PREFACE

This manual covers the construction, function and servicing procedures of the Honda BF8D, BF9.9D, BF10D, BF8B, BF10B, BFP8D, BFP9.9D, BFP10D, BFP8B and BFP10B outboard motors. (BFP8D, BFP9.9D, BFP10D, BFP8B and BFP10B: Power thrust type)

Careful observance of these instructions will result in better, safer service work.

Pay attention to these symbols and their meaning:

⚠ WARNING Indicates a strong possibility of severe personal injury or loss of life if instructions are not followed.

CAUTION: Indicates a possibility of personal injury or equipment damage if instructions are not followed.

ALL INFORMATIONS, ILLUSTRATIONS, DIRECTIONS AND SPECIFICATIONS INCLUDED IN THIS PUBLICATION ARE BASED ON THE LATEST PRODUCT INFORMATION AVAILABLE AT THE TIME OF APPROVAL FOR PRINTING. Honda Motor Co., Ltd. RESERVES THE RIGHT TO MAKE CHANGES WITHOUT INCURRING ANY OBLIGATION WHATEVER. NO PART OF THIS PUBLICATION MAY BE REPRODUCED WITHOUT WRITTEN PERMISSION.

Honda Motor Co., Ltd.
Service Publications Office

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1. SPECIFICATIONS 2. DIMENSIONAL DRAWINGS

1. SPECIFICATIONS

DIMENSIONS AND WEIGHTS

Model	BF8D, BF9.9D, BF10D, BF8B, BF10B						
Description code	BF8D: BAAJ/BF9.9D, BF10D: BABJ/BF8B: BACJ/BF10B: BADJ						
Type	SH	SHS	SR	LH	LHS	LR	*1:XH
Overall length	610 mm (24.0 in)		600 mm (23.6 in)	610 mm (24.0 in)		600 mm (23.6 in)	610 mm (24.0 in)
Overall width	345 mm (13.6 in)						
Overall height	1,105 mm (43.5 in)			1,235 mm (48.6 in)			1,375 mm (54.1 in)
Dry weight	42.0 kg (92.6 lb)	46.5 kg (102.5 lb)	47.0 kg (103.6 lb)	44.5 kg (98.1 lb)	49.0 kg (108.0 lb)	49.5 kg (109.1 lb)	48.5 kg (106.9 lb)
Operating weight	43.4 kg (95.7 lb)	47.9 kg (105.6 lb)	48.4 kg (106.7 lb)	45.9 kg (101.2 lb)	50.4 kg (111.1 lb)	50.9 kg (112.2 lb)	49.9 kg (110.0 lb)
Transom height	433 mm (17.0 in)			563 mm (22.2 in)			703 mm (27.7 in)
Transom angle	5-stage adjustment (4°, 8°, 12°, 16°, 20°)						
Tilting angle	SH, SHS, LH, LHS type: 71° SR, LR, XH: 72°						
Swivel angle	45° right and left						

*1: BF8D and BF8B only.

Model	BFP8D, BFP9.9D, BFP10D, BFP8B, BFP10B					
Description code	BFP8D: BAAJ/BFP9.9D, BFP10D: BABJ/BFP8B: BACJ/BFP10B: BADJ					
Type	LH	LHS	LR	XH	XHS	XR
Overall length	610 mm (24.0 in)		600 mm (23.6 in)	610 mm (24.0 in)		600 mm (23.6 in)
Overall width	345 mm (13.6 in)					
Overall height	1,235 mm (48.6 in)			1,375 mm (54.1 in)		
Dry weight	44.5 kg (98.1 lb)	49.0 kg (108.0 lb)	49.5 kg (109.1 lb)	48.5 kg (106.9 lb)	53.0 kg (116.8 lb)	53.5 kg (117.9 lb)
Operating weight	45.9 kg (101.2 lb)	50.4 kg (111.1 lb)	50.9 kg (112.2 lb)	49.9 kg (110.0 lb)	54.4 kg (119.9 lb)	54.9 kg (121.0 lb)
Transom height	563 mm (22.2 in)			703 mm (27.7 in)		
Transom angle	5-stage adjustment (4°, 8°, 12°, 16°, 20°)					
Tilting angle	LH, LHS type: 71° LR, XH, XHS, XR: 72°					
Swivel angle	45° right and left					

ENGINE

Model	BF8D, BF8B, BFP8D, BFP8B	BF9.9D, BF10D, BF10B, BFP9.9D, BFP10D, BFP10B
Type	Water cooled 4-stroke, overhead valve, vertical twin	
Displacement	222 cm^3 (13.5 cu. in)	
Bore x stroke	58 x 42 mm (2.3 x 1.7 in)	
Rated horsepower	5.9 kW (8.0 PS) at 4,500 – 5,500 min^{-1} (rpm)	*1: 7.3 kW (9.9 PS) at 5,000 – 6,000 min^{-1} (rpm)
		*2: 7.4 kW (10 PS) at 5,000 – 6,000 min^{-1} (rpm)
Maximum torque	12.5 N·m (1.27 kgf·m, 9.18 lbf·ft) at 4,000 min^{-1} (rpm)	13.1 N·m (1.34 kgf·m, 9.67 lbf·ft) at 4,500 min^{-1} (rpm)
Compression ratio	9.0 : 1	
Fuel consumption	377 g (13.3 oz.)/kWh	394 g (13.9 oz.)/kWh
Cooling system	Forced water circulation by impeller pump with thermostat	
Ignition system	CDI	
Ignition timing	0° B.T.D.C. at 1,000 min^{-1} (rpm)	
Spark plug	CR5EH-9 (NGK), U16FER9 (DENSO)	
Carburetor	Horizontal butterfly valve type single carburetor	
Lubricating system	Forced lubrication by trochoid pump	
Oil capacity	1.0 ℓ (1.06 US qt, 0.88 Imp qt) at oil change 1.3 ℓ (1.37 US qt, 1.14 Imp qt) with oil filter replacement	
Recommended oil	SAE 10W-30, API Service classification SG/SH/SJ	
Starting system	Electric starter and recoil starter	
Stopping system	Ignition primary circuit ground	
Fuel used	Automotive unleaded gasoline (minimum 86 pump octane)	
Fuel tank capacity	Steel tank: 13 ℓ (3.4 US gal, 2.9 Imp gal) Plastic tank: 12 ℓ (3.2 US gal, 2.6 Imp gal)	
Fuel pump	Mechanical plunger type	
Exhaust system	Under water type	

*1: BF9.9D and BFP9.9D only
*2: BF10D, BF10B, BFP10D and BFP10B only

LOWER UNIT

Model		BF8D, BF8B, BF9.9D, BF10D, BF10B	BFP8D, BFP8B, BFP9.9D, BFP10D, BFP10B
Clutch		Dog clutch (Forward-neutral-reverse)	
Gear ratio		0.43 (12/28)	
Reduction type		Spiral bevel gear	
Gear case oil capacity		0.285 ℓ (0.27 US qt, 0.23 Imp qt)	
Propeller	Number of blades	4	4
	Diameter	235 mm (9.3 in)	254 mm (10 in)
	Pitch	S type: 229 mm (9.0 in) L, XL type: 203 mm (8.0 in)	165 mm (6.5 in)
	Rotating direction	Clockwise (viewed from rear)	

TYPES OF Honda BF8D/BF9.9D/BF10D/BF8B/BF10B/BFP8D/BFP9.9D/BFP10D/BFP8B/BFP10B OUTBOARD MOTOR

It may be necessary to refer to this chart for reference purposes when reading this manual.

Model	Type	Shaft length	Tiller handle	Remote control	Electric starter	Recoil starter	Charge coil	Stating enrichment system
BF8D/ BF9.9D/ BF10D/ BF8B/ BF10B	SH	S	●			●	6A	Manual
	SHS	S	●		●	●	12A	Automatic
	SR	S		●	●	●	12A	Automatic
	LH	L	●			●	6A	Manual
	LHS	L	●		●	●	12A	Automatic
	LR	L		●	●	●	12A	Automatic
	*1: XH	XL	●			●	6A	Manual
BFP8D/ BFP9.9D/ BFP10D/ BFP8B/ BFP10B	LH	L	●			●	6A	Manual
	LHS	L	●		●	●	12A	Automatic
	LR	L		●	●	●	12A	Automatic
	XH	XL	●			●	6A	Manual
	XHS	XL	●		●	●	12A	Automatic
	XR	XL		●	●	●	12A	Automatic

*1: BF8D and BF8B only

S: Short shaft L: Long shaft XL: Extra long shaft

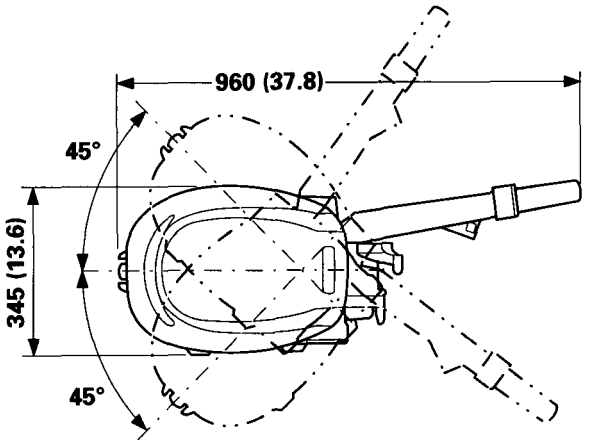
2. DIMENSIONAL DRAWINGS

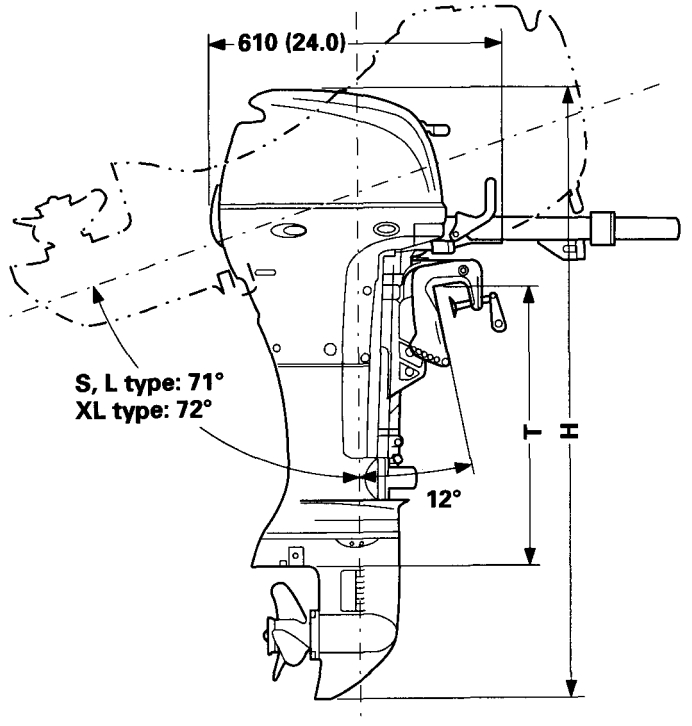
Unit: mm (in)

Tiller Handle Type

Unit: mm (in)

Type	H	T
S	1,105 (43.5)	433 (17.0)
L	1,235 (48.6)	563 (22.2)
XL	1,375 (54.1)	703 (27.7)



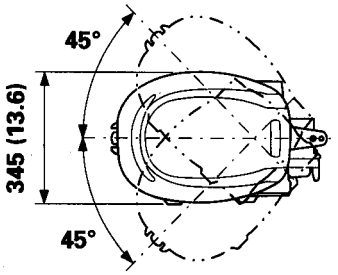


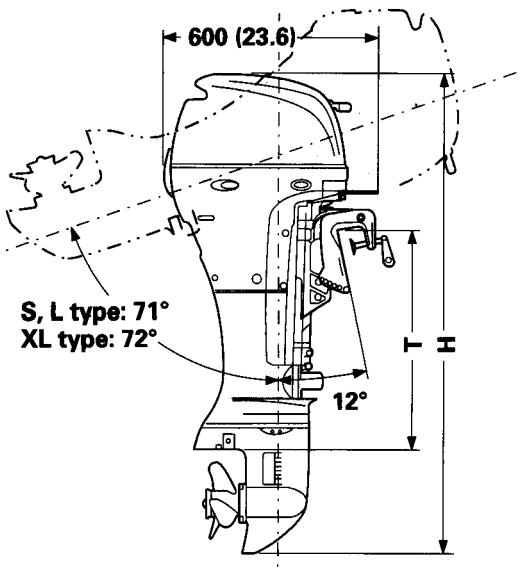
Remote Control Type

Unit: mm (in)

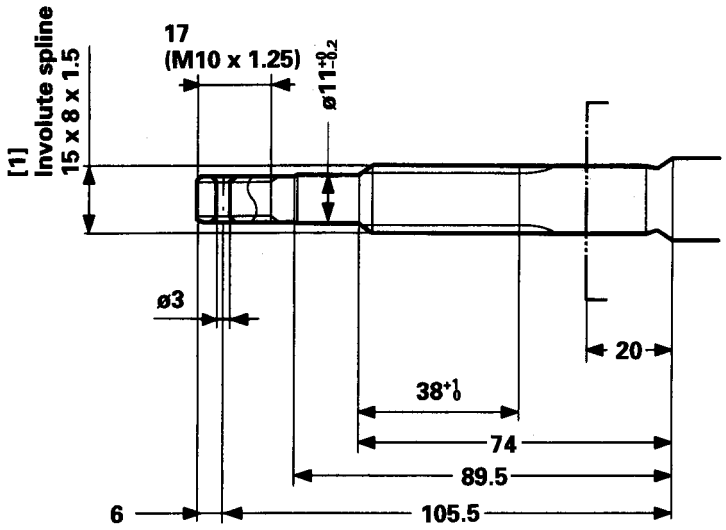
Unit: mm (in)

Type	H	T
S	1,105 (43.5)	433 (17.0)
L	1,235 (48.6)	563 (22.2)
XL	1,375 (54.1)	703 (27.7)





PROPELLER SHAFT DETAIL



1. THE IMPORTANCE OF PROPER SERVICING
2. IMPORTANT SAFETY PRECAUTIONS
3. SERVICE RULES
4. SERIAL NUMBER LOCATIONS
5. MAINTENANCE STANDARDS
6. TORQUE VALUES
7. SPECIAL TOOLS
8. TROUBLESHOOTING
9. CABLE & HARNESS ROUTING
10. LUBRICATION POINTS

1. THE IMPORTANCE OF PROPER SERVICING

Proper servicing is essential to the safety of the operator and the reliability of the outboard motor. Any error or oversight made by the technician while servicing can easily result in faulty operation, damage to the outboard motor, or injury to the operator.

⚠WARNING

- **Improper servicing can cause an unsafe condition that can lead to serious injury or death.**
- **Follow the procedures and precautions in this shop manual carefully.**

Some of the most important precautions are given below. However, we cannot warn you of every conceivable hazard that can arise in performing maintenance or repairs. Only you can decide whether or not you should perform a given task.

⚠WARNING

- **Failure to follow maintenance instructions and precautions can cause you to be seriously hurt or killed.**
- **Follow the procedures and precautions in this shop manual carefully.**

2. IMPORTANT SAFETY PRECAUTIONS

Be sure you have a clear understanding of all basic shop safety practices and that you are wearing appropriate clothing and safety equipment. When performing maintenance or repairs, be especially careful of the following:

- **Read the instructions before you begin, and be sure you have the tools and skills required to perform the tasks safely.**
  Be sure the engine is off before you begin any maintenance or repairs. This will reduce the possibility of several hazards:

- **Carbon monoxide poisoning from engine exhaust.**
  Be sure there is adequate ventilation whenever you run the engine.

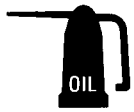
- **Burns from hot parts.**
  Let the engine cool before you touch it.

- **Injury from moving parts.**
  Do not run the engine unless the instruction tells you to do so. Even then, keep your hands, fingers, and clothing away.

To reduce the possibility of a fire or explosion, be careful when working around gasoline. Use only a nonflammable solvent, not gasoline, to clean parts. Keep all cigarettes, sparks, and flames away from the battery and all fuel-related parts.

3. 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 assembling.
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 assembly.
6. After assembly, 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 bolts, 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.



: Apply oil. S. TOOL : Use special tool. GREASE : Apply grease

○ x ○ (○) : Indicates the type, length, and number of the flange bolt used.

P. : Indicates the reference page.

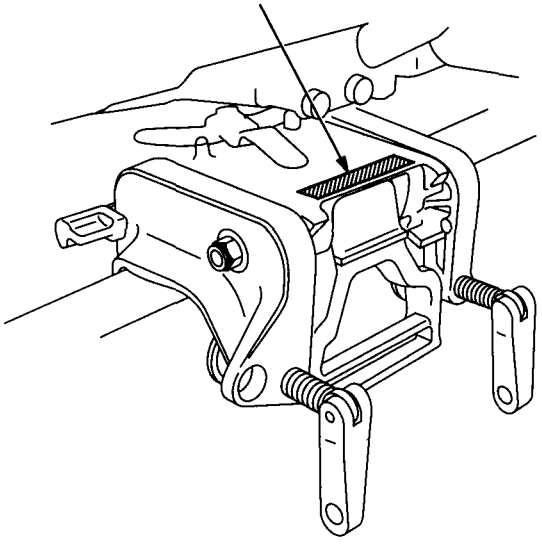
GREASE

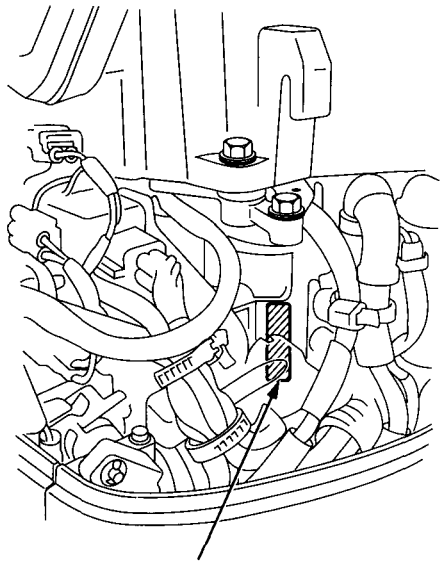
(Molybdenum disulfide oil) : Use molybdenum oil solution (mixture of the engine oil and molybdenum grease with the ratio 1:1).

4. SERIAL NUMBER LOCATION

The engine serial number is stamped on the left front of the cylinder block and the frame serial number is located on the swivel case. Refer to these numbers when ordering parts and when making technical inquiries.

FRAME SERIAL NUMBER





ENGINE SERIAL NUMBER

5. MAINTENANCE STANDARDS

• ENGINE

Part	Item		Standard	Service limit
Engine	Idle speed (in neutral)		900 ± 50 min^{-1} (rpm)	———
	Recommended full throttle rpm		[*1]: 4,500 – 5,500 min^{-1} (rpm)	———
			[*2]: 5,000 – 6,000 min^{-1} (rpm)	———
	Cylinder compression		1.23 – 1.42 MPa (12.5 – 14.5 kgf/cm^2, 178 – 206 psi) at 600 min^{-1} (rpm)	———
Cylinder heads	Warpage		0.05 mm (0.002 in) max.	0.10 mm (0.004 in)
	Valve seat width	IN/EX	0.9 – 1.1 mm (0.035 – 0.043 in)	2.0 mm (0.08 in)
	Camshaft journal I.D.	No. 1	20.000 – 20.021 mm (0.7874 – 0.7882 in)	20.05 mm (0.789 in)
Valves	Clearance	IN	0.15 – 0.19 mm (0.006 – 0.007 in)	———
		EX	0.21 – 0.25 mm (0.008 – 0.010 in)	———
	Stem O.D.	IN	4.975 – 4.990 mm (0.1959 – 0.1965 in)	4.95 mm (0.195 in)
		EX	4.955 – 4.970 mm (0.1951 – 0.1957 in)	4.93 mm (0.194 in)
Valve guides	Guide I.D.	IN/EX	5.000 – 5.012 mm (0.1969 – 0.1973 in)	5.04 mm (0.198 in)
	Stem-to-guide clearance	IN	0.010 – 0.037 mm (0.0004 – 0.0015 in)	0.07 mm (0.003 in)
		EX	0.030 – 0.067 mm (0.0012 – 0.0026 in)	0.12 mm (0.005 in)
Valve springs	Free length		33.28 mm (1.310 in)	32.0 mm (1.26 in)
Rocker arms, rocker arm shaft	Shaft O.D.		12.962 – 12.980 mm (0.5103 – 0.5110 in)	12.92 mm (0.509 in)
	Arm I.D.		13.000 – 13.018 mm (0.5118 – 0.5125 in)	13.04 mm (0.513 in)
	Shaft-to-rocker arm clearance		0.020 – 0.056 mm (0.0008 – 0.0022 in)	0.07 mm (0.003 in)
Camshaft	Camshaft axial play		0.05 – 0.30 mm (0.002 – 0.012 in)	0.4 mm (0.016 in)
	Cam height (IN/EX)		[*1]: 21.916 – 22.076 mm (0.8628 – 0.8691 in)	21.716 mm (0.8550 in)
			[*2]: 23.396 – 23.556 mm (0.9211 – 0.9274 in)	23.196 mm (0.9132 in)
	Journal O.D.	No. 1	19.959 – 19.980 mm (0.7858 – 0.7866 in)	19.93 mm (0.785 in)
		Oil pump	15.966 – 15.984 mm (0.6286 – 0.6293 in)	15.94 mm (0.628 in)
	Journal-to-shaft clearance	No. 1	0.020 – 0.062 mm (0.0008 – 0.0024 in)	0.08 mm (0.003 in)
Oil pump	Rotor tip clearance		0.15 mm (0.006 in) max.	0.20 mm (0.008 in)
	Outer rotor-to-body clearance		0.15 – 0.21 mm (0.006 – 0.008 in)	0.26 mm (0.010 in)
	Rotor-to-pump body side clearance		0.04 – 0.09 mm (0.002 – 0.004 in)	0.12 mm (0.005 in)
	Pump body I.D.		40.71 – 40.74 mm (1.603 – 1.604 in)	40.76 mm (1.605 in)
	Pump body depth		12.04 – 12.07 mm (0.474 – 0.475 in)	12.11 mm (0.477 in)
	Outer rotor height		11.98 – 12.00 mm (0.4717 – 0.4724 in)	11.96 mm (0.471 in)
	Camshaft journal I.D.		16.000 – 16.018 mm (0.6299 – 0.6306 in)	16.05 mm (0.632 in)
	Pump body-to-camshaft clearance		0.016 – 0.052 mm (0.0006 – 0.0020 in)	0.07 mm (0.003 in)
Fuel pump	Pump arm I.D.		13.000 – 13.080 mm (0.5118 – 0.5150 in)	13.10 mm (0.516 in)
	Shaft-to-pump arm clearance		0.020 – 0.118 mm (0.0008 – 0.0046 in)	0.13 mm (0.005 in)
Cylinders	Sleeve I.D.		58.000 – 58.015 mm (2.2835 – 2.2841 in)	58.055 mm (2.2856 in)

[*1]: BF8D, BF8B, BFP8D and BFP8B only
[*2]: BF9.9D, BF10D, BF10B, BFP9.9D, BFP10D and BFP10B only

ENGINE (continued)

Parts	Item		Standard	Service limit
Pistons	Skirt O.D.		57.970 – 57.990 mm (2.2823 – 2.2831 in)	57.92 mm (2.280 in)
	Piston-to-cylinder clearance		0.010 – 0.045 mm (0.0004 – 0.0015 in)	0.10 mm (0.004 in)
	Piston pin bore I.D.		16.002 – 16.008 mm (0.6300 – 0.6302 in)	16.02 mm (0.638 in)
Piston pins	Piston pin O.D.		15.994 – 16.000 mm (0.6297 – 0.6299 in)	15.97 mm (0.629 in)
	Piston-to-piston pin clearance		0.002 – 0.014 mm (0.0001 – 0.0006 in)	0.04 mm (0.002 in)
Piston rings	Side clearance	Top/second	0.025 – 0.055 mm (0.0010 – 0.0022 in)	0.10 mm (0.004 in)
		Oil	0.055 – 0.140 mm (0.0022 – 0.0055 in)	0.20 mm (0.008 in)
	End gap	Top	0.15 – 0.30 mm (0.006 – 0.012 in)	0.5 mm (0.02 in)
		Second	0.35 – 0.50 mm (0.014 – 0.020 in)	0.7 mm (0.03 in)
		Oil	0.20 – 0.80 mm (0.008 – 0.031 in)	1.0 mm (0.04 in)
	Thickness	Top/second	1.175 – 1.190 mm (0.0463 – 0.0469 in)	1.08 mm (0.043 in)
Connecting rods	Small end I.D.		16.007 – 16.022 mm (0.6302 – 0.6308 in)	16.05 mm (0.632 in)
	Big end I.D.		28.020 – 28.033 mm (1.1031 – 1.1037 in)	28.06 mm (1.105 in)
	Big end oil clearance		0.020 – 0.046 mm (0.0008 – 0.0018 in)	0.06 mm (0.002 in)
	Big end side clearance		0.10 – 0.60 mm (0.004 – 0.024 in)	0.7 mm (0.03 in)
Crankshaft	Main journal O.D.		29.984 – 29.993 mm (1.1805 – 1.1808 in)	29.96 mm (1.180 in)
	Crank pin O.D.		27.987 – 28.000 mm (1.1018 – 1.1024 in)	27.96 mm (1.101 in)
	Main journal oil clearance		0.015 – 0.037 mm (0.0006 – 0.0015 in)	0.06 mm (0.002 in)
Carburetor	Main jet		[*1]: #105	———
			[*2]: #98	———
	Pilot screw opening		See page 6-8.	———
	Float height		13.5 mm (0.53 in)	———

[*1]: BF8D, BF9.9D, BF10D, BFP8D, BFP9.9D and BFP10D only
[*2]: BF8B, BF10B, BFP8B and BFP10B only

ELECTRICAL

Parts	Item		Standard	Service limit
Spark plug	Gap		0.8 – 0.9 mm (0.031 – 0.035 in)	———
Ignition coil	Primary coil resistance		0.35 – 0.43 Ω	———
	Secondary coil resistance (with plug caps)		23.0 – 34.8 kΩ	———
Starter motor	Brush length		12.5 mm (0.49 in)	8.5 mm (0.33 in)
	Mica depth		———	0.2 mm (0.01 in)
Charge coil	Resistance	12A charge coil	0.2 – 0.3 Ω	———
		6A charge coil	0.23 – 0.29 Ω	———
Exciter coil	Resistance	Electric starter type	5.0 – 7.4 Ω	———
		Recoil starter type	6.1 – 7.5 Ω	———
Pulse generator	Resistance		351 – 429 Ω	———
SE thermal valve coil	Resistance		1.2 – 1.8 Ω	———

LOWER UNIT

Parts	Item		Standard	Service limit
Propeller shaft	Shaft O.D.		16.973 – 16.984 mm (0.6682 – 0.6687 in)	16.95 mm (0.667 in)
Forward gear	I.D.		17.000 – 17.018 mm (0.6693 – 0.6700 in)	17.04 mm (0.671 in)
Vertical shaft	Shaft O.D.	S and L type	12.976 – 12.995 mm (0.5108 – 0.5116 in)	12.96 mm (0.510 in)
		XL type	14.989 – 15.000 mm (0.5901 – 0.5906 in)	14.97 mm (0.589 in)

6. TORQUE VALUES

• Engine

Item	Thread dia. x pitch	Torque		
		N·m	kgf·m	lbf·ft
Crankcase cover bolts	M6 x 1.0	14	1.4	10
Oil pressure switch	PT1/8 (Apply sealant to the threads.)	8	0.8	5.8
Oil drain bolt	M8 x 1.25	6	0.6	4.3
Oil filter cartridge	M20 x 1.5	12	1.2	9
Spark plugs	M10 x 1.0	12	1.2	9
Cylinder head bolts (L = 83 mm)	M8 x 1.25 (Apply oil to the threads.)	26	2.7	20
Cylinder head bolts (L = 40 mm)	M8 x 1.25	24	2.4	17
Valve adjusting lock nuts	M5 x 0.5	8	0.8	5.8
Connecting rod bolts	M6 x 1.0	12	1.2	9
Timing belt driven pulley bolt	M6 x 1.0	16	1.6	12
Recoil starter pulley bolts	M6 x 1.0	11	1.1	8
Flywheel nut	M14 x 1.5 (Apply oil to the threads.)	88	9.0	65
Timing belt drive pulley lock nut	M24 x 1.0 (Apply oil to the threads.)	54	5.5	40
Oil pump cover bolts	M5 x 0.8	5	0.5	3.6
Oil pump bolts	M6 x 1.0	11	1.1	8
Silencer bolts	M6 x 1.0	9	0.9	6.5
Silencer cover bolt	M6 x 1.0	10	1.0	7
Oil case bolts	M8 x 1.25	24	2.4	17
Thermo sensor	M12 x 1.5	18	1.8	13
Exhaust chamber cover bolts	M6 x 1.0	11	1.1	8

• Gear Case

Item	Thread dia. x pitch	Torque		
		N·m	kgf·m	lbf·ft
Gear case bolts and nuts	M6 x 1.0	12	1.2	9
Propeller 10 mm crown head nut	M10 x 1.25	See page 4-2		
Propeller shaft holder bolts	M6 x 1.0	12	1.2	9
Oil level bolt	M8 x 1.25	3.5	0.35	2.5
Oil drain bolt	M8 x 1.25	3.5	0.35	2.5
Water pump housing bolts	M6 x 1.0	12	1.2	9
Impeller housing bolts	M6 x 1.0	11	1.1	8
Water screen nuts	M5 x 0.8	1	0.1	0.7
Anode metal nut	M6 x 1.0	10	1.0	7
Shift rod B lock nut	M6 x 1.0	10	1.0	7

• Cover

Item	Thread dia. x pitch	Torque		
		N·m	kgf·m	lbf·ft
Left, right engine under cover screw	M5 x 0.8	4.5	0.45	3.3

• Extension Case/Mount Rubber

Item	Thread dia. x pitch	Torque		
		N·m	kgf·m	lbf·ft
Extension case bolts	M8 x 1.25	24	2.4	17
Upper mount rubber stay bolt	M6 x 1.0	12	1.2	9
Lower mount rubber bolts	M8 x 1.25	22	2.2	16
Lower mount rubber cover bolts	M6 x 1.0	12	1.2	9
Extension case stud bolts (XL type)	M6 x 1.0	12	1.2	9
Upper mount rubber bolt	M10 x 1.25	38	3.9	28
Steering friction lever lock nut	M8 x 0.75	2.5	0.25	1.8

• Stern Bracket

Item	Thread dia. x pitch	Torque		
		N·m	kgf·m	lbf·ft
Tilting bolt lock nut (Except XL and remote control type)	M8 x 1.25	24	2.4	17
Tilting shaft nut (XL and remote control type)	7/8-14UNF	17	1.7	12
Stern bracket nut (XL and remote control type)	M8 x 1.25	21	2.1	15

• Tiller Handle

Item	Thread dia. x pitch	Torque		
		N·m	kgf·m	lbf·ft
Tiller handle bracket bolts	M10 x 1.25	33	3.4	25
Tiller handle pivot nut	M8 x 1.25	8	0.8	5.8
Shift shaft plate screws	M5 x 0.8	1.5	0.15	1.1
Shift lever pivot bolt	M6 x 1.0	12	1.2	9
Emergency stop switch nut	M16 x 1.0	1.5	0.15	1.1
Throttle cable lock nut	M6 x 1.0	4.5	0.45	3.3
Starter switch nut	M16 x 1.0	1.5	0.15	1.1

• Frame/Electrical Equipment

Item	Thread dia. x pitch	Torque		
		N·m	kgf·m	lbf·ft
Neutral switch nut	M20 x 1.0	2.5	0.25	1.8
Neutral start cable nut	M6 x 1.0	4.5	0.45	3.3
Starter magnetic switch bolts	M6 x 1.0	7	0.7	5.1
Starter cord terminal nut	M6 x 1.0	5	0.5	3.6
Starter cable terminal nut	M6 x 1.0	6.5	0.65	4.7
Choke cable nut	M11 x 1.25	2.5	0.25	1.8

- Use standard torque values (P. 2-8) of fasteners that are not listed in this table.

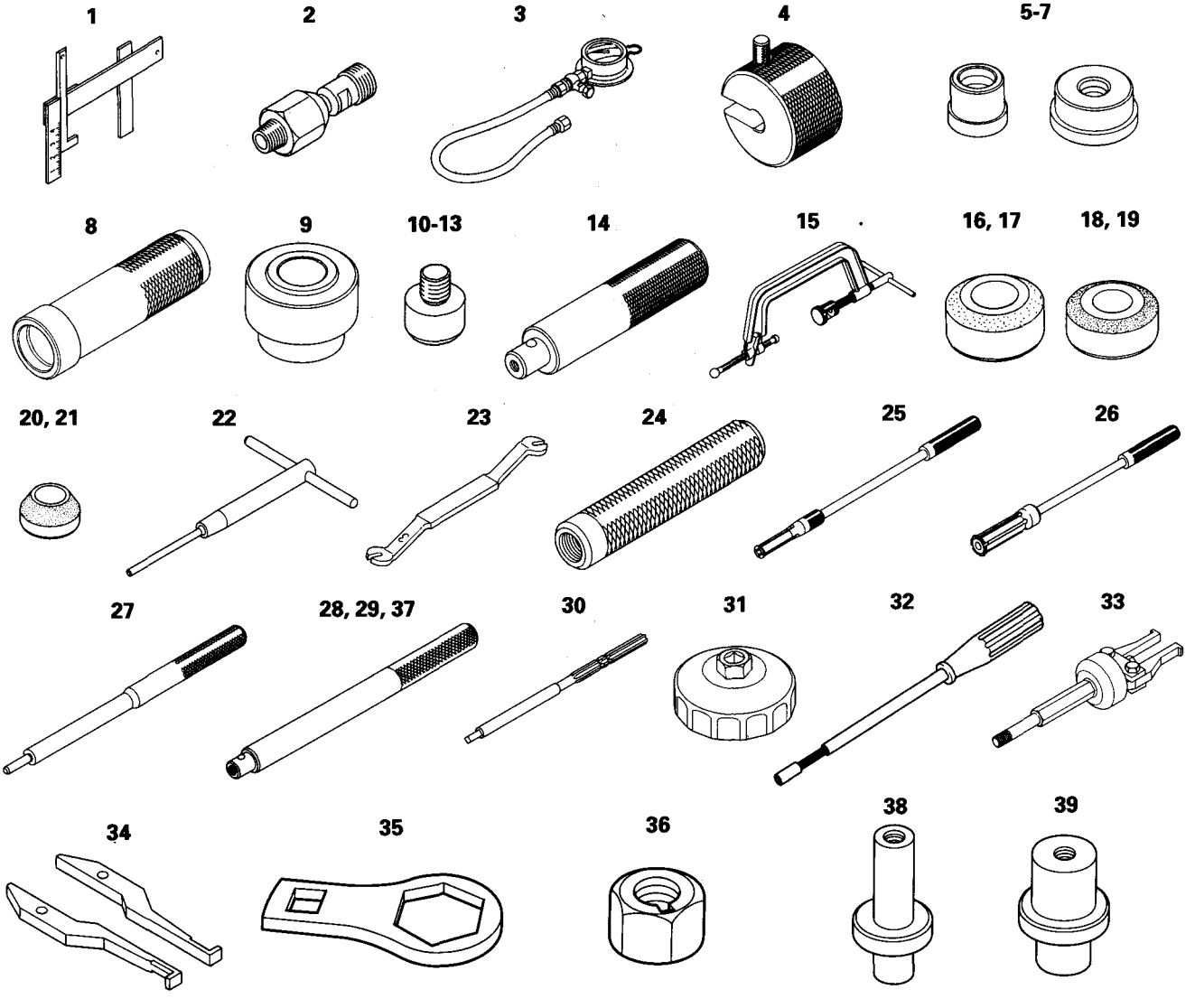
STANDARD TORQUE

Item	Thread size	Torque		
		N·m	kgf·m	lbf·ft
Screw	4 mm	2	0.2	1.4
	5 mm	4.2	0.42	3.0
	6 mm	9	0.9	6.5
Hex. bolt and nut	5 mm	5.2	0.52	3.8
	6 mm	10	1.0	7
	8 mm	21.5	2.15	15.5
	10 mm	34	3.5	25
	12 mm	54	5.5	40
Flange bolt and nut	6 mm	12	1.2	9
	8 mm	26	2.7	20
	10 mm	39	4.0	29
	12 mm	59	6.0	43
SH (small head flange) bolt	6 mm	12	1.2	9
CT (self tapping) bolt	5 mm	5.5	0.55	4.0
	6 mm	12	1.2	9

7. SPECIAL TOOLS

	Tool name	Tool number	Application
1.	Float level gauge	07401 – 0010000	Carburetor float level inspection
2.	Oil pressure gauge attachment	07406 – 0030000	Oil pressure inspection
3.	Oil pressure gauge set	07506 – 3000000	Oil pressure inspection
4.	Remover weigth	07741 – 0010201	Constituent part of the tools 25, 26 and 33
5.	Attachment, 42 x 47 mm	07746 – 0010300	6005 radial ball bearing installation, 25 x 47 x 15 taper roller bearing (outer race) installation (XL type), forward bevel gear bearing installation (S and L types)
6.	Attachment, 24 x 26 mm	07746 – 0010700	17 mm water seal installation, 15 x 24 x 5 mm water seal installation (XL type)
7.	Attachment, 22 x 24 mm	07746 – 0010800	17 x 24 x 20 mm needle bearing removal, 13 mm water seal installation
8.	Inner driver	07746 – 0030100	25 x 47 x 15 taper roller bearing (inner race) installation (XL type)
9.	Attachment, 25 mm inner	07746 – 0030200	25 x 47 x 15 taper roller bearing (inner race) installation (XL type)
10.	Pilot, 15 mm	07746 – 0040300	15 x 21 x 12 mm needle bearing installation (XL type), 15 x 24 x 5 mm water seal installation (XL type)
11.	Pilot, 17 mm	07746 – 0040400	17 x 24 x 20 mm needle bearing removal/ installation, 17 mm water seal installation
12.	Pilot, 25 mm	07746 – 0040600	6005 radial ball bearing installation, forward bevel gear bearing removal (S and L types)
13.	Pilot, 13 mm	07746 – 0041500	13 x 15 x 15 mm bushing removal/installation (S and L types), 13 mm water seal installation
14.	Driver	07749 – 0010000	Driver for 5, 6, 7, 10, 11, 12 and 13
15.	Valve spring compressor	07757 – 0010000	Valve cotter removal/installation
16.	Valve seat cutter, 45° 27.5 mm	07780 – 0010200	Valve seat reconditioning (IN)
17.	Valve seat cutter, 45° 22 mm	07780 – 0010701	Valve seat reconditioning (EX)
18.	Valve seat cutter, 32° 25 mm	07780 – 0012000	Valve seat reconditioning (EX)
19.	Valve seat cutter, 32° 30 mm	07780 – 0012200	Valve seat reconditioning (IN)
20.	Valve seat cutter, 60° 22 mm	07780 – 0014202	Valve seat reconditioning (EX)
21.	Valve seat cutter, 60° 26 mm	07780 – 0014500	Valve seat reconditioning (IN)
22.	Cutter holder 5.0 mm	07781 – 0010400	Valve seat reconditioning (IN/EX)
23.	Valve adjusting wrench, 3 mm	07908 – KE90200	Valve clearance inspection
24.	Remover handle	07936 – 3710100	Constituent part of the tools 32
25.	Bearing remover, 15 mm	07936 – KC10500	15 x 21 x 12 mm needle bearing removal (XL type)
26.	Bearing remover, 25 mm	07936 – ZV10100	6005 radial ball bearing removal, forward bevel gear bearing removal (S and L types)
27.	Valve guide driver, 5.0 mm	07942 – 8920000	Valve guide removal/installation
28.	Needle bearing driver	07946 – KA50000	15 x 21 x 16 mm needle bearing removal/ installation (XL type)
29.	Driver, 15 x 280 mm	07949 – 3710001	17 x 24 x 20 mm needle bearing removal, 25 x 47 x 15 taper roller bearing (outer race) installation (XL type), forward bevel gear bearing installation (S and L types)

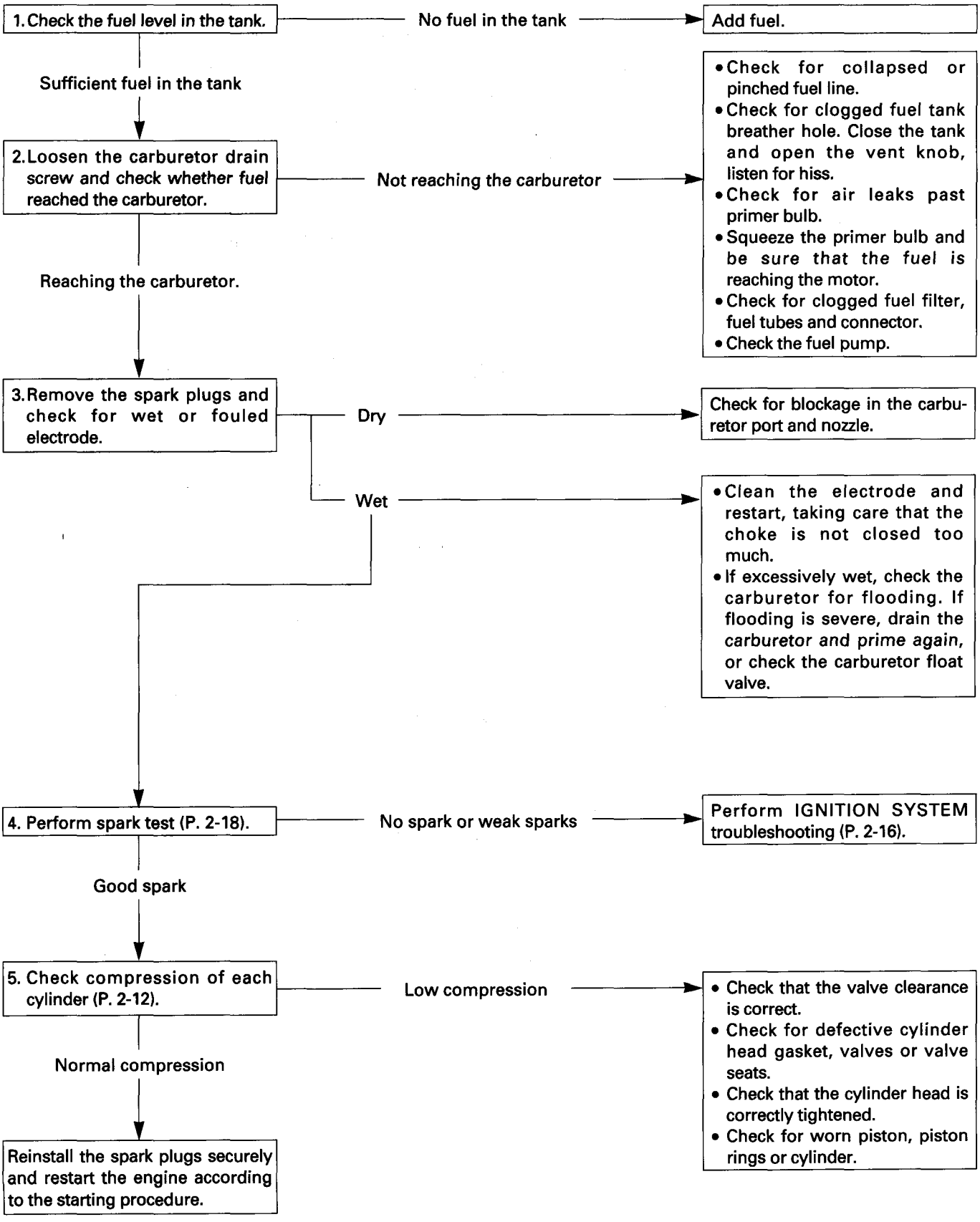
	Tool name	Tool number	Application
30.	Valve guide reamer, 5.010 mm	07984 – MA60001	Valve guide reaming (IN/EX)
31.	Oil filter wrench	07HAA – PJ70100	Oil filter removal/installation
32.	Pilot screw wrench	07KMA – MS60101	Pilot screw adjustment (Bodensee type only)
33.	Bearing race puller	07LPC – ZV30100	25 x 47 x 15 taper roller bearing (outer race) removal (XL type) [Puller jaws of the bearing race puller (07LPC – ZV30100) are removed and replaced with the puller jaws of part number 07WPC – ZW50100.]
34.	Puller jaws, 25 mm	07WPC – ZW50100	25 x 47 x 15 taper roller bearing (outer race) removal (XL type)
35.	30 mm lock nut wrench	07ZPA – ZW90100	24 mm lock nut removal/installation
36.	Crankshaft holder	07ZPB – ZW90100	24 mm lock nut removal/installation
37.	Driver, 13 x 325 mm	07ZPF – ZW90100	13 x 18 x 20 mm bushing removal/installation (S and L types)
38.	Driver, 15/13 x 30 mm	07ZPF – ZW90200	13 x 15 x 15 mm bushing removal/installation (S and L types)
39.	Driver, 14.5 x 18.5 mm	07ZPF – ZW90300	17 x 24 x 20 mm needle bearing installation, 15 x 21 x 12 mm needle bearing installation (XL type)



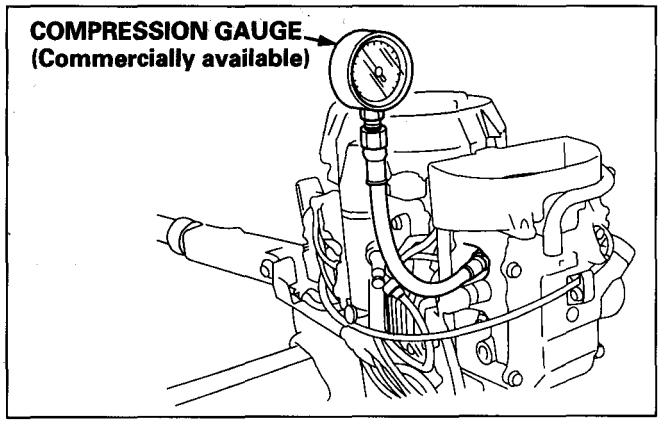
6. TROUBLESHOOTING

a. ENGINE

- **Hard Starting**



CYLINDER COMPRESSION CHECK



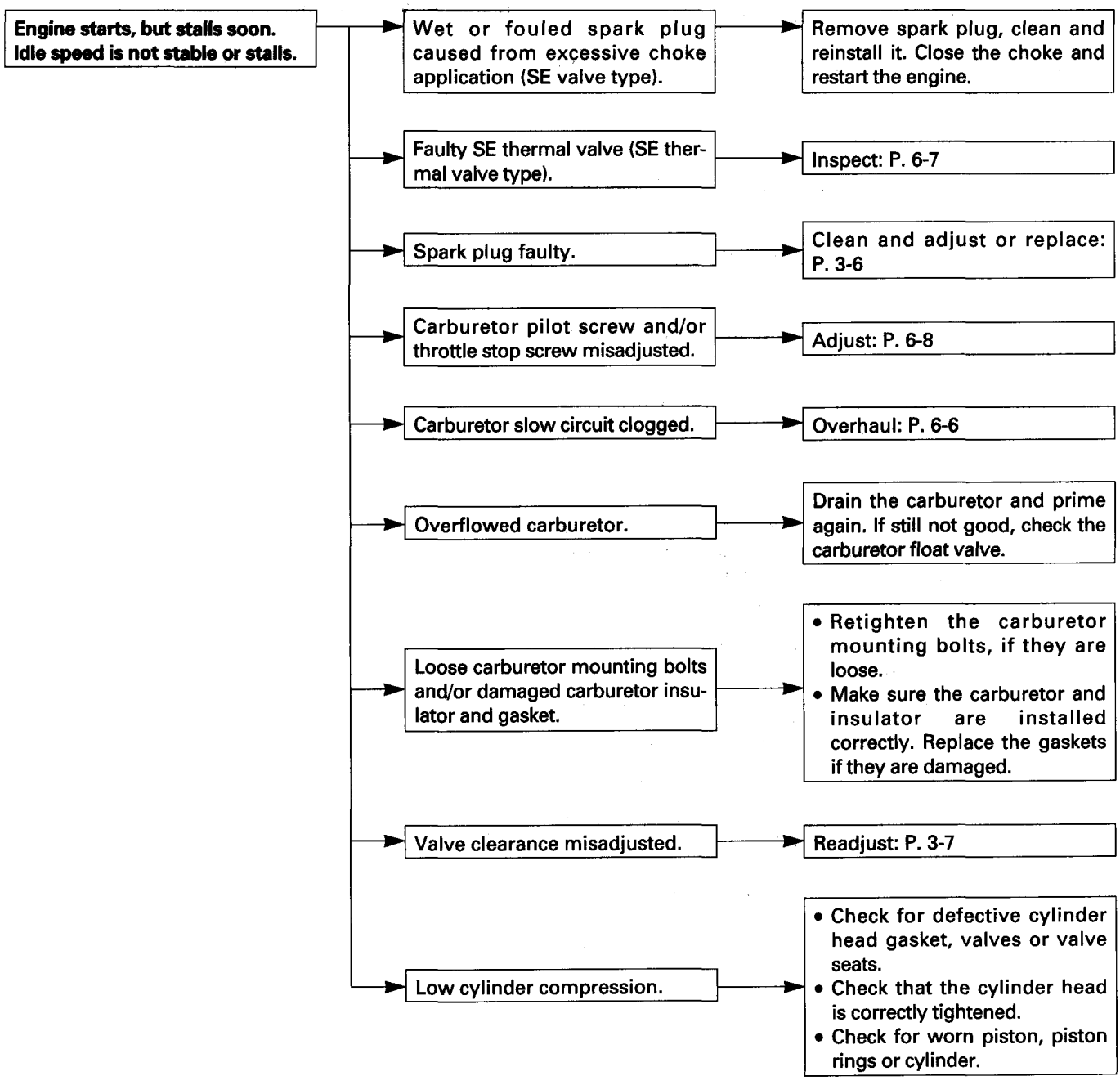
1) Shift the gear into the neutral position.
2) Disengage the emergency stop switch clip from the emergency stop switch.
3) Remove the engine cover and both spark plugs.
4) Install a compression gauge in the No. 1 cylinder plug hole.
5) Disconnect the remote control throttle cable from the throttle arm (Remote control type only).
6) Manually hold the throttle arm or throttle lever in the full open position.
7) Electric starter type: Turn the starter motor using the starter switch (Tiller handle type) or ignition switch (Remote control type) until stable compression is obtained.
   - Do not operate the starter motor for more than 5 seconds at one try. If stable compression is not obtained within 5 seconds, stop the starter motor and wait for 10 – 20 seconds, and repeat the operation again.

   Recoil starter type: Pull the recoil starter several times until stable compression is obtained.

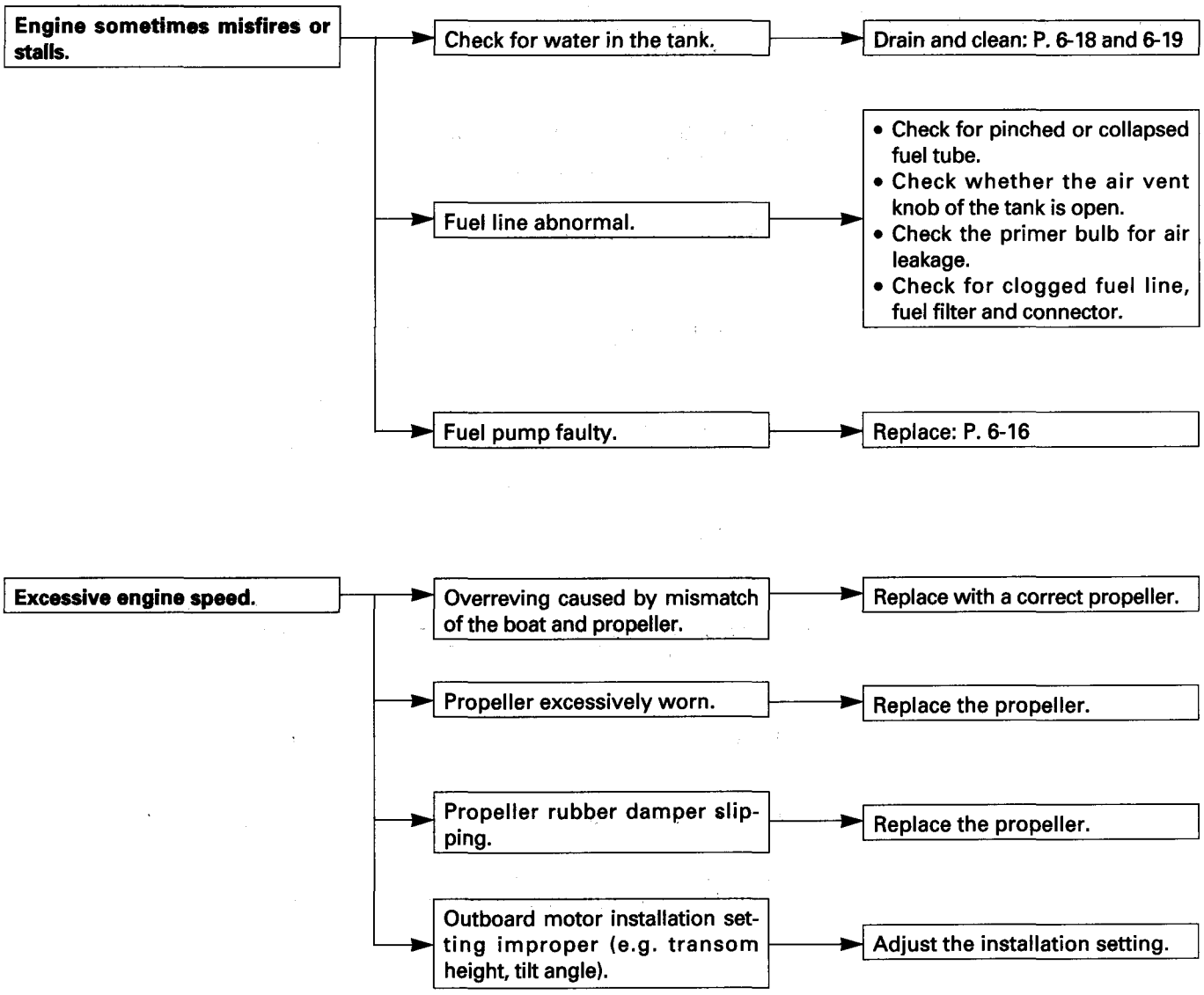
Cylinder compression	1.23 – 1.42 MPa (12.5 – 14.5 kgf/cm², 178 – 206 psi) at 600 min⁻¹(rpm)

8) Reinstall the compression gauge in the No. 2 cylinder plug hole and repeat steps 6 and 7.
9) After inspection, reinstall the removed parts in the reverse order of removal.

• Engine Does Not Run Smoothly



Engine speed does not increase.	SE valve not returned properly (SE valve type).	Return completely.
	Faulty SE thermal valve (SE thermal valve type).	Readjust: P. 6-7
	Throttle cable misadjusted.	Clean or replace: P. 3-13 and 3-14
	Propeller mismatched.	Replace with the correct propeller.
	Spark plug faulty.	Clean and adjust or replace: P. 3-6
	Clogged fuel filter.	Replace: P. 3-11
	Water in carburetor.	Drain the carburetor. If it is still no good, overhaul the carburetor: P. 6-5.
	Valve timing incorrect.	Reinstall the timing belt: P. 9-10.
	Alert system function.	Troubleshooting: P. 2-21.
	Ignition control module faulty.	Inspect: P. 16-19.
Engine speed does not decrease.	Throttle linkage does not move smoothly (Remote control type).	Replace: P. 13-2
	Throttle cable stuck (Tiller handle type).	Replace: P. 15-4


Engine sometimes misfires or stalls.
Check for water in the tank.
Drain and clean: P. 6-18 and 6-19
Fuel line abnormal.
• Check for pinched or collapsed fuel tube.
• Check whether the air vent knob of the tank is open.
• Check the primer bulb for air leakage.
• Check for clogged fuel line, fuel filter and connector.
Fuel pump faulty.
Replace: P. 6-16
Excessive engine speed.
Overreving caused by mismatch of the boat and propeller.
Replace with a correct propeller.
Propeller excessively worn.
Replace the propeller.
Propeller rubber damper slipping.
Replace the propeller.
Outboard motor installation setting improper (e.g. transom height, tilt angle).
Adjust the installation setting.

b. IGNITION SYSTEM

These outboard motors are equipped with an engine overrev limiter which is provided in the ignition control module.

The overrev limiter is activated when the engine rpm exceeds (BF9.9D, BFP9.9D, BF10D, BFP10D, BF10B, BFP10B: 6,300 rpm, BF8D, BFP8D, BF8B, BFP8B: 5,800 rpm). When activated the sparks are emitted to the No. 1 and No. 2 cylinders. The overrev limiter may be activated under such conditions as light propeller load or propeller ventilation.

• Hard Starting

1. Measure the spark plug gap and perform the spark test (P. 2-18).
   - **Plug gap: 0.8 – 0.9 mm (0.31 – 0.35 in)**
   - **Standard plug: CR5EH-9 (NGK), U16FER9 (DENSO)**

No spark or weak spark

2. Perform the spark test again using a new spark plugs.
   - Good sparks → Replace the spark plugs.

No spark

3. Check that the switch clip is installed on the emergency stop switch correctly.
   - Disengaged → Install the clip securely.

Installed

4. Disconnect the black/red wire of the emergency stop switch and perform spark test.
   - Good spark → Replace the emergency stop switch.

No spark

5. Disconnect the exciter coil wire connector, and check for resistance.
   Resistance:
   Electric starter type: 5.0 – 7.4 Ω
   Recoil starter type: 6.1 – 7.5 Ω
   - Abnormal → Replace the exciter coil (recoil starter type) or charge coil (electric starter type).

Normal

Go to page 2-17.

From page 2-16.

6. Disconnect the pulse generator coil wire connector, and check for resistance.
Resistance: 351 – 429 Ω

Abnormal → Replace the pulse generator coil.

Normal

7. Check for voltage leakage caused by damaged high tension wire insulation. Check the ignition coil resistances.
Resistance:
Primary: 0.35 – 0.43 Ω
Secondary: 23.0 – 34.8 kΩ

Abnormal → Replace the ignition coil.

Normal

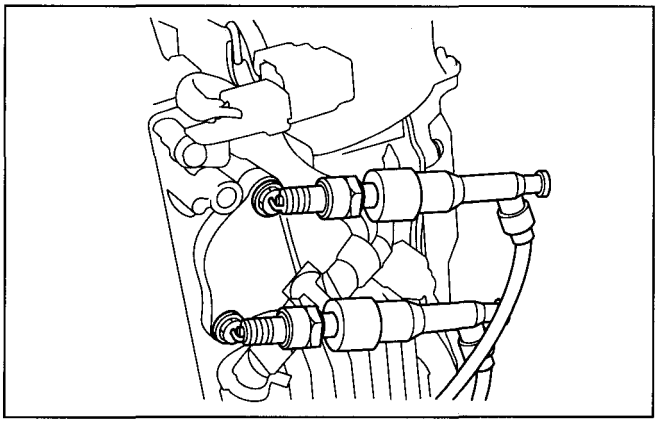
8. Remove the ignition control module and check for resistance between the terminals (P. 16-19).

Abnormal → Replace the ignition control module.

Normal

Check the wire harness for short or open circuit. Replace or repair the wire harness.

SPARK TEST



1) Remove the engine cover. Drain the gasoline from the carburetor.

⚠ WARNING

Gasoline is highly flammable and explosive. If ignited, gasoline can burn you severely.
- **Be sure there is no spilled fuel near the engine.**
- **Place the spark plug away from the spark plug hole. Unburned gas can ignite if it is left in the cylinder.**
- **Loosen the carburetor drain screw to drain the carburetor thoroughly. Pull the recoil starter several times to release the unburned gas from the cylinder before testing the spark plug.**

2) Remove the spark plug caps and spark plugs.

3) Pull the recoil starter several times to release the unburned gas from the cylinders.

4) Attach the removed spark plugs to the plug caps.

5) Set the ignition switch to the "ON" position (Remote control type only) and make sure that the emergency stop switch clip is engaged properly. Ground the negative (–) electrode (i.e. threaded part) of each spark plug against the thermostat cover bolt and pull the recoil starter rope to check whether sparks jump across the electrodes.

6) Remove the spark plugs from the spark plug caps and install the spark plugs to the other cylinder spark plug cap and check spark for the other cylinder.

- **Engine Does Not Stop With The Ignition Switch Turned to OFF Position or Emergency Stop Switch Actuated.**

1. Check the ignition switch (Remote control type) (P. 14-10). → Abnormal → Replace the ignition switch.

Normal ↓

2. Check the emergency stop switch (P. 14-10 or 15-7). → Abnormal → Replace the emergency stop switch.

Normal ↓

Check the wire harness open circuit at the Black/red wire.

c. ELECTRIC STARTER SYSTEM

• Starter Motor Will Not Turn

1. Check the fuse. — Burnt out → Replace the fuse.
   - Good ↓
2. Check the battery. — Abnormal → • Replace or charge the battery. • Connect the battery terminals securely or remove the corrosion.
   - Normal ↓
3. Check the neutral switch (P. 16-20). — Abnormal → Replace the neutral switch.
   - Normal ↓
4. Check the ignition switch (Remote control type) (P. 14-10) or starter switch (tiller handle type) (P. 15-6). — Abnormal → Replace the ignition switch or starter switch.
   - Normal ↓
5. Check the starter magnetic switch (P. 16-5). — Abnormal → Replace the starter magnetic switch.
   - Normal ↓
6. Check the starter motor. — Abnormal → Repair or replace the starter motor.
   - Normal ↓
7. Check the regulator/rectifier (P. 16-30). — Abnormal → Replace the regulator/rectifier.
   - Normal ↓

Replace or repair the wire harness.

• Starter Motor Turns but Engine Does Not Turn.

1. Check the pinion gear and ring gear for engagement. — No good → • Check the return spring for fatigue. • Check the pinion gear for smooth movement. • Correct the pinion gear and ring gear engagement or replace.
   - Good ↓

Check or replace the overrunning clutch.

- **Starter Motor and Engine Turn Slowly.**

1. Check the battery.
   - Abnormal → • Replace or charge the battery. • Connect the battery terminals securely or remove the corrosion.
   - Normal ↓
2. Check the engine oil viscosity.
   - No good → Replace the engine oil.
   - Good ↓
3. Connect the battery to the starter motor directly and check whether the starter motor turns.
   - Turns normally → Replace the starter magnetic switch.
   - Does not turn ↓

Replace or overhaul the starter motor.
- Faulty brush holder or armature.

d. CHARGING SYSTEM

- **Battery Under Charged**

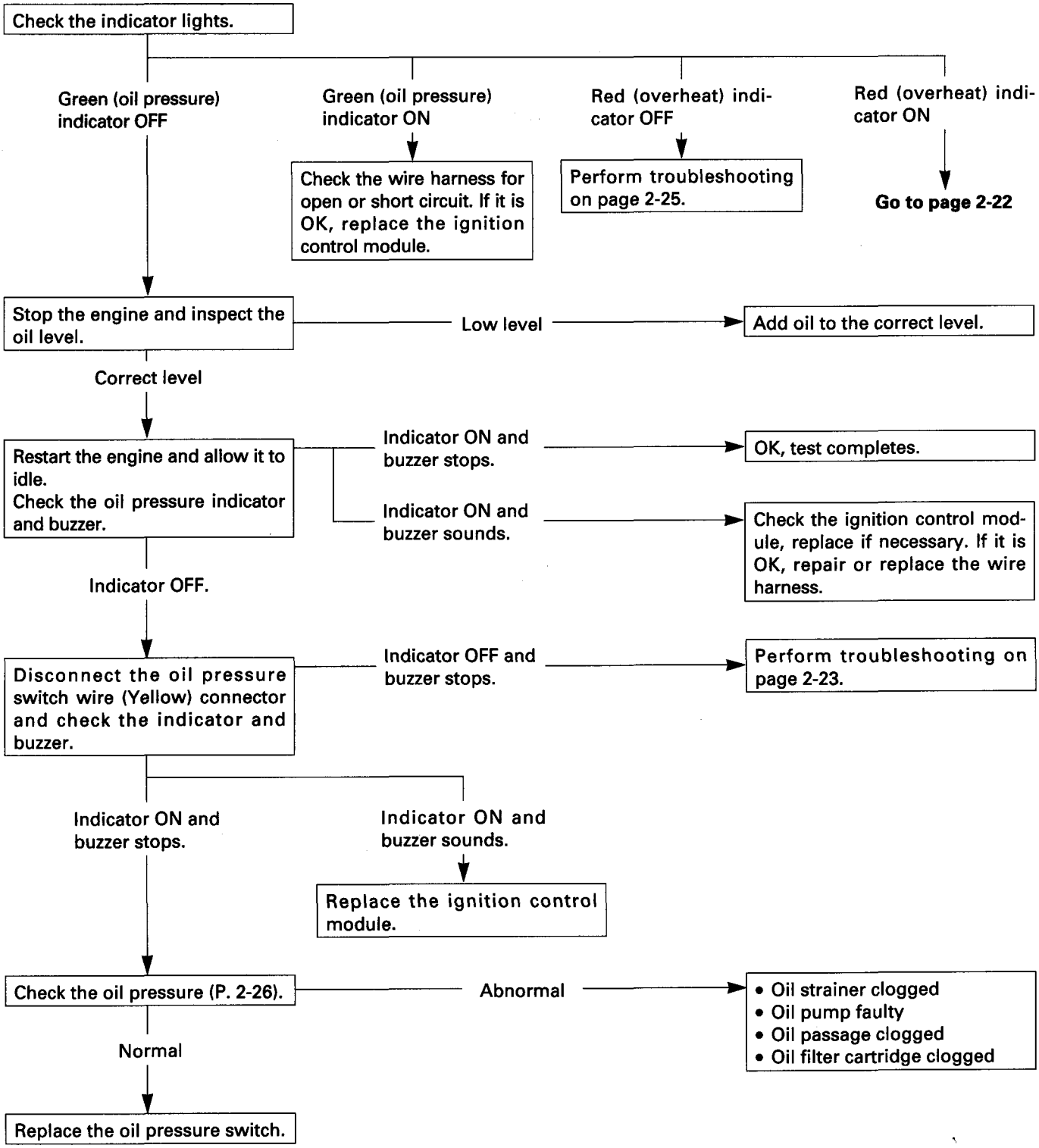
1. Check the battery condition and cable connection.
   - Abnormal → • Replace or charge the battery. • Connect the battery terminals securely or remove the corrosion.
   - Normal ↓
2. Check the fuse.
   - Burnt out → Replace the fuse.
   - Good ↓
3. Check the charge coil (P. 9-4, 5).
   - Abnormal → Replace the charge coil.
   - Normal ↓
4. Check the regulator/rectifier (P. 16-30).
   - Abnormal → Replace the regulator/rectifier.
   - Normal ↓

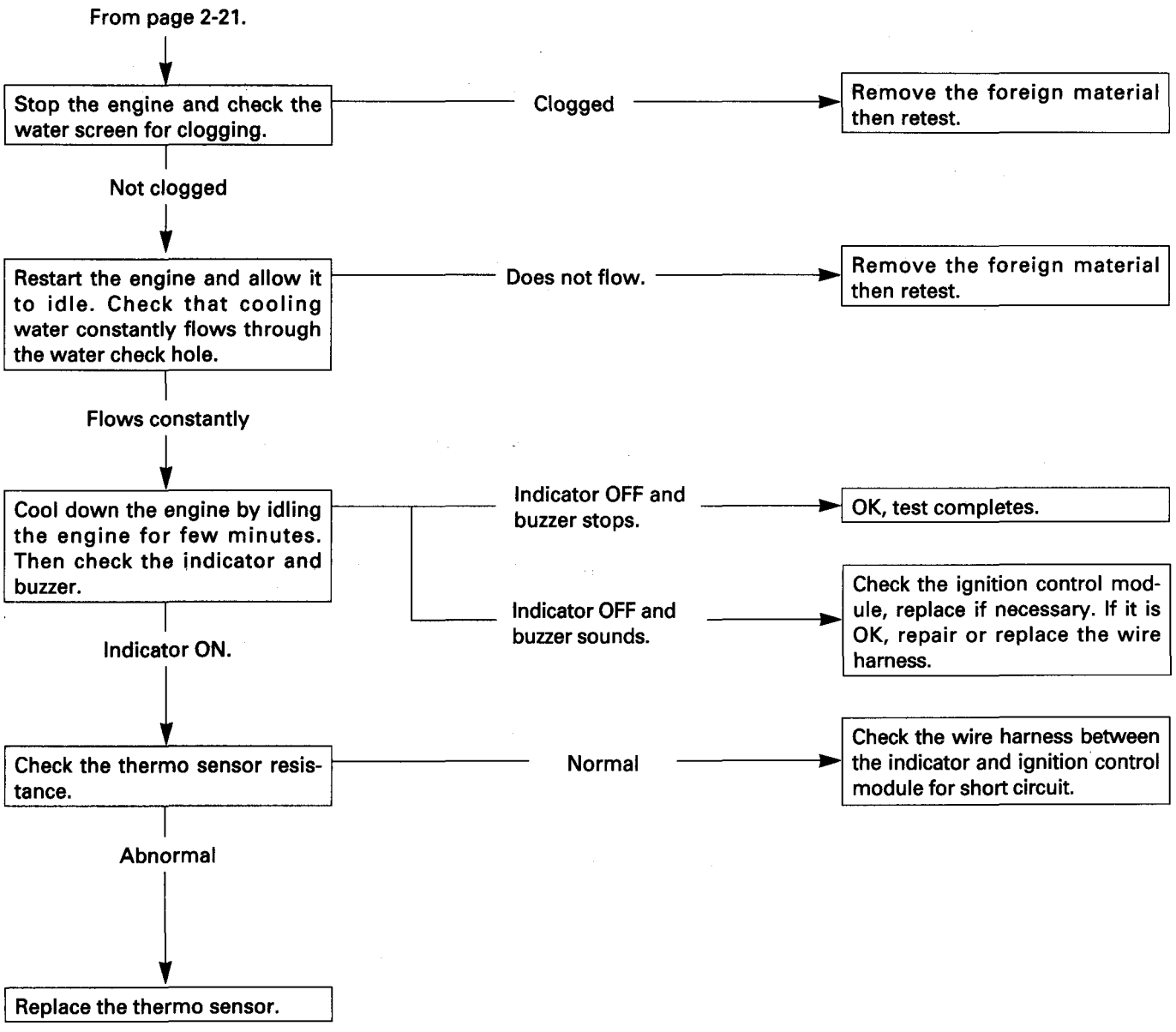
Replace or repair the wire harness.

e. ALERT SYSTEM

These outboard motors are equipped with an alert system which protects the engine by controlling the engine speed in the ignition control module. When trouble occurs, the system slows down the engine speed gradually. The system is provided with indicator light and buzzer sound (remote control type only) to indicate the cause of trouble.

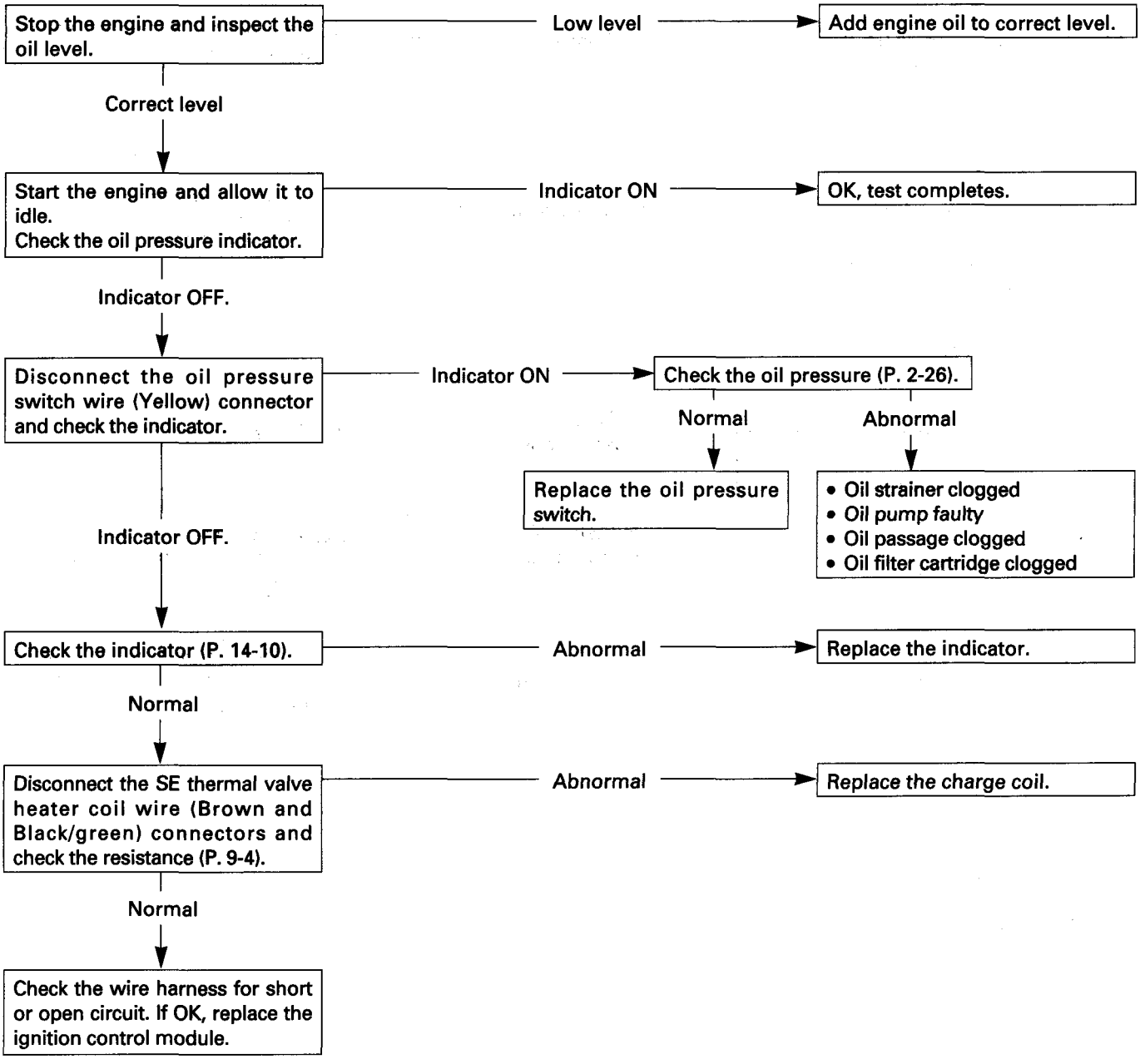
• Warning Buzzer Sounds (Remote Control Type)



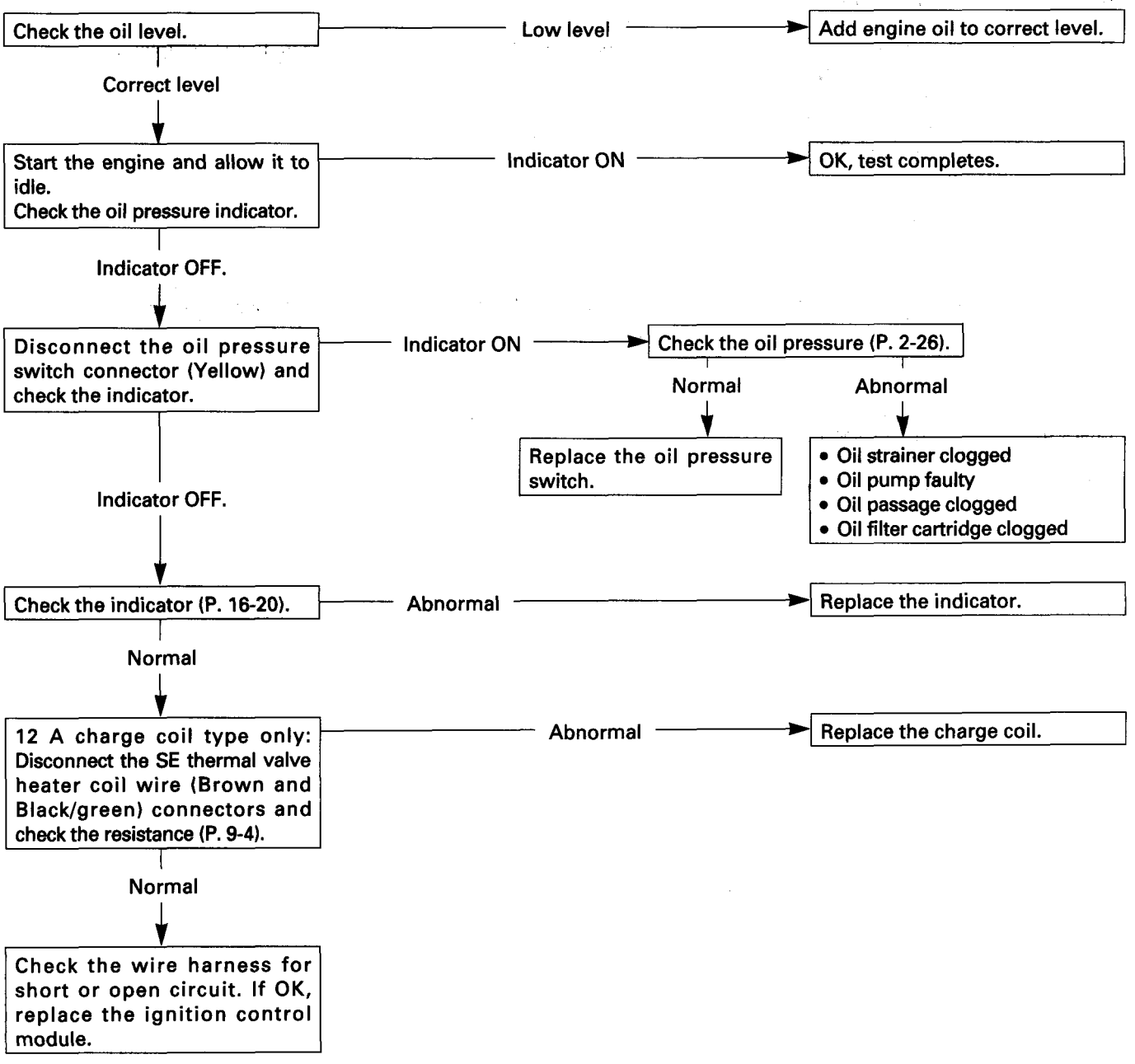

From page 2-21.
Stop the engine and check the water screen for clogging.
Clogged
Remove the foreign material then retest.
Not clogged
Restart the engine and allow it to idle. Check that cooling water constantly flows through the water check hole.
Does not flow.
Remove the foreign material then retest.
Flows constantly
Cool down the engine by idling the engine for few minutes. Then check the indicator and buzzer.
Indicator OFF and buzzer stops.
OK, test completes.
Indicator OFF and buzzer sounds.
Check the ignition control module, replace if necessary. If it is OK, repair or replace the wire harness.
Indicator ON.
Check the thermo sensor resistance.
Normal
Check the wire harness between the indicator and ignition control module for short circuit.
Abnormal
Replace the thermo sensor.

• Oil Pressure Indicator (Green) Test

REMOTE CONTROL TYPE

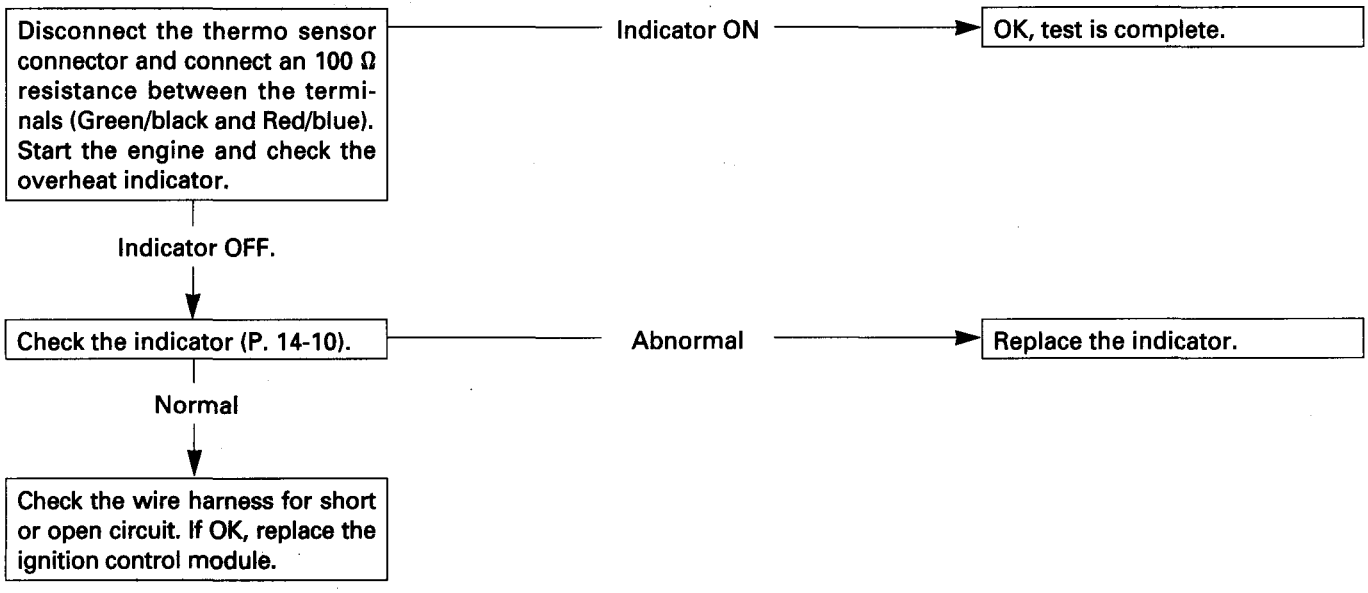


TILLER HANDLE TYPE



- **Overheat Indicator (Red) Test**

REMOTE CONTROL TYPE



OIL PRESSURE TEST

1) Remove the engine cover and check the engine oil level (P. 3-2).

2) Disconnect the oil pressure switch wire connector.

3) Install a pressure gauge attachment (special tool) on an oil pressure gauge that has a scale calibrated to a maximum of 196 – 490 kPa (2 – 5 kgf/cm², 28 – 71 psi) to the outboard motor.

CAUTION:

Tighten the adapter to the specified torque. Do not overtighten the adapter to avoid damaging the threads of the crankcase.

TORQUE: 8 N·m (0.8 kgf·m, 5.8 lbf·ft)

4) Run the outboard motor in an outboard test tank with the water at least 4 inches above the antiventilation plate. Allow the engine to warm up to normal operating temperature (engine oil temperature 80°C/176°F).

⚠ WARNING

Engine exhaust contains poisonous carbon monoxide gas that can cause unconsciousness and death.
- **If the engine must be running, make sure the area is well ventilated.**

5) Measure the oil pressure.

Standard oil pressure	147 kPa (1.5 kgf/cm², 21.3 psi) at engine speed 900 ± 50 min⁻¹ (rpm) in neutral

If the oil pressure is less than the specification, check the oil pump (section 10) for wear, or oil filter screen and oil passage for clog.

6) Remove the oil pressure gauge and attachment.

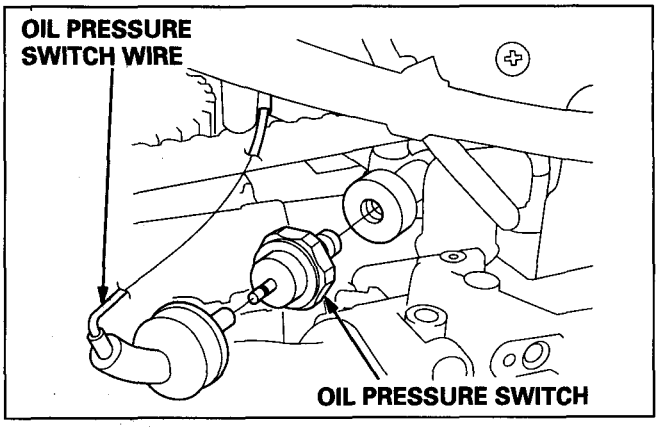
7) Protect the threads by applying sealing tape 1.5 to 2 turns or applying the liquide sealant, and tighten the oil pressure switch to the specified torque using a torque wrench.

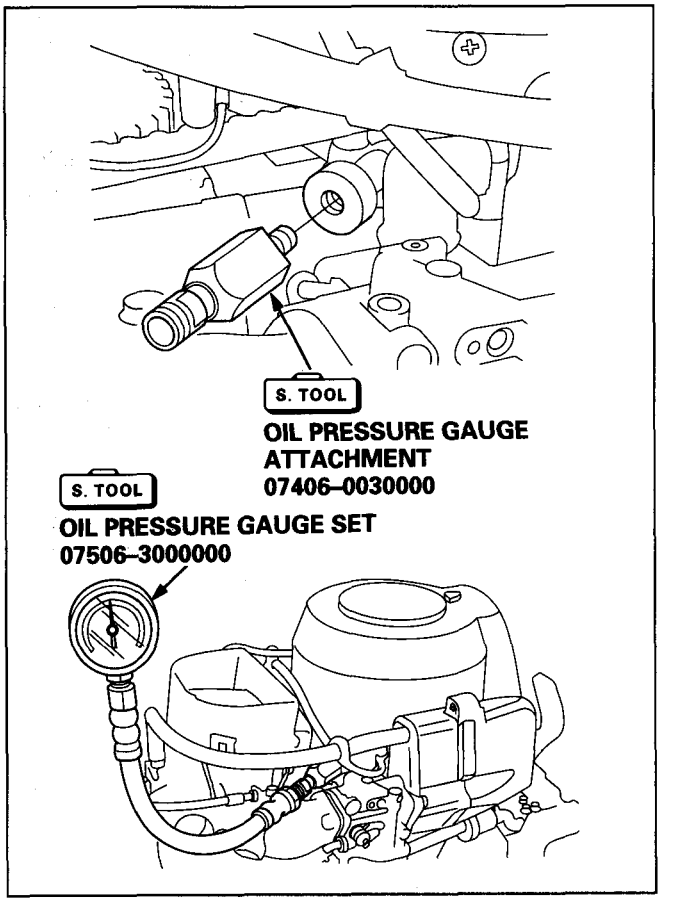
CAUTION:

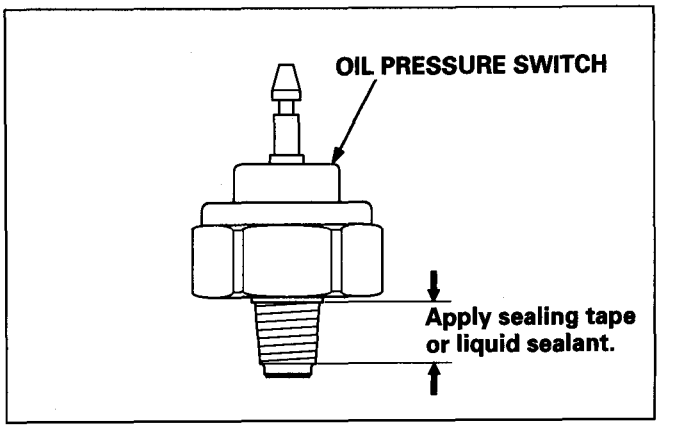
Tighten the oil pressure switch to the specified torque. Do not overtighten the adapter to avoid damaging the threads of the crankcase.

TORQUE: 8 N·m (0.8 kgf·m, 5.8 lbf·ft)

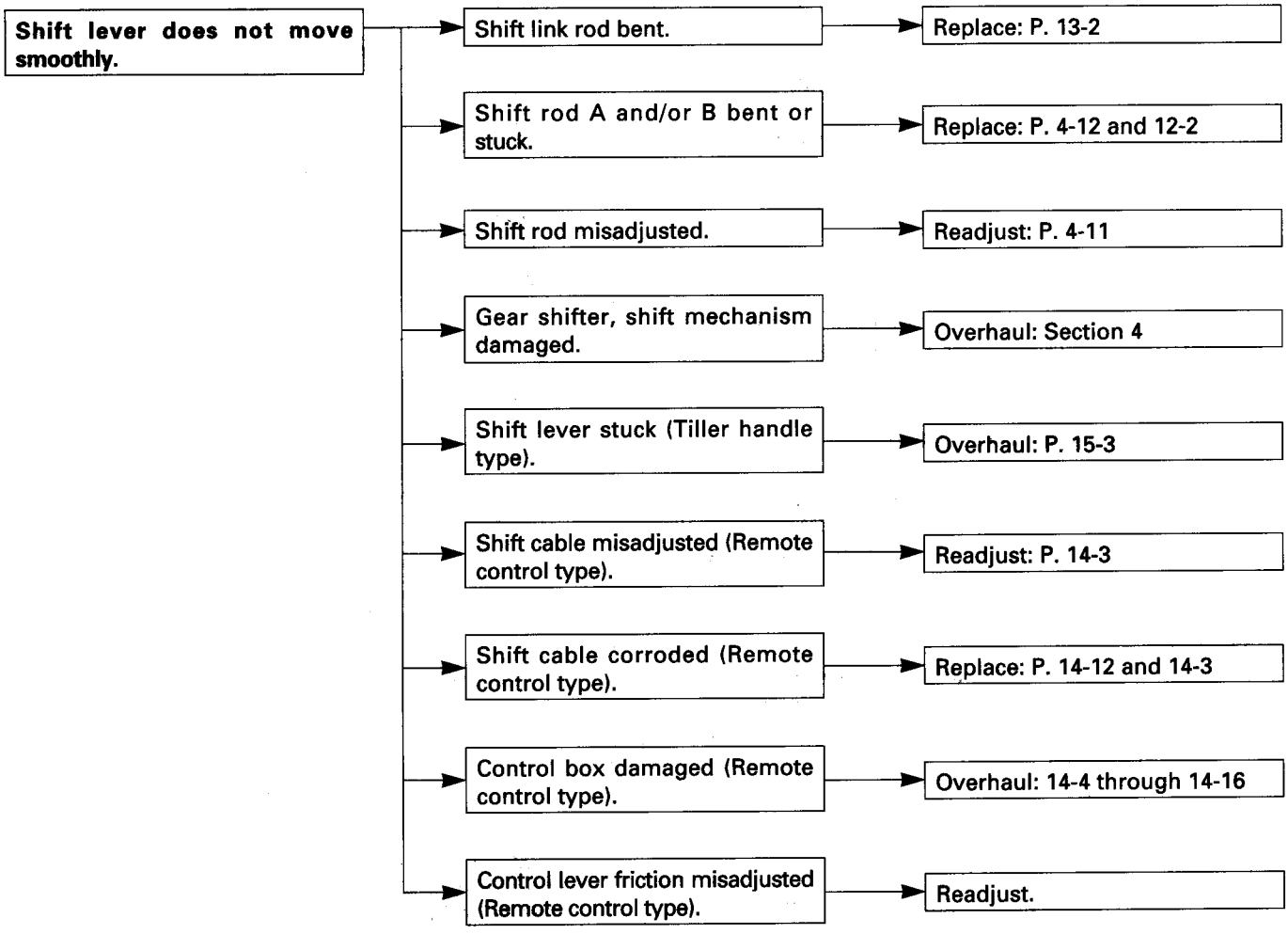
8) Connect the oil pressure switch wire and install the engine cover.







f. SHIFT LEVER



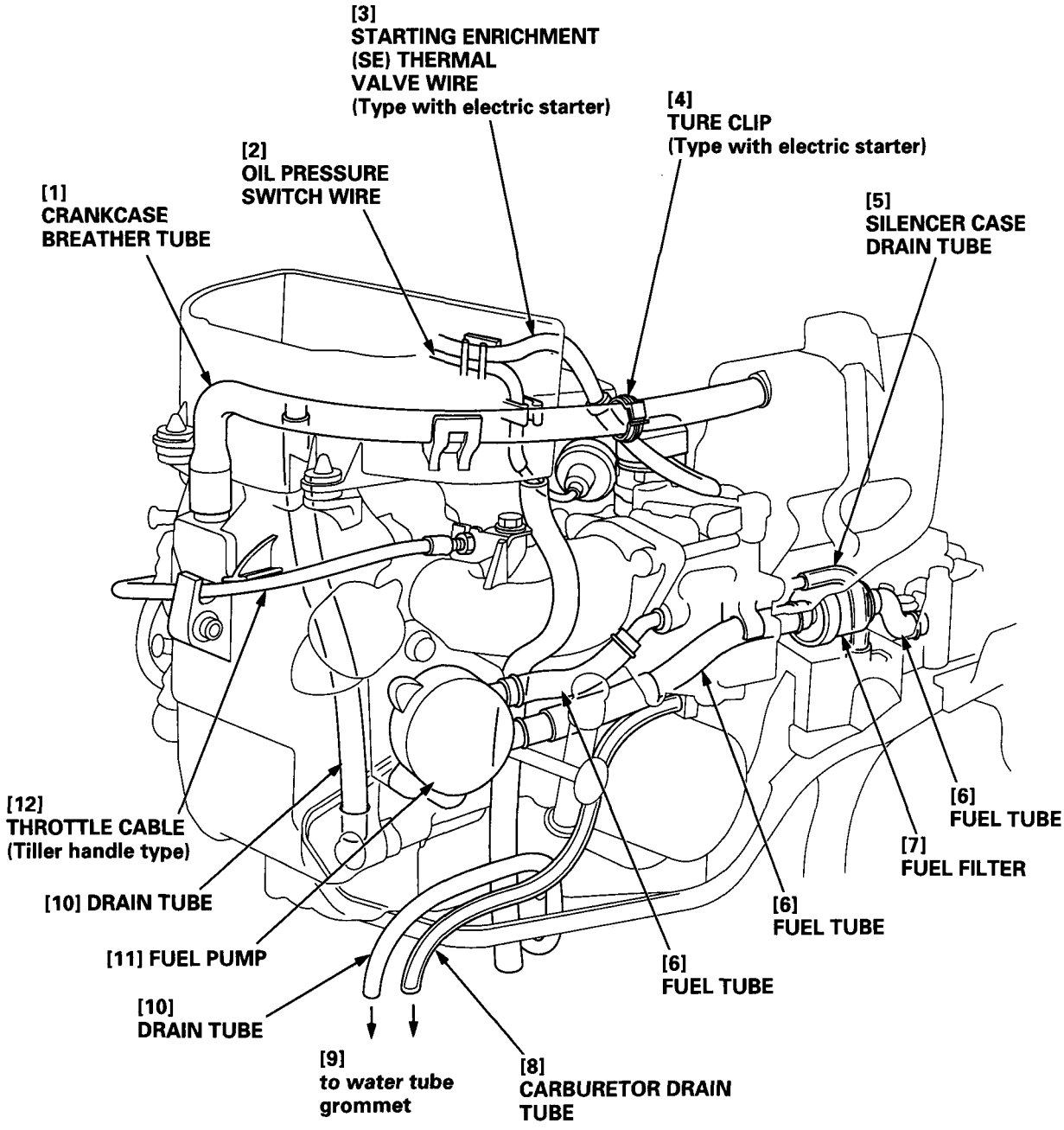
g. STEERING

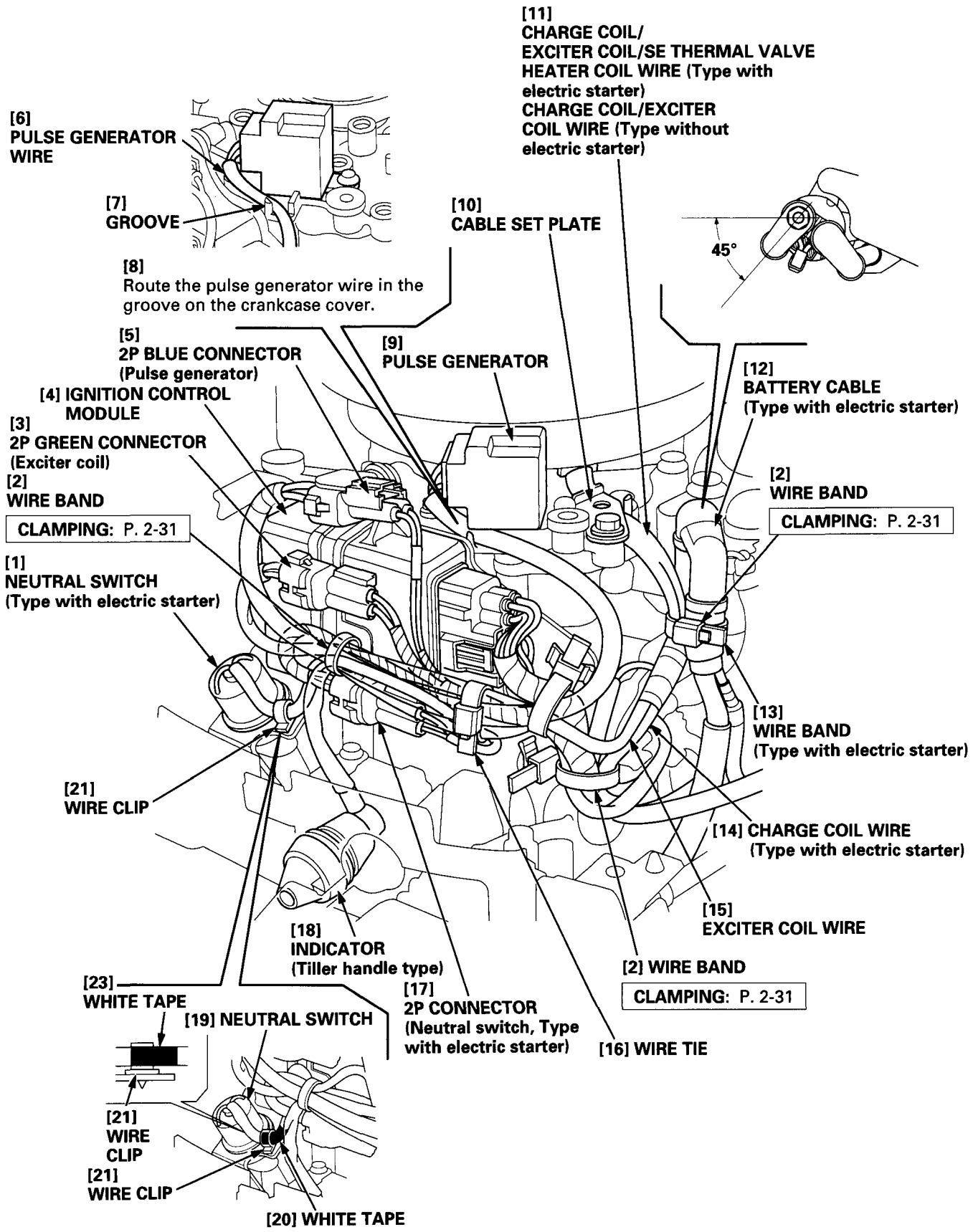
Hard Steering	Steering cable damaged or stuck (Remote control type).	Replace.
	Steering cable misadjusted (Remote control type).	Readjust.
	Steering plate and/or rod bent or damaged (Remote control type).	Replace: P. 14-1
	Steering friction lever misadjusted (Tiller handle type).	Adjust: P. 12-5
	Friction lever and block damaged or corroded (Tiller handle type).	Overhaul: P. 12-4
	Mount frame out of grease.	Lubricate: P. 2-40
	Swivel case liner damaged.	Replace: P. 12-6
	Upper mount rubber damaged or mounting bolt loose.	Replace or tighten: P. 12-2

h. LOWER UNIT

Milky colored gear oil	Loose gear case mounting bolts.	Retighten the bolts.
	Damaged O-ring or water seal of the gear case.	Overhaul: Section 4
	Damaged vertical shaft water seal.	Replace: Section 4
	Damaged shift rod seal and/or scratched shift rod.	Replace: Section 4

9. CABLE & HARNESS ROUTING

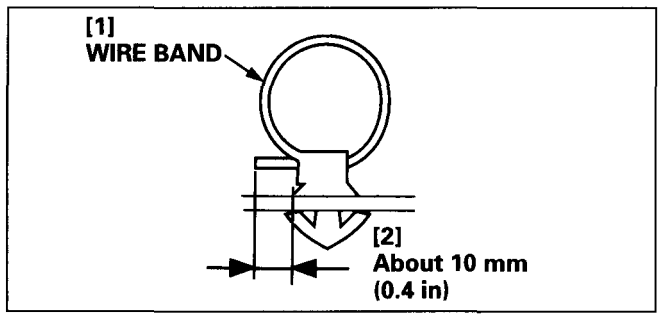


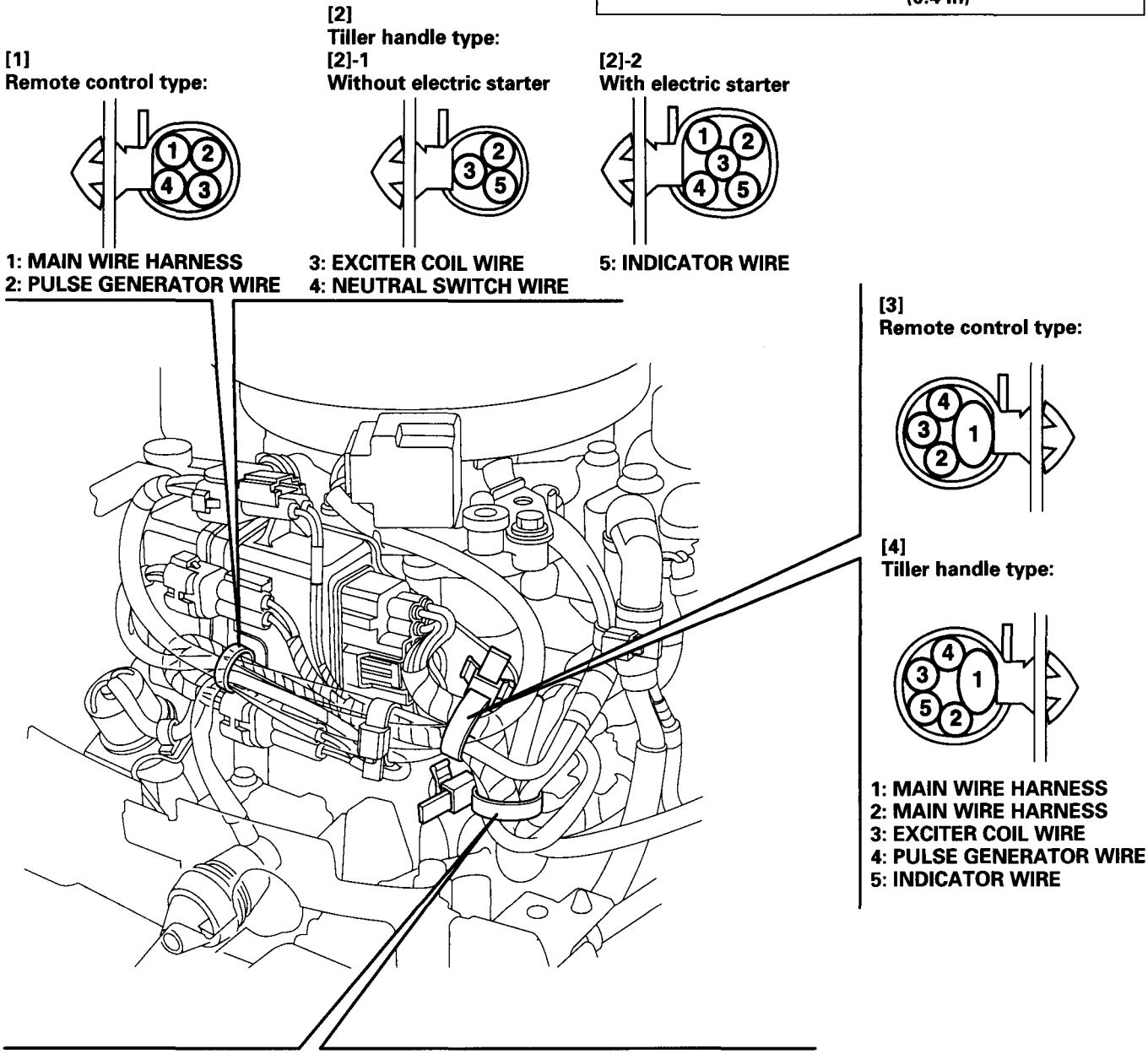


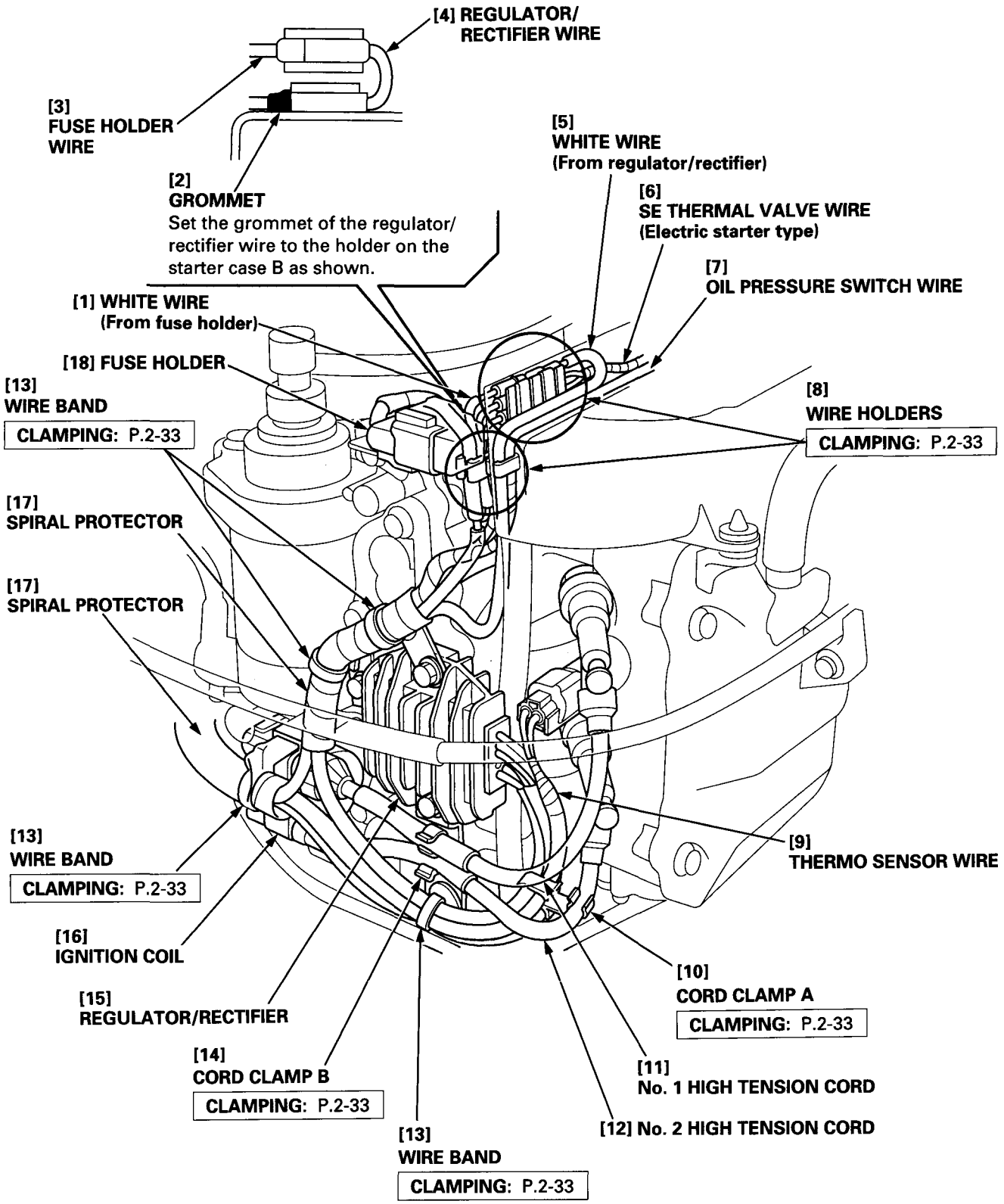
[22] Clamp the neutral switch wire with the wire clip by aligning the edge of the white tape with the clip as shown.

• WIRE BAND CLAMPING

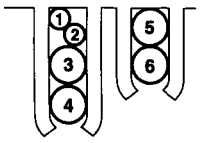
- Replace the wire band with new one, if it has been cut.
- After securing the wires with a new wire band, cut the end of the wire band so as to have the projected length about 10 mm (0.4 in).





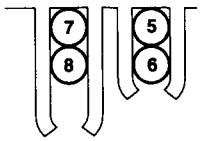

[4] REGULATOR/
RECTIFIER WIRE
[3]
FUSE HOLDER
WIRE
[2]
GROMMET
Set the grommet of the regulator/
rectifier wire to the holder on the
starter case B as shown.
[5]
WHITE WIRE
(From regulator/rectifier)
[6]
SE THERMAL VALVE WIRE
(Electric starter type)
[7]
OIL PRESSURE SWITCH WIRE
[1] WHITE WIRE
(From fuse holder)
[18] FUSE HOLDER
[13]
WIRE BAND
CLAMPING: P.2-33
[8]
WIRE HOLDERS
CLAMPING: P.2-33
[17]
SPIRAL PROTECTOR
[17]
SPIRAL PROTECTOR
[13]
WIRE BAND
CLAMPING: P.2-33
[9]
THERMO SENSOR WIRE
[16]
IGNITION COIL
[15]
REGULATOR/RECTIFIER
[14]
CORD CLAMP B
CLAMPING: P.2-33
[13]
WIRE BAND
CLAMPING: P.2-33
[10]
CORD CLAMP A
CLAMPING: P.2-33
[11]
No. 1 HIGH TENSION CORD
[12] No. 2 HIGH TENSION CORD

[1]
With 12A charge coil:

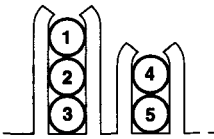


1: SE THERMAL VALVE WIRE
2: SE THERMAL VALVE WIRE
3: STARTER WIRE (to regulator/rectifier)
4: STARTER WIRE (to fuse holder)
5: OIL PRESSURE SWITCH WIRE
6: REGULATOR/ RECTIFIER WIRE
7: CHARGE RECEPTACLE WIRE
8: CHARGE RECEPTACLE WIRE (to fuse holder)

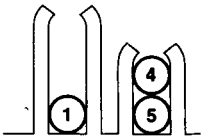
[2]
With 6A charge coil:



[3] With 12A charge coil:

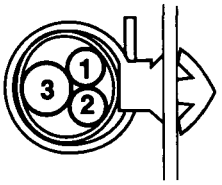


[4] With 6A charge coil:

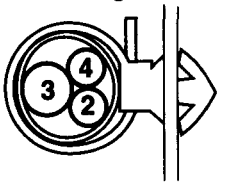


1: WHITE WIRE CONNECTORS
2: BROWN/WHITE WIRE CONNECTORS
3: BLACK/GREEN WIRE CONNECTORS
4: REGULATOR/RECTIFIER WIRE
5: OIL PRESSURE SWITCH WIRE

[9]
With 12A charge coil:

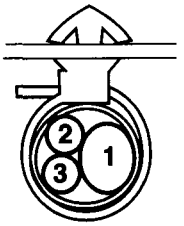


[10]
With 6A charge coil:

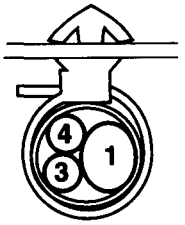


1: STARTER CABLE (fuse line)
2: REGULATOR/RECTIFIER WIRE
3: MAIN WIRE HARNESS
4: CHARGE RECEPTACLE WIRE

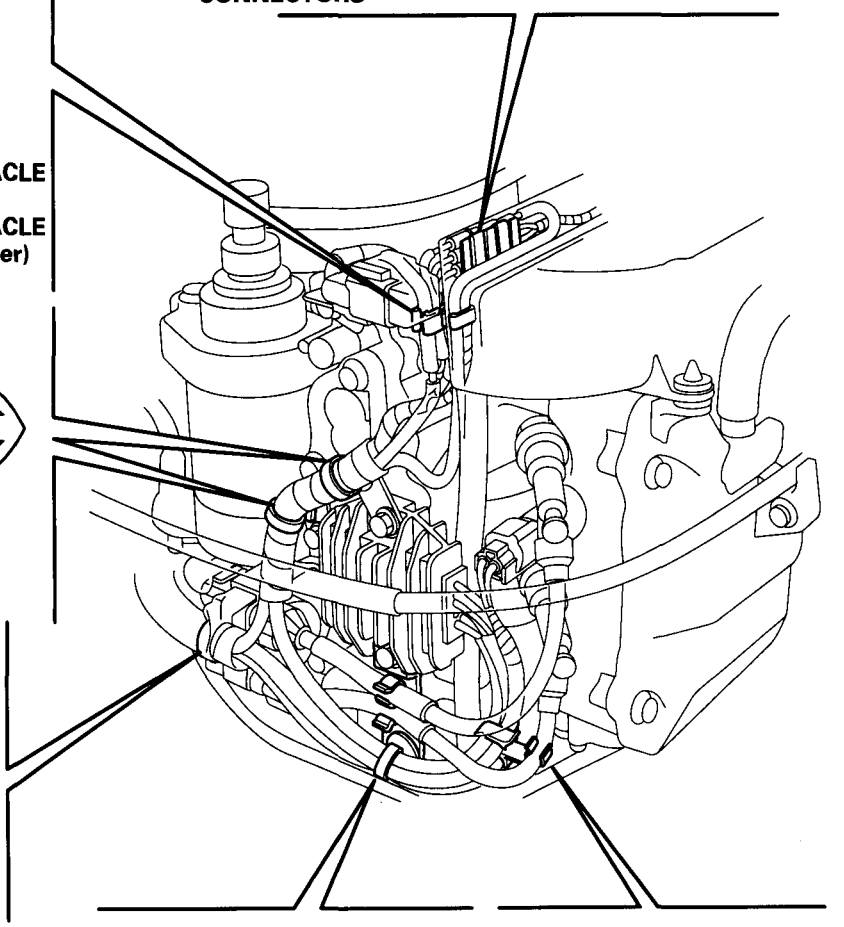
[7]
With 12A charge coil:

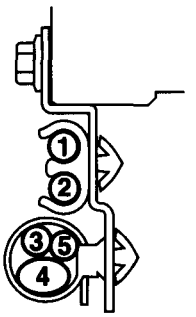


[8]
With 6A charge coil:

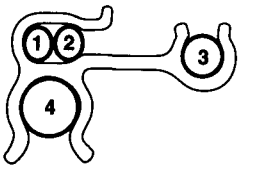


1: MAIN WIRE HARNESS
2: STARTER CABLE (fuse line)
3: REGULATOR/RECTIFIER WIRE
4: CHARGE RECEPTACLE WIRE

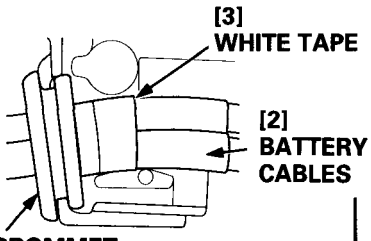




[6]
1: No. 1 HIGH TENSION CORD
2: No. 2 HIGH TENSION CORD
3: REGULATOR/RECTIFIER WIRE (fuse line)
4: REGULATOR/RECTIFIER WIRE
5: THERMO SENSOR WIRE



[5]
1: REGULATOR/RECTIFIER WIRE (fuse line)
2: THERMO SENSOR WIRE
3: No. 2 HIGH TENSION CORD
4: REGULATOR/RECTIFIER WIRE



[3]
WHITE TAPE

[2]
BATTERY
CABLES

[1]
OIL CASE GROMMET
Align the inside of the grommet with the white tape on the battery cables, and install them onto the oil case.

[5]
WIRE BAND

For wiring and clamping, see page:
Remote control type: P. 2-35
Tiller handle type:
Type with 12 A charge coil: P. 2-36
Type with 6 A charge coil: P. 2-37

[6]
BATTERY CABLE
(Type with electric starter)

[4]
CONNECTOR
BRACKET B

[7] STARTER MAGNETIC
SWITCH
(Type with electric starter)

[8]
WIRE BAND
CLAMPING: P.2-33

[13] BATTERY
GROUND CABLE
(Type with electric starter)

[9]
IGNITION COIL

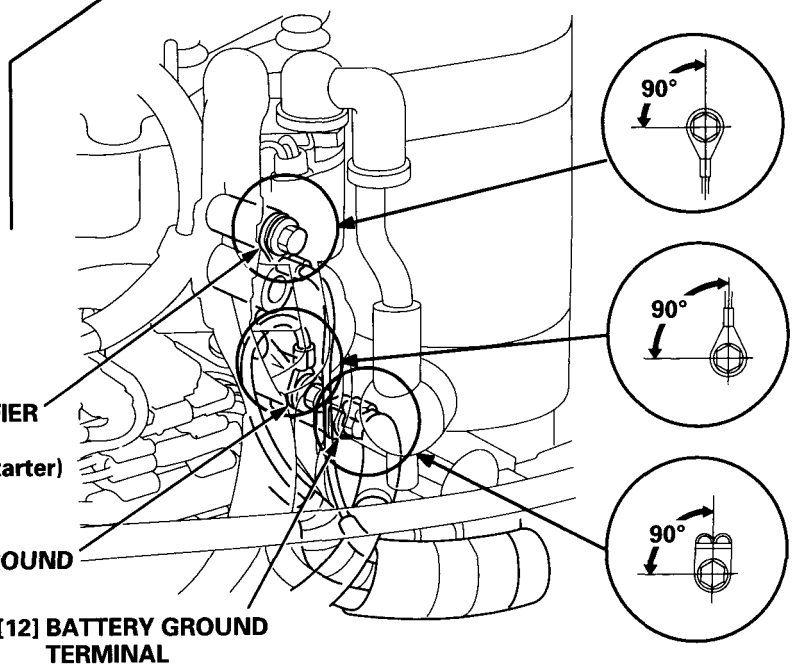
[14] BLACK/
BLUE

[18]
BLACK MARK

[17]
GREEN MARK

[15]
BLACK

[16]
IGNITION COIL
Connect the primary wires to the ignition coil as shown.



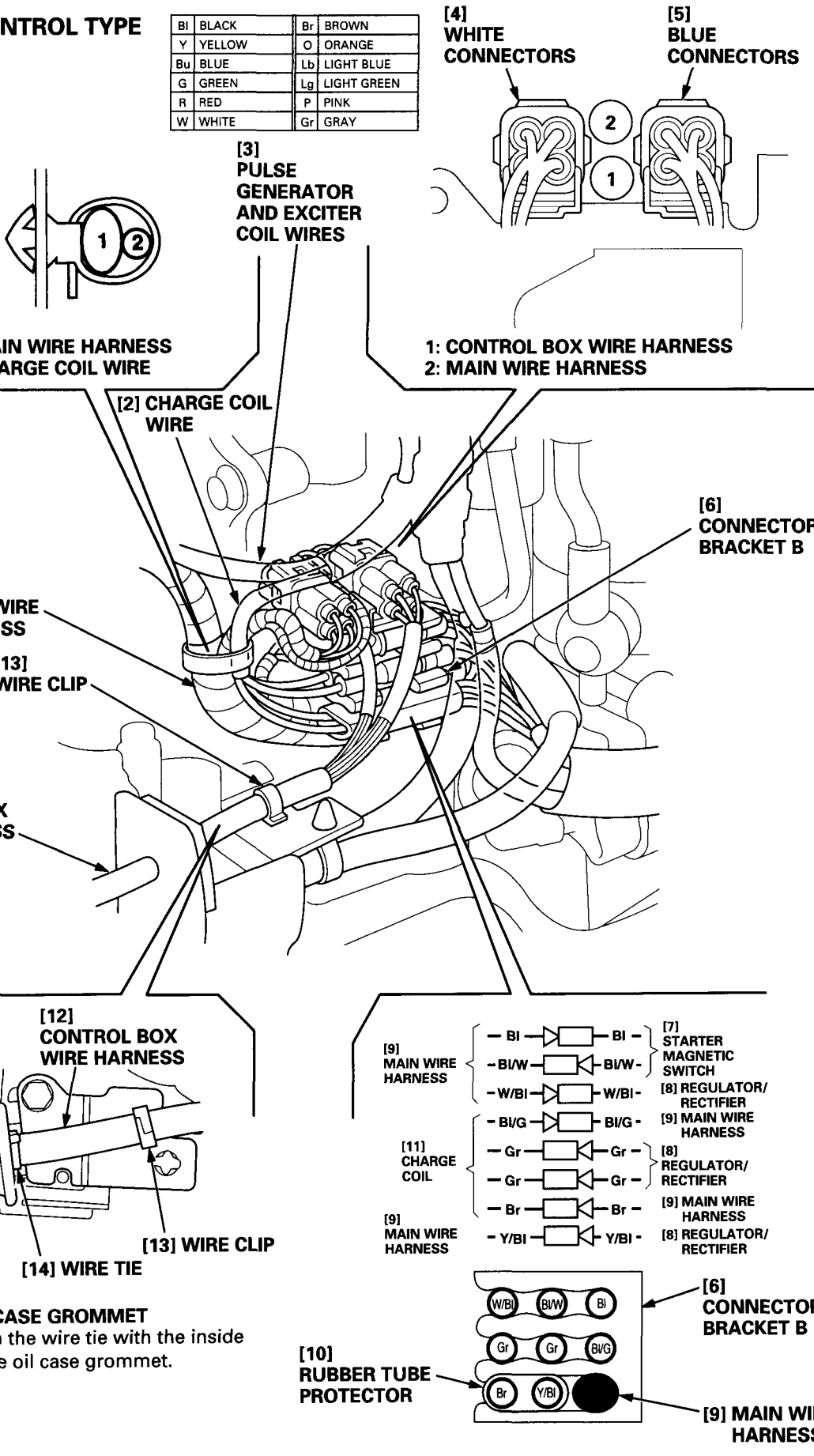
[10] REGULATOR/RECTIFIER
GROUND TERMINAL
(Type with electric starter)

[11]
ENGINE GROUND
TERMINAL

[12] BATTERY GROUND
TERMINAL
(Type with electric starter)

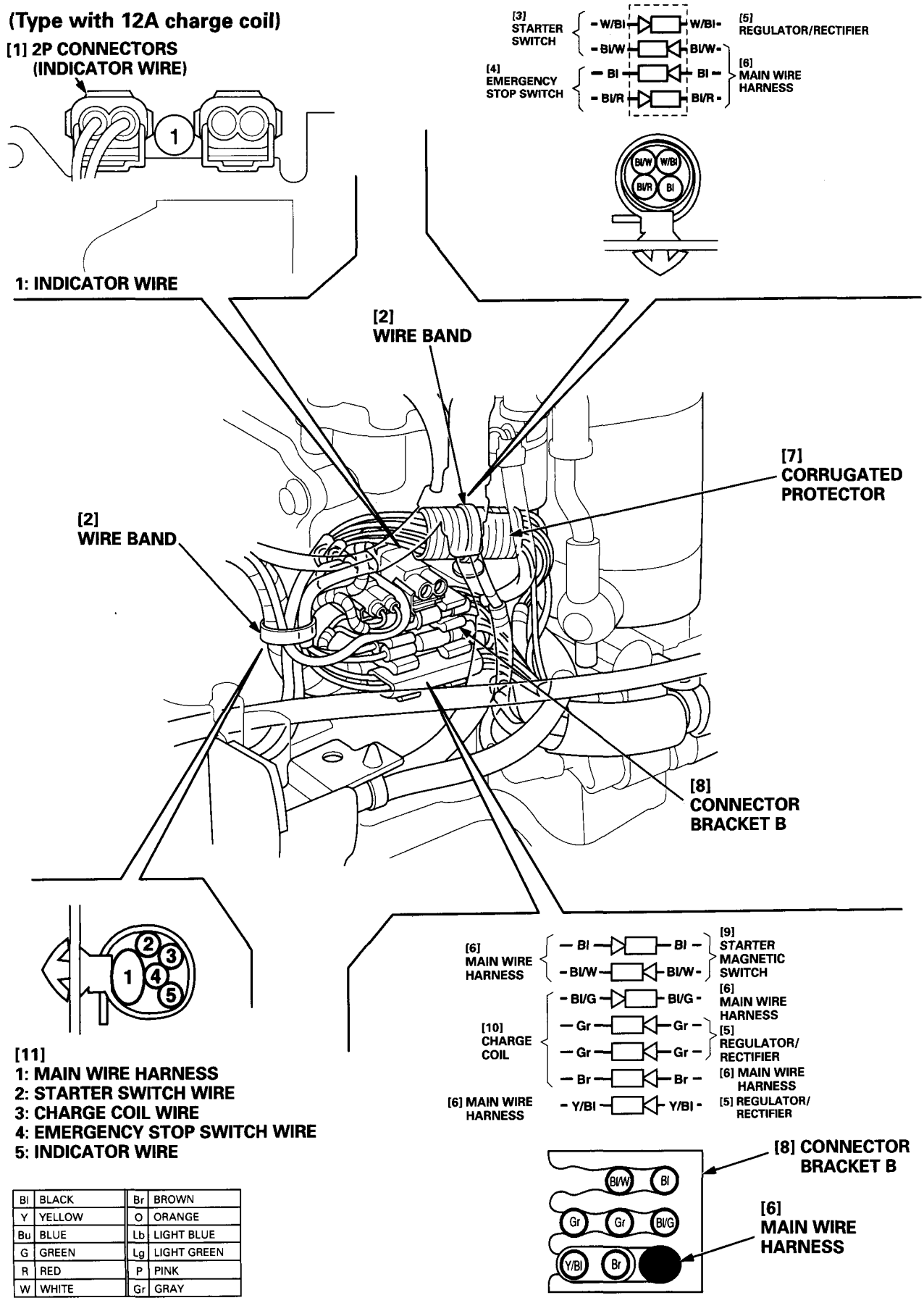
- **REMOTE CONTROL TYPE**

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**

(Type with 12A charge coil)

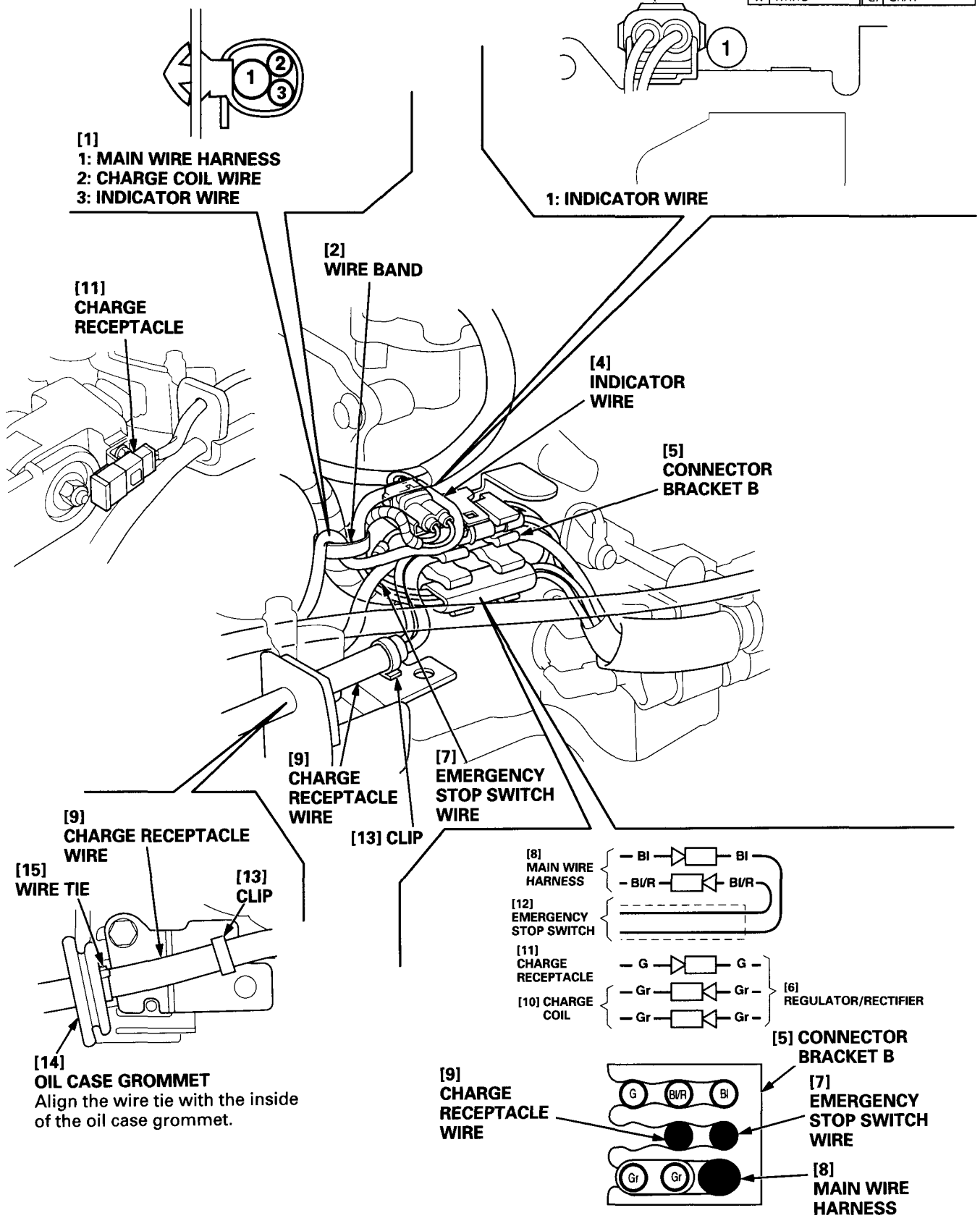


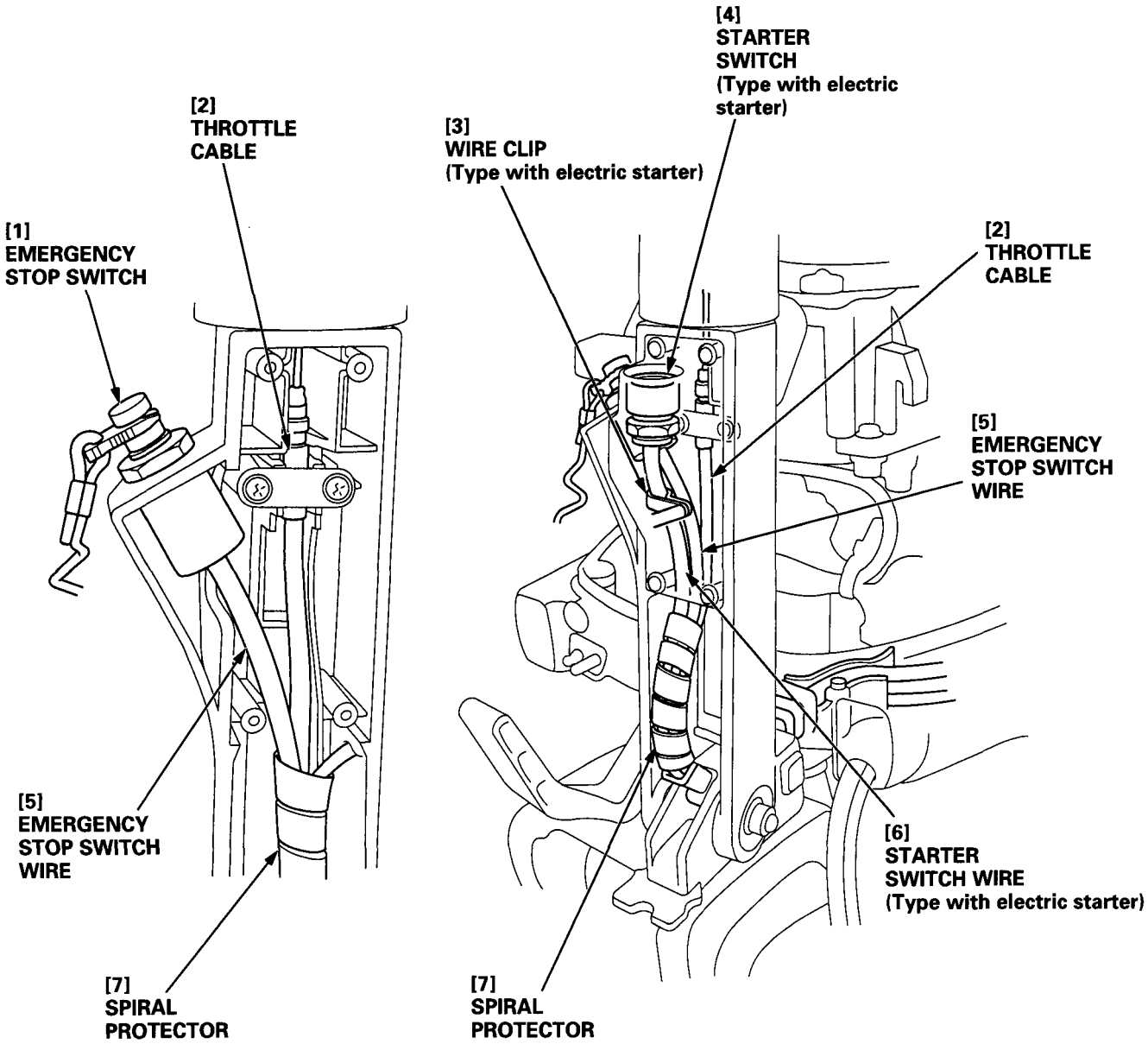
Bl	BLACK	Br	BROWN
Y	YELLOW	O	ORANGE
Bu	BLUE	Lb	LIGHT BLUE
G	GREEN	Lg	LIGHT GREEN
R	RED	P	PINK
W	WHITE	Gr	GRAY

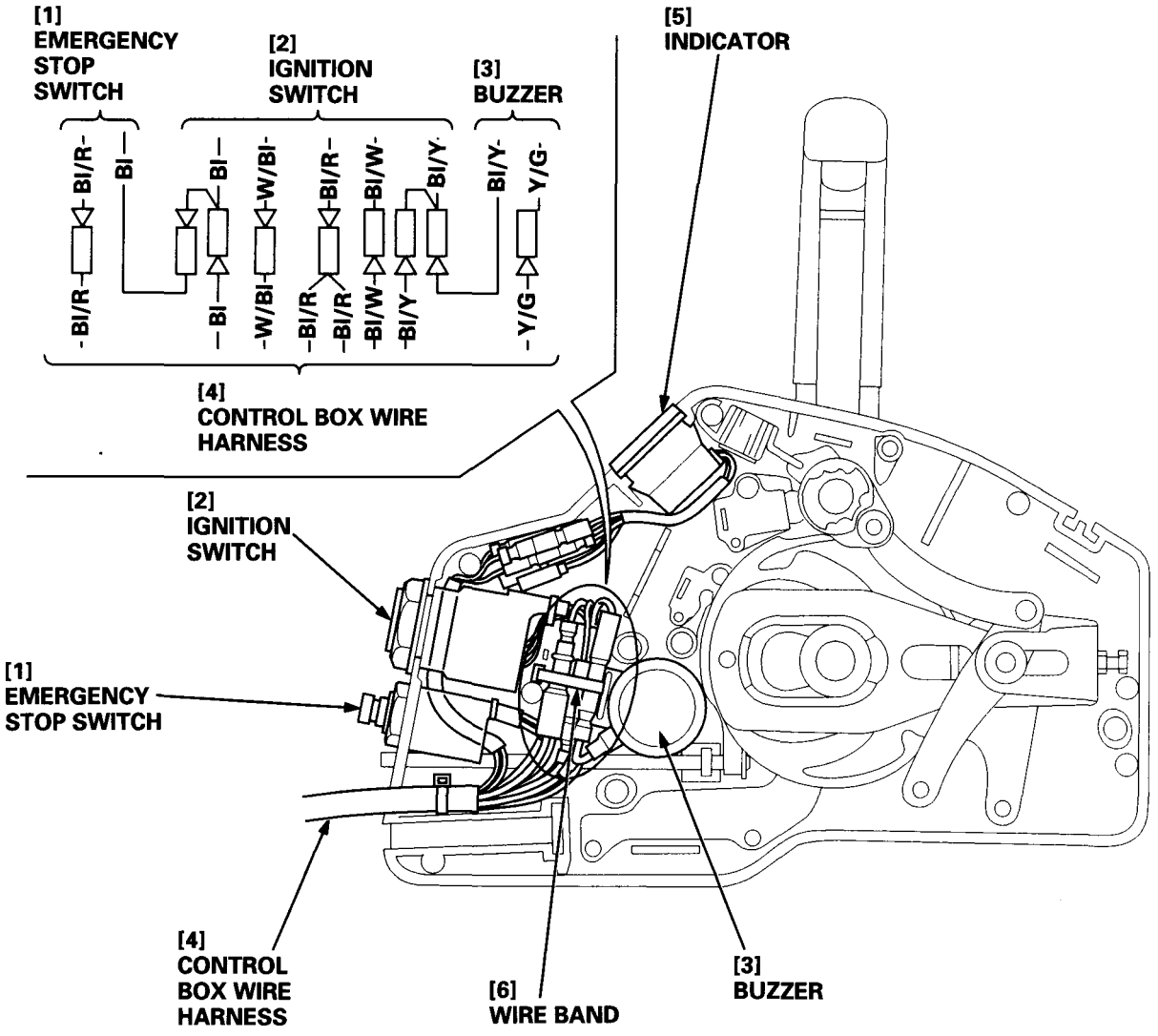
- **TILLER HANDLE TYPE**

(Type with 6A charge coil)

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




[1]
EMERGENCY
STOP SWITCH
[2]
THROTTLE
CABLE
[5]
EMERGENCY
STOP SWITCH
WIRE
[7]
SPIRAL
PROTECTOR
[4]
STARTER
SWITCH
(Type with electric
starter)
[3]
WIRE CLIP
(Type with electric starter)
[2]
THROTTLE
CABLE
[5]
EMERGENCY
STOP SWITCH
WIRE
[6]
STARTER
SWITCH WIRE
(Type with electric starter)
[7]
SPIRAL
PROTECTOR

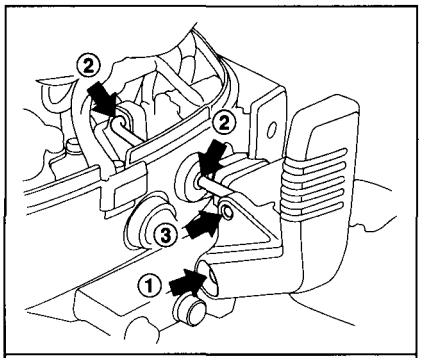


Bl	BLACK	Br	BROWN
Y	YELLOW	O	ORANGE
Bu	BLUE	Lb	LIGHT BLUE
G	GREEN	Lg	LIGHT GREEN
R	RED	P	PINK
W	WHITE	Gr	GRAY

10. LUBRICATION POINTS

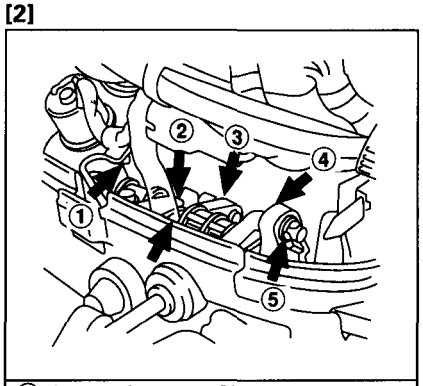
Apply marine anti-corrosion grease to the parts shown below.

[1]

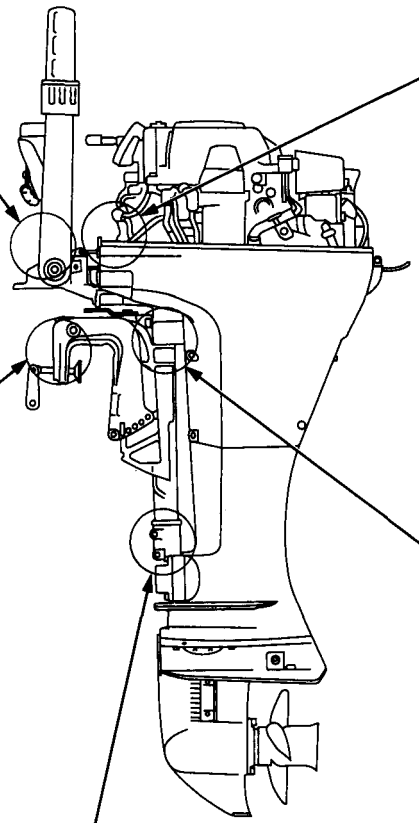


① SHIFT LEVER PIVOT BOLT
② OIL CASE GROMMET
③ LINK ROD

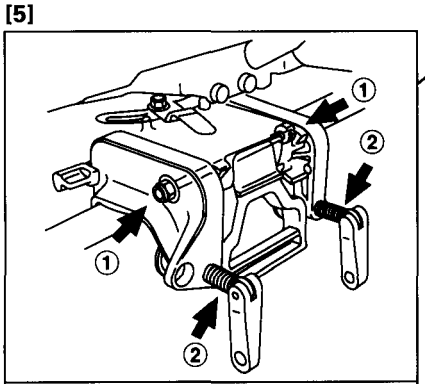
[2]



① SHIFT SHAFT (SWITCH CAM)
② DETENT SPRING (DETENT POINT)
③ SHIFT ROD A (BEARING)
④ SHIFT SHAFT PLATE (BEARINGS)
⑤ LINK ROD (BEARING)

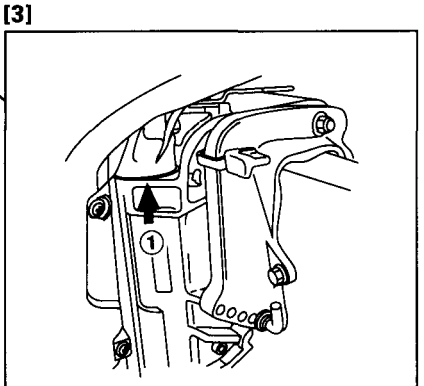


[5]



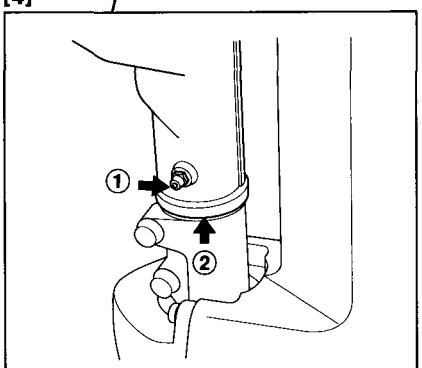
① TILTING BOLT (BEARING POINT)
② CLAMP SCREW

[3]



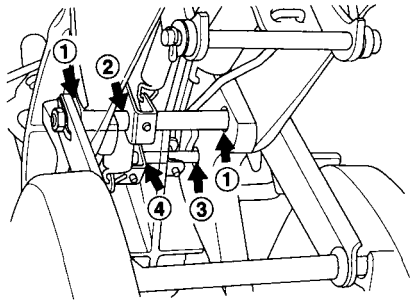
① MOUNT FRAME (THRUST WASHER)

[4]

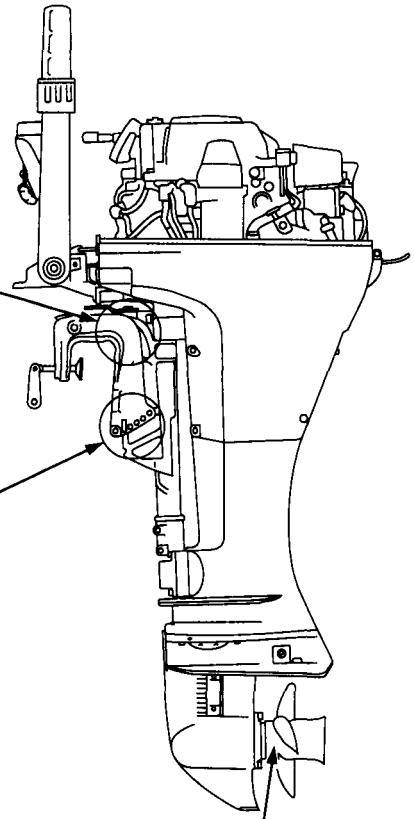


① SWIVEL CASE LINER (GREASE FITTING)
② LOWER RUBBER MOTOR MOUNT (SWIVEL COLLAR)

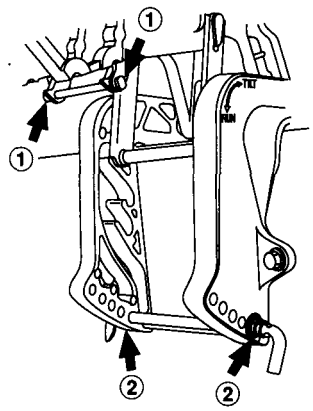
[1]



① TILT SHAFT
② TILT SHAFT BRACKET
③ TILT LEVER
④ RELEASE ROD BRACKET, TILT LEVER BRACKET

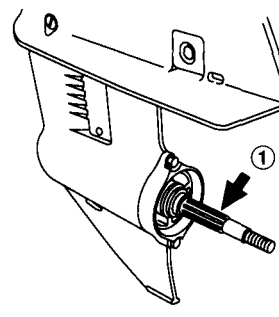


[2]



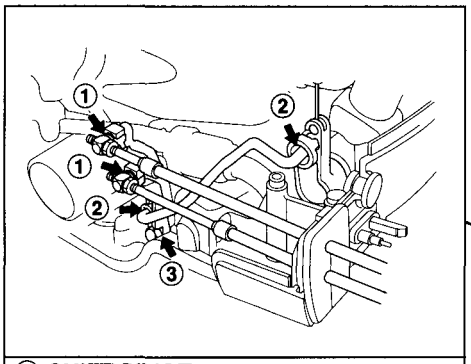
① REVERSE LOCK SHAFT
② ADJUSTING ROD

[3]

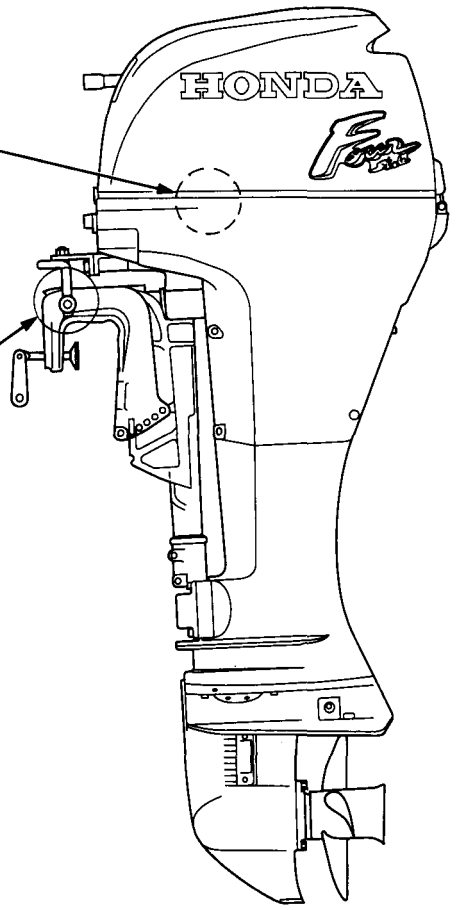


① PROPELLER SHAFT

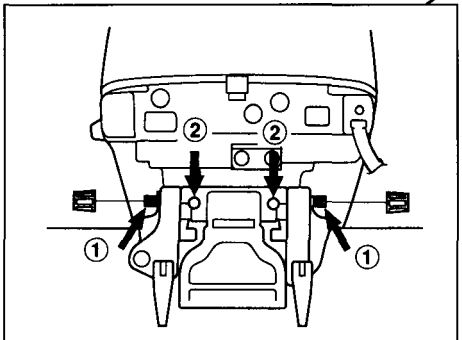
[1]



① SHIFT PIVOT
② SHIFT LINK ROD
③ SHIFT ARM



[2]



① TILTING SHAFT
(BEARING, THREAD)
② SWIVEL CASE
(GREASE FITTING)

1. MAINTENANCE SCHEDULE
2. ENGINE OIL
3. OIL FILTER CARTRIDGE
4. GEAR CASE OIL
5. SPARK PLUG
6. VALVE CLEARANCE
7. CARBURETOR
8. FUEL FILTER
9. FUEL TANK STRAINER
10. FUEL TUBES
11. THROTTLE LINKAGE
12. TIMING BELT
13. CRANKCASE BREATHER
14. EXHAUST EMISSION (BODENSEE TYPE ONLY)

1. MAINTENANCE SCHEDULE

REGULAR SERVICE PERIOD (2) Perform at every indicated month or operating hour interval, whichever comes first. / ITEM		Each use	First month or 20 Hrs	Every 6 months or 100 Hrs	Every Year or 200 Hrs	Refer to page
Engine oil	Check level	○				3-2
	Change		○	○		
Oil filter	Change				○	3-3
Gear case oil	Check level			○		3-5
	Change		○		○	
	Check for water contamination			○		
Starter rope	Check			○		—
Carburetor linkage	Check-Adjust		○	○		3-13
Valve clearance	Check-Adjust		○		○	3-7
Spark plugs	Check-Adjust			○		3-6
	Replace				○	
Propeller and cotter pin	Check	○				—
Anode	Check	○				—
Idle speed	Check-Adjust		○	○		3-10
Lubrication	Grease		○ (1)	○ (1)		2-40
Fuel tank and tank filter	Clean				○	3-12
Thermostat	Check				○	11-5
Fuel filter	Check			○		3-11
	Change				○	
Fuel line	Check	○	Every 2 years (Replace if necessary)			3-13
Bolts and nuts	Check-Retighten		○	○		—
Crankcase breather tube	Check				○	6-2

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

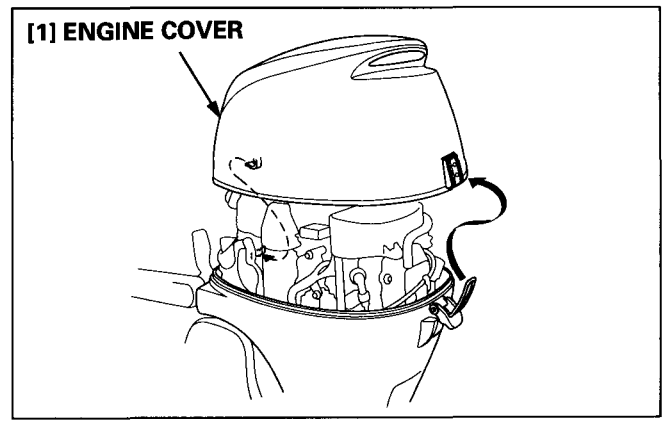
2. ENGINE OIL

• Oil Level Check

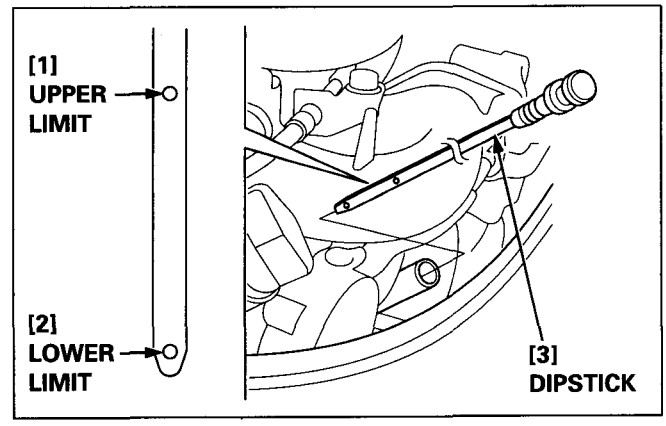
1) Run the outboard motor in an outboard test tank with the water at least 4 inches above the anti-ventilation plate. Allow the engine to warm up to normal operating temperature.

⚠ WARNING

Engine exhaust contains poisonous carbon monoxide gas that can cause unconsciousness and death.
- **If the engine must be running, make sure the area is well ventilated.**



2) Stop the engine and remove the engine cover. Hold the outboard motor upright.



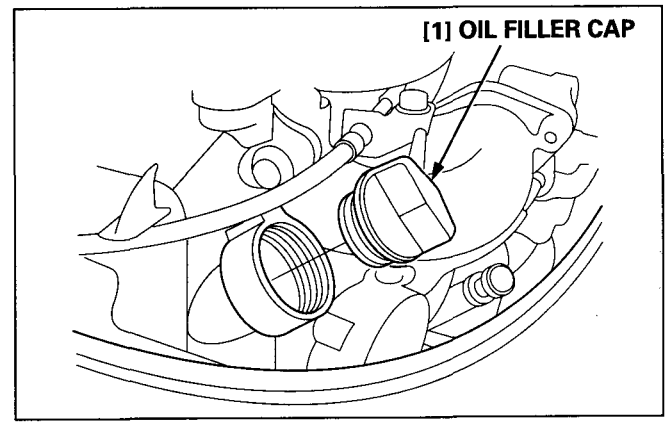
3) Remove the dipstick and wipe it clean.

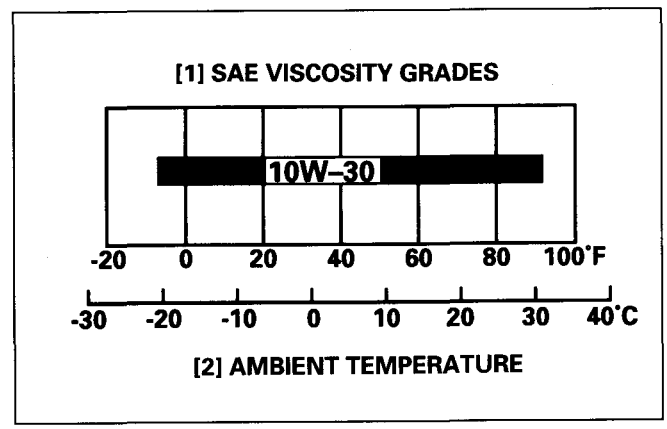
4) Insert the dipstick all the way in, then pull it out and check the oil level. Check the engine oil condition, change the engine oil if it is stale or contaminated with foreign material.

5) If the oil level is low, remove the oil filler cap and add the recommended engine oil to reach the upper limit mark on the dipstick.

Recommended engine oil	SAE 10 W-30 API Service classification SG/SH/SJ

Use a 4-stroke motor oil that meets or exceeds the requirements for API service classification SG, SH or SJ. Always check the API service label on the oil container to be sure it includes the letters SG, SH or SJ. Engine oil is a major factor affecting performance and service life. Use 4-stroke automotive detergent oil.





• Oil Change

Drain the used oil while the engine is warm. Warm oil drains quickly and completely.

1) Hold the outboard motor upright.

2) Remove the oil filler cap and oil drain bolt, and drain the engine oil into a suitable container.

   Please dispose of the used motor oil in a manner that is compatible with the environment. We suggest you take used oil in a sealed container to your local recycling center or service station for reclamation. Do not throw it in the trash, pour it on the ground, or down a drain.

CAUTION:

Used engine oil contains substances that have been identified as carcinogenic. If repeatedly left in contact with the skin for prolonged periods, it may cause skin cancer.
Wash your hands thoroughly with soap and water as soon as possible after contact with used engine oil.

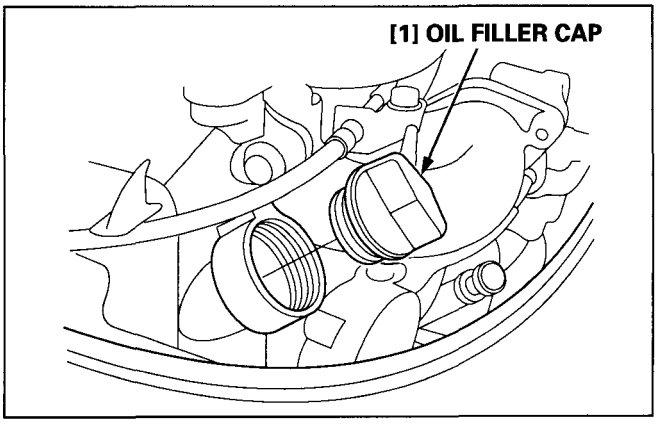
3) Make sure the O-ring is in good condition, replace it with new one if necessary. Reinstall the drain bolt and the O-ring, and tighten the drain bolt securely.

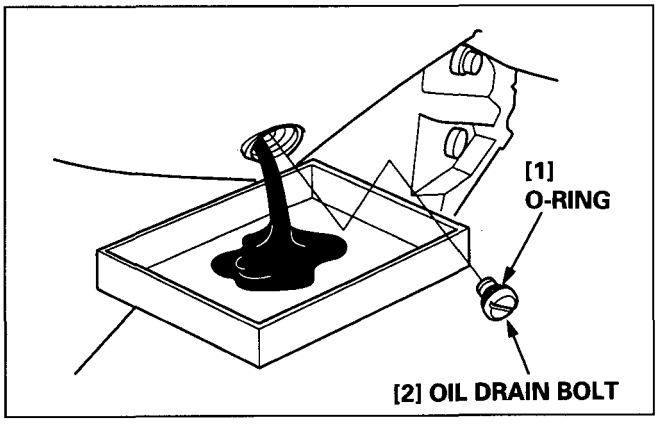
   TORQUE: 6 N·m (0.6 kgf·m, 4.3 lbf·ft)

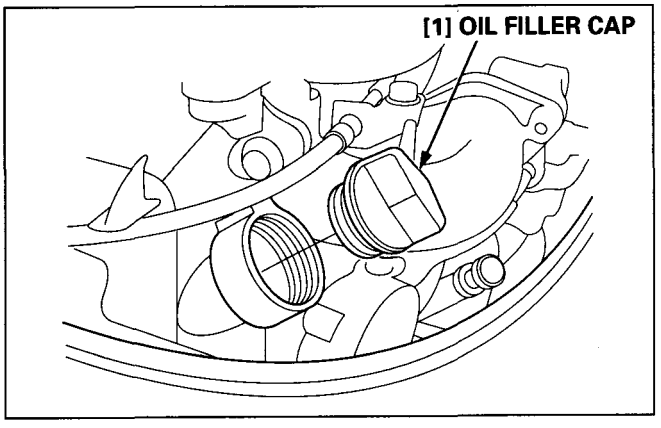
4) Fill the engine with the correct amount of the recommended oil. Reinstall the oil filler cap securely.

Engine oil capacity	1.0 ℓ (1.06 US qt, 0.88 Imp qt)

5) Recheck the oil level shown on the level gauge; if near or below the lower limit mark, fill to the upper limit mark with the recommended oil.







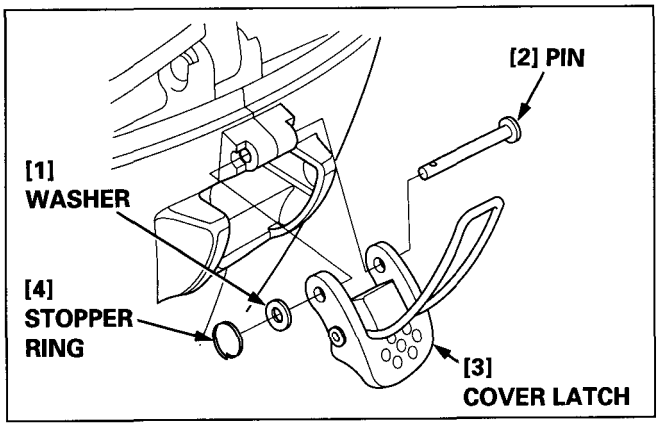
3. OIL FILTER CARTRIDGE

• Replacement

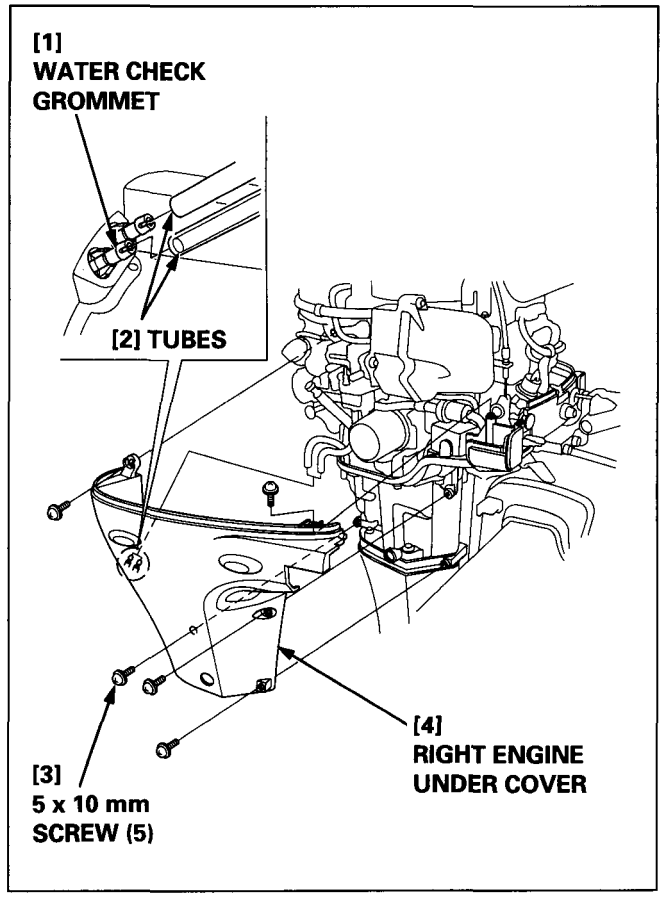
1) Remove the engine cover.

2) Drain the engine oil (P. 3-2).

3) Remove the stopper ring and then remove the washer, pin and cover latch.

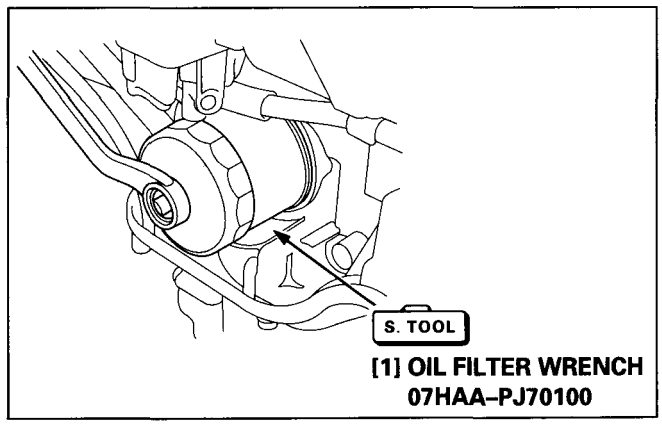


4) Remove the five 5 x 10 mm screws attaching the right engine under cover. Pull the right engine under cover and disconnect the tubes from the water check grommet on the right engine under cover, then remove the right engine under cover.



5) Place a rag under the oil filter to trap oil leakage.

6) Remove the oil filter using the oil filter wrench and let the remain oil drain out. Dispose of the oil filter in a manner that is compatible with the environment.

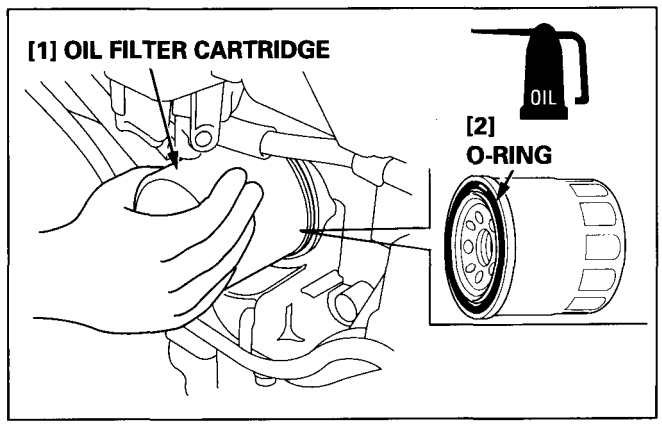


7) Apply a thin coat of engine oil to the new oil filter O-ring.

8) Clean the oil filter mounting boss with clean lag, then apply a thin coat of engine oil to the filter mounting boss.

9) Screw on the new oil filter cartridge by hand until the O-ring contacts the filter base, then tighten the oil filter an additional 7/8 turns using the oil filter wrench.

TORQUE: 12 N·m (1.2 kgf·m, 9 lbf·ft)



10) Fill the crankcase with the specified amount of recommended engine oil.

Engine oil capacity (with oil filter replacement)	1.3 ℓ (1.37 US qt, 1.14 Imp qt)

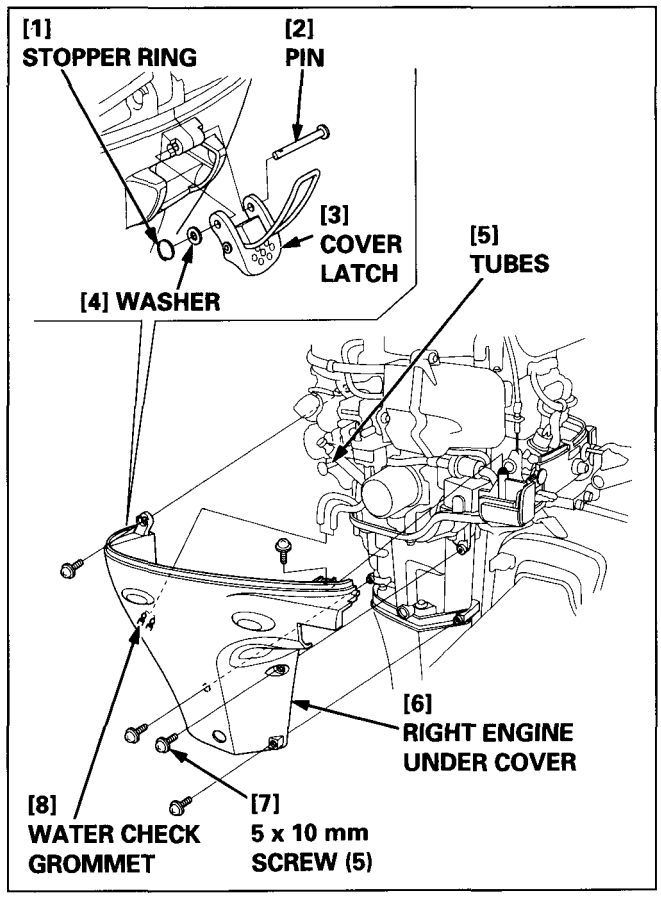
11) Start and run the motor for a few minutes, then stop and check for oil leaks in the oil filter cartridge area and the oil level. Fill to the upper limit mark if necessary.

12) Connect the tubes to the water grommet on the right engine under cover, then install the right engine under cover and tighten the 5 mm screws.

TORQUE: 4.5 N·m (0.45 kgf·m, 3.3 lbf·ft)

13) Install the cover latch with the washer, pin and stopper ring securely.

14) Reinstall the engine cover.

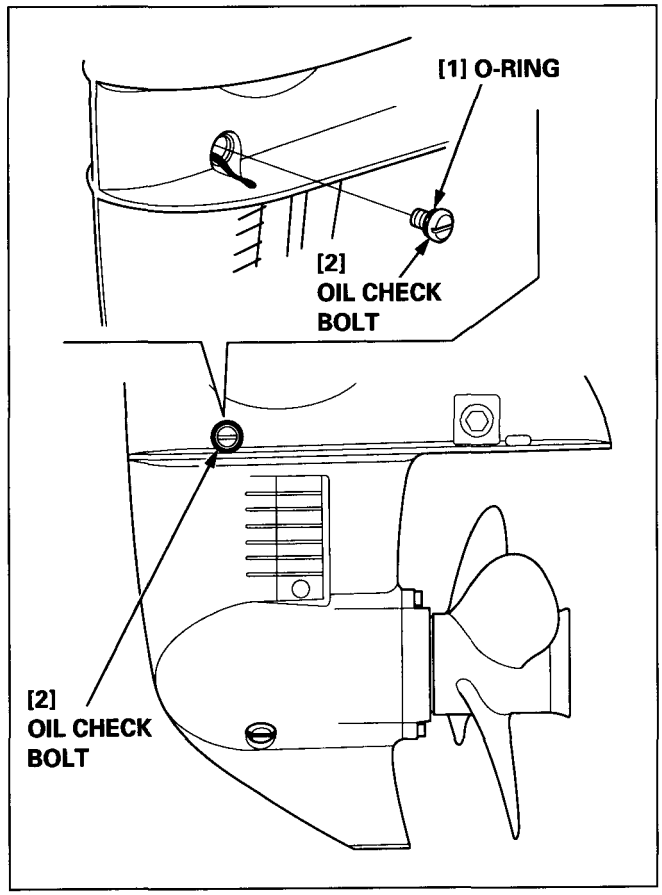


4. GEAR CASE OIL

• *Inspection*

1) Place the outboard motor upright.

2) Remove the oil check bolt, and check whether the gear case oil flows out of the gear case.
If it flows out, reinstall the oil check bolt. If the oil does not flow out, add oil (P. 3-6).



• Adding Gear Case Oil

1) Remove the oil drain bolt, and install a commercially available gear oil pump in the oil drain bolt hole.

2) Remove the oil check bolt, add gear case oil until it flows out of the oil level bolt hole.

Recommended gear case oil	API standard GL-4 or GL-5 SAE #90 outboard motor gear oil

• Oil Change

1) Place the outboard motor upright.

2) Remove the oil check bolt, oil drain bolt, and drain the gear case oil into a suitable container.

   Check for water in the drained gear case oil.

   If there is water in the gear case oil, check the gasket and water seal for damage and check torque at each tightening point of the gear case.

3) Install a commercially available gear oil pump or gear oil bottle in the oil drain bolt hole.

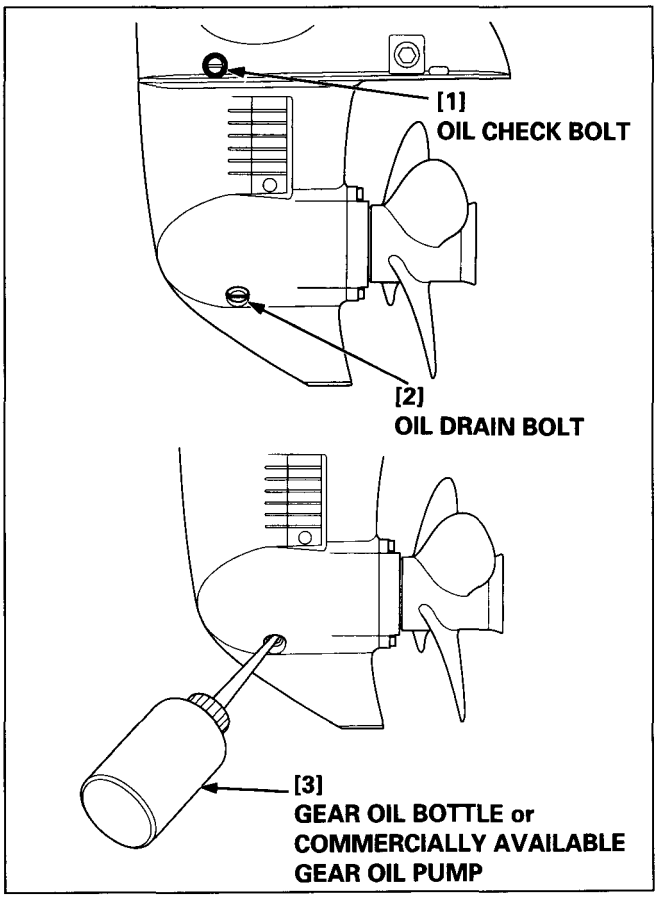
Gear case oil capacity	0.285 ℓ (0.27 us qt, 0.23 Imp qt)

4) When the oil flows out of the oil level check hole, install the O-ring and oil check bolt quickly.
   - Before installing the O-ring, make sure that the O-ring is in good condition, replace with new one if necessary.

5) Then install the oil drain bolt and O-ring.

6) Tighten the oil drain bolt and oil check bolt securely.

   TORQUE: 3.5 N·m (0.35 kgf·m, 2.5 lbf·ft)



5. SPARK PLUG

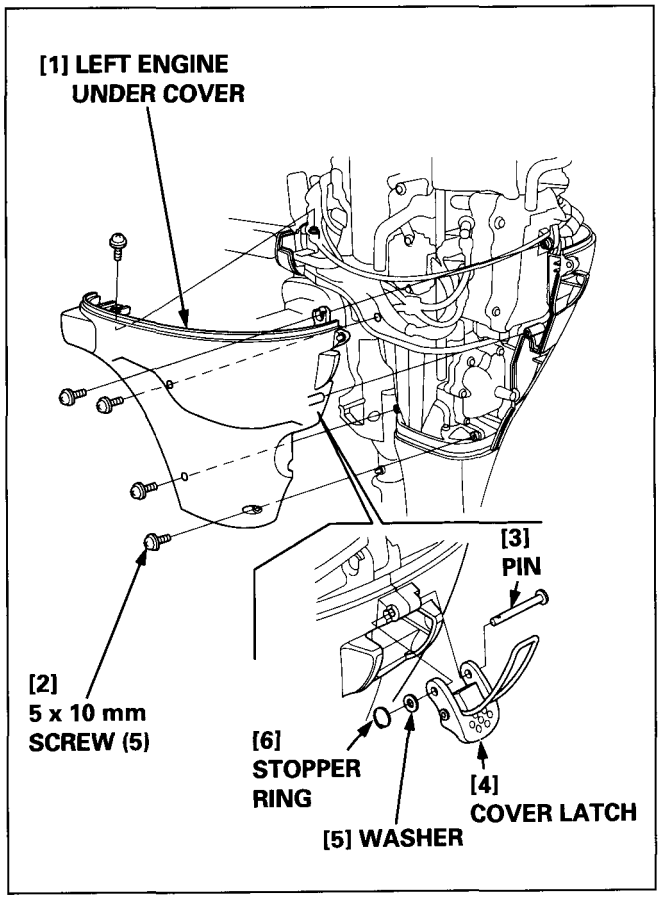
• Inspection/Cleaning

If the engine has been running, the engine will be very hot. Allow it to cool before proceeding.

1) Remove the engine cover.

2) Remove the stopper ring and then remove the washer, pin and cover latch.

3) Remove the five 5 x 10 mm screws and left engine under cover.



4) Remove the spark plug caps, then remove the spark plugs using a spark plug wrench.

5) Visually inspect the spark plug. Discard the plug if the insulator is cracked or chipped.

6) Remove carbon or other deposits with a stiff wire brush.

7) Measure the plug gap with a wire-type feeler gauge. If necessary, adjust the gap by bending the side electrode.

Standard spark plug	CR5EH-9 (NGK) U16FER9 (DENSO)
Spark plug gap	0.8 – 0.9 mm (0.031 – 0.036 in)

8) Make sure the sealing washers are in good condition; replace if necessary.

9) Install the plug fingertight to seat the washer, then tighten with a plug wrench to compress the sealing washer.

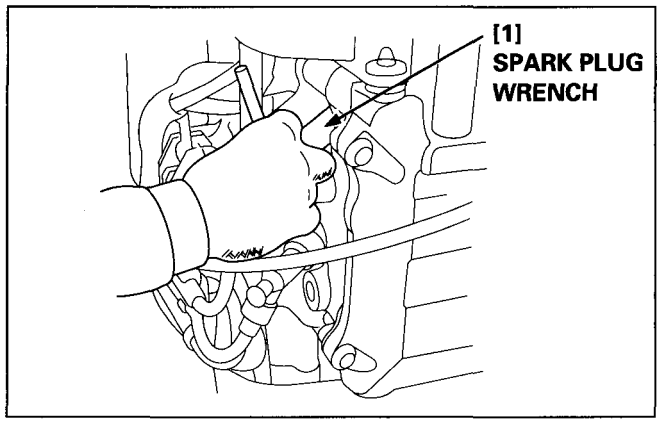
If reinstalling the used spark plug, tighten 1/8 – 1/4 turn after the spark plug seats.

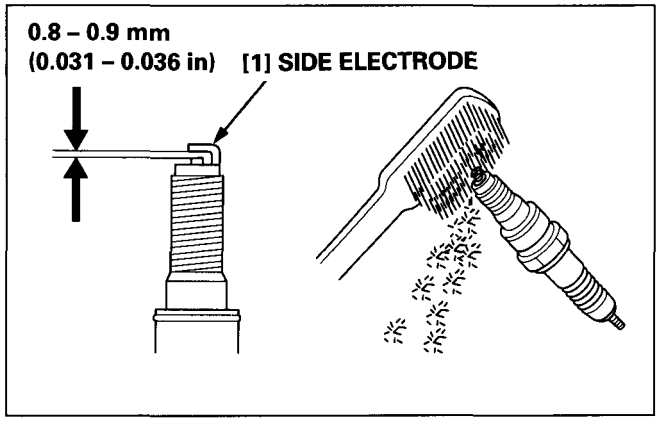
If installing a new spark plug, tighten 1/2 turn after the spark plug seats.

CAUTION:

- **The spark plugs must be securely tightened. An improperly tightened spark plug can become very hot and may damage the engine.**
- **Overtightening the spark plug can damage the threads in the cylinder head.**

10) Reinstall the spark plug caps and then install the removed parts in the reverse order of removal.





6. VALVE CLEARANCE

• Inspection

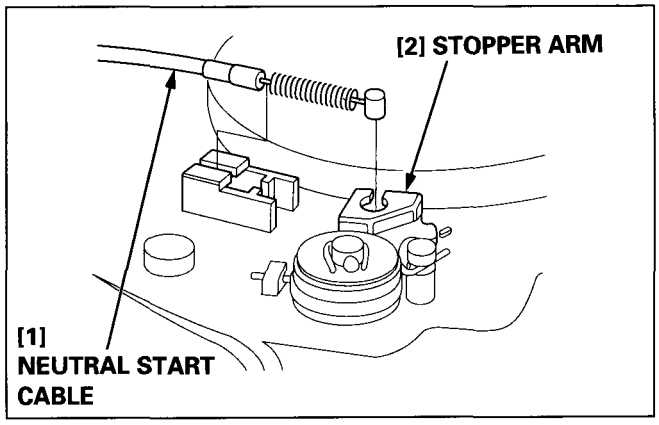
Valve clearance inspection and adjustment must be performed with the engine cold.

1) Remove the engine cover.

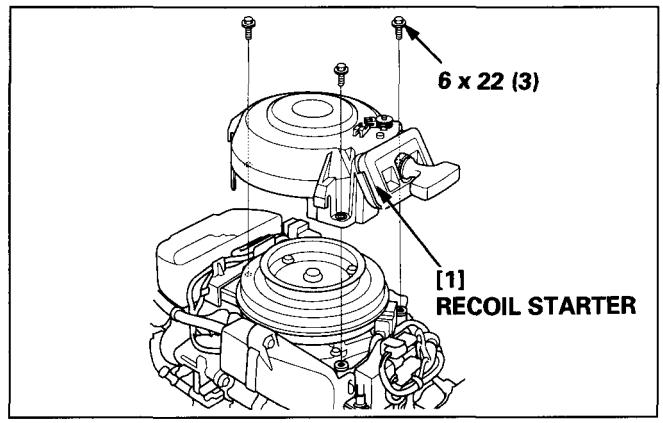
2) Set the gear in the neutral position.

3) Remove the right engine under cover (P. 3-3 and 4) and left engine under cover (P. 3-6).

4) Disconnect the neutral start cable from the stopper arm on the recoil starter.



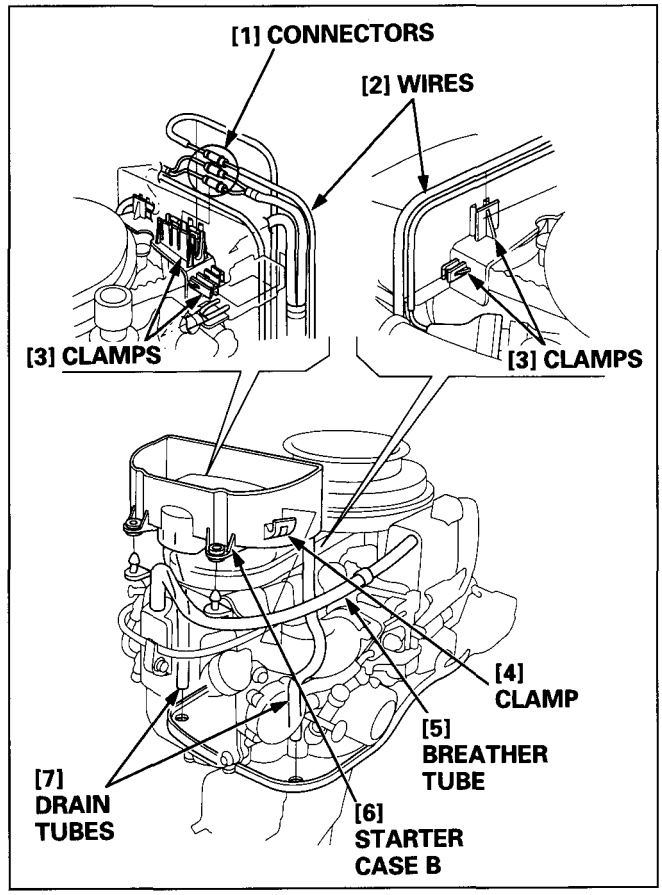
5) Remove the three 6 x 22 mm flange bolts and recoil starter.



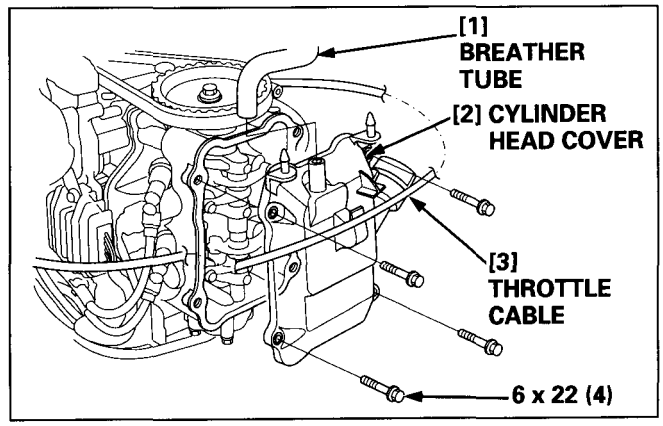
6) Pull out the connectors and wires from the clamp on the starter case B.

7) Release the breather tube from the clamp on the starter case B.

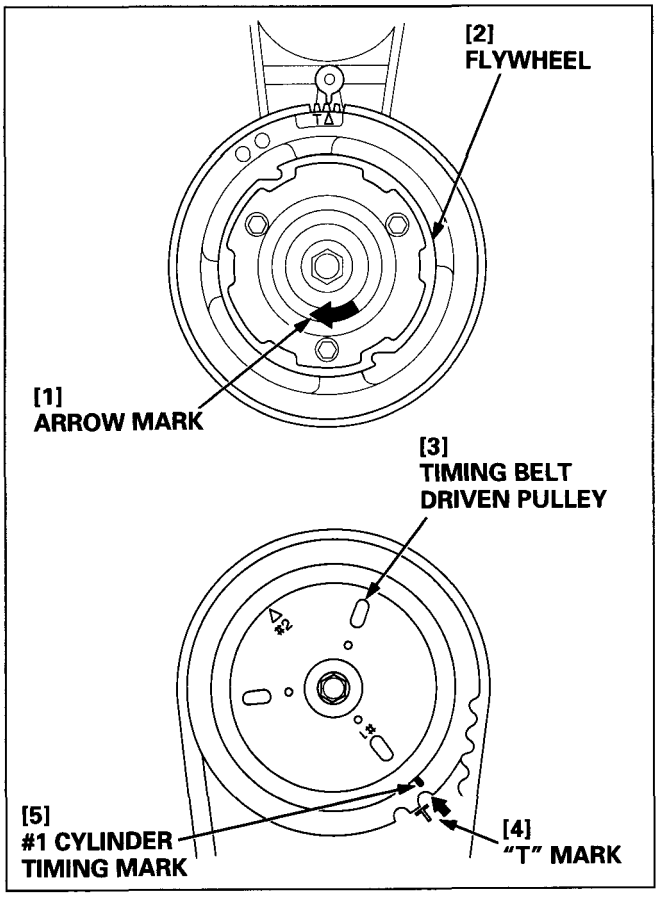
8) Remove the starter case B with the drain tube attached by disconnecting the drain tubes from the lower setting holes.



9) Disconnect the breather tube from the cylinder head cover. Remove the four 6 x 22 mm flange bolts and the cylinder head cover.



10) Turn the crankshaft clockwise by turning the flywheel clockwise (in the arrow marked direction) until the "▮" #1 timing mark on the timing belt driven pulley aligns with the "⬆T" mark on the cylinder head.
   - In this position, the No. 1 cylinder is at top dead center of its compression stroke.
   - Don't turn the flywheel counterclockwise.

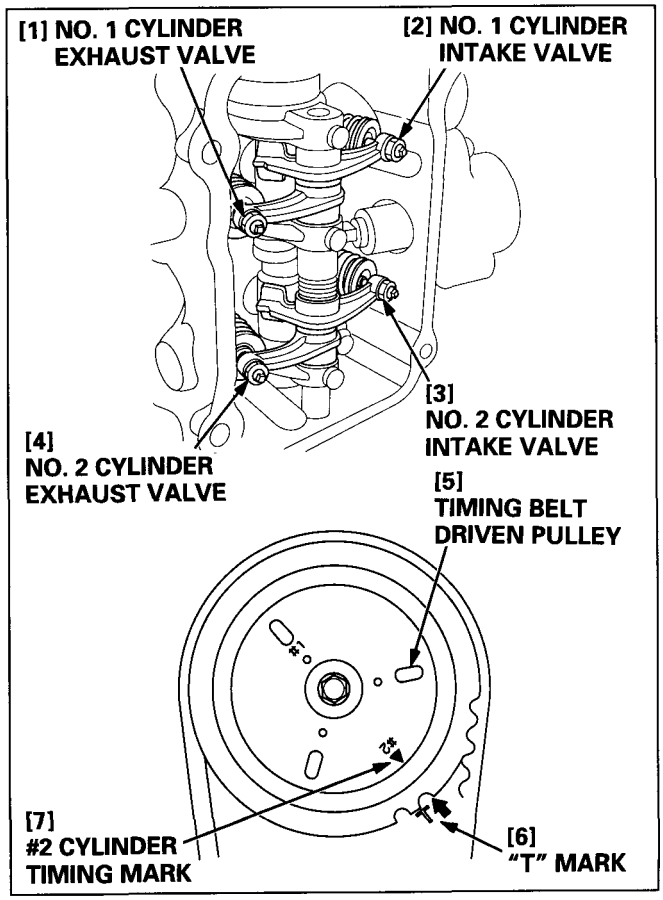


11) With the engine in the position described in step 10, check the intake and exhaust valve clearances at No. 1 cylinder by inserting a feeler gauge between the valve stem and the rocker arm.

Valve clearances	IN	0.15 – 0.19 mm (0.006 – 0.007 in)
	EX	0.21 – 0.25 mm (0.008 – 0.010 in)

12) Turn the crankshaft 360 degrees ("▲" #2 timing mark should align with the "⬆T" mark on the cylinder head) to put the No. 2 cylinder at top dead center of its compression stroke, and then check the intake and exhaust valve clearances for No. 2 cylinder.

If adjustment is necessary, perform the valve clearance adjustment according to the procedures described on the next page.



• Adjustment

If the valve clearance adjustment is necessary, proceed as follows:

1) Hold the valve adjusting screw using the valve adjusting wrench and loosen the lock nut.

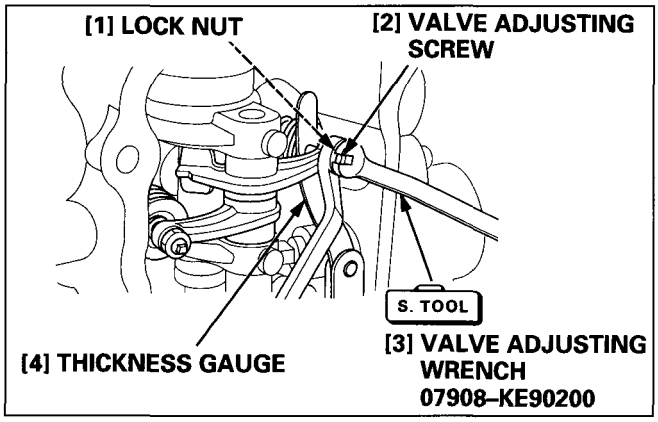
2) Turn the valve adjusting screw to obtain the specified intake and exhaust valve clearances.

3) Hold the valve adjusting screw and tighten the lock nut to the specified torque.

   TORQUE: 8 N·m (0.8 kgf·m, 5.8 lbf·ft)

4) Recheck the valve clearance after tightening the lock nut.

5) After adjustment, install the removed parts in the reverse order of removal.
   - Make sure that the wire harnesses and connectors are set in the place correctly (see pages 2-30 through 2-37 for wire harness and cable routing).



7. CARBURETOR

• Pilot Screw

The pilot screw is fitted with a limiter cap that prevents excessive enrichment of the air-fuel mixture in order to comply with emissions regulations (Canadian model only).

Do not attempt to remove the limiter cap for pilot screw adjustment. The limiter cap cannot be removed without breaking the pilot screw (Canadian model only).

Pilot screw adjustment must be performed only when it is disassembled (P. 6-8).

• Idle Speed

1) Run the outboard motor in an outboard test tank with the water at least 4 inches above the anti-ventilation plate. Allow the engine to warm up to normal operating temperature (*engine oil temperature* 50 – 60°C/122 – 140°F).

⚠ WARNING

Engine exhaust, contains poisonous carbon monoxide gas that can cause unconsciousness and death.
- **If the engine must be running, make sure the area is well ventilated.**

2) Stop the engine and remove the engine cover.

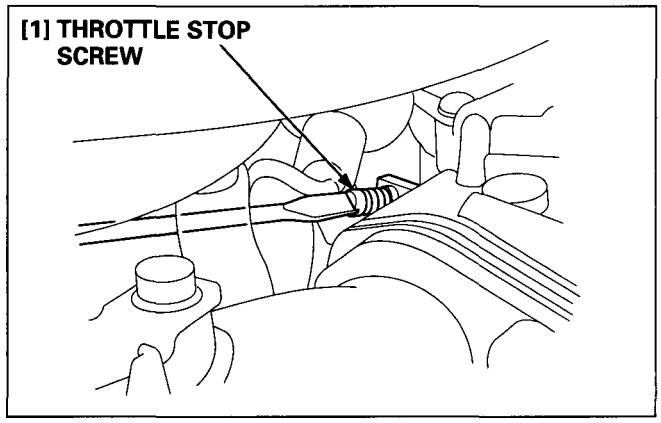
3) Attach an engine tachometer and restart the engine.

   • Follow the tachometer manufacturer's instructions.

4) After engine speed has stabilized, turn the throttle stop screw to obtain the specified idle speed.

Specified idle speed in neutral	900 ± 50 min^{-1} (rpm)

5) Install the engine cover.



8. FUEL FILTER

• Inspection

1) Remove the engine cover.

2) Check the fuel filter for water accumulation or sediment, *if water or sediment is found, replace the fuel filter.*

• Replacement

⚠ WARNING

Gasoline is highly flammable and explosive.
You can be burned or seriously injured when handling fuel.
- **Keep heat, sparks, and flame away.**
- **Wipe up spills immediately.**

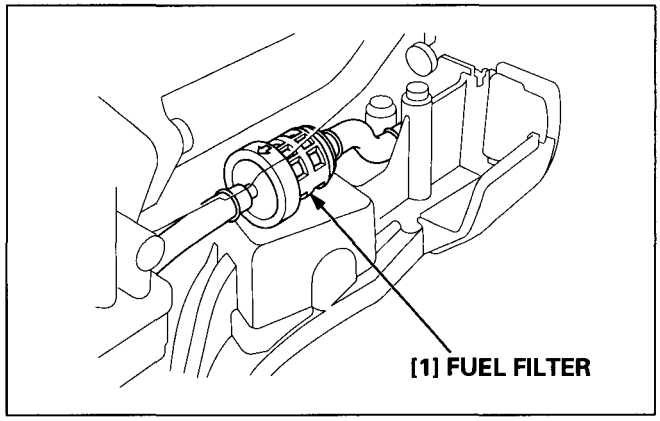
1) *Remove the right engine under cover* (P. 3-3 and 4).

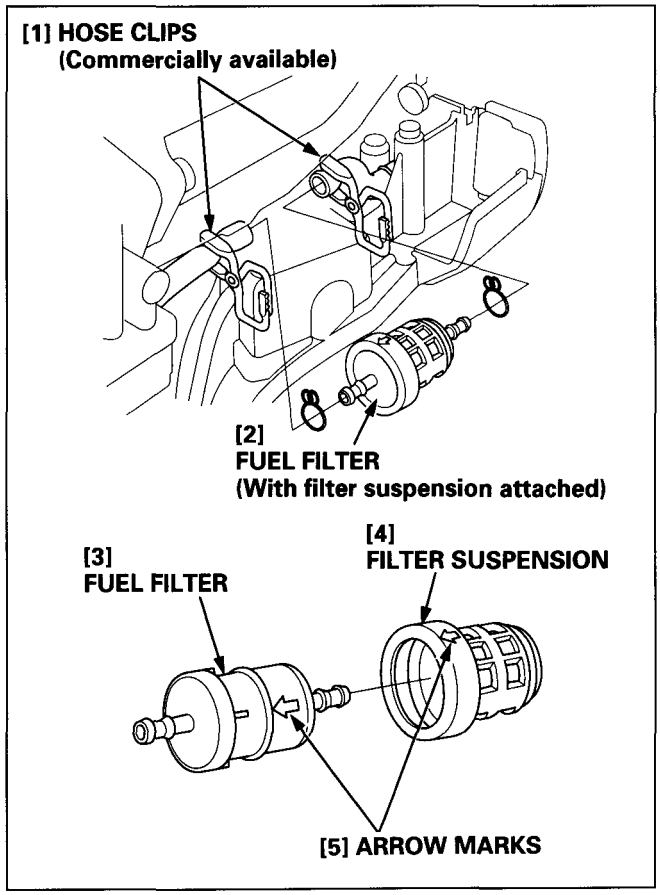
2) Pinch the fuel tubes at both sides of the fuel filter with two commercially available hose clips.

3) Disconnect the fuel tubes being careful to prevent fuel leakage and remove the fuel filter with the filter suspension attached.

4) Remove the fuel filter from the filter suspension and discards the fuel filter.

5) Install a new fuel filter into the filter suspension so the arrow mark points to the same direction as shown.

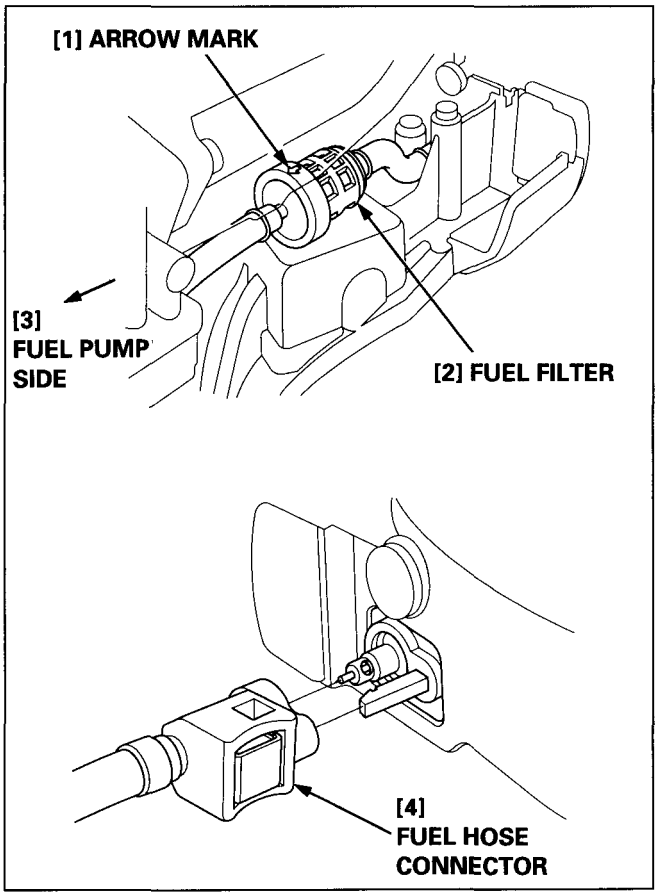




6) Install a new fuel filter with the filter suspension attached so the arrow mark on the filter suspension points toward the fuel pump side.

7) Connect the fuel tubes and remove the hose clips.

8) Connect the fuel hose connector to the outboard motor. Pump the primer bulb, and make sure that there are no fuel leaks.



9. FUEL TANK STRAINER

• Inspection/Cleaning

⚠ WARNING

Gasoline is highly flammable and explosive.
You can be burned or seriously injured when handling fuel.
- **Keep heat, sparks, and flame away.**
- **Wipe up spills immediately.**

1) Drain the fuel tank into a suitable container.

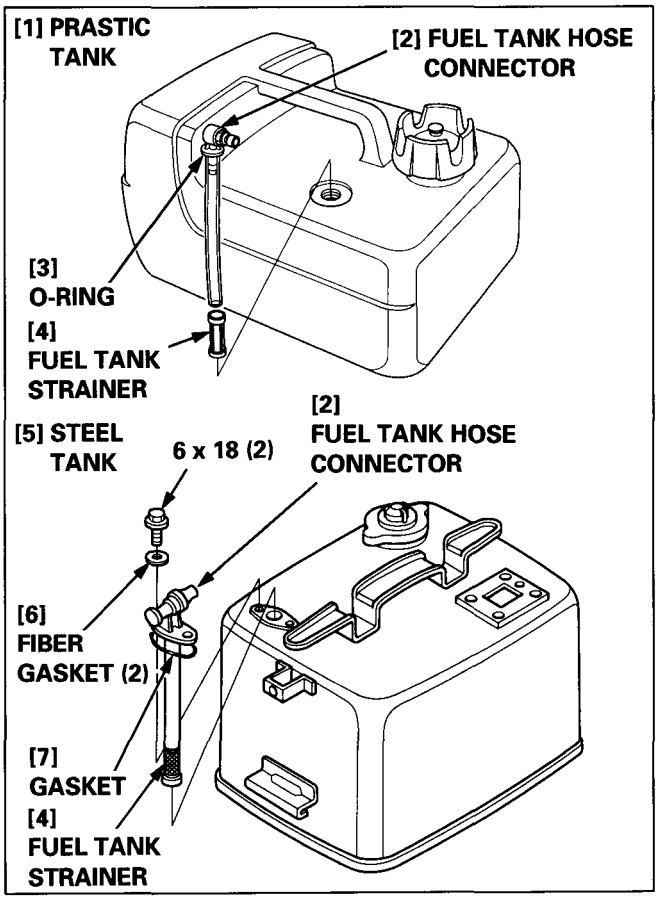
2) Remove the fuel tank hose connector and fuel tank strainer from the fuel tank.
   - Plastic tank:
     Remove the fuel tank connector by turning it in counterclockwise.
   - Steel tank:
     Remove the two 6 x 18 mm flange bolts and fiber gaskets, then remove the fuel tank connector and gasket.

3) Remove any dirt or foreign material from the fuel tank strainer, and check for tears in the strainer mesh. Replace the strainer if necessary.

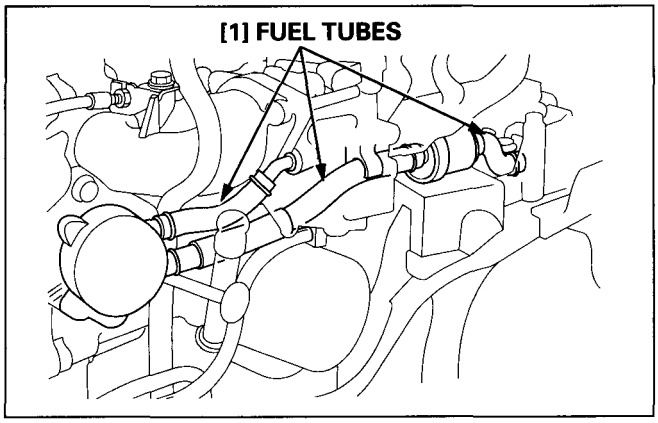
4) Clean the fuel tank with cleaning solvent and allow the fuel tank to dry thoroughly.

5) Reinstall the fuel tank connector in the reverse order of removal.

   - Make sure that the O-ring (plastic tank) or gasket (steel tank) is in good condition, replace if necessary.



10. FUEL TUBES



• Inspection/Replacement

1) Remove the engine cover. Check the fuel tubes for deterioration, cracks, and other damage.

2) Replace the fuel tubes if necessary.

3) After installing the fuel tubes, connect the fuel hose connector to the outboard motor. Pump the primer bulb, and make sure that there is no fuel leaks.

4) Reinstall the engine cover.

11. THROTTLE LINKAGE

• Inspection/Adjustment

TILLER HANDLE TYPE

1) Remove the engine cover.

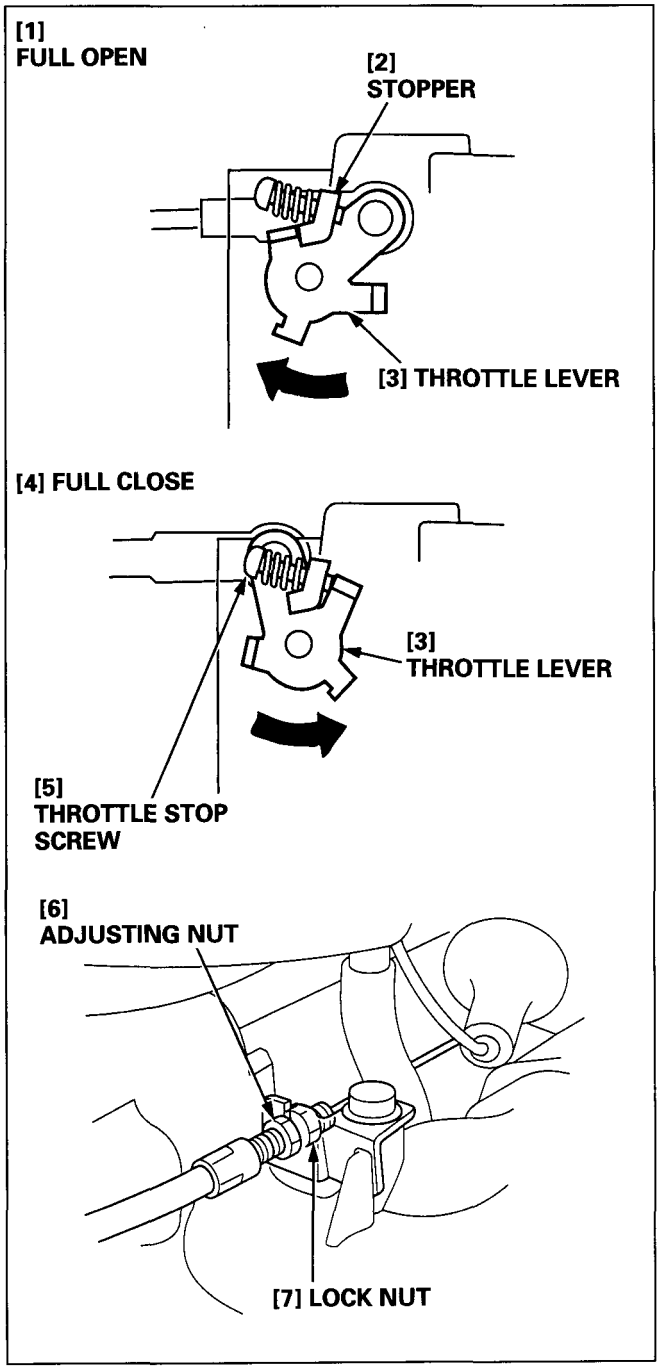
2) Turn the throttle grip to the full open position, and check that the throttle lever is in contact with the stopper. If it is not, adjust as follows.

3) Loosen the lock nut and turn the adjusting nut.

4) After adjustment, tighten the lock nut securely.

TORQUE: 4.5 N·m (0.45 kgf·m, 3.3 lbf·ft)

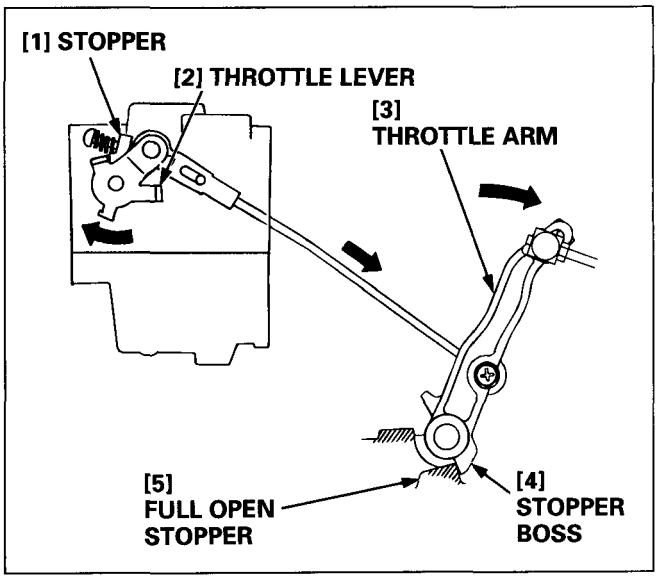
5) *Operate the throttle grip several times, then turn the* throttle grip from fully closed position to fully open position and check that the throttle lever is in contact with the stopper at fully open position, and in contact with the throttle stop screw at fully closed position.



REMOTE CONTROL TYPE

1) Remove the engine cover and right engine under cover (P. 3-3 and 4).

2) Move the control lever to the full open position, and check that the throttle arm stopper boss is in contact with the full open stopper. At this time, the throttle lever should contact to the stopper. If it is not, adjust as follows.

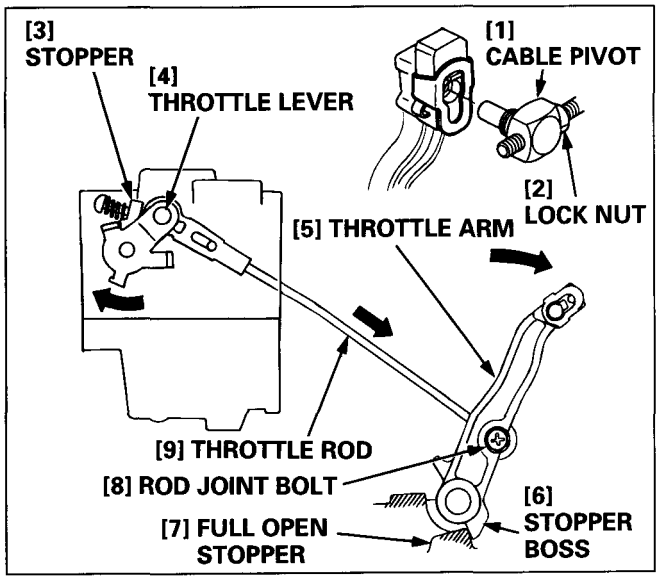


3) Disconnect the throttle control cable pivot from the throttle arm.

4) Loosen the 5 x 8 mm throttle rod joint bolt.

5) Move the throttle arm until the throttle arm stopper boss is in contact with the full open stopper and hold the throttle arm in this position.

6) Move the throttle rod until the carburetor throttle lever is in contact with the stopper and tighten the 5 x 8 mm rod joint bolt securely.



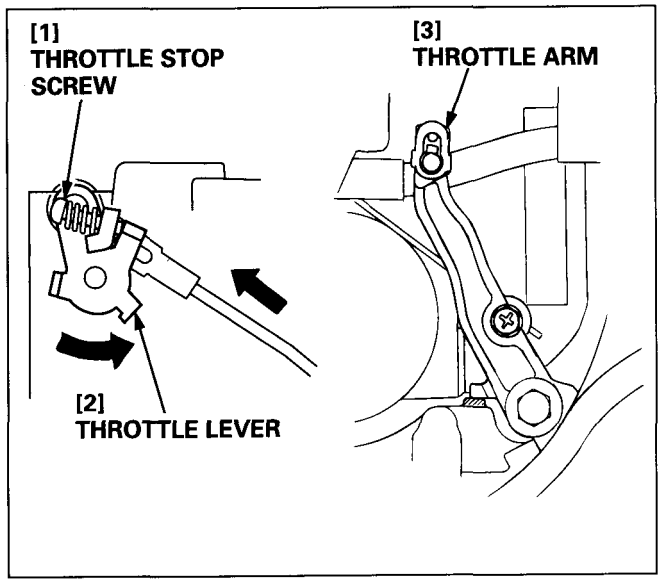
7) Move the throttle arm to the full close position and make sure that the carburetor throttle lever is in contact with the throttle stop screw.

8) Set the remote control lever in the full open position.

9) Loosen the pivot lock nut, and adjust by turning the pivot, then install the pivot to the throttle arm with the throttle arm in full open position (the throttle arm open stopper should contact with the stopper).

10) Tighten the pivot lock nut securely.

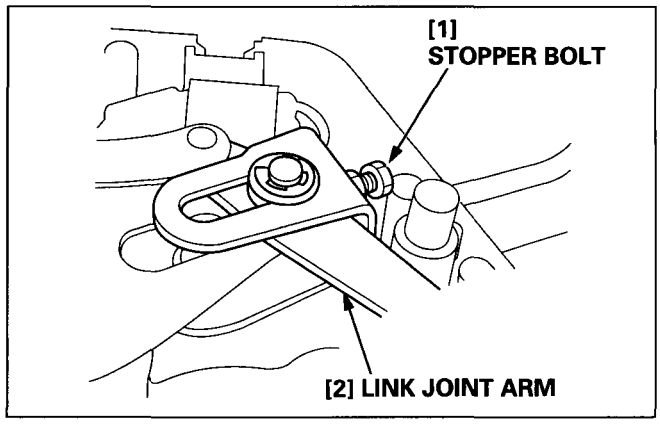
11) Move the control lever to the full close position and check that the carburetor throttle lever is in contact with the throttle stop screw.



12) Remove the remote control box covers B and C (P. 14-4).

13) *Move the control lever to the full open position and* make sure that the link joint arm is in contact with the stopper bolt. If not in contact, turn the stopper bolt until it contacts with the link joint arm.

14) After adjustment, reinstall the removed part in the reverse order of removal.



12. TIMING BELT

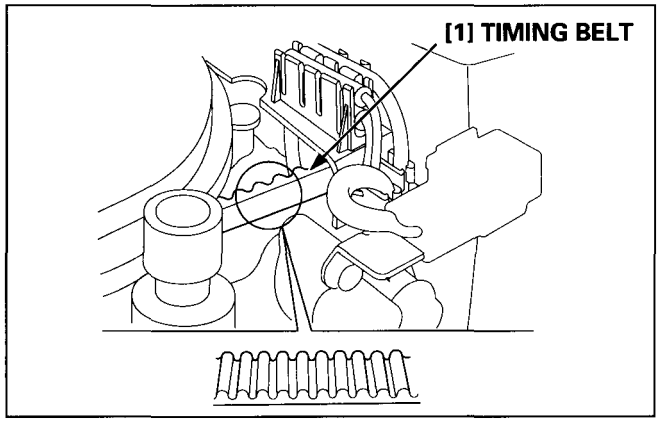
• Inspection

1) Remove the engine cover.

2) Remove the recoil starter (P. 3-7 and 8).

3) Check the timing belt for wear or damage. Replace the timing belt if it is worn or damaged.

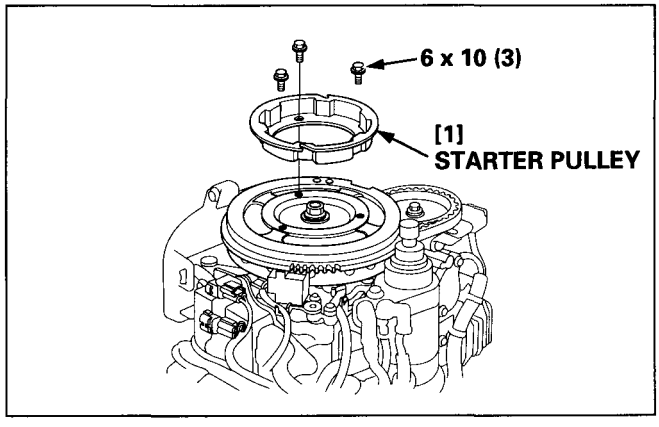
4) Check the timing belt and the related parts for oil and grease. If contaminated with oil or grease, clean the parts and replace the timing belt.



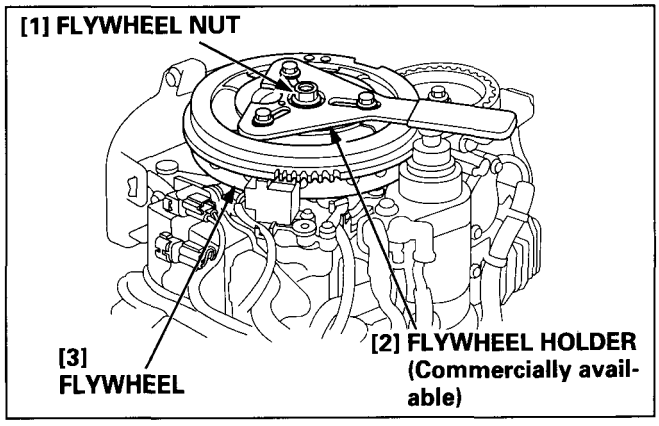
• Replacement

1) Remove the starter case B (P. 7-10).

2) Remove the three 6 x 10 mm flange bolts and starter pulley.



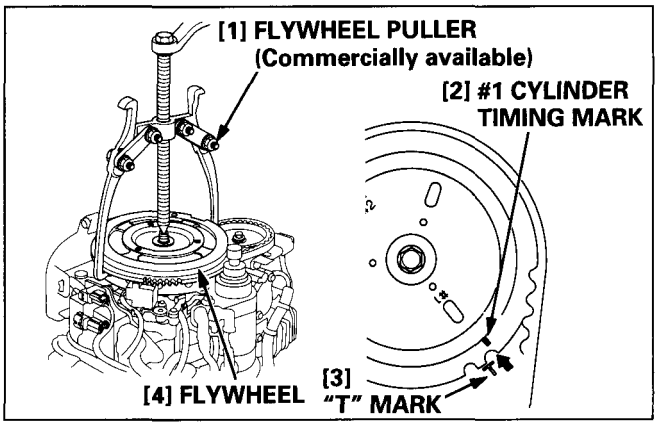
3) Hold the flywheel using the commercially available flywheel holder and remove the flywheel nut.



4) Set a commercially available flywheel puller to the flywheel securely avoiding the magnet sections and taking care not to damage the ring gear.

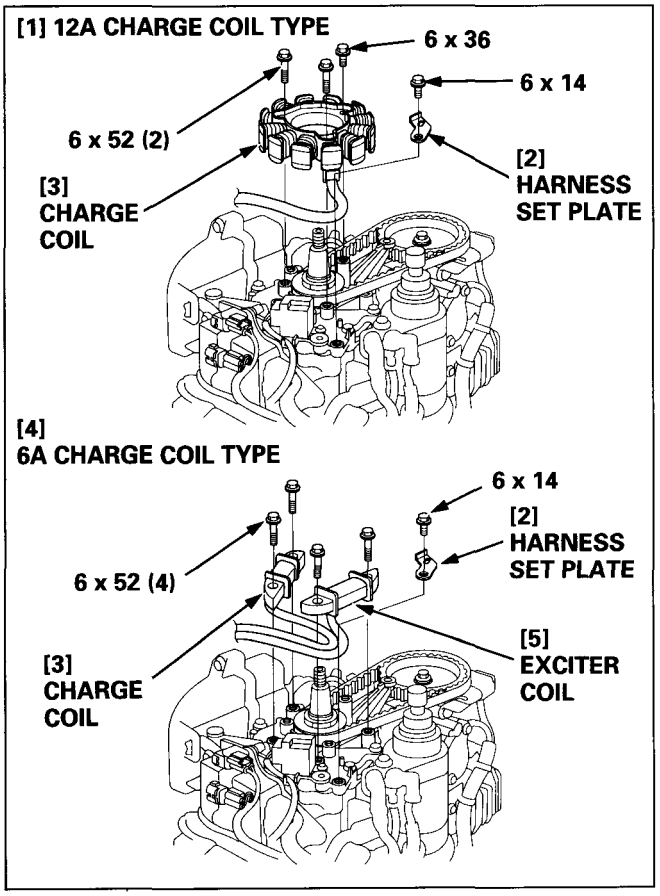
   • Do not hit the flywheel with a hammer.

5) Before removing the flywheel, turn the flywheel clockwise until the No. 1 cylinder is at top dead center of its compression stroke (the "▮" #1 timing mark on the timing belt driven pulley aligns with the "⬆T" mark on the cylinder head. Remove the flywheel and woodruff key.

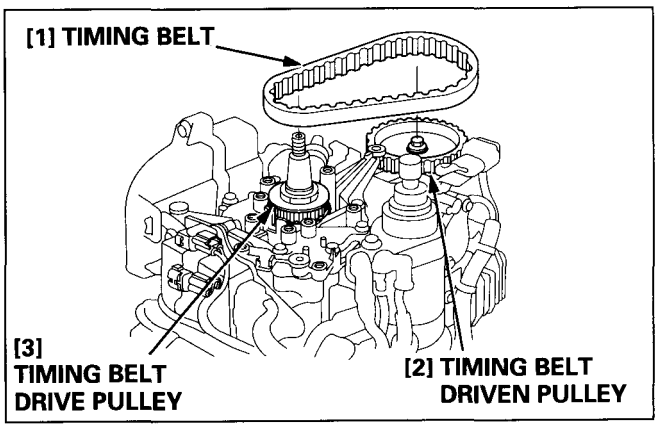


6) Remove the 6 x 14 mm flange bolt and harness set plate.

7) Remove the 6 mm flange bolts and coil.
   12A charge coil type:
   — two 6 x 52 mm and 6 x 36 mm flange bolts and charge coil
   6A charge coil type:
   — two 6 x 52 mm flange bolts and charge coil
   — two 6 x 52 mm flange bolts and exciter coil.

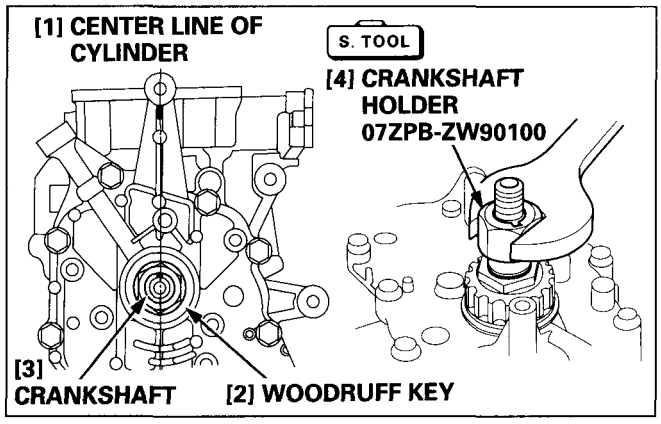


8) Remove the timing belt from the timing belt driven pulley, then remove the timing belt from the timing belt drive pulley.

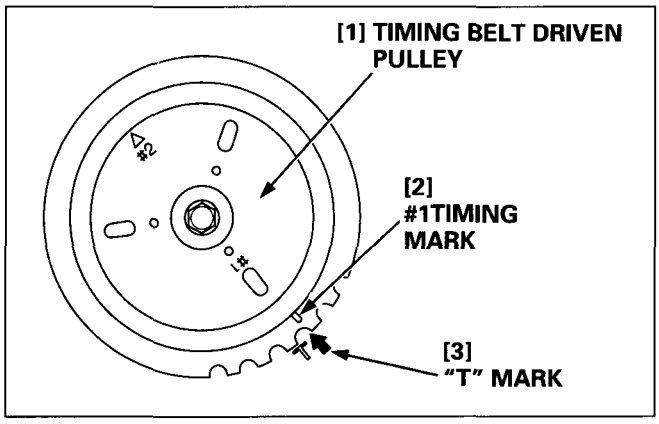


9) Remove the spark plug caps and spark plugs.

10) Make sure that the woodruff key on the crankshaft aligns with the center line of cylinder as shown. If necessary, turn the crankshaft using the crankshaft holder.

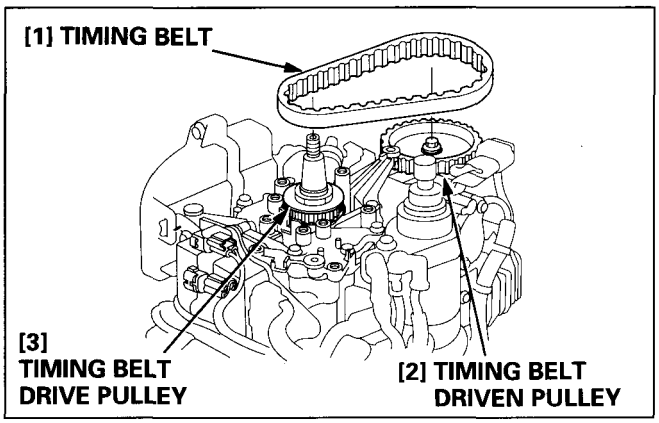


11) Make sure that the "▮" #1 timing mark on the timing driven pulley aligns with the "⬆T" mark on the cylinder head. If necessary align the mark by turning the driven pulley.



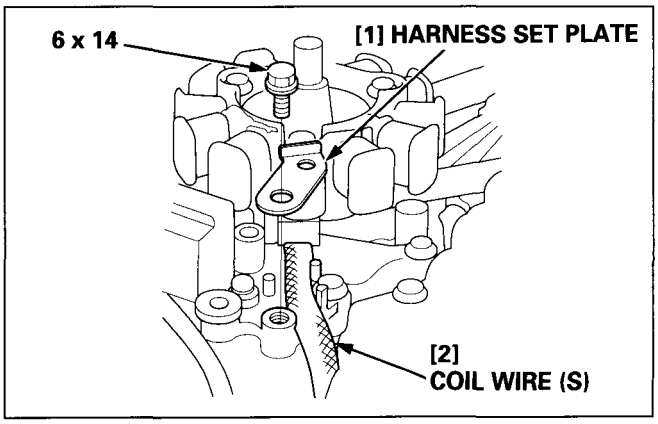
12) Install a new timing belt on the timing belt drive pulley and then on the driven pulley taking care not to allow the alignment marks to come out of alignment.

13) After installation, be sure that the alignment marks are in the proper alignment.



14) Reinstall the charge coil and exciter coil.

15) Route the charge coil and exciter coil wire(s) on the crankcase as shown and secure them with the harness set plate. Tighten the 6 x 14 mm flange bolt.



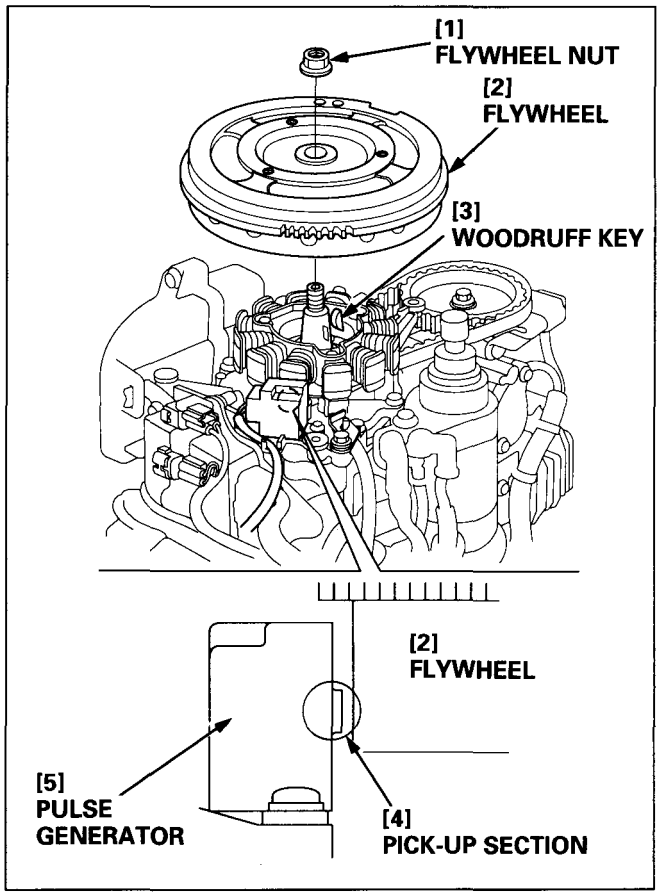
16) Clean off oil or grease from the crankshaft and flywheel mating surfaces (tapered section). Make sure that there are no metal objects stuck to the magnets of the flywheel.

17) Install the flywheel by aligning the woodruff key on the crankshaft with the key groove of the flywheel taking care not to damage the pick-up point of the ignition pulse generator.

18) Apply oil to the thread and seating surface of the flywheel nut.

19) Hold the flywheel using a commercially available flywheel holder and tighten the flywheel nut.

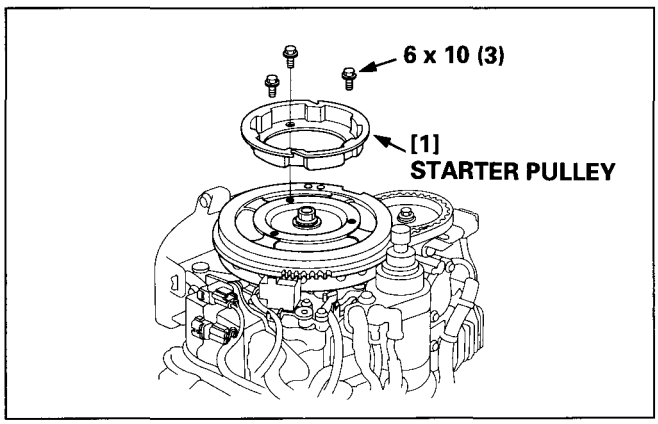
TORQUE: 88 N·m (9.0 kgf·m, 65 lbf·ft)



20) Install the starter pulley and tighten the three 6 x 10 mm flange bolts.

TORQUE: 11 N·m (1.1 kgf·m, 8 lbf·ft)

21) Install the following removed parts in the reverse order of removal.
— starter case B.
— recoil starter.
— neutral start cable.
— left and right engine under covers.
— engine cover.



13. CRANKCASE BREATHER

• Inspection

Check the breather tube, and replace the breather tube which show deterioration, damage or loose.

14. EXHAUST EMISSION (BODENSEE TYPE ONLY)

• Inspection

⚠ WARNING

- **Engine, exhaust system and analyzer become very hot. Wear insulation glove to avoid severe burns.**
- **Running the outboard motor for long time without sufficient water will damage the lower nunit parts.**
- **Keep clean of moving parts.**

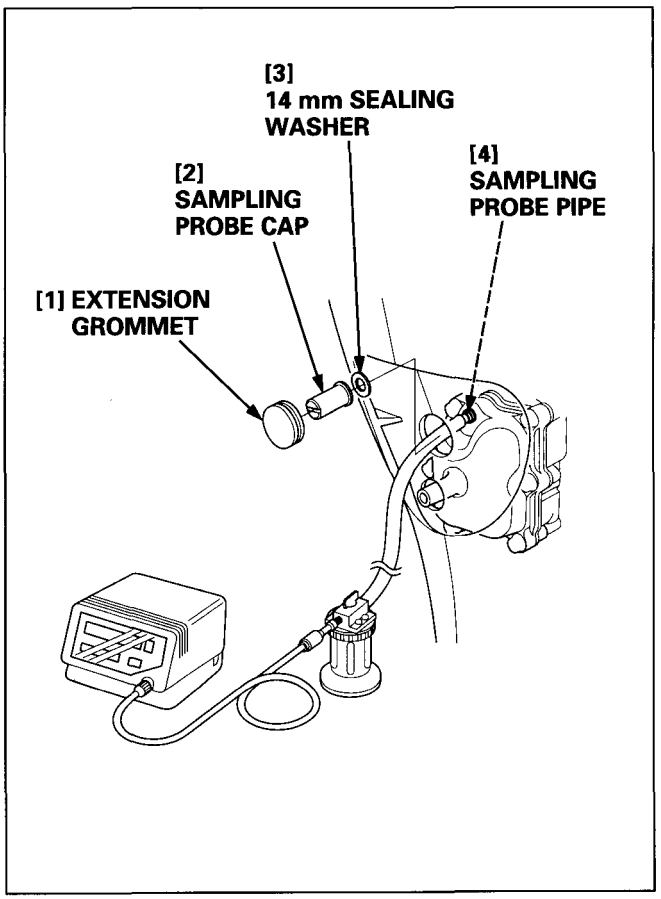
Before this operation perform the following maintenance.
- Ignition timing.
- Spark plugs.
- Valve clearance.
- Crankcase breather.
- Idle speed.

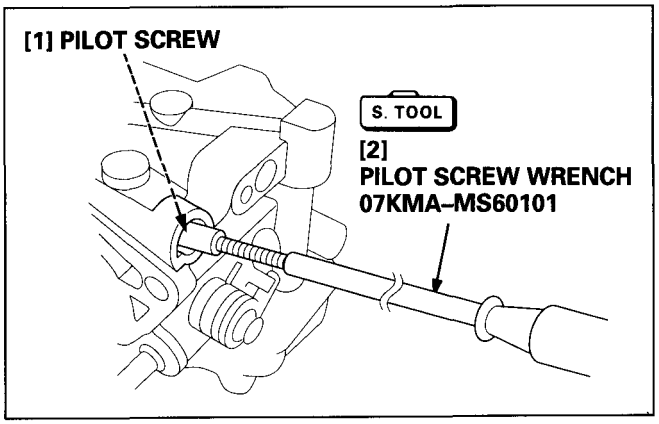
1) Remove the grommet (P. 5-2).
2) Remove the cap and sealing washer.
3) Route the sampling tube through the tube joint installation hole and connect the tube end to the sampling probe. Pinch the sampling tube using a clip to avoid leaking exhaust gas.
4) Start the engine and run at 3,500 – 4,000 min^{-1} (rpm) for about 2 minutes to warm up the engine until the engine temperature is 55 ± 5°C (131 ± 41°F).
   - Run the outboard motor in an outboard test tank with the water at least 150 mm (6 in) above the anti-ventilation plate.
5) Connect the sampling tube to an analyzer for exhaust emission according to the manufacturer's instructions.
6) Remove the tube pinch to free sampling tube and measure value of CO, HC and CO_2 at idle.

	STANDARD VALUE
CO	8.4% Max. (7.6% Max.)
HC	819 ppm Max. (630 ppm Max.)
CO_2	10% Min. (11% Min.)
Idle speed	900^{+200}_{-0} min^{-1} (rpm)

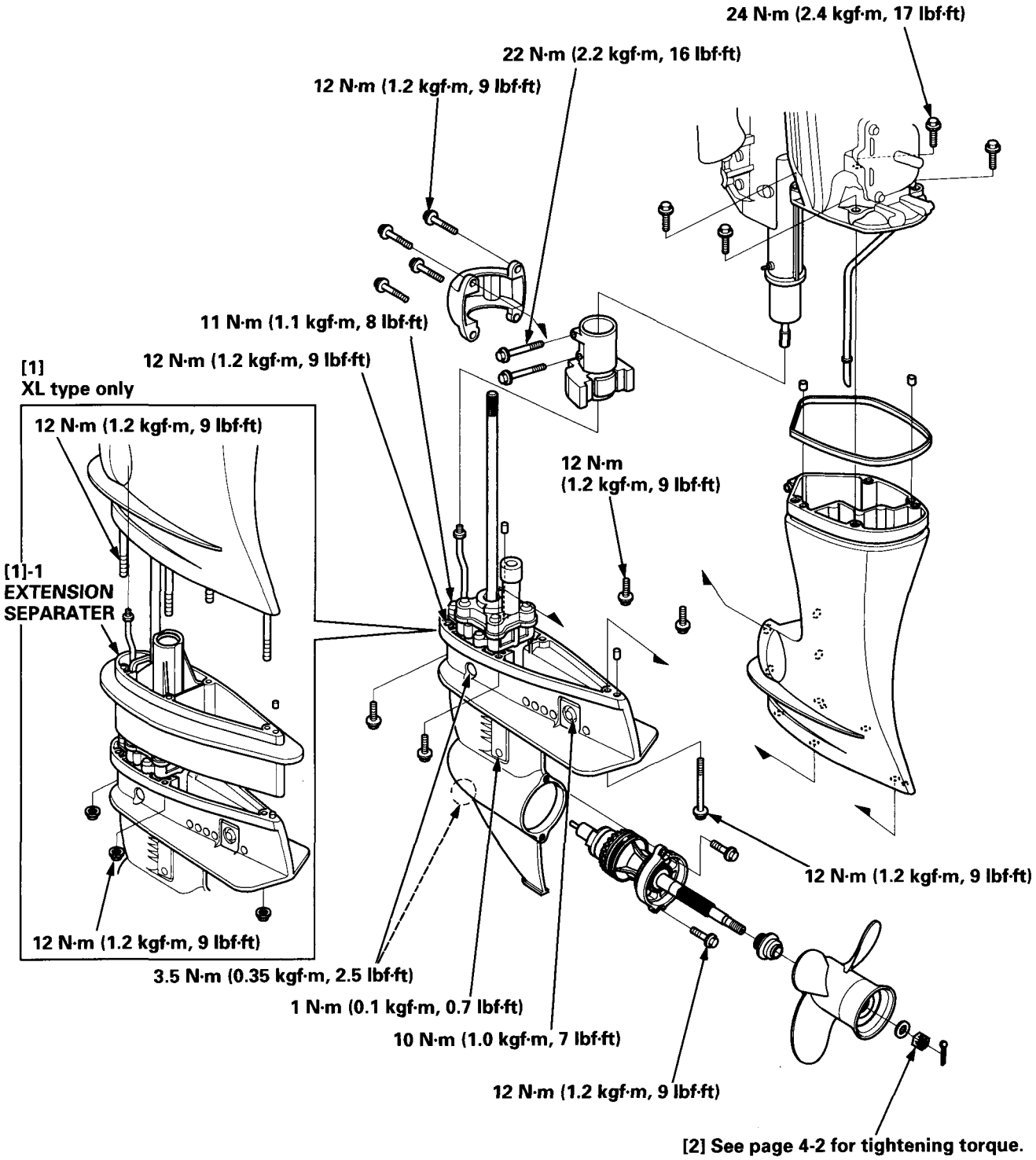
( ): BF10B and BFP10B only

7) If the measurements are without the specifications, adjust as following.
   a. Turn the pilot screws in or out to obtain the standard values using the pilot screw wrench according to the pilot screw adjustment procedures (P. 6-8 and 9)
      TOOL:
      Pilot screw wrench 07KMA – MS60101
   b. If the measured value have not yet reached standard, inspect and repair the following and recheck.
      - Decarbonization from the combustion chamber.
      - Refacing valve seats and lapping valve and valve seat.
      - Checking valve stem seal condition.
      - Checking piston ring conditions.
8) After inspection, remove the test equipment and reinstall the gasket and tighten the cap to the specified torque.
   TORQUE: 5 N·m (0.5 kgf·m, 3.6 lbf·ft)
9) Install the grommet (P. 5-2).





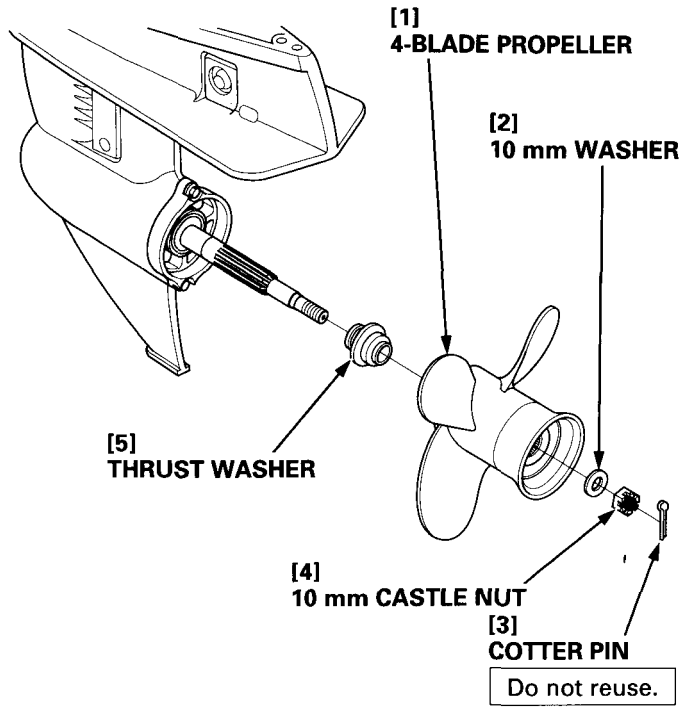
1. PROPELLER
2. PROPELLER SHAFT HOLDER
3. GEAR CASE ASSEMBLY
4. WATER PUMP
5. VERTICAL SHAFT/BEVEL GEAR
6. GEAR CASE/ANODE/WATER SCREEN
7. EXTENSION CASE
8. EXHAUST CHAMBER COVER



1. PROPELLER

a. REMOVAL

1) Remove the 3 mm cotter pin and discard it.
2) Remove the 10 mm castle nut and washer.
3) Remove the propeller and thrust washer.



b. INSTALLATION

1) Apply marine grease to the spline and thread sections of the propeller shaft.
2) Install the thrust washer with the flange section toward the gear case.
3) Install the propeller and 10 mm washer onto the propeller shaft.
4) Tighten the 10 mm castle nut to the specified torque.

   TORQUE: 1 N·m (0.1 kgf·m, 0.7 lbf·ft)

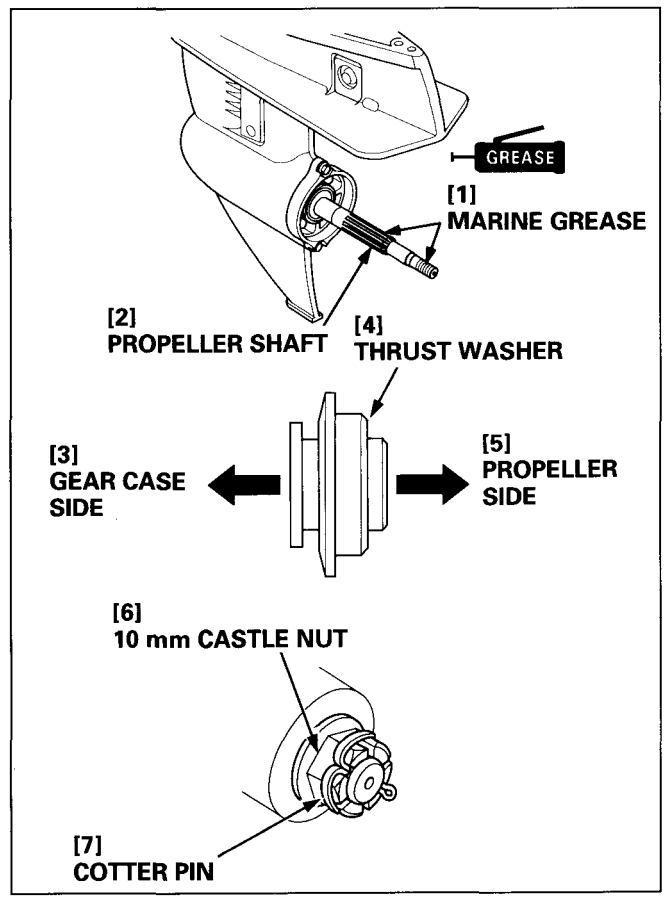
5) If the new cotter pin cannot be set, tighten the nut additionally until the cotter pin can be set.

   • Do not overtighten exceeding the maximum torque.

   MAX. TORQUE: 34 N·m (3.5 kgf·m, 25 lbf·ft)

6) Install a new cotter pin and bend the pin ends as shown to stake the castle nut as shown.

   • Be sure to use the genuine Honda part (stainless steel) or equivalent.



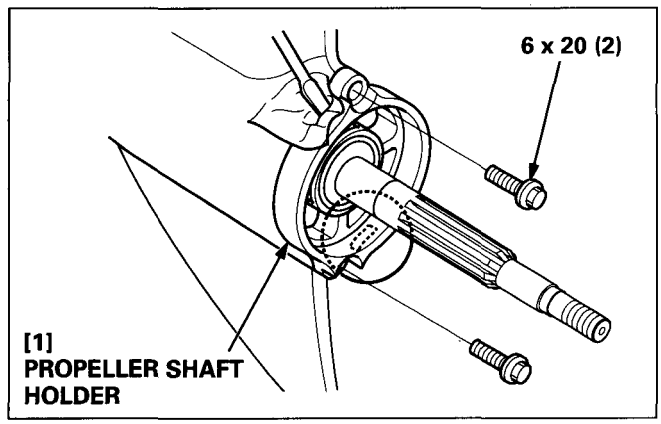
2. PROPELLER SHAFT HOLDER

a. REMOVAL

1) Remove the propeller (P. 4-2).

2) Set the gear in the neutral position and remove the two 6 x 20 mm flange bolts.

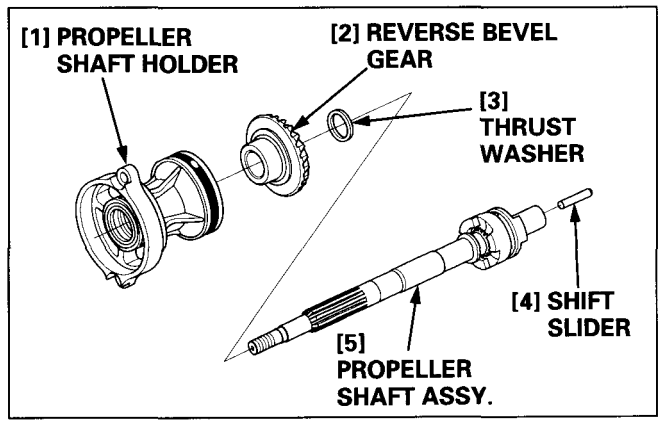
3) Using a screw drivers, remove the propeller shaft holder assembly with care not to damage the gear case.



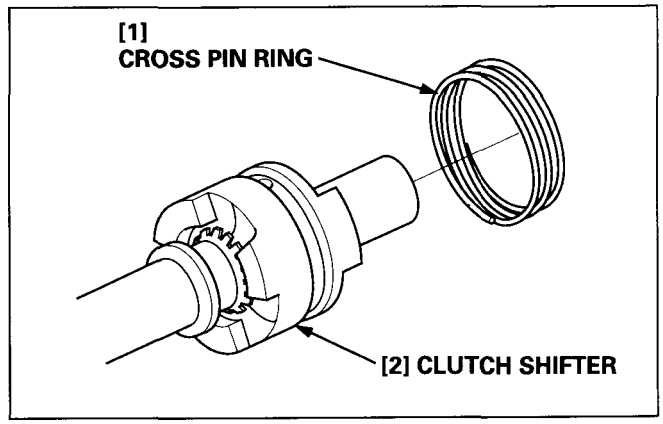
b. DISASSEMBLY

1) Remove the shift slider.

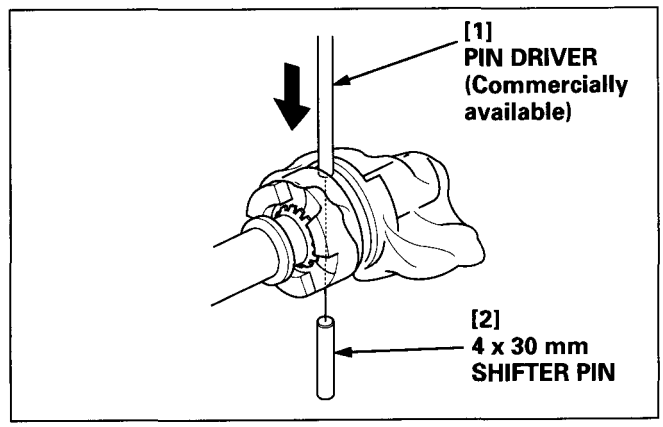
2) Remove the propeller shaft assembly, reverse bevel gear and thrust washer from the propeller shaft holder.



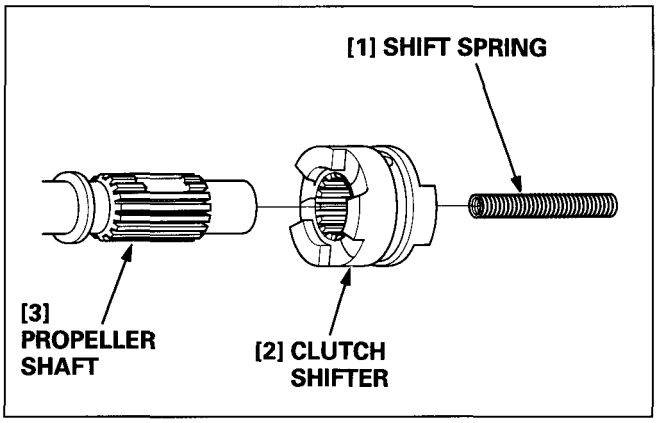
3) Remove the cross pin ring from the clutch shifter.



4) Drive out the 4 x 30 mm shifter pin using a commercially available 4 mm pin driver.



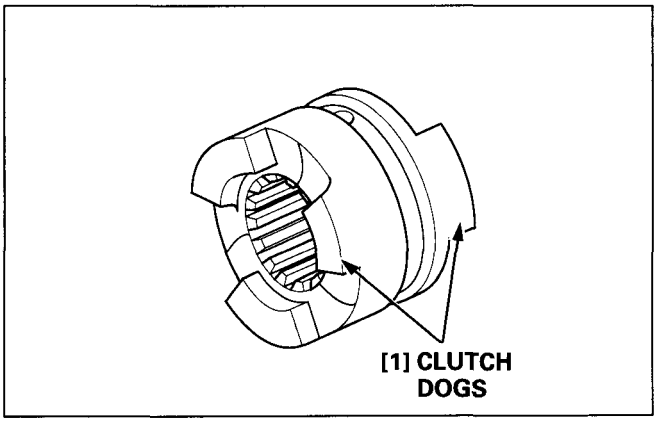
5) Remove the shift spring and clutch shifter from the propeller shaft.



c. INSPECTION

• CLUTCH SHIFTER

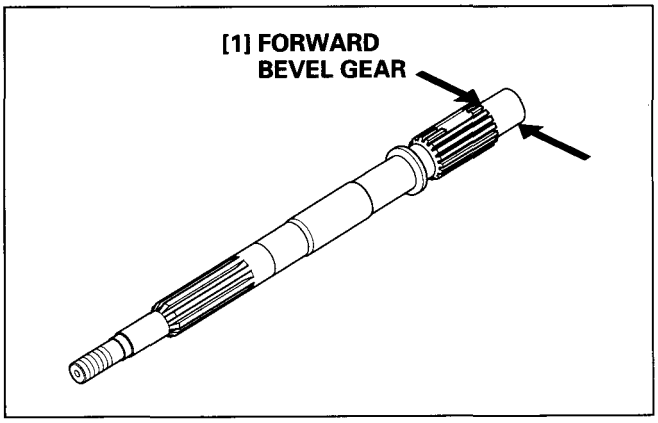
Check the clutch dogs for wear or damage.



• PROPELLER SHAFT

Measure the O.D. of the propeller shaft.

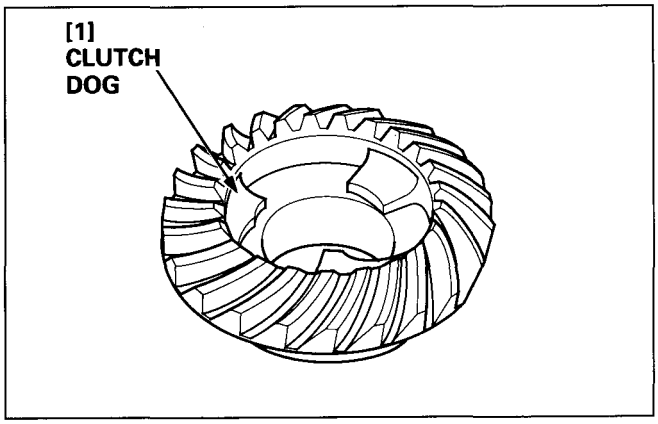
Standard	Service limit
16.973 – 16.984 mm (0.6682 – 0.6687 in)	16.95 mm (0.667 in)



• REVERSE BEVEL GEAR

Check the clutch dogs and gear teeth for wear or damage.

Replace as an assembly with the propeller shaft if necessary.



• BALL BEARING/WATER SEAL

1) Check the ball bearing by turning the inner race with your finger. Replace the ball bearing with new one if bearing inner race does not turn smoothly, quietly, or outer race fits very loose.

2) Inspect the needle bearing for wear or damage. Replace if necessary.

3) Inspect the water seal for damage or water leaks. Replace if necessary.

d. BALL BEARING REPLACEMENT

1) Remove the ball bearing using the bearing remover, and weight.

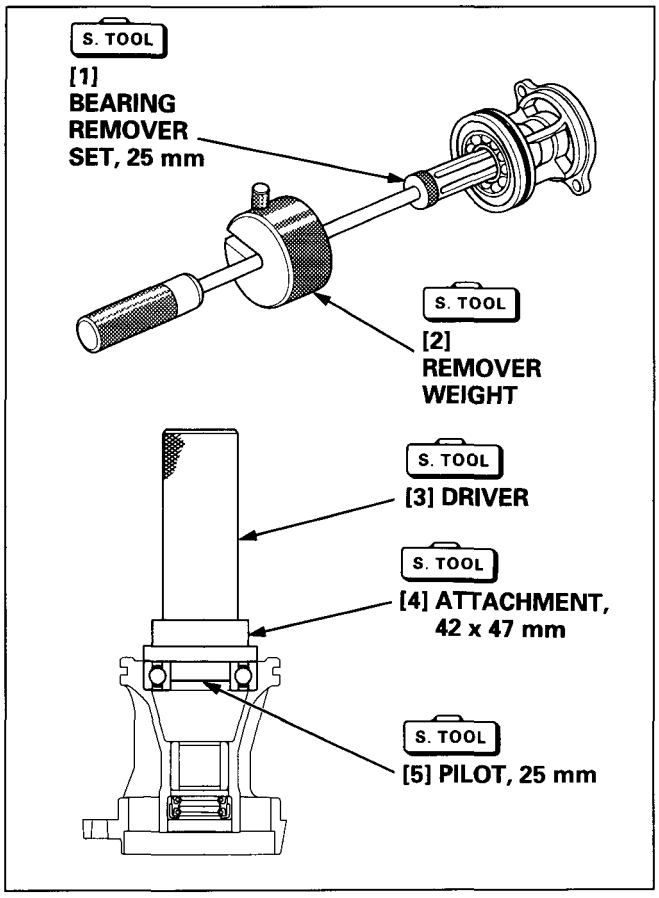
TOOLS:

Bearing remover set, 25 mm	**07936 – ZV10100**
Remover weight	**07741 – 0010201**

2) Install a new ball bearing using the driver, attachment, 42 x 47 mm and pilot, 25 mm.

TOOLS:

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



e. WATER SEAL REPLACEMENT

1) Remove the water seal from the propeller shaft holder using a commercially available seal remover.

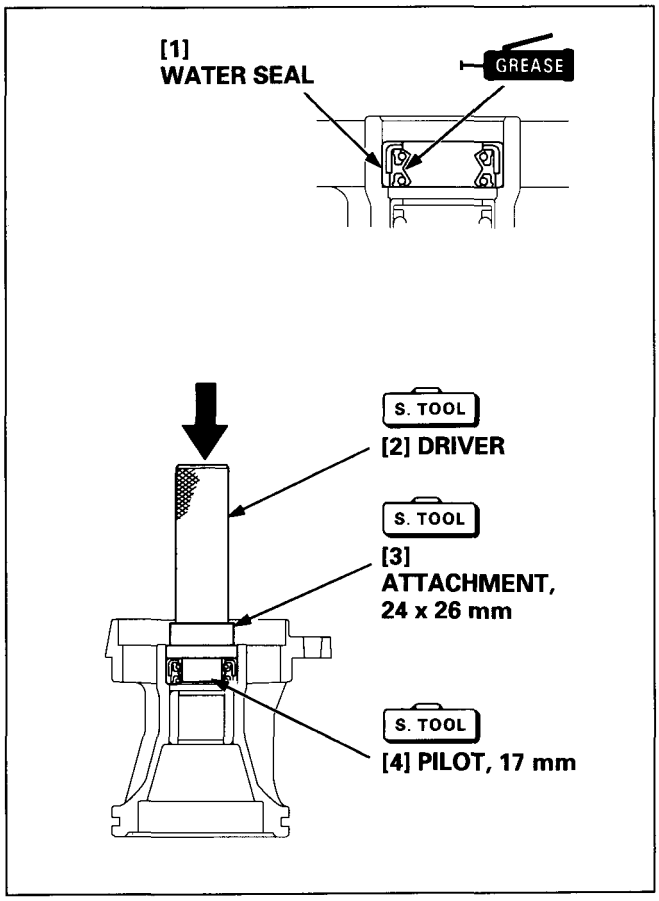
2) Clean the installation area of the propeller shaft holder and apply soapy water to the outside of a new water seal.

3) Install the new water seal using the driver, attachment 24 x 26 mm and pilot, 17 mm noting installation direction.

TOOLS:

Driver	**07749 – 0010000**
Attachment, 24 x 26 mm	**07746 – 0010700**
Pilot, 17 mm	**07746 – 0040400**

4) After installation, apply grease to the lip of the water seal.



f. NEEDLE BEARING REPLACEMENT

1) Remove the water seal from the propeller shaft holder using a commercially available seal remover.

2) Remove the needle bearing using the driver, attachment 22 x 24 mm and pilot, 17 mm.

TOOLS:

Driver	**07749 – 0010000**
Attachment, 22 x 24 mm	**07746 – 0010800**
Pilot, 17 mm	**07746 – 0040400**

3) Press in a new needle bearing with the driver, 14.5 x 18.5 mm and pilot 17 mm, using the hydraulic press.

- Set the pilot, 17 mm to the larger diameter side of the attachment as shown.

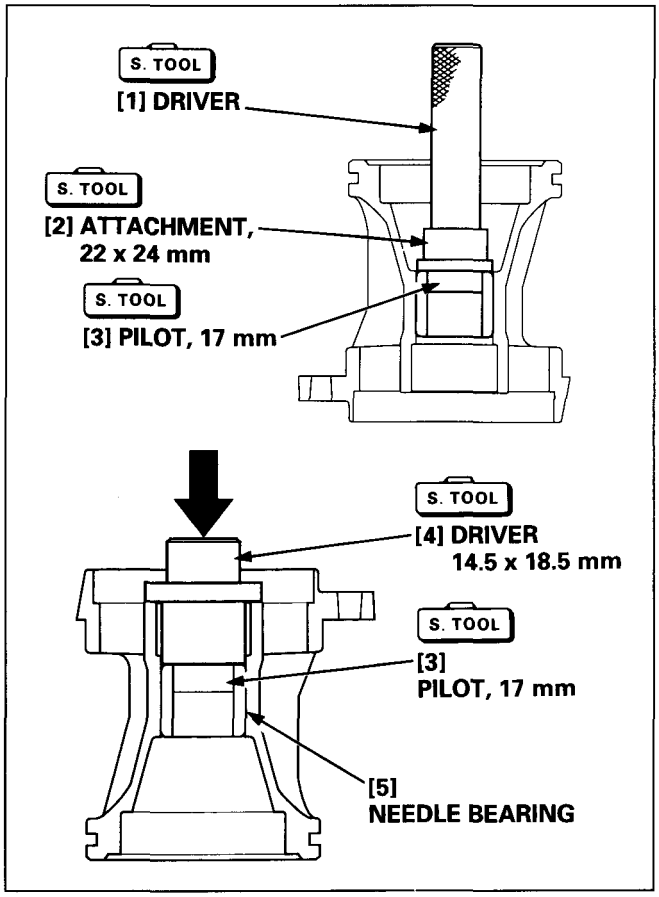
TOOLS:

Driver, 14.5 x 18.5 mm	**07ZPF – ZW90300**
Pilot, 17 mm	**07746 – 0040400**

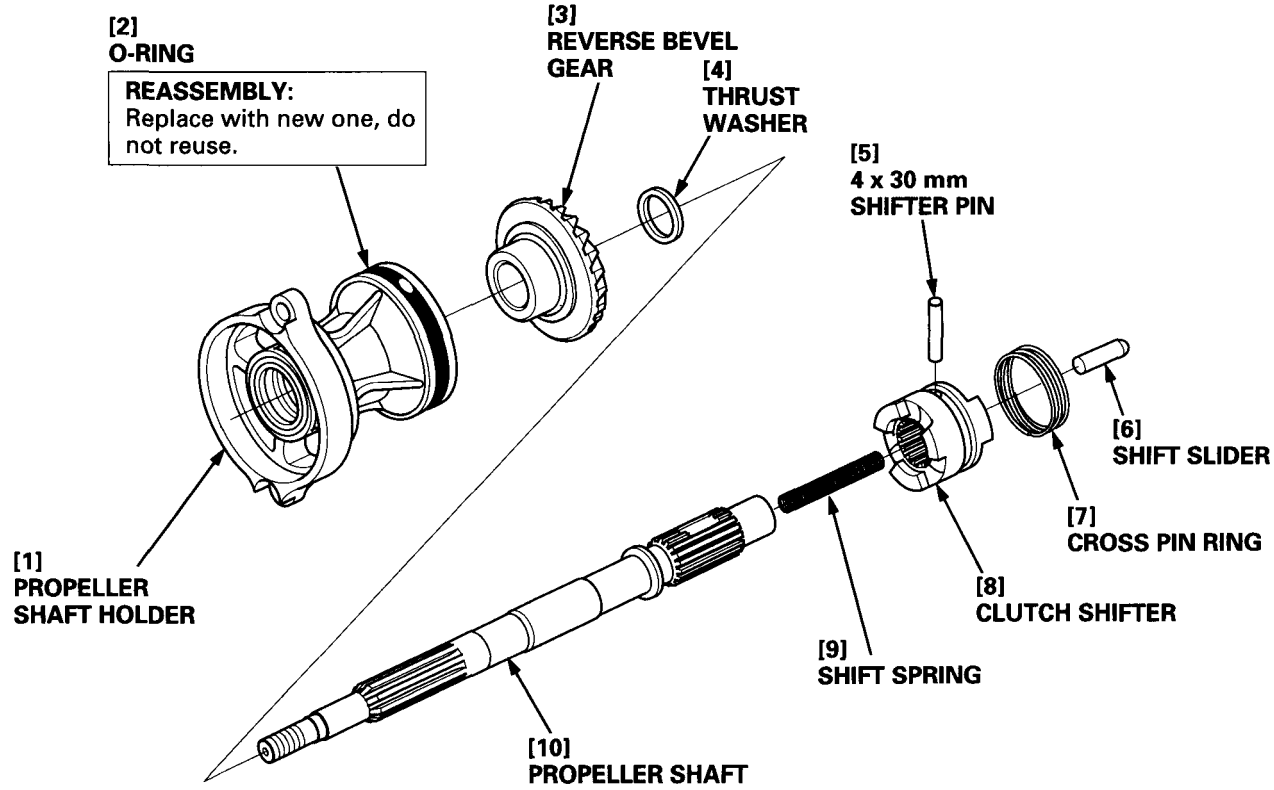
4) Install a new water seal using the driver, attachment, 24 x 26 mm and pilot, 17 mm noting installation direction (P. 4-5).

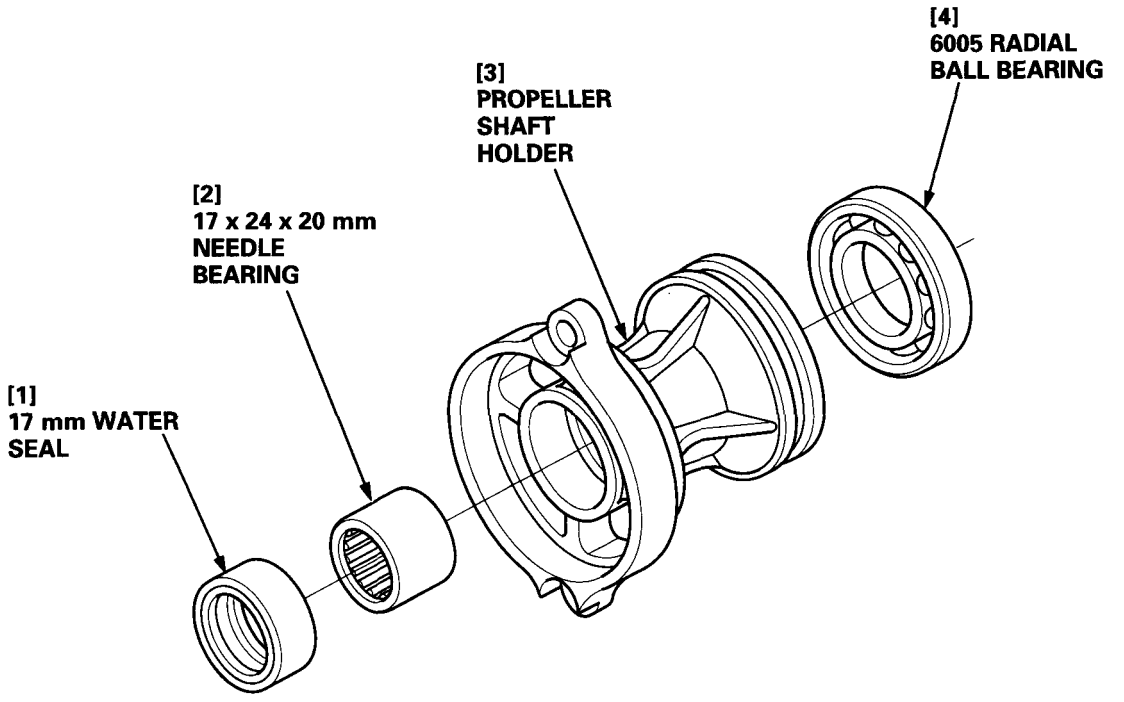
TOOLS:

Driver	**07749 – 0010000**
Attachment, 24 x 26 mm	**07746 – 0010700**
Pilot, 17 mm	**07746 – 0040400**



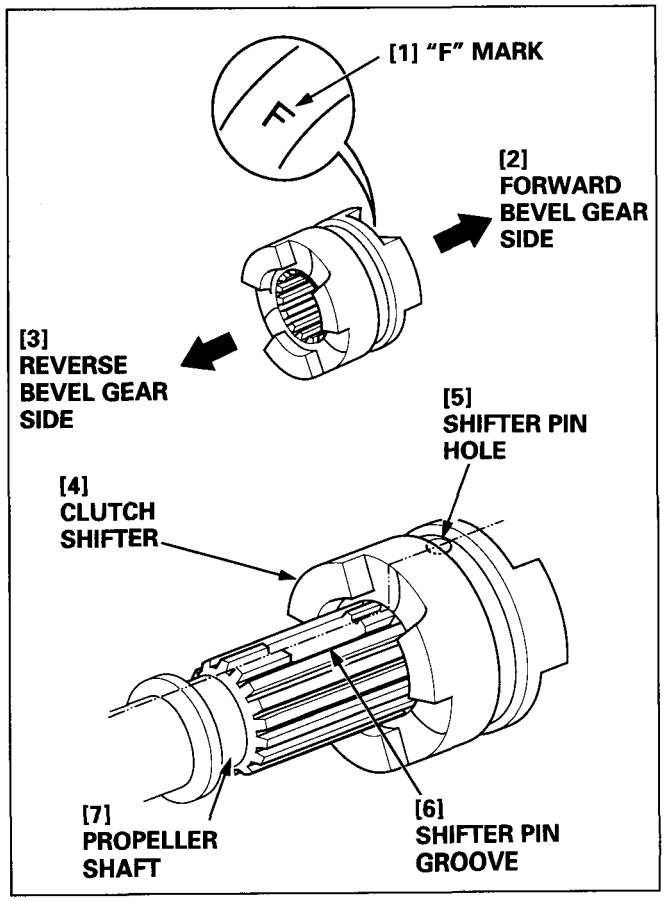
g. ASSEMBLY



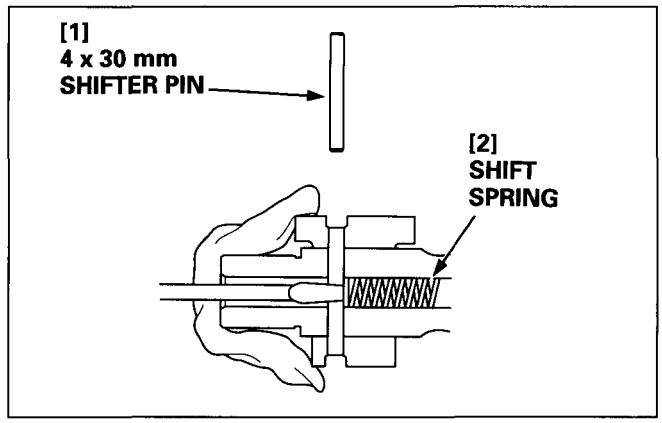


1) Install the clutch shifter with the "F" mark facing toward the forward bevel gear side and align the center of the clutch shifter pin hole with the shifter pin groove of the propeller shaft as shown.

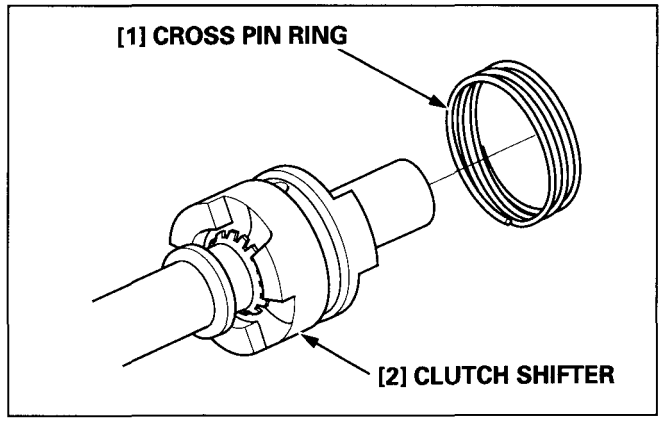
2) Install the shift spring into the propeller shaft.



3) Push the shift spring with a screw driver and install the 4 x 30 mm shifter pin.



4) Install the cross pin ring.

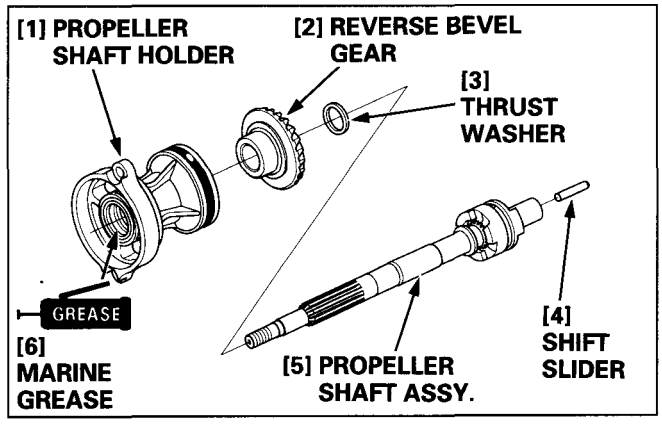


5) Apply marine grease to the water seal lips.

6) Install the reverse bevel gear to the ball bearing inner race of the propeller shaft holder.

7) Install the thrust washer onto the propeller shaft, then install them into the propeller shaft holder.

8) Install the shift slider.



h. INSTALLATION

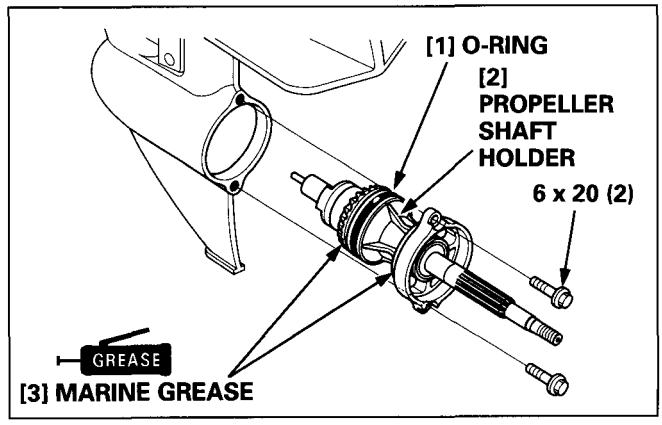
1) Install a new O-ring to the propeller shaft holder.

2) Apply marine grease to the O-ring and mating surfaces of the propeller shaft holder and gear case.

3) Install the propeller shaft holder assembly to the gear case and tighten the two 6 x 20 mm flange bolts to the specified torque.

TORQUE: 12 N·m (1.2 kgf·m, 9 lbf·ft)

4) After reassembly, add the recommended gear oil to the gear case (P. 3-6).



3. GEAR CASE ASSEMBLY

a. REMOVAL

1) Shift the gear into the "R" (reverse) position.

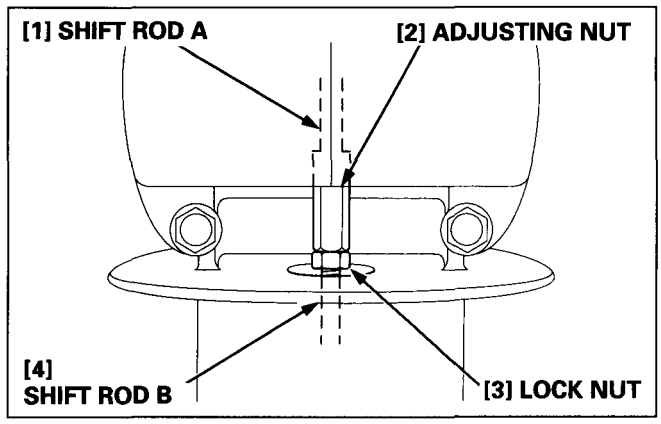
2) Loosen the lock nut and disconnect the shift rod B from the shift rod A by turning the adjusting nut.

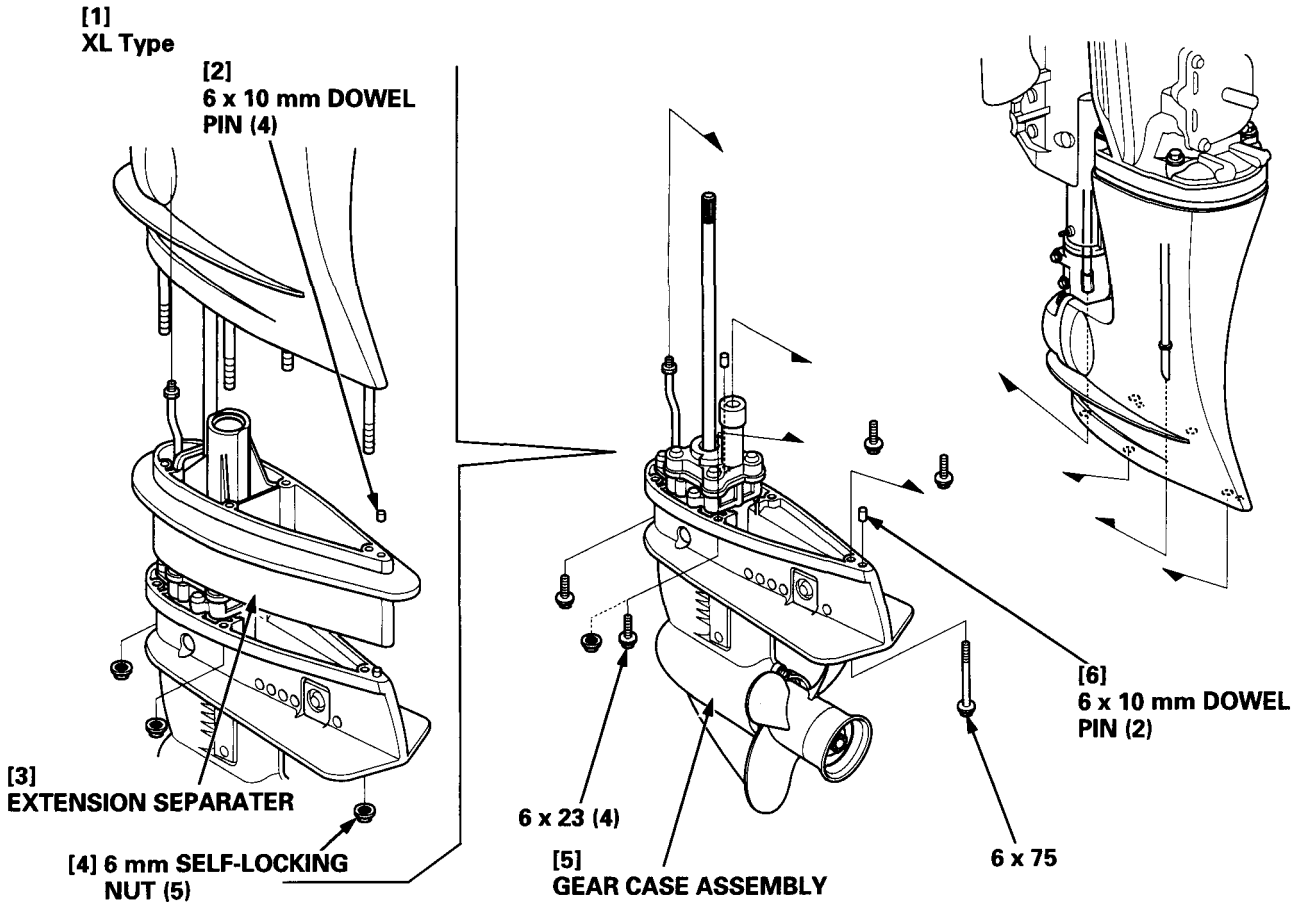
3) Tilt up the motor.

4) Remove the 6 mm flange bolts or 6 mm self-locking nuts.
   - S and L type:
     four 6 x 23 mm flange bolts and 6 x 75 mm flange bolt.
   - XL type:
     five 6 mm self-locking nuts.

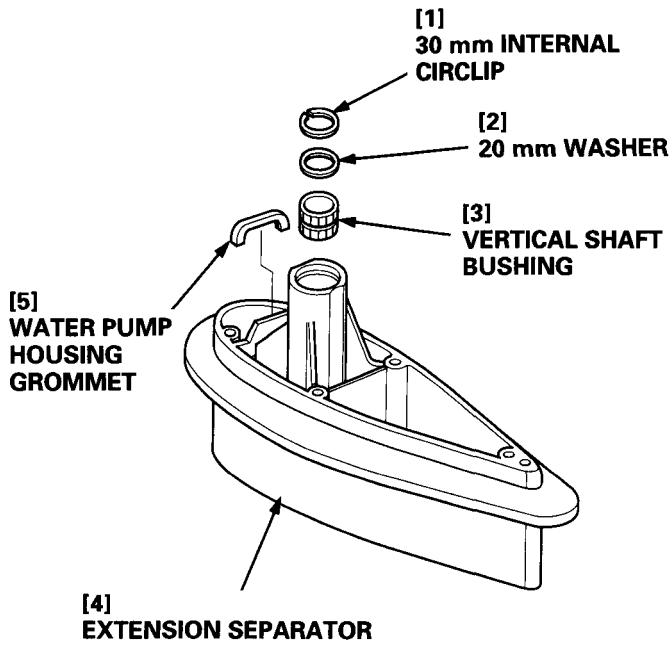
5) Remove the gear case and two 6 x 10 mm dowel pins.

   XL type only:
   Remove the extension separator and two 6 x 10 mm dowel pins.





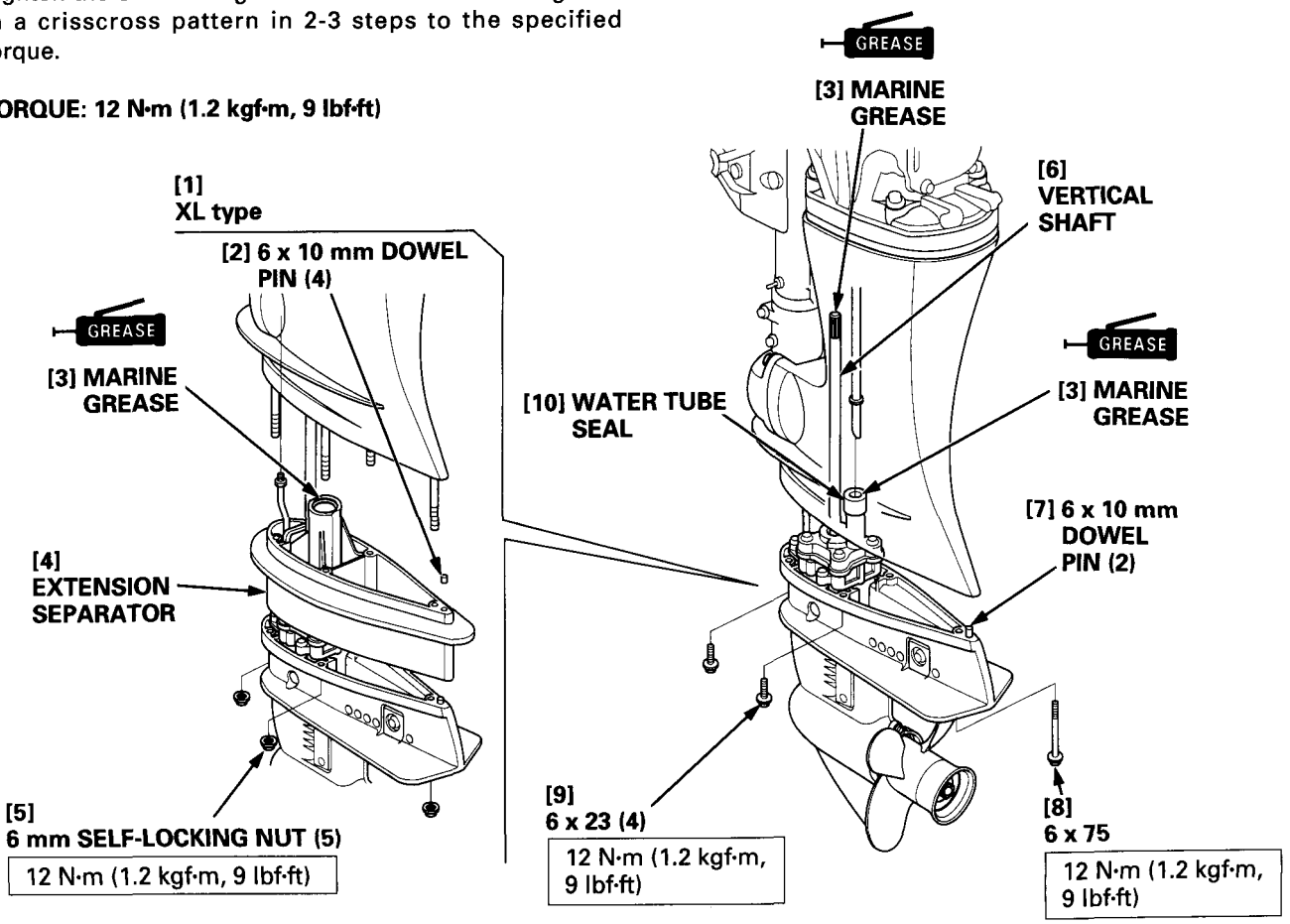
• **Extension Separator Disassembly/Reassembly**



b. INSTALLATION

1) Install the two 6 x 10 mm dowel pins on the gear case.
2) XL type only: Apply marine grease to the inside of the vertical shaft bushing and set the two 6 x 10 mm dowel pins on the extension separator. Set the extension separator onto the gear case.
3) Apply marine grease to the following position:
   — spline of the vertical shaft.
   — inside of the water tube seal.
4) Install the gear case assembly by aligning the vertical shaft spline with the crankshaft, and water tube with the water tube seal.
5) Loosely install the 6 mm flange bolts or 6 mm self-locking nuts.
6) Tighten the 6 mm flange bolts or 6 mm self-locking nuts in a crisscross pattern in 2-3 steps to the specified torque.

TORQUE: 12 N•m (1.2 kgf•m, 9 lbf•ft)



7) Make sure that the gear shift is in the "R" (reverse) position.

8) Turn the lock nut on the shift rod B to obtain 8 mm (0.3 in) from top of the shift rod B to top of the lock nut as shown.

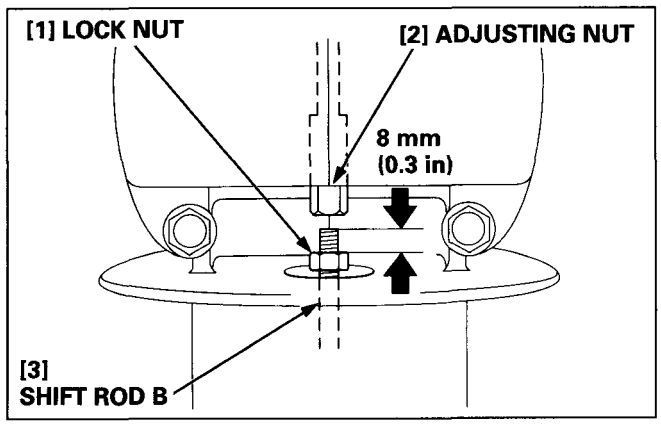
9) Make sure that the shift rod is in the reverse position and connect the shift rod B to the shift rod A by threading the adjusting nut until the adjusting nut comes in contact with the lock nut.

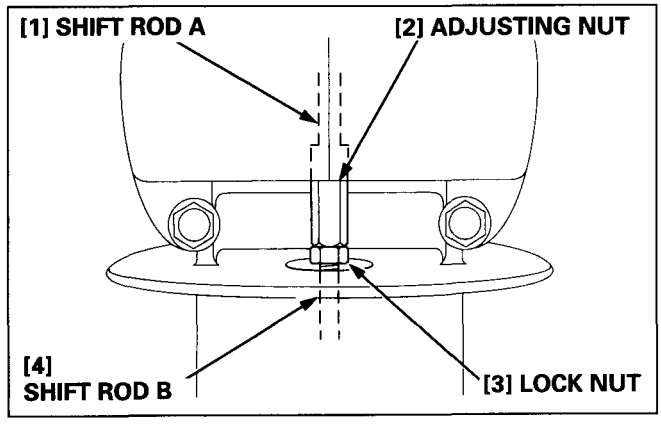
10) When the adjusting nut contacts the lock nut, tighten the lock nut by holding the adjusting nut.

TORQUE: 10 N·m (1.0 kgf·m, 7 lbf·ft)

11) After adjustment, be sure that the gearshift lever or remote control lever moves smoothly in all positions.

12) After reassembly, add the recommended gear oil to the gear case (P. 3-6).





4. WATER PUMP

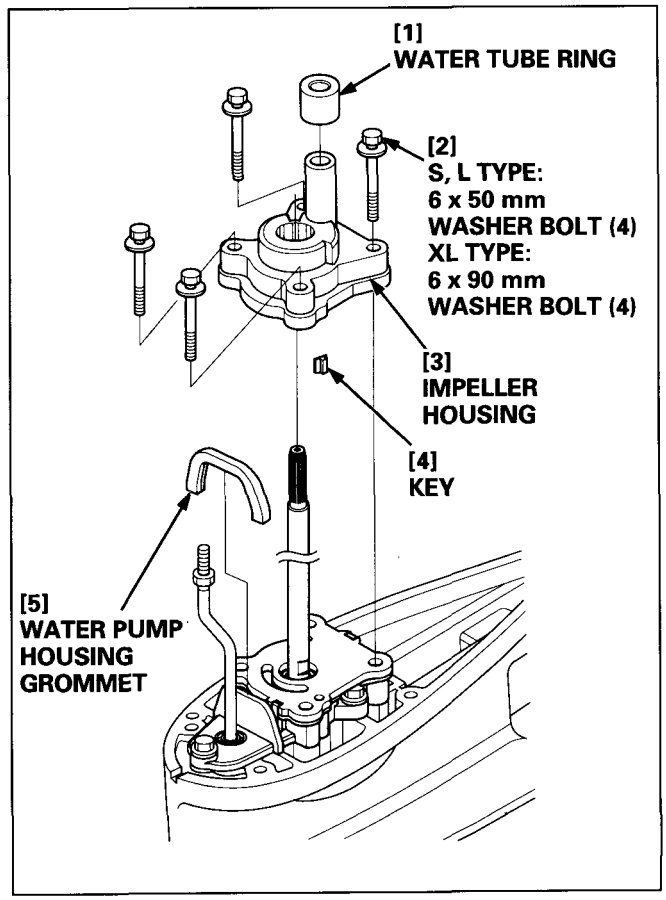
a. DISASSEMBLY

1) Remove the following:
   — propeller (P. 4-2).
   — propeller shaft holder (P. 4-3).
   — gear case assembly (P. 4-9).
   — extension separator (XL type only) (P. 4-9).

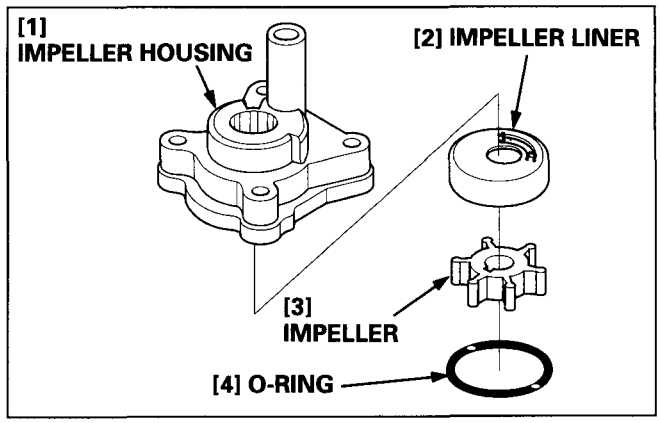
2) Remove the water tube seal ring and water pump housing grommet.

3) Remove the four 6 mm washer bolts and impeller housing.
   - S and L types:
     four 6 x 50 mm washer bolts
   - XL type:
     four 6 x 90 mm washer bolts

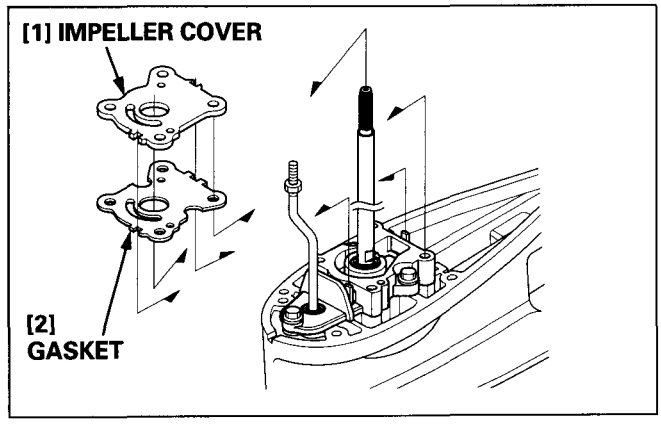
4) Remove the key from the vertical shaft.



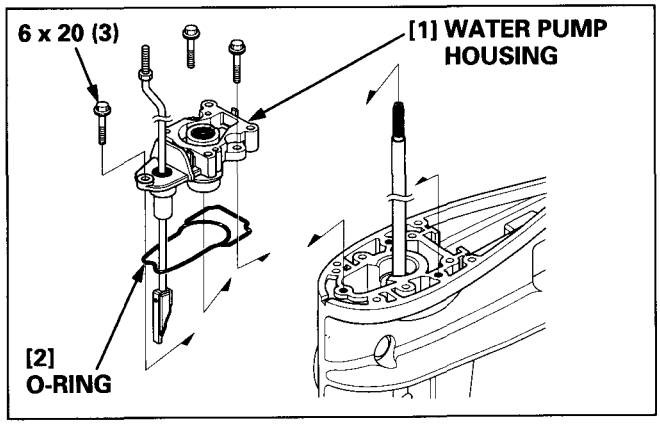
5) Remove the O-ring, pump impeller and impeller liner from the impeller housing.



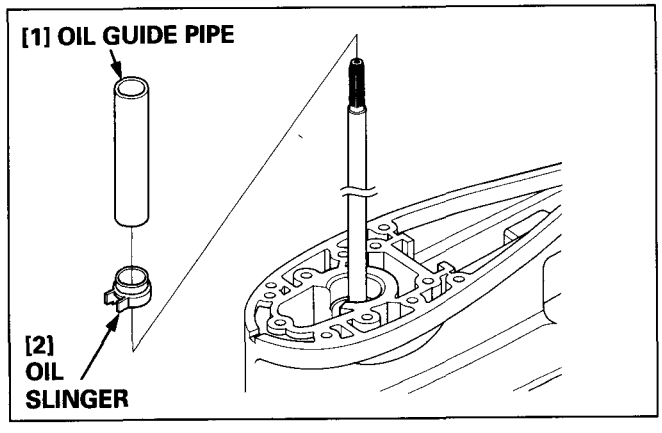
6) Remove the impeller cover and gasket.
   - Replace the gasket with a new one when the gasket is removed.



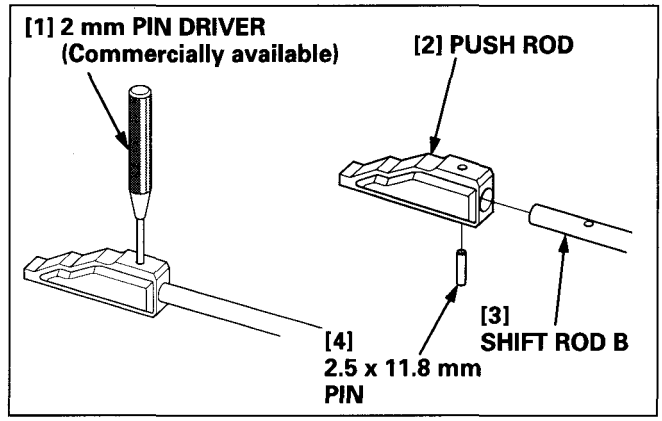
7) Remove the three 6 x 20 mm flange bolts, and remove the water pump housing and O-ring.



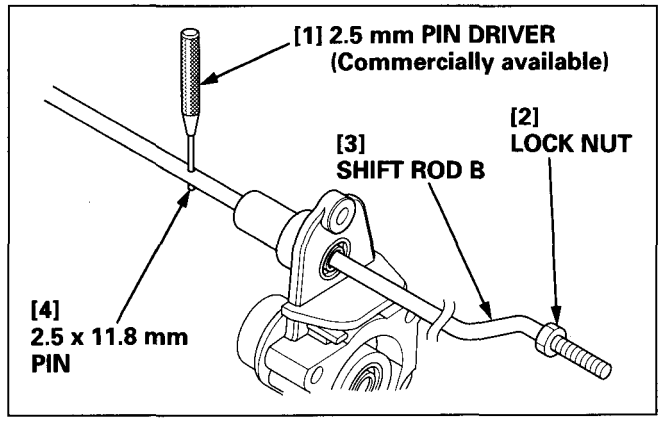
8) Remove the oil guide pipe and oil slinger.



9) Drive out the 2.5 x 11.8 mm pin using a commercially available pin driver, and remove the push rod from the shift rod B.



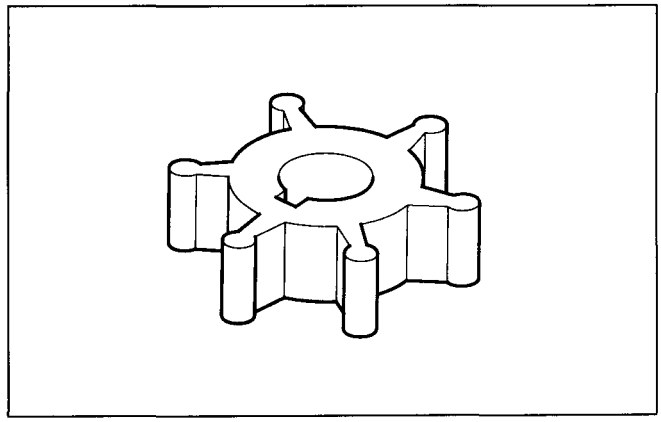
10) Drive out the 2.5 x 11.8 mm pin using commercially available pin driver, and remove the shift rod B from the water pump housing.



b. INSPECTION

• PUMP IMPELLER

Check the pump impeller for wear, damage or cracks, replace if necessary.

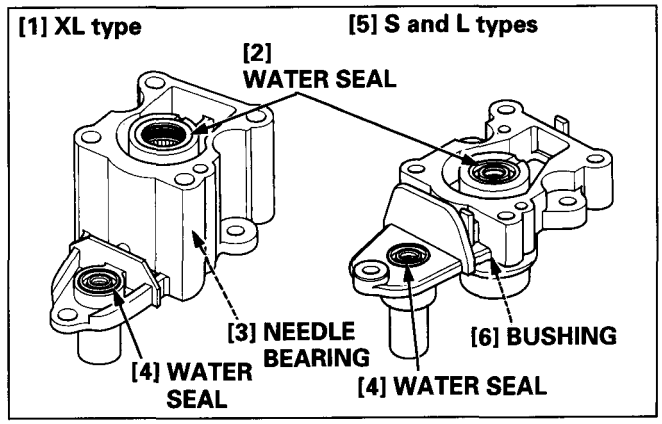


• WATER PUMP HOUSING

S and L types: Check the water seals and bushing for wear or damage.

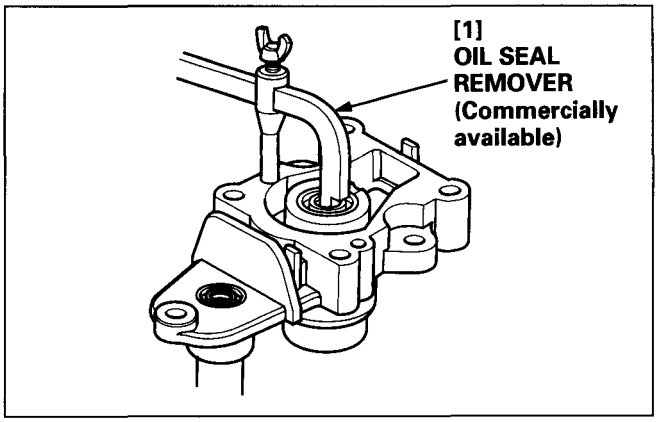
XL type: Check the water seals and needle bearing for wear or damage.

Replace if necessary (P. 4-14 and 15).



c. WATER SEAL REPLACEMENT

1) Remove the water seal using a commercially available oil seal remover.

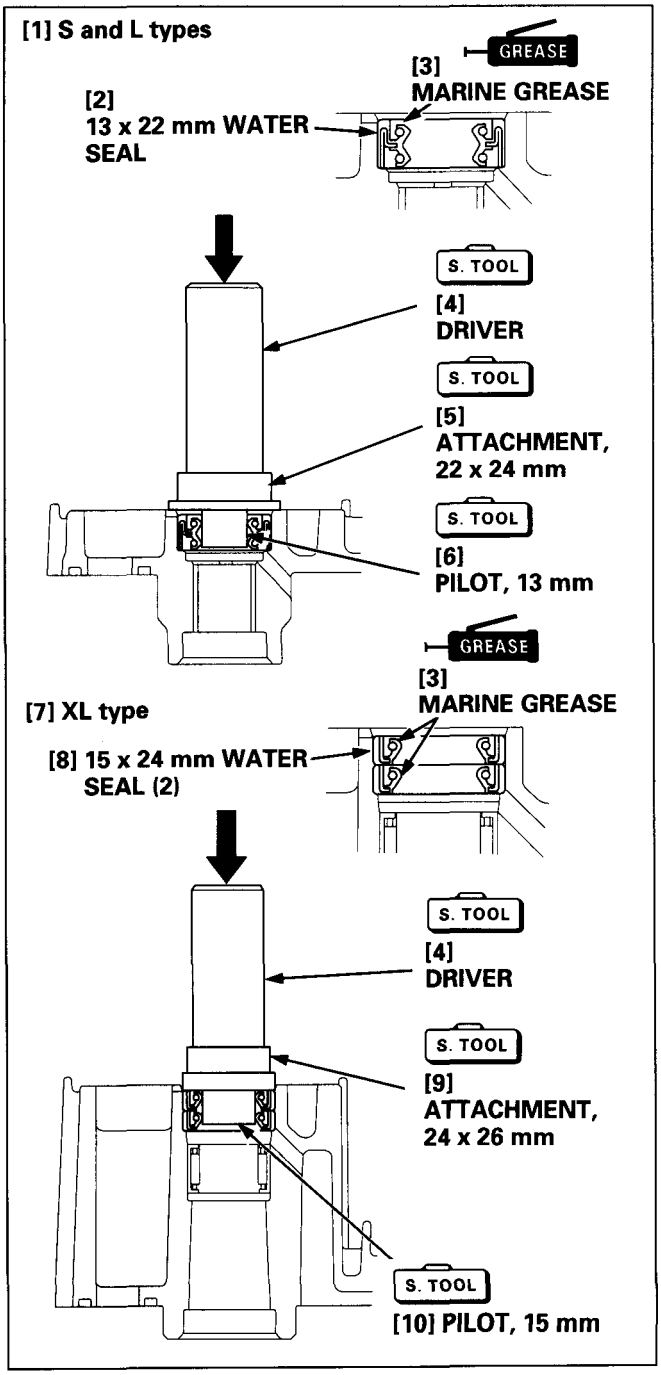


2) Apply soapy water to the outside of the new water seal(s), and install the water seal in the direction shown using the following tools.

TOOLS:

S and L types:	
Driver	**07749 – 0010000**
Attachment, 22 x 24 mm	**07746 – 0010800**
Pilot, 13 mm	**07746 – 0041500**
XL type:	
Driver	**07749 – 0010000**
Attachment, 24 x 26 mm	**07746 – 0010700**
Pilot, 15 mm	**07746 – 0040300**

3) After installation, apply marine grease to the lip of the water seal(s).



d. BUSHING REPLACEMENT (S and L types)

1) Remove the water seal (P. 4-14).

2) Set the tools as shown, and press out the bushing using a hydraulic press.

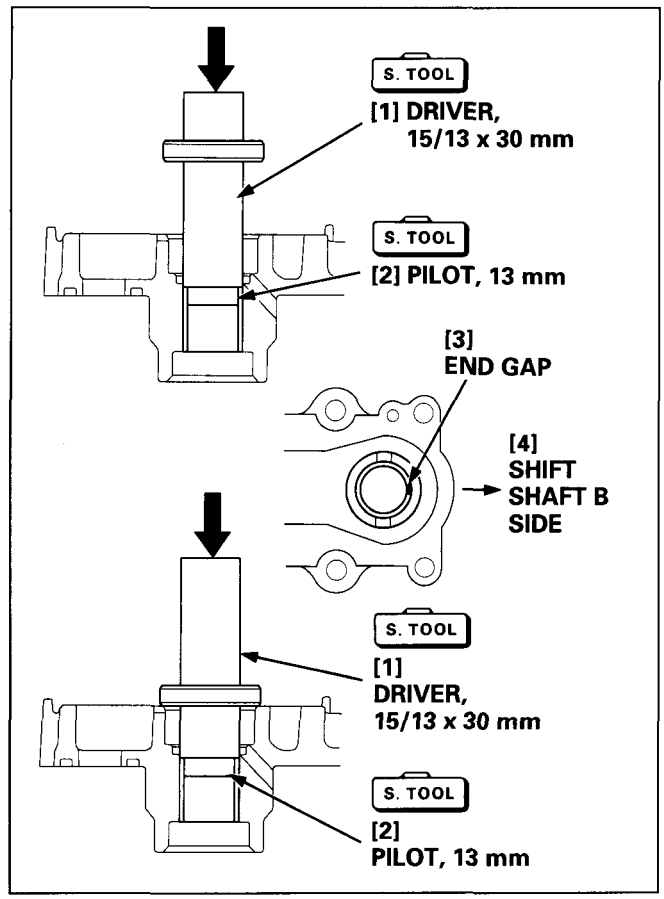
3) Apply gear oil to the outside of the new bushing and set the bushing and tools as shown.
   - Put the bushing on the impeller housing with the end gap facing to the shift rod B side as shown.

4) Press in the bushing using hydraulic press.

TOOLS:

Driver, 15/13 x 30 mm	**07ZPF – ZW90200**
Pilot, 13 mm	**07746 – 0041500**

5) Install a new water seal (P. 4-14).



e. NEEDLE BEARING REPLACEMENT (XL type)

1) Remove the water seals (P. 4-14).

2) Remove the needle bearing using the bearing remover.

TOOLS:

Bearing remover set, 15 mm	**07936 – KC10500**
Remover weight	**07741 – 0010201**

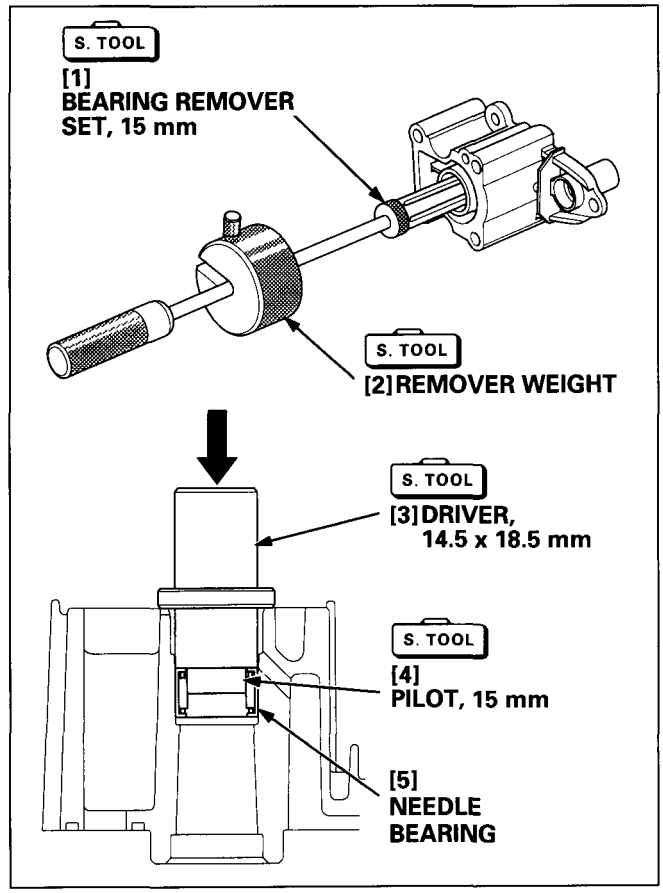
3) Apply gear oil to the outside of the new needle bearing and set the needle bearing and tools as shown.

4) Press in the needle bearing using hydraulic press.

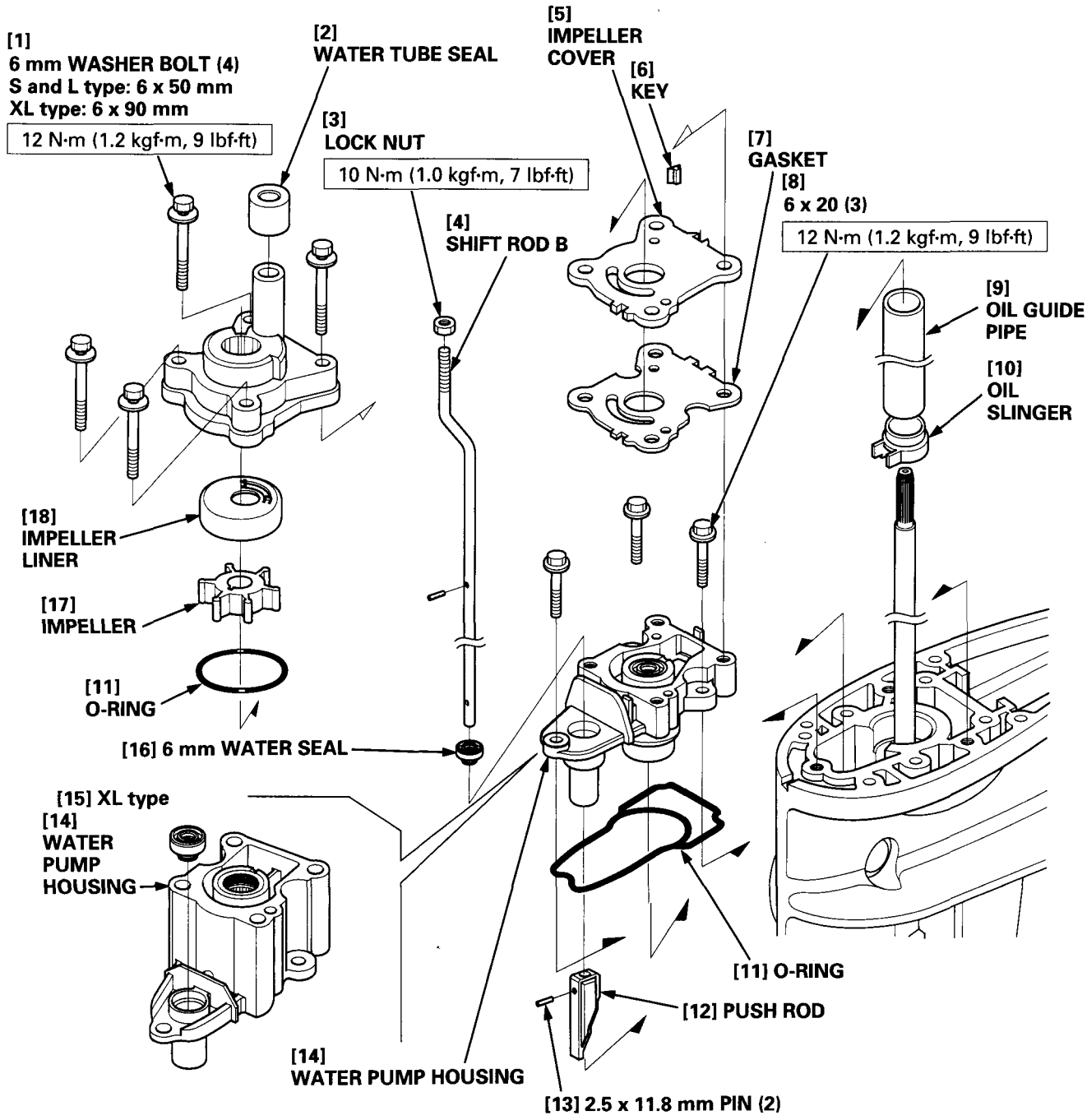
TOOLS:

Driver, 14.5 x 18.5 mm	**07ZPF – ZW90300**
Pilot, 15 mm	**07746 – 0040300**

5) Install a new water seals (P. 4-14).



f. ASSEMBLY

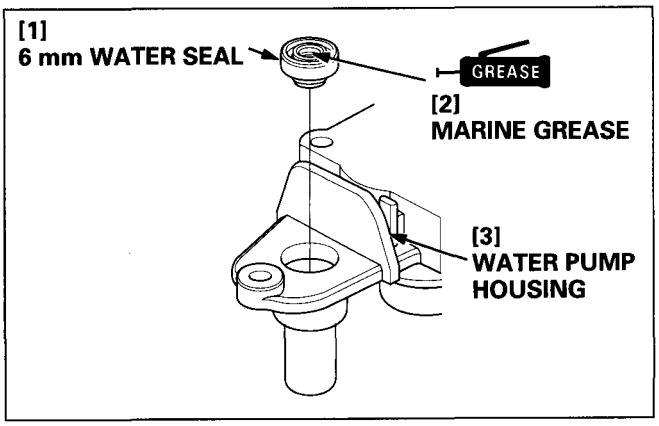


1) Install a new 6 mm water seal, if it was removed;

   a. Clean off any grease or oil from the water seal installation area of the water pump housing.

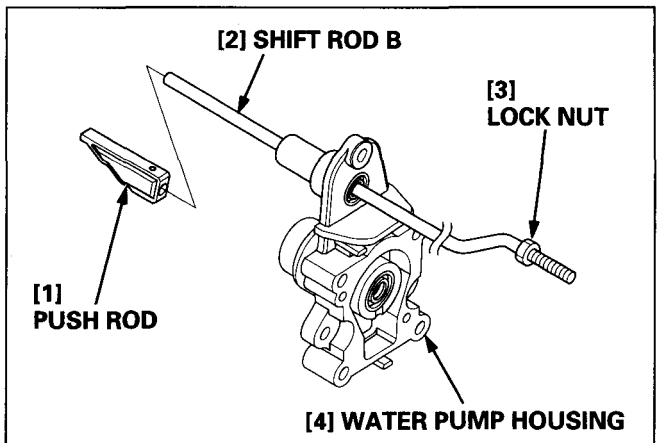
   b. Apply soapy water to the outside of the water seal and install it securely.

2) Apply marine grease to the lip of the water seal.

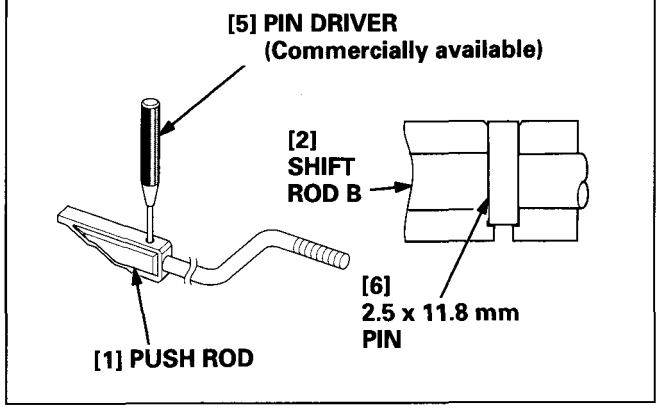


3) Install the lock nut to the shift rod B and install the shift rod B to the water pump housing.

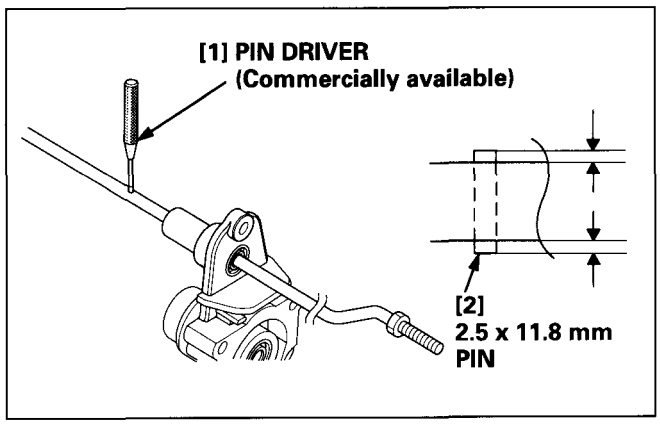
4) Place the shift rod B as shown and set the push rod to the shift rod B noting the installation direction.



5) Align the pin holes of the push rod with the pin hole of the shift rod B, and drive the 2.5 x 11.8 mm pin in from the chamfer side using a commercially available pin driver.

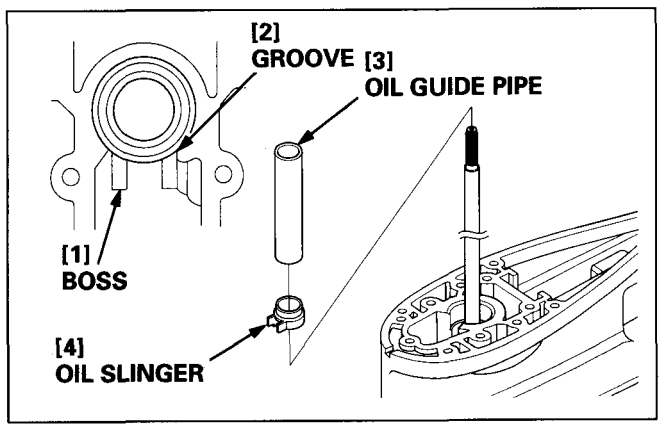


6) Install the 2.5 x 11.8 mm pin to the shift rod B as shown using a commercially available pin driver.
   - The projected length of both ends of the pin should be equal.



7) Install the oil slinger into the gear case by aligning the boss with the groove of the gear case as shown.

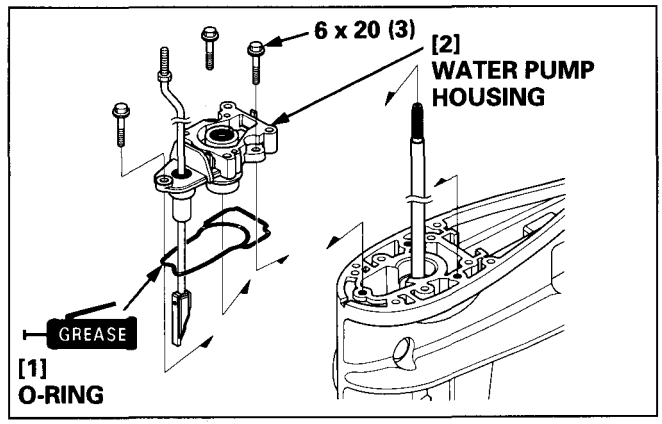
8) Install the oil guide pipe.



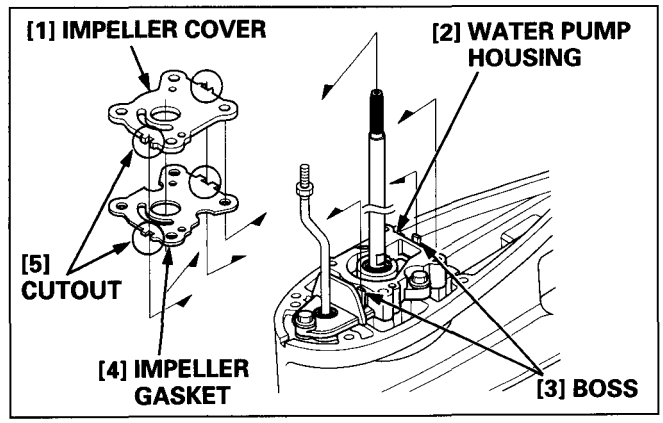
9) Apply marine grease to the O-ring and install the O-ring to the water pump housing.

10) Install the water pump housing assembly to the gear case with the shift slider contacting surface facing toward the propeller side as shown and tighten the four 6 x 20 mm flange bolts.

TORQUE: 12 N•m (1.2 kgf•m, 9 lbf•ft)

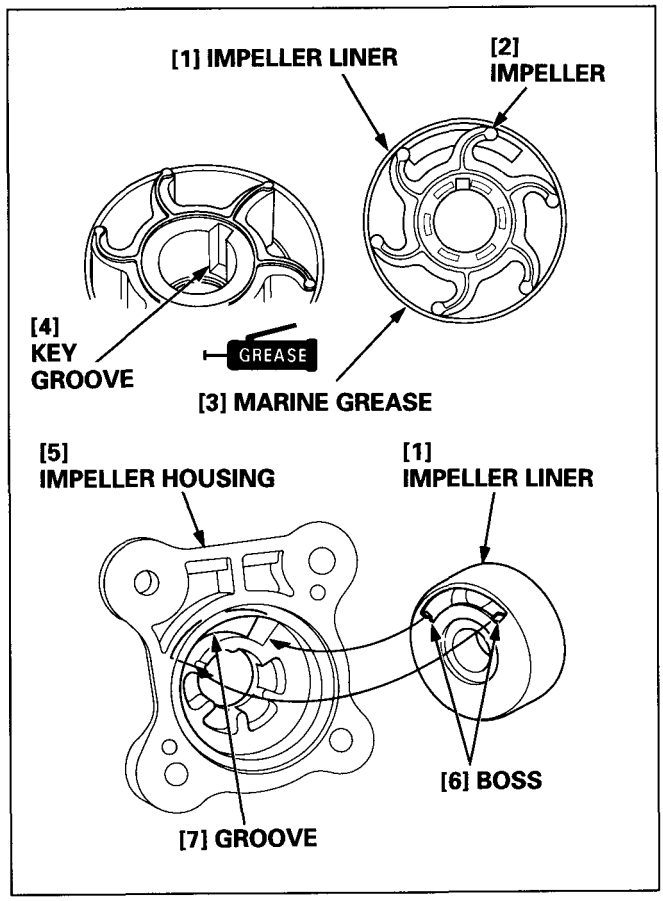


11) Install the impeller gasket and impeller cover by aligning the cutout with the boss of the water pump housing.



12) Apply marine grease to the inside of the impeller liner, and install the impeller by turning it counterclockwise with the open end of the key groove toward the bottom of the motor. Align the holes of the impeller and pump liner.

13) Apply thin coat of grease to the outside of the liner to hold it in the impeller housing. Install the pump liner and impeller as an assembly by aligning the tabs of the liner with the groove of the impeller housing.



14) Apply marine grease to a new O-ring and install it in the impeller housing.

15) Apply thin coat of grease to the key setting groove of the vertical shaft and set the key.

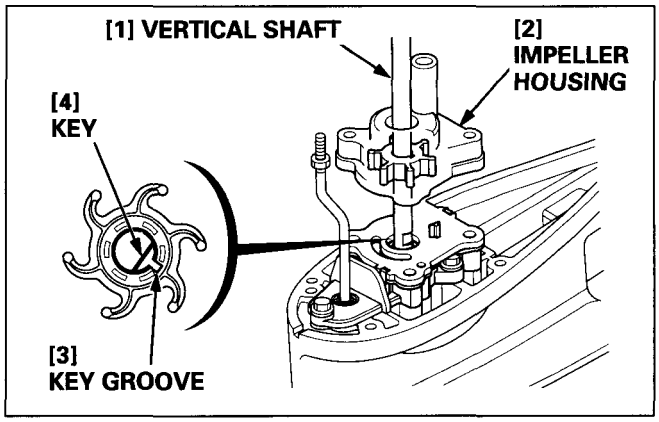
16) Install the impeller housing assembly by aligning the key groove of the impeller with the key on the vertical shaft by turning the vertical shaft clockwise taking care not to allow the key to come off from the vertical shaft.

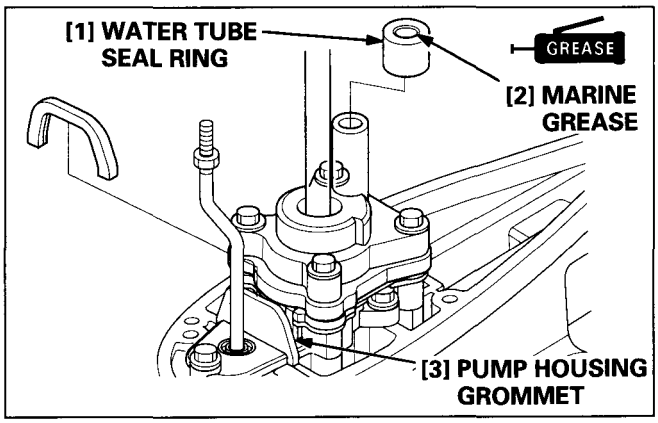
17) Install the 6 mm washer bolts (S and L type 6 x 50 mm, XL type 6 x 90 mm) and tighten the bolts to the specified torque.

TORQUE: 11 N•m (1.1 kgf•m, 8 lbf•ft)

18) Apply marine grease to the inside of the water tube seal ring and install it to the impeller housing. Install the water pump housing grommet.

19) Install the following:
— gear case assembly (P. 4-10 and 11)
— propeller shaft holder (P. 4-8).
— propeller (P. 4-2).





5. VERTICAL SHAFT/BEVEL GEAR

a. DISASSEMBLY

1) Remove the following:
— propeller (P. 4-2)
— propeller shaft holder (P. 4-3).
— gear case assembly (P. 4-9)
— water pump (P. 4-11).

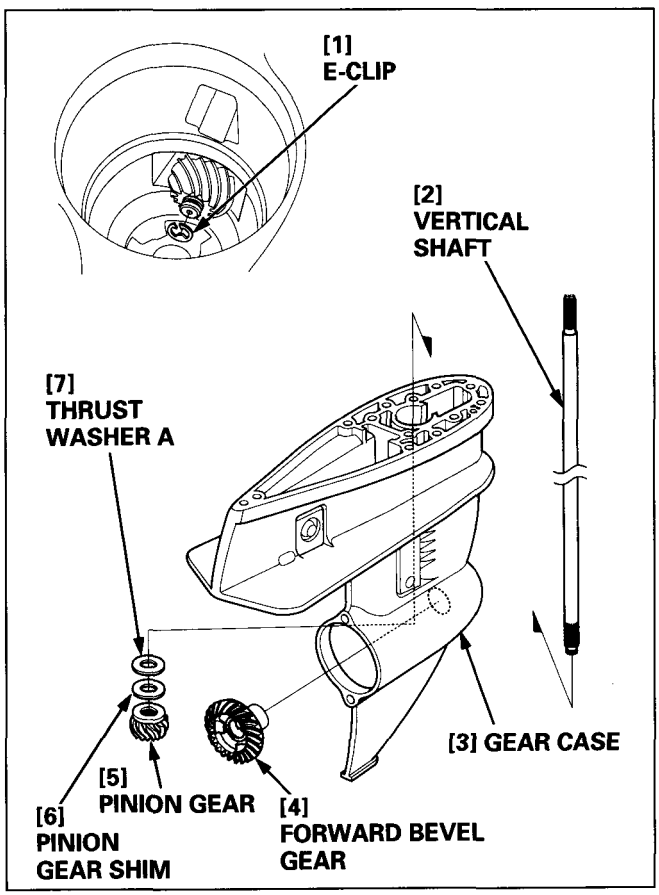
2) Remove the 8 mm E-clip from the vertical shaft and discard it. Replace with new one when reassembly.

3) Remove the vertical shaft.

4) Remove the pinion gear, pinion gear shim, thrust washer and vertical shaft.

5) Remove the forward bevel gear.

- When replacing the gear case, vertical shaft, pinion gear and/or forward bevel gear, select the shim according to the shim selection on page 4-23.



b. INSPECTION

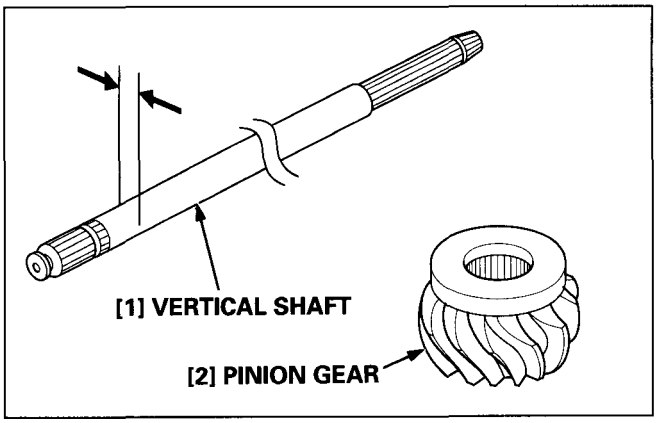
• VERTICAL SHAFT/PINION GEAR

1) Check the pinion gear for wear or damage, replace if necessary.

2) Check the mating section of the vertical shaft and pinion gear for wear or damage, replace if necessary.

3) Measure the O.D. of the vertical shaft at the needle bearing or bushing section. If the measurement is lower than the service limit, replace the vertical shaft and check the bushing or needle bearing in the gear case and water pump housing (P. 4-13).

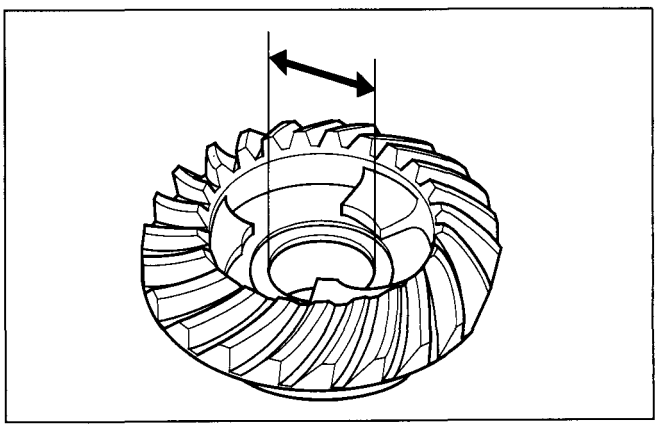
	Standard	Service limit
S and L types	12.975 – 12.995 mm (0.5108 – 0.5116 in)	12.96 mm (0.510 in)
XL type	14.989 – 15.000 mm (0.5901 – 0.5906 in)	14.97 mm (0.589 in)



• FORWARD BEVEL GEAR

Check the clutch dogs and gear for wear or damage. Measure I.D. of the gear.

Standard	Service limit
17.000 – 17.018 mm (0.6693 – 0.6700 in)	17.04 mm (0.671 in)



• BEARING

S and L types: Check the ball bearing by turning the inner race with your finger. Replace the ball bearing with new one if the bearing inner race does not turn smoothly or quietly.

XL type: Check the taper roller bearing. Replace the bearing with new one if it is worn or damaged. Check the needle bearing for wear or damage. Replace if necessary.

c. PROPELLER SHAFT BEARING REPLACEMENT

S and L types

1) Remove the ball bearing using the bearing remover and discard it. Remove the shim from the gear case.

TOOLS:

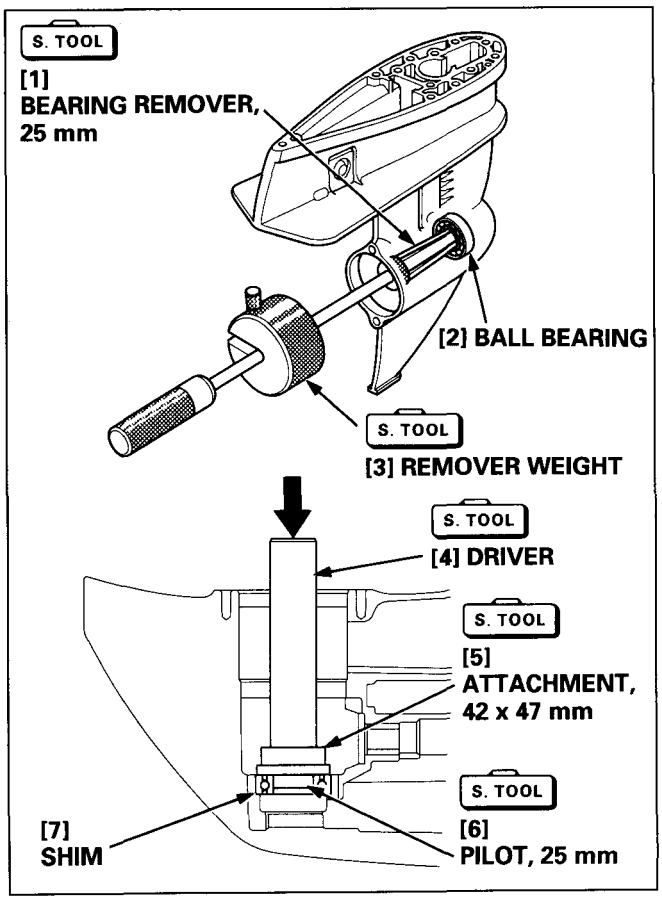
Bearing remover set, 25 mm	**07936 – ZV10100**
Remover weight	**07741 – 0010201**

2) Select the shim (P. 4-23).

3) Apply gear oil to the outside of the new ball bearing. Place the shim to the gear case. Drive in the ball bearing.

TOOLS:

Driver	**07949 – 3710001**
Attachment, 42 x 47 mm	**07746 – 0010300**
Pilot, 25 mm	**07746 – 0040600**



• **XL type**

1) Before removing the bearing outer race, replace the jaw of the bearing race puller with the 25 mm puller jaw as shown.
2) Set the bearing race puller to the bearing outer race and remove the bearing outer race. Then, remove the 40 mm shim.

TOOLS:

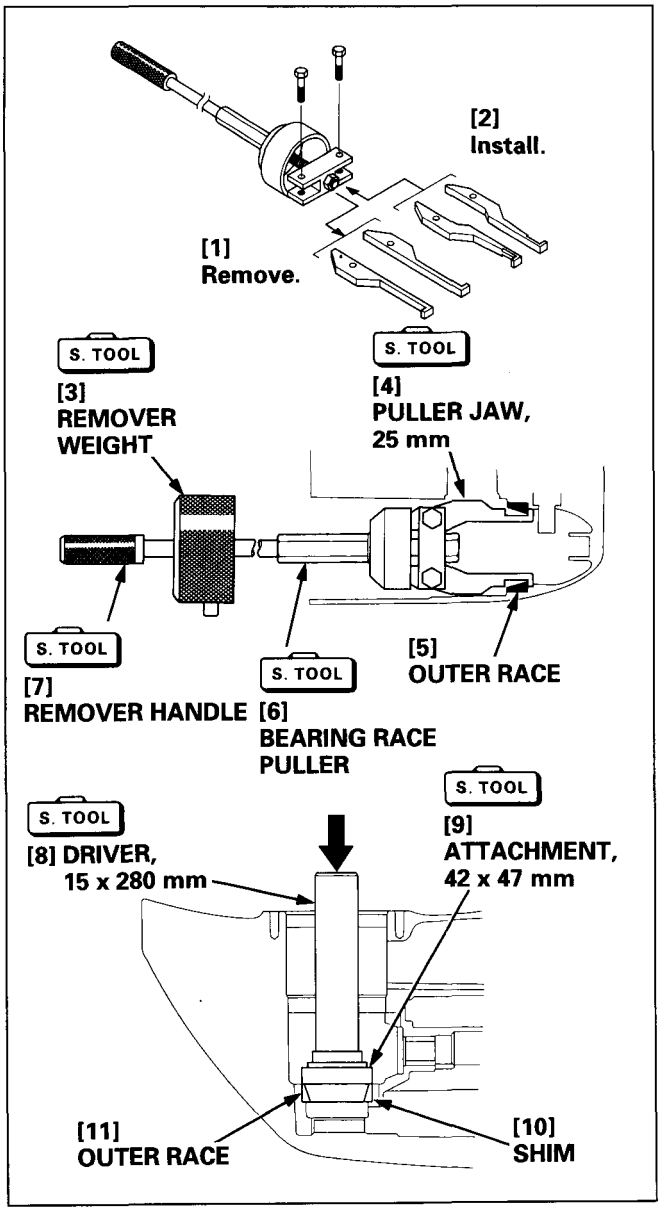
Bearing race puller	**07LPC – ZV30100**
Remover weight	**07741 – 0010201**
Remover handle	**07936 – 3710100**
Puller jaw, 25 mm	**07WPC – ZW50100**

3) Select the shim (P. 4-23).

4) Apply gear oil to the outside of a new bearing outer race. Place the shim to the gear case. Drive the bearing outer race into the gear case with the larger I.D. side toward out.

TOOLS:

Driver, 15 x 280 mm	**07949 – 3710001**
Attachment, 42 x 47 mm	**07746 – 0010300**

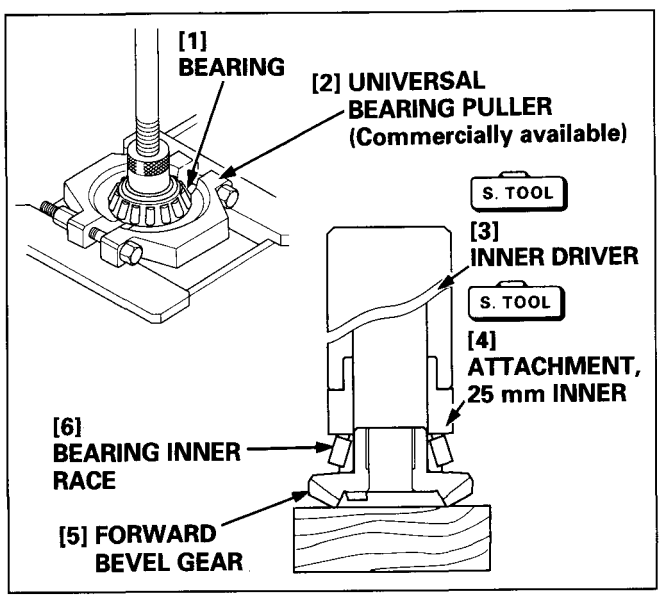


5) Remove the taper roller bearing from the forward bevel gear using a commercially available universal bearing puller.

6) Apply gear oil to the inside of a new bearing inner race. Drive the bearing inner race into the forward bevel gear using a hydraulic press.

TOOLS:

Inner driver	**07746 – 0030100**
Attachment, 25 mm inner	**07746 – 0030200**

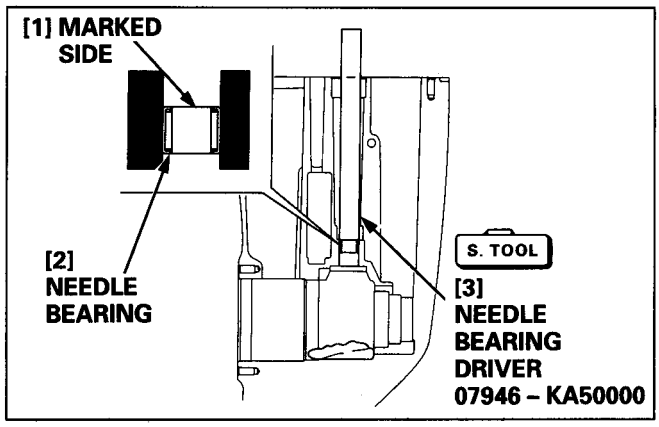


d. NEEDLE BEARING REPLACEMENT (XL type)

1) Set the driver and mark the gear case upper surface position on the driver as shown.

2) Drive out the needle bearing and discard it.

3) Drive in a new needle bearing to the marked position with the marked side toward out.

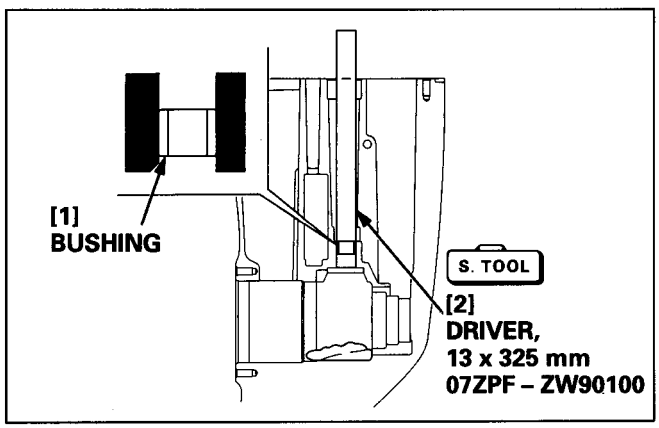


e. BUSHING REPLACEMENT (S and L types)

1) Set the driver and mark the gear case upper surface position on the driver as shown.

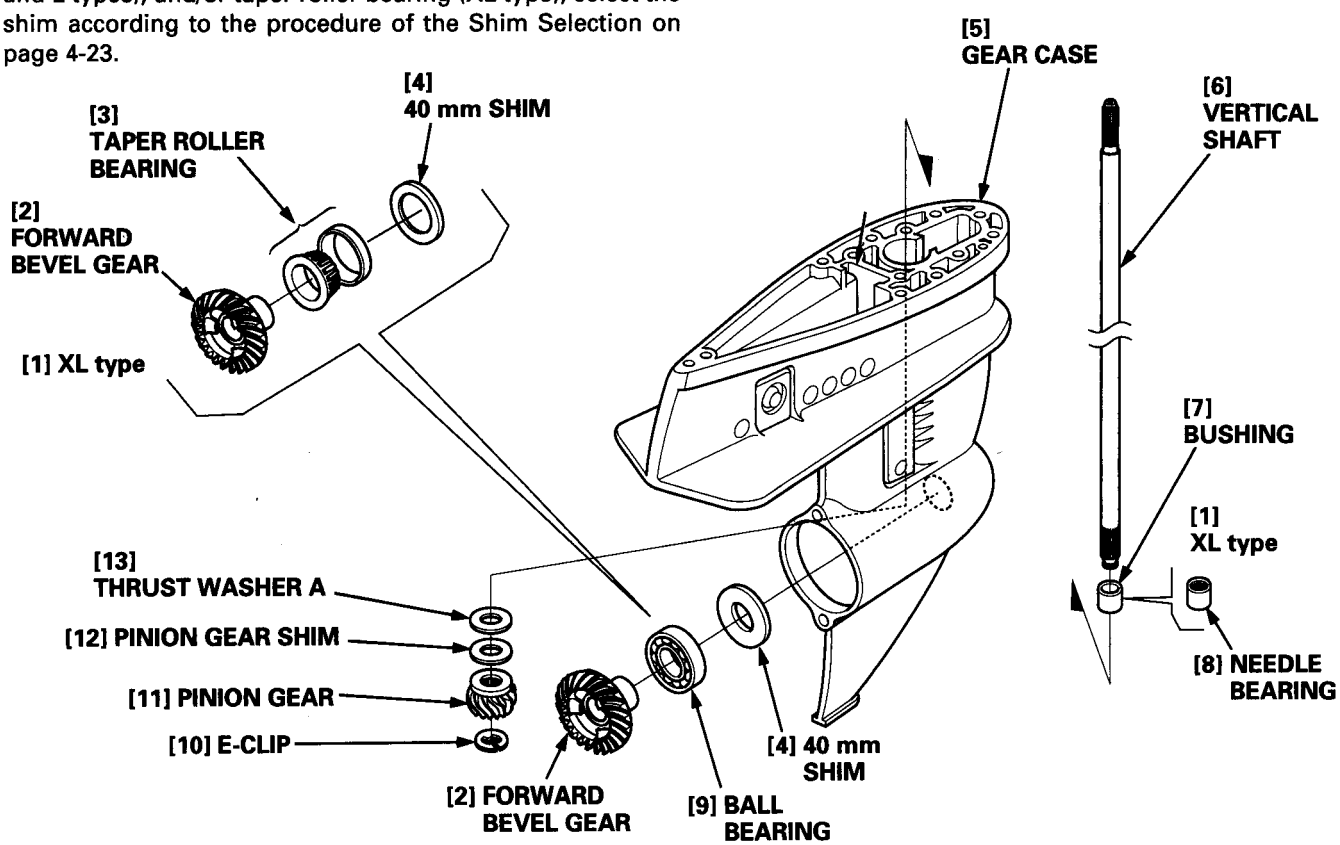
2) Drive out the bushing and discard it.

3) Drive in a new bushing to the marked position.



f. ASSEMBLY

When replacing the gear case, vertical shaft, ball bearing (S and L types), and/or taper roller bearing (XL type), select the shim according to the procedure of the Shim Selection on page 4-23.



1) Clean off oil or grease from the spline section of the vertical shaft lower end and pinion gear I.D.

2) Install the forward bevel gear to the gear case.

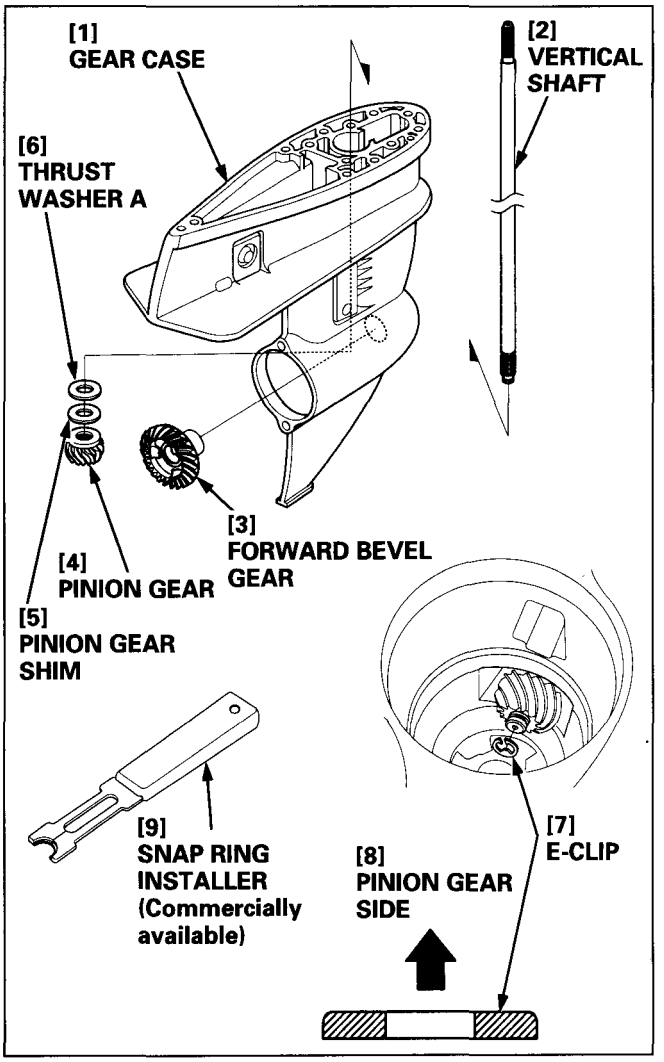
3) Install the vertical shaft into the gear case.

4) Install the pinion gear shim, and thrust washer A and pinion gear.

5) Install a new E-clip with cham fered edges facing the pinion gear side, using a commercially available snap ring installer taking care not to bend or deform the E-clip.
   • Do not reuse the removed E-clip.

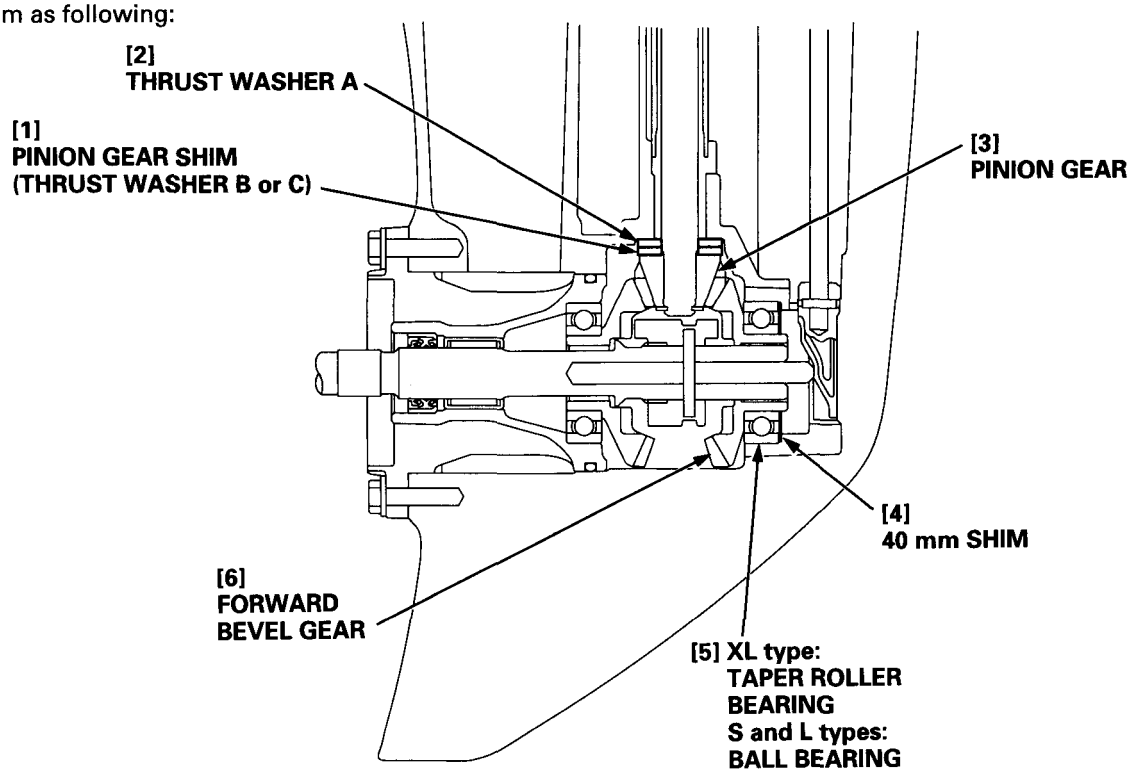
6) Install the following:
   — water pump (P. 4-16).
   — propeller shaft holder (P. 4-8).
   — propeller (P. 4-2).

7) Install the gear case assembly (P. 4-10).



g. SHIM SELECTION

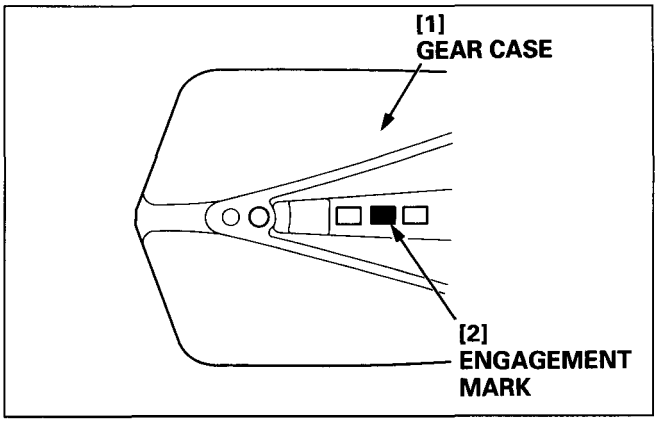
When replacing the gear case, vertical shaft, ball bearing (S and L types), and/or taper roller bearing (XL type), select the shim as following:



• THRUST WASHER

Select the shim (thrust washer B or C) according to the engagement mark on the gear case.

Engagement mark	Thrust washer	Thickness
B	Thrust washer B	2.53 mm (0.100 in)
C	Thrust washer C	2.56 mm (0.101 in)



• 40 mm SHIM

S and L types:

Select the 40 mm shim according to the engagement mark on the gear case.

Engagement mark	Shim type	Thickness
1	Shim A	0.08 mm (0.003 in)
2	Shim B	0.10 mm (0.004 in)
3	Shim C	0.12 mm (0.005 in)

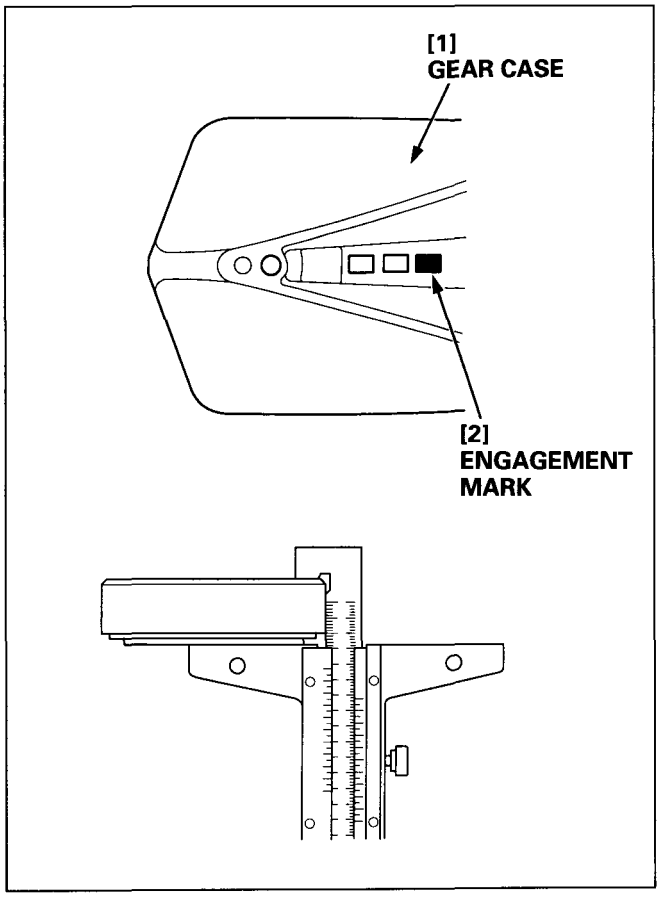
XL type:

1) Clean the taper roller bearing.

2) Assemble the outer race and inner race of the taper roller bearing and turn the outer race 2 – 3 turns. Then measure the bearing height from the outer race end to the inner race end as shown and record the measurement.

3) Cross-reference the bearing height and engagement mark on the gear case, and select the shim(s) of the appropriate thickness from the shim selection table.

Shim type	Thickness
Shim A	0.08 mm (0.003 in)
Shim B	0.10 mm (0.004 in)
Shim C	0.12 mm (0.005 in)
Shim D	0.15 mm (0.006 in)



Shim Selection Table (Shim thickness and selection example)

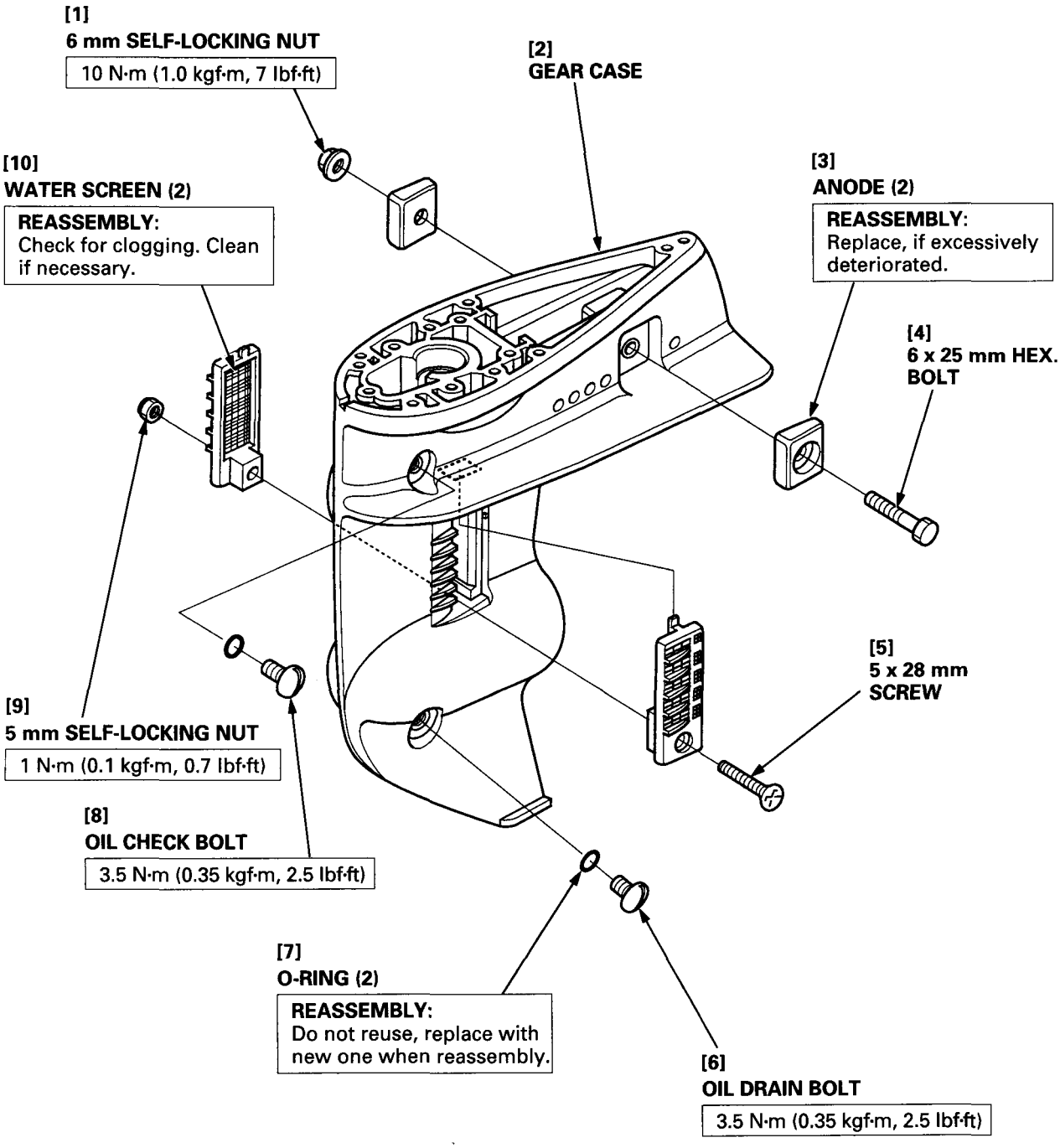
unit: mm (in)

Bearing height / Engagement mark	15.15 – 15.20 (0.596 – 0.598)	15.10 – 15.15 (0.594 – 0.596)	15.05 – 15.10 (0.593 – 0.594)	15.00 – 15.05 (0.591 – 0.593)	14.95 – 15.00 (0.589 – 0.591)	14.90 – 14.95 (0.587 – 0.589)	14.85 – 14.90 (0.585 – 0.587)	14.80 – 14.85 (0.583 – 0.585)
3	0.15 mm D x 1	0.18 mm A x 1, B x 1	0.24 mm C x 2	0.28 mm A x 1, B x 2	0.34 mm B x 1, C x 2	0.38 mm A x 1, D x 2	0.44 mm A x 1, C x 3	0.48 mm C x 4
2	0.12 mm C x 1	0.16 mm A x 2	0.22 mm B x 1, C x 1	0.27 mm C x 1, D x 1	0.32 mm B x 2, C x 1	0.36 mm C x 3	0.42 mm C x 1, D x 2	0.46 mm B x 1, C x 3
1	0.10 mm B x 1	0.15 mm D x 1	0.20 mm B x 2	0.24 mm C x 2	0.30 mm D x 2	0.34 mm B x 1, C x 2	0.40 mm B x 1, D x 2	0.44 mm A x 1, C x 3

6. GEAR CASE/ANODE/WATER SCREEN

a. DISASSEMBLY/REASSEMBLY

The anodes and water screens can be serviced with the gear case mounted on the outboard motor.

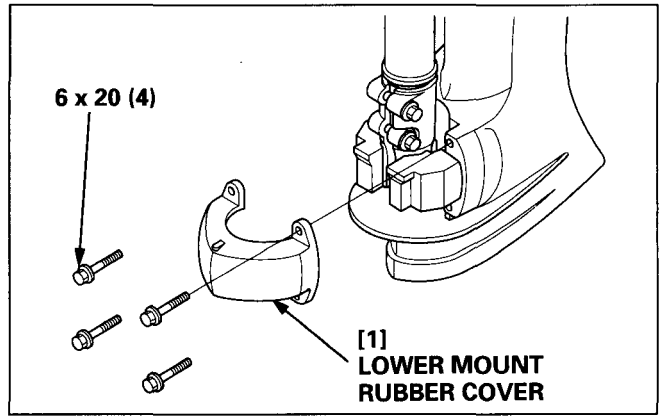


7. EXTENSION CASE

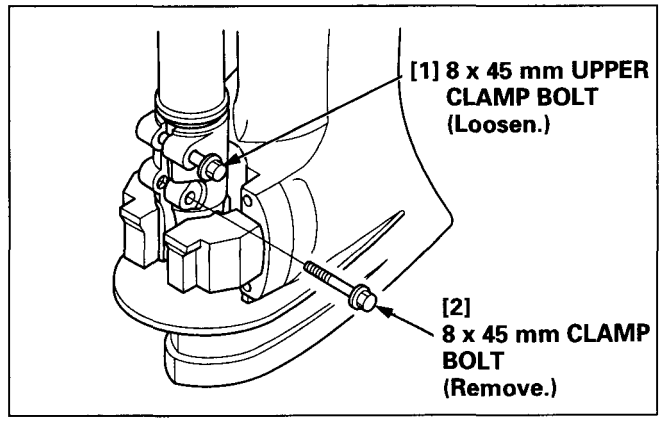
a. REMOVAL

1) Remove the following:
   — engine cover (P. 5-1).
   — left and right engine under covers (P. 5-2 and 3).
   — gear case assembly (P. 4-9).
   — extension separator (XL type only) (P. 4-9).

2) Remove the four 6 x 20 mm flange bolts and lower mount rubber cover.



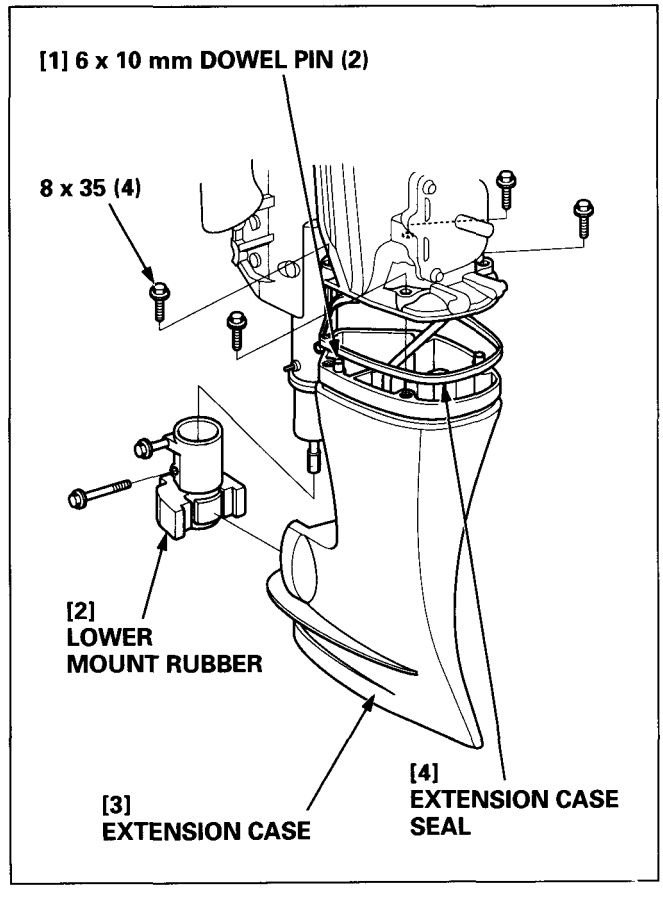
3) Loosen the 8 x 45 mm upper clamp bolt and remove the 8 x 45 mm lower clamp bolt.



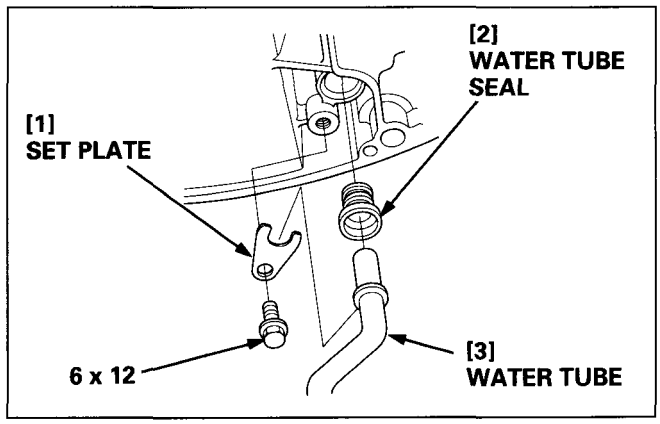
4) Remove the four 8 x 35 mm flange bolts attaching the extension case.

5) Remove the extension case and lower mount rubber.

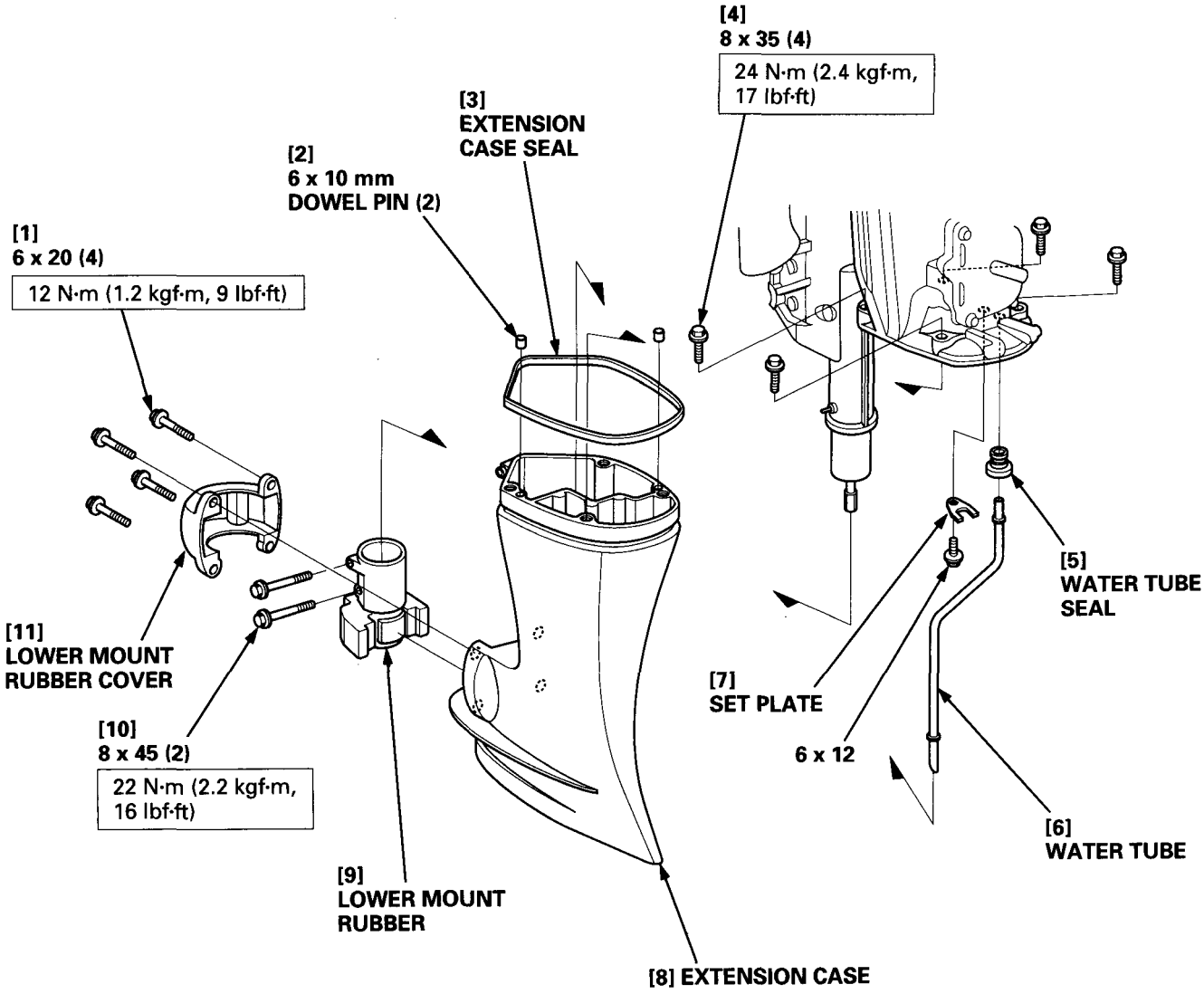
6) Remove the two 6 x 10 mm dowel pins and extension case seal.



7) Remove the 6 x 12 mm flange bolt and set plate, and remove the water tube and water tube seal.

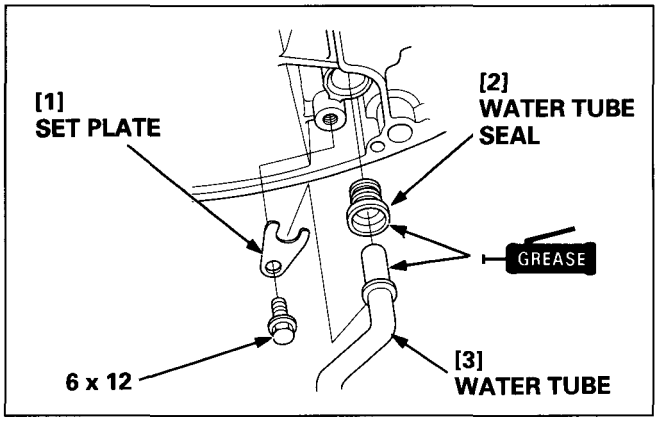


b. INSTALLATION



1) Apply marine grease to the water tube seal and set it to the mount case.

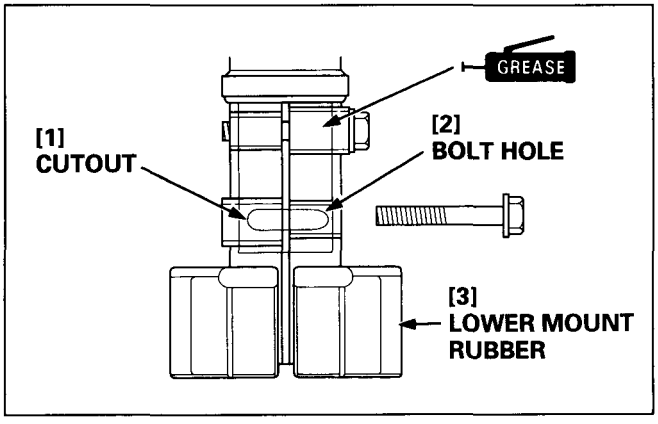
2) Set the water tube in the place and secure the set plate and 6 x 12 mm flange bolt.



3) Apply grease to the inside of the lower mount rubber.

4) Install the lower mount rubber to the mount frame.

5) Align the lower pinch bolt hole with the cutout in the mount frame as shown and loosely install the lower pinch bolt.

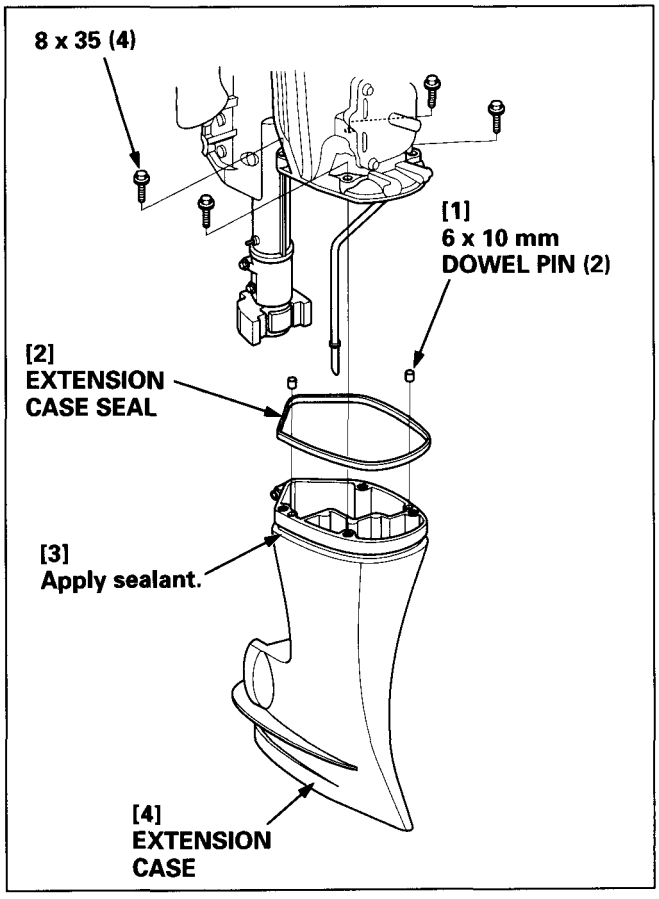


6) Install the two 6 x 10 mm dowel pins onto the extension case.

7) Apply sealant (Three bond #5222B or equivalent) to the sealing surface and install the extension case seal onto the extension case and assemble the extension case with the oil case.

8) Tighten the four 8 x 35 mm flange bolts to the specified torque.

TORQUE: 24 N•m (2.4 kgf•m, 17 lbf•ft)



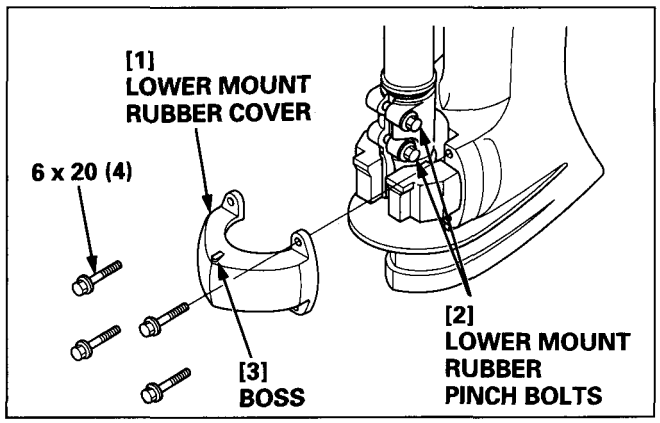
9) Tighten the lower mount rubber pinch bolts to the specified torque.

TORQUE: 22 N·m (2.2 kgf·m, 16 lbf·ft)

10) Install the lower mount rubber cover with the boss toward up and tighten the four 6 x 20 mm flange bolts.

TORQUE: 12 N·m (1.2 kgf·m, 9 lbf·ft)

11) Reinstall the following:
— gear case assembly (P. 4-10).
— left and right engine under covers (P. 5-2 and 3).
— engine cover (P. 5-1).

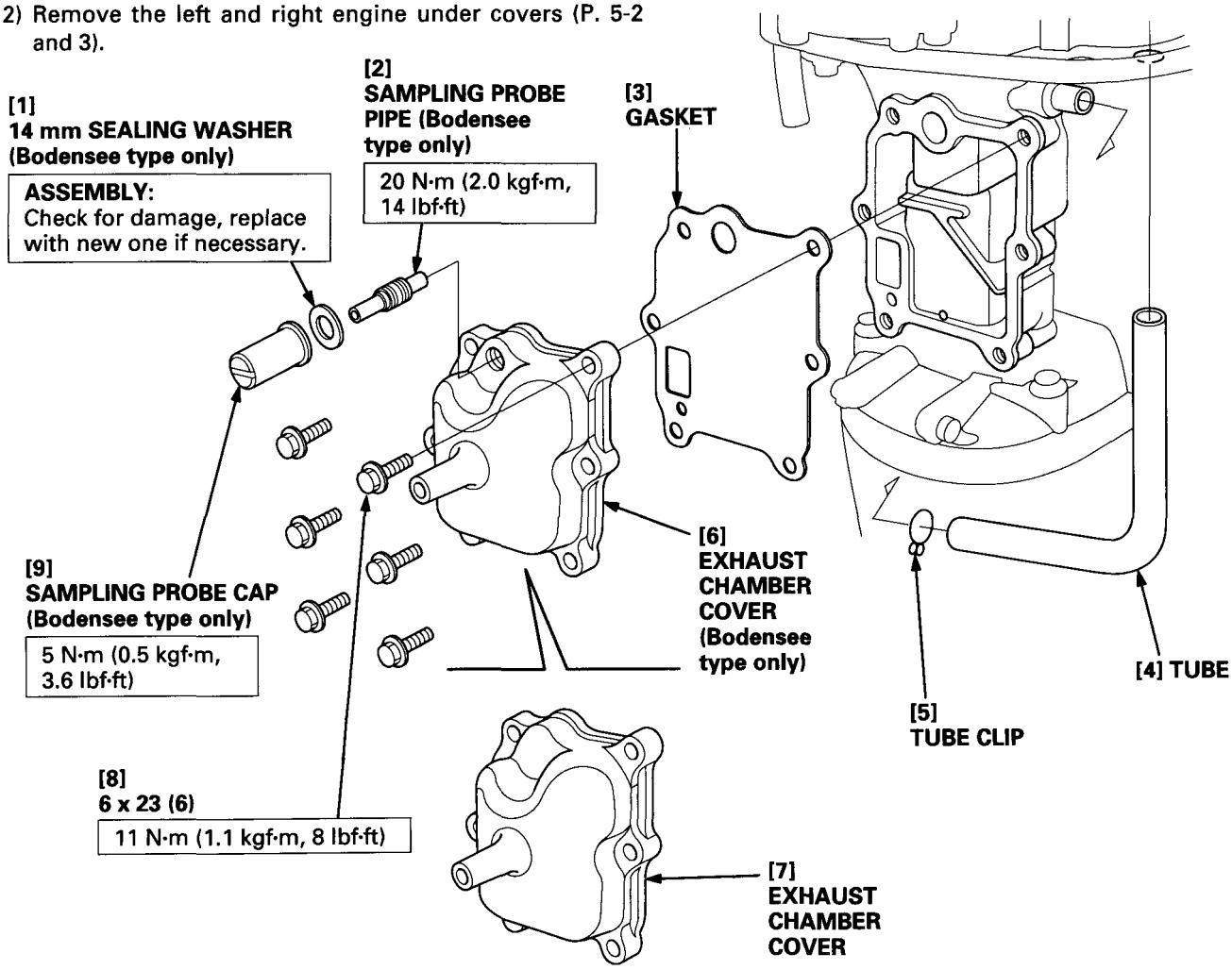


8. EXHAUST CHAMBER COVER

a. DISASSEMBLY/REASSEMBLY

1) Remove the engine cover (P. 5-1).

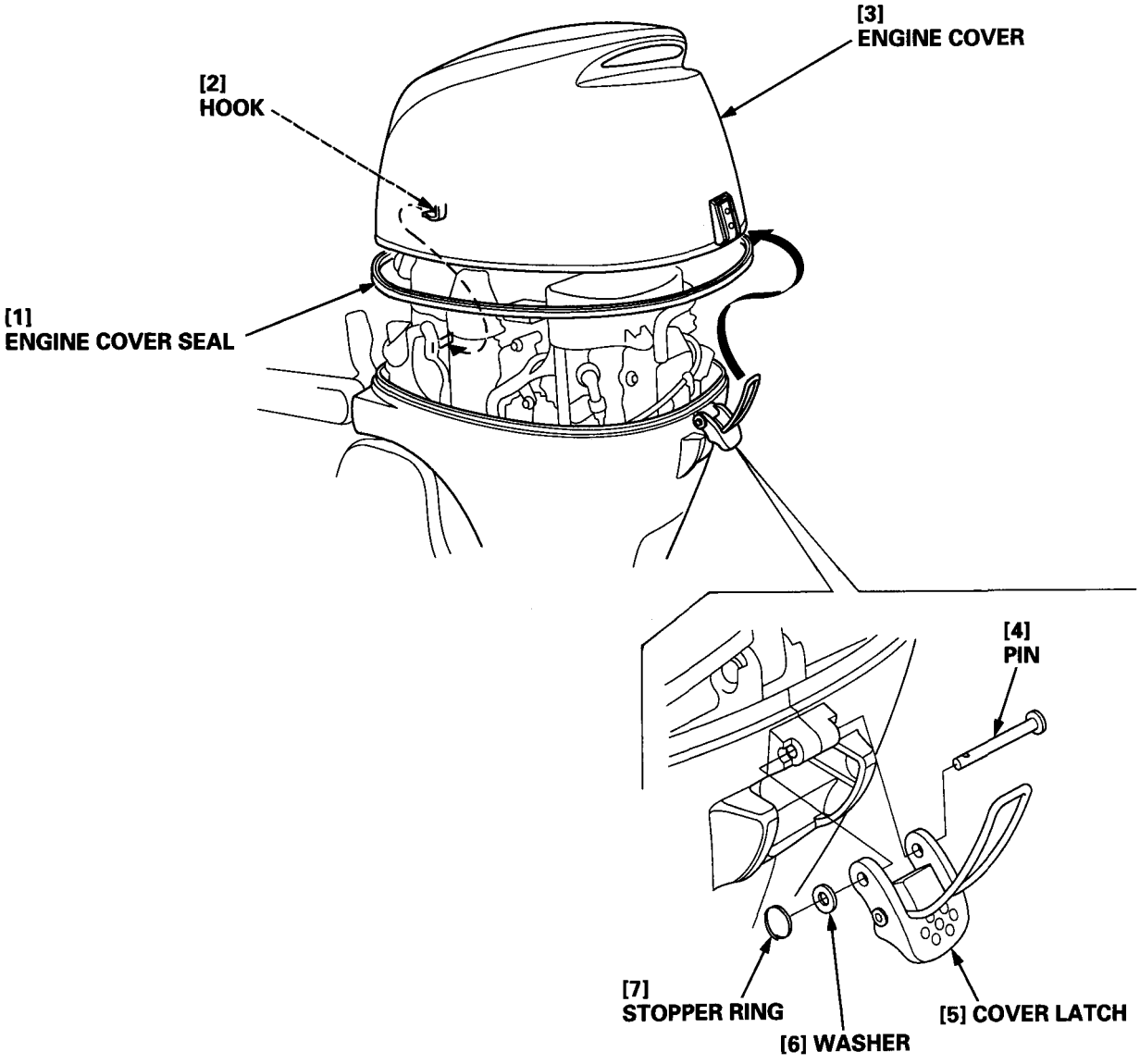
2) Remove the left and right engine under covers (P. 5-2 and 3).



1. ENGINE COVER
2. LEFT ENGINE UNDER COVER
3. RIGHT ENGINE UNDER COVER

1. ENGINE COVER

a. DISASSEMBLY/REASSEMBLY



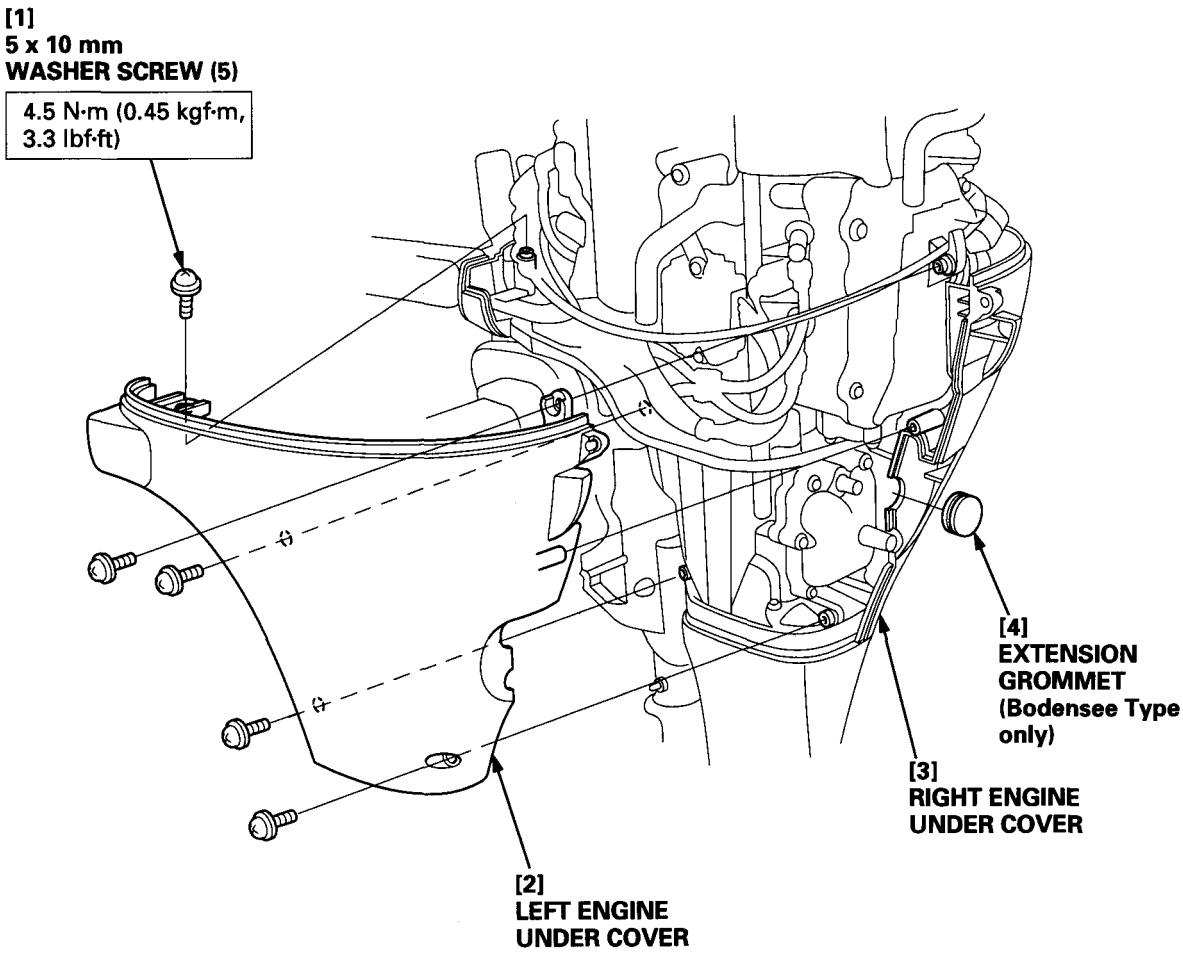
2. LEFT ENGINE UNDER COVER

a. REMOVAL

1) Remove the engine cover and cover latch (P. 5-1).

2) Remove the five 5 x 10 mm washer screws.

3) Pull off the engine under cover from the boss of the oil case at the front of the outboard motor, then remove the left engine under cover.



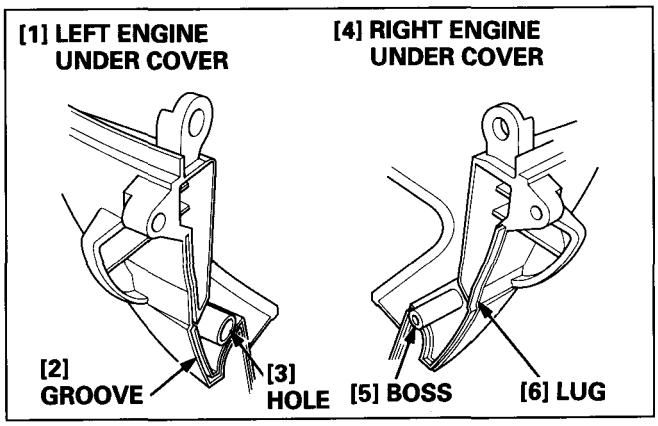
b. INSTALLATION

1) Install the left engine under cover.
   - At the front side; align the hole of the left engine under cover with the boss of the oil case.
   - At the rear side; align the groove of the left engine under cover with the lug of the right engine under cover and align the hole with the boss.

2) Tighten the washer screws securely.

   TORQUE: 4.5 N·m (0.45 kgf·m, 3.3 lbf·ft).

3) Reinstall the cover latch and engine cover (P. 5-1).



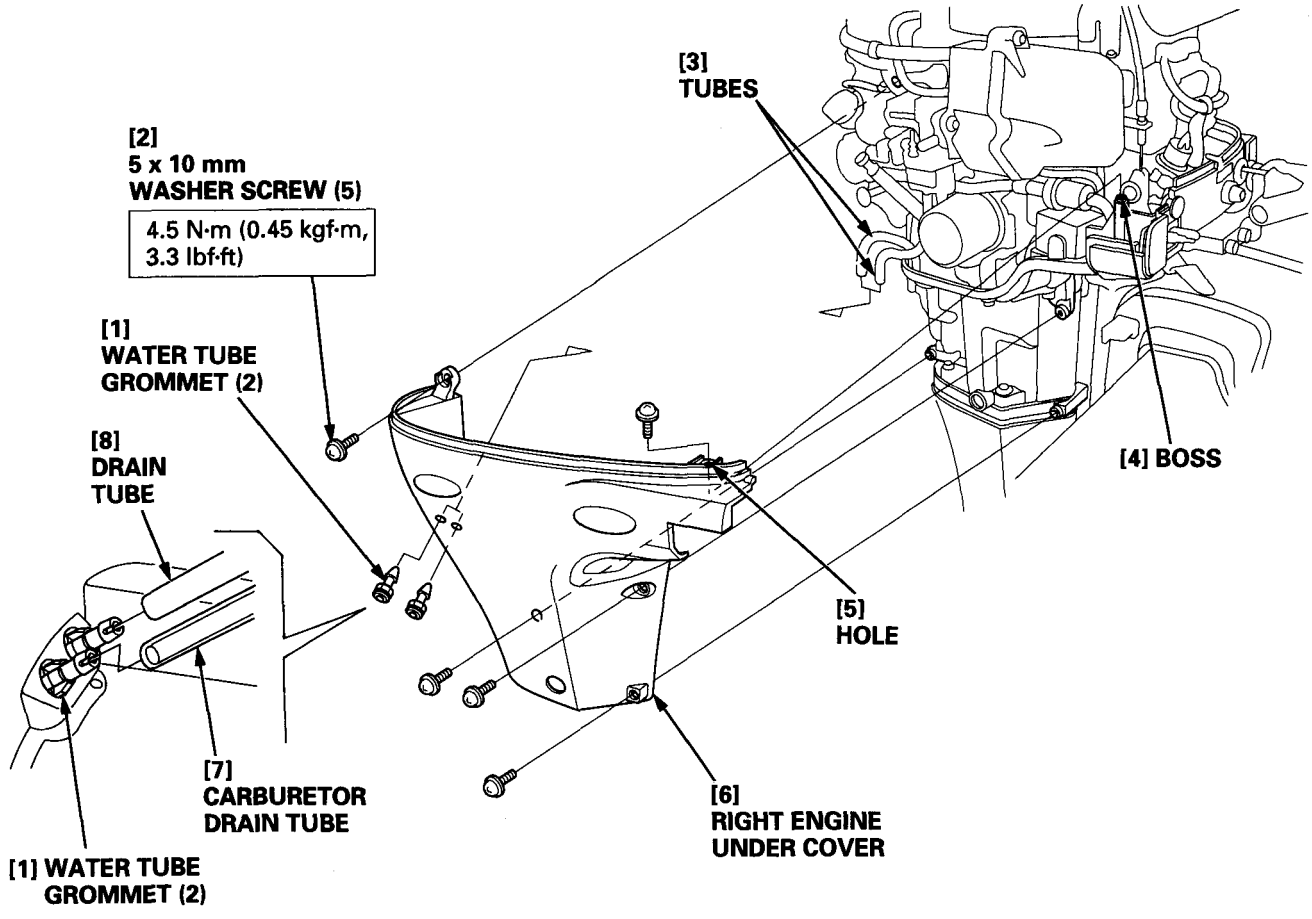
3. RIGHT ENGINE UNDER COVER

a. REMOVAL

1) Remove the engine cover and cover latch (P. 5-1).

2) Remove the five 5 x 10 mm washer screws.

3) Pull off the right engine under cover from the boss of the oil case at the front of the outboard motor and disconnect the drain tube from the water tube grommet. Then, remove the left engine under cover.



b. INSTALLATION

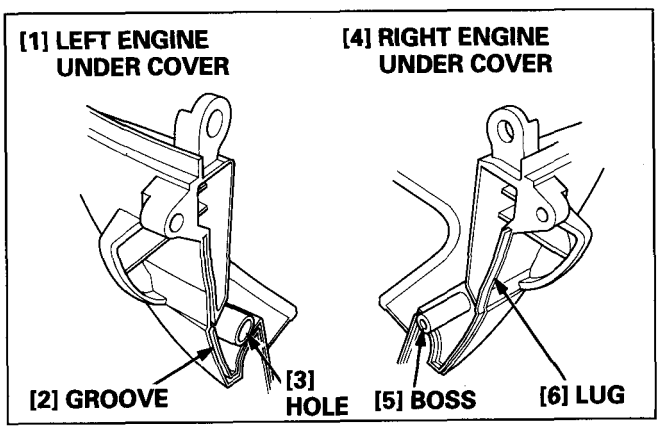
1) Connect the drain tubes to the water tube grommet.

2) Install the right engine under cover.
   - At the front side; align the hole of the right engine under cover with the boss of the oil case.
   - At the rear side; align the lug of the right engine under cover with the grooves of the left engine under cover align and the boss with the hole.

3) Tighten the washer screws securely.

   TORQUE: 4.5 N·m (0.45 kgf·m, 3.3 lbf·ft).

4) Reinstall the cover latch and engine cover (P. 5-1).

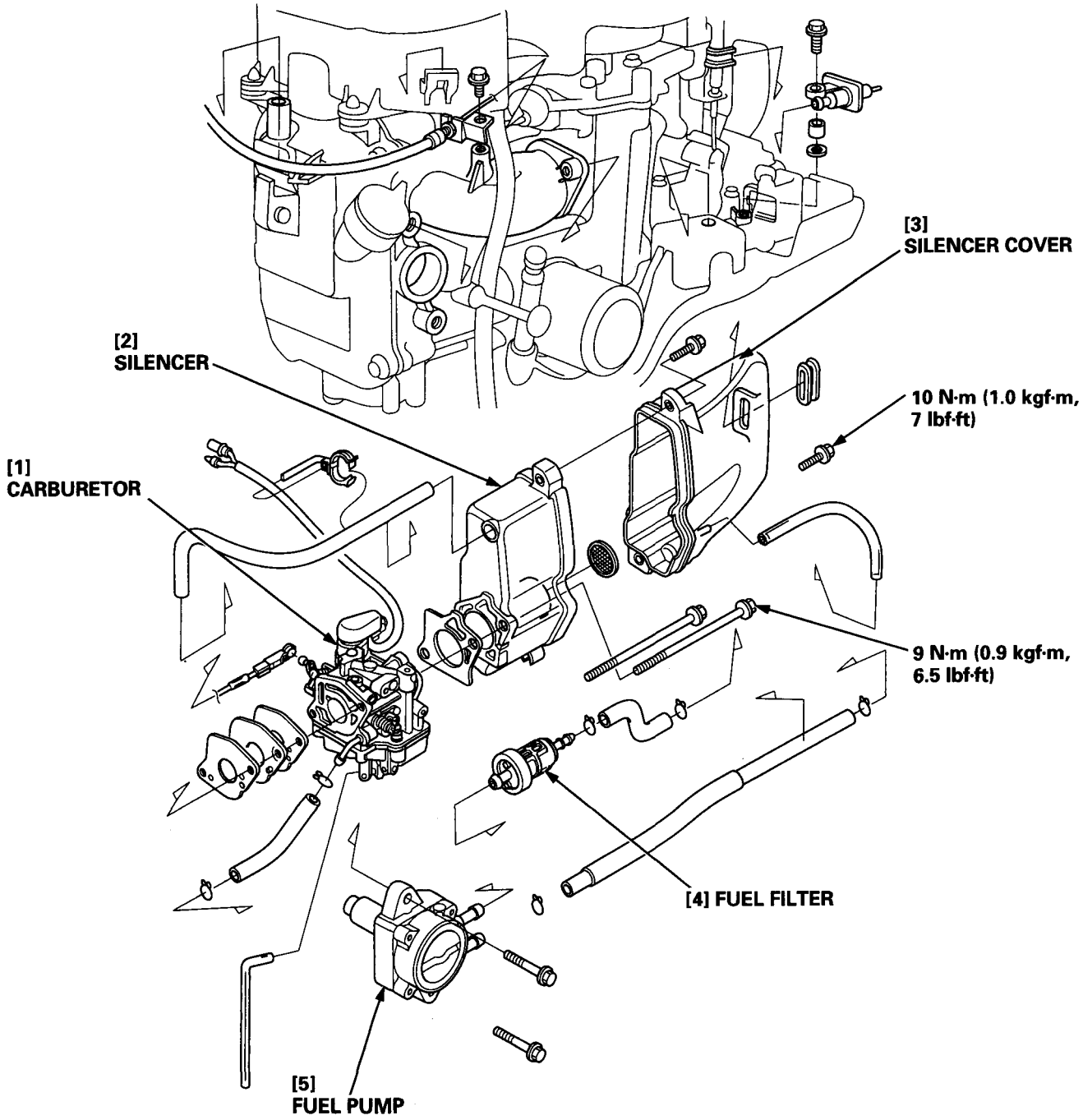


1. CARBURETOR
2. CHOKE CABLE
3. FUEL PUMP/FUEL FILTER
4. FUEL TANK

⚠ WARNING

Gasoline is highly flammable and explosive.
You can be burned or seriously injured when handling fuel.

- **Keep heat, sparks, and flame away.**
- **Handle fuel only outdoors.**
- **Wipe up spills immediately.**



1. CARBURETOR

a. REMOVAL

Before removal, drain the gasoline into a suitable container from the carburetor by loosening the drain screw.

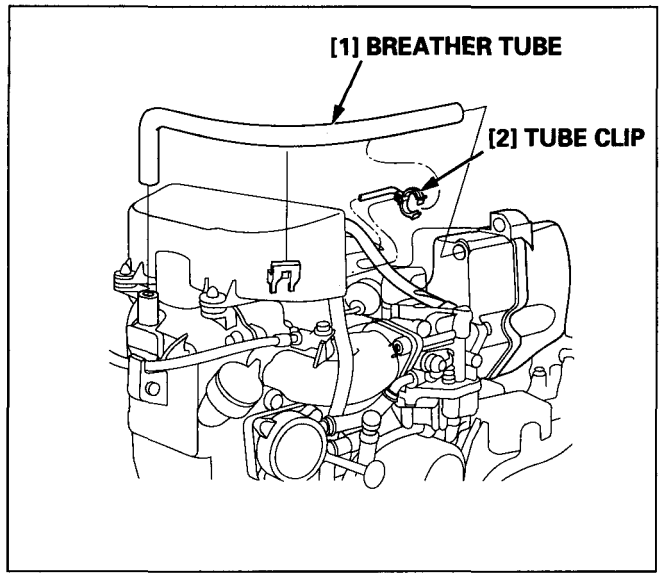
⚠ WARNING

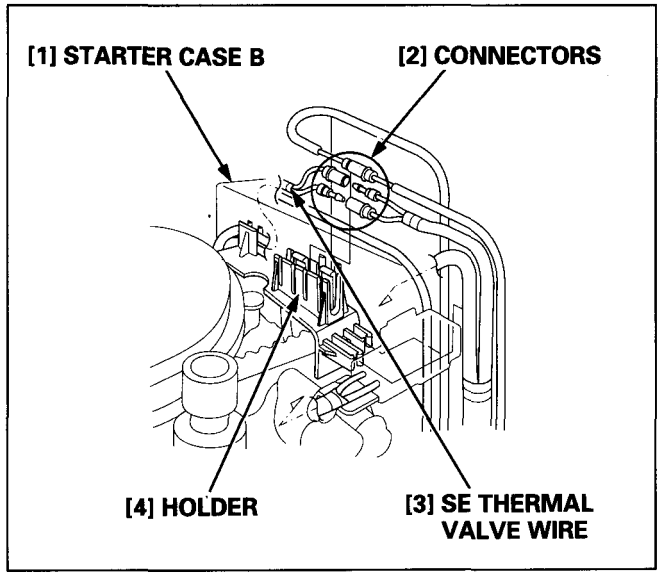
Gasoline is highly flammable and explosive.
You can be burned or seriously injured when handling fuel.
- **Keep heat, sparks, and flame away.**
- **Handle fuel only outdoors.**
- **Wipe up spills immediately.**

1) Remove the engine cover and right engine under cover (P. 5-3).

2) Open the tube clip (Electric starter type) and disconnect the crankcase breather tube from the silencer.
   - Check the breather tube for deterioration, cracks or other damage. Clean or replace if necessary.

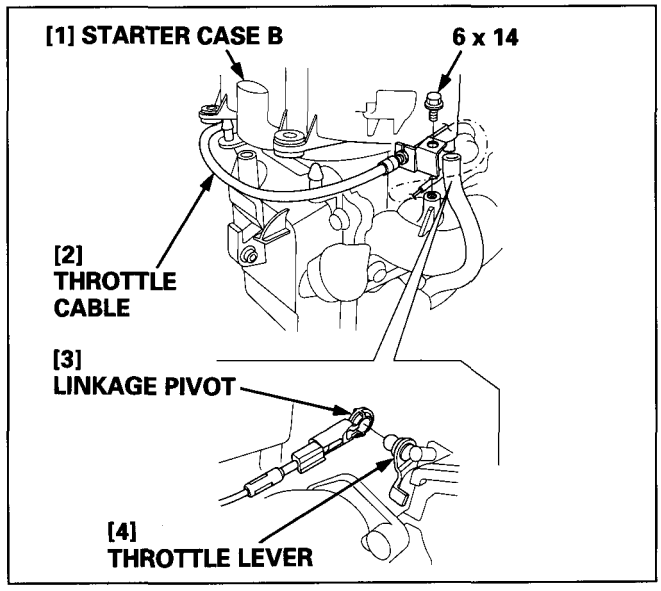
3) Disconnect the starting enrichment (SE) thermal valve wire connectors and remove the wire from the holders on the starter case B (Electrical starter type).



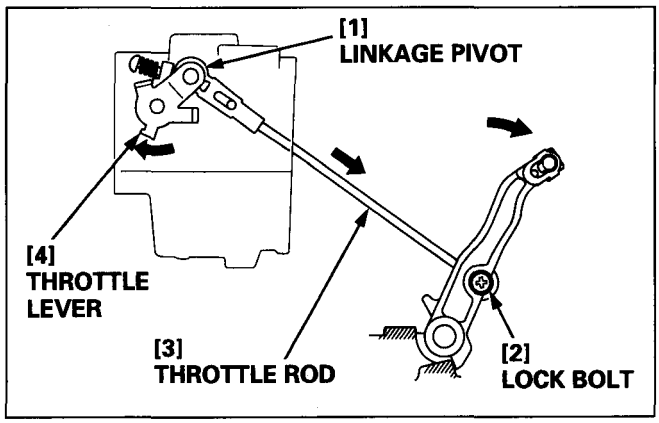


4) Disconnect the drain tube from the starter case B.

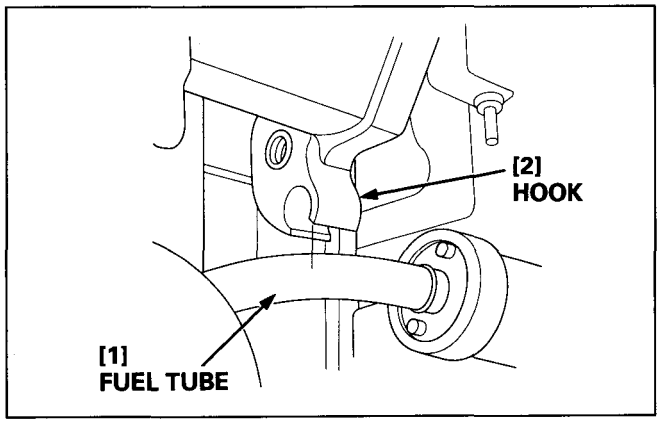
5) Remove the 6 x 14 mm flange bolt and remove the throttle cable holder, and then disconnect the throttle cable linkage pivot from the throttle lever (Tiller handle type).



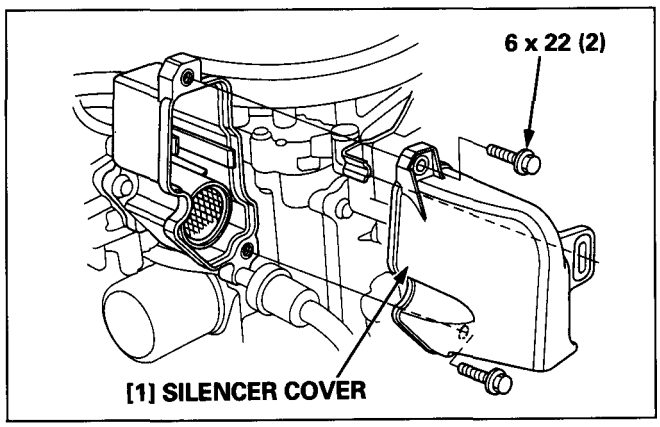
6) Loosen the throttle rod lock bolt and disconnect the linkage pivot from the carburetor throttle lever (Remote control type).



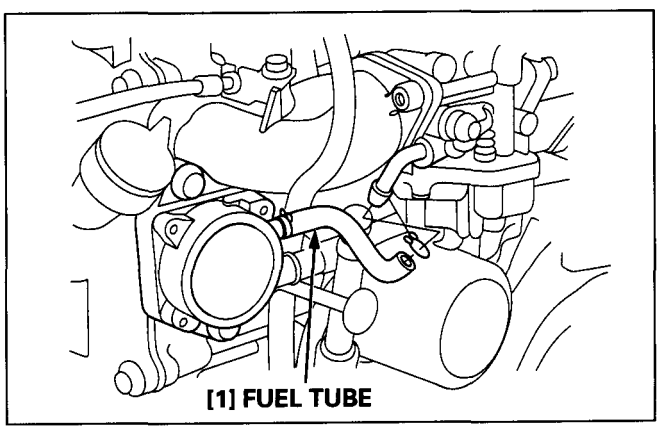
7) Remove the fuel tube from the hook of the silencer cover.



8) Remove the two 6 x 22 mm flange bolts and silencer cover.

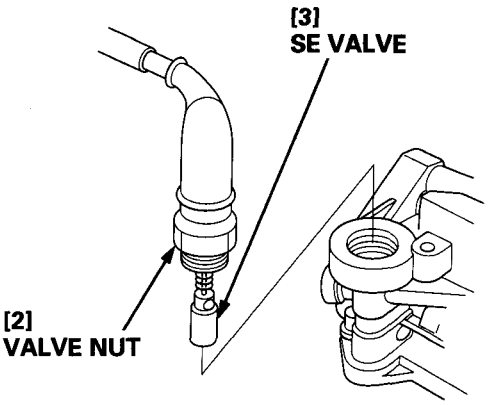


9) Disconnect the fuel tube between the fuel pump and carburetor from the carburetor.

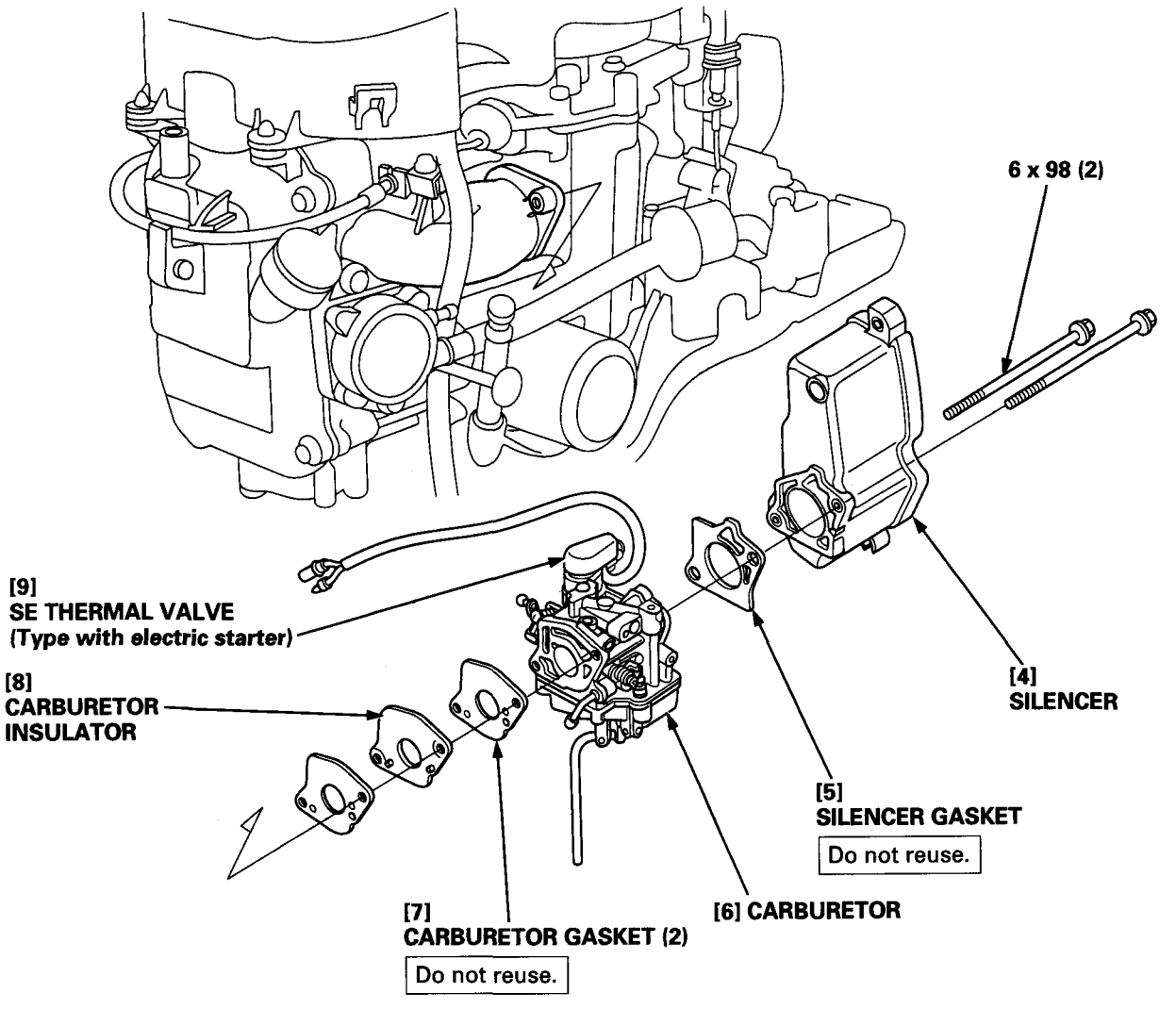


10) Remove the two 6 x 98 mm flange bolts, silencer, carburetor, gasket and carburetor insulators.
    - Replace the carburetor gasket and insulator gaskets with new ones when disassembly. Do not reuse.

11) Loosen the valve nut and remove the SE valve (Type without electric starter).



[1] Type without electrc starter



b. DISASSEMBLY

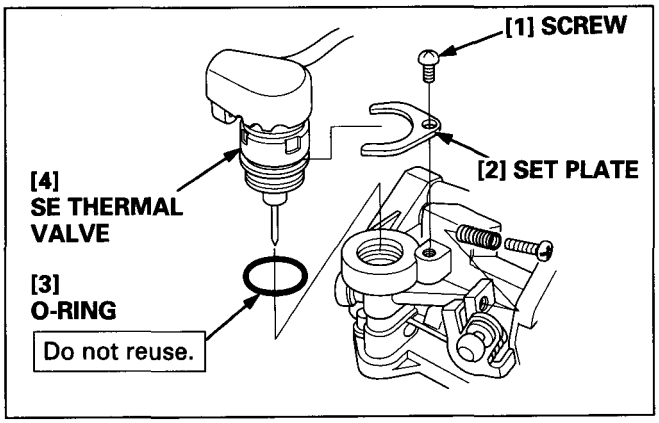
- Before disassembly, completely drain the carburetor by loosening the drain screw. Clean the outside of the carburetor before disassembly.

⚠ WARNING

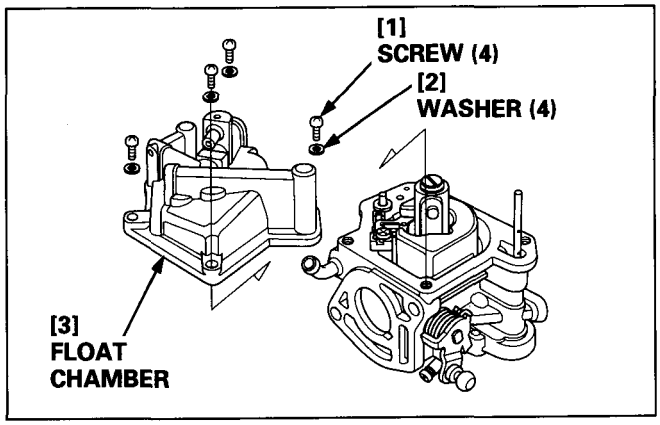
Gasoline is highly flammable and explosive.
You can be burned or seriously injured when handling fuel.
- **Keep heat, sparks, and flame away.**
- **Handle fuel only outdoors.**
- **Wipe up spills immediately.**

1) Remove the screw and set plate, then remove the auto SE thermal valve and O-ring (Electrical starter type).

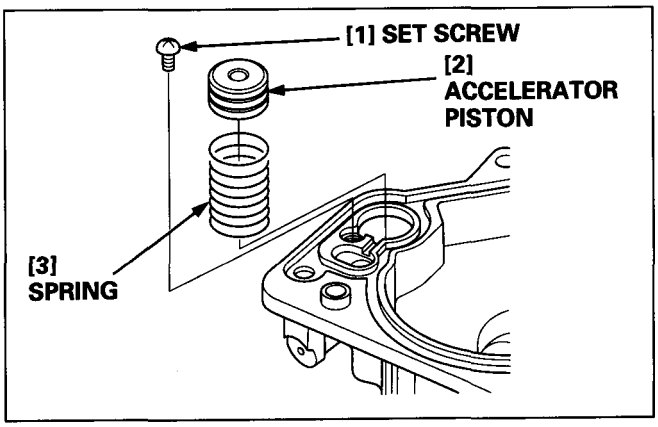
2) Remove the drain tube from the float chamber.



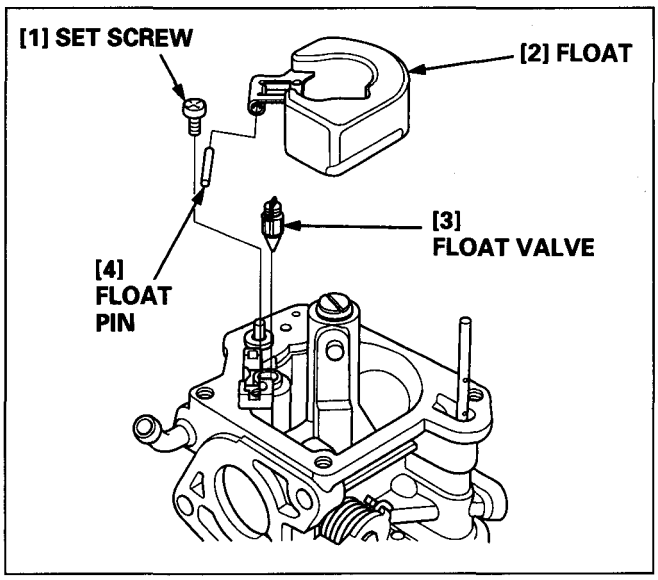
3) Remove the four washers and screws and remove the float chamber and O-ring.

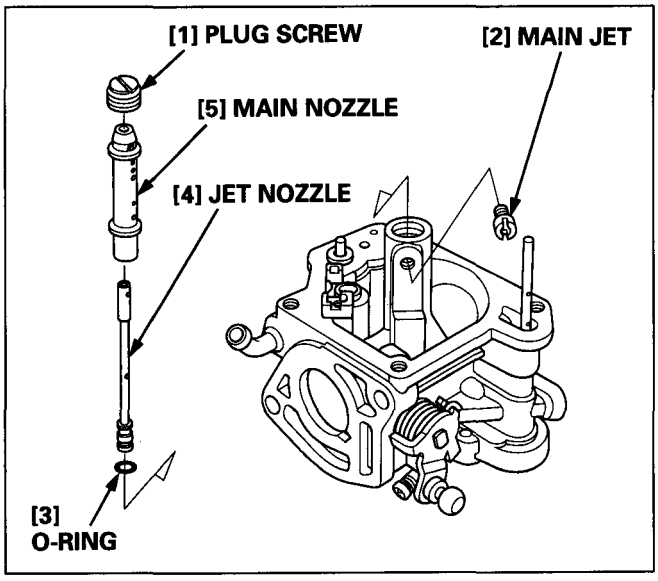


4) Remove the set screw and remove the accelerator piston and spring.



5) Remove the set screw, then pull out the float pin and remove the float and float valve.





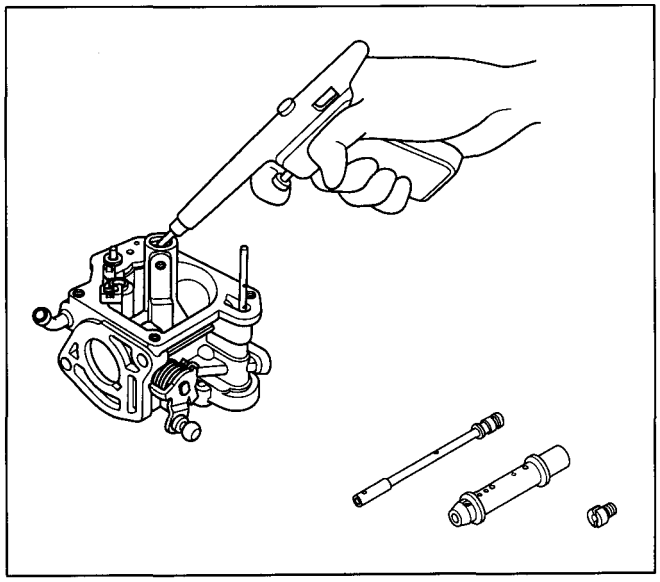
6) Remove the main jet with care not to damage the main jet.

7) Remove the plug screw, main nozzle and jet nozzle taking care not to damage them.

c. CLEANING

CAUTION:

- **Some commercially available chemical cleaners are caustic. These cleaners may damage plastic parts such as O-rings, float and float valve. Check the container for instructions. If you are in doubt, do not use these products to clean carburetor.**
- **High air pressure may damage the carburetor. Use low pressure setting when cleaning the passages and parts.**



1) Clean the carburetor body, removed parts and float chamber with cleaning solvent.

2) Use low air pressure and blow off the removed jets, nozzles and passages of the carburetor body and float chamber.

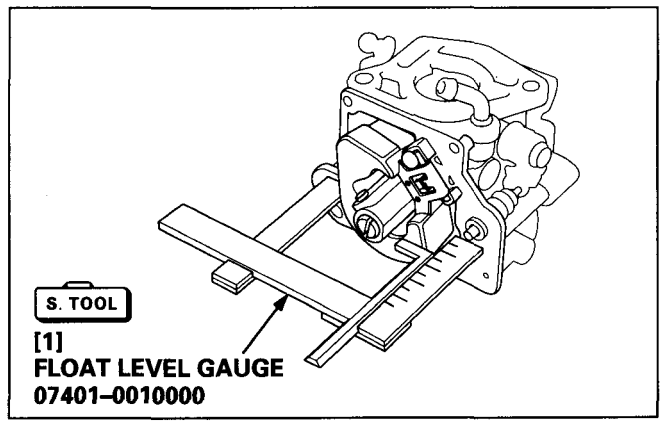
d. INSPECTION

• Float Level Height

Place the carburetor in the position shown and measure the distance between the float top and carburetor body when the float just contacts the seat without compressing the valve spring.

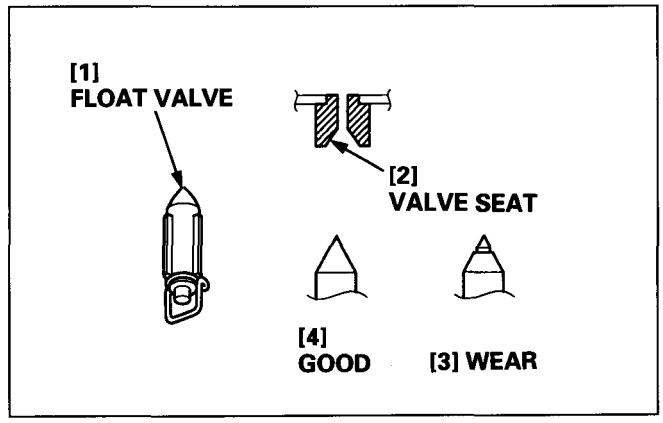
Standard float height	13.5 mm (0.53 in)

If the height is out of specification, adjust the float height by bending the float mounting tab carefully.



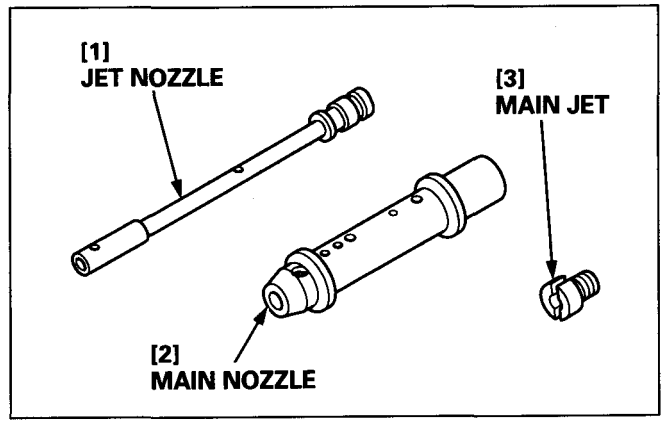
• Float/Float Valve/Float Valve Seat

1) Check the float for crack or damage. Replace if necessary.
2) Check the float valve for wear or damage, replace if necessary.



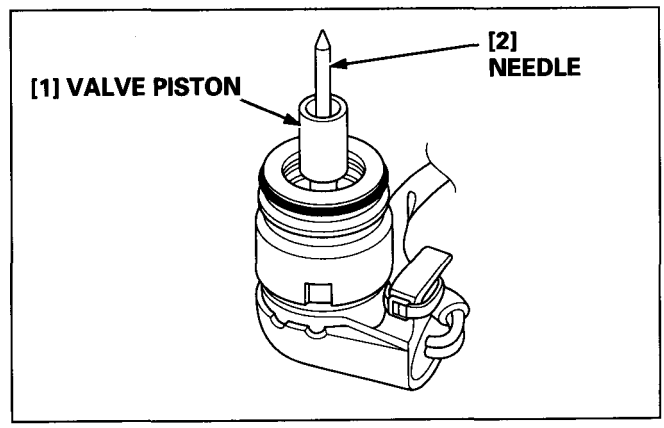
• Nozzles/Jets

Check the main jet, main nozzle and jet nozzle for clog or damage. Replace if necessary.



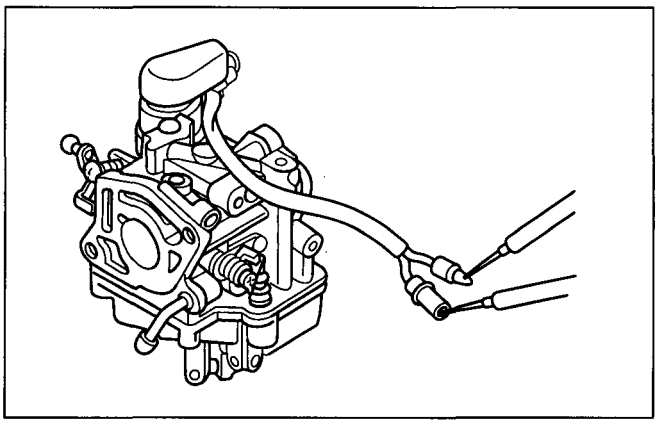
• SE Thermal Valve

1) Check the valve piston and needle for wear or scratch, replace as assembly, if necessary.



2) Measure the resistance between the terminals
   - This test can be made with the carburetor installed on the motor.

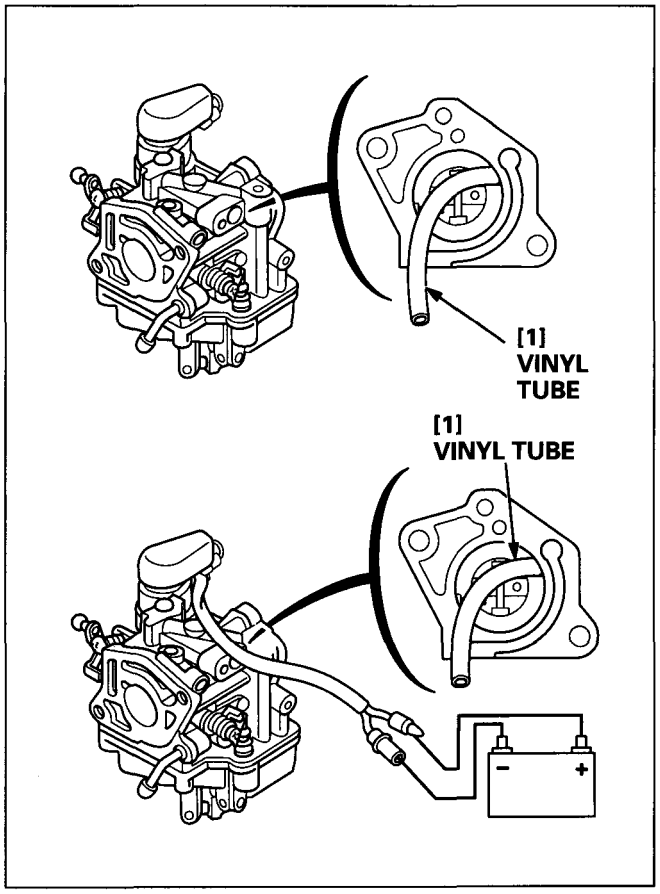
Resistance	15.8 – 24.2 Ω



3) Install a vinyl tube as shown.

4) At room temperature, make sure that breath passes through passage.

5) Connect the 12V battery positive terminal to the Brown/white terminal and negative to Black/green terminal for about five minutes. Then check that breath does not pass through.

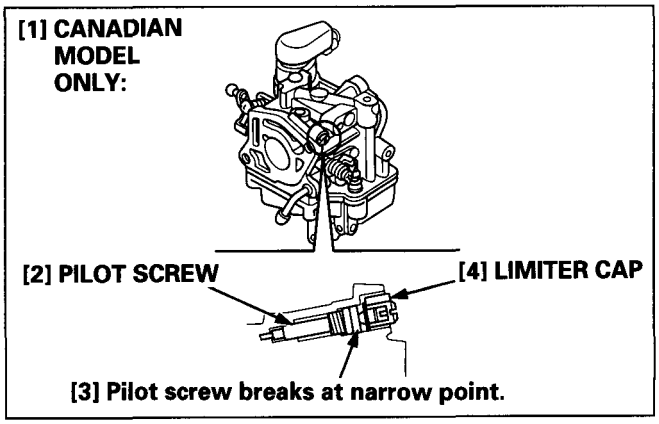


e. PILOT SCREW REPLACEMENT

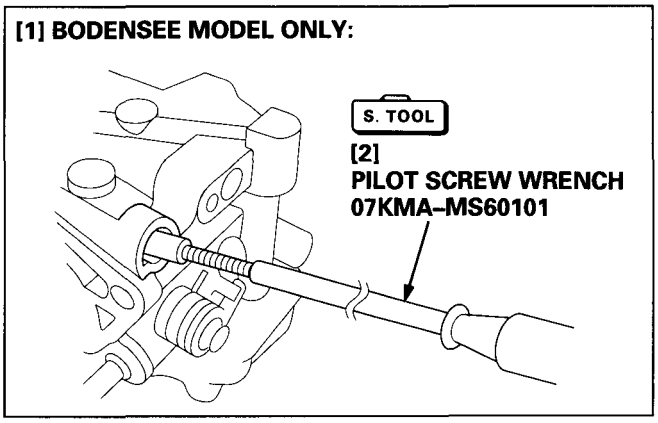
Canadian models only:
Leave the pilot screw and limiter cap in place during carburetor cleaning. Remove only if necessary for carburetor repair.

Removal of the limiter cap requires breaking the pilot screw. A new pilot screw and limiter cap must be installed.

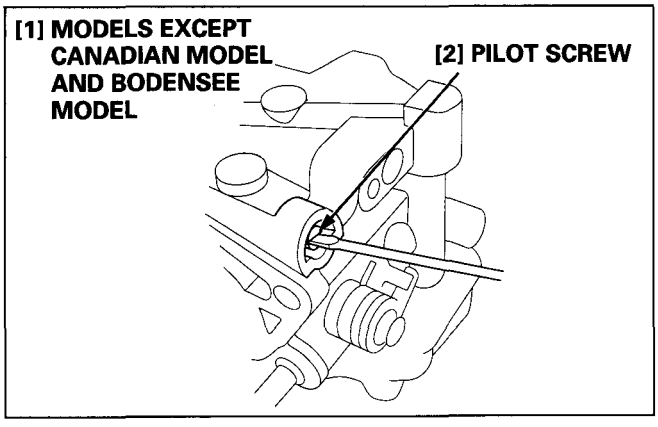
1) When the limiter cap has been broken off, remove the broken pilot screw.



Bodensee model only:
Do not remove the pilot screw except for cleaning.
2) Remove the pilot screw using the special tool as shown.



Models except canadian model and bodensee model:
Do not remove the pilot screw except for cleaning.
3) Remove the pilot screw.



All models:
4) Place a new O-ring on the replacement pilot screw, and install it on the carburetor.

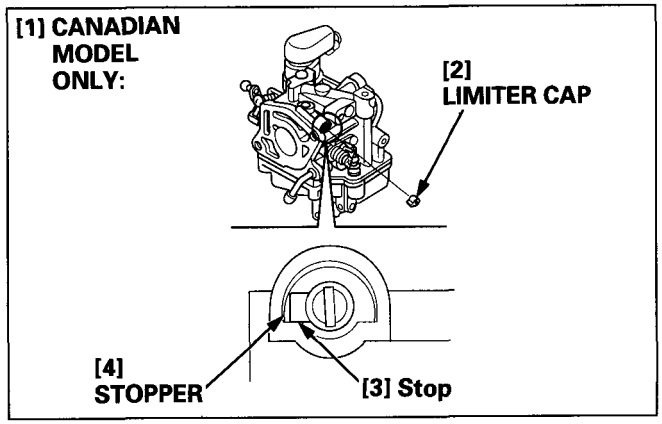
5) Turn the pilot screw in until it is fully seated, then turn the screw out the required number of turns.

Pilot screw opening	BF8D, BF8B, BFP8D, BFP8B	2 – 1/2 turns out
	BF9.9D, BF10D, BFP9.9D, BFP10D	[*1]: 2 – 3/8 turns out [*2]: 2 – 7/8 turns out
	BF10B, BFP10B	[*1]: 2 – 1/4 turns out [*2]: 2 – 1/2 turns out

[*1]: Type with SE valve
[*2]: Type with SE thermal valve

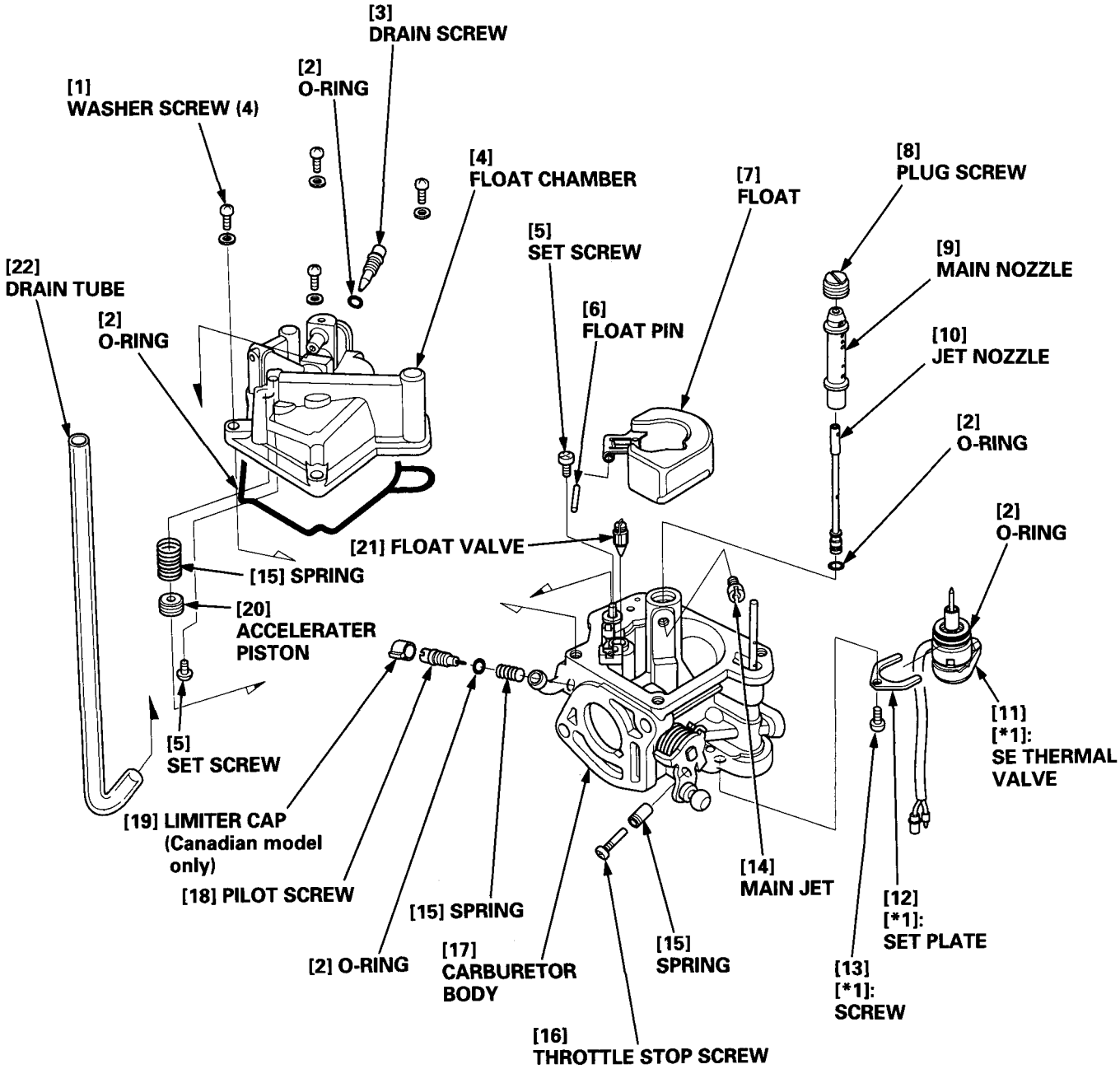
Canadian models only:
6) Apply LOCTITE® 638 to the inside of the limiter cap, then install the cap so its stop prevents the pilot screw from turning counterclockwise.

Be careful to avoid turning the pilot screw while installing the limiter cap. The pilot screw must stay at its required setting position.



f. CARBURETOR ASSEMBLY

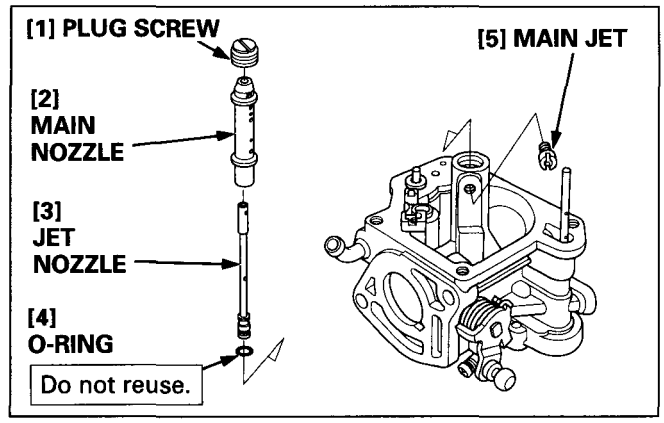
[*1]: Electric starter type only



1) Install a new O-ring on the jet nozzle.

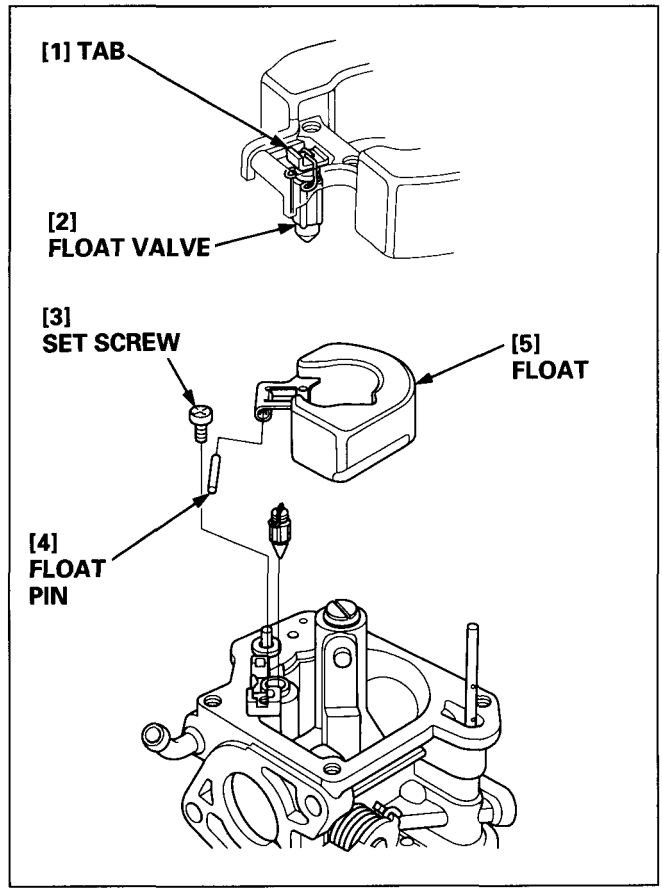
2) Install the jet nozzle and main nozzle and secure them with the plug screw.

3) Install the main jet.
   - Take care not to damage the jet and nozzle when handling them.

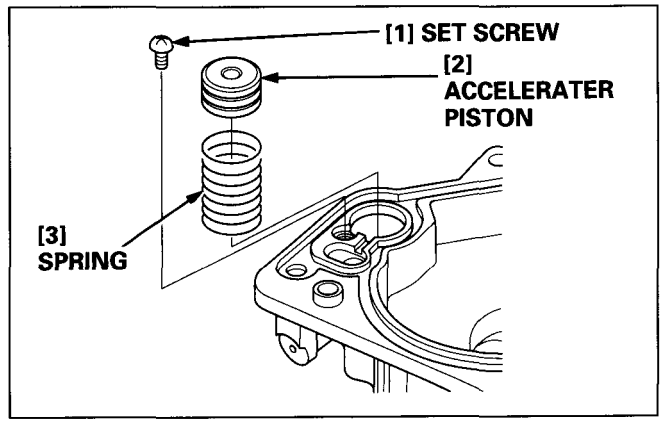


4) Install the float valve on the float tab as shown.

5) Insert the float pin into the float and set them on the carburetor body. Secure them with the set screw.

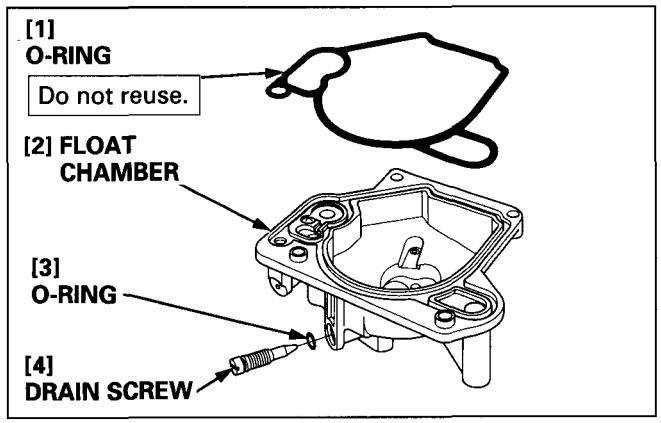


6) Install the spring and accelerator piston and secure the piston with the set screw.

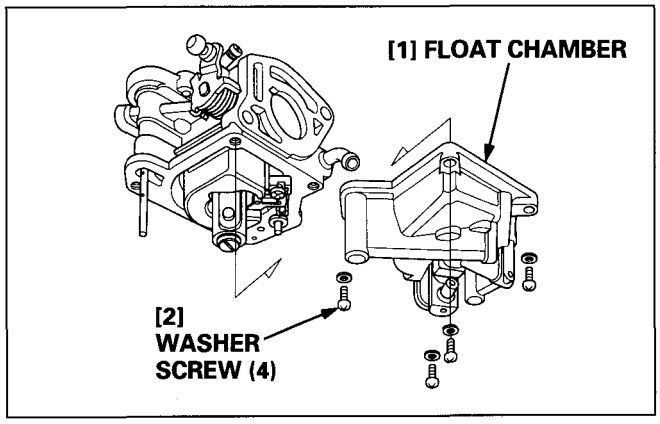


7) Install a new O-ring on the drain screw and install the drain screw in the float chamber.

8) Install a new O-ring (float chamber seal) on the float chamber.



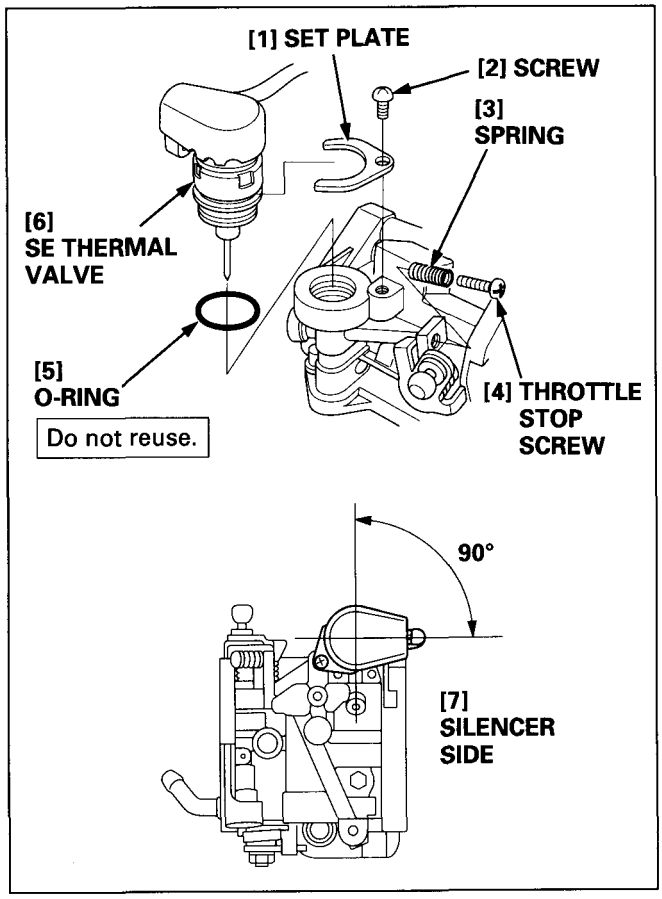
9) Install the float chamber on the carburetor body and tighten the four washer screws securely.



10) Install the throttle stop screw and spring.

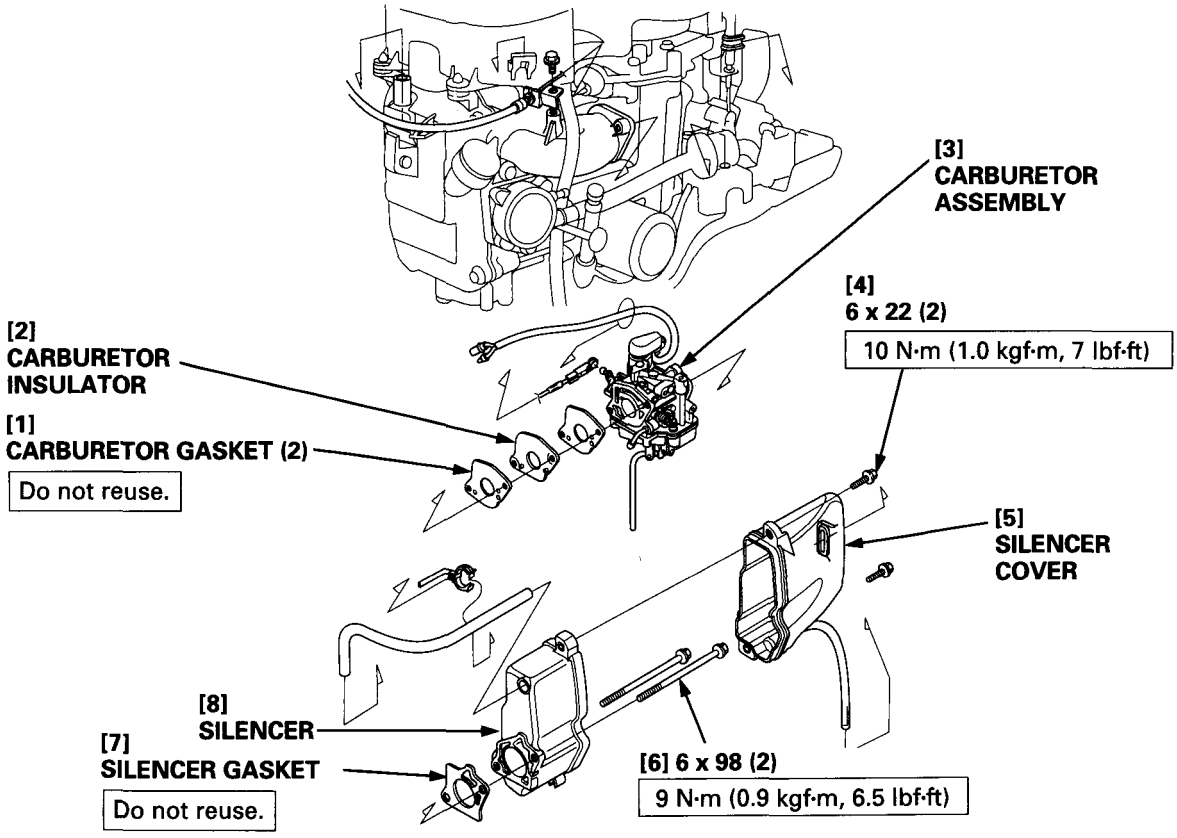
11) Install a new O-ring on the SE thermal valve and install the SE thermal valve with the setting plate and loosely install the setting screw.

12) Set the SE thermal valve as shown noting the direction and tighten the set screw securely.



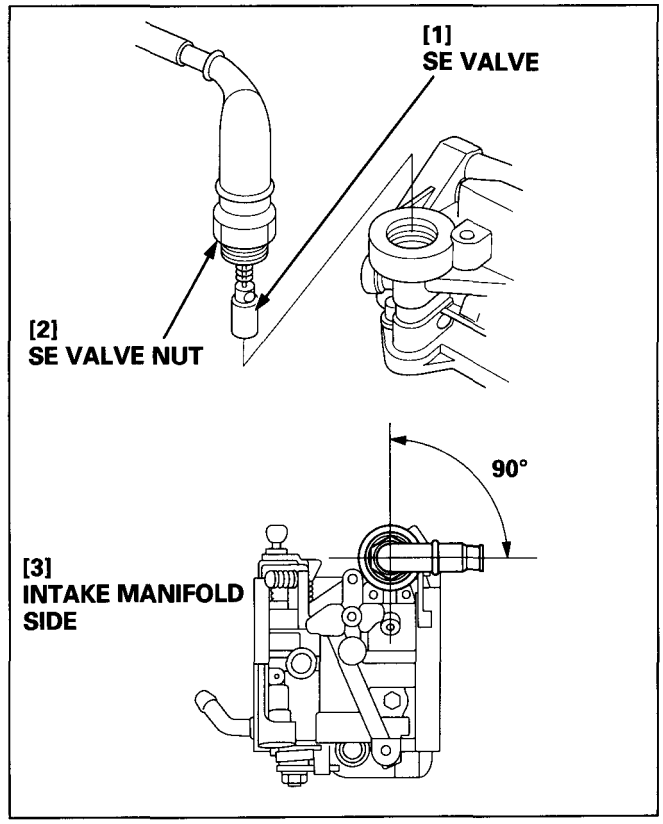
g. INSTALLATION

- Take care to prevent foreign material from entering the engine.



1) Install the SE valve noting the direction, and secure the valve nut (Type without electric starter).

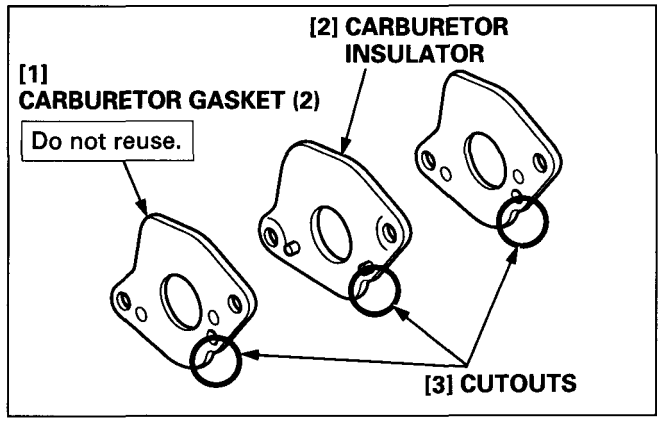
TORQUE: 2 N·m (0.2 kgf·m, 1.4 lbf·ft)



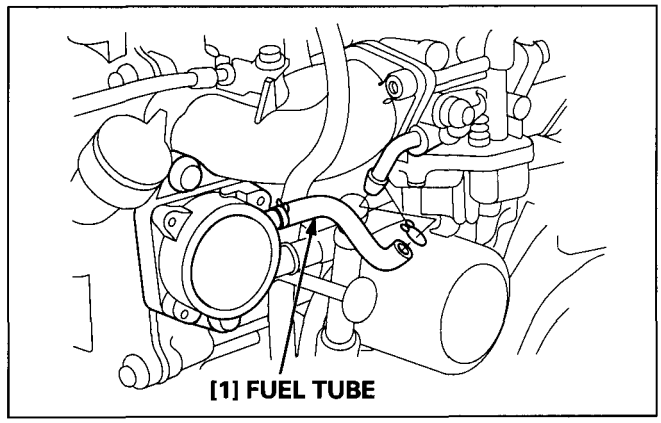
2) Install the carburetor, silencer, carburetor insulator, new carburetor gaskets and a silencer gasket.
   - Align the cutouts of the carburetor insulator and carburetor gaskets.

3) Tighten the two 6 x 98 mm flange bolt to the specified torque.

   TORQUE: 9 N·m (0.9 kgf·m, 6.5 lbf·ft)



4) Connect the fuel tube to the carburetor.

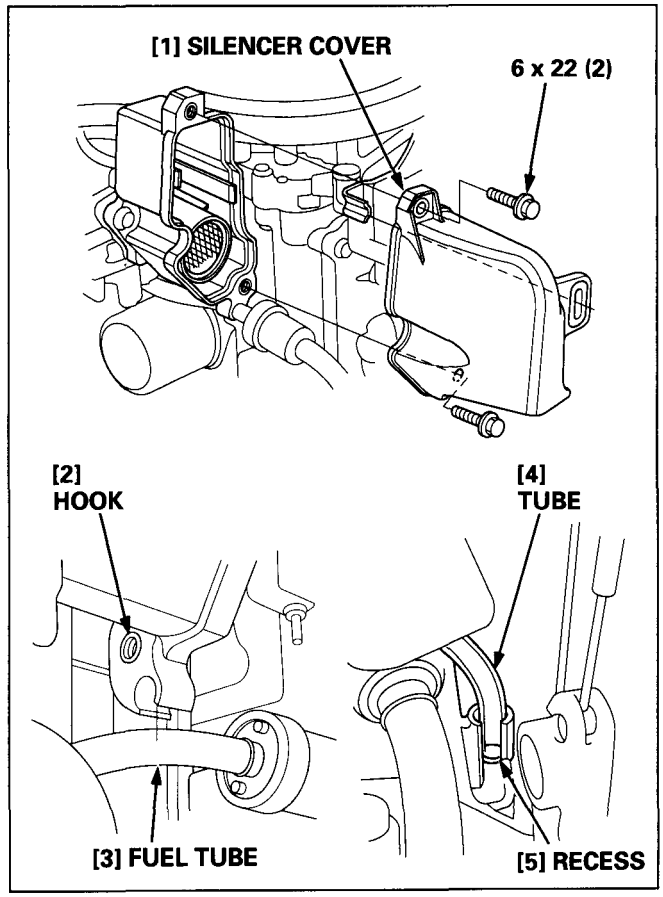


5) Install the silencer cover and tighten the 6 x 22 mm flange bolts to the specified torque.

   TORQUE: 10 N·m (1.0 kgf·m, 7 lbf·ft)

6) Insert the tube end into the recess of the oil case as shown.

7) Clamp the fuel tube with the hook of the silencer cover.

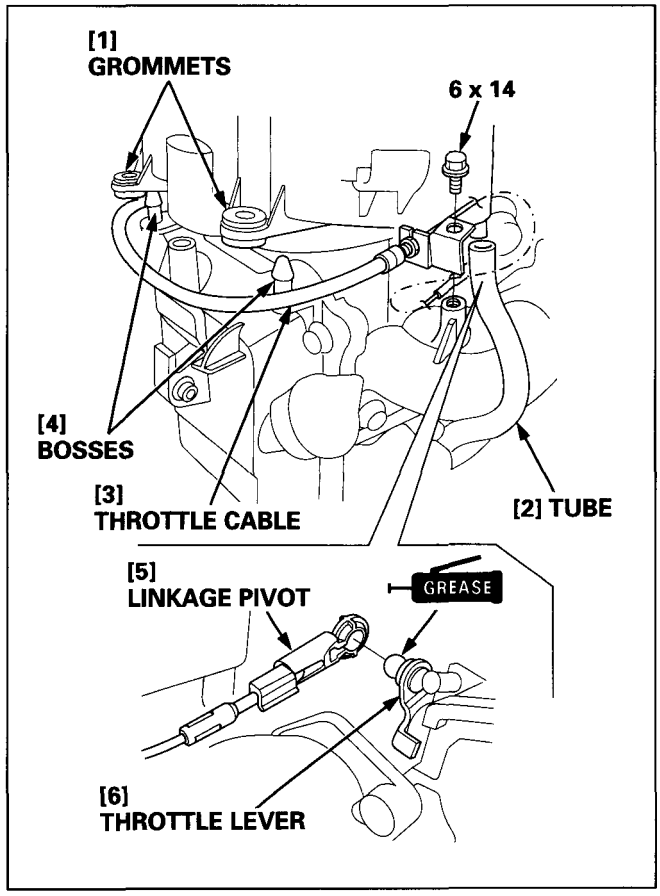


8) Connect the linkage pivot to the carburetor throttle lever.

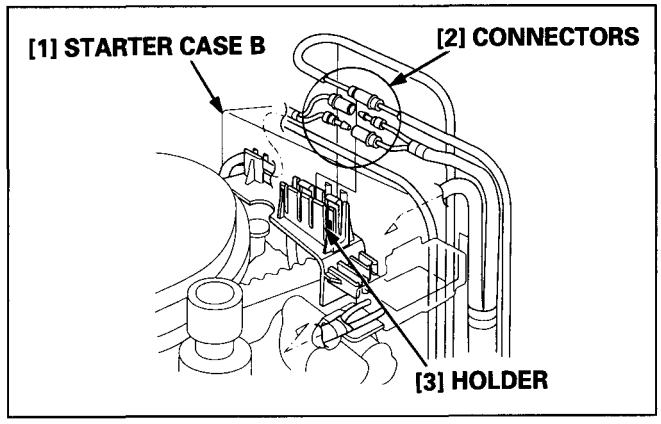
9) Install the throttle cable stay with the 6 x 14 mm flange bolt (Tiller handle type). After installation, adjust the throttle linkage (P. 3-13).

10) Connect the tube to the tube joint of the starter case B, and set the starter case B securely by setting the grommets to the bosses of the cylinder head cover.

11) Connect the throttle control cable to the throttle arm (Remote control type). After installation, adjust the throttle linkage (P. 3-14).



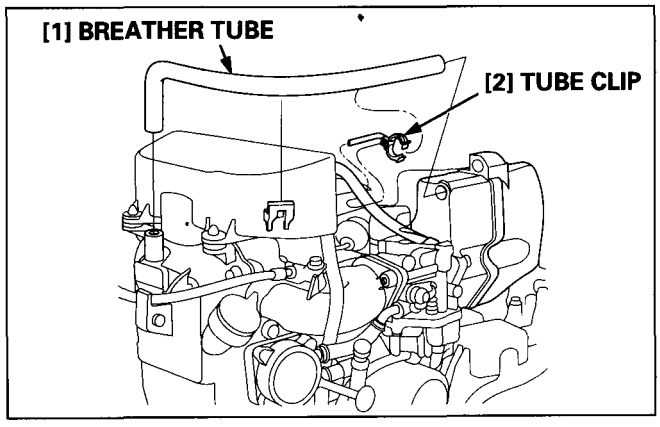
12) Connect the SE thermal valve wire connectors and secure the wires with the clamp on the starter case B (Electric starter type).



13) Install the breather tube between the silencer and cylinder head cover.

14) Clamp the tube with the 13 mm tube clip (Electric starter type).

15) Reinstall the right engine under cover (P. 5-3) and engine cover.

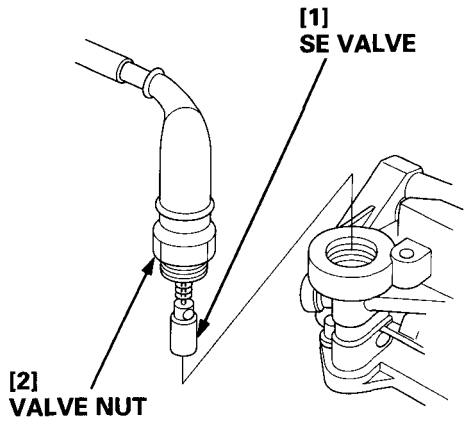


2. CHOKE CABLE
(Type without electric starter)

- Take care to prevent foreign material from entering the carburetor.

a. REMOVAL

1) Remove the engine cover and right engine under cover (P. 5-2).
2) Remove the recoil starter (P. 7-2).
3) Loosen the valve nut, then disconnect the SE valve from the carburetor.
4) Remove the SE valve and spring.
5) Loosen the cable nut and remove the choke cable from the oil case.

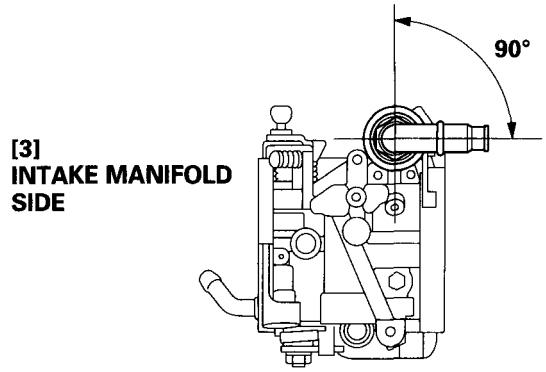


b. INSTALLATION

1) Completely loosen the cable holder nut and install the choke cable.
2) Secure the cable by tightening the nut.
3) Install the spring and SE valve.
4) Install the SE valve to the carburetor and loosely tighten the valve nut.

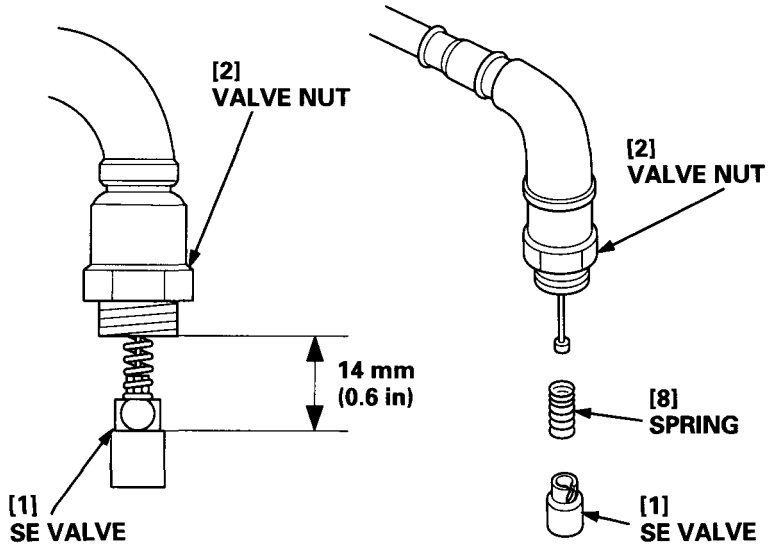
   TORQUE: 2 N·m (0.2 kgf·m, 1.4 lbf·ft)

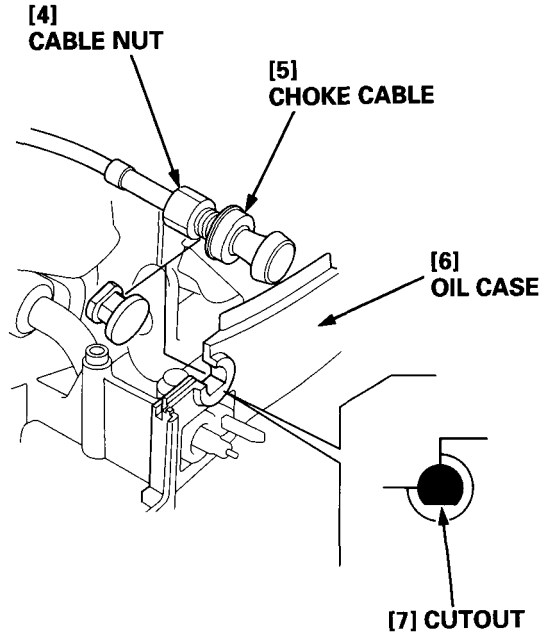
   Adjust the cable direction as shown and tighten the valve nut securely.



c. ADJUSTMENT

Check the distance from the end of the valve nut to the stepped surface of the SE valve. It should be 14 mm (0.6 in).





3. FUEL PUMP/FUEL FILTER

SHOP MANUAL NEWS

a. REMOVAL

⚠ WARNING

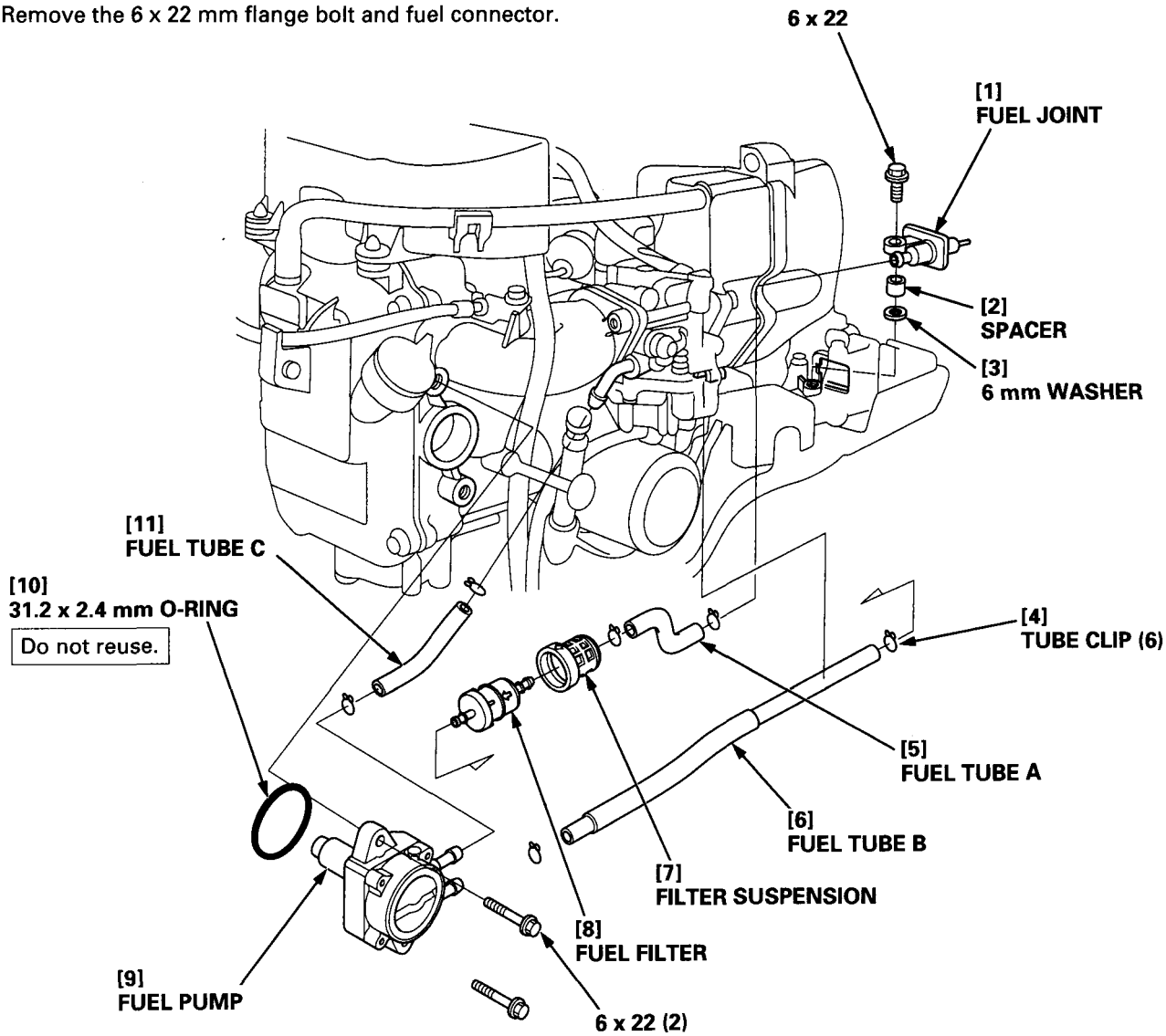
Gasoline is highly flammable and explosive.
You can be burned or seriously injured when handling fuel.
- **Keep heat, sparks, and flame away.**
- **Handle fuel only outdoors.**
- **Wipe up spills immediately.**

1) Remove the engine cover and right engine under cover (P. 5-2).

2) Slide the tube clips and disconnect the fuel tubes.
   - Wipe up the spilled gasoline immediately.

3) Remove the two 6 x 22 mm flange bolts and fuel pump.
   - Take care to prevent foreign material from entering the engine.

4) Remove the 6 x 22 mm flange bolt and fuel connector.

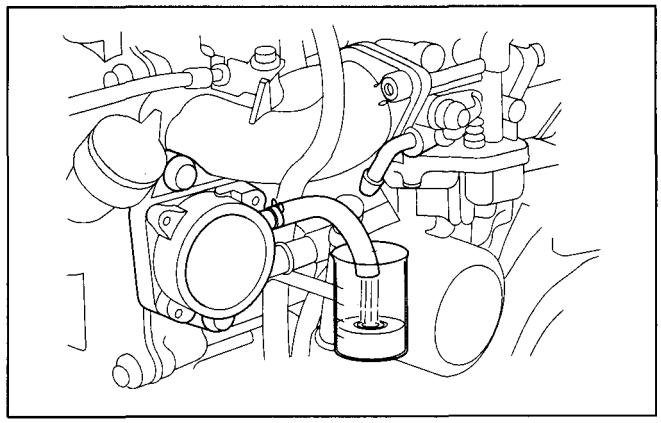


b. INSPECTION

• FUEL PUMP

⚠ WARNING

Gasoline is highly flammable and explosive.
You can be burned or seriously injured when handling fuel.
- **Keep heat, sparks, and flame away.**
- **Handle fuel only outdoors.**
- **Wipe up spills immediately.**



1) Remove the spark plugs from the No. 1 and 2 cylinder.

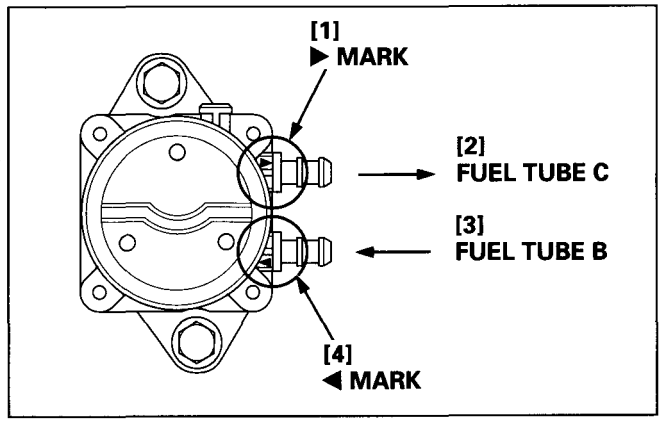
2) Connect the fuel tube from the fuel tank to the fuel connector.

3) Disconnect the fuel tube C from the carburetor.

4) Squeeze the primer bulb until the fuel reaches to the fuel pump.
   - Receive the flowing fuel with suitable container.

5) Turn the camshaft by operating the recoil starter several times, and check for fuel flow.

6) After inspection, reconnect the fuel tube C to the carburetor and make sure that there is no fuel leak.



c. INSTALLATION

- Before installation check the fuel tubes for deterioration, cracks, and other damage. Replace if necessary.

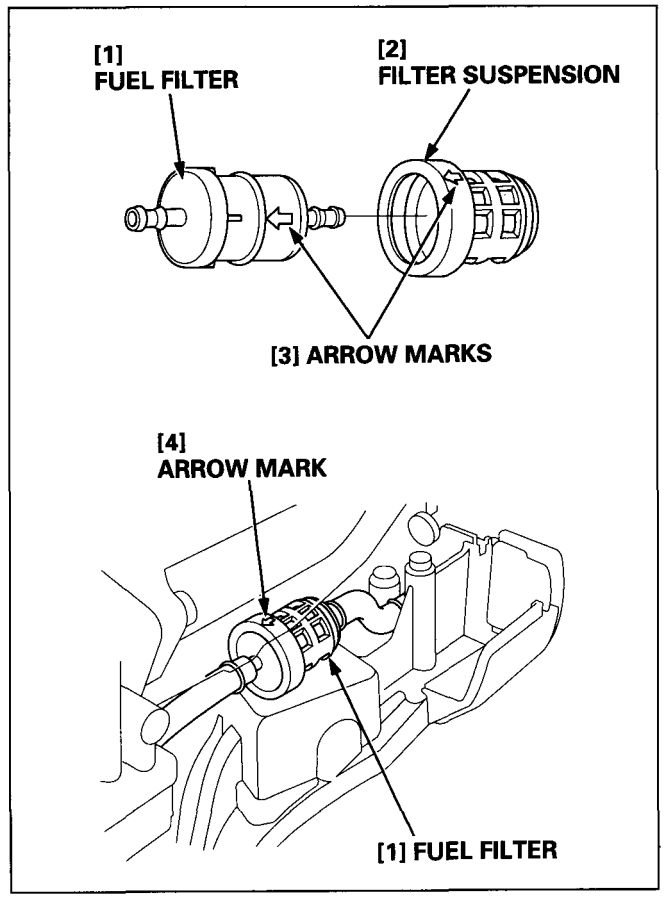
1) Apply oil to a new O-ring and install it to the fuel pump.

2) Install the fuel pump with the tube joints facing the carburetor side and tighten the 6 x 22 mm flange bolts securely.

3) Connect the fuel tube B to the lower joint (◀ mark) and fuel tube C to the upper joint (▶mark).

4) Install the fuel filter into the filter suspension so the arrow mark points to the same direction as shown. Install them so the arrow mark on the filter suspension points toward the fuel pump side.

5) After installation, connect the fuel hose connector to the outboard motor. Pump the primer bulb, and make sure that there is no fuel leaks.



4. FUEL TANK

a. DISASSEMBLY/REASSEMBLY

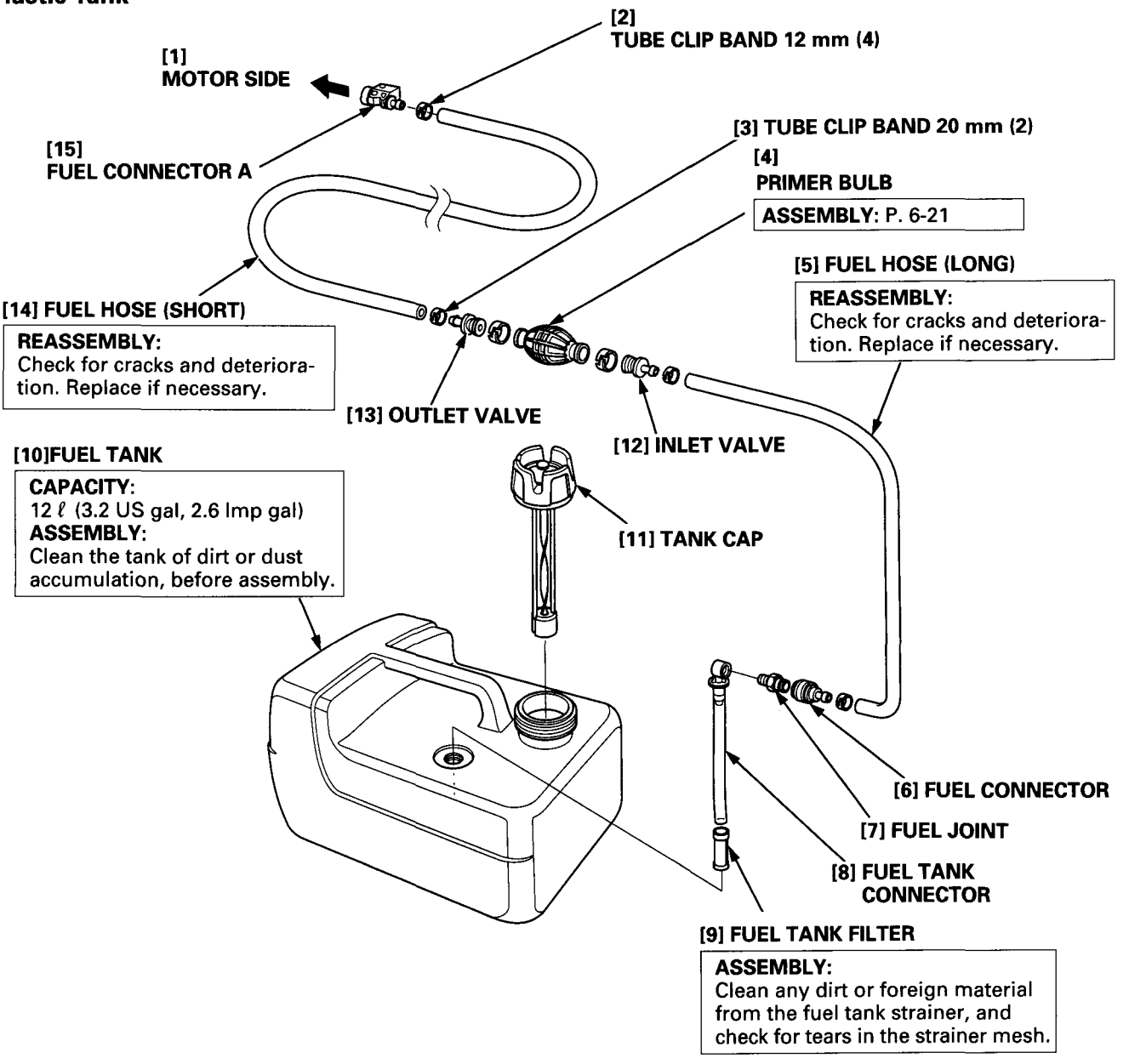
Drain the fuel tank and fuel line completely before disassembly.

⚠ WARNING

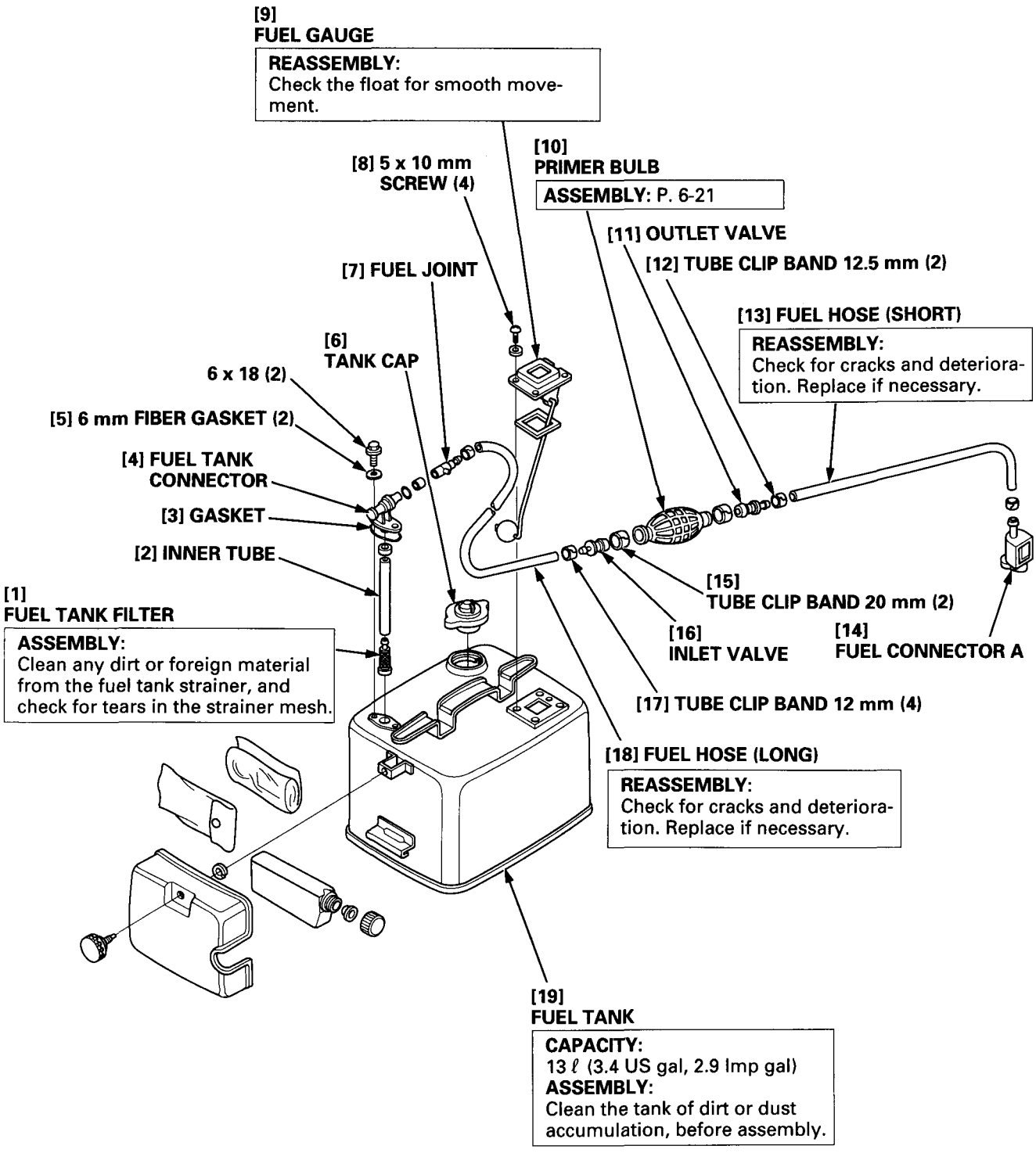
Gasoline is highly flammable and explosive.
You can be burned or seriously injured when handling fuel.
- **Keep heat, sparks, and flame away.**
- **Handle fuel only outdoors.**
- **Wipe up spills immediately.**

- Remove any dirt or foreign material from the fuel tank strainer, and check for tears in the strainer mesh. Replace the strainer if necessary.

• Plastic Tank



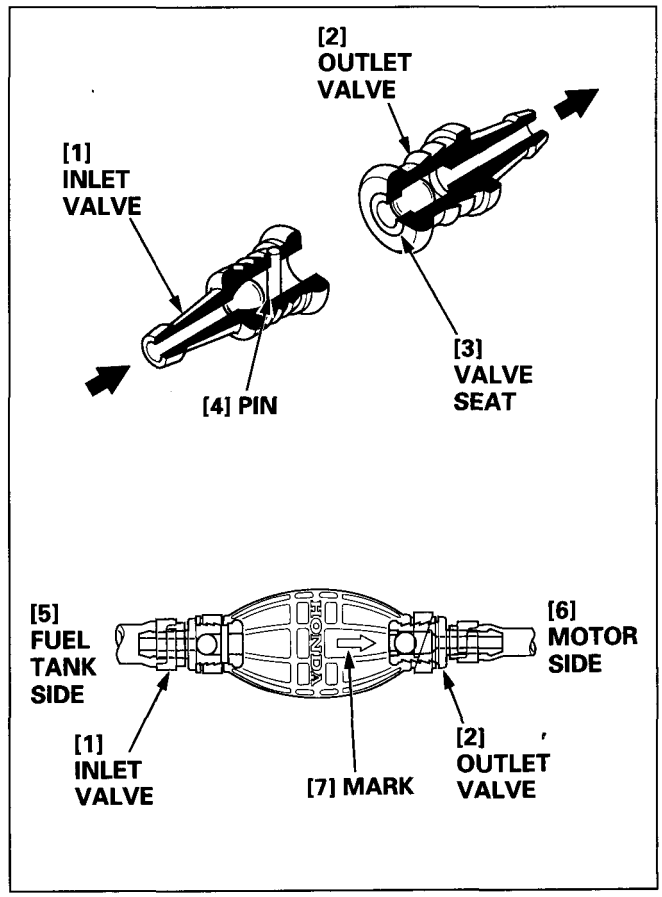
• **Steel Tank**


[9]
FUEL GAUGE
REASSEMBLY:
Check the float for smooth movement.
[8] 5 x 10 mm SCREW (4)
[10]
PRIMER BULB
ASSEMBLY: P. 6-21
[11] OUTLET VALVE
[12] TUBE CLIP BAND 12.5 mm (2)
[7] FUEL JOINT
[13] FUEL HOSE (SHORT)
REASSEMBLY:
Check for cracks and deterioration. Replace if necessary.
[6]
TANK CAP
6 x 18 (2)
[5] 6 mm FIBER GASKET (2)
[4] FUEL TANK CONNECTOR
[3] GASKET
[2] INNER TUBE
[1]
FUEL TANK FILTER
ASSEMBLY:
Clean any dirt or foreign material from the fuel tank strainer, and check for tears in the strainer mesh.
[15]
TUBE CLIP BAND 20 mm (2)
[16]
INLET VALVE
[14]
FUEL CONNECTOR A
[17] TUBE CLIP BAND 12 mm (4)
[18] FUEL HOSE (LONG)
REASSEMBLY:
Check for cracks and deterioration. Replace if necessary.
[19]
FUEL TANK
CAPACITY:
13 ℓ (3.4 US gal, 2.9 Imp gal)
ASSEMBLY:
Clean the tank of dirt or dust accumulation, before assembly.

• INLET/OUTLET VALVE INSTALLATION

1) Install the inlet valve (has the pin) at the side marked with "➡" on the priming bulb.

2) Install the outlet valve (has the valve seat) at the other side.
   - Do not confuse the inlet valve with the outlet valve.
   - Install the priming bulb with the "➡" mark toward the motor side.

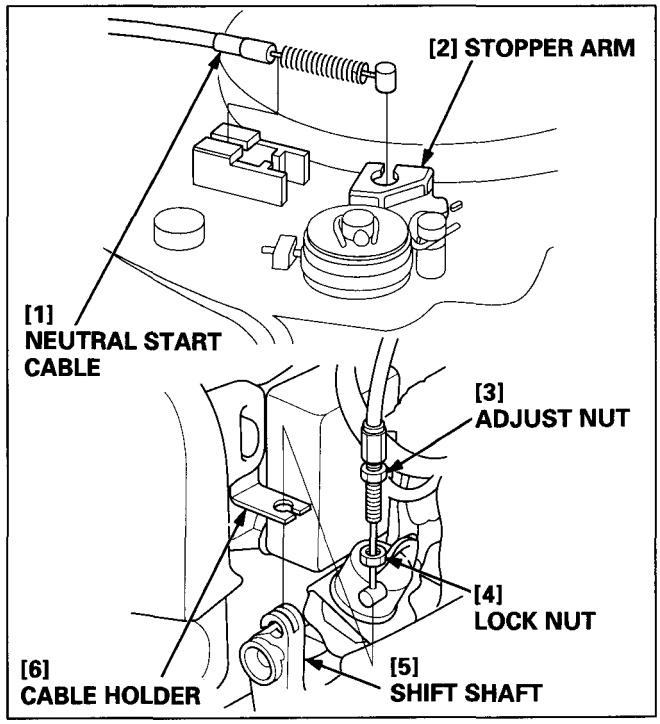


1. NEUTRAL START CABLE
2. RECOIL STARTER
3. STARTER CASE B

1. NEUTRAL START CABLE

a. REMOVAL

1) Remove the engine cover.
2) Shift the gear into the neutral position.
3) Disconnect the upper cable end from the stopper arm.
4) Disconnect the lower cable end from the shift shaft.
5) Loosen the lock nut and adjusting nut, then remove the neutral start cable.

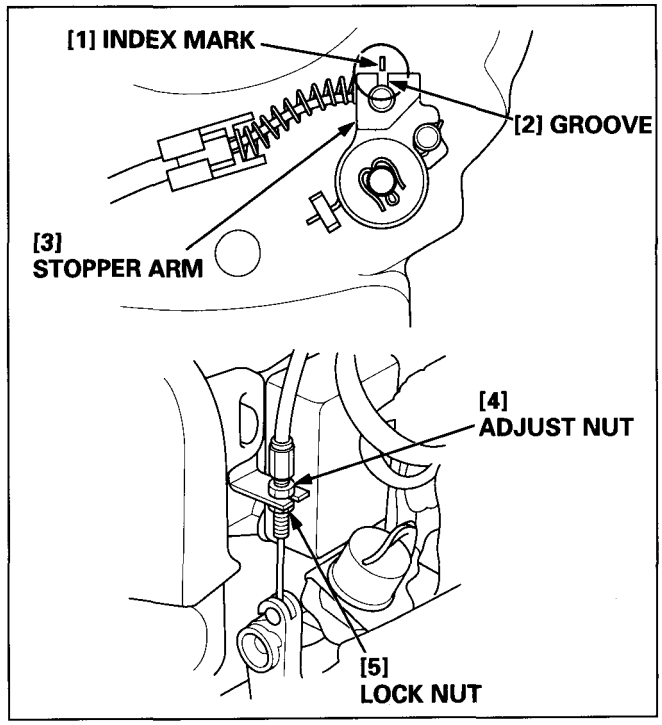


b. INSTALLATION

1) Make sure the gear is in the neutral position.
2) Connect the neutral starter cable lower end to the shift shaft.
3) Route the cable properly and set the cable outer end to the recoil starter case, then connect the cable upper end to the stopper arm.
4) Adjust the neutral start cable as follows.

c. ADJUSTMENT

1) Remove the engine cover and shift the gear into the neutral position.
2) Loosen the lock nut and turn the adjust nut until the groove of the stopper arm aligns with the index mark on the recoil starter case.
3) Tighten the lock nut securely.
4) After adjustment check for proper operation of the neutral start mechanism by operating the recoil starter.
5) Install the engine cover.



2. RECOIL STARTER

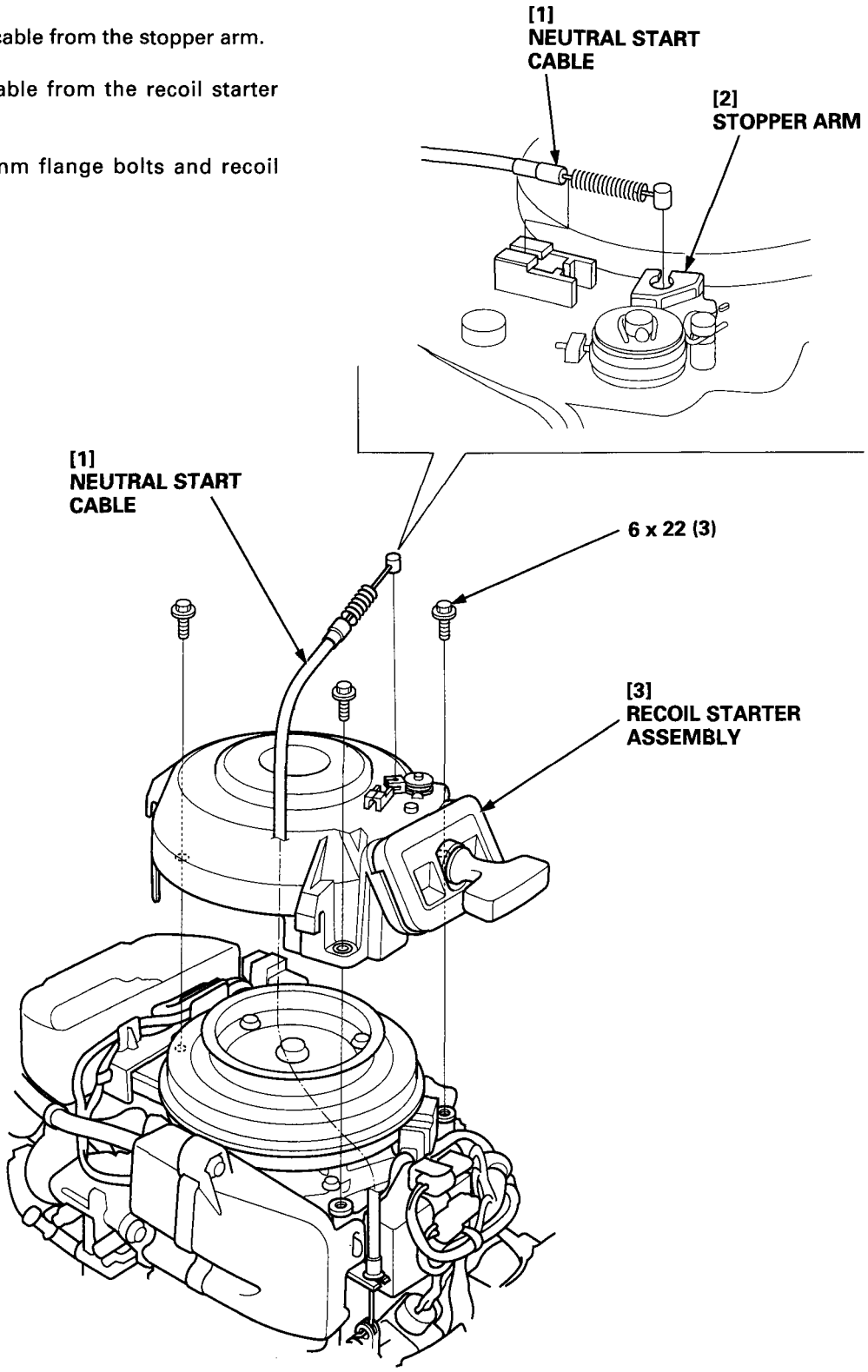
a. REMOVAL

1) Remove the engine cover.

2) Disconnect the neutral start cable from the stopper arm.

3) Pull out the neutral start cable from the recoil starter case.

4) Remove the three 6 x 22 mm flange bolts and recoil starter assembly.



b. DISASSEMBLY

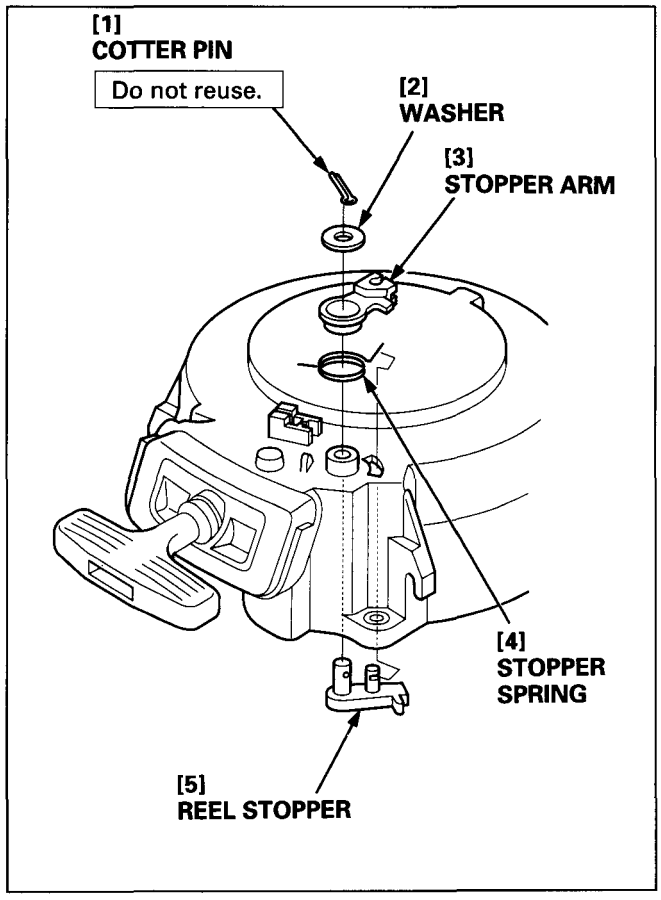
⚠ WARNING

- **Wear gloves and eye protection.**
- **During disassembly, take care not to allow the return spring to come out.**

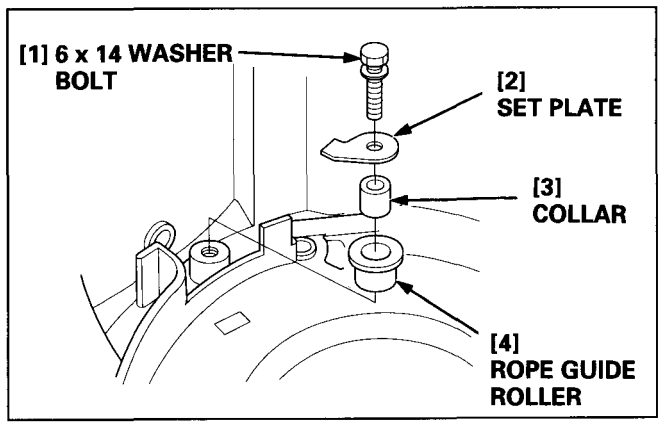
1) Remove the cotter pin and washer, and discard the cotter pin.
   - Replace with new one when reassembly.

2) Unhook the stopper spring from the reel stopper.

3) Remove the stopper arm, stopper spring and reel stopper.

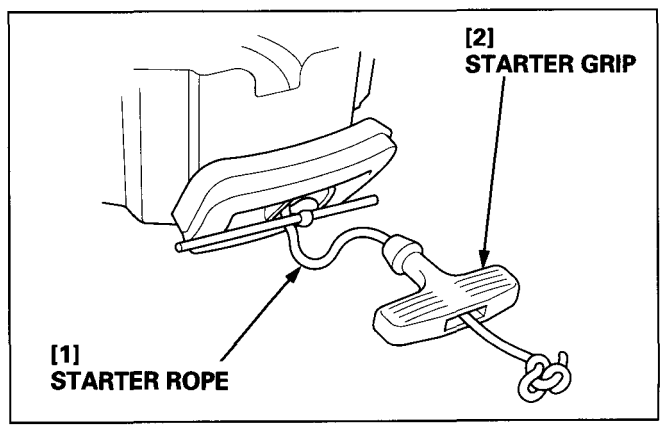


4) Remove the 6 x 14 mm washer bolt, set plate, collar and rope guide roller.



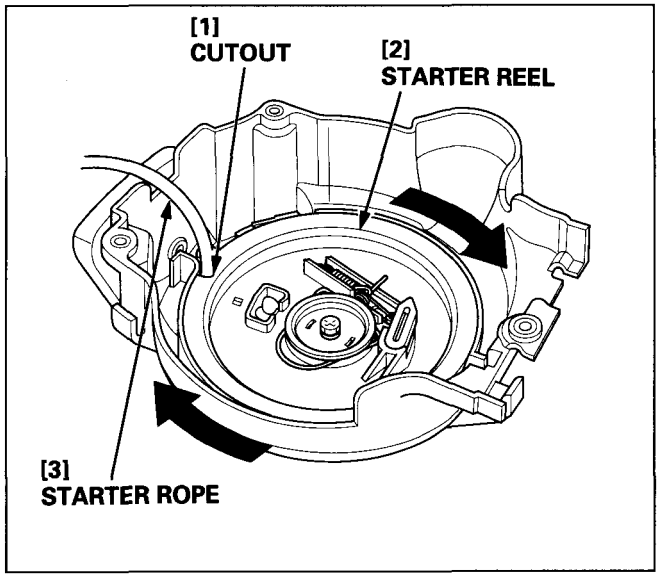
5) Pull out the starter rope end from the start grip, and untie the rope end.

6) Hold the starter rope and remove the starter grip.



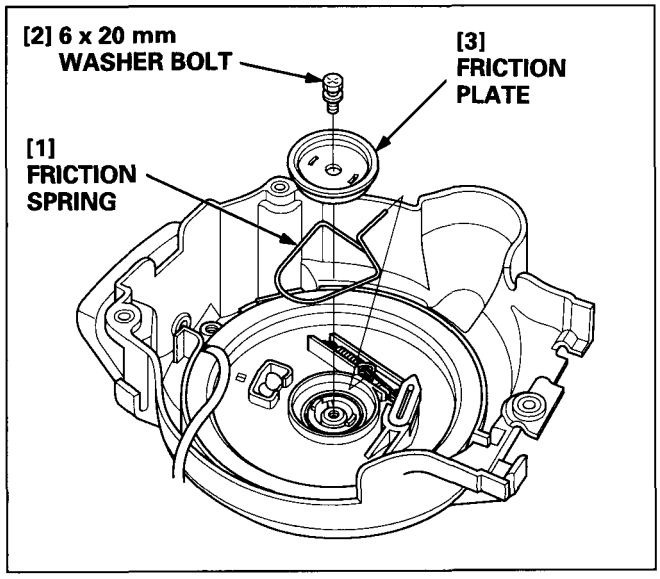
7) Pull out the starter rope from the starter case holding the starter reel to prevent it from turning.

8) Align the starter rope with the cutout of the starter reel. Hold the starter rope end and slowly turn the reel clockwise to release the spring preload.



9) Remove the 6 x 20 mm washer bolt, friction plate and friction spring.

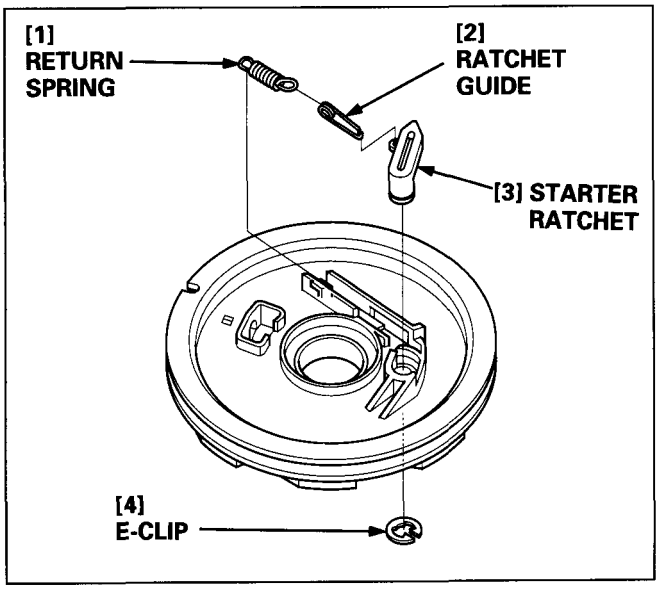
10) Remove the recoil starter reel from the starter case taking care not to allow the starter spring to come out.



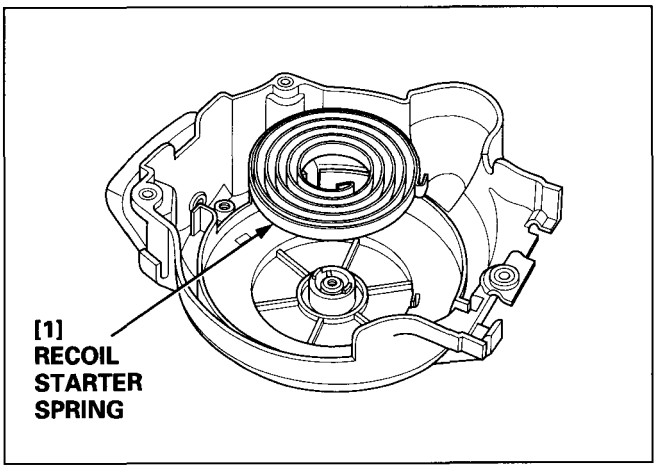
11) Pry off the E-clip from the starter ratchet behind the starter reel.

12) Remove the starter ratchet, ratchet guide and ratchet return spring.

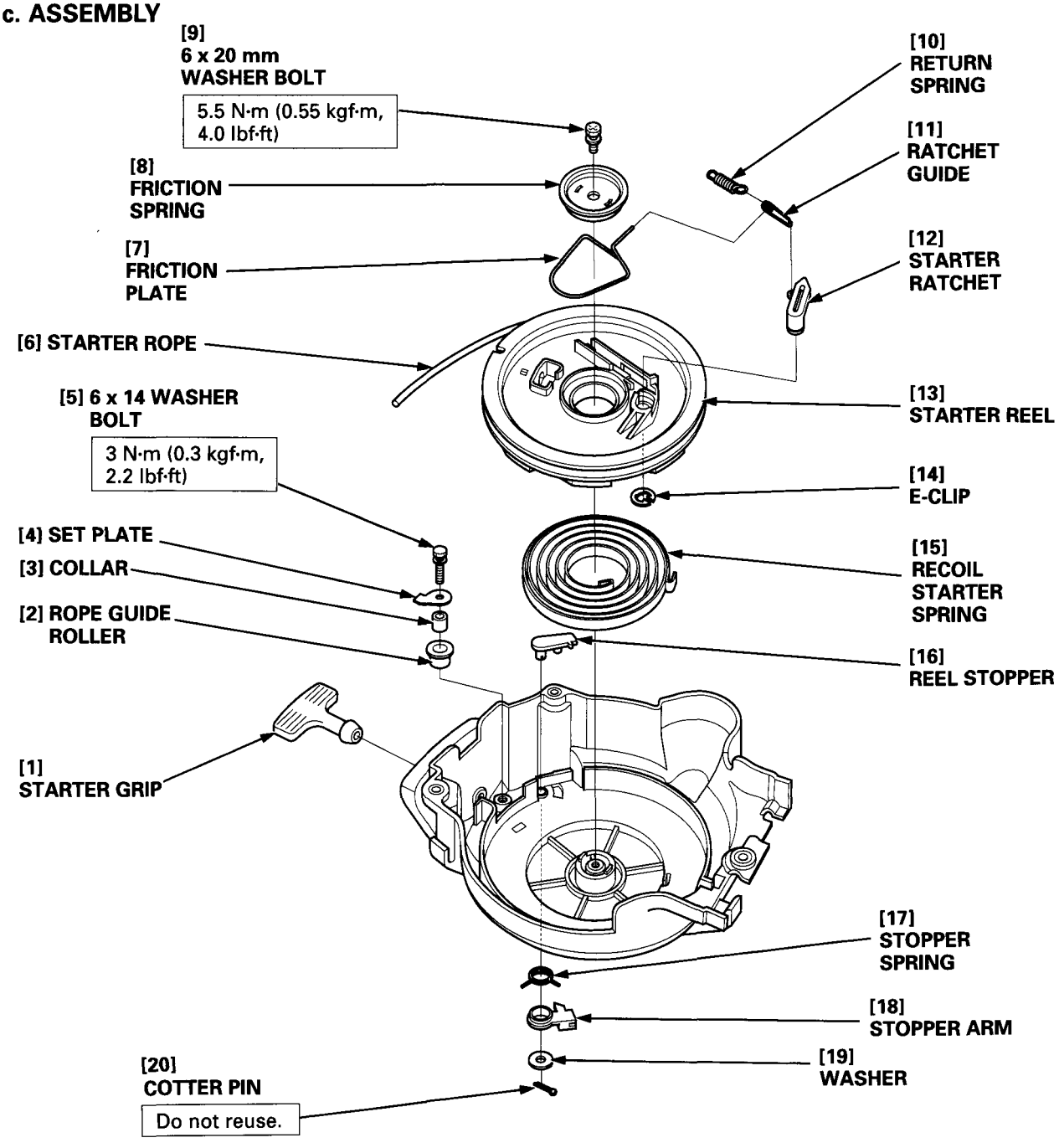
13) Check the starter rope for fraying or wearing. Pull out the starter rope if replacement is necessary.



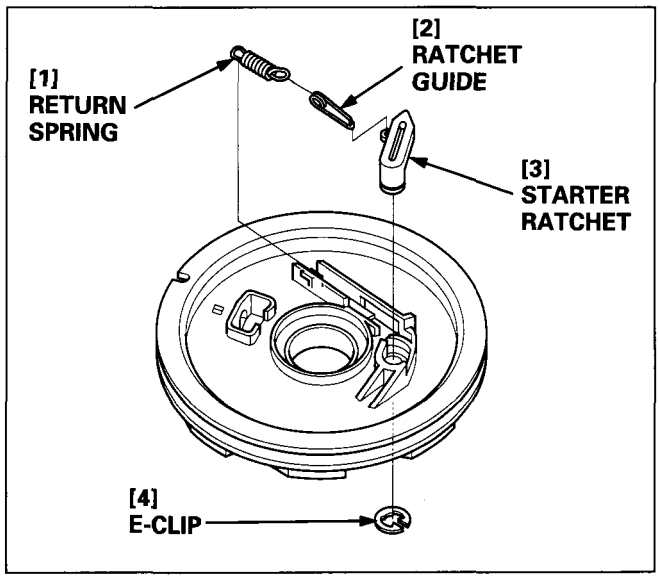
14) Remove the recoil starter spring from the starter case if necessary.
    - Take care not to allow the return spring to come out.



c. ASSEMBLY



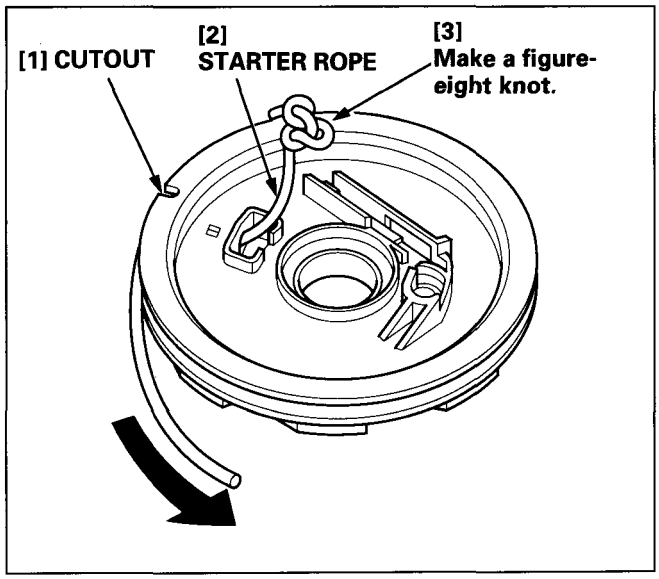
1) Install the return spring, ratchet guide and starter ratchet, and set the E-clip.



2) Check the starter rope for fraying or wear, replace if necessary.

3) Insert new starter rope end into the starter reel and make a figure-eight knot at the rope end.

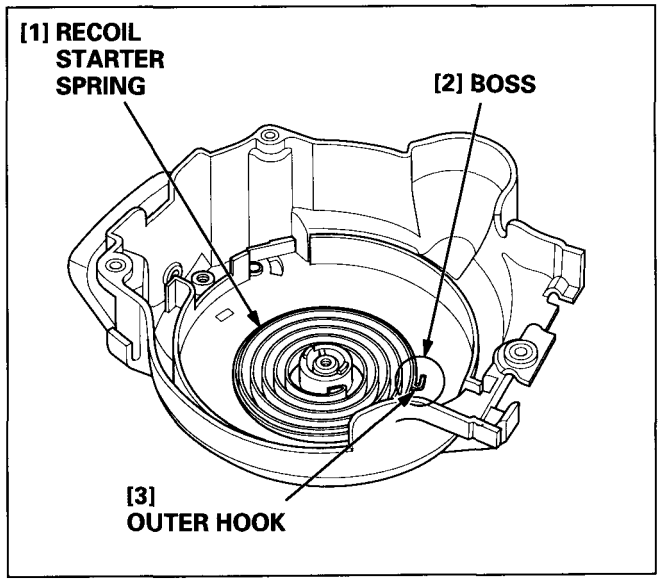
4) Wind the starter rope onto the starter reel counterclockwise with ratchet mounting section facing up and align the rope with cutout of the starter reel.



5) Wind the return spring and install it on the starter case. Hook the outer hook of the return spring against the boss of the starter case as shown.

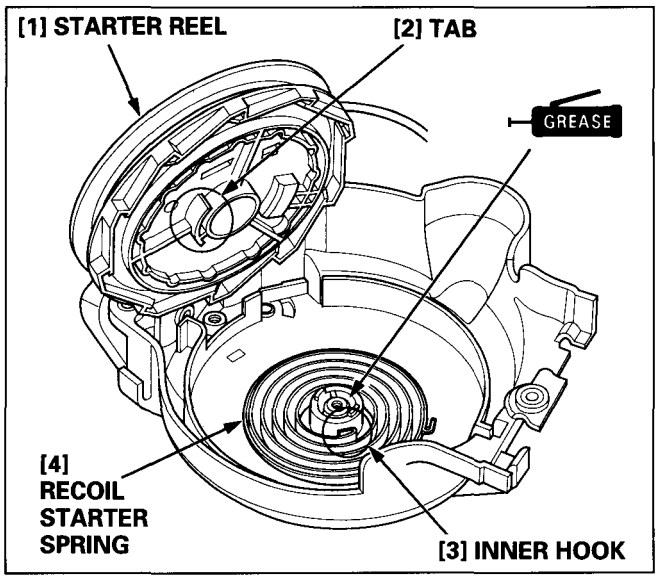
⚠ WARNING

- **Wear gloves and eye protection.**
- **During disassembly, take care not to allow the return spring to come out.**



6) Apply grease to the starter reel mounting boss on the starter case.

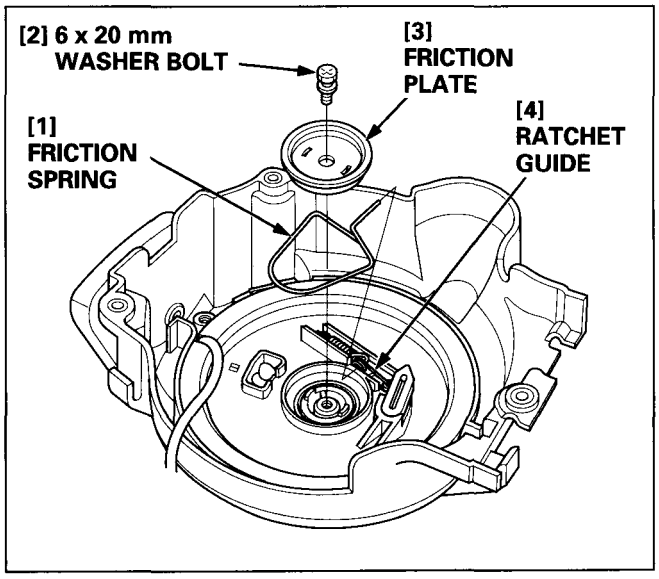
7) Install the starter reel and turn the starter reel counter-clockwise to align the spring inner hook with the tab on the starter case. Be sure the rope end is out from the cutout of the starter reel.



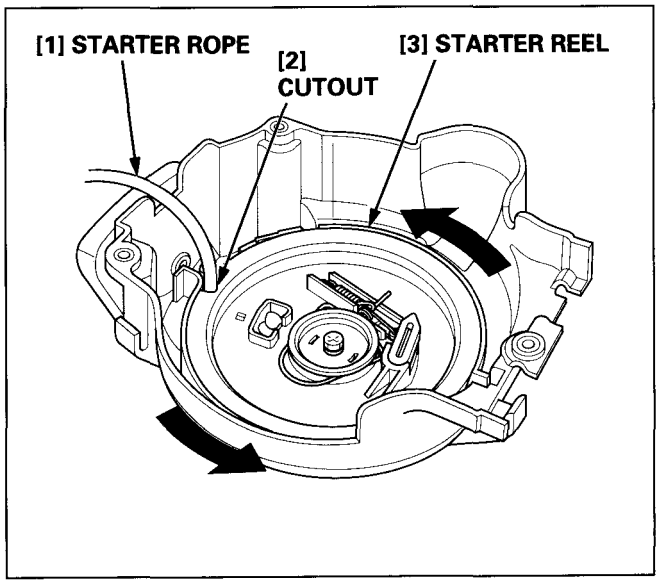
8) Set the friction spring on the friction plate.

9) Insert the friction spring end into the ratchet guide and secure them with the 6 x 20 mm washer bolt.

TORQUE: 5.5 N·m (0.55 kgf·m, 4.0 lbf·ft)

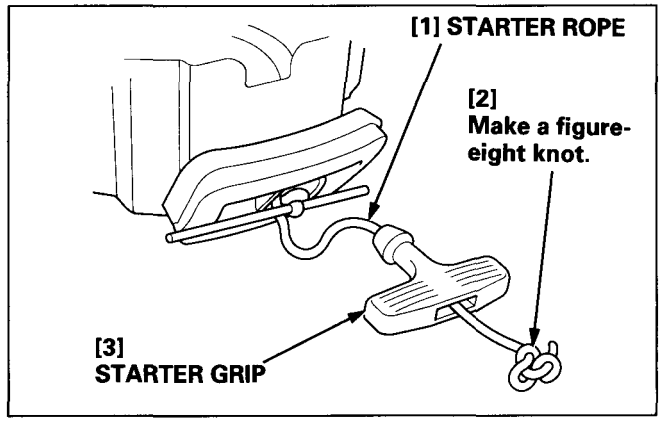


10) Turn the starter reel 2 turns in the direction of the arrow for pre-tensioning of the starter spring while holding the starter rope end not to let it get out of the cutout.



11) Pull out the rope end from the starter case hole holding the starter reel not to turn.

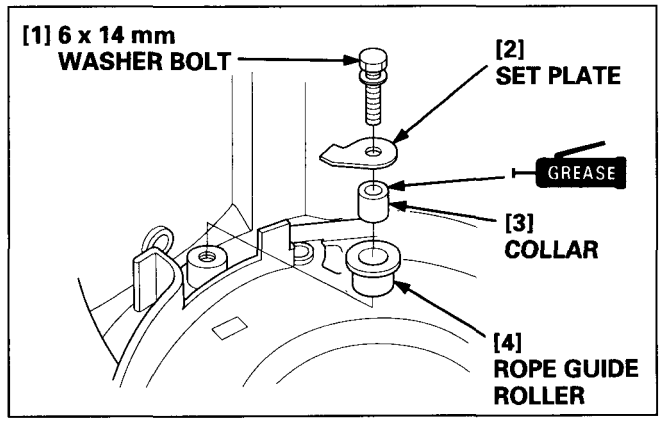
12) Install the starter grip, and make a figure-eight knot.



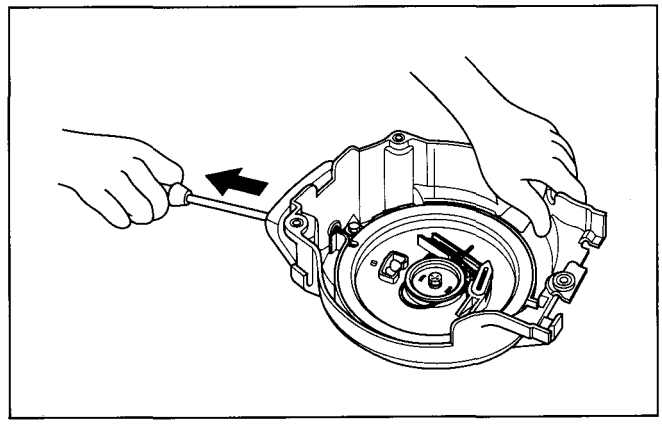
13) Apply grease to the outside of the collar.

14) Install the rope guide roller, collar and set plate, and tighten the 6 x 14 mm washer bolt securely.

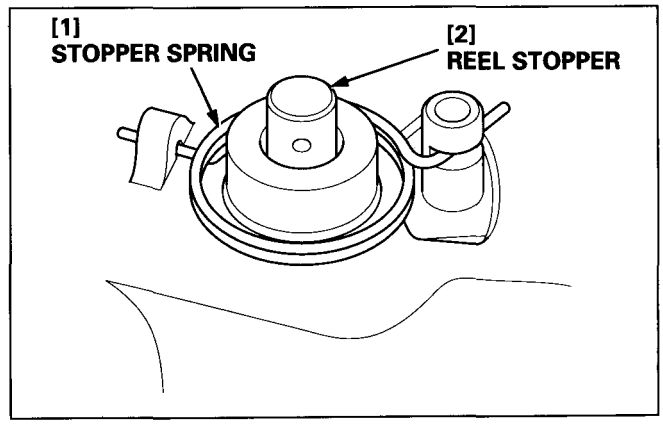
TORQUE: 3 N·m (0.3 kgf·m, 2.2 lbf·ft)



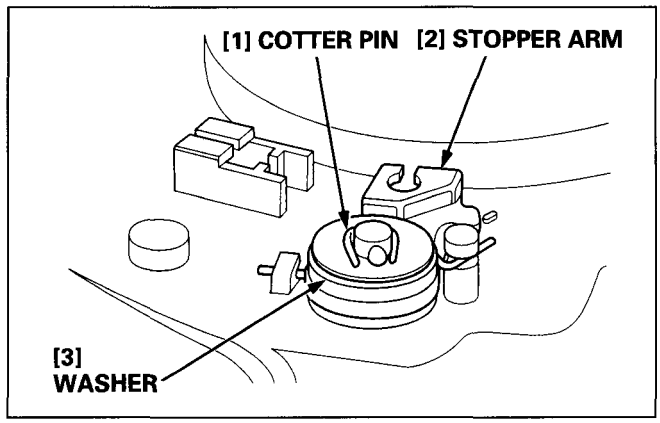
15) Check the operation of starter assembly by pulling the starter rope several times.



16) Install the reel stopper and stopper spring, and set the spring as shown.

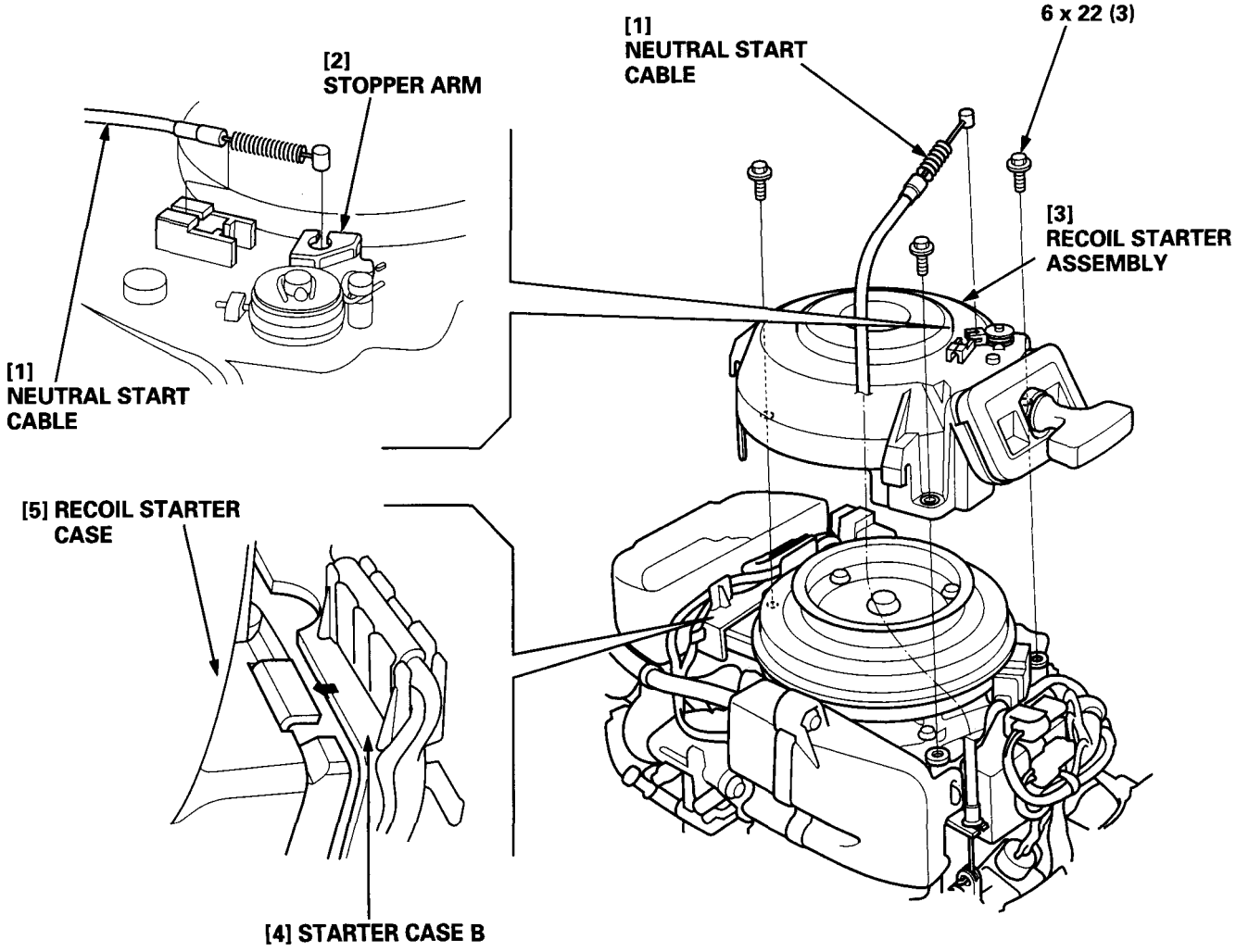


17) Install the stopper arm and washer, then secure them using a new cotter pin.



d. INSTALLATION

1) Install the recoil starter assembly by aligning the recoil starter case and starter case B as shown.
2) Connect the neutral start cable to the stopper arm.
3) Adjust the neutral start cable (P. 7-1).
4) Install the engine cover.



3. STARTER CASE B

a. REMOVAL

1) Remove the following parts:
   — engine cover (P. 5-1).
   — left engine under cover (P. 5-2).
   — right engine under cover (P. 5-3).
   — recoil starter (P. 7-2).

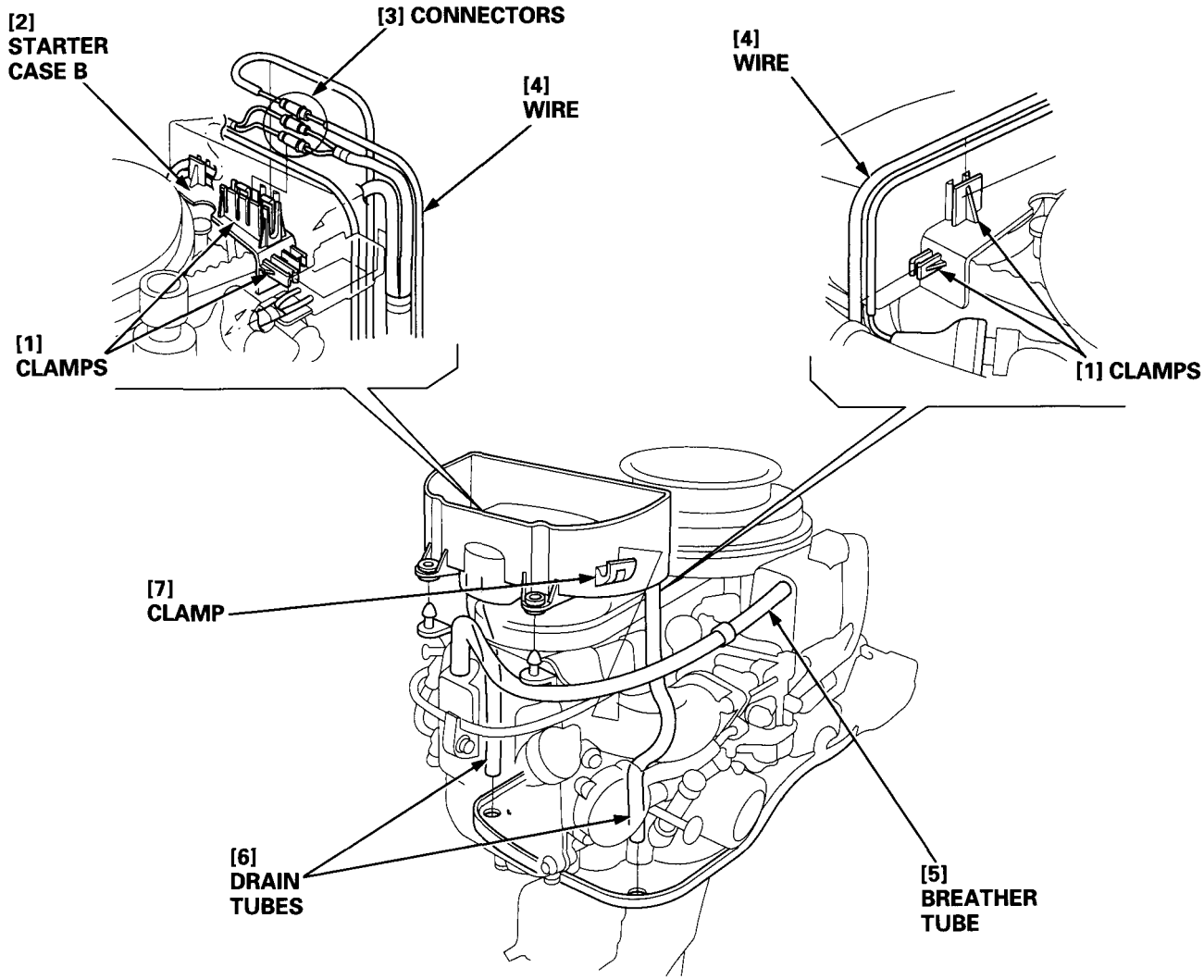
2) Pull out the connectors and wires from the clamp on the starter case B.

3) Pull off the breather tube from the clamp on the starter case B and remove it. Disconnect the breather tube from the cylinder head cover.

4) Remove the starter case B with the drain tube attached by disconnecting the drain tubes from the lower setting holes.

b. INSTALLATION

Installation is the reverse order of removal.



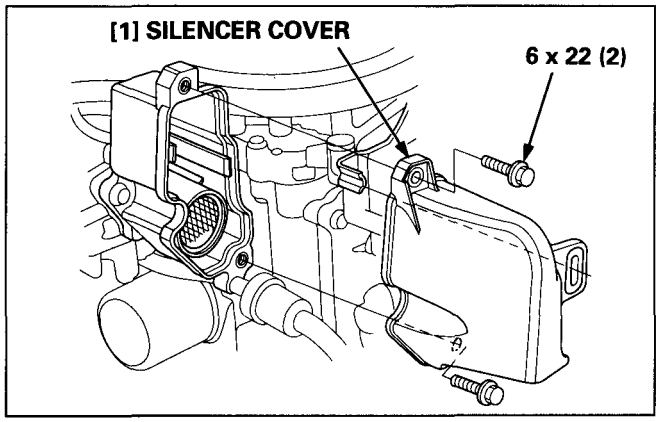
1. ENGINE REMOVAL 2. ENGINE INSTALLATION

1. ENGINE REMOVAL

1) Remove the following:
   — engine cover (P. 5-1).
   — left engine under cover (P. 5-2).
   — right engine under cover (P. 5-3).
   — recoil starter (P. 7-2) and neutral start cable (P. 7-1).
   — remote control cables (P. 14-2).

2) Drain the engine oil into a suitable container (P. 3-2).

3) Remove the two 6 x 22 mm flange bolts and silencer cover.

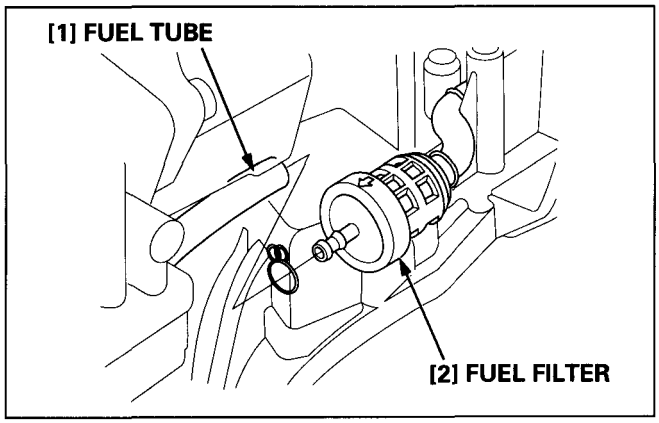


4) Loosen the carburetor drain screw and drain the carburetor into a suitable container.

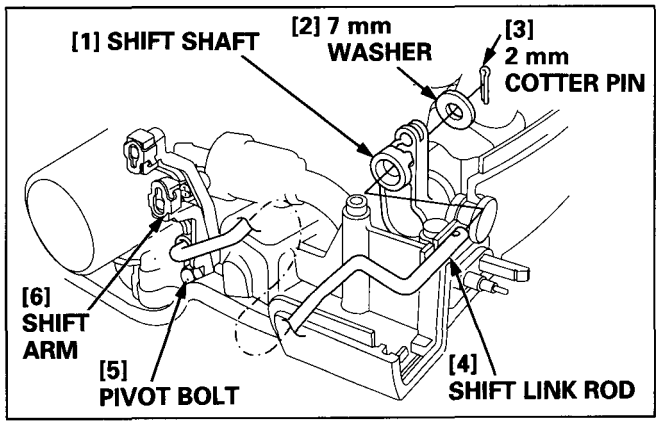
⚠ WARNING

Gasoline is highly flammable and explosive.
You can be burned or seriously injured when handling fuel.
- **Keep heat, sparks, and flame away.**
- **Handle fuel only outdoors.**
- **Wipe up spills immediately.**

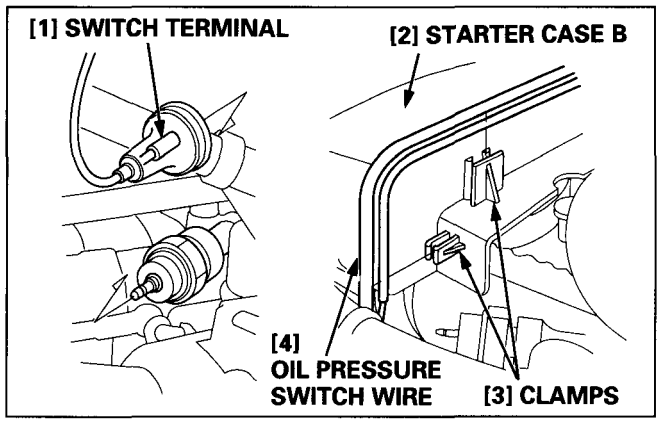
5) Disconnect the fuel tube from the fuel filter.



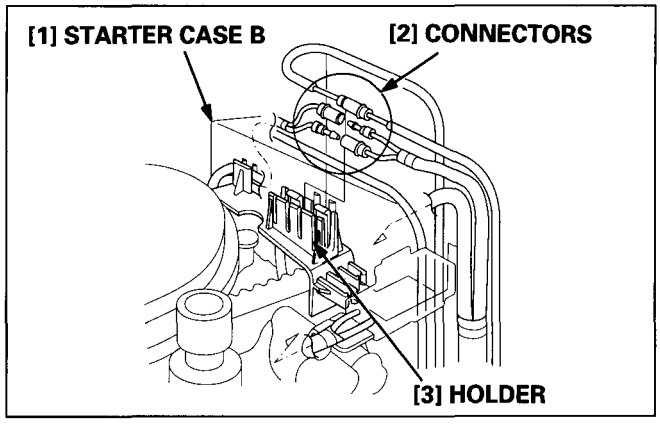
6) Loosen the shift arm pivot bolt fully. Remove the cotter pin and 7 mm washer and disconnect the shift linkage from the shift shaft (Remote control type only).



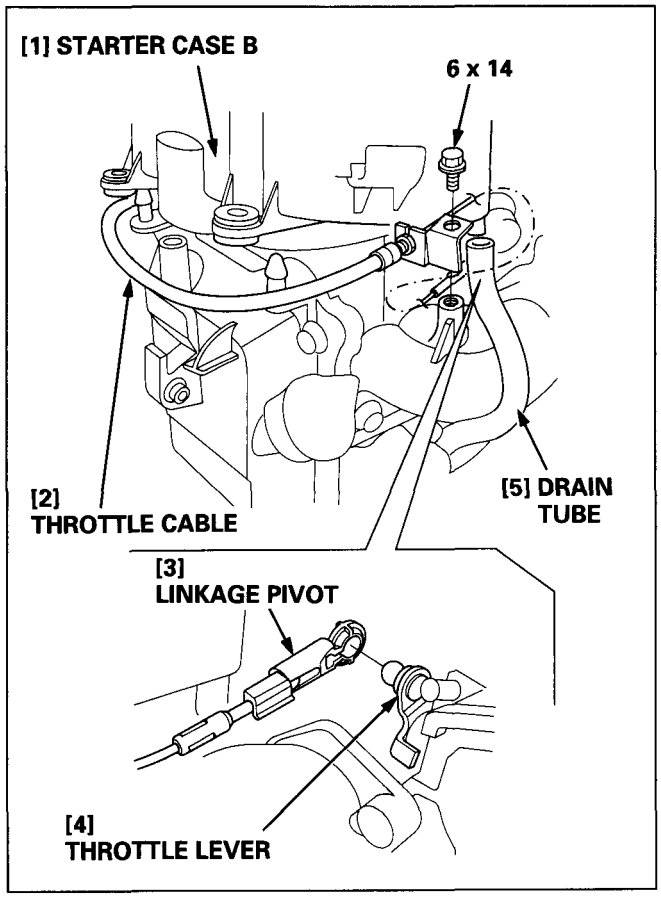
7) Disconnect the oil pressure switch terminal and remove the wire from the clamps on the starter case B.



8) Remove the SE thermal valve wire connectors from the holder of the starter case B and disconnect the connectors (Electric starter type).



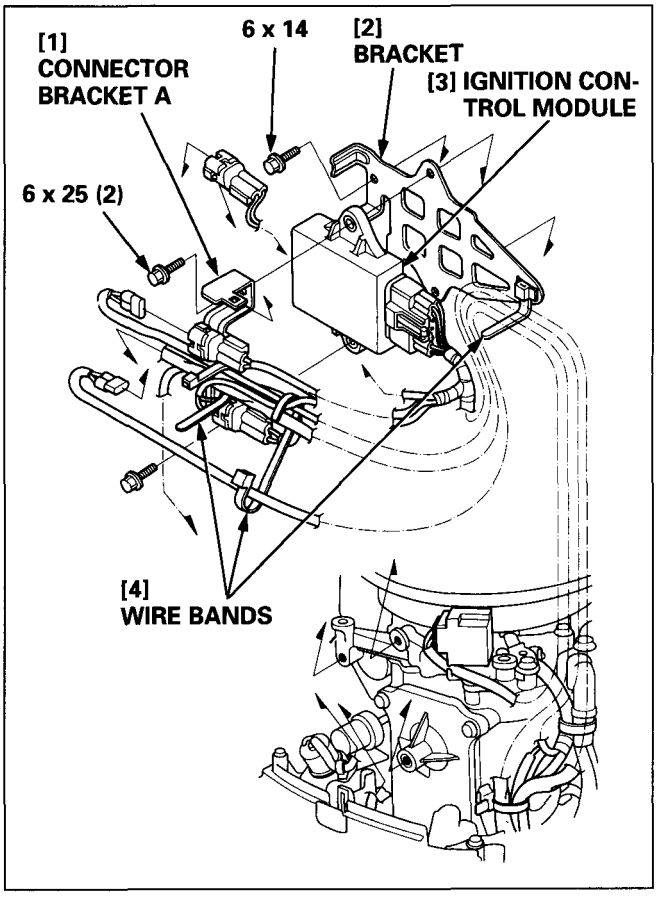
9) Pull up the starter case B slightly and disconnect the drain tube from the starter case B, and remove the 6 x 14 mm flange bolt and throttle cable stay, then disconnect the linkage pivot of the throttle cable from the carburetor throttle lever (Tiller handle type only).



10) Unfasten the wire bands and remove the pulse generator connector (Blue) and exciter coil connector (Green). Disconnect the connectors.

11) Remove the two 6 x 25 mm flange bolts, connector bracket A and ignition control module.

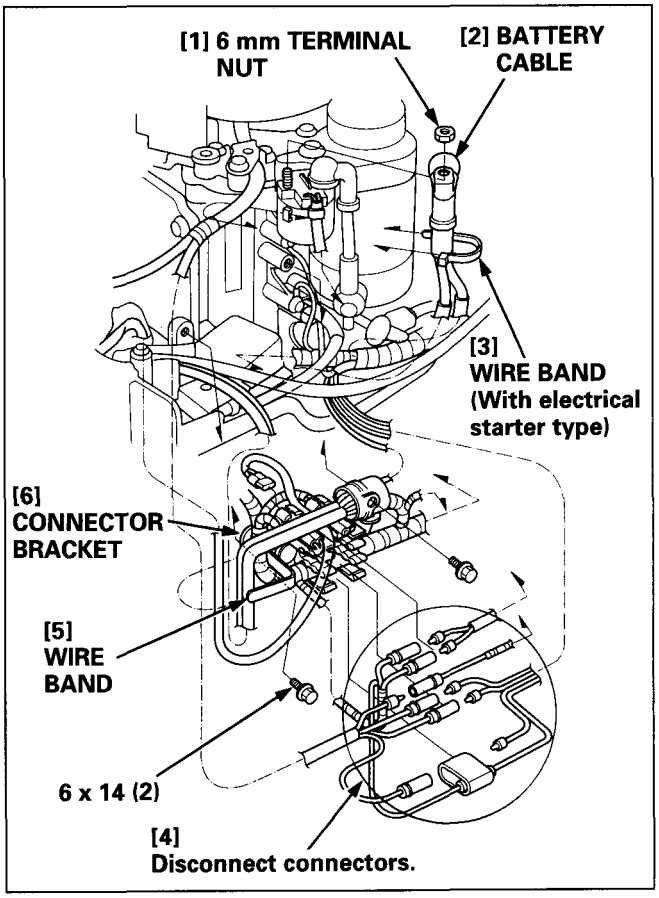
12) Remove the 6 x 14 mm flange bolt and bracket.



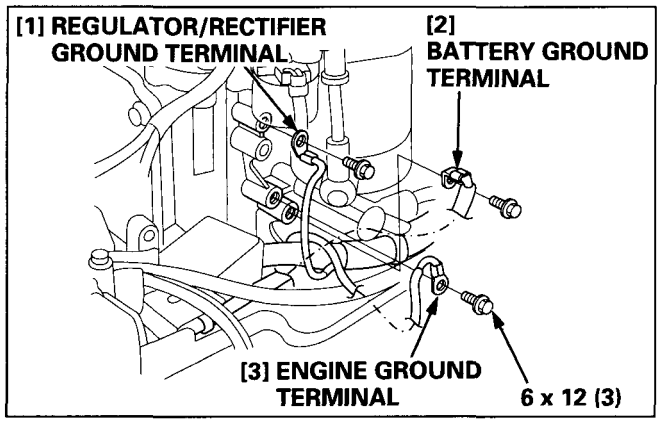
13) Unfasten the wire band at the starter magnetic switch. Release the charge coil wire and disconnect the battery cable from the starter magnetic switch by removing the 6 mm terminal nut (Electric starter type only).

14) Pull off the connectors from the connector holder, and disconnect the wire connectors of the;
— starter magnetic switch wire (Electric starter type).
— charge coil wire.

15) Remove the two 6 x 14 mm flange bolts and connector bracket.



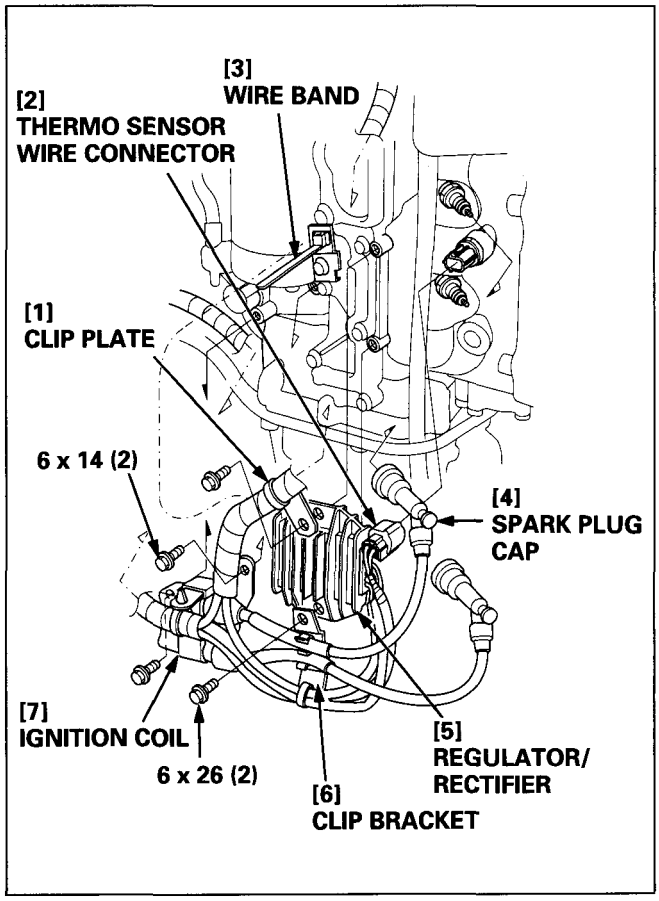
16) Remove the 6 x 12 mm flange bolts and disconnect the ground terminal;
— battery ground terminal (Electric starter type).
— regulator/rectifier ground terminal (Electric starter type).
— engine ground terminal.



17) Disconnect the spark plug caps and thermo sensor wire connector. Unfasten the wire band and release the wire harness.

18) Remove the two 6 x 26 mm flange bolts and clip bracket, clip plate, and regulator/rectifier.

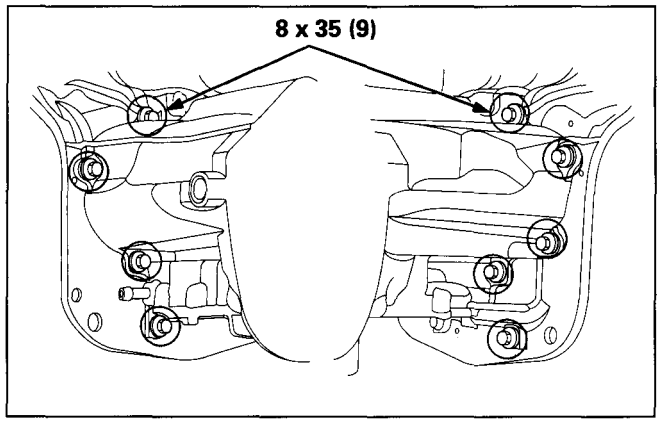
19) Remove the two 6 x 14 mm flange bolts and ignition coil.

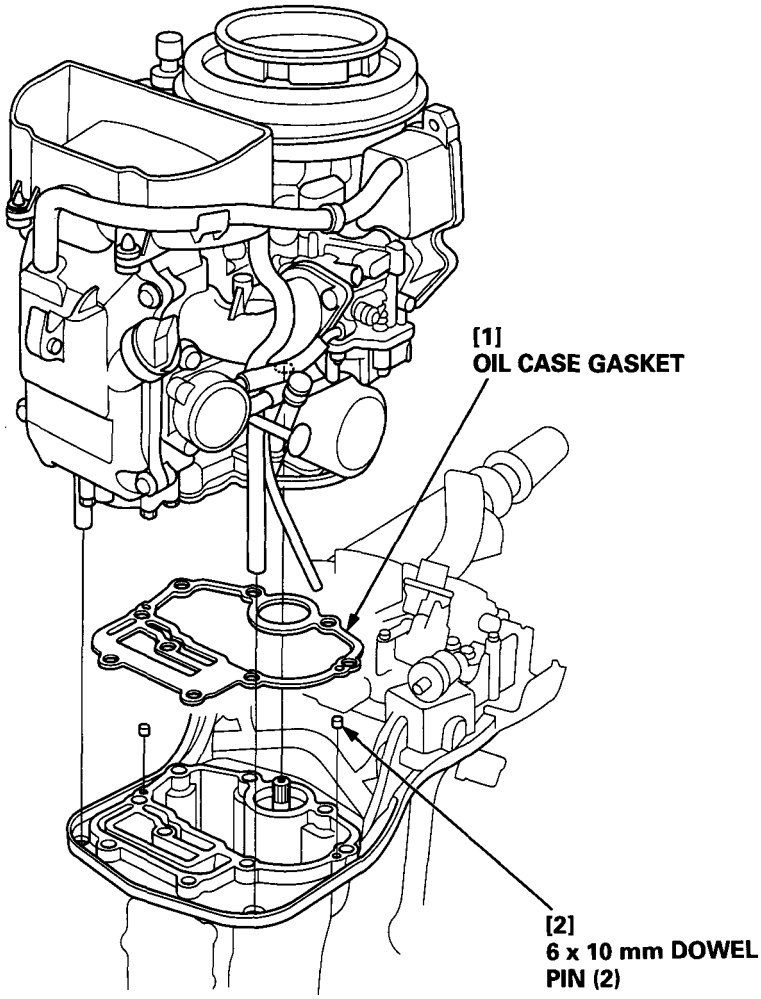


20) Remove the exhaust chamber cover (P. 4-29).

21) Remove the nine 8 x 35 mm engine mounting bolts and remove the engine from the oil case.

22) Remove the two 6 x 10 mm dowel pins and oil case gasket.

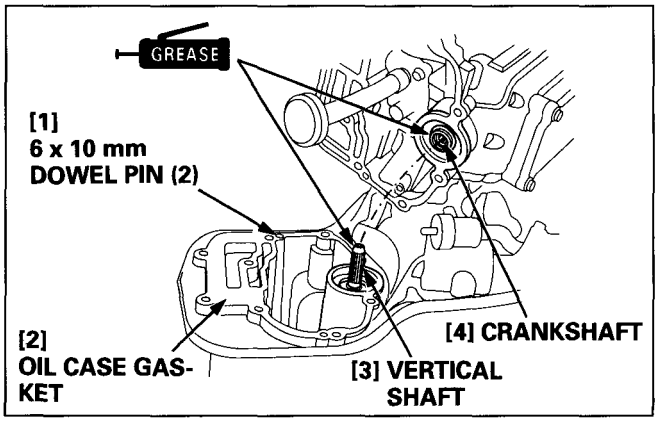




2. ENGINE INSTALLATION

1) Install the two 6 x 10 mm dowel pins and a new oil case gasket.
   - Replace the oil case gasket with new one, when reassembling.

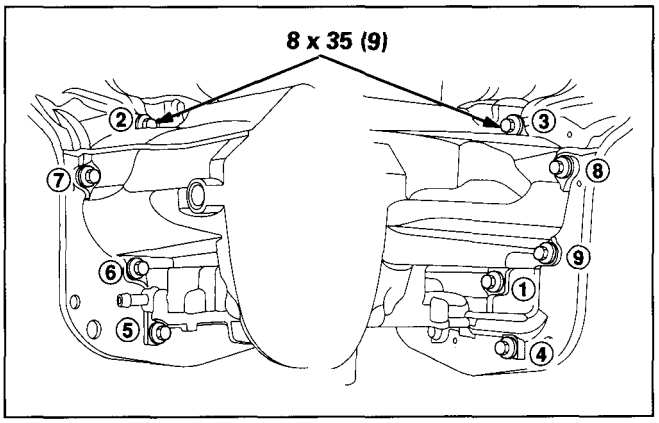
2) Apply marine grease to the spline of the vertical shaft, and install the engine by aligning the vertical shaft and crankshaft.



3) Tighten the engine mount bolts to the specified torque.
   - Tighten the bolt in the numbered sequence as shown in 2 – 3 steps.

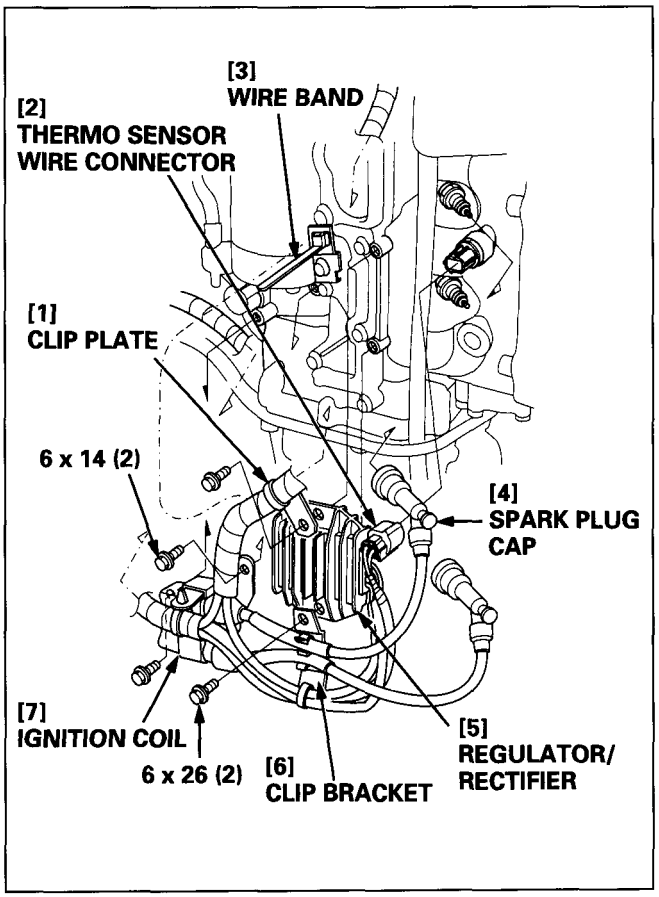
   TORQUE: 24 N·m (2.4 kgf·m, 17 lbf·ft)

4) Install the exhaust chamber (P. 4-29).



5) Install the following:
   — ignition coil.
   — regulator/rectifier.
   — clip plate and clip bracket.

6) Route the wires and connect the spark plug caps, and thermo sensor connector. Secure the wires with the wire band.
   - Replace the wire band with new one, if it is cut.

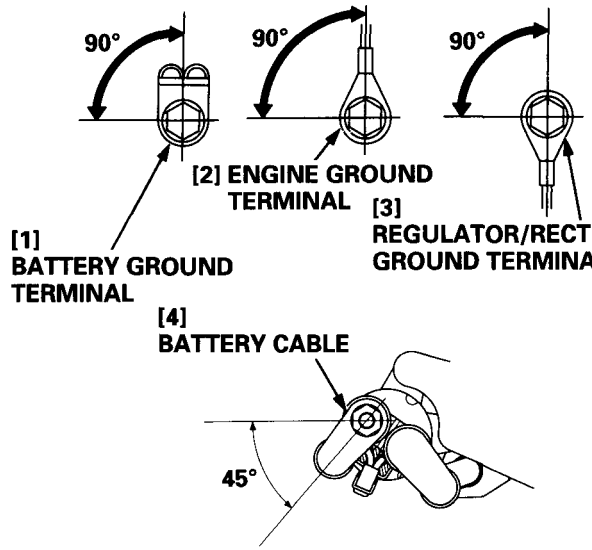


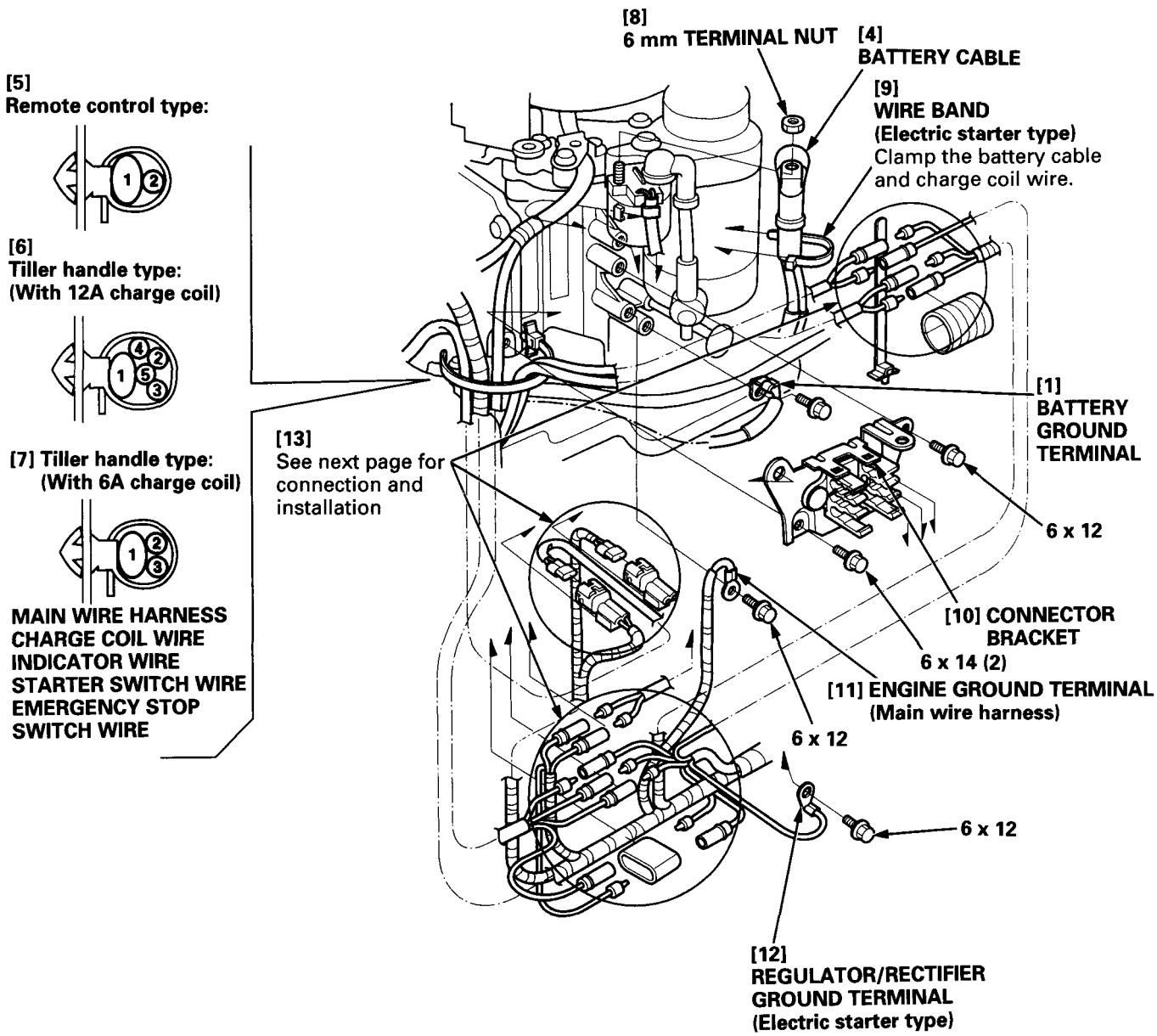
7) Install the connector bracket and secure the two 6 x 14 mm flange bolts.

8) Connect the battery cable to the starter magnetic switch and secure it with the 6 mm terminal nut.

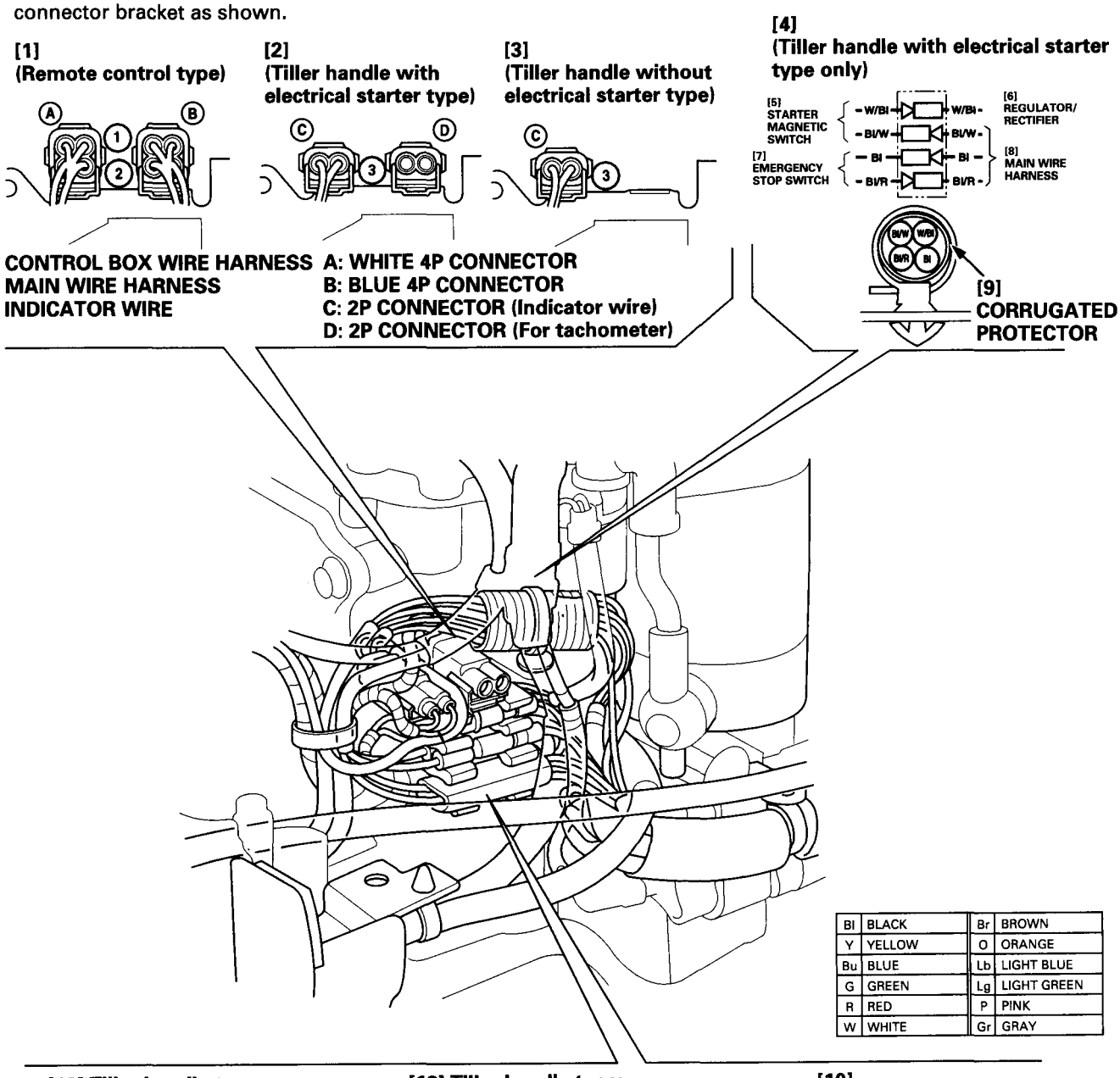
9) Tighten the 6 x 12 mm flange bolts to the ground terminals:
   — battery ground terminal (Electric starter type).
   — regulator/rectifier ground terminal (Electric starter type).
   — engine ground terminal

10) Route the wires and secure the wires with the wire bands as shown.
   • Replace the wire bands with new ones if they are cut.



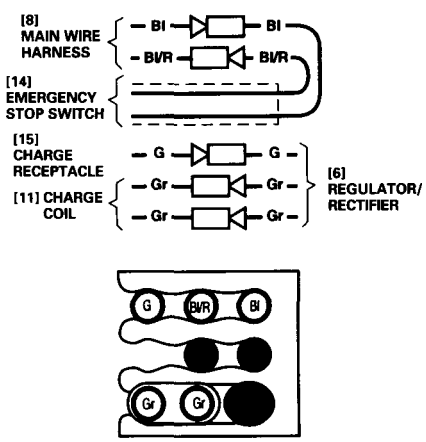


11) Connect the wire connectors and set them on the connector bracket as shown.

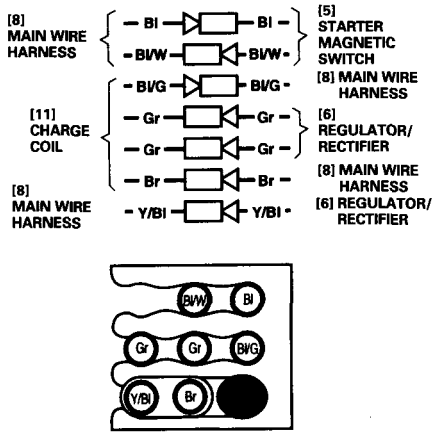


Bl	BLACK	Br	BROWN
Y	YELLOW	O	ORANGE
Bu	BLUE	Lb	LIGHT BLUE
G	GREEN	Lg	LIGHT GREEN
R	RED	P	PINK
W	WHITE	Gr	GRAY

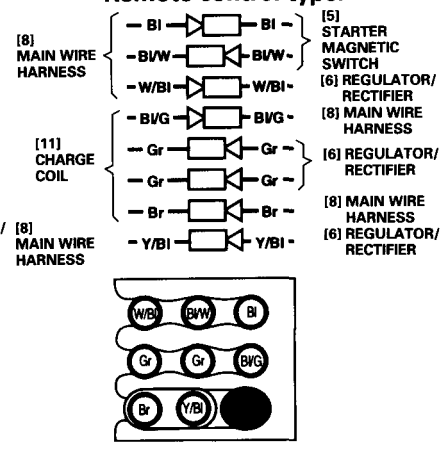
[13] Tiller handle type: (with 6A charge coil)



[12] Tiller handle type: (with 12A charge coil)

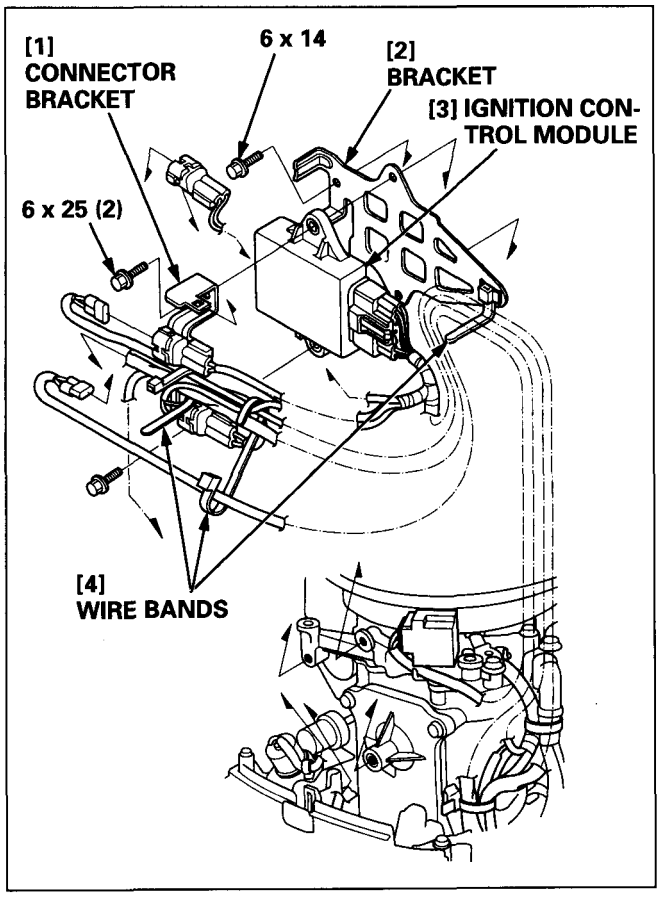


[10] Remote control type:



12) Install the bracket with the 6 x 14 mm flange bolt, and then install the ignition control module and connector bracket using the two 6 x 25 mm flange bolts.

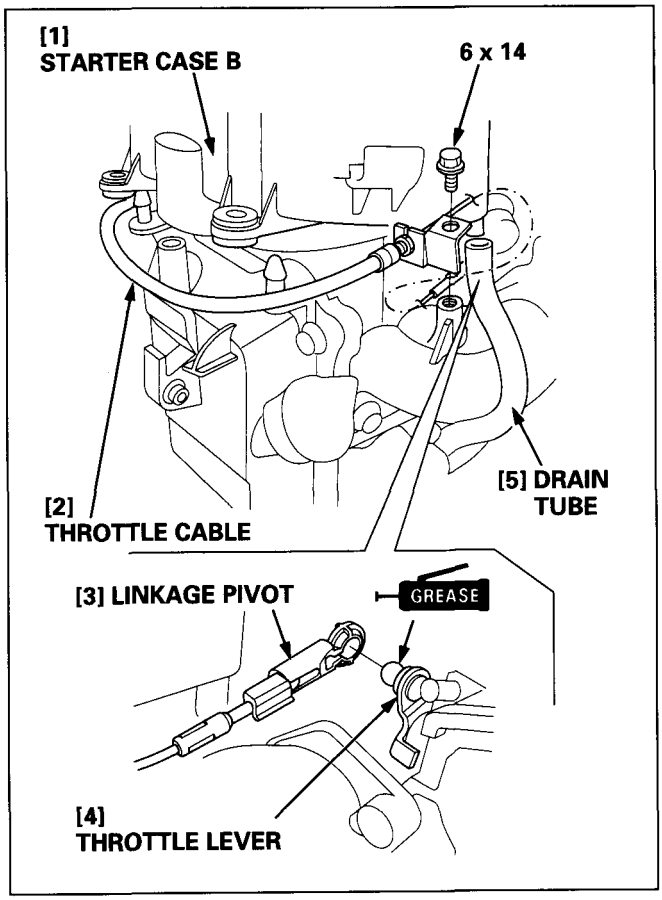
13) Connect the pulse generator wire and exciter coil wire connectors and set them on the connector bracket.



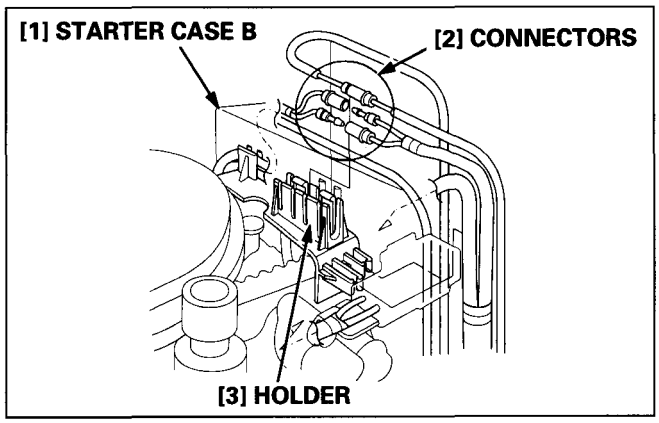
14) Apply grease to the pivot of the throttle lever and connect the throttle cable linkage pivot to the carburetor throttle lever.

15) Place the throttle cable holder by aligning the flange with the space of the lib and mounting boss, and tighten the 6 x 14 mm flange bolt.

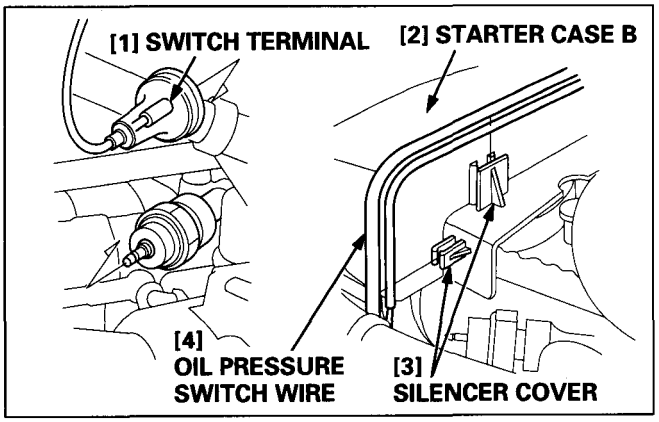
16) Set the starter case in the place and connect the drain tube to the starter case.



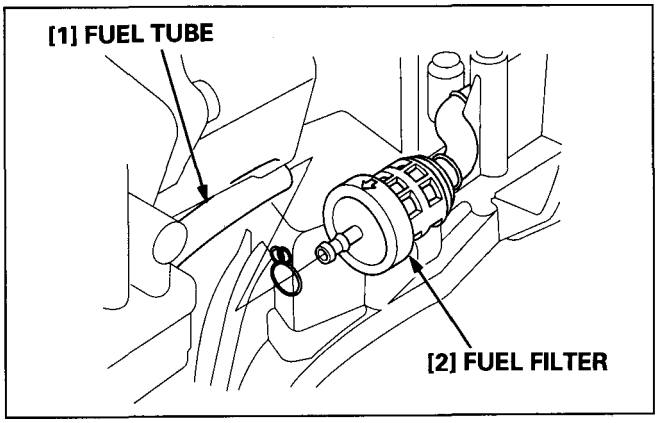
17) Connect the SE thermal valve wire connector and set the connectors and wires on the clamps of the starter case B.



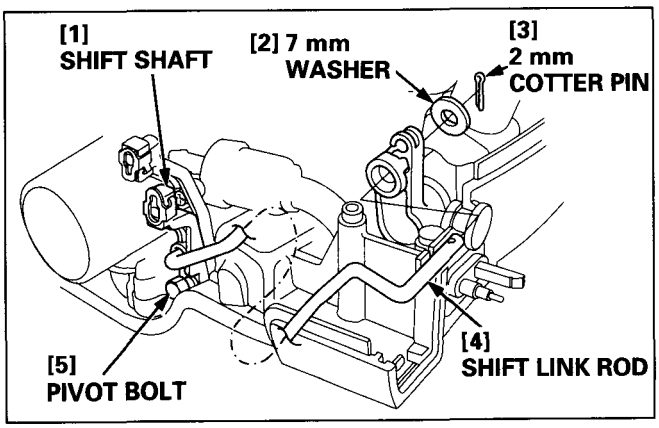
18) Connect the oil pressure switch wire terminal and set the wire on the clamps of the starter case B.



19) Connect the fuel filter to the fuel tube.



20) Install the shift link rod to the shift shaft and install the 7 mm washer on the shift link rod. Secure it with a new 2 mm cotter pin. Tighten the shift arm pivot bolt.
- Replace the 2 mm cotter pin with a new one, when removed.



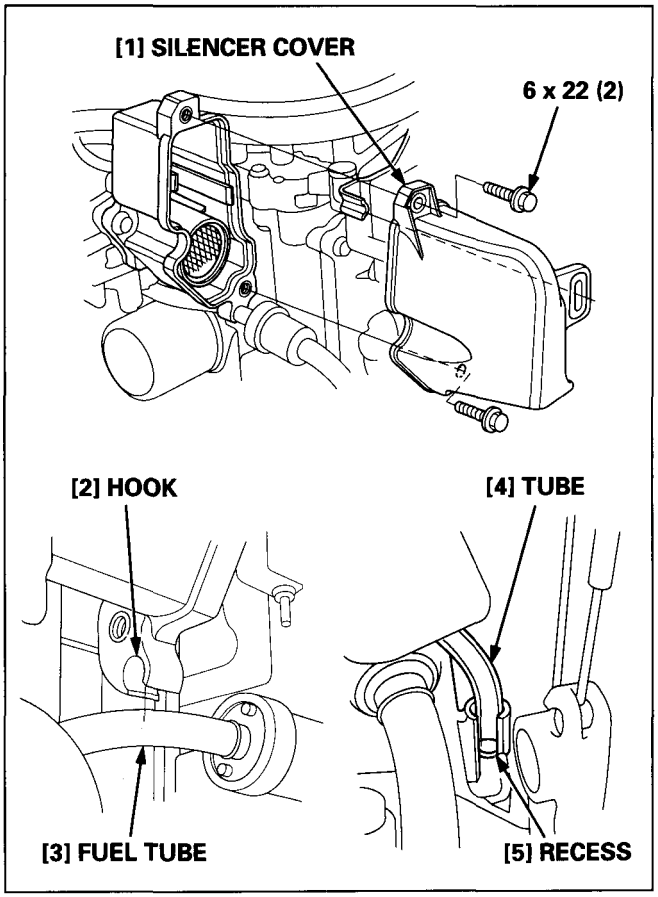
21) Install the silencer cover and insert the tube end into the recess on the oil case as shown.

TORQUE: 10 N·m (1.0 kgf·m, 7 lbf·ft)

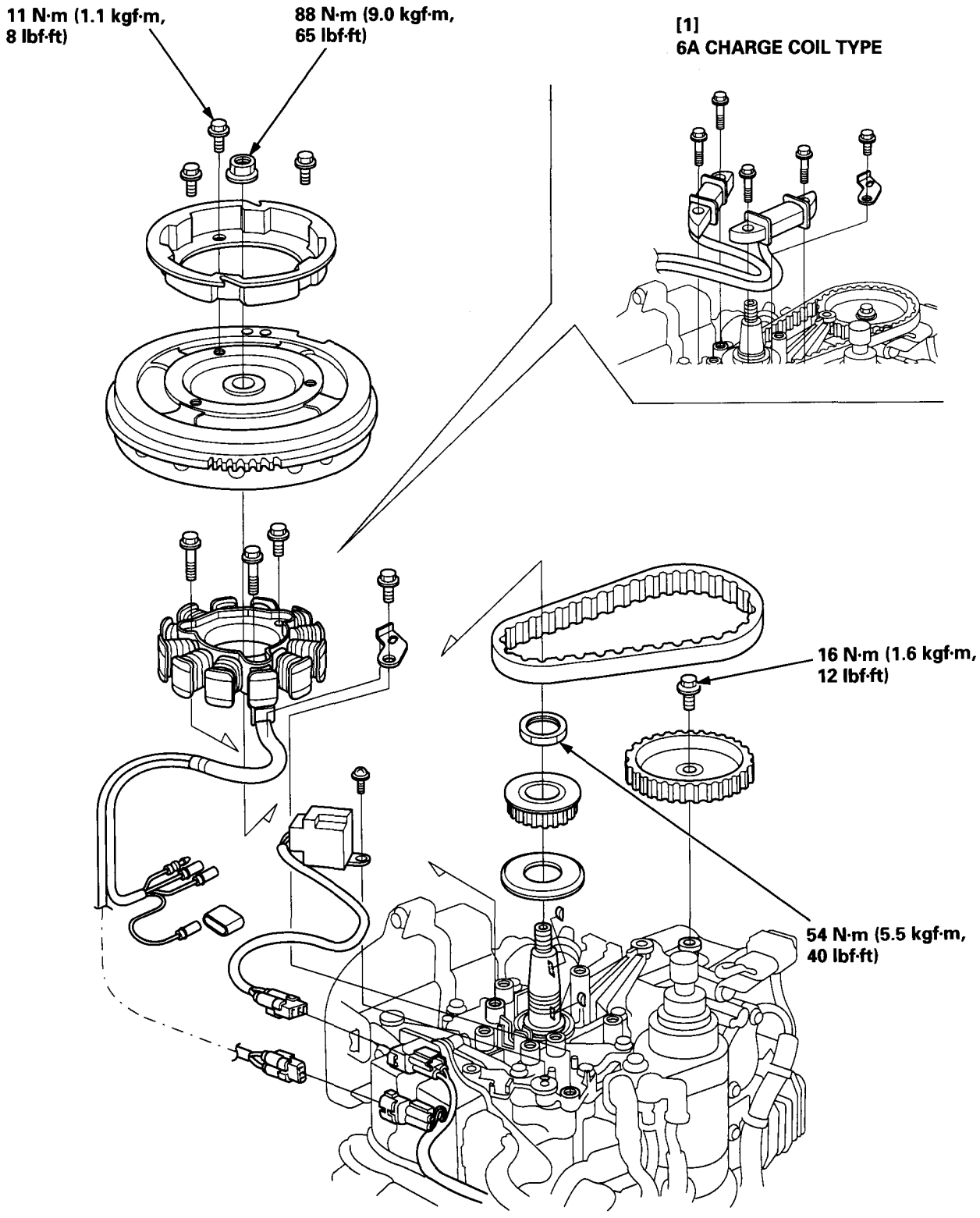
22) Hook the fuel tube on the hook of the silencer cover.

23) Reinstall the removed parts in the reverse order of removal.
— recoil starter and neutral start cable (P. 7-9).
— remote control cable (P. 14-2).
— left engine under cover (P. 5-2).
— right engine under cover (P. 5-3).
— engine cover (P. 5-1).

24) After installation check the following and adjust if necessary.
— throttle cable (P. 3-13).
— neutral start cable (P. 7-1).



1. FLYWHEEL/COILS	2. TIMING BELT/PULLEYS



1. FLYWHEEL/COILS

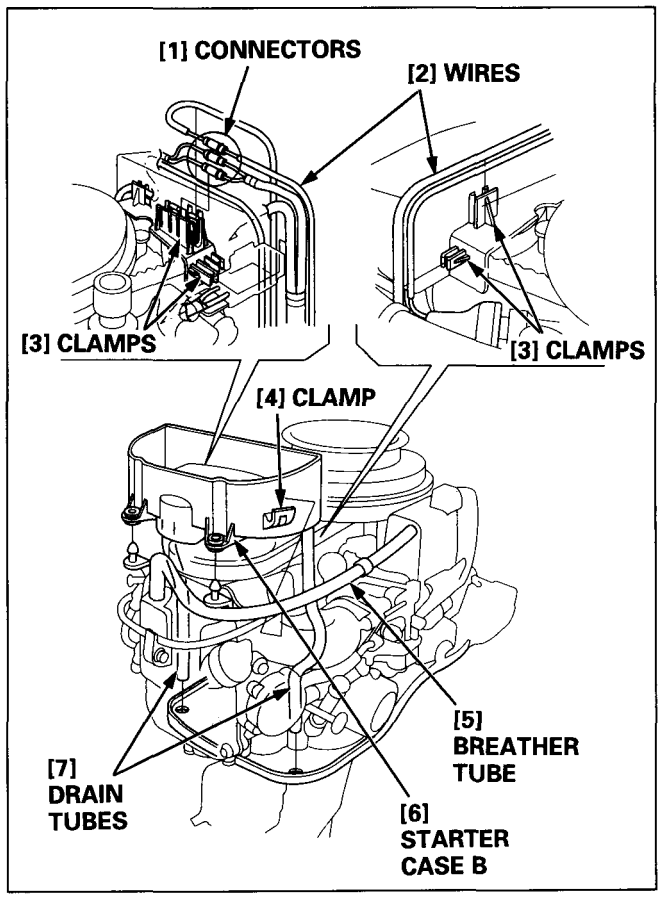
a. REMOVAL

1) Remove the following:
   — engine cover (P. 5-1).
   — left engine under cover (P. 5-2).
   — right engine under cover (P. 5-3).
   — recoil starter (P. 7-2).

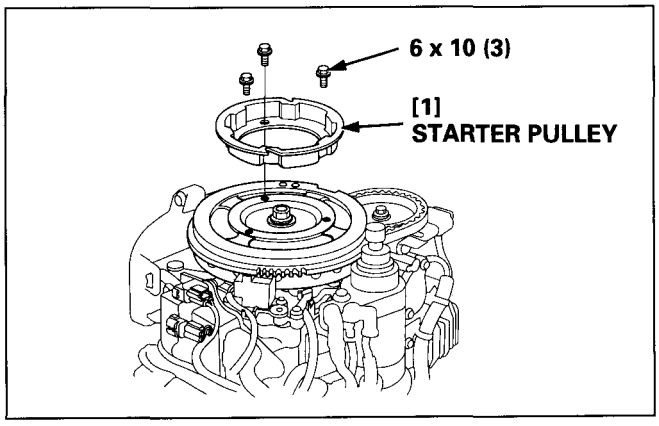
2) Pull out the connectors and wires from the clamp on the starter case B.

3) Release the breather tube from the clamp on the starter case B.

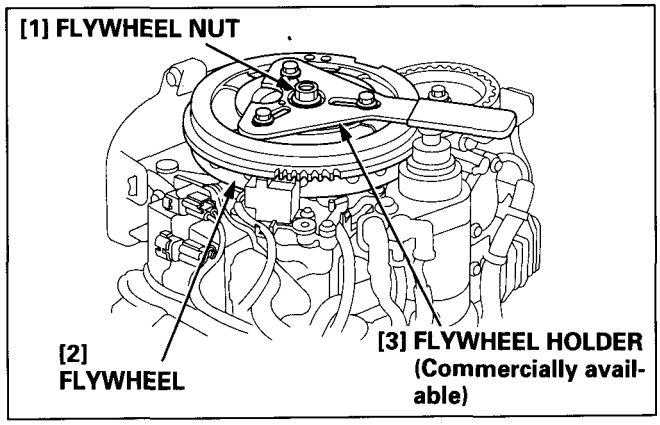
4) Remove the starter case B with the drain tube attached by disconnecting the drain tubes from the lower setting holes.



5) Remove the three 6 x 10 mm flange bolts and starter pulley.

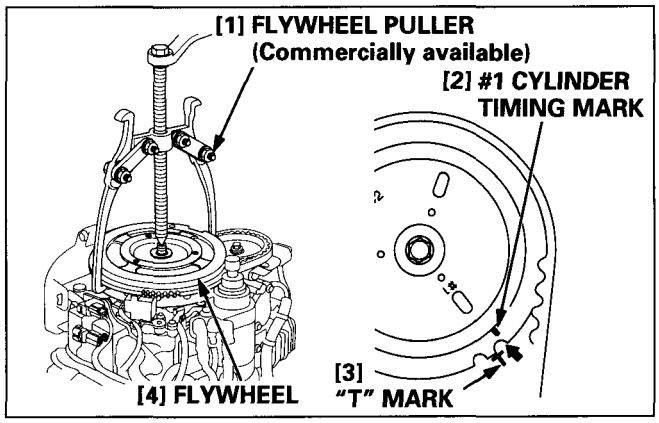


6) Hold the flywheel using the commercially available flywheel holder and remove the flywheel nut.

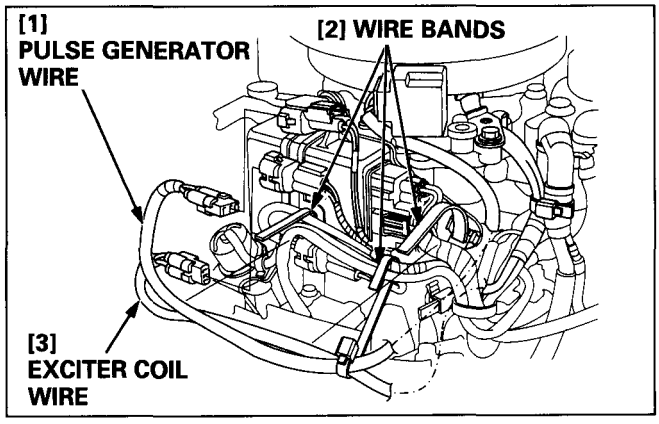


7) Set a commercially available flywheel puller to the flywheel securely avoiding the magnet sections and taking care not to damage the ring gear.
   • Do not hit the flywheel with a hammer.

8) Before removing the flywheel, turn the flywheel clockwise until the No. 1 cylinder is at top dead center of its compression stroke (the "▮" #1 timing mark on the timing belt driven pulley aligns with the " ⬆T" mark on the cylinder head. Remove the flywheel and woodruff key.

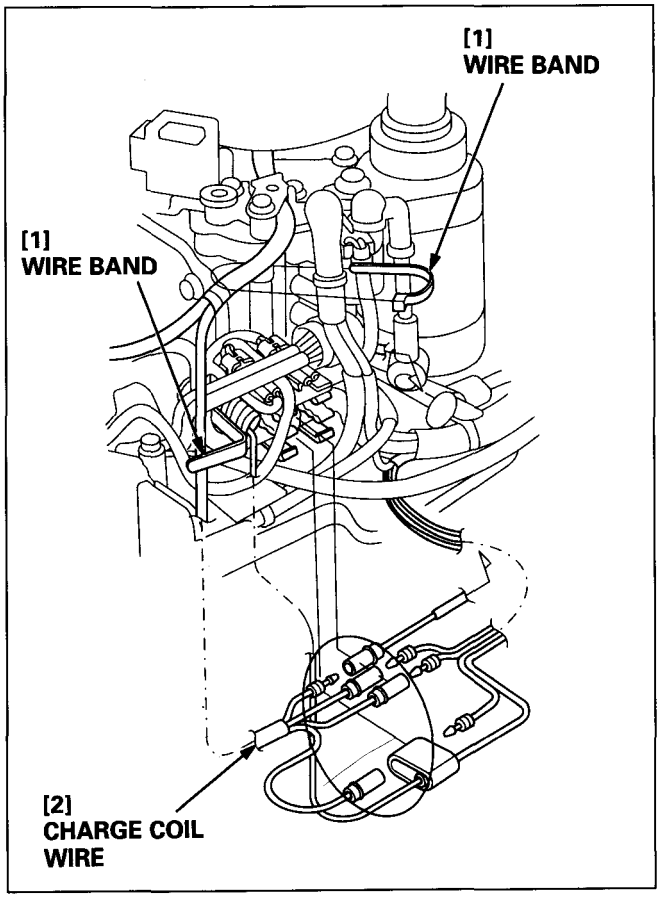


9) Disconnect the pulse generator and exciter coil wire connectors. Open the wire bands and pull off the wires.



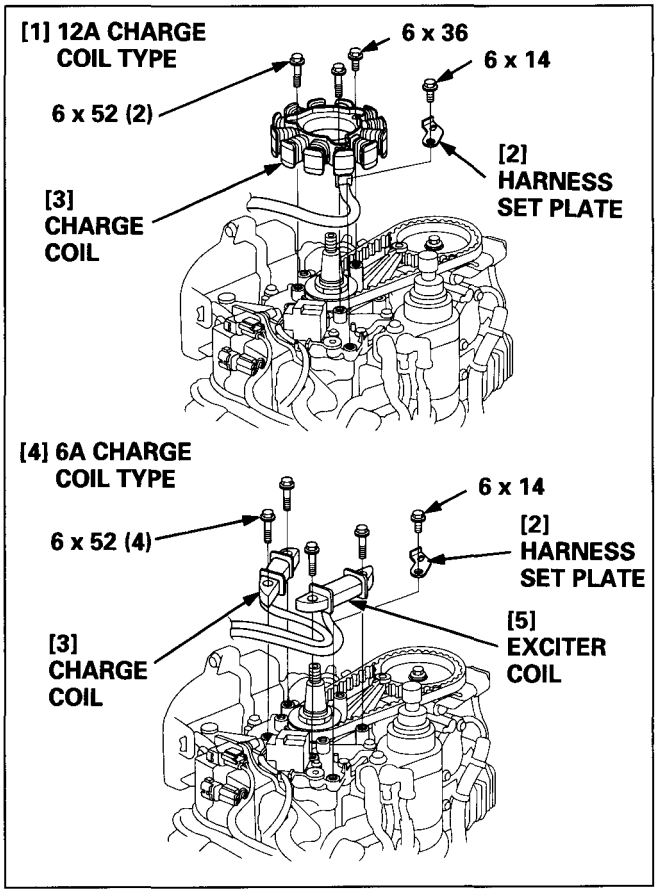
10) Unfasten the wire band and pull off the charge coil wire.

11) Remove the connectors from the connector bracket and disconnect the charge coil wire connectors.

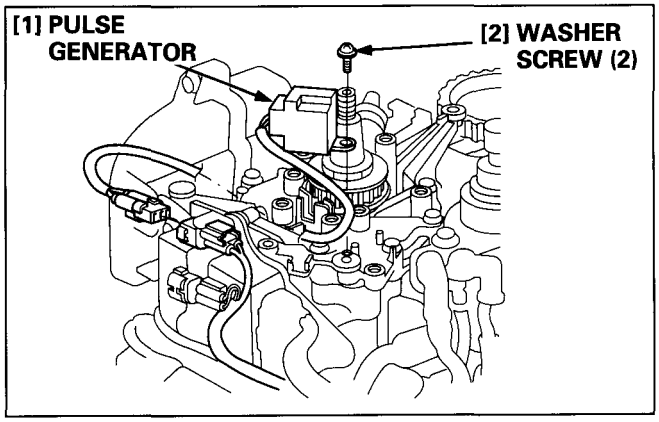


12) Remove the 6 x 14 mm flange bolt and harness set plate.

13) Remove the 6 mm flange bolts and coil:
12A charge coil type:
two 6 x 52 mm and one 6 x 36 mm flange bolts and charge coil
6A charge coil type:
two 6 x 52 mm flange bolts and charge coil
two 6 x 52 mm flange bolts and exciter coil



14) Remove the two washer screws and pulse generator.

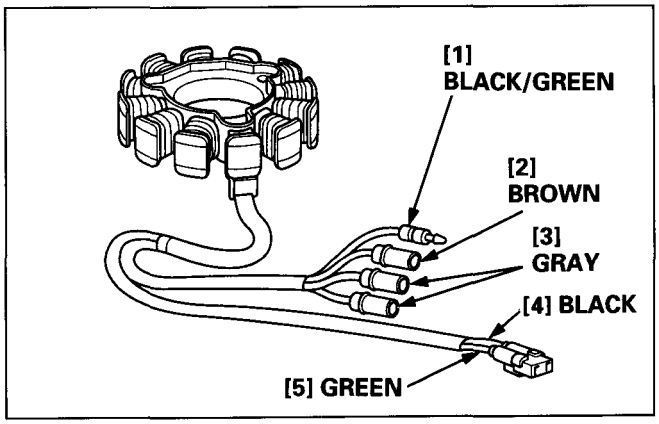


b. INSPECTION

• CHARGE COIL (12A charge coil type)

Measure the resistance between the coil terminals.

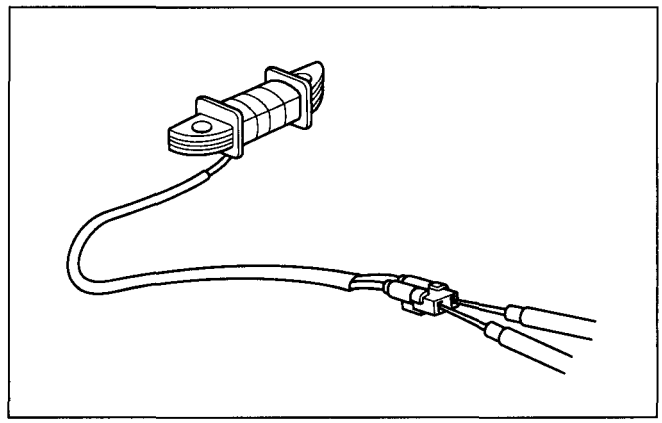
Coil	Wire color	Standard resistance
Charge coil	Gray and Gray	0.2 – 0.3 Ω
Exciter coil	Black and Green	5.0 – 7.4 Ω
SE thermal valve heater	Black/green and Brown	1.2 – 1.8 Ω



• CHARGE COIL (6A Charge coil type)

Measure the resistance between the Gray terminals.

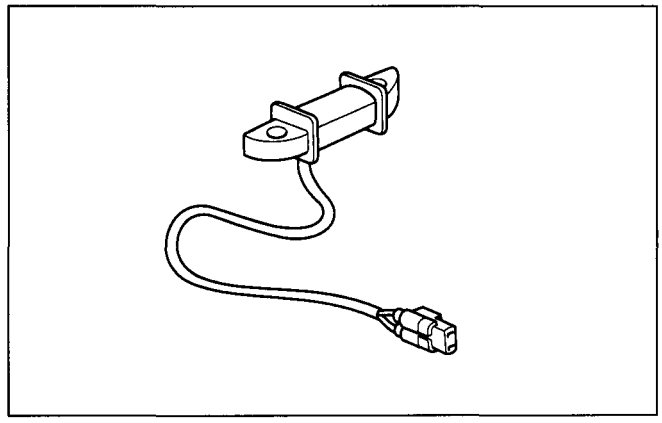
Standard resistance	0.23 – 0.29 Ω



• EXCITER COIL (6A Charge coil type)

Measure the resistance between the Black and Green terminals.

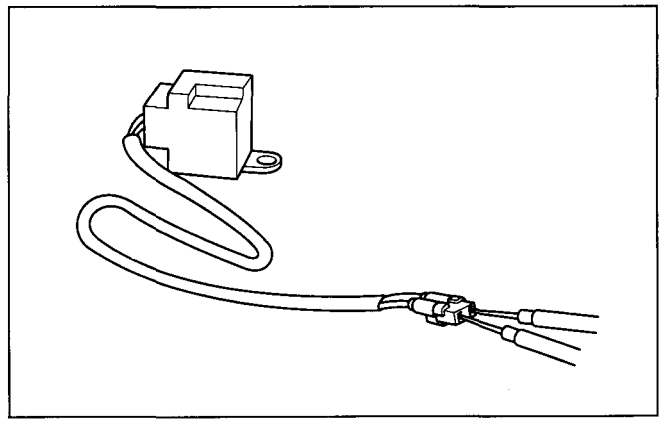
Standard resistance	6.1 – 7.5 Ω



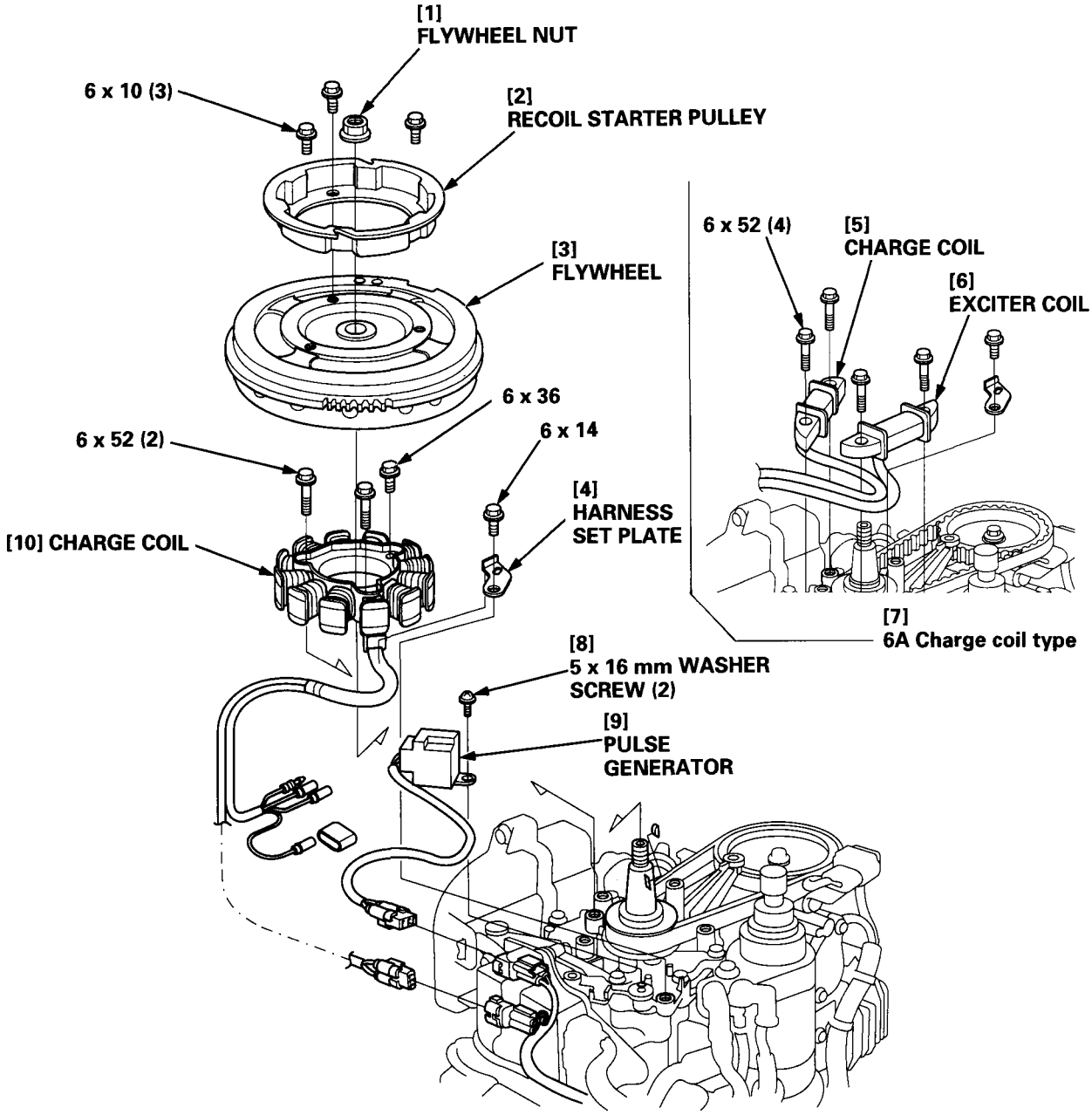
• PULSE GENERATOR (All types)

Measure the resistance between the Blue and Black terminals.

Standard resistance	351 – 429 Ω

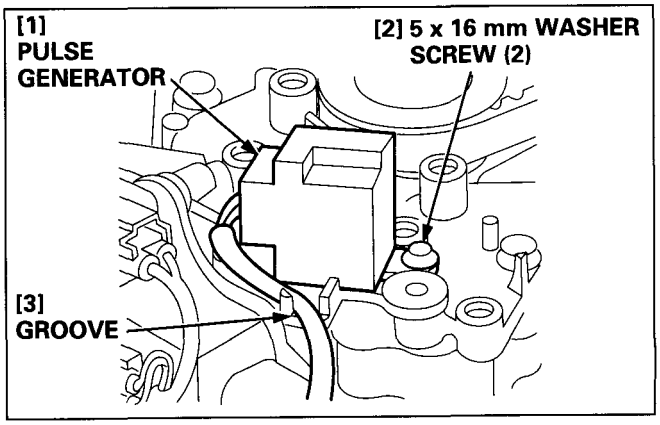


c. INSTALLATION



1) Route the pulse generator wire in the groove of the crankcase cover as shown and install the pulse generator.

2) Tighten the two 5 x 16 mm washer screws.



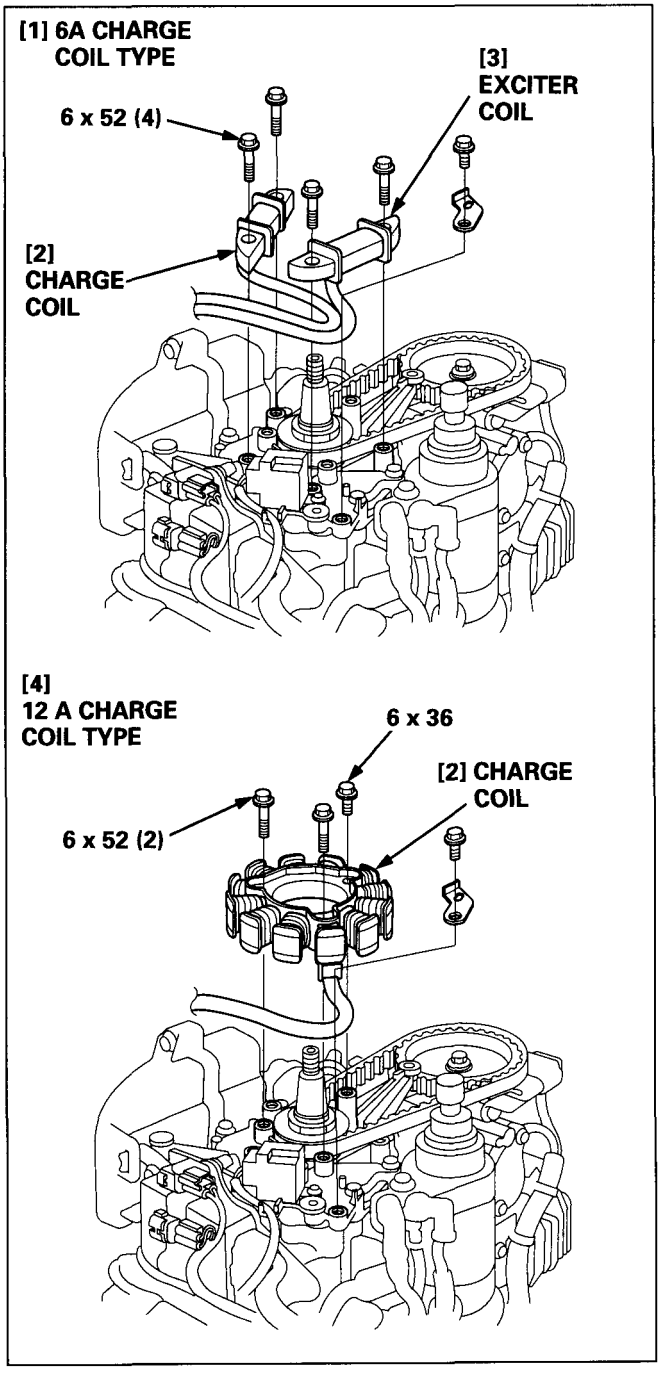
3) Install the charge and exciter coils:

- **6A charge coil type:**

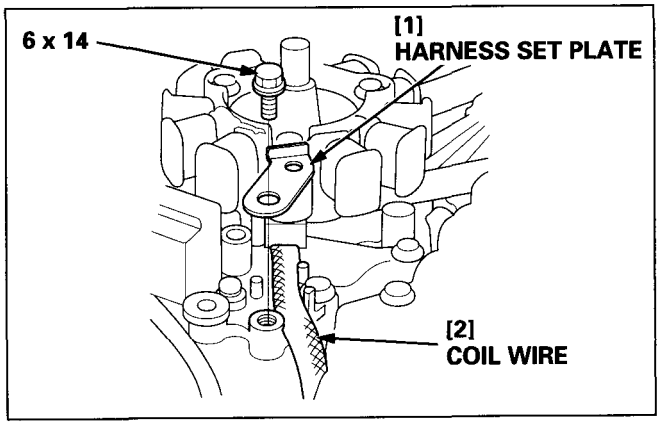
Install the charge and exciter coils and tighten the four 6 mm flange bolts.

- **12A charge coil type:**

Install the charge coil and tighten the three 6 mm flange bolts.

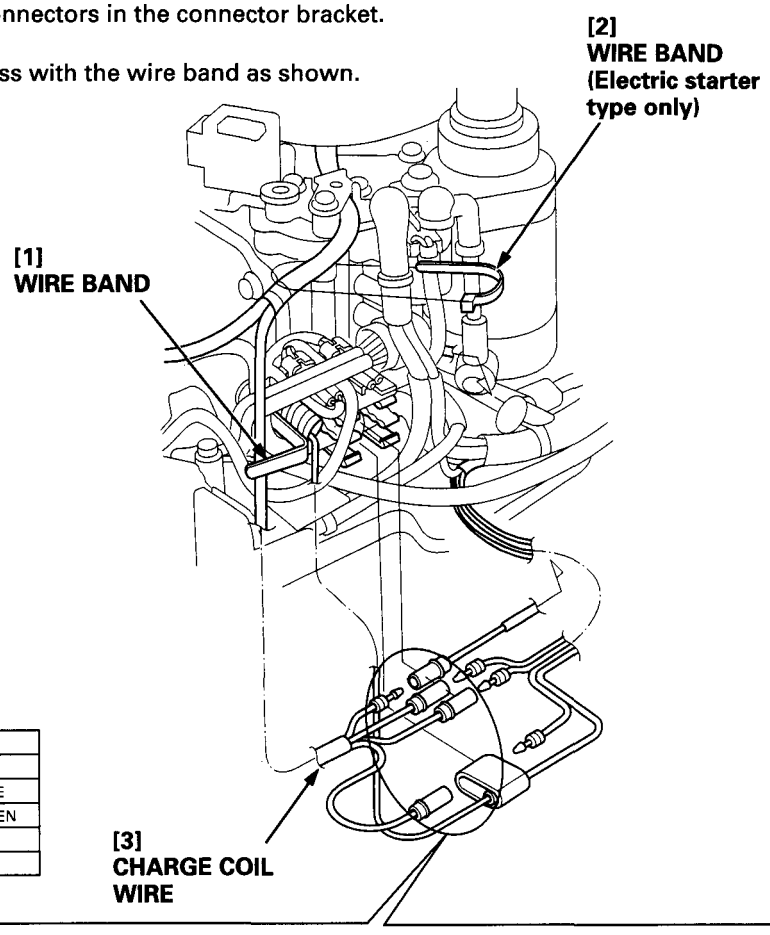


4) Route the charge coil and exciter coil wire on the crankcase as shown and secure it with the harness set plate. Tighten the 6 x 14 mm flange bolt.

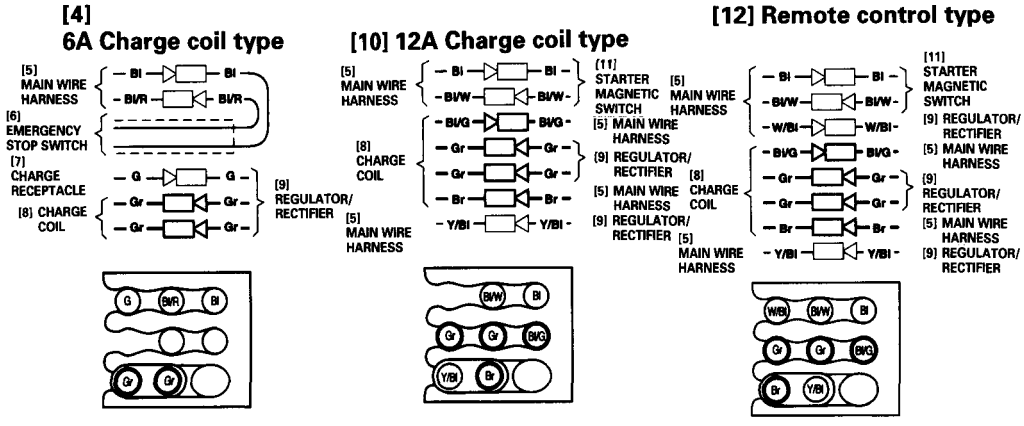


5) Route the wire harness and connect the charge coil wire connectors. Set the connectors in the connector bracket.

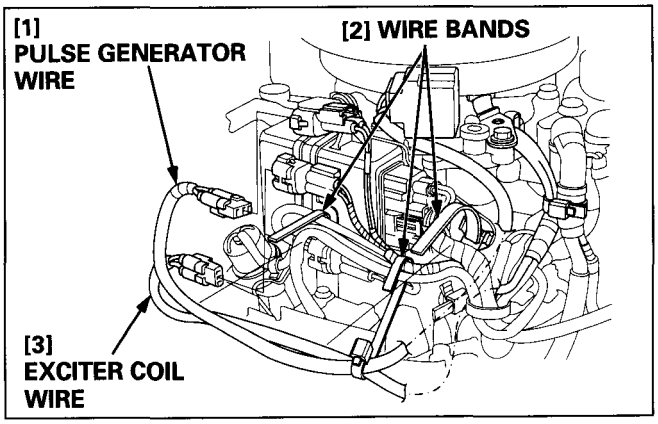
6) Secure the wire harness with the wire band as shown.



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



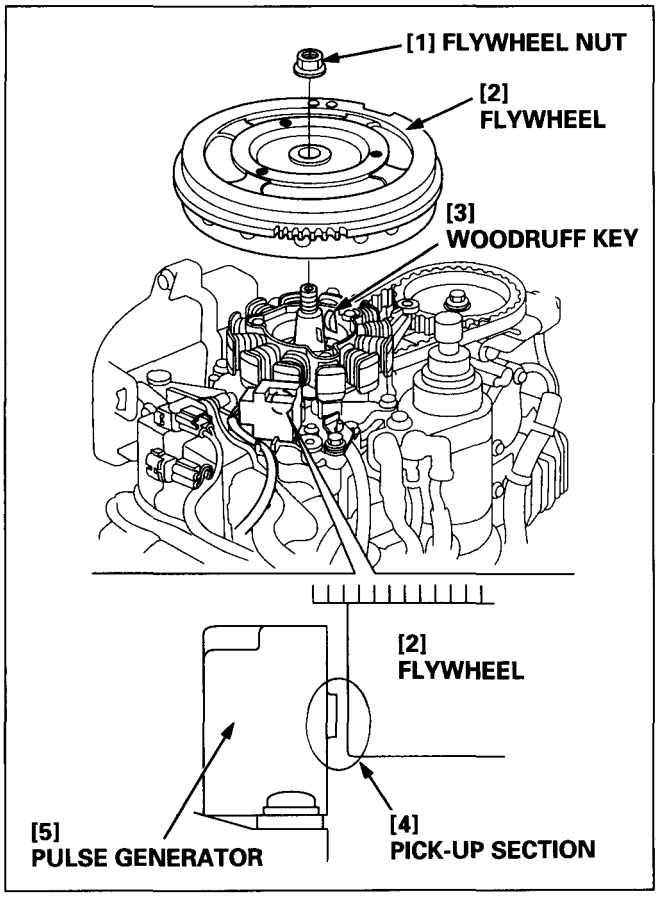
7) Connect the pulse generator and exciter coil wire connectors. Secure the wire harness with the wire bands as shown.



8) Clean off oil or grease from the crankshaft and flywheel mating surfaces (tapered section). Make sure that there are no metal objects stuck to the magnets of the flywheel.

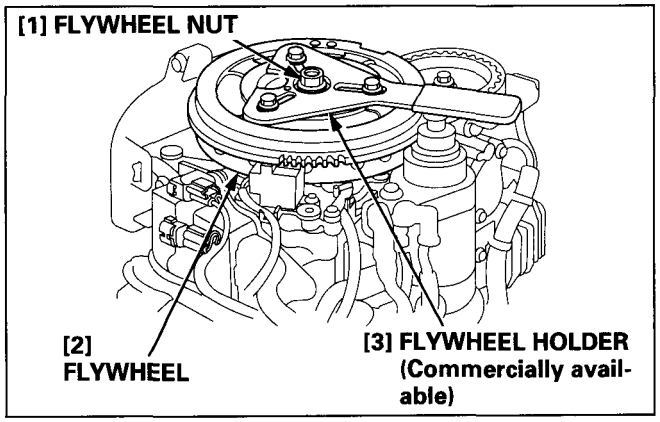
9) Install the flywheel by aligning the woodruff key on the crankshaft with the key groove of the flywheel taking care not to damage the pick-up point of the pulse generator.

10) Apply oil to the thread and seating surface of the flywheel nut.



11) Hold the flywheel using the commercially available flywheel holder and tighten the flywheel nut.

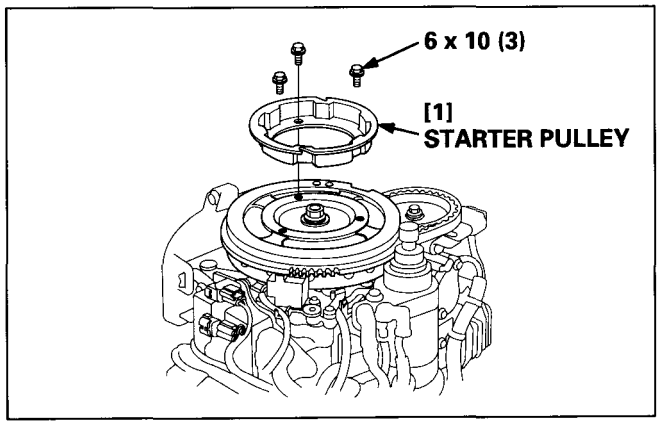
TORQUE: 88 N·m (9.0 kgf·m, 65 lbf·ft)



12) Install the starter pulley and tighten the three 6 x 10 mm flange bolts.

TORQUE: 11 N·m (1.1 kgf·m, 8 lbf·ft)

13) Install the following removed parts in the reverse order of removal.
— starter case B (P. 7-10).
— recoil starter (P. 7-9).
— neutral start cable (P. 7-1).
— left and right engine under covers (P. 5-2 and 3).
— engine cover (P. 5-1).



2. TIMING BELT/PULLEYS

a. REMOVAL

1) Remove the following:
   — engine cover (P. 5-1).
   — left engine under cover (P. 5-2).
   — right engine under cover (P. 5-3).
   — recoil starter (P. 7-2).

2) If it is necessary to remove the timing belt driven pulley, loosen the timing belt driven pulley mounting bolt.

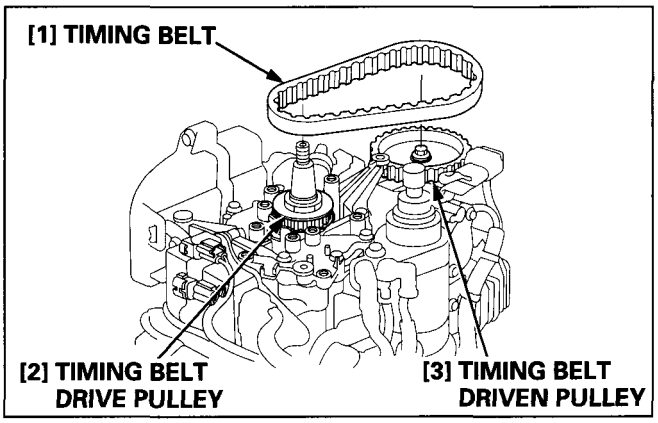
3) Remove the flywheel and coils (P. 9-2).

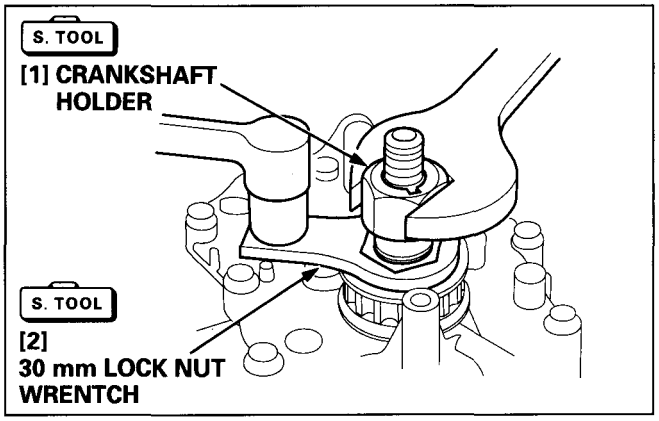
4) Remove the timing belt from the timing belt driven pulley, then remove the timing belt from the timing belt drive pulley.

5) Hold the crankshaft using the crankshaft holder as shown and loosen the 24 mm lock nut with the lock nut wrench.

TOOLS:

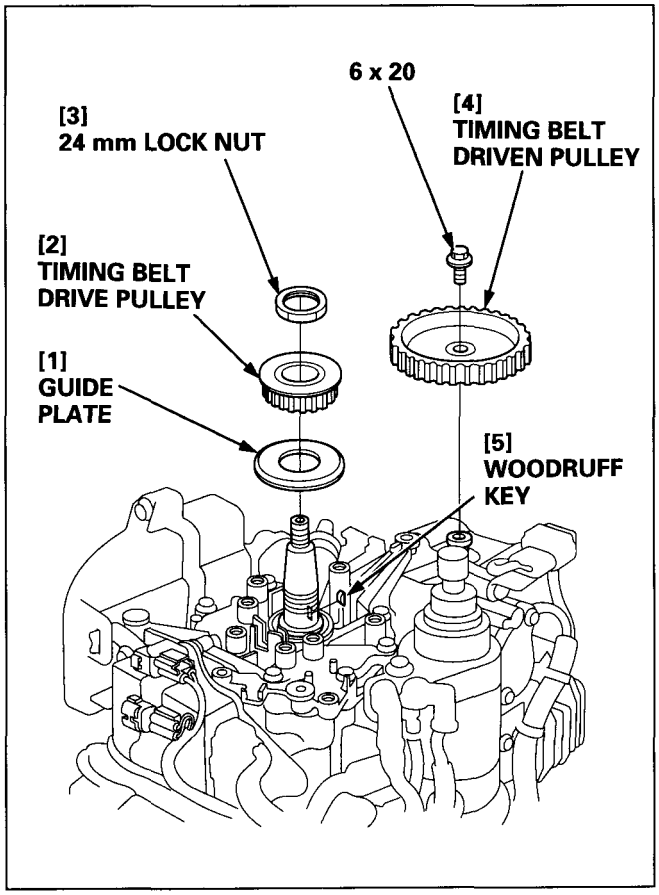
Crankshaft holder	**07ZPB – ZW90100**
30 mm Lock nut wrench	**07ZPA – ZW90100**



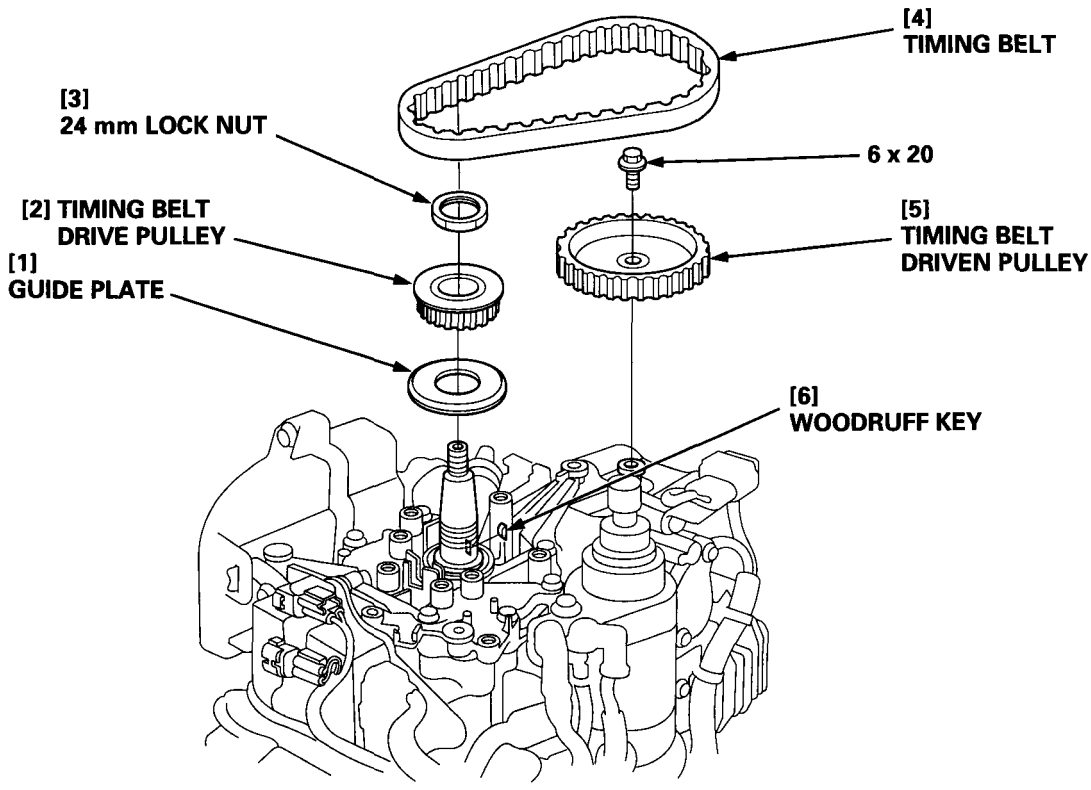


6) Remove the timing belt drive pulley, guide plate and woodruff key.

7) Remove the 6 x 20 mm flange bolt and timing belt driven pulley.



b. INSTALLATION



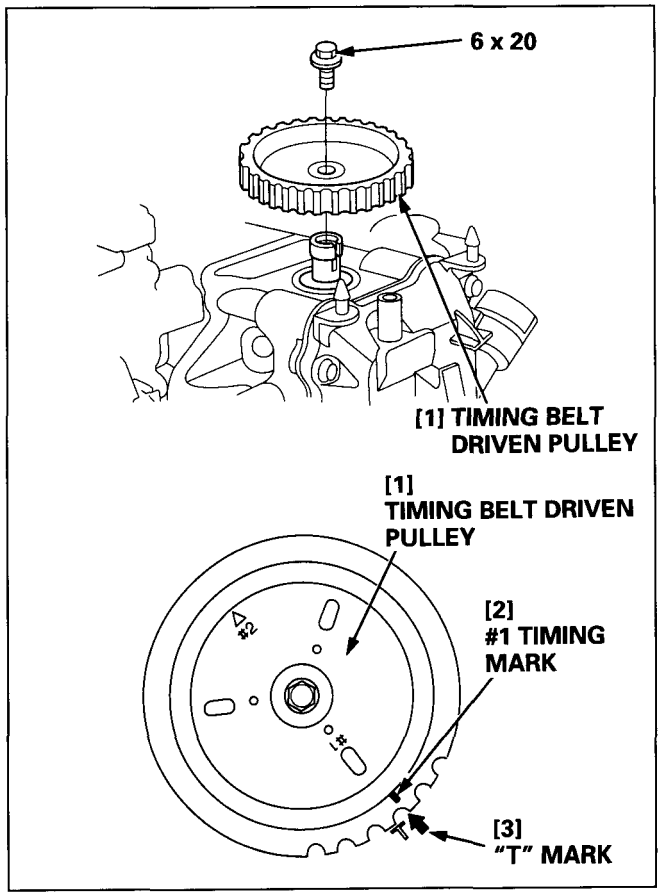
1) Remove the spark plug caps and spark plugs.

2) Install the timing belt driven pulley on the camshaft by aligning the key of the pulley with the key groove of the camshaft.

3) Apply oil to the thread and seating surface of the 6 x 20 mm flange bolt and tighten it to the specified torque.

   TORQUE: 16 N·m (1.6 kgf·m, 12 lbf·ft)

4) Make sure that the "▮" #1 mark on the timing driven pulley aligns with the "▲ T" mark on the cylinder head. If necessary align the mark by turning the driven pulley counterclockwise.



5) Install the guide plate in the direction shown.

6) Install the woodruff key onto the crankshaft and install the timing belt drive pulley in the direction shown.

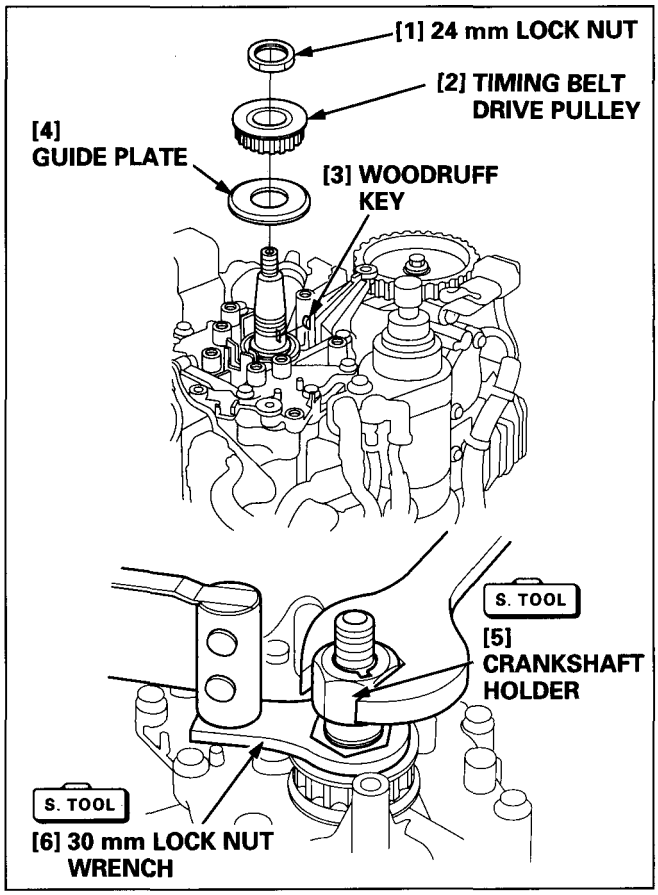
7) Apply oil to the thread and seating surface of the 24 mm lock nut, and install it loosely on the crankshaft.

8) Hold the crankshaft with the crankshaft holder and tighten the 24 mm lock nut to the specified torque using the lock nut wrench.

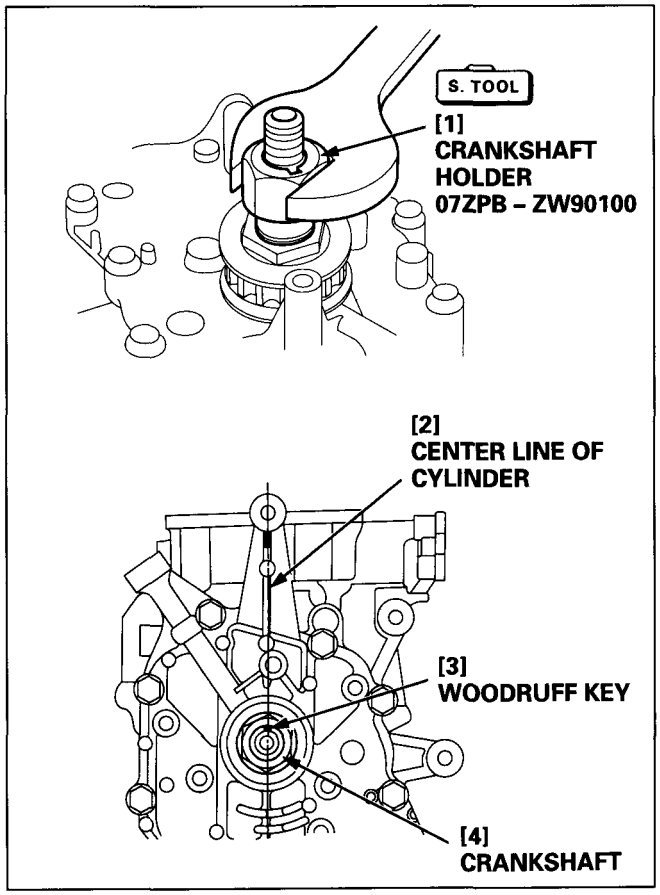
TORQUE: 54 N·m (5.5 kgf·m, 40 lbf·ft)

TOOLS:

Crankshaft holder	**07ZPB – ZW90100**
30 mm Lock nut wrench	**07ZPA – ZW90100**



9) Make sure that the woodruff key on the crankshaft aligns with the center line of cylinder as shown. If necessary, turn the crankshaft clockwise using the crankshaft holder.

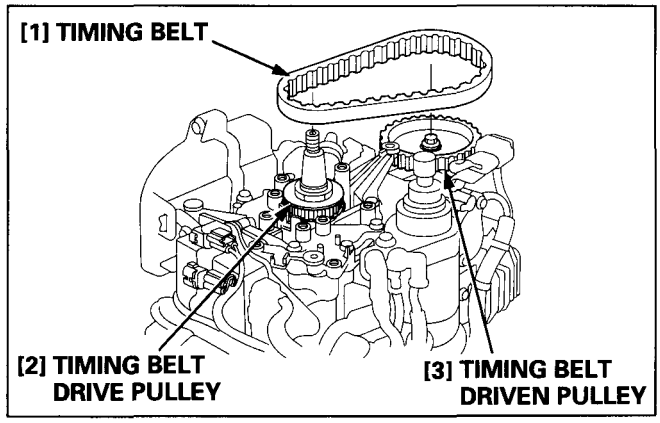


10) Check the timing belt, replace the timing belt if it is worn or damaged. Check the timing belt and the related parts for oil and grease. If contaminated with oil or grease, clean the parts and replace the timing belt with new one.

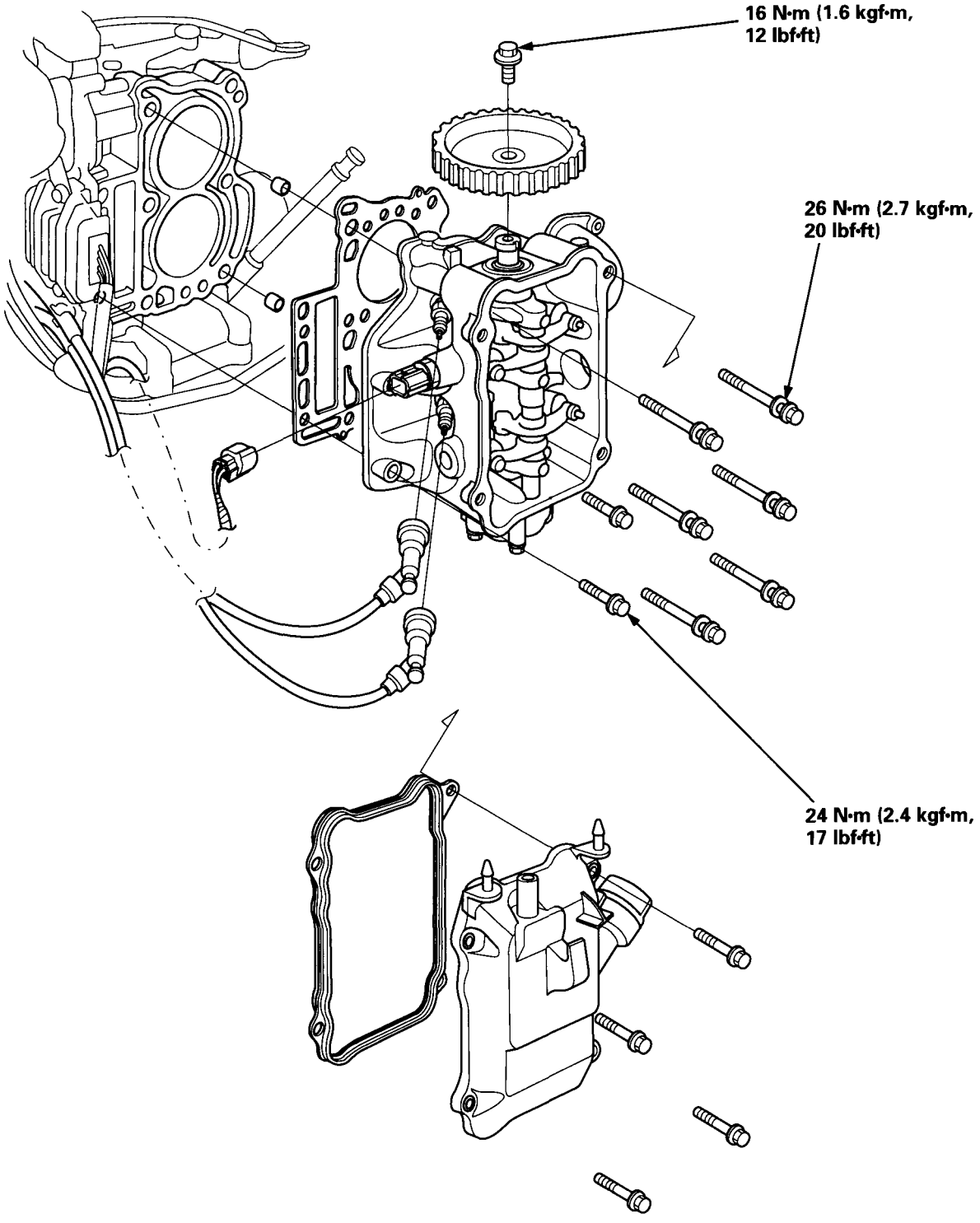
11) Install the timing belt on the timing belt drive pulley and then on the driven pulley taking care not to allow the alignment marks to come out of alignment.

12) After installation, be sure that the alignment marks are in the proper alignment.

13) Reinstall the removed parts:
— flywheel (P. 9-9).
— pulse generator (P. 9-6).
— charge coil (P. 9-7).
— starter case B (P. 7-10).
— recoil starter (P. 7-9).
— neutral start cable (P. 7-1).
— left and right engine under covers (P. 5-2 and 3).
— engine cover (P. 5-1).



1. CYLINDER HEAD REMOVAL
2. OIL PUMP
3. CYLINDER HEAD DISASSEMBLY
4. VALVE GUIDE REPLACEMENT
5. VALVE SEAT REFACING
6. CYLINDER HEAD ASSEMBLY
7. CYLINDER HEAD INSTALLATION



1. CYLINDER HEAD REMOVAL

Cylinder head assembly can be serviced with the engine installed on the frame.

1) Remove the oil filler cap and oil drain bolt, and drain the engine oil into a suitable container (P. 3-2).

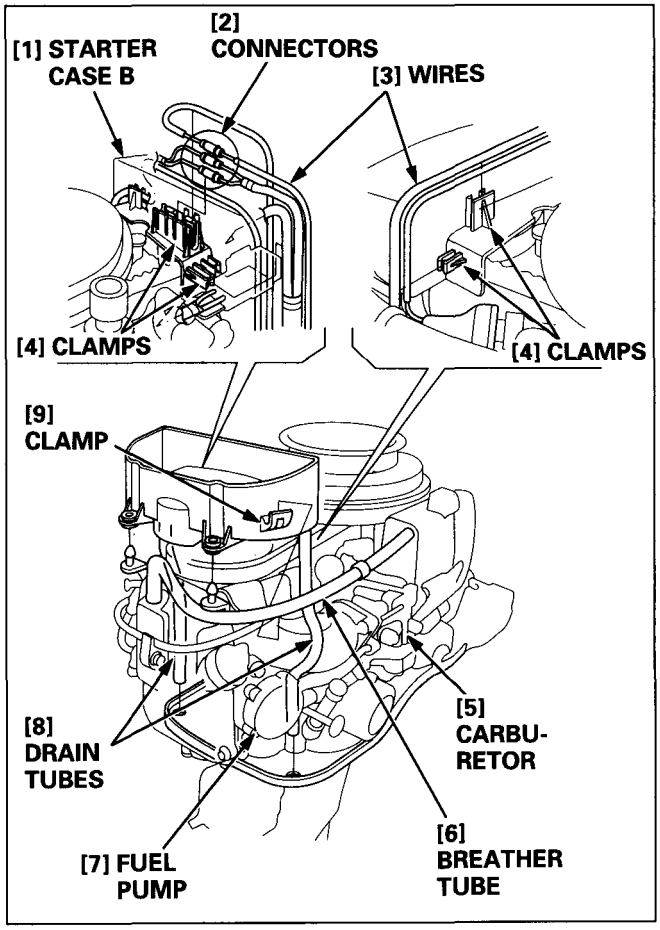
2) Remove the following parts:
   — engine cover (P. 5-1).
   — left engine under cover (P. 5-2).
   — right engine under cover (P. 5-3).
   — recoil starter (P. 7-2).

3) Pull out the connectors and wires from the clamp on the starter case B.

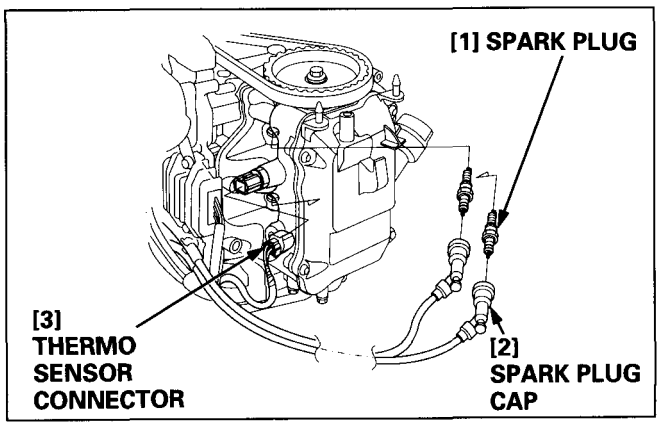
4) Pull off the breather tube from the clamp on the starter case B and remove it. Disconnect the breather tube from the cylinder head cover.

5) Remove the starter case B with the drain tube attached by disconnecting the drain tubes from the lower setting holes.

6) Remove the silencer and carburetor (P. 6-2), and fuel pump (P. 6-17).



7) Disconnect the thermo sensor connector and spark plug caps, and remove the spark plugs.

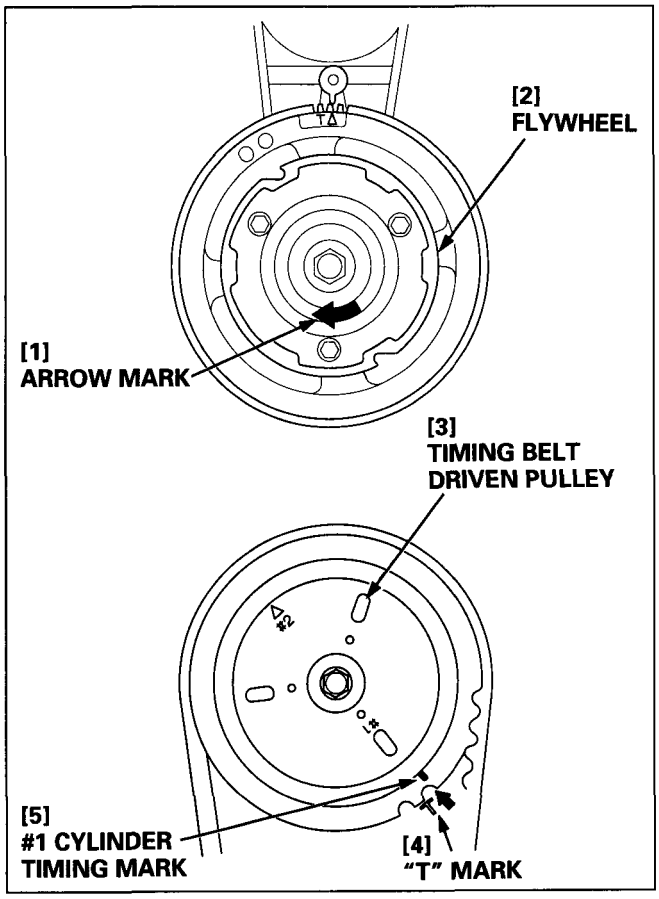


8) Loosen the timing belt driven pulley mounting bolt.

9) Turn the crankshaft clockwise by turning the flywheel clockwise (in the arrow marked direction) until the "▮" #1 timing mark on the timing belt driven pulley aligns with the "⬆T" mark on the cylinder head.

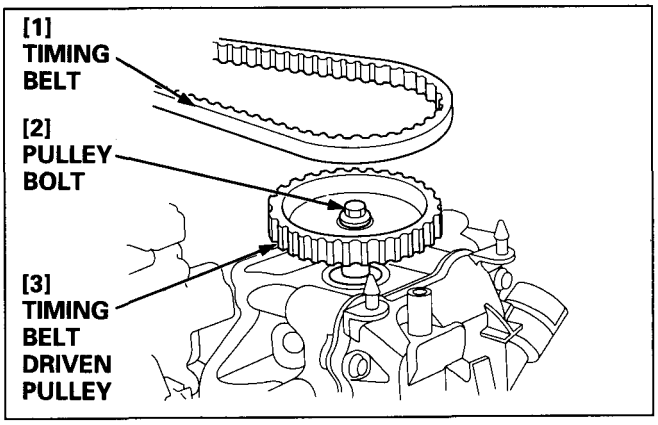
CAUTION:

Don't turn the flywheel counterclockwise or the water pump may be damaged.

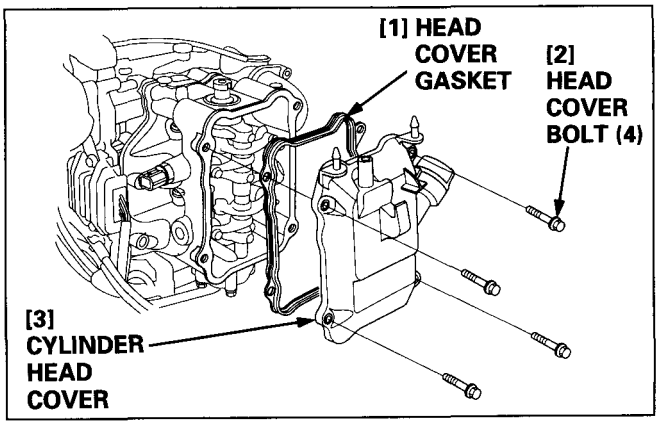


10) Remove the timing belt from the timing belt driven pulley taking care not to damage the timing belt.

11) Remove the pulley bolt and timing belt driven pulley.

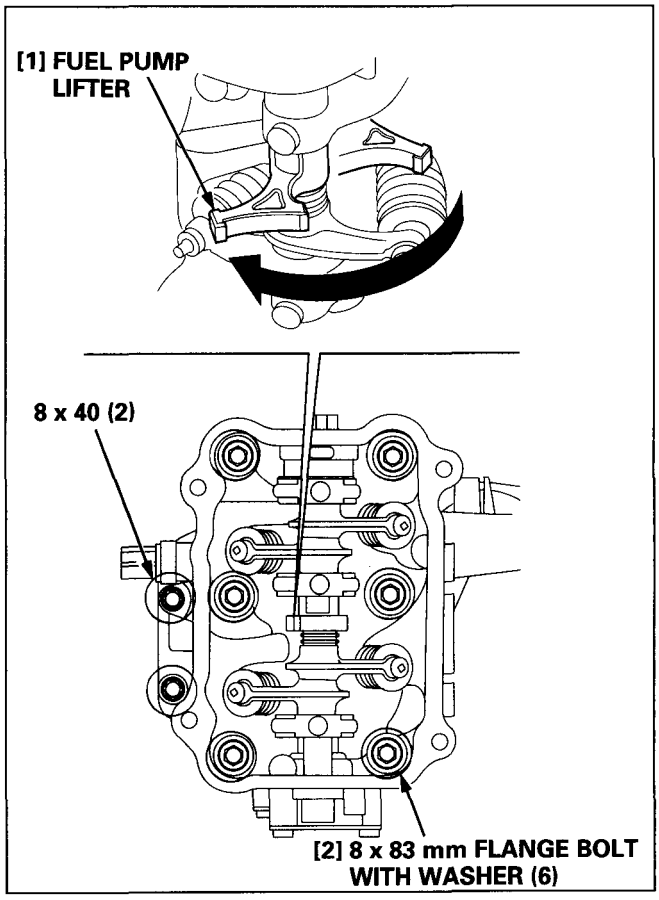


12) Remove the four head cover bolts, cylinder head cover and head cover gasket.

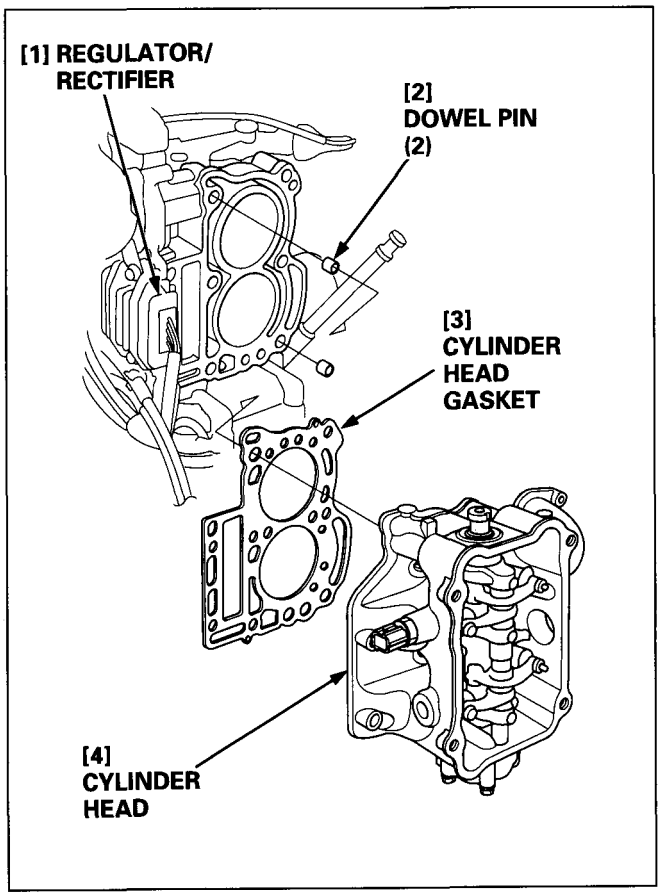


13) Turn the fuel pump lifter as shown.

14) Loosen the cylinder head bolts in a crisscross pattern in 2 – 3 steps, then remove the cylinder head bolts.



15) Remove the cylinder head, gasket and dowel pins.
- Take care not to damage the regulator/rectifier (Equipped type).



2. OIL PUMP

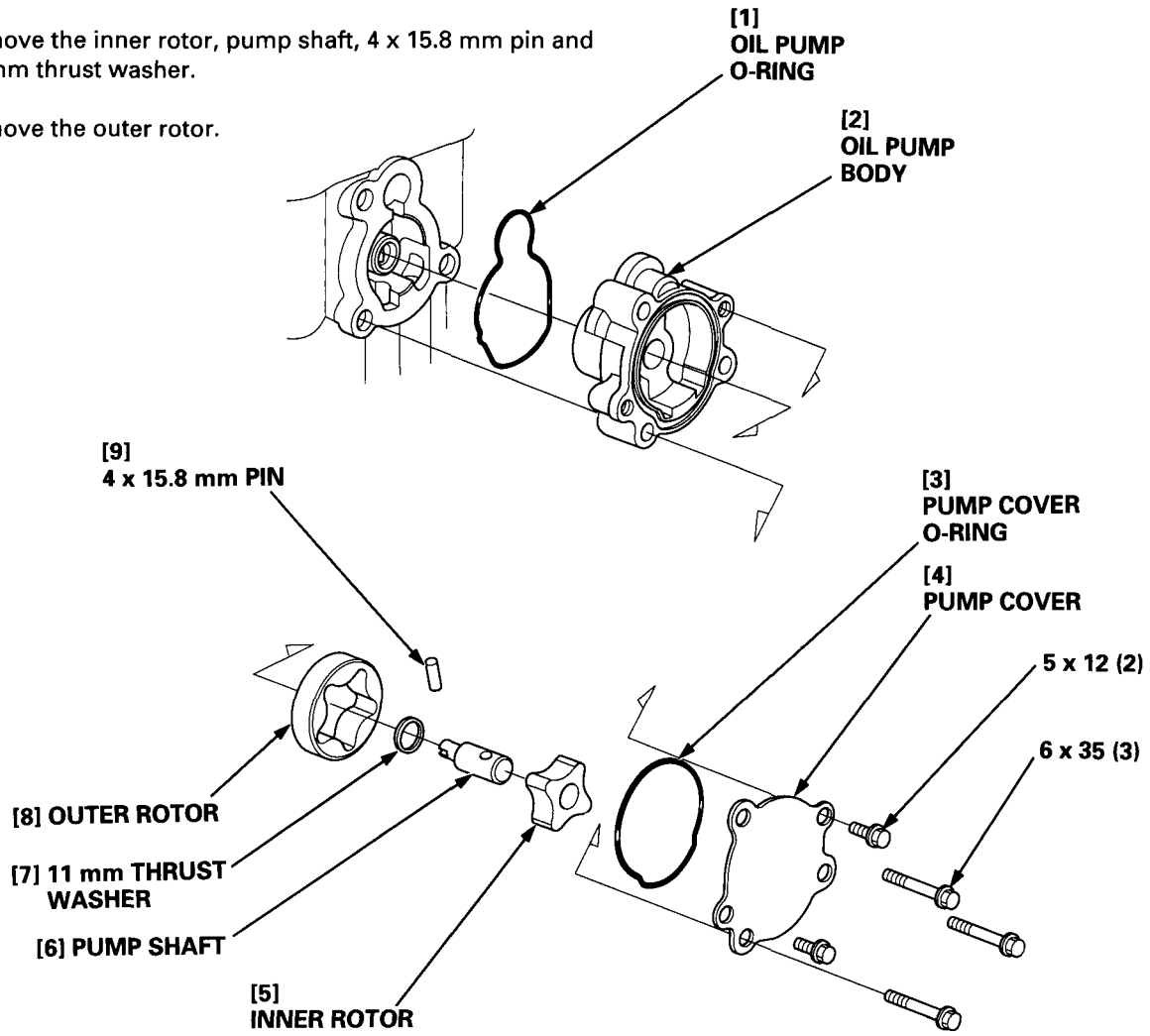
a. DISASSEMBLY

1) Remove the three 6 x 35 mm flange bolts and remove the oil pump assembly and oil pump O-ring. Discard the O-ring, replace with new one when reassembly.

2) Remove the two 5 x 12 mm flange bolts and remove the oil pump cover and cover O-ring. Discard the O-ring, replace with new one when reassembly.

3) Remove the inner rotor, pump shaft, 4 x 15.8 mm pin and 11 mm thrust washer.

4) Remove the outer rotor.

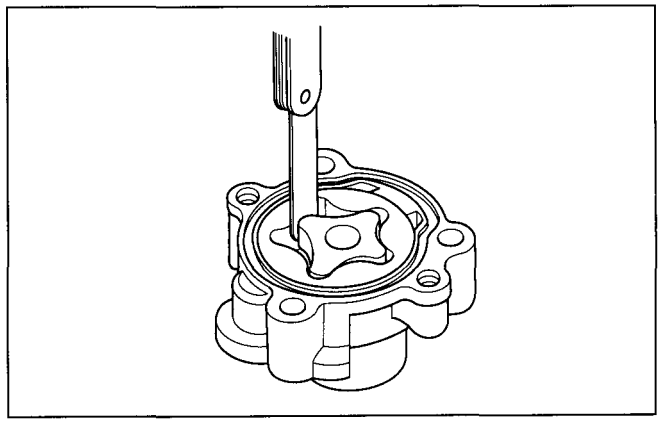


b. INSPECTION

• ROTOR TIP CLEARANCE

Measure the oil pump rotor tip clearance with the pump shaft installed.

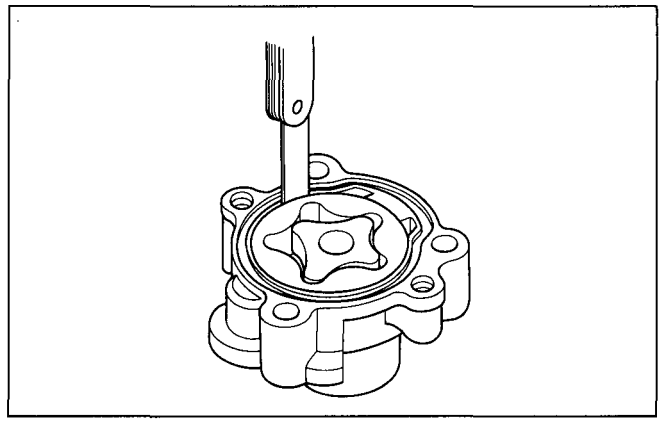
Standard	Service limit
0.15 mm (0.006 in) max.	0.20 mm (0.008 in)



• OUTER ROTOR-TO-BODY CLEARANCE

Measure the outer rotor-to-body clearance with the pump shaft installed.

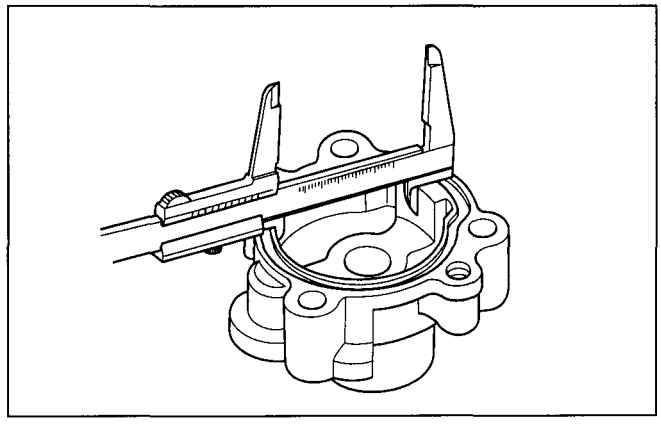
Standard	Service limit
0.15 – 0.21 mm (0.006 – 0.008 in)	0.26 mm (0.010 in)



• PUMP BODY I.D.

Measure the pump body I.D..

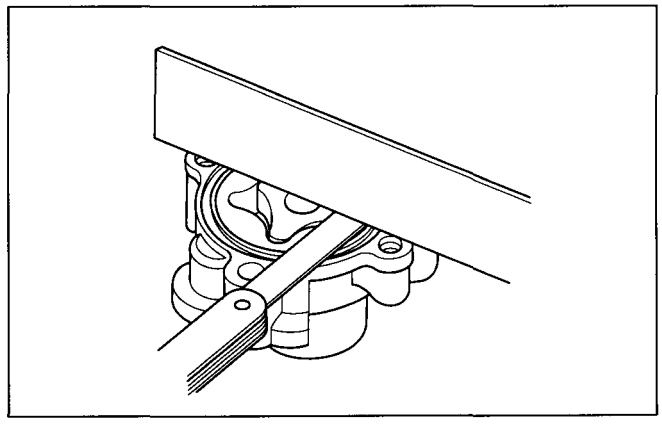
Standard	Service limit
40.71 – 40.74 mm (1.603 – 1.604 in)	40.76 mm (1.605 in)



• ROTOR-TO-BODY SIDE CLEARANCE

Measure the rotor-to-body side clearance.

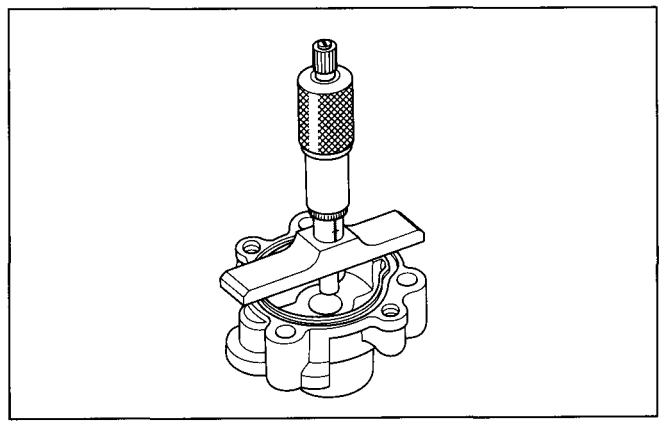
Standard	Service limit
0.04 – 0.09 mm (0.002 – 0.004 in)	0.12 mm (0.005 in)



• PUMP BODY DEPTH

Measure the pump body depth.

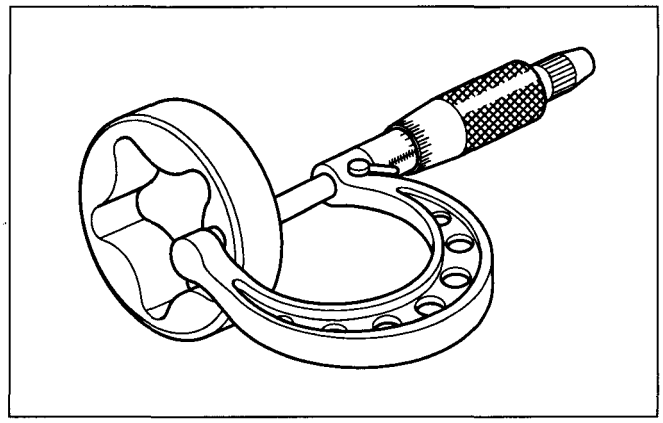
Standard	Service limit
12.04 – 12.07 mm (0.474 – 0.475 in)	12.11 mm (0.477 in)



• OUTER ROTOR HEIGHT

Measure the outer rotor height.

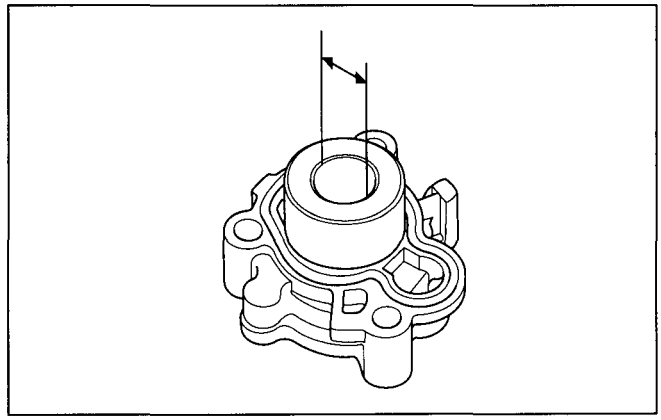
Standard	Service limit
11.98 – 12.00 mm (0.4717 – 0.4724 in)	11.96 mm (0.471 in)



• CAMSHAFT JOURNAL I.D.

Measure and record the oil pump body camshaft journal I.D..

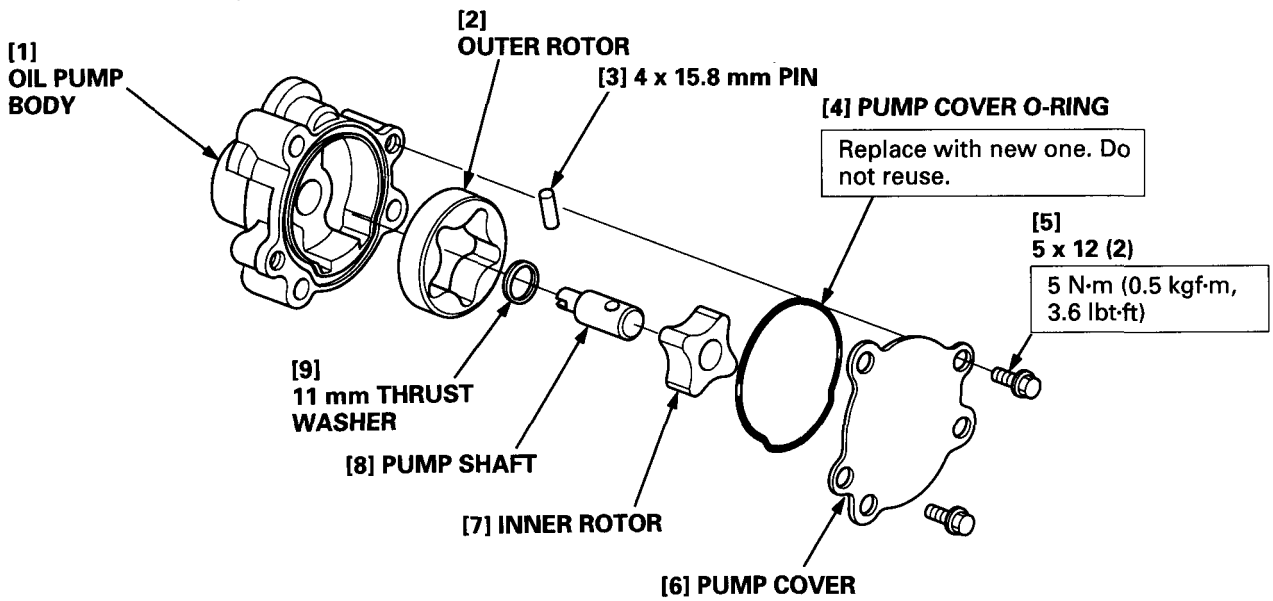
Standard	Service limit
16.000 – 16.018 mm (0.6299 – 0.6306 in)	16.05 mm (0.632 in)



c. ASSEMBLY

1) Clean all the disassembled parts with solvent.
2) Install the 4 x 15.8 mm pin to the oil pump shaft.
3) Install the 11 mm thrust washer, pump shaft with the 4 mm pin attached to the inner rotor by aligning the pin with the groove of the inner rotor.
4) Install the outer rotor, and install the inner rotor with the pump shaft, washer, and pin attached to the pump body.
5) Install a new pump cover O-ring and pump cover, then tighten the 5 x 12 mm flange bolts.

TORQUE: 5 N·m (0.5 kgf·m, 3.6 lbf·ft)



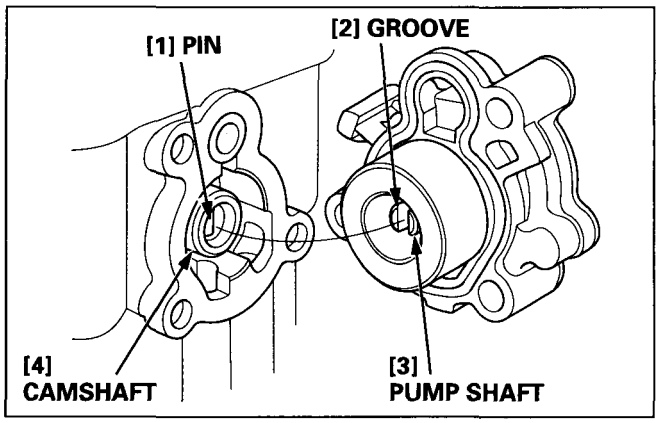
d. INSTALLATION

1) Install a new oil pump O-ring on the oil pump body.

2) Install the oil pump assembly by aligning the groove of the oil pump shaft with the pin on the camshaft as shown.

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

TORQUE: 11 N·m (1.1 kgf·m, 8 lbf·ft)



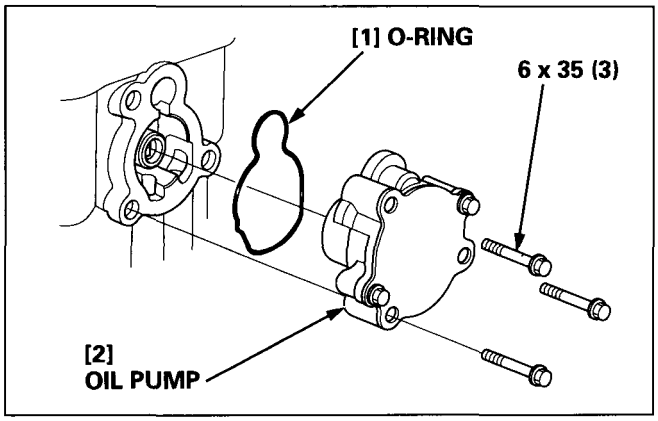
3. CYLINDER HEAD DISASSEMBLY

Before removing the cylinder head, check the camshaft axial play (P. 10-10).

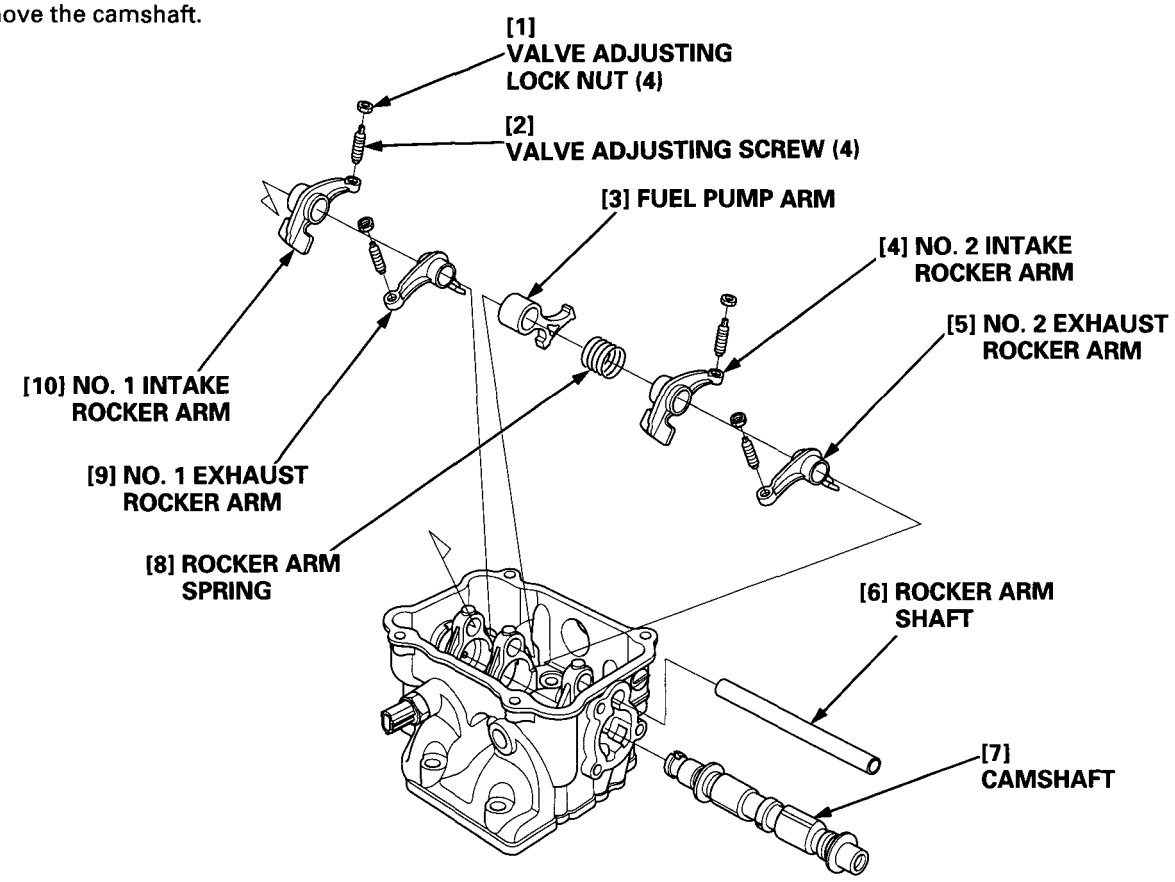
1) Remove the three 6 x 35 mm flange bolts, oil pump and O-ring.

2) Loosen the valve adjusting lock nuts and valve adjusting screws fully.

3) Pull the rocker arm shaft slowly, and remove the rocker arms, spring, and fuel pump lifter.
   - Mark the rocker arm shaft and all rocker arms so they can be placed back in their original position.



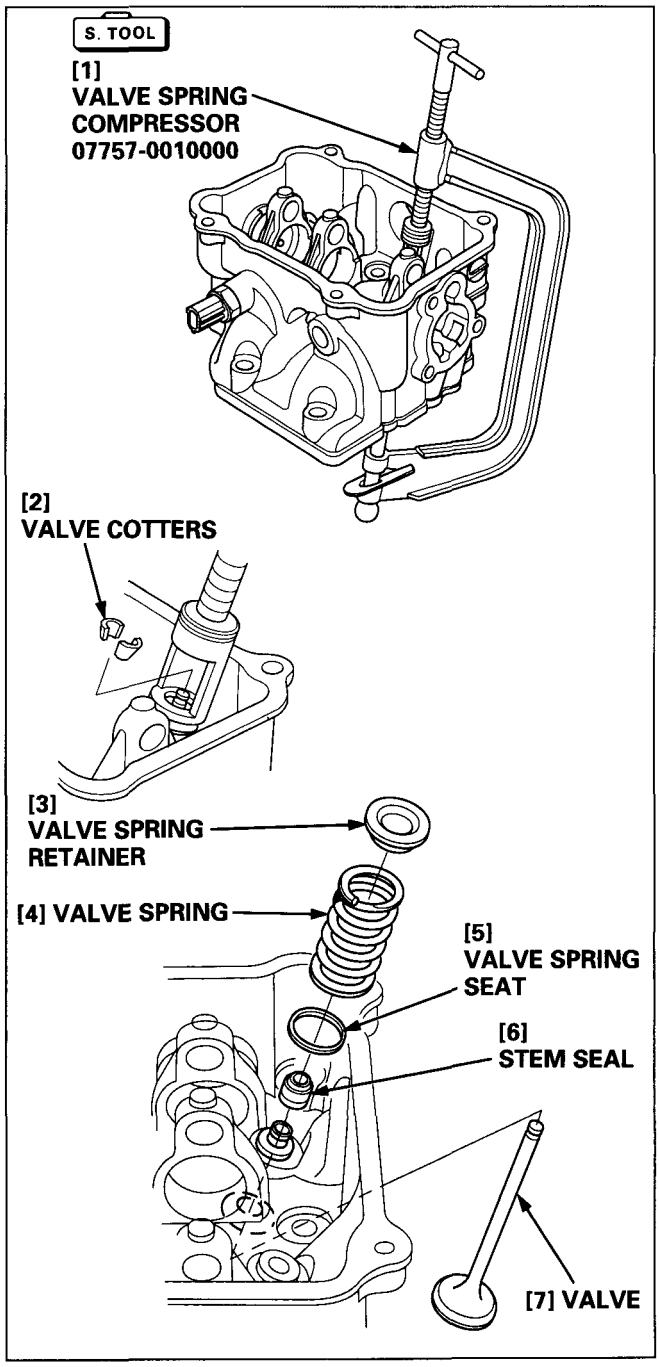
4) Remove the camshaft.



5) Set the valve spring compressor and compress the valve spring.

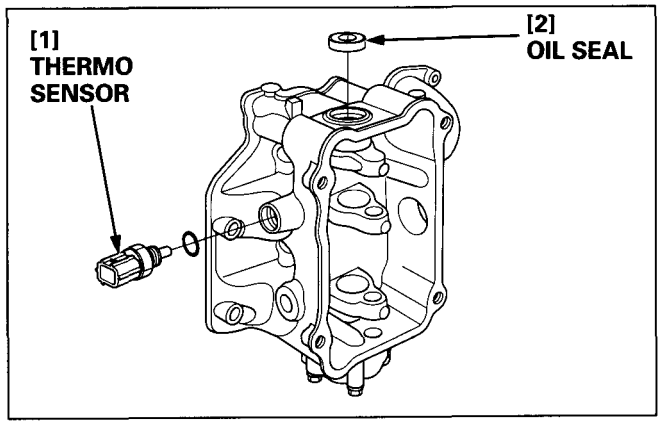
6) Remove the valve cotters, then release the valve spring compressor and remove the spring retainer, valve spring, valve spring seat and valve. Remove the valve stem seal if necessary.

- Valve stem seal must be replaced with new one when disassembled.
- Store all parts according the cylinder so they can be placed back in their original position.



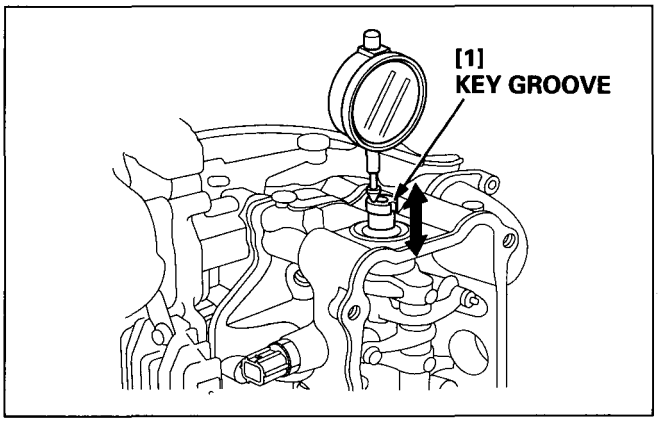
7) Inspect the oil seal for damage, replace if necessary.

8) Remove the thermo sensor.



a. INSPECTION

• CAMSHAFT AXIAL PLAY



- Perform this inspection with the rocker arms, rocker arm shaft, and oil pump installed.

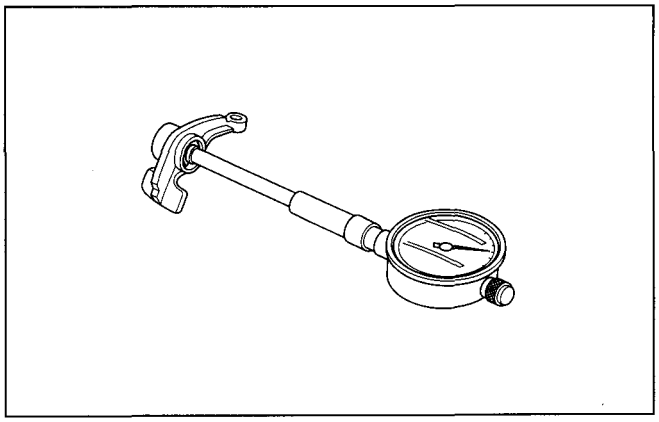
1) Loosen the valve adjust lock nuts and valve adjusters fully.

2) Turn the camshaft so the key groove faces toward the cylinder head cover as shown.

3) Measure the camshaft axial play with a dial indicator by moving the camshaft up and down.

Standard	Service limit
0.05 – 0.30 mm (0.002 – 0.012 in)	0.40 mm (0.016 in)

• ROCKER ARMS



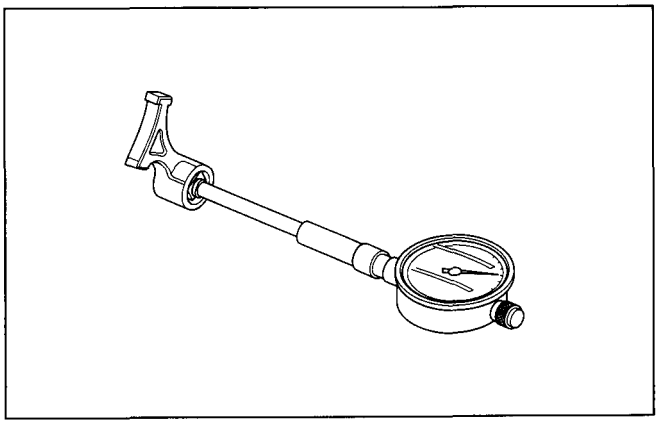
1) Inspect the sliding surface of the rocker arms, where they contact the camshaft, for wear or damaged.

2) Inspect the contact surface of the valve adjuster for wear or damage.

3) Measure and record the I.D. of the rocker arm.

Standard	Service limit
13.000 – 13.018 mm (0.5118 – 0.5125 in)	13.04 mm (0.513 in)

• FUEL PUMP ARM



1) Inspect the sliding surface of the fuel pump lifter, where they contact the camshaft, for wear or damaged.

2) Measure and record the I.D. of the fuel pump arm.

Standard	Service limit
13.000 – 13.080 mm (0.5118 – 0.5150 in)	13.10 mm (0.516 in)

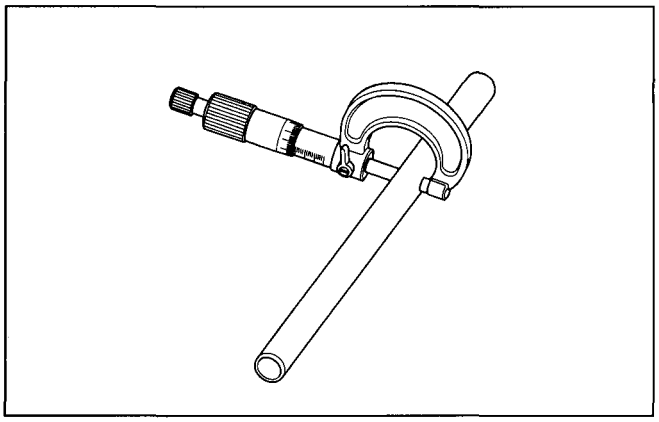
• ROCKER ARM SHAFT

1) Measure and record the O.D. of the rocker arm shaft.

Standard	Service limit
12.962 – 12.980 mm (0.5103 – 0.5110 in)	12.92 mm (0.509 in)

2) Calculate the rocker arm shaft-to-rocker arm and fuel pump lifter-to-rocker arm shaft clearance.

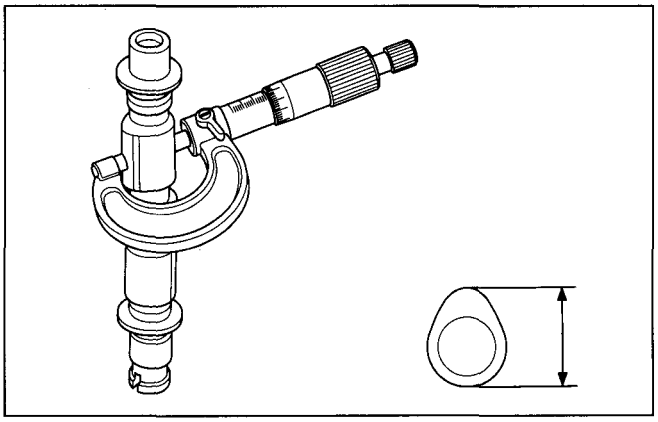
	Standard	Service limit
Rocker arm-to-shaft	0.020 – 0.056 mm (0.0008 – 0.0022 in)	0.07 mm (0.003 in)
Fuel pump arm-to-shaft	0.020 – 0.118 mm (0.0008 – 0.0046 in)	0.13 mm (0.005 in)



• CAMSHAFT

1) Inspect the cam lobe surface for scoring or evidence of insufficient lubrication. Measure the cam lobe height.

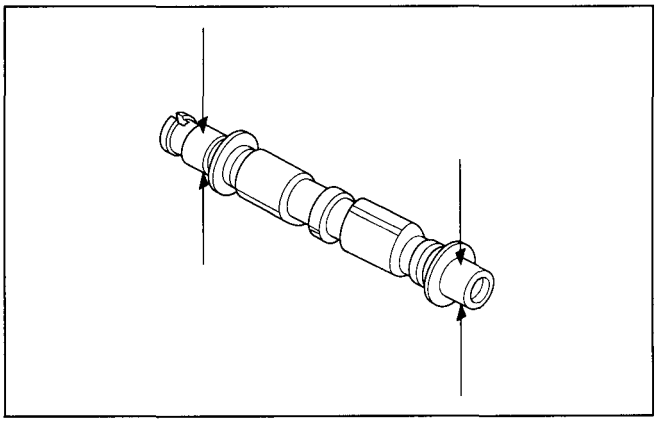
	Standard	Service limit
BF8D, BFP8D	21.916 – 22.076 mm (0.8628 – 0.8691 in)	21.716 mm (0.8550 in)
BF9.9D, BFP9.9D	23.396 – 23.556 mm (0.9211 – 0.9274 in)	23.196 mm (0.9132 in)



- Inspect the rocker arm if the cam lobe is worn or damaged.

2) Inspect the camshaft journal surface for wear or damage. Measure and record the camshaft journal O.D..

	Standard	Service limit
No. 1	19.959 – 19.980 mm (0.7858 – 0.7866 in)	19.93 mm (0.785 in)
Oil pump	15.966 – 15.984 mm (0.6286 – 0.6293 in)	15.94 mm (0.628 in)



3) Calculate the camshaft-to-oil pump body clearance.

Standard	Service limit
0.016 – 0.052 mm (0.0006 – 0.0020 in)	0.07 mm (0.003 in)

• CYLINDER HEAD

1) Remove the carbon deposits from the combustion chamber.

2) Check the spark plug hole and valve for cracks.

3) Check the cylinder head for warpage with a straight edge and feeler gauge.

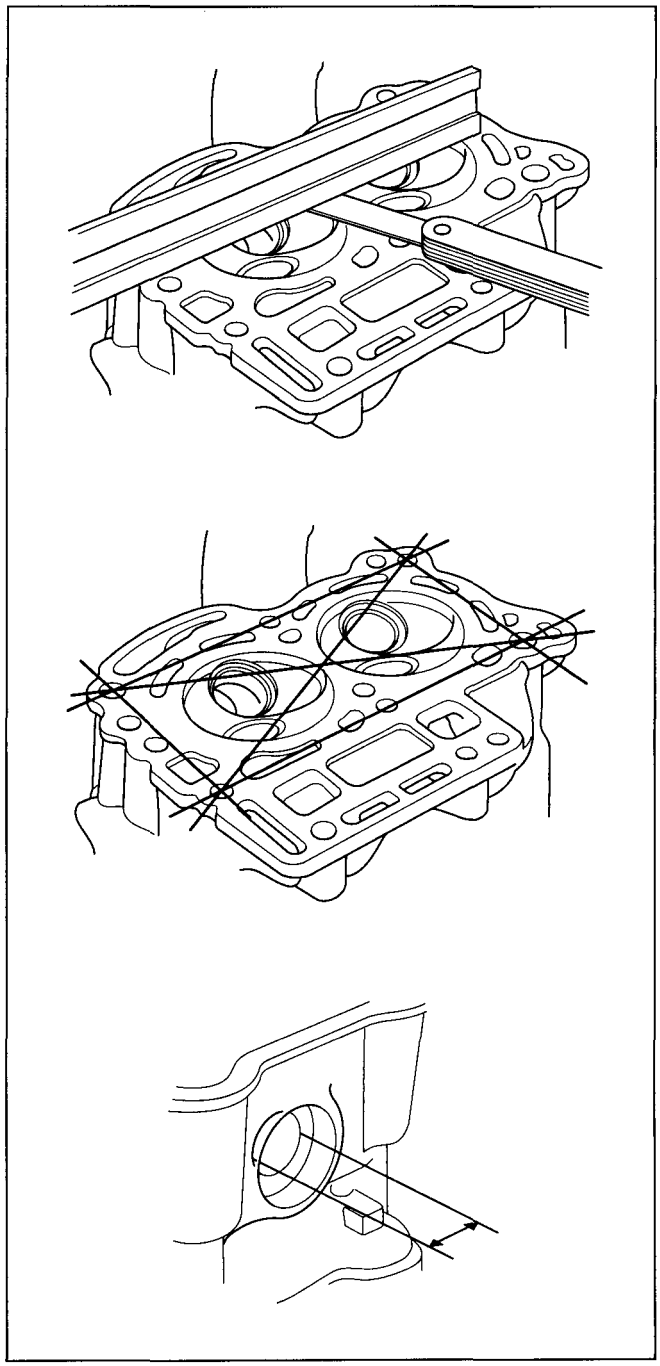
Standard	Service limit
0.05 mm (0.002 in) max.	0.10 mm (0.004 in)

4) Measure and record the camshaft journal I.D..

	Standard	Service limit
No. 1	20.000 – 20.021 mm (0.7874 – 0.7882 in)	20.05 mm (0.789 in)

5) Calculate the camshaft-to-cylinder head clearance.

Standard	Service limit
0.020 – 0.062 mm (0.0008 – 0.0024 in)	0.08 mm (0.003 in)

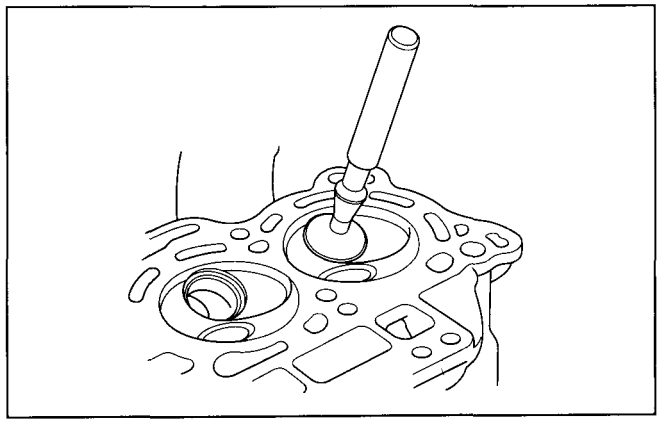


• VALVE SEATS

1) Thoroughly clean the combustion chamber and valve seats to remove carbon deposits.

2) Apply a light coat of Prussian Blue compound or erasable felt-tipped marker ink to the valve seats.

3) 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 transferred marking compound will show contact on any area of the seat.

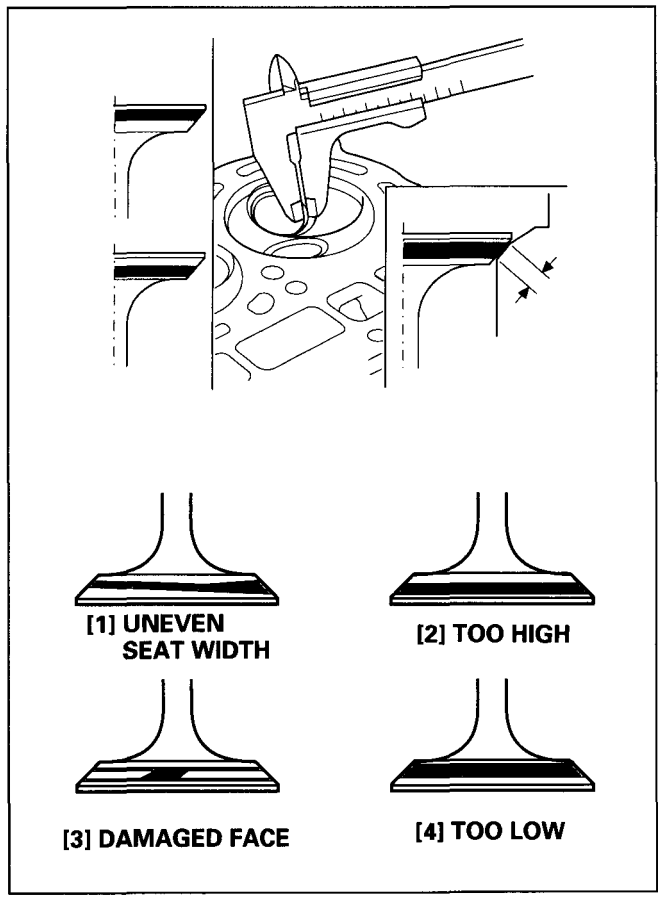


4) Remove and inspect the valve seat face. The valve seat contact should be within the specified width and even all around the circumference.

Standard	Service limit
0.9 – 1.1 mm (0.035 – 0.043 in)	2.0 mm (0.08 in)

Inspect the valve seat face for:

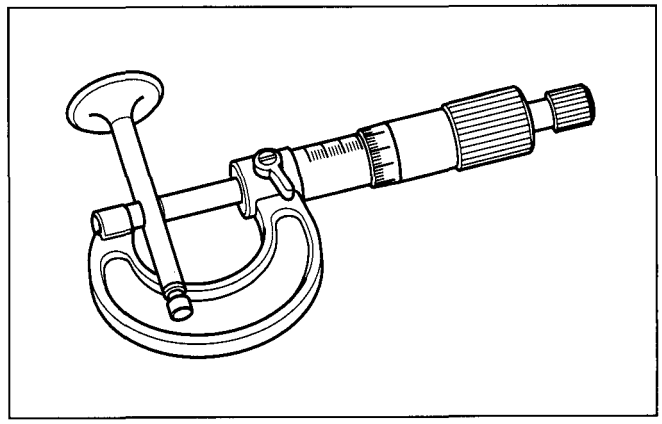
- Uneven seat width: replace the valve and reface the valve seat.
- Damaged face: replace the valve and reface the valve seat.
- Contact area too high or too low: reface the valve seat.
- The valve cannot be ground. If the valve face is burned or badly worn or if it contacts the seat unevenly, replace the valve.



• VALVES

1) Inspect each valve for bending, burning or abnormal seat wear.
2) Insert the valve in the guide and check the valve movement.
3) Measure and record the valve stem O.D..

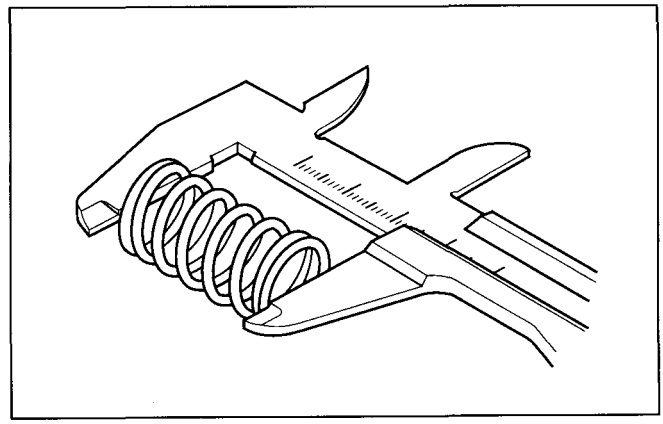
	Standard	Service limit
Intake	4.975 – 4.990 mm (0.1959 – 0.1965 in)	4.95 mm (0.195 in)
Exhaust	4.955 – 4.970 mm (0.1951 – 0.1957 in)	4.93 mm (0.194 in)



• VALVE SPRING FREE LENGTH

Measure the valve spring free length.

Standard	Service limit
33.28 mm (1.310 in)	32.0 mm (1.26 in)



• VALVE GUIDES

1) Ream the valve guide to remove any deposits before checking the valve guide I.D..
   - Insert the valve guide reamer from the combustion chamber side of the head and always rotate the reamer clockwise.

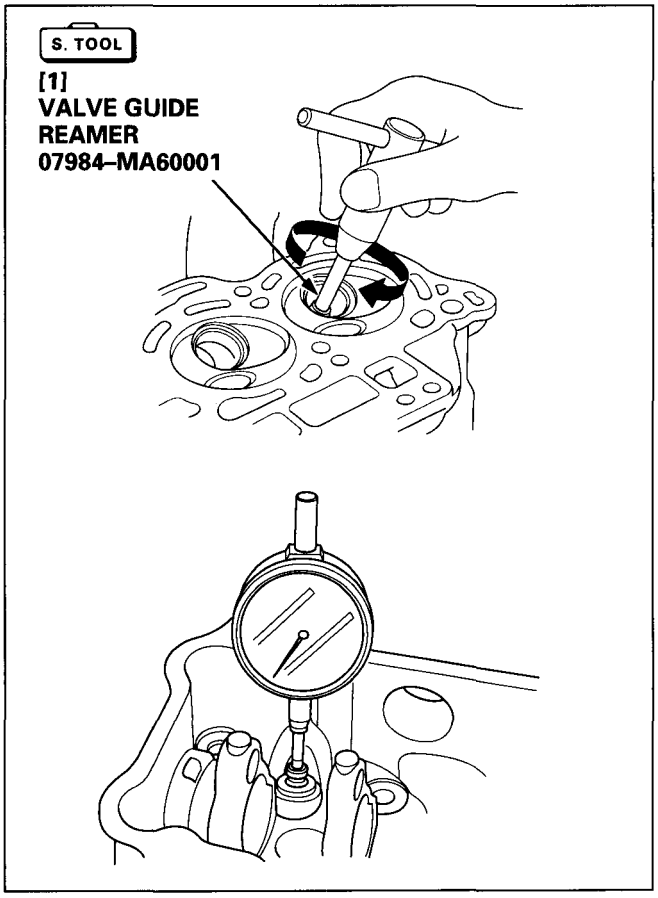
2) Measure and record the valve guide I.D..

	Standard	Service limit
Intake	5.000 – 5.012 mm (0.1969 – 0.1973 in)	5.04 mm (0.198 in)
Exhaust	5.000 – 5.012 mm (0.1969 – 0.1973 in)	5.04 mm (0.198 in)

3) Subtract each valve stem O.D. from the corresponding guide I.D. to obtain the stem-to-guide clearance.

	Standard	Service limit
Intake	0.010 – 0.037 mm (0.0004 – 0.0015 in)	0.07 mm (0.003 in)
Exhaust	0.030 – 0.067 mm (0.0012 – 0.0026 in)	0.12 mm (0.005 in)

4) If the stem-to-guide clearance is out of the specification, determine if a new guide with standard dimensions would bring the clearance within tolerance. If so, replace any valve guide as necessary and ream to fit. If the clearance is out of the specification with the new valve guide, replace the valves and guides.
   - Reface the valve seats whenever the valve guides are replaced (P. 10-15).



4. VALVE GUIDE REPLACEMENT

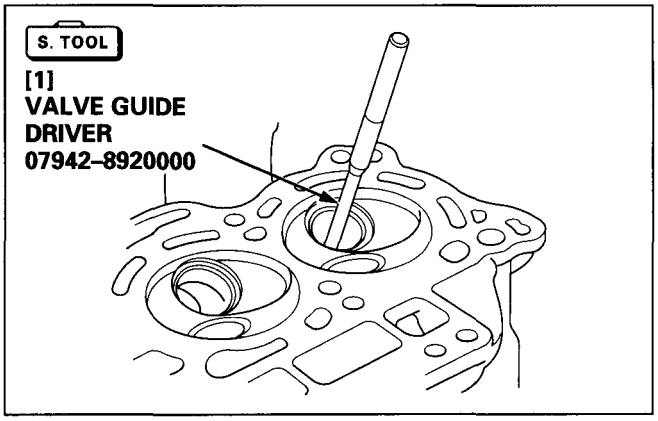
1) Chill the replacement valve guides in the freezer section of a refrigerator for about an hour.

2) Support the cylinder head with wooden blocks. Drive the valve guides out of the head from the combustion chamber side.

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.

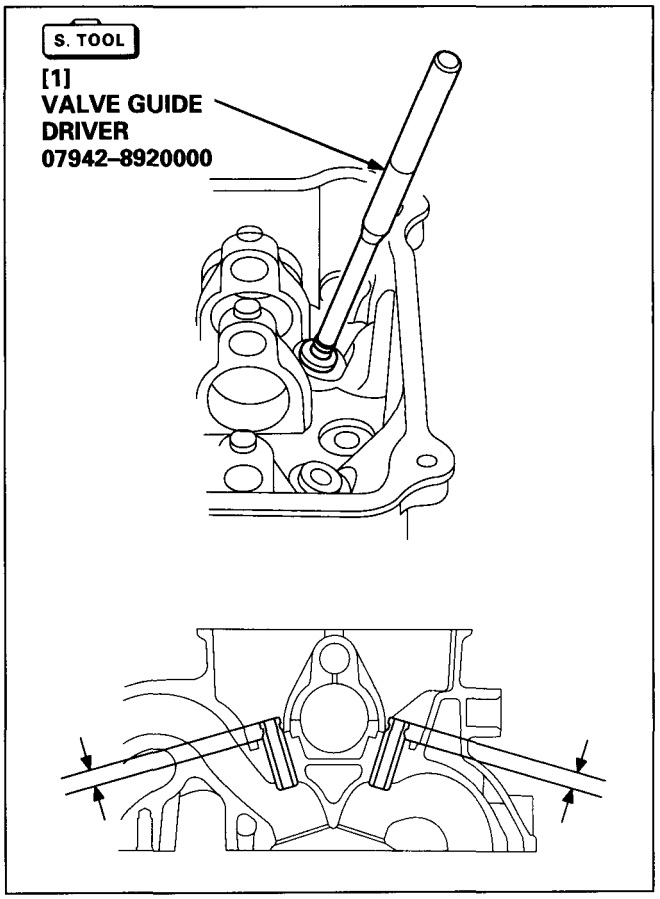


4) Install the new valve guides from the valve spring side of the cylinder head.

5) Drive the valve guides while measuring valve guide height from the cylinder head.

Valve guide height	Intake	7.0 mm (0.28 in)
	Exhaust	7.0 mm (0.28 in)

6) After installation, inspect the valve guide for damage. Replace the guide if damaged.



• VALVE GUIDE REAMING

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

1) Coat the reamer and valve guide with cutting oil.

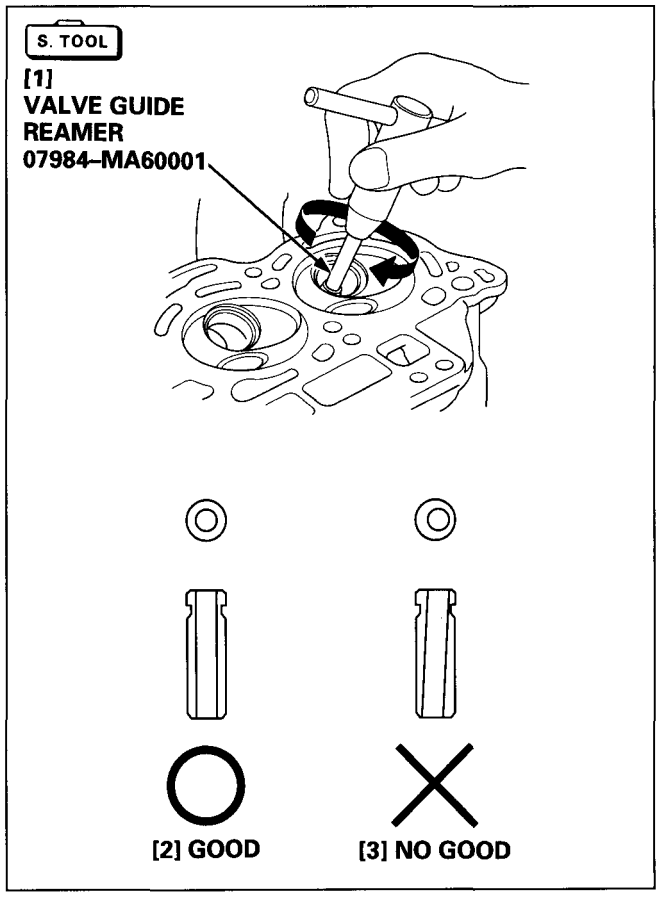
2) Rotate the reamer clockwise through the valve guide the full length of the reamer.

3) Continue to rotate the reamer clockwise while removing it from the valve guide.

4) Thoroughly clean the cylinder head to remove any cutting residue.

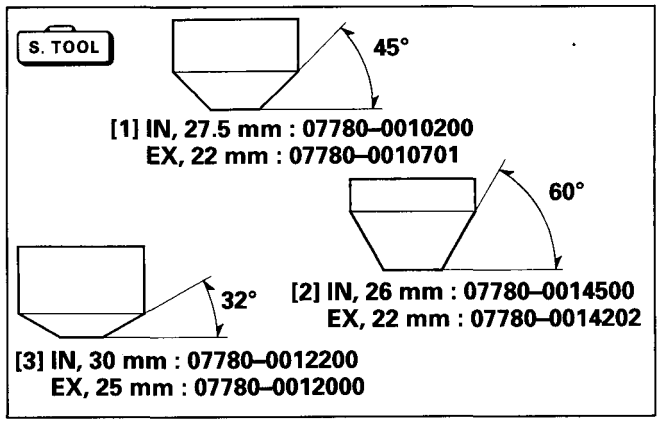
5) Check the valve guide bore; it should be straight, round and centered in the valve guide. Insert the valve and check operation. If the valve does not operate smoothly, the guide may have been bent during installation. Replace the valve guide if it is bent or damaged.

6) Check the stem-to-guide clearance. (P. 10-14).

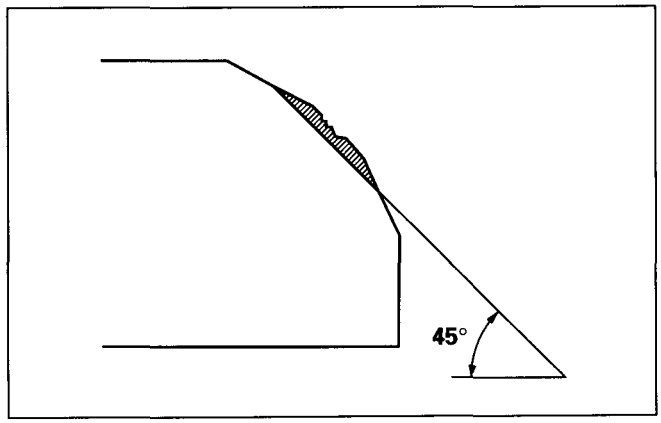


5. VALVE SEAT REFACING

- Recondition the valve seat. Follow the valve seat cutter manufacturer's instructions.
- Be careful not to grind the seat more than necessary.

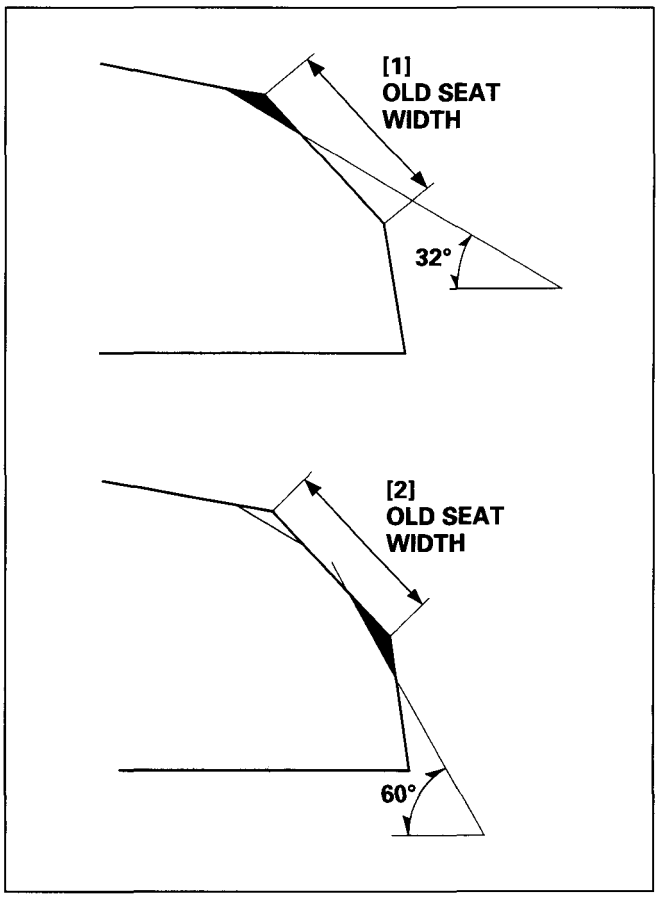


1) Using a 45° cutter, remove enough material to produce a smooth and concentric seat. Turn the cutter clockwise, never counterclockwise. Continue to turn the cutter as you lift it from the valve seat.



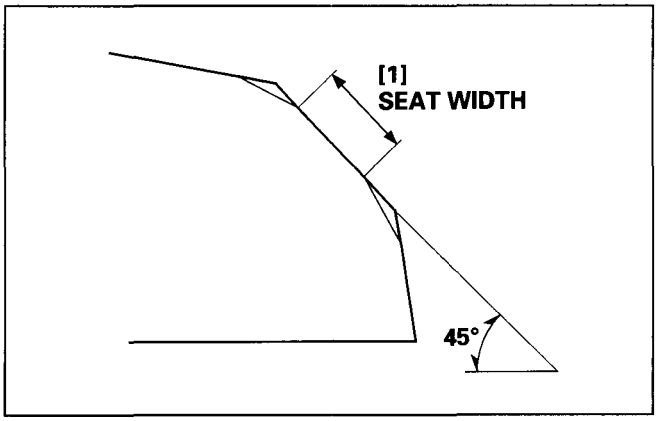
2) Use the 32° and 60° cutter to narrow and adjust the valve seat so that it contacts the middle of the valve face.

- The 32° cutter removes material from the top edge.
- The 60° cutter removes material from the bottom edge.



3) Be sure that the width of the finished valve seat is within specification.

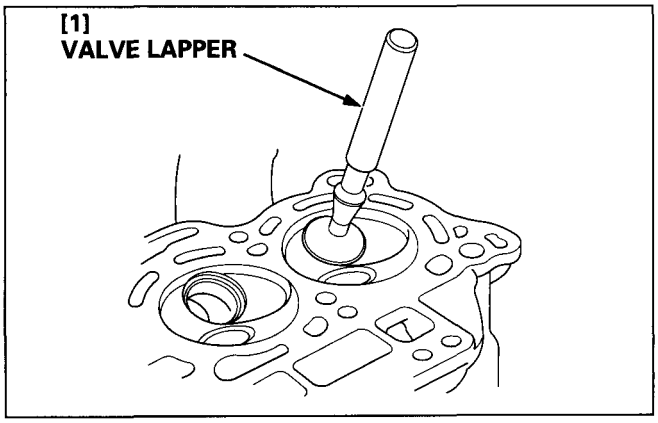
Standard valve seat width	0.9 – 1.1 mm (0.035 – 0.043 in)



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

5) 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 transferred marking compound, should have good contact all the way around.

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



7) Check valve clearance after assembly.

CAUTION:

To avoid severe engine damage, be sure to remove all lapping compound from the cylinder head before assembly.

6. CYLINDER HEAD ASSEMBLY

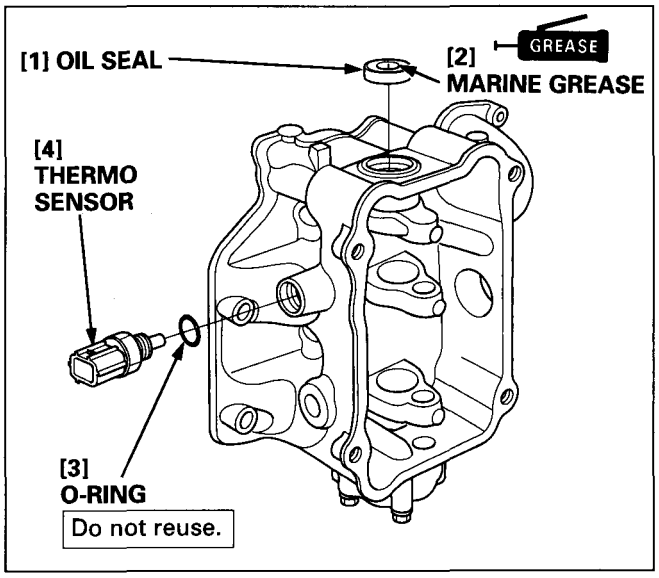
1) Clean the cylinder head with a solvent and blow through all oil passages with compressed air.

2) Install a new O-ring onto the thermo sensor.

3) Apply liquid sealant (Three bond #1201, #1215 or equivalent) to the thread of the thermo sensor. Then install the thermo sensor and tighten it to the specified torque.

   TORQUE: 18 N·m (1.8 kgf·m, 13 lbf·ft)

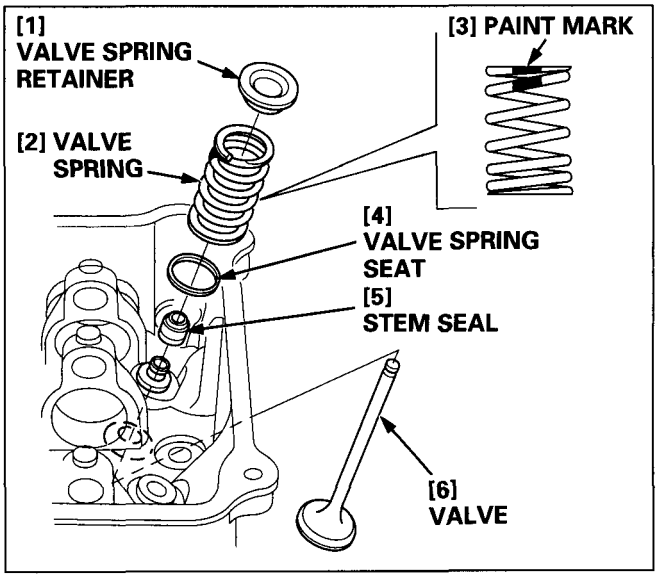
4) Install a new oil seal, then apply grease to the lip of the oil seal.



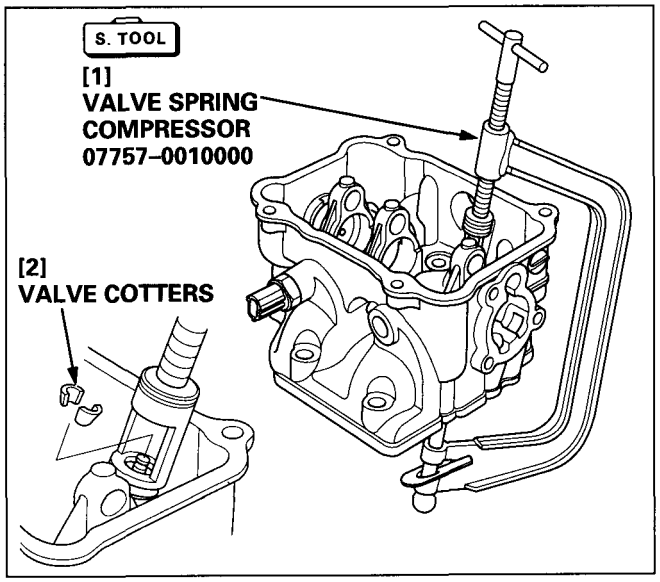
5) Install the valve spring seats and new stem seals.

6) Lubricate the valve stem with engine oil and insert the valve into the valve guide by turning the valve slowly to prevent damage to the stem seal.

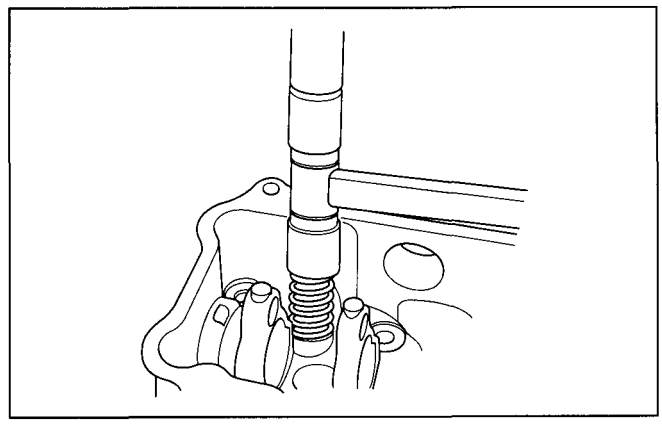
7) Install the valve springs with the side marked with the paint mark toword the valve spring retainer. Install the valve spring retainers.



8) Install the valve cotters using the valve spring compressor taking care not to damage the cylinder head.
   - Do not interchange the intake and exhaust valves.
   - Do not compress the valve spring more than necessary to prevent loss of tension.



9) Support the cylinder head above the work bench surface to prevent possible valve damage. Tap the valve stems gently using two plastic hammers as shown to seat the cotters firmly.

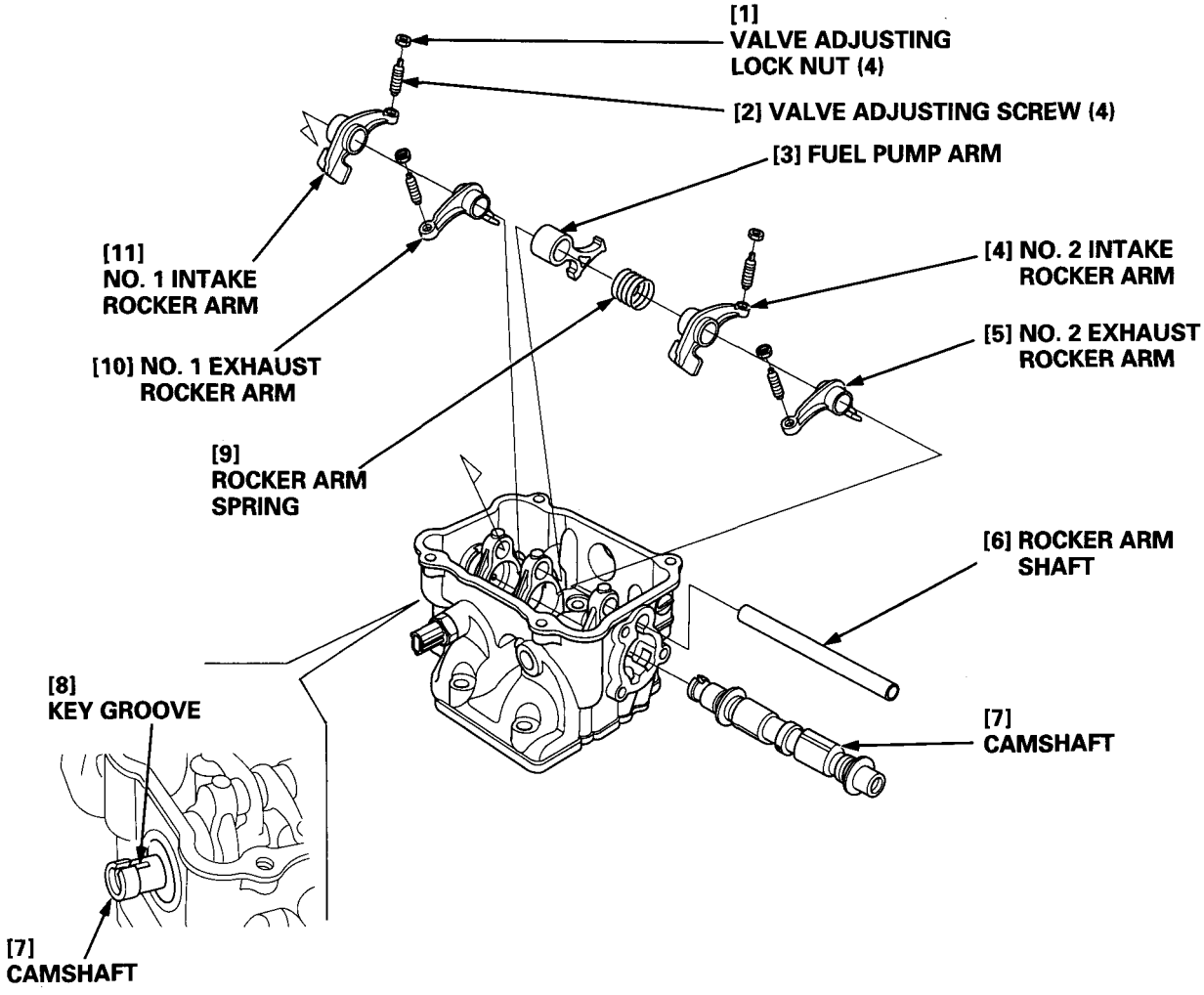


10) Apply molybdenum oil solution to the camshaft journals and cam lobes. Install the camshaft with the key groove facing the rocker arm side as shown.
    - Take care not to damage the oil seal.

11) Lubricate the rocker arms and rocker arm shaft with molybdenum oil solution.

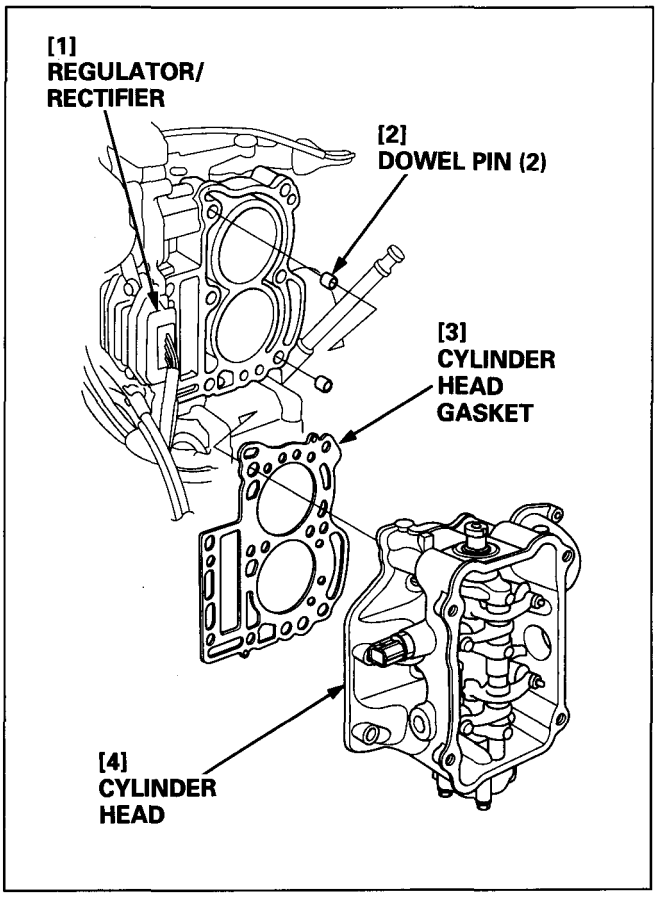
12) Make sure the valve adjusting screw and lock nuts are loosened fully. Install the intake and exhaust rocker arms, rocker arm spring and fuel pump lifter.

13) Install the oil pump (P. 10-8).



7. CYLINDER HEAD INSTALLATION

1) Install the two dowel pins and a new cylinder head gasket.



2) Turn the fuel pump lifter as shown and install the cylinder head.

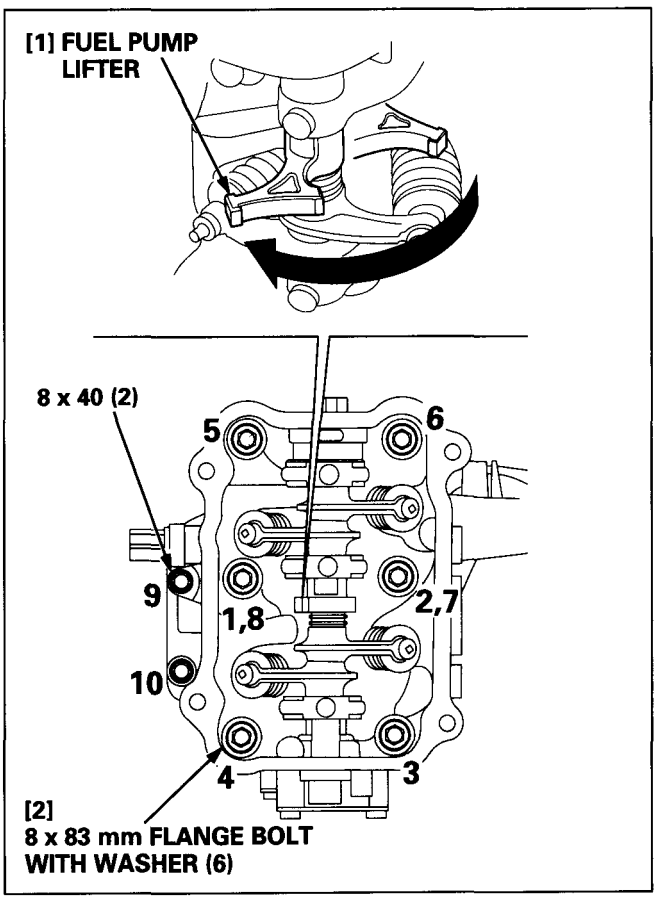
3) Apply oil to the 8 x 83 mm bolt threads and flange surfaces and install them.

   • Do not apply oil to the 8 x 40 mm flange bolts.

4) Tighten the cylinder head bolts to the specified torque.

   • Tighten the bolts in the numbered sequence shown in 2 – 3 steps.

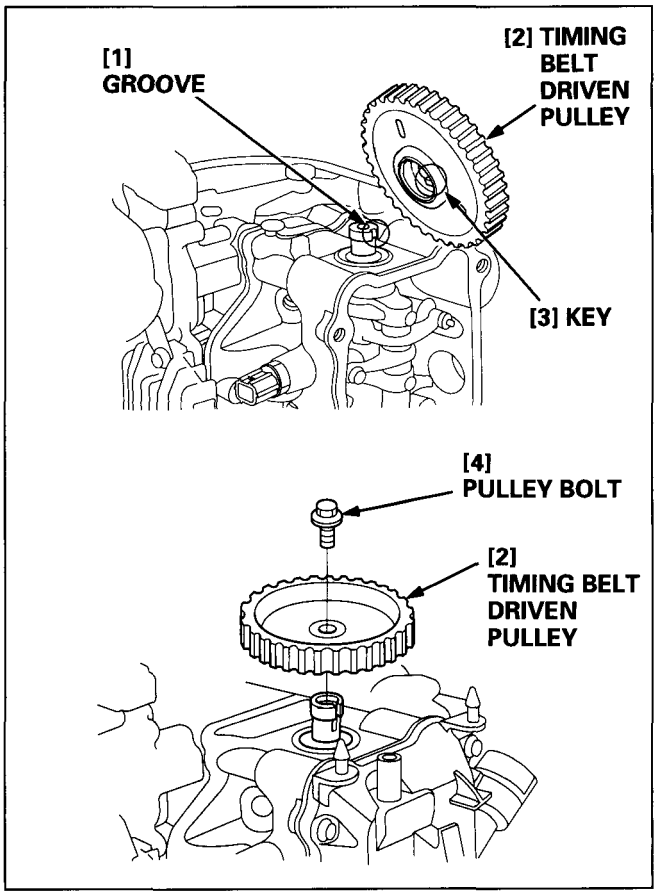
TORQUE:
8 x 83 mm flange bolt: 26 N·m (2.7 kgf·m, 20 lbf·ft)
8 x 40 mm flange bolt: 24 N·m (2.4 kgf·m, 17 lbf·ft)



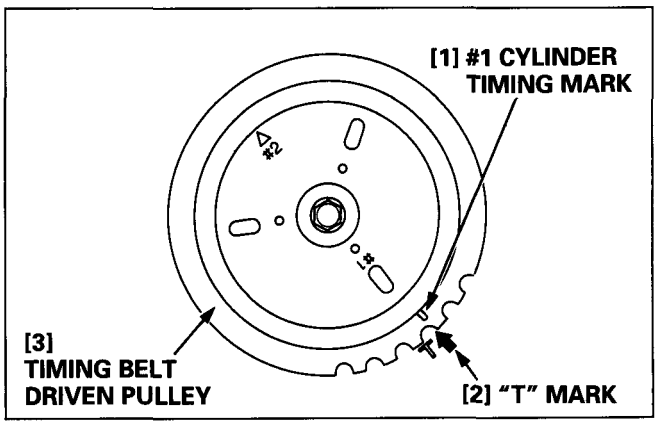
5) Install the timing belt driven pulley on the camshaft by aligning the key of the pulley with the groove of the camshaft.

6) Apply oil to the threads and flange surface of the pulley bolt. Tighten the bolt to the specified torque.

TORQUE: 16 N·m (1.6 kgf·m, 12 lbf·ft)



7) Make sure that the valve adjusters and lock nuts are loose firmly. Turn the timing belt driven pulley clockwise until the "▮" #1 timing mark on the timing belt driven pulley aligns with the "⬆T" mark on the cylinder head.



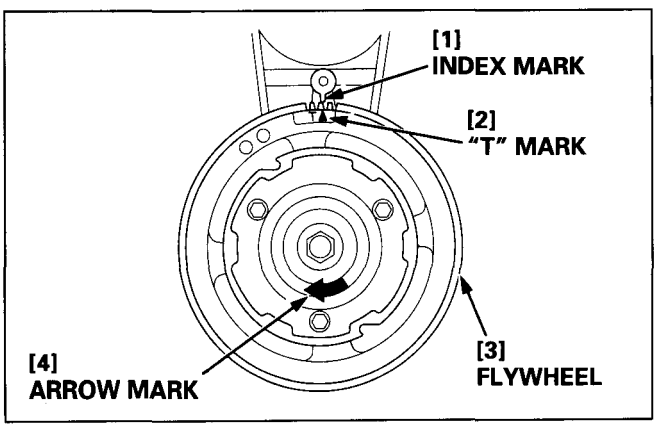
8) Turn the crankshaft clockwise by turning the flywheel clockwise (in the arrow marked direction) until the "⬆T" on the flywheel aligns with the "▮" on the crankcase.

- Don't turn the flywheel counterclockwise.

9) Install the timing belt on the timing belt driven pulley taking care not to allow the alignment marks to come out of alignment.

10) After installation, be sure that the alignment marks are in the proper alignment.

11) Adjust the valve clearances (P. 3-9 and 10).

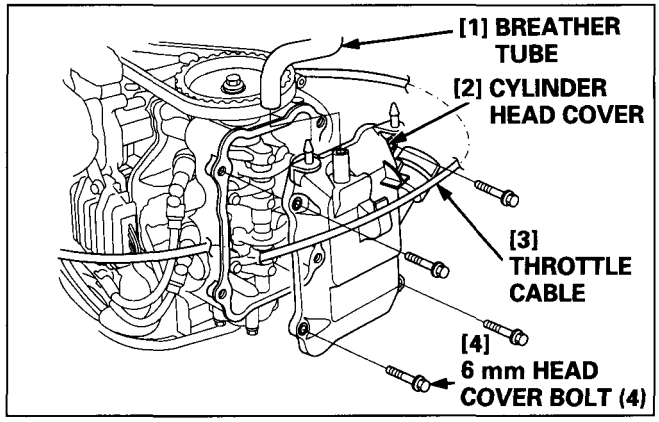


12) Set the cylinder head cover gasket to the cylinder head cover, then install the cylinder head cover.

13) Tighten the four head cover bolts securely.

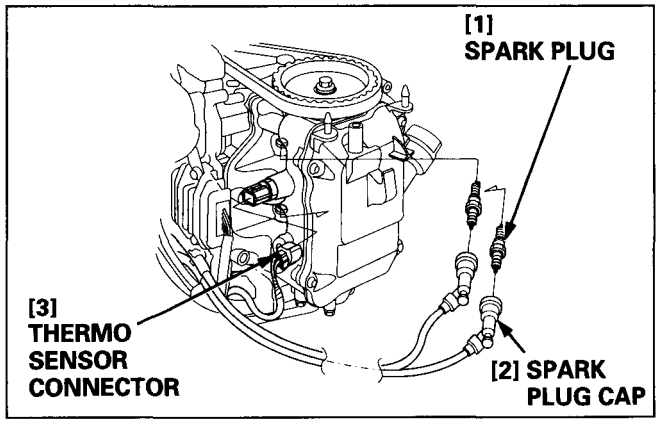
14) Secure the throttle cable by hooking on the clamp of the cylinder head cover (Tiller handle type only).

15) Connect the breather tube to the cylinder head cover.



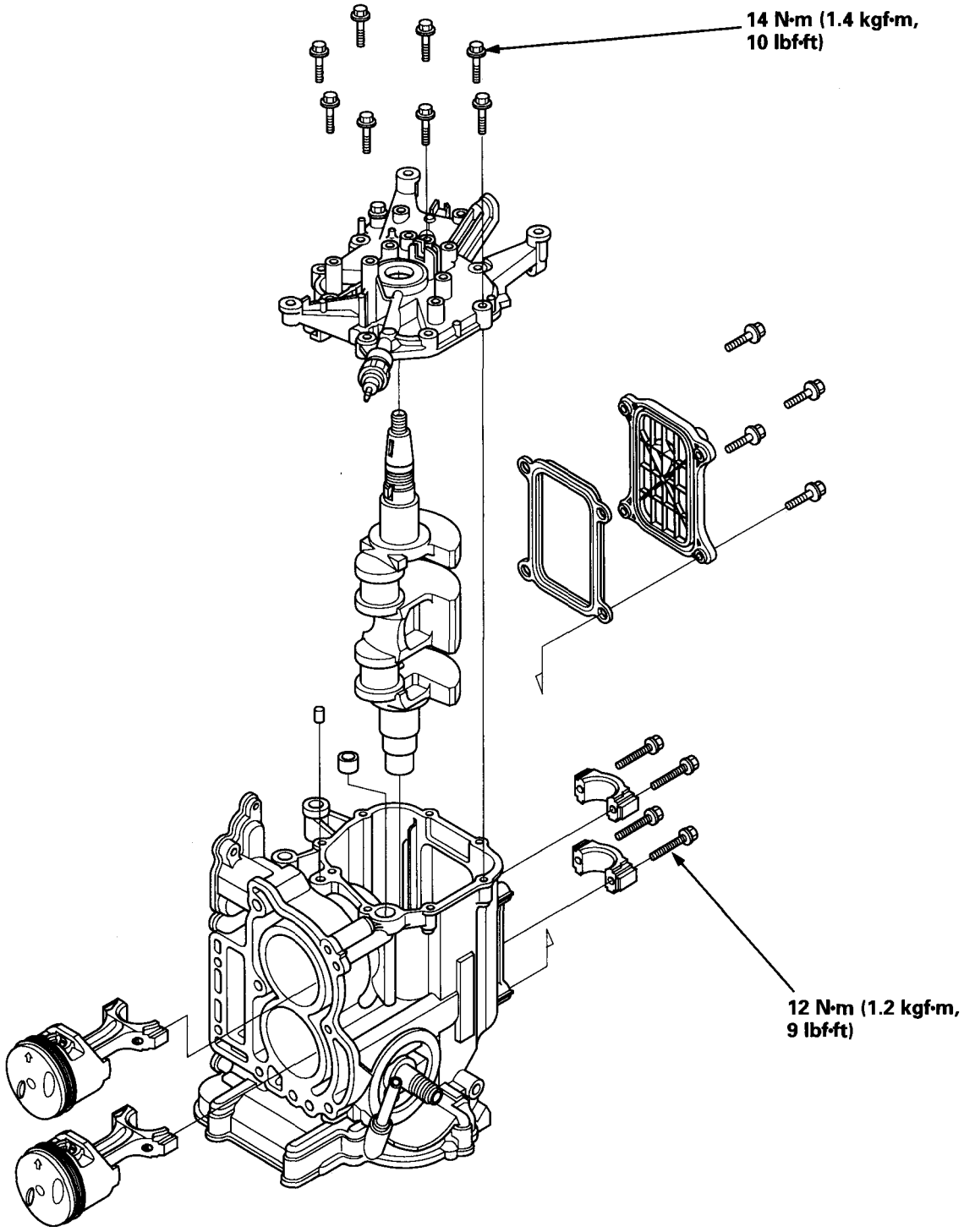
16) Install the spark plugs and connect the spark plug caps and thermo sensor connector.

17) Reinstall the removed parts:
— starter case B (P. 7-10).
— recoil starter (P. 7-9).
— neutral start cable (P. 7-1).
— left and right engine under covers (P. 5-2 and 3).
— engine cover.



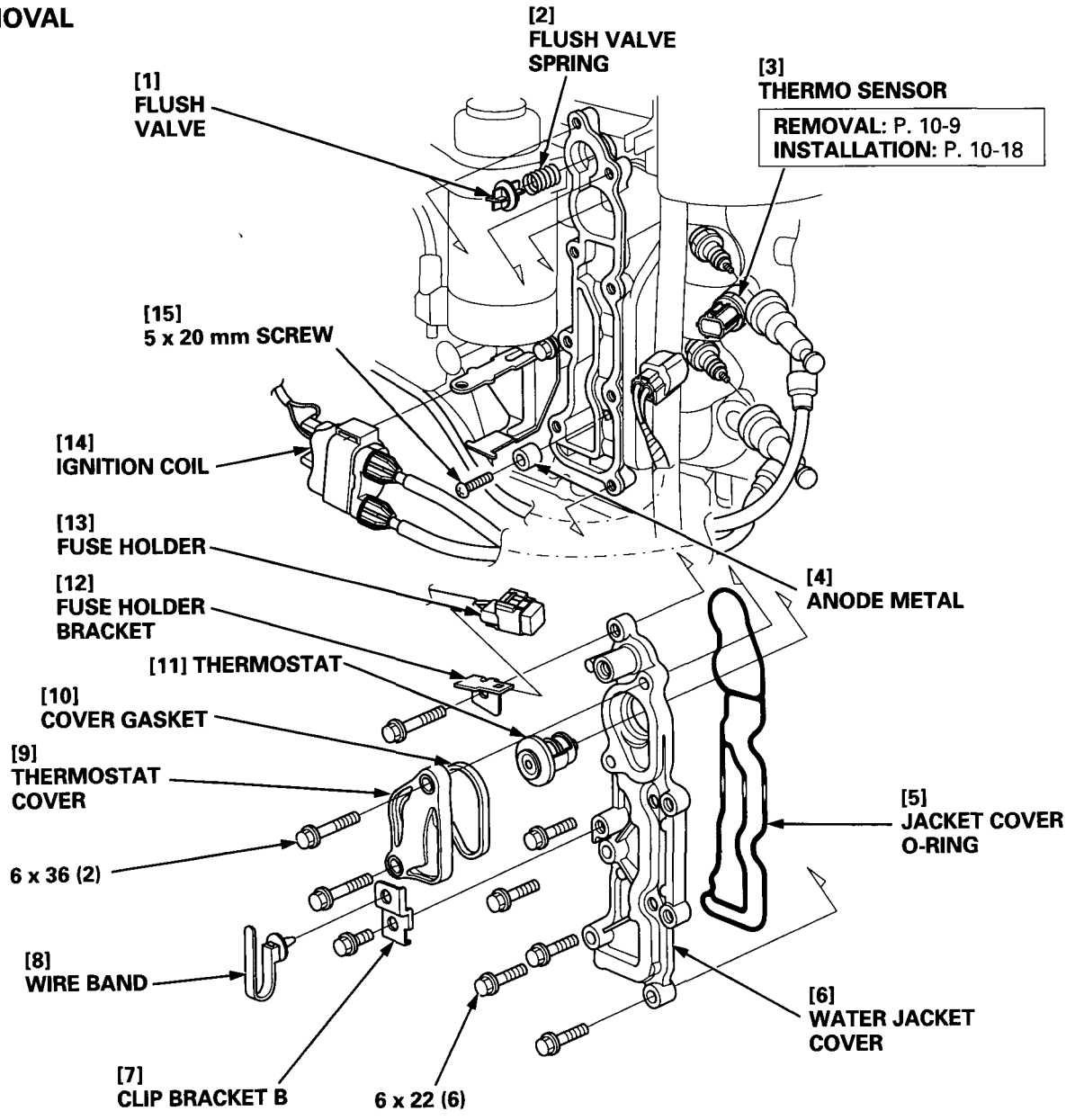
Date of Issue: Oct., 2000
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1. THERMOSTAT/WATER JACKET
2. OIL STRAINER
3. PISTON
4. CRANKSHAFT/CYLINDER BLOCK



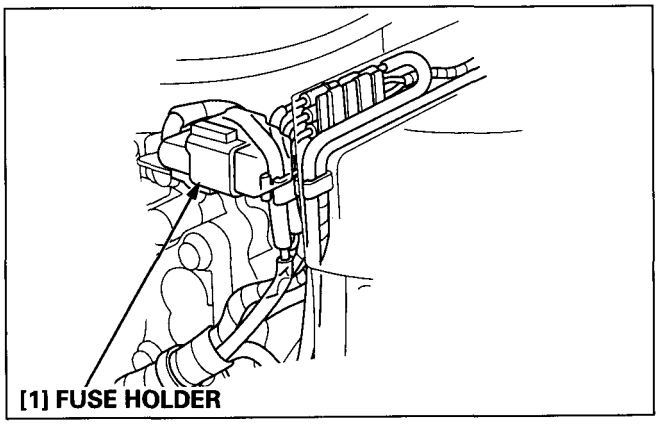
1. THERMOSTAT/WATER JACKET

a. REMOVAL



1) Remove the following:
   — engine cover (P. 5-1).
   — left engine under cover (P. 5-2).
   — recoil starter (P. 7-2).

2) Pull off the fuse holder from the fuse holder bracket (Type with charge coil).



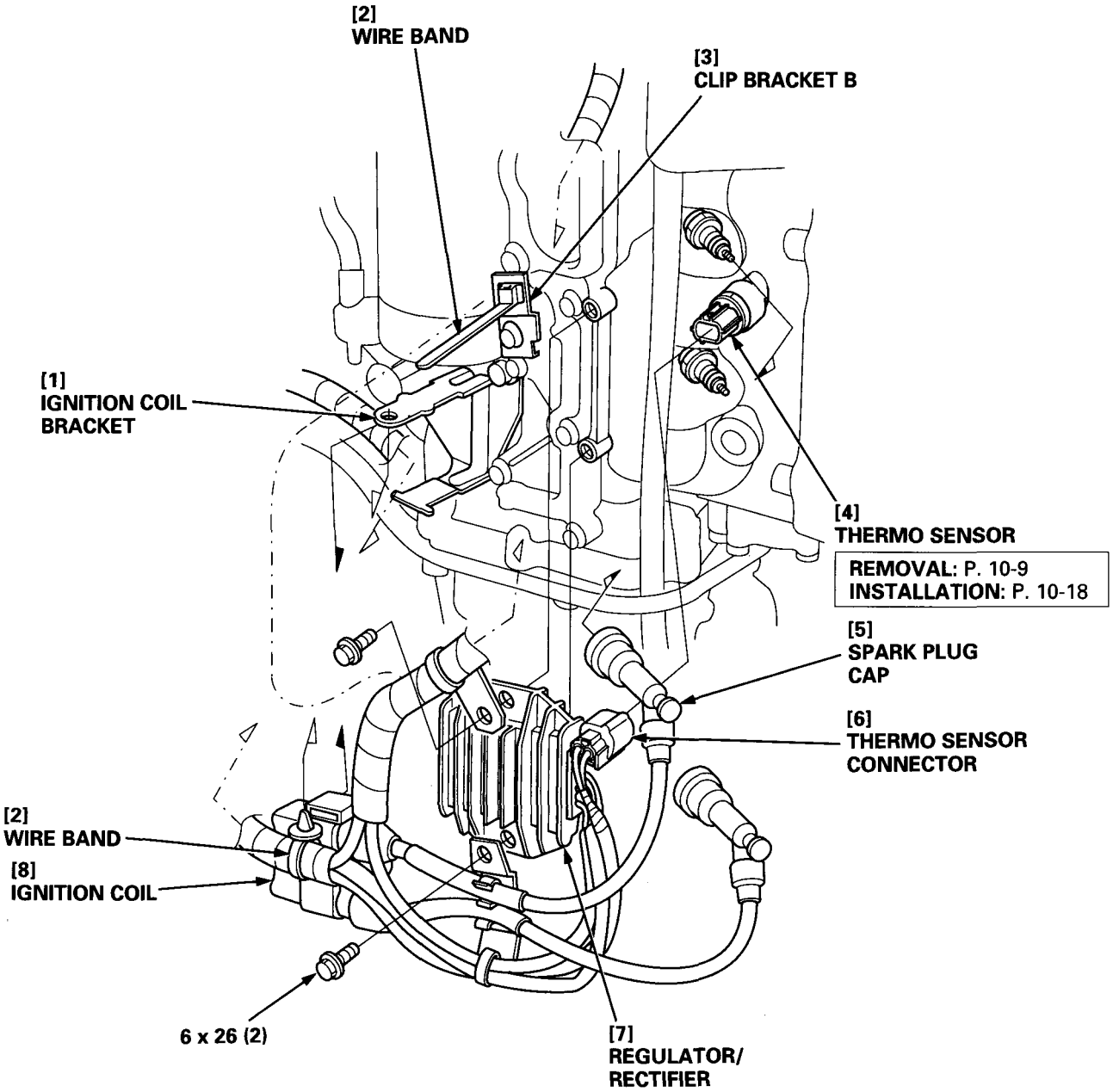
3) Disconnect the thermo sensor wire connector and remove the spark plug caps from the spark plugs.

4) Open the wire band on the clip bracket B and unfasten the wire harness.

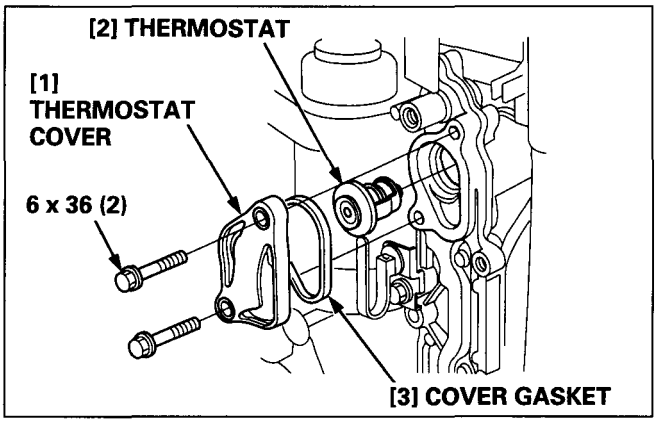
5) Remove the wire band from the ignition coil bracket.

6) Remove the two 6 x 26 mm flange bolts and remove the regulator/rectifier.

7) Remove the ignition coil from the ignition coil bracket.

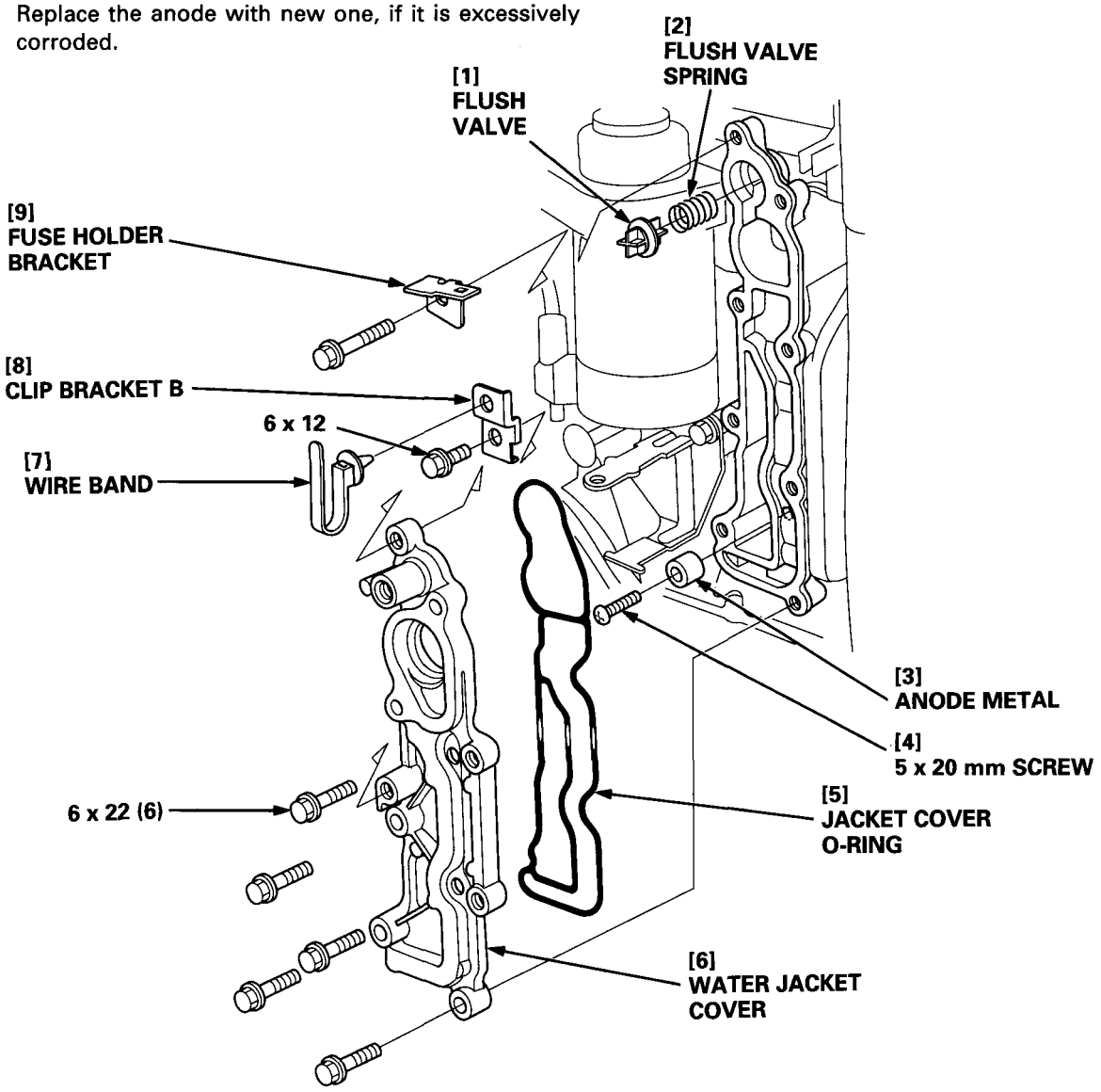


8) Remove the two 6 x 36 mm flange bolts and remove the thermostat cover, cover gasket and thermostat.



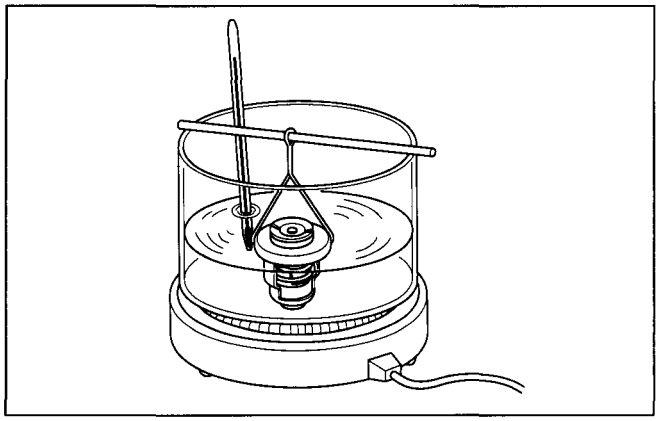
9) Remove the six 6 x 22 mm flange bolts and remove the following:
   — fuse holder bracket.
   — water jacket cover.
   — jacket cover O-ring.
   — water tube seal.
   — flush valve and flush valve spring.

10) Remove the 5 x 20 mm screw and anode metal.
   • Replace the anode with new one, if it is excessively corroded.



b. INSPECTION

• THERMOSTAT



1) Immerse the thermostat in water as shown.

2) Heat the water and observe the operation of the thermostat as the water temperature increase.

3) Measure the water temperature when the thermostat starts opening.
   - Don't let the thermometer and thermostat touch the container; this may cause a false reading.

4) Measure the lift height when fully open.

Start opening	60°C (140°F)
Fully open	70°C (158°F)
Lift height	More than 3.0 mm (0.12 in)

• THERMO SENSOR

- The sensor resistance decreases as the coolant temperature increases as shown in the right chart.

1) Disconnect the 2P connector from the thermo sensor and measure the resistance between the sensor terminals at the room temperature.

   Resistance: 1 – 5 kΩ

2) Connect the sencer connector and start the engine, check the voltage between the Red/blue (+) and Green/black (–).

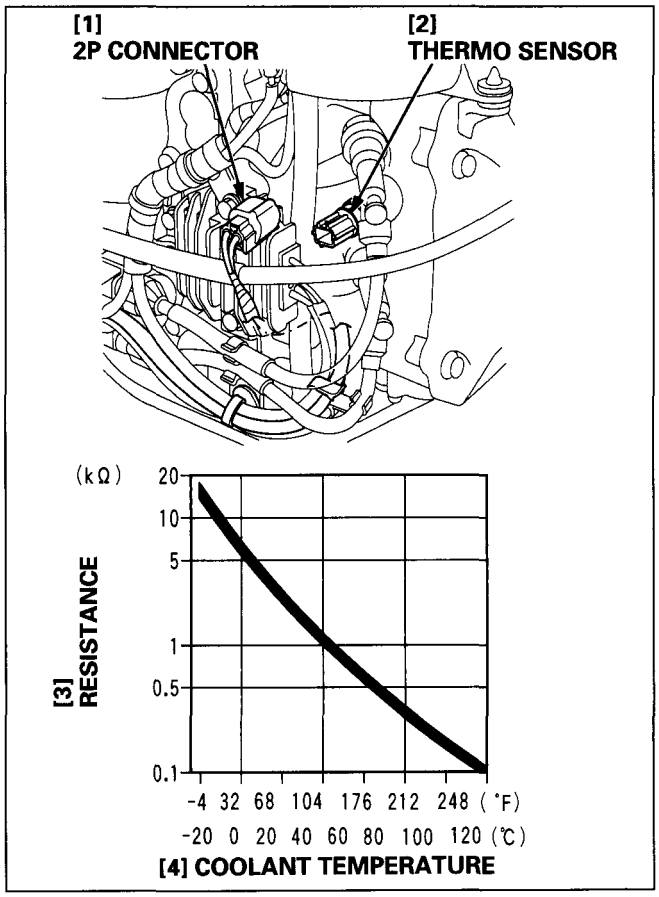
   If there is no voltage, check the open circuit in the wires and ignition control module.

3) Start the engine and warm up the engine to normal operating temperature.

4) Stop the engine, and disconnect the 2P connector and measure the resistance.

   Resistance: 200 – 400 Ω

   - See page 10-8 for removal and page 10-17 for installation.



c. INSTALLATION

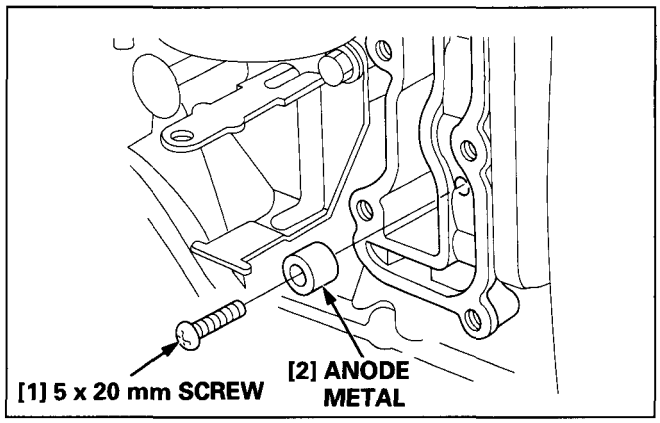
1) Check the anode metal, if it is excessively corroded. Replace with new one. Install the anode metal and tighten the 5 x 20 mm screw securely.

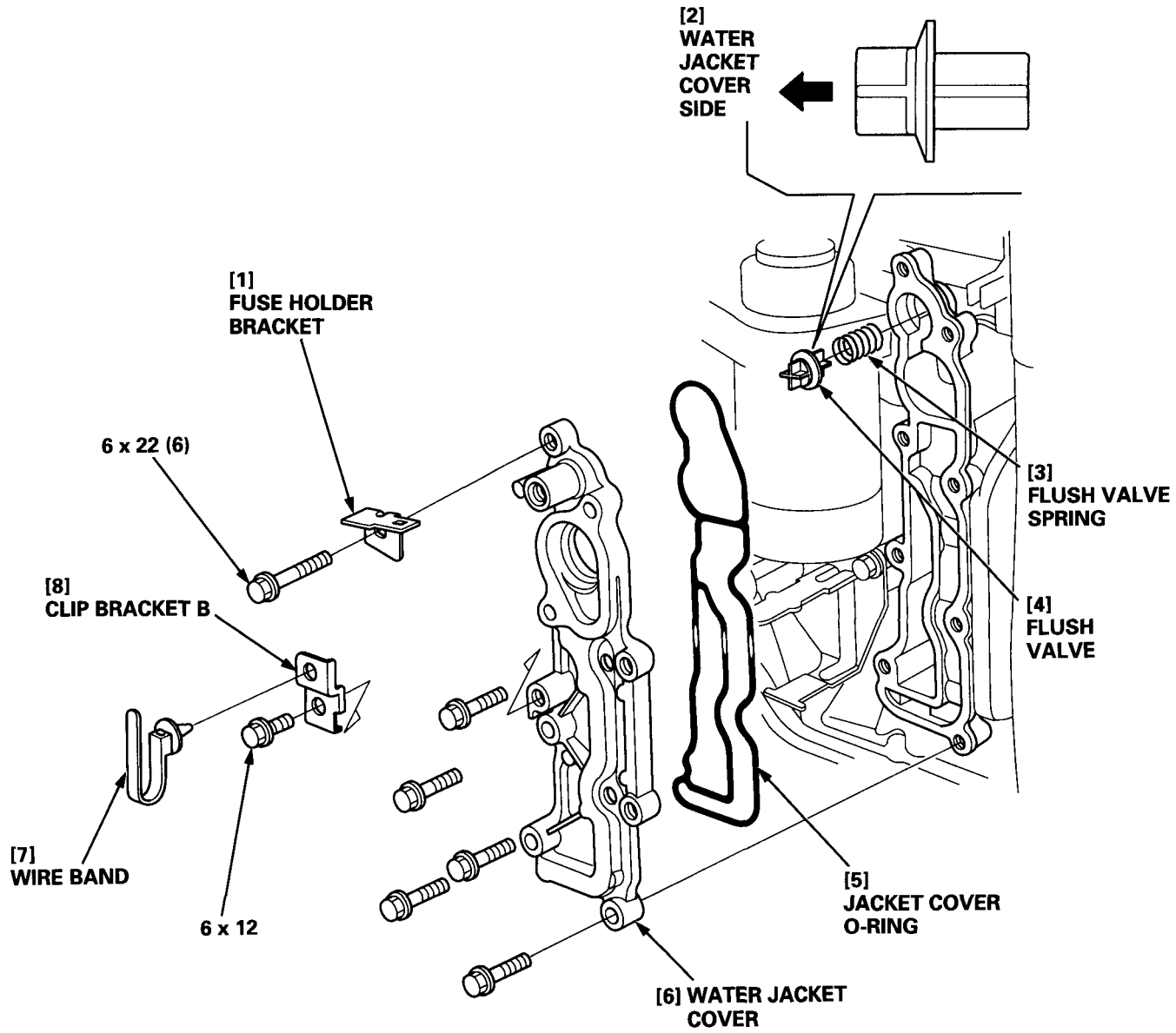
2) Install a new jacket cover O-ring on the water jacket cover securely.

3) Install the flush valve spring and flush valve with the short side facing the cover side as shown.

4) Install the water jacket cover and tighten the six 6 x 22 mm flange bolts.

5) Install the clip bracket B and wire band.





6) Install a new cover gasket to the thermostat cover.

7) Install the thermostat and thermostat cover and tighten the 6 x 36 mm flange bolts securely.

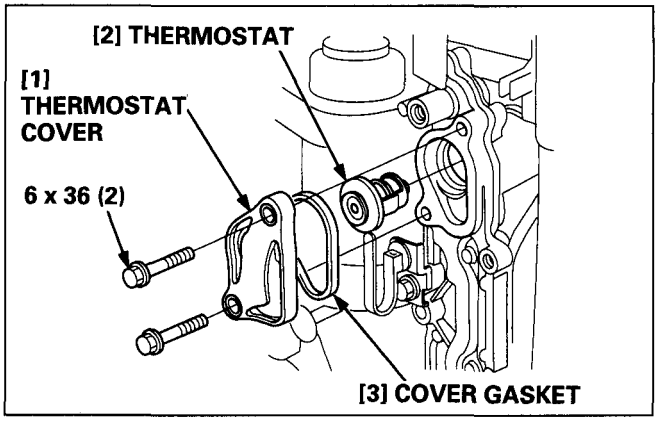
8) Install the ignition coil to the ignition coil bracket.

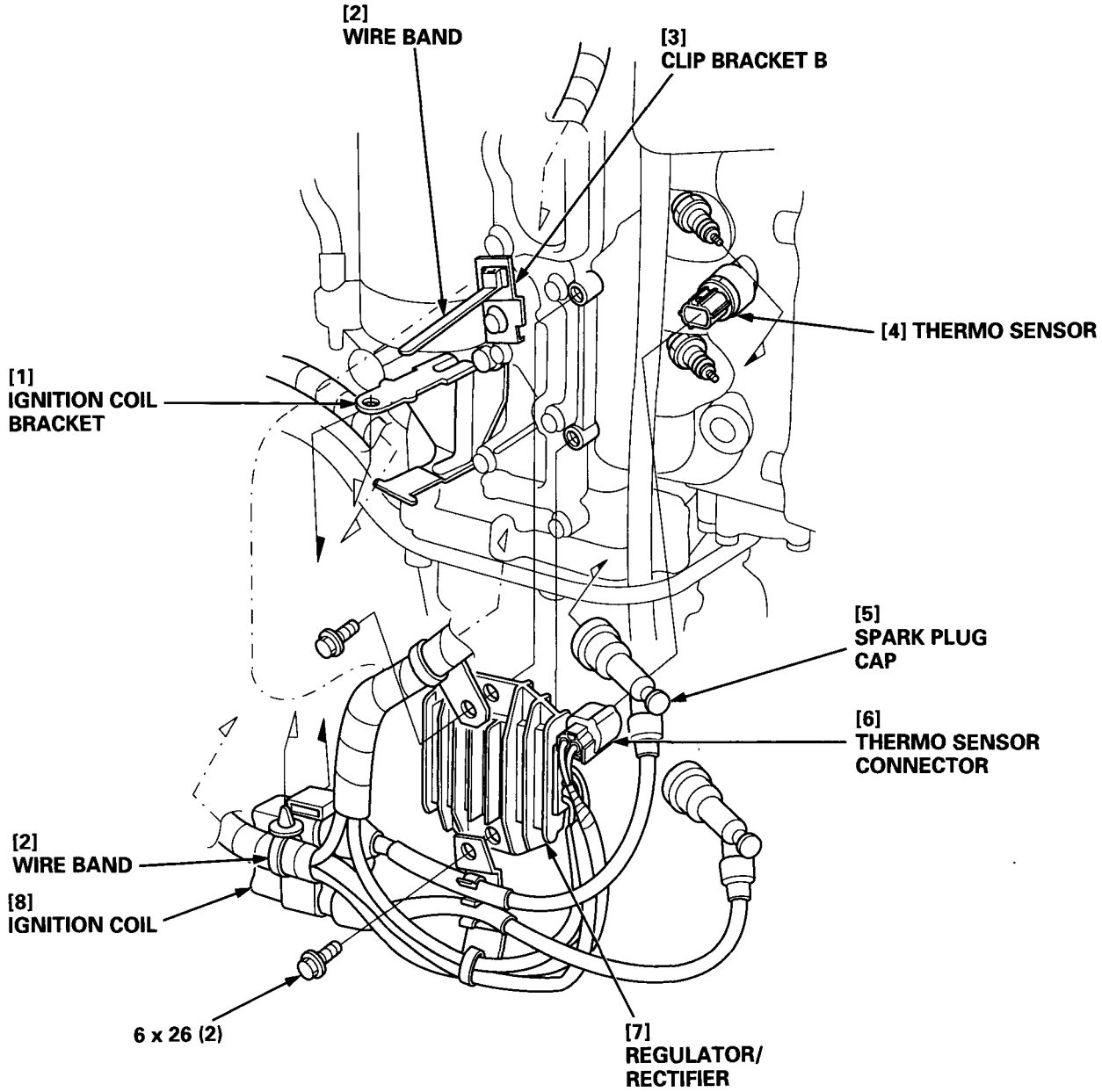
9) Install the regulator/rectifier and clip brackets C and D and tighten the 6 mm flange bolts.

10) Route the wire harness and ignition coil wires and secure them with the wire bands.
    - Replace the wire band with new one if it is cut.

11) Connect the thermo sensor connector and spark plug caps.

12) Reinstall the removed parts in the reverse order of removal.



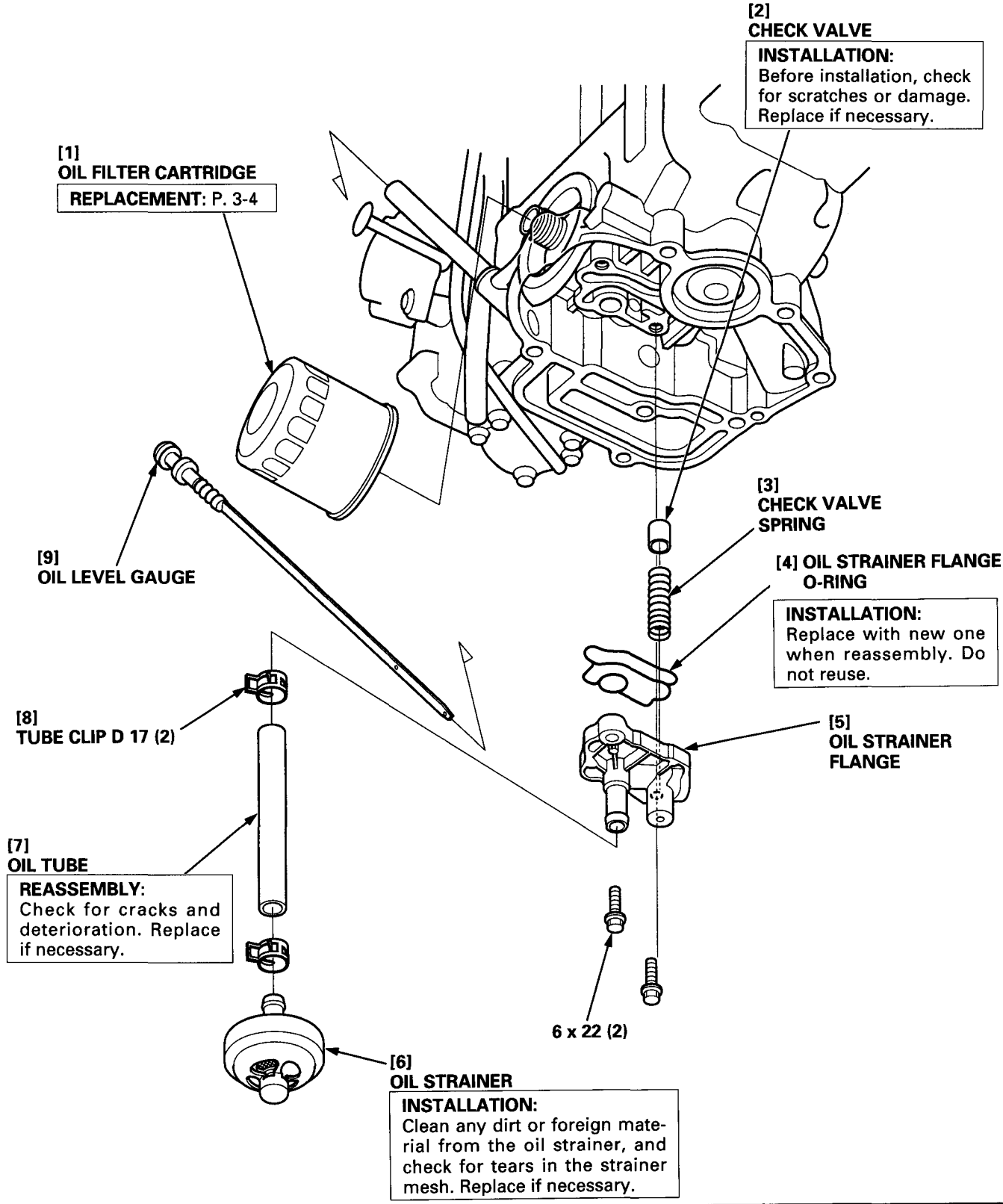


2. OIL STRAINER

a. DISASSEMBLY/REASSEMBLY

Remove the engine (Section 8).

- Before installation check the fuel tubes for deterioration, cracks, and other damage. Replace if necessary.



3. PISTON

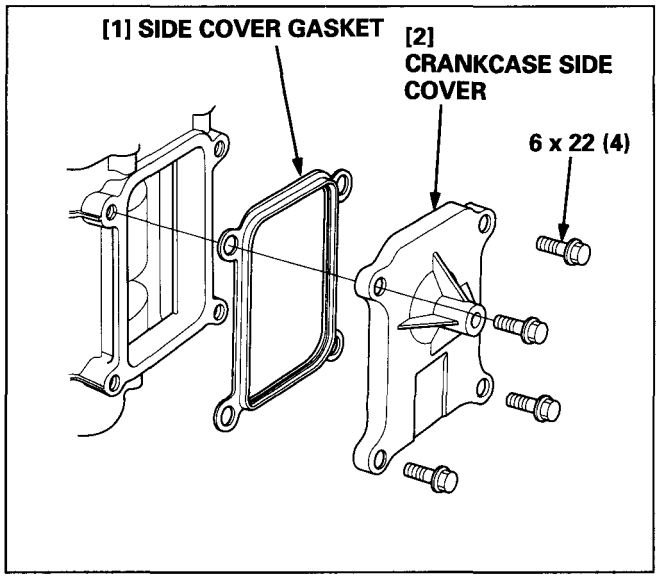
a. REMOVAL

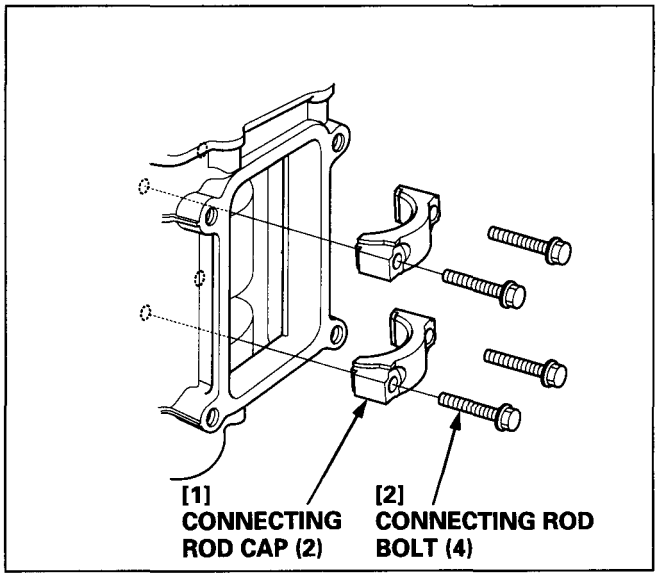
1) Remove the engine (Section 8) and remove the following:
   — flywheel and timing belt drive pulley (P. 9-2 and 10).
   — silencer and carburetor (P. 6-2).
   — fuel pump and fuel filter (P. 6-17).
   — cylinder head (P. 10-2).

2) Remove the four 6 x 22 mm flange bolts and crankcase side cover and side cover gasket.

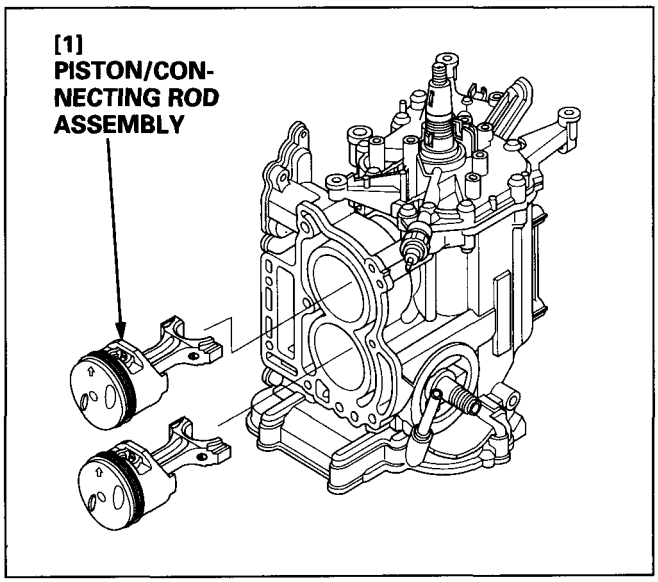
3) Turn the crankshaft until the piston is at top dead center.

4) Remove the connecting rod bolts and connecting rod caps.
   • Mark the connecting rod caps so they can be placed back in their original position.





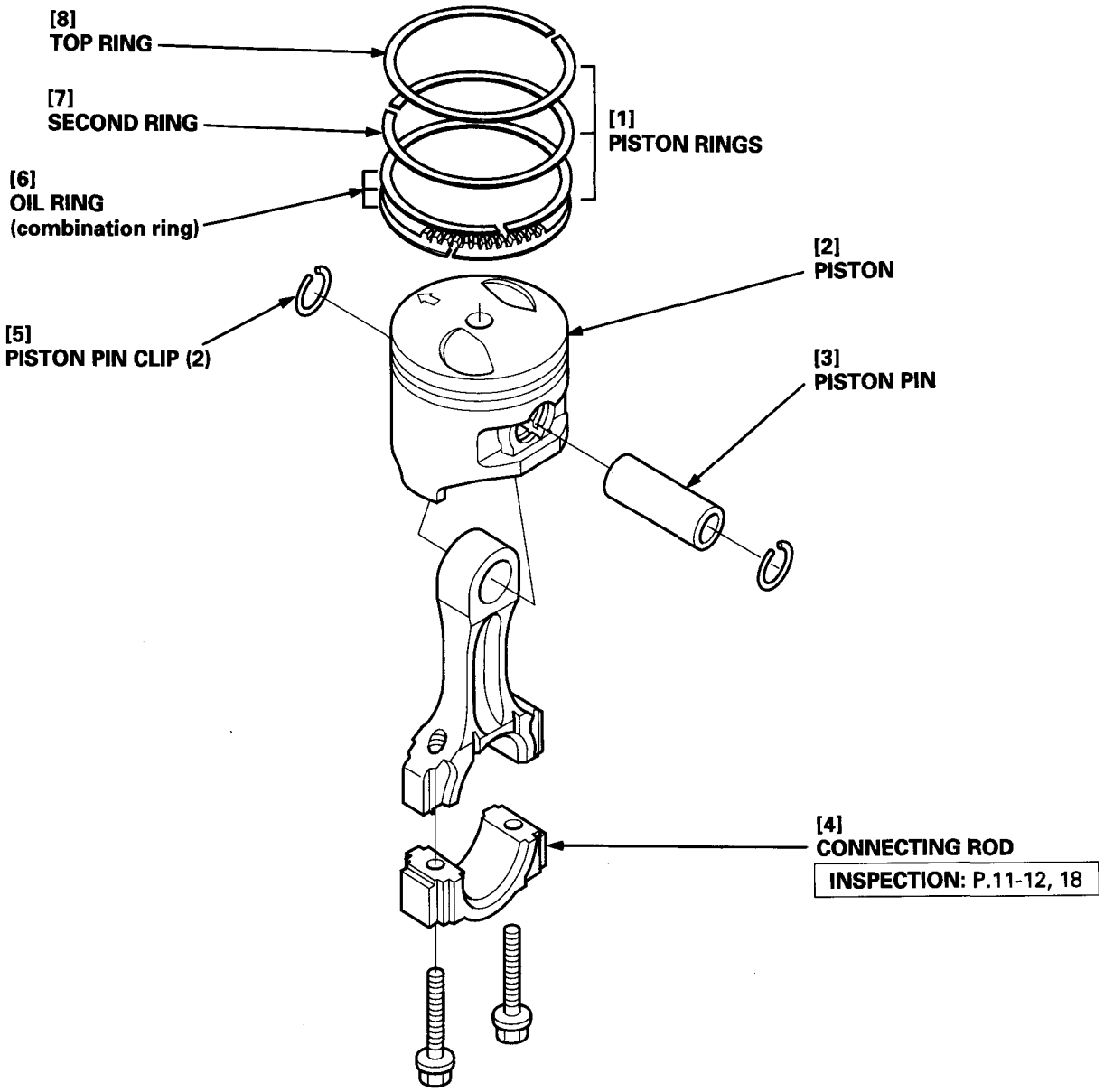
5) Remove the piston/connecting rod assemblies.
   • Mark the piston/connecting rod assemblies so they can be placed back in their original position.



b. DISASSEMBLY

1) Remove the piston pin clip using a long nose pliers, and remove the piston pin and connecting rod from the piston.

2) Spread each piston ring and remove it by lifting it up at a point just opposite the gap.
   - Take care not to damage the piston ring by spreading the ends too far.
   - Be careful not to damage the piston during the piston ring removal.



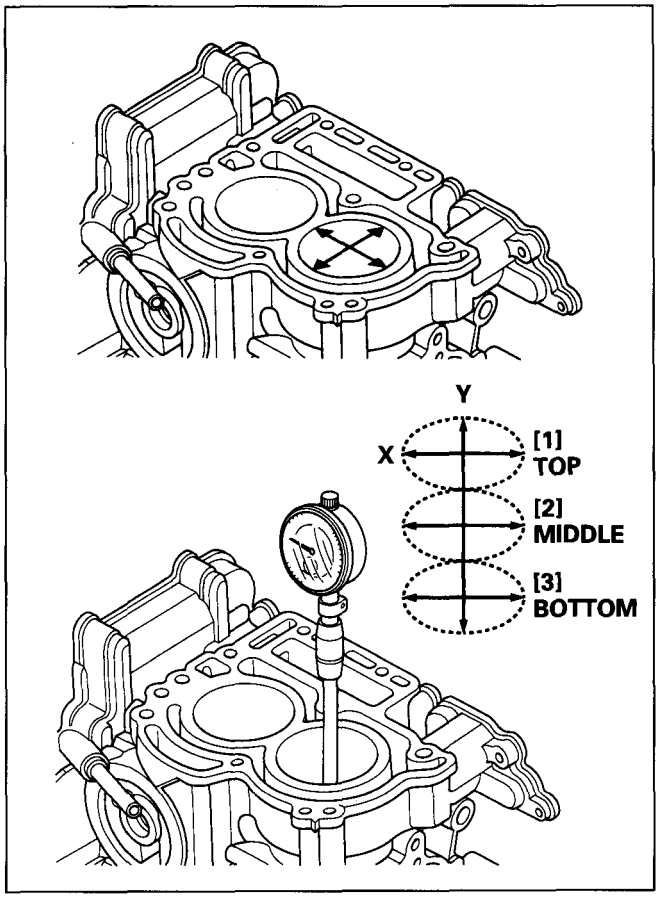
c. INSPECTION

• CYLINDER

1) Check the cylinder wall for scratches and wear.

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

Standard	Service limit
58.000 – 58.015 mm (2.2835 – 2.2841 in)	58.055 mm (2.2856 in)

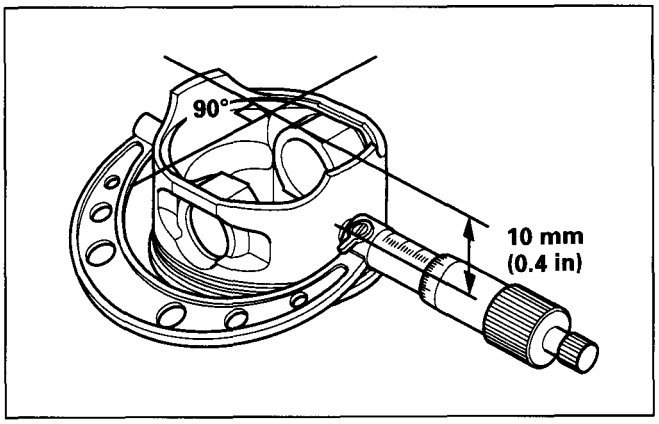


• PISTONS

1) Inspect the piston for cracks or other damage. Inspect the ring grooves for excessive wear and carbon buildup.

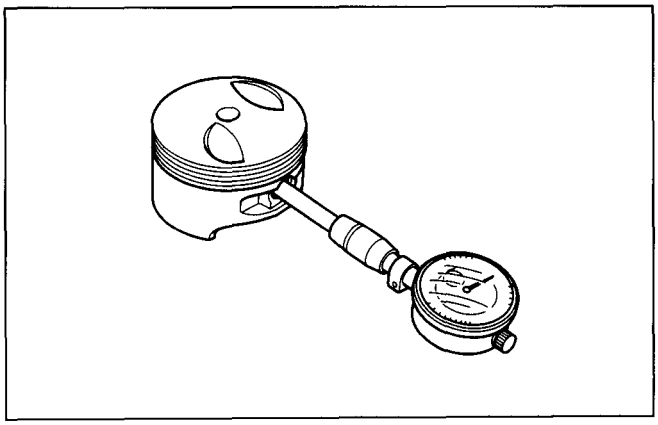
2) Measure and record the piston O.D..
   - Take measurements 10 mm (0.4 in) from the bottom, and 90° to the piston pin hole.

Standard	Service limit
57.970 – 57.990 mm (2.2823 – 2.2831 in)	57.92 mm (2.280 in)



3) Measure the piston pin hole I.D. in an X and Y axis. Take the maximum reading to determine I.D..

Standard	Service limit
16.002 – 16.008 mm (0.6300 – 0.6302 in)	16.02 mm (0.638 in)



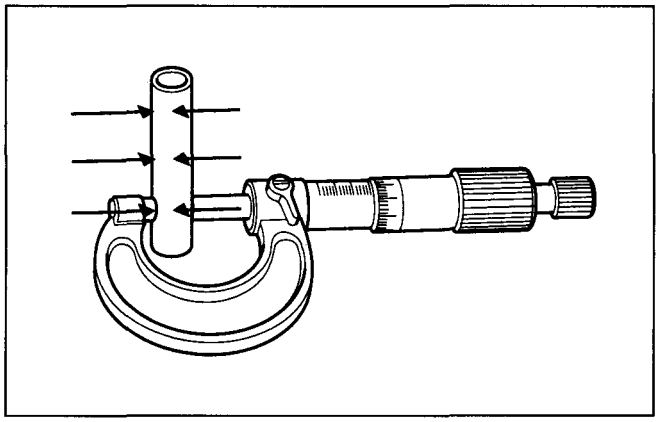
4) Calculate the piston-to-cylinder clearance.

Standard	Service limit
0.010 – 0.045 mm (0.0004 – 0.0015 in)	0.10 mm (0.004 in)

• PISTON PINS

1) Measure and record the piston pin O.D. at three position shown.

Standard	Service limit
15.994 – 16.000 mm (0.6297 – 0.6299 in)	15.97 mm (0.629 in)



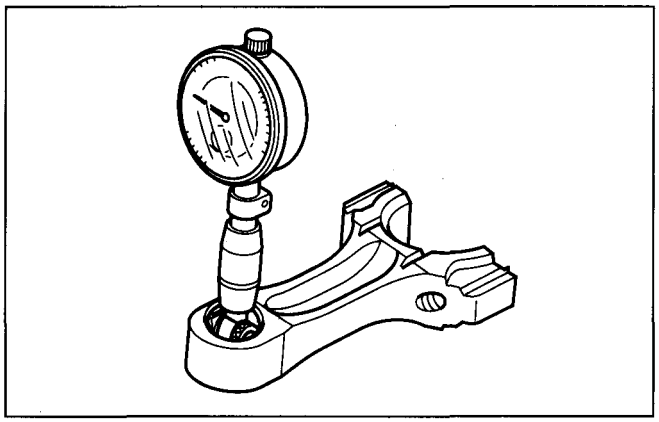
2) Calculate the piston pin-to-piston clearance.

Standard	Service limit
0.002 – 0.014 mm (0.0001 – 0.0006 in)	0.04 mm (0.002 in)

• CONNECTING ROD SMALL END I.D.

Measure and record the connecting rod small end I.D..

Standard	Service limit
16.007 – 16.022 mm (0.6302 – 0.6308 in)	16.05 mm (0.632 in)

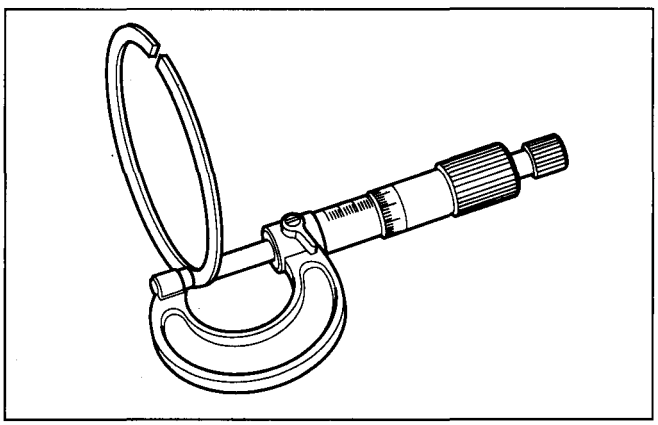


• PISTON RINGS

1) Inspect the piston rings, replace them if they are worn.
   - Replace the piston ring as a set.

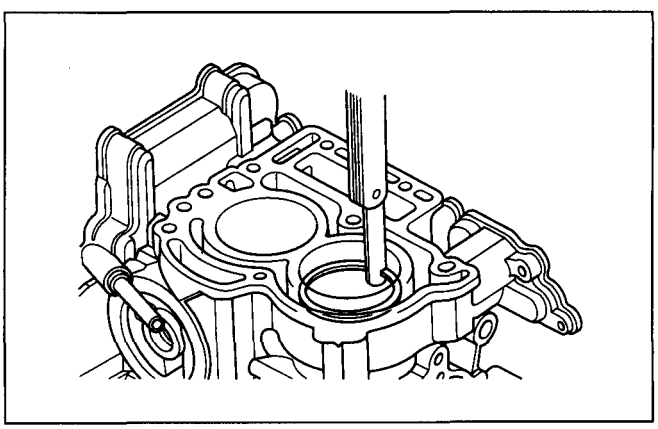
2) Measure the piston ring thickness.

	Standard	Service limit
Top/second	1.175 – 1.190 mm (0.0463 – 0.0469 in)	1.08 mm (0.043 in)



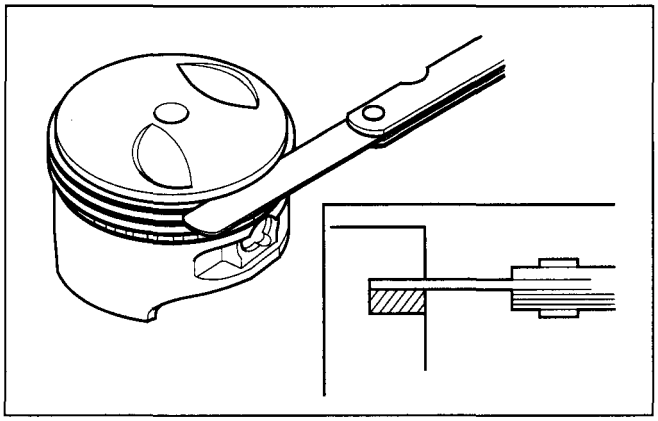
3) Using a piston, push the ring securely into the cylinder and measure the end gap using a feeler gauge.

	Standard	Service limit
Top	0.15 – 0.30 mm (0.006 – 0.012 in)	0.5 mm (0.02 in)
Second	0.35 – 0.50 mm (0.014 – 0.020 in)	0.7 mm (0.03 in)
Oil (side rail)	0.20 – 0.80 mm (0.008 – 0.031 in)	1.0 mm (0.04 in)



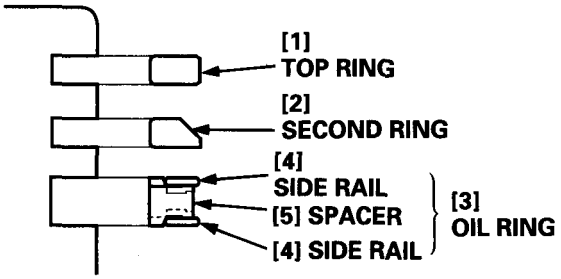
4) Reinstall the piston rings into the piston grooves. Push in the ring until the outer surface of the piston ring is nearly flush with the piston and measure the side clearance using a feeler gauge.

	Standard	Service limit
Top/ second	0.025 – 0.055 mm (0.0010 – 0.0022 in)	0.10 mm (0.004 in)
Oil	0.055 – 0.140 mm (0.0022 – 0.0055 in)	0.20 mm (0.008 in)



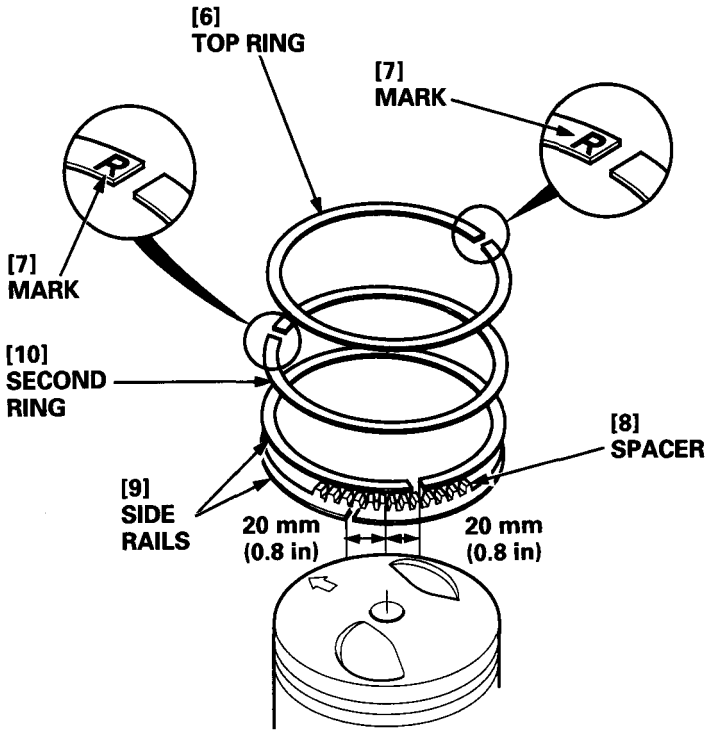
d. ASSEMBLY

1) Clean the piston and carefully install the piston rings.
   - Take care not to damage the piston ring by spreading the ends too far.
   - Be careful not to damage the piston during the piston ring removal.
   - Clean carbon deposits from the piston ring grooves with a ring that will be discarded. Never use a wire brush; it will scratch the grooves.
   - Do not confuse the top and second rings. The top ring is chrome-coated and second not coated.
   - Install the top and second rings with the mark facing up.
   - Oil ring; first install the spacer then install the side rails.



2) After installing the ring make sure that they rotate freely, without sticking.

3) Space the ring end gaps 120° apart and side rail end gaps about 20 mm (0.8 in) as shown.

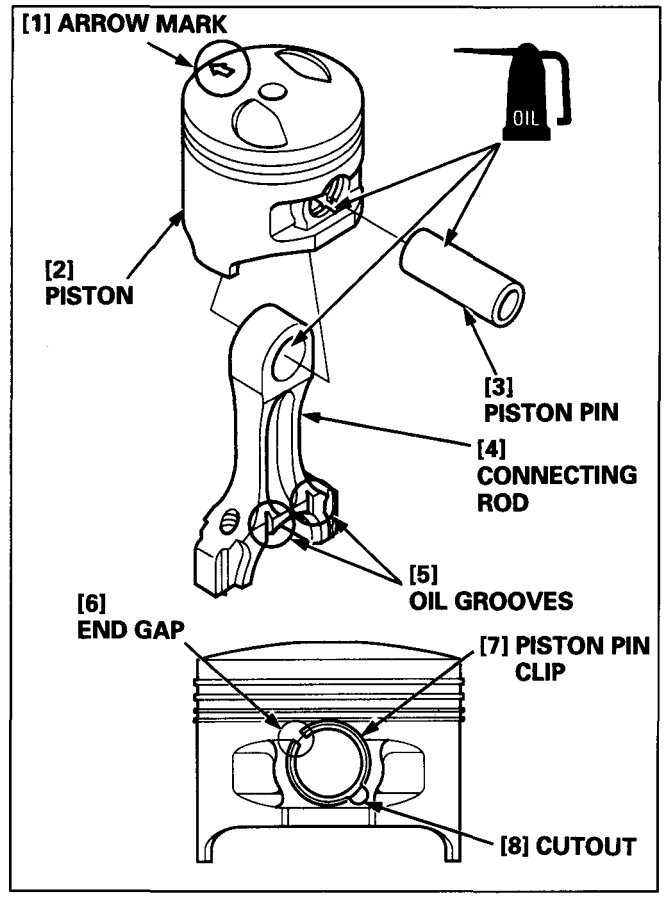


4) Apply engine oil to the piston pin, connecting rod small end I.D. and piston pin bore.

5) Install the connecting rod to the piston with the oil groove facing the opposite side of the arrow mark on the piston head.

6) Install the piston pin.

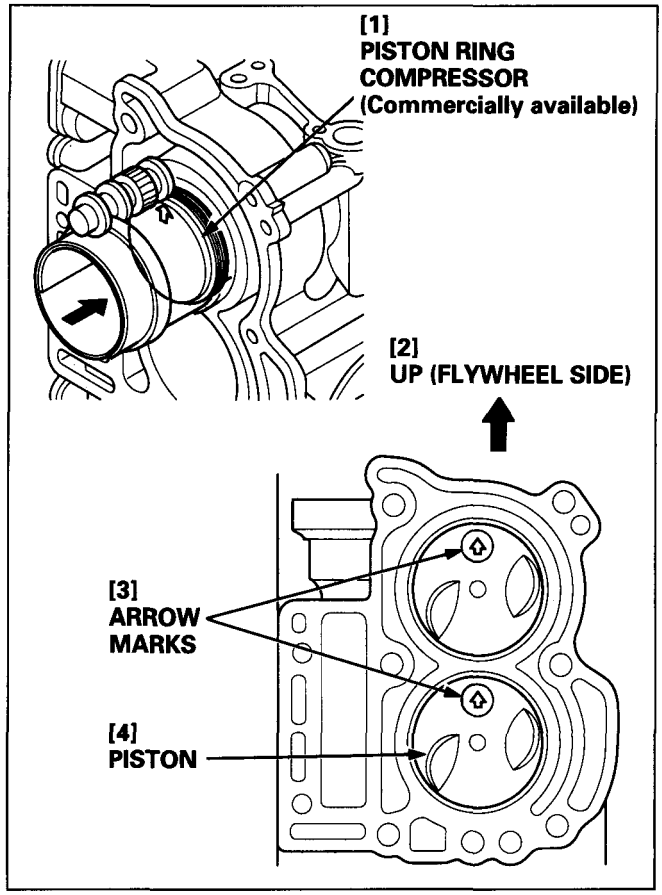
7) Install a new piston pin clip.
   - Always use a new piston pin clip, never reuse the used clip.
   - Set the piston pin clip in the groove properly.
   - Do not align the clips end gap with the cutout.



e. INSTALLATION

1) Apply engine oil to the piston outer surface, piston rings and cylinder wall.

2) Set the piston to a commercially available piston ring compressor. Install the pistons with the arrow mark on the piston head facing up.
   - Take care not to damage the piston rings and cylinder wall.



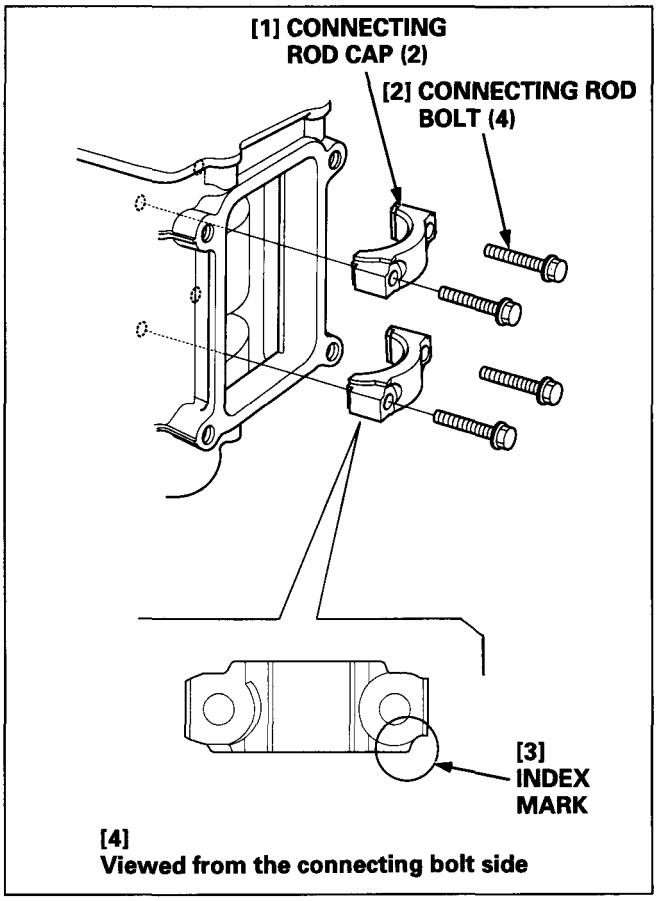
3) Align the connecting rod big ends with the crankshaft.

4) Apply engine oil to the crank pins and connecting rod caps.

5) Install the connecting rod cap by aligning the index mark.

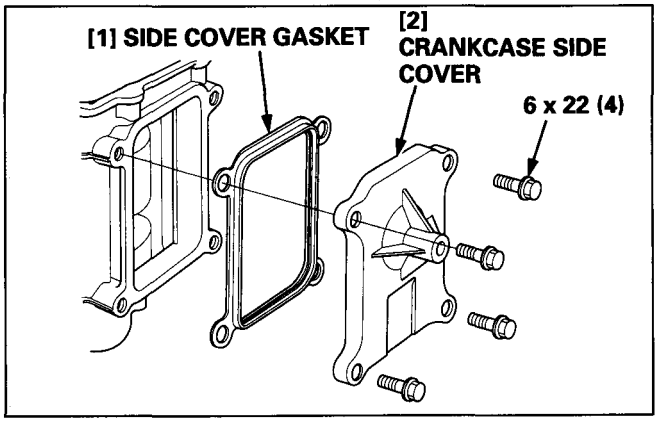
6) Apply oil to the threads and flange section of the connecting rod bolts and tighten them to the specified torque.

TORQUE: 12 N·m (1.2 kgf·m, 9 lbf·ft)



7) Set the side cover gasket on the crankcase side cover, and install them on the crankcase. Tighten the 6 x 22 mm flange bolts securely.

8) Reinstall the removed parts in the reverse order of removal.



4. CRANKSHAFT/CYLINDER BLOCK

a. DISASSEMBLY

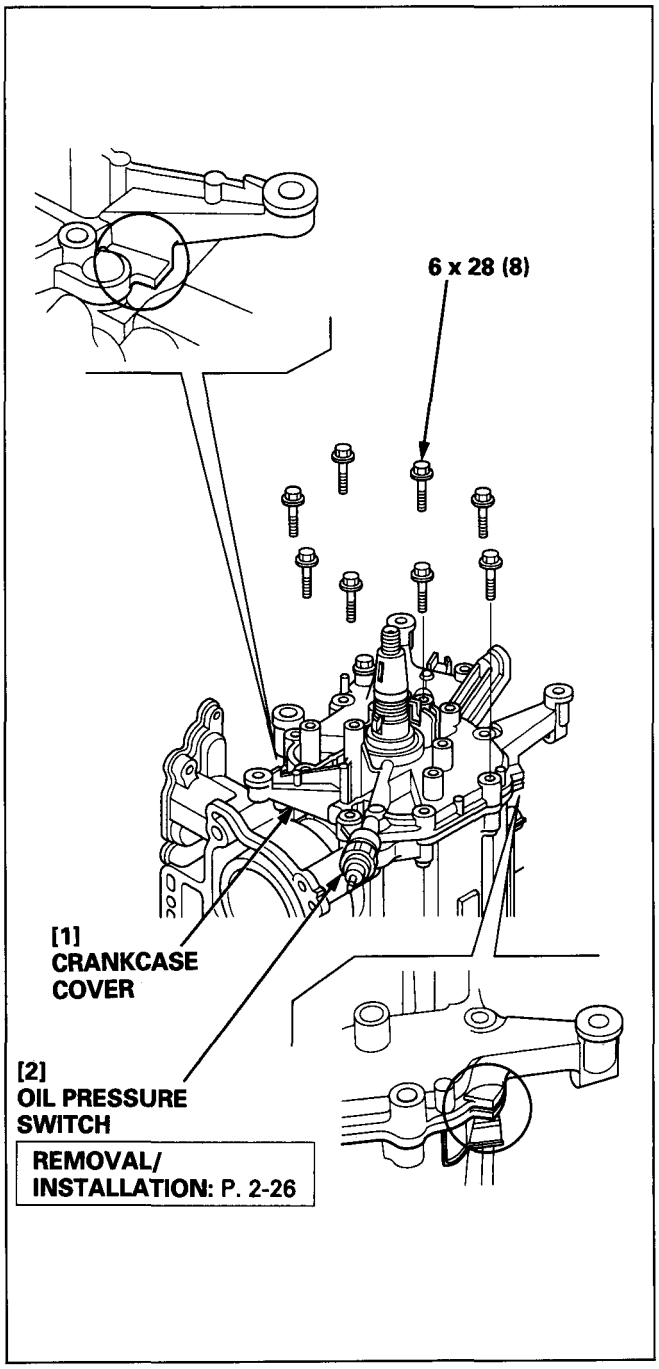
1) Remove the engine (Section 8) and remove the following:
   — flywheel and timing belt drive pulley (P. 9-2 and 10).
   — silencer and carburetor (P. 6-2).
   — fuel pump and fuel filter (P. 6-17).
   — cylinder head (P. 10-2).

2) Turn the crankshaft until the piston is at top dead center.

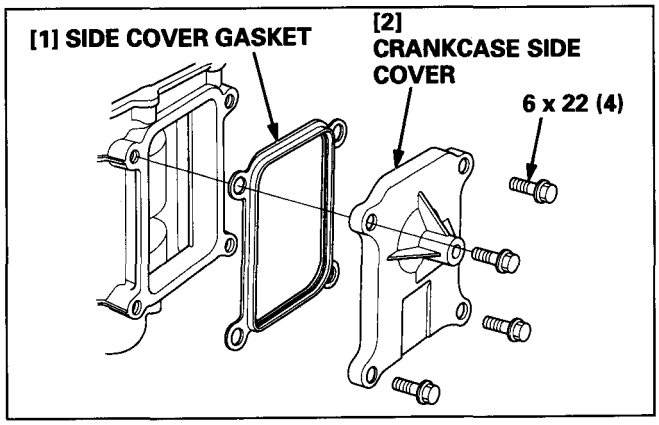
3) Remove the eight 6 x 28 mm flange bolts.
   • Loosen the bolts in a crisscross pattern in 2 – 3 steps.

4) Insert a screwdriver or equivalent tool into the concave in the position shown, and lift the crankcase cover slightly.
   • Be careful not to damage the mating surface when removing the crankcase cover.

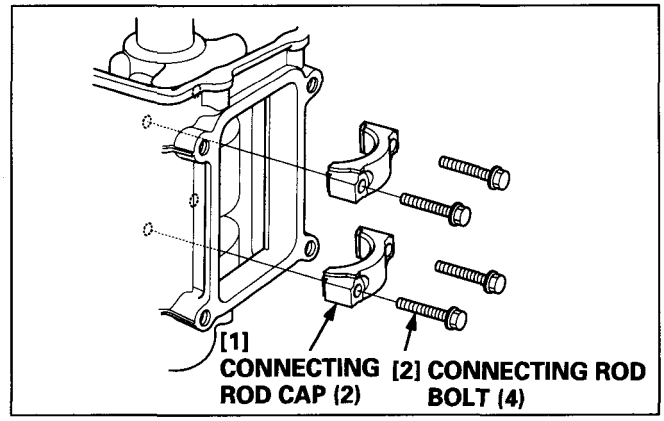
5) Remove the crankcase cover and 8 x 14 mm and 14 x 20 mm dowel pins.



6) Remove the four 6 x 22 mm flange bolts and crankcase side cover and side cover gasket.

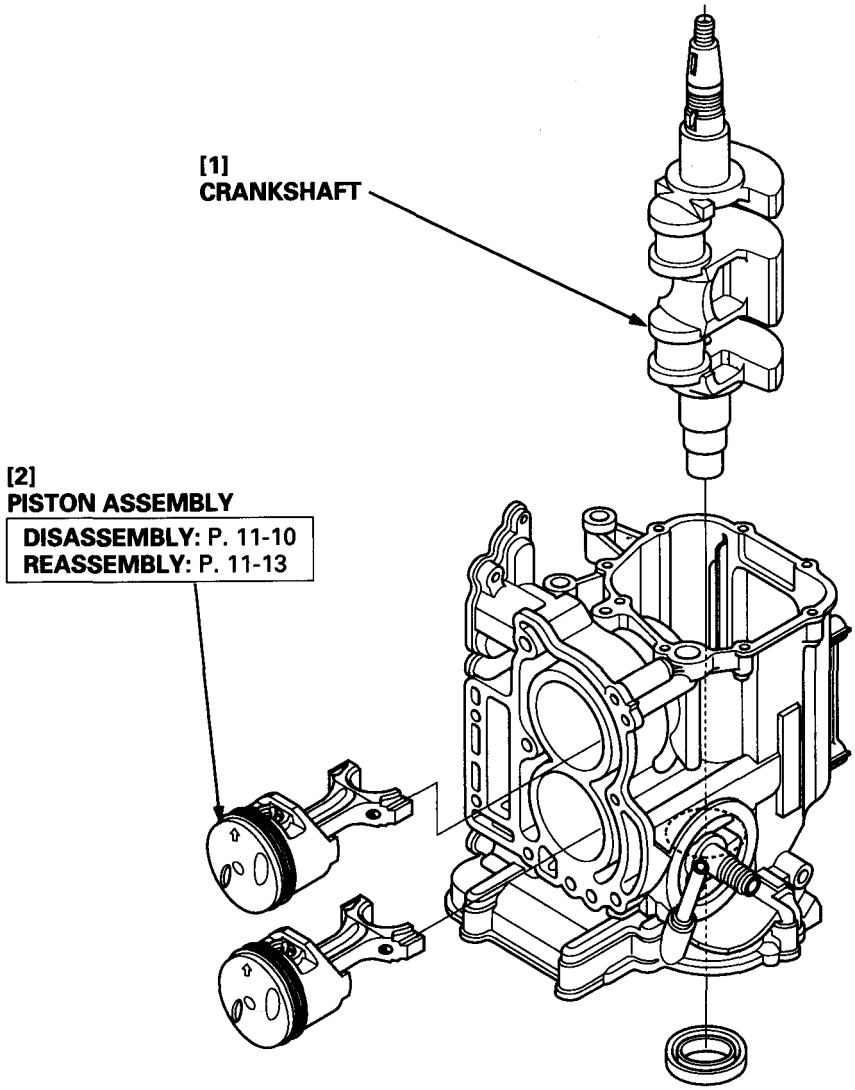


7) Remove the connecting rod bolts and connecting rod caps.
   - Mark the connecting rod caps so they can be placed back in their original position.



8) Remove the piston assemblies.
   - Mark the pistons so they can be placed back in their original position.

9) Remove the crankshaft from the cylinder block.



b. INSPECTION

• CRANKSHAFT

1) Clean oil thoroughly from the crank pin and the inner wall of the connecting rod big end.

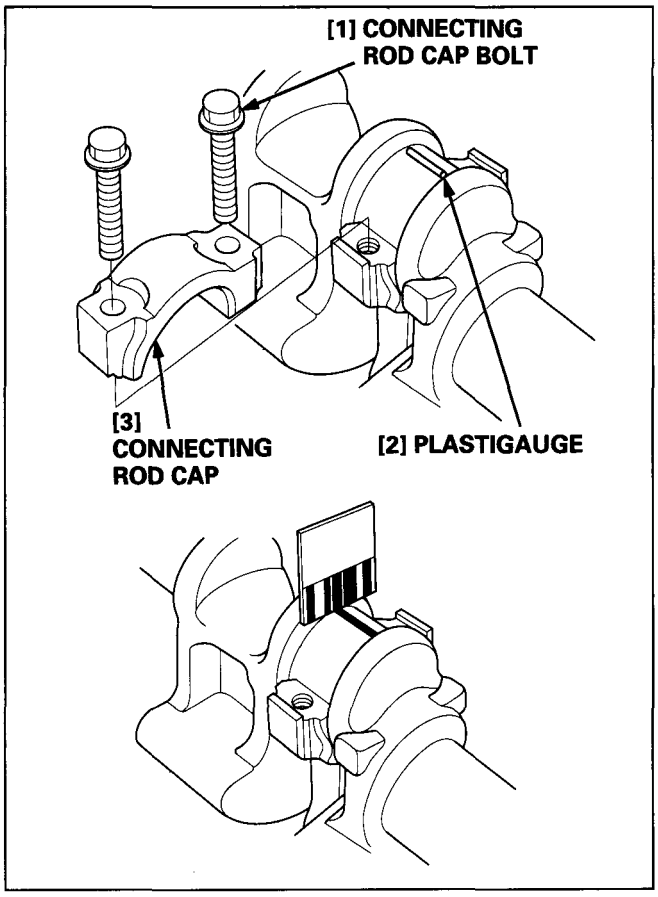
2) Place a piece of plastigauge on the crank pin, install the connecting rod and cap and tighten the bolts.

TORQUE: 12 N•m (1.2 kgf•m, 9 lbf•ft)

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

3) Remove the connecting rod and measure the plastigauge at its widest portion.

Standard	Service limit
0.020 – 0.046 mm (0.0008 – 0.0018 in)	0.06 mm (0.002 in)

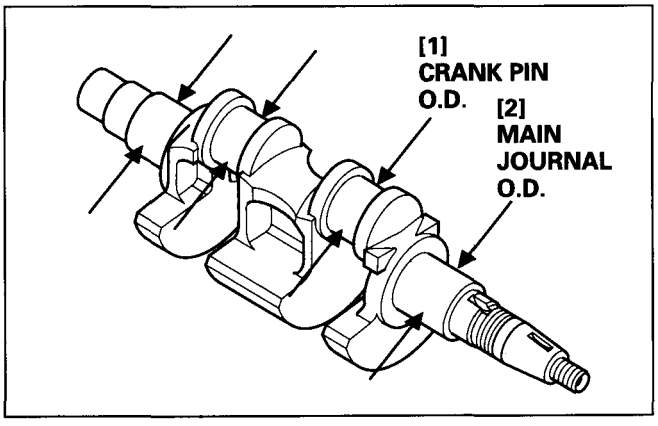


4) Measure and record the main journal O.D..

Standard	Service limit
29.984 – 29.993 mm (1.1805 – 1.1808 in)	29.96 mm (1.180 in)

5) Measure the crank pin journal O.D..

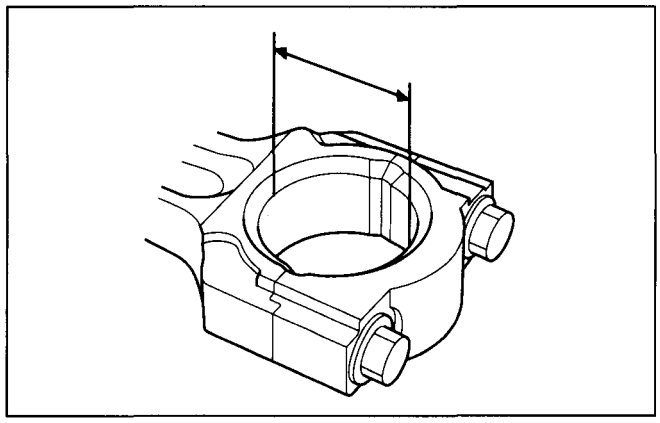
Standard	Service limit
27.987 – 28.000 mm (1.1018 – 1.1024 in)	27.96 mm (1.101 in)



• CONNECTING ROD

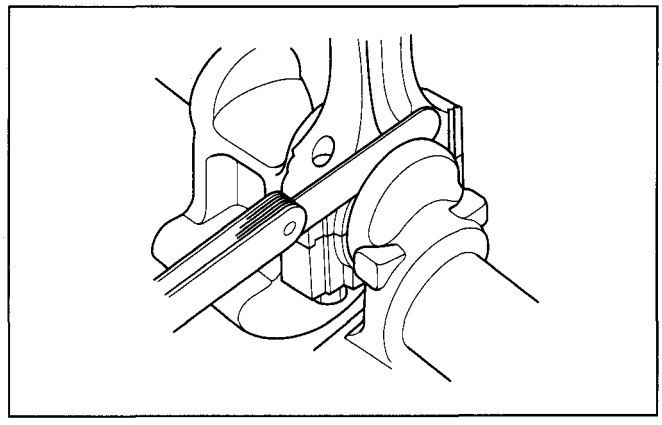
1) Measure the connecting rod big end I.D..

Standard	Service limit
28.020 – 28.033 mm (1.1031 – 1.1037 in)	28.06 mm (1.105 in)

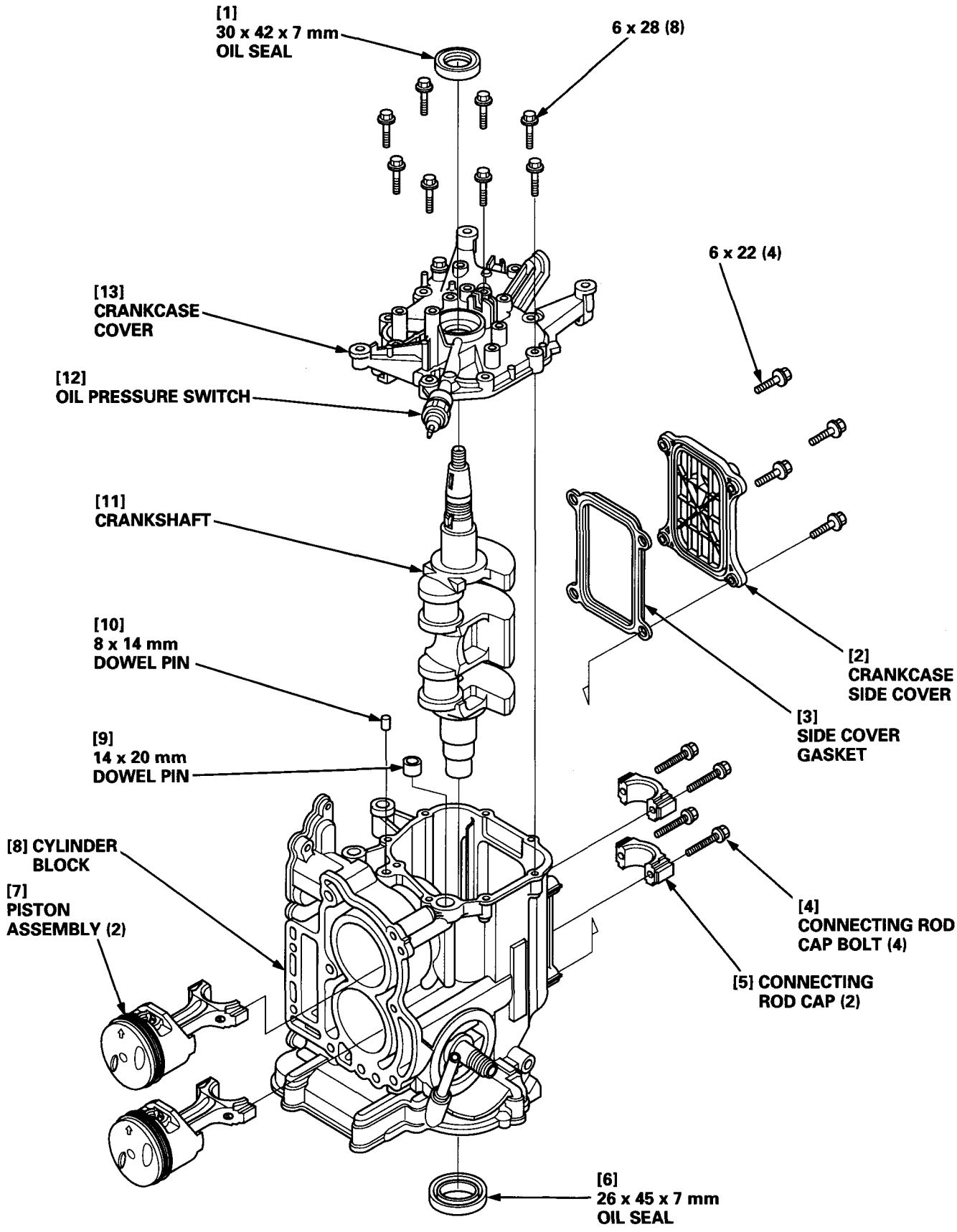


2) Install the connecting rod and connecting rod cap, and tighten the connecting rod cap bolts. Measure the connecting rod big end side clearance with the connecting rod facing up as shown using a feeler gauge.

Standard	Service limit
0.10 – 0.60 mm (0.004 – 0.024 in)	0.7 mm (0.03 in)

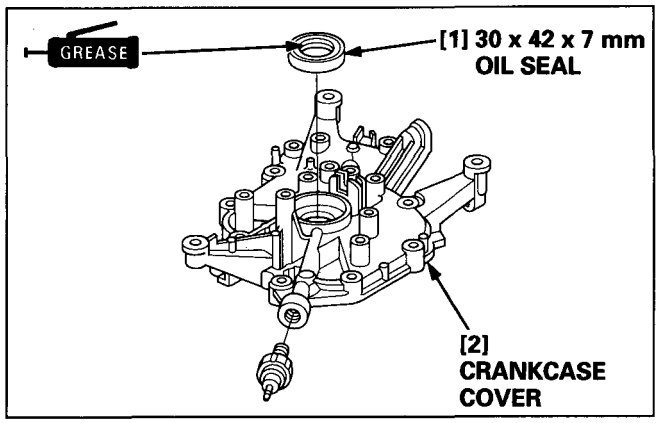


c. ASSEMBLY


[1]
30 x 42 x 7 mm
OIL SEAL
6 x 28 (8)
6 x 22 (4)
[13]
CRANKCASE
COVER
[12]
OIL PRESSURE SWITCH
[11]
CRANKSHAFT
[10]
8 x 14 mm
DOWEL PIN
[9]
14 x 20 mm
DOWEL PIN
[8] CYLINDER
BLOCK
[7]
PISTON
ASSEMBLY (2)
[2]
CRANKCASE
SIDE COVER
[3]
SIDE COVER
GASKET
[4]
CONNECTING ROD
CAP BOLT (4)
[5] CONNECTING
ROD CAP (2)
[6]
26 x 45 x 7 mm
OIL SEAL

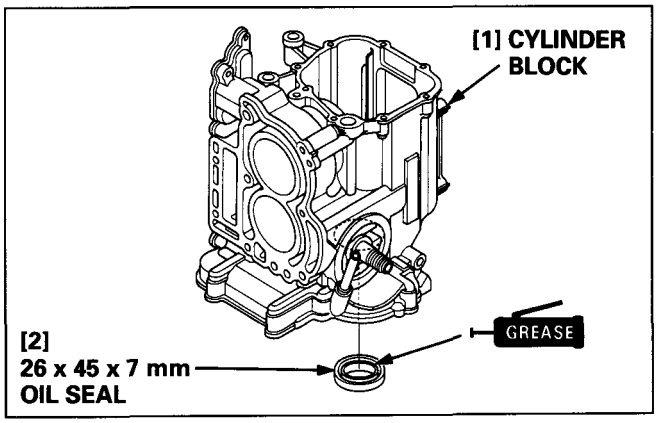
1) Check the oil seal of the crankcase cover, replace if damaged. Remove the oil seal and discard it. Install a new oil seal securely.

2) Apply grease to the lip of the oil seal.

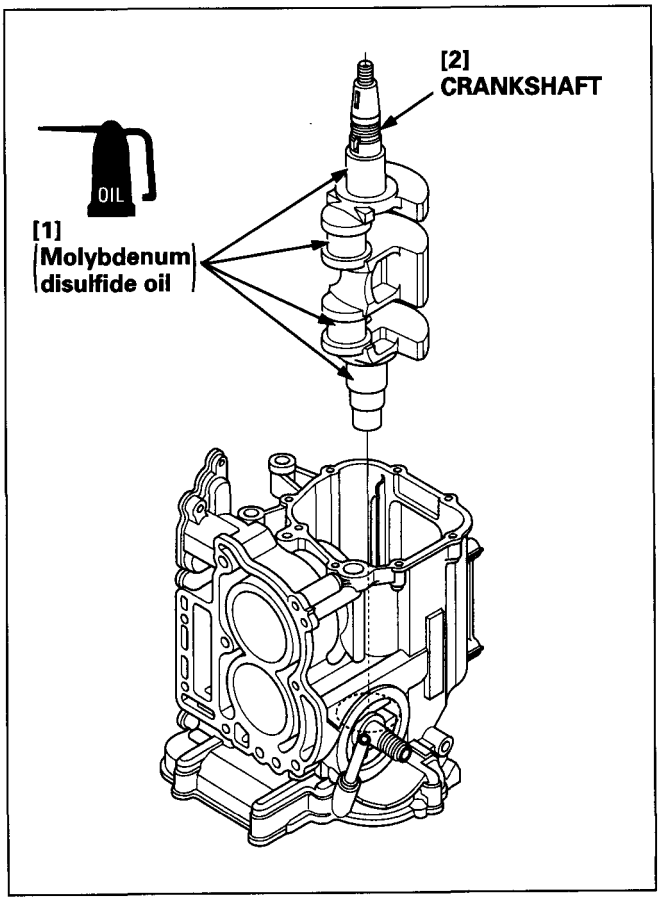


3) Check the oil seal of the cylinder block, replace if damaged. Remove the oil seal and discard it. Install a new oil seal securely.

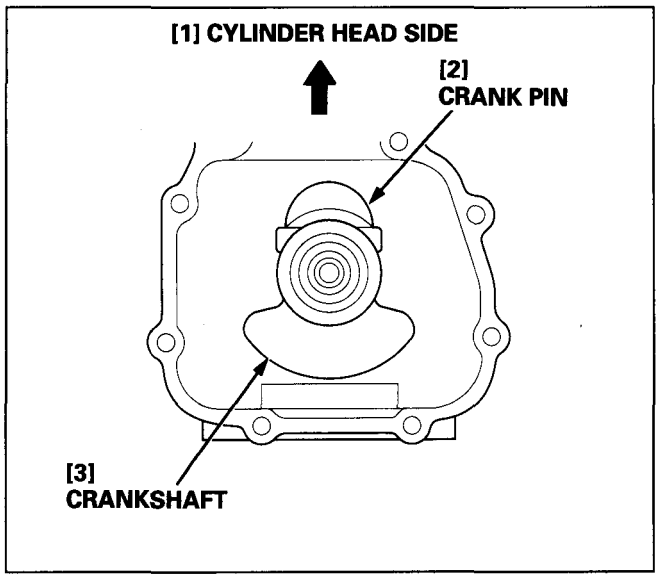
4) Apply soupy water to the outside of the new oil seal and install the oil seal.
Apply grease to the lip of the oil seal.



5) Apply molybdenum oil solution to the crankshaft journals and crank pins. Install the crankshaft.
   - Take care not to damage the oil seal.

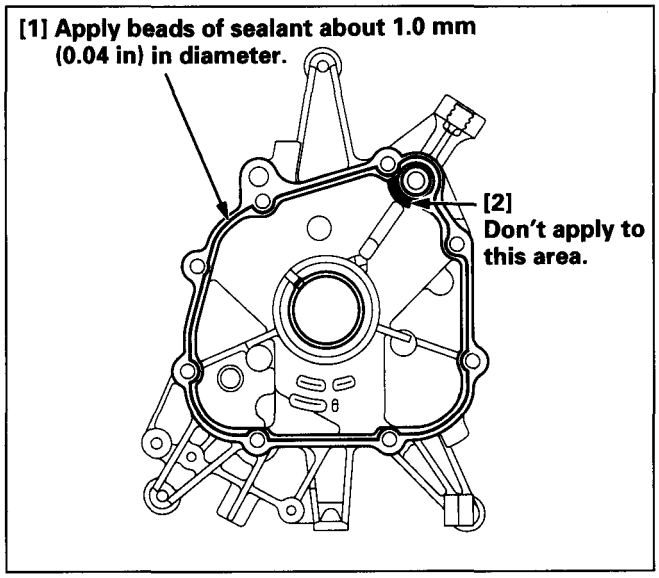


6) Set the crankshaft at T.D.C. by turning.

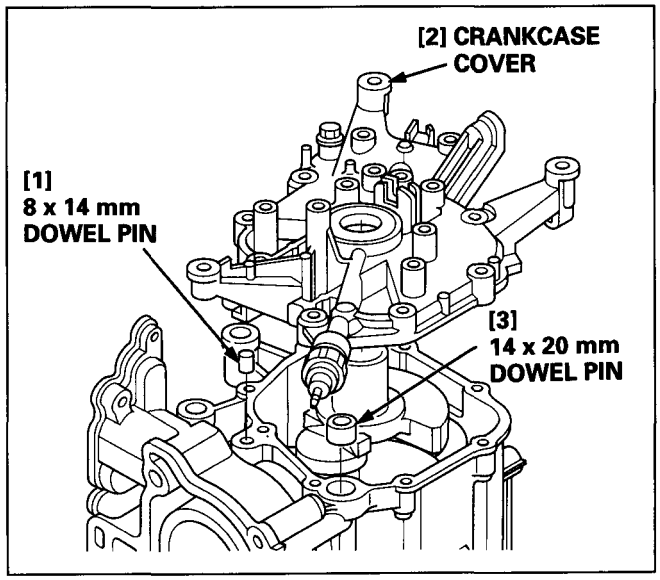


7) Clean the crankcase cover and cylinder block mating surfaces with a degreasing cleaning agent or a clean shop towel.

8) Apply liquid sealant (Three Bond 1280B) to the position shown on the crankcase cover.
   - Apply beads of sealant about 1.0 mm (0.04 in) in diameter.
   - Assemble the crankcase side cover within 3 minutes after application of the liquid sealant.
   - Wait for 20 minutes after assembly. Do not add oil or start the engine during this period.

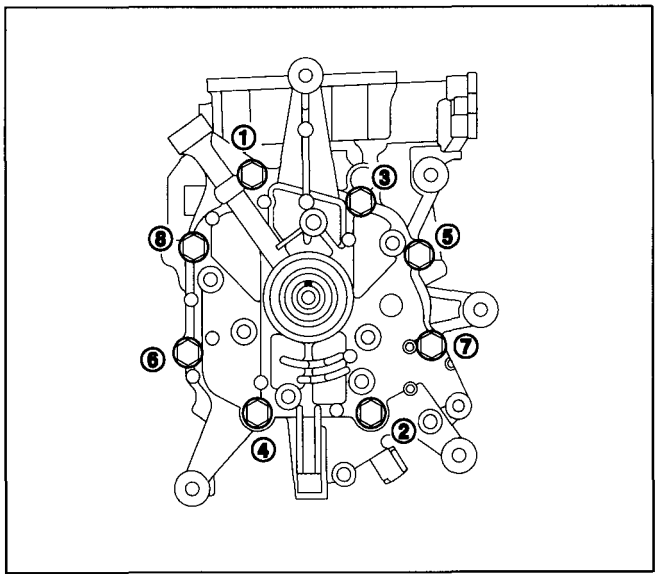


9) Install the 8 x 14 mm and 14 x 20 mm dowel pin and crankcase cover.



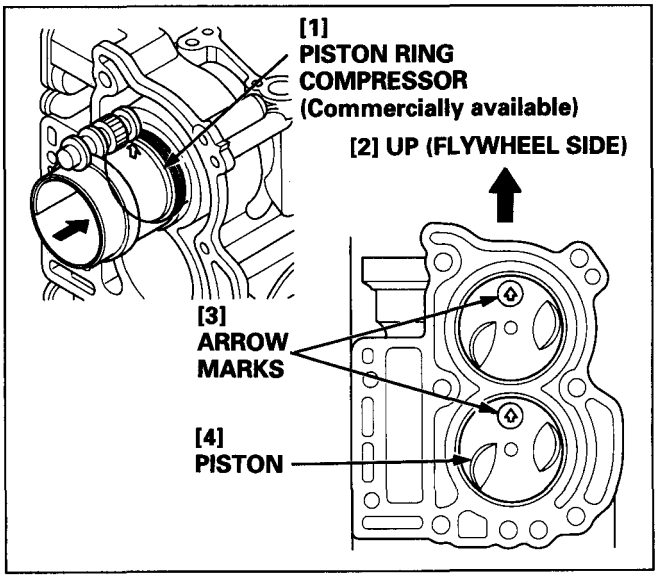
10) Apply oil to the threads and flange surfaces of the 6 x 28 mm flange bolts and tighten them to the specified torque.
    - Tighten the bolts in the numbered sequence shown in 2 - 3 steps.

TORQUE: 14 N•m (1.4 kgf•m, 10 lbf•ft)



11) Apply engine oil to the piston outer surface, piston rings and cylinder wall.

12) Set the piston to a commercially available piston ring compressor. Install the pistons with the arrow mark on the piston head facing up.
    - Take care not to damage the piston rings and cylinder wall.



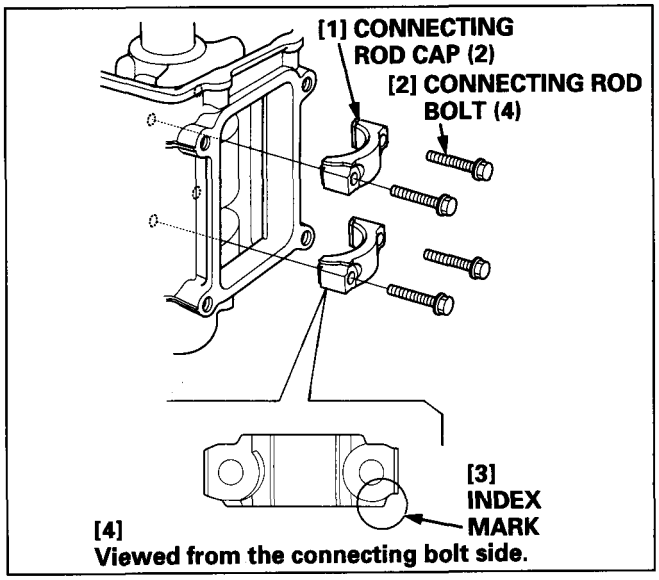
13) Align the connecting rod big ends with the crankshaft.

14) Apply engine oil to the crank pins and connecting rod caps.

15) Install the connecting rod cap by aligning the index mark.

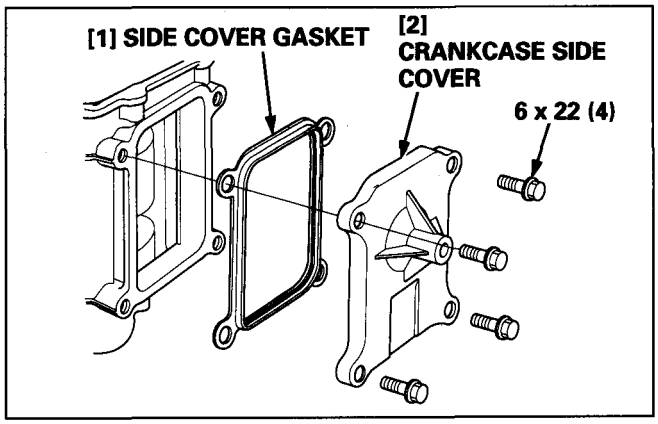
16) Apply oil to the threads and flange section of the connecting rod bolts and tighten them to the specified torque.

TORQUE: 12 N•m (1.2 kgf•m, 9 lbf•ft)

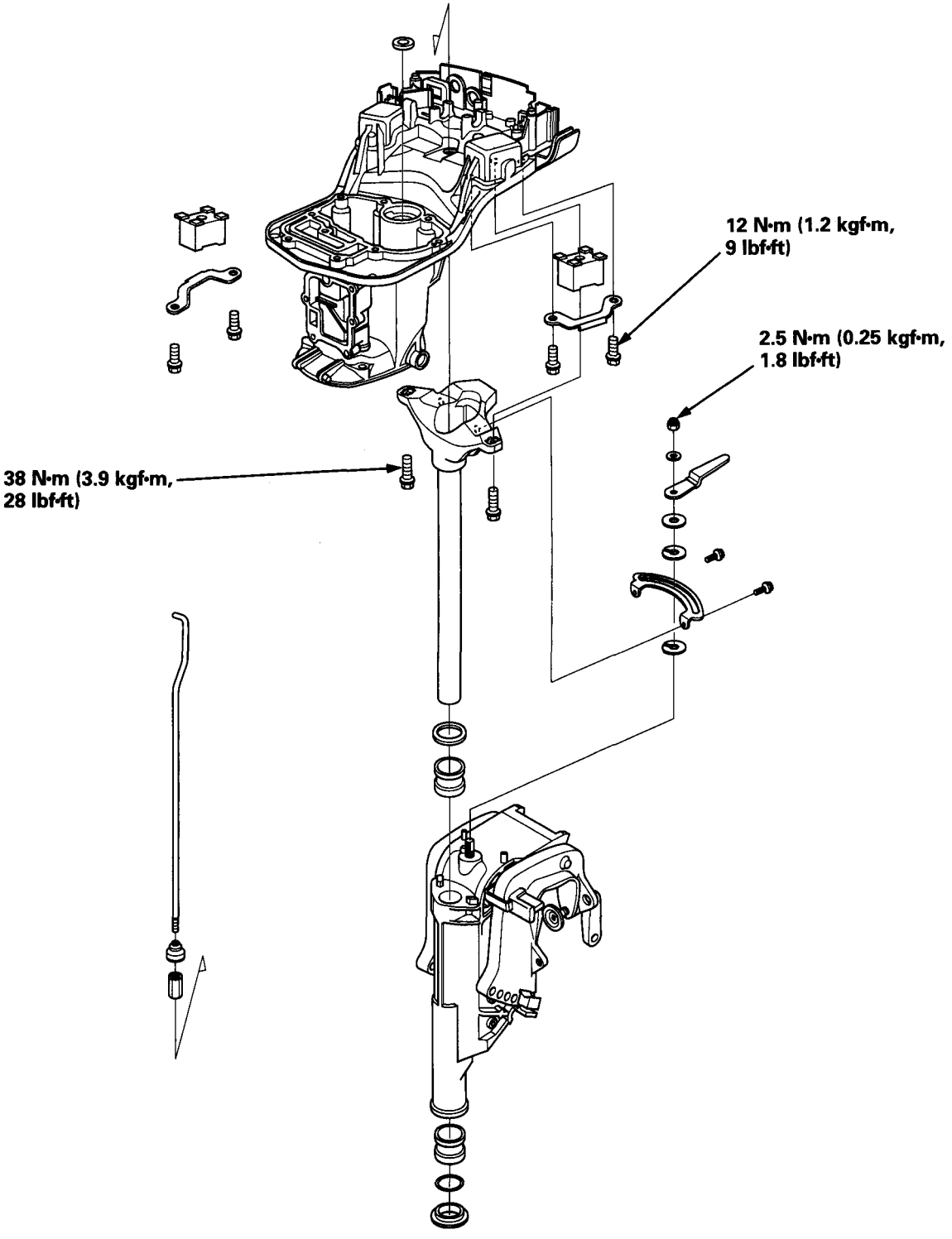


17) Set the side cover gasket on the crankcase side cover, and install them on the crankcase. Tighten the 6 x 22 mm flange bolts securely.

18) Reinstall the removed parts:
— timing belt drive pulley (P. 9-11).
— charge coil and flywheel (P. 9-8).
— cylinder head (P. 10-20).
— recoil starter (P. 7-9).
— fuel pump and fuel filter (P. 6-18).
— carburetor and silencer (P. 6-13).



1. OIL CASE	3. MOUNT FRAME
2. FRICTION ADJUSTING LEVER	4. STERN BRACKET/SWIVEL CASE



1. OIL CASE

a. DISASSEMBLY

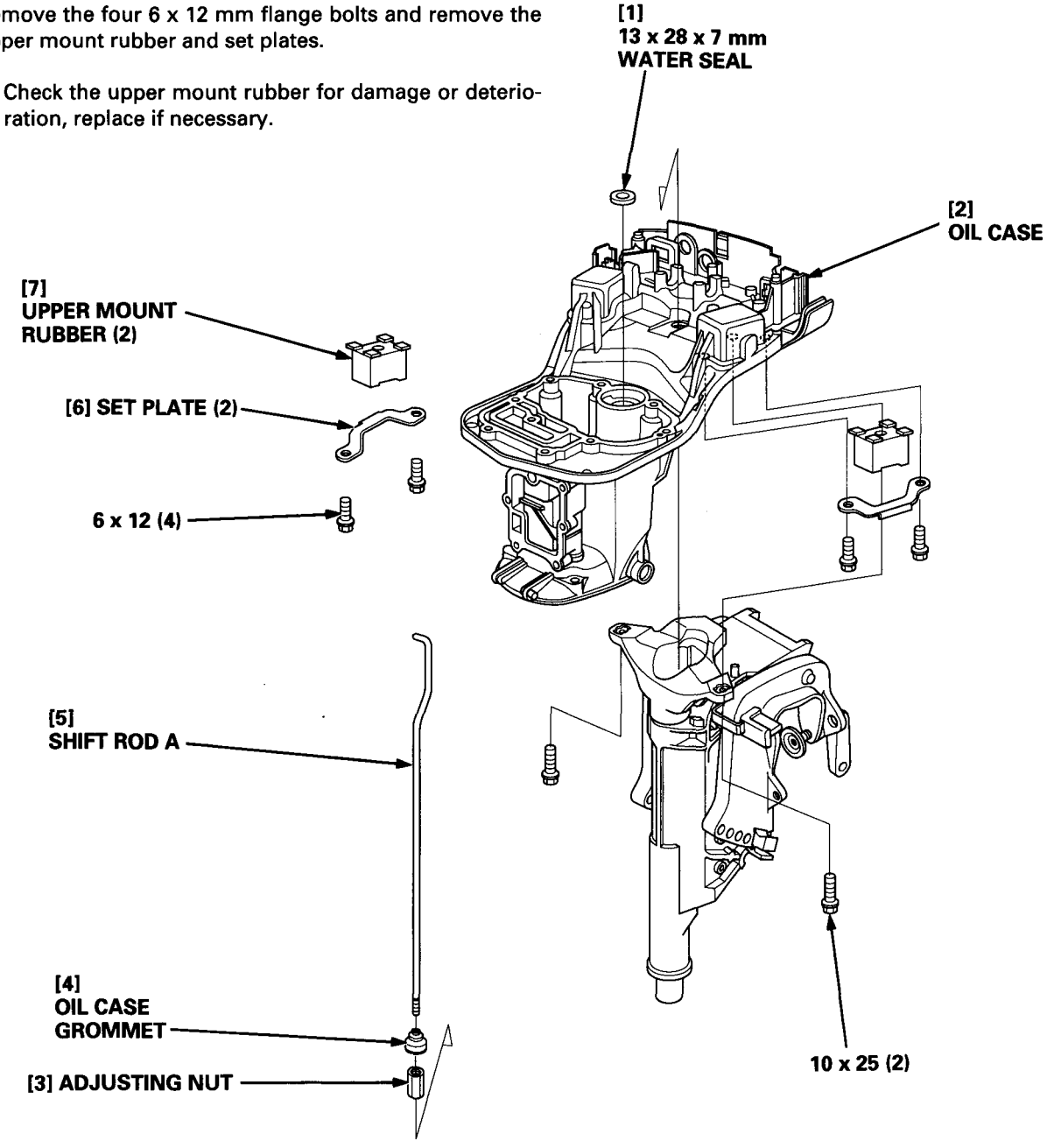
1) Remove the engine (section 8), then remove the following:
   — gear case assembly (P. 4-9).
   — extension case and lower mount rubber (P. 4-26).
   — remote control cable (P. 14-2).
   — tiller handle (P. 15-2).
   — shift linkage (P. 13-2 and 3).

2) Remove the shift rod A, adjusting nut and oil case grommet.

3) Remove the two 10 x 25 mm flange bolts and remove the oil case.

4) Remove the four 6 x 12 mm flange bolts and remove the upper mount rubber and set plates.

   • Check the upper mount rubber for damage or deterioration, replace if necessary.

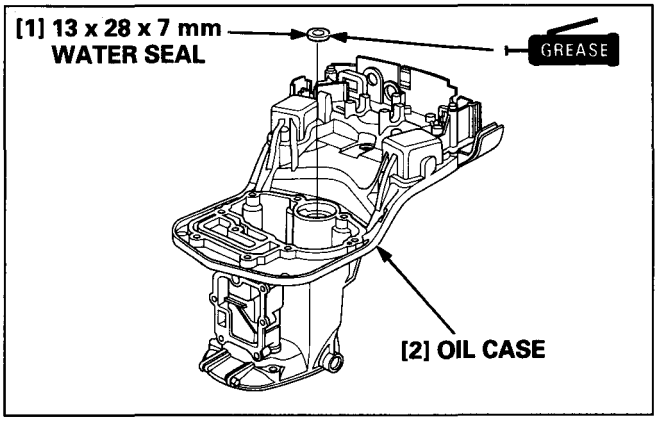


b. WATER SEAL REPLACEMENT

1) Check the water seal, replace with new one if damaged. Remove and discard the water seal.

2) Install a new water seal properly.

3) Apply marine grease to the lips of the water seal.

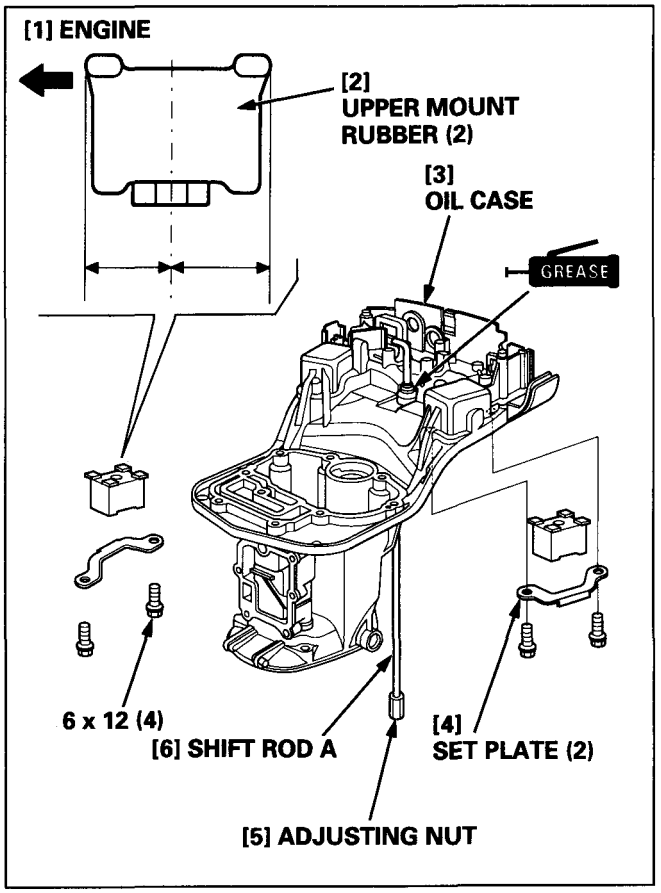


c. ASSEMBLY

1) Apply marine grease to the inside of the oil case grommet. Install the shift rod A, adjusting nut and oil case grommet.

2) Inspect the upper mount rubber for cracks or damage, replace if necessary. Install the upper mount rubber with the shorter side facing toward the engine as shown. Install the set plate and tighten the 6 x 12 mm flange bolts to the specified torque.

TORQUE: 12 N·m (1.2 kgf·m, 9 lbf·ft)

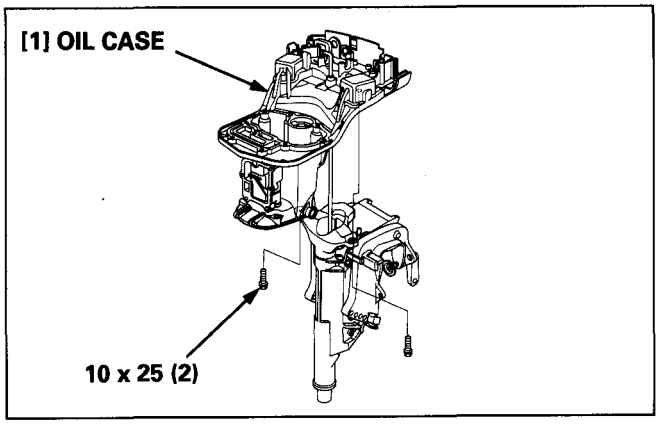


3) Install the oil case onto the mount frame assembly.

4) Tighten the two 10 x 25 mm flange bolts to the specified torque.

TORQUE: 38 N·m (3.9 kgf·m, 28 lbf·ft)

5) Install the removed parts in the reverse order of removal.



2. FRICTION ADJUSTING LEVER

SHOP MANUAL NEWS

a. DISASSEMBLY

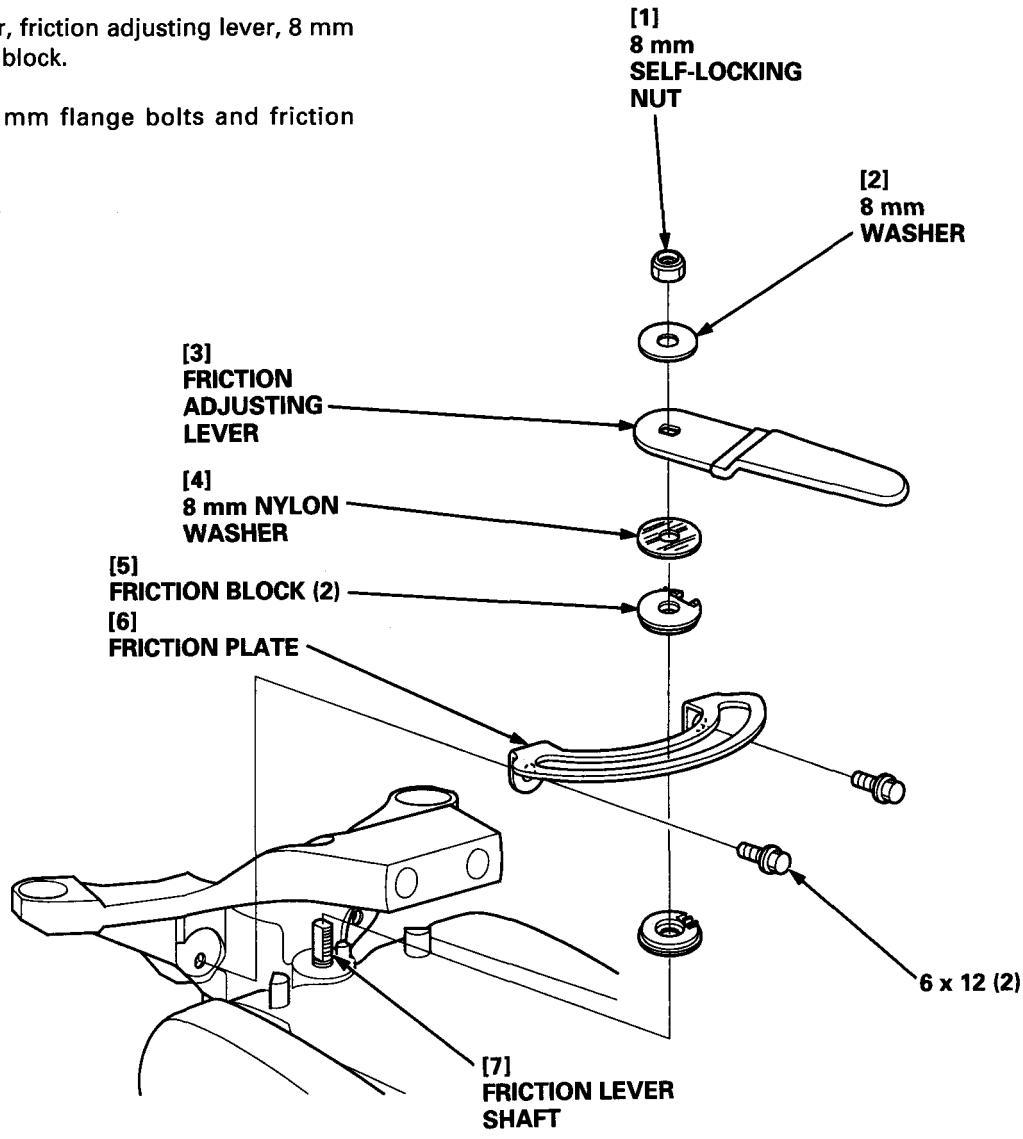
- The friction adjusting lever can be serviced with the oil case and engine installed.

1) Remove the 8 mm self-locking nut.

2) Remove the 8 mm washer, friction adjusting lever, 8 mm nylon washer and friction block.

3) Remove the two 6 x 12 mm flange bolts and friction plate.

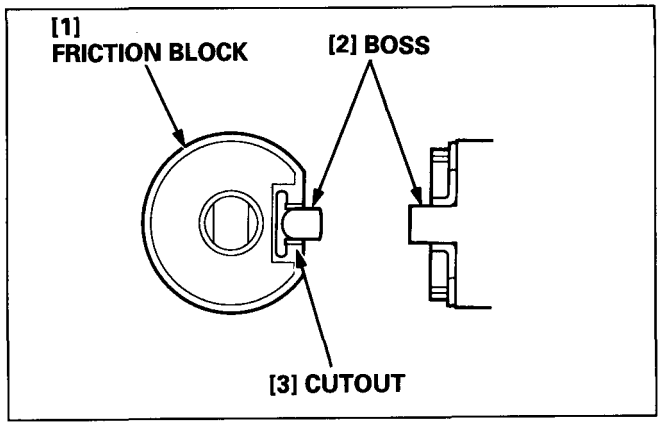
4) Remove the friction block.



b. ASSEMBLY

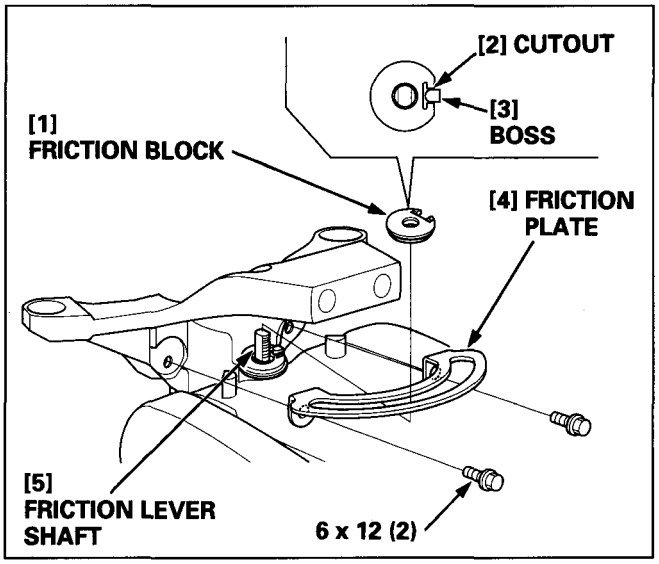
1) Before installation, check the disc surface of the friction block for wear. Replace if necessary.

2) Clean off grease or oil from the disc surfaces of the friction blocks and friction plate. Install one of the friction block onto the friction lever shaft by aligning the cutout with the boss on the swivel case and facing the disc surface toward the friction plate as shown.



3) Install the friction plate to the mount frame by aligning the groove with the friction lever shaft.

4) Install the other friction block onto the friction lever shaft by aligning the cutout with the boss on the swivel case and facing the disc surface toward the friction plate.



5) Install the 8 mm nylon washer, friction adjusting lever and 8 mm washer.

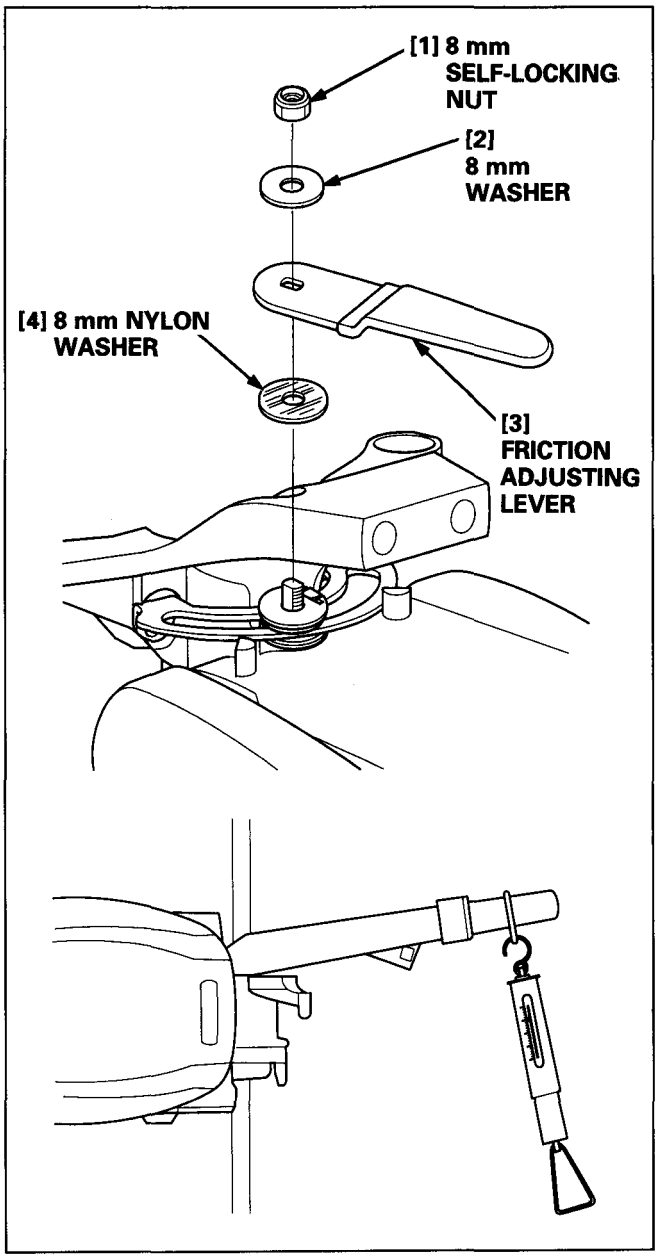
6) Turn the adjusting lever full to the right, and hold it in *this position and tighten the 8 mm self-locking nut to the* specified torque.

TORQUE: 2.5 N·m (0.25·kgf·m,1.8·lbf·ft)

7) Check the starting torque by measuring the starting force by using a spring scale at the center of the tiller handle as shown.

The motor should not start to move with less than 20 N (2.0 kgf, 44 lbf).

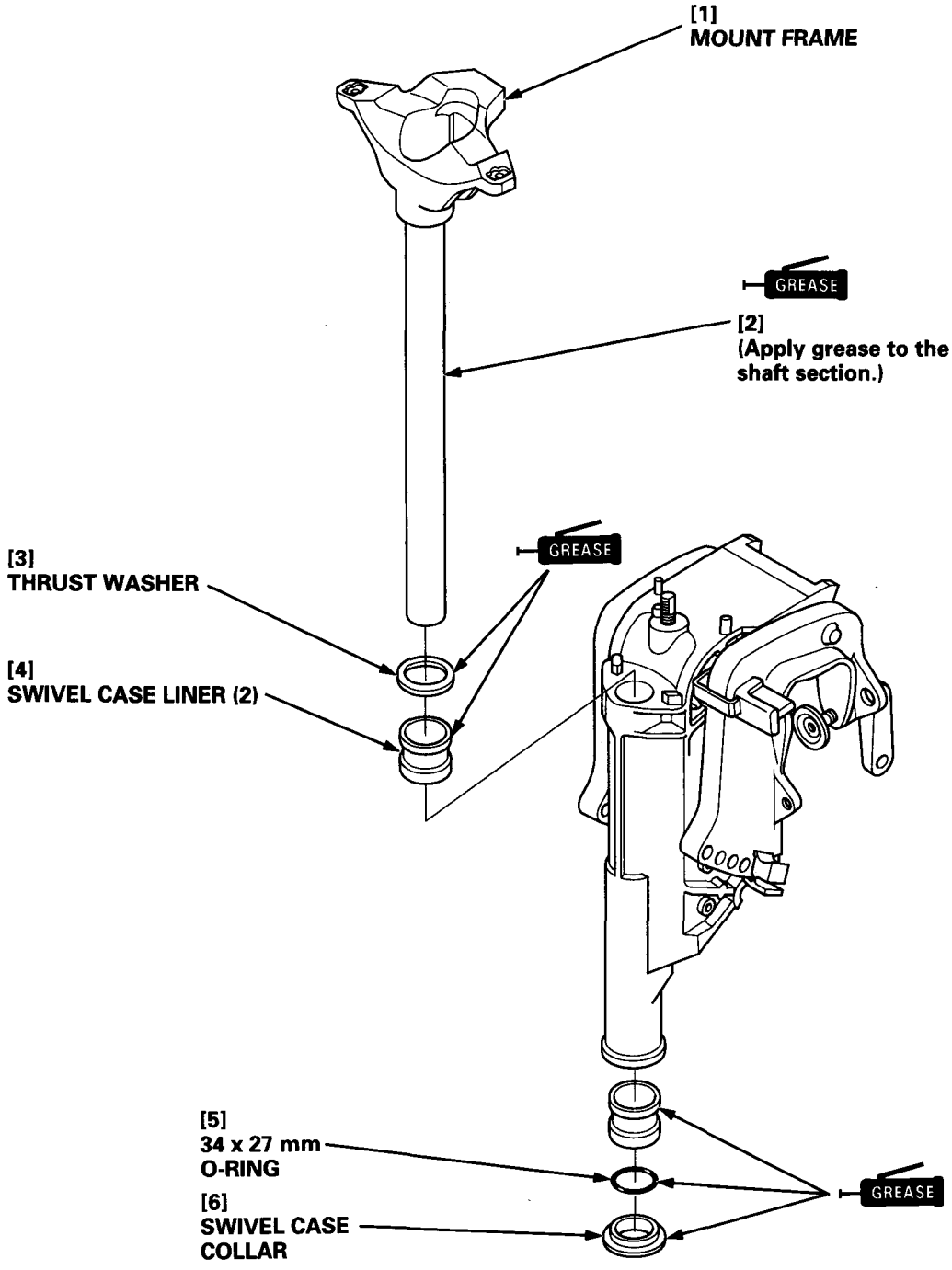
8) Retighte the self-locking nut if necessary.



3. MOUNT FRAME

a. REMOVAL/INSTALLATION

Refer to the following pages for removal/installation:
— engine removal/installation (section 8).
— oil case removal (P. 12-2), installation (P. 12-3).
— friction adjusting lever removal (P. 12-4), installation (P. 12-4).
• When reassembling, apply marine grease to the sliding surfaces of the disassembled parts.



4. STERN BRACKET/SWIVEL CASE

a. STERN BRACKET REMOVAL

• S and L types with tiller handle

1) Remove the following:
   — oil case (P. 12-2).
   — friction adjusting lever (P. 12-4).
   — mount frame (P. 12-6).

2) Remove the adjusting rod.

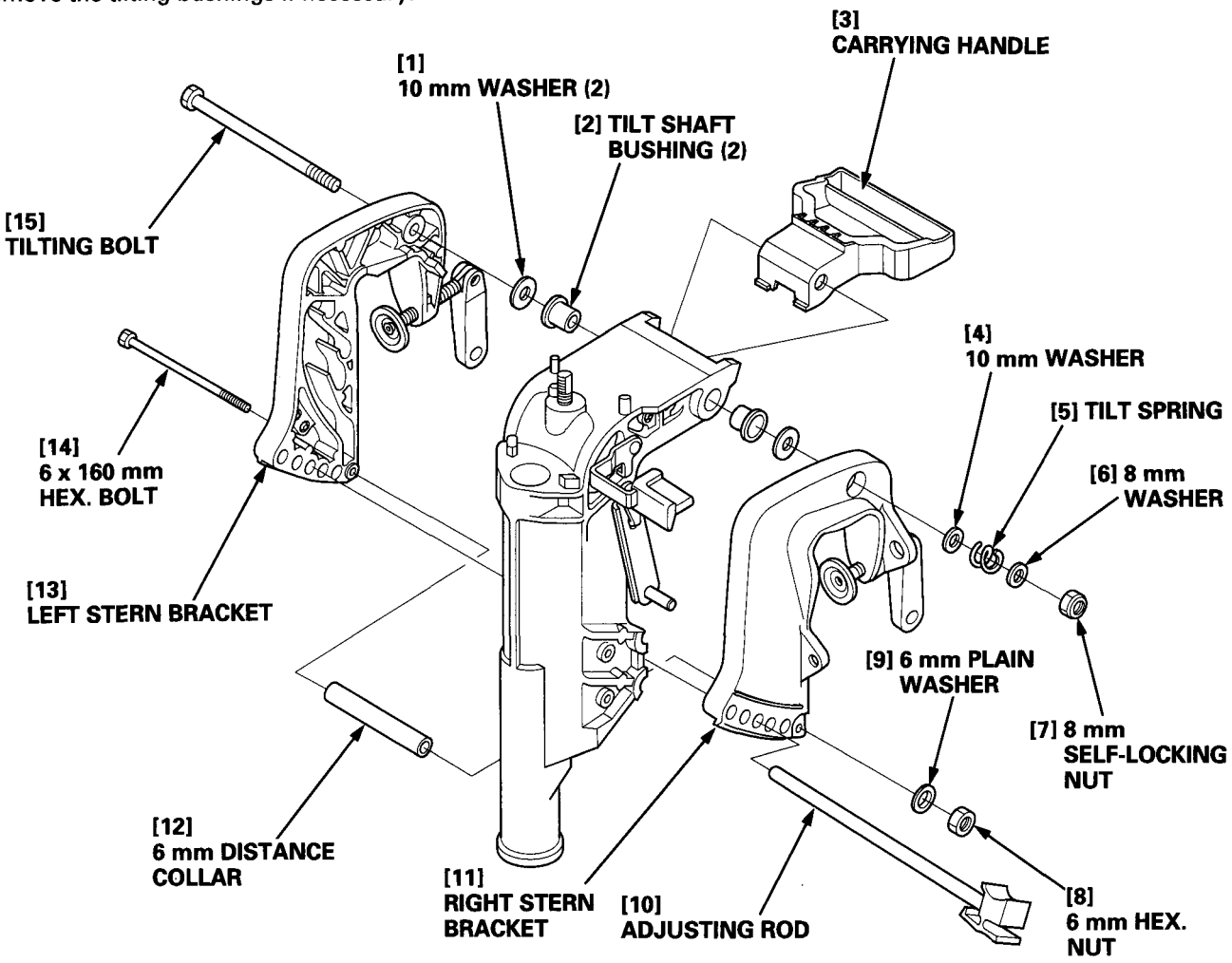
3) Loosen the 8 mm self-locking nut, then remove the 6 mm hex. nut, 6 mm plain washer, 6 mm distance collar and 6 x 160 mm hex. bolt.

4) Remove the 8 mm self-locking nut, 8 mm washer, tilt spring and 10 mm washer.

5) Remove the right stern bracket and 10 mm washers.

6) Remove the tilting bolt, 10 mm washer, carrying handle and left stern bracket.

7) Remove the tilting bushings if necessary.



• UL type and Remote control type

1) Remove the following:
   — oil case (P. 12-2).
   — friction adjusting lever (P. 12-4).
   — mount frame (P. 12-6).

2) Remove the adjusting rod.

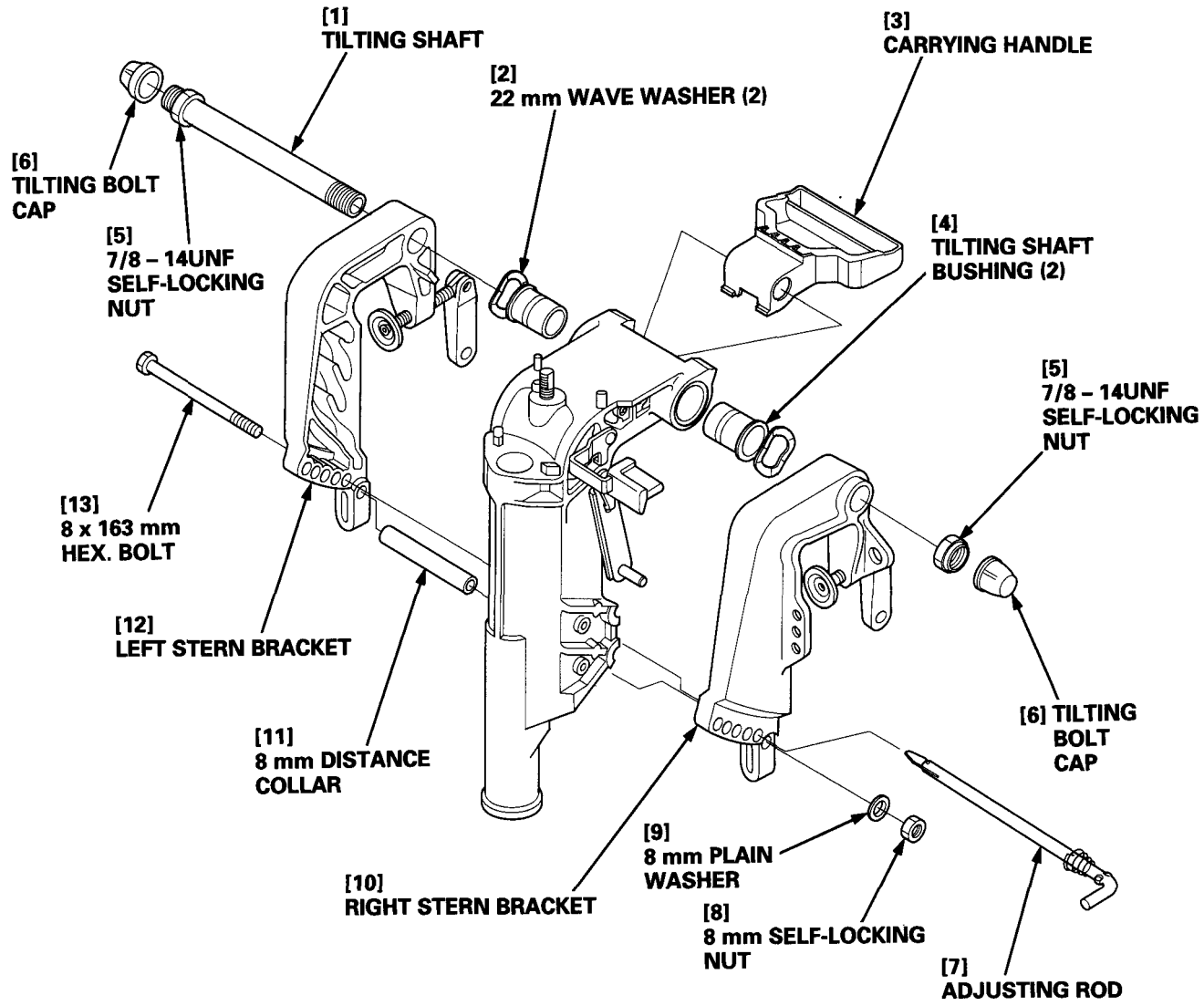
3) Remove the tilting bolt cap and loosen the 7/8-14UNF self-locking nut, then remove the 8 mm self-locking nut, 8 mm plain washer, 8 mm distance collar and 8 x 163 mm hex. bolt.

4) Remove the 7/8-14UNF self-locking nut.

5) Remove the right stern bracket and 22 mm wave washer.

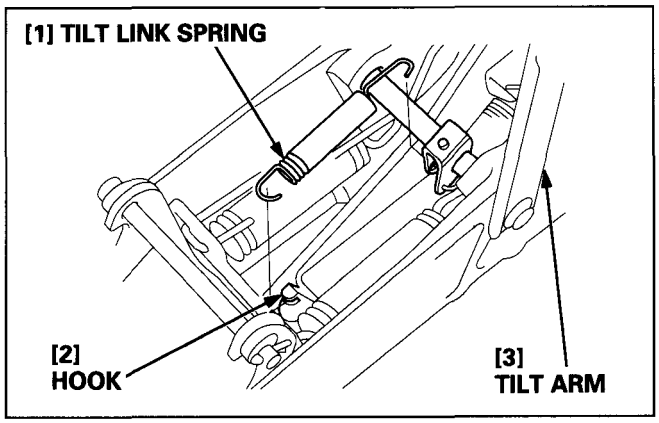
6) Remove the tilting shaft, 22 mm wave washer, carrying handle and left stern bracket.

7) Remove the tilting bushings if necessary.

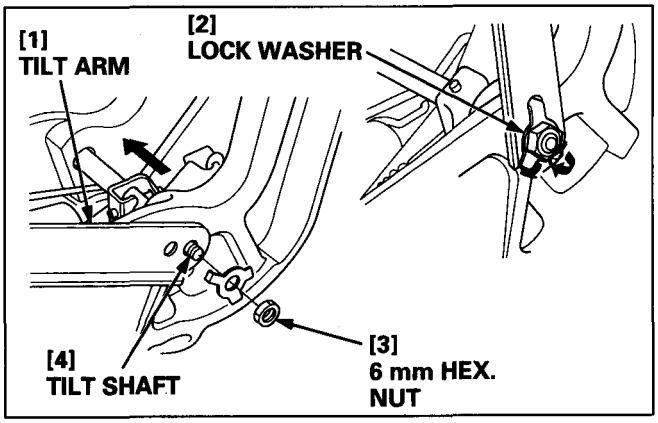


b. SWIVEL CASE DISASSEMBLY

1) Raise up the tilt arm and unhook the tilt link spring from the hook on the swivel case. Then remove the tilt link spring.

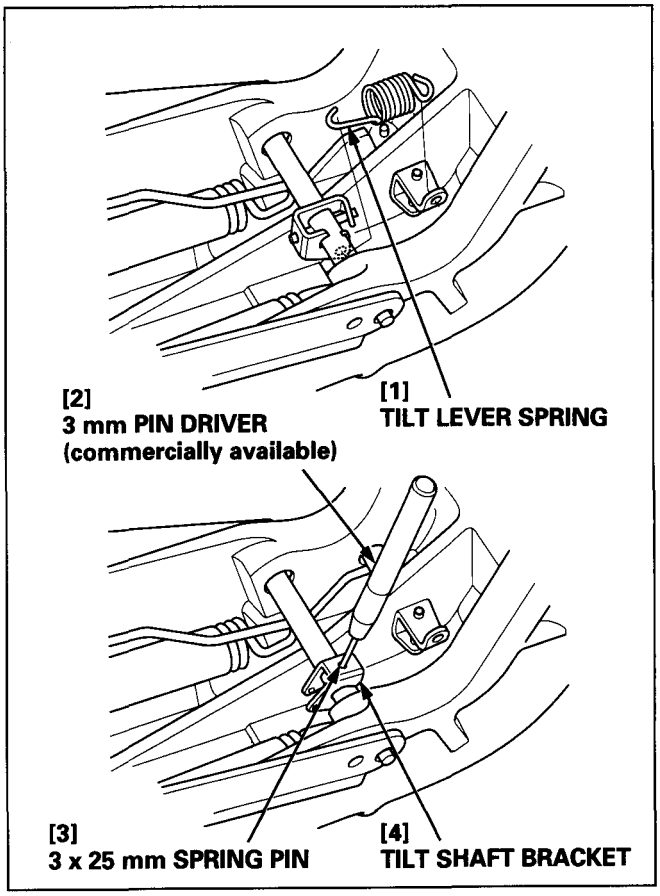


2) Stretch the bent tabs of the lock washer and loosen the 6 mm hex. nut. Remove the 6 mm hex. nut and lock washer, then push the tilt shaft slightly.
   - Replace the lock washer with new one when reassembly.



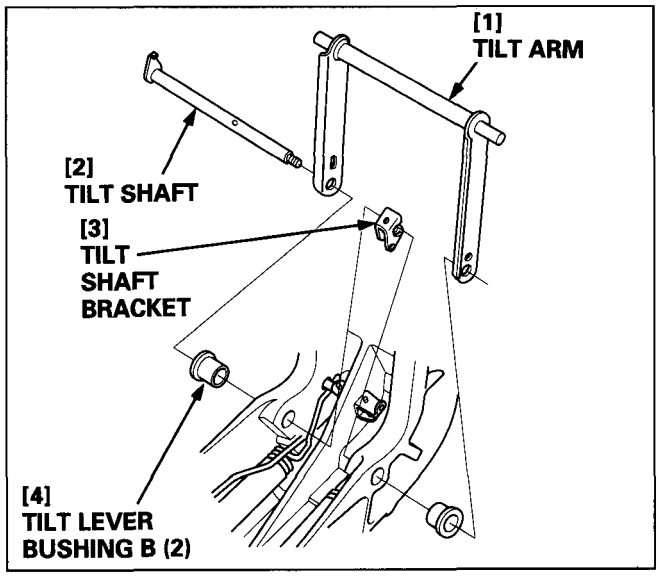
3) Remove the tilt lever spring.

4) Drive out the 3 x 25 mm spring pin using a commercially available 3 mm pin driver and discard the spring pin. Replace the spring pin with new one when reassembly.



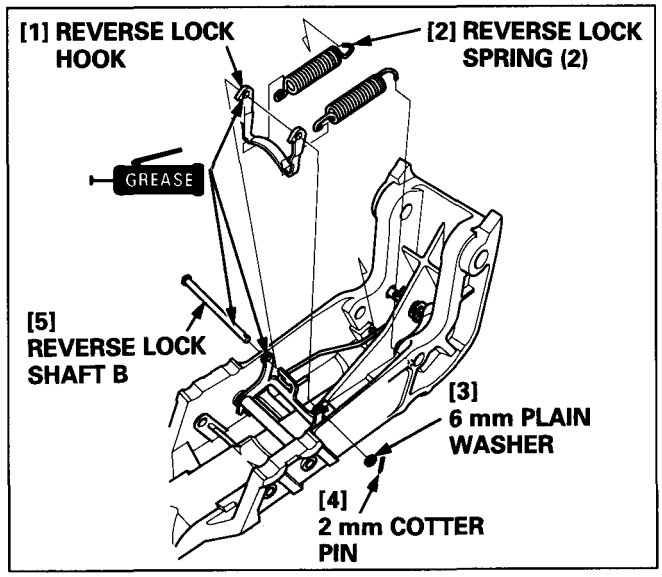
5) Remove the tilt shaft, tilt shaft bracket and tilt arm.

6) Check the tilt lever bushing B for wear or damage. Replace if necessary.



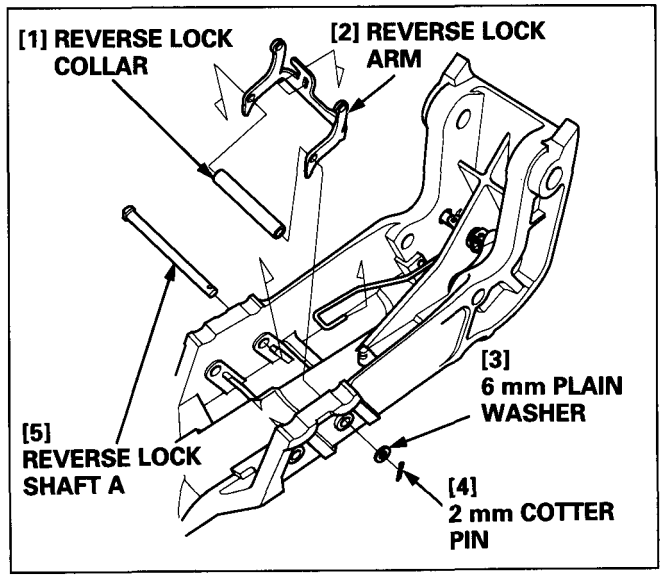
7) Remove and discard the 2 mm cotter pin.
   - Replace the 2 mm cotter pin with new one when reassembly. Don't reuse.

8) Remove the 6 mm plain washer and reverse lock shaft B, then remove the reverse lock hook and two reverse lock springs.



9) Remove and discard the 2 mm cotter pin.
   - Replace the 2 mm cotter pin with new one when reassembly. Don't reuse.

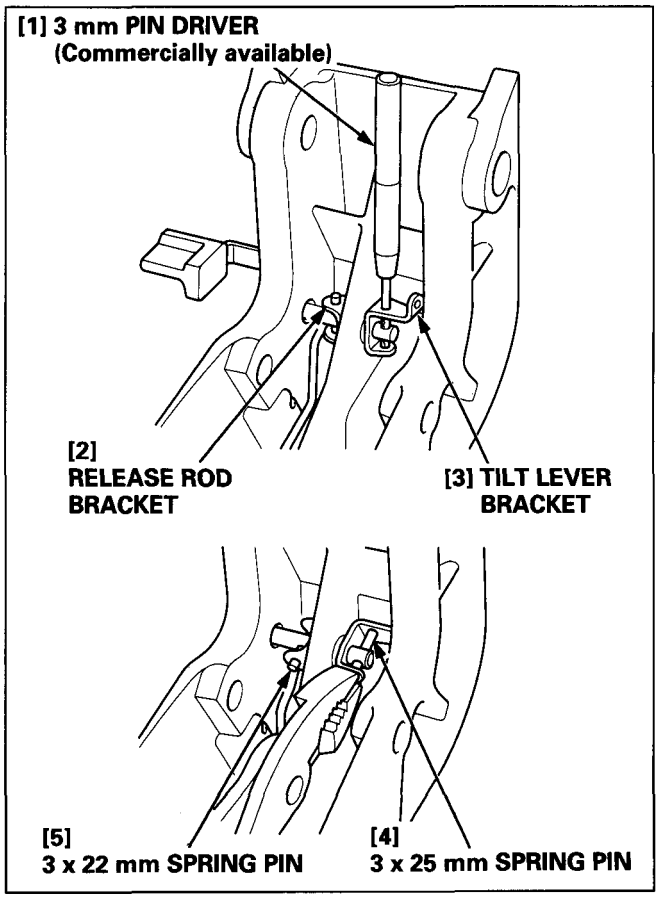
10) Remove the 6 mm plain washer, reverse lock shaft A and reverse lock collar. Disengage the release rod from the reverse lock arm and remove the reverse lock arm.



11) Drive the 3 x 25 mm spring pin using a commercially available 3 mm pin driver until it comes clear of the upper side of the tilt lever bracket.

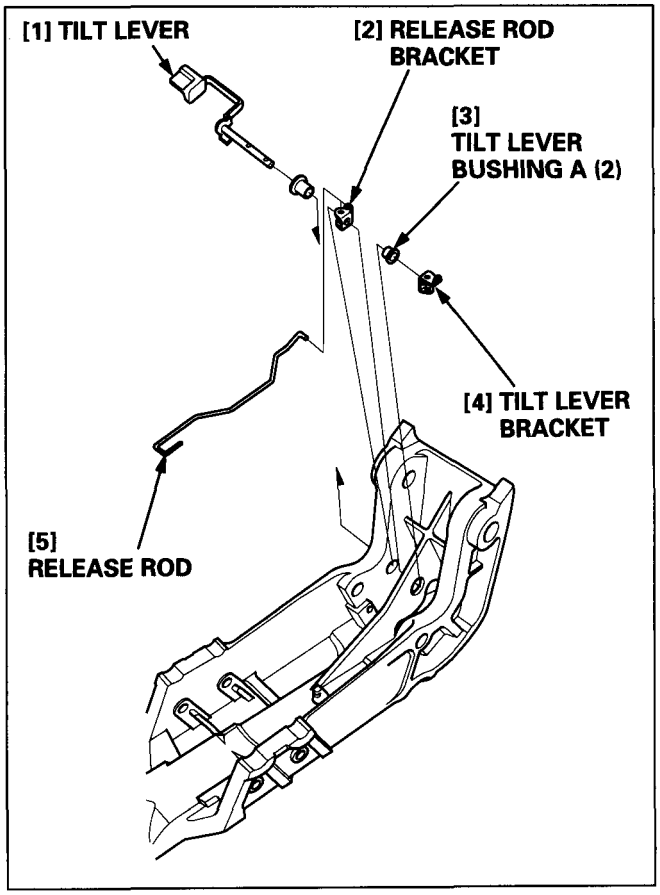
12) Drive the 3 x 22 mm spring pin according to the above procedure until it comes clear of the upper side of the release rod bracket.

13) Pull the spring pins out of the bracket using a vise pliers and discard the spring pins. Replace the spring pins with new ones when reassembly.

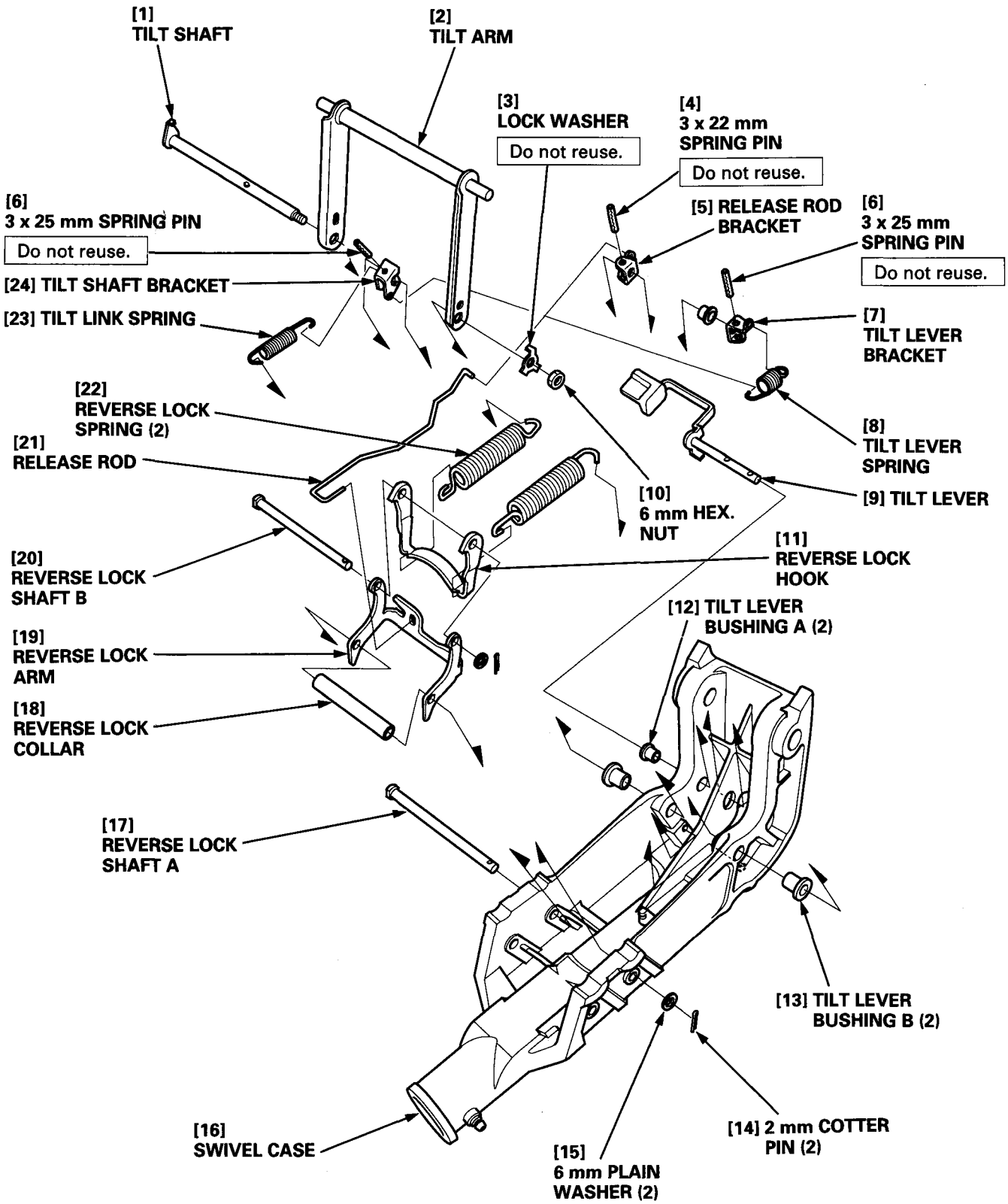


14) Remove the tilt lever, then remove the release rod, release rod bracket and tilt lever bracket.

15) Check the tilt lever bushing A for wear or damage. Replace if necessary.



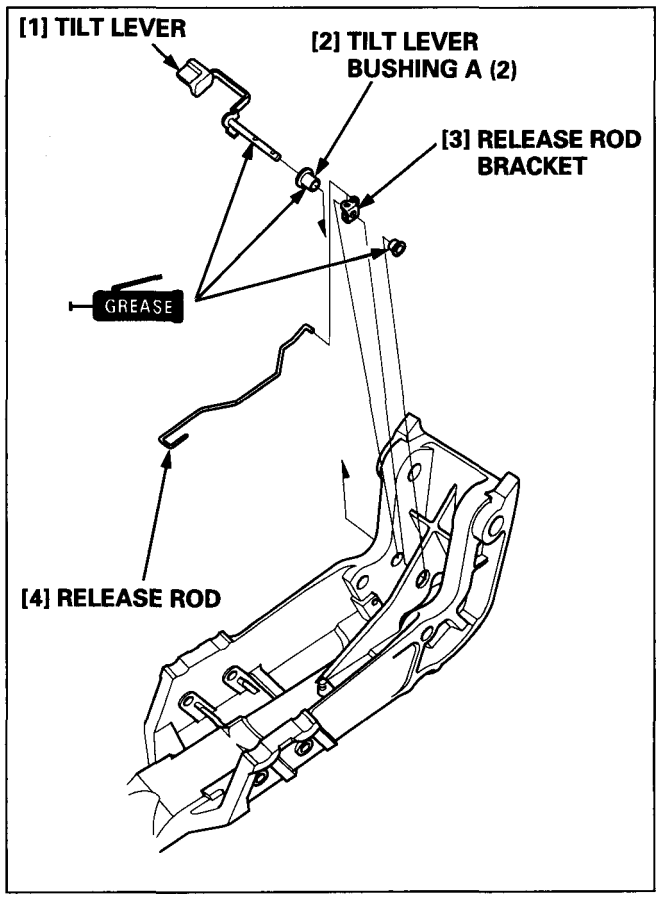
c. SWIVEL CASE ASSEMBLY



1) Check the tilt lever bushing A for wear or damage, replace with new one if necessary.

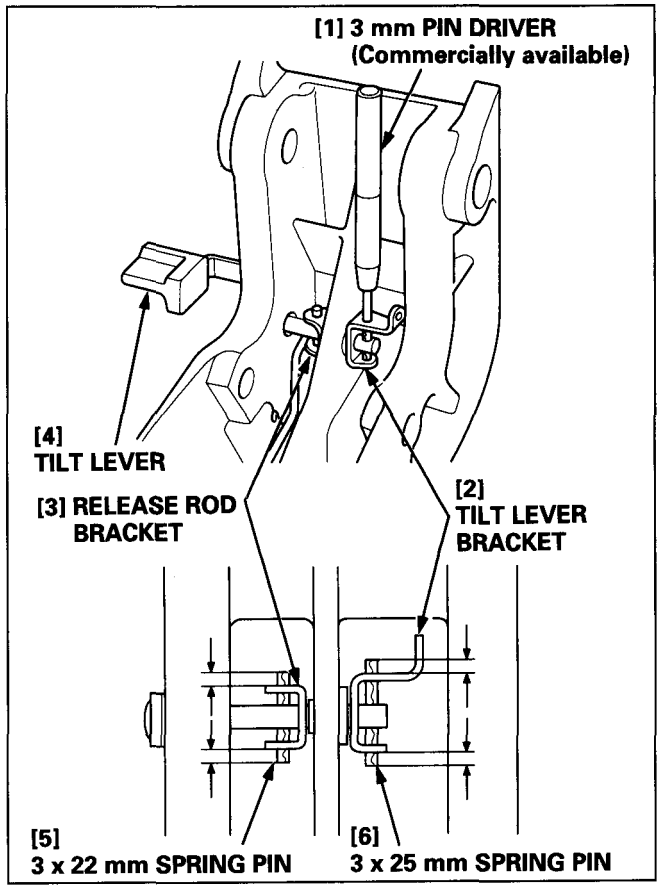
2) Apply grease to the tilt lever bushing A.

3) Connect the release rod to the release rod bracket. Install the tilt lever, release rod bracket and tilt lever bracket.



4) Set the tilt lever, release rod bracket and tilt lever bracket in the position shown and set the new 3 x 22 mm and 3 x 25 mm spring pins.

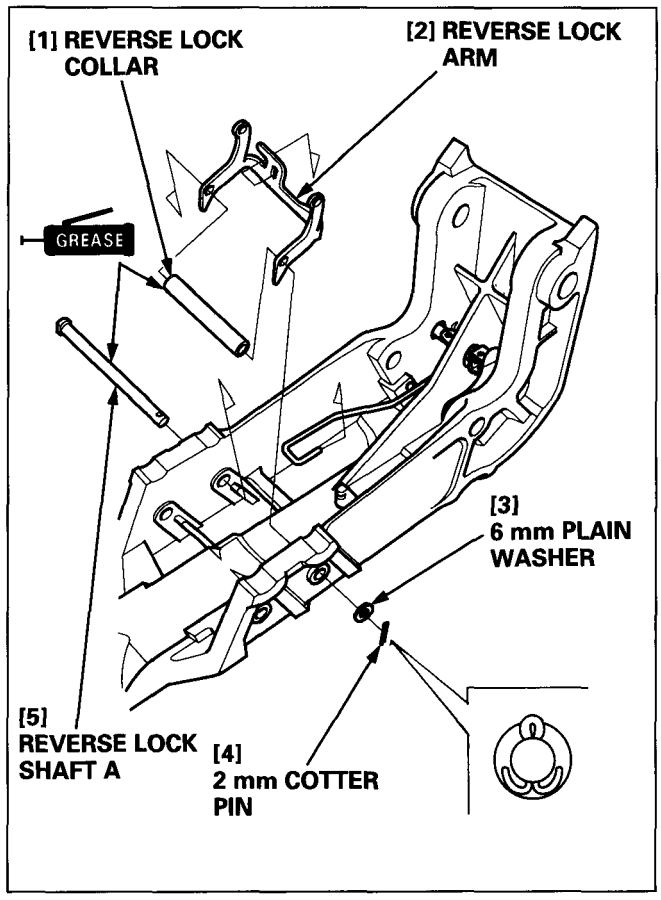
5) Drive the spring pins using a commercially available pin driver until the projected length of both ends are equal as shown.



6) Engage the release rod with the reverse lock arm.

7) Apply grease to the shaft pivot holes of the swivel case and install the reverse lock arm, reverse lock collar and reverse lock shaft A.

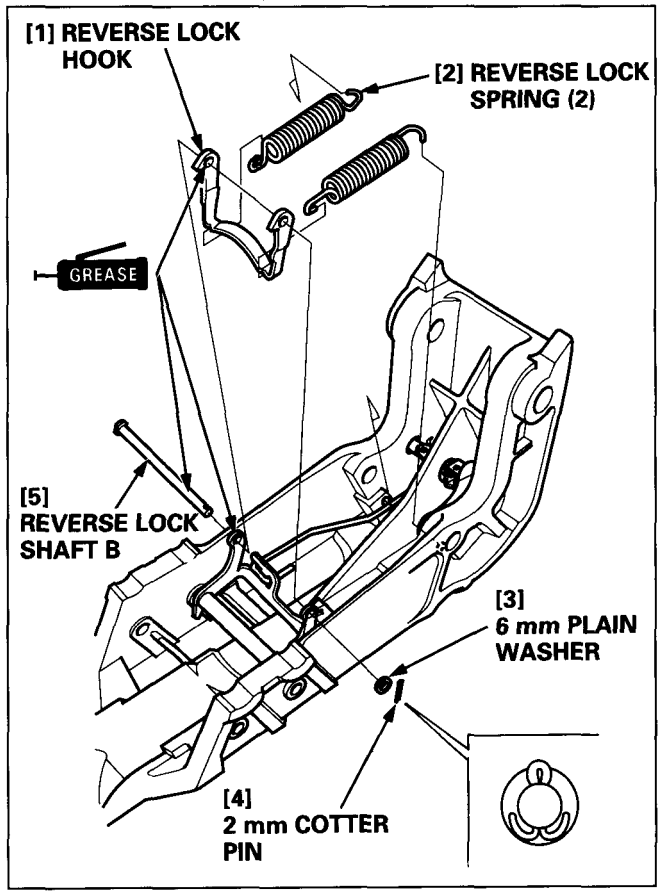
8) Install the 6 mm plain washer and install a new 2 mm cotter pin, and spread the ends as shown.



9) Apply grease to the reverse lock hook pivot holes of the reverse lock arm.

10) Install the reverse lock springs, reverse lock hook and reverse lock shaft B.

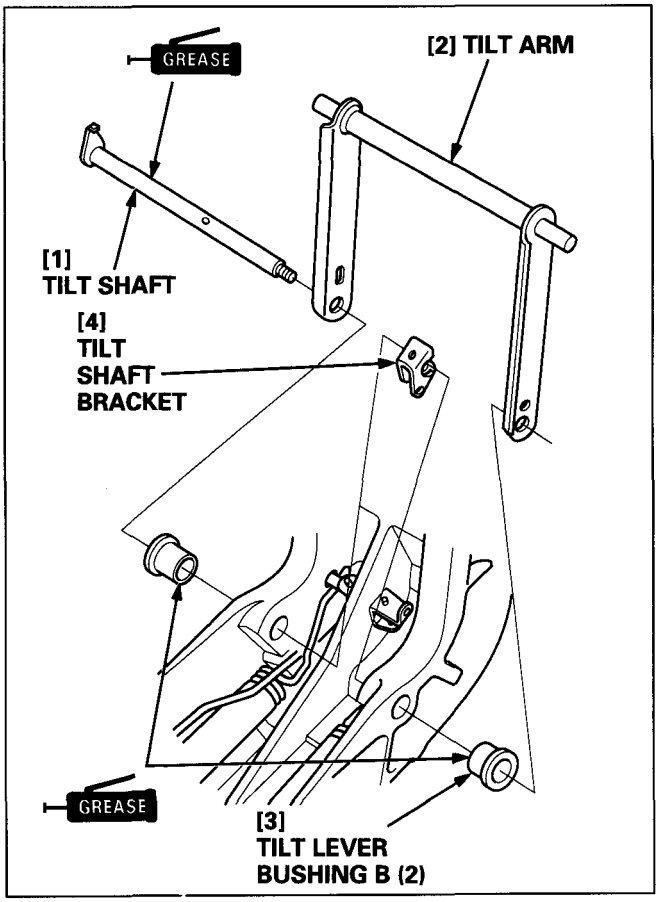
11) Install the 6 mm plain washer and install a new 2 mm cotter pin, and spread the ends as shown.



12) Check the tilt lever bushing B for wear or damage, replace with new one if necessary.

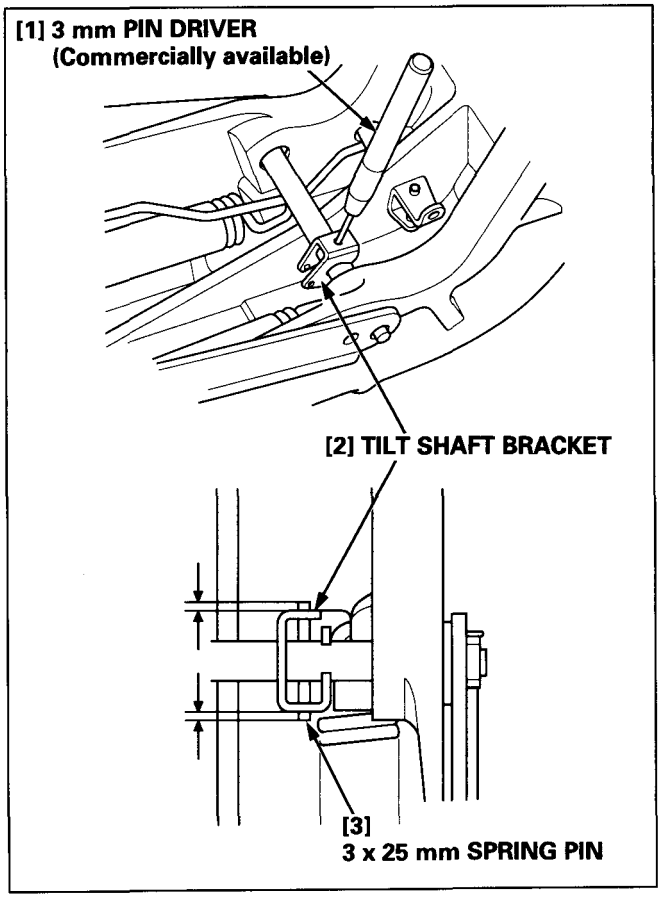
13) Apply grease to the tilt lever bushing B.

14) Install the tilt arm, tilt shaft and tilt shaft bracket.

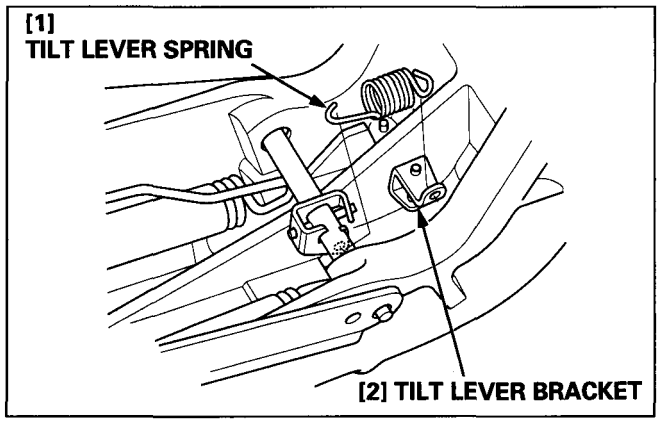


15) Turn the tilt shaft until the locking tab faces toward up. Align the pin holes of the tilt shaft bracket with pin hole of tilt shaft and set a new 3 x 25 mm spring pin.

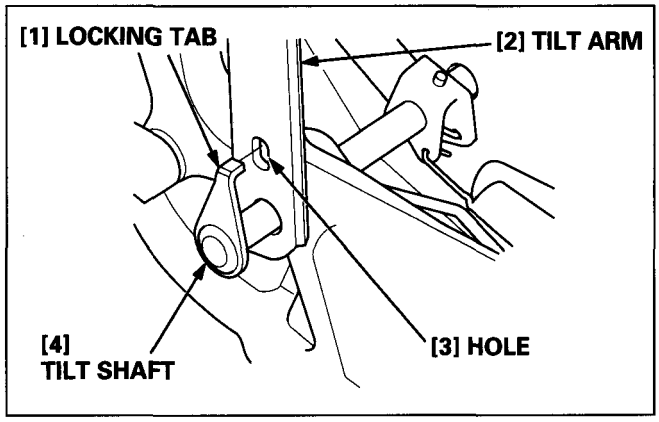
16) Drive the spring pins using a commercially available pin driver until the projected length of both ends are equal as shown.



17) Install the tilt lever spring with the short end toward the tilt lever bracket.

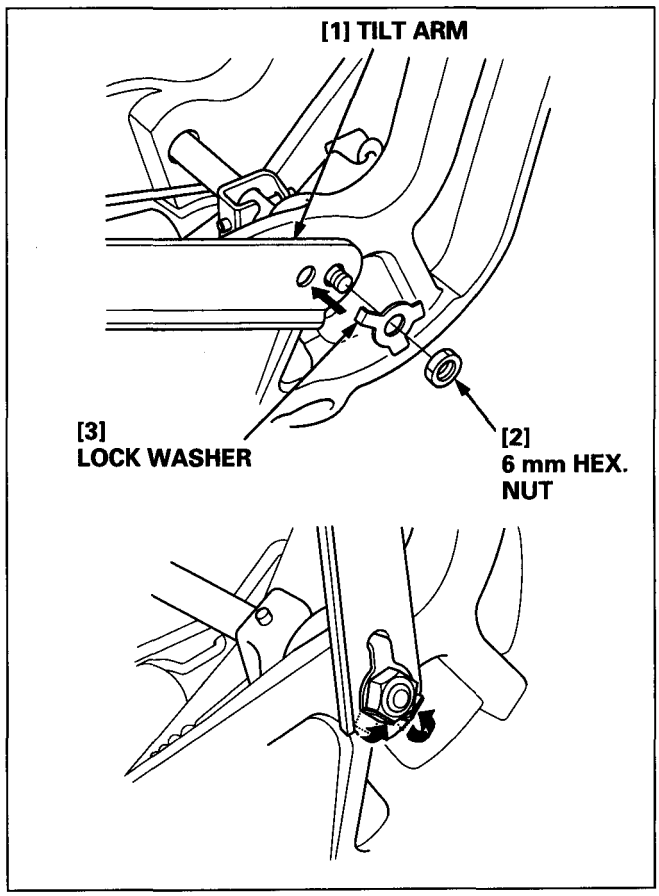


18) Set the locking tab in the hole of the tilt arm as shown.

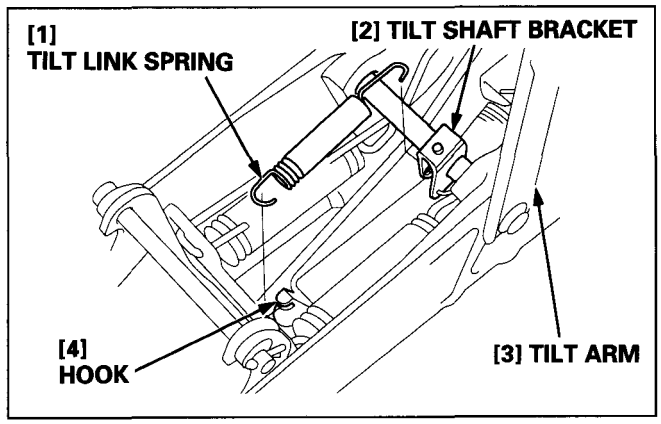


19) Install new lock washer by aligning the locking tab with the hole on the tilt arm.

20) Tighten the 6 mm hex. nut securely, then bend the tab to lock the nut as shown.



21) Install the tilt link spring with the long end hook to the tilt shaft bracket.



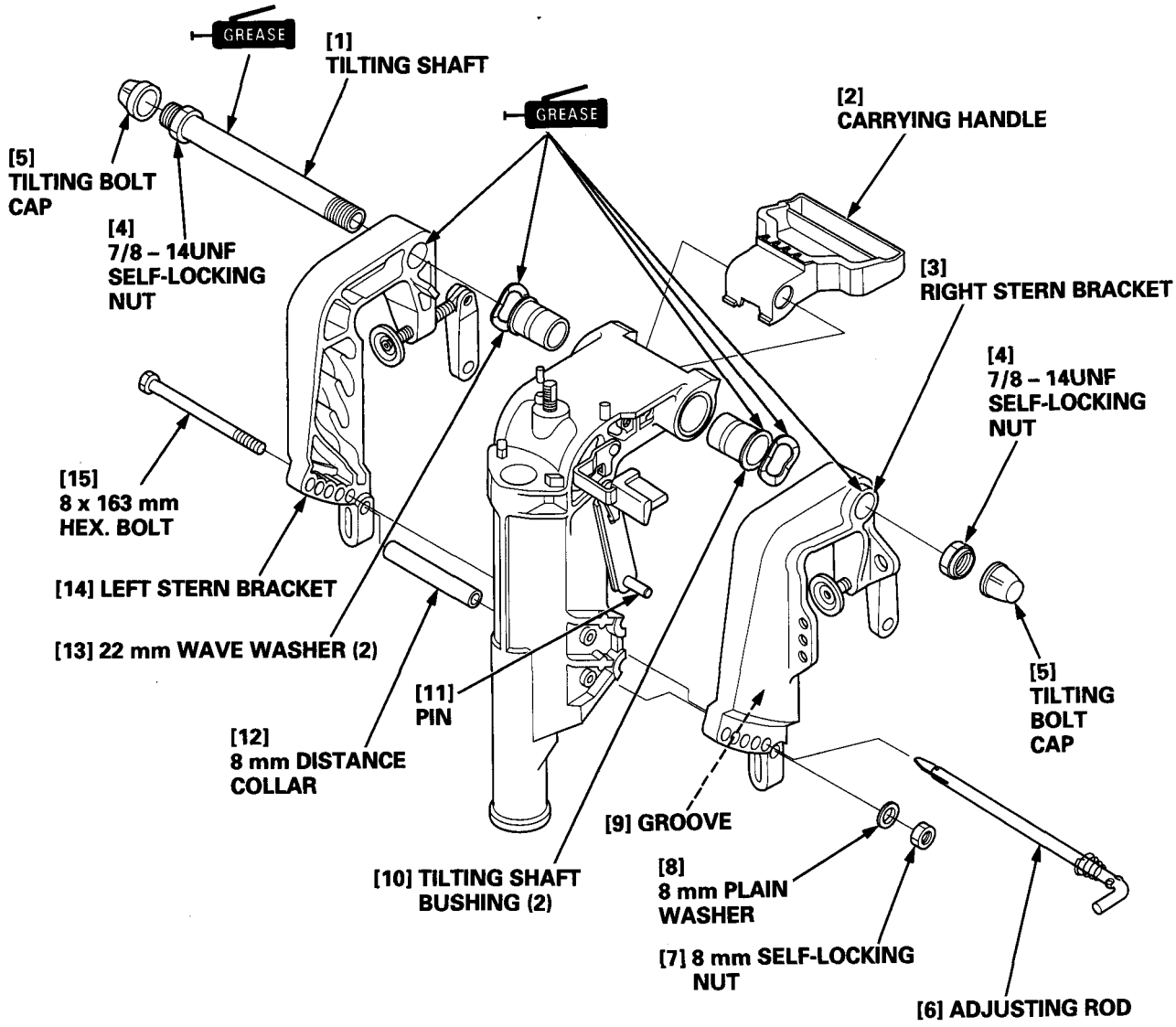
d. STERN BRACKET ASSEMBLY

UL type and Remote control type:

Assemble in the reverse order of removal.

- Apply grease to the threads of the tilting shaft, tilting shaft busings, 22 mm wave washers and tilting shaft mounting hole of the left and right stern brackets.
- Align the pins of the tilt arm of the swivel case with the groove of the left and right stern brackets.
- Loosely install the tilting shaft and self-locking nuts and tighten the 8 mm self-locking nut to the specified torque. Then, tighten the 7/8-14 UNF self-locking nut to the specified torque.

TORQUE:
8 mm self-locking nut: 21 N·m (2.1 kgf·m, 15 lbf·ft)
7/8-14 UNF self-locking nut: 17 N·m (1.7 kgf·m, 12 lbf·ft)

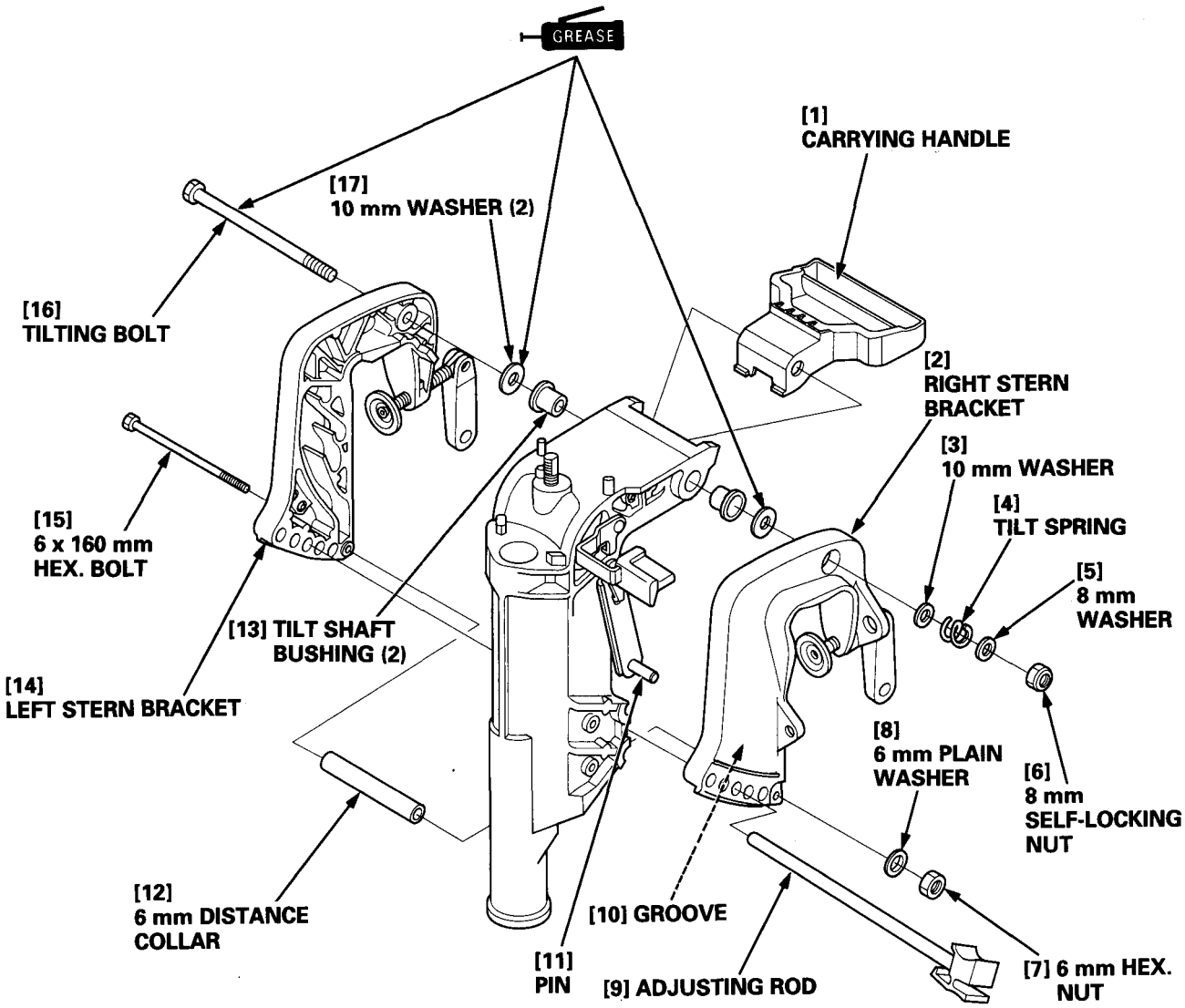


S and L types with tiller handle:

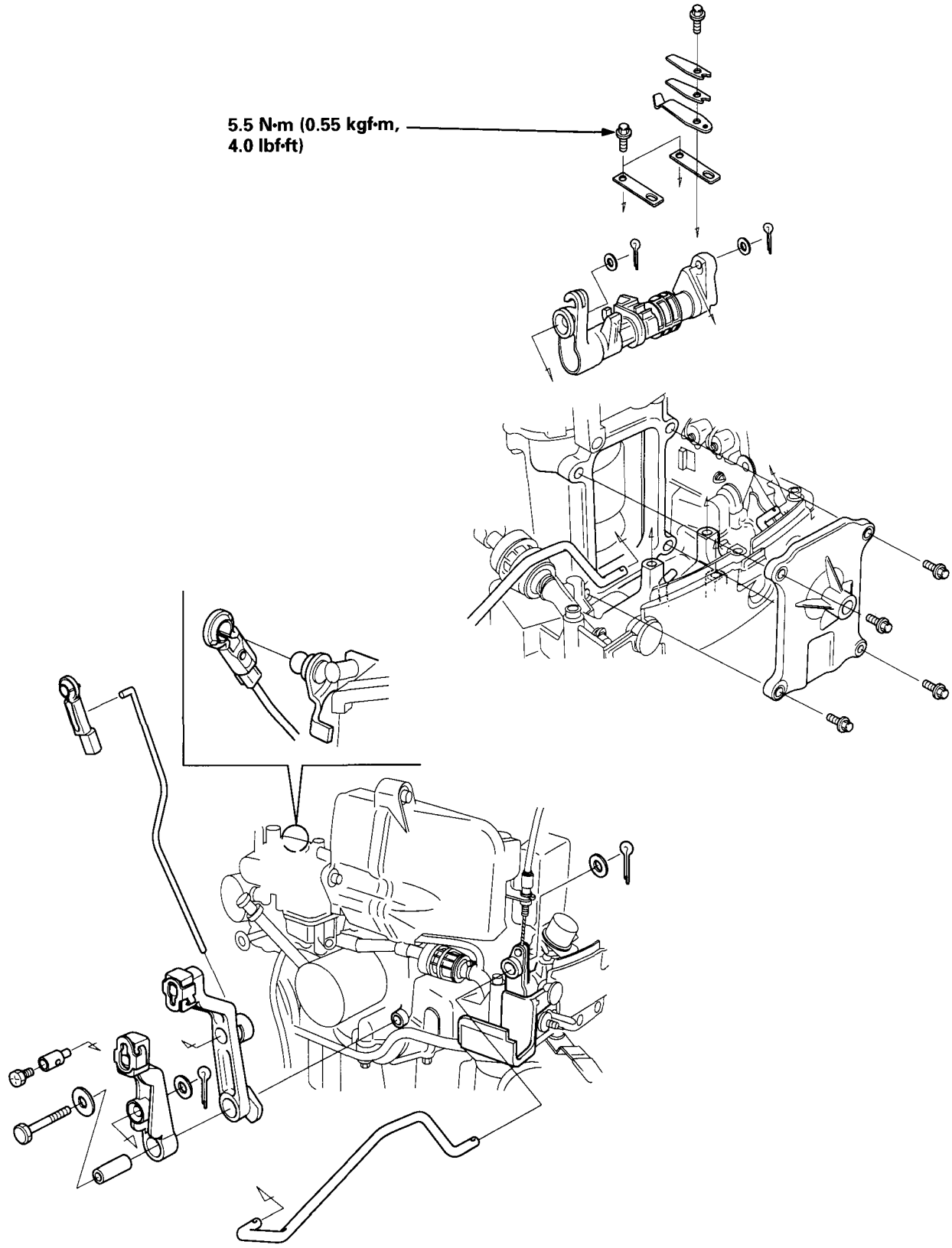
Assemble in the reverse order of removal.

- Apply grease to the threads of the tilting shaft and tilting shaft mounting hole of the left and right stern brackets.
- Align the pins of the tilt arm of the swivel case with the groove of the left and right stern brackets.
- Loosely install the tilting shaft and self-locking nuts and tighten the 6 mm hex. nut securely. Then, tighten the 8 mm self-locking nut to the specified torque.

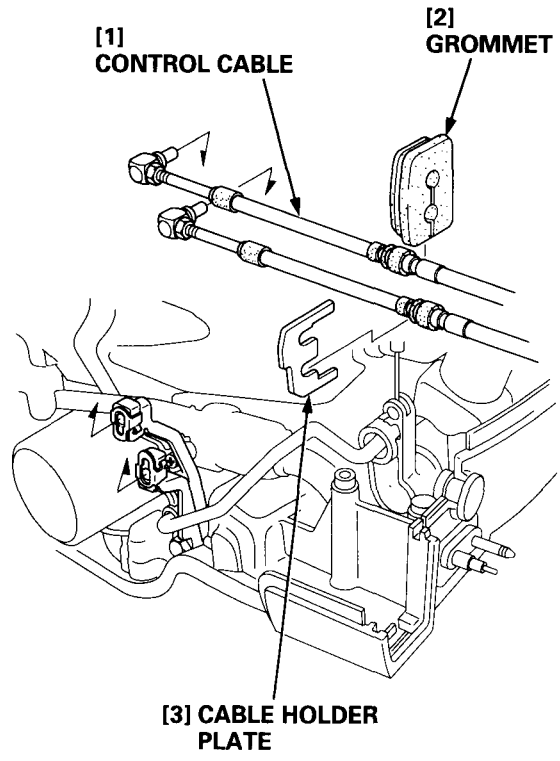
TORQUE:
8 mm self-locking nut: 24 N·m (2.4 kgf·m,17 lbf·ft)



1. SHIFT ARM/THROTTLE ARM (REMOTE CONTROL TYPE ONLY)
2. SHIFT SHAFT



1. SHIFT ARM/THROTTLE ARM (REMOTE CONTROL TYPE ONLY)



a. REMOVAL

1) Remove the following:
   — engine cover (P. 5-1).
   — right engine under cover (P. 5-3).

2) Disconnect the remote control cables.

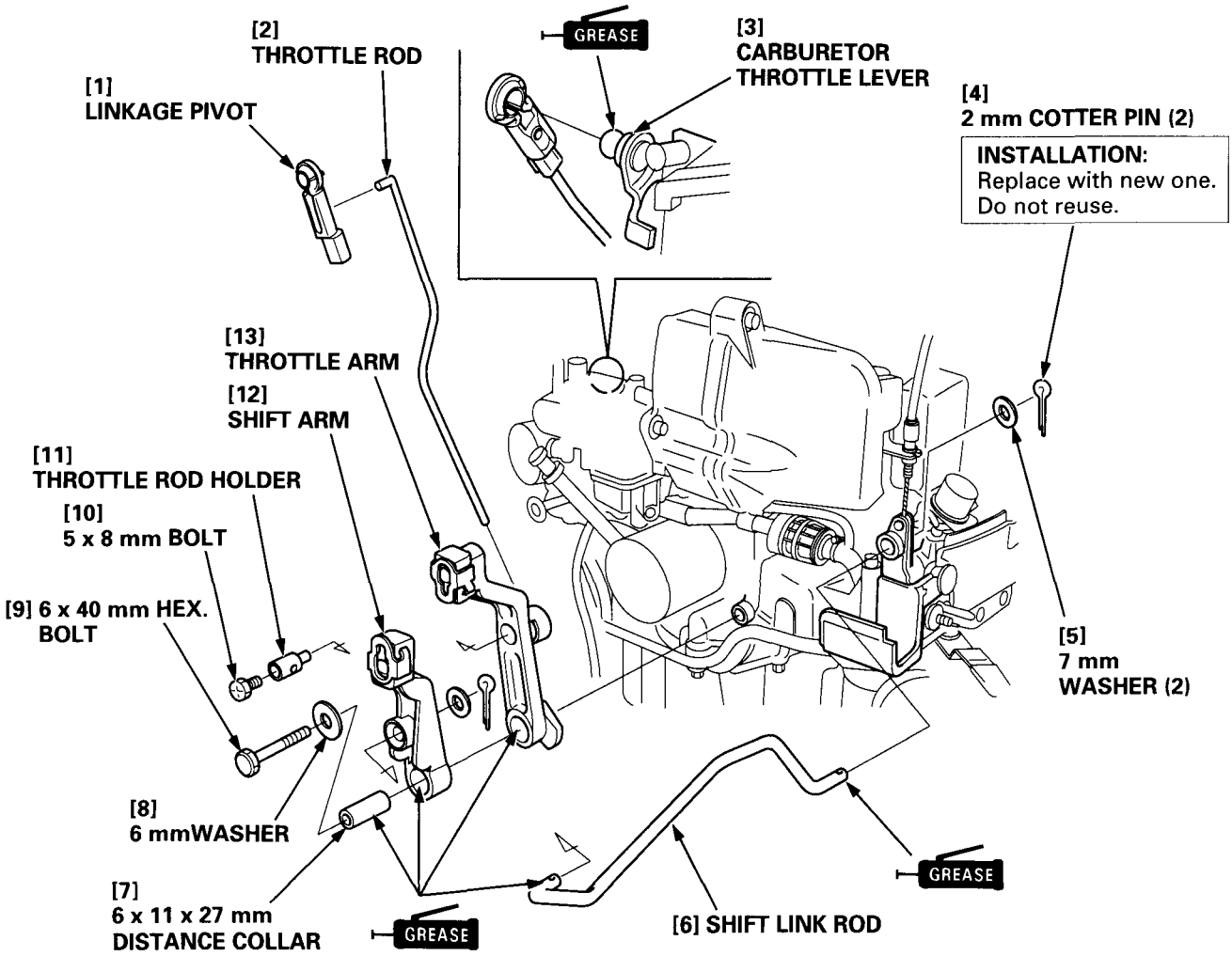
3) Loosen the 5 x 8 mm bolt, then disconnect the link pivot from the carburetor throttle lever.

4) Remove the 6 x 40 mm hex. bolt, then remove the distance collar, shift arm and throttle arm.

5) Spread the ends of the 2 mm cotter pin and remove it and 7 mm washer, then disconnect the shift link rod from the shift arm.

b. INSTALLATION

Installation is the reverse order of removal.
- After installation adjust the throttle linkage (P. 3-13).



2. SHIFT SHAFT

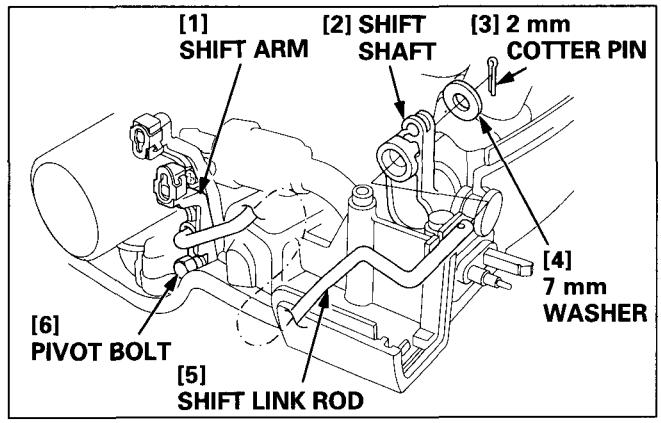
a. REMOVAL

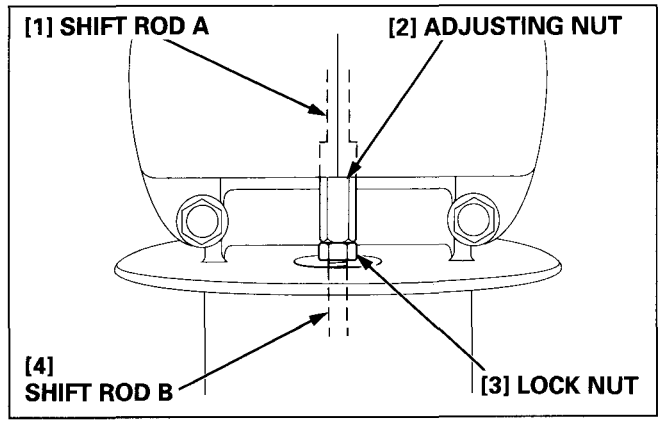
1) Remove the following:
   — engine cover (P. 5-1).
   — right engine under cover (P. 5-3).
   — ignition control module and neutral switch (P. 16-18).

2) Disconnect the neutral start cable from the shift shaft (P. 7-1).

3) Remote control type only:
   Disconnect the remote control cables (P. 14-2).
   Loosen the shift arm pivot bolt (6 x 40 mm hex. bolt) fully. Spread the end of the 2 mm cotter pin and remove and discard it. Remove the 7 mm washer and disconnect the link rod from the shift shaft.
   • Replace the cotter pin with new one when reassembly.

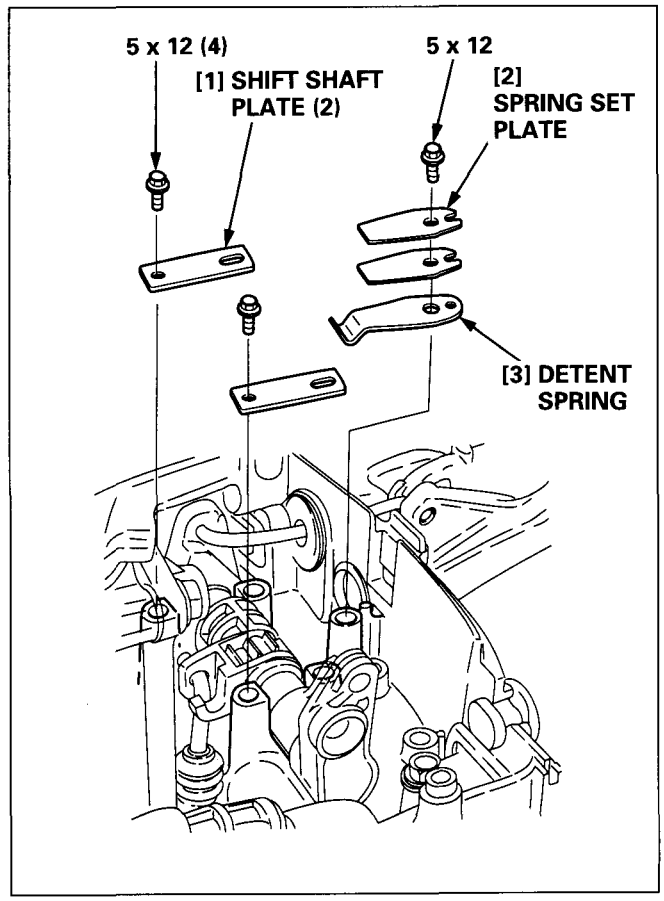
4) Shift the gear into the reverse position and loosen the lock nut. Disconnect the shift rod A from the shift rod B by turning the adjusting nut.



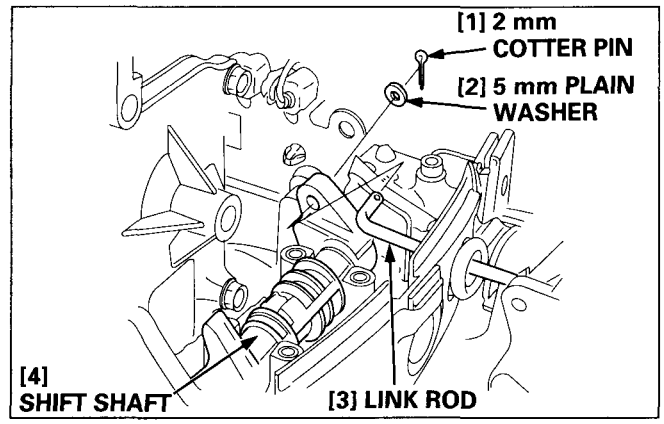


5) Remove the 5 x 12 mm flange bolt, detent spring and spring set plates (Remote control type: one plate, Tiller handle type: two plates).

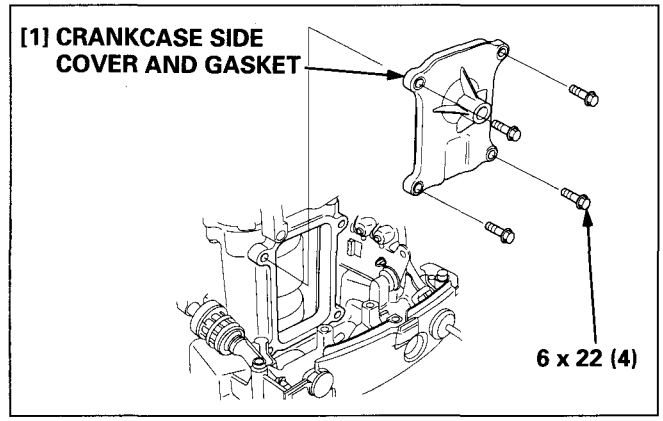
6) Remove the four 5 x 12 mm flange bolts and shift shaft plates.



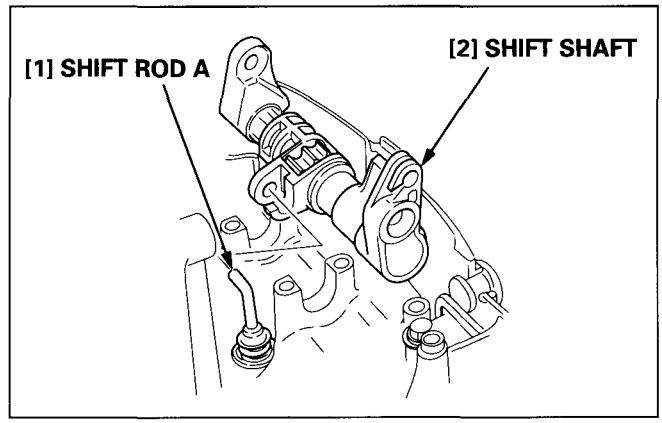
7) Tiller handle type only:
Spread the end of the 2 mm cotter pin, and remove and discard it. Remove the 5 mm plain washer and disconnect the link rod from the shift shaft.
- Replace the cotter pin with new one when reassembly.



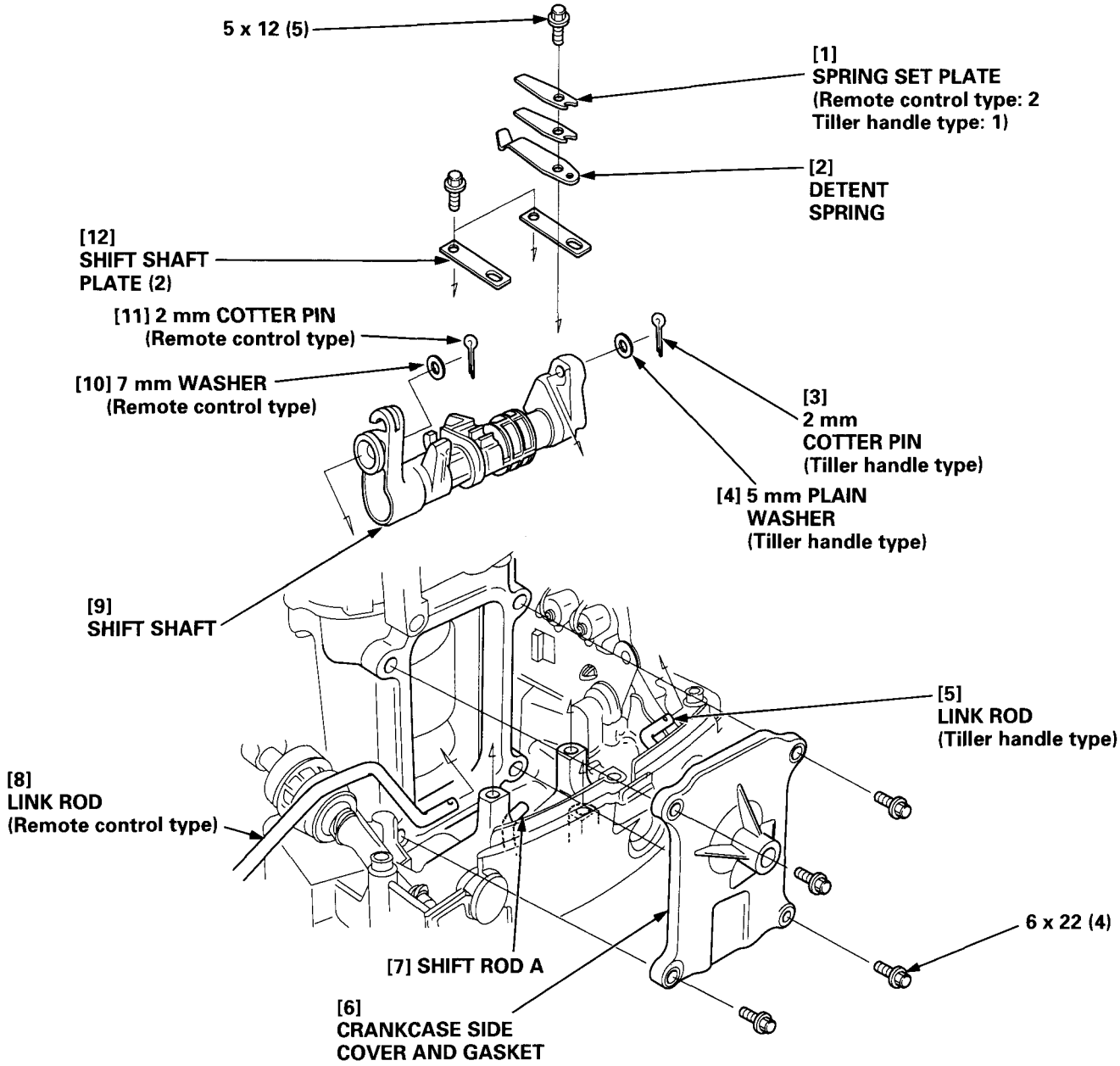
8) Remove the four 6 x 22 mm flange bolts and crankcase side cover and cover gasket.
- Cover the crankcase opening with a clean shop towel to protect it from dirt or foreing material.



9) Disconnect the shift rod A from the shift shaft and remove the shift shaft.

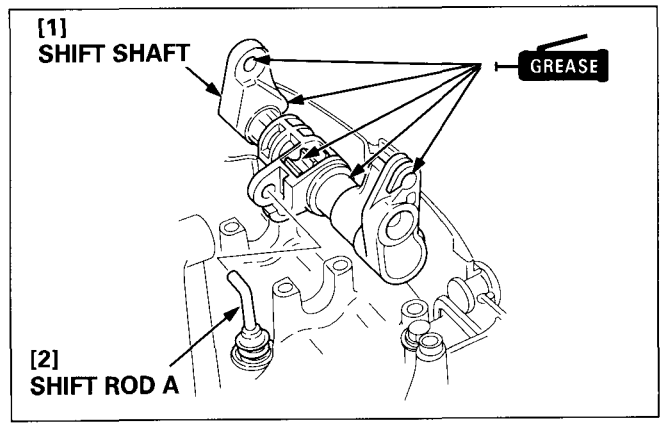


b. INSTALLATION

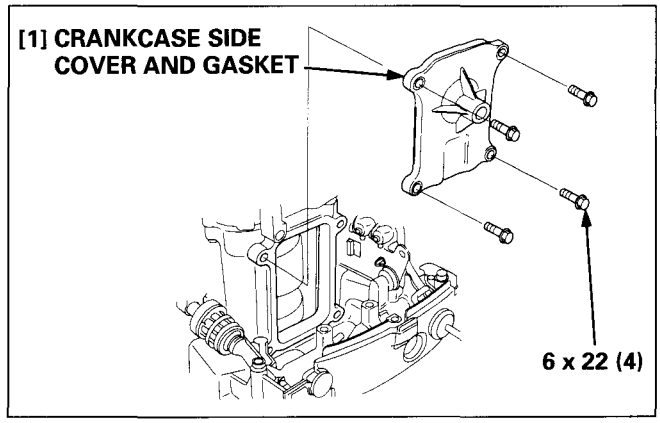


1) Apply grease to the shift shaft;
   — link pivot holes.
   — detent spring sliding area.
   — set plate sliding area.

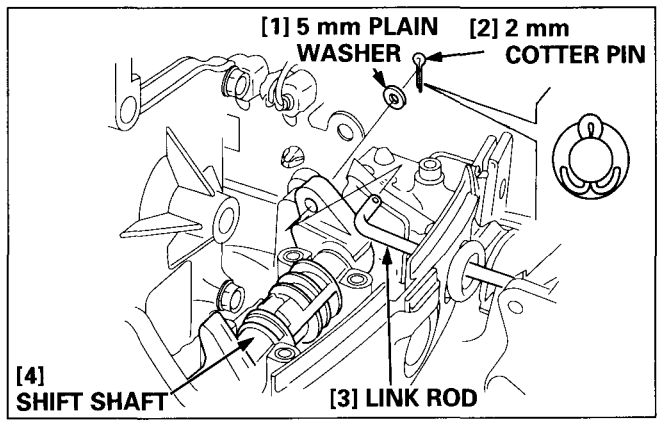
2) Connect the shift shaft to the shift rod A, then set it in the place.



3) Install the crankcase side cover and gasket, tighten the 6 x 22 mm flange bolts securely.



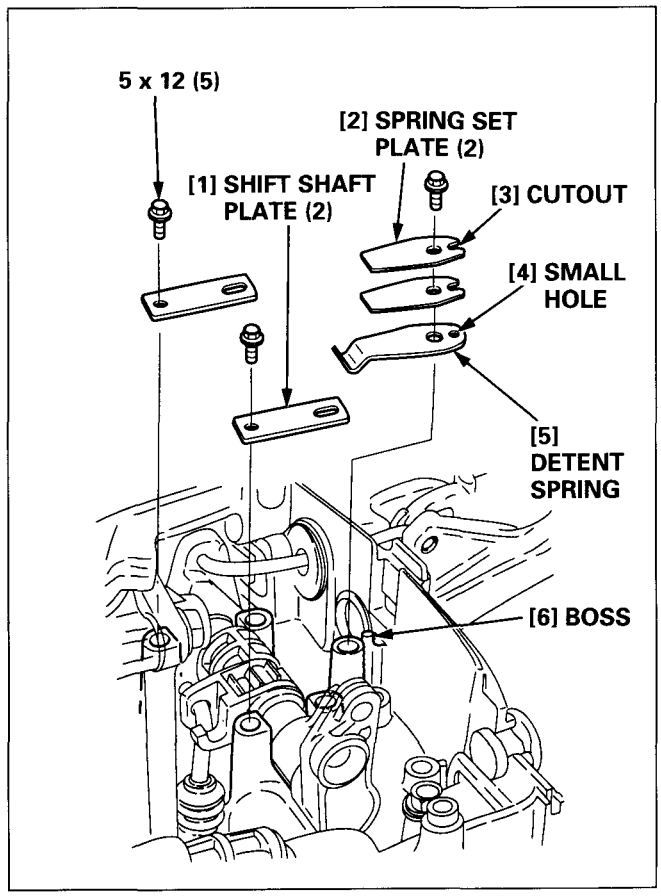
4) Tiller handle type; connect the link rod to the shift shaft. Install the 5 mm plain washer and a new 2 mm cotter pin, spread the ends of the cotter pin as shown.



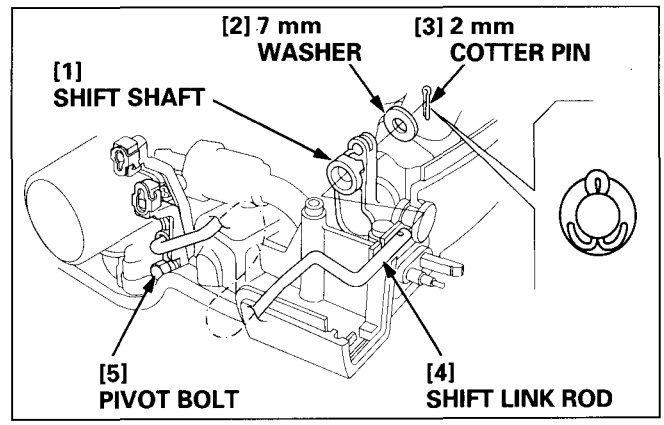
5) Install the shift shaft plates with the slotted hole toward front as shown and tighten the 5 x 12 mm flange bolts securely.

TORQUE: 5.5 N·m (0.55 kgf·m , 4.0 lbf·ft)

6) Install the detent spring and spring set plate (Remote control type: 2, Tiller handle type: 1) and tighten the 5 x 12 mm flange bolts securely.
- Align the small hole with the boss of the oil case.
- Align the cutout of the spring set plate with the boss of the oil case.



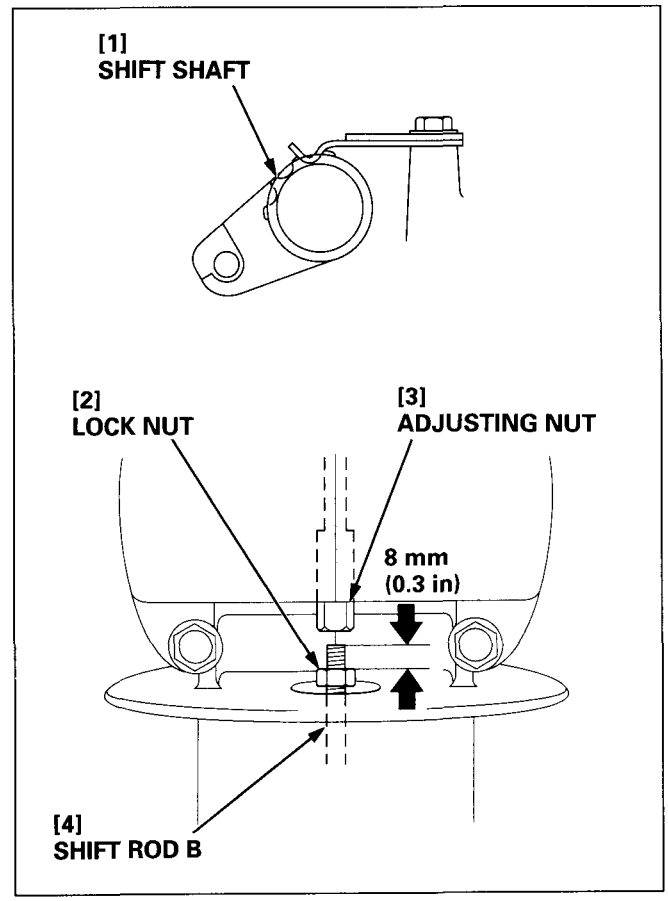
7) Remote control type; connect the link rod to the shift shaft. Install the 7 mm washer and a new 2 mm cotter pin, spread the ends of the cotter pin as shown. Tighten the shift arm pivot bolt securely.



8) Set the shift shaft in the reverse position as shown.

9) Turn the lock nut on the shift rod B to obtain 8 mm (0.3 in) from top of the shift rod B to top of the lock nut as shown.

10) Make sure that the shift rod is in reverse position and connect the shift rod B to the shift rod A by threading the adjusting nut until the adjusting nut comes in contact with the lock nut.



11) When the adjusting nut contacts the lock nut, tighten the lock nut by holding the adjusting nut.

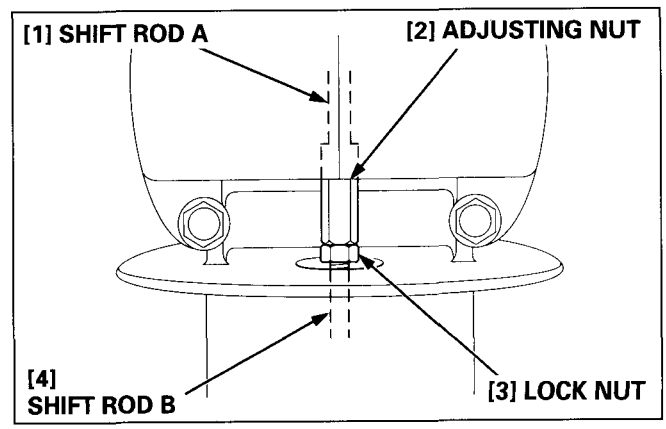
TORQUE: 10 N·m (1.0 kgf·m , 7 lbf·ft)

12) After installation, be sure that the gearshift lever or remote control lever moves smoothly into any gear position.

13) Connect the control cables (Remote control type).

14) Reinstall the removed parts in the reverse order of removal:

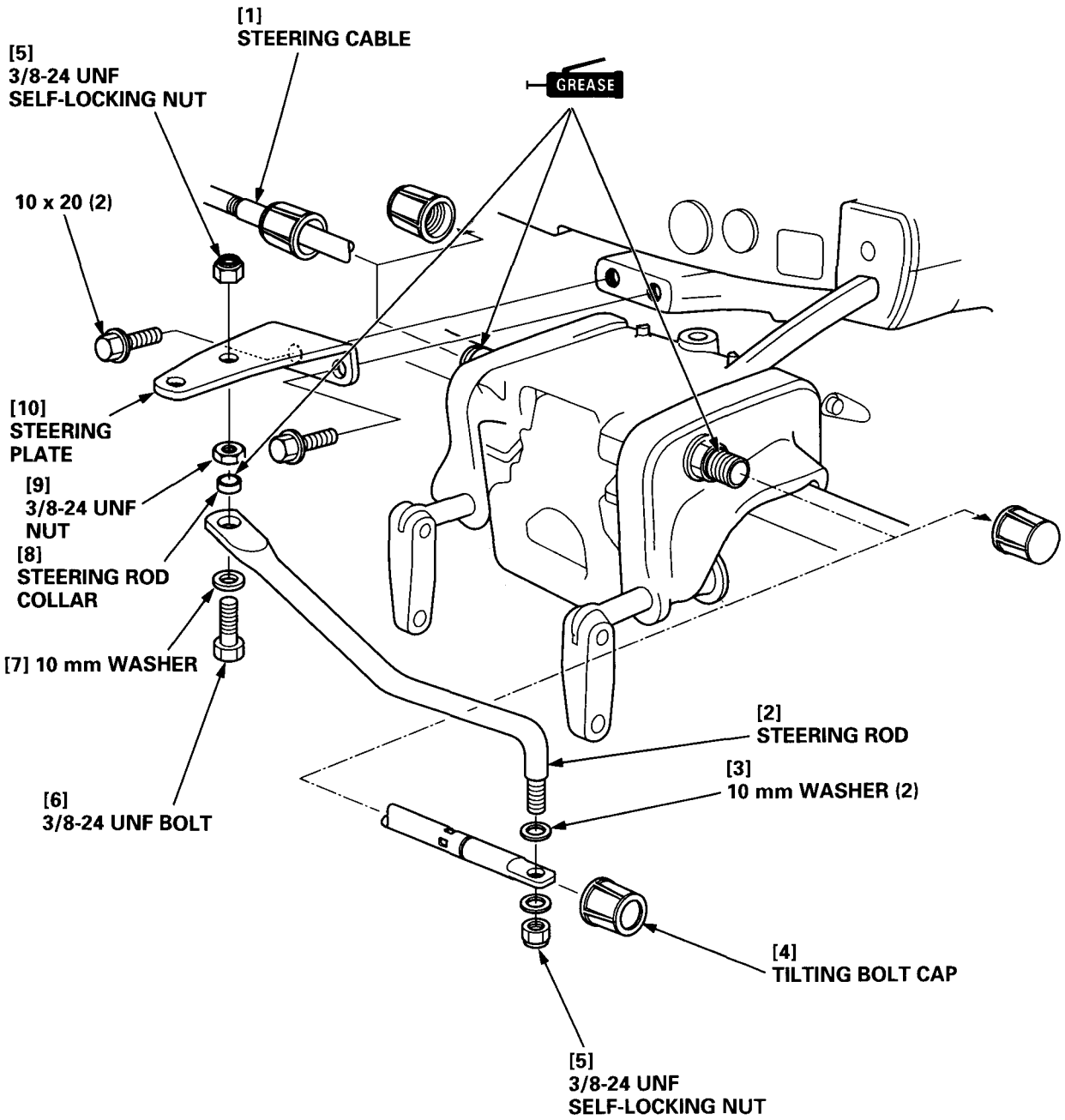
— ignition control module and neutral switch (P. 16-18).
— right engine under cover (P. 5-3).
— engine cover (P. 5-1).



1. STEERING ROD
2. REMOTE CONTROL CABLES
3. REMOTE CONTROL BOX

1. STEERING ROD

a. DISASSEMBLY/REASSEMBLY



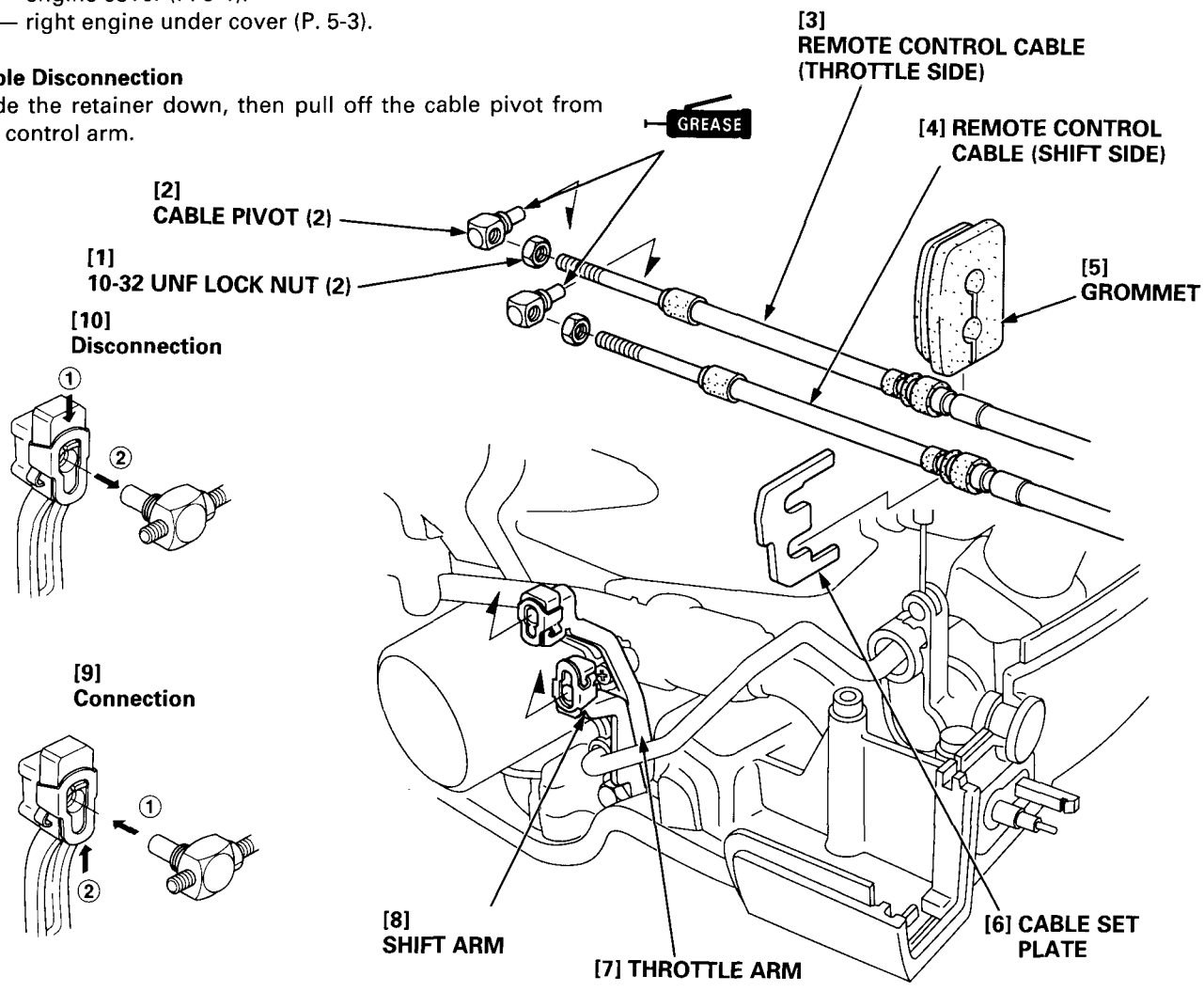
2. REMOTE CONTROL CABLES

a. REMOVAL/INSTALLATION

• MOTOR SIDE

1) Remove the following:
   — engine cover (P. 5-1).
   — right engine under cover (P. 5-3).

Cable Disconnection
Slide the retainer down, then pull off the cable pivot from the control arm.



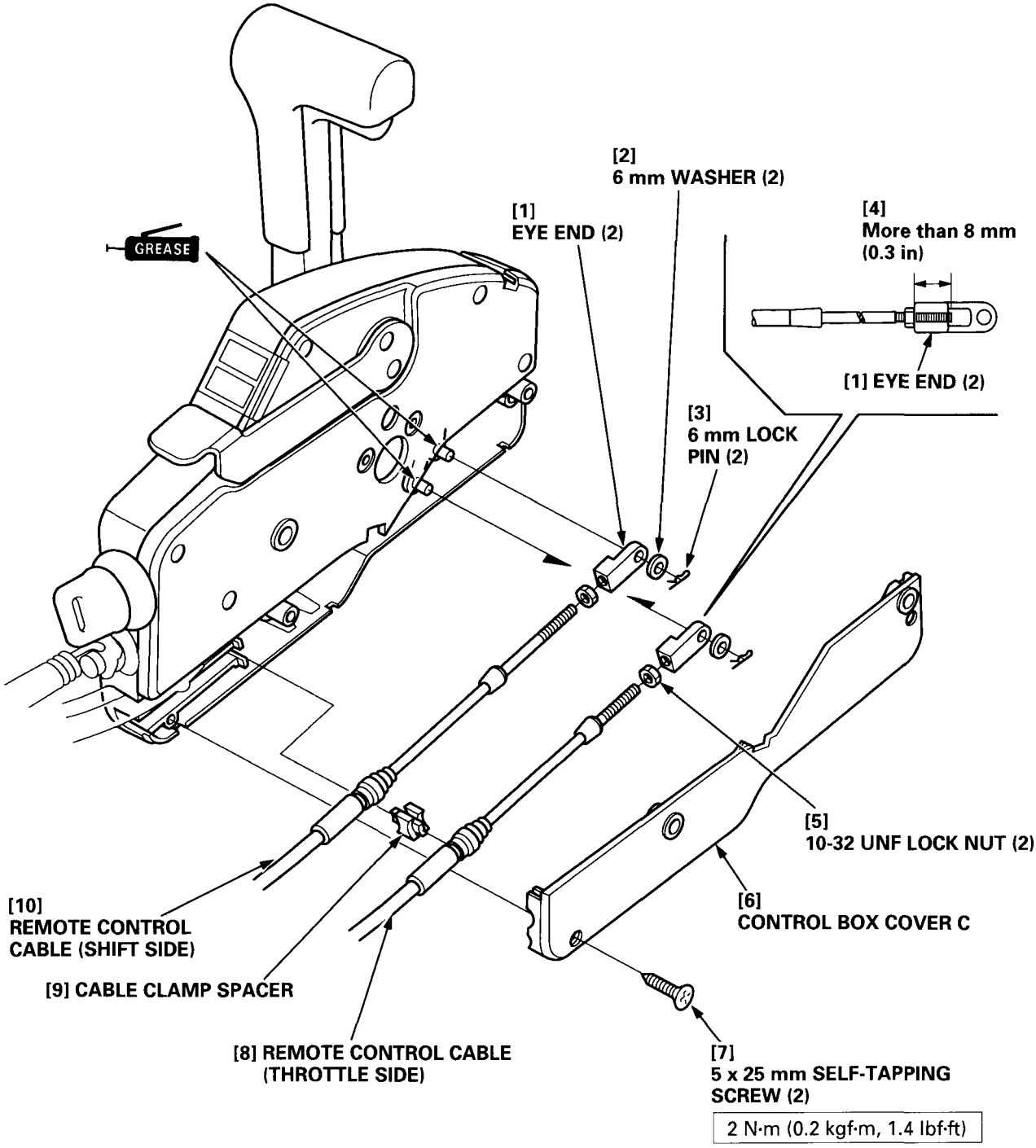
Cable Connection:
1) Before connection, adjust the cable pivot position as follows.
   Shift Cable:
   a. Set the control lever to the neutral position.
   b. Adjust the cable pivot position by tuning the cable pivot with the shift shaft in neutral position.
   Throttle Cable:
   a. Set the control lever to the fully open position.
   b. Adjust the cable pivot position by turning the cable pivot with the carburetor full throttle position.

2) Slide down the retainer, then set the cable pivot and secure the pivot by sliding up the retainer and aligning it with the groove of the cable pivot.

3) Tighten the lock nuts securely.

• CONTROL BOX SIDE

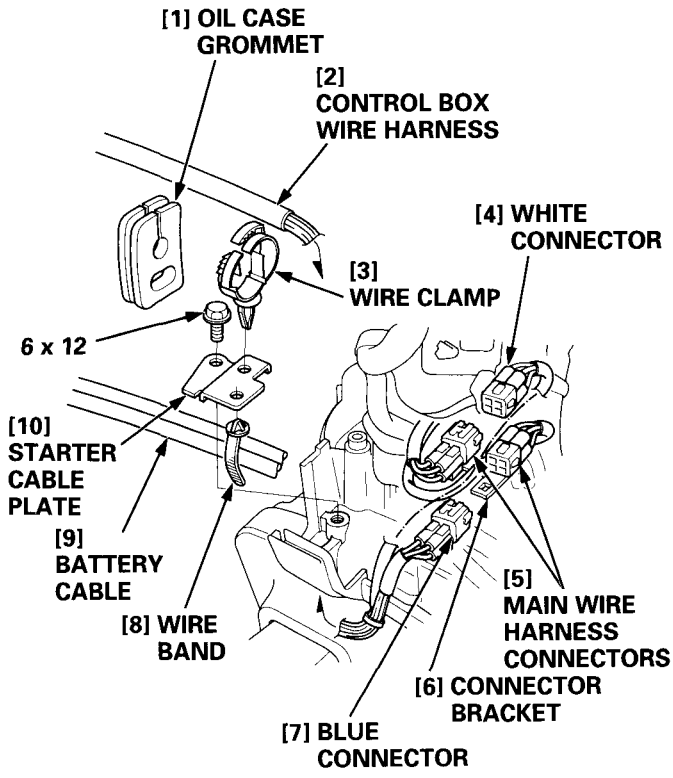
- Screw the lock nut and eye end more than 8 mm (0.3 in) onto the threads of the remote control cable and tighten the lock nut securely.
- Apply grease to the pin of the control arm before connecting the cable.
- After installation, adjust the cables and connect to the motor (P. 14-2).



3. REMOTE CONTROL BOX

a. REMOVAL

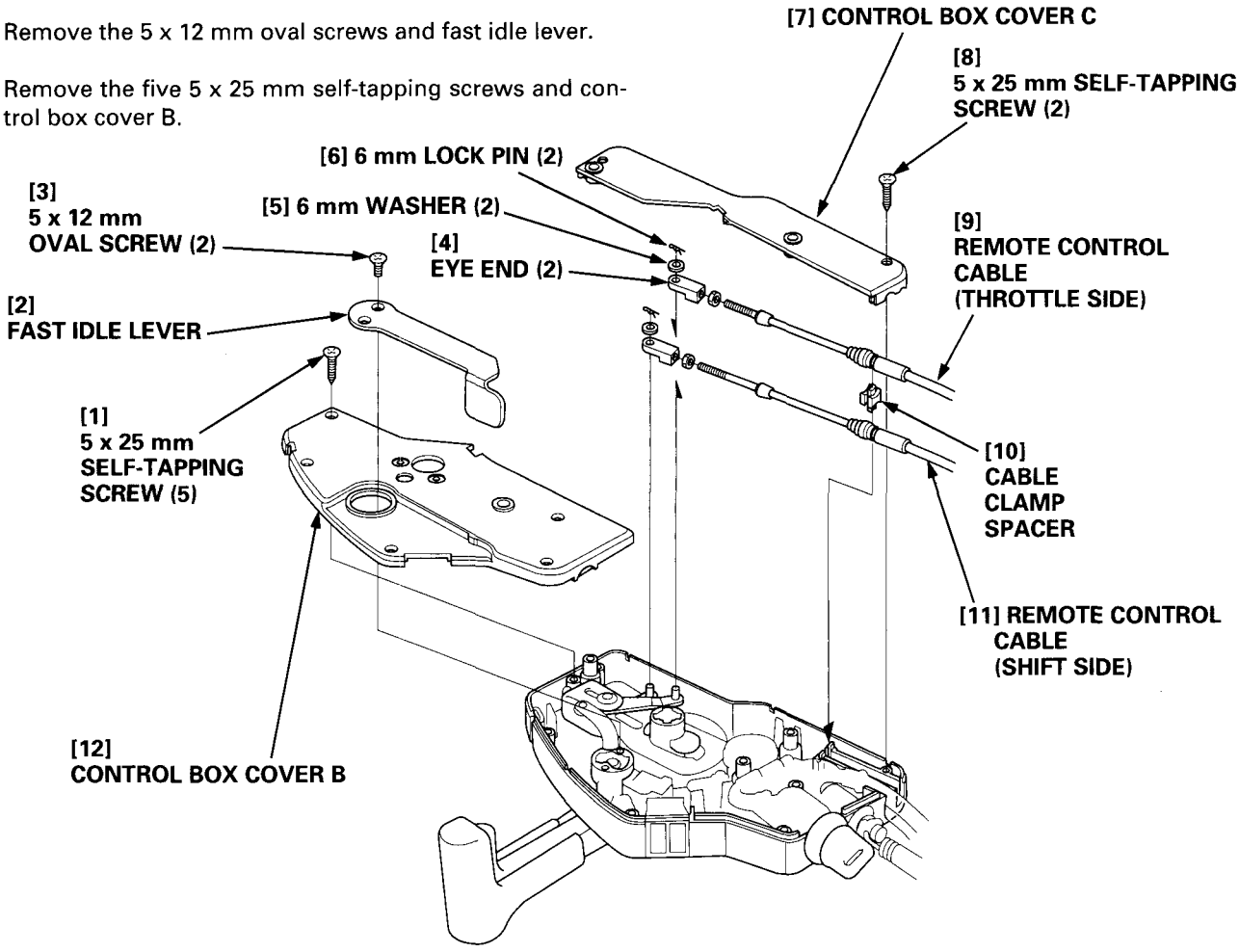
1) Remove the engine cover.
2) Disconnect the remote control cables from the motor (P. 14-2).
3) Disconnect the connectors and pull the blue connector from the connector holder.
4) Open the wire clamp and remove the control box wire harness.
5) Remove the remote control box.



b. DISASSEMBLY

• COVERS AND CABLES

1) Remove the two 5 x 25 mm self-tapping screws and control box cover B.
2) Remove the 6 mm lock pins and washers and disconnect the control cables, two 6 mm washers and cable clamp spacer.
3) Remove the 5 x 12 mm oval screws and fast idle lever.
4) Remove the five 5 x 25 mm self-tapping screws and control box cover B.



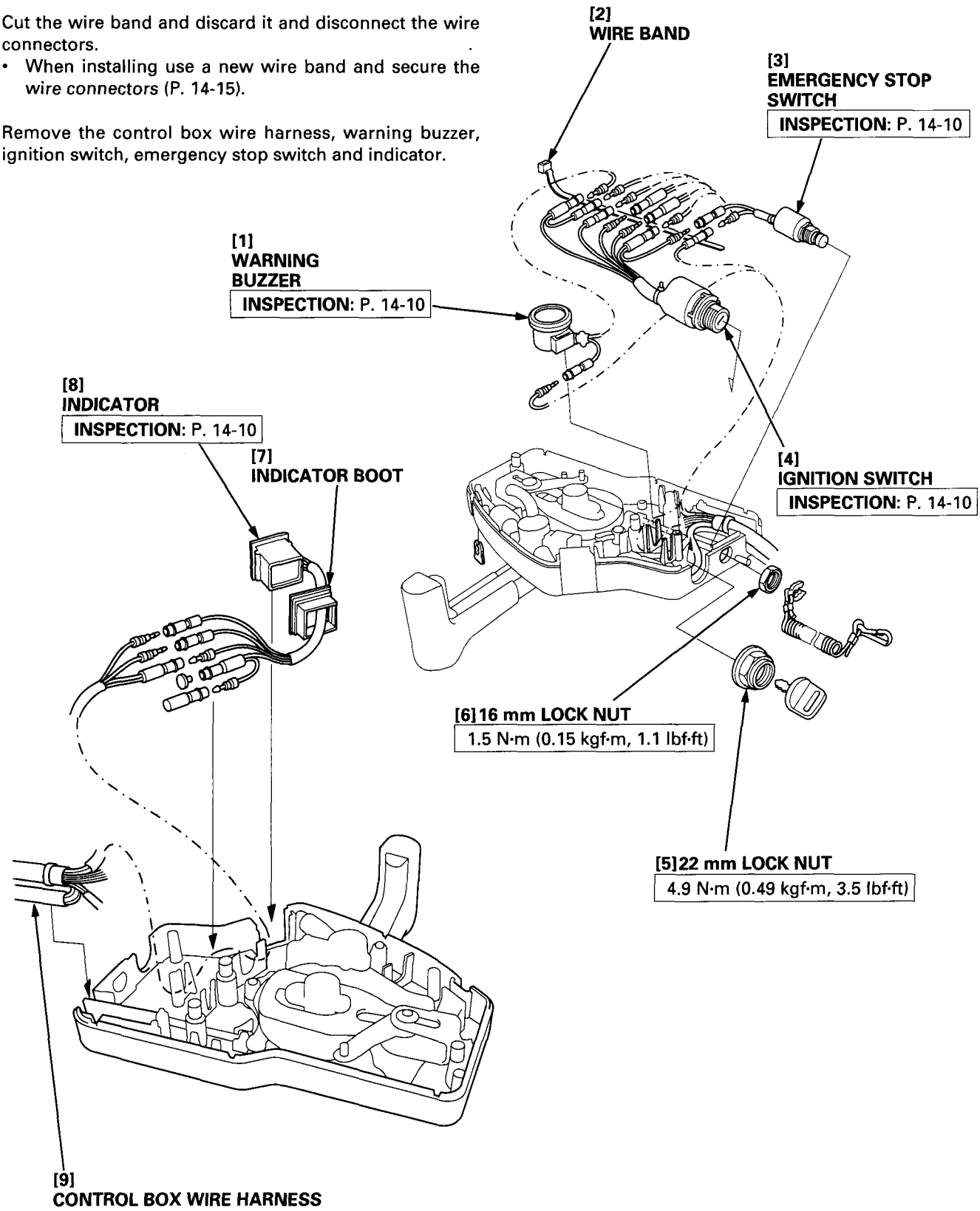
• ELECTRICAL COMPONENTS

1) Remove the 22 mm lock nut and ignition switch.

2) Remove the 16 mm lock nut and emergency stop switch.

3) Cut the wire band and discard it and disconnect the wire connectors.
   - When installing use a new wire band and secure the wire connectors (P. 14-15).

4) Remove the control box wire harness, warning buzzer, ignition switch, emergency stop switch and indicator.



• SLIDING PLATE

1) Remove the 4 mm E-clip and 6 mm washer and disconnect the link joint arm from the fast idle wheel.

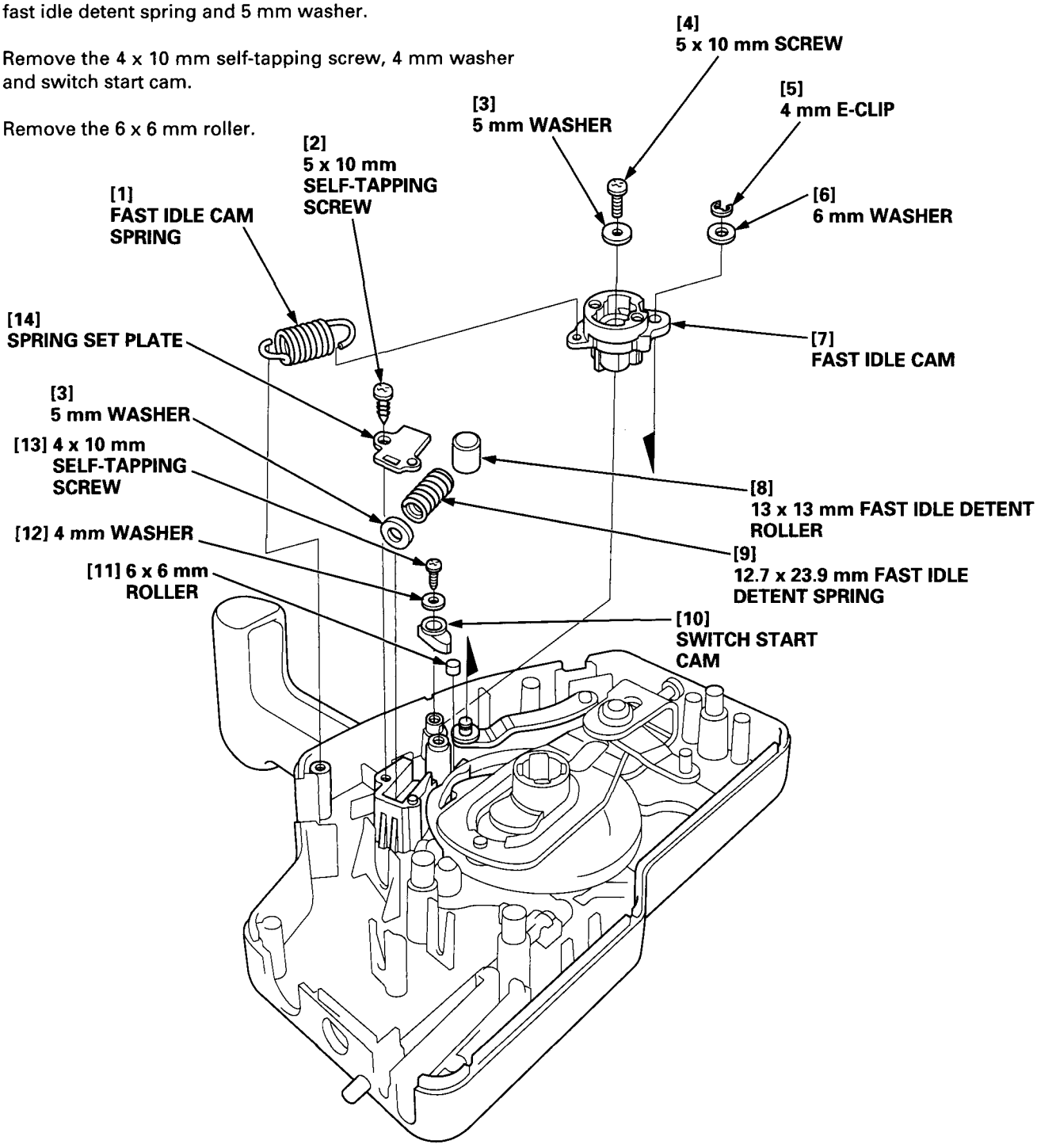
2) Remove the fast idle spring.

3) Remove the 5 x 10 mm screw and 5 mm washer. Remove the fast idle cam and spring.

4) Remove the 5 x 10 mm self-tapping screw, and remove the spring set plate, 13 x 13 mm fast idle detent roller, fast idle detent spring and 5 mm washer.

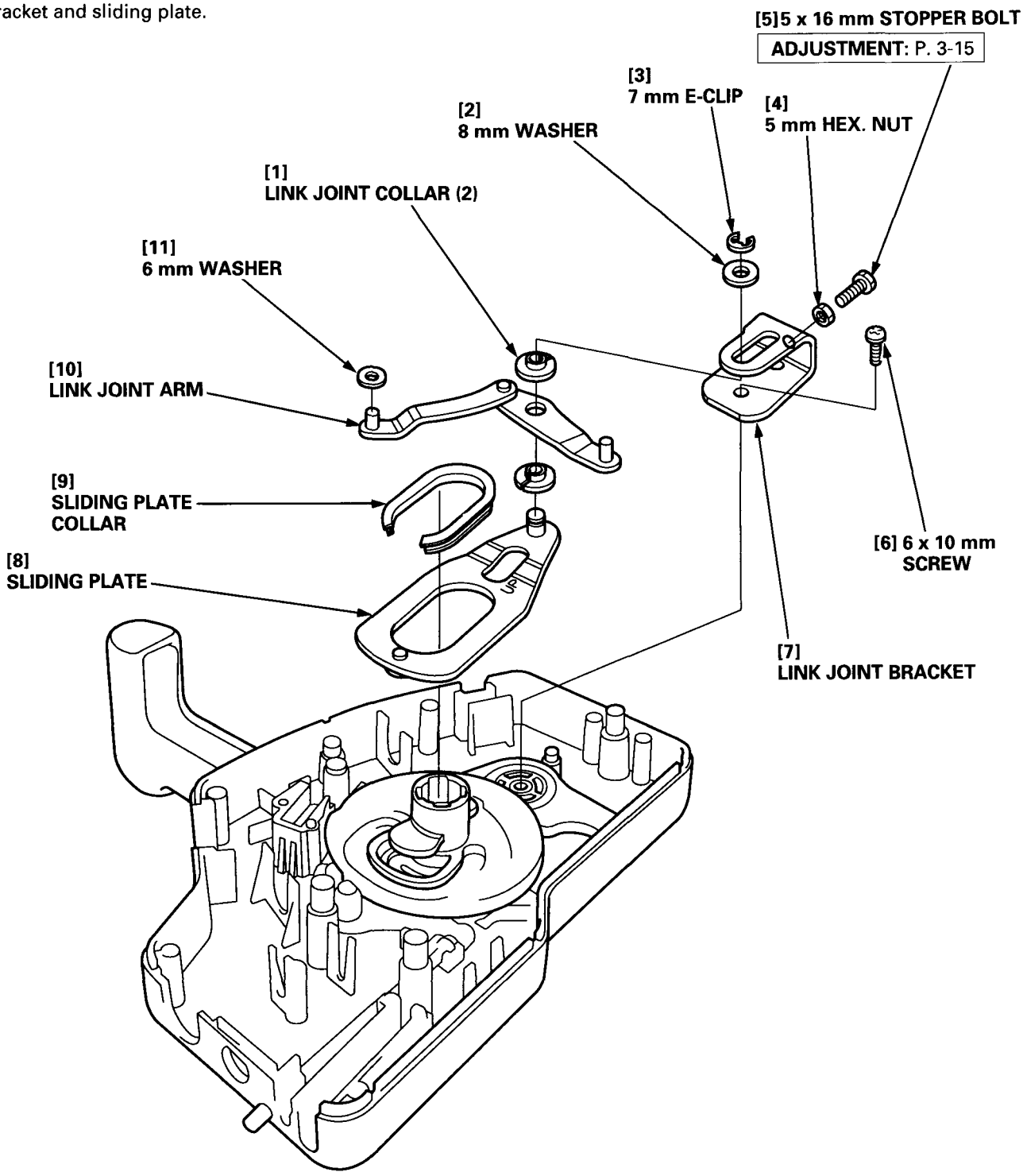
5) Remove the 4 x 10 mm self-tapping screw, 4 mm washer and switch start cam.

6) Remove the 6 x 6 mm roller.



7) Remove the 7 mm E-clip and 8 mm washer and remove the link joint arm and link joint collars.

8) Remove the 6 x 10 mm screw and remove the joint link bracket and sliding plate.



• CONTROL WHEEL

1) Remove the 8 x 35 mm hex. bolt and 8 mm washer.

2) Remove the control lever and control wheel.

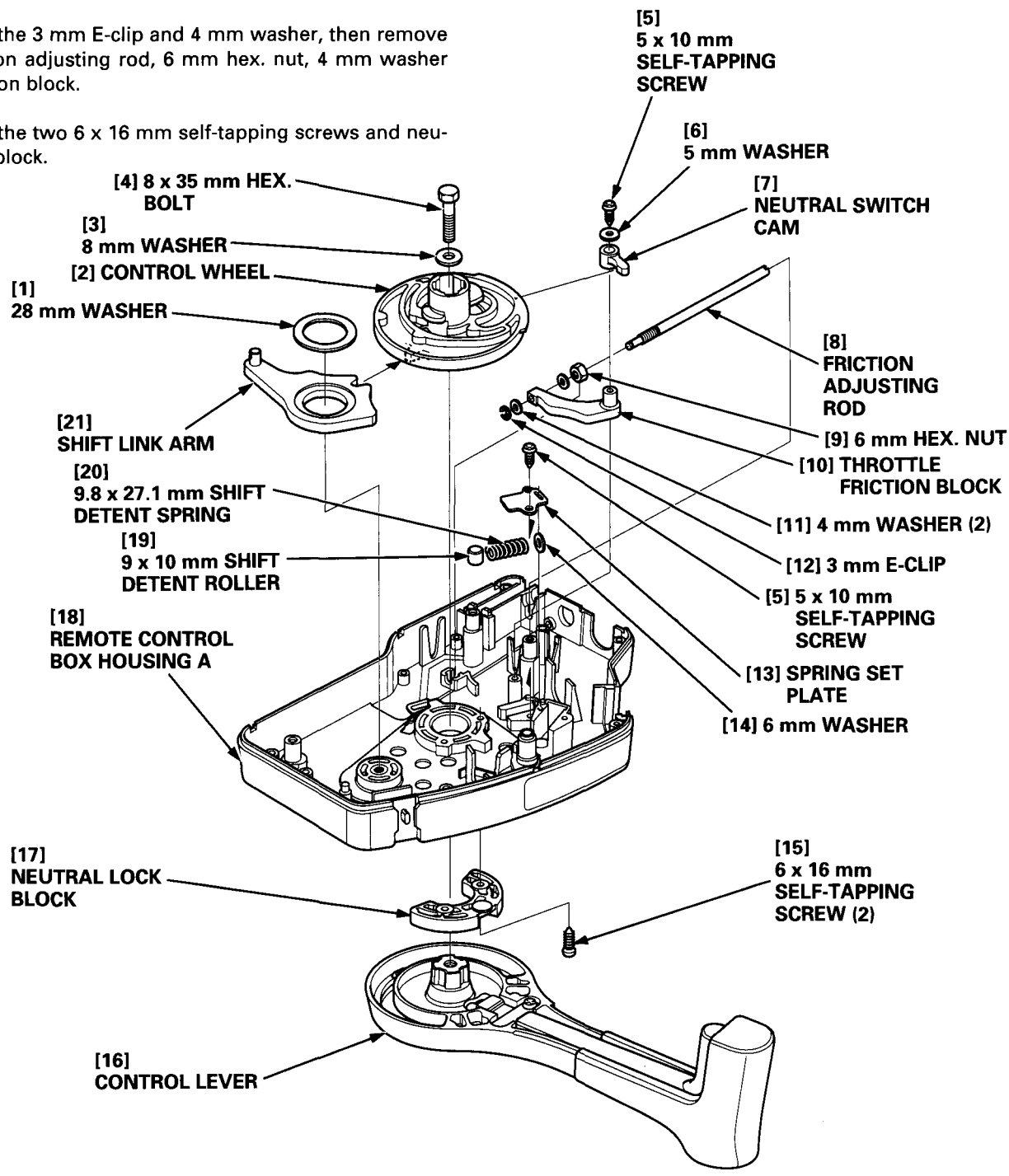
3) Remove the 28 mm washer and shift link arm.

4) Remove the 5 x 10 mm self-tapping screw, and remove the spring set plate, 9 x 10 mm shift detent roller, spring and 6 mm washer.

5) Remove the 5 x 10 mm self-tapping screw, 5 mm washer and neutral switch cam.

6) Remove the 3 mm E-clip and 4 mm washer, then remove the friction adjusting rod, 6 mm hex. nut, 4 mm washer and friction block.

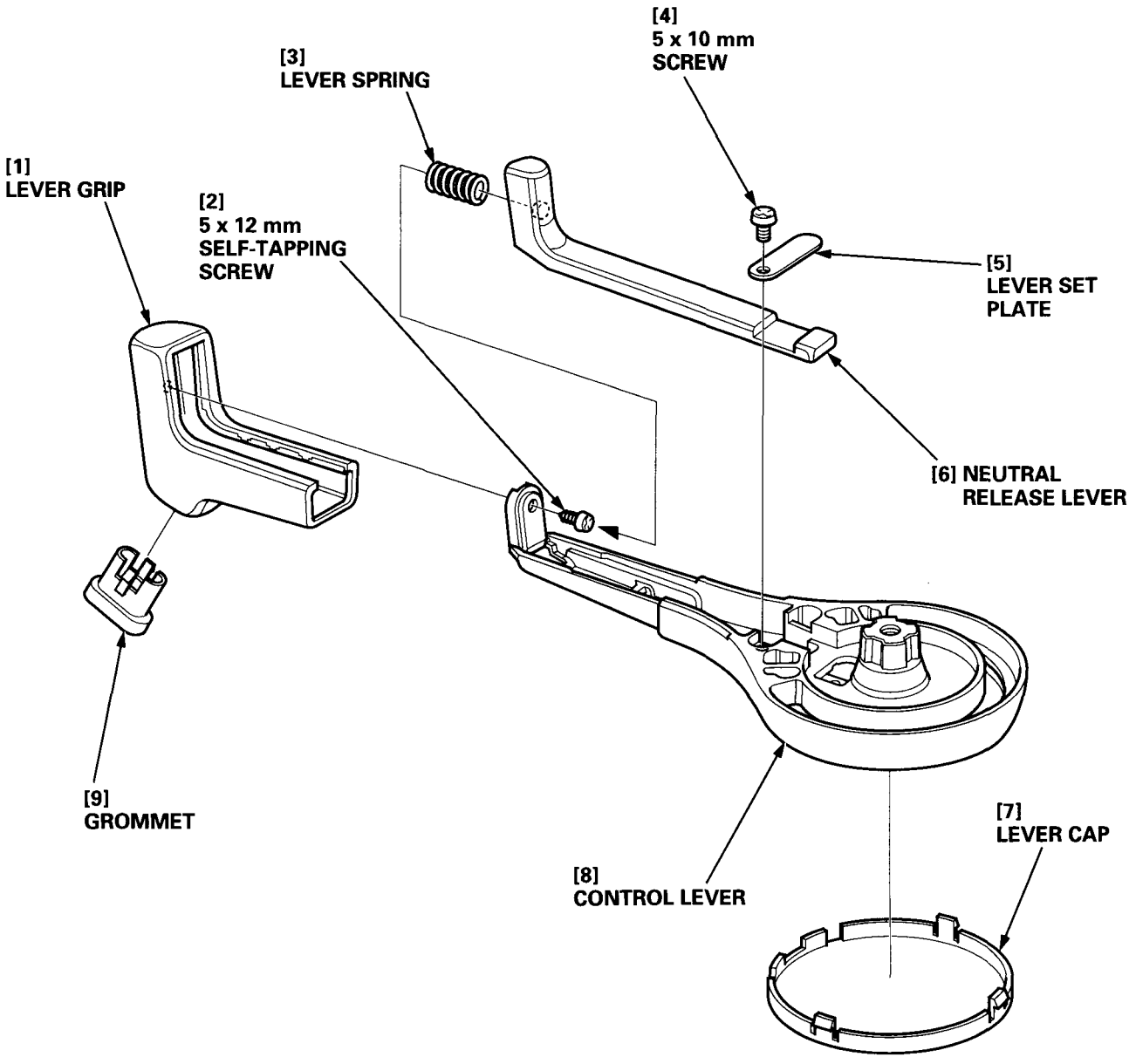
7) Remove the two 6 x 16 mm self-tapping screws and neutral lock block.



• CONTROL LEVER

1) Remove the 5 x 10 mm screw, lever set plate, neutral release lever and lever spring.

2) Remove the 5 x 12 mm self-tapping screw and control lever grip.



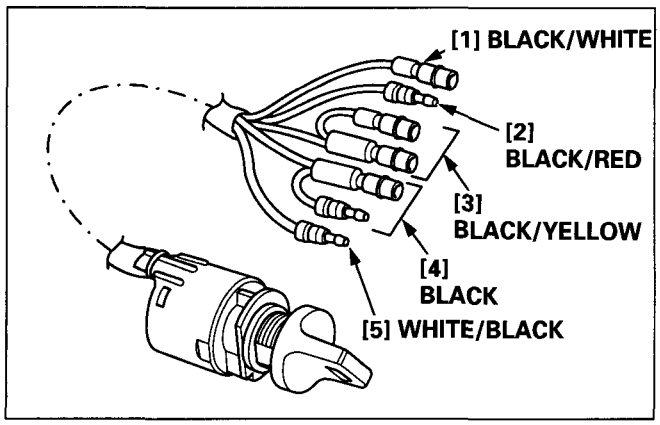
c. INSPECTION

• IGNITION SWITCH

Check for continuity between the terminals according to the table below.

There should be continuity between ○—○.

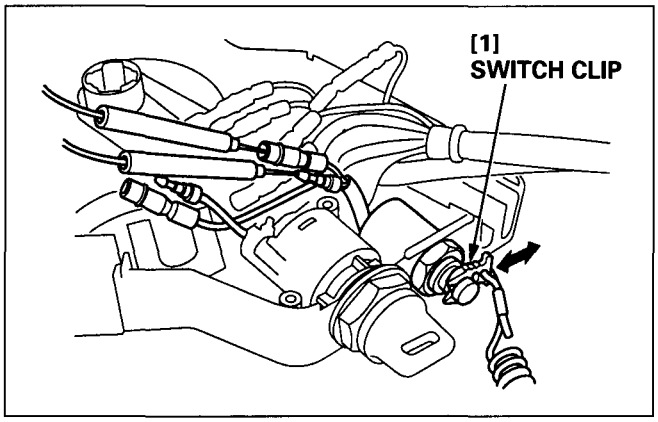
Collar / Position	Black	Black/ red	White/ black	Black/ yellow	Black/ white
OFF	○	○			
ON			○	○	
START			○	○	○



• EMERGENCY STOP SWITCH

Check for continuity between the terminals according to the table below.

Clip engaged.	There should be no continuity.
Clip disengaged.	There should be continuity.
Clip engaged and button pushed.	There should be continuity.

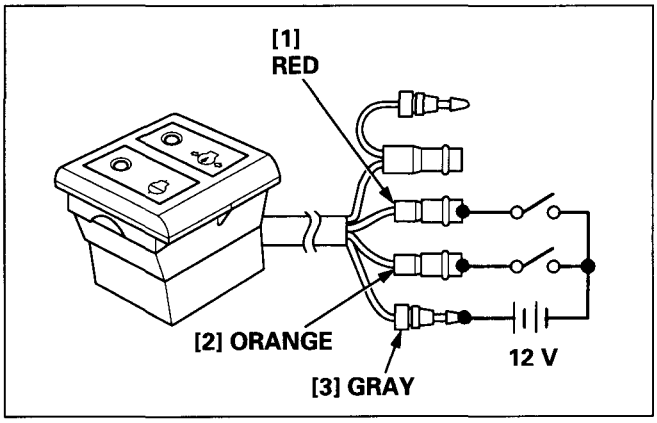


• INDICATOR

The green indicator should turn on when connecting a 12 V battery (+) terminal to the Gray terminal and (–) to the Orange terminal.

The red indicator should turn on when connecting a 12 V battery (+) terminal to the Gray terminal and (–) to the Red terminal.

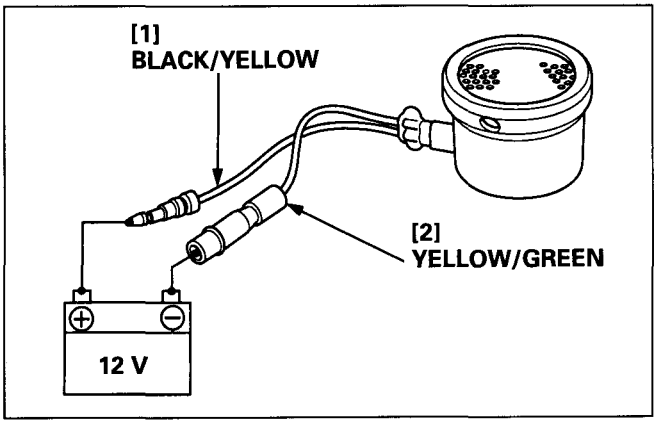
- Be sure the battery is in good condition before performing the test.



• WARNING BUZZER

Connect a battery (+) terminal to the Black/yellow terminal and (–) terminal to the Yellow/green. The warning buzzer should sound.

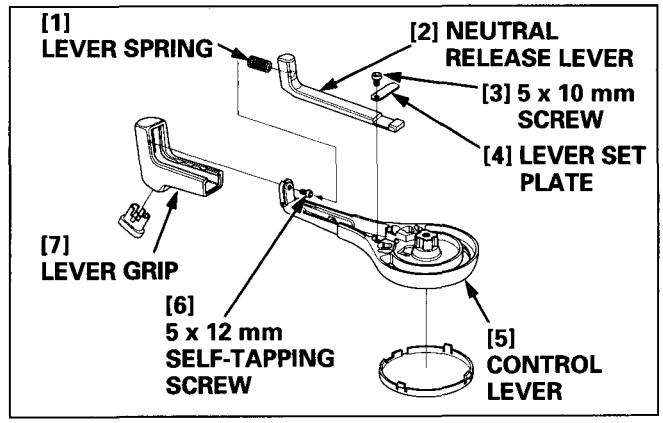
- Be sure the battery is in good condition before performing the test.



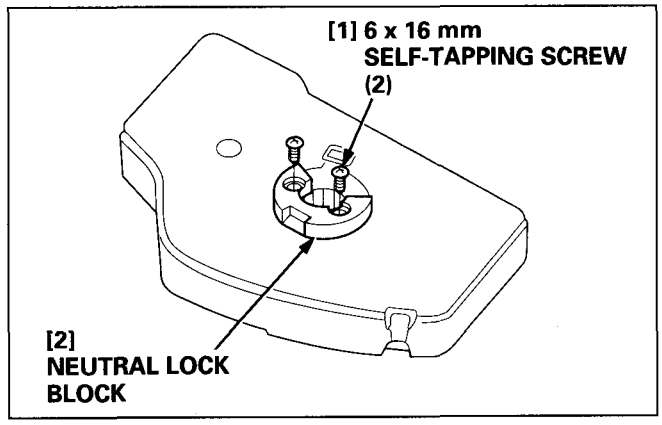
d. ASSEMBLY

1) Install the lever grip and secure it with the 5 x 12 mm self-tapping screw.

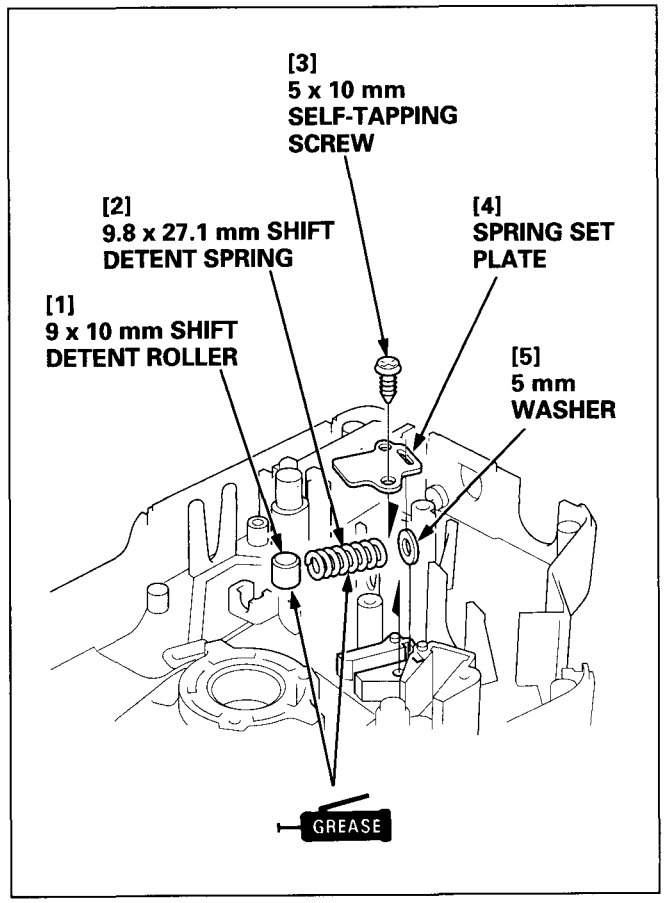
2) Install the lever spring, neutral release lever and lever set plate, and tighten the 5 x 10 mm screw.



3) Install the neutral lock block as shown and secure it with the 6 x 16 mm self-tapping screws.

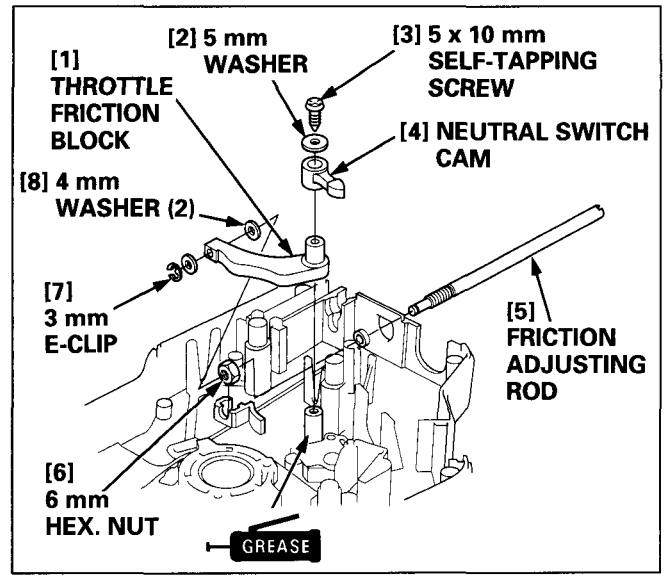


4) Apply marine grease to the detent spring (9.8 x 27.1 mm) and detent roller (9 x 10 mm). Install the 5 mm washer, spring and detent roller. Set the spring set plate by aligning the hole of the set plate with the boss of the control box housing, and tighten the 5 x 10 mm self-tapping screw.



5) Apply marine grease to the friction block pivot point. Set the 6 mm hex. nut in the control box housing, and thread the adjusting rod slightly. Install the 4 mm washer to the adjusting rod, then install the throttle friction block and 4 mm washer and secure the 3 mm E-clip.

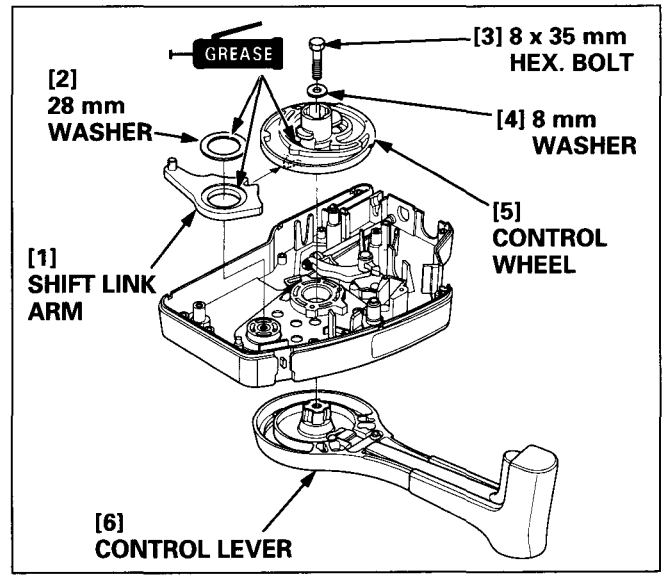
6) Install the neutral switch cam and 5 mm washer and secure the 5 x 10 mm self-tapping screw.



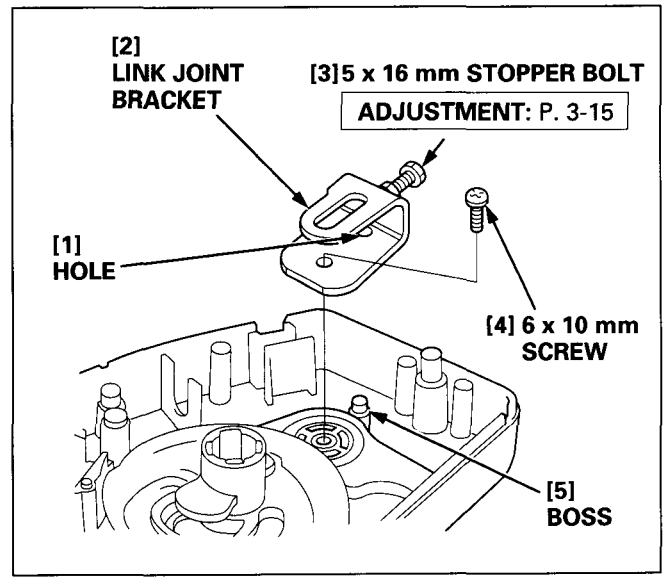
7) Apply marine grease to the sliding surfaces of the shift link arm, 28 mm washer, control wheel and control lever, then install them in the control box housing.

8) Install the 8 mm washer and tighten the 8 x 35 mm hex. bolt to the specified torque.

TORQUE: 20 N·m (2.0 kgf·m, 14 lbf·ft)



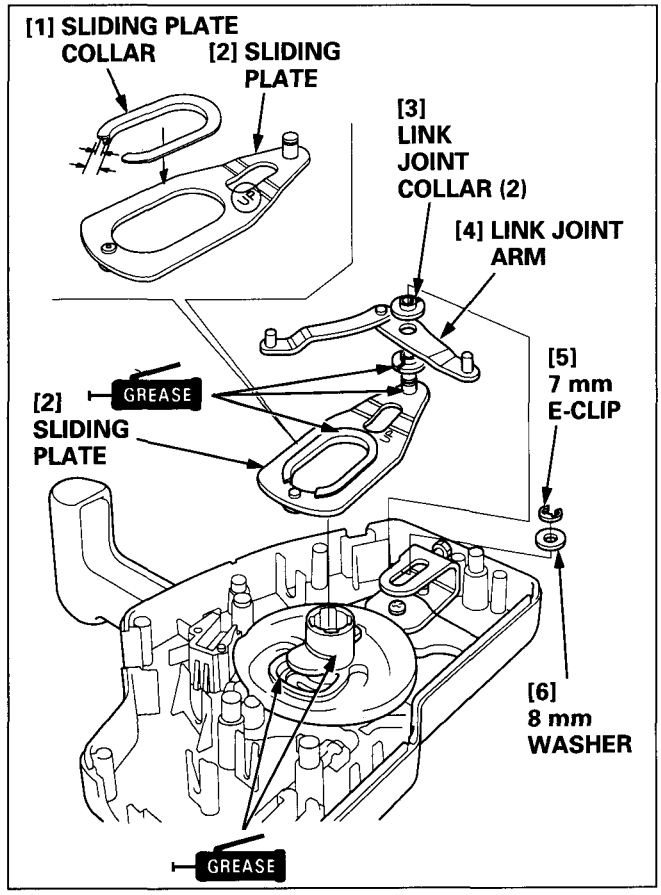
9) Install the link joint bracket by aligning the hole of the link joint bracket with the boss on the control box housing.
Tighten the 6 x 10 mm screw.



10) Attach the sliding plate collar to the sliding plate with its opening toward the opposite side of the UP mark and shorter lip facing down as shown.

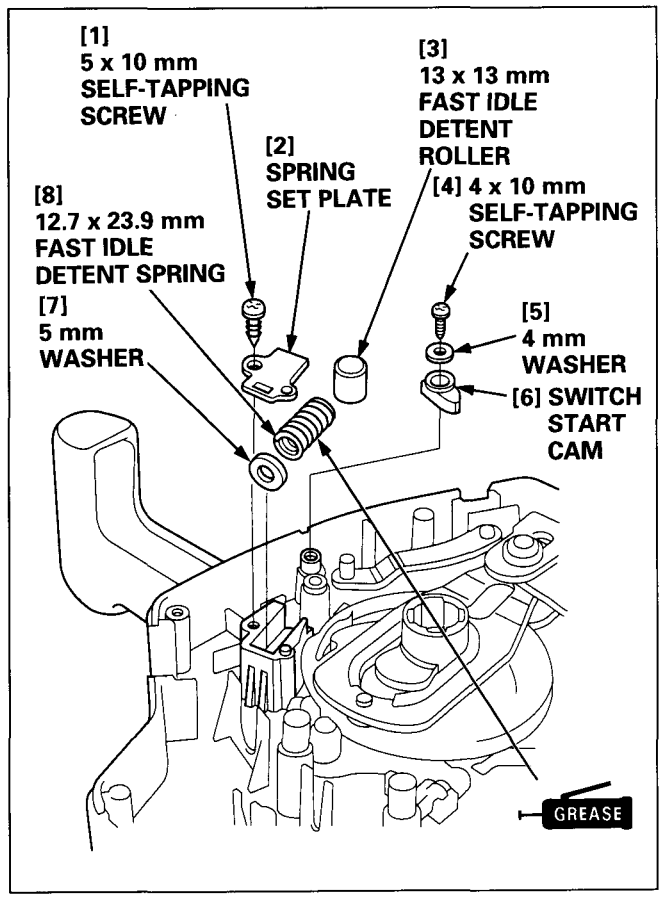
11) Apply marine grease to the sliding surfaces of the sliding plate and control wheel, and install the sliding plate with the UP mark facing up.

12) Install the link joint arm and link joint collars to the sliding plate, then install them onto the control wheel and secure them with the 8 mm washer and 7 mm E-clip.



13) Apply marine grease to the detent spring (12.7 x 23.9 mm) and detent roller (13 x 13 mm). Install the 5 mm washer, spring and detent roller. Set the spring set plate by aligning the hole of the set plate with the boss of the control box housing, and tighten the 5 x 10 mm self-tapping screw.

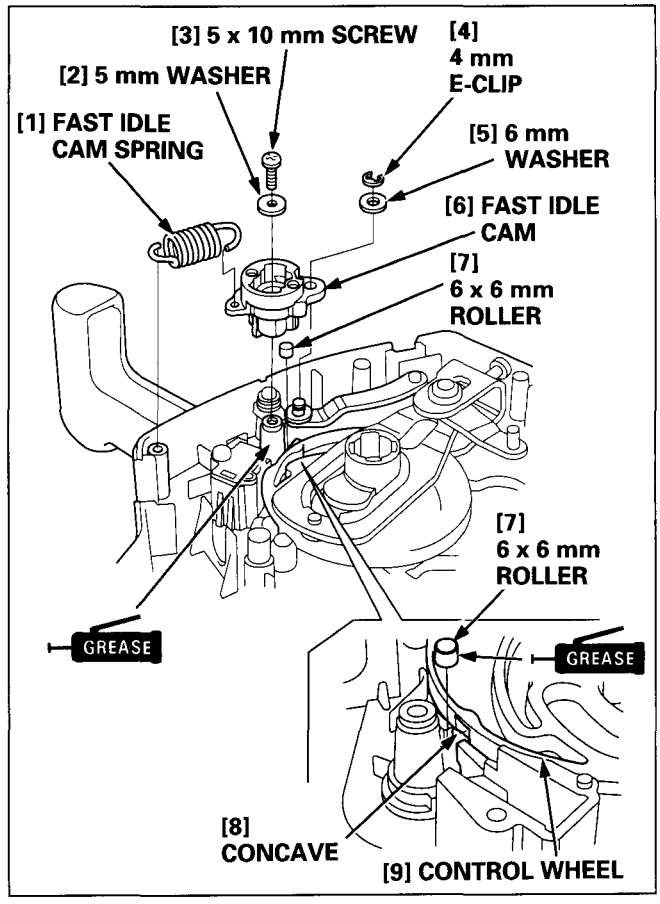
14) Install the switch start cam, 4 mm washer and 4 x 10 self-tapping screw.



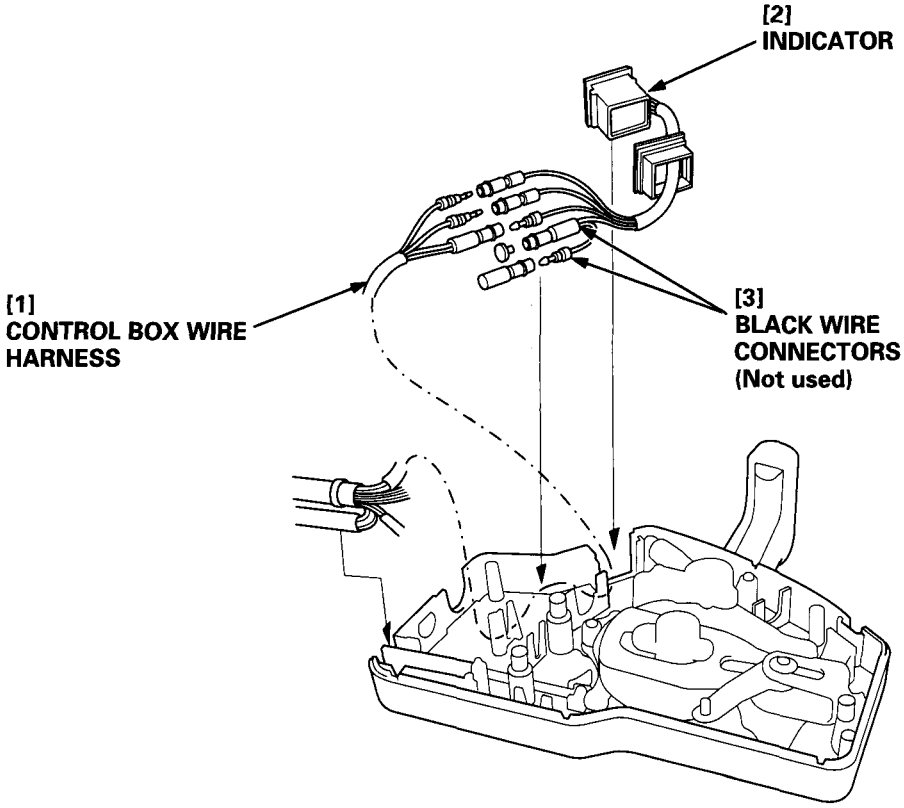
15) Apply marine grease to the 6 x 6 mm roller and install it in the concave of the control wheel as shown.

16) Apply marine grease to the sliding surfaces of the fast idle cam. Set the fast idle spring to the fast idle cam and install them on the idle cam pivot shaft by pushing the detent roller slightly. Install the 5 mm washer and tighten the 5 x 10 mm screw.

17) Install the 6 mm washer and secure the 4 mm E-clip.



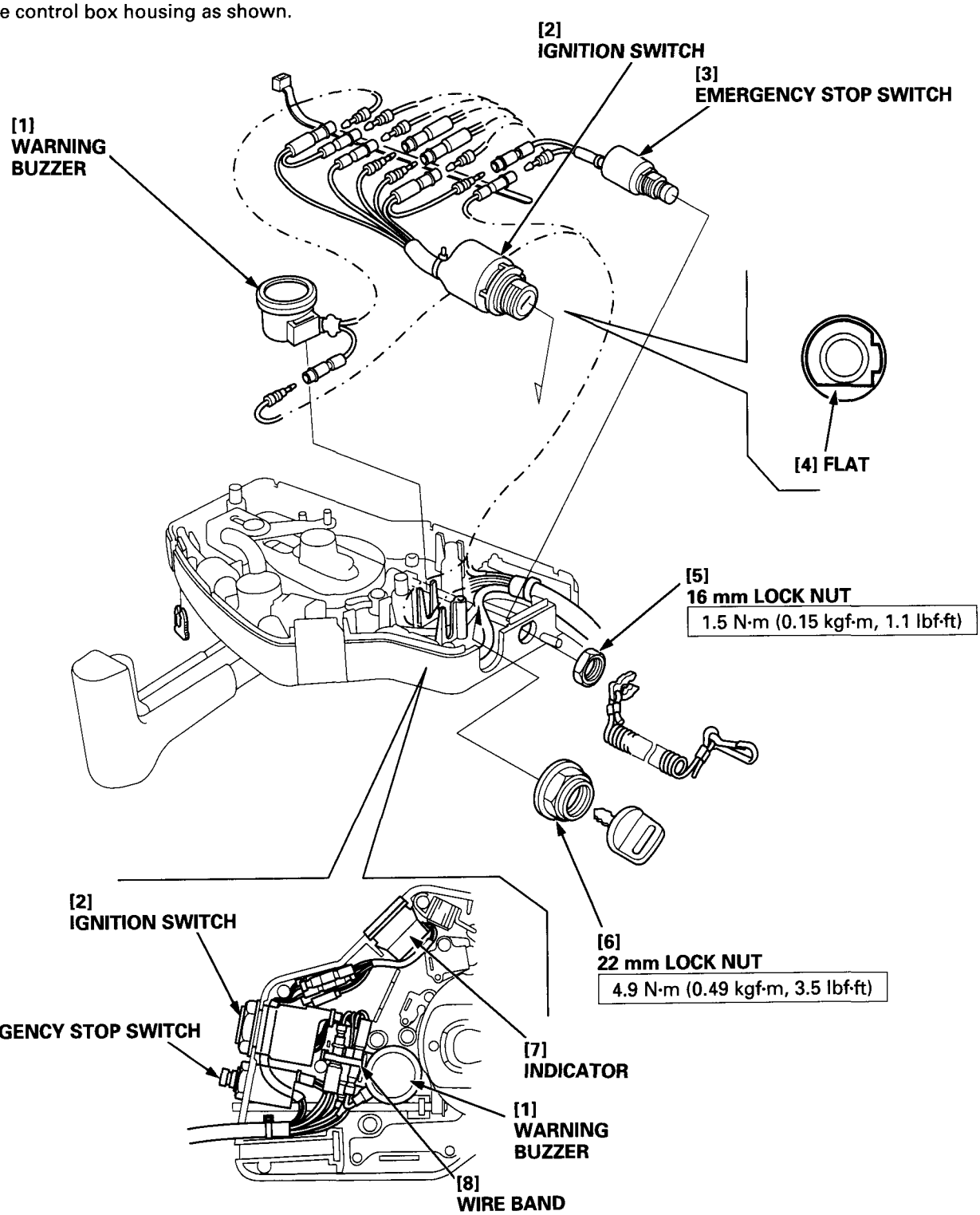
18) Install the control box wire harness and indicator, and then connect the connectors.



19) Install the emergency stop switch and ignition switch and tighten the lock nuts to the specified torque.
    - Install the ignition switch with the flat of the flange facing down as shown.

TORQUES:
16 mm Lock nut: 1.5 N·m (0.15 kgf·m, 1.1 lbf·ft)
22 mm Lock nut: 4.9 N·m (0.49 kgf·m, 3.5 lbf·ft)

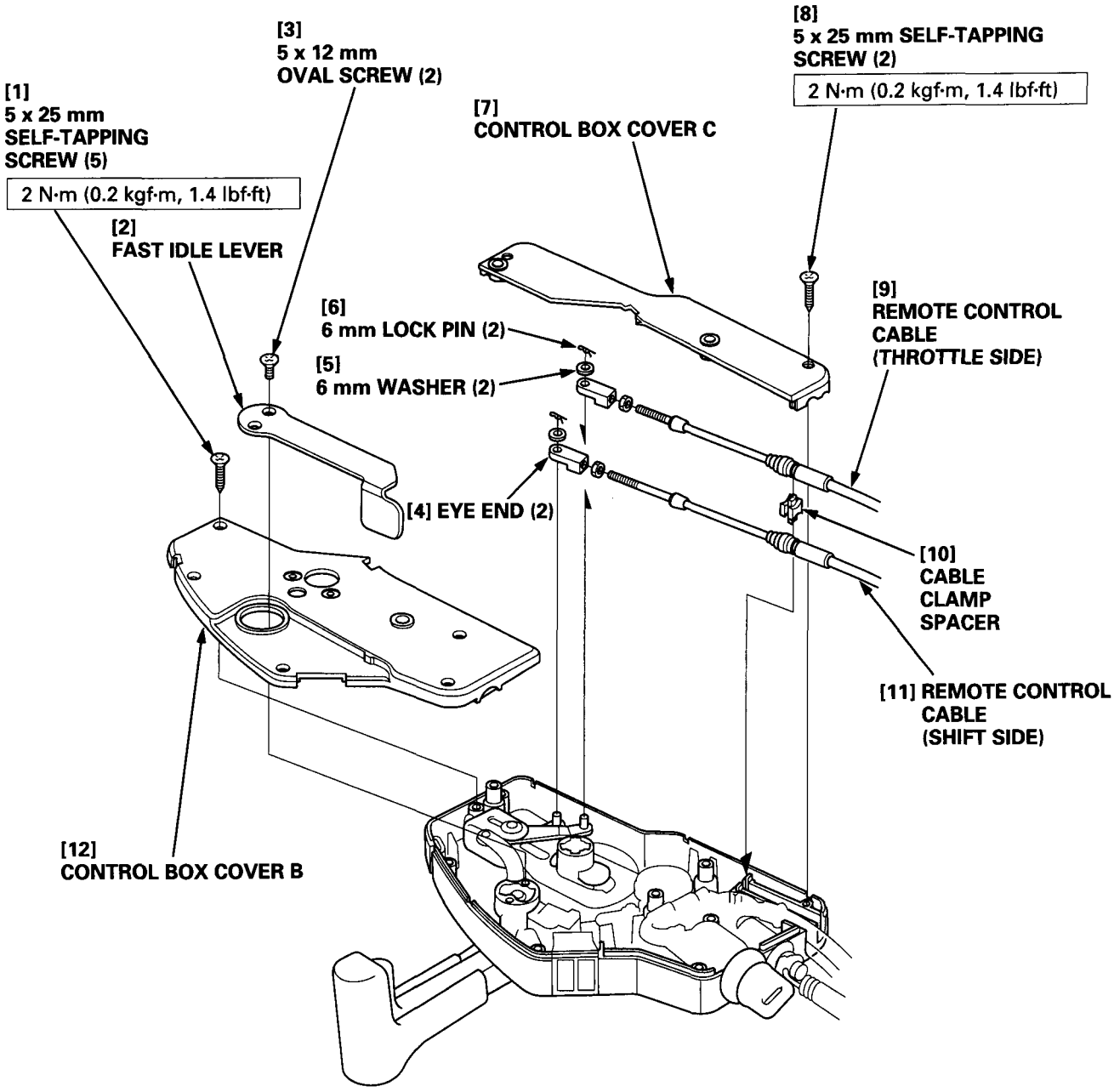
20) Install the warning buzzer. Connect the connectors and clamp the connectors with the wire band. Set the wires in the control box housing as shown.



21) Install the control box cover B and tighten the 5 x 25 mm self-tapping screws.

22) Install the fast idle lever and tighten the 5 x 12 mm oval screws.

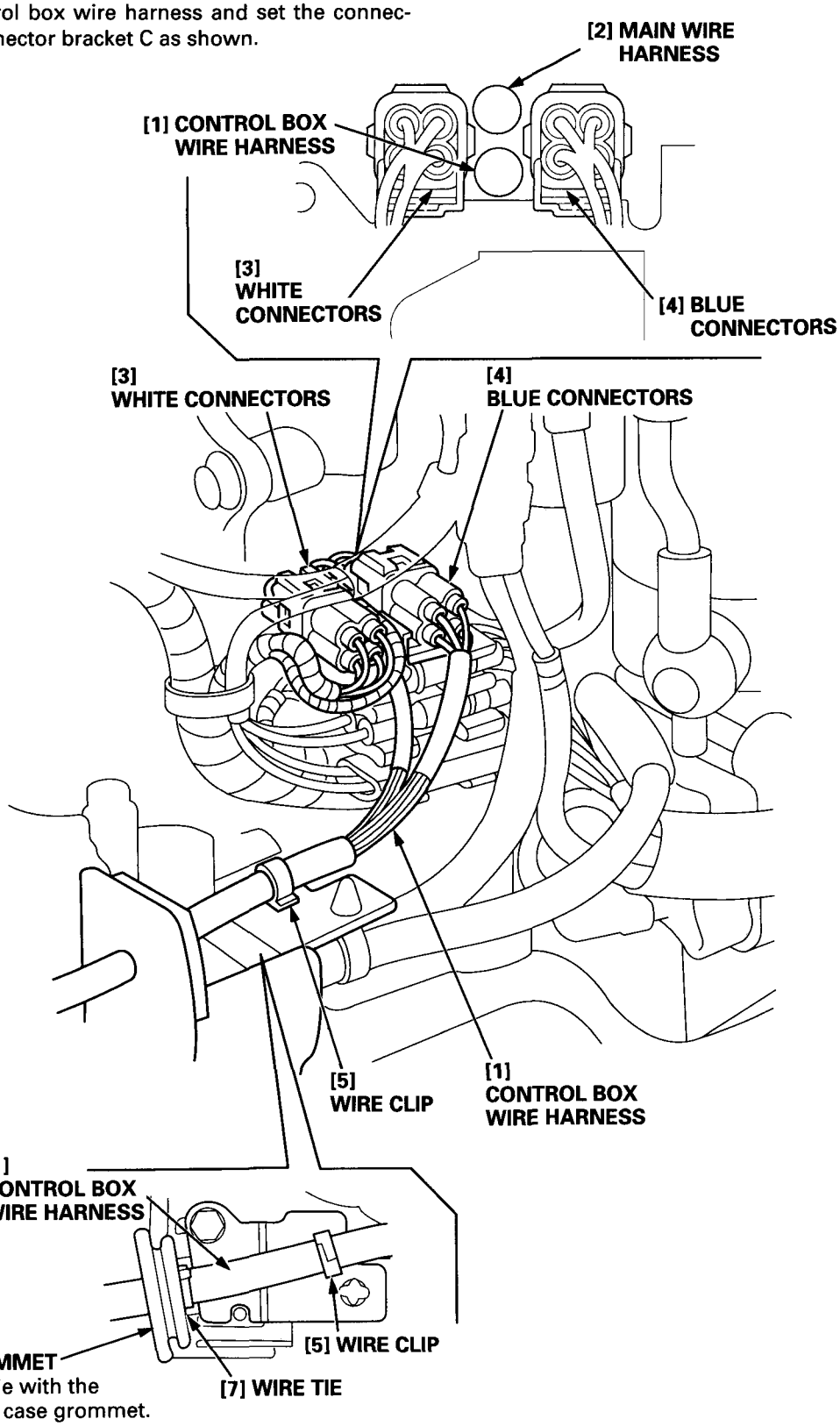
23) Connect the control cables and install the control box cover C and tighten the 5 x 25 mm self-tapping screws.



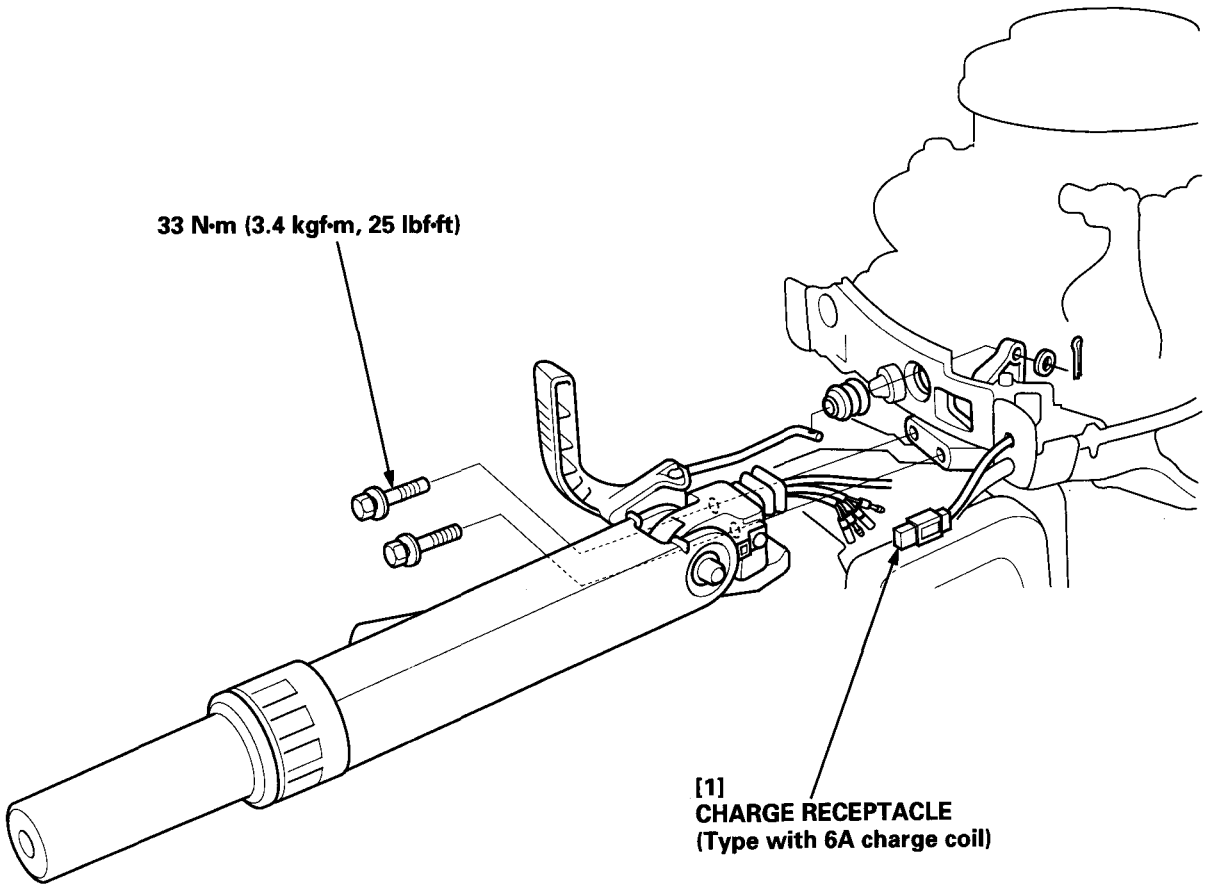
e. INSTALLATION

Installation is the reverse order of removal.

- Install the control box wire harness by aligning the cable tie with the oil case grommet as shown.
- Route the control box wire harness and set the connectors on the connector bracket C as shown.



1. REMOVAL
2. DISASSEMBLY
3. INSPECTION
4. ASSEMBLY
5. INSTALLATION

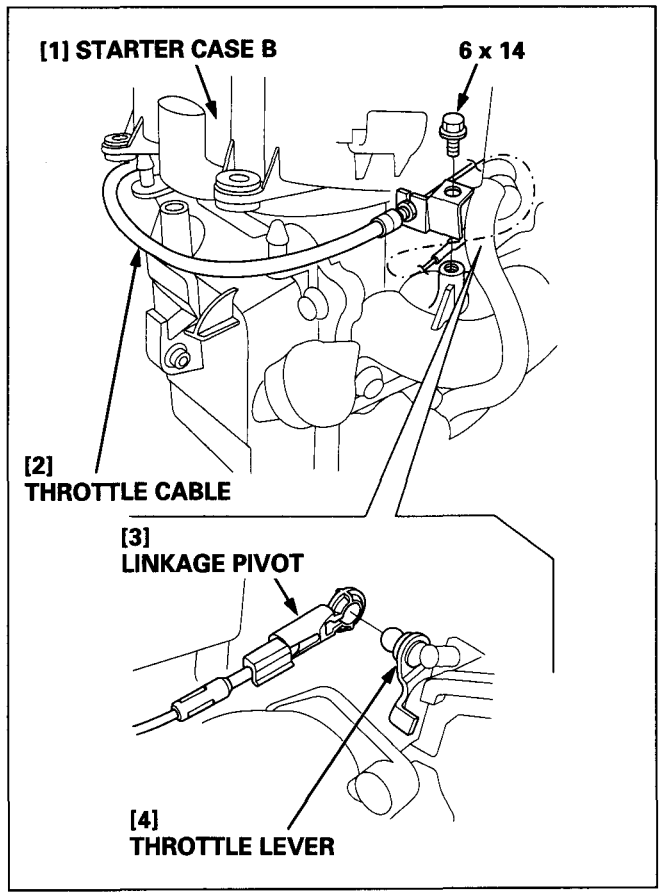


1. REMOVAL

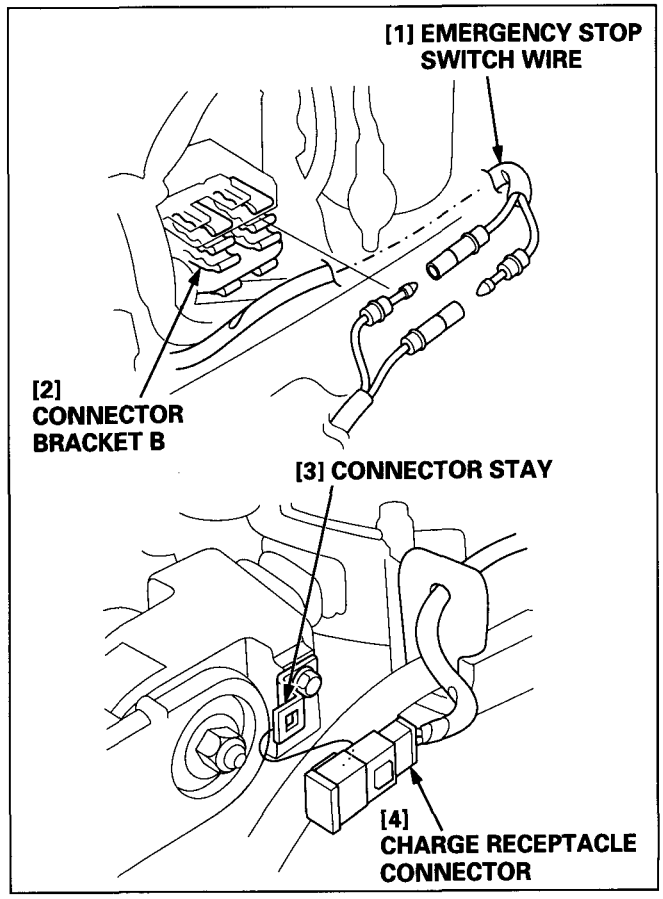
1) Remove the following:
   — engine cover (P. 5-1).
   — left engine under cover (P. 5-2).

2) Lift the starter case B slightly, and disconnect the tube from the starter case B at the carburetor side.

3) Remove the 6 x 14 mm flange bolt and throttle cable stay. Disconnect the throttle cable linkage pivot from the carburetor throttle lever.

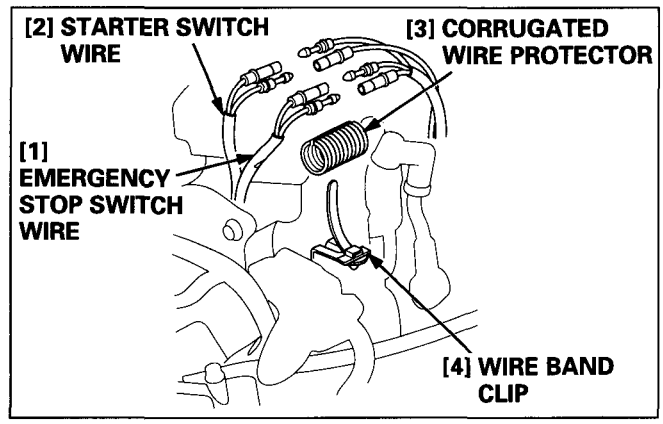


4) Type without electric starter: Remove the emergency stop switch wire connectors from connector bracket B and disconnect them. Remove the charge receptacle connector from the stay.



5) Type with electric starter: Release the wire band clip on the connector bracket C and remove the wire protector, then disconnect the starter switch and emergency stop switch wire connectors.

6) Open the wire band and remove the switch wires.

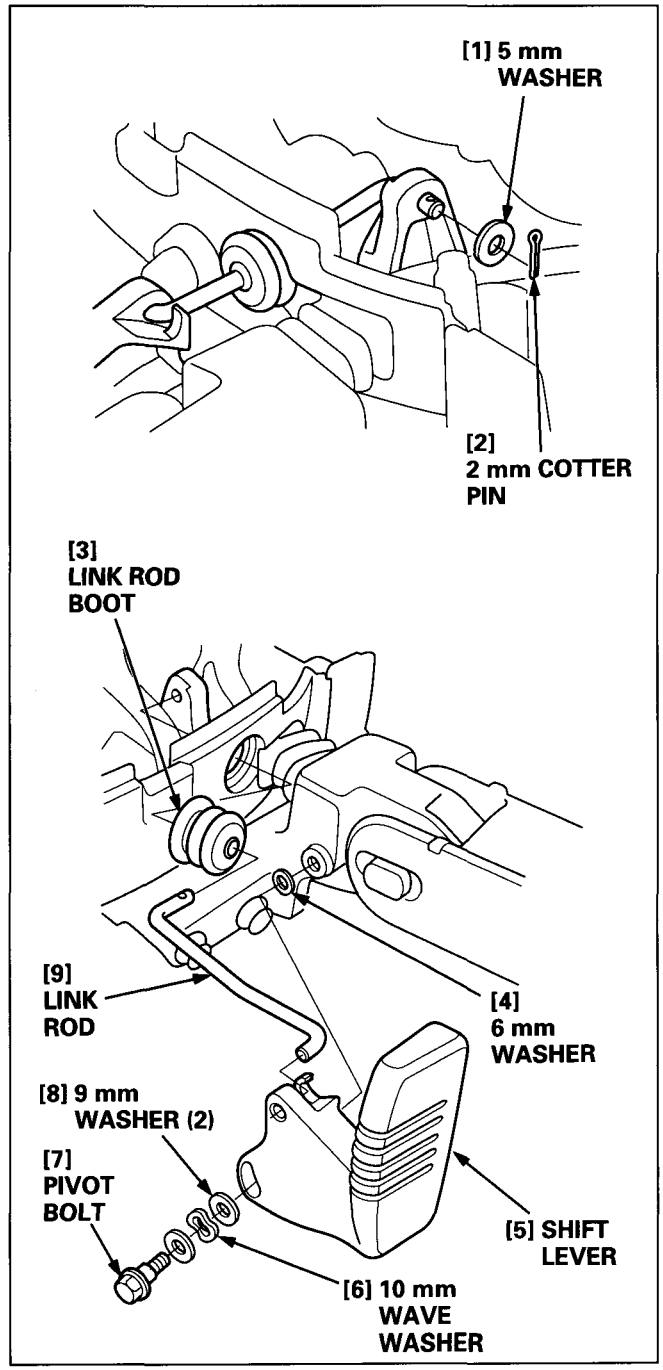


7) Remove the 2 mm cotter pin and 5 mm washer and disengage the link rod from the shift shaft.
   - Do not reuse the 2 mm cotter pin, replace with new one when reassembly.

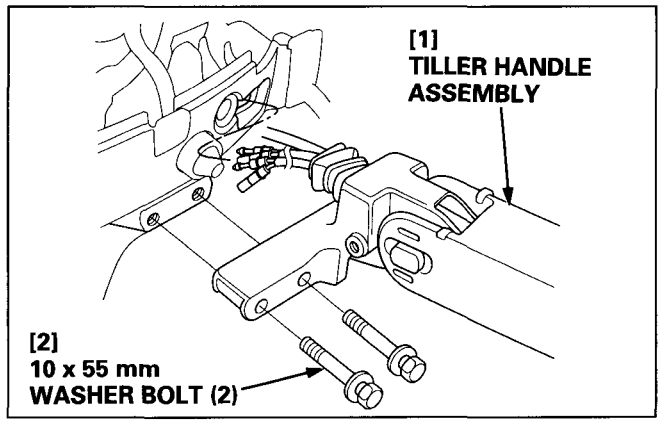
8) Remove the shift lever pivot bolt, 10 mm wave washer, two 9 mm washers, 6 mm washer and shift lever from the tiller handle.

9) Remove the link rod boot, link rod and shift lever as an assembly.

10) Remove the link rod from the shift lever if necessary.

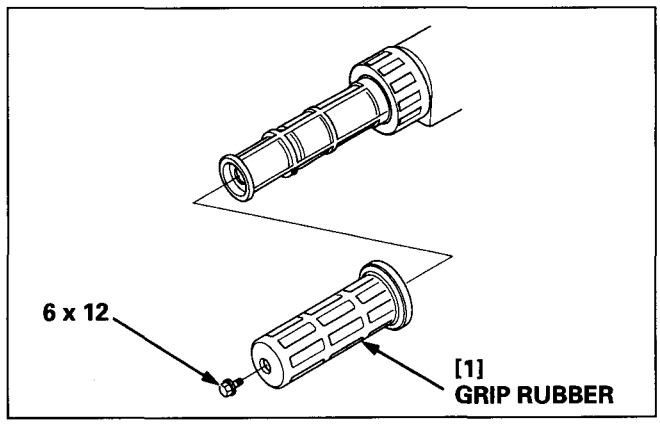


11) Remove the 10 x 55 mm washer bolts and tiller handle assembly.



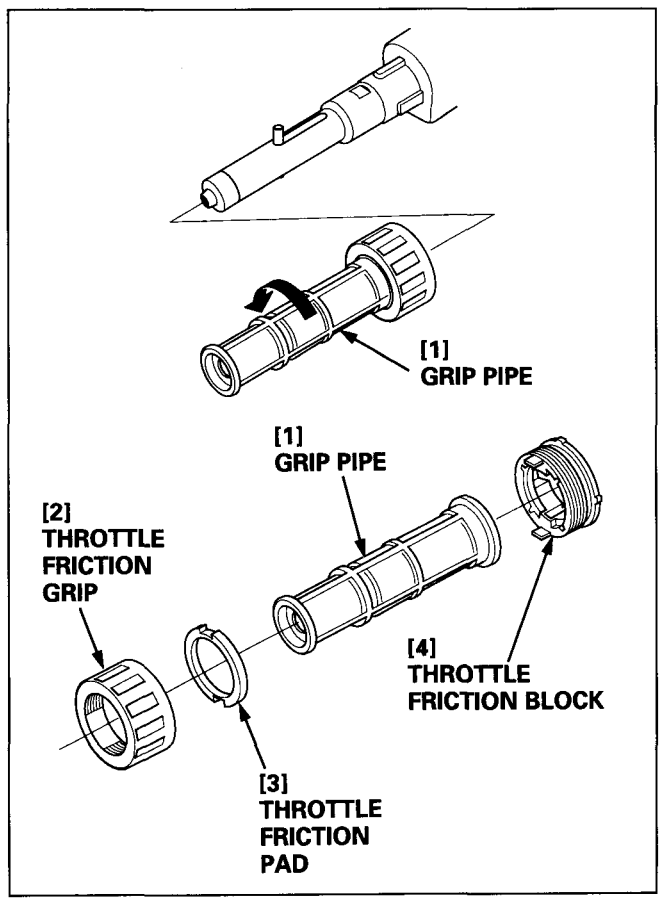
2. DISASSEMBLY

1) Remove the grip rubber, then remove the 6 x 12 mm flange bolt.

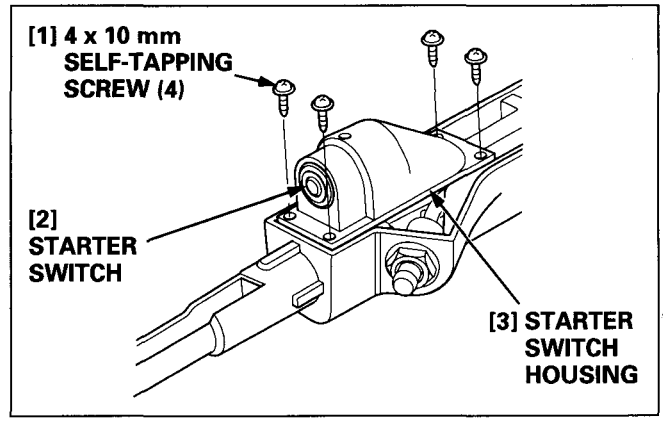


2) Loosen the throttle friction grip, remove the throttle grip pipe assembly by turning it counterclockwise viewed from the grip end.

3) Remove the throttle friction grip, throttle friction pad, and throttle friction block from the throttle grip pipe.



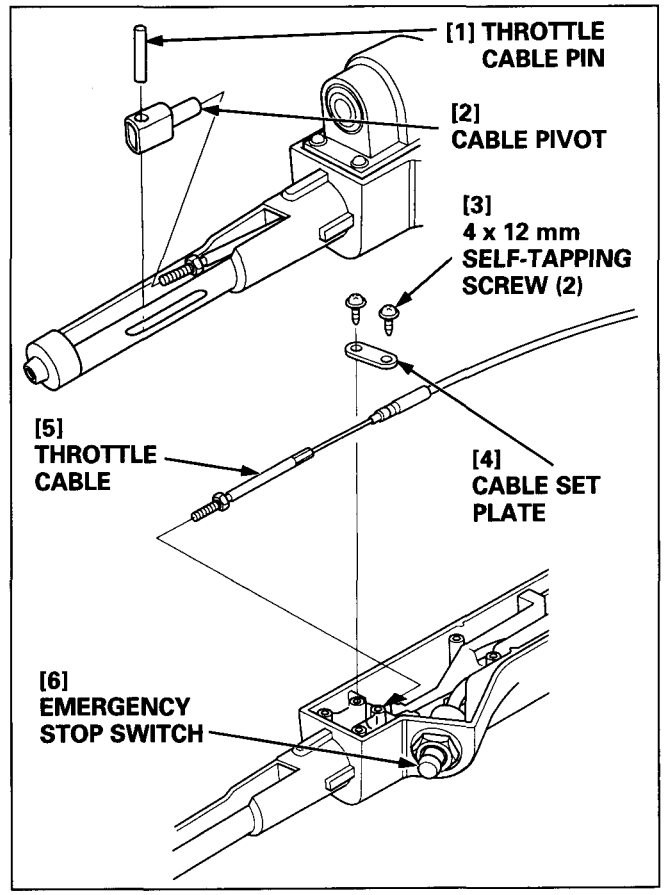
4) Remove the four 4 x 10 mm self-tapping screws and lift up the starter switch housing with the starter switch attached (Type with electric starter).
   - See page 15-6 for the starter switch replacement.



5) Remove the throttle cable pin from the cable pivot.

6) Loosen the lock nut and remove the throttle cable pivot.

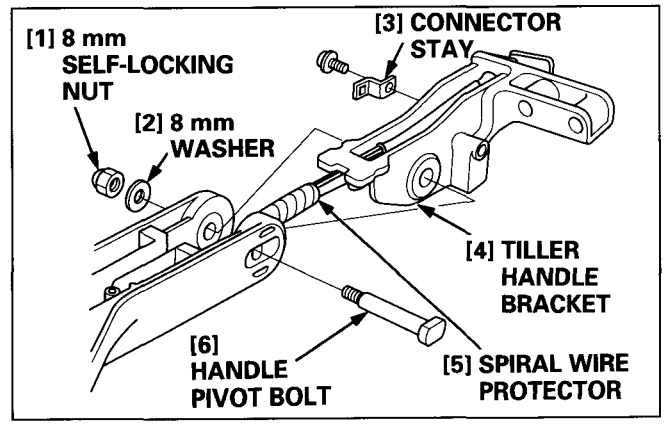
7) Remove the two 4 x 12 mm self-tapping screws and cable set plate.
   - See page 15-7 for the emergency stop switch replacement.



8) Remove the spiral wire protector, then pull out the throttle cable and switch wires taking care not to damage the switch wires.

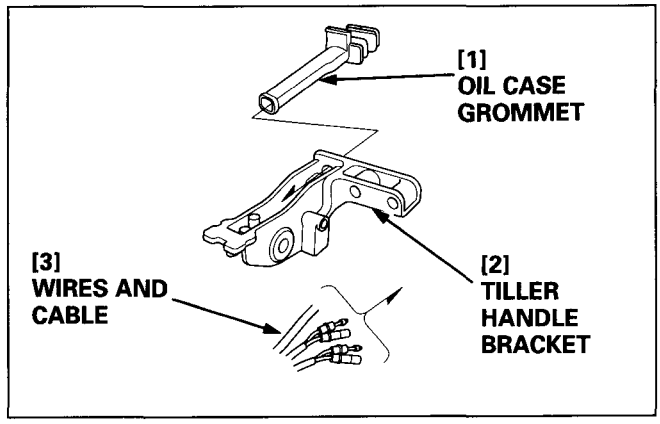
9) Remove the 8 mm self-locking nut and 8 mm washer. Remove the handle pivot bolt and separate the tiller handle bracket.

   Remove the connector stay (Type with 6 A charge coil).



10) Remove the tiller handle bracket.

11) Remove the spiral protector from the wires and pull out the switch wires and throttle cable, and then remove the oil case grommet from the tiller handle bracket.



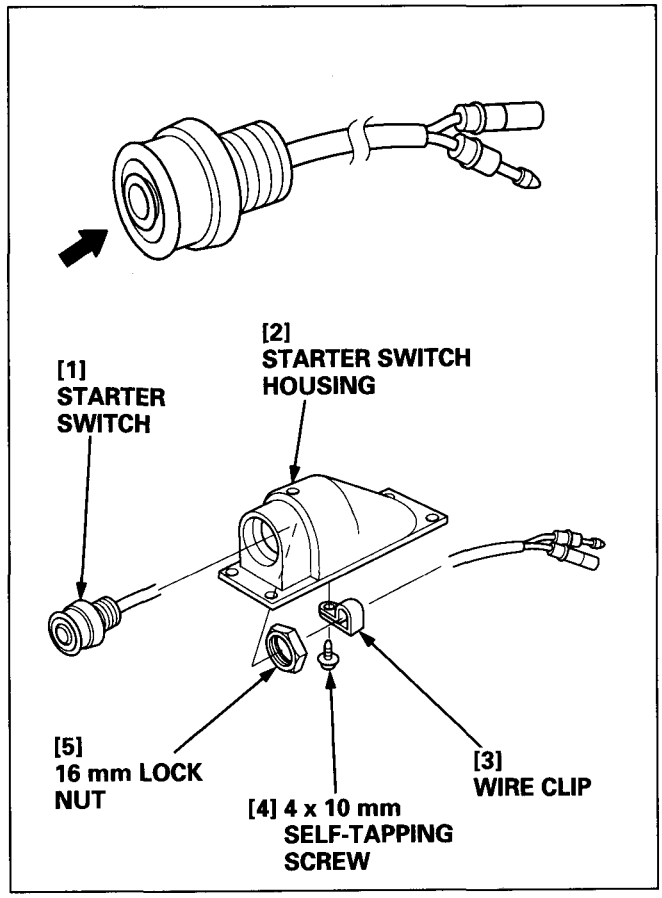
3. INSPECTION

• STARTER SWITCH

- The starter switch test can be performed with the switch installed on the tiller handle.

Check for continuity between the terminals.

There should be continuity between the terminals when the switch is pushed and no continuity with the switch free. Replace it necessary.



• STARTER SWITCH REPLACEMENT

1) Remove the 4 x 10 mm self-tapping screw and wire clip.

2) Remove the 16 mm lock nut and remove the starter switch from the starter switch housing.

3) Install a new starter switch and tighten the 16 mm lock nut to the specified torque.

   TORQUE: 1.5 N•m (0.15 kgf•m, 1.1 lbf•ft)

4) Set the wire clip in the place and secure it with the 4 x 10 mm self-tapping screw.

• EMERGENCY STOP SWITCH

Check for continuity between the terminals according to the table below.

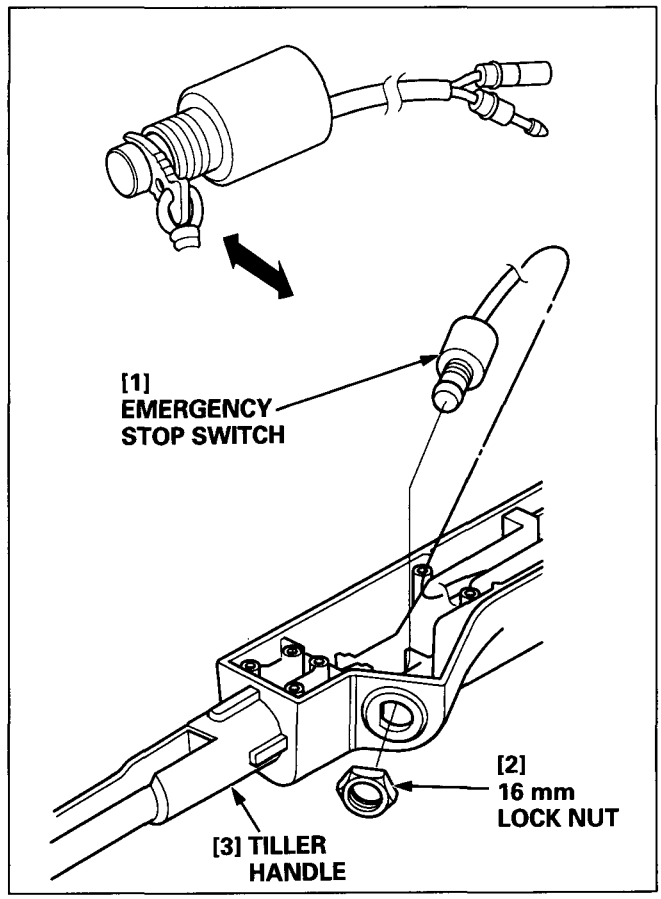
Clip engaged.	There should be no continuity.
Clip disengaged.	There should be continuity.
Clip engaged and button pushed.	There should be continuity.

• EMERGENCY STOP SWITCH REPLACEMENT

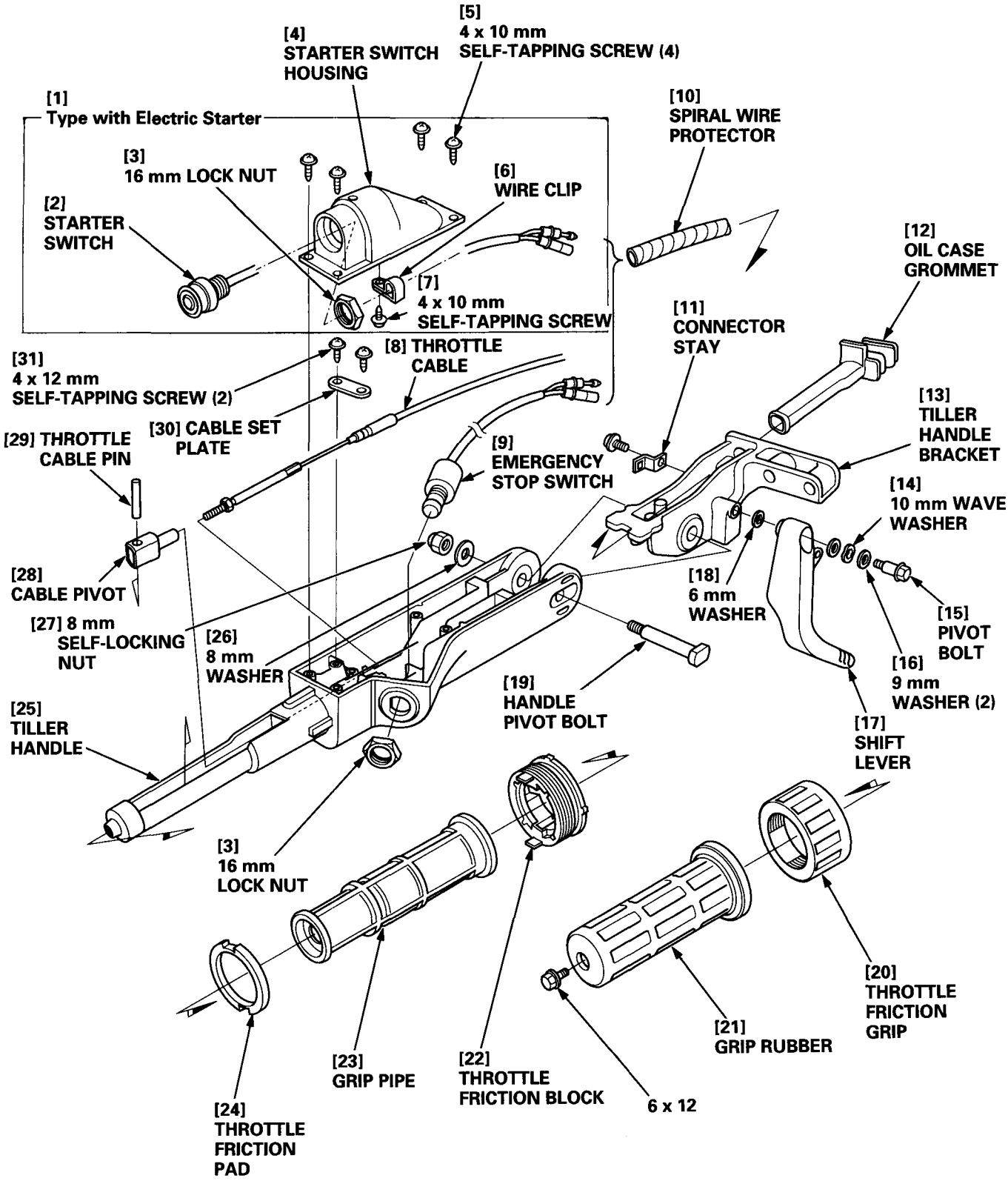
1) Remove the 16 mm lock nut and remove the emergency stop switch. Replace if necessary.

2) Install a new emergency stop switch and tighten the 16 mm lock nut to the specified torque.

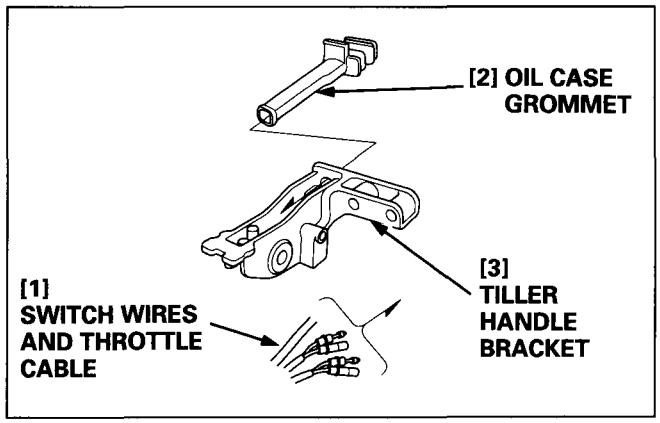
TORQUE: 1.5 N•m (0.15 kgf•m, 1.1 lbf•ft)



4. ASSEMBLY


[1]
Type with Electric Starter
[2]
STARTER SWITCH
[3]
16 mm LOCK NUT
[4]
STARTER SWITCH HOUSING
[5]
4 x 10 mm
SELF-TAPPING SCREW (4)
[6]
WIRE CLIP
[7]
4 x 10 mm
SELF-TAPPING SCREW
[8] THROTTLE CABLE
[9]
EMERGENCY STOP SWITCH
[10]
SPIRAL WIRE PROTECTOR
[11]
CONNECTOR STAY
[12]
OIL CASE GROMMET
[13]
TILLER HANDLE BRACKET
[14]
10 mm WAVE WASHER
[15]
PIVOT BOLT
[16]
9 mm WASHER (2)
[17]
SHIFT LEVER
[18]
6 mm WASHER
[19]
HANDLE PIVOT BOLT
[20]
THROTTLE FRICTION GRIP
[21]
GRIP RUBBER
[22]
THROTTLE FRICTION BLOCK
[23]
GRIP PIPE
[24]
THROTTLE FRICTION PAD
[25]
TILLER HANDLE
[26]
8 mm WASHER
[27] 8 mm
SELF-LOCKING NUT
[28]
CABLE PIVOT
[29] THROTTLE CABLE PIN
[30] CABLE SET PLATE
[31]
4 x 12 mm
SELF-TAPPING SCREW (2)
[3]
16 mm
LOCK NUT
6 x 12

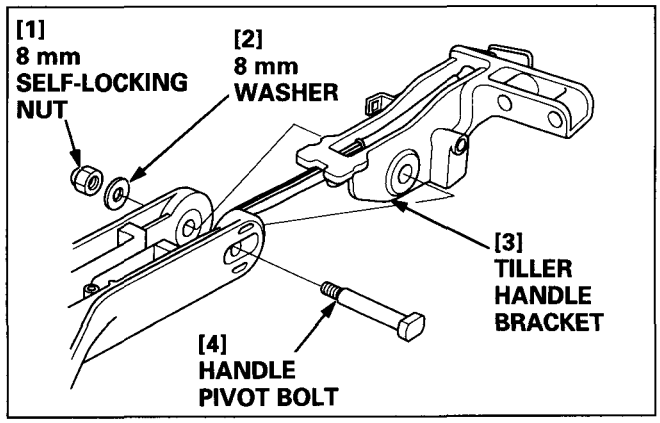
1) Install the oil case grommet to the tiller handle bracket, then install the switch wires and throttle cable through the oil case grommet.
   - If the starter switch was removed from the starter switch housing; before installing it on the oil case grommet and tiller handle bracket, install the starter switch to the starter switch housing (P. 15-6).



2) Install the tiller handle bracket to the tiller handle.

3) Install the handle pivot bolt and 8 mm washer, and tighten the 8 mm self-locking nut to the specified torque.

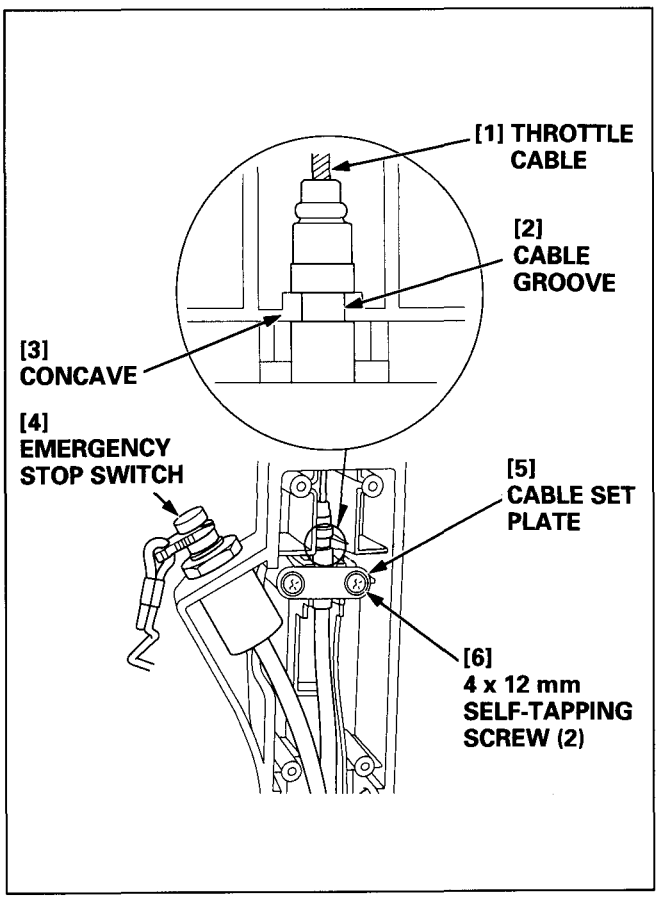
   TORQUE: 8 N•m (0.8 kgf•m, 5.8 lbf•ft)



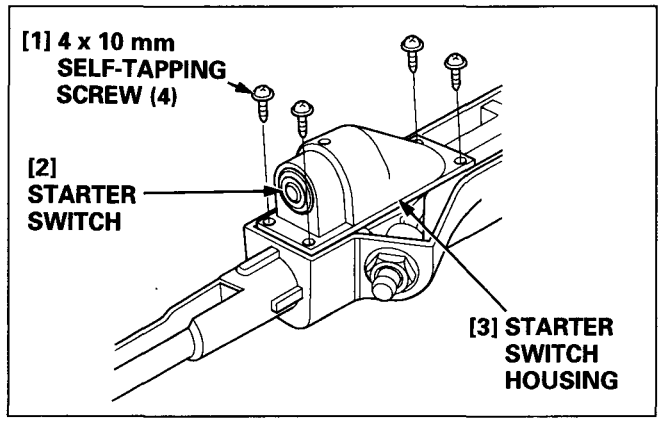
4) Install the throttle cable on the tiller handle by aligning the setting groove of the cable outer with the concave of the tiller handle as shown. Set the cable set plate and tighten the two 4 x 12 mm self-tapping screws securely.

   TORQUE: 1.5 N•m (0.15 kgf•m, 1.1 lbf•ft)

5) Install the emergency stop switch if it has been removed (P. 15-7).

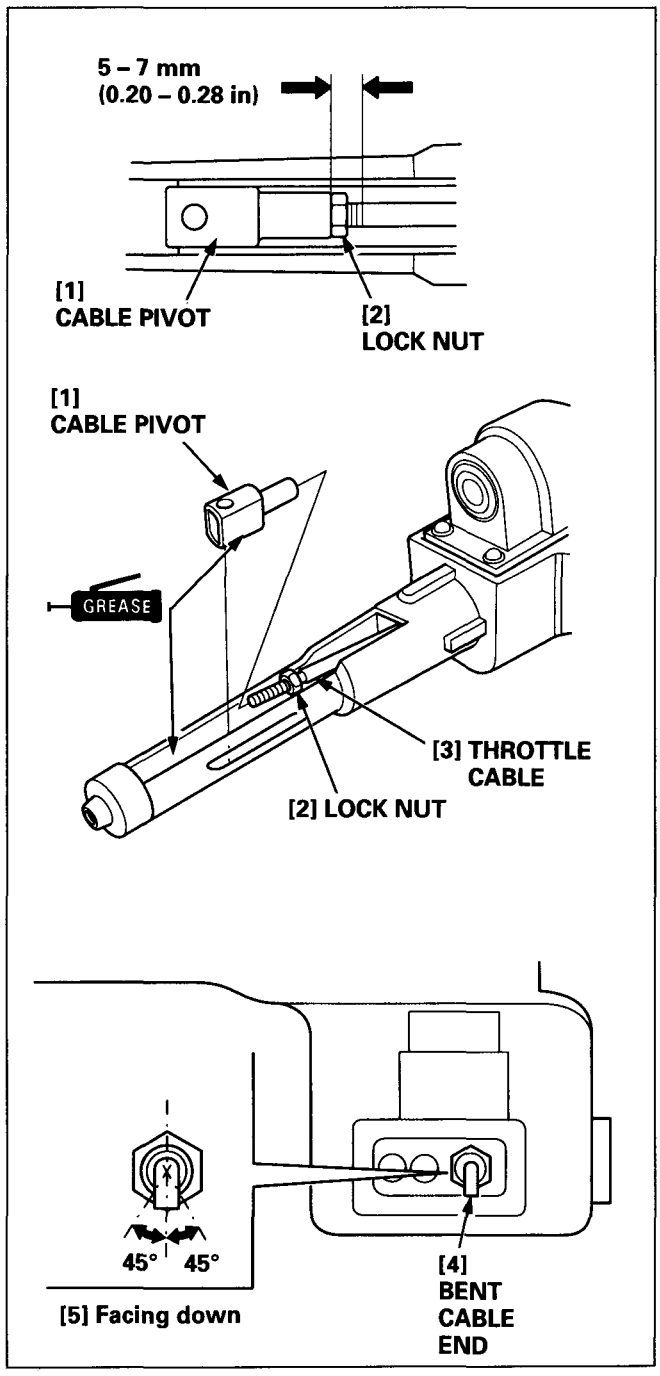


6) Install the starter switch housing assembly on the tiller handle and tighten the 4 x 10 mm self-tapping screws (*Type with electric starter*).

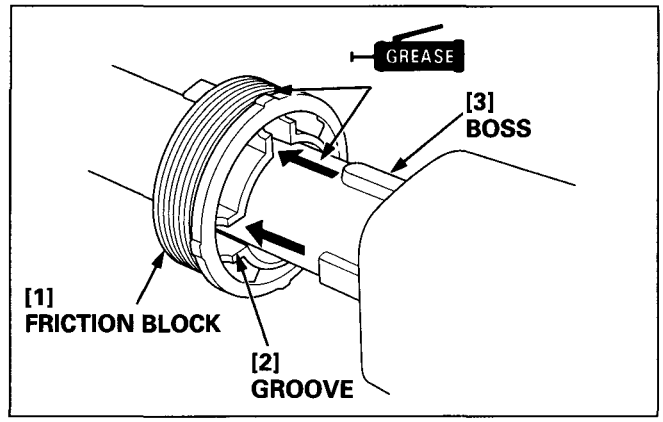


7) Loosen the lock nut fully and screw the cable pivot as shown.
   - Make sure that the bent end (motor side) faces as shown.

8) Tighten the lock nut securely. Apply grease to the sliding surfaces of the cable pivot.



9) Apply grease to the throttle grip installation surface of the tiller handle and friction block. Install the friction block by aligning the grooves of the throttle friction block with the bosses of the tiller handle as shown.

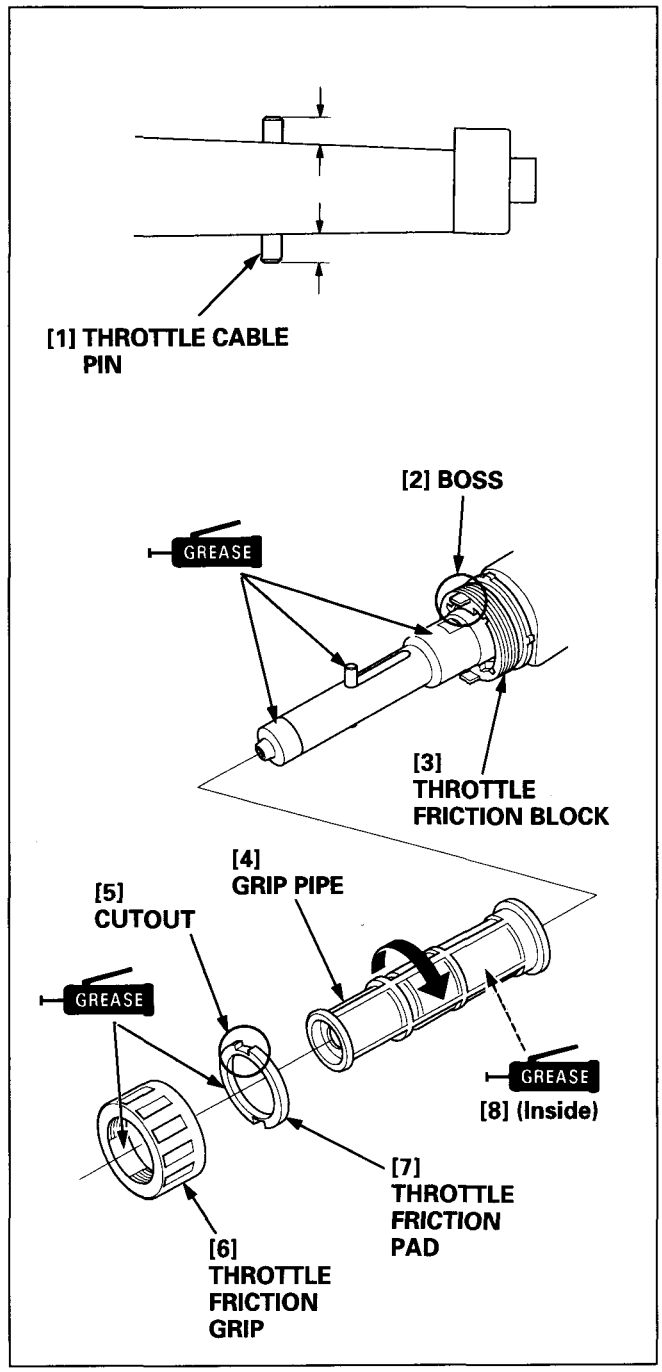


10) Install the throttle cable pin on the cable pivot with the projected length at both ends of the pin equal as shown.

11) Apply grease to the inside of the throttle grip pipe, inside of the friction grip, other ends of the throttle cable pin, handle pipe and both sides of the friction pad. Set the throttle friction pad on the grip pipe.

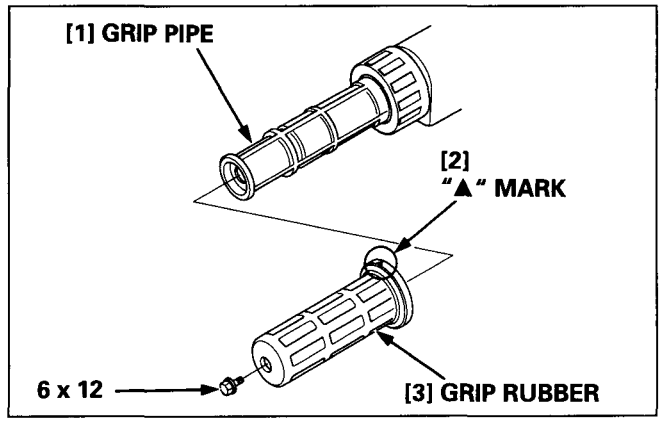
12) Install the grip pipe on the tiller handle by slowly turning it clockwise.

13) Tighten the throttle friction grip against the throttle friction block aligning the cutout of the throttle friction pad with the boss of the friction block.

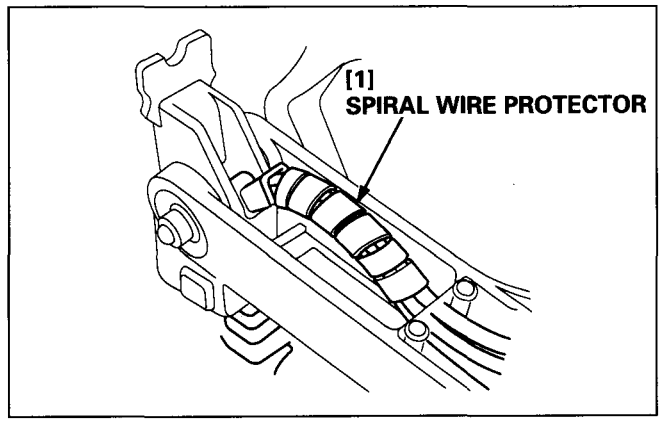


14) Install the grip rubber with "▲" mark facing up.

15) Tighten the 6 x 12 mm flange bolt securely.



16) Lap the spiral wire protector around the throttle cable and switch wires as shown.



5. INSTALLATION

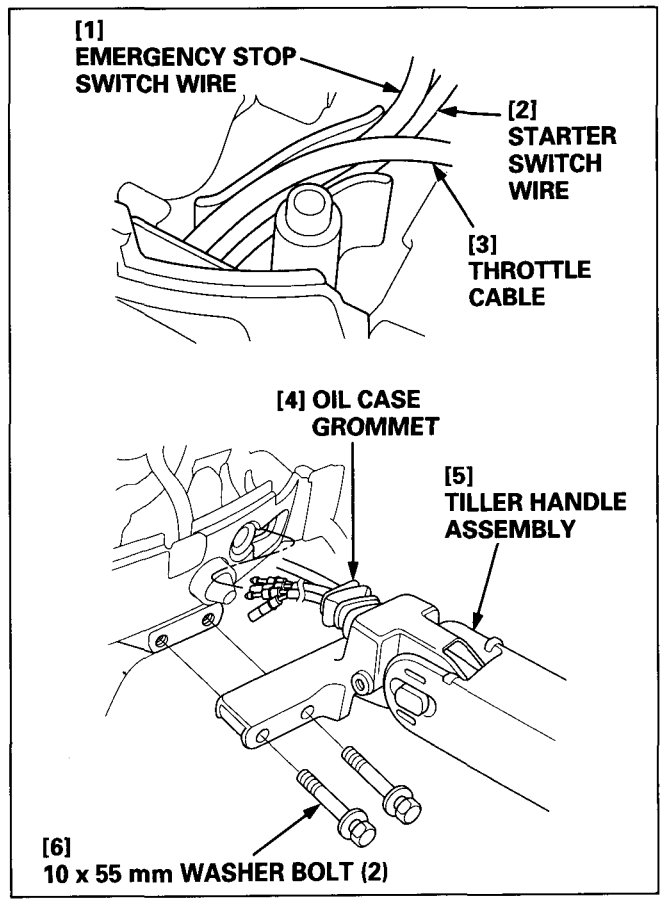
1) Set the tiller handle assembly on the oil case and loosely tighten the 10 x 50 mm flange bolts.

2) Pass the throttle cable and switch wires through the oil case hole and set the oil case grommet securely.

3) Route the wires and throttle cable as shown.

4) Tighten the 10 x 55 mm washer bolts to the specified torque.

TORQUE: 33 N·m (3.4 kgf·m, 25 lbf·ft)

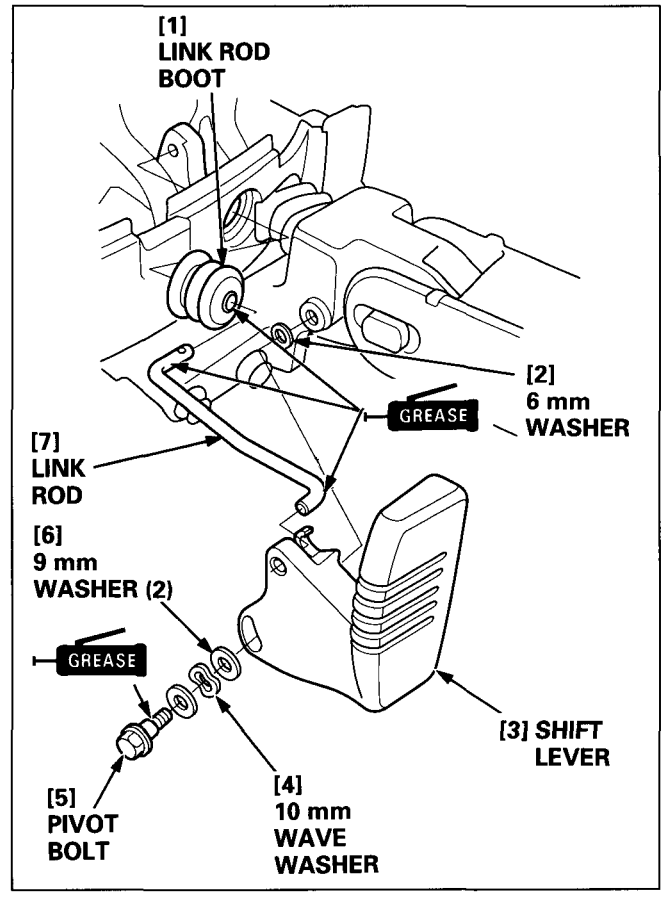


5) Apply grease to the link rod end and link rod boot. Connect the link rod to the shift lever.

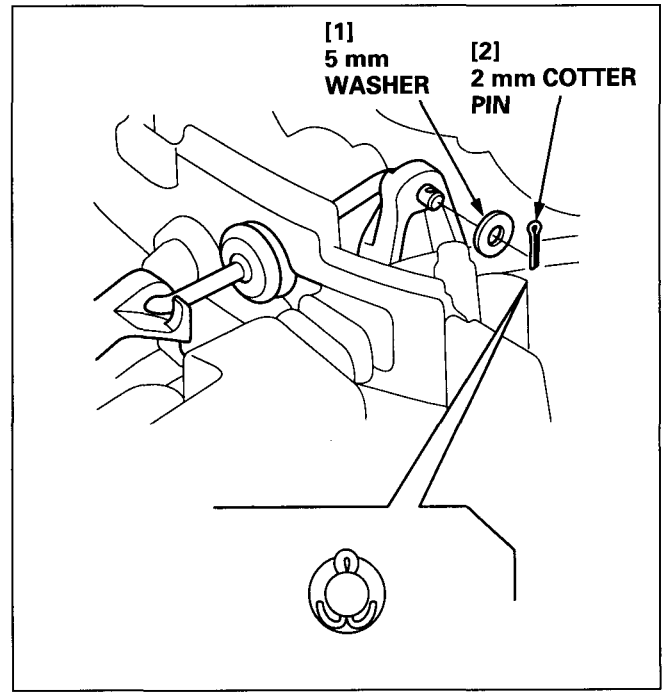
6) Apply grease to the sliding surface of the pivot bolt. Install the shift lever, 6 mm washer, two 9 mm washers, 10 mm wave washer and tighten the pivot bolt.

TORQUE: 12 N·m (1.2 kgf·m, 9 lbf·ft)

7) Set the link rod boot securely.



8) Connect the link rod to the shift shaft and install the 5 mm washer and a new 2 mm cotter pin. Spread the ends of the cotter pin as shown.

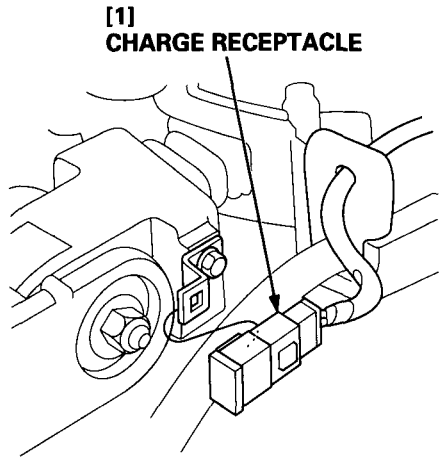


9) Route the switch wires as shown and connect the wire connectors. Set them on the connector bracket (Type without electric starter) or lap them with the corrugated wire protector and secure them with the wire band clip (Type with electric starter).

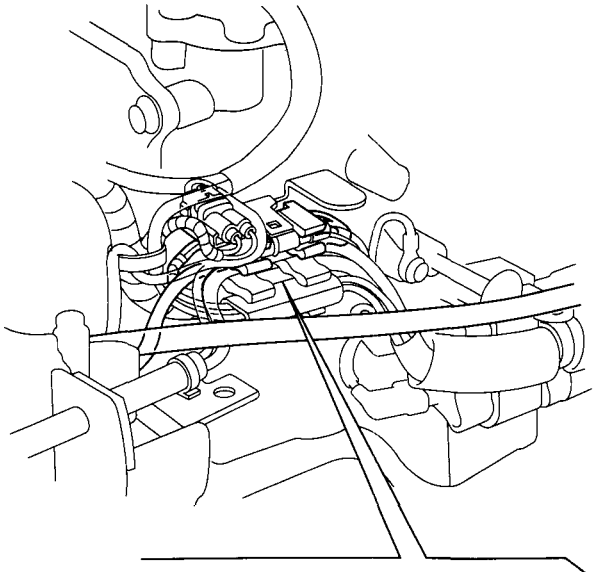
10) Set the charge receptacle on the bracket (Type with 6 A charge coil).

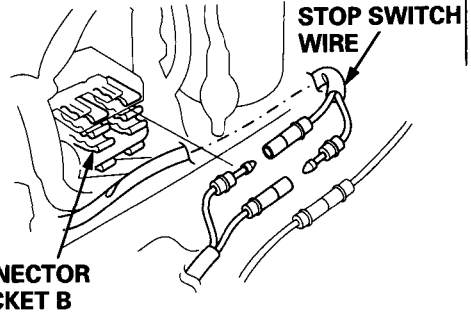
11) Connect the throttle cable to the carburetor and install the throttle cable holder.

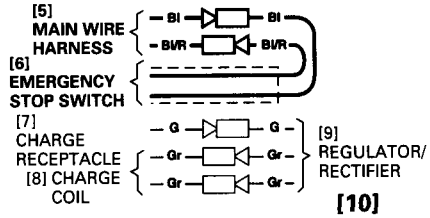
12) Install the left engine under cover (P. 5-2) and engine cover.



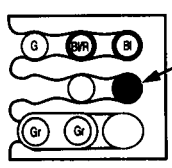
[2]
TYPE WITHOUT ELECTRIC STARTER:





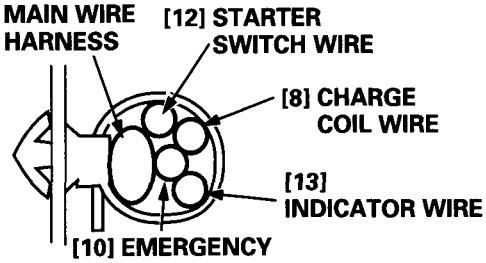


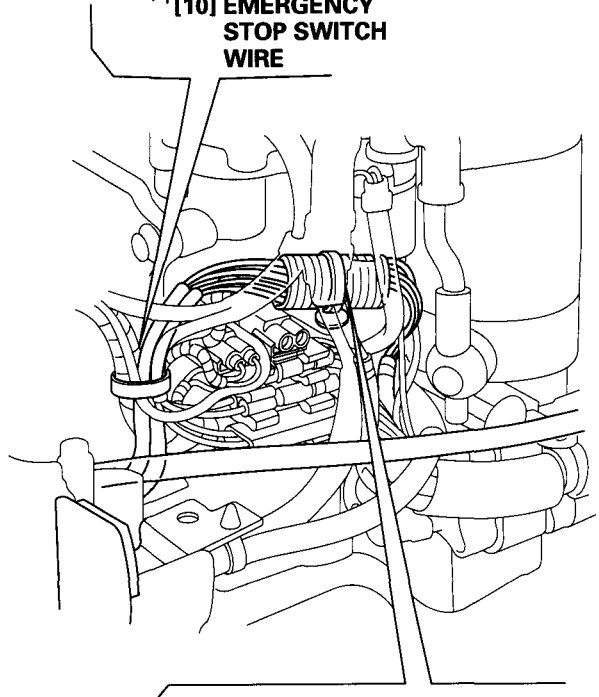
[10]
EMERGENCY STOP SWITCH WIRE

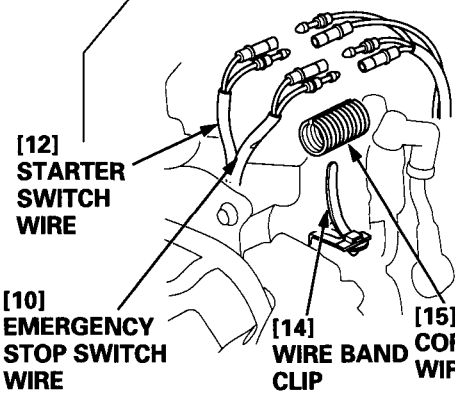


Bl	BLACK	Br	BROWN
Y	YELLOW	O	ORANGE
Bu	BLUE	Lb	LIGHT BLUE
G	GREEN	Lg	LIGHT GREEN
R	RED	P	PINK
W	WHITE	Gr	GRAY

[11]
TYPE WITH ELECTRIC STARTER:







1. STARTER MOTOR
2. BATTERY CABLE (12 A CHARGE COIL TYPE ONLY)
3. CHARGE RECEPTACLE WIRE (6 A CHARGE COIL TYPE ONLY)
4. IGNITION CONTROL MODULE/NEUTRAL SWITCH
5. CONNECTOR BRACKET B
6. IGNITION COIL/REGULATOR/RECTIFIER

1. STARTER MOTOR

a. REMOVAL

1) Remove the following:
   — engine cover (P. 5-1).
   — left engine under cover (P. 5-2).
   — recoil starter (P. 7-2).
   — flywheel (P. 9-2).

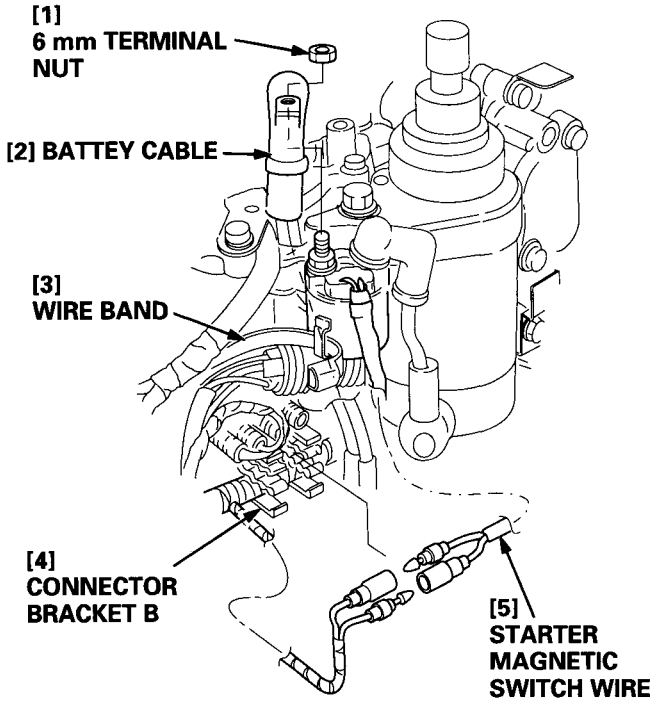
2) Disconnect the battery cables from the battery, before starter motor removal.
   • Disconnect the negative (–) cable first, then disconnect the positive (+) cable.

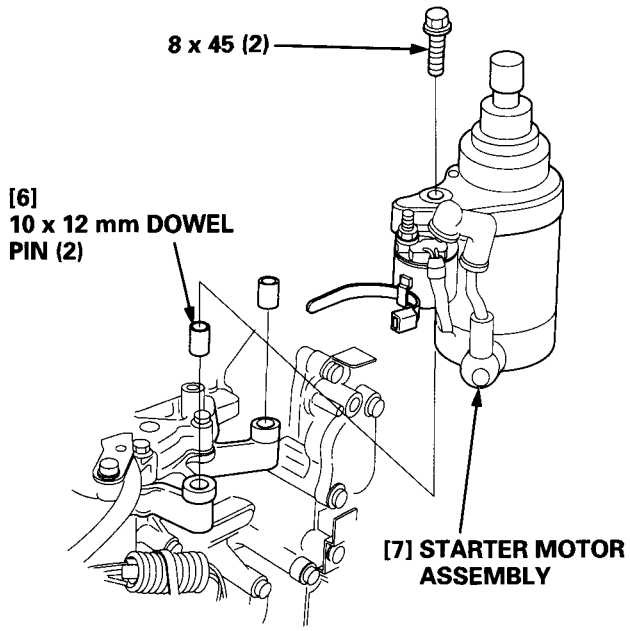
3) Open the wire band on the starter magnetic switch.

4) Remove the 6 mm terminal nut and disconnect the battery cable from the starter magnetic switch.

5) Pull the starter magnetic switch wire connectors from the connector bracket B and disconnect the connectors.

6) Remove the two 8 x 45 mm flange bolts and remove the starter motor and two 10 x 12 mm dowel pins.



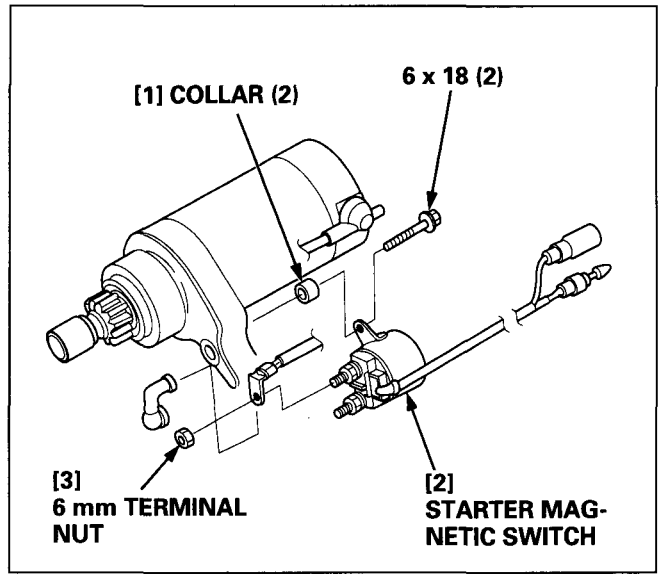


b. DISASSEMBLY

• STARTER MAGNETIC SWITCH

1) Remove the 6 mm terminal nut and disconnect the starter cord from the starter magnetic switch terminal.

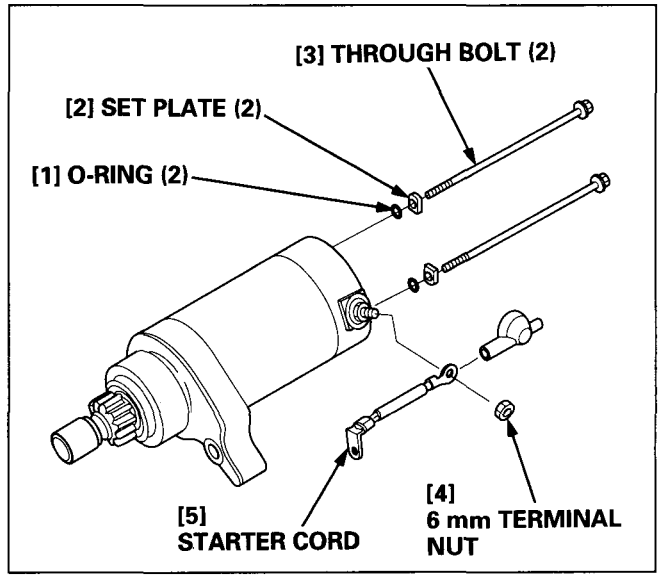
2) Remove the 6 x 18 mm flange bolts, then remove the starter magnetic switch and collars.
   - See page 16-5 for starter magnetic switch inspection.



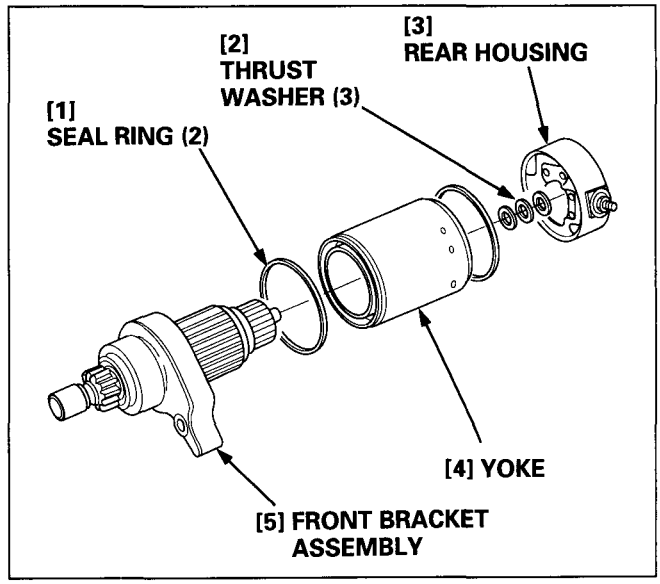
• REAR HOUSING/BRUSH HOLDER

1) Remove the 6 mm terminal nut and disconnect the starter cord from the rear housing.

2) Remove the through bolts, set plates and O-rings.

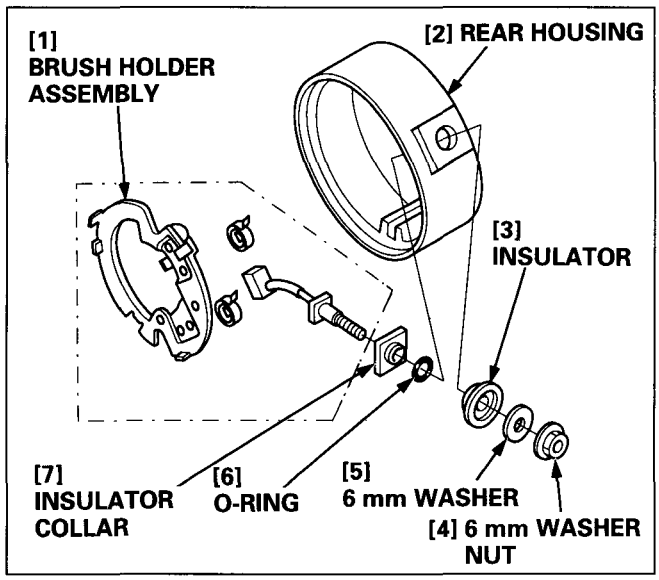


3) Remove the rear housing with the brush holder attached, thrust washers, seal rings and yoke.



4) Remove the 6 mm washer nut, 6 mm washer and insulator collar.

5) Remove the brush holder from the rear housing.

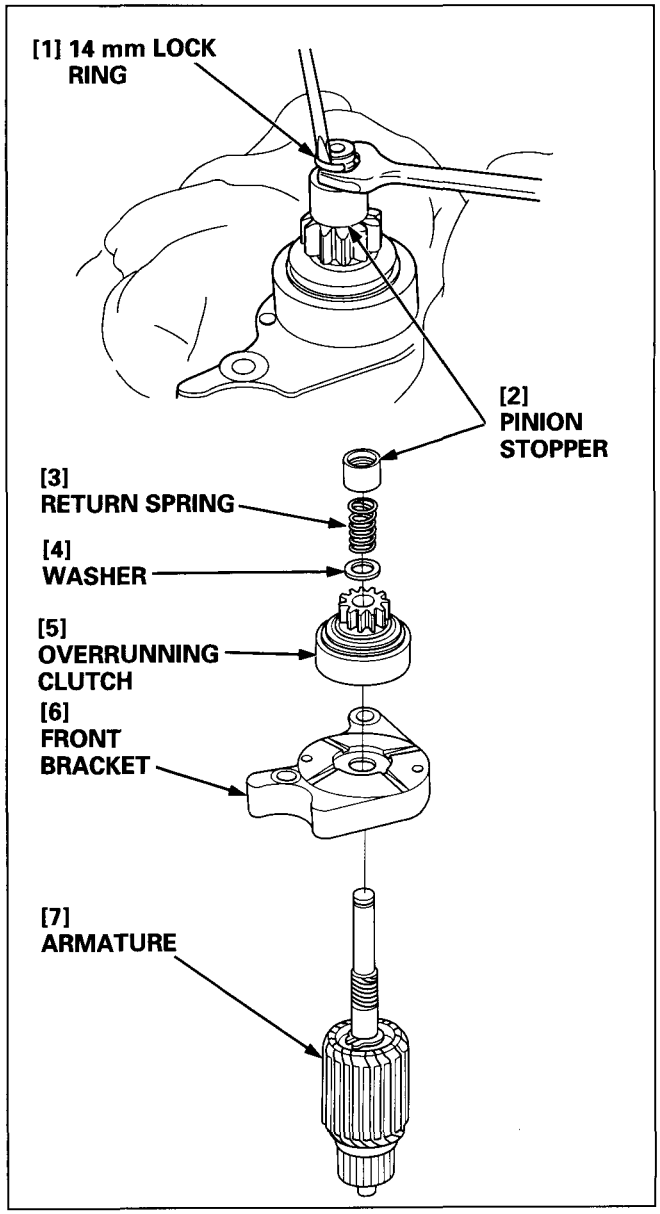


• FRONT BRACKET/OVERRUNNING CLUTCH/ ARMATURE

1) Hold the front bracket/armature assembly upright in a vice as shown.

2) Push down the pinion stopper using a offset wrench and pry off the 14 mm lock ring using a screw-driver.

3) Remove the return spring, washer, overrunning clutch and front bracket from the armature.

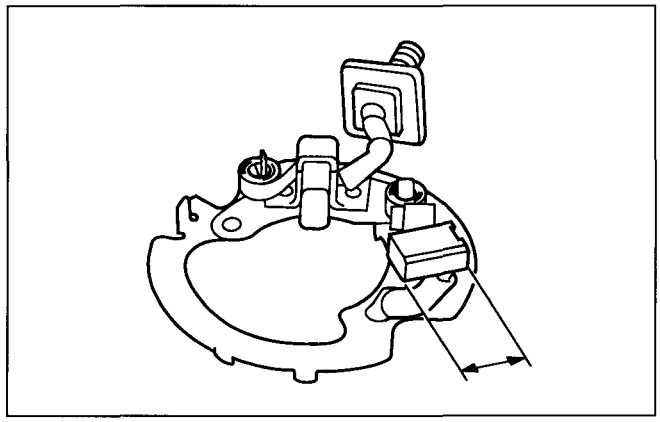


c. INSPECTION

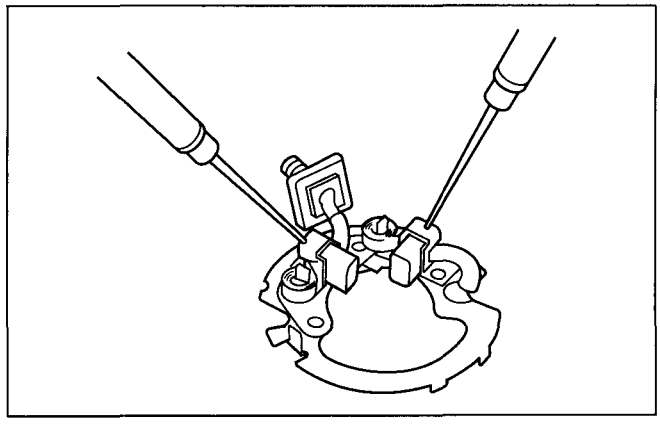
• BRUSH

1) Measure the brush length.
If the brush length is less than the service limit, replace the brush holder assembly.

Standard	Service limit
12.5 mm (0.49 in)	8.5 mm (0.33 in)



2) Check for continuity between the brushes.
There should be no continuity between the brushes. If necessary, replace the brush holder as an assembly.



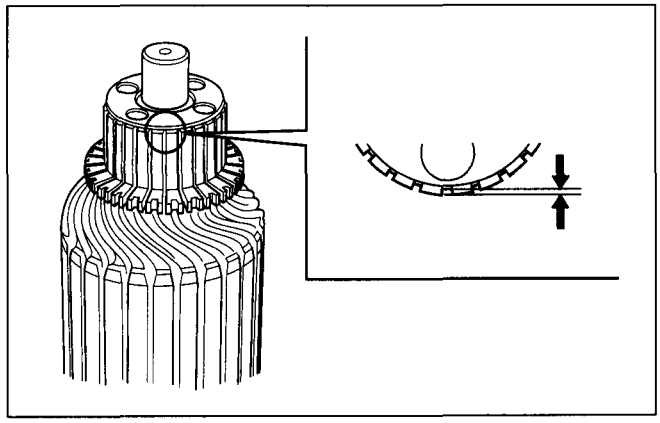
• ARMATURE

1) Check the armature for wear or damage. Check the over-running clutch installation section of the shaft for wear or damage. Replace if necessary.

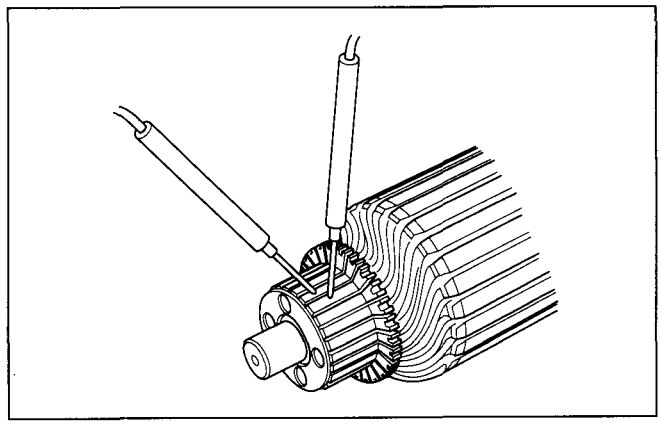
2) Visually inspect the commutator surface for dust, rust or other damage. If necessary, wipe it with a clean lint-free cloth or dress with a fine emery cloth.

3) Measure the mica depth. If the grooves are clogged, clean the grooves and measure the depth again. If the measurement is less than the service limit, replace the armature.

Service limit	0.2 mm (0.01 in)

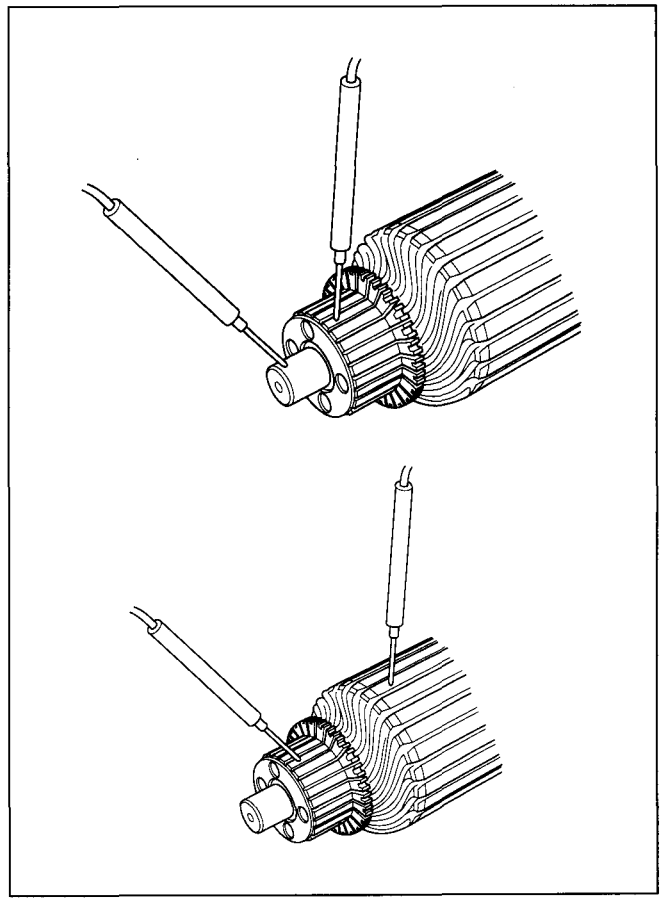


4) Check for continuity between each segment. If an open circuit exists between any two segment, replace the armature.



5) Check for continuity between the commutator and armature coil core. If continuity exists, replace the armature.

6) Check for continuity between the commutator and armature shaft. If there is continuity, replace the armature.



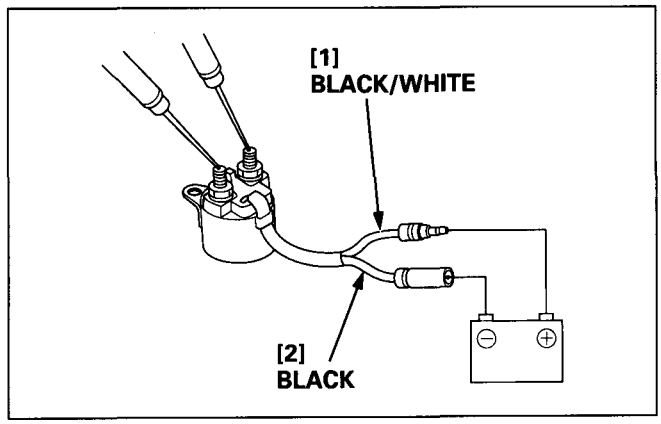
• STARTER MAGNETIC SWITCH

- This test can be performed with the starter magnetic switch installed on the starter motor.
- Be sure the battery is in good condition before performing this test.

Connect a 12 V battery to the magnetic switch terminals as shown.

There should be continuity between the terminals.

There should be no continuity when the battery is disconnected.



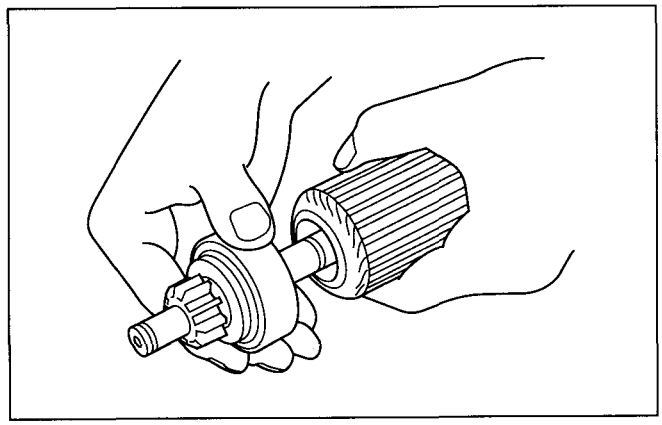
• OVERRUNNING CLUTCH

1) Check the pinion gear for wear or damage and replace if necessary.

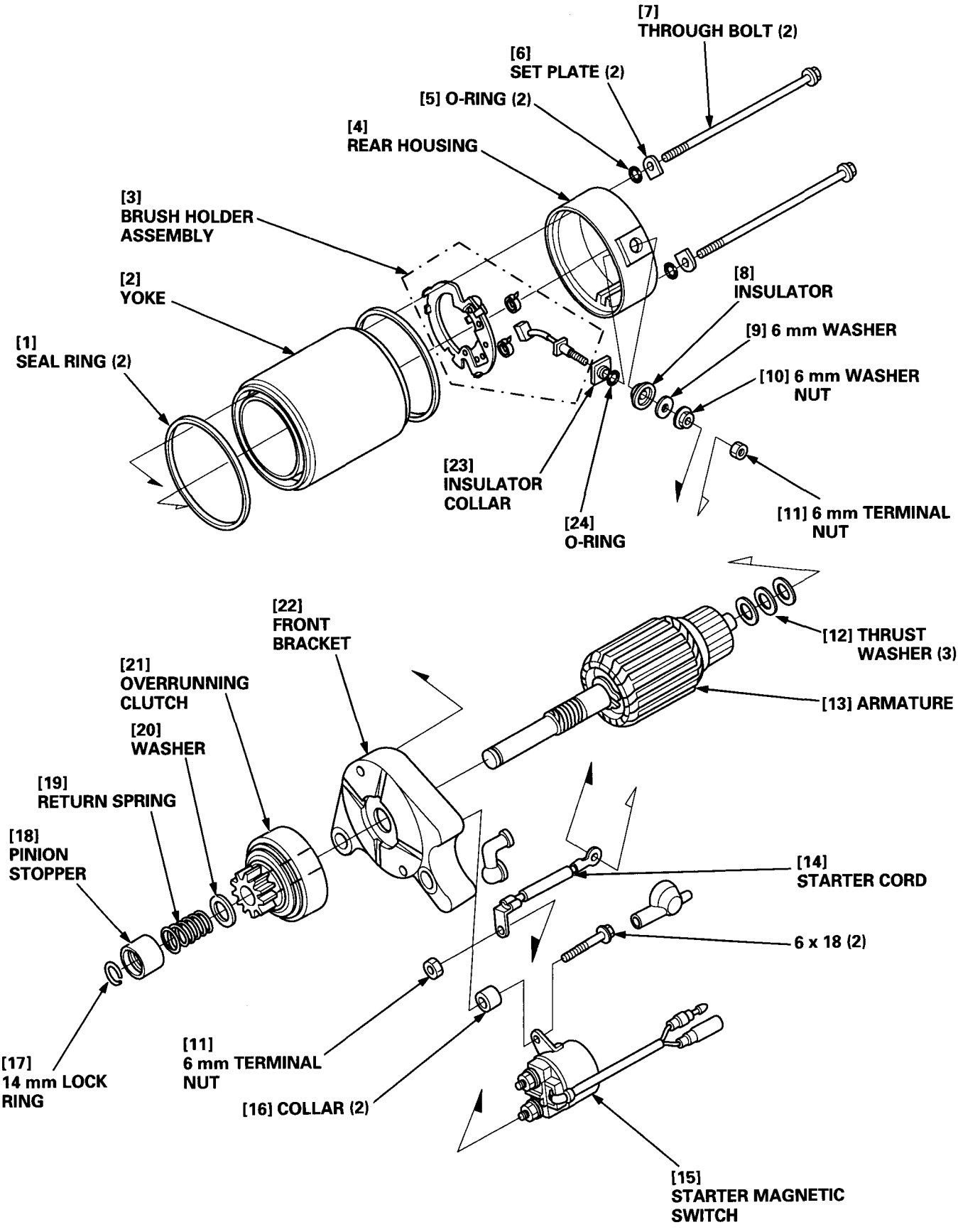
   If the pinion gear is worn or damaged, the flywheel ring gear must be inspected.

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

3) Check the overrunning clutch operation by holding the armature and turning the overrunning clutch. The overrunning clutch should turn counterclockwise freely and should not turn clockwise viewed from overrunning clutch side.



d. ASSEMBLY

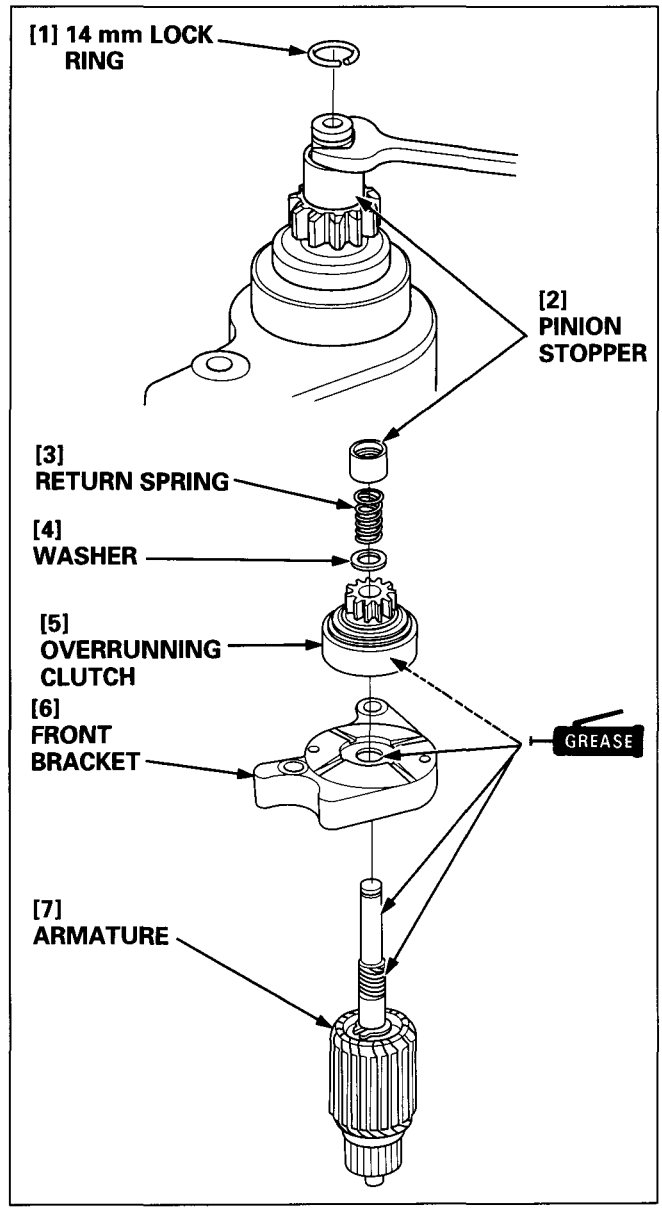

[7]
THROUGH BOLT (2)
[6]
SET PLATE (2)
[5] O-RING (2)
[4]
REAR HOUSING
[3]
BRUSH HOLDER
ASSEMBLY
[2]
YOKE
[1]
SEAL RING (2)
[8]
INSULATOR
[9] 6 mm WASHER
[10] 6 mm WASHER
NUT
[23]
INSULATOR
COLLAR
[24]
O-RING
[11] 6 mm TERMINAL
NUT
[22]
FRONT
BRACKET
[12] THRUST
WASHER (3)
[21]
OVERRUNNING
CLUTCH
[13] ARMATURE
[20]
WASHER
[19]
RETURN SPRING
[18]
PINION
STOPPER
[14]
STARTER CORD
6 x 18 (2)
[17]
14 mm LOCK
RING
[11]
6 mm TERMINAL
NUT
[16] COLLAR (2)
[15]
STARTER MAGNETIC
SWITCH

1) Apply grease to the armature shaft, bearing and seal lip of the front bracket, and sliding surface of the overrunning clutch.

2) Install the front bracket onto the armature.

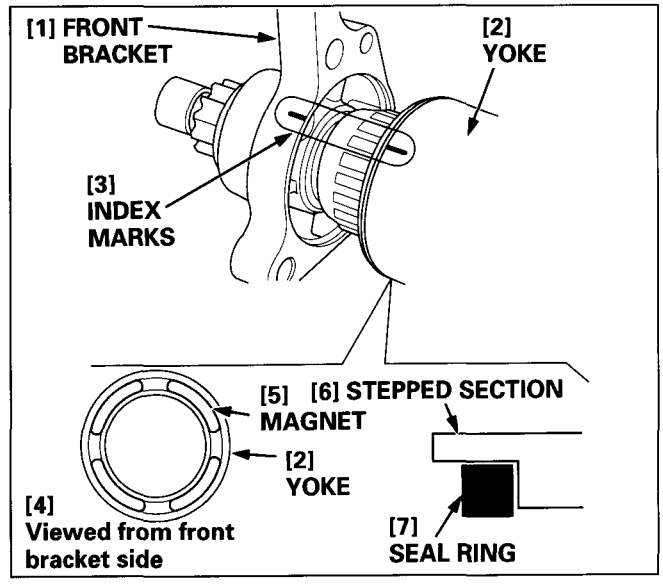
3) Install the overrunning clutch, washer, return spring and pinion stopper.

4) Hold the armature upright and push down the pinion stopper using an offset wrench. Install the 14 mm lock ring.



5) Make sure that the seal ring is in good condition, replace if necessary. Install the seal ring on the yoke.
   - Set the seal ring on the stepped section of the yoke properly taking care not to pinch the yoke and front bracket.

6) Make sure that there is no obstruction on the magnets. Install the yoke noting the installation direction as shown and align the index mark on the yoke with the index mark on the front bracket.

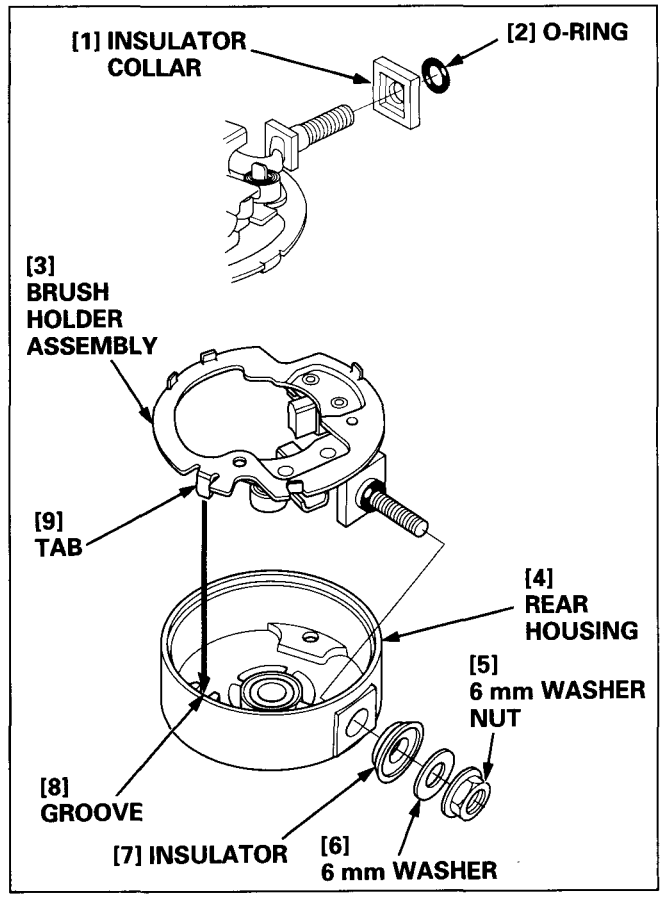


7) Install the brusher and brush springs in the brush holder.

8) Install the insulator collar and O-ring to the brush holder.

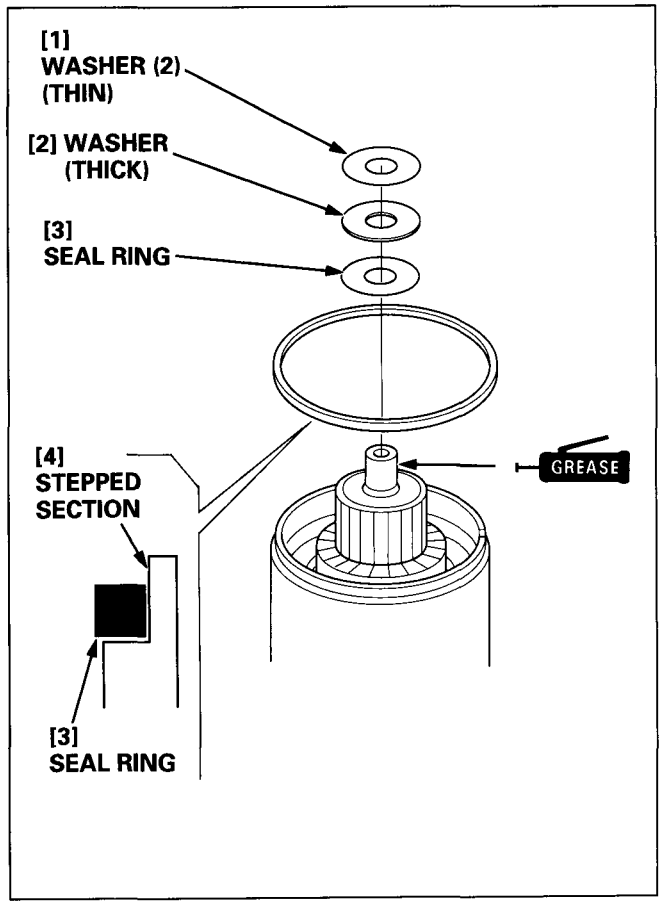
9) Install the brush holder in the rear housing by aligning the tab of the brush holder with groove of the rear housing as shown.

10) Install the insulator and 6 mm washer and tighten the 6 mm washer nut securely.



11) Apply grease to the armature shaft. Install the washers on the armature shaft.
   - Note the washers installation position.

12) Make sure that the seal ring is in good condition, replace if necessary. Install the seal ring.
   - Set the seal ring on the stepped section of the yoke properly taking care not to pinch the yoke and rear housing.



13) Install the rear housing and align the index mark on the rear housing with the index mark on the yoke.

14) Apply oil to the new O-rings and install the set plate and the O-ring to each through bolt.

15) Tighten the through bolts securely.

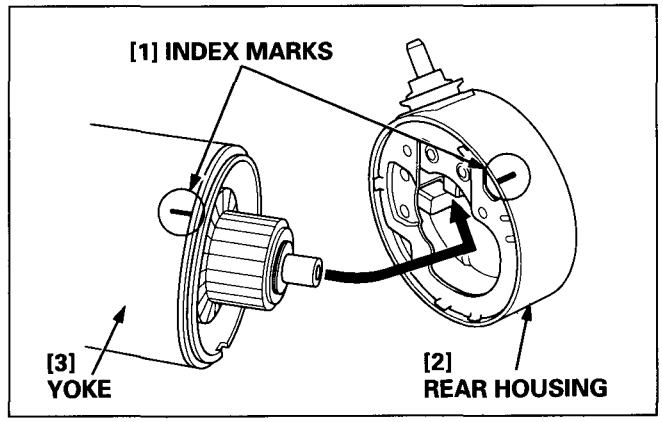
16) Install the collars and starter magnetic switch and tighten the 6 x 18 mm flange bolts to the specified torque.

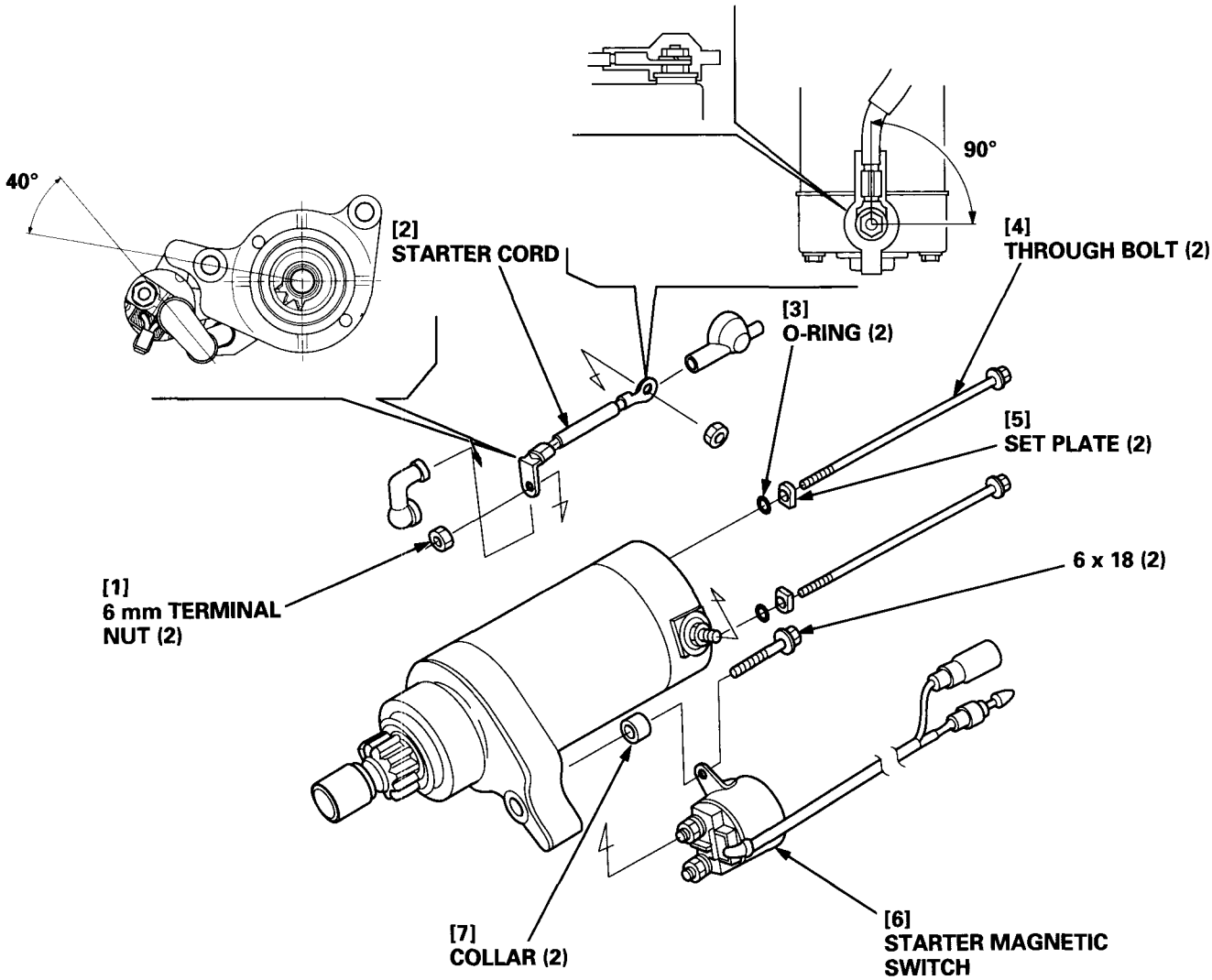
TORQUE: 7 N•m (0.7 kgf•m, 5.1 lbf•ft)

17) Install the starter cord between the brush terminal and starter magnetic switch terminals and loosely install the 6 mm terminal nuts.

18) Adjust the starter cord terminal direction and tighten the terminal nuts to the specified torque.

TORQUE: 5 N•m (0.5 kgf•m, 3.6 lbf•ft)





e. INSTALLATION

1) Install the 10 x 12 mm dowel pin on the crankcase cover.

2) Install the starter motor and tighten the 8 x 45 mm flange bolts securely.

3) Route the starter magnetic switch wire and connect the connectors.

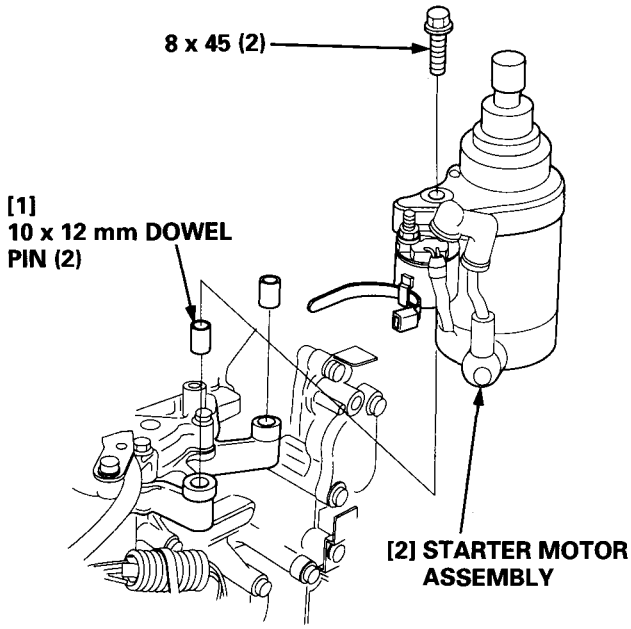
4) Connect the battery cable to the starter magnetic switch and adjust the terminal direction.

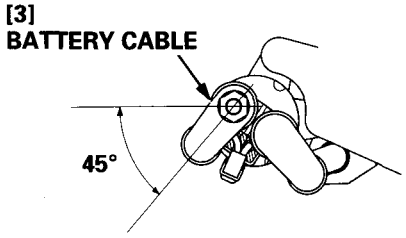
5) Tighten the terminal nut to the specified torque.

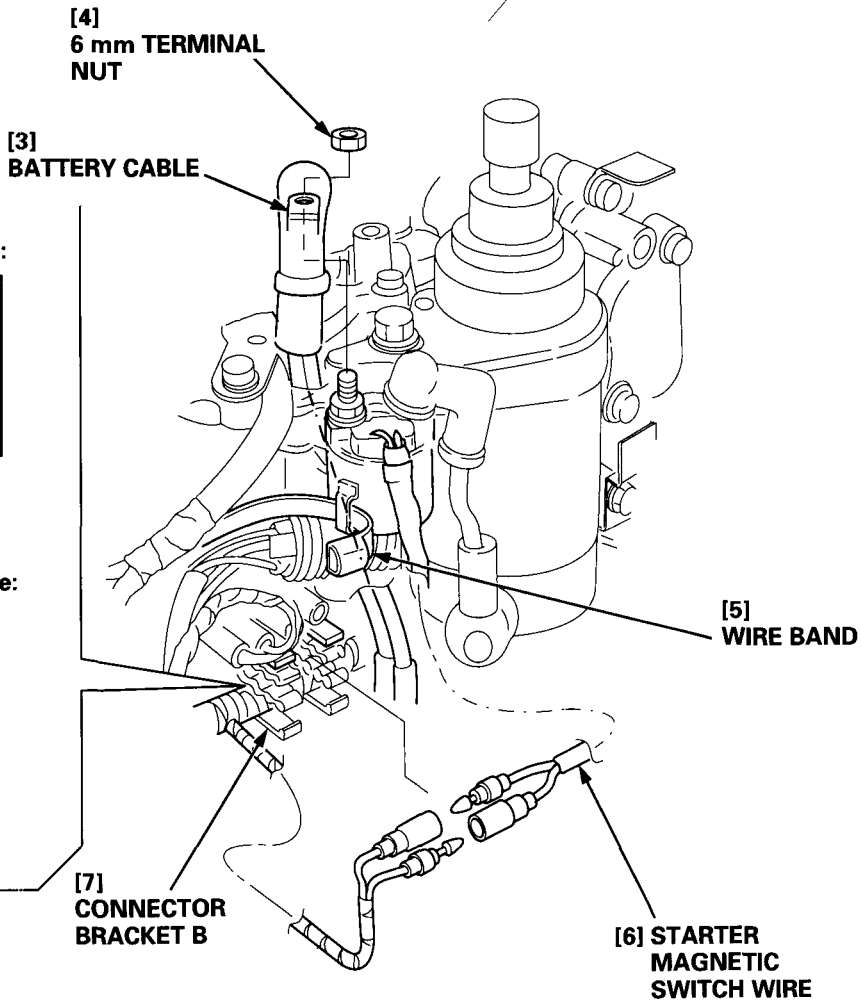
   TORQUE: 6.5 N·m (0.65 kgf·m, 4.7 lbf·ft)

6) Secure the battery cable and charge coil wire with the wire band on the starter magnetic switch.

7) Install the removed parts in the reverse order of removal:
   — flywheel (P. 9-9).
   — recoil starter (P. 7-9).
   — left engine under cover (P. 5-2).
   — engine cover (P. 5-1).





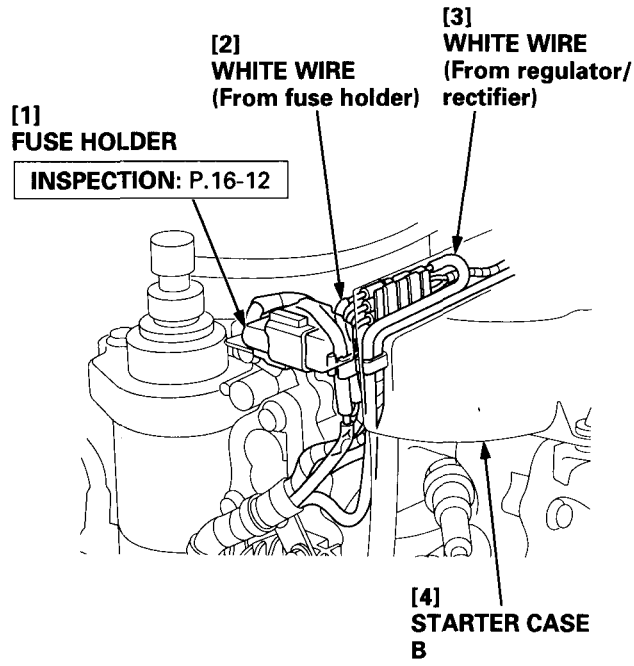


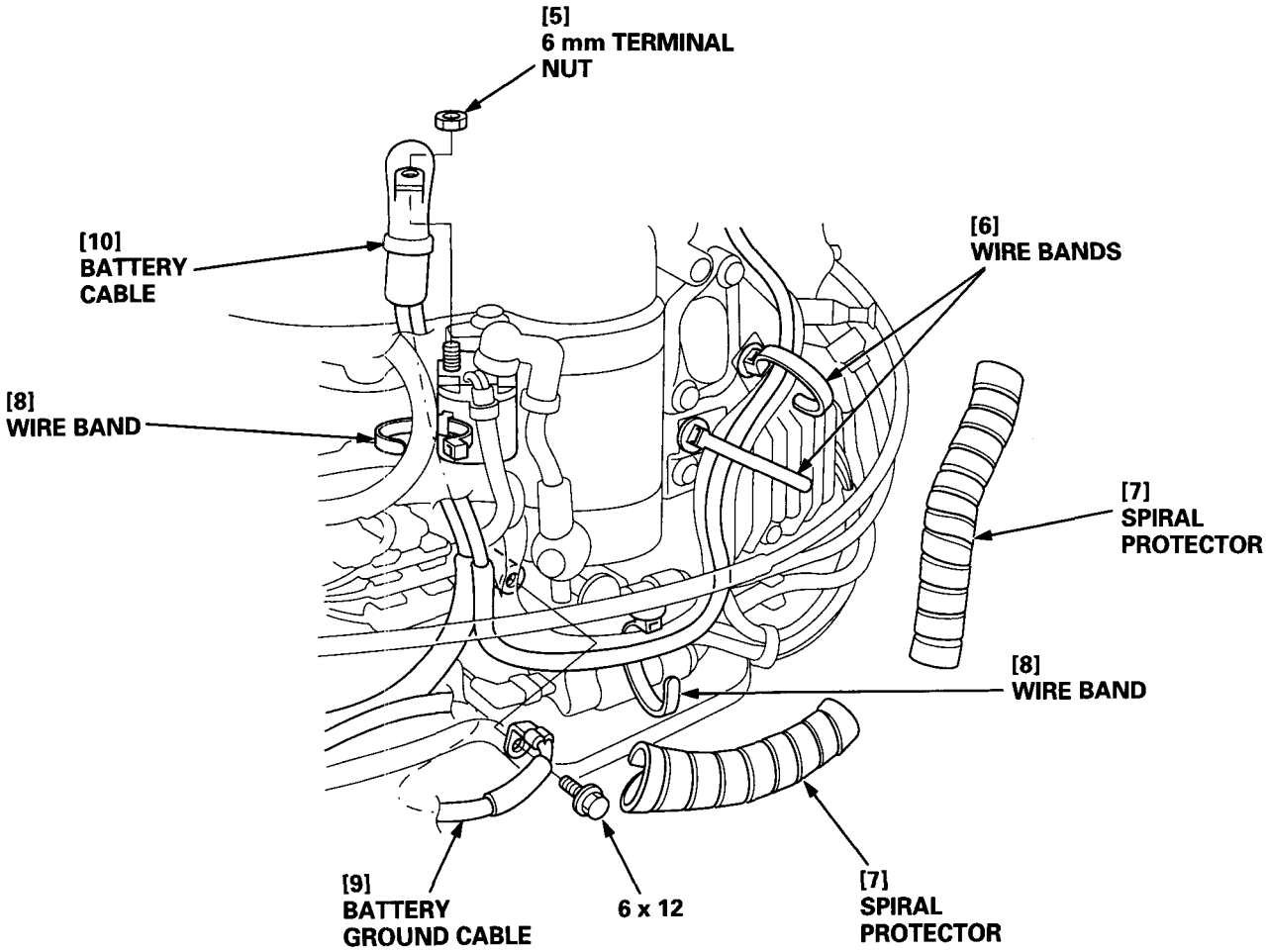
Bl	BLACK	Br	BROWN
Y	YELLOW	O	ORANGE
Bu	BLUE	Lb	LIGHT BLUE
G	GREEN	Lg	LIGHT GREEN
R	RED	P	PINK
W	WHITE	Gr	GRAY

2. BATTERY CABLE (12A CHARGE COIL TYPE ONLY)

a. REMOVAL

1) Remove the following:
   — engine cover (P. 5-1).
   — left engine under cover (P. 5-2).
2) Remove the fuse holder from the fuse holder bracket.
3) Pull off the white wire (main fuse line) connectors from the clamp on the starter case B, and disconnect them.
4) Open the three wire bands and remove the spiral protectors.
5) Open the wire band on the starter magnetic switch.
6) Remove the 6 mm terminal nut and disconnect the battery cable from the starter magnetic switch.
7) Remove the 6 x 12 mm flange bolt and remove the battery ground cable.

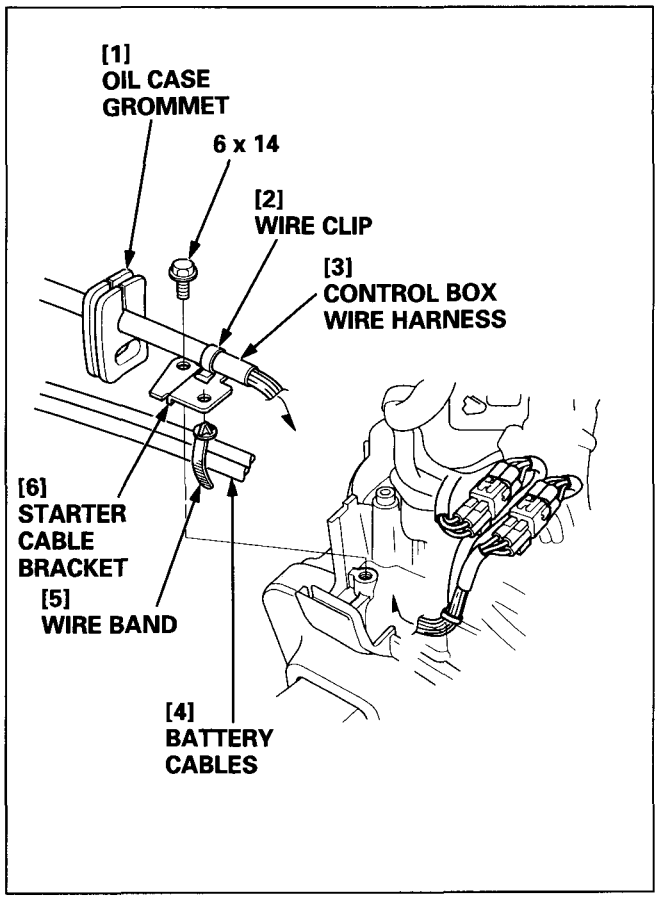




8) Remote control type only: Open the wire clip and release the control box wire harness.

9) Remove the 6 x 14 mm flange bolt and starter cable bracket.

10) Open the wire band and remove the battery cables.



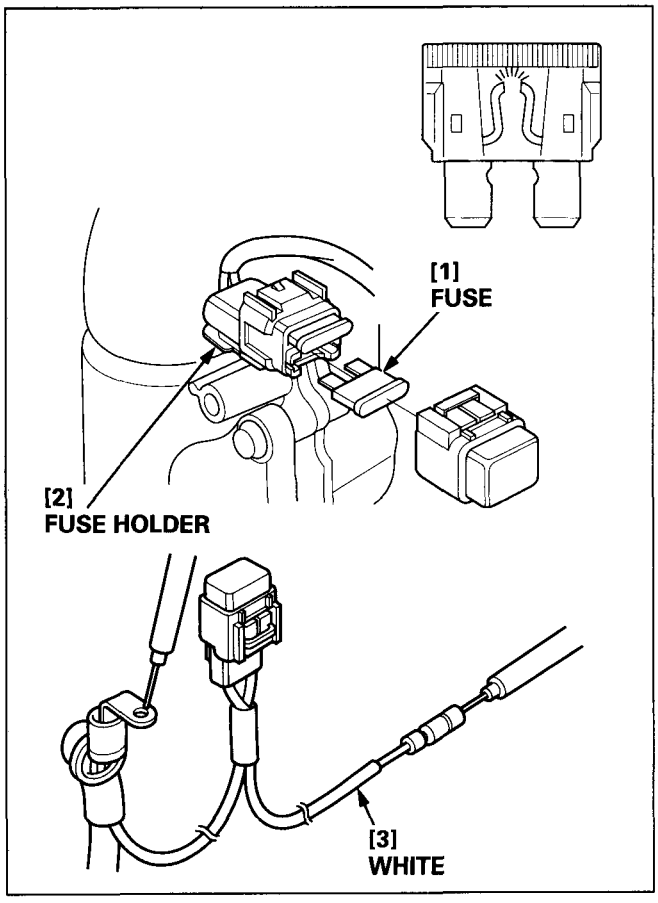
b. INSPECTION

- Before inspection or replacement, disconnect the battery cable from the battery.

1) Remove the fuse from the fuse holder and check for continuity between the terminals.
There should be continuity, replace if necessary.

2) Install the fuse to the fuse holder.

3) Check for continuity between the white wire connector and battery positive terminal.
There should be continuity.

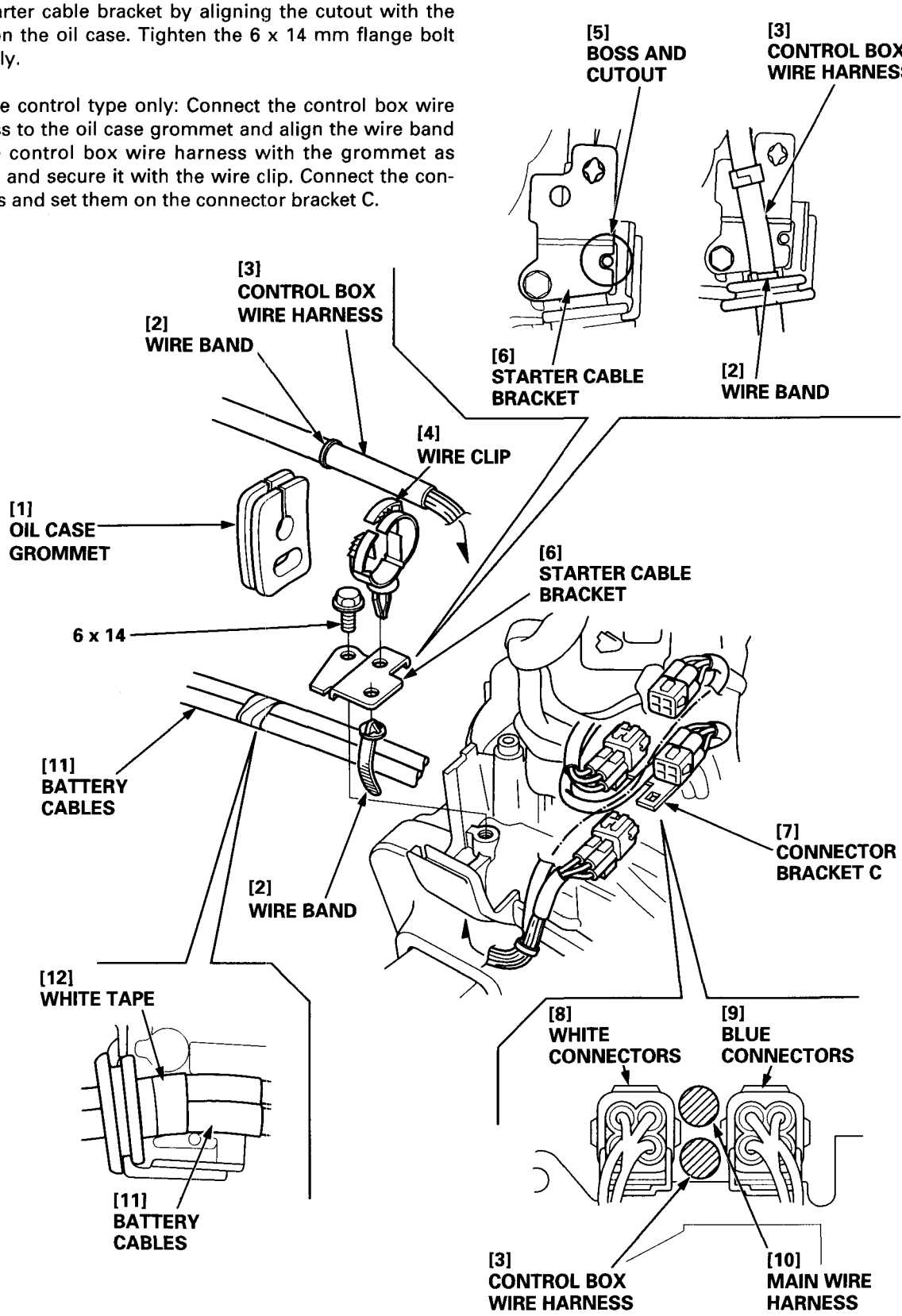


c. INSTALLATION

1) Install the oil case grommet to the battery cables and align the inside of the grommet with the white tape on the battery cables, and install them on the oil case.

2) Secure the battery cables with the wire band and install the starter cable bracket by aligning the cutout with the boss on the oil case. Tighten the 6 x 14 mm flange bolt securely.

3) Remote control type only: Connect the control box wire harness to the oil case grommet and align the wire band on the control box wire harness with the grommet as shown and secure it with the wire clip. Connect the connectors and set them on the connector bracket C.



4) Route the battery cables.

5) Tighten the battery cable ground terminal to the cylinder block using the 6 x 12 mm flange bolt.

6) Connect the battery cable positive terminal to the starter magnetic switch and install the 6 mm terminal nut. Adjust the terminal direction shown and tighten the terminal nut to the specified torque.

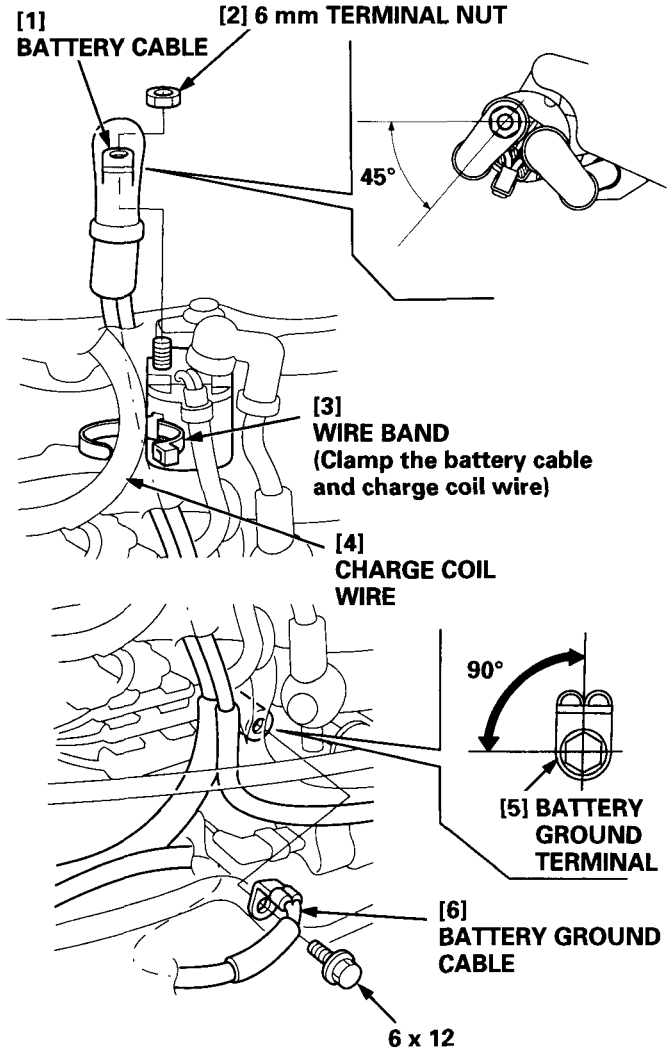
TORQUE: 6.5 N•m (0.65 kgf•m, 4.7 lbf•ft)

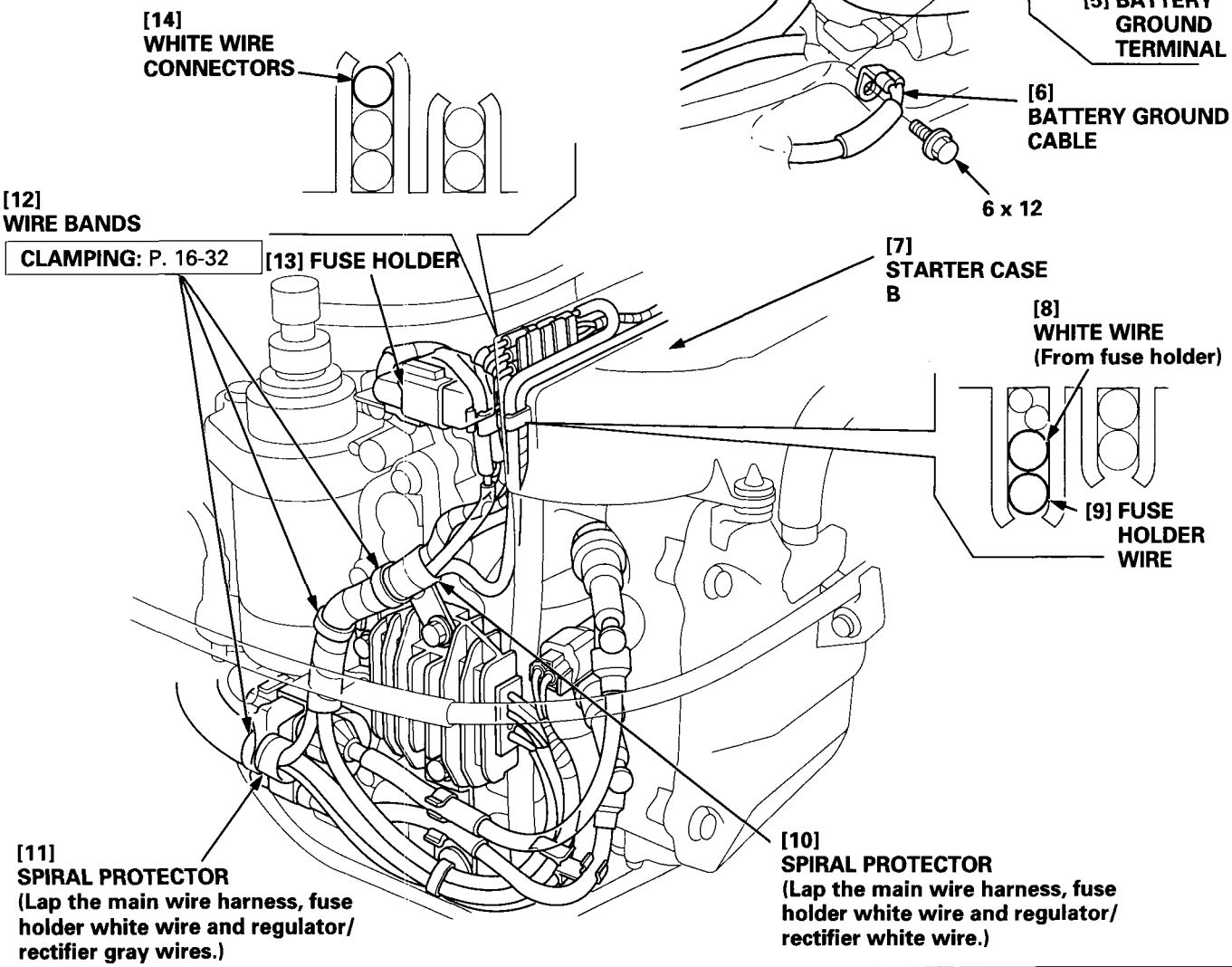
7) Clamp the battery cable and charge coil wire with the wire band on the starter magnetic switch.

8) Route the battery cable (fuse line) as shown, secure it with the wire bands and lap the wires with the spiral protectors.

9) Connect the white wire connectors and set them on the connector holder on the starter case B.

10) Set the fuse holder on the fuse holder bracket and secure the wires as shown.





3. CHARGE RECEPTACLE WIRE (6A CHARGE COIL TYPE ONLY)

a. REMOVAL

1) Remove the following:
   — engine cover (P. 5-1).
   — left engine under cover (P. 5-2).

2) Remove the fuse holder from the fuse holder bracket.

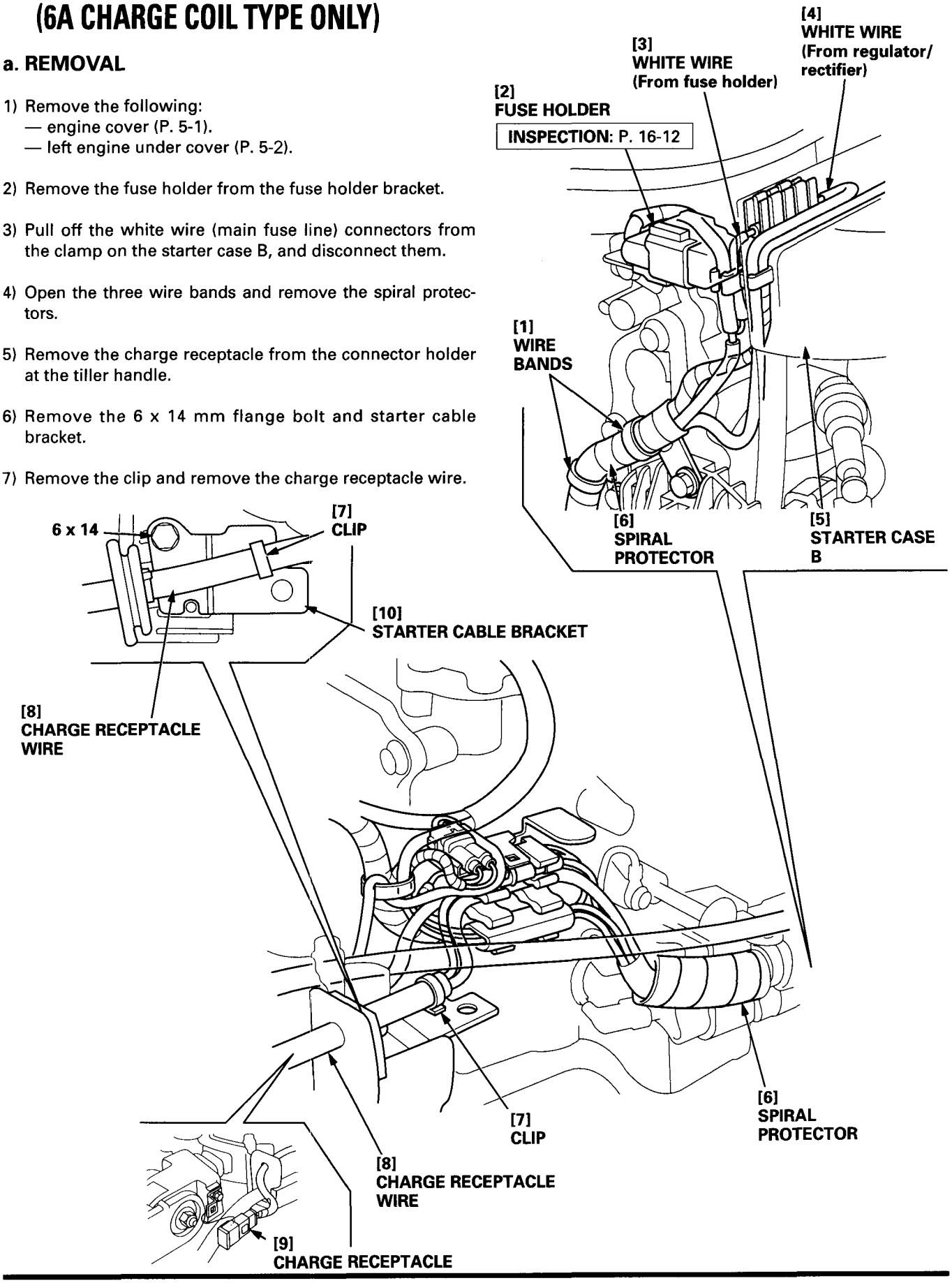
3) Pull off the white wire (main fuse line) connectors from the clamp on the starter case B, and disconnect them.

4) Open the three wire bands and remove the spiral protectors.

5) Remove the charge receptacle from the connector holder at the tiller handle.

6) Remove the 6 x 14 mm flange bolt and starter cable bracket.

7) Remove the clip and remove the charge receptacle wire.

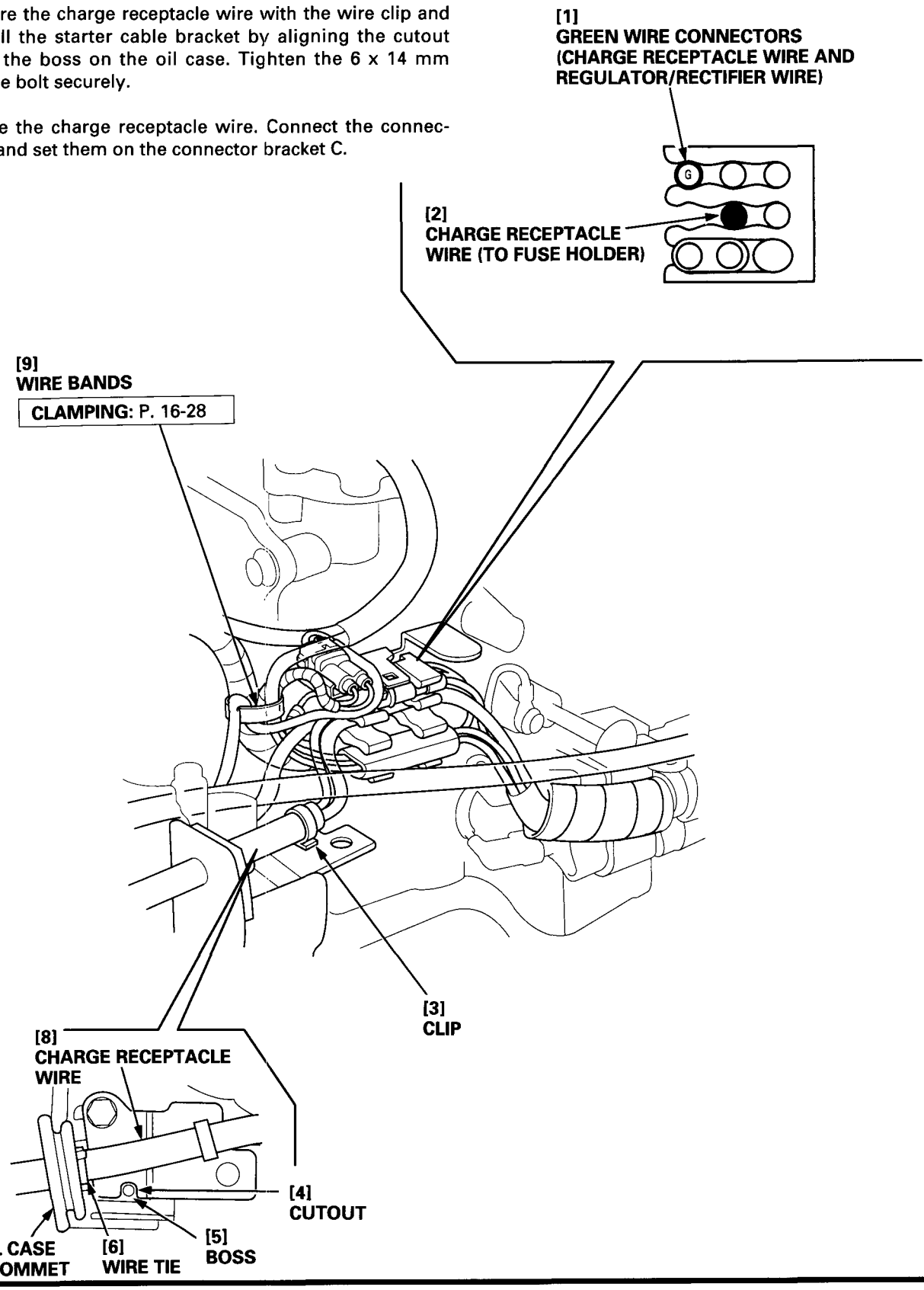


b. INSTALLATION

1) Install the oil case grommet on the charge receptacle wire and align the inside of the grommet with the wire tie on the wire. Install them on the oil case.

2) Secure the charge receptacle wire with the wire clip and install the starter cable bracket by aligning the cutout with the boss on the oil case. Tighten the 6 x 14 mm flange bolt securely.

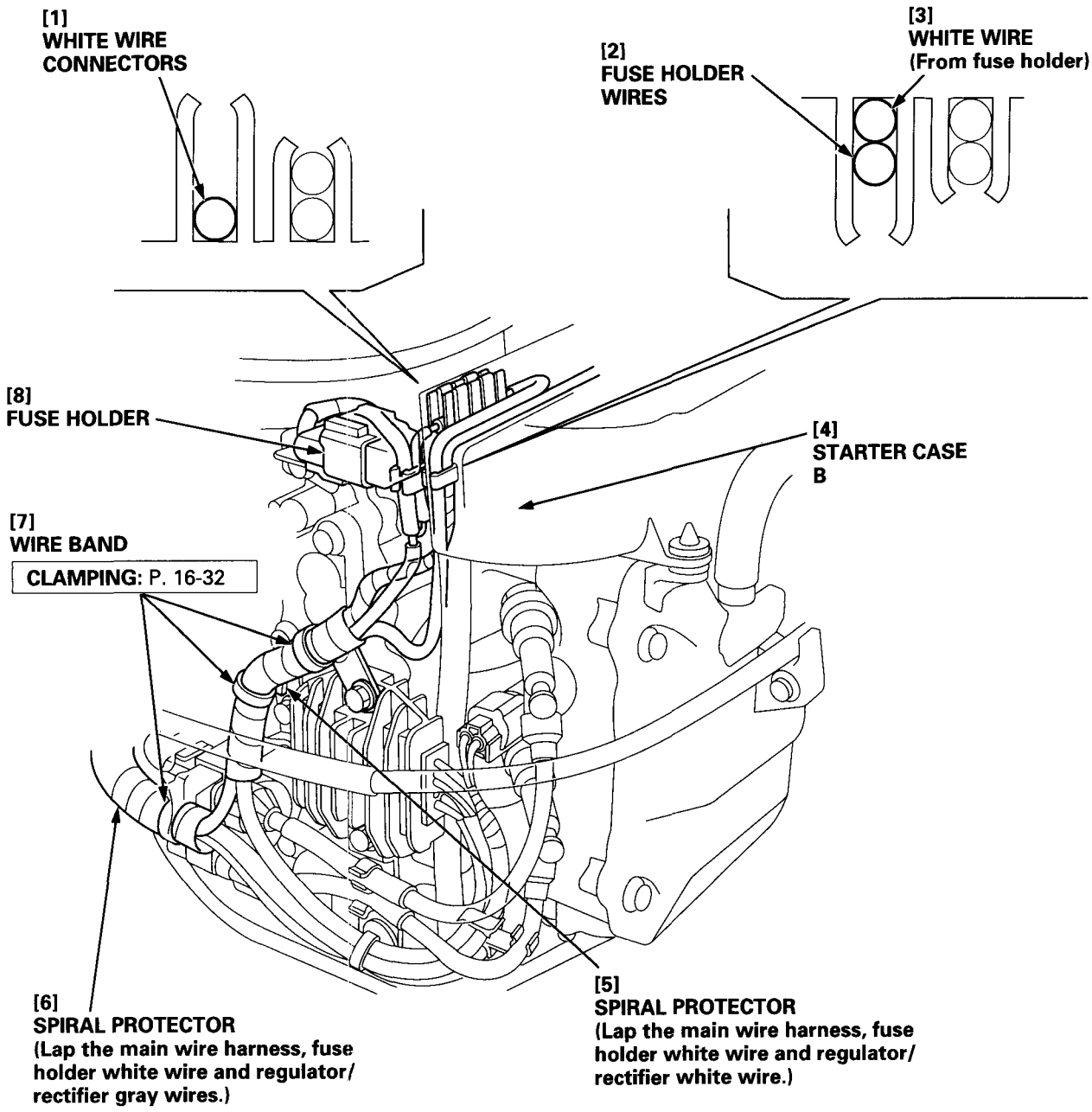
3) Route the charge receptacle wire. Connect the connectors and set them on the connector bracket C.



4) Route the charge receptacle wire as shown and lap the wires with the spiral protectors, then secure them with the wire bands.

5) Connect the white wire connectors and set them on the connector holder on the starter case B.

6) Set the fuse holder on the fuse holder bracket and secure the wires as shown.

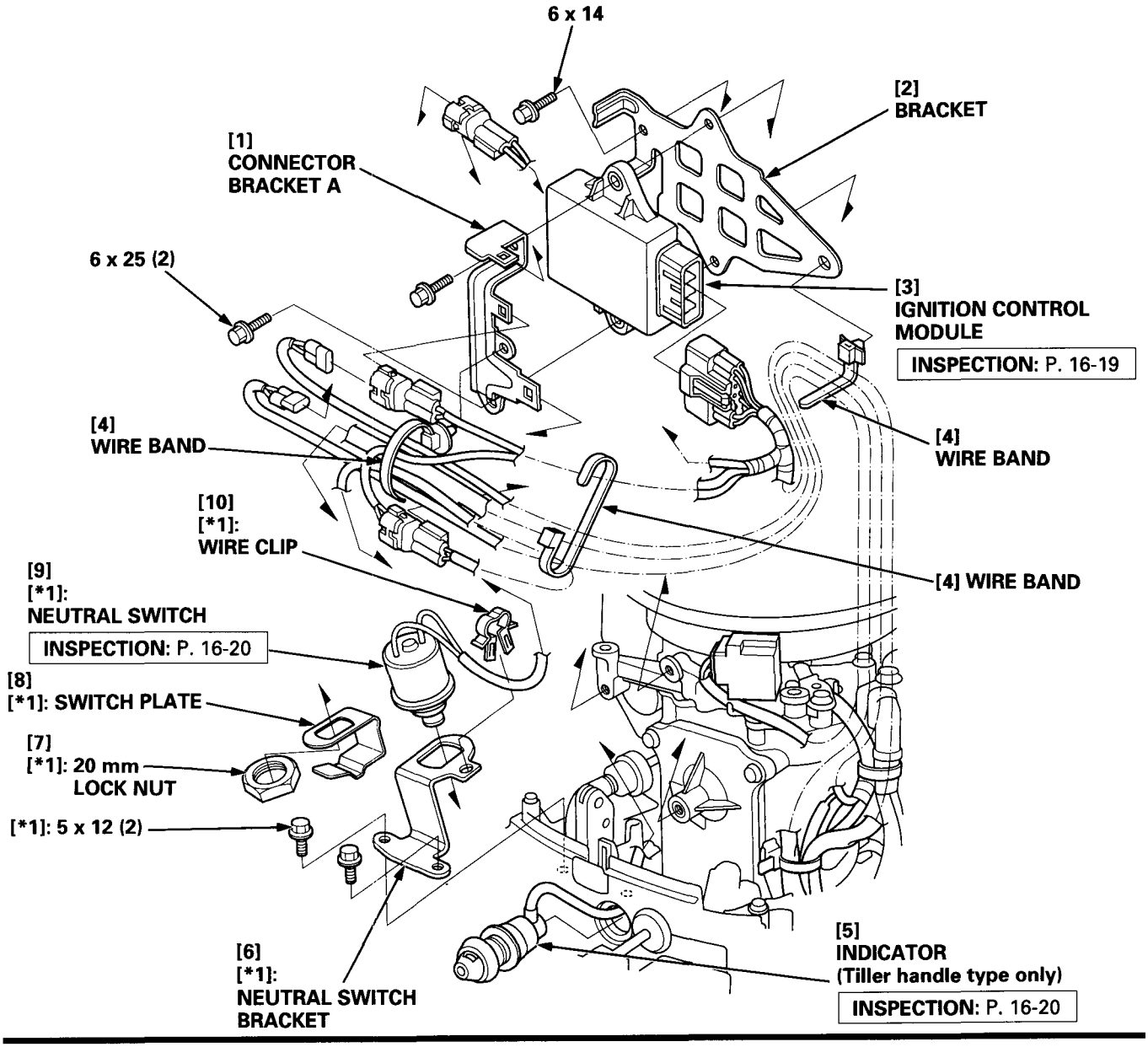


4. IGNITION CONTROL MODULE/NEUTRAL SWITCH

a. REMOVAL

1) Remove the following:
   — engine cover (P. 5-1).
   — left engine under cover (P. 5-3).
   — neutral start cable (P. 7-1).
   — recoil starter (P. 7-2).
   — silencer cover (P. 8-1).
2) Open the wire bands, and then pull off the wire connectors and disconnect the connectors.
3) Remove the two 6 x 25 mm flange bolts, and remove the connector bracket A and ignition control module.
4) Remove the 6 x 14 mm flange bolt and the bracket.
5) Remove the two 5 x 12 mm flange bolts and remove the neutral switch bracket with the neutral switch installed.
   • If the neutral switch removal is needed, remove the 20 mm lock nut and remove the neutral switch and switch plate from the neutral switch bracket.

[*1]: Type with electric starter



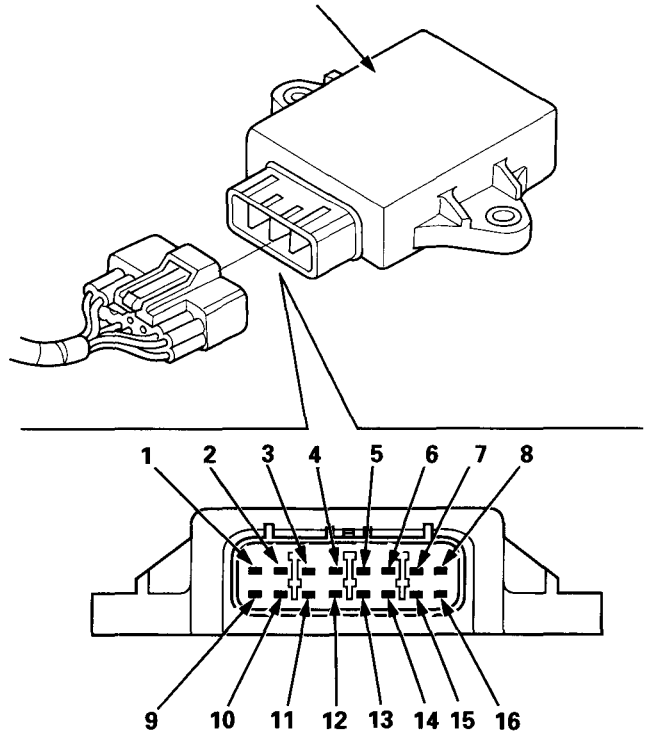
b. INSPECTION

• IGNITION CONTROL MODULE

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

- Use a tester that is equivalent to or higher than the performance specified;
- Internal resistance: 20 kΩ/VDC, 9 kΩ/VAC
- Be careful not to touch the metallic part of the tester probe with your body. Otherwise, correct resistance value cannot be obtained.
- Read the tester manufacturer's operation instructions carefully before operation with a tester. Follow the instructions of the Service Manual. Be sure the tester's battery is fully charged and check the meter before using the tester.
- Use a R x 1 scale of an commercially available multimeter, and meter shows current flow from negative (–) to positive (+). The diode is good if the meter shows current flowing one way.

[1]
IGNITION CONTROL MODULE



[2]
INSPECTION TABLE

[3] Unit : kΩ

[4]Positive probe / [5] Negative probe	1	2	3	4	5	6	7	8
1		∞	∞	100 – ∞	14 – 100	5 – 40	12 – 90	26 – 400
2	26 – 500		∞	300 – ∞	90 – ∞	50 – ∞	70 – ∞	90 – ∞
3	∞	∞		∞	∞	∞	∞	∞
4	∞	∞	∞		∞	∞	∞	∞
5	∞	∞	∞	∞		∞	∞	∞
6	13 – 100	∞	∞	24 – 400	1.6 – 11		3.8 – 24	8 – 60
7	24 – 400	∞	∞	35 – 1,000	7.5 – 60	8 – 60		14 – 100
8	∞	∞	∞	∞	∞	∞	∞	
9	35 – 1,000	∞	∞	70 – ∞	6.5 – 50	2 – 14	7.5 – 60	18 – 200
10	13 – 100	∞	∞	24 – 400	1.6 – 11	0	3.8 – 24	8 – 60
11	45 – ∞	∞	∞	100 – ∞	17 – 150	6 – 50	13 – 100	9.5 – 80
12	45 – 1,000	∞	∞	100 – ∞	17 – 200	6 – 50	13 – 100	9 – 80
13	∞	∞	∞	∞	∞	∞	∞	∞
14	∞	∞	∞	∞	∞	∞	∞	∞
15	13 – 100	∞	∞	24 – 400	1.4 – 11	0	3.8 – 24	8 – 60
16	18 – 200	∞	∞	26 – 400	4.6 – 30	1.8 – 14	9 – 70	10 – 80

[1] INSPECTION TABLE (continued)

[2] Unit : kΩ

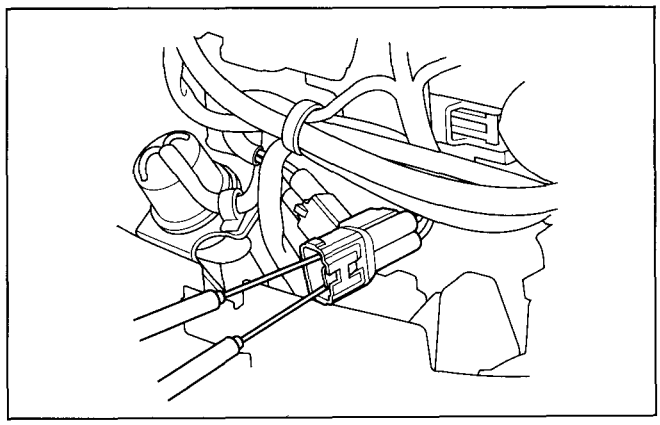
[3] Positive probe / [4] Negative probe	9	10	11	12	13	14	15	16
1	50 – ∞	4.8 – 40	17 – 200	17 – 200	100 – ∞	26 – 500	5 – 40	8.5 – 70
2	90 – ∞	60 – ∞	90 – ∞	90 – ∞	∞	90 – ∞	60 – ∞	70 – ∞
3	∞	∞	∞	∞	∞	∞	∞	∞
4	∞	∞	∞	∞	∞	∞	∞	∞
5	∞	∞	∞	∞	∞	∞	∞	∞
6	30 – 500	0	2 – 15	2 – 15	24 – 400	8.5 – 70	0	1.4 – 11
7	35 – 1,000	4 – 24	8 – 60	8 – 60	30 – 500	15 – 150	4 – 24	5.5 – 45
8	∞	∞	∞	∞	∞	∞	∞	∞
9		1.8 – 14	8 – 60	8 – 60	70 – ∞	18 – 300	2 – 14	4.8 – 35
10	30 – 500		2 – 15	2 – 15	24 – 400	8.5 – 70	0	1.4 – 11
11	45 – ∞	6 – 50		18 – 300	100 – ∞	9.5 – 80	6.5 – 50	9.5 – 90
12	45 – 1,000	6 – 50	18–300		100 – ∞	9.5 – 80	6 – 50	9.5 – 80
13	∞	∞	∞	∞		∞	∞	∞
14	∞	∞	∞	∞	∞		∞	∞
15	30 – 500	0	2 – 15	2 – 15	24 – 400	8.5 – 70		1.4 – 11
16	35 – 500	1.8 – 14	4.8 – 35	4.8 – 35	26 – 400	11 – 90	1.6 – 11	

• NEUTRAL SWITCH

Check for continuity between the terminals.

There should be continuity with the switch pushed (gearshift in NEUTRAL).

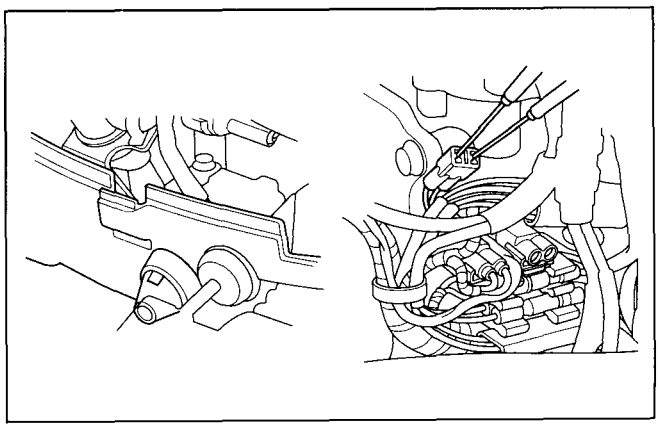
There should be no continuity with the switch released (gearshift in FORWARD or REVERSE).



• INDICATOR

The indicator should turn on when connecting a 12 V battery (+) terminal to the Orange terminal and (–) to the Black terminal.

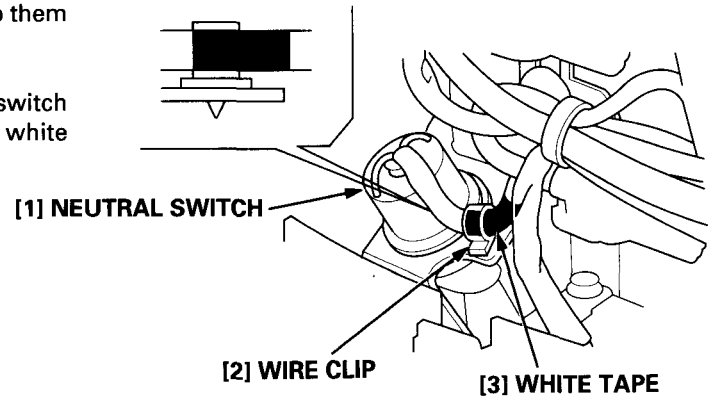
- Be sure the battery is in good condition before performing the test.

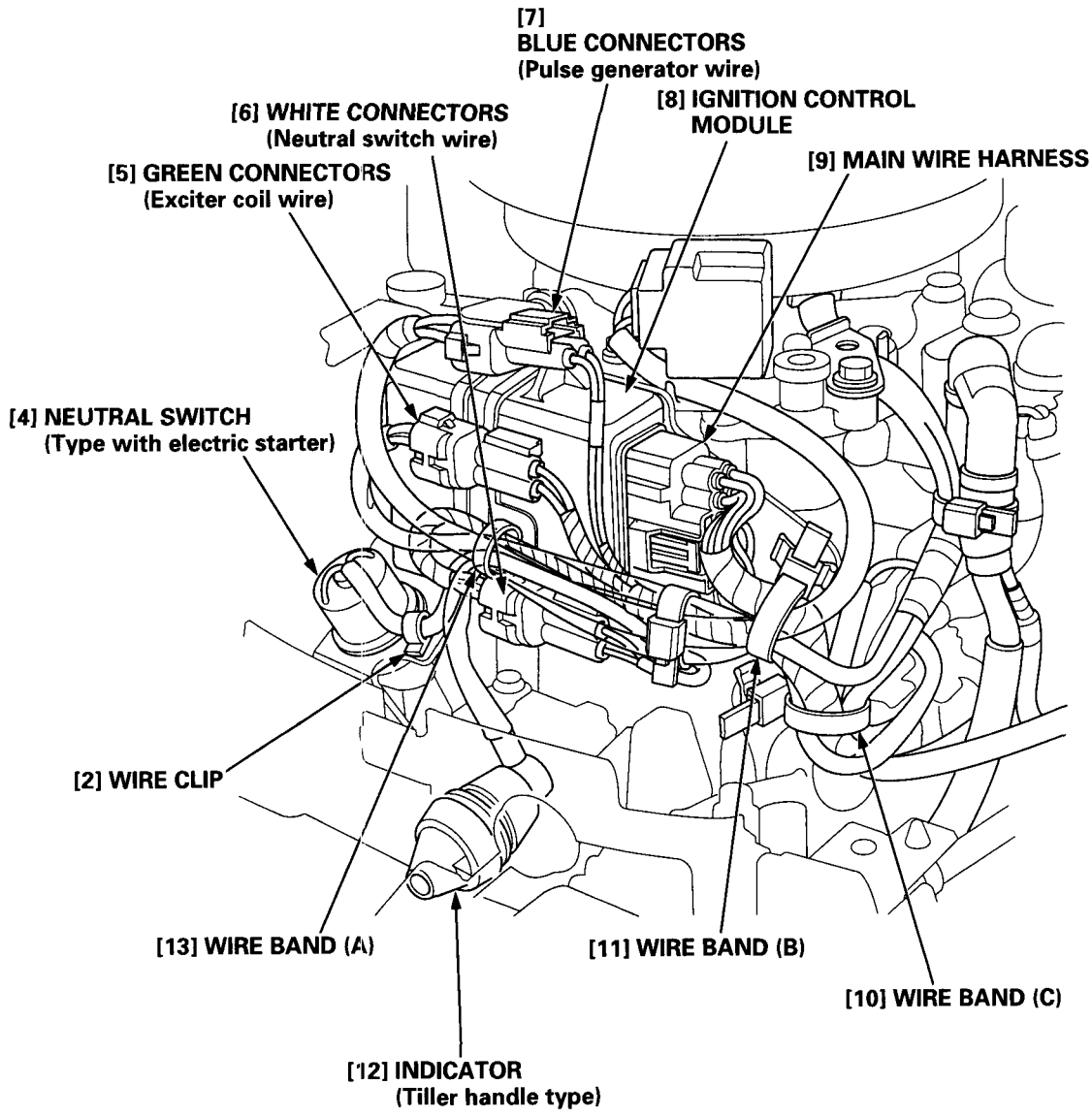


c. INSTALLATION

Installation is the reverse order of removal.

- Connect the connectors and set them on the connector bracket as shown. Route the wire harness and clamp them with the wire bands (A, B, and C sections) as shown.
- With electric starter type only: Clamp the neutral switch wire with the wire clip by aligning the edge of the white tape with the clip as shown.





• WIRE CLAMPING POINTS

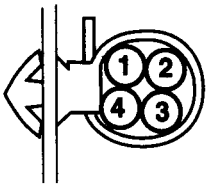
- Replace the wire band with new one, if it has been cut.

• Wire band (A)

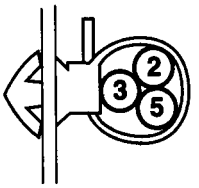
Clamp the pulse generator wire, neutral switch wire (electric starter type), exciter coil wire, indicator wire (tiller handle type) and main wire harness.

1: Main wire harness (to neutral switch)
2: Pulse generator wire
3: Exciter coil wire
4: Neutral switch wire
5: Indicator wire

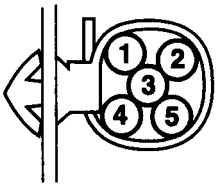
[1] Remote control type:



[2] Tiller handle type:
[2]-1 Without electric starter



[2]-2
With electric starter

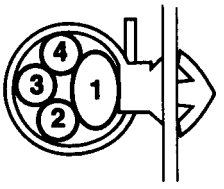


• Wire band (B)

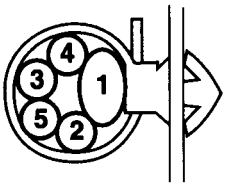
Clamp the pulse generator wire, neutral switch wire (electric starter type), exciter coil wire, indicator wire (tiller handle type) and main wire harness.

1: Main wire harness (to ignition control module)
2: Main wire harness (to pulse generator, exciter coil, neutral switch)
3: Exciter coil wire
4: Pulse generator wire
5: Indicator wire

[1] Remote control type:



[2] Tiller handle type:

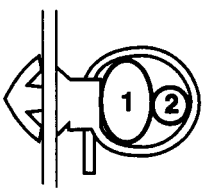


• Wire band (C)

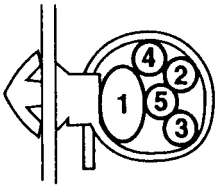
Clamp the starter switch wire, emergency stop switch wire, indicator wire (Tiller handle type), charge coil wire and main wire harness.

1: Main wire harness (to ignition control module)
2: Charge coil wire
3: Indicator wire
4: Starter switch wire
5: Emergency stop switch wire

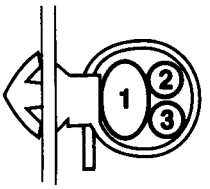
[1] Remote control type:



[2]-2 With electric starter:



[2] Tiller handle type:
[2]-1 Without electric starter, with 6 A charge coil



5. CONNECTOR BRACKET B

a. REMOVAL/INSTALLATION

• REMOTE CONTROL TYPE

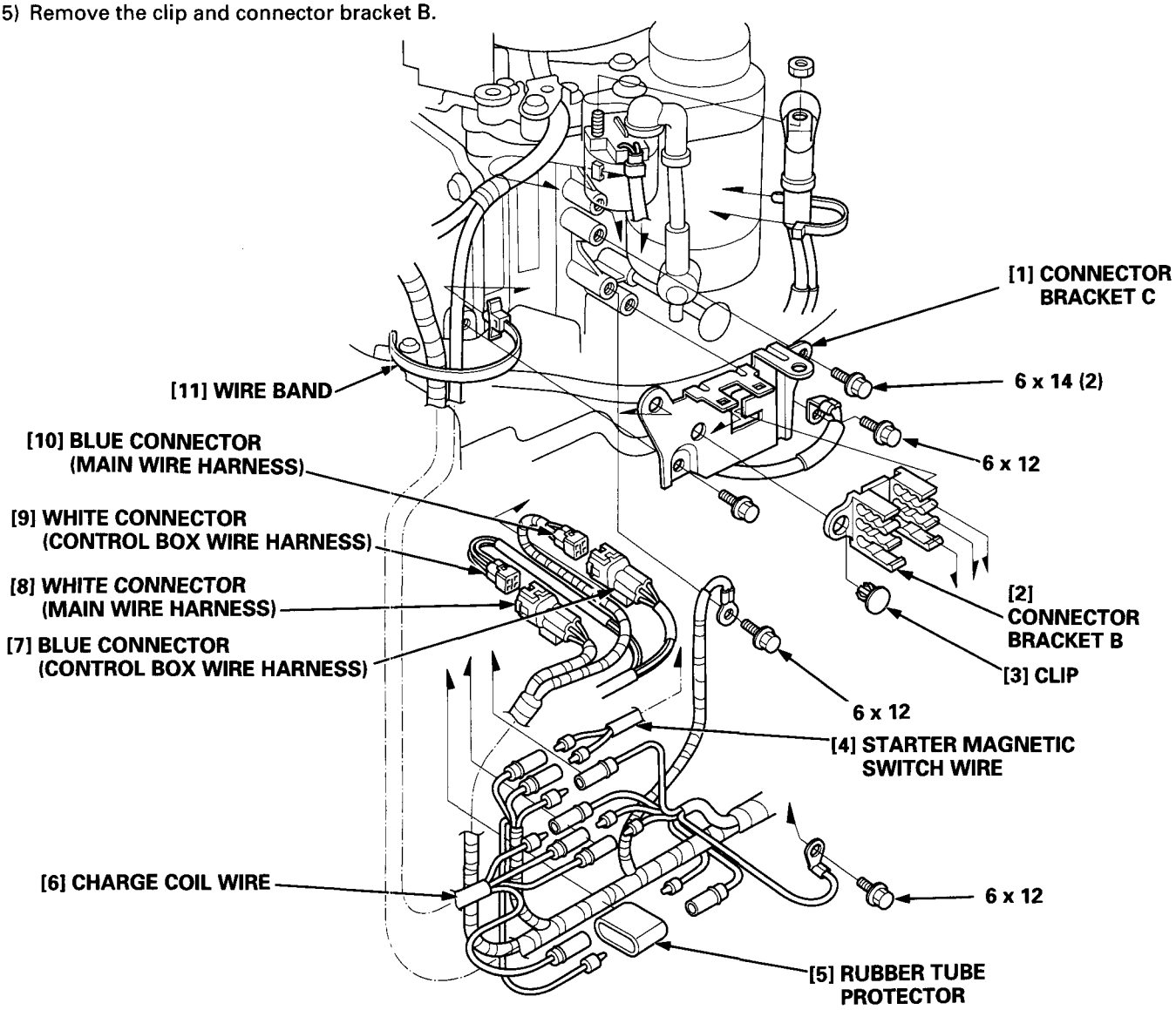
1) Remove the following:
   — engine cover (P. 5-1).
   — left engine under cover (P. 5-3).
   — neutral start cable (P. 7-1).
   — recoil starter (P. 7-2).
   — silencer cover (P. 8-1).
   — ignition control module (P. 16-18).

2) Pull off the two 4P connectors from the connector bracket C and disconnect them.

3) Pull out the connectors and wires from the connector bracket B, and disconnect the connectors.

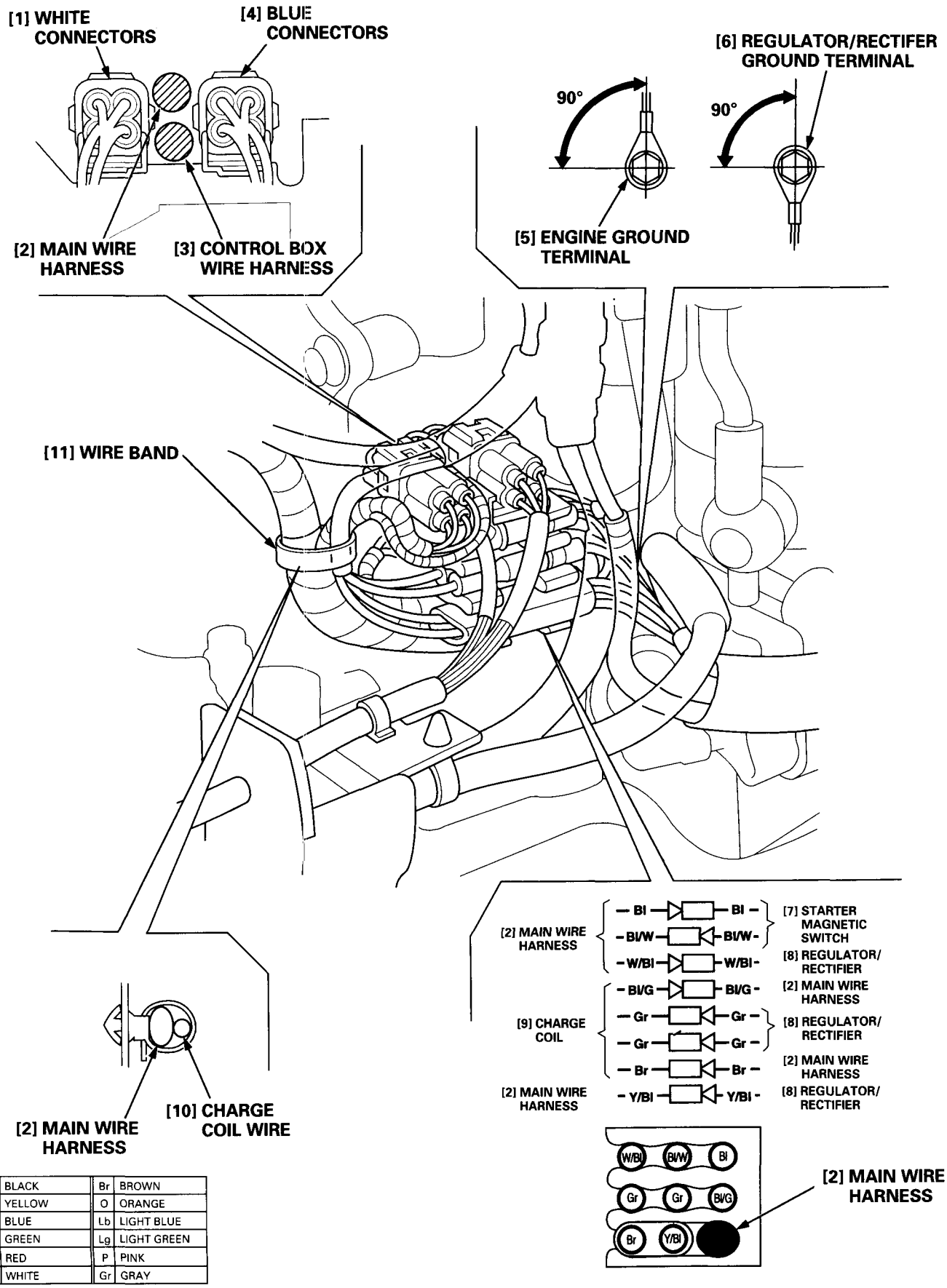
4) Remove the 6 x 14 mm flange bolts and remove the connector bracket C.

5) Remove the clip and connector bracket B.



Installation is the reverse order of removal.

- Replace the wire band with new one, if it has been cut.



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 (With electric starter)

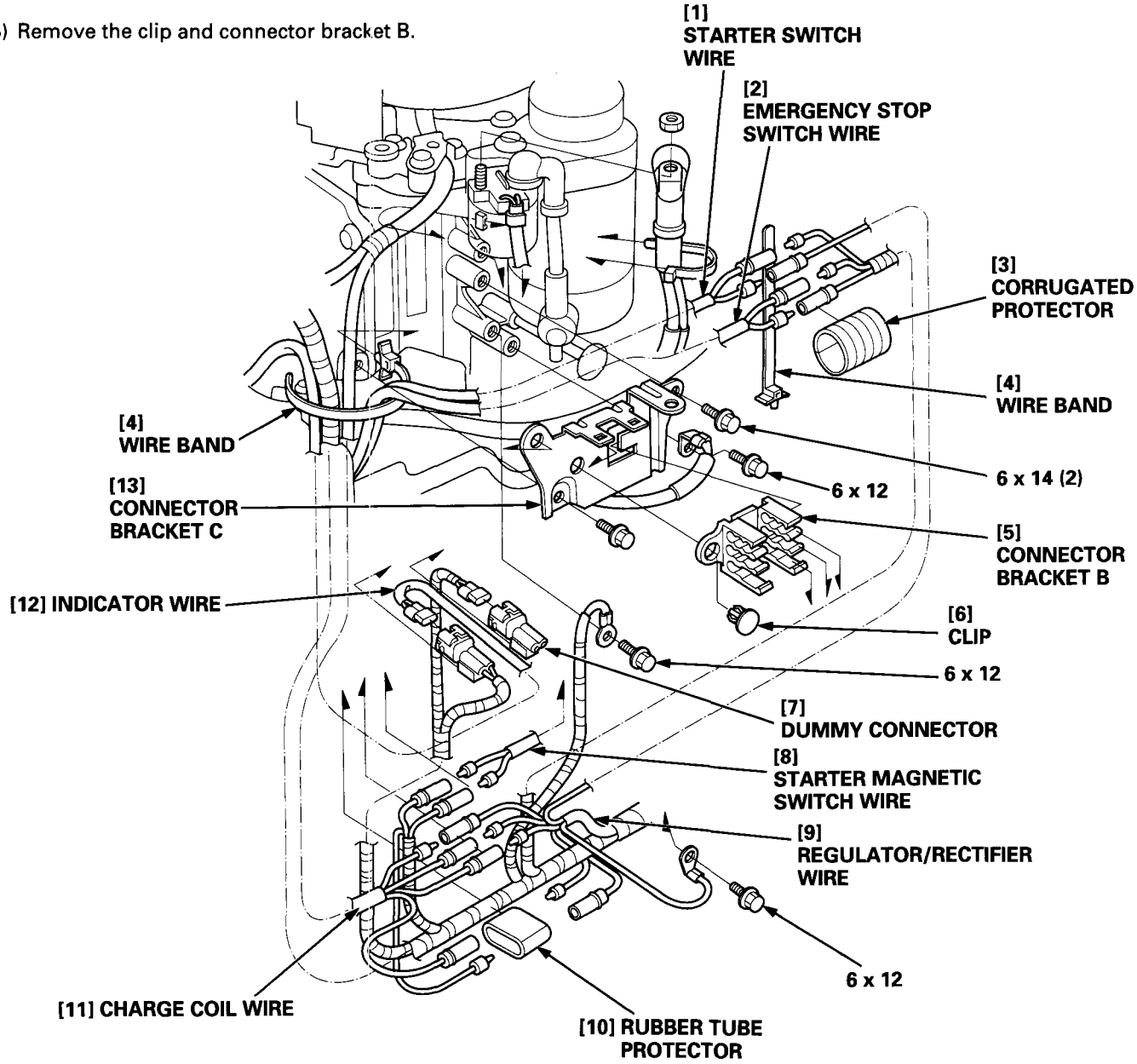
1) Remove the following:
   — engine cover (P. 5-1).
   — left engine under cover (P. 5-3).
   — neutral start cable (P. 7-1).
   — recoil starter (P. 7-2).
   — silencer cover (P. 8-1).
   — ignition control module (P. 16-18).

2) Pull off the two 2P connectors from the connector bracket C and disconnect them.

3) Pull out the connectors and wires from the connector bracket B, and disconnect the connectors.

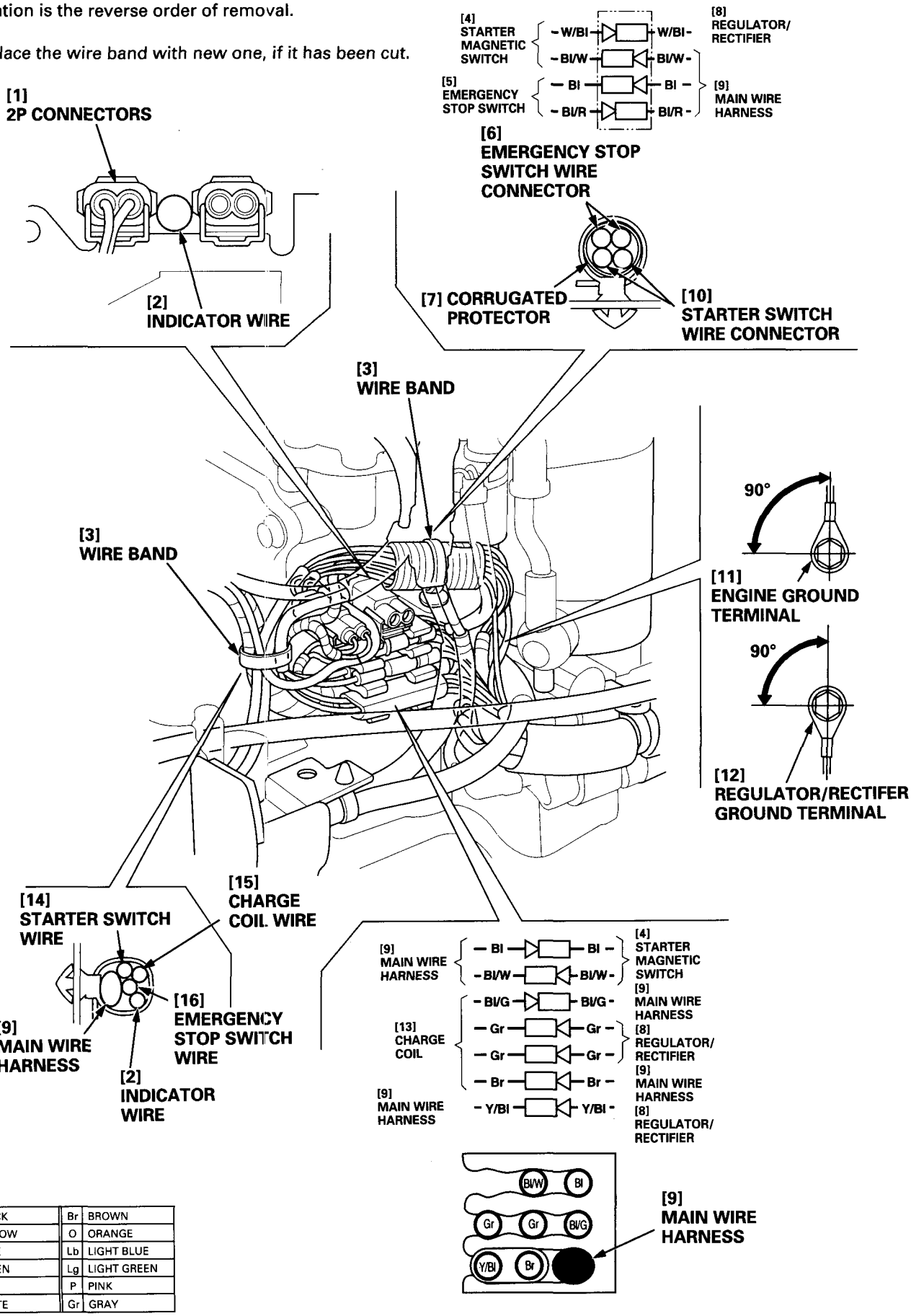
4) Remove the 6 x 14 mm flange bolts and remove the connector bracket C.

5) Remove the clip and connector bracket B.



Installation is the reverse order of removal.

- Replace the wire band with new one, if it has been cut.



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
(Without electric starter, with 6A charge coil)

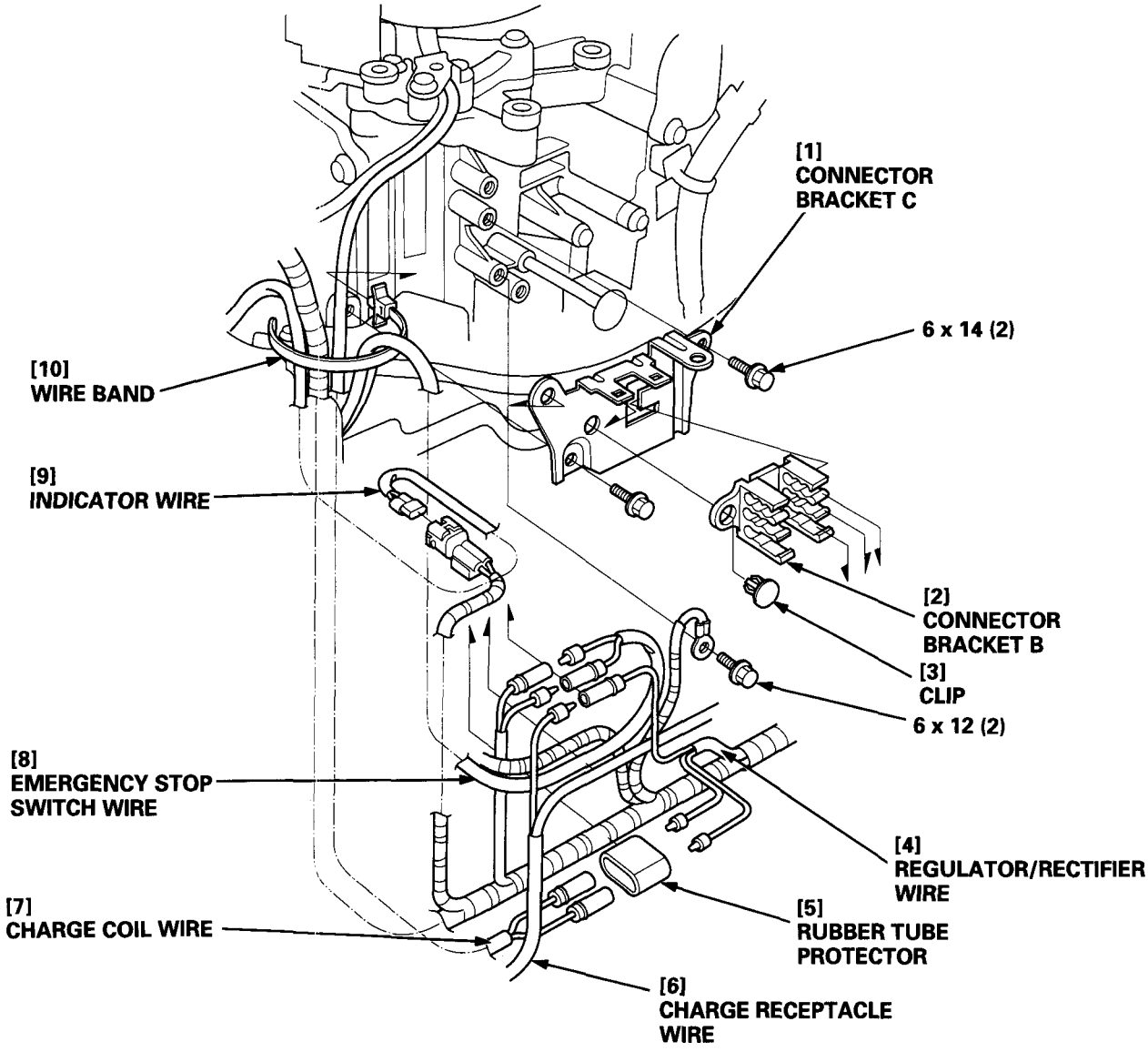
1) Remove the following:
   — engine cover (P. 5-1).
   — left engine under cover (P. 5-2).
   — neutral start cable (P. 7-1).
   — recoil starter (P. 7-2).
   — silencer cover (P. 8-1).
   — ignition control module (P. 16-18).

2) Pull off the 2P connector from the connector bracket C and disconnect it.

3) Pull out the connectors and wires from the connector bracket B, and disconnect the connectors.

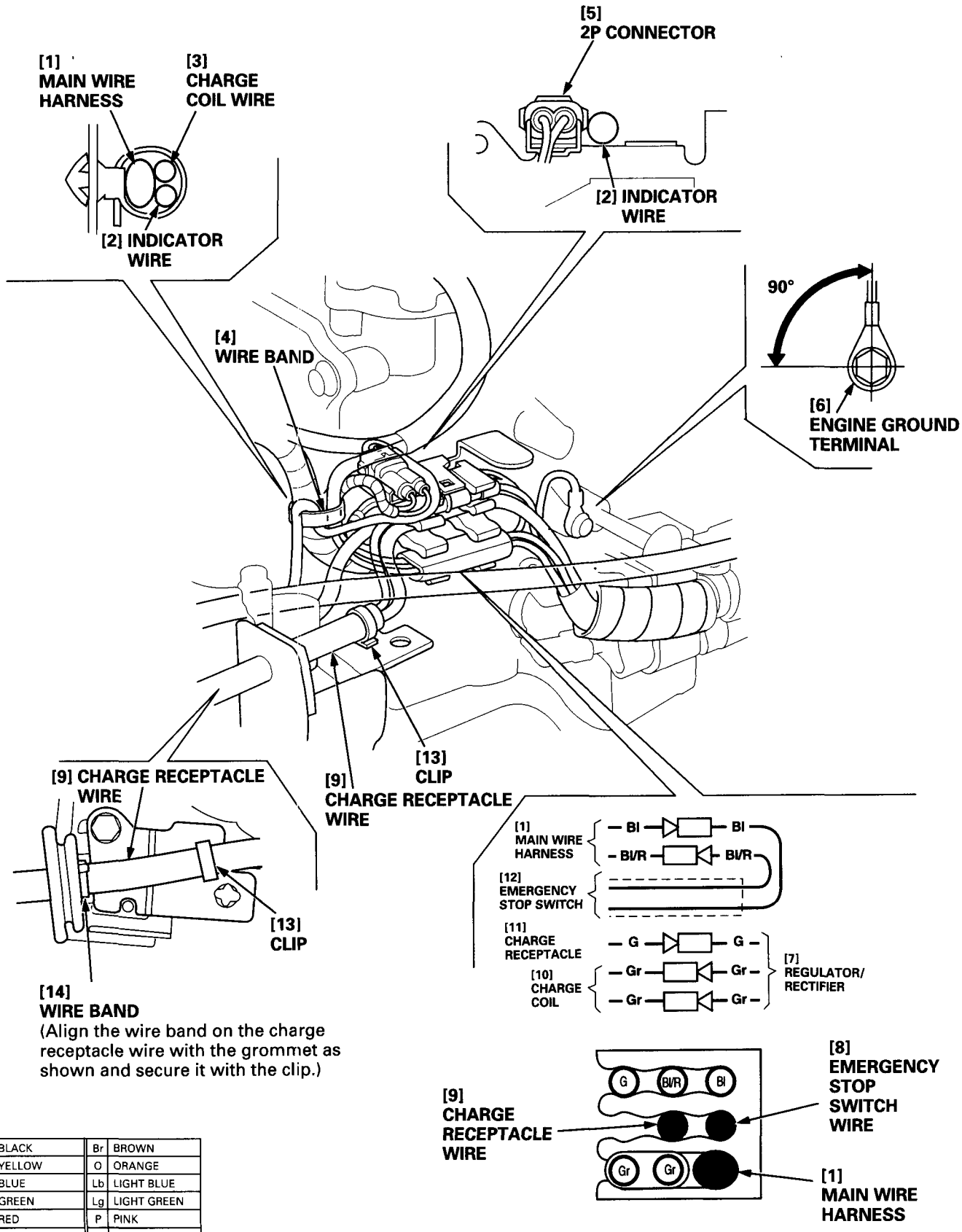
4) Remove the 6 x 14 mm flange bolts and remove the connector bracket C.

5) Remove the clip and connector bracket B.



Installation is the reverse order of removal.

- Replace the wire band with new one, if it has been cut.



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

6. IGNITION COIL/REGULATOR/RECTIFIER

a. REMOVAL

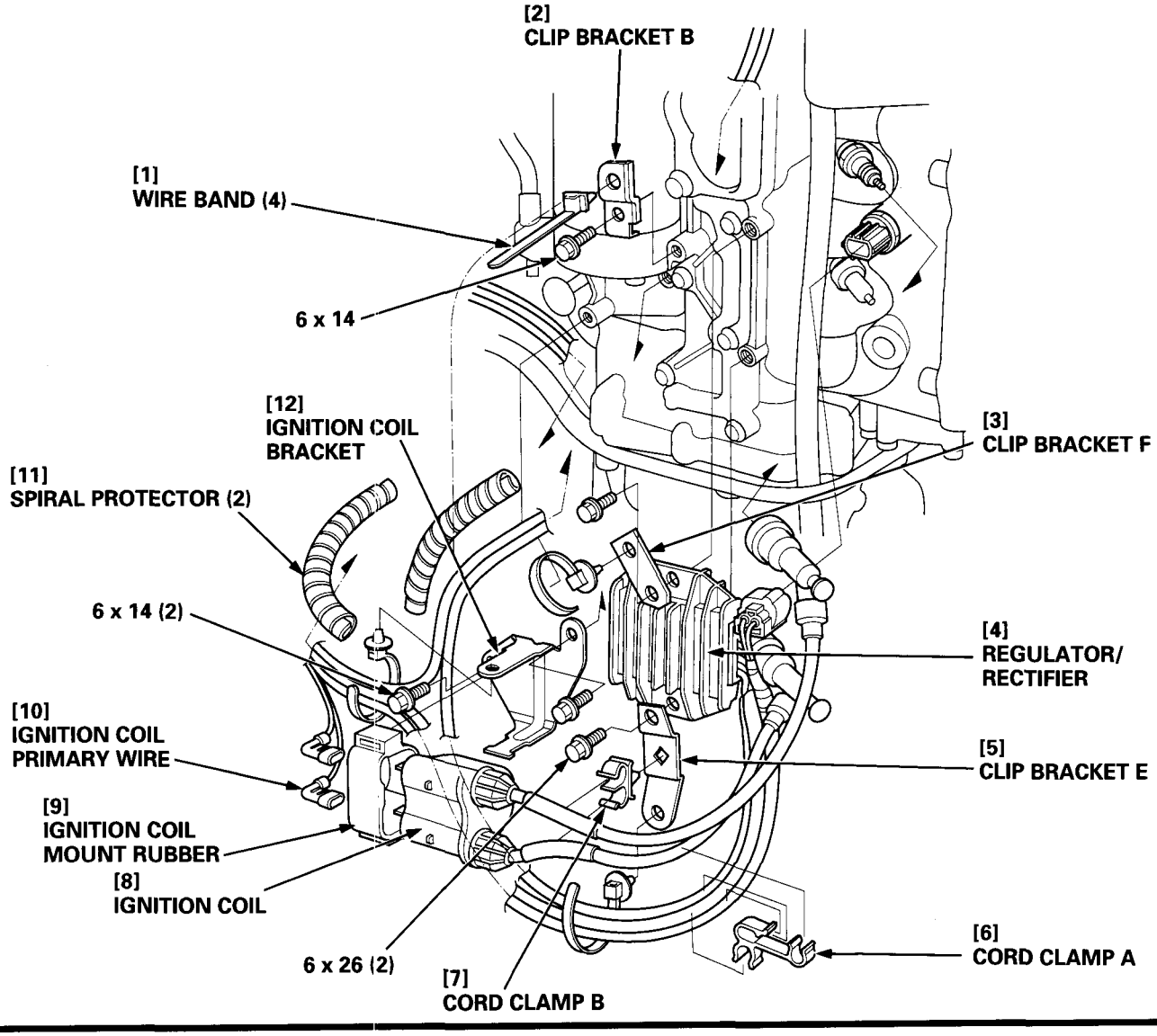
1) Remove the following:
   — engine cover (P. 5-1).
   — left engine under cover (P. 5-3).
   — neutral start cable (P. 7-1).
   — recoil starter (P. 7-2).
   — silencer cover (P. 8-1).
   — ignition control module (P. 16-18).

2) Disconnect the spark plug caps from the spark plugs.

3) Disconnect the ignition coil primary wires from the ignition coil and remove the ignition coil.

4) Remove the 6 x 25 mm flange bolts, clip bracket F and E and regulator/rectifier.

5) Remove the 6 x 14 mm flange bolts and ignition coil bracket.



b. INSPECTION

• IGNITION COILS

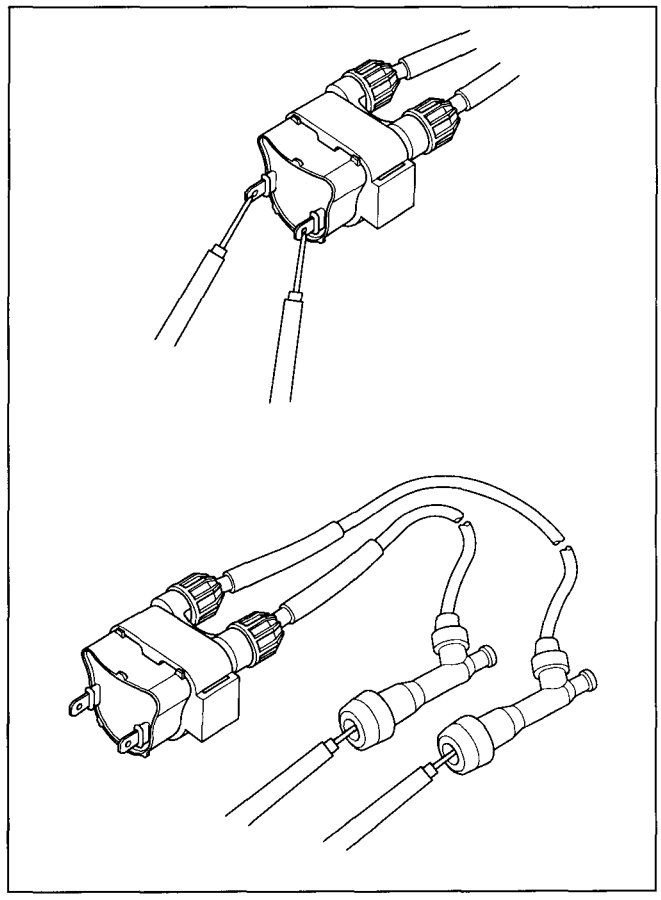
1) Check the high tension cords for cracked or damaged insulation. Replace if necessary.

2) Measure the resistance of the primary coil by touching the ohmmeter leads to the ignition coil's primary terminals.

Standard resistance	0.35 – 0.43 Ω

3) Measure the resistance of the secondary side of the coil by touching the ohmmeter leads to the spark plug caps.

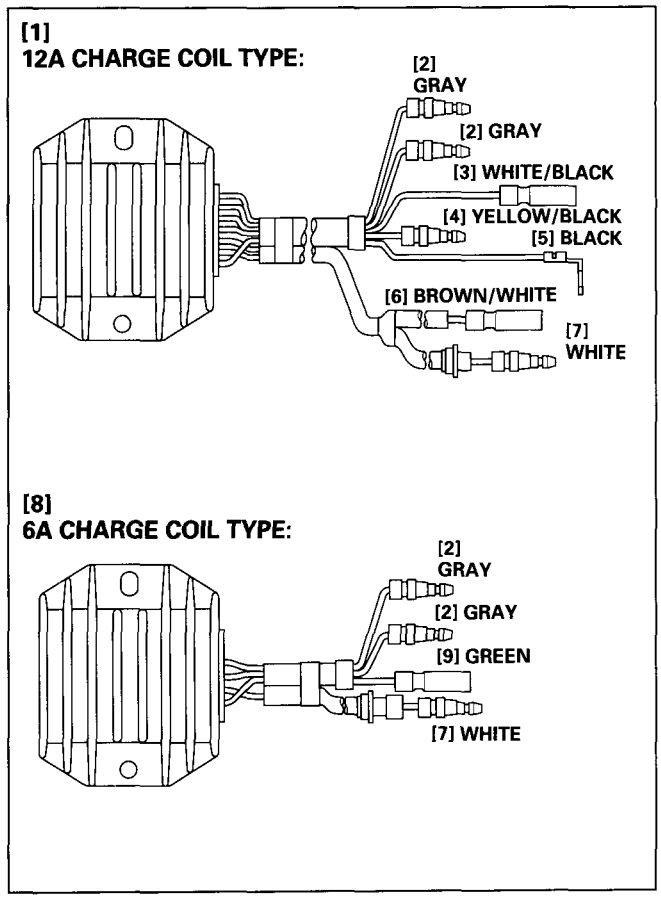
Standard resistance	23.0 – 34.8 kΩ



• REGULATOR/RECTIFIER

Measure the resistance between the terminals and be sure that the measurements conform to the ranges shown in the table on next page.

- Use a tester that is equivalent to or higher than the performance specified; Internal resistance: 20 kΩ/VDC, 9 kΩ/VAC.
- Be careful not to touch the metallic part of the tester probe with your body. Otherwise correct resistance value cannot be obtained.
- Read the tester manufacturer's operation instructions carefully before operation with a tester. Follow the instructions of the Service Manual. Be sure the tester's battery is fully charged and check the meter before using the tester.
- Use a R x 1 scale of an commecially available multimeter, and meter shows current flow from negative (–) to positive (+). The diode is good if the meter shows current flowing one way.



6A CHARGE COIL:

Unit: Ω

Tester (+) probe / Tester (–) probe	Gray 1	Gray 2	White	Green
Gray 1		∞	∞	∞
Gray 2	∞		∞	∞
White	1k – 200k	1k – 200k		500 – 100k
Green	100 – 50k	100 – 50k	∞	

12A CHARGE COIL:

Unit: Ω

Tester (+) probe / Tester (–) probe	Gray 1	Gray 2	White, White/black	Black	Yellow/ black	Brown/ white
Gray 1		∞	∞	∞	∞	∞
Gray 2	∞		∞	∞	∞	∞
White, White/black	1k – 200k	1k – 200k		500 – 100k	∞	∞
Black	100 – 50k	100 – 50k	∞		∞	∞
Yellow/black	∞	∞	∞	∞		∞
Brown/white	∞	∞	∞	∞	100 – 50k	

BOBINE DE CHARGE DE 6 A:

Unité: Ω

Pointe de touche (+) du vérificateur / Pointe de touche (–) du vérificateur	Gris 1	Gris 2	Blanc	Vert
Gris 1		∞	∞	∞
Gris 2	∞		∞	∞
Blanc	1k – 200k	1k – 200k		500 – 100k
Vert	100 – 50k	100 – 50k	∞	

BOBINE DE CHARGE DE 12 A:

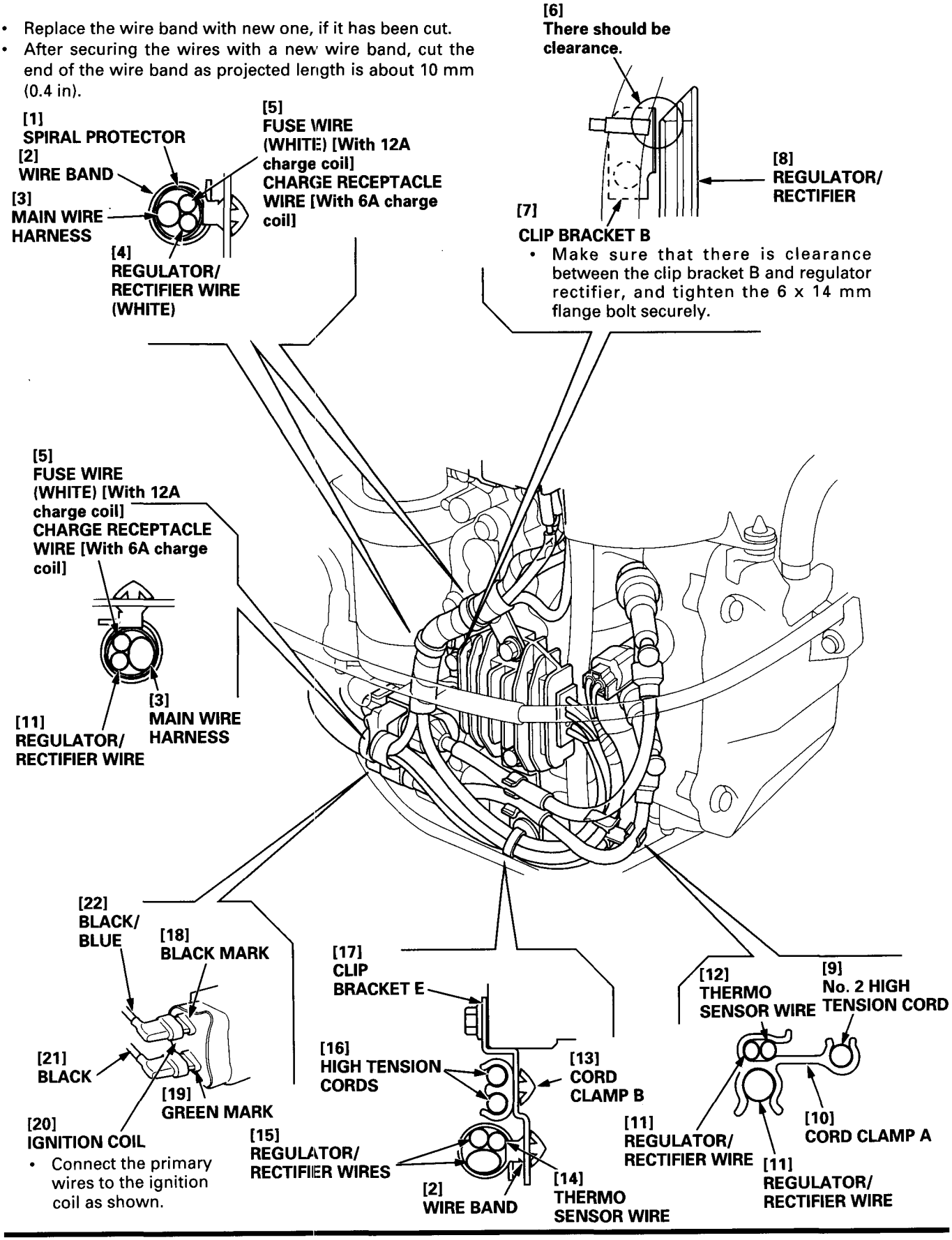
Unité: Ω

Pointe de touche (+) du vérificateur / Pointe de touche (–) du vérificateur	Gris 1	Gris 2	Blanc, Blanc/noir	Noir	Jaune/noir	Marron/blanc
Gris 1		∞	∞	∞	∞	∞
Gris 2	∞		∞	∞	∞	∞
Blanc, Blanc/noir	1k – 200k	1k – 200k		500 – 100k	∞	∞
Noir	100 – 50k	100 – 50k	∞		∞	∞
Jaune/noir	∞	∞	∞	∞		∞
Marron/blanc	∞	∞	∞	∞	100 – 50k	

c. INSTALLATION

Installation is the reverse order of removal.

- Replace the wire band with new one, if it has been cut.
- After securing the wires with a new wire band, cut the end of the wire band as projected length is about 10 mm (0.4 in).



1. ACCELERATOR PUMP 2. Starting Enrichment (SE) SYSTEM

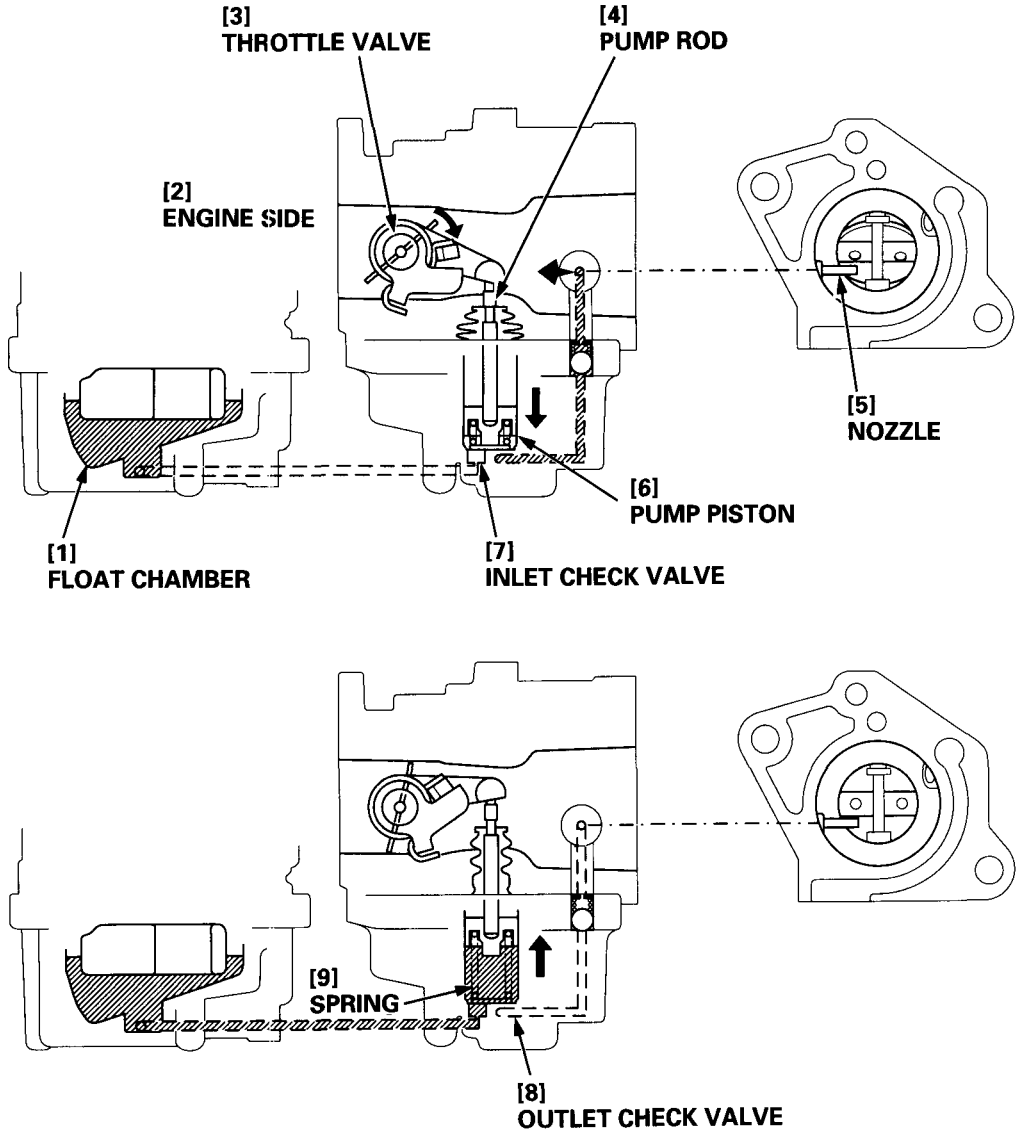
1. ACCELERATOR PUMP

When the throttle valve opens quickly for acceleration, etc, the air flow velocity at the venturi slows down quickly, too, decreasing the vacuum. Because the induced fuel amount decreases, compared to the suction air amount, the air/fuel mixture sucked into the cylinder temporarily becomes too lean and the engine can flame out.

The acceleration pump is equipped to prevent the lean air/fuel mixture. In short, it is designed to increase the fuel amount and make the air/fuel mixture richer when the throttle opens quickly.

When the throttle valve opens, the acceleration pump piston is pushed down via the pump rod. Because the inlet check valve is closed this time, the pump chamber is pressured and the outlet check valve is opened. Therefore, the fuel is injected from the nozzle into the main bore.

When the throttle valve is closed, the acceleration pump piston is pushed back by the spring force, the inlet check valve opens, and the fuel in the float chamber enters the pump chamber. The outlet check valve is closed this time, preventing suction of the air through the nozzle.

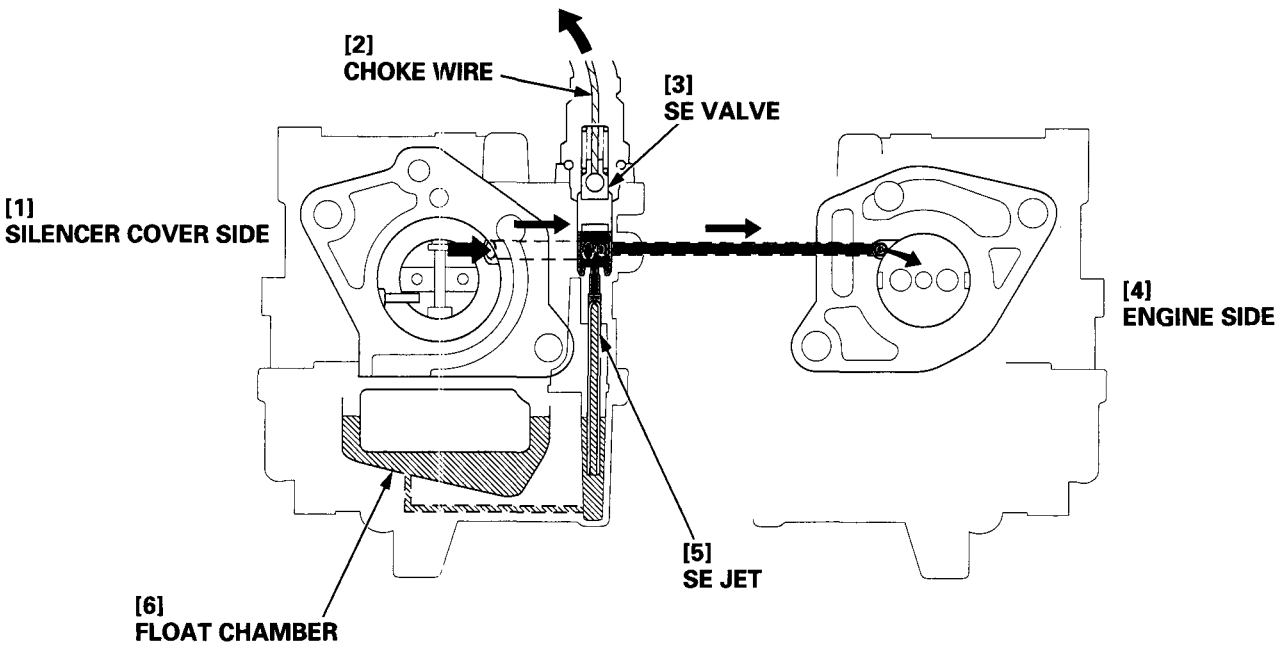


2. Starting Enrichment (SE) SYSTEM

This engine is equipped with the new system of the Manual Starting Enrichment (SE) System or Automatic SE System in place of the existing choke system.

Manual SE System

The manual SE system is the manual fuel increase system. When the choke knob is pulled, the SE valve at the end of the wire is pulled up and the fuel increase circuit opens. The air enters the circuit through the SE air jet this time, producing vacuum. The fuel is drawn and supplied from the float chamber via the SE jet by this vacuum, and it is injected to the main bore to provide the rich air/fuel mixture to the engine.



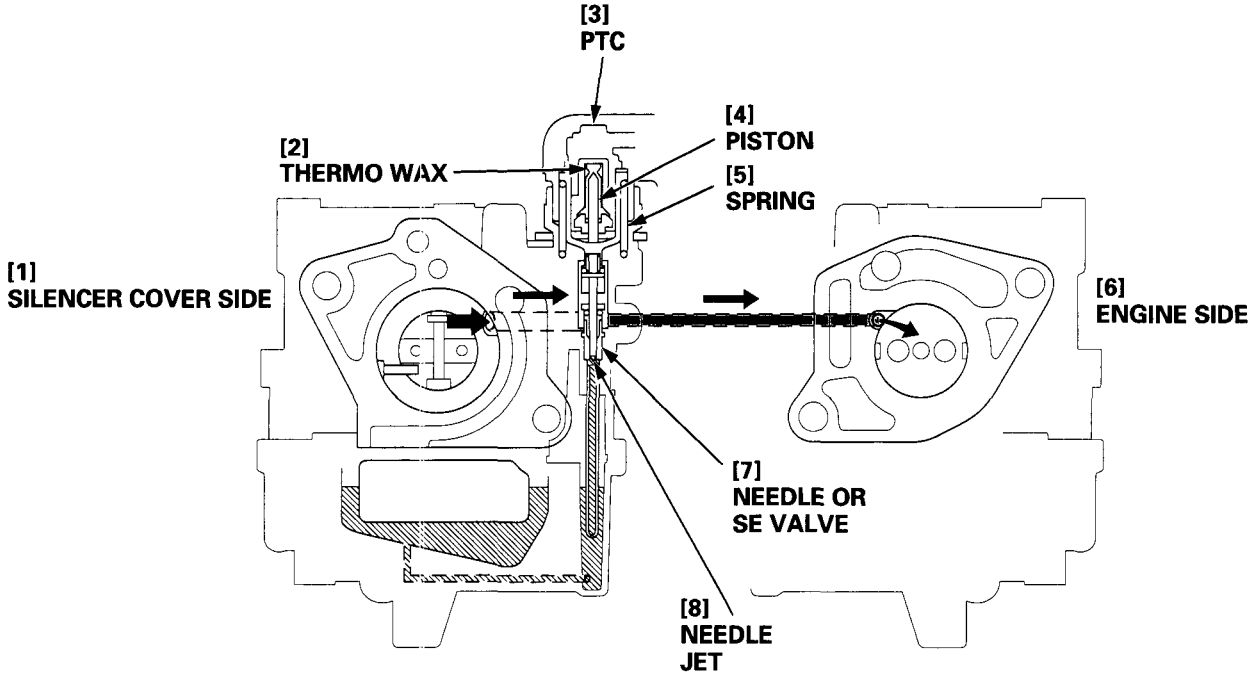
Automatic SE System

The SE (Starting Enrichment) thermal valve is the automatic SE system consisting of the PTC (heating element), thermo wax (thermal expansion element), piston, starter valve, etc.

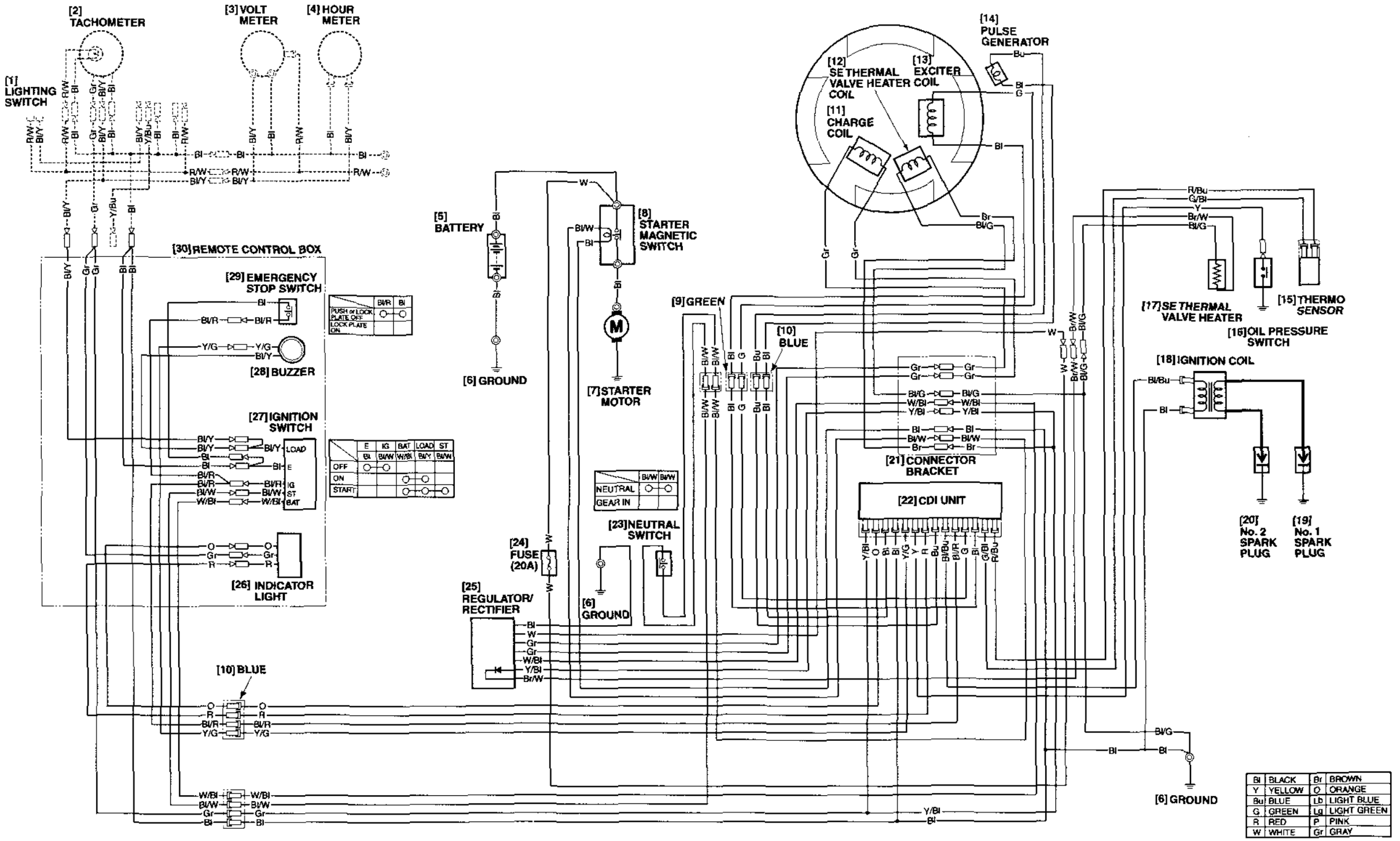
When the engine is at a stop, the starter valve is pushed up by the spring, making the fuel injection circuit open, and the SE thermal valve is ready to increase the fuel amount.

When the engine starts, the fuel is supplied through the fuel increase circuit, while the electric current from the heater coil flows to the PTC to heat it. The thermo wax is expanded by this heat, and this movement of the thermo wax pushes down the SE valve closing the fuel increase circuit as a result.

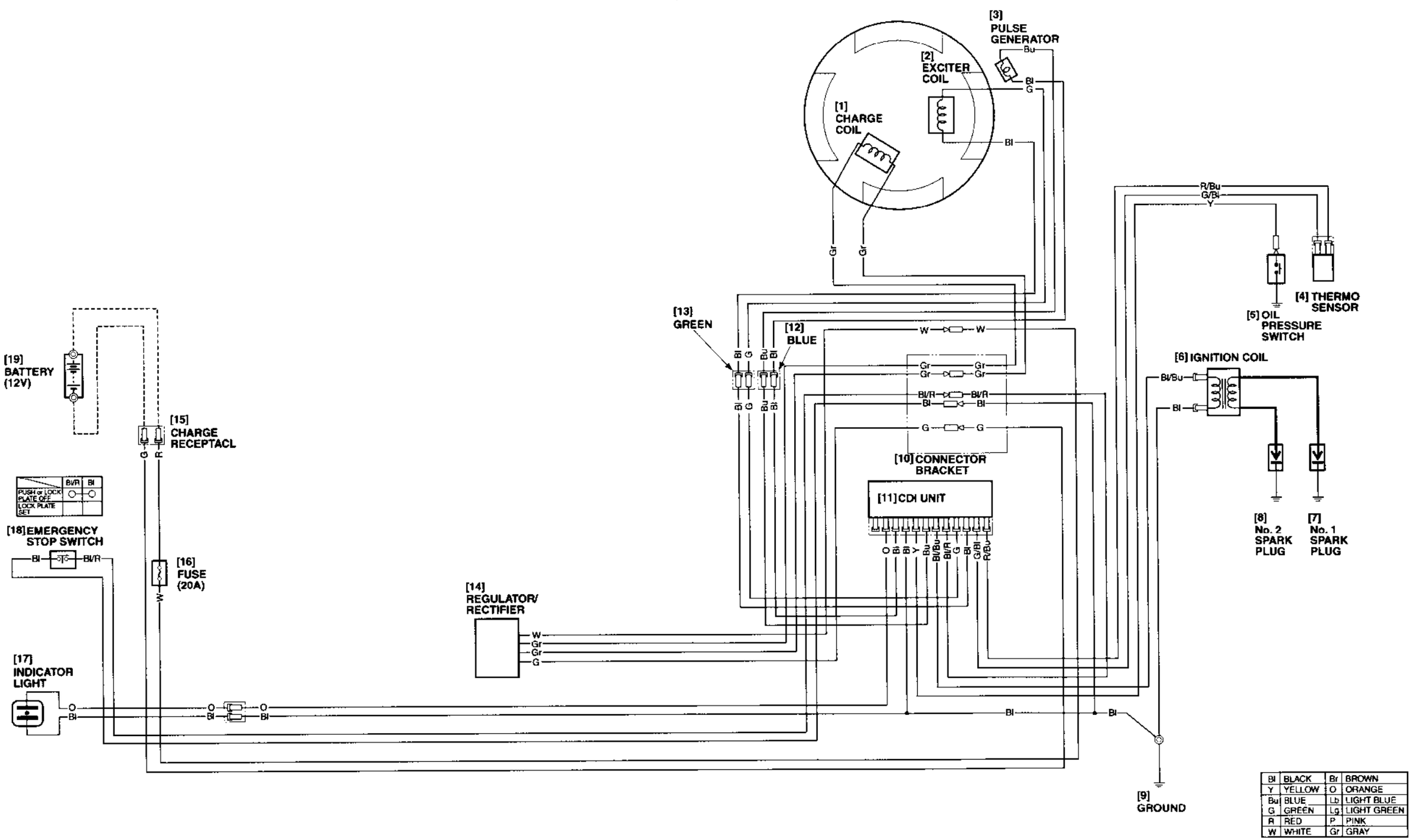
When the engine stops, the wax cools down and the fuel increase circuit starts to close, as the electric current stops flowing to the PTC.



REMOTE CONTROL TYPE



TILLER HANDLE TYPE (Type with 6A charge coil)



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

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PREFACE

This manual covers the construction, function and servicing procedures of the Honda BF8D•BF9.9D• BF10D Outboard motors (Power tilt and gas assisted tilt type).

For service information which is not covered in this supplement, please refer to the base shop manual (Parts number 66ZW900).

Careful observance of these instructions will result in better, safe service work.

Pay attention to these symbols and their meaning:

⚠WARNING Indicates a strong possibility of severe personal injury or loss of life if instructions are not followed.

CAUTION: Indicates a possibility of personal injury or equipment damage if instructions are not followed.

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

Date of Issue: October, 2003
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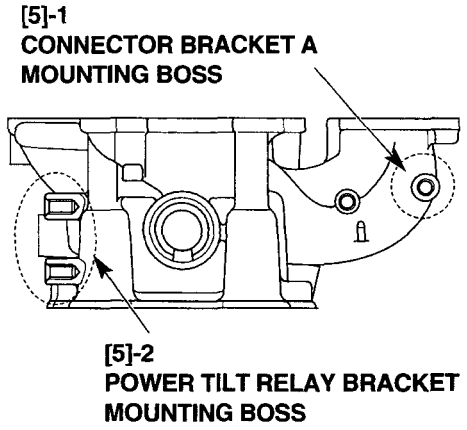
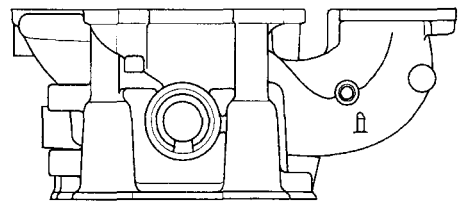
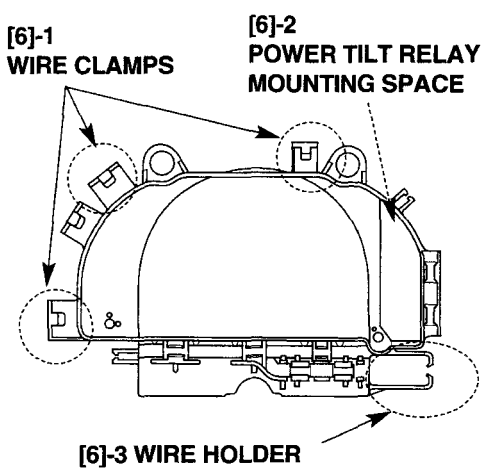
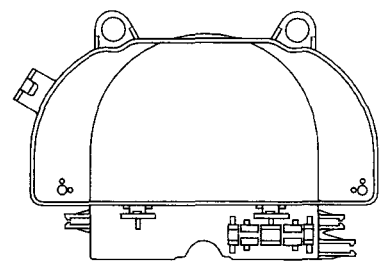
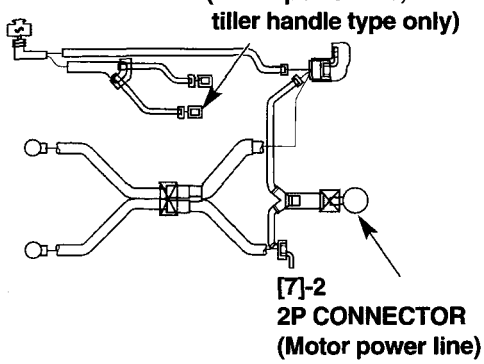
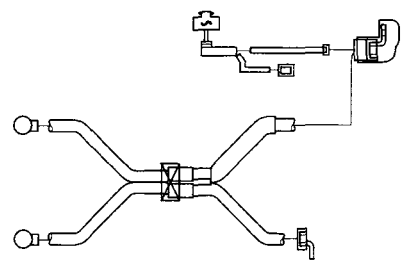
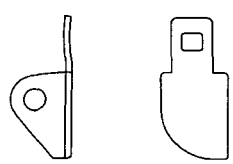
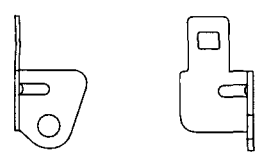
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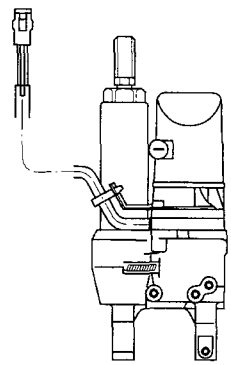
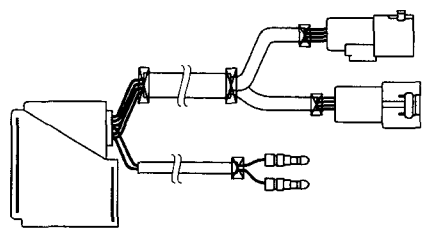
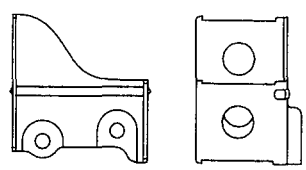
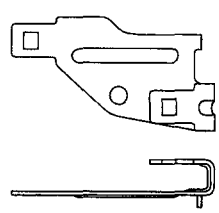
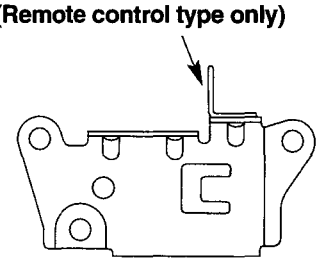
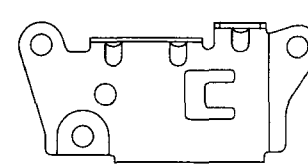
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   1. REMOTE CONTROL BOX 14-1

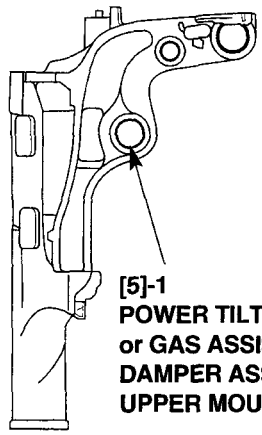
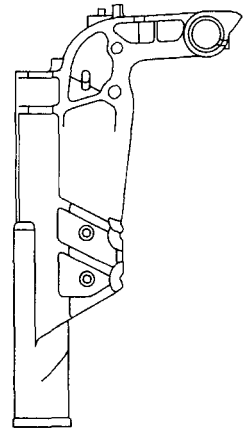
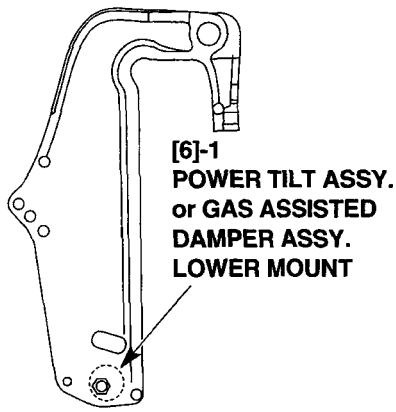
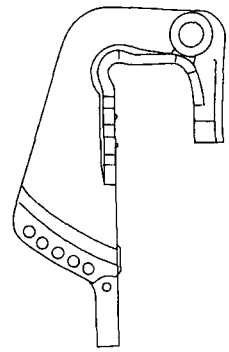
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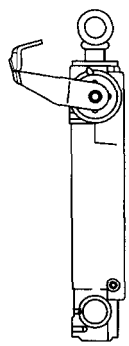
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17. WIRING DIAGRAMS 17-1

[1] Type / [2] Item	[3] Power tilt type	[4] Mechanical tilt type
[5] Cylinder head		
[6] Starter case B		
[7] Battery cable		
[8] Fuse holder		

[1] Type / [2] Item	[3] Power tilt type	[4] Mechanical tilt type
[5] Power tilt assembly		
[6] Power tilt relay		
[7] Power tilt relay bracket		
[8] Connector bracket A		
[9] Connector bracket C	**[9]-1** **6P CONNECTOR INSTALLED** **(Remote control type only)** 	

[1] Type / [2] Item	[3] Power tilt type and gas assisted tilt type	[4] Mechanical tilt type
[5] Swivel case		
[6] Stern bracket		

[1] Type / [2] Item	[7] Gas assisted tilt type	[4] Mechanical tilt type
[8] Gas assisted damper assembly		

1. SPECIFICATIONS	2. DIMENSIONAL DRAWINGS

1. SPECIFICATIONS

DIMENSIONS AND WEIGHTS

Model	BF8D			
Description code	BAAJ			
Type	SG	SHG	LG	LHG
Overall length	610 mm (24.0 in)			
Overall width	345 mm (13.6 in)			
Overall height	1,105 mm (43.5 in)		1,235 mm (48.6 in)	
Dry weight (With propeller mounted)	51.0 kg (112 lb)	54.0 kg (119 lb)	52.0 kg (115 lb)	55.5 kg (123 lb)
Operating weight	52.4 kg (116 lb)	55.4 kg (122 lb)	53.4 kg (118 lb)	56.9 kg (125 lb)
Transom height	433 mm (17.0 in)		563 mm (22.2 in)	
Transom angle	4 stage adjustment (8° , 12° , 16° , 20°)			
Tilting angle	68°			
Swivel angle	45° right and left			

Model	BF9.9D, BF10D						
Description code	BABJ						
Type	SG	SHG	SHT	LG	LHG	LHT	LRT
Overall length	610 mm (24.0 in)						600 mm (23.6 in)
Overall width	345 mm (13.6 in)						
Overall height	1,105 mm (43.5 in)			1,235 mm (48.6 in)			
Dry weight (With propeller mounted)	51.0 kg (112 lb)	54.0 kg (119 lb)	55.5 kg (122 lb)	52.0 kg (115 lb)	55.5 kg (122 lb)	57.0 kg (126 lb)	56.0 kg (123 lb)
Operating weight	52.4 kg (116 lb)	55.4 kg (122 lb)	56.9 kg (125 lb)	53.4 kg (118 lb)	56.9 kg (125 lb)	58.4 kg (129 lb)	57.4 kg (127 lb)
Transom height	433 mm (17.0 in)			563 mm (22.2 in)			
Transom angle	4 stage adjustment (8° , 12° , 16° , 20°)						
Tilting angle	68°						
Swivel angle	45° right and left						

Types of Honda BF8D, BF9.9D, BF10D Outboard Motors

It may be necessary to refer to this chart for reference purposes when reading this manual.

Model	BF8D, BF9.9D, BF10D						
Type	SG	SHG	SHT	LG	LHG	LHT	LRT
Shaft length	S	S	S	L	L	L	L
Remote control							○
Gas assisted tilt	○	○		○	○		
Power tilt			○			○	○
Electric starter		○	○		○	○	○

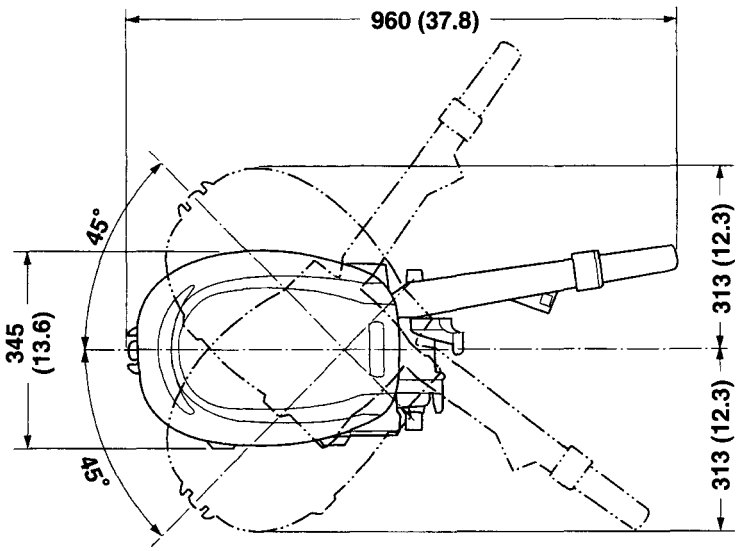
S: Short shaft, L: Long shaft

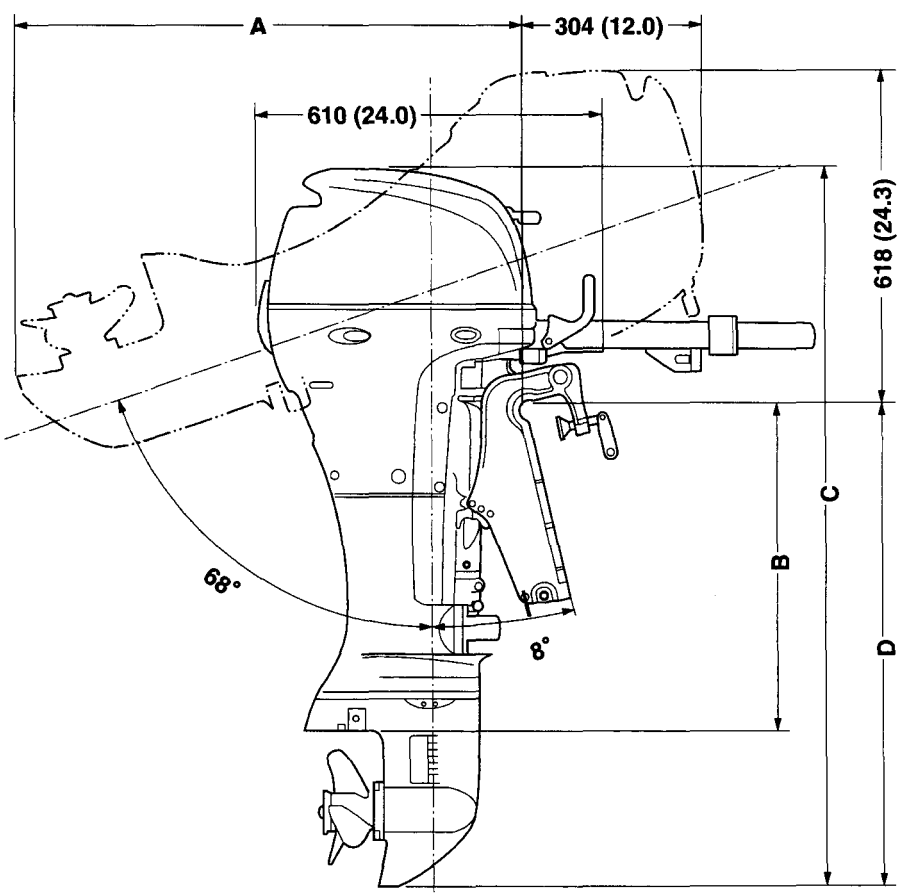
2. DIMENSIONAL DRAWINGS

• Tiller handle type

Unit: mm (in)

Type	A	B	C	D
S Type	742 (29.2)	433 (17.0)	1,105 (43.5)	695 (27.4)
L Type	859 (33.8)	563 (22.2)	1,235 (48.6)	825 (32.5)

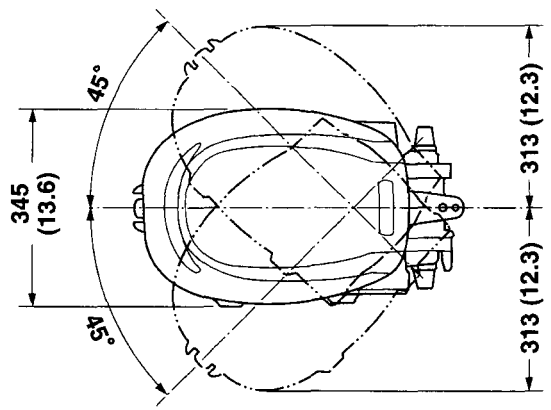


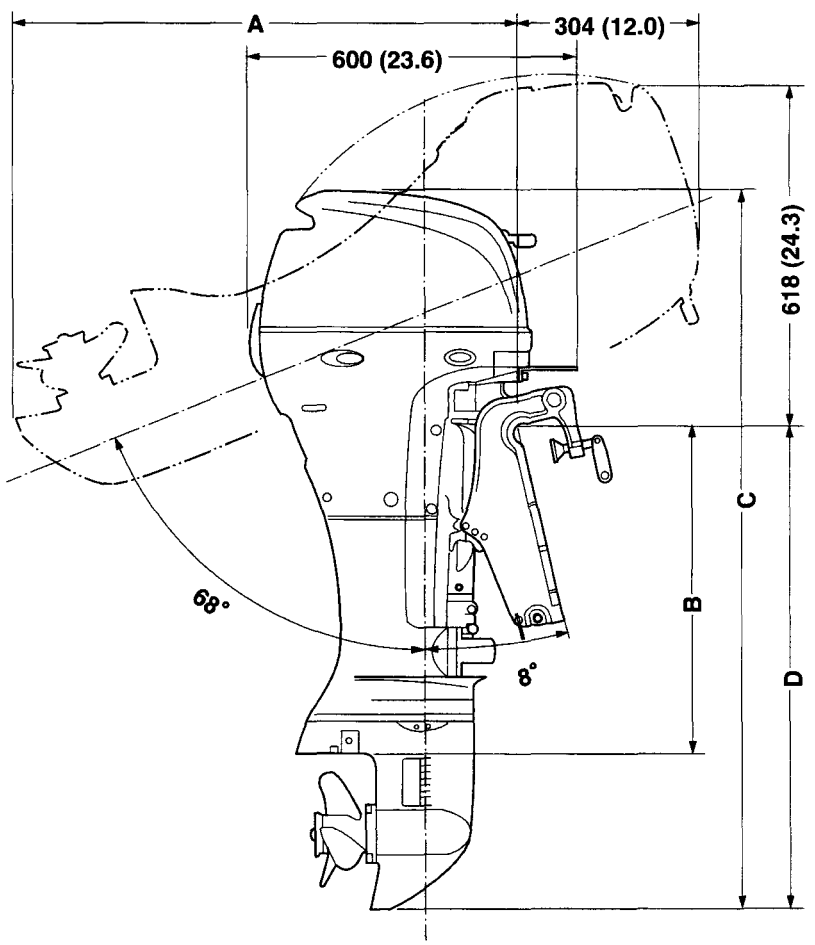


• Remote control type

Unit: mm (in)

Type	A	B	C	D
S Type	742 (29.2)	433 (17.0)	1,105 (43.5)	695 (27.4)
L Type	859 (33.8)	563 (22.2)	1,235 (48.6)	825 (32.5)





1. TORQUE VALUES
2. SPECIAL TOOLS
3. TROUBLESHOOTING
4. CABLE & HARNESS ROUTING (Power Tilt Type Only)
5. LUBRICATION POINTS

1. TORQUE VALUES

• Power Tilt

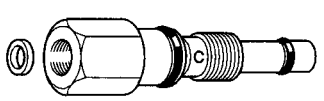
Item	Thread dia. x pitch	Torque		
		N•m	kgf•m	lbf•ft
• Power tilt				
Upper joint metal lock nut	M10 x 1.25	41.5	4.2	30
Oil hole cap bolt	3/8-16UNC	1.1	0.11	0.80
Oil tank bolt	M5 x 0.8	4.4	0.45	3.3
Outer tube	M46 x 1.5	152	15.5	112
Gear pump socket bolt	M5 x 0.8	5	0.5	3.6
Spool valve cap	M22 x 1.0	22	2.2	16
Manual valve	M12 x 1.75	1.7	0.17	1.2
• Gas assisted tilt				
Tilt lever nut	M6 x 1.0	12	1.2	9
• Stern bracket				
Upper joint metal lock nut (*1)	M10 x 1.25	40	4.1	30

*1: Tighten to specified torque then loosen 1/2 turn.

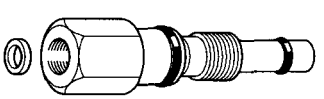
2. SPECIAL TOOLS

No.	Tool name	Tool number	Application
①	Gauge joint A	070PJ-V150100	Blow pressure inspection
②	Gauge joint B	070PJ-V150200	

①



②



4. TROUBLESHOOTING

a. GAS ASSISTED TILT

Excessive tilt up load	Seized tilting pivot.	Clean and lubricate: (P. 12-2 thru 4).
	Faulty gas assisted tilt.	Replace: (P. 12-17 thru 19).
Does not hold	Tilt lever is in TILT position.	Turn to RUN position.
	Faulty gas assisted tilt.	Replace: (P. 12-17 thru 19).

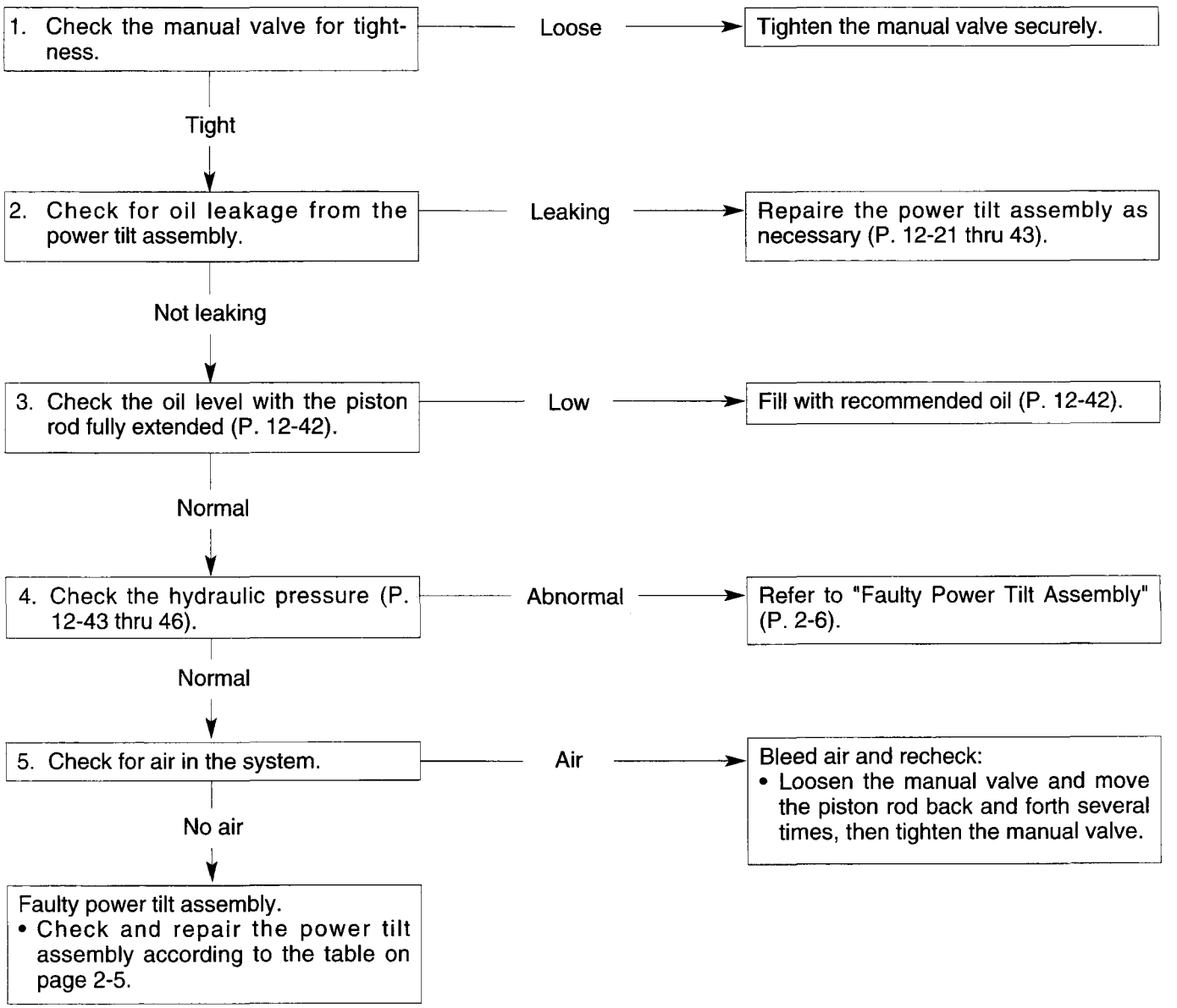
b. POWER TILT

• Power Tilt Does Not Move

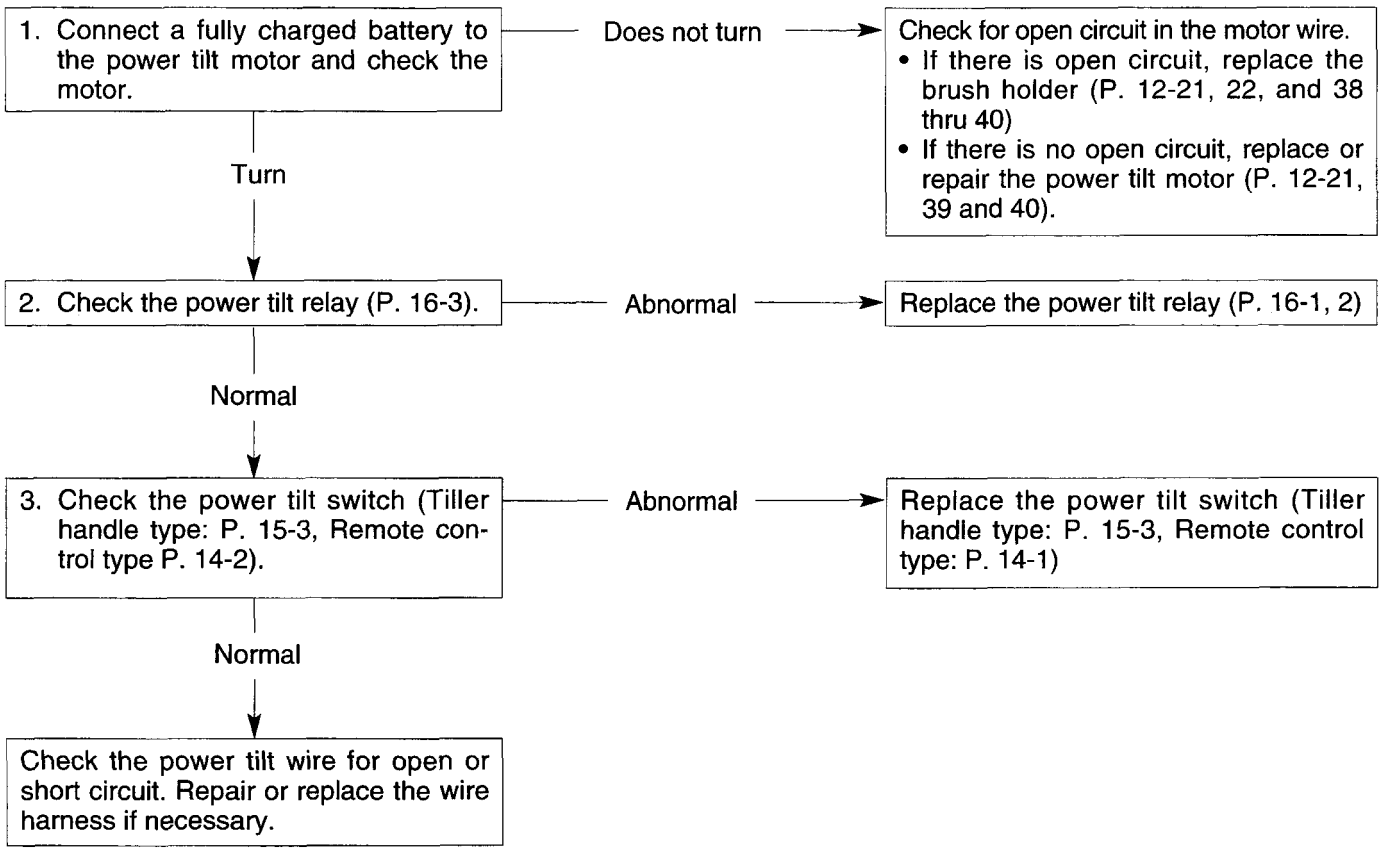
1. Check for motor sound.
   - Does not sound → Go to "Power Tilt Motor Does Not Operate " TROUBLESHOOTING on page 2-4.
   - Sound.
2. Check the manual valve.
   - Loose → Tighten the manual valve securely.
   - Tight
3. Check the oil level with the piston rod fully extended (P. 12-42).
   - Low → Fill with recommended oil (P. 12-42).
   - Normal
4. Check for air in the system.
   - Air → Bleed air and recheck:
     - Loosen the manual valve and move the piston rod back and forth several times, then tighten the manual valve.
   - No air
5. Check for oil leakage from the power tilt assembly.
   - Leaking → Repair the power tilt assembly as necessary (P. 12-21 thru 43).
   - Not leaking

Faulty power tilt assembly.
- Check and repair the power tilt assembly according to the table on page 2-5.

• Power Tilt Does Not Hold



• Power Tilt Motor Does Not Operate

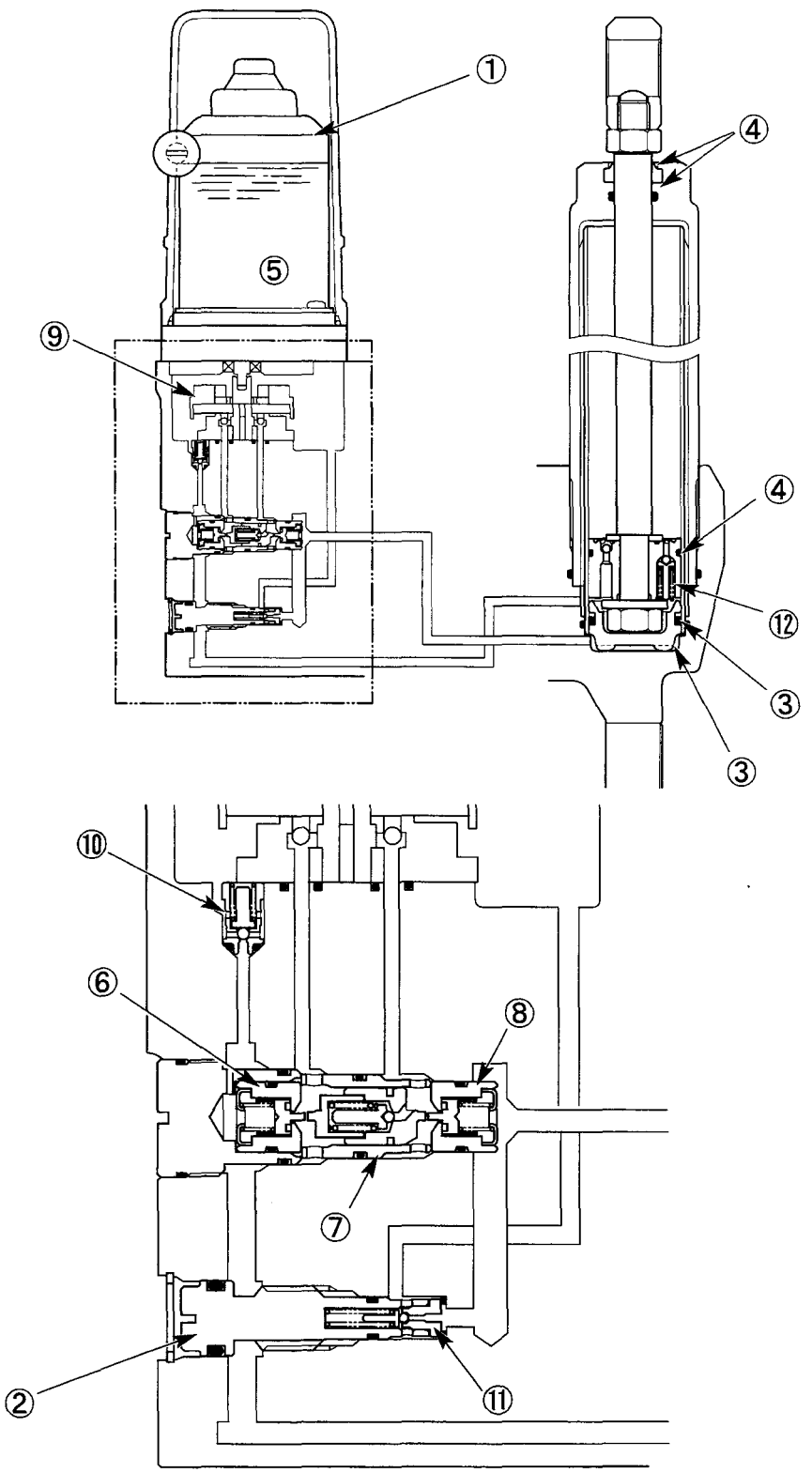


• Faulty Power Tilt Assembly

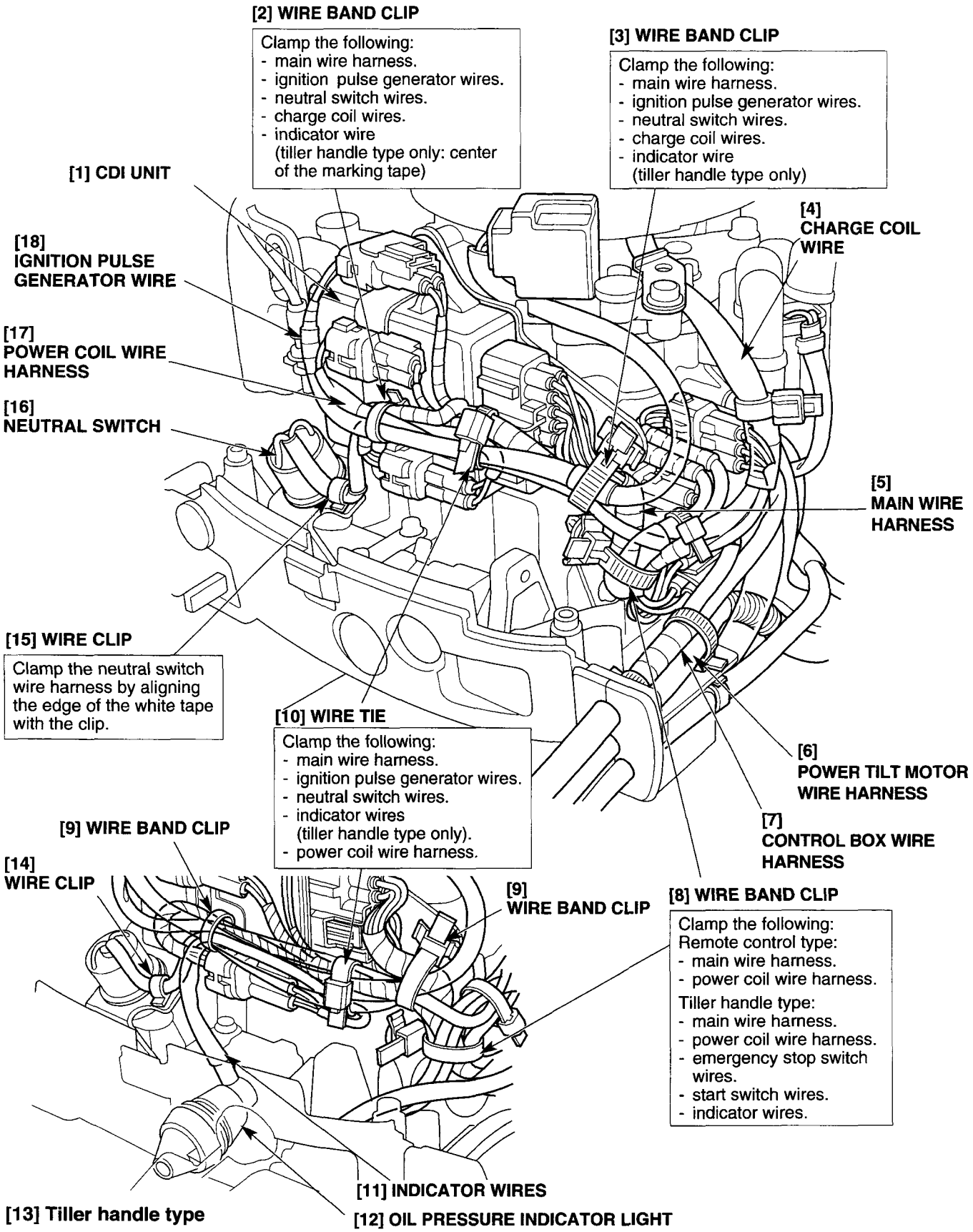
Quick Reference Chart

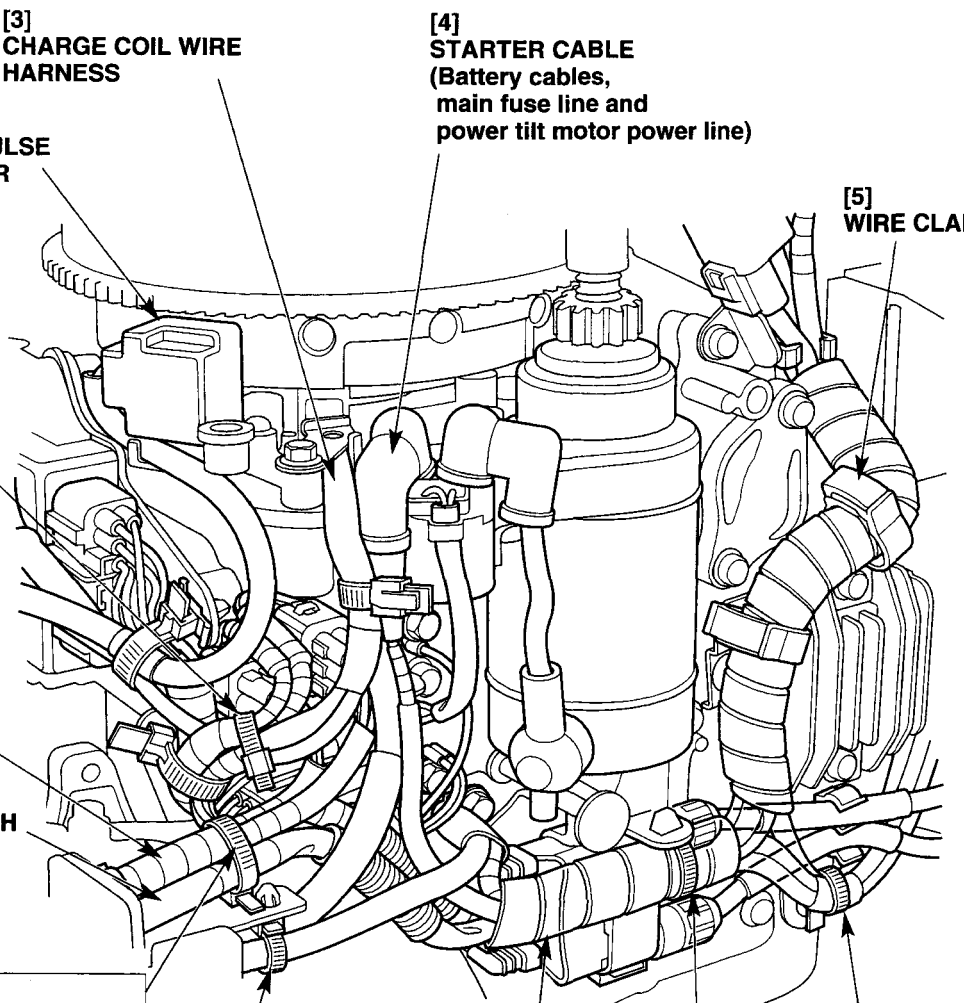
Symptom				Pressure		Check point See page 2-6	Check/repair method
Does not tilt up	Does not tilt down.	Does not hold		Lower chamber hydraulic pressure low or drops	Upper chamber hydraulic pressure low or drops		
		Contracted side	Extended side				
O	O	—	—	O	O	① Motor	Check the motor
O	O	O	O	O	O	② Manual valve	Check the manual valve for tightening, damage or foreign material. Check the O-ring for damage, replace if necessary. Replace the manual valve if necessary.
O	—	O	—	O	—	③ Free piton, O-ring, backup ring	Check the O-ring and backup ring for damage, replace if necessary. Replace the piston rod assembly if necessary.
—	O	—	O	—	O	④ Piston rod, O-ring, dust seal	Check the O-ring, dust seal for damage, replace if necessary.
O	O	—	—	O	O	⑤ Oil (ATF)	Check the oil level and add if necessary
O	O	—	O	—	O	⑥ Upper chamber check valve	Check the check valve for damage, wear or foreign material. Clean and reassemble the spool valve properly.
O	O	O	O	O	O	⑦ Spool valve (with built-in upper relief valve)	Check the valve for damage, wear or foreign material. Clean and reassemble the spool valve properly. Do not disassemble the spool valve, either as the upper relief valve is built in the spool valve.
O	O	O	—	O	—	⑧ Lower chamber check valve	Check the check valve for damage, wear or foreign material. Clean and reassemble the spool valve properly.
O	O	—	—	O	O	⑨ Gear pump	Replace the gear pump assembly
—	O	—	O	—	O	⑩ Down relief valve	Check the valve for damage, wear or foreign material. Clean and reassemble the spool valve properly.
O	—	O	—	O	—	⑪ Thermal valve (in the manual valve)	Check the check valve for damage, wear or foreign material. Clean and reassemble the manual valve properly.
—	O	—	O	—	O	⑫ Shock relief valve (in the piston)	Check the relief valve for damage, wear or foreign material.

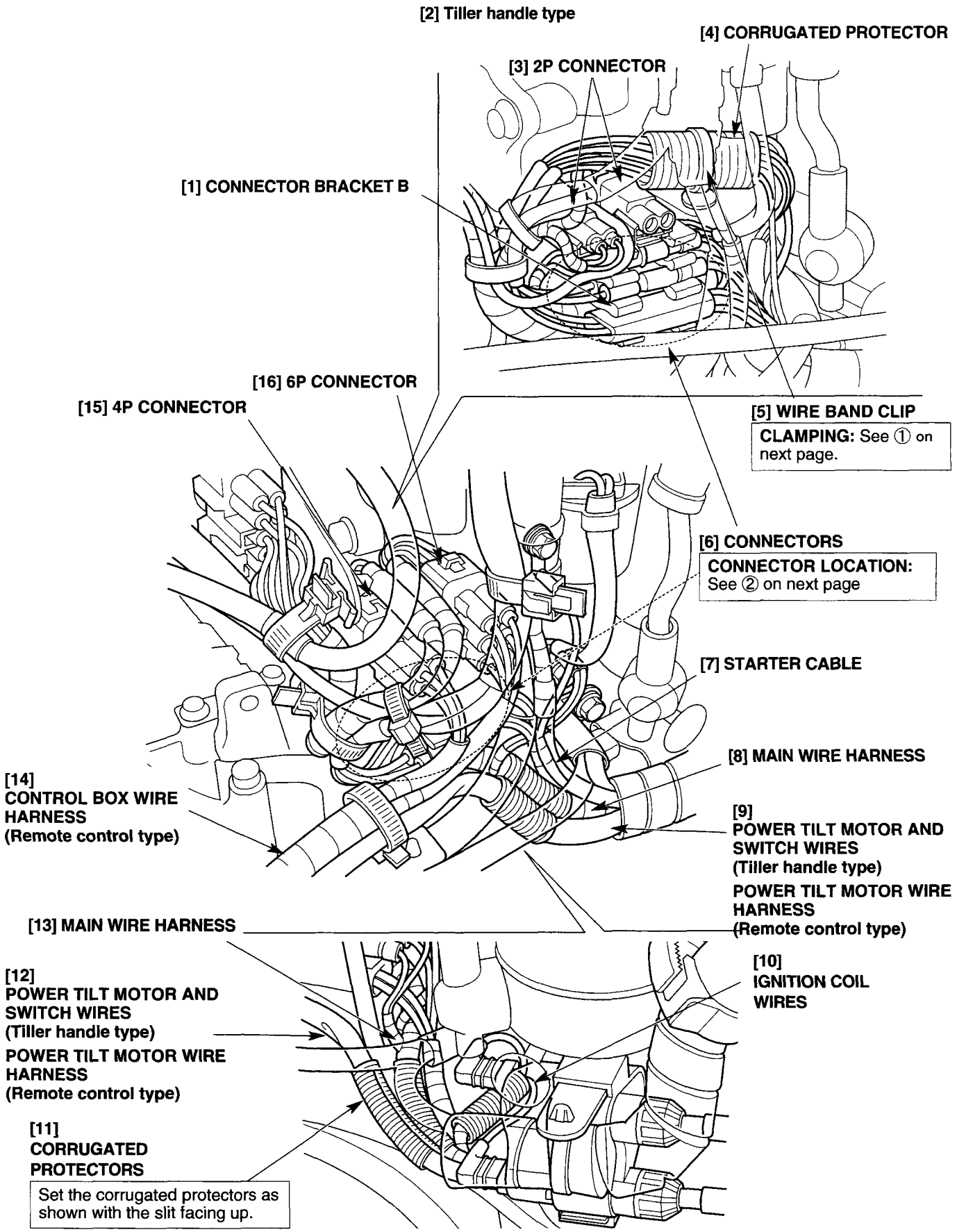
Check point



4. CABLE & HARNESS ROUTING (Power Tilt Type Only)

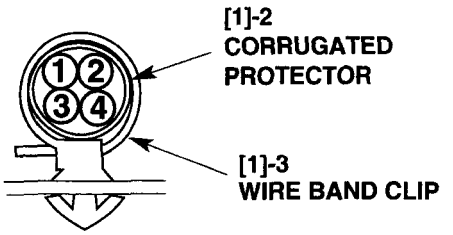


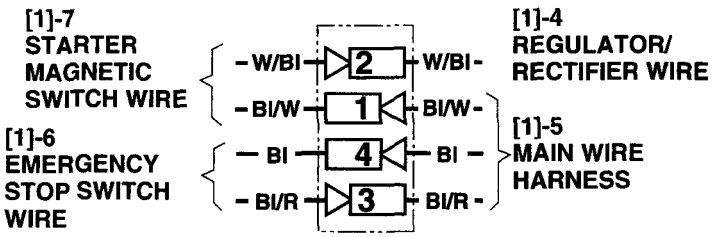

[3]
CHARGE COIL WIRE HARNESS
[4]
STARTER CABLE
(Battery cables, main fuse line and power tilt motor power line)
[2]
IGNITION PULSE GENERATOR
[5]
WIRE CLAMP (2)
[1] WIRE TIE
Clamp the following:
- branch point of the main wire harness.
- charge coil wires.
- neutral switch wires.
- Indicator wires. (tiller handle type only).
[12]
CONTROL BOX WIRE HARNESS
(Remote control type)
[11]
POWER TILT SWITCH WIRE HARNESS
(Tiller handle type)
[10] WIRE BAND CLIP
Remote control type:
Clamp the control box wire harness and center of the white tape of the power tilt motor wire harness.
Tiller handle type:
Clamp the center of white tape of the power tilt motor and power tilt switch wires.
[7] WIRE BAND CLIP
[8] LOWER SPIRAL PROTECTOR
Wrap the following wires starting from the branch point of the main wire harness.
- main wire harness.
- power tilt motor wire harness.
- starter cable.
- power tilt switch wire harness (tiller handle type only).
- regulator/rectifier wire harness.
[6] WIRE BAND CLIP
Clamp the following:
- power tilt relay wire harness
- center of the gray tape of the regulator/ rectifier wire harness.
[9] WIRE BAND CLIP
Align the inside of the grommet with the edge of the white of the starter cables and clamp them with the wire band clip.
[9]-1 WHITE CLIP
[9]-2 GROMMET


[2] Tiller handle type
[4] CORRUGATED PROTECTOR
[3] 2P CONNECTOR
[1] CONNECTOR BRACKET B
[16] 6P CONNECTOR
[15] 4P CONNECTOR
[5] WIRE BAND CLIP
CLAMPING: See ① on next page.
[6] CONNECTORS
CONNECTOR LOCATION: See ② on next page
[7] STARTER CABLE
[8] MAIN WIRE HARNESS
[14] CONTROL BOX WIRE HARNESS (Remote control type)
[9] POWER TILT MOTOR AND SWITCH WIRES (Tiller handle type)
POWER TILT MOTOR WIRE HARNESS (Remote control type)
[13] MAIN WIRE HARNESS
[10] IGNITION COIL WIRES
[12] POWER TILT MOTOR AND SWITCH WIRES (Tiller handle type)
POWER TILT MOTOR WIRE HARNESS (Remote control type)
[11] CORRUGATED PROTECTORS
Set the corrugated protectors as shown with the slit facing up.

[1] CLAMPING①

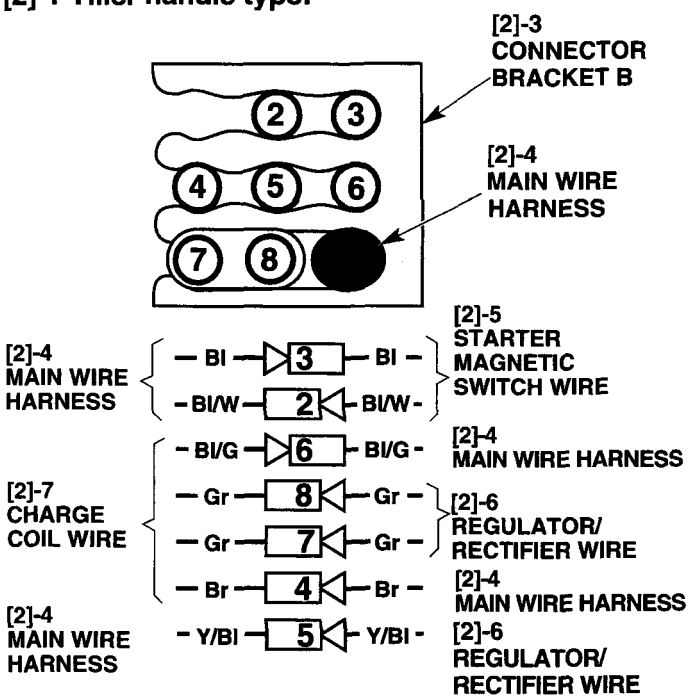
[1]-1 Tiller handle type only



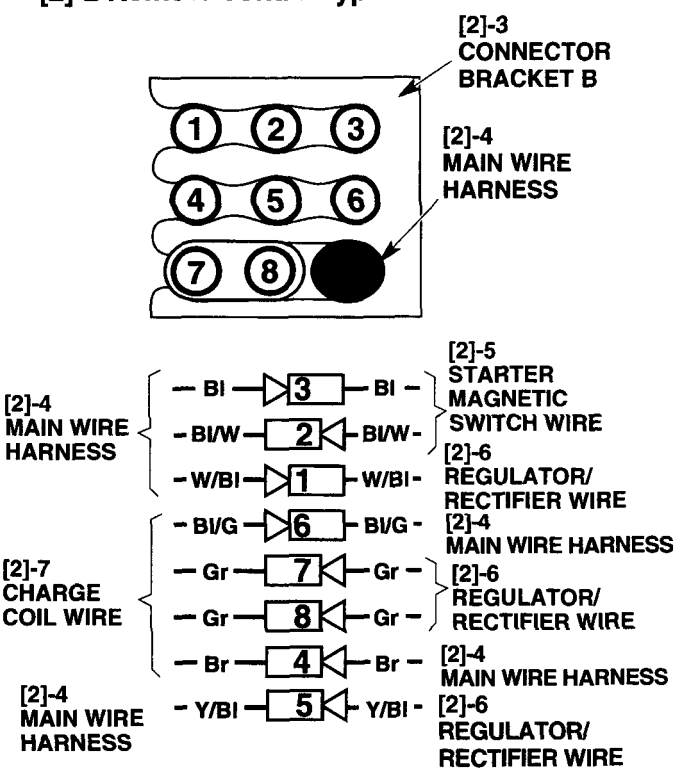


[2] CONNECTOR LOCATION②

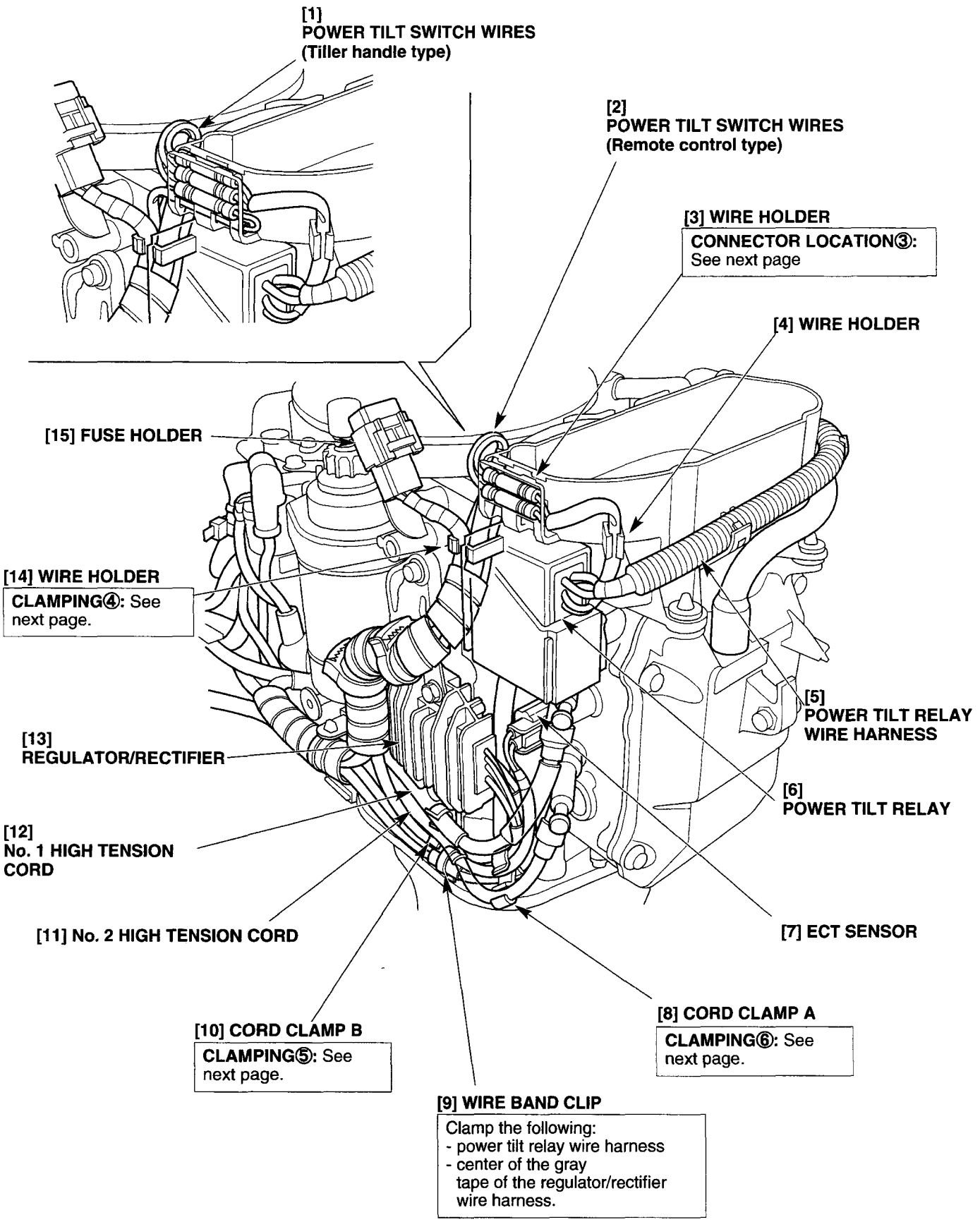
[2]-1 Tiller handle type:



[2]-2 Remote control type:

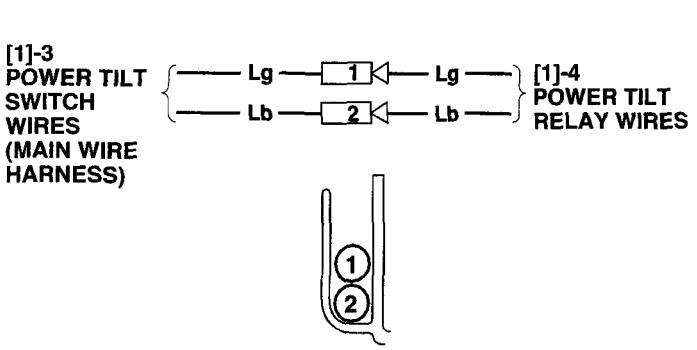


Bl	BLACK	Br	BROWN
Y	YELLOW	O	ORANGE
Bu	BLUE	Lb	LIGHT BLUE
G	GREEN	Lg	LIGHT GREEN
R	RED	P	PINK
W	WHITE	Gr	GRAY

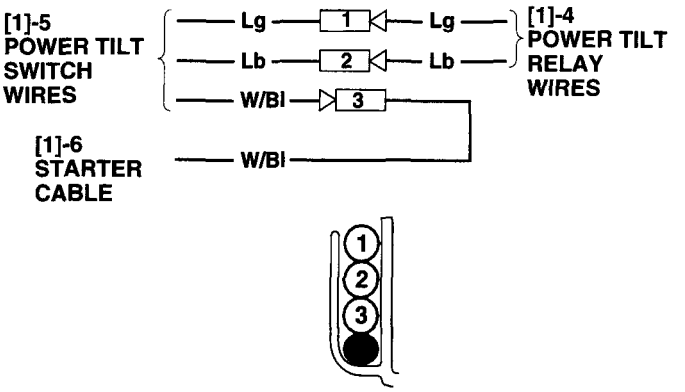

[1]
POWER TILT SWITCH WIRES
(Tiller handle type)
[2]
POWER TILT SWITCH WIRES
(Remote control type)
[3] WIRE HOLDER
CONNECTOR LOCATION③:
See next page
[4] WIRE HOLDER
[15] FUSE HOLDER
[14] WIRE HOLDER
CLAMPING④: See next page.
[5]
POWER TILT RELAY
WIRE HARNESS
[13]
REGULATOR/RECTIFIER
[6]
POWER TILT RELAY
[12]
No. 1 HIGH TENSION
CORD
[11] No. 2 HIGH TENSION CORD
[7] ECT SENSOR
[8] CORD CLAMP A
CLAMPING⑥: See next page.
[10] CORD CLAMP B
CLAMPING⑤: See next page.
[9] WIRE BAND CLIP
Clamp the following:
- power tilt relay wire harness
- center of the gray tape of the regulator/rectifier wire harness.

[1] CONNECTOR LOCATION③

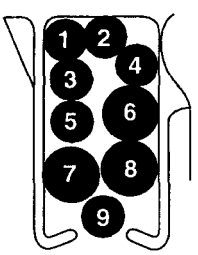
[1]-1 Remote control type



[1]-2Tiller handle type

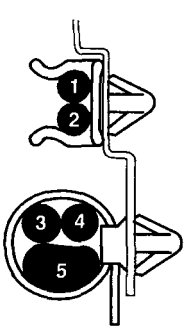


[2] CLAMPING④



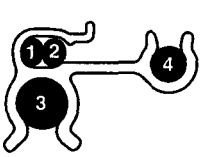
[2]-1
1 MAIN WIRE HARNESS GROUND LINE (BLACK/GREEN)
2 OIL PRESSURE SWITCH WIRE
3 REGULATOR/RECTIFIER WIRE SE THERMAL VALVE HEATER LINE (BROWN/WHITE)
4 REGULATOR/RECTIFIER WIRE (WHITE)
5 Tiller handle type:
STARTER CABLE POWER TILT SWITCH LINE (WHITE/BLACK)
Remote control type:
MAIN WIRE HARNESS POWER TILT SWITCH LINE
6 STARTER CABLE POWER TILT RELAY LINE
7 STARTER CABLE FUSE LINE
8 POWER TILT MOTOR WIRE
9 POWER TILT SWITCH WIRE (Tiller handle type only)

[3] CLAMPING⑤

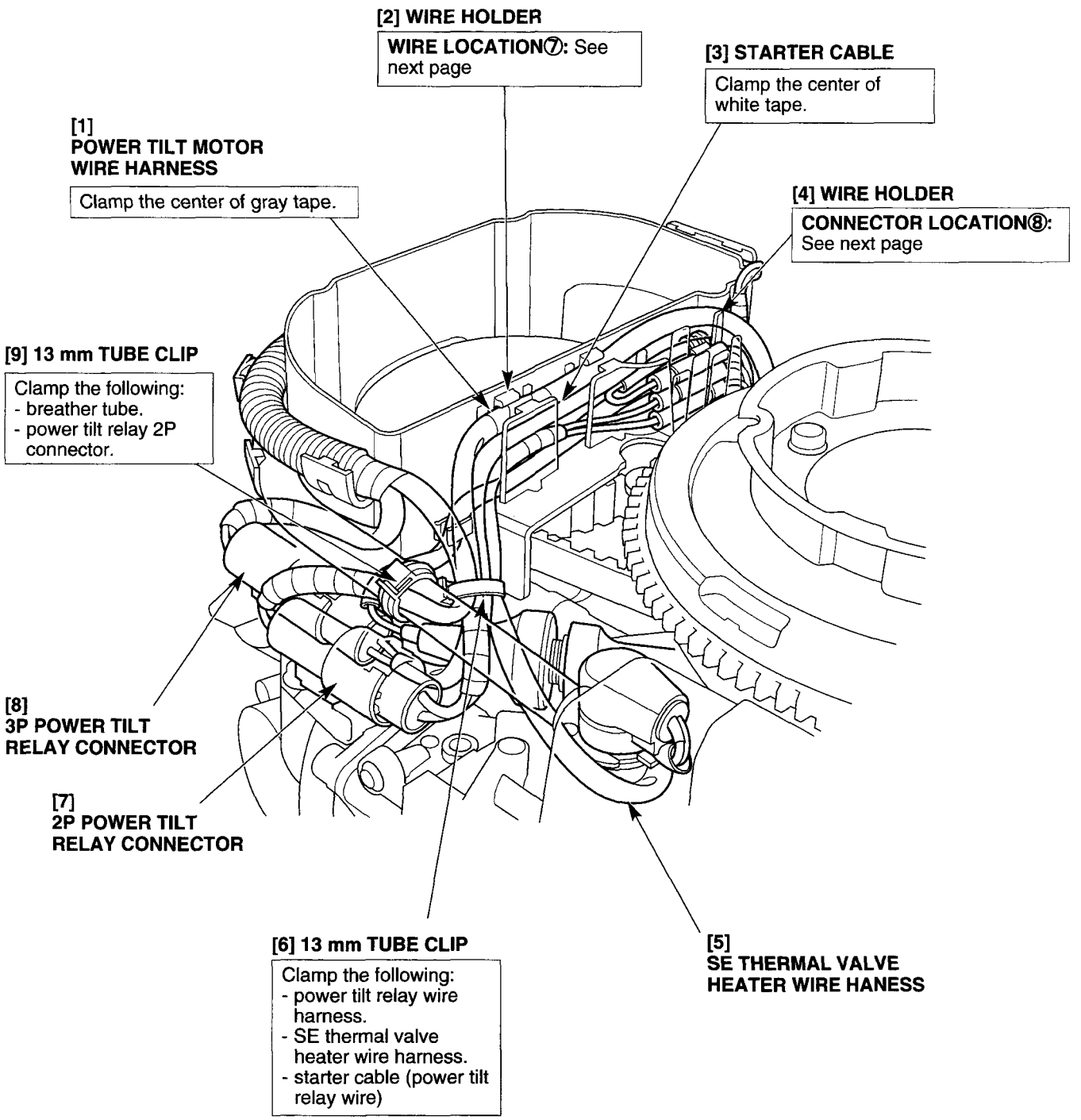


[3]-1
1 No. 1 HIGH TENSION CORD
2 No. 2 HIGH TENSION CORD
3 REGULATOR/RECTIFIER WIRE (Fuse line)
4 ECT SENSOR WIRE
5 REGULATOR/RECTIFIER WIRE

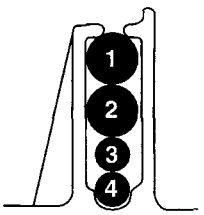
[4] CLAMPING⑥



[4]-1
1 REGULATOR/RECTIFIER WIRE (Fuse line)
2 ECT SENSOR WIRE
3 REGULATOR/RECTIFIER WIRE
4 No. 2 HIGH TENSION CORD


[2] WIRE HOLDER
WIRE LOCATION⑦: See next page
[3] STARTER CABLE
Clamp the center of white tape.
[1]
POWER TILT MOTOR WIRE HARNESS
Clamp the center of gray tape.
[4] WIRE HOLDER
CONNECTOR LOCATION⑧: See next page
[9] 13 mm TUBE CLIP
Clamp the following:
- breather tube.
- power tilt relay 2P connector.
[8]
3P POWER TILT RELAY CONNECTOR
[7]
2P POWER TILT RELAY CONNECTOR
[6] 13 mm TUBE CLIP
Clamp the following:
- power tilt relay wire harness.
- SE thermal valve heater wire harness.
- starter cable (power tilt relay wire)
[5]
SE THERMAL VALVE HEATER WIRE HANESS

[1] WIRE LOCATION⑦

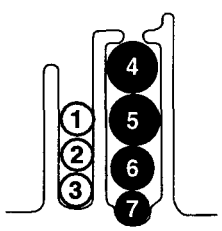


[1]-1
1 POWER TILT MOTOR WIRE
2 STARTER CABLE POWER TILT RELAY LINE
3 SE THERMAL VALVE HEATER WIRE
4 OIL PRESSURE SWITCH WIRE

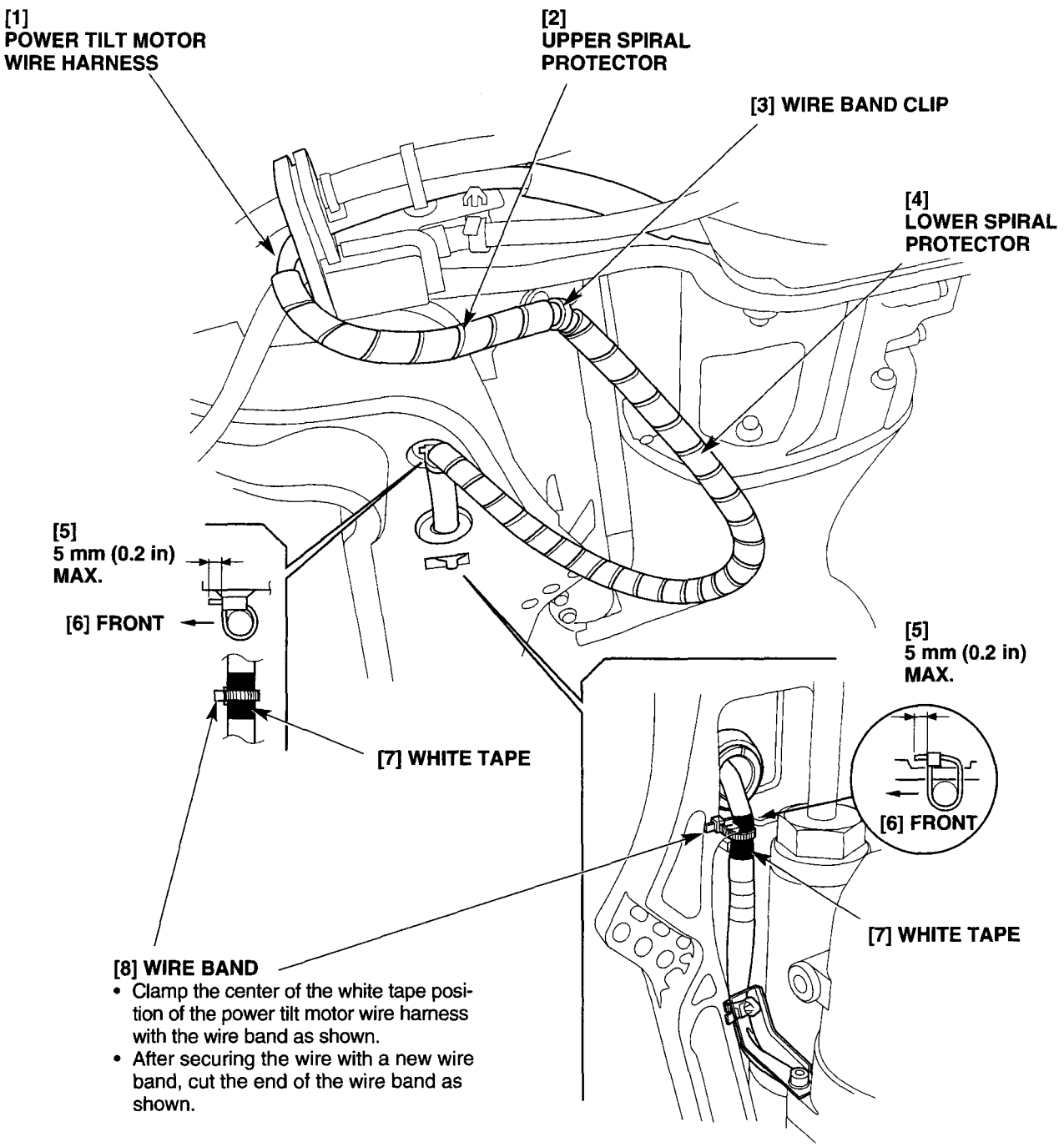
[2] CONNECTOR LOCATION⑧

[2]-1
REGULATOR/RECTIFIER WIRE — W — 1 — W — [2]-3 STARTER CABLE

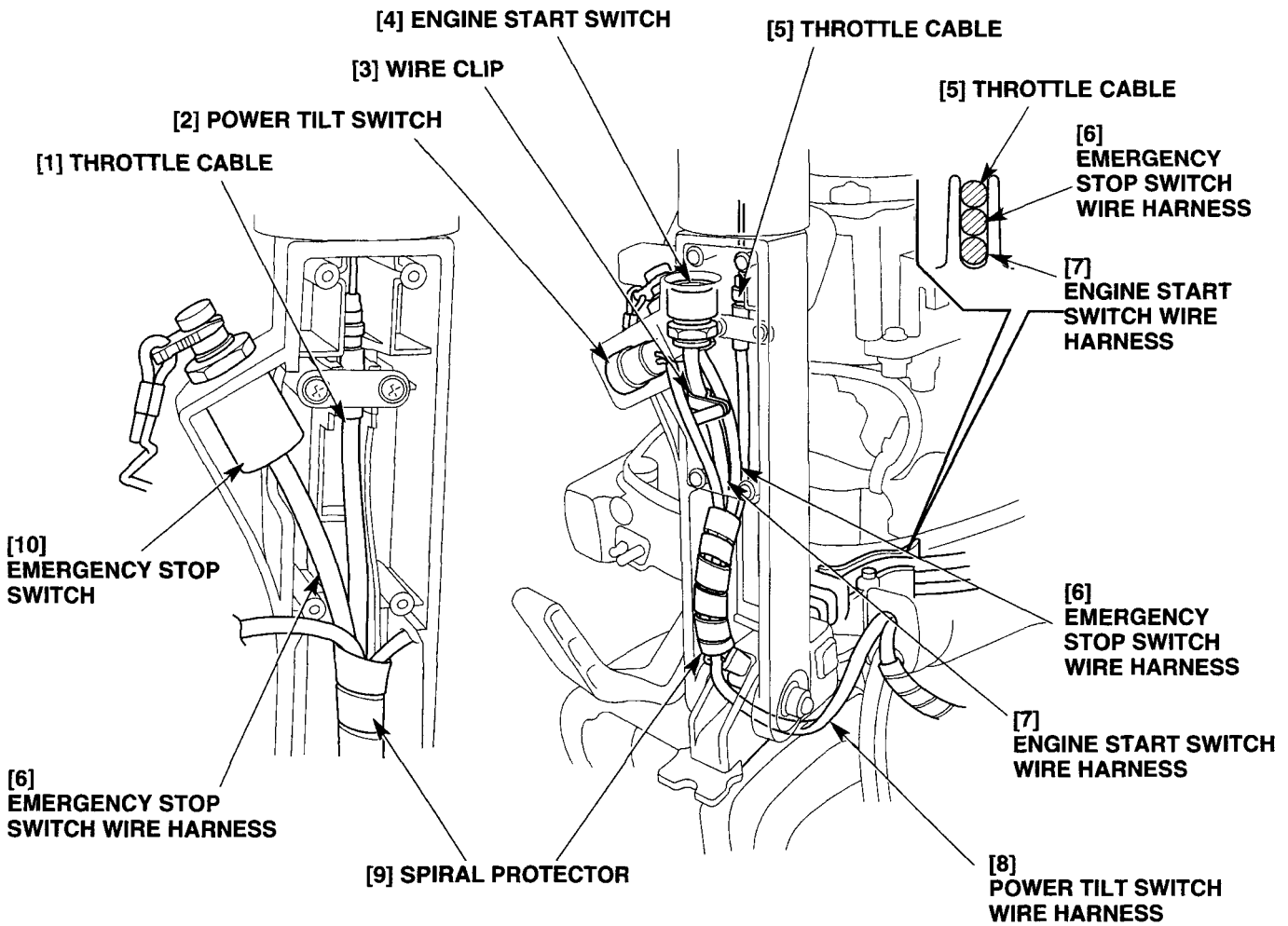
[2]-2
SE THERMAL VALVE
HEATER WIRES
- Br/W — 2 — Br/W — [2]-4 MAIN WIRE HARNESS
- Bl/G — 3 — Bl/G — [2]-1 REGULATOR/RECTIFIER WIRE



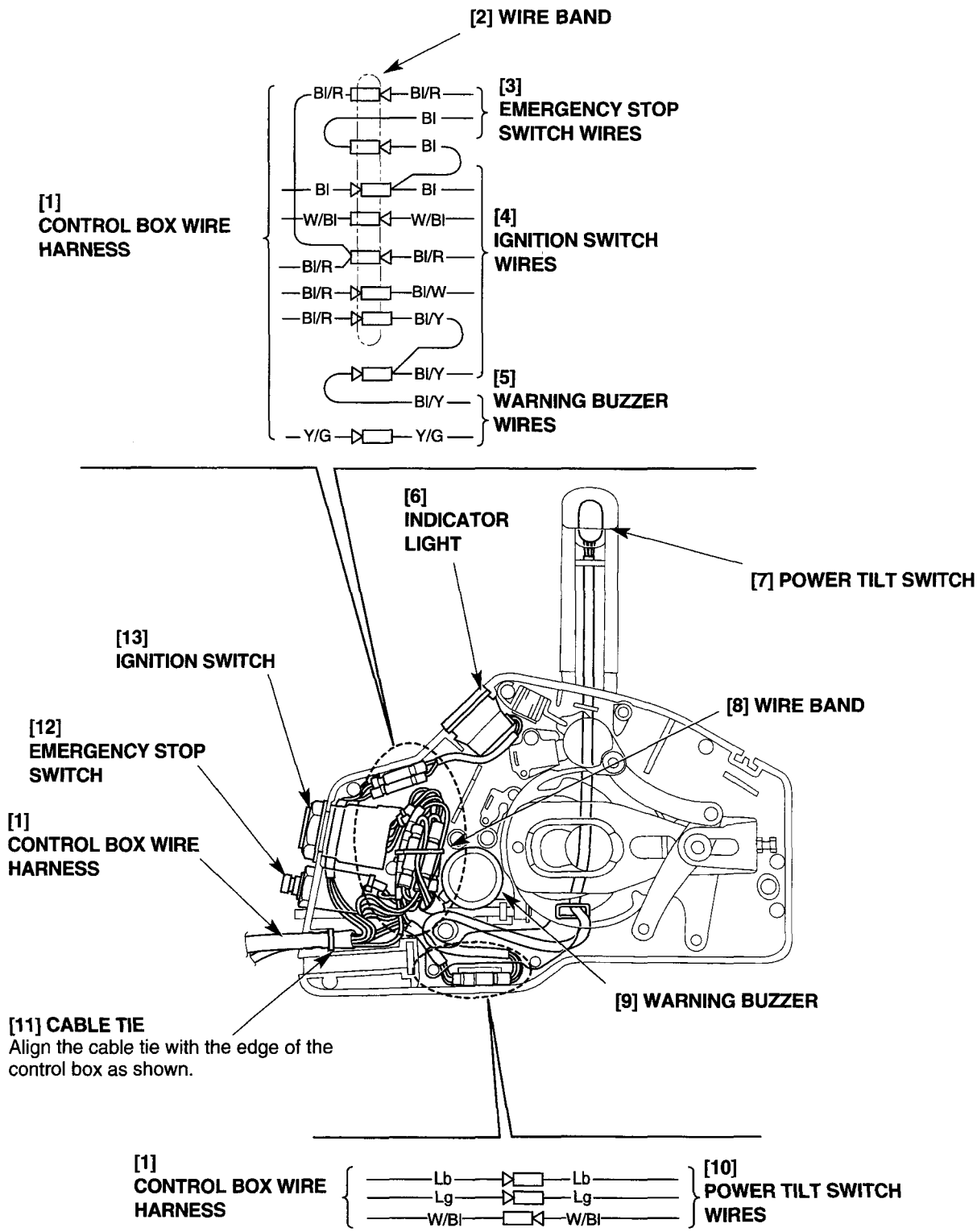
[2]-5
4 POWER TILT MOTOR WIRE
5 STARTER CABLE POWER TILT RELAY LINE
6 REGULATOR/RECTIFIER WIRE FUSE LINE (WHITE)
7 OIL PRESSURE SWITCH WIRE


[1]
POWER TILT MOTOR
WIRE HARNESS
[2]
UPPER SPIRAL
PROTECTOR
[3] WIRE BAND CLIP
[4]
LOWER SPIRAL
PROTECTOR
[5]
5 mm (0.2 in)
MAX.
[6] FRONT
[7] WHITE TAPE
[5]
5 mm (0.2 in)
MAX.
[6] FRONT
[7] WHITE TAPE
[8] WIRE BAND
• Clamp the center of the white tape position of the power tilt motor wire harness with the wire band as shown.
• After securing the wire with a new wire band, cut the end of the wire band as shown.

Tiller handle type

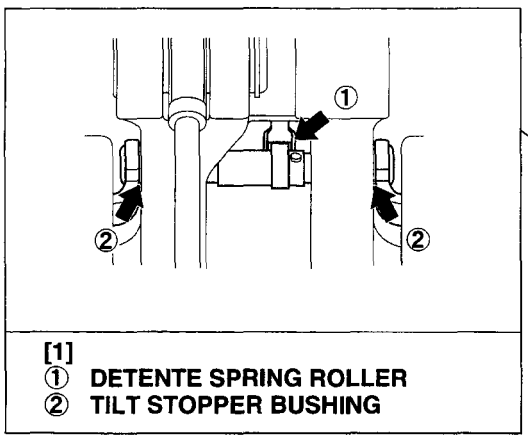


Remote control type

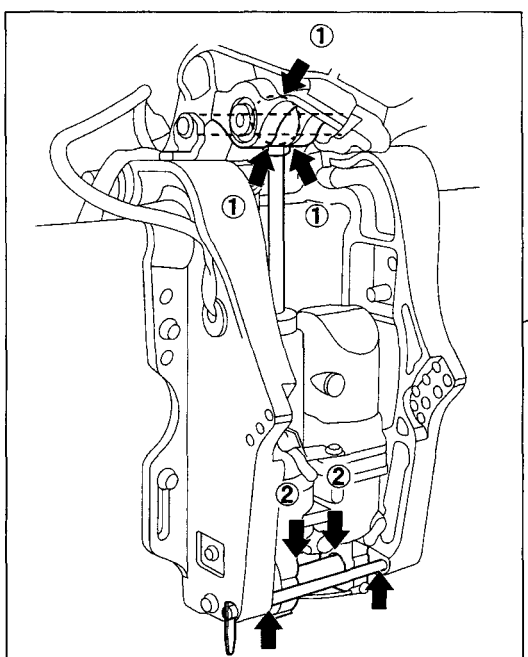


5. LUBRICATION POINTS

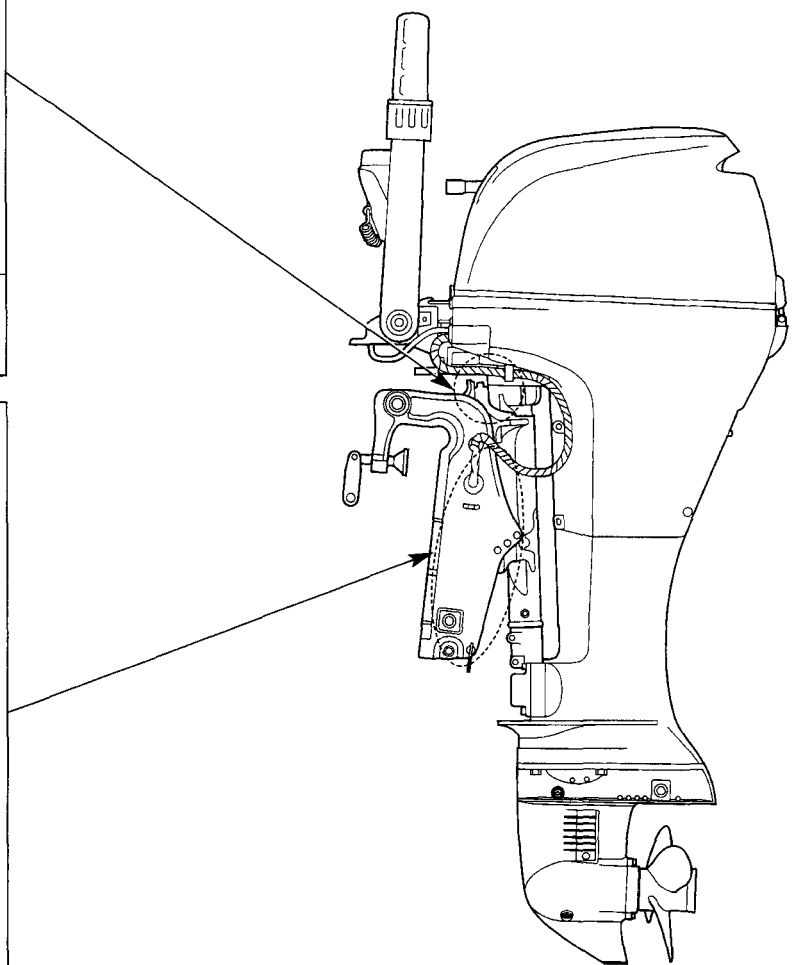
Apply marine grease.



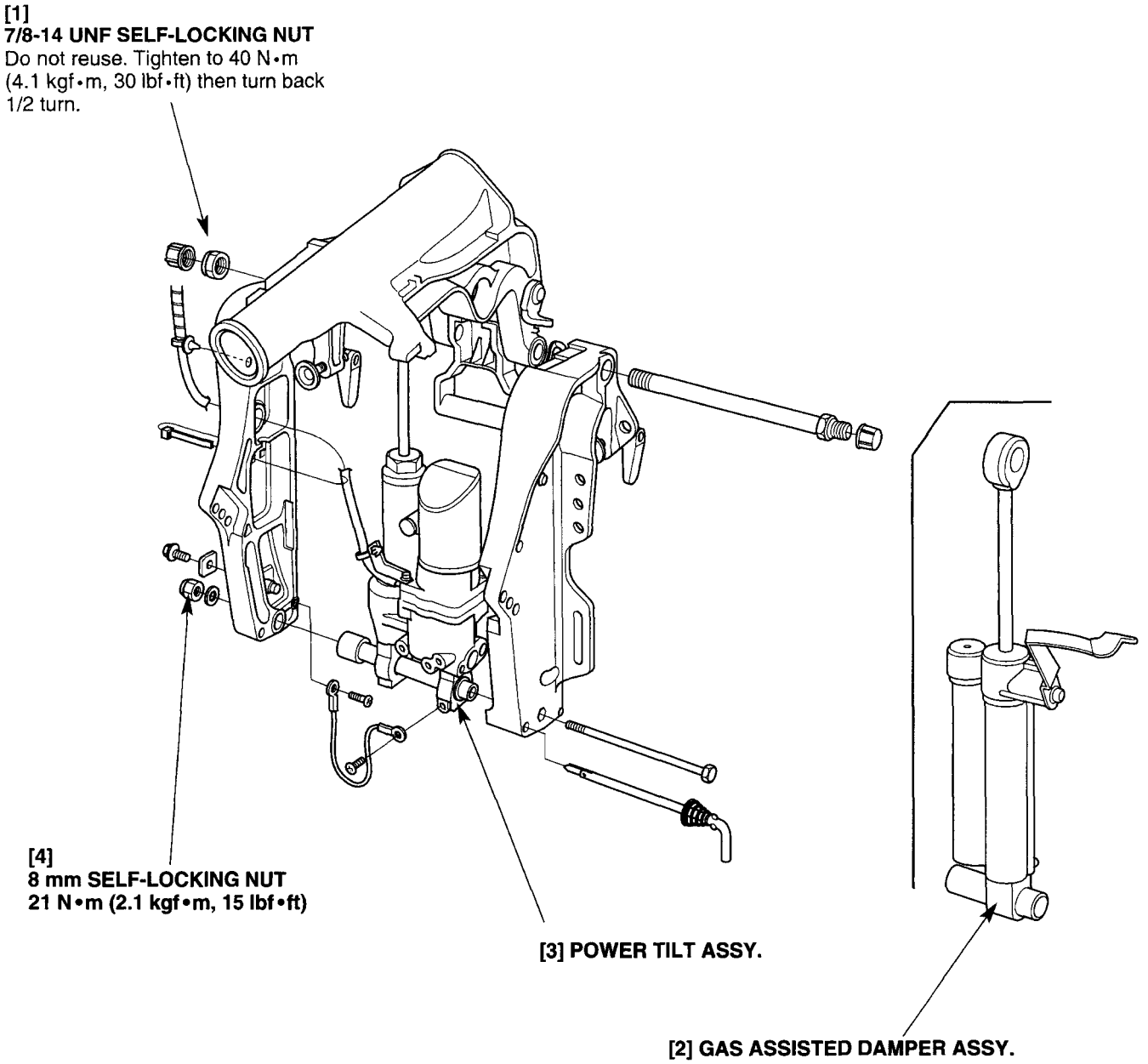
[1]
① DETENTE SPRING ROLLER
② TILT STOPPER BUSHING



[2]
① UPPER CYLINDER BUSHING
② LOWER CYLINDER BUSING



1. STERN BRACKET	3. GAS ASSISTED TILT ASSEMBLY
2. SWIVEL CASE	4. POWER TILT ASSEMBLY

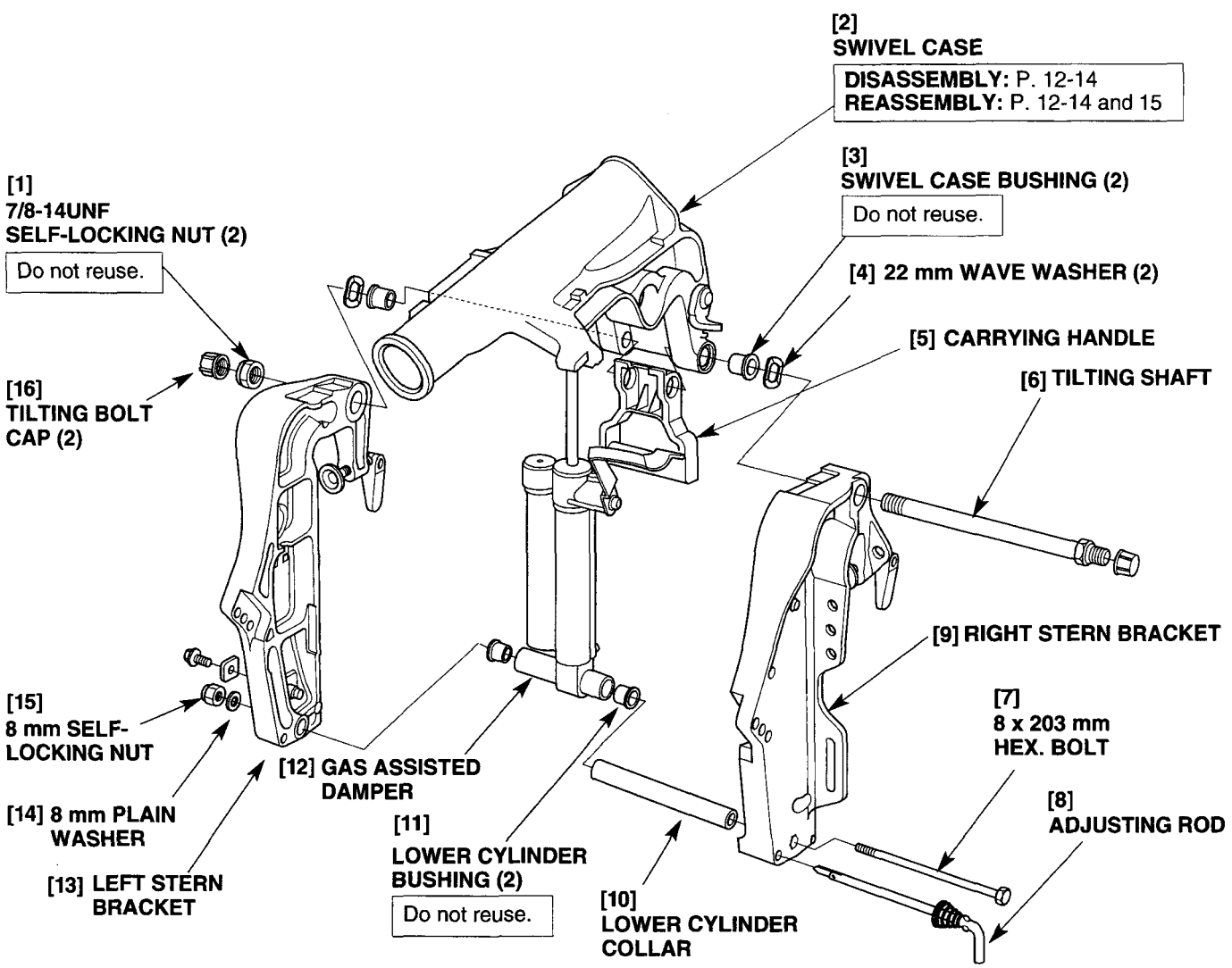


1. STERN BRACKET

• Gas Assisted Tilt Type

a. REMOVAL

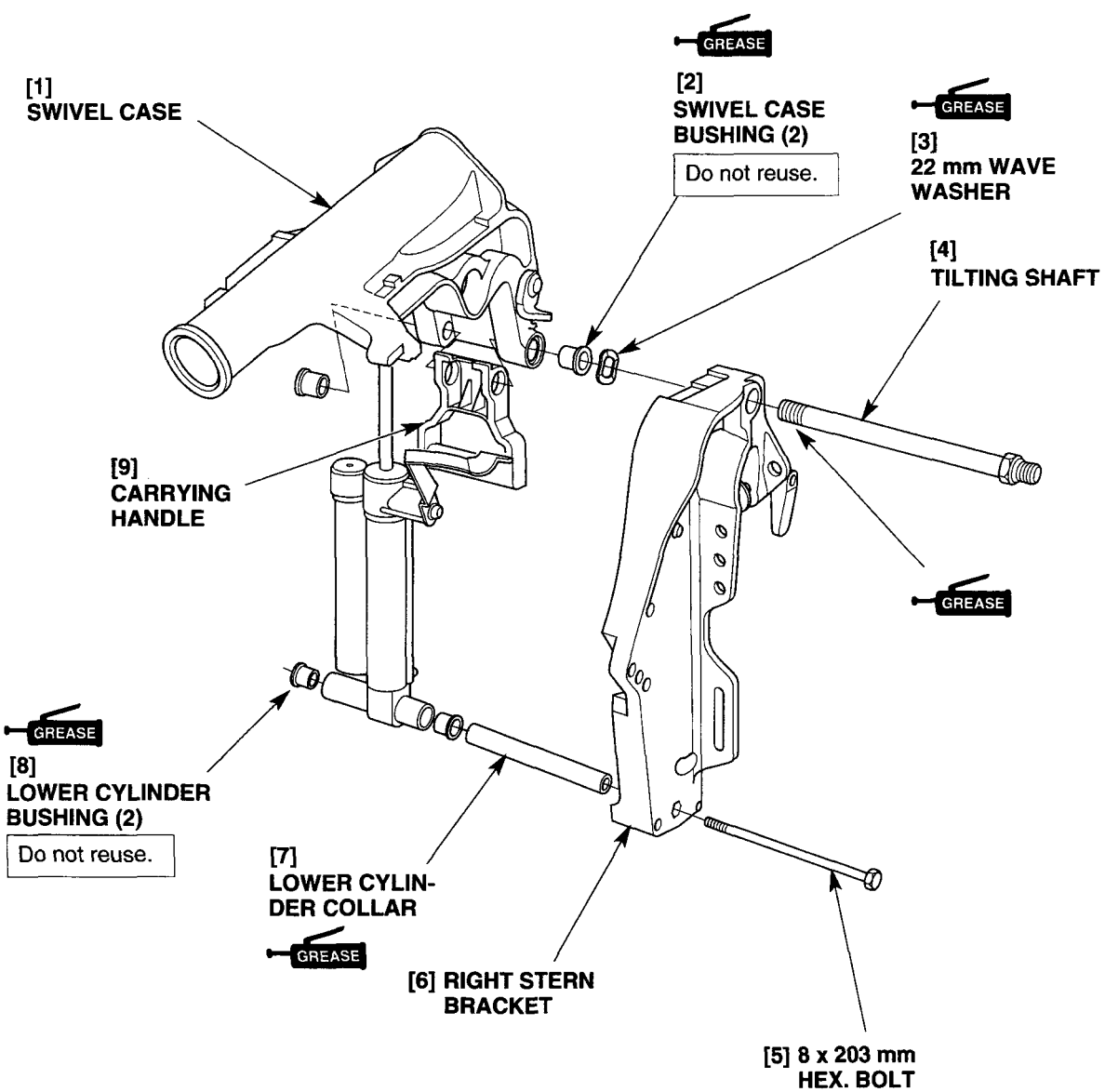
1) Move the tilt lever to free position to release the gas assisted damper and tilt up the outboard motor.
2) Remove the adjusting rod.
3) Remove the tilting bolt cap and loosen the 7/8-14UNF self-locking nut, then remove the 8 mm self-locking nut, 8 mm plain washer and 8 x 203 mm hex. bolt.
4) Remove the 7/8-14UNF self-locking nut and discard it. Replace the self-locking nut with new one when reassembly.
5) Remove the left stern bracket, lower cylinder collar and 22 mm wave washer.
6) Remove the tilting shaft, 22 mm wave washer, carrying handle and right stern bracket.
7) Remove the swivel case and lower cylinder bushings if necessary.



b. INSTALLATION

1) Apply marine grease to new swivel case bushings and install them to the swivel case.
2) Apply marine grease to new lower cylinder bushings and lower cylinder collar, then install them to the gas assisted dumper lower mount.
3) Apply marine grease to the threads of the tilting shaft, mounting hole and wave washers.
4) Install the right stern bracket, carrying handle,and 22 mm wave washer, and install the tilting bolt.
5) Install the 8 x 203 mm hex. bolt.

GREASE : Apply marine grease.



6) Apply grease to the 22 mm wave washer and install the wave washer and right stern bracket.

7) Loosely install a new 7/8-14UNF self-locking nut.

8) Install the 8 mm washer and 8 mm self-locking nut. Tighten the 8 mm self-locking nut to the specified torque.

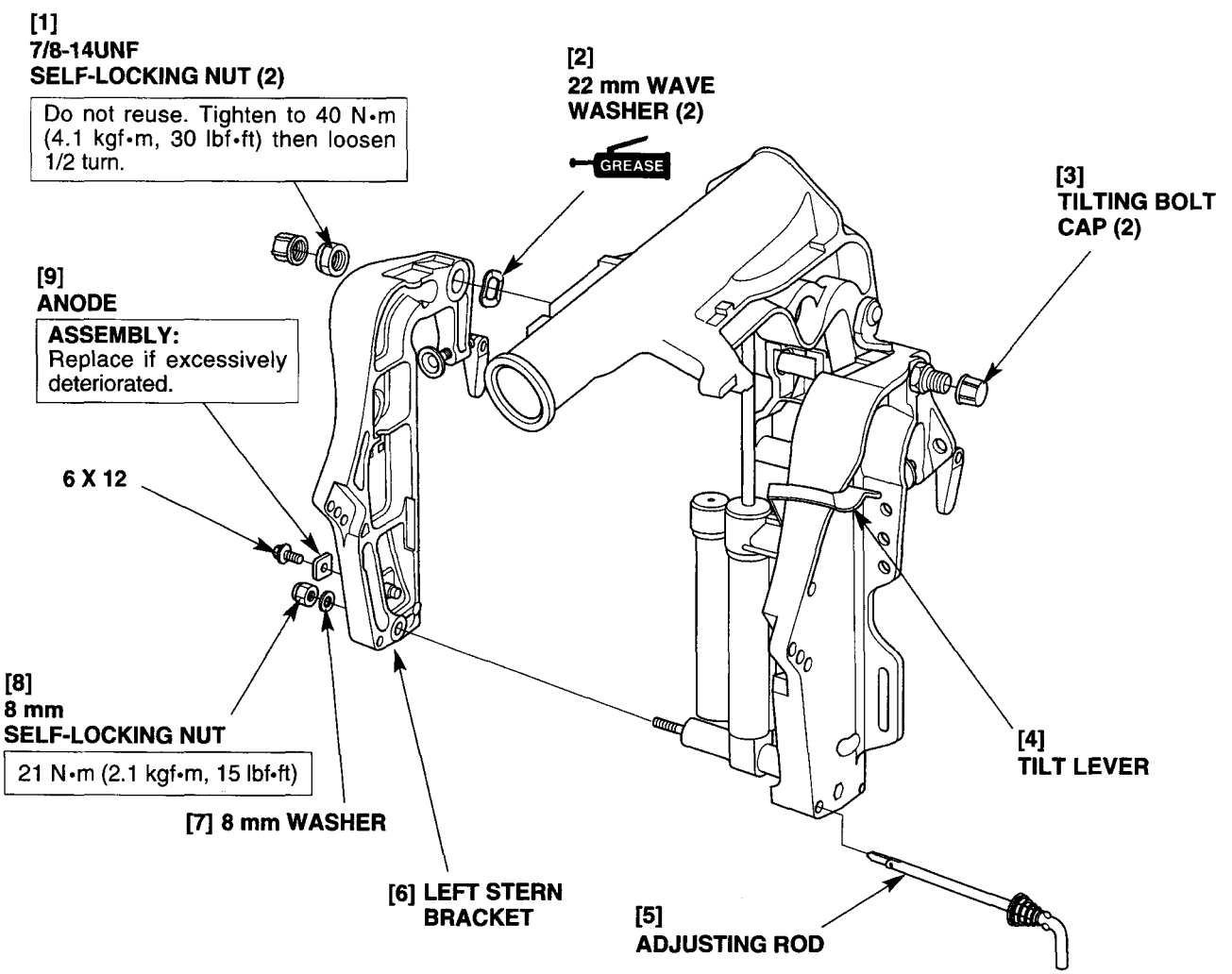
TORQUE: 21 N•m (2.1 kgf•m, 15 lbf•ft)

9) Tighten the 7/8-14UNF self-locking nut to 40 N•m (4.1 kgf•m, 30 lbf•ft) then loosen 1/2 turn.

10) Install the adjusting rod and tilting bolt caps.

11) Move the tilt lever to tilt position and make sure that the swivel case moves free.

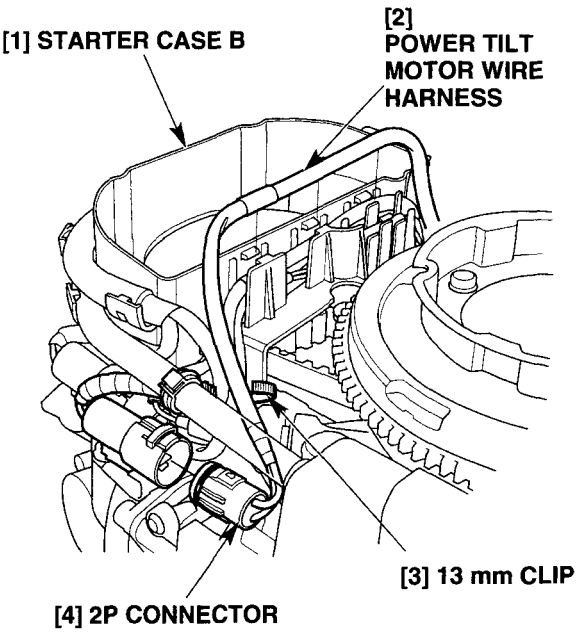
12) Install the removed parts in the reverse order of removal.

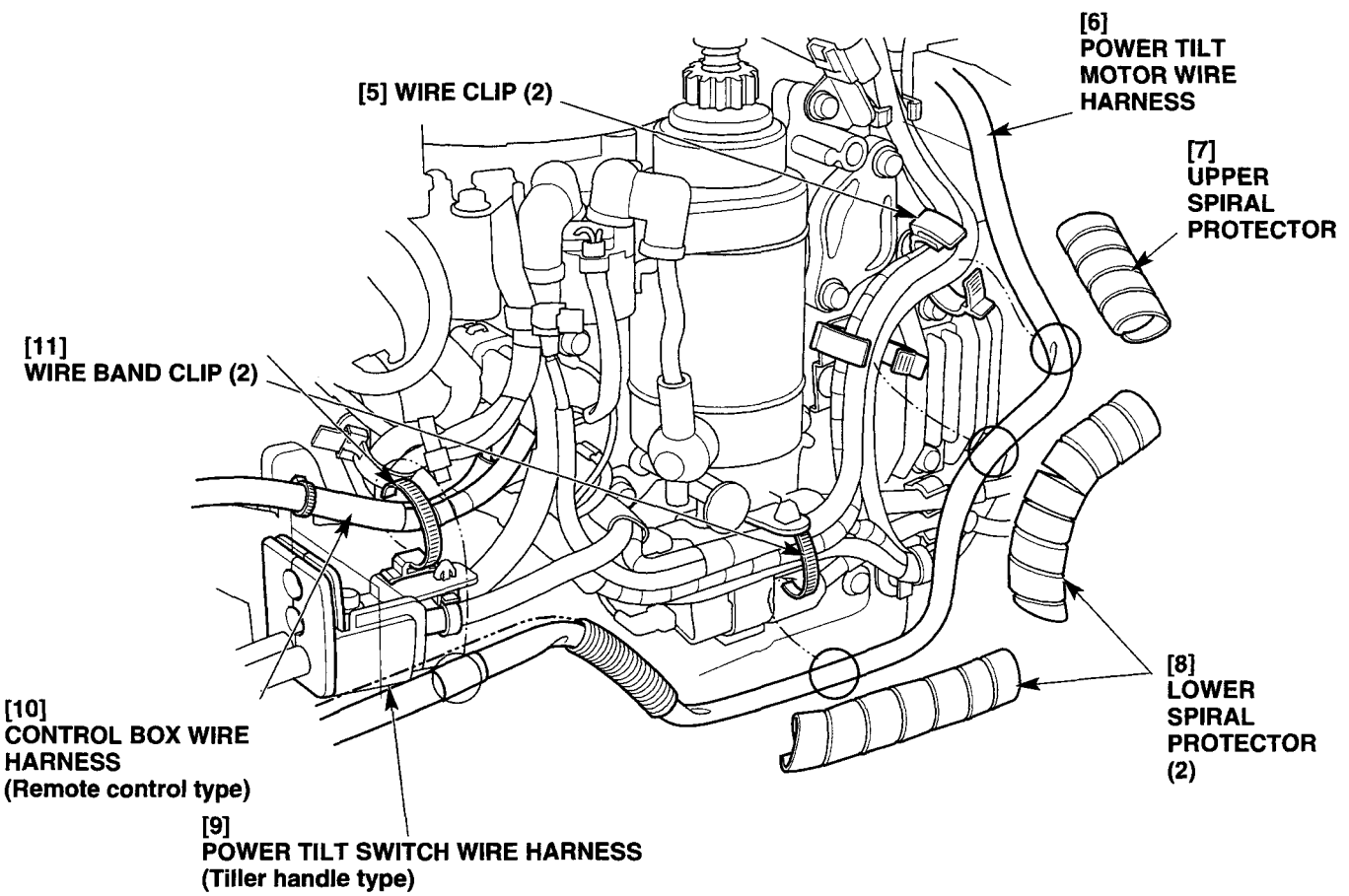


• Power Tilt Type

a. REMOVAL

1) Remove the following:
   - engine cover (P. 5-1 of the base shop manual).
   - left engine under cover (P. 5-2 of the base shop manual).
   - right engine under cover (P. 5-3 of the base shop manual).
   - recoil starter (P. 7-2 of the base shop manual).
2) Open the 13 mm clip and disconnect the power tilt motor 2P connector, then remove the motor wire harness from the starter case B.
3) Remove the power tilt motor wire from the motor:
   - Open the wire clips.
   - Open the wire band clips.
   - Remove the spiral protectors.

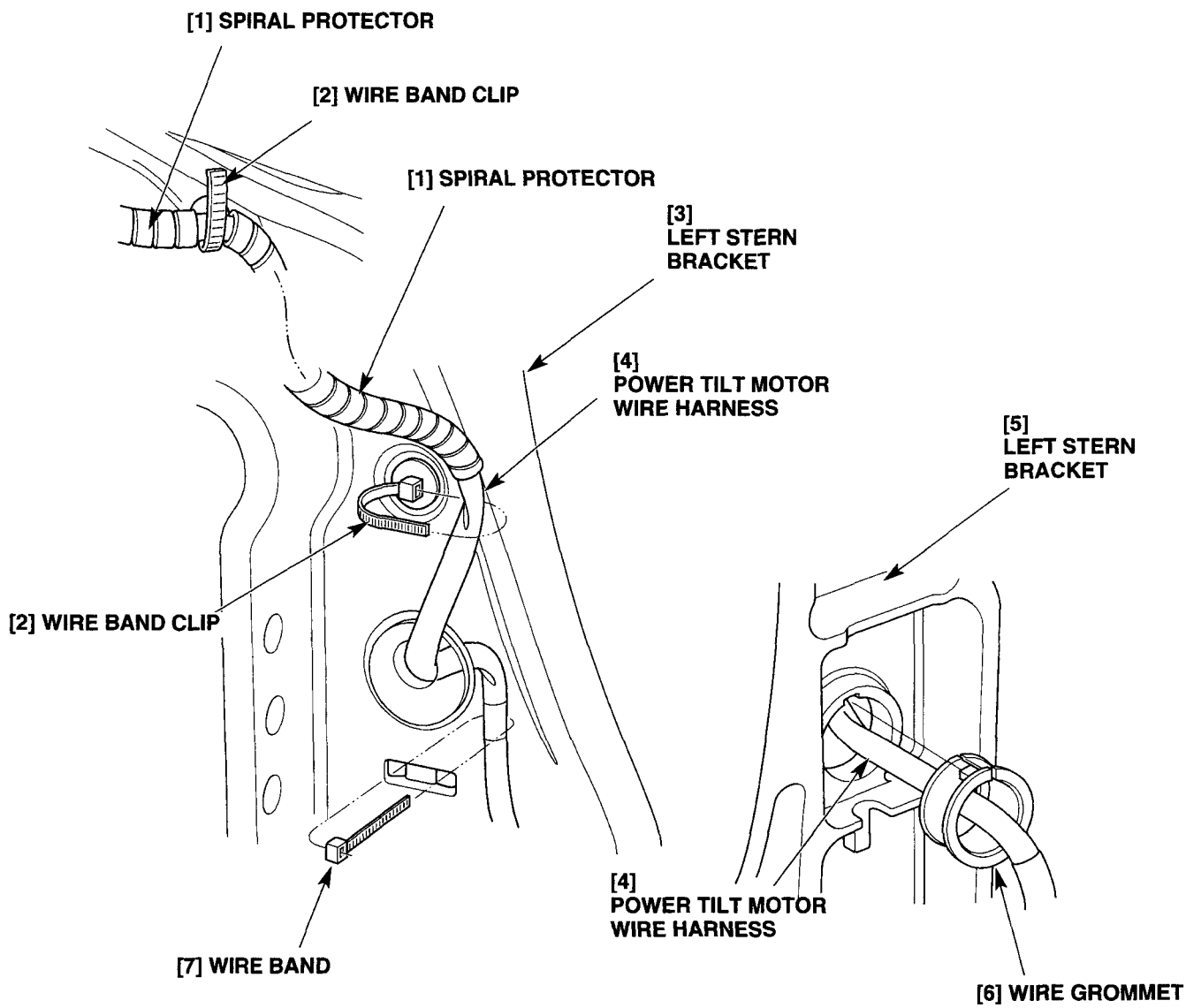




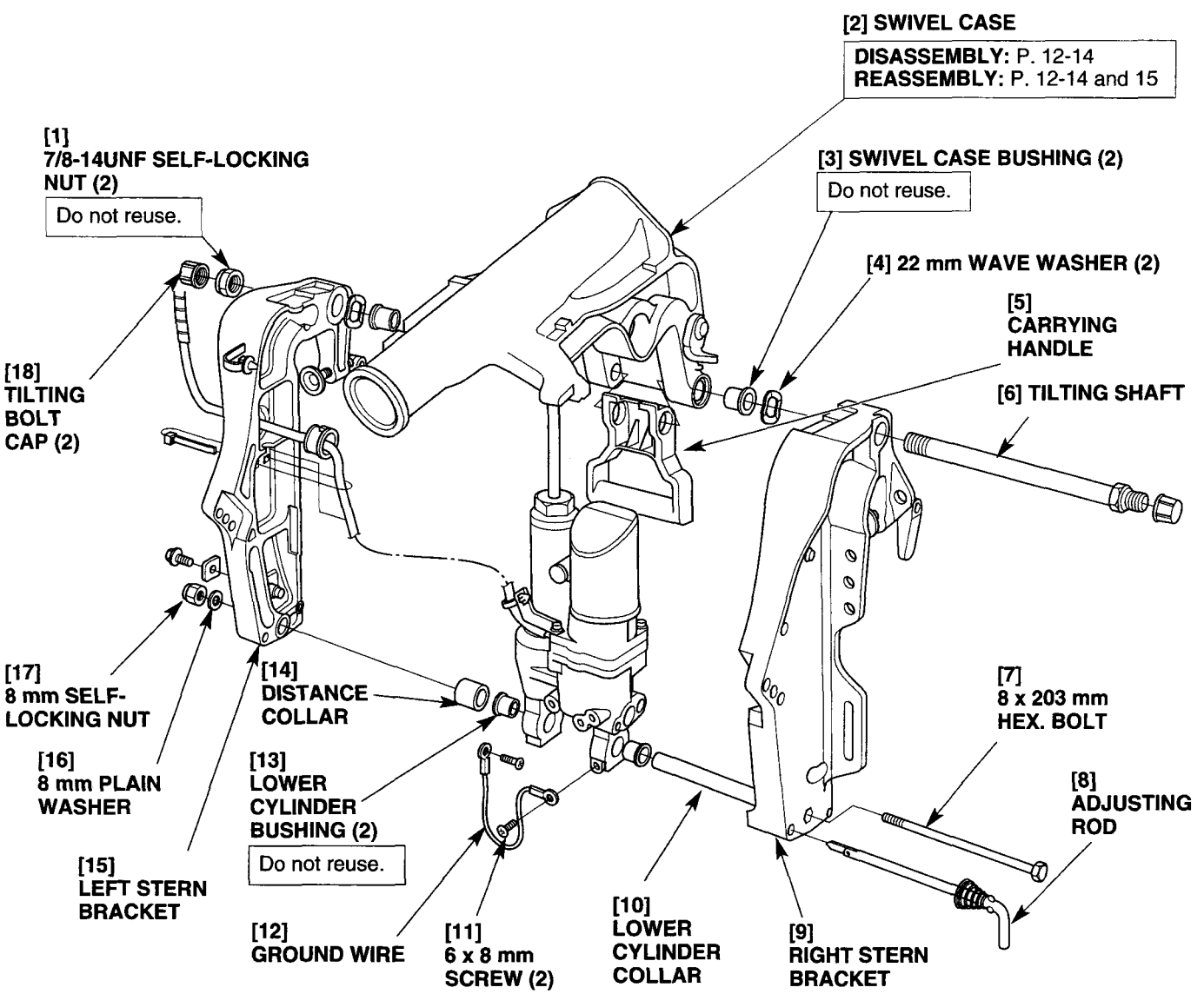
4) Open the wire band clips

5) Remove the wire band and free the motor wire from the left stern bracket. Remove the spiral protectors.

6) Remove the motor wire grommet and motor wire harness from the left stern bracket.



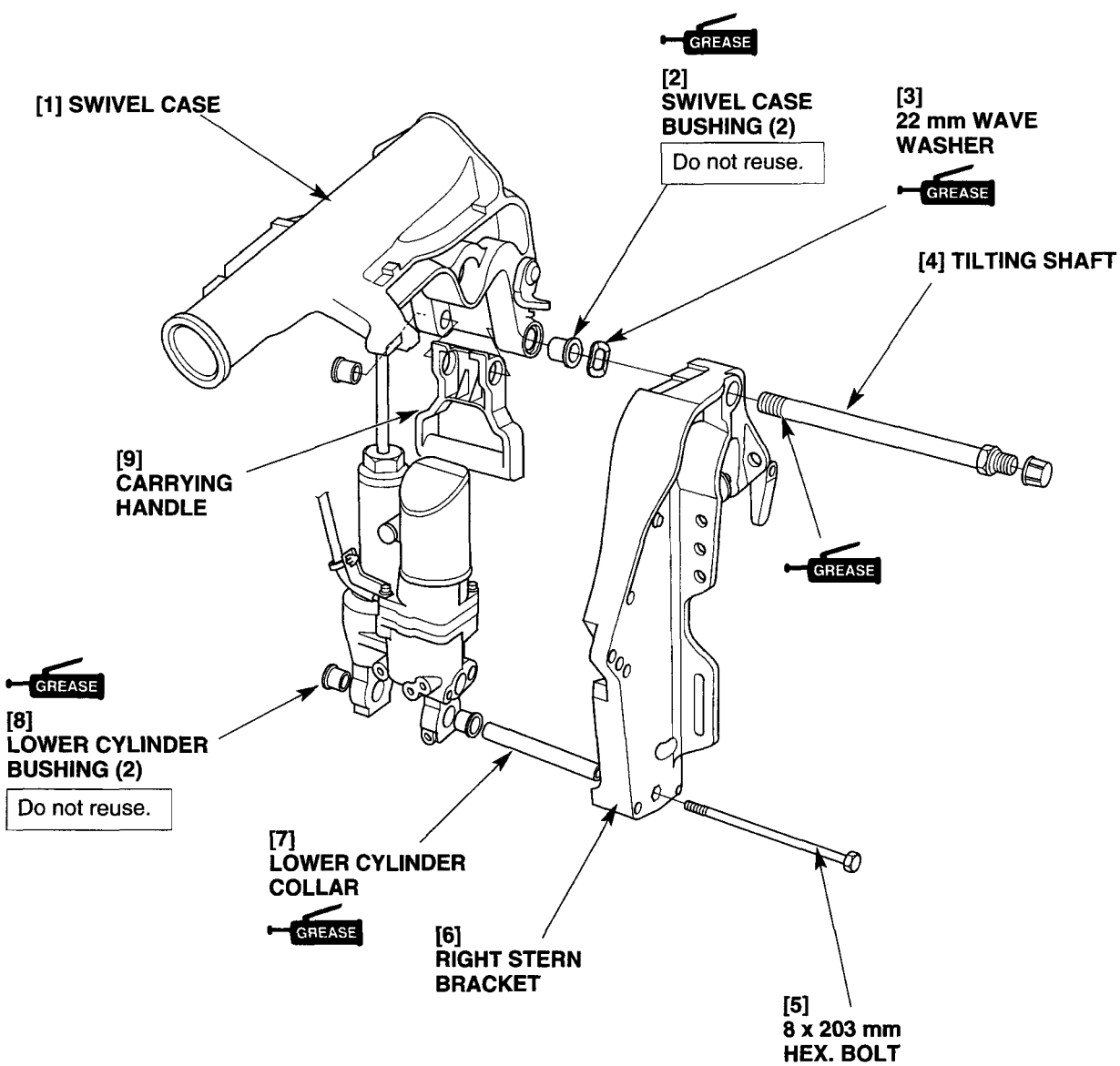
7) Remove the 6 x 8 mm screws and ground wire.
8) Turn the manual valve counterclockwise fully and rise the swivel case completely.
9) Remove the adjusting rod.
10) Remove the tilting bolt cap and loosen the 7/8-14UNF self-locking nut, then remove the 8 mm self-locking nut, 8 mm plain washer.
11) Remove the 7/8-14UNF self-locking nut.
12) Remove the left stern bracket, distance collar and 22 mm wave washer.
13) Remove the tilting shaft, 22 mm wave washer, carrying handle and right stern bracket.
14) Remove the lower cylinder collar.
15) Remove the swivel case and lower cylinder bushings if necessary.



b. INSTALLATION

1) Apply marine grease to new swivel case bushings and install them to the swivel case.
2) Apply marine grease to new lower cylinder bushings and lower cylinder collar, then install them to the power tilt assembly lower mount.
3) Apply marine grease to the threads of the tilting shaft, mounting hole and wave washers.
4) Install the right stern bracket, carrying handle,and 22 mm wave washer, and install the tilting bolt.
5) Install the 8 x 203 mm hex. bolt.

GREASE : Apply marine grease.



6) Set the motor wire grommet to the power tilt motor wire harness and install them to the left stern bracket by aligning the boss of the grommet with the groove of the left stern bracket

7) Apply grease to the 22 mm wave washer and distance collar, then install the wave washer, distance collar and left stern bracket.

8) Loosely install a new 7/8-14UNF self-locking nut.

9) Install the 8 mm washer and 8 mm self-locking nut. Tighten the 8 mm self-locking nut to the specified torque.

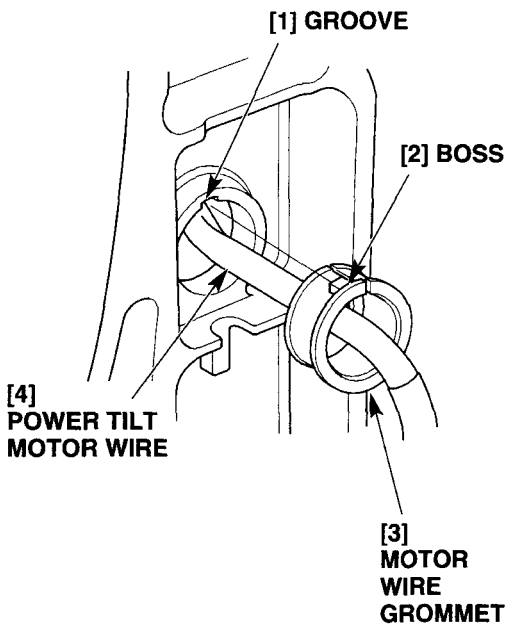
TORQUE: 21 N•m (2.1 kgf•m, 15 lbf•ft)

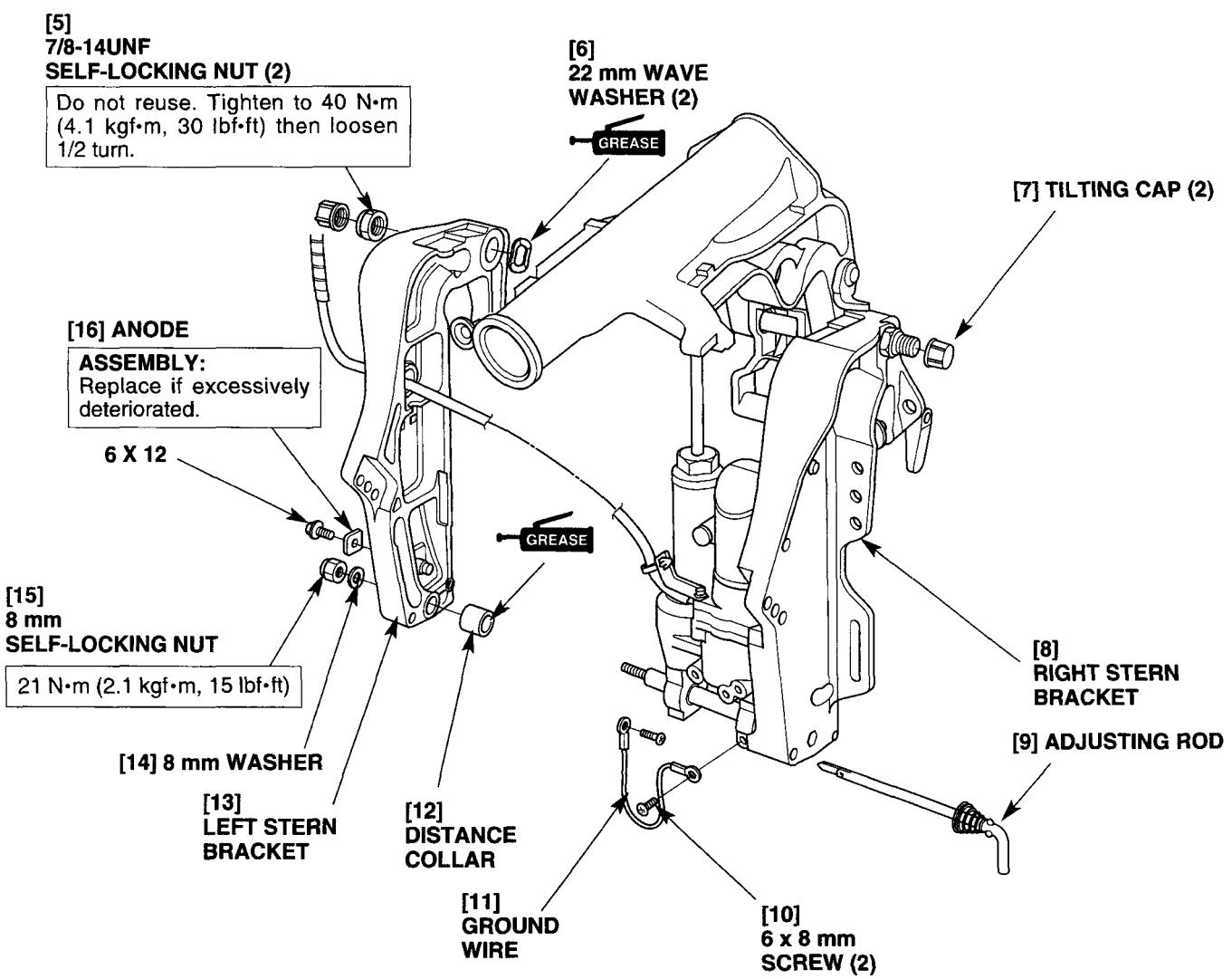
10) Tighten the 7/8-14UNF self-locking nut to 40 N•m (4.1 kgf•m, 30 lbf•ft) then loosen 1/2 turn.

11) Install the adjusting rod and tilting bolt caps.

12) Install the anode and tighten the 6 x 12 mm flange bolt securely if the anode removed.

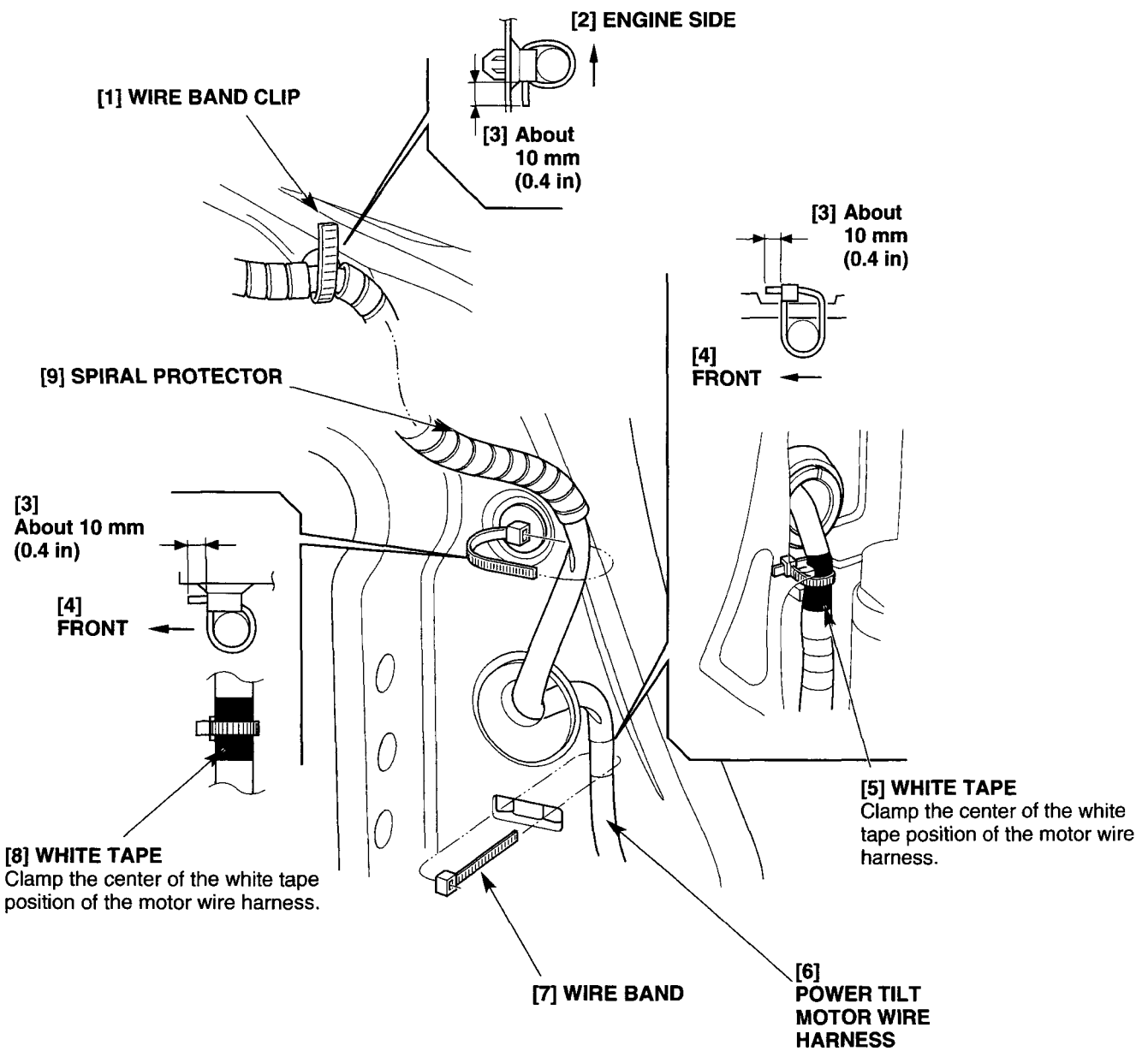
13) Make sure that the swivel case moves free.





14) Secure the power tilt motor wire with the wire band and wire band clip to the left stern bracket and oil case as shown.

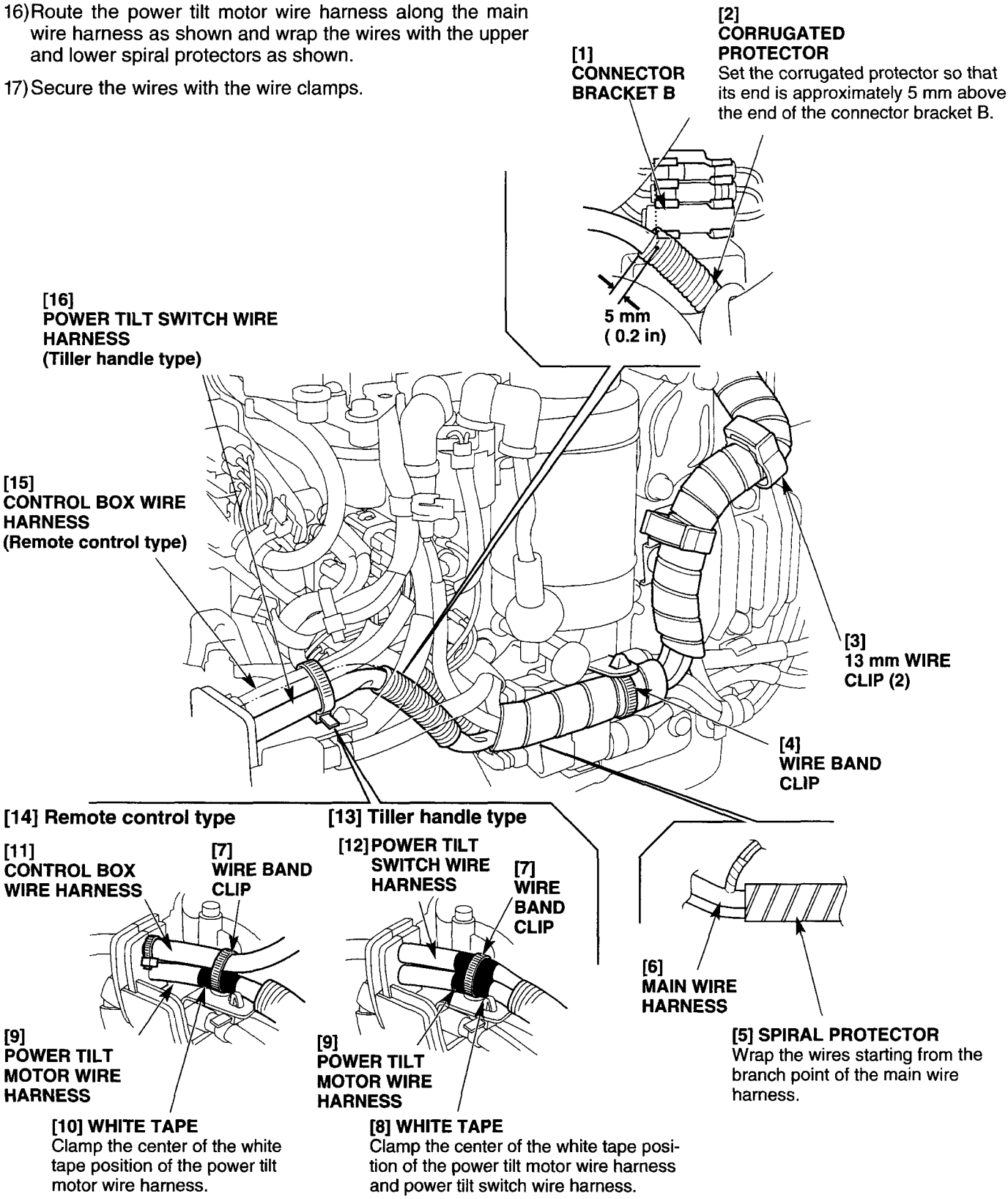
- If the wire band or wire band clip was cut, replace with new one. After securing the wire, cut the projected end length to 10 mm (0.4 in).



15) Route the power tilt motor wire harness and control box wire harness and secure the wires with the wire band clip. Cover the motor and switch wires with the corrugated protector as shown.

16) Route the power tilt motor wire harness along the main wire harness as shown and wrap the wires with the upper and lower spiral protectors as shown.

17) Secure the wires with the wire clamps.

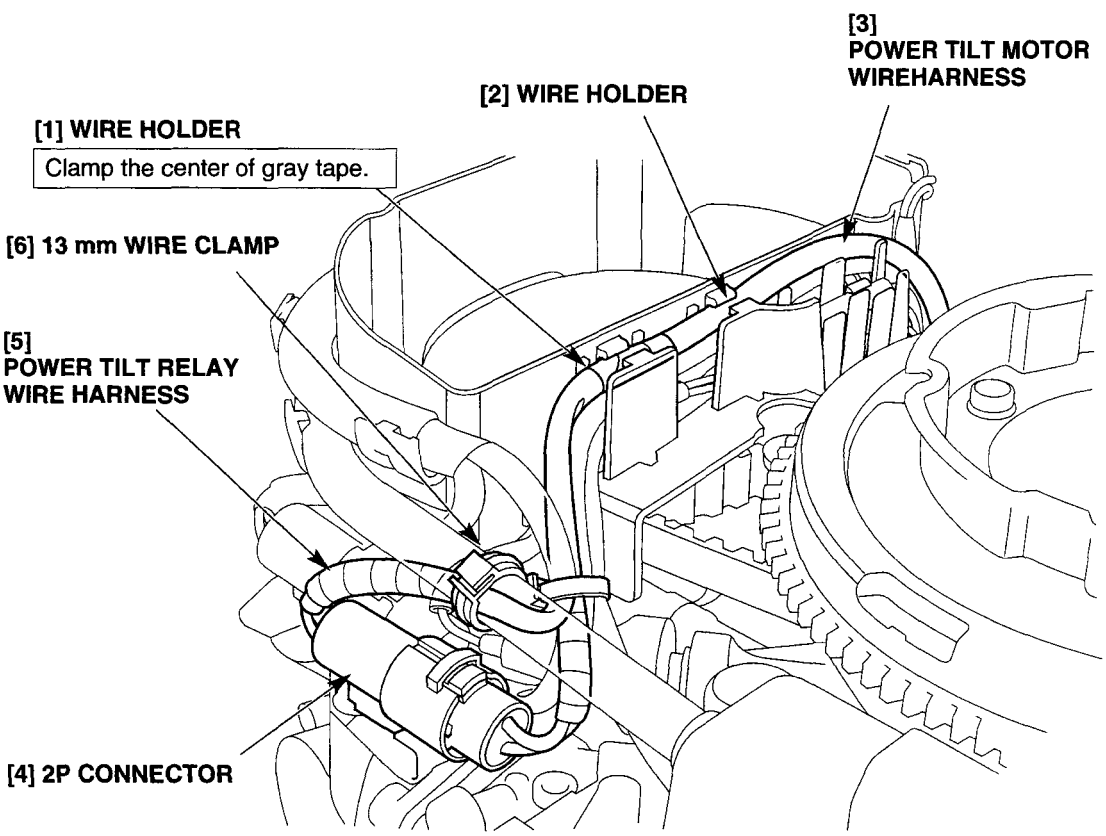


18) Connect the power tilt motor wire to the power tilt relay wire 2P connector and set them on the connector bracket A.

19) Route the power tilt motor wire harness and set it into the wire holders.

20) Secure the wires with the 13 mm wire clamp.
- If the wire band was cut, replace with new one. After securing the wire, cut the projected end length shown.

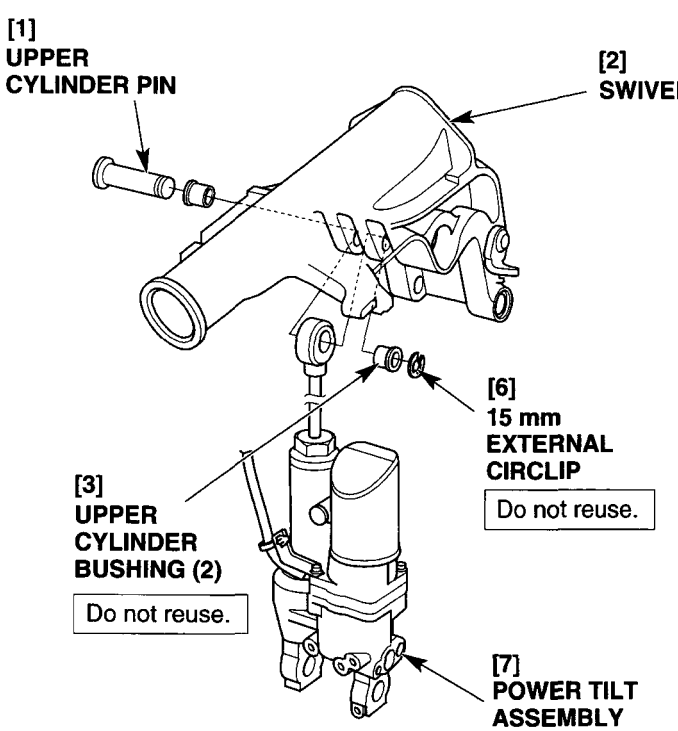
21) Install the removed parts in the reverse order of removal.



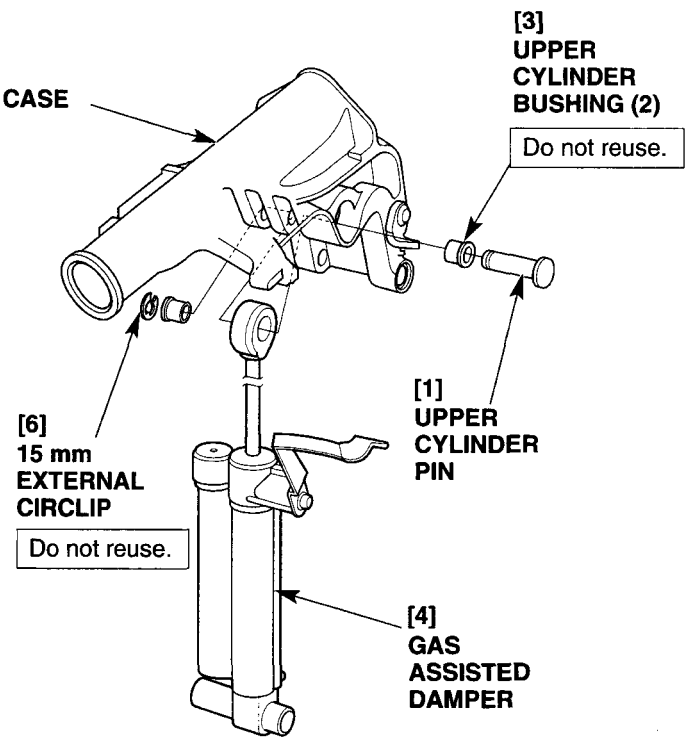
2. SWIVEL CASE

a. REMOVAL

1) Remove the engine (see Section 8 of the base shop manual) , then remove the following:
   - oil case (P. 12-2 of the base shop manual).
   - friction adjusting lever (P. 12-4 of the base shop manual).
   - mount frame (P. 12-6 of the base shop manual).
2) Remove the stern bracket (Gas assisted tilt type: P. 12-2 and Power tilt type: 12-5 thru. 12-7)
3) Remove the 15 mm external circlip. Replace with new one during reassembly.
4) Remove the upper cylinder pin and separate the gas assisted damper assembly or power tilt assembly from the swivel case.
5) Remove the upper cylinder bushings if necessary.



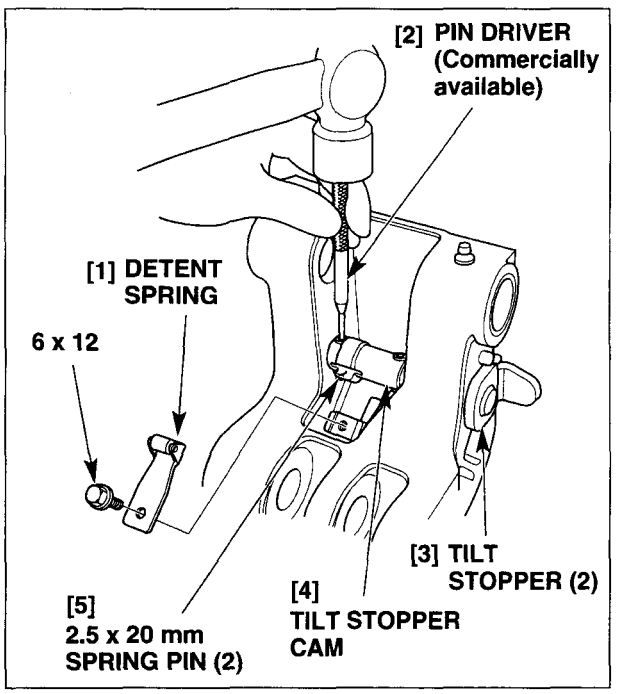
[8] Power Tilt Type



[5] Gas Assisted Tilt Type

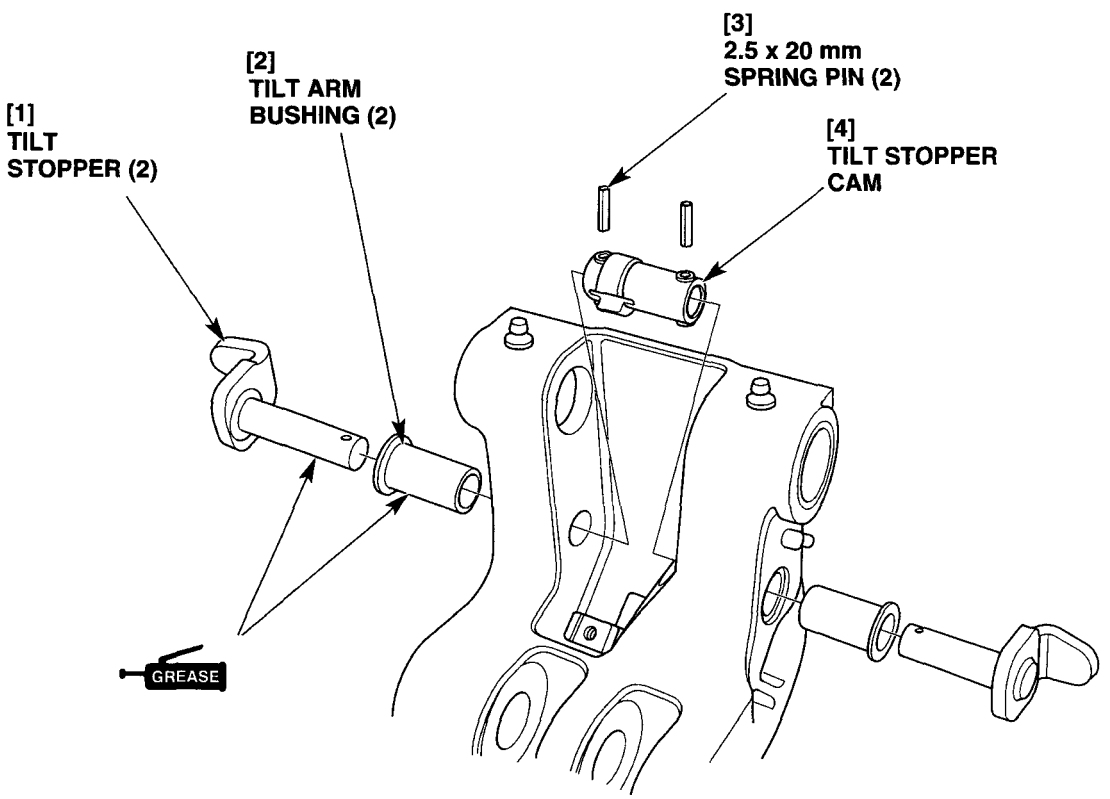
b. DISASSEMBLY

1) Remove the 6 x 12 mm flange bolt and detent spring.
2) Drive out the 2.5 x 20 mm spring pins using commercially available pin driver.
3) Remove the tilt stopers and tilt stopper cam.
4) Remove the tilt arm bushings.

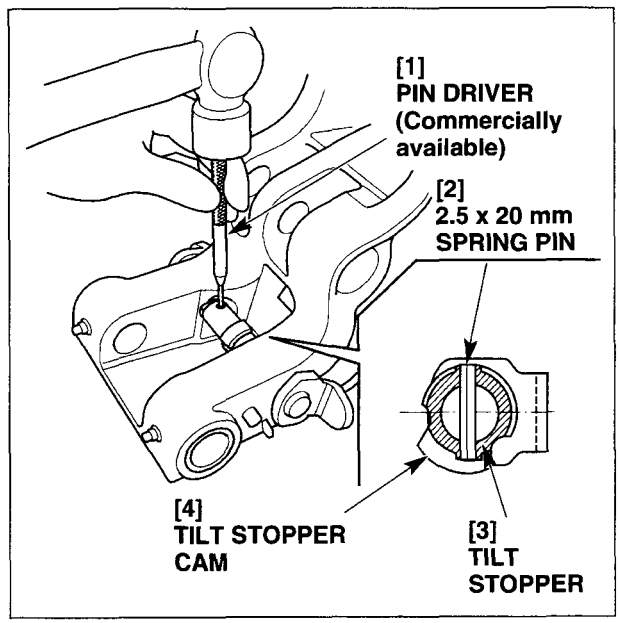


c. REASSEMBLY

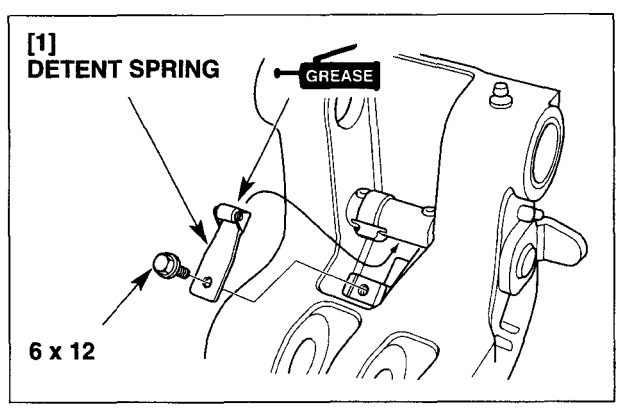
1) Apply marine grease to the tilt arm bushings and install them.
2) Apply marine grease to the tilt stopper shaft, then install the tilt stopper cam and tilt stoppers.



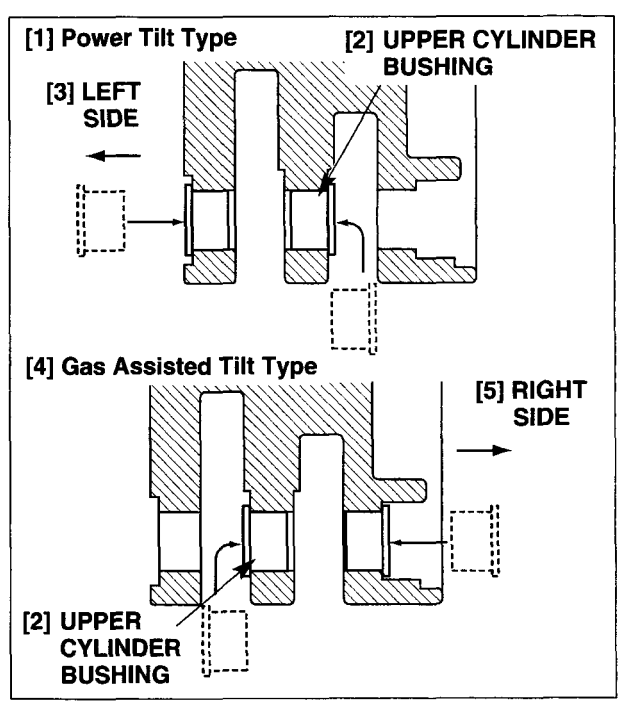
3) Align the pin hole to the tilt stopper and tilt stopper cam as shown and drive the 2.5 x 20 mm spring pin using a commercially available pin driver until the pin end aligns with the tilt stopper cam as shown.



4) Install the detent spring and tighten the 6 x 12 mm flange bolt securely. Apply grease to the roller of the detent spring.



5) If the upper cylinder bushing removed, install new cylinder bushings to the swivel case as shown. Apply marine grease to the inside of both upper cylinder bushings.



d. INSTALLATION

6) Power tilt type: Install the power tilt assembly with the power tilt motor facing to the right side.

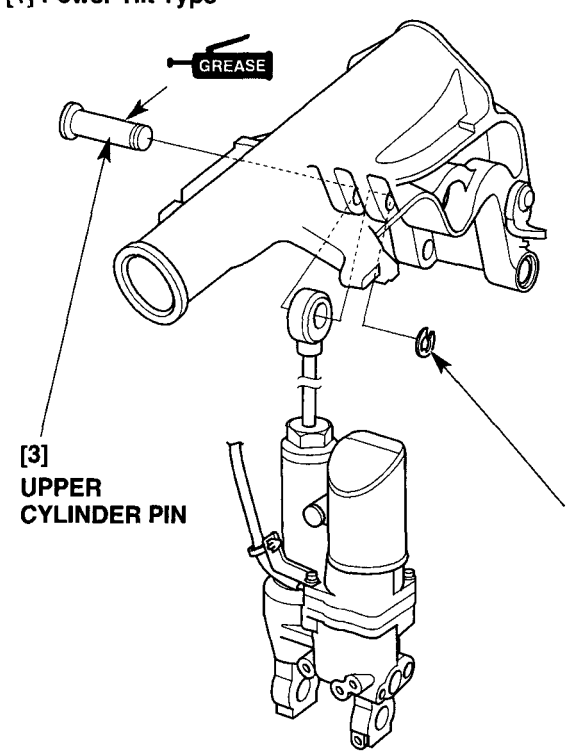
   Gas assisted tilt type: Install the gas assisted damper with the tilt lever facing to the right side.

7) Apply grease to the upper cylinder pin and install it.

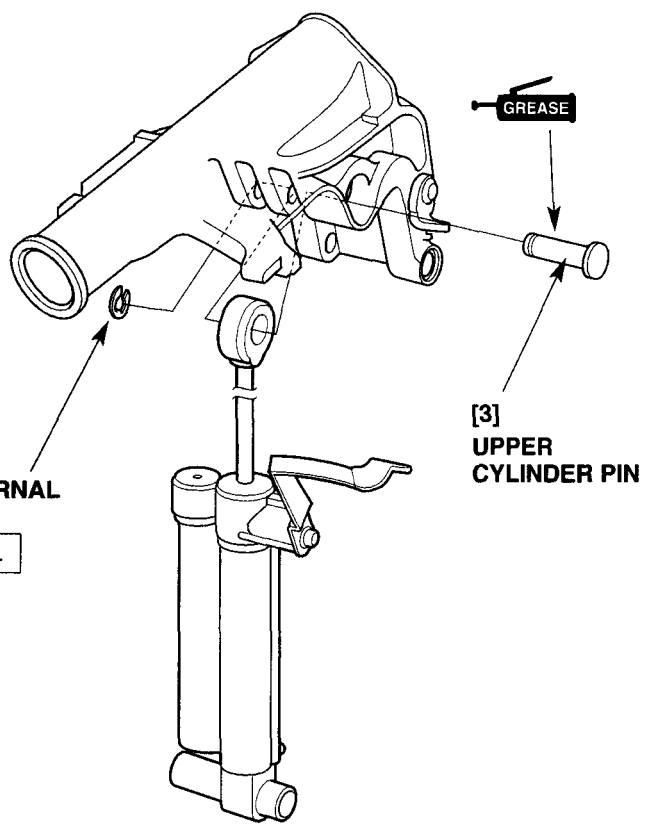
8) Secure the upper cylinder pin with a new 15 mm external circlip.

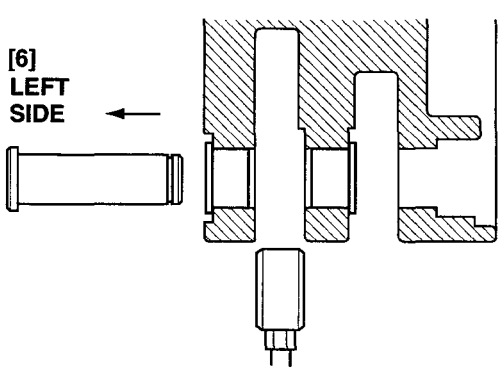
9) Install the following in the reverse order of removal:
   - stern bracket (Power tilt type: P. 12-8 thru. 12-12, Gas assisted tilt type: P. 12-3 and 4).
   - oil case, friction adjusting lever, mount frame (Section 12 of the base shop manual).
   - engine (Section 8 of the base shop manual).

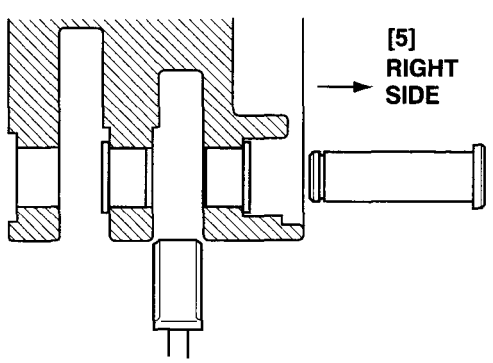
[1] Power Tilt Type



[2] Gas Assisted Tilt Type







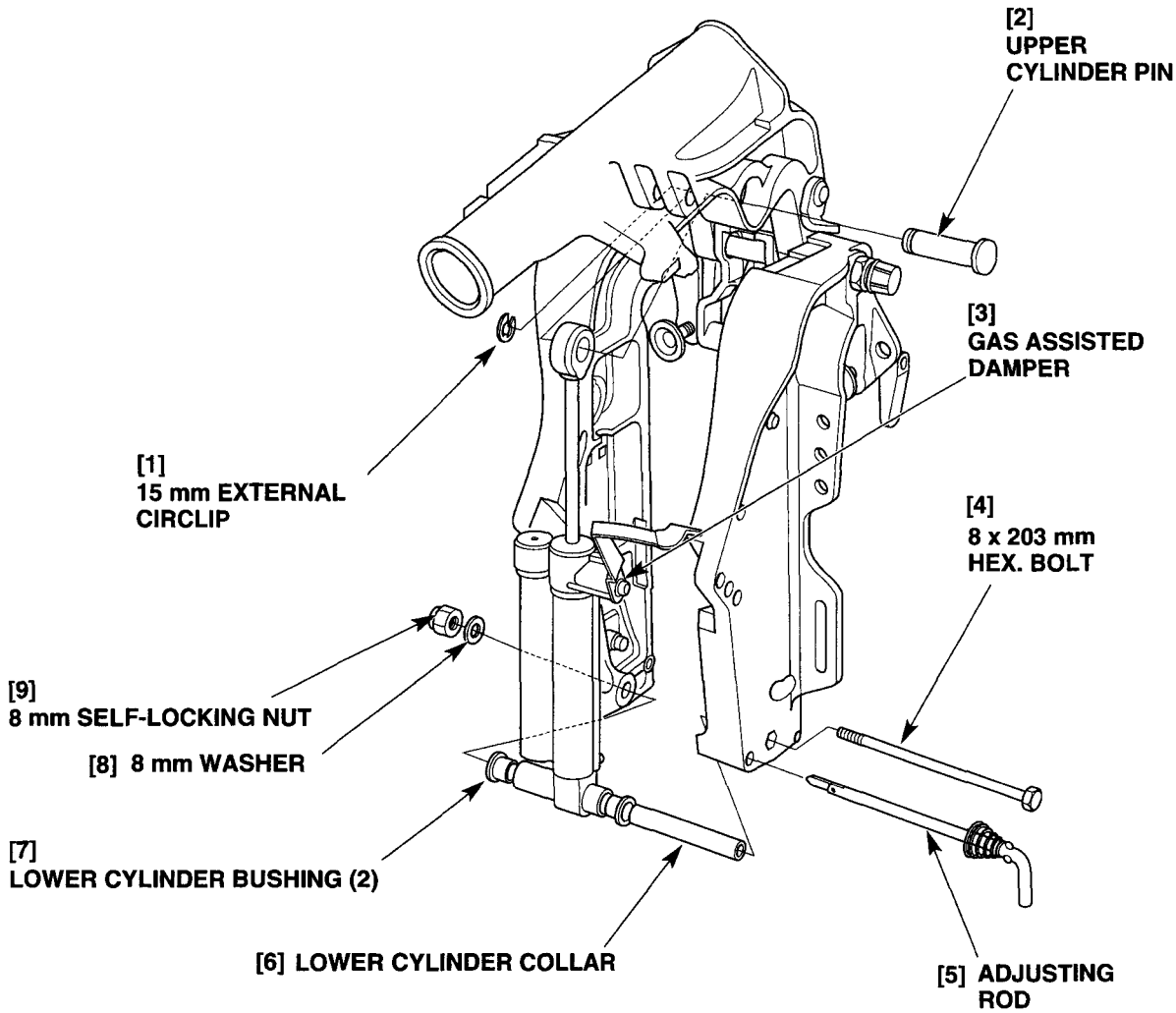
3. GAS ASSISTED TILT ASSEMBLY

a. REMOVAL

1) Remove the adjusting rod.
2) Remove the 8 mm self-locking nut, 8 mm plain washer and 8 x 203 mm hex. bolt.
3) Remove the 15 mm external circlip and pull out the upper cylinder pin.
4) Remove the gas assisted damper from the swivel case.
5) Remove the lower cylinder collar and lower cylinder bushings.

CAUTION:

After removing the gas-assisted damper, store it upright with the upper cylinder pin mounting part toward up. Do not store the gas-assisted damper by laying it on its side or with the lower cylinder bushing installation part toward up.

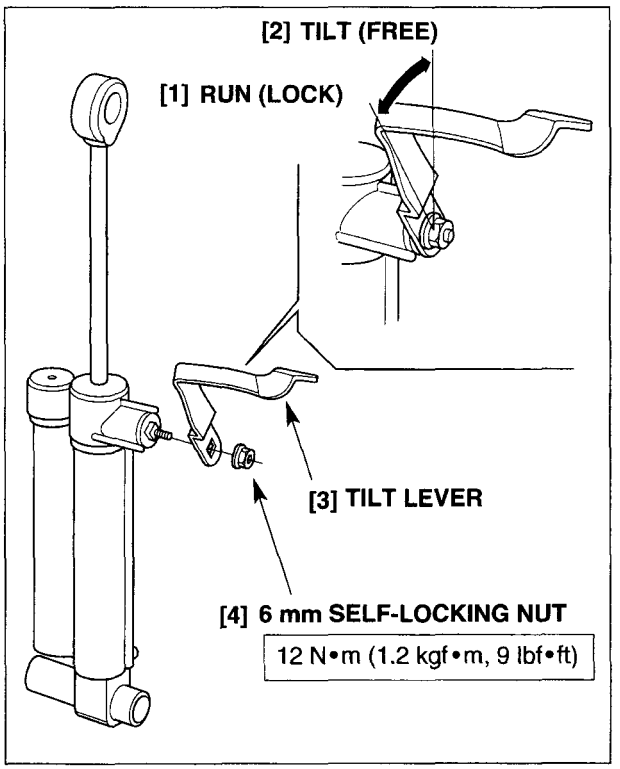


b. TILT LEVER REPLACEMENT

- Before removing the tilt lever, set the tilt lever to the run position
- Install the tilt lever by aligning the mounting hole of the lever with the tilt lever shaft as shown.

CAUTION:

Store the gas-assisted damper upright with the upper cylinder pin mounting part toward up. Do not store the gas-assisted damper by laying it on its side or with the lower cylinder bushing installation part toward up.



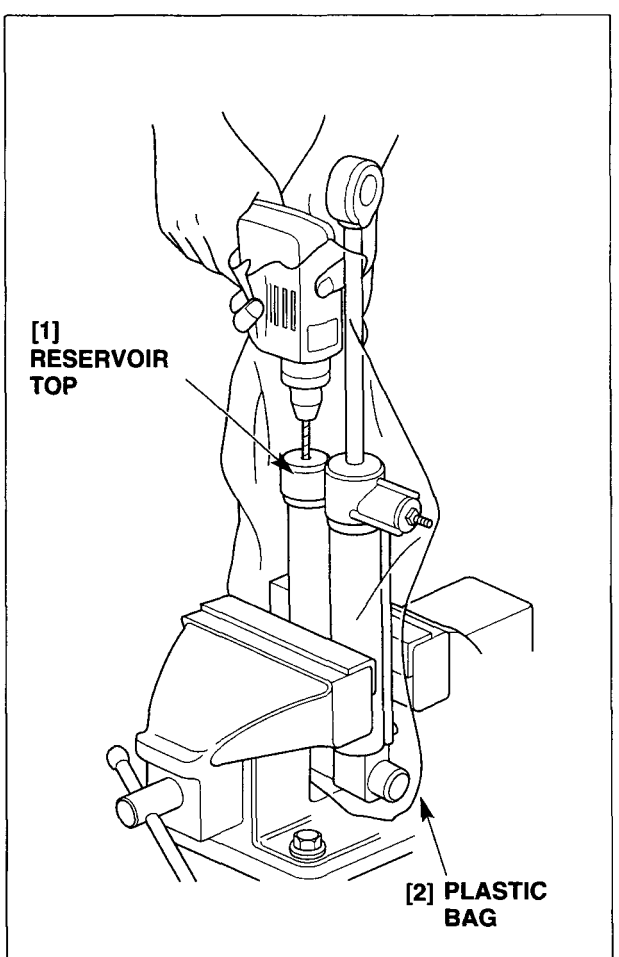
c. DISPOSAL

1) Set the tilt lever in the "TILT" position with the piston rod fully extended, then remove the tilt lever.
2) Center punch the reservoir end to mark the drilling point.
3) Wrap the damper inside a plastic bag and support the damper in a vice as shown.
4) Through the open end of the plastic bag, insert a drill motor with a sharp 2 - 3 mm (5/64 - 1/8 in) drill bit.

⚠ WARNING

- **The gas assisted damper contains nitrogen gas and oil under heigh pressure. Do not drill any farther reservoir top, or you may drill into the oil chamber; oil escaping under high pressure may cause serious personal injury.**
- **Do not use a dull drill bit which could cause a build-up of excessive heat and pressure inside the damper, leading to explosion and severe personal injury.**
- **Always wear eye protection to avoid getting metal shaving in your eyes when the gas pressure is released. The plastic bag is only intended to shield you from the escaping gas.**

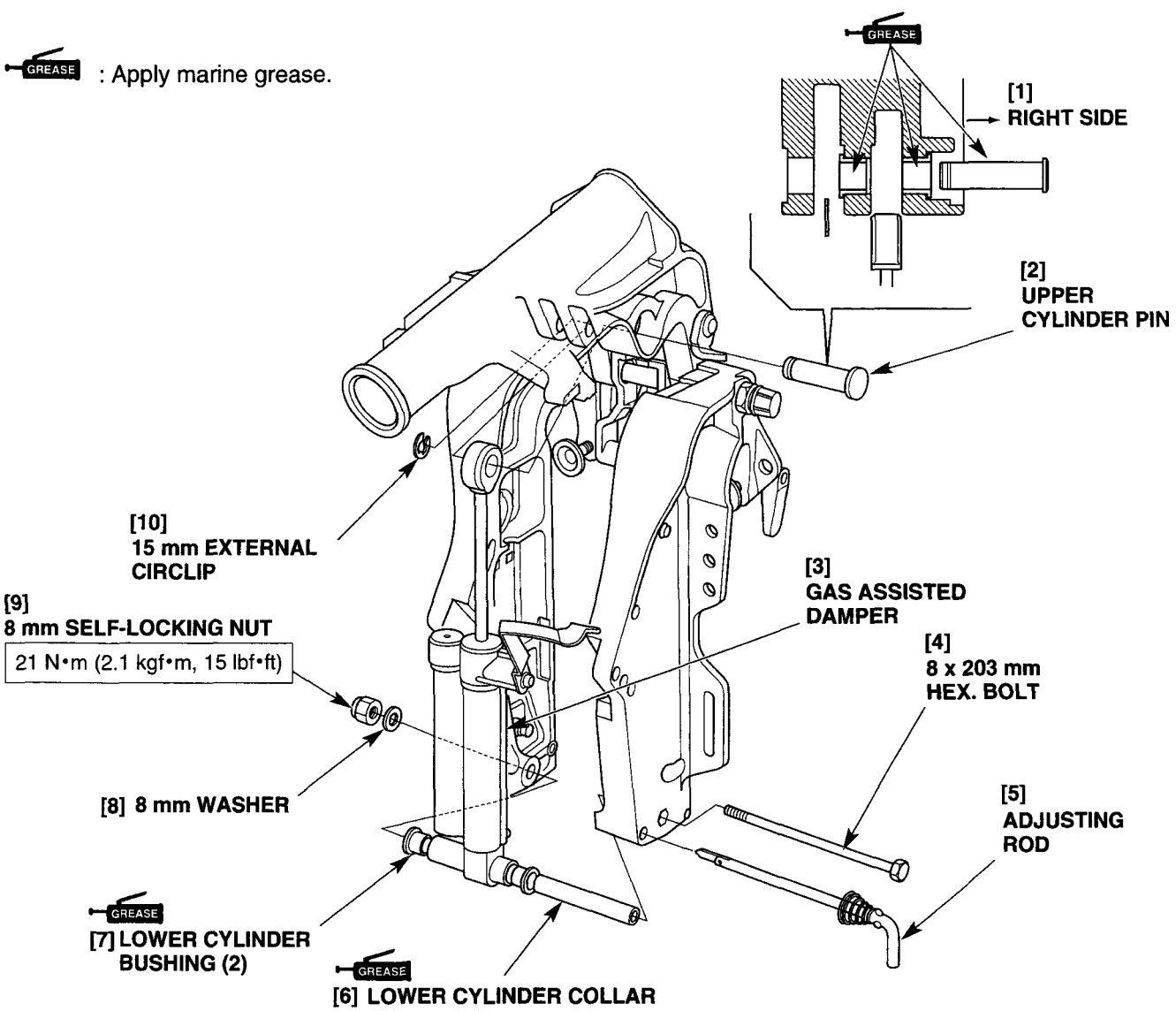
5) Hold the bag around the drill motor and briefly run the drill motor inside the bag; this will inflate the bag with air from the drill motor and keep the bag from getting caught in the bit when you start.



d. INSTALLATION

1) Install new lower cylinder bushings if they are removed.
2) Apply marine grease to the lower cylinder bushings and lower cylinder collar, then install the lower cylinder collar to the gas assisted dumper lower mount.
3) Apply marine grease to the swivel case bushings.
4) Install the gas assisted damper to the swivel case.
   - Set the piston rod in the fully extended position before installation.
5) Install the upper cylinder pin through the right side of the swivel case as shown and secure it with the 15 mm external circlip.
6) Set the gas assisted damper to the lower mounting hole and install the 8 x 203 mm hex. bolt and 8 mm washer.
7) Tighten the 8 mm self-locking nut to the specified torque.

TORQUE: 21 N•m (2.1 kgf•m, 15 lbf•ft)



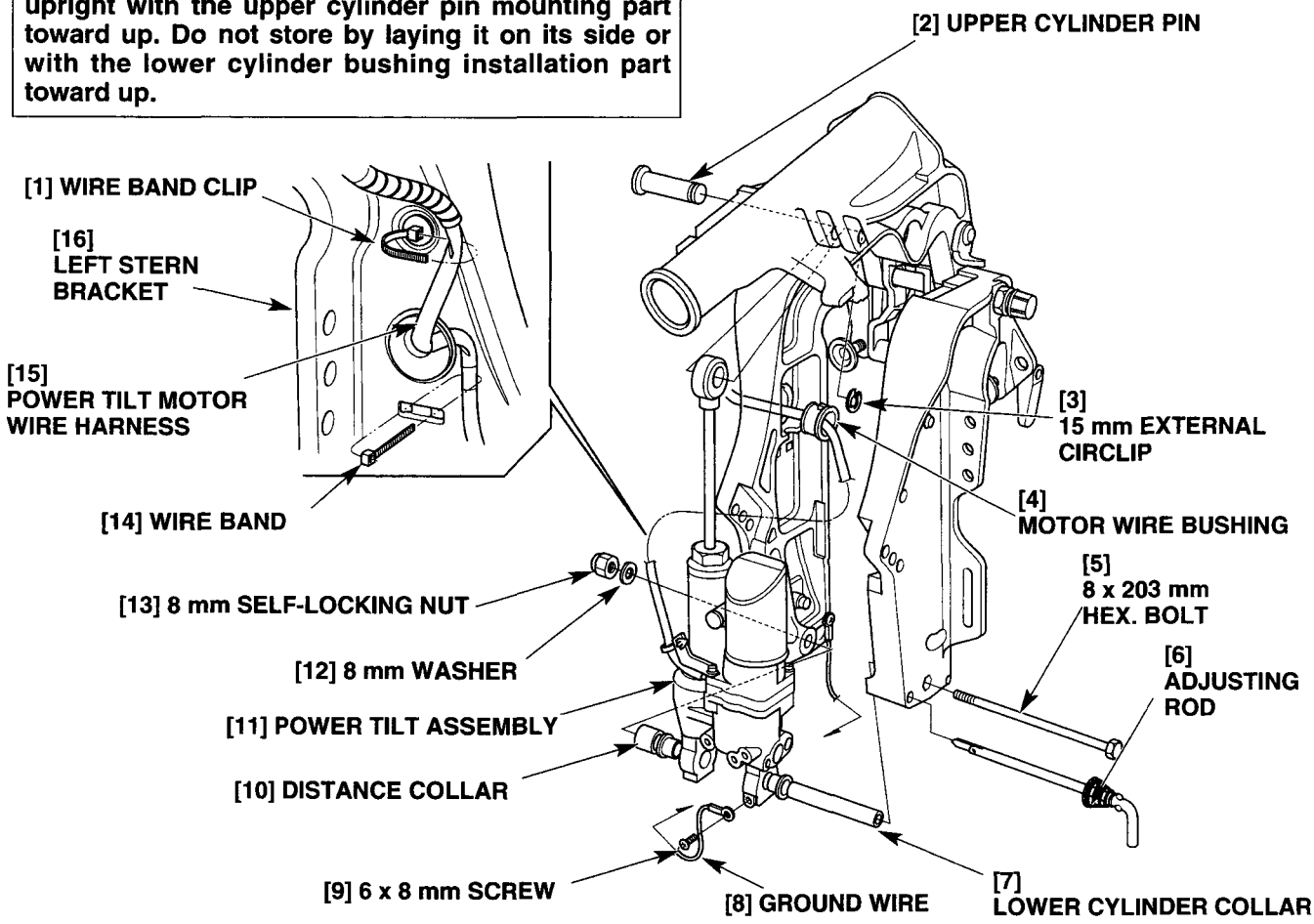
4. POWER TILT ASSEMBLY

a. REMOVAL

1) Remove the following:
   - power tilt motor wire harness from the motor (P. 12-5 and 12-6).
   - friction adjusting lever (Tiller handle type only P. 12-4 of base shop manual).
   - mount frame (P. 12-6 of the base shop manual).
2) Open the wire band and wire band clip and free the motor wire haness from the right stern bracket, then pull the motor wire harness from the left stern bracket with the motor wire bushing.
3) Remove the 6 x 8 mm screw and ground wire from the power tilt assembly.
4) Remove the adjusting rod.
5) Remove the 8 mm self-locking nut and 8 mm plain washer.
6) Remove the distance collar and lower cylinder collar.
7) Tilt up the swivel case, and remove the 15 mm external circlip and upper cylinder pin and remove the power tilt assembly.

CAUTION:

After removing the power tilt assembly, store it upright with the upper cylinder pin mounting part toward up. Do not store by laying it on its side or with the lower cylinder bushing installation part toward up.



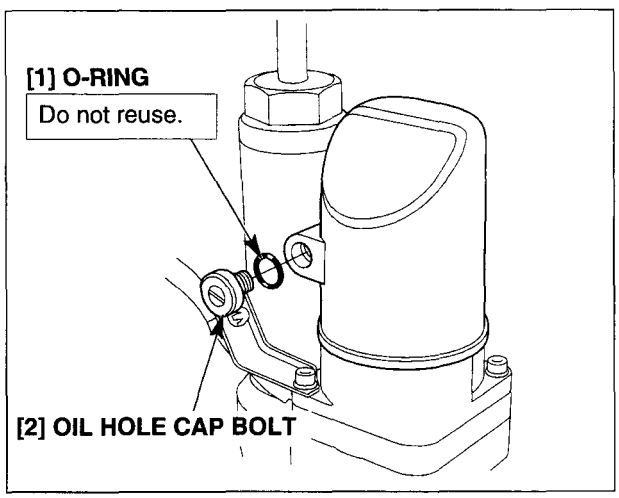
b. DISASSEMBLY

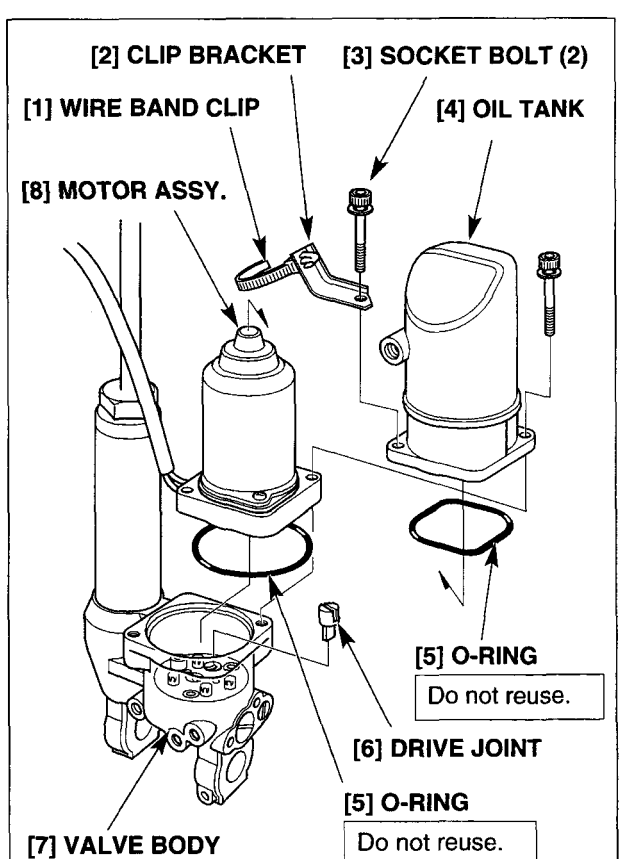
CAUTION:

- **Do not disassemble the gear pump assembly. If it is faulty, replace it as an assembly.**
- **Do not use a shop towel, cloth, gloves, etc.**
- **Do not reuse the drained automatic transmission fluid (ATF).**
- **Do not hold at the outer tube when holding the power tilt assembly in a vise during operation.**
- **Clean the removed parts in fresh automatic transmission fluid (ATF), and blow each port of the parts with compressed air. Set the parts neatly in a suitable container with care not to contaminate them with dust and dirt.**
- **Do not reuse the O-rings.**
- **Remove each valve and sleeve with care not to damage the sliding surface of the parts.**

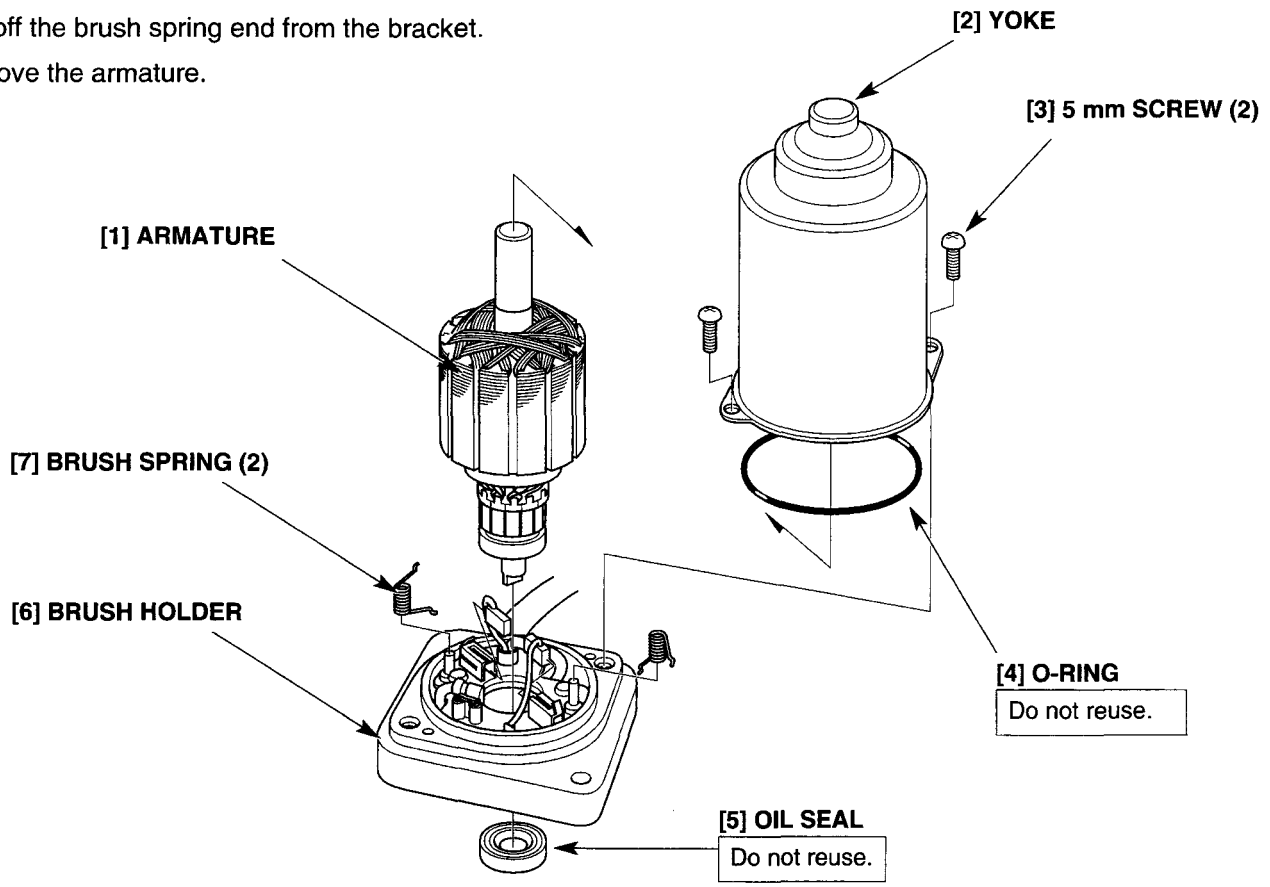
• POWER TILT MOTOR

1) Connect the power tilt motor 2P connector and operate the power tilt motor assembly until the piston rod extends fully.
2) Loosen the manual valve fully.
3) Remove the oil hole cap bolt and drain the ATF in the oil tank through the bolt hole.
4) Remove the O-ring from the oil hole cap bolt and discard it. Replace the O-ring with a new one on reassembly.
   - Do not drain the ATF by pushing in the piston rod.
5) Open the wire band clip and free the motor wire.
6) Remove the two socket bolts and washers, and remove the oil tank and power tilt motor assembly.
7) Drain the ATF from the valve body.
8) Remove the two O-rings from the power tilt motor assembly and discard them. Replace the O-rings with new ones when reassembly.
9) Remove the drive joint from the gear pump assembly.





10) Remove the 5 mm screws, yoke and O-ring.
11) Pull off the brush spring end from the bracket.
12) Remove the armature.



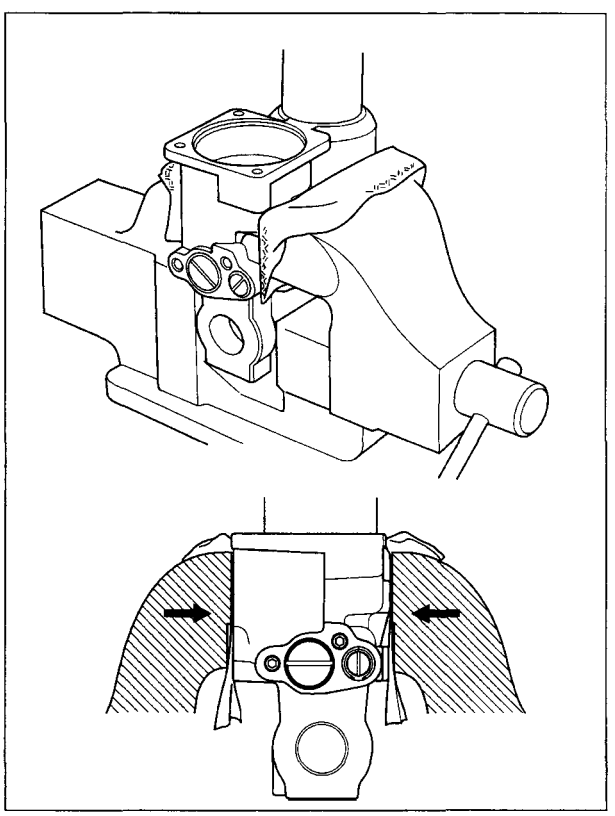
• CYLINDER, PISTON ROD

1) Hold the valve body in a vise with shop towel or soft jaws as shown.

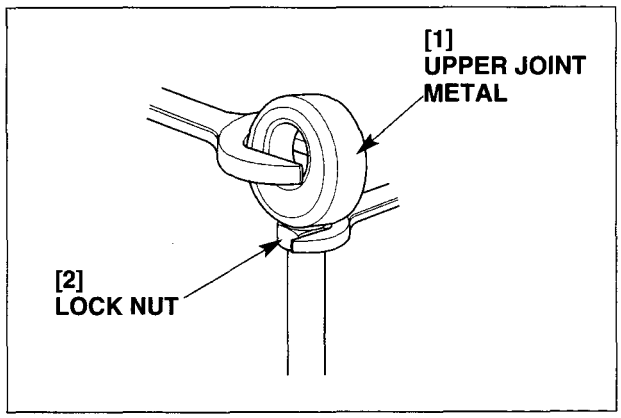
CAUTION:

Take care not to tighten the vise too tight as it damages the valve body

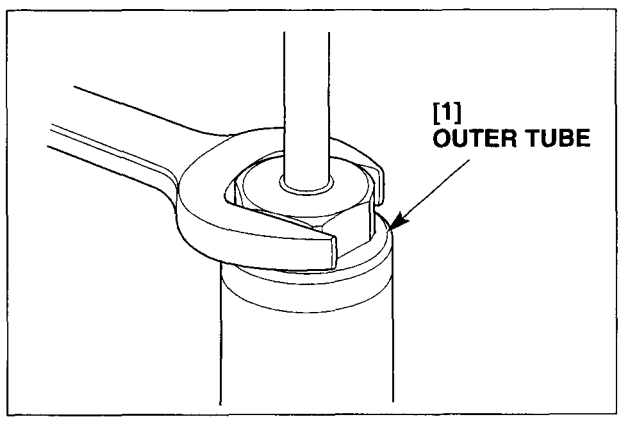
- If it necessary to disassemble the valve body, loosen the spool vale (P. 12-26).



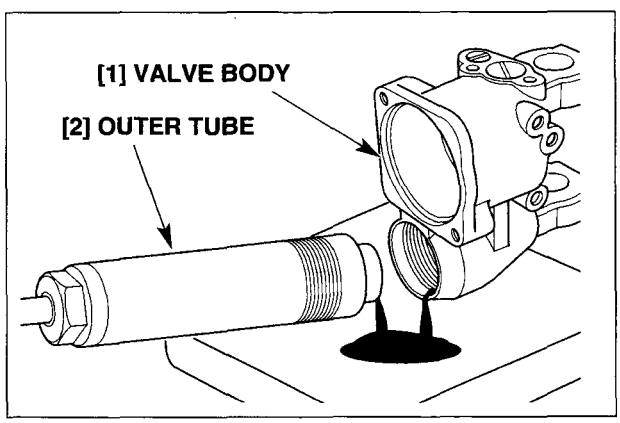
2) Loosen the lock nut, then remove the upper joint metal and lock nut.



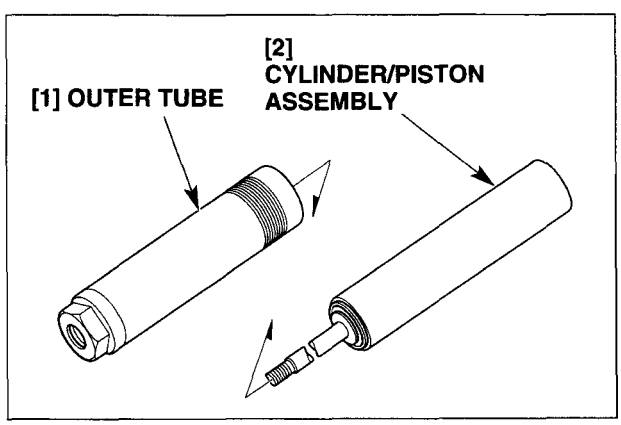
3) Loosen the outer tube, then remove the valve body from the vise.



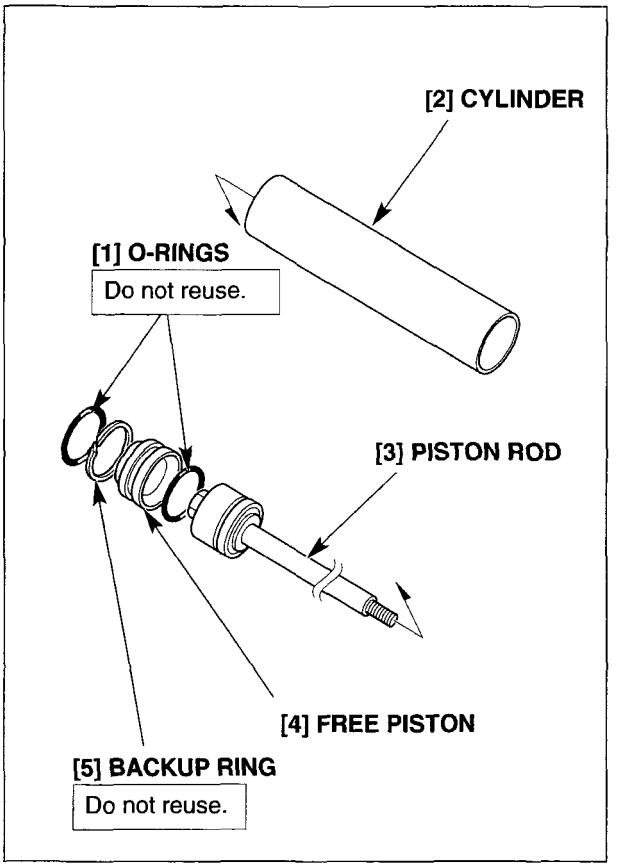
4) Loosen the outer tube slowly. Drain the residual ATF from the outer tube and valve body and remove the outer tube from the valve body.



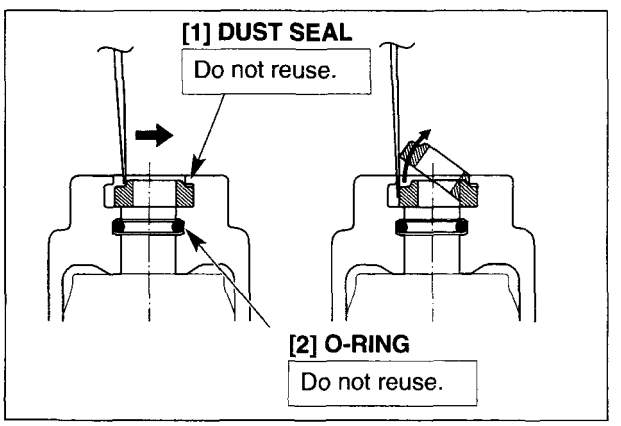
5) Remove the cylinder/piston assembly from the outer tube.



6) Remove the piston rod and free piston from the cylinder.
7) Remove the O-ring from the piston rod and discard it. Replace the O-ring with a new one during reassembly.
8) Remove the backup ring and O-ring from the free piston and discard them. Replace the backup ring and O-ring as a set during reassembly.

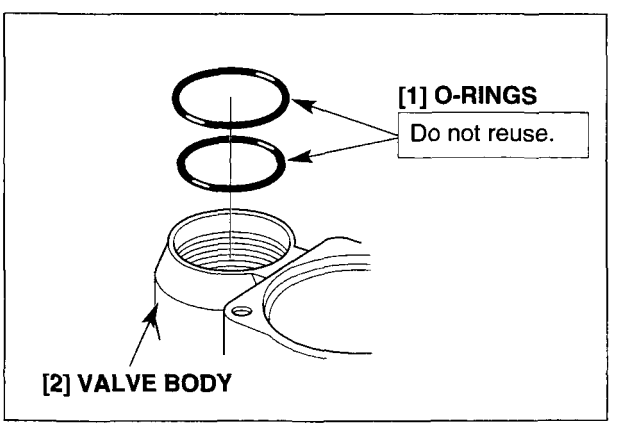


9) Remove the dust seal and O-ring from the outer tube and discard them. Replace the O-ring and dust seal with new one during reassembly.

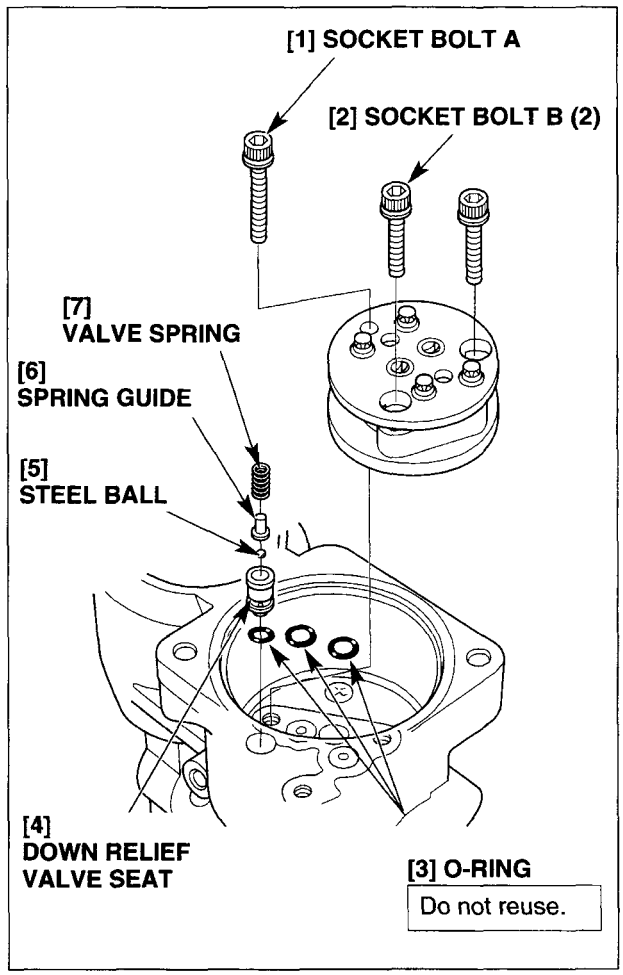


• VALVE BODY

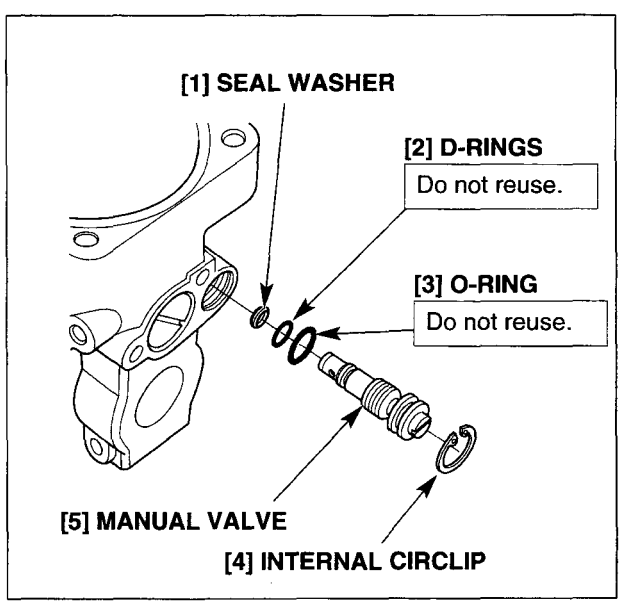
1) Remove the two O-rings from the valve body and discard them. Replace the O-rings with the new ones during reassembly.



2) Remove the socket bolts and gear pump assembly.
   - Do not disassemble the gear pump assembly. If it is faulty, replace it as an assembly.
3) Remove the two O-rings, valve spring, spring guide, steel ball and the down relief valve seat from the valve body. Remove the O-ring from the down relief valve seat. Discard the O-rings, replace the O-rings with new ones during reassembly.



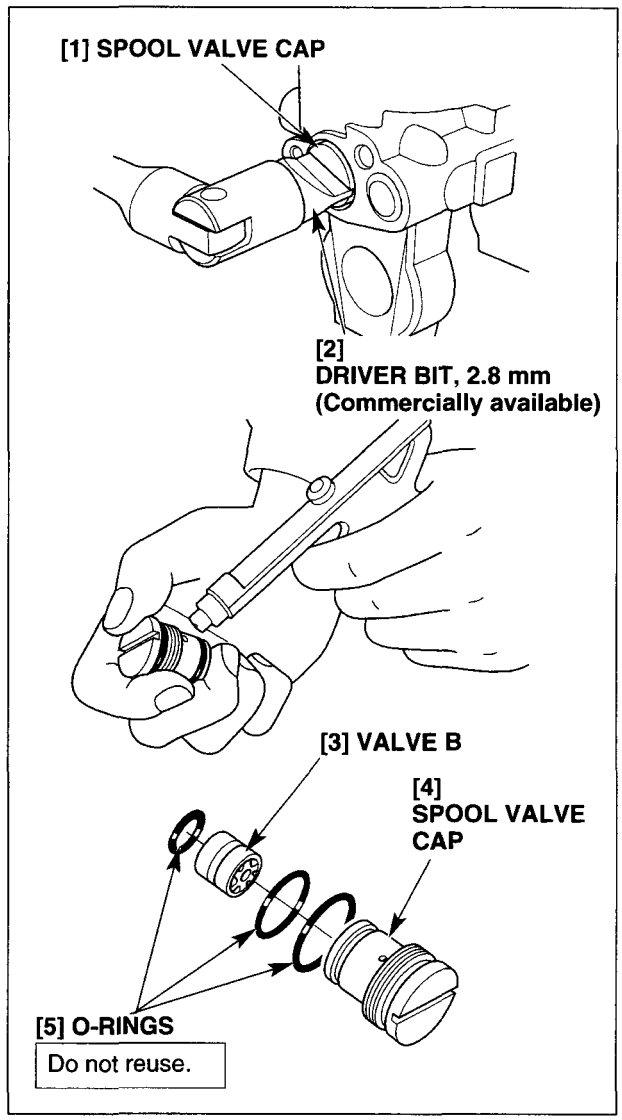
4) Remove the internal circlip, and remove the manual valve and seal washer.
5) Remove the O-rings and discard them. Replace with new ones during reassembly.



6) Remove the spool valve cap using a commercially available driver bit 2.8 mm.

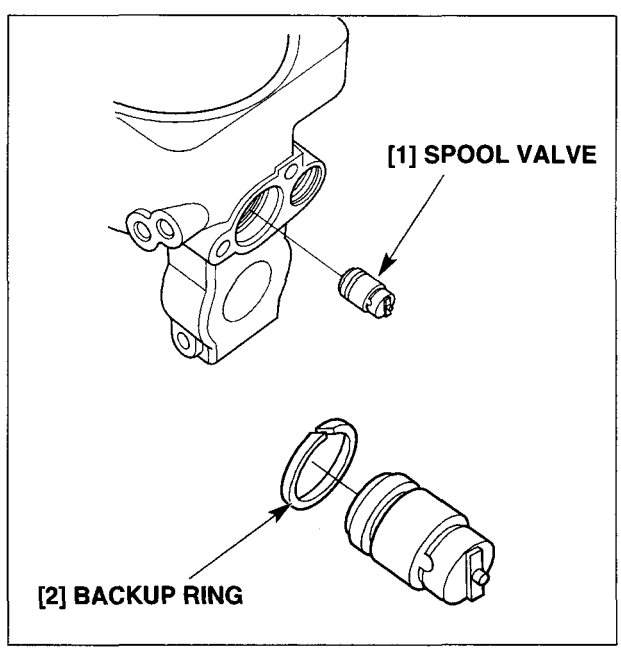
7) Apply a small shot of air pressure to the oil hole in the spool valve cap to remove the valve B. Remove the valve B from the spool valve cap.

8) Remove the O-rings from the spool valve cap and valve B and discard them. Replace the O-rings with the new ones during reassembly.



9) Remove the spool valve from the valve body

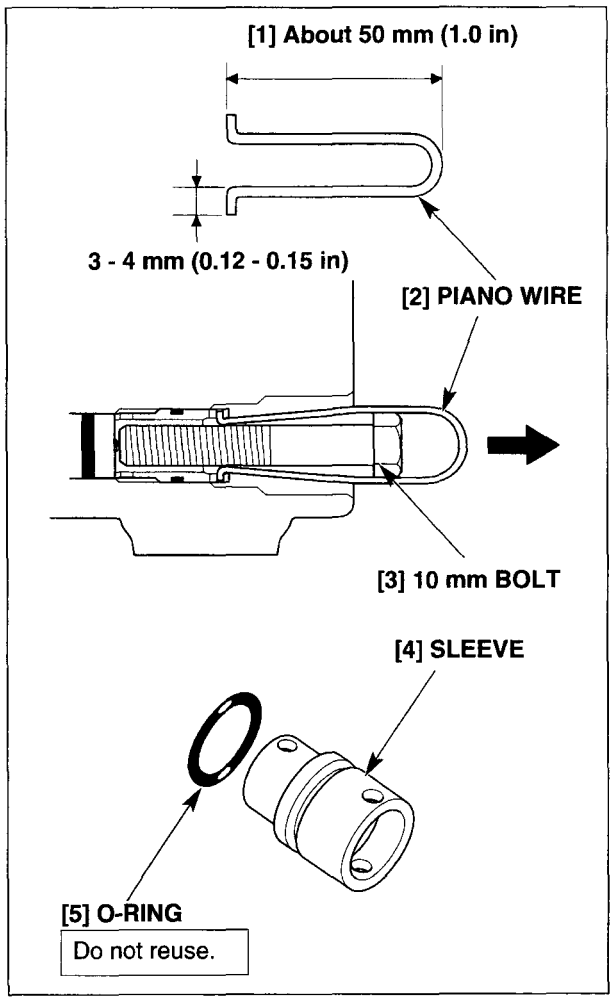
Check the backup ring on the spool valve for damage and scratches. Replace the backup ring if it is damaged or scratched.



10) Process a piece of piano wire of 1.5 mm in diameter as shown.

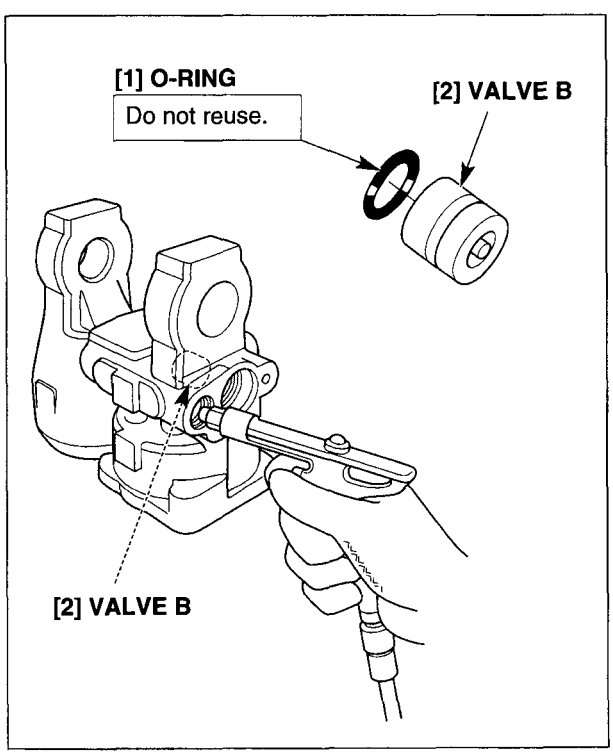
11) Set the processed wire in the holes in both sides of the sleeve as shown, and secure the wire by inserting the 10 mm bolt into the sleeve. Remove the sleeve from the valve body by pulling the wire with care not to damage the valve body.

Remove the O-ring from the sleeve and discard it. Replace the O-ring with a new one during reassembly.



12) Set the valve body as shown. Apply a small shot of air pressure to the manual valve installation hole to remove valve B. Remove the valve B from the valve body

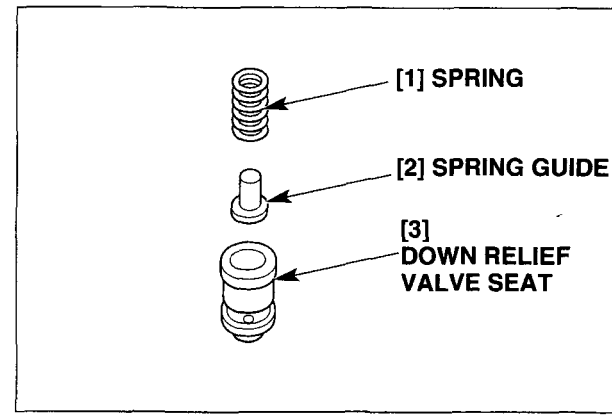
13) Remove the O-ring from the valve comp. B. Replace the O-ring with a new one during reassembly.



c. INSPECTION

• DOWN RELIEF VALVE SEAT

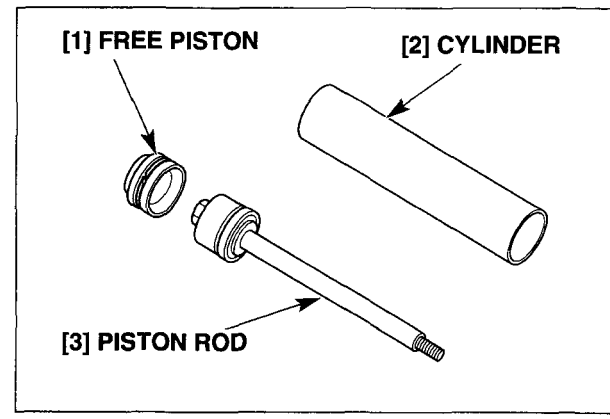
Check the down relief valve seat, spring guide and spring for wear or damage. Replace the down relief valve seat, spring guide or spring if damaged or worn.



• CYLINDER, PISTON, FREE PISTON

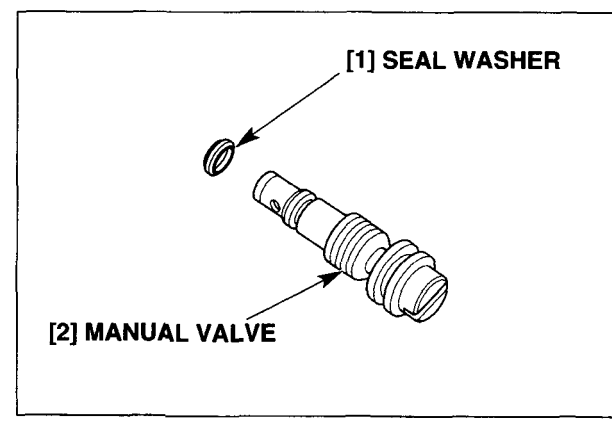
Check the piston rod for damage and being bent. Replace the piston rod with a new one if necessary.

Check the inner and outer surfaces of the cylinder for damage and scratches. Replace the cylinder with a new one if it is damaged or scratched.



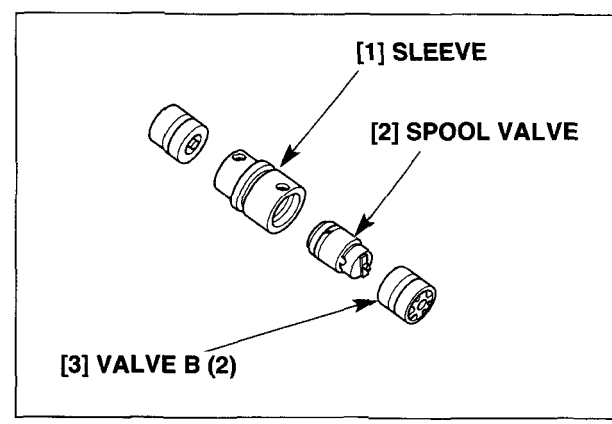
• MANUAL VALVE SEALING CUP

Check the manual valve and seal washer for wear or damage and deterioration. Replace if it is damaged or deteriorated.



• SPOOL VALVES

Check the sliding surface of the valve B, spool valve, sleeve for damage, scratch and wear. Replace if necessary.



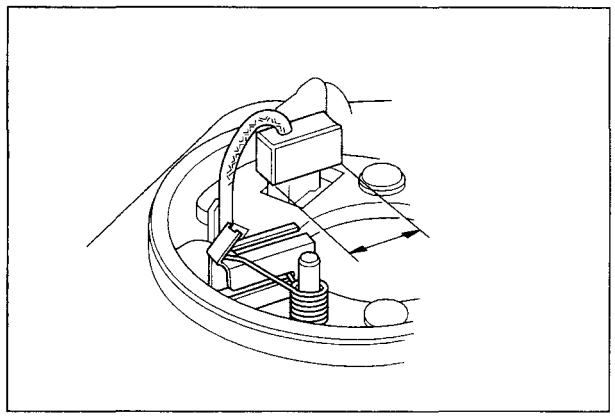
• POWER TILT MOTOR

• Brush

Measure the brush length.

If the brush length is less than the service limit, replace the brush holder assembly.

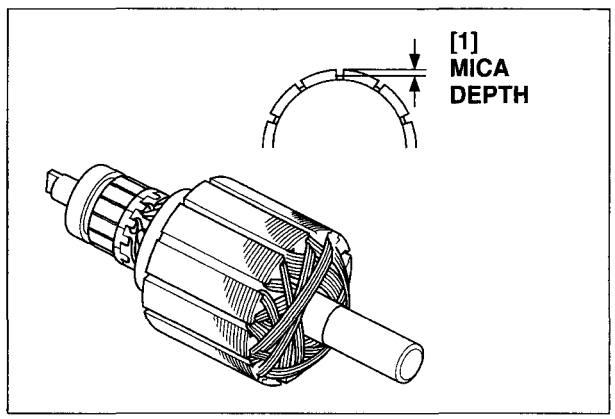
Standard	Service limit
10 mm (0.4 in)	6 mm (0.2 in)



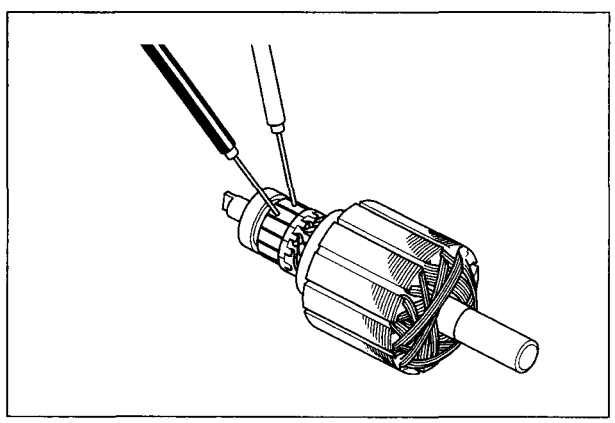
• Armature

1) Check the armature for wear or damage. Replace if necessary.
2) Visually inspect the commutator surface for dust, rust or other damage. If necessary, wipe it with a clean lint-free cloth or dress with a fine emery cloth.
3) Measure the mica depth. If the grooves are clogged, clean the grooves and measure the depth again. If the measurement is less than the service limit, replace the armature.

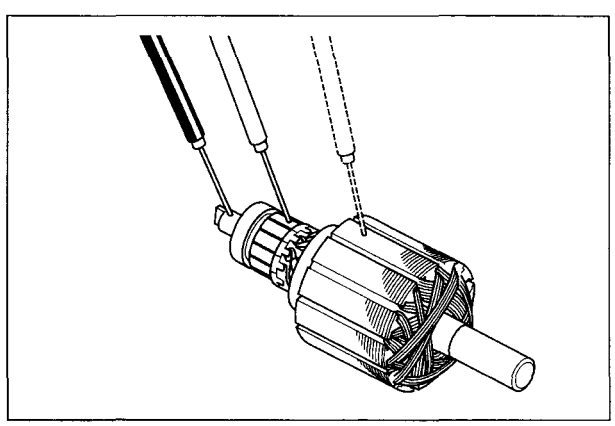
Service limit	0.8 mm (0.03 in)



4) Check the bearing for play. Replace the armature if it has excessive play or abnormal noise.
5) Check for continuity between each segment. If an open circuit exists between any two segment, replace the armature.



6) Check for continuity between the commutator and armature coil core. If continuity exists, replace the armature.
7) Check for continuity between the commutator and armature shaft. If there is continuity, replace the armature.



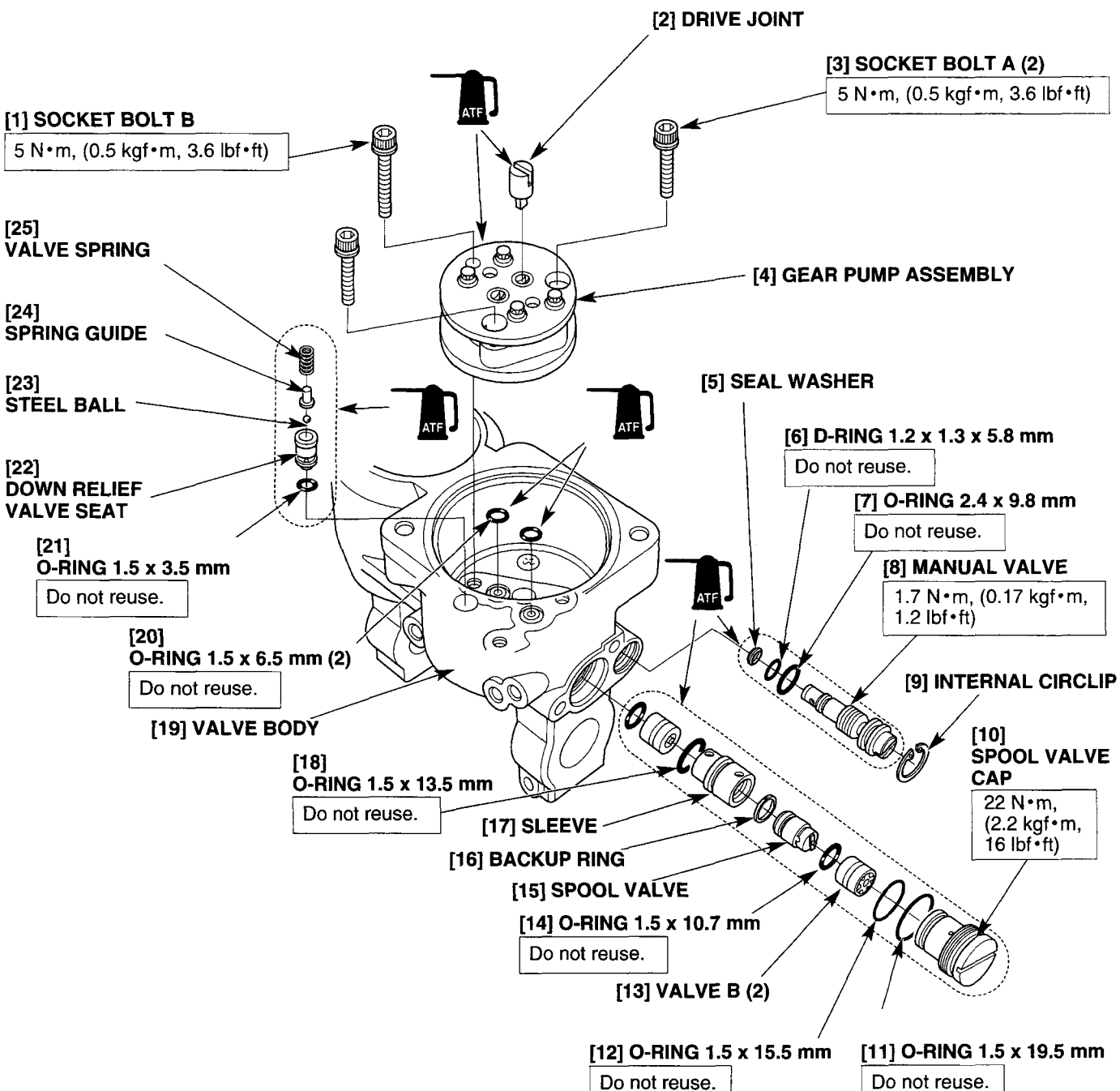
d. REASSEMBLY

• VALVE BODY

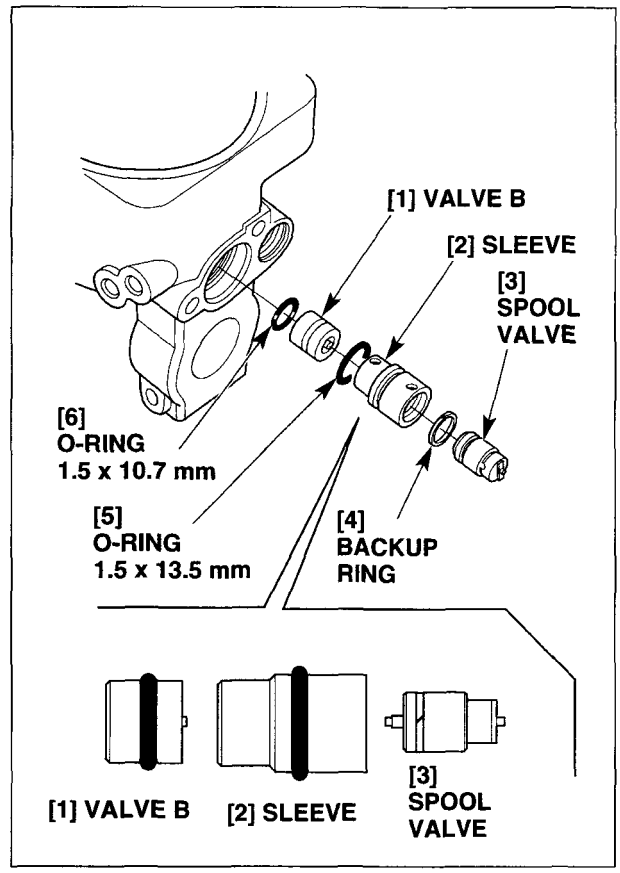
CAUTION:

- **Do not reuse O-rings.**
- **Do not use a shop towel, cloth, gloves, etc during reassembly.**
- **Assemble the parts with care not to let the foreign particles and dirt enter the valve body and gear pump assembly.**

ATF : Apply ATF.

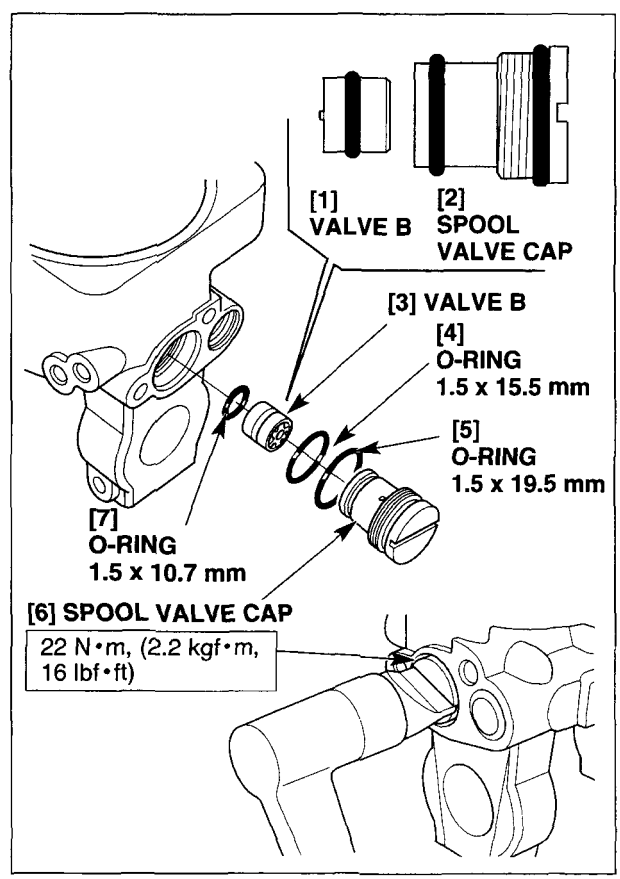


1) Clean the parts in fresh ATF, and blow each port of the parts with compressed air. Check that the parts are free from contamination with dust and dirt before reassembly.
2) Apply ATF to a new O-ring, and install it on the valve B.
3) Apply ATF to the valve B and install the valve B in the valve body noting the installation direction.
4) Apply ATF to a new O-ring, and install it on the sleeve.
5) Set the new backup ring on the spool valve and apply ATF to the outer surface of the spool valve.
6) Install the spool valve in the sleeve noting the installation direction.
7) Apply ATF to the sleeve, and install the sleeve in the valve body noting the installation direction.



8) Apply ATF to a new O-ring, and install it on the valve B.
9) Apply ATF to the valve B and install it in the spool valve cap noting the installation direction.
10) Apply ATF to the new O-rings, and install the O-rings on the spool valve cap.
11) Tighten the spool valve cap to the specified torque using the commercially available 2.8 mm driver bit.

TORQUE: 22 N•m (2.2 kgf•m, 16 lbf•ft)

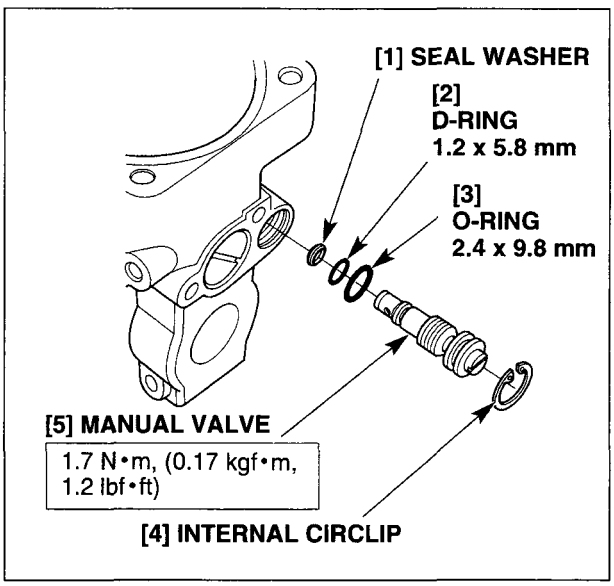


12) Apply ATF to the sealing washer, and set it in the valve body at right angles. Be careful not to set it at an inclined angle, which can lead to the sealing washer collapsing.

13) Apply ATF to two new O-rings, and install the O-rings on the manual valve.

14) Tighten the manual valve to the specified torque, and set the internal circlip in the groove in the valve body securely.

TORQUE: 1.7 N•m (0.17 kgf•m, 1.2 lbf•ft)



15) Apply ATF to a new O-ring, and install it on the down relief valve seat.

16) Apply ATF to the down relief valve seat and install it in the valve body

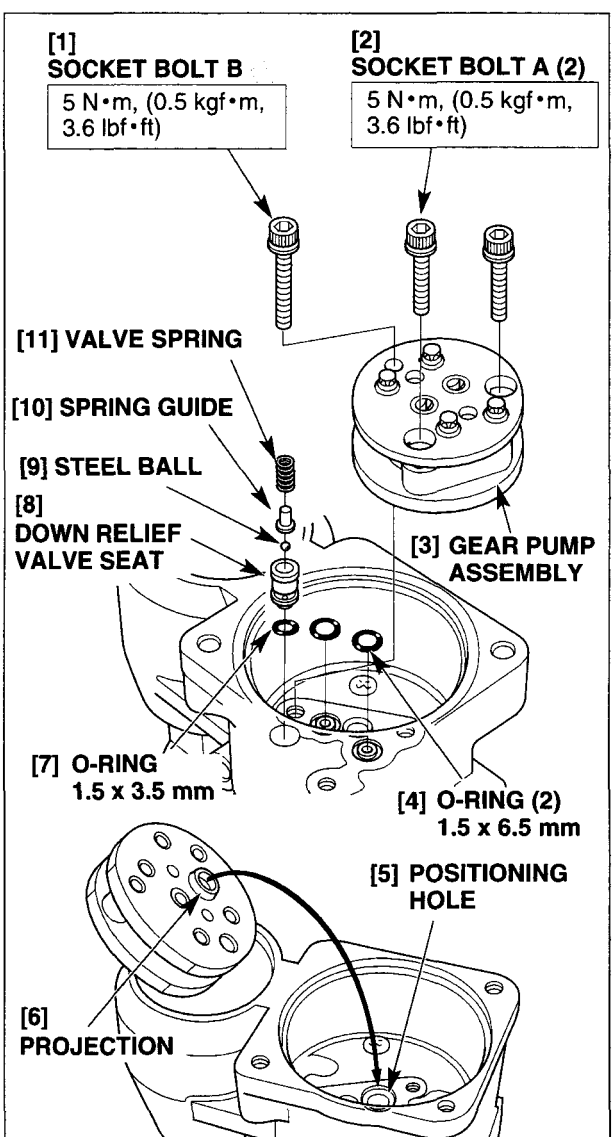
17) Install the steel ball, spring guide and the valve spring in the down relief valve seat.

18) Apply ATF to the two new O-rings and install the O-rings in the valve body in the positions shown.

19) Install the gear pump assembly in the valve body by aligning the projection at the bottom of the gear pump assembly with the positioning hole in the valve body with care not to let the O-rings come out of position in the valve body

20) Tighten the socket bolts to the specified torque.

TORQUE: 5 N•m (0.5 kgf•m, 1.3 lbf•ft)



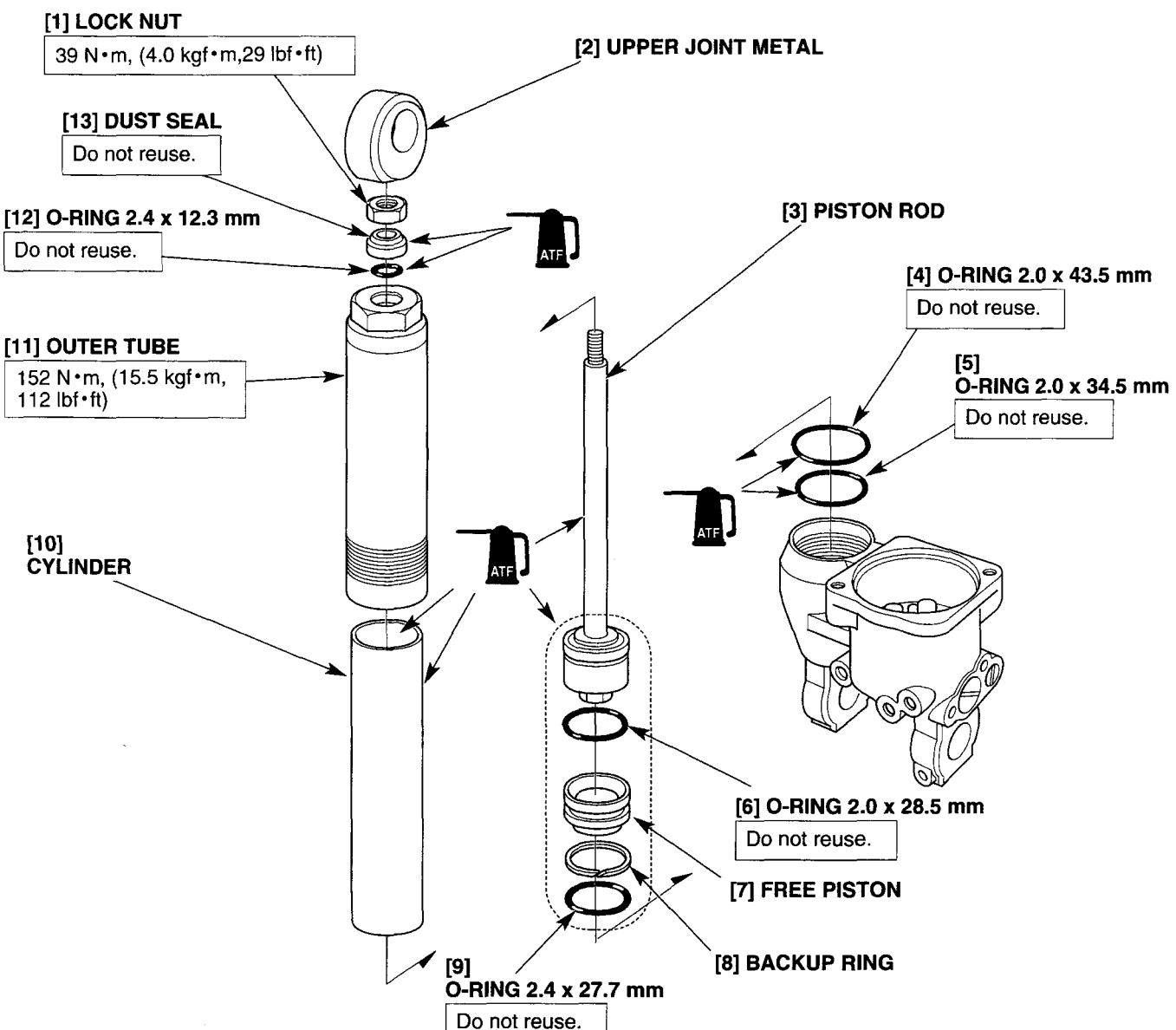
• CYLINDER, PISTON

CAUTION:

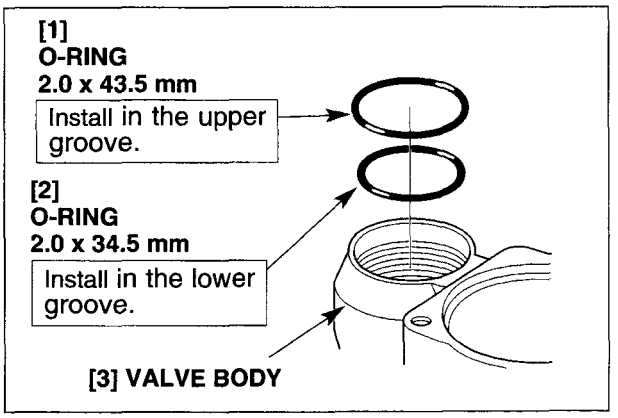
- **Do not reuse O-rings and dust seal.**
- **Do not use a shop towel, cloth, gloves, etc when reassembly.**
- **Assemble the parts with care not to let the foreign particles and dirt enter the valve body and gear pump assembly.**

1) Clean the parts in the fresh ATF. Check that the parts are free from contamination with dust and dirt before reassembly.

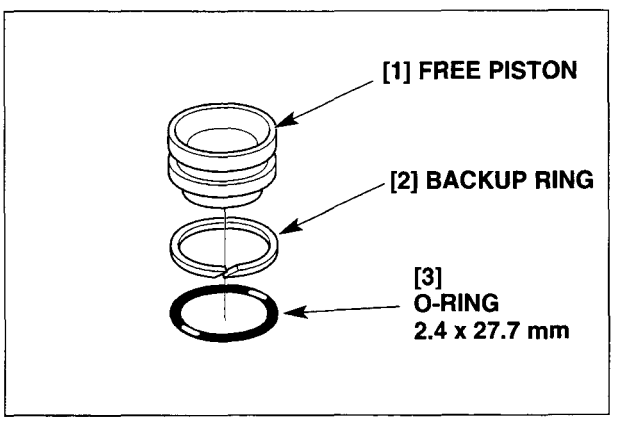
ATF : Apply ATF.



2) Apply ATF to two new O-rings, and install the O-rings in the valve body.
   - Install the smaller O-ring in the lower groove and the larger O-ring in the upper groove of the valve body.



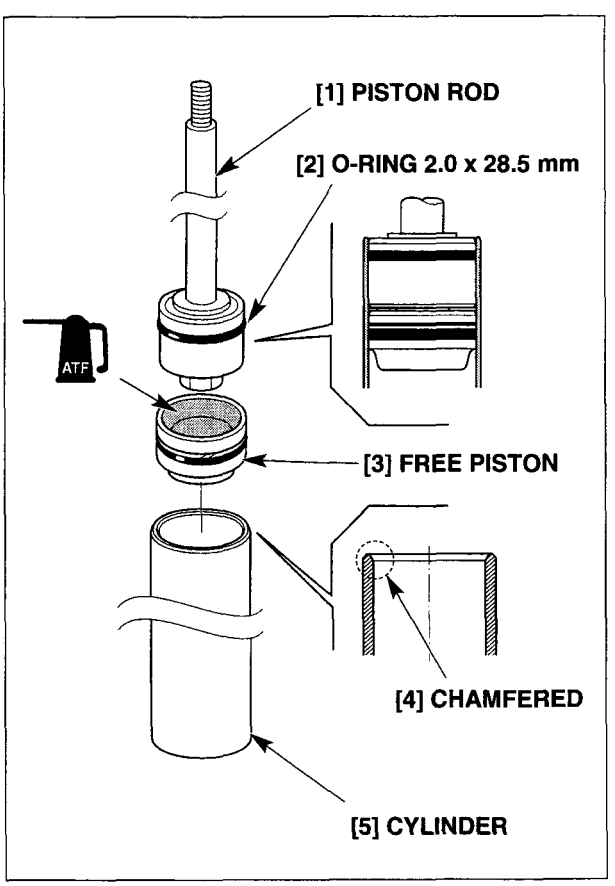
3) Apply ATF to a new O-ring and backup ring, and install them on the free piston.



4) Apply ATF to a new O-ring and install it on the piston rod.
5) Apply ATF to the inner wall of the cylinder.
6) Install the free piston in the cylinder and pour fresh ATF to the free piston.
7) Install the piston rod in the cylinder from the chamfered ends at the inside of the cylinder and push in the piston rod until the piston rod end aligns with the cylinder end as shown.

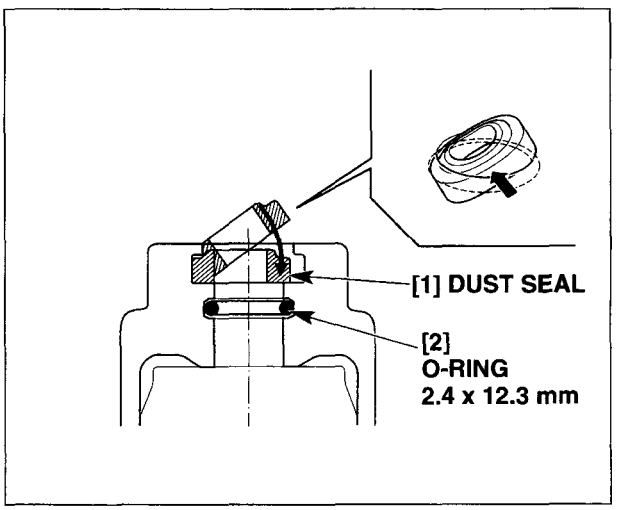
CAUTION:

Take care not to damage the free piston O-ring and backup ring and the piston rod O-ring.



8) Apply ATF to a new O-ring, and install it in the lower groove in the outer tube.

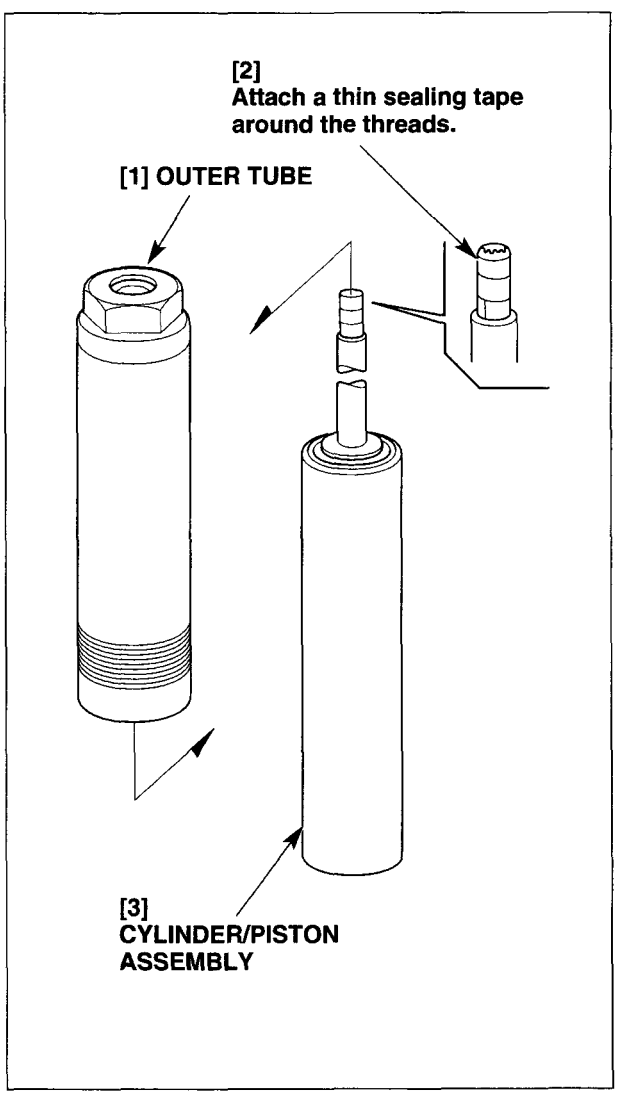
9) Apply ATF to the new dust seal. Holding it with your fingers so that it shapes "U" and install it in the upper groove in the outer tube.



10) Attach a thin sealing tape around the threads at the end of the piston rod.

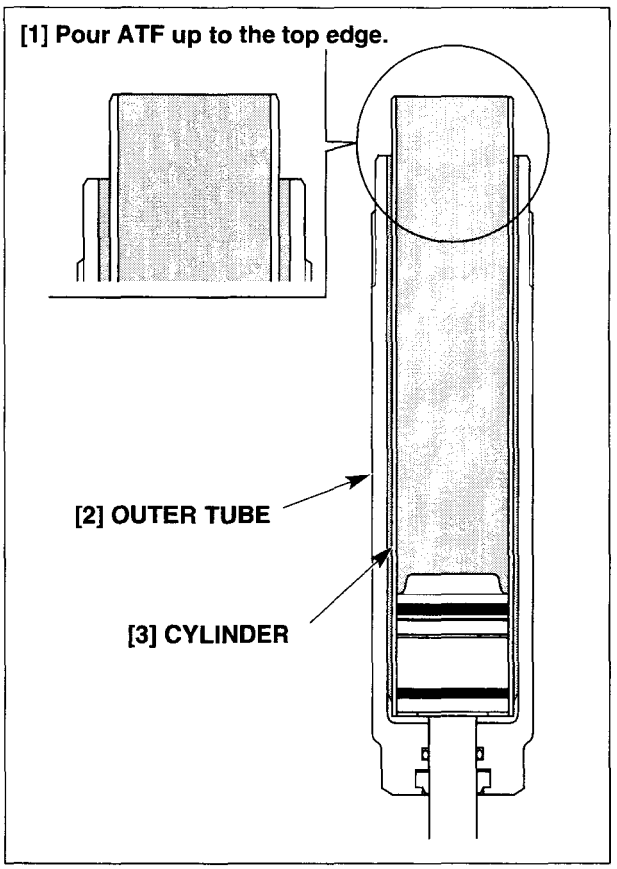
11) Install the cylinder/piston assembly in the outer tube.
- If it is hard to install the piston rod end in the outer tube, apply ATF to the piston rod end, then insert the piston rod into the outer tube by turning the outer tube.
- Take care not to push the piston rod into the cylinder with force.
- When the piston rod is pushed into the cylinder with force, push in the free piston in the cylinder as full as it goes with the threaded part of the piston rod facing down and by holding the outer tube and cylinder securely.

12) After installation, remove the sealing tape from the threads at the end of the piston rod.



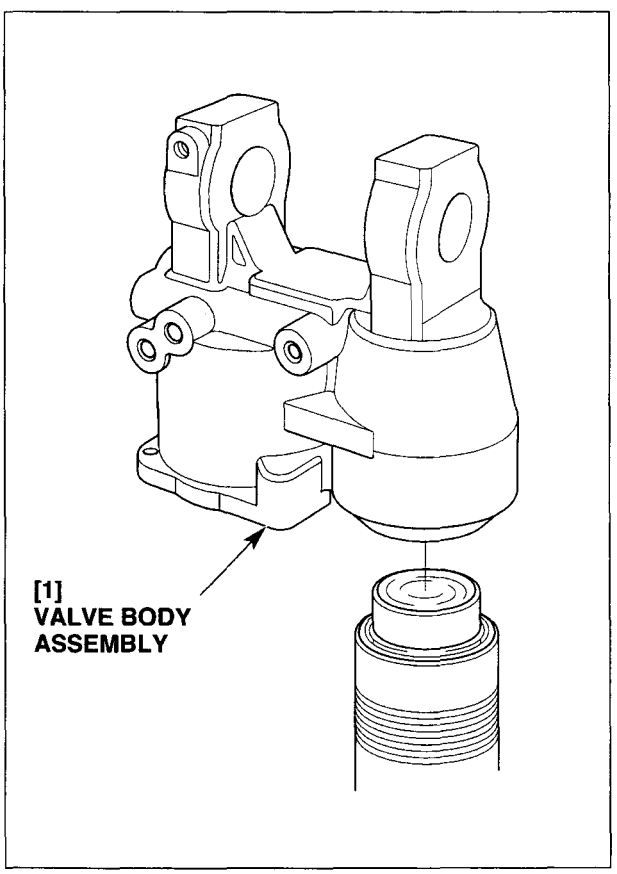
13) Turn the piston rod of the outer tube/piston rod assembly upside down and check whether the piston rod is extended fully.

14) Pour fresh ATF into the cylinder and outer tube up to the top edge of the cylinder and outer tube.



15) Install the valve body on the outer tube that had been filled with ATF in 14, and tighten the valve body.

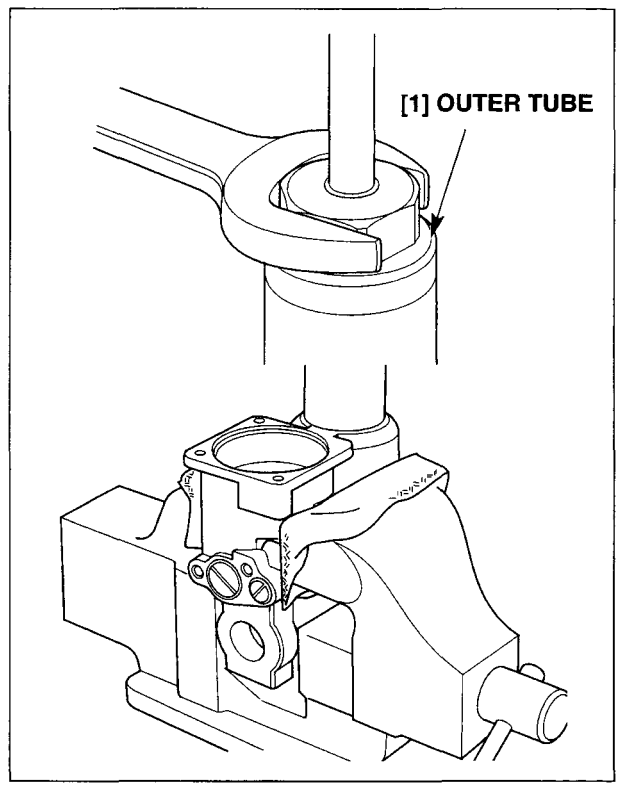
- Install the valve body with care not to spill ATF from the outer tube/piston rod assembly.



16) Hold the valve body in a vise as shown. Taking care not to tighten the vise too tight as it damages the valve body

17) Tighten the outer tube to the specified torque.

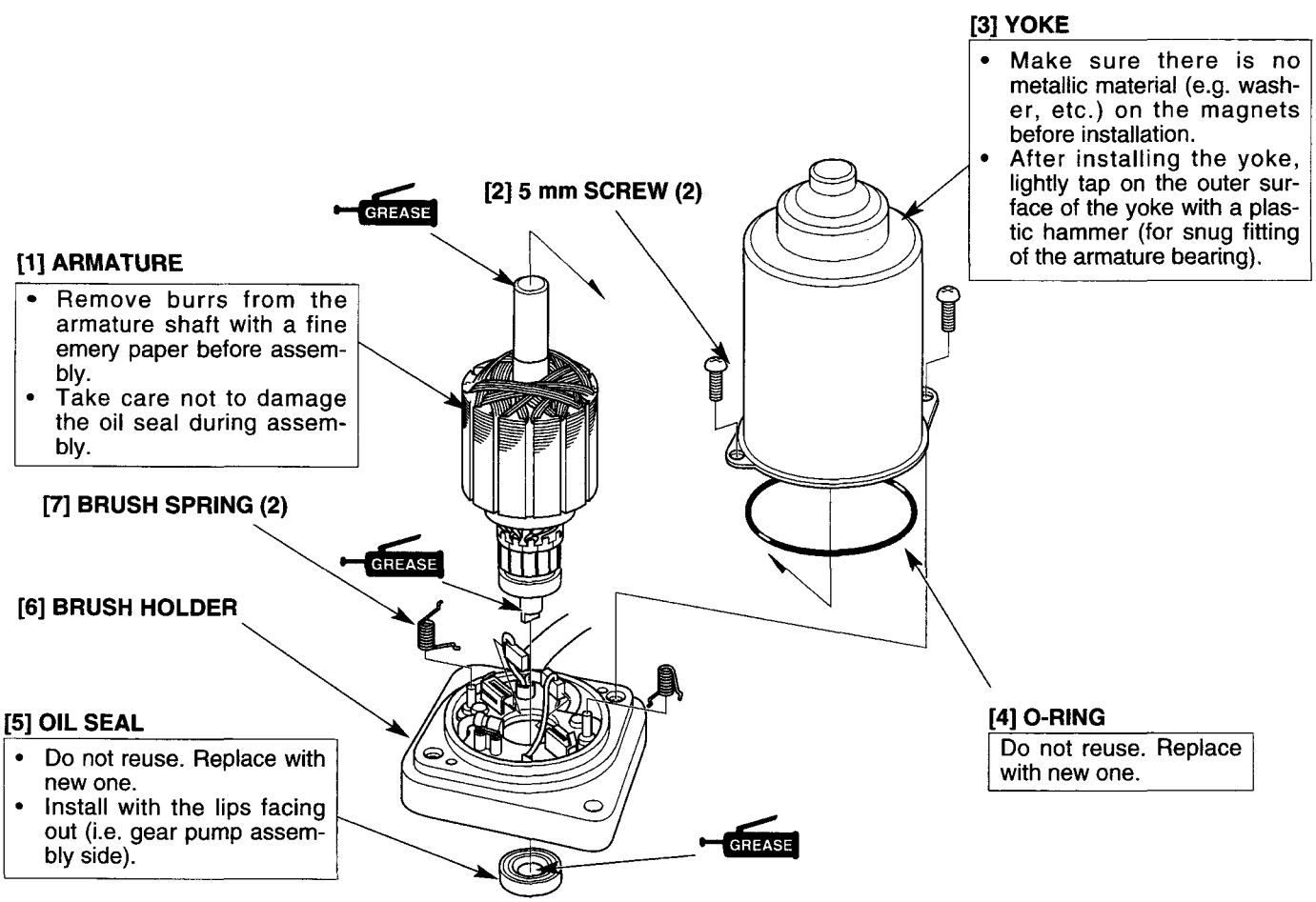
TORQUE: 152 N•m (15.5 kgf•m, 112 lbf•ft)



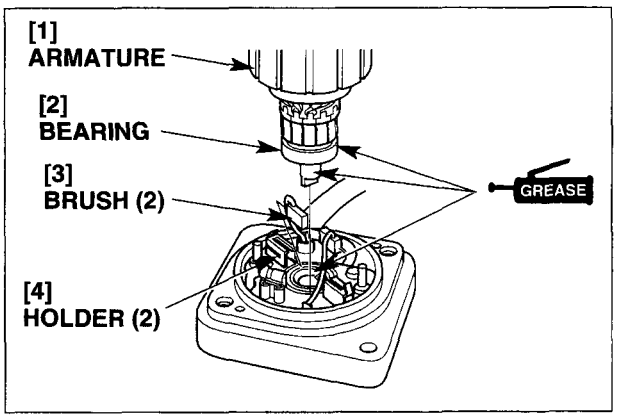
• POWER TILT MOTOR

CAUTION:

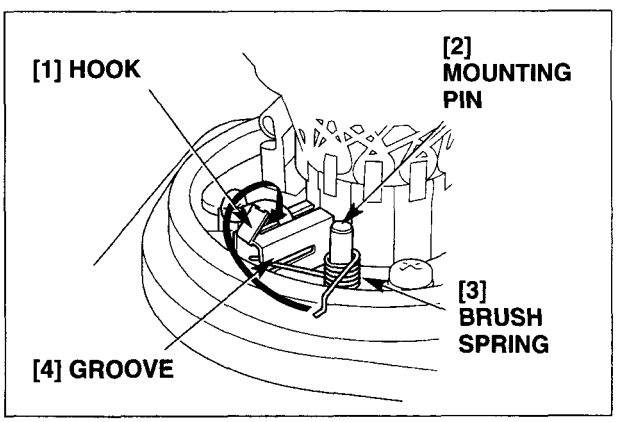
- **Do not reuse the O-ring.**
- **Do not use a shop towel, cloth, gloves, etc when reassembly.**



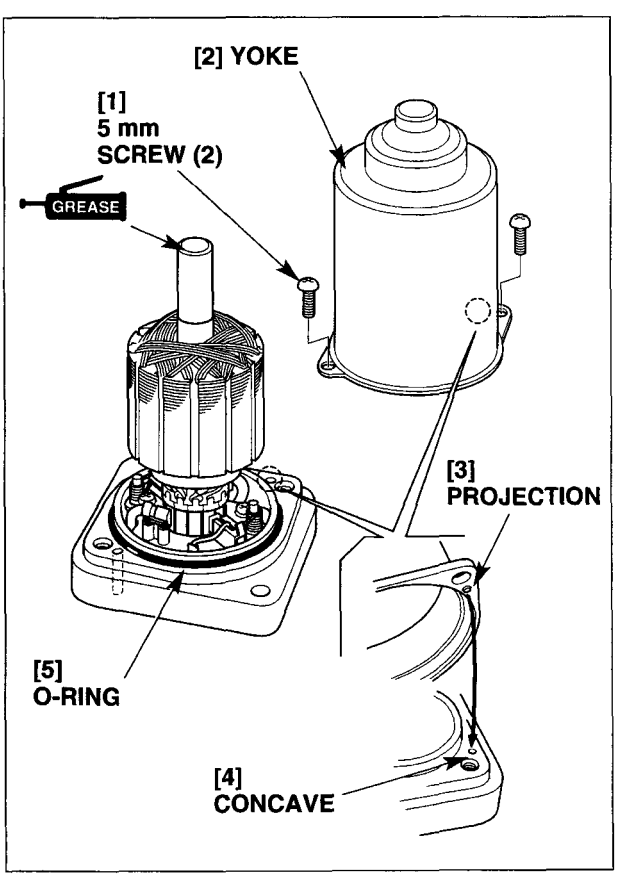
1) Set the brushes on the each holder.
2) Apply grease to the bearing and oil seal lip and install the armature.
   - Remove burrs from the armature shaft with fine emery paper before assembly.
   - Take care not to damage the oil seal during assembly.



3) Set the brush springs over the mounting pins of the brush holder.
4) Set the lower straight part of the brush spring in the groove of the brush holder.
5) Set the upper straight part of the brush spring on the hook of the brush holder.



6) Set a new O-ring on the brush holder.
7) Make sure there is no metallic material (e.g. washer, etc.) on the magnets before installation.
8) Hold the armature shaft and install the yoke by aligning its projection with the concave in the brush holder.
9) Tighten the two screws securely. After tightening, be sure there is no lifting between the yoke and brush holder.
10) After assembly, lightly tap on the outer surface of the yoke with a plastic hammer (for snug fitting of the armature bearing).

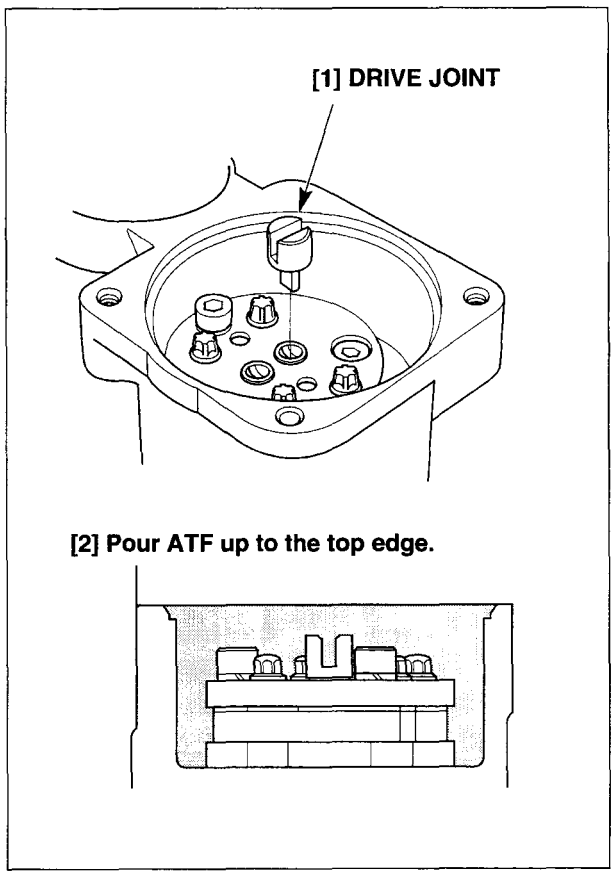


11) Loosen the manual valve by turning it 3 turns or more.

12) Install the drive joint in the position of the gear pump assembly as shown.

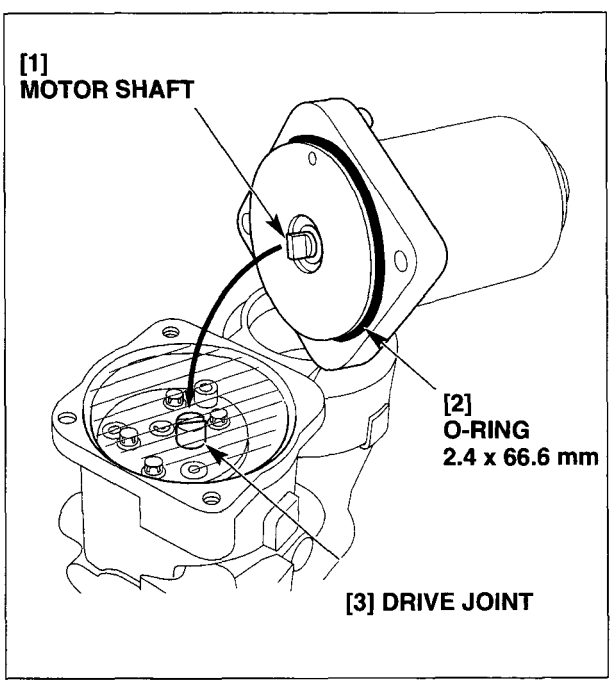
13) Fill the gear pump chamber with the fresh ATF up to the upper edge of the chamber. If the ATF in the valve body contains air bubbles, remove the air bubbles using an oil bottle or equivalent tool.

- Do not pour ATF into the valve body gear pump chamber quickly. Pour the fluid slowly.
- Trapped air in the system causes faulty operation. Remove the air bubbles in the fluid securely.



14) Apply ATF to a new O-ring, and install it on the power tilt motor assembly.

15) Install the power tilt motor assembly on the valve body so that the power tilt motor wire is at the outer tube side and align the motor shaft with the groove of the drive joint as shown.



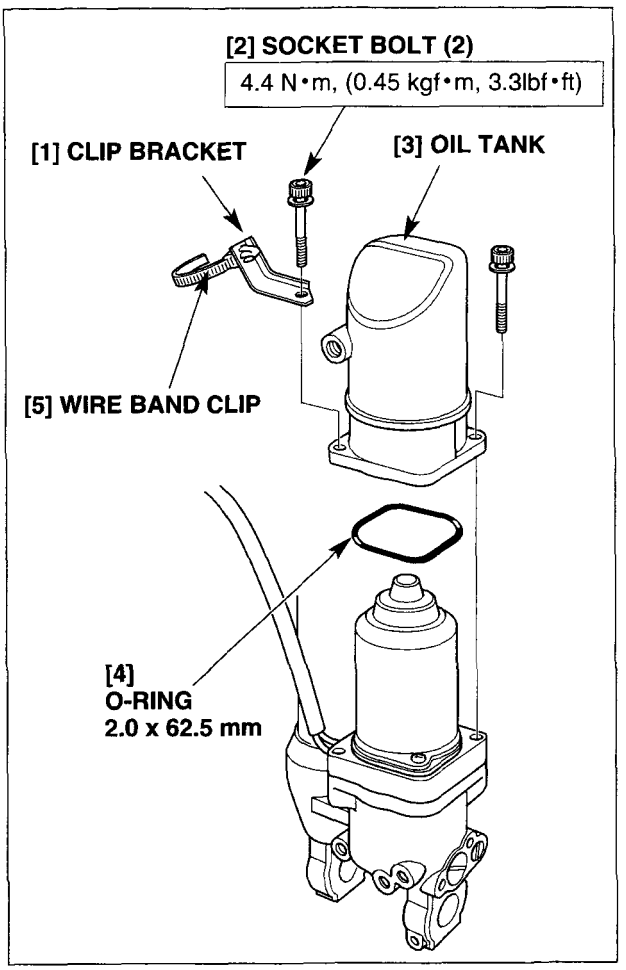
16) Apply ATF to a new O-ring, and install it on the power tilt motor assembly.

17) Install the oil tank on the power tilt motor assembly so that the oil hole cap bolt mounting hole is at the motor wire side.

18) Set the wire band clip on the clip bracket, and secure the motor wire.

19) Tighten the two socket bolts to the specified torque.

TORQUE: 4.4 N•m (0.45 kgf•m, 3.3 lbf•ft)



e. ATF FILLING

1) Using a syringe or equivalent tool, add approximately 30 cm^3 (1.01 US oz, 1.06 Imp oz) of ATF slowly through the oil filler port of the oil tank.

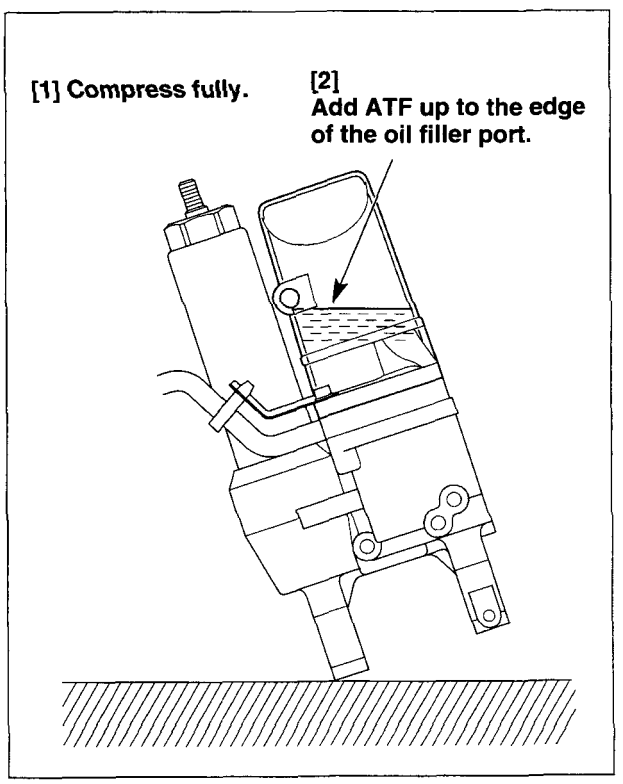
2) After adding ATF, tighten the manual valve securely.
   - Wipe up any spilled ATF thoroughly.
   - Be sure that the oil hole cap bolt is not tightened.

3) Connect a fully charged battery, power tilt relay, power tilt switch, the motor so that the power tilt assembly can be operated.

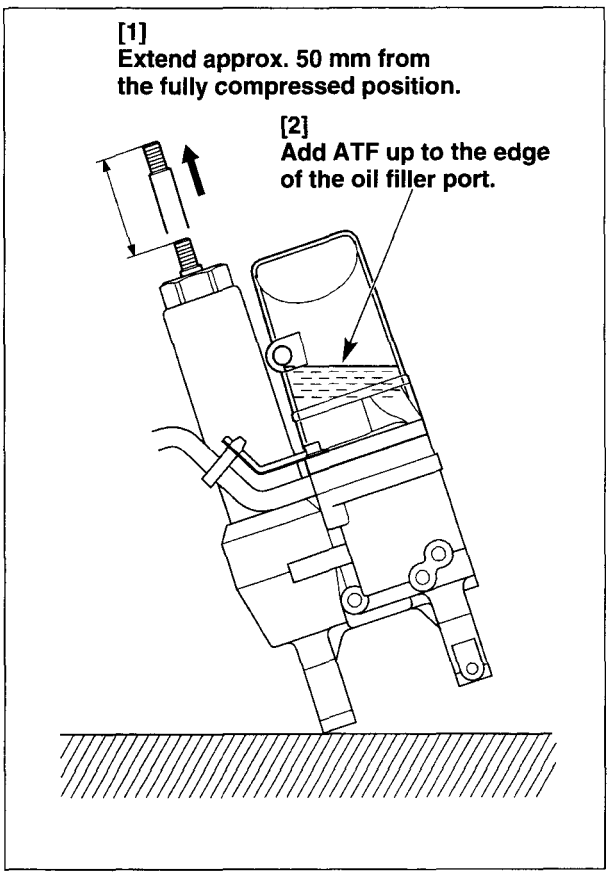
4) To bleed air the ATF, lean the power tilt assembly to the left, viewed from the oil filler port side, several times slowly at an angle of 10° to 30° as shown.

5) Push the "DN" side of the power tilt switch and compress the piston rod fully.

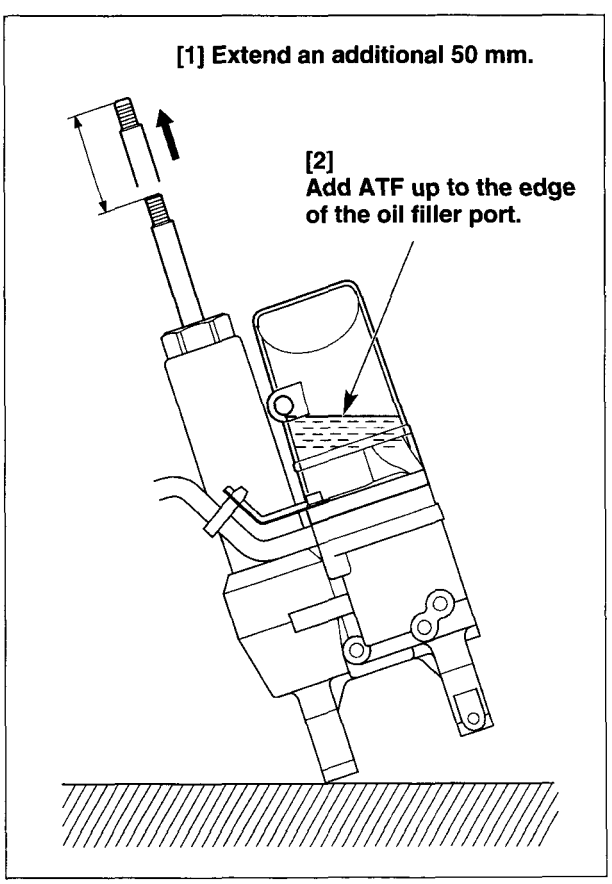
6) Using a syringe or equivalent tool, add ATF slowly until the fluid flows out of the oil filler port of the oil tank.



7) Lean the power tilt assembly to the side as shown with the piston rod fully compressed. Push the "UP" side of the power tilt switch and extend the piston rod approximately 50 mm (2 in) from the end of the piston rod.
8) With the power tilt assembly inclined to the side, add ATF to the oil tank slowly until the fluid flows out of the oil filler port by using a syringe or equivalent tool.

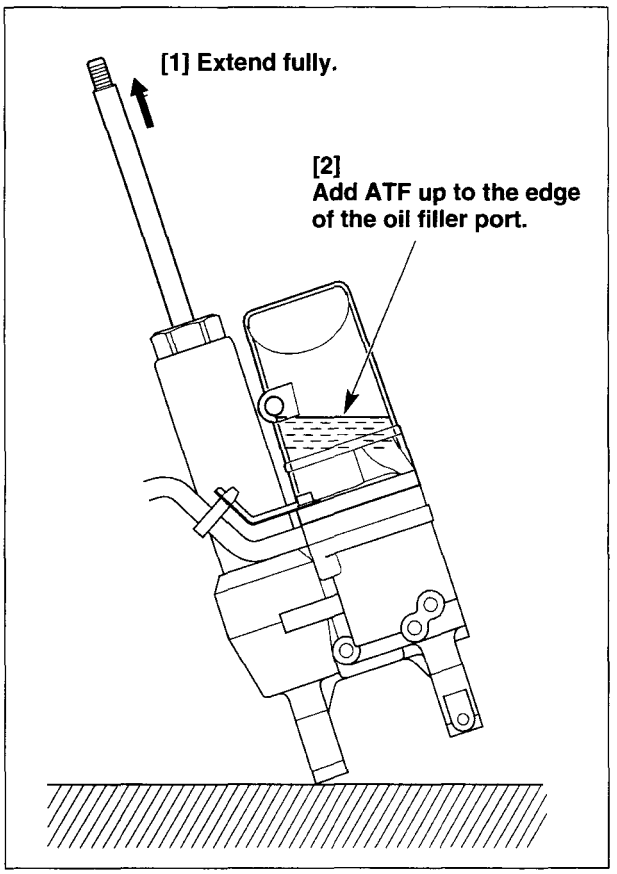


9) Push the "UP" side of the power tilt switch with the power tilt assembly inclined to the side, and extend the piston rod an additional 50 mm from the end of the piston rod.
10) With the power tilt assembly inclined to the side, add ATF to the oil tank slowly until the fluid flows out of the oil filler port by using a syringe or equivalent tool.



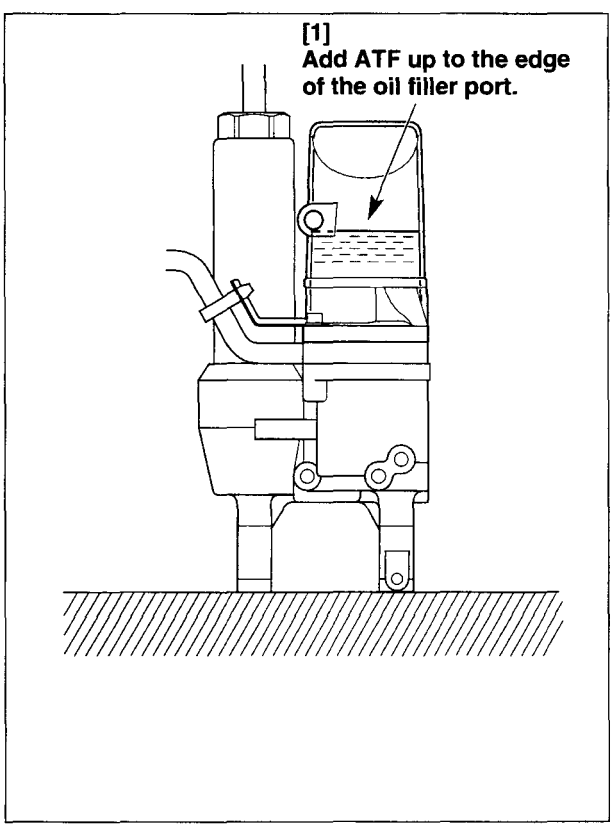
11) With the power tilt assembly inclined to the side, push the "UP" side of the power tilt switch and extend the piston rod as far as it goes.

12) With the power tilt assembly inclined to the side, add ATF to the oil tank slowly until the fluid flows out of the oil filler port by using a syringe or equivalent tool.



13) Set the power tilt assembly upright. Using a syringe or equivalent tool, catch the ATF flowing out of the oil filler port of the oil tank until the fluid level is at the edge of the filler port.

14) Check whether the ATF level is at the edge of the filler port.

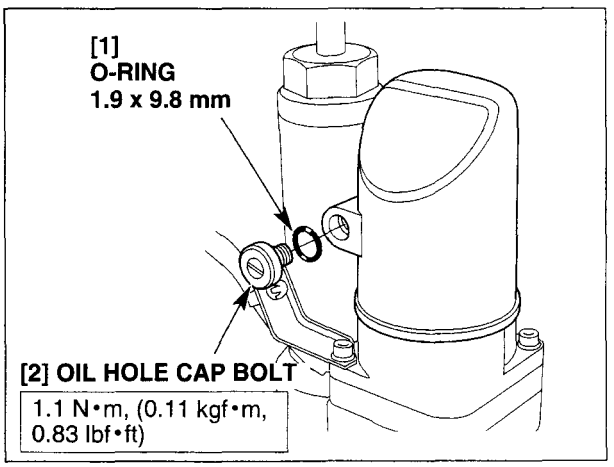


15) Install a new O-ring on the oil hole cap bolt and tighten the oil hole cap bolt to the specified torque.

TORQUE: 1.1 N•m (0.11 kgf•m, 0.83 lbf•ft)

16) Push the "UP" side and "DN" side of the power tilt switch, and check to see that the piston rod moves smoothly.

17) Disconnect the motor connector, battery, power tilt relay and switch.

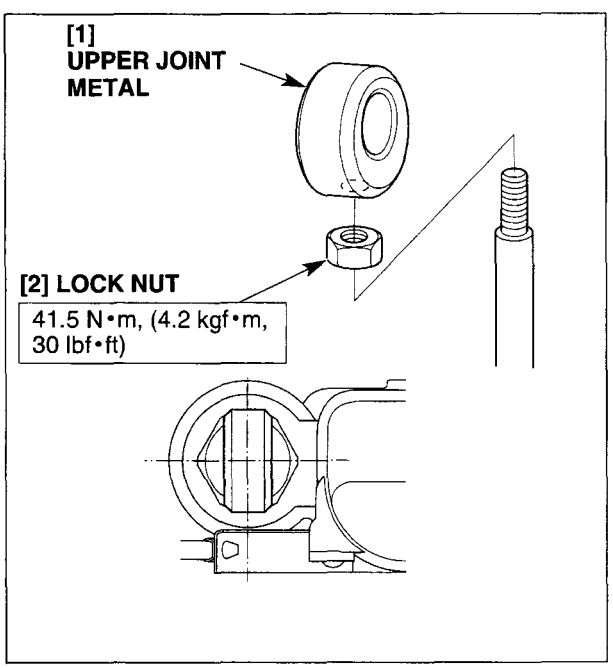


g. UPPER JOINT METAL INSTALLATION

1) Install the lock nut and upper joint metal against the piston rod.
   - Be sure that the piston rod end is not protruding from the upper joint metal.
2) Holding the upper joint metal, tighten the lock nut to the specified torque.

TORQUE: 41.5 N•m (4.2 kgf•m, 30 lbf•ft)

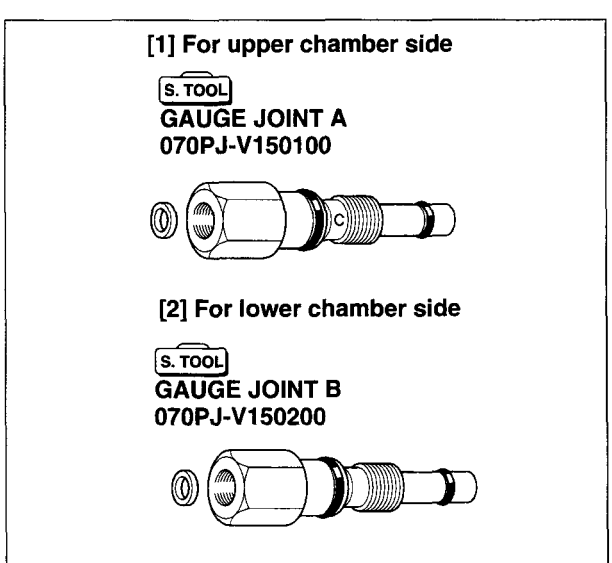
3) Set the upper joint metal at the installation angle shown.



f. HYDRAULIC PRESSURE INSPECTION

After assembling the power tilt assembly, perform the hydraulic pressure inspection. Install the power tilt assembly after the hydraulic pressure inspection.

- Extend the piston rod of the power tilt assembly fully after operating (moving up and down) the piston rod several times.
- Remove the power tilt assembly if it is mounted (P. 12-13).
- Connect each engine side cable and motor 2P connector so that the power tilt assembly can operate while it is isolated from the outboard motor.
- Check the ATF level in the power tilt assembly oil tank. It must be at the specified level (P. 12-42).
- Perform the cylinder upper chamber side and lower chamber side hydraulic pressure inspection using the special tools.



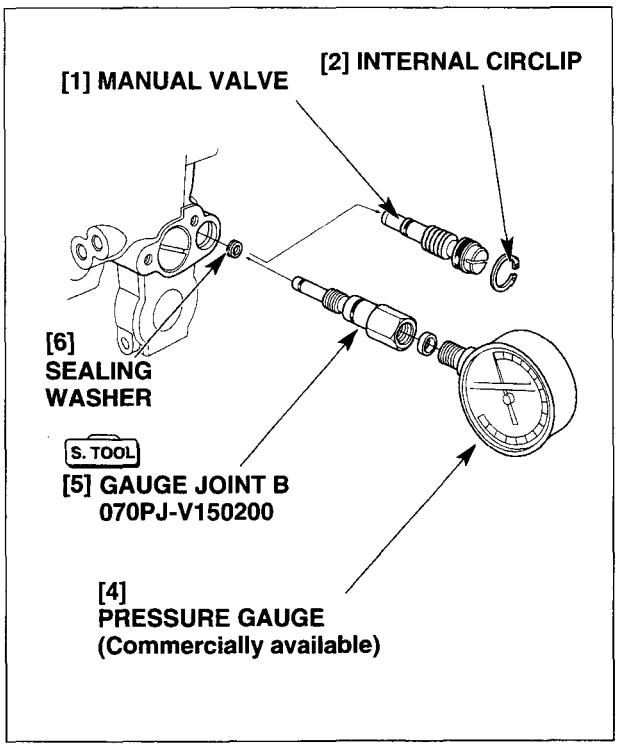
• LOWER CHAMBER SIDE HYDRAULIC PRESSURE

1) Remove the internal circlip, manual valve and sealing washer from the valve body. Install the special tool (gauge joint body B) and the sealing washer, and tighten the special tool to the specified torque.

TORQUE: 1.7 N•m (0.17 kgf•m, 1.2 lbf•ft)

CAUTION:

- **Be sure to remove the manual valve with the piston rod fully extended, or ATF spurts out.**
- **A small amount of ATF flows out after removing the valve. Install the special tool quickly.**
- **Install the sealing washer securely not to let it collapse in the valve body.**



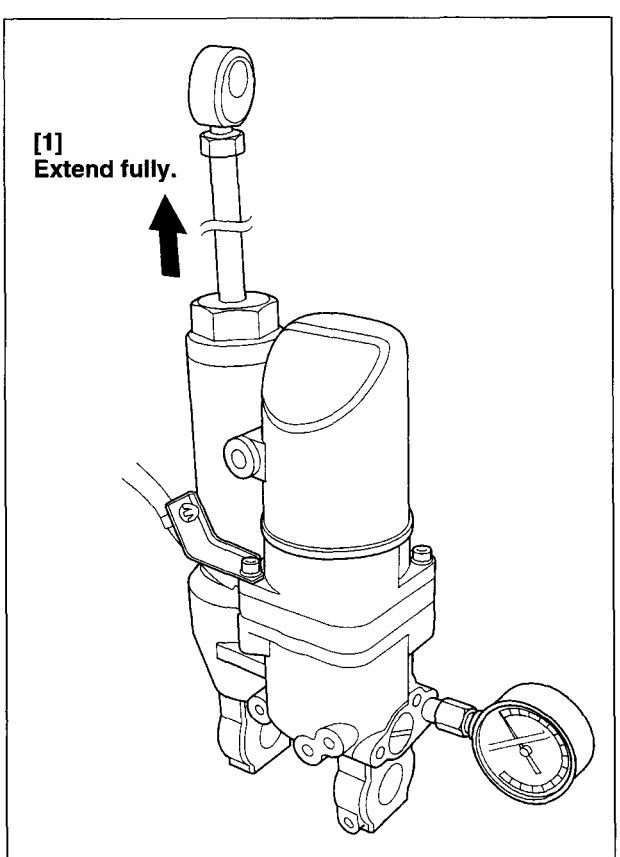
2) Attach a commercially available pressure gauge to the special tool that is set in the valve body
   - Use the pressure gauge which measures 20 Mpa (200 kgf/cm², 2,800 psi) or above .
   - Be sure that the ATF level in the oil tank is at the specified level (P. 13-42).

3) Push the "DN" side of the power tilt switch and compress the piston rod fully.

4) Push the "UP" side of the power tilt switch again. With the piston rod extended fully, measure the lower chamber hydraulic pressure by reading the pressure gauge.

HYDRAULIC PRESSURE (Lower chamber side)	4.26 - 5.00 MPa (43.5 -51.0 kgf/cm², 619 - 725 psi)

   - If the hydraulic pressure is out of the specified range, check each part of the power tilt assembly for oil leakage.
   - If there is no oil leakage but the hydraulic pressure drops below the specified pressure quickly, the power tilt motor assembly can be faulty. Replace the motor assembly with a new one and measure the hydraulic pressure again.
   - After measuring the lower chamber hydraulic pressure, measure the upper chamber hydraulic pressure.



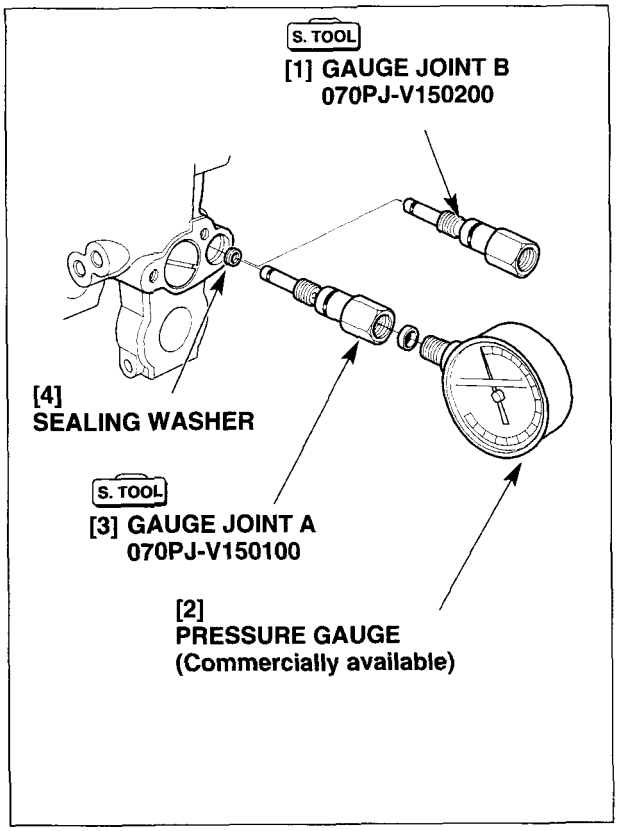
• UPPER CHAMBER HYDRAULIC PRESSURE

1) Remove the gauge joint body B that is for measurement of the lower chamber hydraulic pressure from the valve body Install the gauge joint body A that is for measurement of the upper chamber hydraulic pressure in the valve body. Tighten the special tool to the specified torque.

TORQUE: 1.7 N•m (0.17 kgf•m, 1.2 lbf•ft)

CAUTION:

- **Be sure to remove the special tool with the piston rod fully extended, or ATF spurts out.**
- **A small amount of ATF flows out after removing the gauge joint body B. Install the gauge joint body quickly.**
- **Install the sealing washer securely not to let it collapse in the valve body**

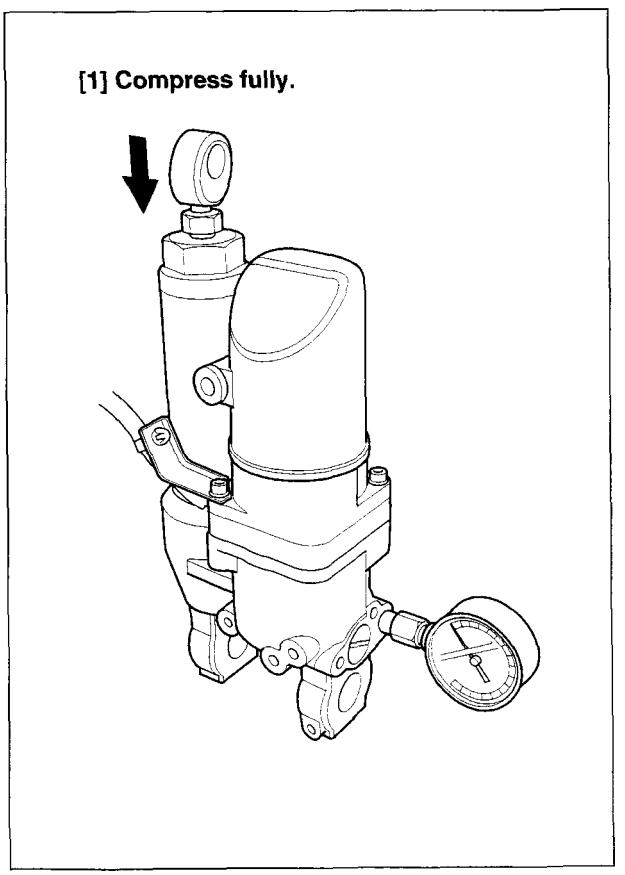


2) Attach a commercially available pressure gauge to the special tool that is set in the valve body.
   - Use the pressure gauge which measures 20 Mpa (200 kgf/cm², 2,800 psi) or above.
   - Be sure that the ATF level in the oil tank is at the specified level (P. 12-42).

3) Push the "DN" side of the power tilt switch and compress the piston rod fully. With the piston rod compressed fully, measure the upper chamber hydraulic pressure by reading the pressure gauge.

HYDRAULIC PRESSURE (Upper chamber side)	3.74 - 4.73 MPa (38.2 -48.3 kgf/cm², 543 - 687 psi)

   - If the hydraulic pressure is out of the specified range, check each part of the power tilt assembly for oil leakage.
   - If there is no oil leakage but the hydraulic pressure drops below the specified pressure quickly, the power tilt motor assembly can be faulty. Replace the motor assembly with a new one and measure the hydraulic pressure again.



4) Push the "UP" side of the power tilt switch and extend the piston rod fully.
5) Remove the special tool and pressure gauge from the valve body Install the sealing washer, manual valve and the internal circlip in the valve body.

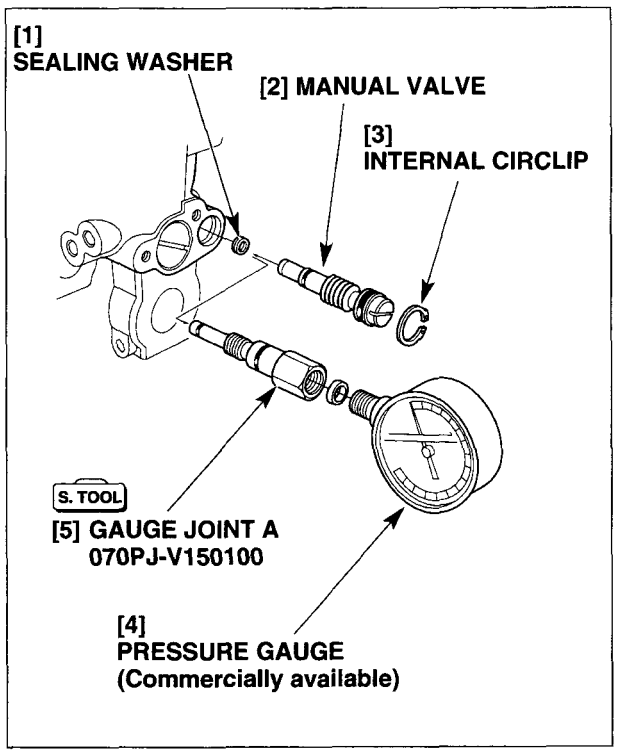
CAUTION:

- **Be sure to remove the special tool with the piston rod fully extended, or ATF spurts out.**
- **A small amount of ATF flows out after removing the tool. Install the manual valve quickly.**
- **Install the sealing washer securely not to let it collapse in the valve body.**

6) Tighten the manual valve to the specified torque.

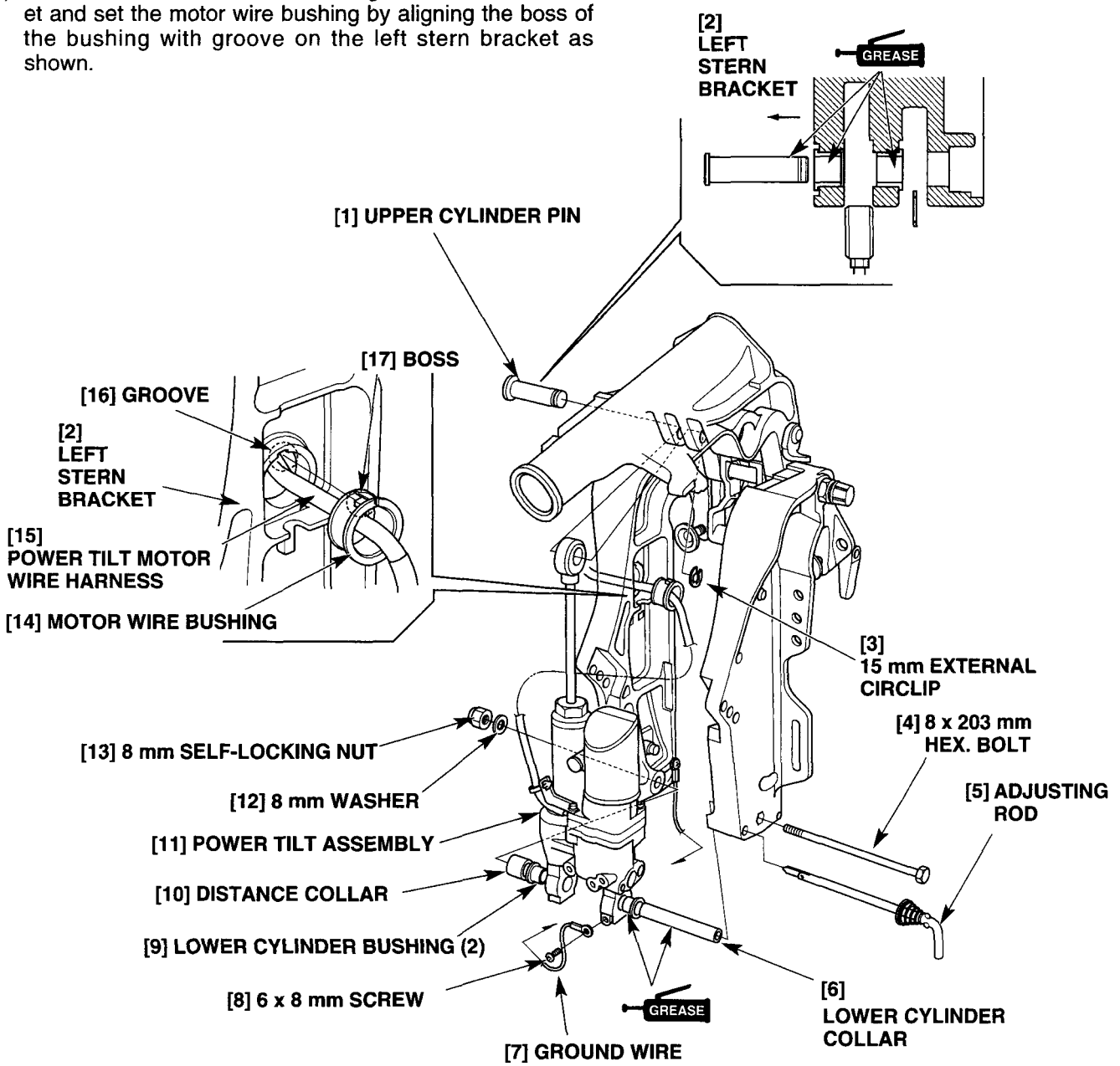
TORQUE: 1.7 N•m (0.17 kgf•m, 1.2 lbf•ft)

7) With the piston rod fully extended, check whether the ATF level is at the edge of the filler port of the oil tank (P. 12-42). If the oil level is low, add ATF up to the edge of the filler port.
8) Install the power tilt assembly (P. 12-47).



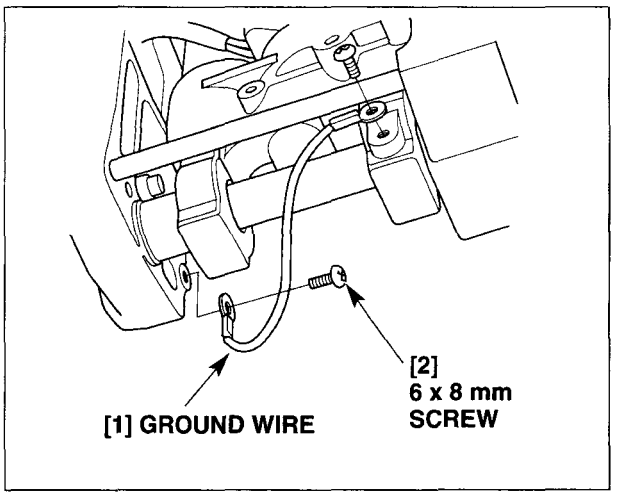
g. INSTALLATION

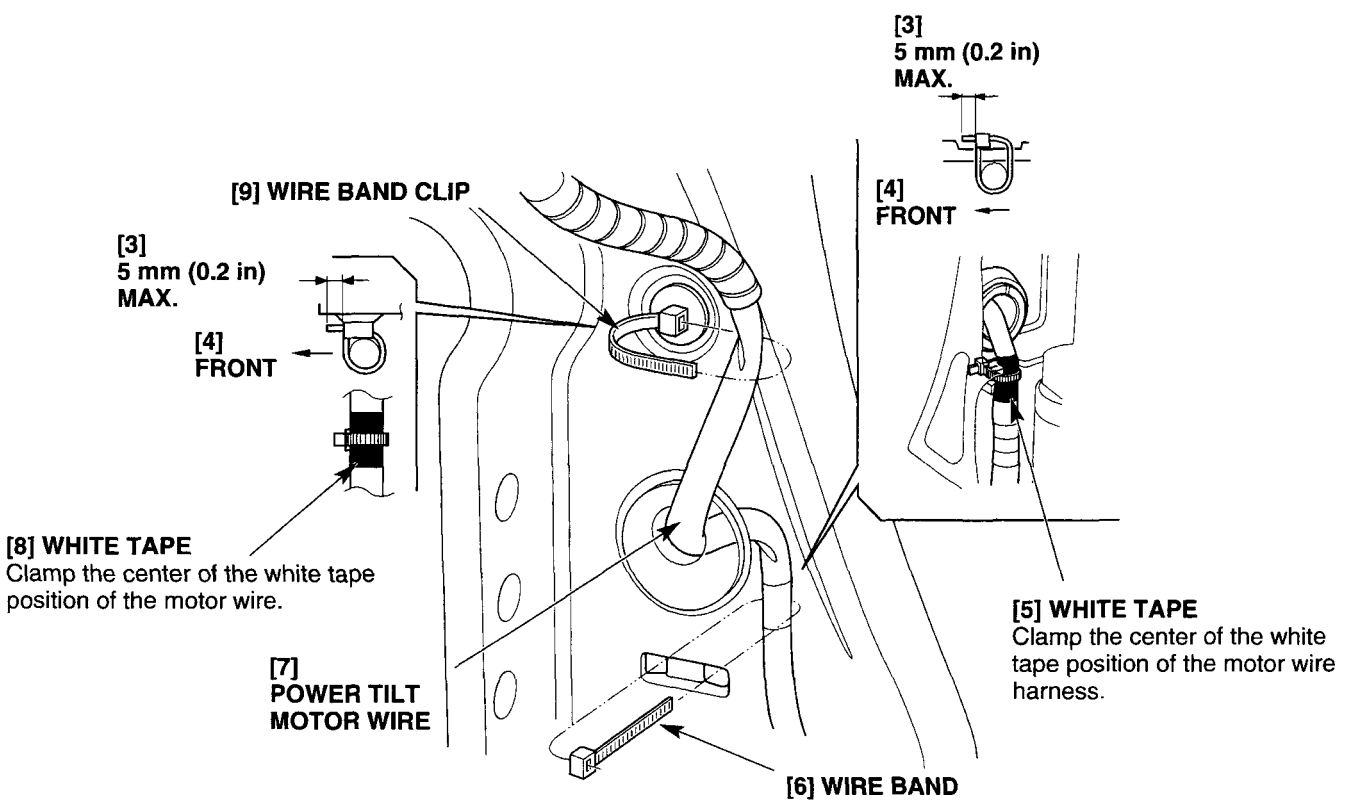
1) Apply marine grease to upper cylinder bushing.
2) Set the power tilt assembly to the swivel case as shown and install the upper cylinder pin and secure the 15 mm external circlip.
3) Apply grease to the lower cylinder bushings and lower cylinder collar, and install them on the power tilt assembly.
4) Install the distance collar on the lower cylinder collar and set the lower mount of the power tilt assembly between the stern bracket.
5) Install the 8 x 203 mm hex. bolt, 8 mm washer and 8 mm self-locking nut.
6) Pass the motor wire harness through the left stern bracket and set the motor wire bushing by aligning the boss of the bushing with groove on the left stern bracket as shown.



6) Connect the ground wire to the power tilt assembly by tightening the 6 x 8 mm screw.

7) Secure the motor wire with the wire band and wire band clip as shown.





8) After assembly, check the power tilt operation. Loosen the manual valve and check the manual tilting operation.

- Clicking sound can be heard when the outboard motor is tilted up fast with the manual valve set in the TILT position. Note that this is normal. When the tilt up speed is fast, the sound is mechanically produced as the free piston failed to synchronize with the piston.

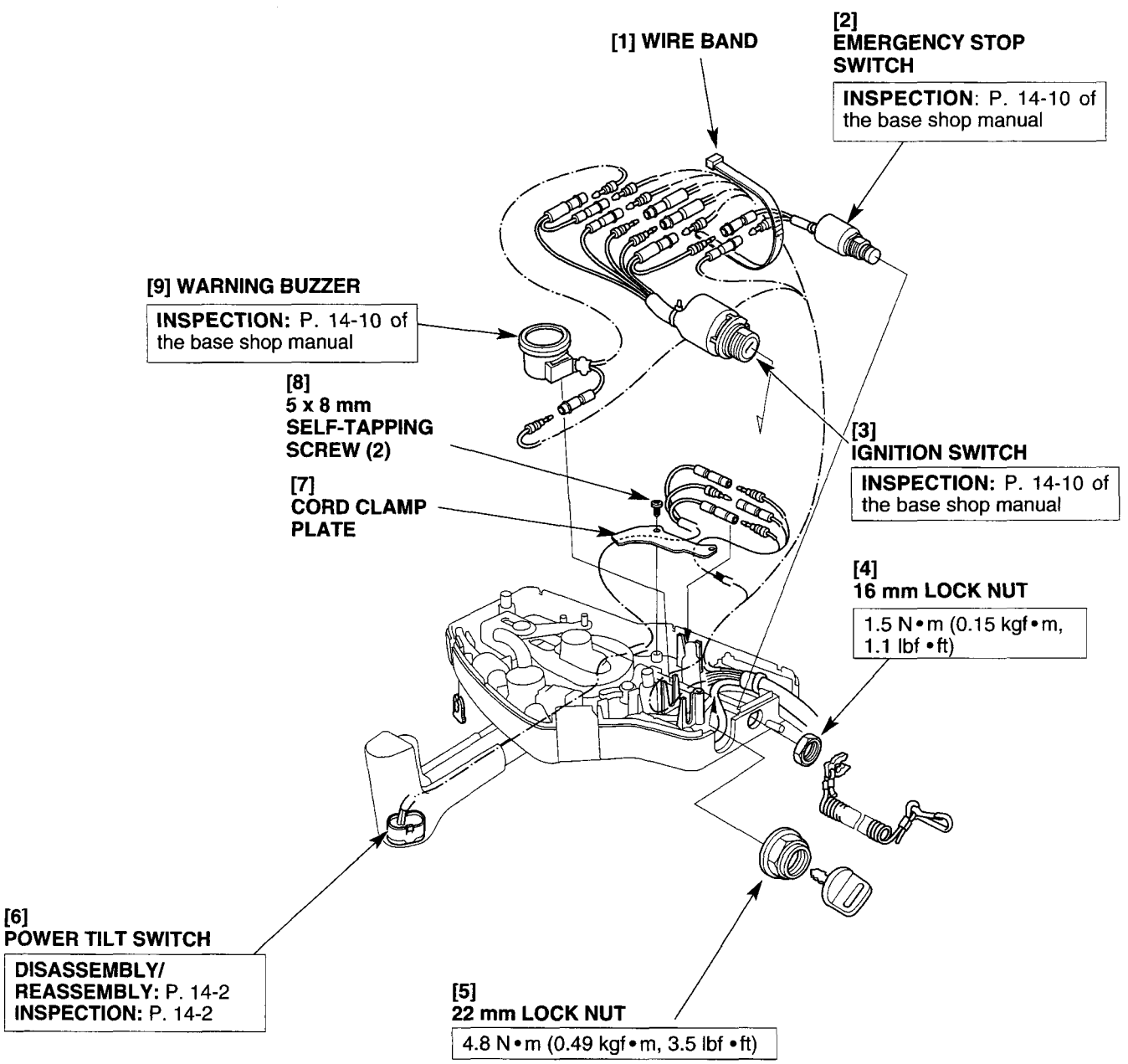
1. REMOTE CONTROL BOX

1. REMOTE CONTROL BOX

a. DISASSEMBLY/REASSEMBLY

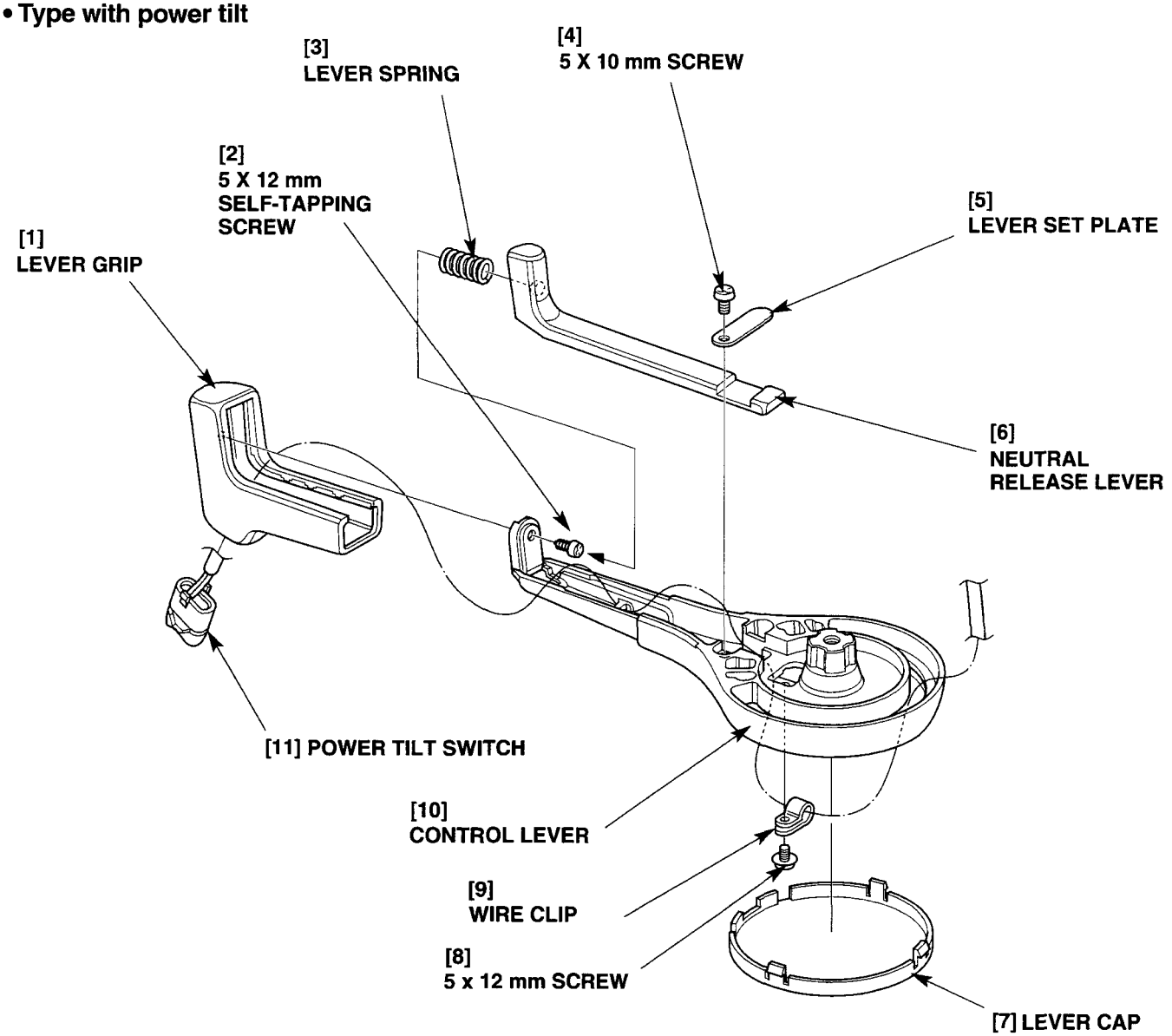
• ELECTRICAL EQUIPMENT

See page 2-17 for wire connection.



• CONTROL LEVER

• Type with power tilt



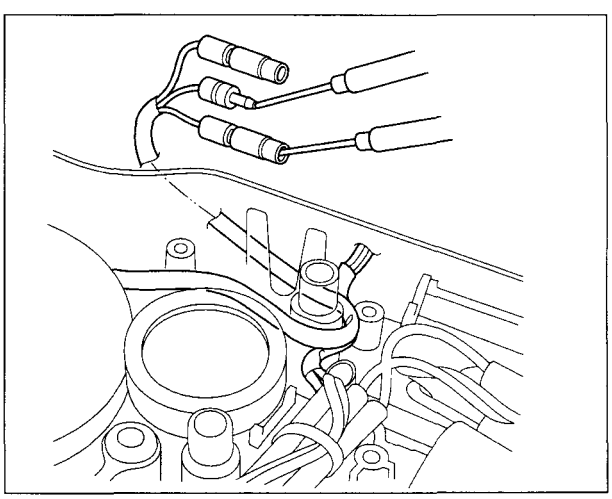
b. INSPECTION

• POWER TILT SWITCH

Check for continuity between the terminals according to the table below.

There should be continuity between O—O.

Collar / Position	Light green	White/black	Light blue
UP	O	O	
Neutral			
DOWN		O	O

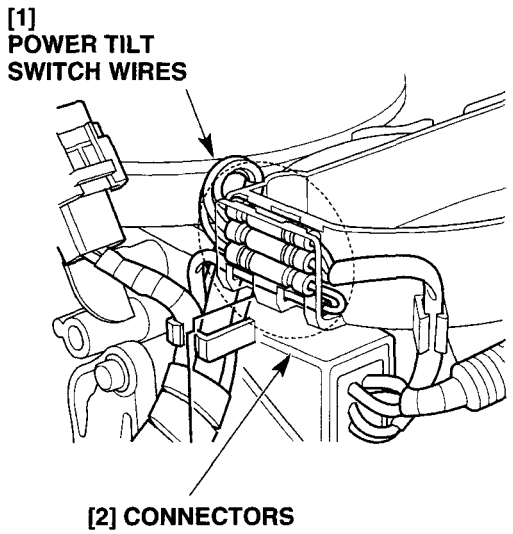


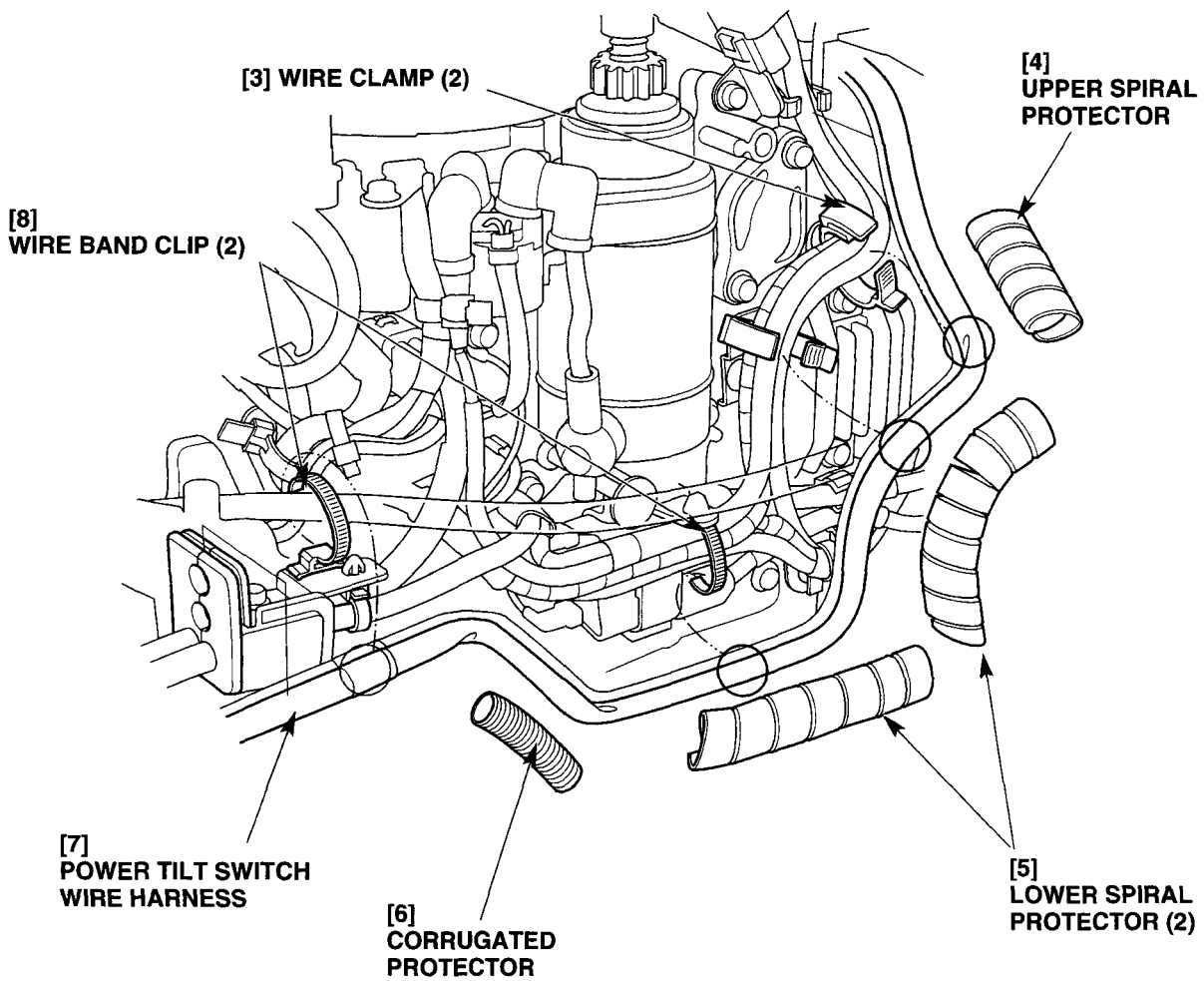
1. TILLER HANDLE	2. POWER TILT SWITCH

1. TILLER HANDLE

a. REMOVAL

1) Remove the engine cover and disconnect the power tilt switch wire connectors.
2) Remove the power tilt switch wire from the motor:
   - Open the wire clamps and wire band clip.
   - Remove the spiral protectors.
   - Remove the corrugated protector.

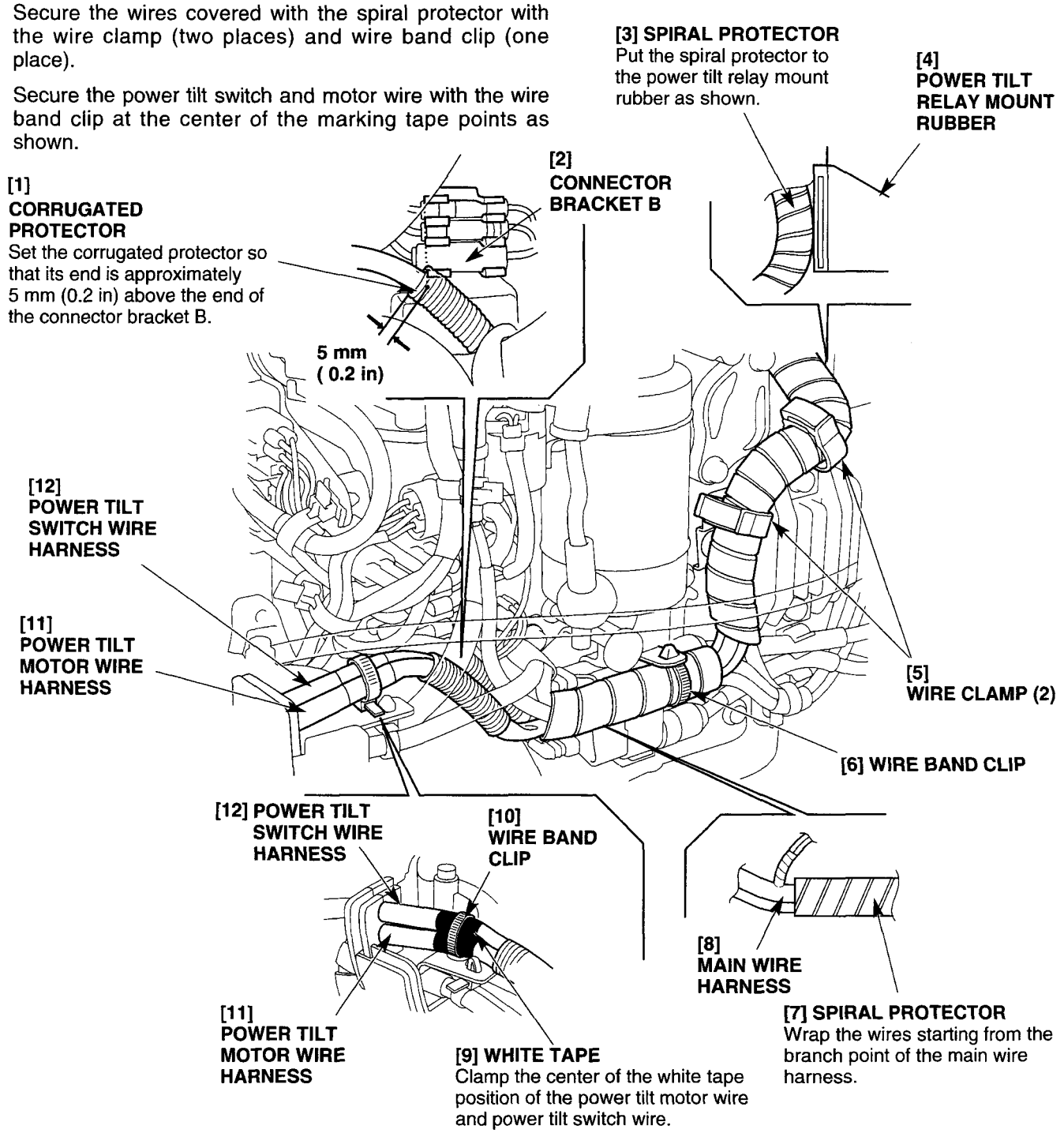




b. INSTALLATION

Installation is the reverse order of removal.

- Route the power tilt switch wire along the main wire harness.
- Wrap the wires with the lower spiral protector (shorter) starting from the branch point of the main wire harness as shown.
- Cover the motor and switch wire with the corrugated protector and set it in the place as shown.
- Secure the wires covered with the spiral protector with the wire clamp (two places) and wire band clip (one place).
- Secure the power tilt switch and motor wire with the wire band clip at the center of the marking tape points as shown.



2. POWER TILT SWITCH

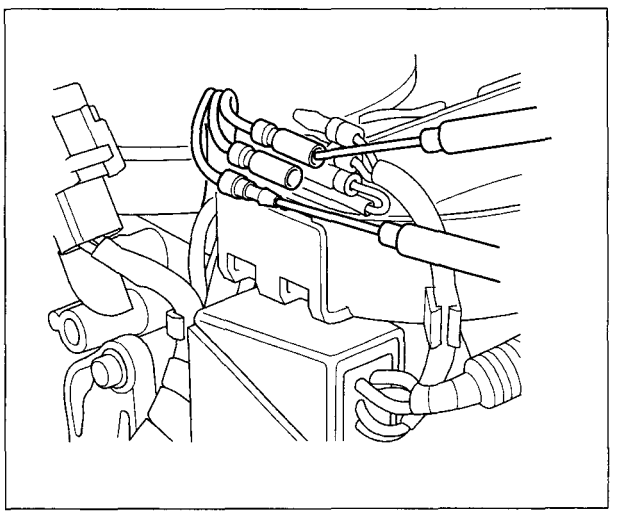
a. INSPECTION

- The power tilt switch test can be performed with the switch installed on the tiller handle.

Check for continuity between the terminals according to the table below.

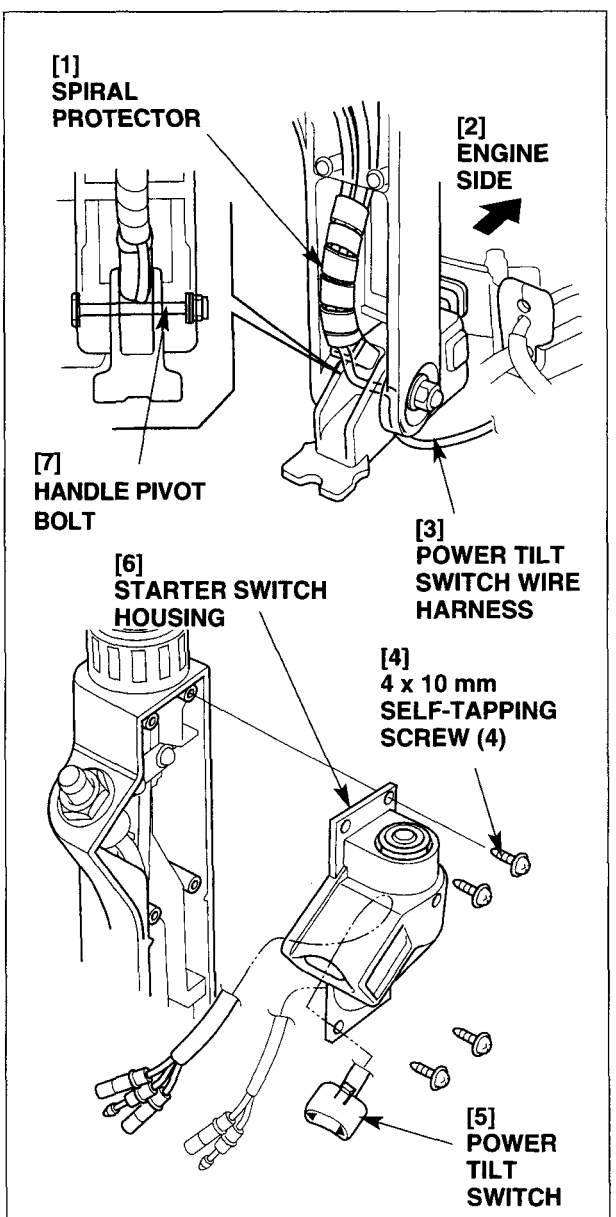
There should be continuity between O—O.

Collar / Position	Light green	White/black	Light blue
UP	O	O	
Neutral			
DOWN		O	O



b. REPLACEMENT

1) Remove the spiral protector, then pull out the switch wires tacking care not to damage.
2) Remove the 4 x 10 mm self-tapping screws and starter switch housing.
3) Remove the power tilt switch from the starter switch housing.
4) Install a new power tilt switch.
5) Install the starter switch housing and tighten the 4 x 10 mm self-tapping screws.
6) Route the switch wire harness over the pivot bolt as shown.
7) Lap the spiral protector around the throttle cable and switch wire harness as shown.



1. POWER TILT RELAY

1. POWER TILT RELAY

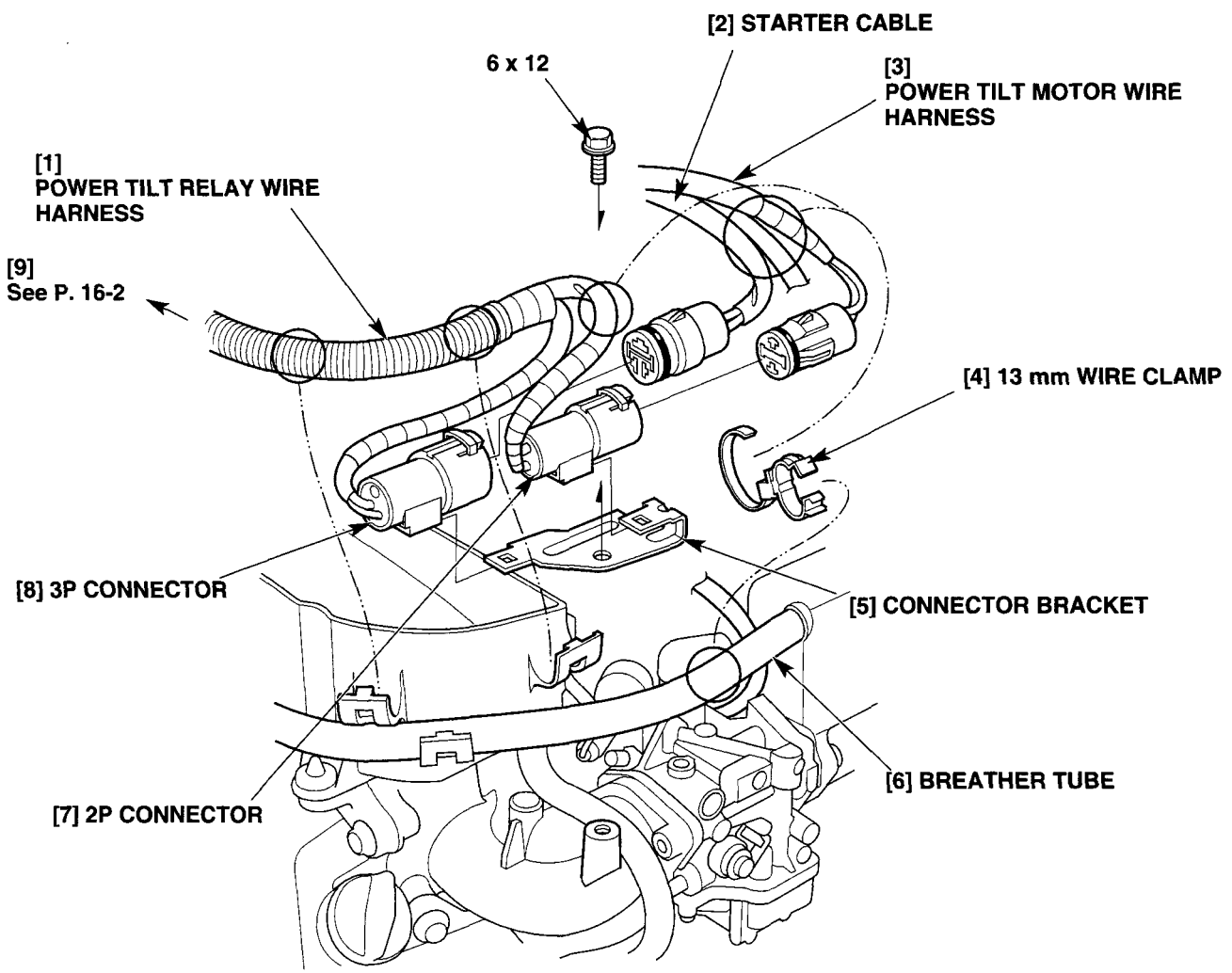
a. REMOVAL

1) Remove the engine cover (P. 5-1 of the base shop manual).

2) Open the wire band of the 13 mm wire clamp and free the wires.

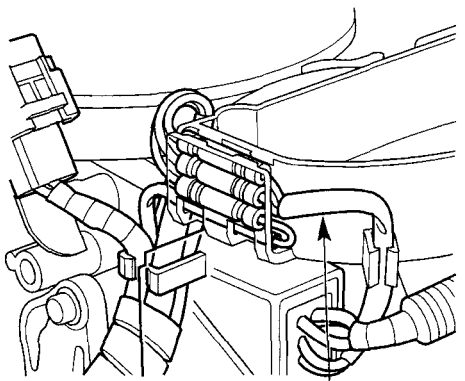
3) Remove the 2P and 3P connectors from the connector bracket and disconnect them.

4) Remove the 6 x 12 mm flange bolt and connector bracket if necessary.

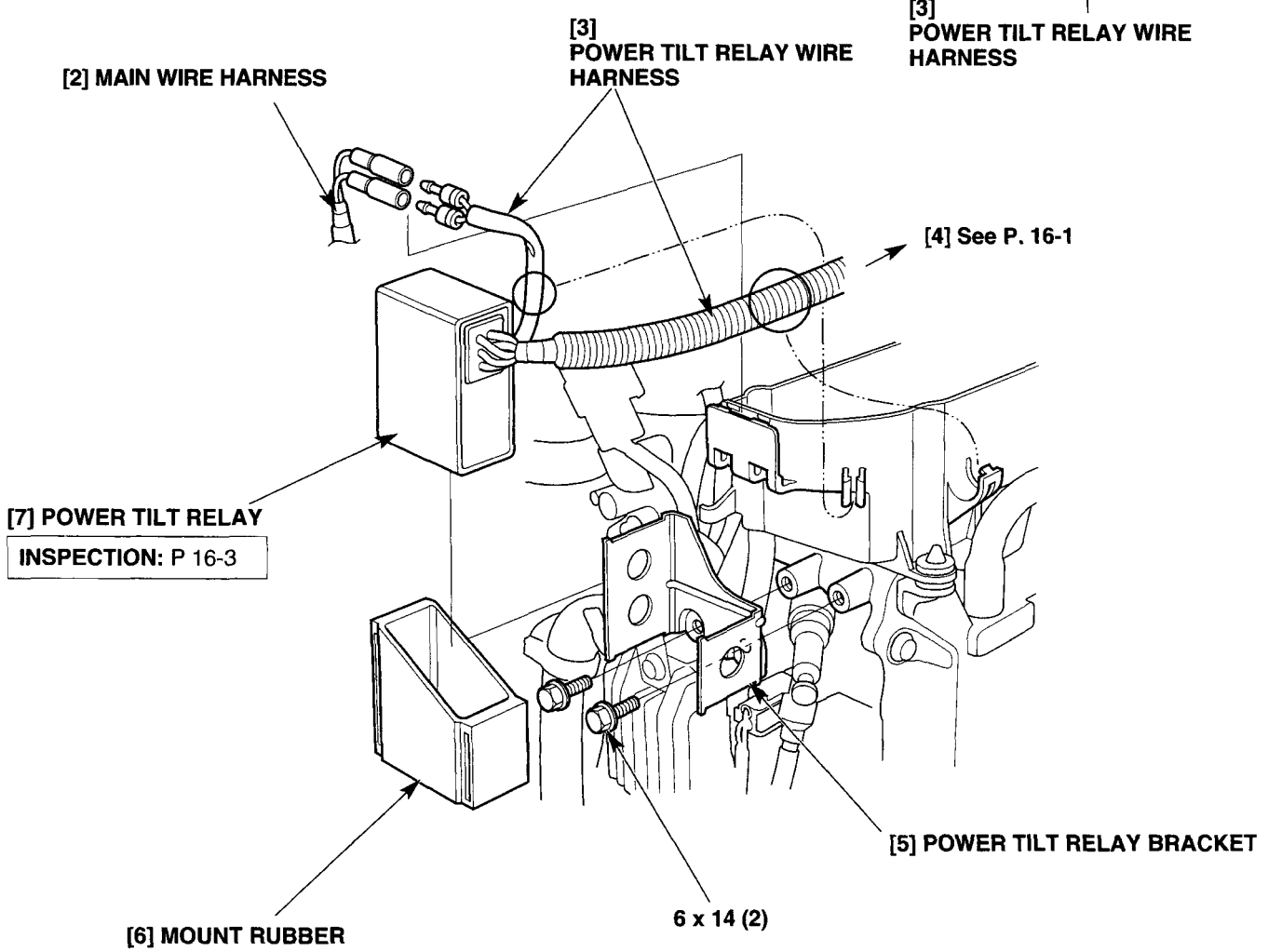


5) Disconnect the power tilt relay connectors from the power tilt switch wire (Tiller handle type) or main wire harness (Remote control type).
6) Pull the power tilt relay wires from the starter case B and remove the power tilt relay with the rubber mount attached.
7) Remove the 6 x 14 mm flange bolts and power tilt relay bracket if necessary.

[1] Tiller handle type:

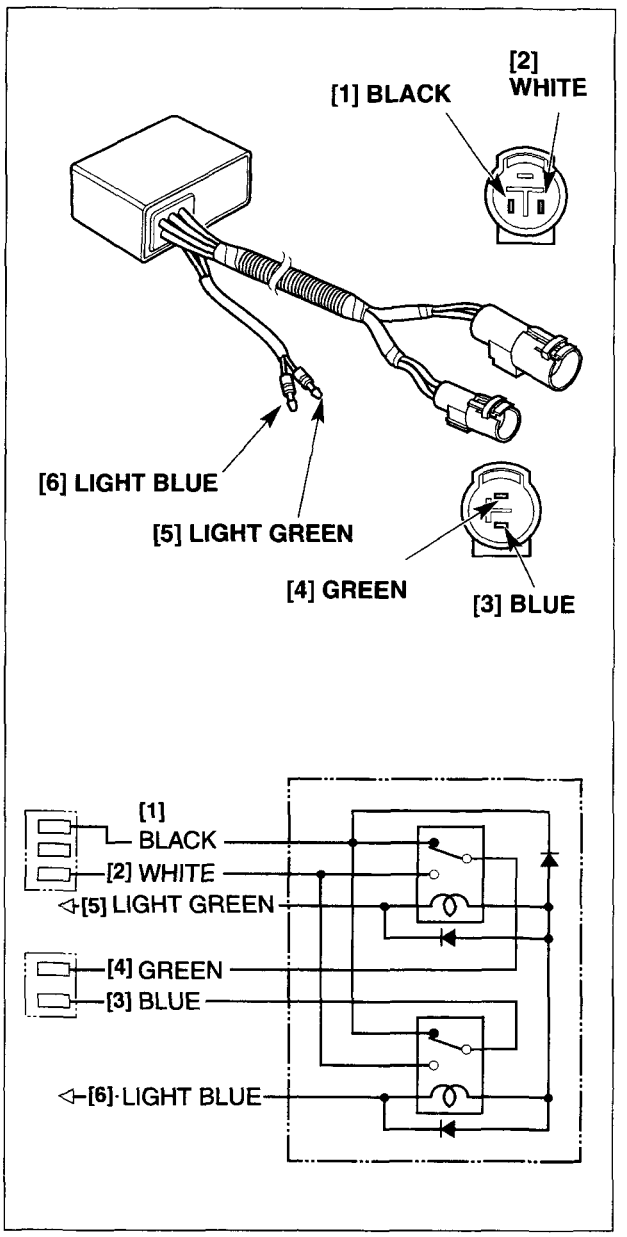


[3] POWER TILT RELAY WIRE HARNESS



b. INSPECTION

1) Check for continuity between the terminals:
   - There should be continuity between the Light green and Black terminals.
   - There should be continuity between the Blue and Black terminals.
   - There should be no continuity between the White and Black terminals.
2) Measure the resistance between the terminals.
   - There should be 44.0 - 48.5Ω between the Green and Black terminals.
   - There should be 44.0 - 48.5Ω between the Light blue and Black terminals.
3) Connect the battery to the Light blue (+) and Black (-) terminals and check for continuity between the terminals.
   - There should be continuity between the White and Blue terminals.
4) Connect a battery to the Light green (+) and Black (-) terminals and check for continuity between the terminals.
   - There should be continuity between the White and Green terminals

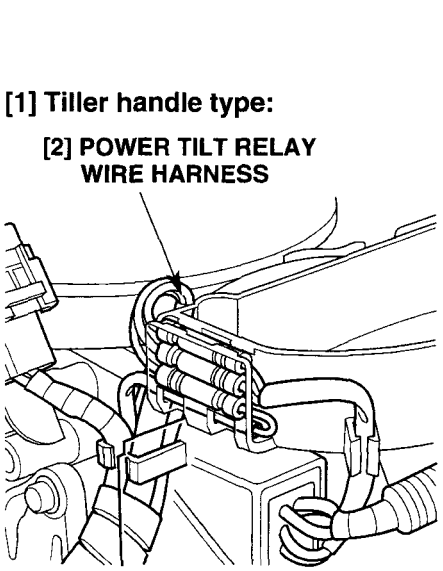


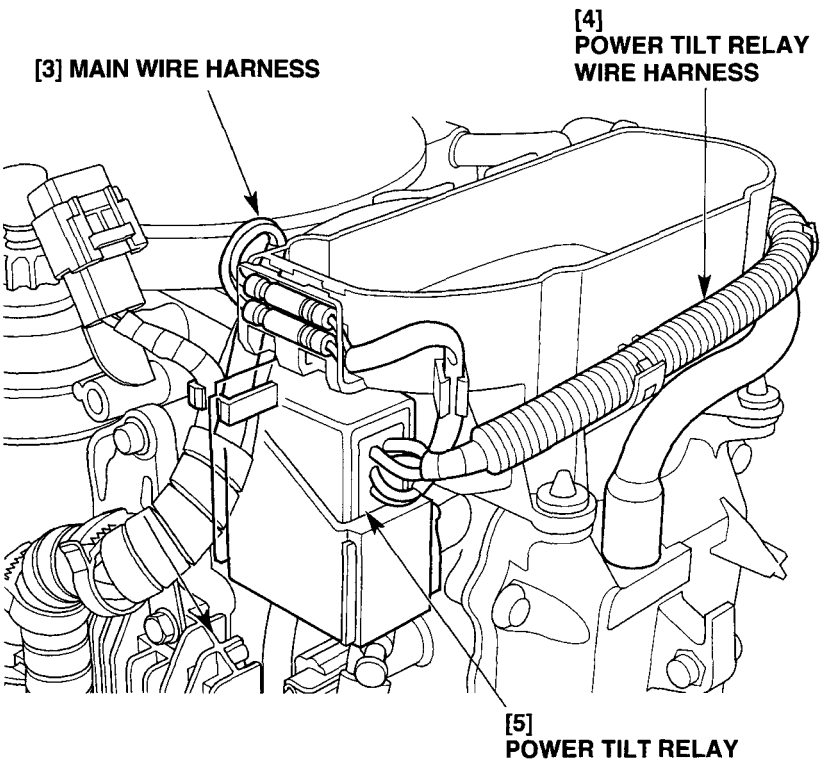
c. INSTALLATION

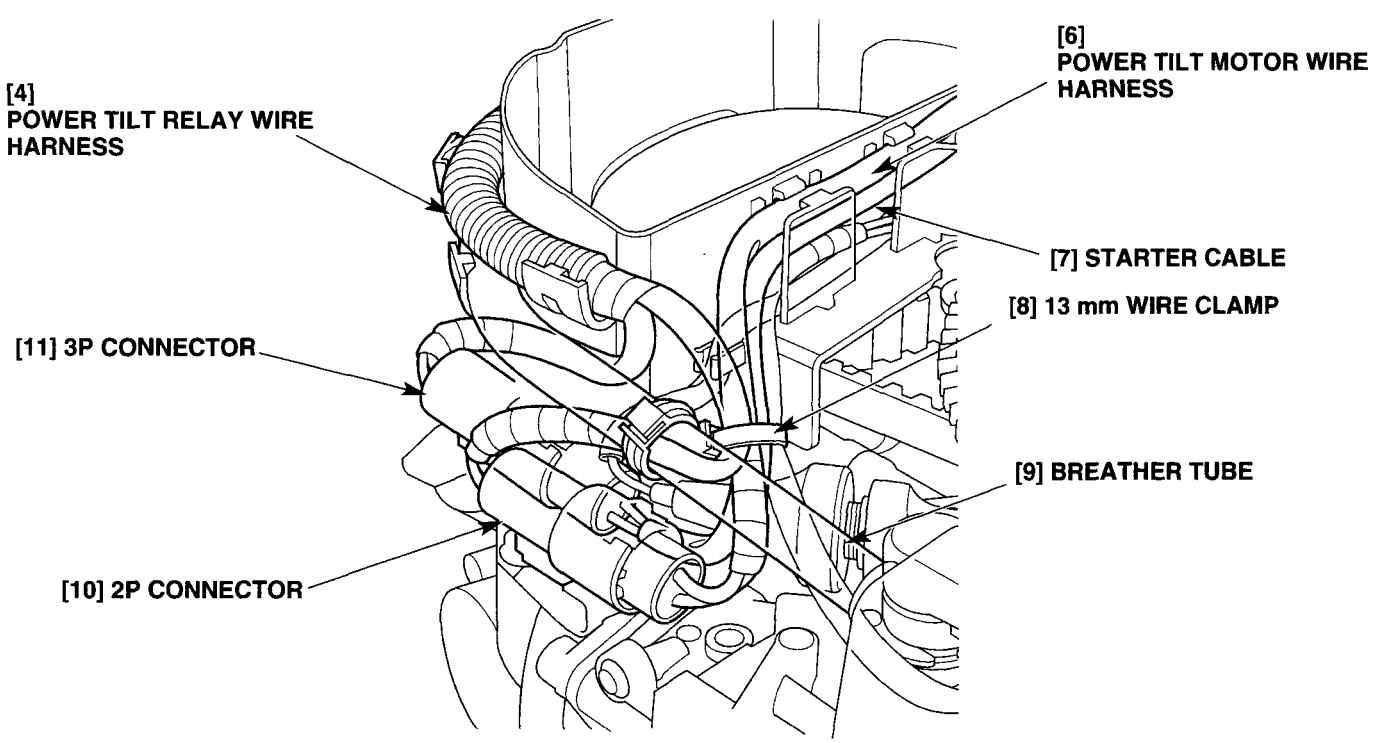
Install the power tilt relay in the reverse order of removal.

- Secure the relay wires in the holders on the starter case B as shown.
- Clamp the wires with the 13 mm wire clamp as shown.

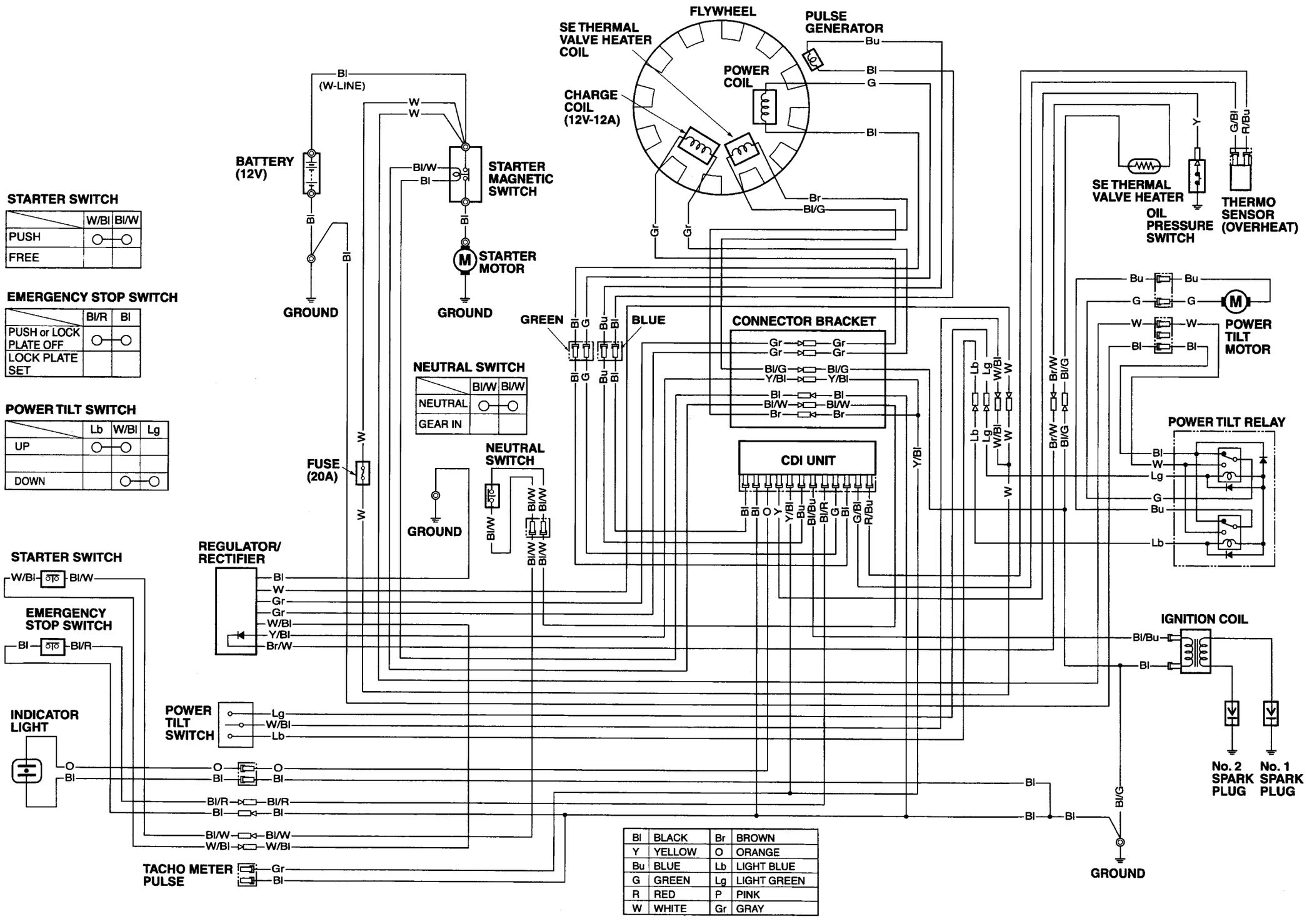
[1] Tiller handle type:



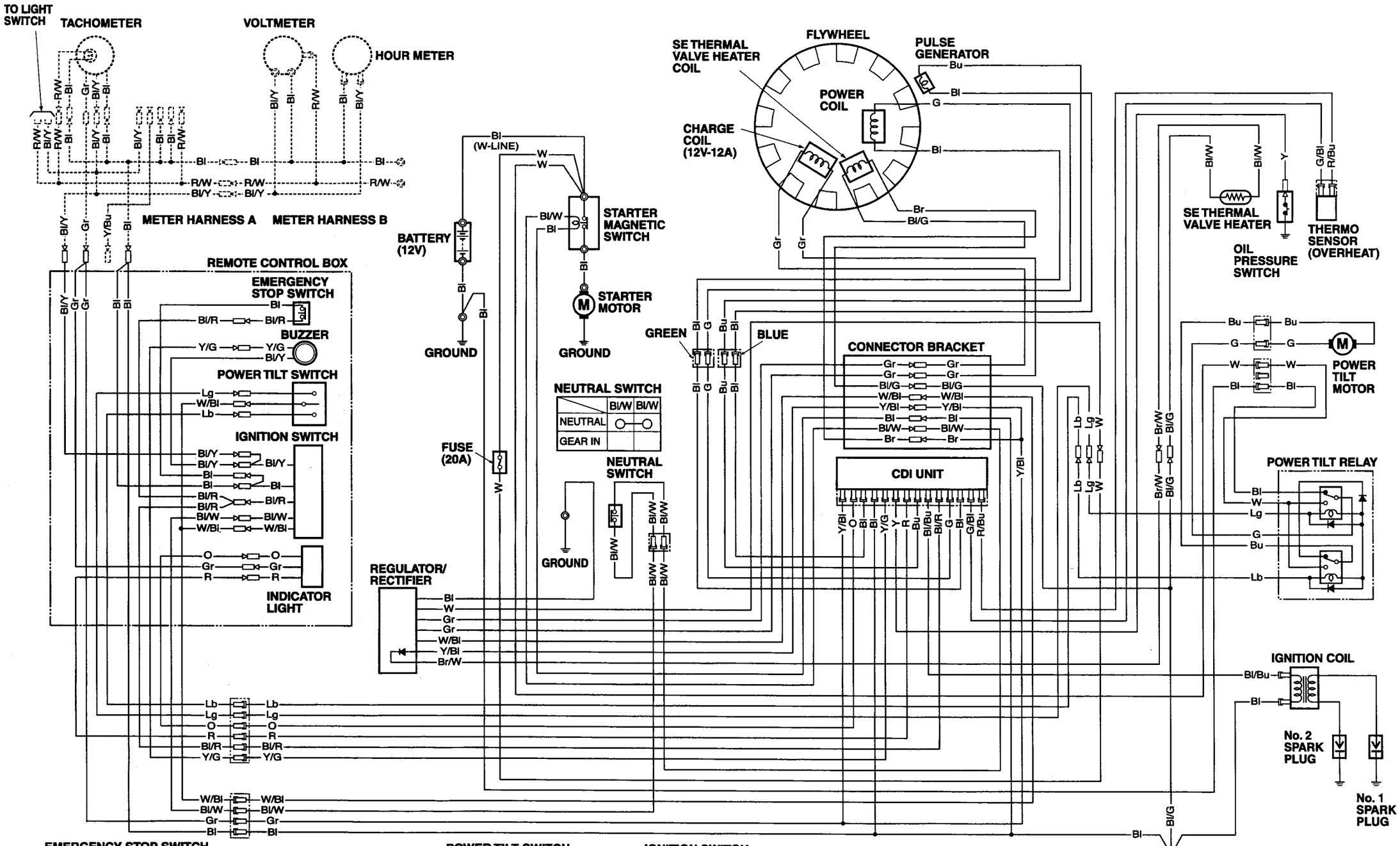




TILLER HANDLE TYPE WITH POWER TILT



REMOTE CONTROL TYPE WITH POWER TILT



EMERGENCY STOP SWITCH

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

POWER TILT SWITCH

	Lb	W/Bl	Lg
UP	○	○	
DOWN		○	○

IGNITION SWITCH

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

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

HONDA

Shop Manual News

OUTBOARD MOTOR

Power Equipment

News No.	Issue Date
P/P-151	Dec. 2002

SOME PARTS OF CHANGES

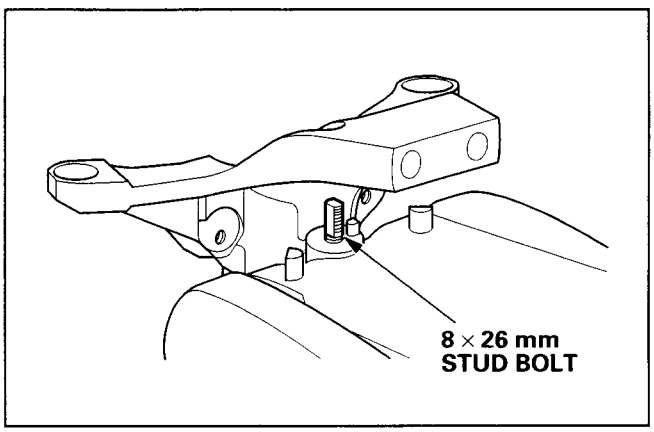
Page 2

Applicable Information	Publication No.	Applicable Page
BF8D·BF9.9D·BF10D·BFP8D·BFP9.9D BFP10D·BF8B·BF10B·BFP8B·BFP10B	66ZW900	6-17, 12-4, 12-5, 13-2

CHANGE LOCATIONS

• Friction lever assembly (P. 12-4 and 5).

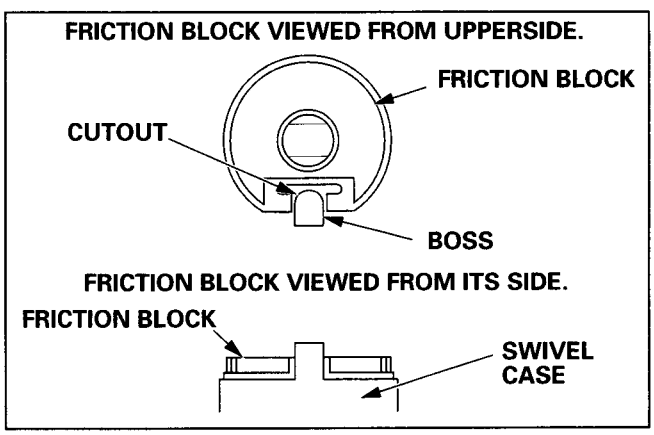
1) Clean the screw hole for the 8 × 26 mm stud bolt. Turn the stud bolt counterclockwise one to one and a half revolutions after fully tightening the bolt.



2) Install one of the friction block onto 8 × 26 mm stud bolt by aligning the cutout with the boss on the swivel case and facing the disc surface toward the oil case as shown.

NOTE:

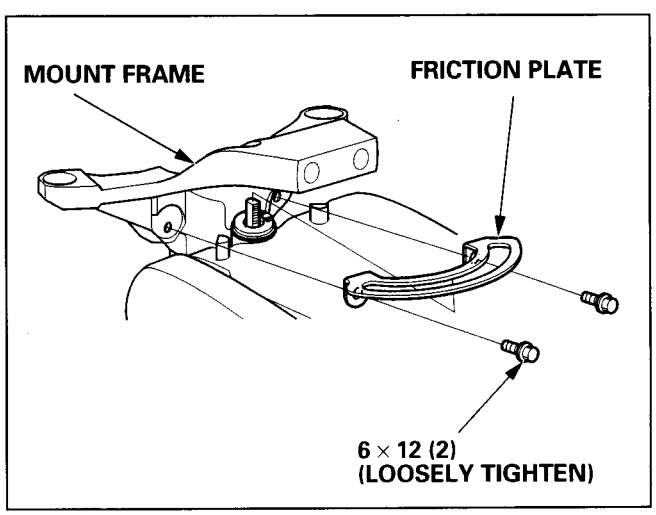
- Replace the friction blocks as a pair when the disk surface of the friction block is worn.
- Clean off grease from the disc surface.



3) Install the friction plate onto the mount frame and loosely tighten the two 6 × 12 mm flange bolts.

NOTE:

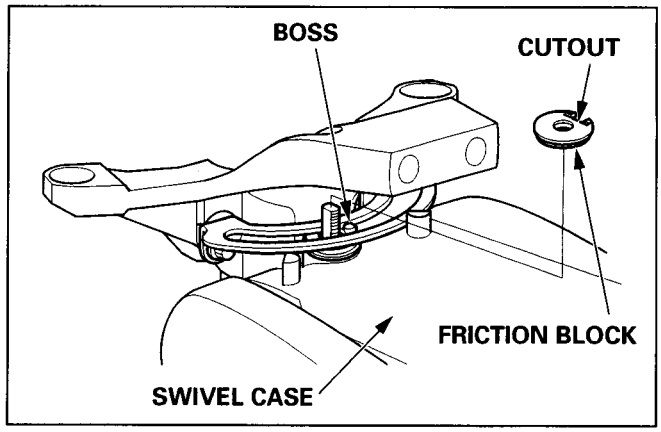
Do not fully tighten the 6 × 12 mm flange bolts.



4) Make sure the disc surface of the friction blocks are free of grease.

NOTE:

Clean off grease from the disc surface.



5) Install one of the friction blocks onto the 8 × 26 mm stud bolt by aligning the cutout with the boss on the swivel case and facing the disc surface toward the friction plate as shown.

6) Check the 8 mm nylon washer, steering friction and 8 mm washer are free of grease.

NOTE:

Clean off grease from the parts.

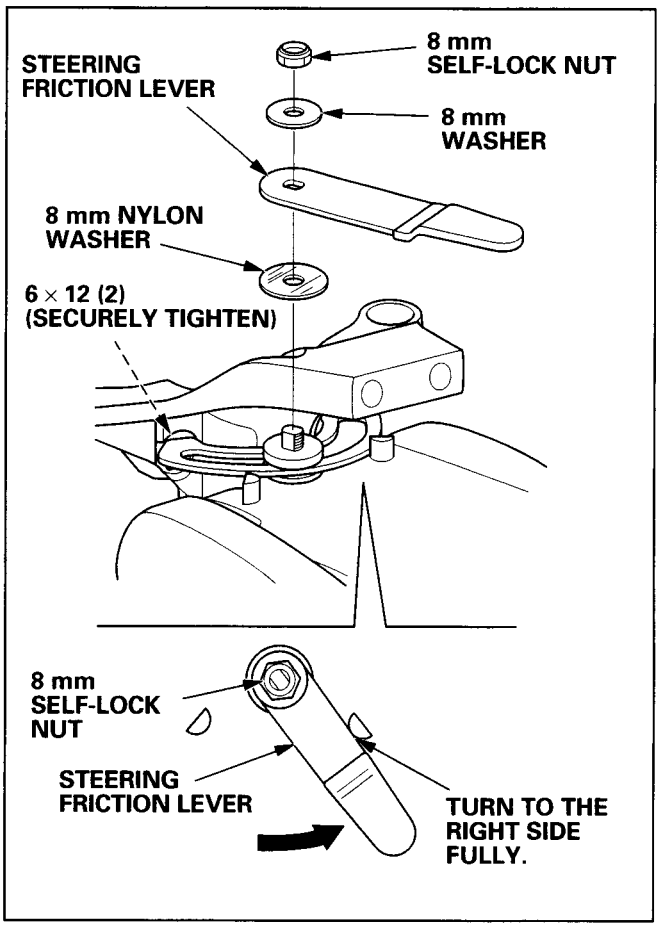
7) Install the 8 mm nylon washer, steering friction lever and 8 mm washer.
Turn the steering friction lever to the right side fully, and hold it in this position.

8) Tighten the 8 mm self-locking nut to the specified torque.

TORQUE: 2.5 N·m (0.25 kgf·m, 1.8 lbf·ft)

9) Tighten the two 6 × 12 flange bolts which are loosely tightened in step 3 securely.

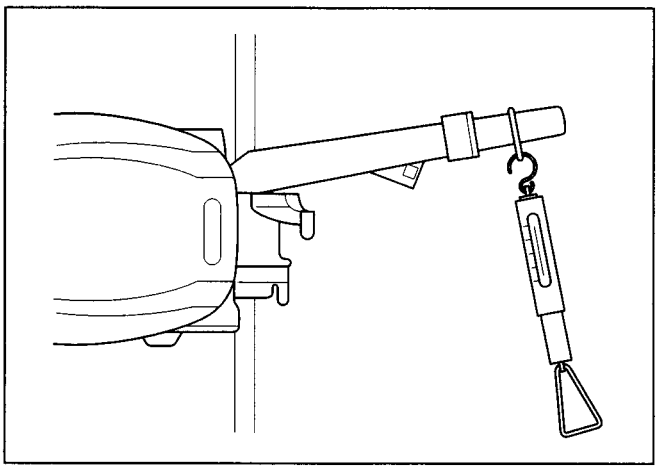
10) Adjust the steering friction after assembling.



11) Check the starting torque by measuring the starting force by using a spring scale at the center of the tiller handle as shown.

The motor should not start to move with less than 20 N·m (2.0 kgf·m, 14.5 lbf·ft).

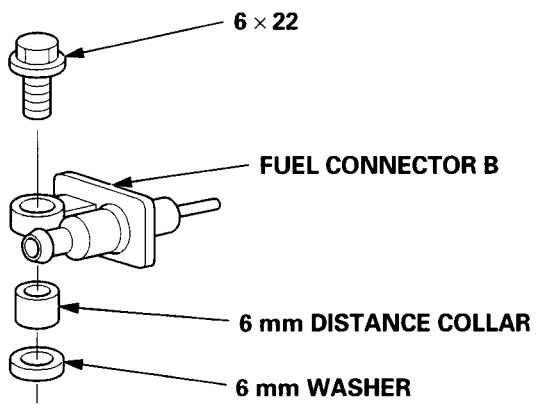
12) Retighten the self-locking nut if necessary.



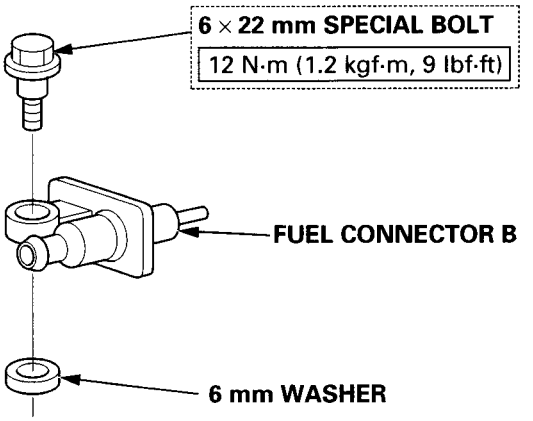
• Fuel connector B installation bolt have been changed from the following frame serial number. (P. 6-17)

Model	Frame serial number
BF8D	BACJ-1100165
BF9.9D	BABJ-1105242

Before Modification



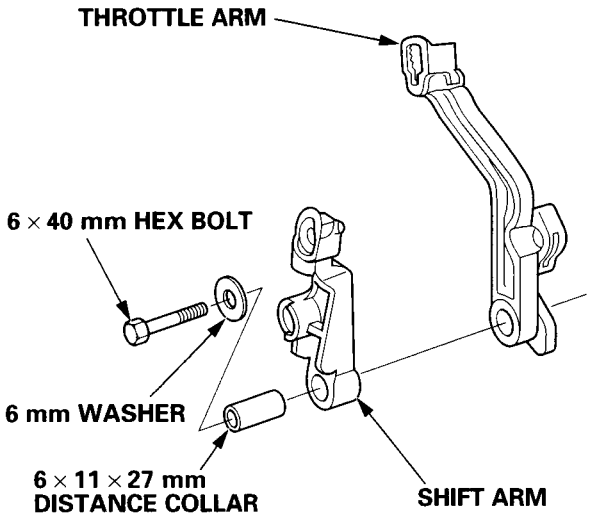
After Modification



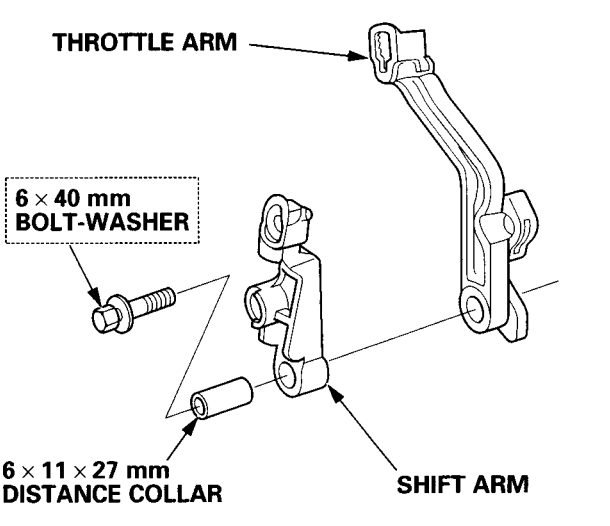
• Throttle arm tightening bolt have been changed from the following frame serial number. (P.13-2)

Model	Type	Frame serial number
BF8D	SR, LR, XR	BACJ-1100165
BF9.9D		BABJ-1105242

Before Modification



After Modification



1.	Specifications	2 - 6
2.	Service information	7 - 48
3.	Maintenance	49 - 67
4.	Propeller/Gear case/Extension case	68 - 96
5.	Engine covers	97 - 99
6.	Fuel system	100 - 120
7.	Recoil starter	121 - 130
8.	Engine removal/Installation	131 - 141
9.	Flywheel/Timing belt	142 - 154
10.	Cylinder head/Valves/Oil pump	155 - 176
11.	Crankcase/Crankshaft/Piston	177 - 200
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