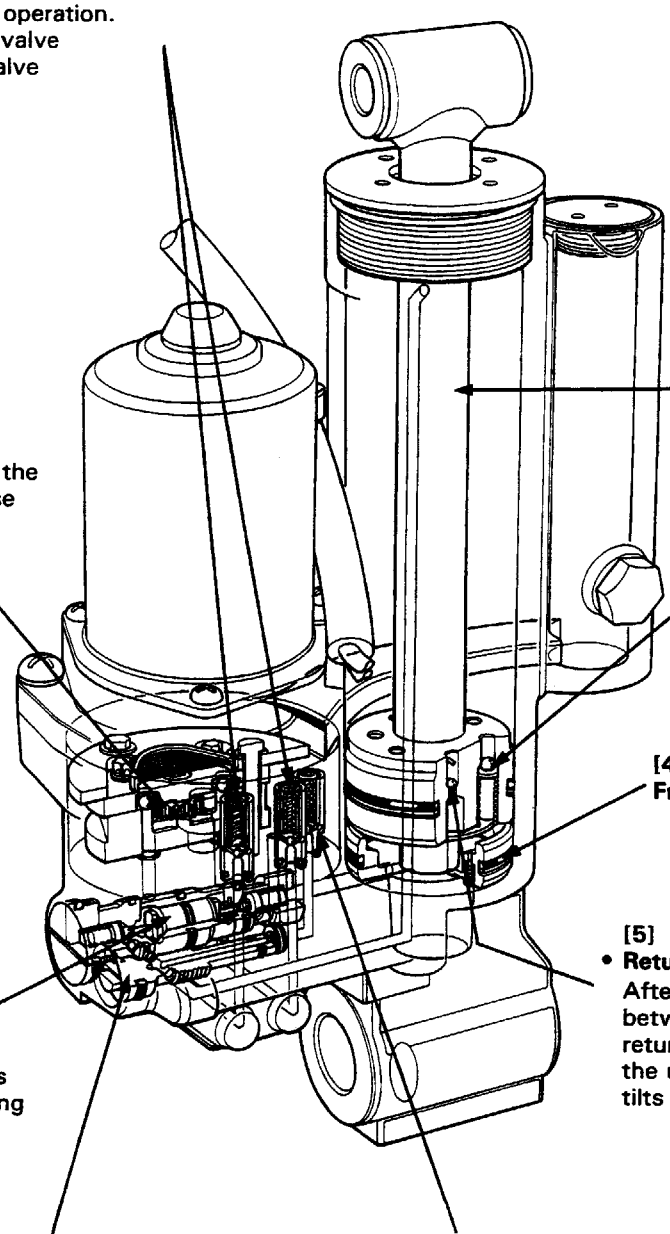
1) Power tilt (including cruising in shallows):
   Hydraulically raises/lowers the outboard to the designated position by pressing the button.
   A range where is not under the large thrust such as for cruising in shallows, mooring, etc. (range of 20°—60° in the drawing.)
2) Power trim:
   Adjusts the balance of the boat while acceleration or cruising, resulting in improved acceleration, maximum speed, operationability, and fuel consumption.
   Requires large lifting power as the outboard is under the thrust while operation (range of 0°—20° in the drawing.)
3) Reverse lock:
   Maintains the reverse thrust. When collision with the obstacles in the water, it unlocks to absorb the impact.
4) Shock absorber:
   Reduces the impact when the reverse lock is released.



<Construction and operation>

- **Power trim & tilt type**

[1]
- **UP/DOWN relief:**
Operates to protect the circuit and the outboard when it is caught with the obstacles during the full tilt up/down or during operation.
Left side: Down relief valve
Right side: Up relief valve



[2]
Piston

[3]
- **Shock valve:**
Operates to release the oil between the piston and free piston and absorbs the impact when the outboard collides with the obstacles in the water

[4]
Free piston

[5]
- **Return valve:**
After the collision, oil released between the piston and free piston returns through the return valve to the upper chamber and the outboard tilts down.

[6]
- **Thermal valve:**
Operates to release the pressure, when the excessive thrust is applied or when the internal pressure rises excessively due to the change in temperature.

[7]
- **Manual valve:**
Opens the circuit to allow the manual operation, when the motor or pump becomes faulty.

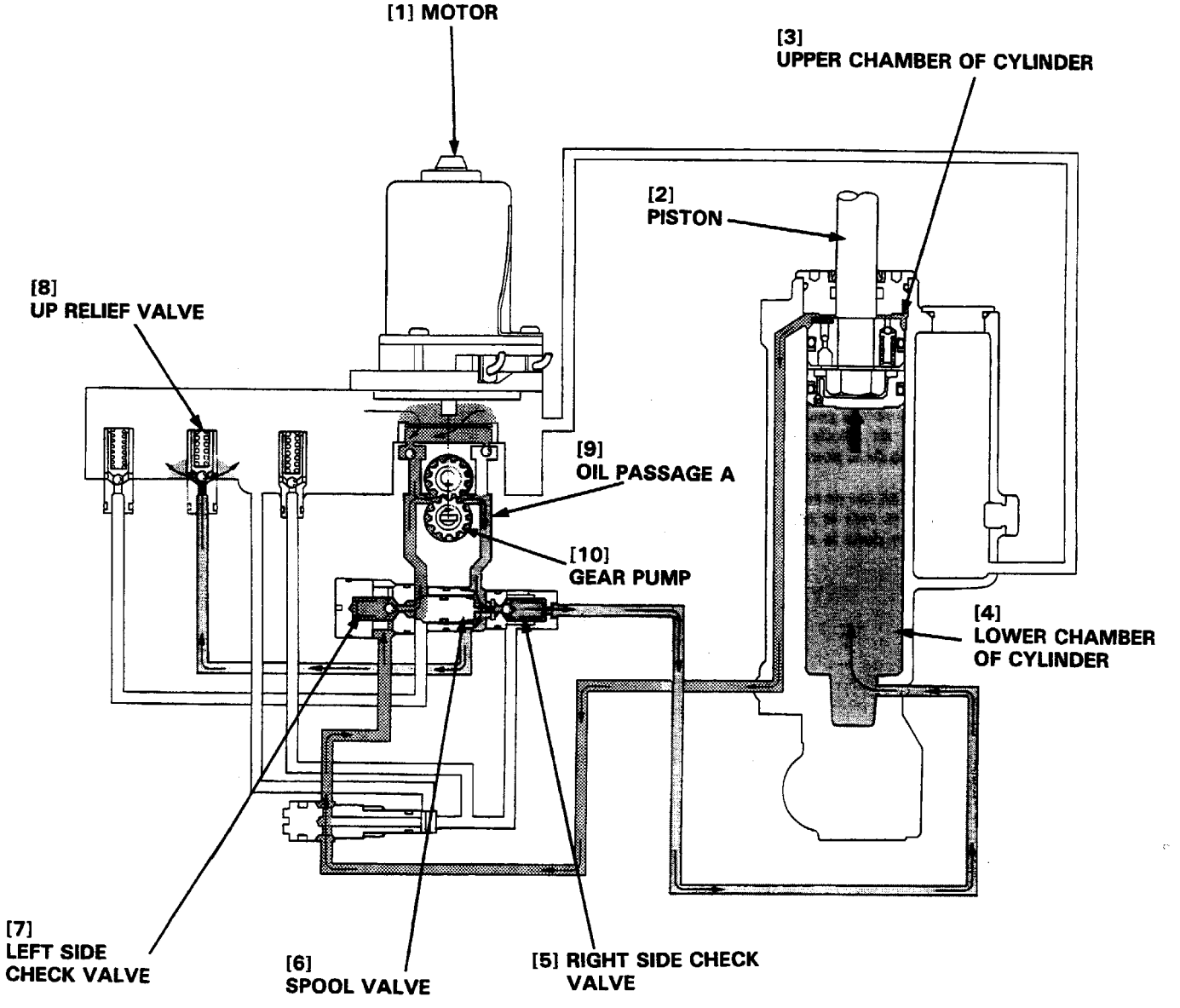
[8]
- **Spool valve:**
Moves to right or left and switches the oil flow according to the rotating direction of the pump.

[9]
- **Pump:**
Supplies oil to the UP side when rotating in normal direction, and to the DOWN side when rotating in reverse direction.

- **Hydraulic circuit**

<Tilt up operation>

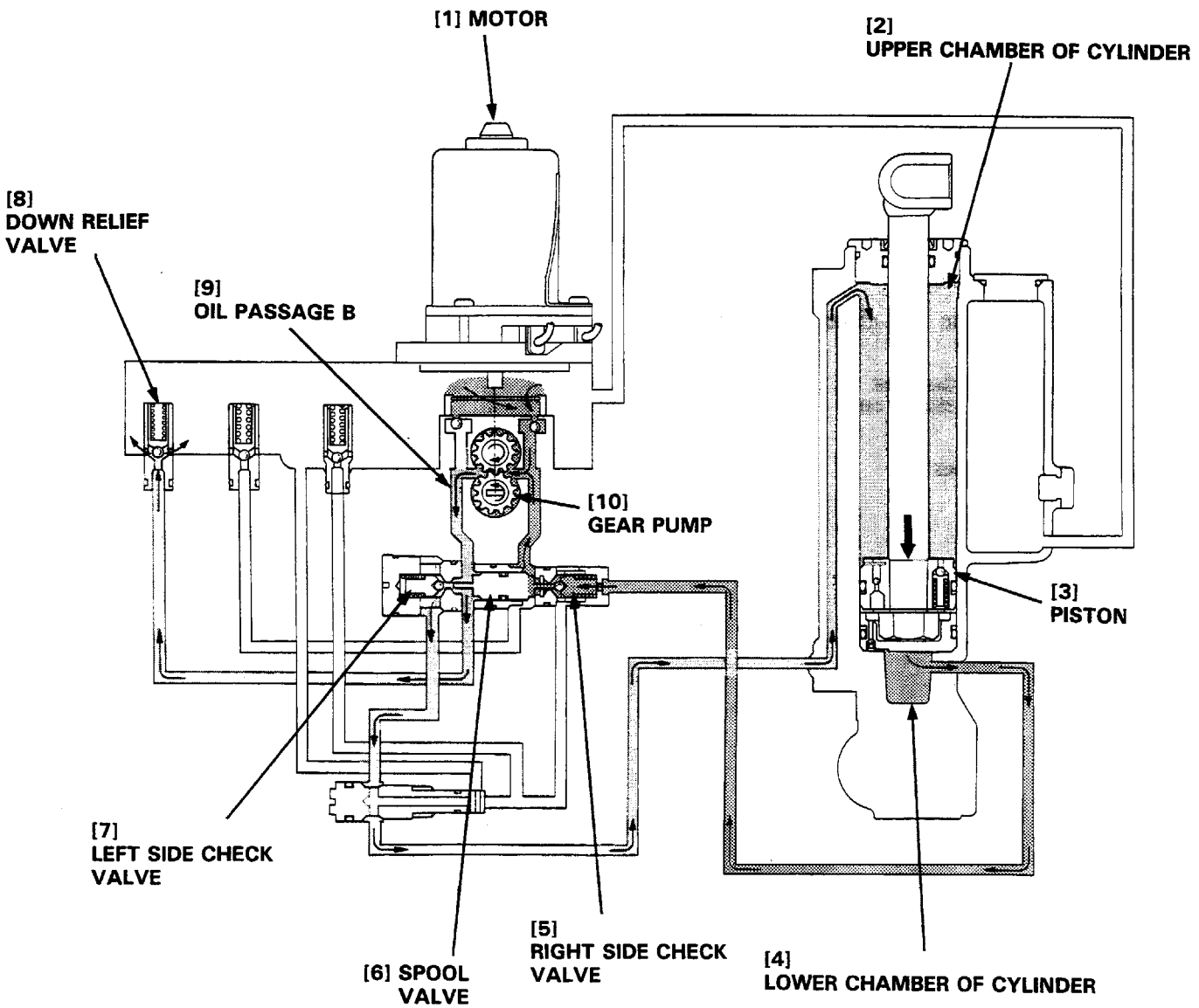
The motor rotates clockwise when the "UP" side of the power trim & tilt switch is pressed, and the oil flows from the gear pump to the spool valve. As this oil moves the spool valve to the left and pushes the left side check valve open, the oil in the upper chamber of the cylinder returns to the gear pump, oil pressure in the oil passage A increases further, right side check valve opens, and the oil flows to the lower chamber of the cylinder and pushes the piston up to allow the outboard motor to tilt up.
The oil in the upper chamber of the cylinder passes through the left side check valve and returns to the gear pump.
As oil pressure in the lower chamber of the cylinder increases when the outboard is in the full tilt up position, it is relieved by the up relief valve.



<Tilt down operation>

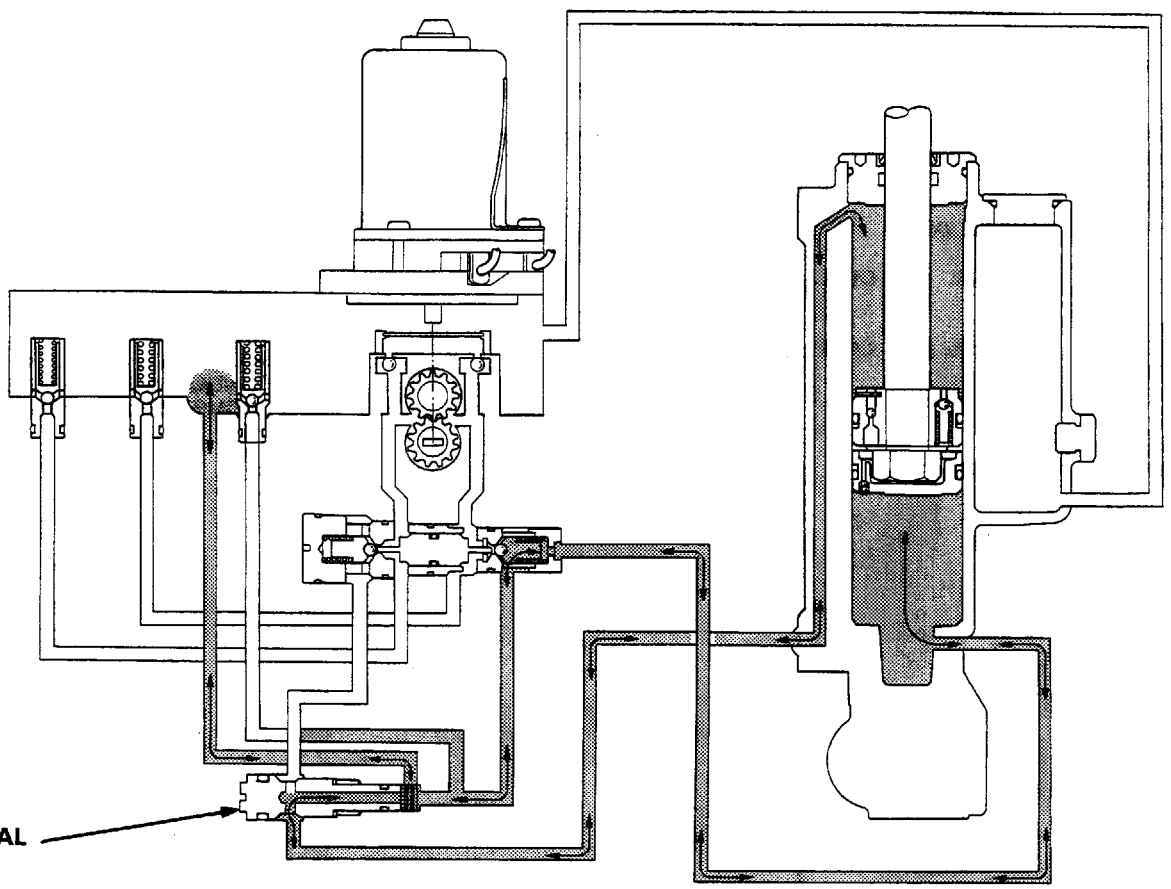
The motor rotates counterclockwise when the "DOWN" side of the power trim & tilt switch is pressed, and the oil flows from the gear pump to the spool valve. As this oil moves the spool valve to the right and pushes the right side check valve open, the oil in the lower chamber of the cylinder returns to the gear pump, oil pressure in the oil passage B increases further, left side check valve opens, and the oil flows to the upper chamber of the cylinder and pushes the piston down to allow the outboard motor to tilt down.

The oil in the lower chamber of the cylinder passes through the right side check valve and returns to the gear pump.
As oil pressure in the upper chamber of the cylinder increases when the outboard is in the full tilt down position, it is relieved by the down relief valve.



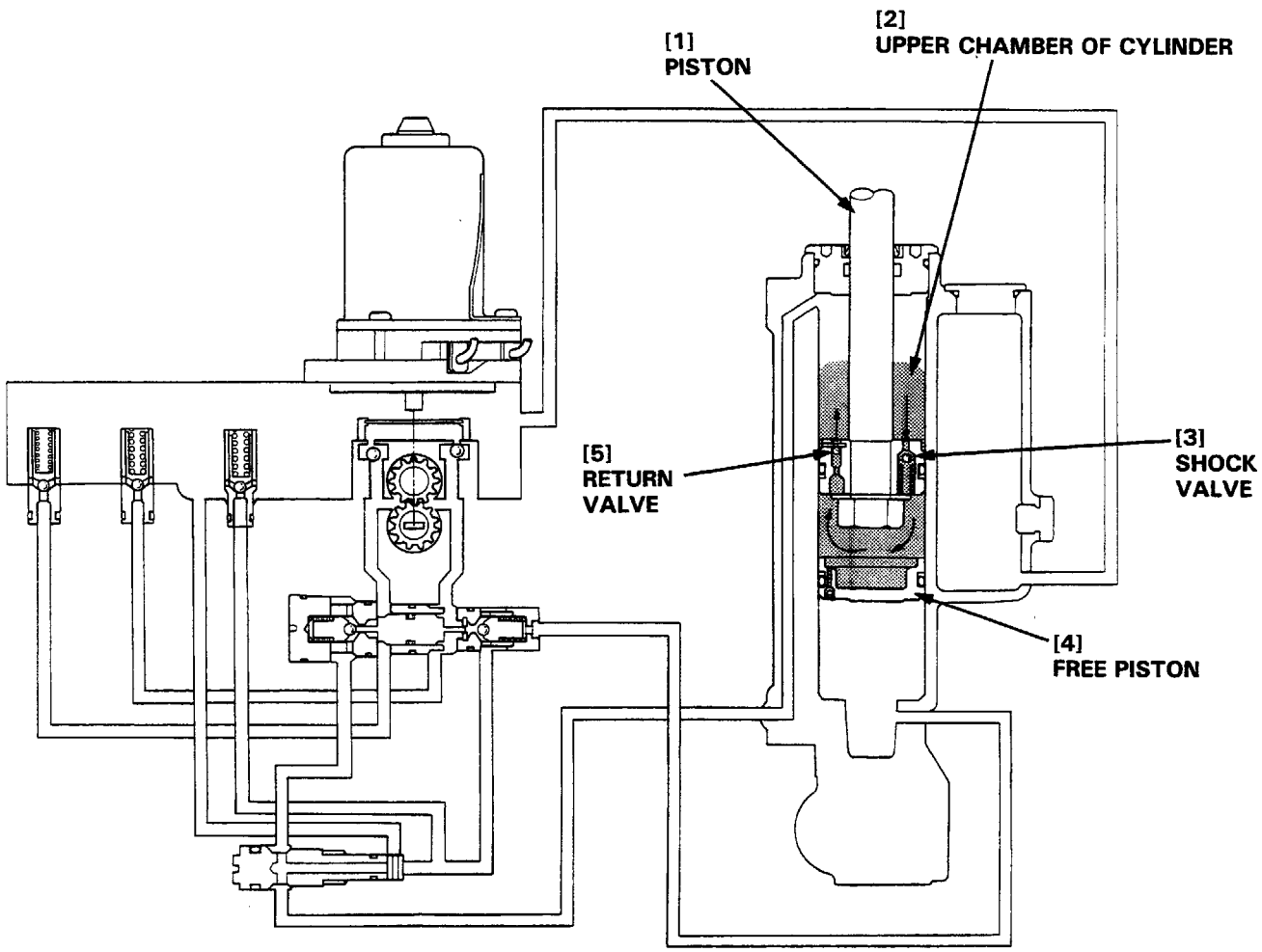
<Manual operation>

The manual valve opens when it is turned counterclockwise, forming the manual passage to allow an easy manual tilt up or tilt down of the outboard motor.
When the manual valve is tightened fully clockwise while tilting up/down the outboard motor, the manual passage closes and the outboard motor locks in the position.



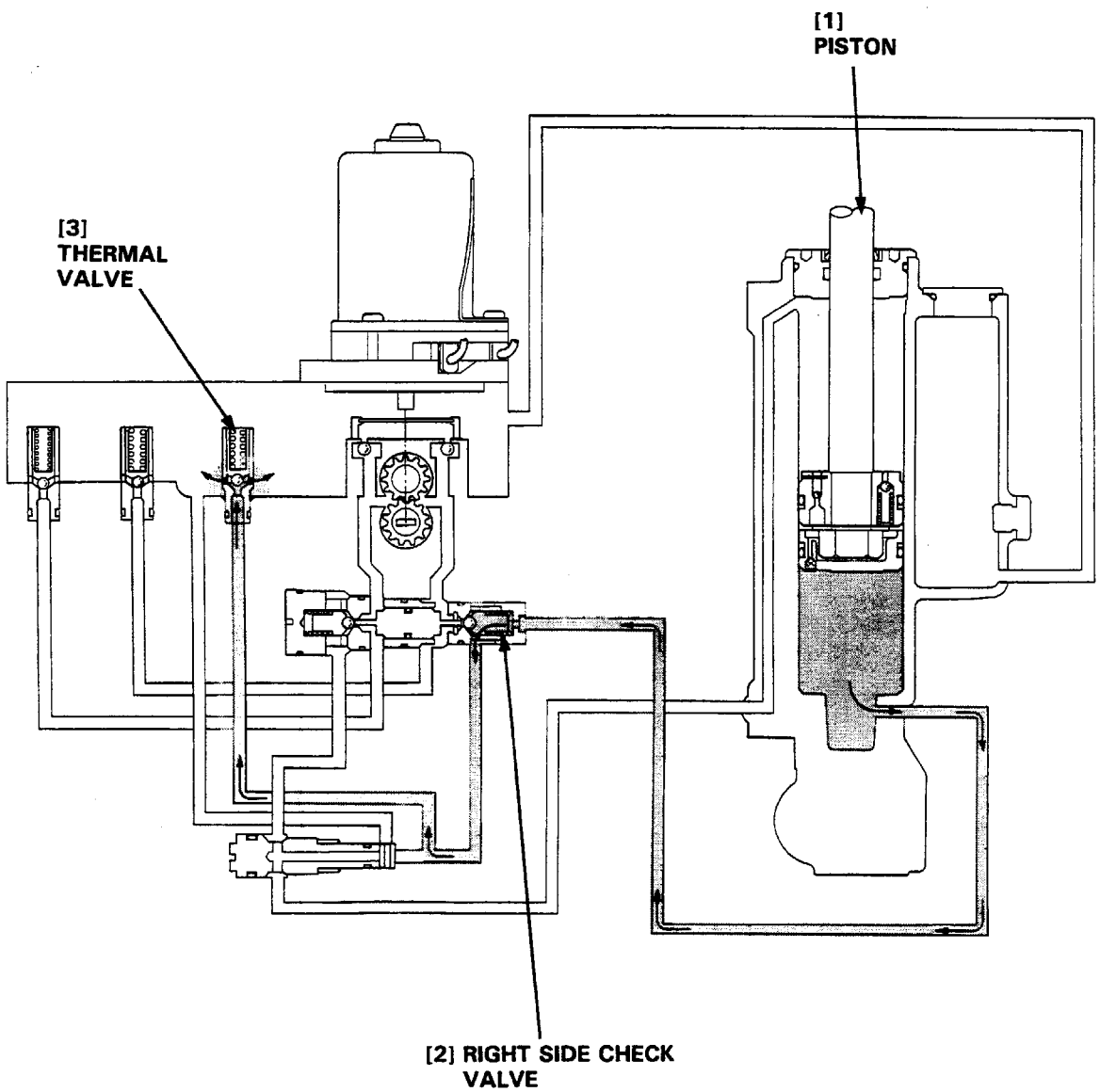
<Shock valve and return valve>

The outboard motor is equipped with the shock valve and return valve to protect it and allow it to cruise at a designated tilt angle.
Because the piston rises and the oil in the upper chamber of the cylinder is pressured when force is applied to the outboard motor from front while cruising at a designated tilt angle, the shock valve opens and the oil flows between the free piston, located under the piston, and the piston to absord the impact and thereby to protect the outboard motor. When the outboard motor is away from the force, the piston lowers by the dead weight of the outboard motor and the thrust. The oil between the piston and free piston flows through the return valve in the piston and enters the upper chamber of the cylinder.



<Thermal valve>

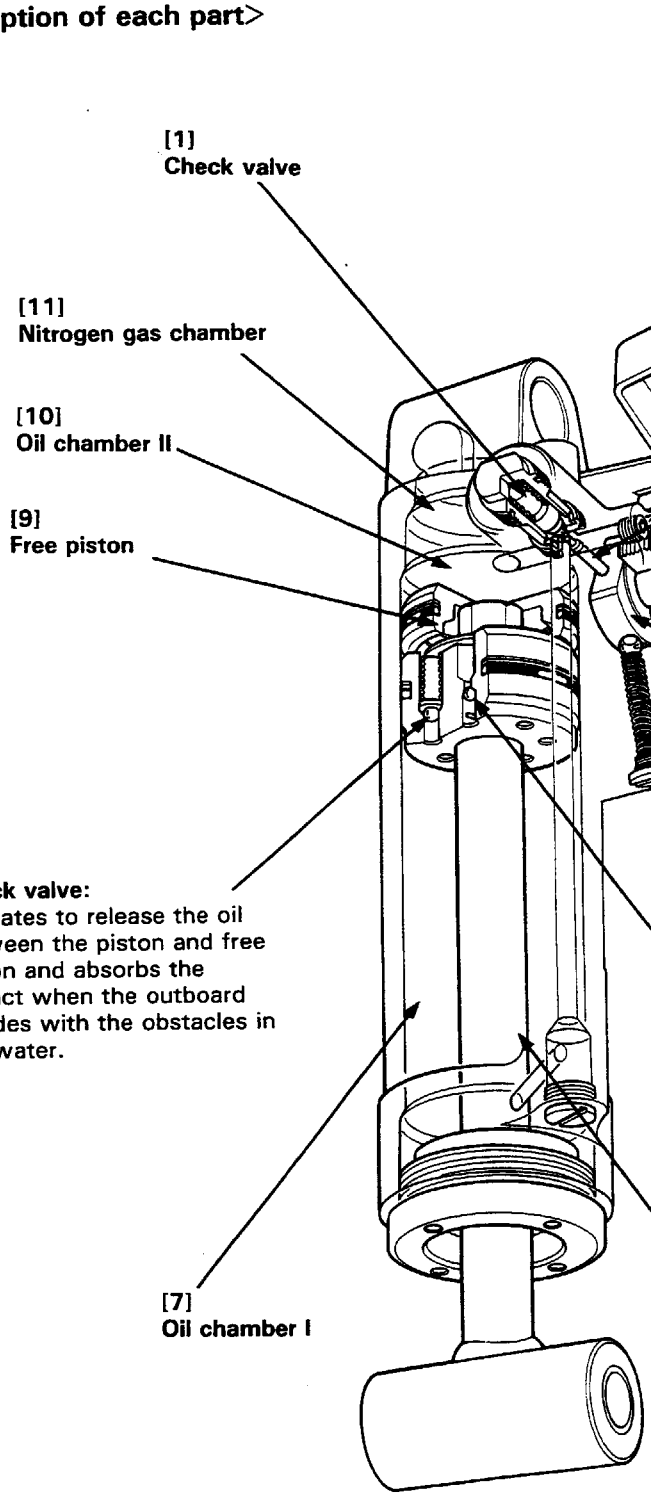
The outboard motor is equipped with the thermal valve to protect it and allow it to cruise at a designated trim angle. Because the piston lowers and oil in the upper chamber of the cylinder is pressured when force is applied to the outboard motor from rear while cruising at a designated trim/tilt angle, the oil flows through the right side check valve and activates the thermal valve to release the oil pressure and thereby to protect the outboard motor.



GAS ASSISTED SYSTEM

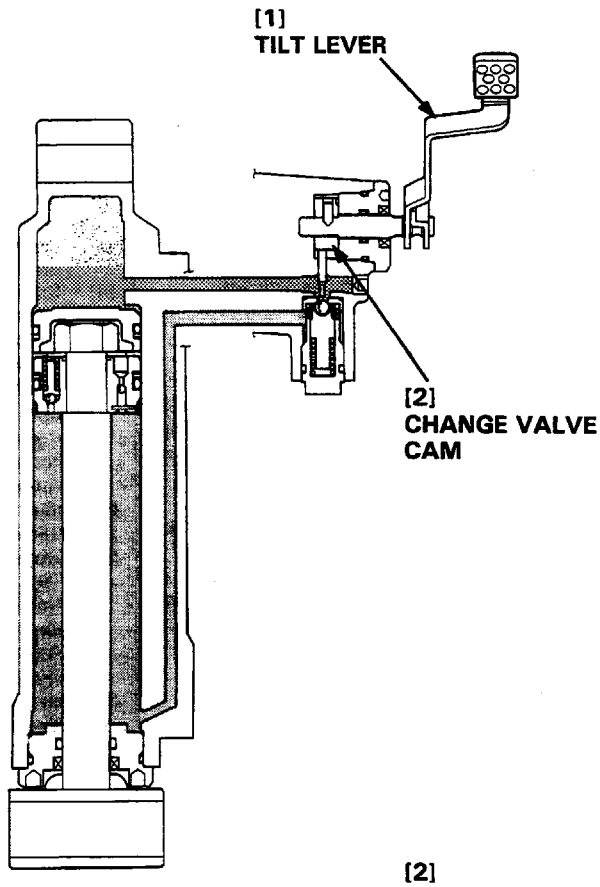
- **Gas assisted tilt type**

<Description of each part>



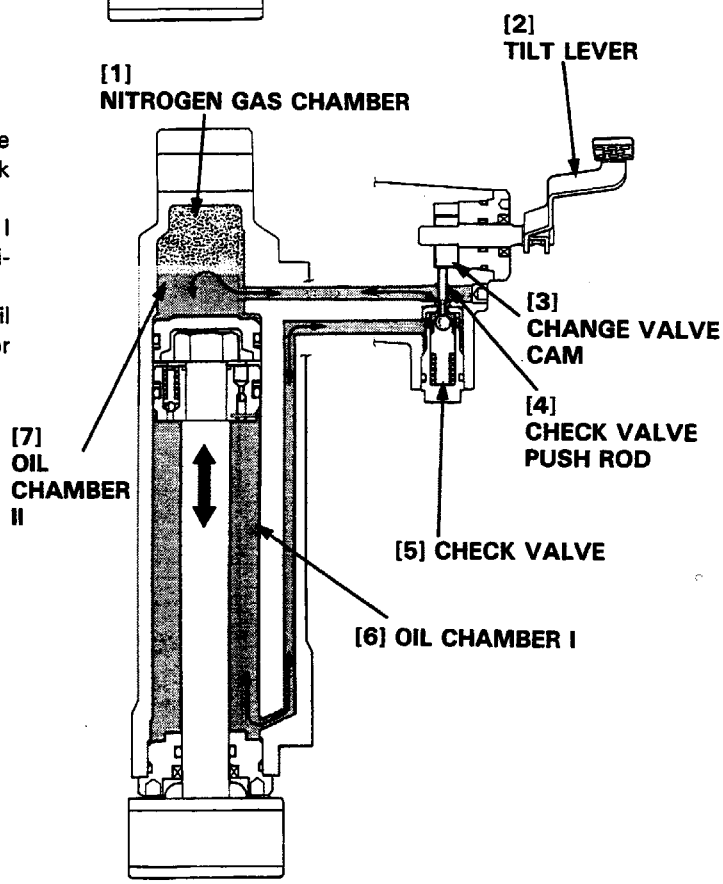
<At tilt lock>

When the tilt lever is in the "LOCK" position, the piston does not move as the change valve cam is also in the "LOCK" position and the oil passage closes.



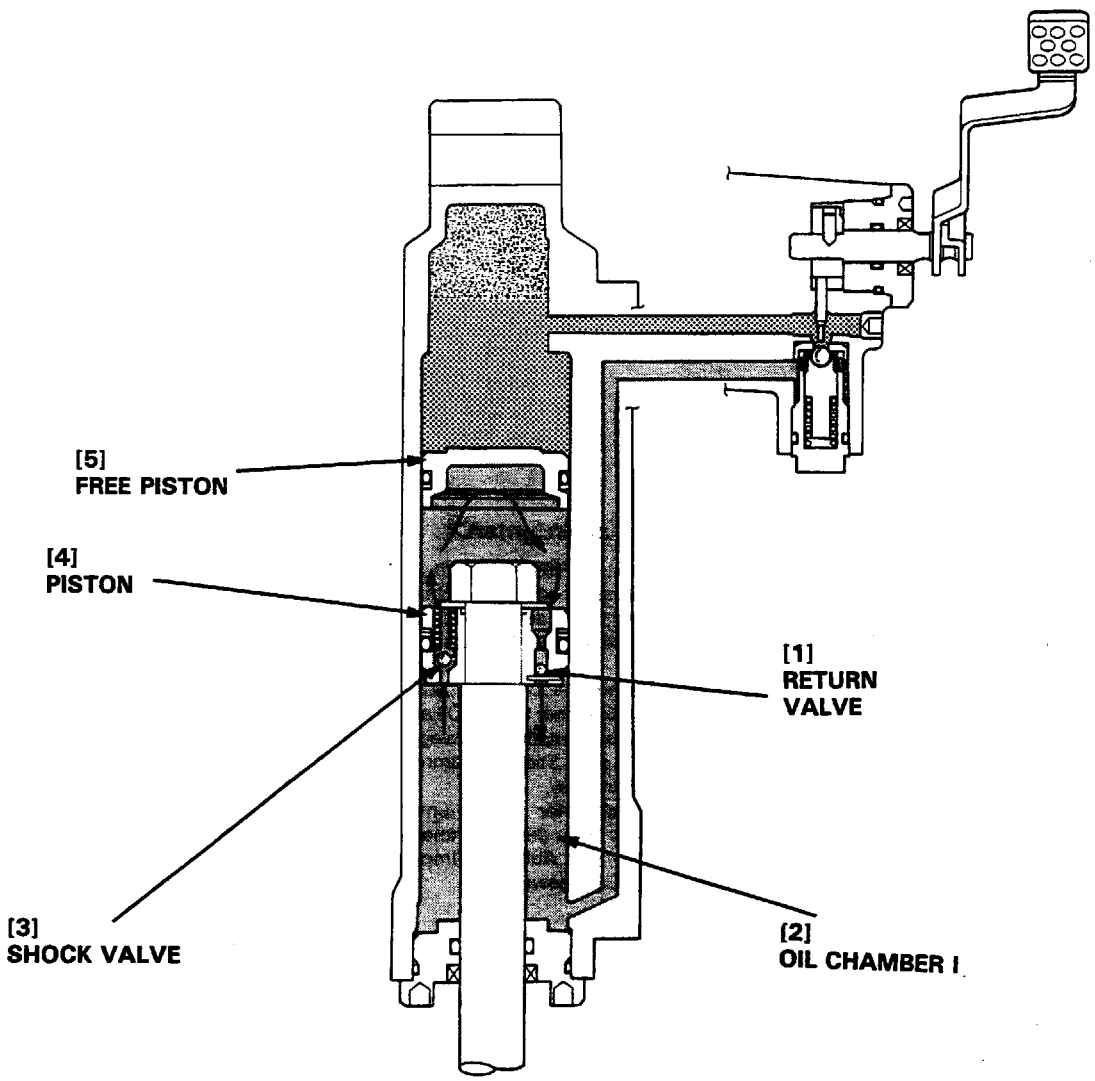
<At tilt up/down>

When the tilt lever is set in the "FREE" position, the change valve cam lifts the check valve push rod and opens the check valve, resulting in the oil flowing into the oil passage.
When tilting up the outboard motor, the oil in the oil chamber I enters the oil chamber II and the outboard can be tilted up easily because of the nitrogen gas in the nitrogen gas chamber.
When tilting down the outboard motor, the oil in the oil chamber II flows to the oil chamber I and the outboard motor lowers by its own weight.

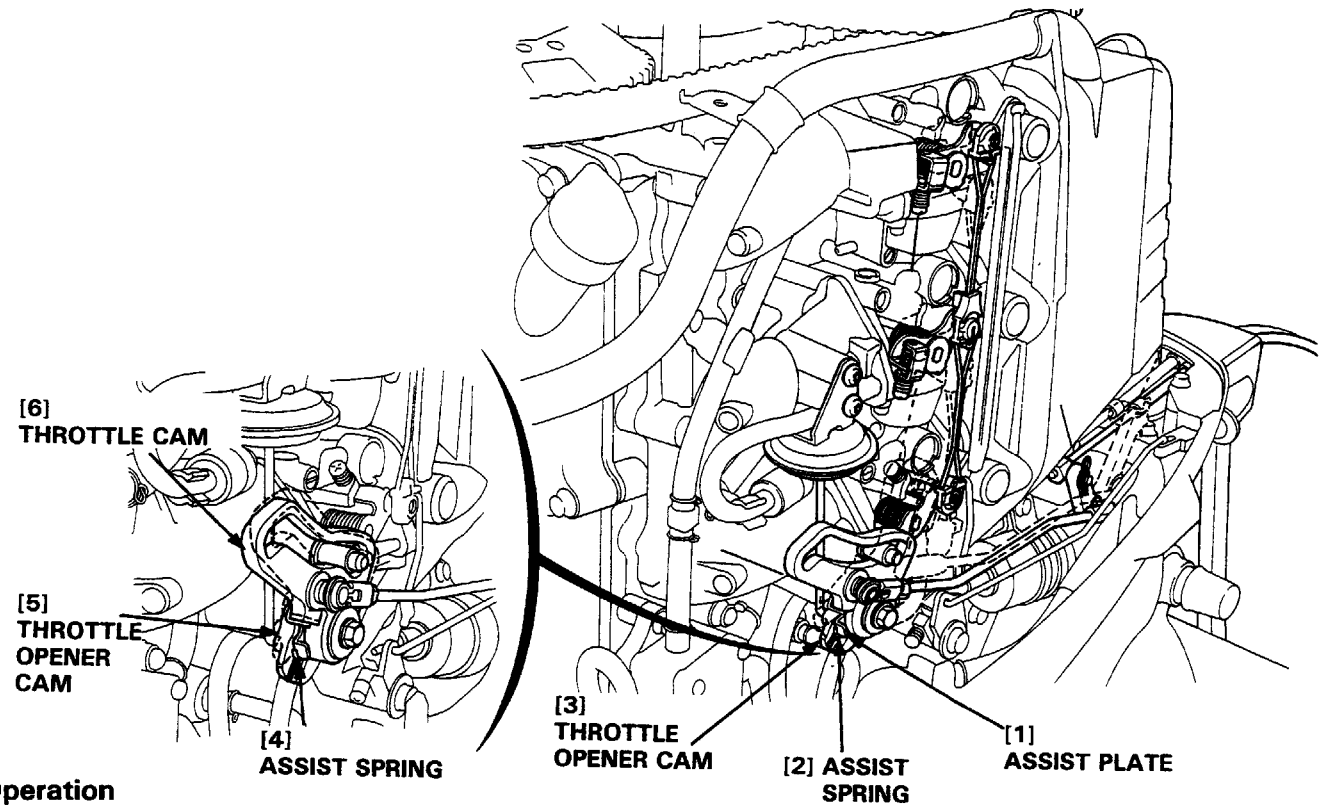


<At collision>

Because the piston lowers and pressures the oil in the oil chamber I when the outboard motor is struck with an obstacle while cruising, the shock valve opens and oil enters between the piston and free piston to absorb the collision impact.
When the outboard motor is away from the obstacle, the piston rises by the dead weight of the outboard motor and the thrust.
The oil between the piston and the free piston flows through the return valve in the piston to the oil chamber I.



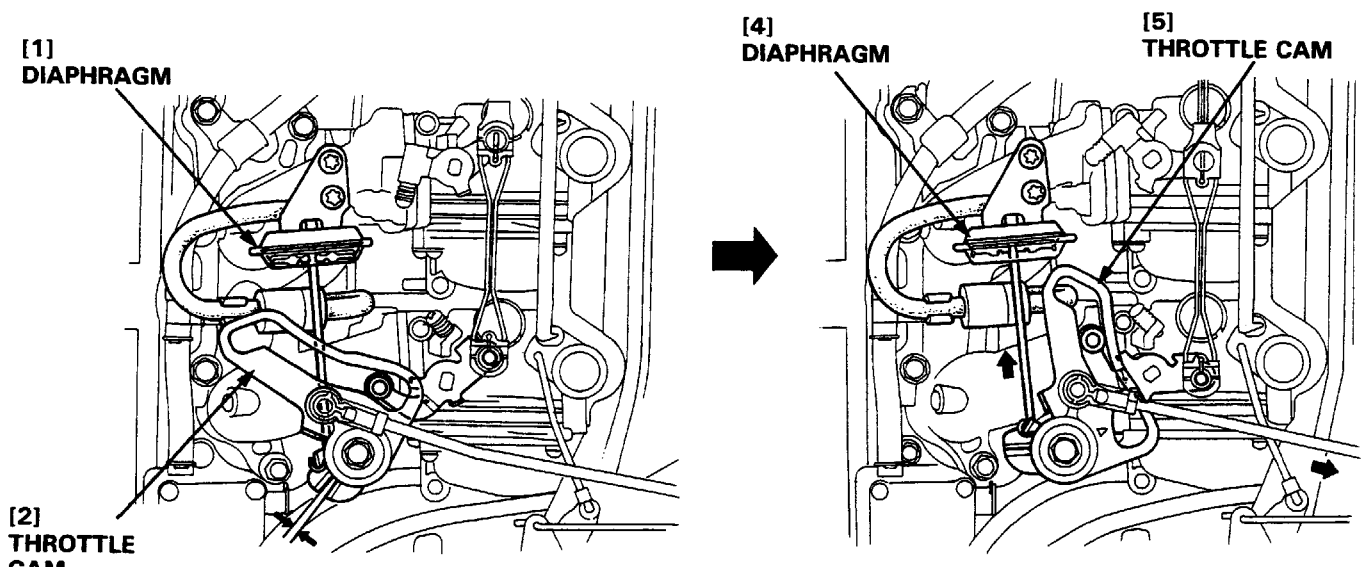
CARBURETOR ACCELERATION/DECELERATION SYSTEM



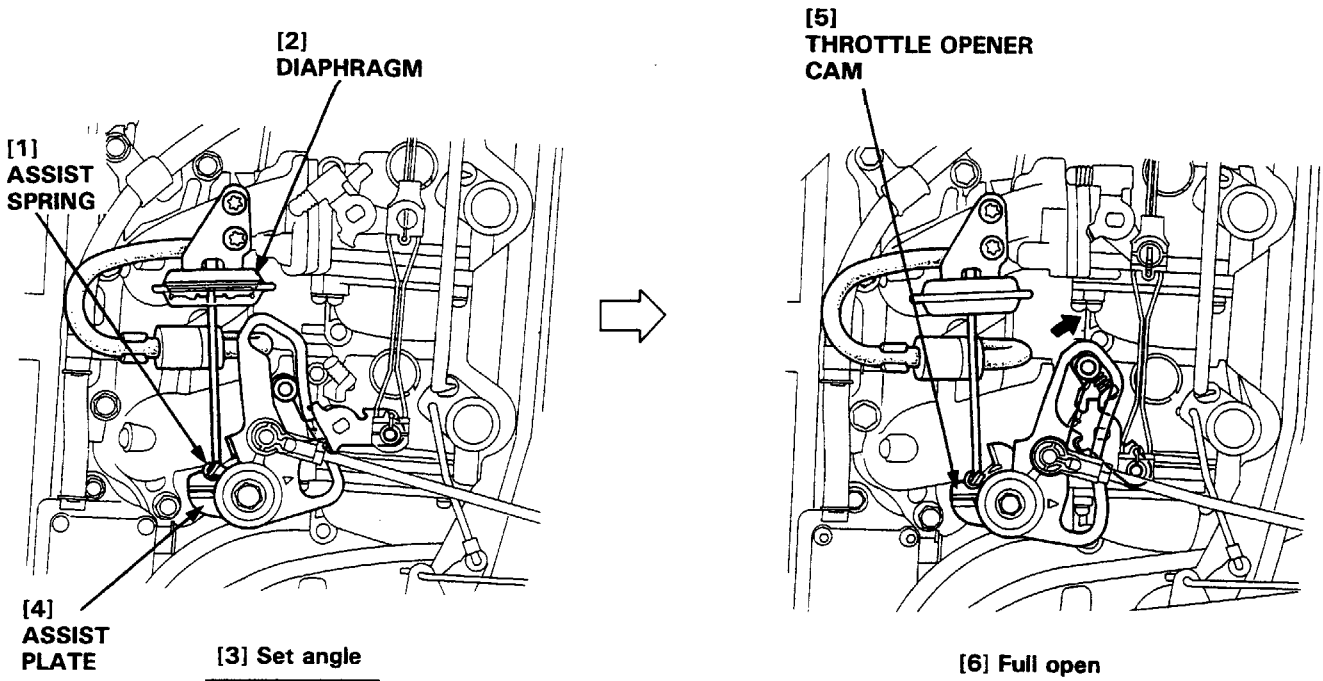
Operation

- **At acceleration**
  When the throttle is opened quickly for sharp acceleration of the outboard motor from a constant speed, the diaphragm moves to the full stroke position at the set angle of the throttle cam, and the carburetor main well is pressured instantaneously and the fuel in the well is discharged through the main nozzle by the air pushed by the diaphragm.

  When the throttle is opened slowly, the pressured air is bled through the air bleed and air jet not to discharge the fuel excessively.



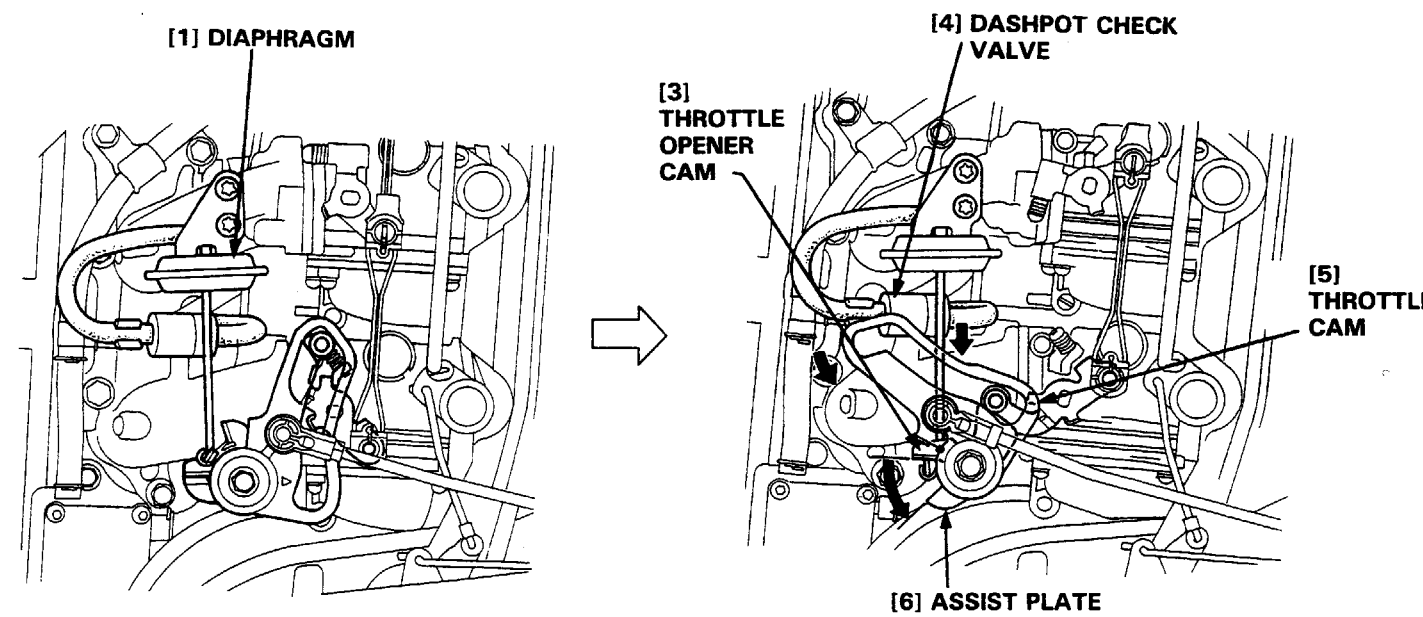
- **From the set angle to full open**
  From the operation angle where the diaphragm is at the full stroke position to the fully open throttle, the throttle opener cam interconnected to the diaphragm via the assist spring operates, which is called the lost motion mechanism, and the diaphragm does not move further.



[3] Set angle

[6] Full open

- **At quick close**
  When the throttle is moved quickly to the fully closed position, the leak jet in the dashpot check valve restricts the air flowing into the diaphragm and the opener cam return spring absorbs the return force of the throttle cam to allow the throttle cam to close slowly and, thereby, to prevent incomplete combustion of the engine.



[2]
Full open

[7] At quick close

PREFACE

This supplement describes service procedures for the Honda BF35A and BF45A Outboard Motors.

For service information which is not covered in this supplement, please refer to the base manuals, part number 66ZV300.

HONDA MOTOR CO., LTD.
SERVICE PUBLICATIONS OFFICE

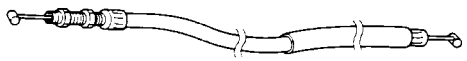
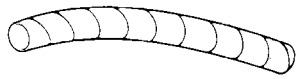
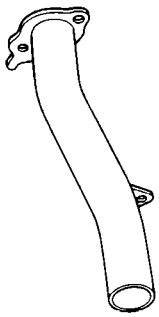
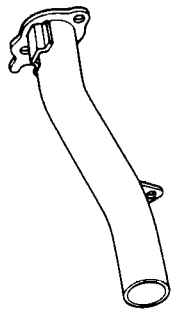
CONTENTS

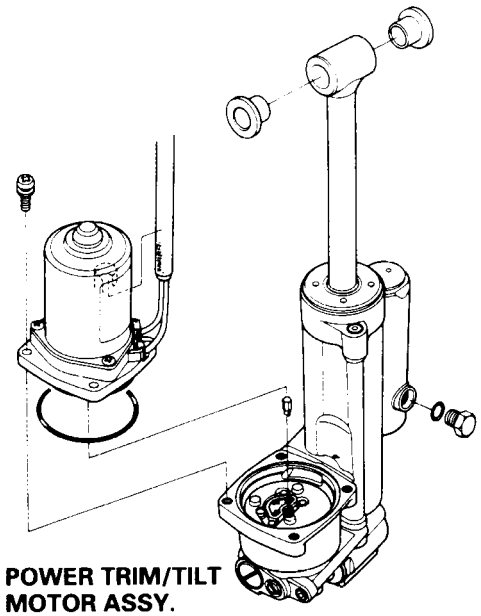
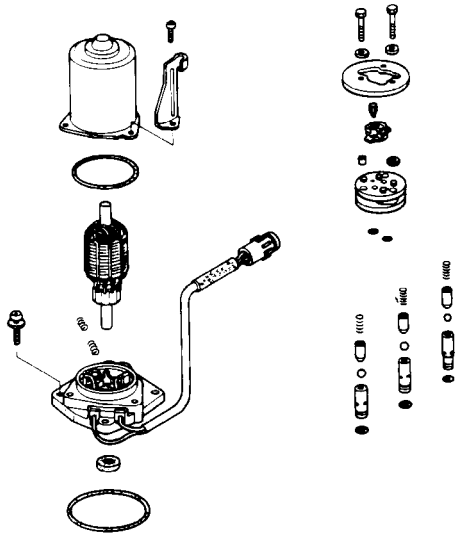
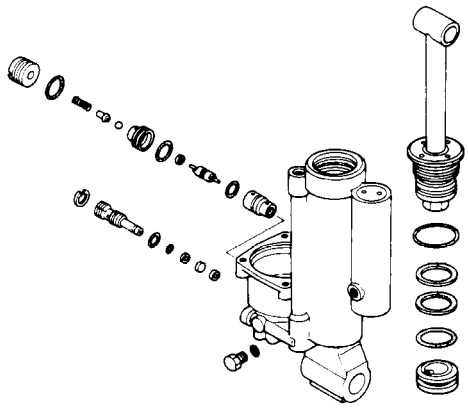
The marked sections contain no changes. They are not covered in this manual.

Date of Issue July 1994

OUTLINE OF CHANGES

•CHANGE LOCATIONS

<table>
<tr><th>Model / Item</th><th>Before change: Tiller handle type</th><th>After change: Tiller handle type</th></tr>
<tr><td>Throttle cable
Spiral tube</td><td> 
THROTTLE CABLE (2)</td><td> 
THROTTLE CABLE (2)
 
SPIRAL TUBE</td></tr>
<tr><td rowspan="2">EXHAUST PIPE</td><td>Frame serial number:
BF35A; 1000001 – 1005441
BF45A; 1000001 – 1013155</td><td>Frame serial number:
BF35A; 1005442 and subsequent
BF45A; 1013156 and subsequent</td></tr>
<tr><td>  </td><td>  </td></tr>
</table>

Item \ Model	Before change: POWER TRIM/TILT TYPE	After change: POWER TRIM/TILT TYPE
Power tilt assembly	**POWER TRIM/TILT ASSY.**  **POWER TRIM/TILT MOTOR ASSY.**	**POWER TRIM/TILT PARTS**  

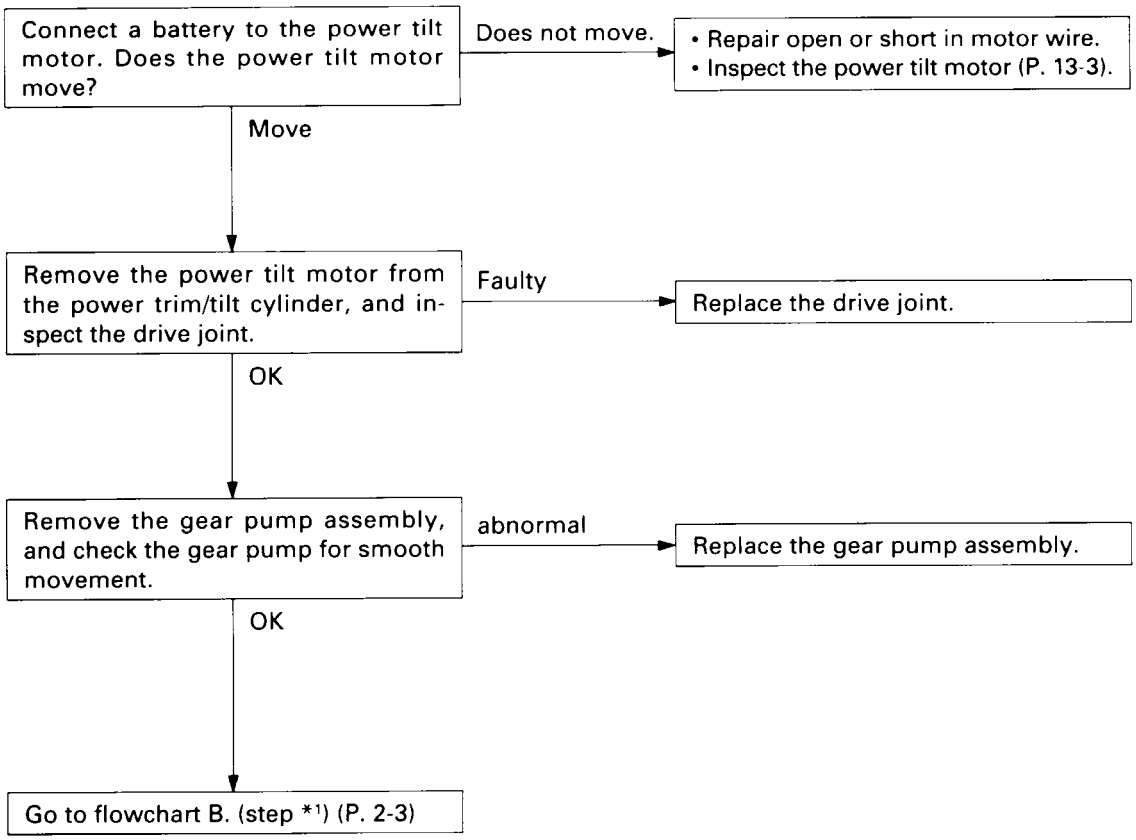
1. TORQUE VALUES

Item	Thread Dia. (mm) and pitch (length)	Torque values		
		N·m	kg-m	ft-lb
• POWER TILT ASSEMBLY				
Motor mount screw	M5 x 0.8	6	0.6	4.3
Gear pump bolt	M5 x 0.8	5	0.5	3.6
Spool valve cap	M22 x 1.0	20	2.0	14.5
Oil cap bolt	M12 x 1.5	15	1.5	10.8
Cylinder cap	M48 x 1.5	45	4.5	32.5

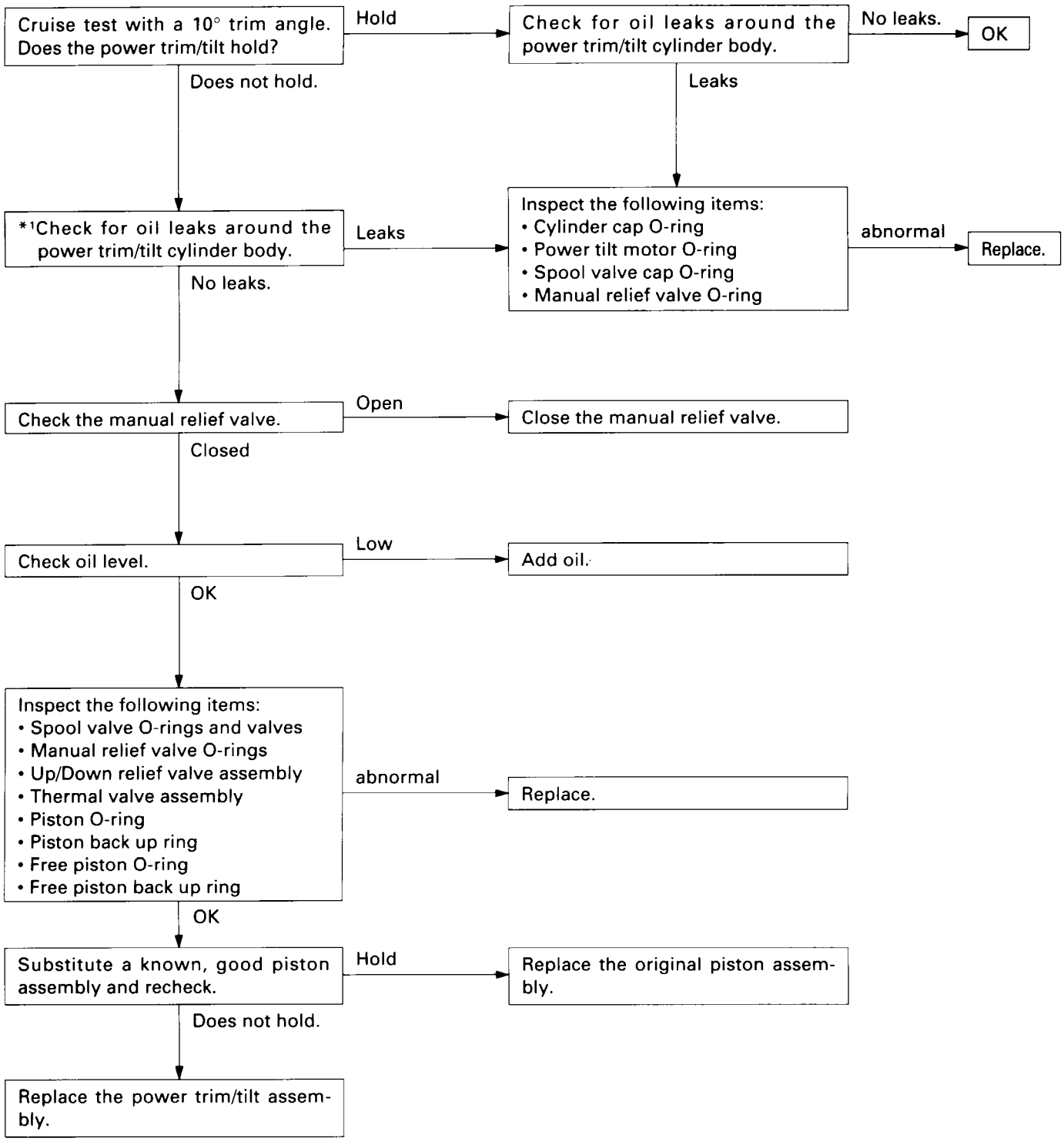
2. TROUBLESHOOTING

A. THE POWER TRIM/TILT DOES NOT MOVE UP OR DOWN (Power trim & tilt type)

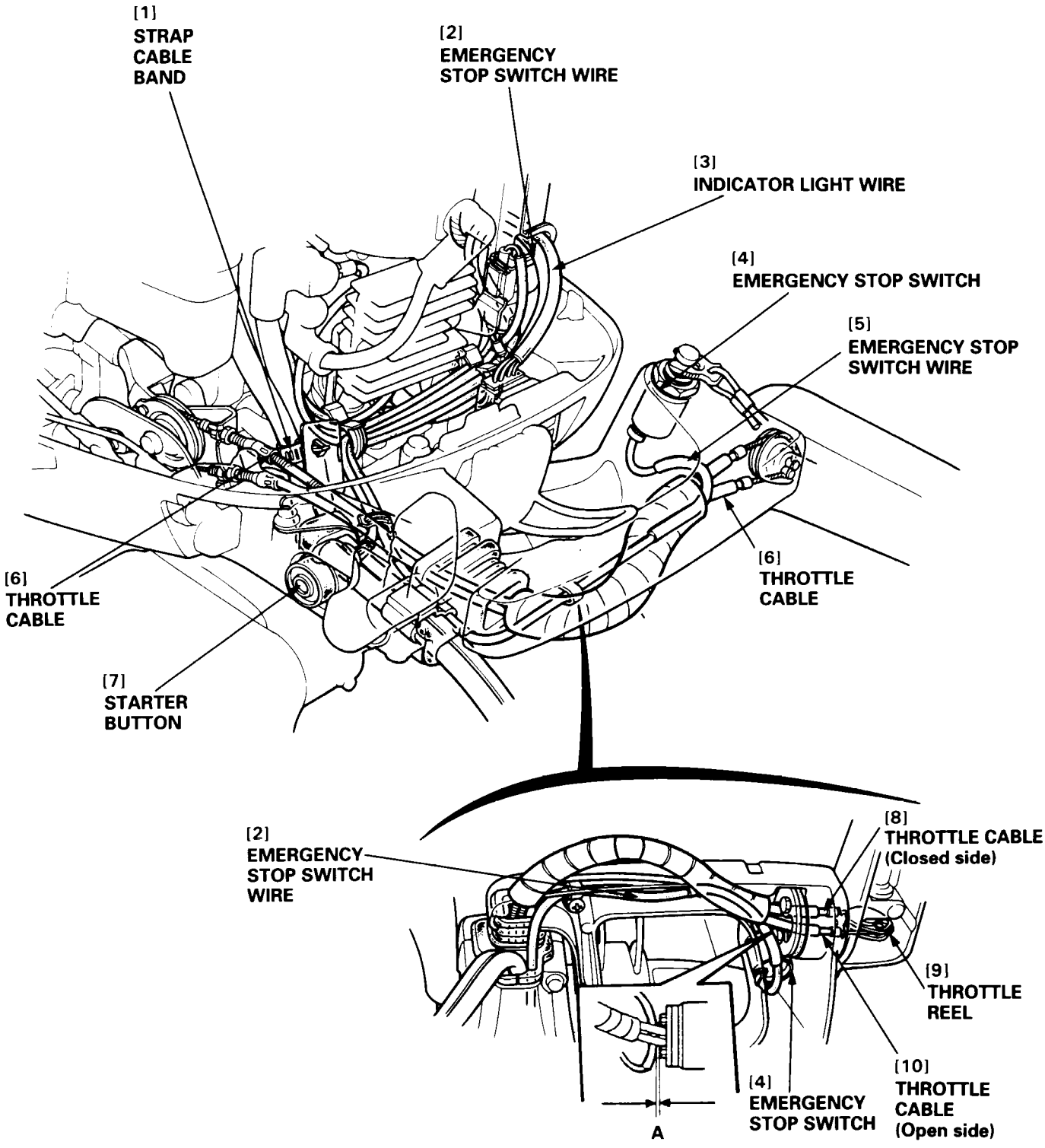
NOTE:
Be sure that the battery cables are connected. Battery voltage must be 12 V or above.



B. THE POWER TRIM/TILT DOES NOT HOLD (Power trim & tilt type)



3. CABLE/HARNESS ROUTING
(Tiller handle type)

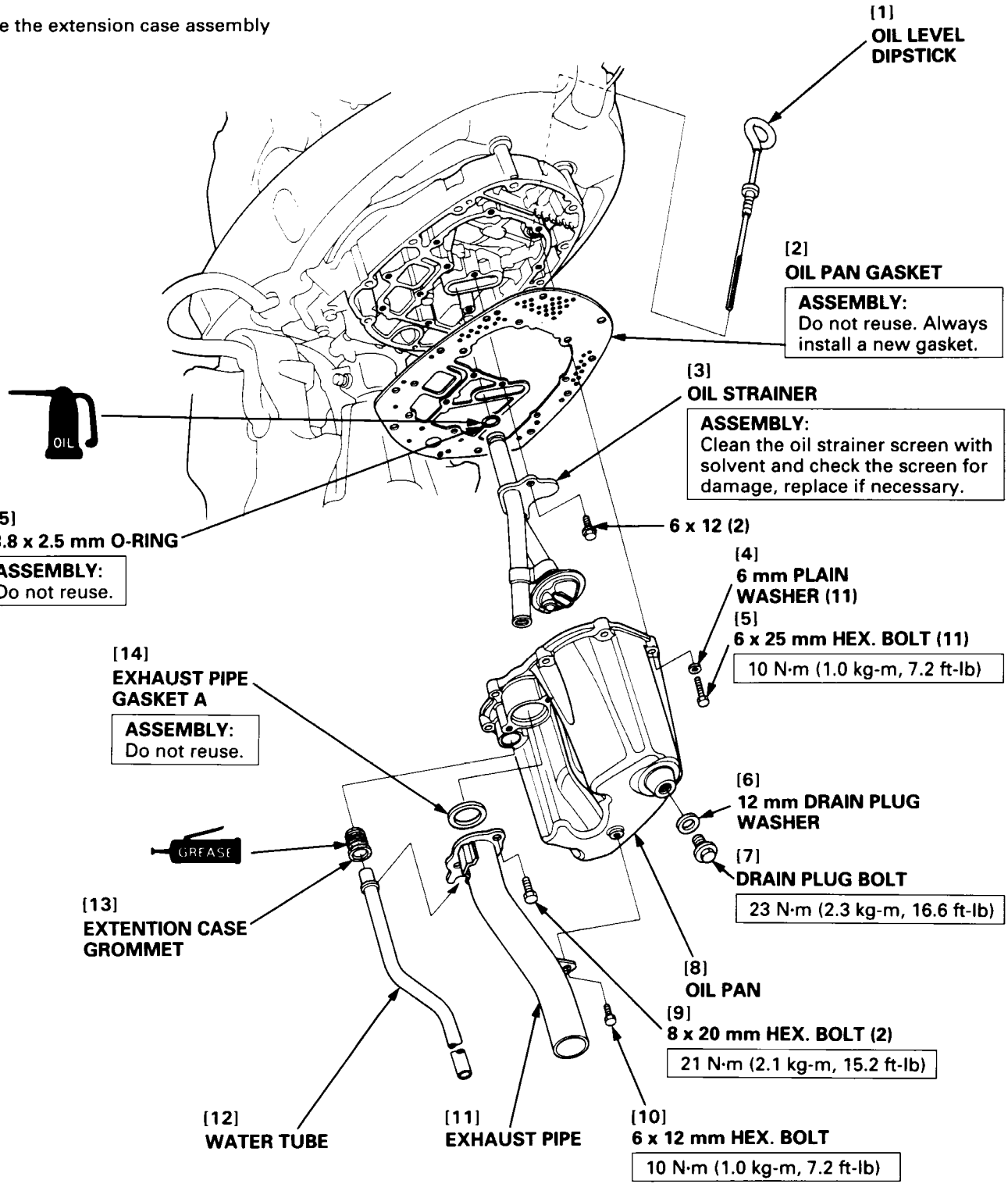


NOTE:
Move the handlebar up and down and be sure that the clearance between the emergency stop switch wire and bolt (A in the drawing) is 1 mm (0.04 in) or more.

1. OIL PAN/MUFFLER

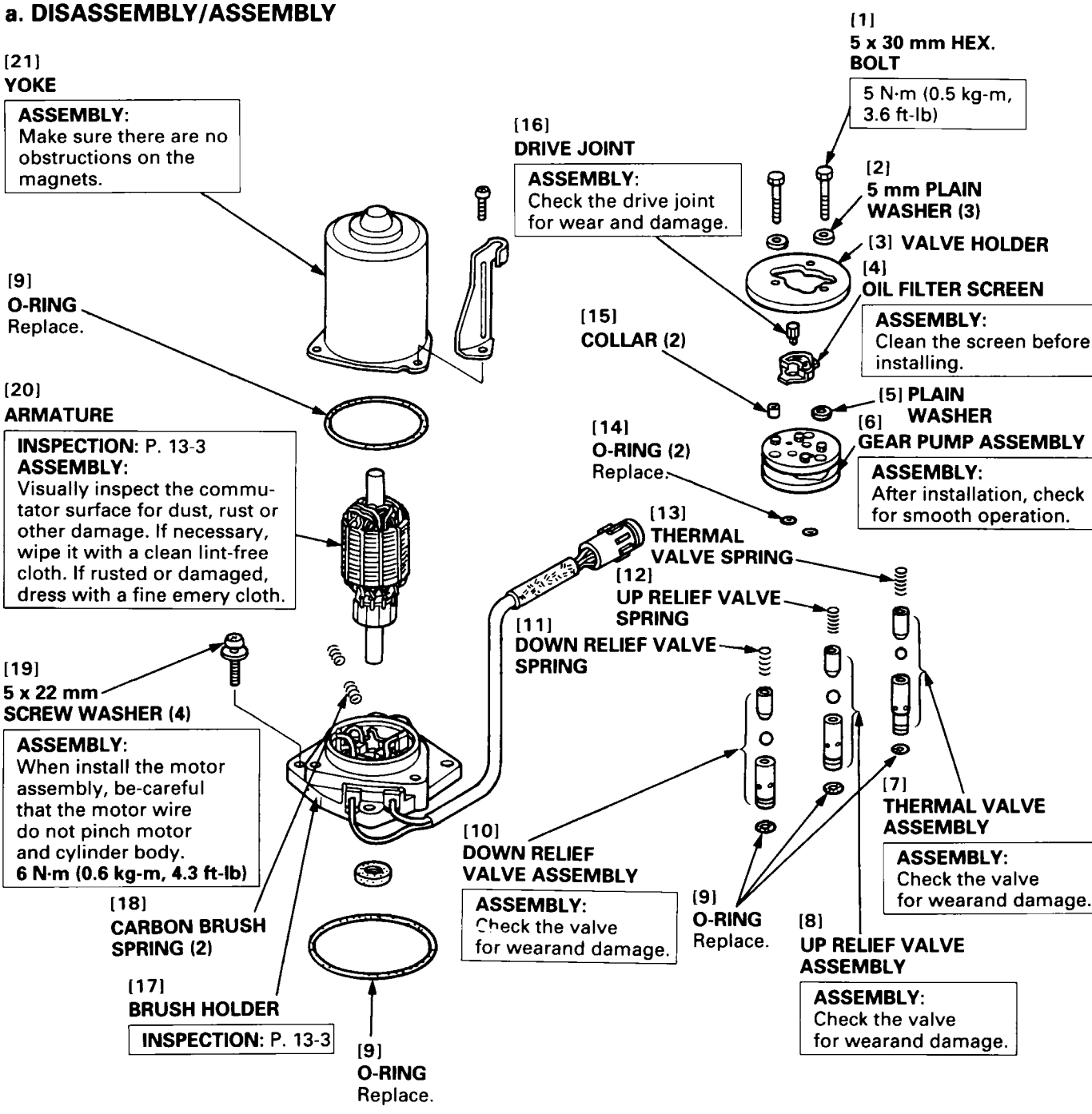
DISASSEMBLY/ASSEMBLY

Remove the extension case assembly

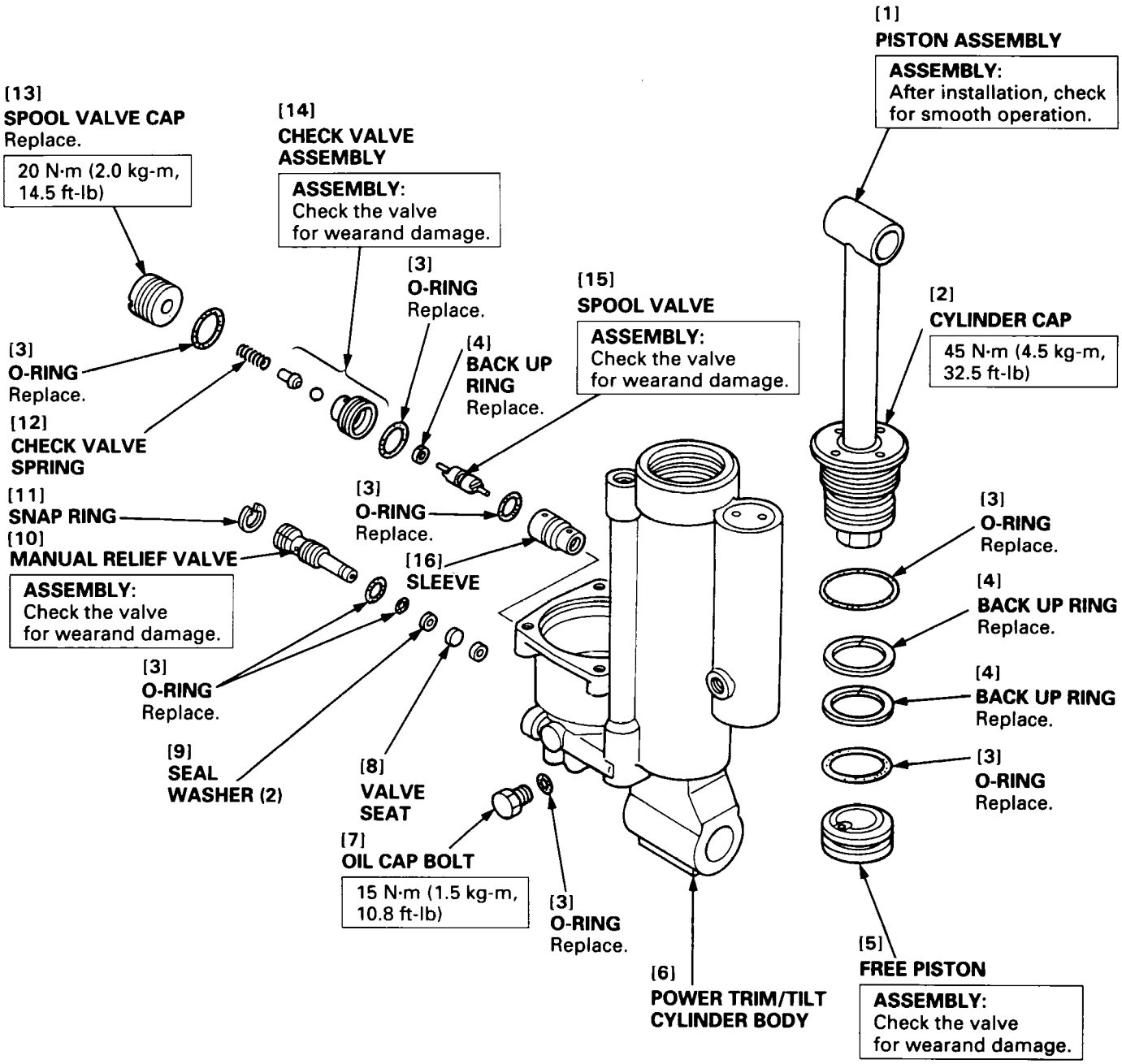


1. POWER TILT ASSEMBLY (POWER TRIM & TILT TYPE)

a. DISASSEMBLY/ASSEMBLY



a. DISASSEMBLY/ASSEMBLY

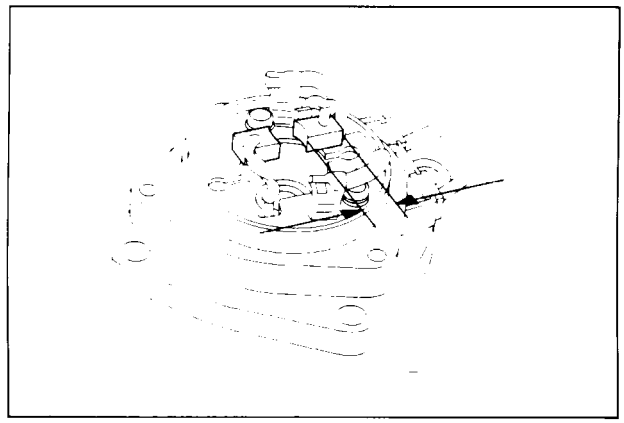


b. INSPECTION

• BRUSH LENGTH

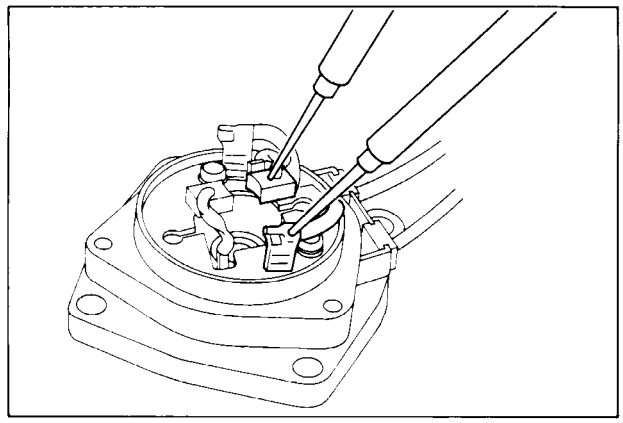
Measure the brush length.
If brush length is less than standard, replace the brush holder.

STANDARD	SERVICE LIMIT
9.8 mm (0.39 in)	5 mm (0.2 in)



• BRUSH INSULATION

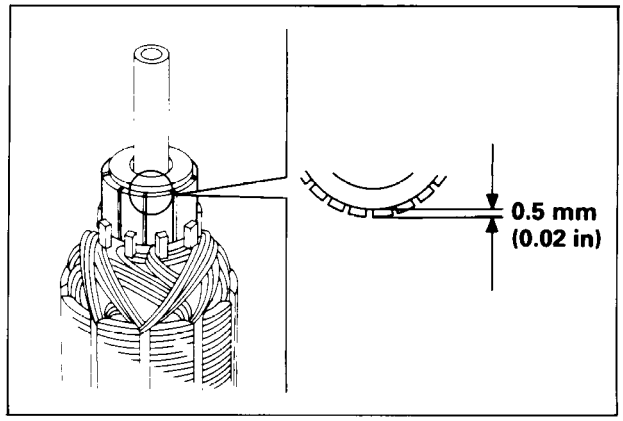
Check for continuity between the brushes.
There should be no continuity.



• MICA DEPTH

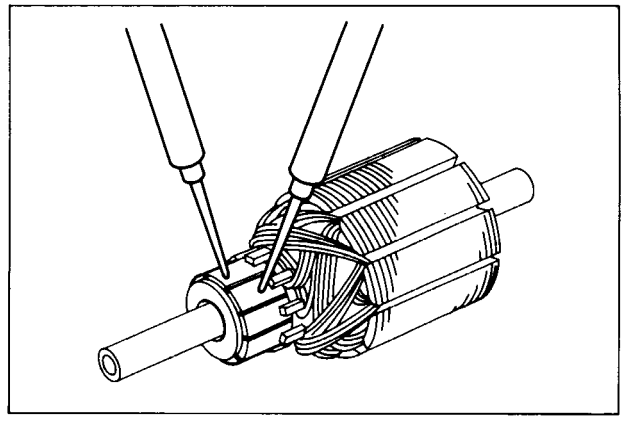
If the grooves are clogged or mica depth is less than the service limit, recut the grooves using a hacksaw blade or a small file.

SERVICE LIMIT	0.5 mm (0.02 in)

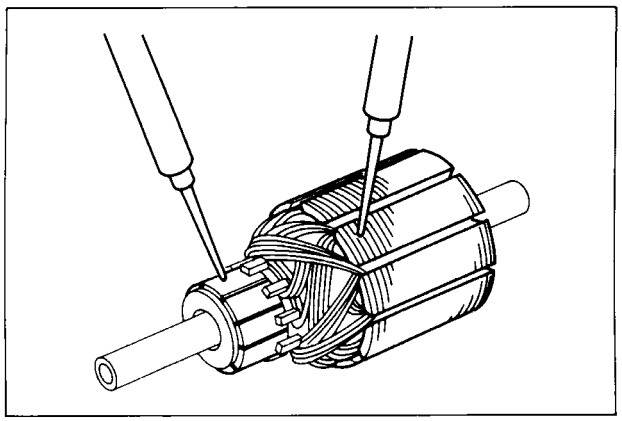


• ARMATURE

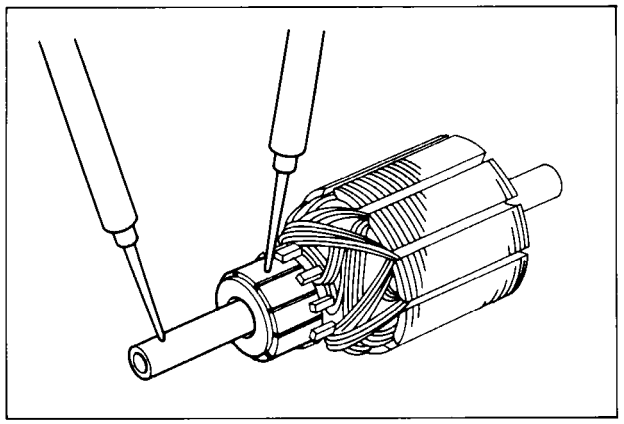
CONTINUITY CHECK—SEGMENTS
Check for continuity between each segment. If an open circuit exists between any two segments, replace the armature.



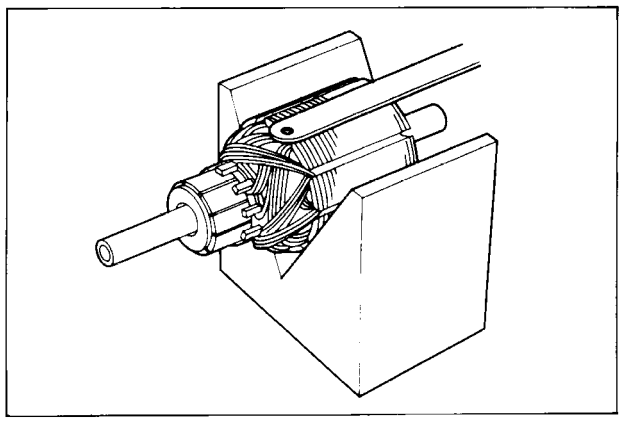
SHORT CIRCUIT TEST—CORE-TO-COMMUTATOR
Check for continuity between the commutator and armature coil core.
If continuity exists, replace the armature.



SHORT CIRCUIT TEST—SHAFT-TO-COMMUTATOR
Check for continuity between the commutator and armature shaft.
If there is continuity, replace the armature.



SHORT CIRCUIT TEST—ARMATURE
Place the armature in an armature tester (commercially available).
Hold a hacksaw blade close to the armature core. If the blade is attracted to the core or vibrates when the core is turned, the armature is shorted. Replace the armature.



HONDA
OUTBOARD
MOTOR

Shop Manual News

Power Equipment

News No.	Issue Date
P/P-087	Nov. 2000

SOME PARTS OF CHANGES

The method of installing the water seal which had been described to the undermentioned shop manual was changed.

Applicable Information	Publication No.	Applicable Pages	Size of Water Seal
BF2D	66ZW600	15-1, 15-2	11 x 21 x 8 mm
BF20A/25A	66ZV700	12-2, 12-5	22 x 35 x 7 mm
		12-8, 12-9	17 x 30 x 7 mm
		12-8	6 mm
BF35A/45A	66ZV300	11-5, 11-8	22 x 35 x 7 mm
		11-10, 11-11	17 x 30 x 7 mm
BF75A/90A	66ZW000Z	11-4, 11-5	10 x 21 x 6 mm
		11-8, 11-11	30 x 45 x 7 mm
BF115A/130A	66ZW500	12-5, 12-6	10 x 21 x 6 mm
		12-10, 12-15	30 x 45 x 7 mm

CHANGE LOCATIONS

The liquid applied to the circumference of water seals has been changed.

After Modification	Before Modification
INSTALLATION: • Do not reuse. • Apply grease to the mating surface and lips of the seals. • Apply soapy water to the circumference of the seals.	**INSTALLATION:** • Do not reuse. • Apply grease to the mating surface, circumference and lips of the seals.

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HONDA

Shop Manual News

BF35A·BF45A·BF40A·BF50A

Power Equipment

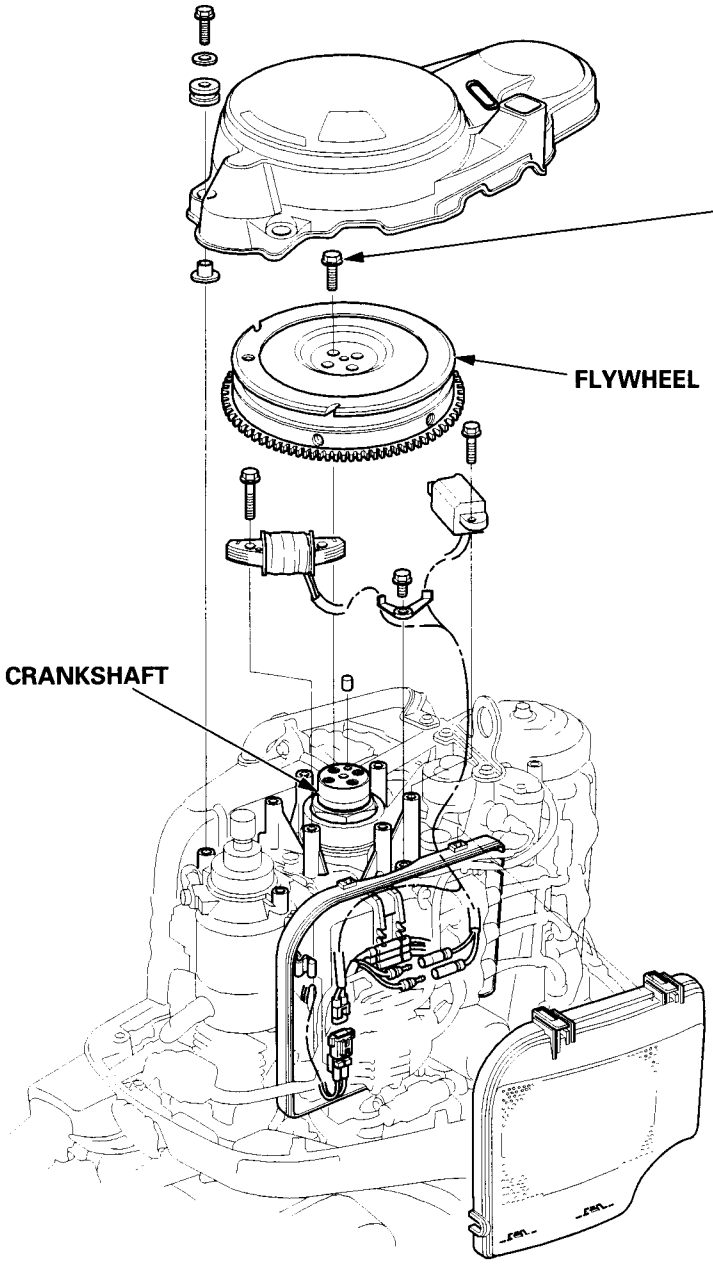
News No.	Issue Date
P/P-161	Mar. 2003

SOME PARTS OF CHANGES

Applicable Information	Publication No.	Applicable Page
BF35A·BF45A·BF40A·BF50A	66ZV300	6-2

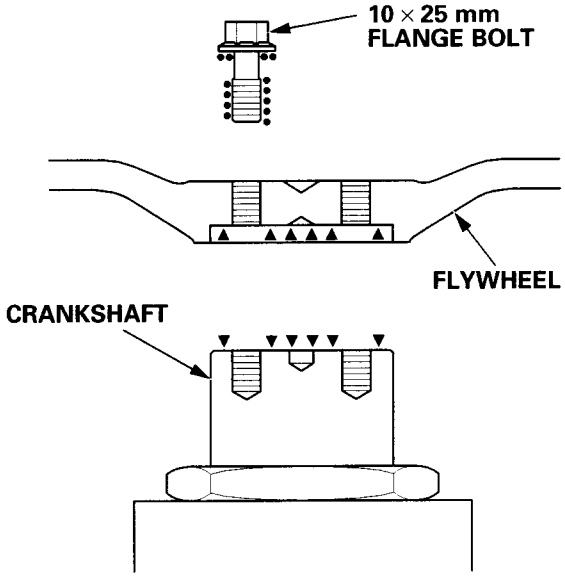
CHANGE LOCATIONS

• Before installing the flywheel, degrease the back side (the crankshaft side) of the flywheel and the end face of the crankshaft. Also, install 10 × 25 mm flange bolts into the flywheel after applying engine oil to the flanged part and threaded part of the bolts.



▲ : DEGREASING
Wipe the flywheel with a clean shop towel sprayed with degreasing agent.

● : APPLYING ENGINE OIL TO THE BOLTS
• Apply engine oil thinly to the flanged part and threaded part.
• Do not apply so much engine oil so that it drips from the bolts.



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Service Publication Office

英仏独西Ⓨ 680.2003.3