WSM

WORKSHOP MANUAL
DIESEL ENGINE

OC60-E2,OC95-E2

Kubota

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SAFETY FIRST

This symbol, the industry's "Safety Alert Symbol" is used throughout this manual and on labels on the machine itself to warn of the possibility of personal injury. Read these instructions carefully.It is essential that you read the instructions and safety regulations before you attempt to repair or use this unit.

DANGER
- **Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.**

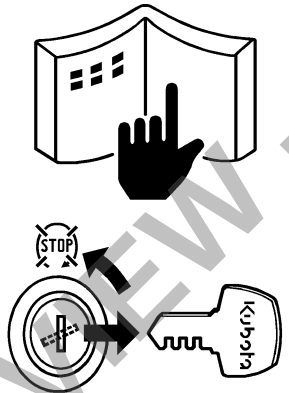
WARNING
- **Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.**

CAUTION
- **Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury.**

IMPORTANT
- **Indicates that equipment or property damage could result if instructions are not followed.**

NOTE
- **Gives helpful information.**

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BEFORE SERVICING AND REPAIRING

- Read all instructions and safety instructions in this manual and on your engine safety decals.
- Clean the work area and engine.
- Park the machine on a firm and level ground.
- Allow the engine to cool before proceeding.
- Stop the engine, and remove the key
- Disconnect the battery negative cable

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SAFETY STARTING

- Do not start the engine by shorting across starter terminals or bypassing the safety start switch.
- Unauthorized modifications to the engine may impair the function and / or safety and affect engine life.

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SPECIFICATIONS

Model	OC60-E2(-X)	OC60-E2(-X)-L	OC95-E2(-X)	OC95-E2(-X)-L
Number of Cylinders	1			
Type	Oil-cooled 4-cycle diesel engine			
Bore x Stroke mm (in.)	72 x 68 (2.83 x 2.68)		83 x 77 (3.27 x 3.03)	
Total Displacement cm^3 (cu.in.)	276 (16.8)	276 (16.8)	416 (25.4)	416 (25.4)
ISO Net Continuous kW / min^{-1} (rpm) (HP / min^{-1} (rpm))	4.2 / 3600 (5.6 / 3600)		6.3 / 3600 (8.5 / 3600)	
ISO / SAE Net Intermittent kW / min^{-1} (rpm) (HP / min^{-1} (rpm))	4.5 / 3600 (6.1 / 3600)		7.0 / 3600 (9.5 / 3600)	
Maximum Bare Speed min^{-1} (rpm)	3800			
Minimum Bare Idling Speed min^{-1} (rpm)	1300			
Combustion System	TVCS (Three-vortex combustion system)			
Fuel Injection Pump	ND type (DENSO)			
Governor	Centrifugal mechanical governor			
Direction of Rotation	Clockwise (View from flywheel side)			
Injection Nozzle	DN4PD82 (DENSO)			
Injection Timing (Static)	0.26 to 0.30 rad (15 ° to 17 °) before top dead center		0.23 to 0.26 rad (13 ° to 15 °) before top dead center	
Injection Pressure	13.7 MPa (140 kgf/cm^2, 1987 psi)			
Compression Ratio	24.5 : 1		24.0 : 1	
Lubricating System	Forced lubrication with trochoid pump			
Lubricating Filter	Oil strainer			
Cooling System	Oil cooling + Air cooling			
Starting System	Electric starting with starter			
Starting Motor	12 V 1.0 kW		12 V 1.2 kW	
Charging Alternator	12 V, 48 W	12 V, 150 W	12 V, 48 W	12 V, 150 W
Fuel	Diesel fuel No.2-D (ASTM D975)			
Fuel Tank Capacity	3.6 L (0.95 U.S.gals, 0.79 Imp.gals)		5.5 L (1.45 U.S.gals, 1.2 Imp.gals)	
Lubricating Oil	Quality better than API service CC class (SAE 10W-30)			
Lubricating Oil Capacity	1.3 L (1.37 U.S.qts, 1.14 Imp.qts)		1.7 L (1.80 U.S.qts, 1.49 Imp.qts)	
Weight (Dry) kg (lbs)	38(83.8)		55 (121.3)	

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4. LUBRICANTS, AND FUEL

No.	Place	Capacity		Lubricants, fuel and coolant
		OC60-E2	OC95-E2	
1	Engine oil	1.3 L 1.4 U.S.qts 1.1 lmp.qts	1.7 L 1.8 U.S.qts 1.5 lmp.qts	Higher than CC class (API) Above 25 ℃ (77 ℉) : SAE10W-30 SAE10W-40 SAE30 0 to 25 ℃ (32 to 77 ℉) : SAE10W-30 SAE10W-40 SAE20 Below 0 ℃ (32 ℉) : SAE10W-30 SAE10W-40 SAE10
2	Fuel	3.6 L 0.95 U.S.gals 0.79 lmp.gals	5.5 L 1.45 U.S.gals 1.21 lmp.gals	Diesel fuel No. 2-D (No. 1-D deisel fuel, if temperature is below -10 ℃ (14 ℉).)

*KUBOTA original transmission hydraulic fluid.

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5. MAINTENANCE CHECK LIST

No	Item		Service interval								Refere-nce page
			Daily	Initial 25h	Every 100h	Every 500h	Every 800h	Every 1500h	Every 1 year	Every 2 year	
1	Engine oil	Checking	☆								G-6
		Changing		☆	☆						G-7
2	Oil strainer	Cleaning		☆	☆						G-7
3	Rubber hoses and clamp bands	Checking	☆								G-6
		Changing								☆	G-10
4	Air cleaner	Cleaning			☆						G-8
		Changing	Once year or after 6 cleanings								G-10
5	Fuel filter	Cleaning			☆						G-8
		Changing				☆					G-8
6	Valve clearance	Checking					☆				G-9
7	Nozzle injection pressure and spraying condition	Checking						☆			G-9, 10
		Cleaning						☆			G-9, 10

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1. TROUBLESHOOTING

Symptom	Probable Cause	Solution	Reference Page
Engine Does Not Start	● No fuel	Replenish fuel	—
	● Air in the fuel system	Vent air	—
	● Water in the fuel system	Replace fuel and repair or replace fuel system	—
	● Fuel pipe clogged	Clean	—
	● Fuel filter clogged	Clean and replace	G-8
	● Excessively high viscosity of fuel or engine oil at low temperature	Use the specified fuel	G-4
	● Fuel with low cetane number	Use the specified fuel	G-4
	● Fuel leak due to loose injection pipe retaining nut	Tighten nut	—
	● Incorrect injection timing	Adjust	S-15
	● Fuel camshaft worn	Replace	S-47
	● Injection nozzle clogged	Clean	G-9, 10
	● Injection pump malfunctioning	Replace	S-26
	● Seizure of crankshaft, camshaft, piston, cylinder liner or bearing	Replace	S-44, 47
	● Compression leak from cylinder head	Replace head gasket, Tighten cylinder head bolt and nozzle holder Correct valve seat	S-12
	● Deficient compression	Check and correct valve	S-12
	● Improper valve seat alignment, valve spring broken, valve seized	Replace	S-42
	● Incorrect valve timing	Adjust	S-12
	● Piston ring and liner worn	Replace	S-44, 46
	● Excessive valve clearance	Adjust	G-9
Engine Revolution Is Not Smooth	● Fuel filter clogged or dirty	Clean	G-8
	● Air cleaner clogged	Clean or replace	G-8
	● Fuel leak due to loose injection pipe retaining nut	Tighten nut	—
	● Injection pump malfunctioning	Replace	S-26
	● Incorrect nozzle injection pressure	Repair or adjust	S-17
	● Injection nozzle stuck or clogged	Replace	—
	● Fuel overflow pipe clogged	Clean	—
	● Governor malfunctioning	Repair	M-10, 12

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3. TIGHTENING TORQUES

- Screws, bolts and nuts must be tightened to the specified torque with a torque wrench.
- Several screws and nuts such as those used on the cylinder head must be tightened in proper sequence and to the proper torque.

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[1] TIGHTENING TORQUES FOR SPECIAL USE SCREWS, BOLTS AND NUTS

Item	Size x Pitch	N·m	kgf·m	ft-lbs
**Cylinder head screws (OC60-E2)	M10 x 1.5	51.9 to 56.8	5.3 to 5.8	38.3 to 42.0
**Cylinder head screws (OC95-E2)	M12 x 1.75	68.6 to 73.6	7.0 to 7.5	50.6 to 54.2
**Connecting rod screws (OC60-E2)	M7 x 1.0	18.6 to 21.6	1.9 to 2.2	13.7 to 15.9
**Connecting rod screws (OC95-E2)	M8 x 1.25	27.5 to 30.4	2.8 to 3.1	20.3 to 22.4
*Flywheel nut (OC60-E2)	M20 x 1.5	137 to 157	14 to 16	101 to 116
*Flywheel nut (OC95-E2)	M24 x 1.5	235 to 255	24 to 26	174 to 188
Side cover screws	M8 x 1.25	23.5 to 27.4	2.4 to 2.8	17.4 to 20.3
**Rocker arm bracket mounting nut	M8 x 1.25	23.5 to 27.4	2.4 to 2.8	17.4 to 20.3
Injection pump mounting screw	M6 x 1.0	9.8 to 11.3	1.0 to 1.15	7.2 to 8.3
Injection pump eye joint bolt	M10 x 1.0	14.7 to 19.6	1.5 to 2.0	10.8 to 14.5
Injection pipe retaining nuts	M12 x 1.5	24.5 to 34.3	2.5 to 3.5	18.1 to 25.3
Oil pipe eye joint bolt	M12 x 1.25	24.5 to 29.4	2.5 to 3.0	18.1 to 21.7
Grow plug	M10 x 1.25	19.6 to 24.5	2.0 to 2.5	14.5 to 18.1
Nozzle holder mounting nuts	M8 x 1.25	13.72 to 17.6	1.4 to 1.8	10.1 to 13.0
Oil switch taper screw	PT1/8	14.7 to 19.6	1.5 to 2.0	10.8 to 14.5
Exhaust manifold mounting nuts	M8 x 1.25	23.5 to 27.4	2.4 to 2.8	17.4 to 20.3

* Apply Molycoat oil to the threads of the nuts marked "*" and tighten them up.
** Apply enough engine oil to the threads and bearing surface of the bolts and nuts marked "**" and tighten them up.

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2. SERVICING SPECIFICATIONS

ENGINE BODY

Item		Factory Specification	Allowable Limit
Cylinder Head Surface Flatness		—	0.05 mm 0.0020 in.
Top Clearance	OC60-E2	0.60 to 0.75 mm 0.0236 to 0.0295 in.	—
	OC95-E2	0.65 to 0.80 mm 0.0256 to 0.0315 in.	—
Cylinder Head Gasket Thickness (Gromet Section)	Free (OC60-E2)	1.05 to 1.20 mm 0.0413 to 0.0472 in.	—
	Free (OC95-E2)	1.35 to 1.55 mm 0.0531 to 0.0610 in.	—
	Tightened (OC60-E2)	0.95 to 1.05 mm 0.0374 to 0.0413 in.	—
	Tightened (OC95-E2)	1.25 to 1.35 mm 0.0492 to 0.0531 in.	—
Compression Pressure		35 to 40 kgf/cm^2 3.43 to 3.92 MPa 498 to 569 psi	25.2 kgf/cm^2 2.47 MPa 358 psi
Valve Clearance (Cold)		0.14 to 0.18 mm 0.0055 to 0.0071 in.	—
Valve Seat Width		2.12 mm 0.0835 in.	—
Valve Seat Angle		45 ° 0.785 rad	—
Valve Face Angle		45.5 ° 0.794 rad	—
Valve Recessing		0.60 to 0.85 mm 0.0236 to 0.0335 in.	1.3 mm 0.0512 in.
Clearance Between Valve Stem and Valve Guide	OC60-E2	0.030 to 0.057 mm 0.0012 to 0.0022 in.	0.1 mm 0.0039 in.
	OC95-E2	0.035 to 0.065 mm 0.0014 to 0.0026 in.	0.1 mm 0.0039 in.
Valve Stem O.D.	OC60-E2	5.968 to 5.980 mm 0.2350 to 0.2354 in.	—
	OC95-E2	6.960 to 6.975 mm 0.2740 to 0.2746 in.	—
Valve Guide I.D.	OC60-E2	6.010 to 6.025 mm 0.2366 to 0.2372 in.	—
	OC95-E2	7.010 to 7.025 mm 0.2760 to 0.2766 in.	—

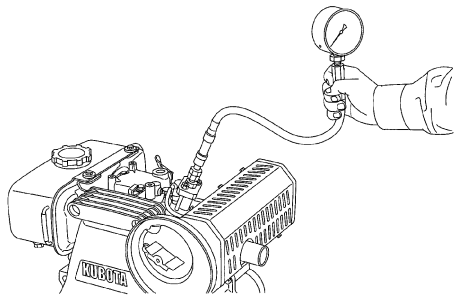
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4. CHECKING, DISASSEMBLING AND SERVICING

[1] CHECKING AND ADJUSTING

(1) Engine Body



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Compression Pressure

1. After warming up the engine, stop it and remove the air cleaner, and nozzle holder.
2. Install a compression tester for diesel engines to nozzle holder hole.
3. After making sure that the speed control lever is set at the stop position (Non-injection), run the engine at 3.3 to 5.0 1/s (200 to 300 rpm) with the starter.
4. Read the maximum pressure. Measure the pressure more than twice.
5. If the measurement is below the allowable limit, check the cylinder, piston ring, top clearance, valve and cylinder head.
6. If the measurement is below the allowable limit, apply a small amount of oil to the cylinder wall through the nozzle hole and measure the compression pressure again.
7. If the compression pressure is still less than the allowable limit, check the top clearance, valve clearance and cylinder head.
8. If the compression pressure increases after applying oil, check the cylinder wall and piston rings.

■ NOTE

- **Check the compression pressure with the specified valve clearance.**
- **Always use a fully charged battery for performing this test.**
- **Variances in cylinder compression values should be under 10 %.**

Compression pressure	Factory spec.	3.43 to 3.92 MPa 35 to 40 kgf/cm^2 497 to 568 psi
	Allowable limit	2.47 MPa 25.2 kgf/cm^2 358 psi

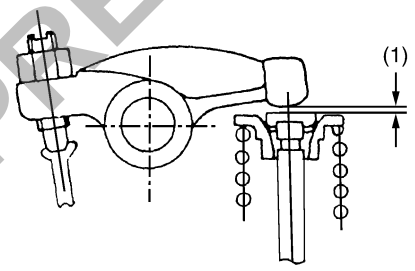
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Valve Clearance

■ IMPORTANT

- **The valve clearance must be inspected and adjusted as needed when the engine is cold (equal to the atmospheric air temperature).**

Valve clearance (Cold)	Factory spec.	0.14 to 0.18 mm 0.0055 to 0.0071 in.



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(1) Valve Clearance

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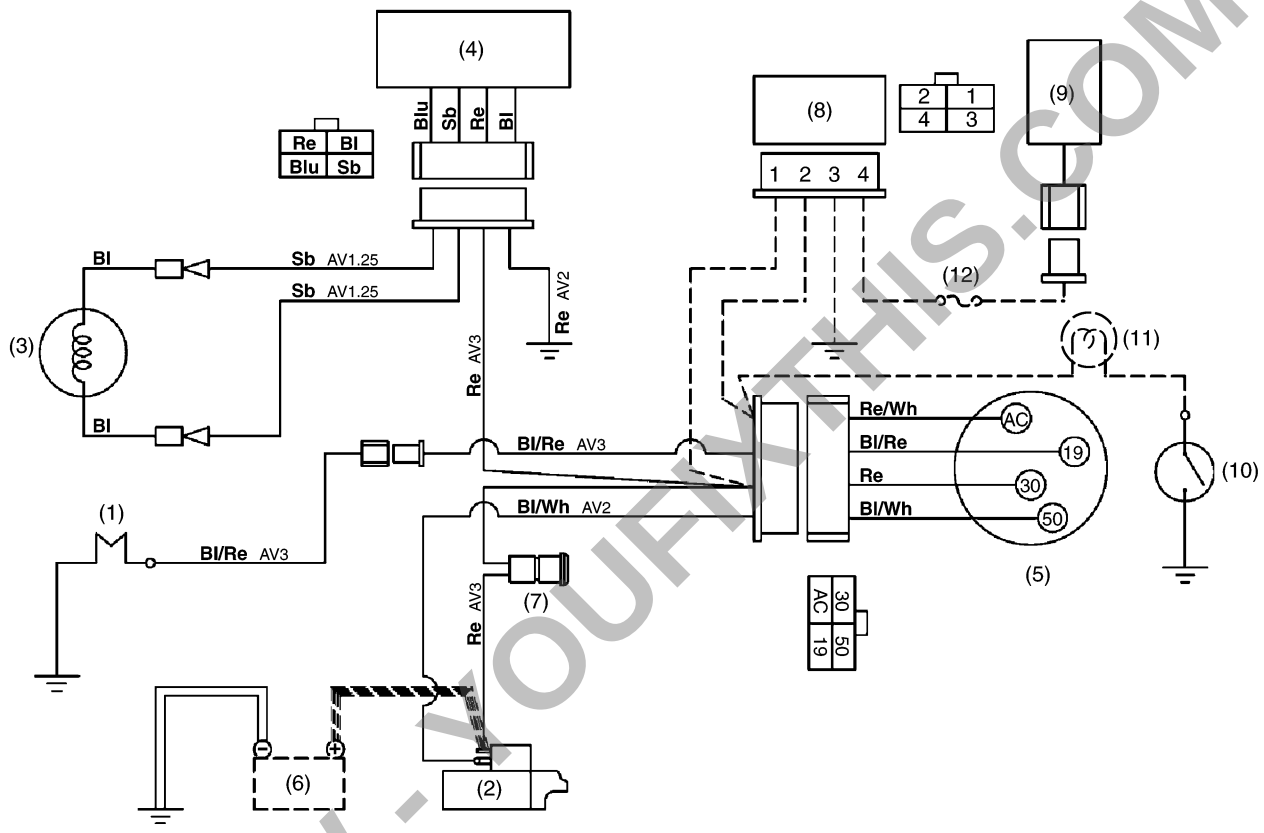
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6. ELECTRICAL SYSTEM

[1] GENERAL

The electrical system of the engine consists of a starting system (including a starter, glow plugs, etc.), a charging system (including a alternator, regulator, etc.), and key switch.

■ **[STANDARD TYPE]**



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(1)	Glow Plug	(5)	Key Switch	(9)	Stop Solenoid	**Bl:**	**Black**
(2)	Starter	(6)	Battery (12V)	(10)	Oil Pressure Switch	**Re:**	**Red**
(3)	Dynamo (48 W)	(7)	Slow Blow Fuse	(11)	Warning Lamp (Option)	**Blu:**	**Blue**
(4)	Regulator	(8)	Timer	(12)	Fuse (15A)	**Sb:**	**Sky Blue**
						Bl / Wh:	**Black / White**
						Bl / Re:	**Black / Red**
						Re / Wh:	**Red / White**

■ **NOTE**

- **The dot lines indicate option parts.**
- **The following modell is with stop solenoid.**

  OC60-E2-D1-QX
  OC60-E2-D1-GX
  OC95-E2-D1-GX

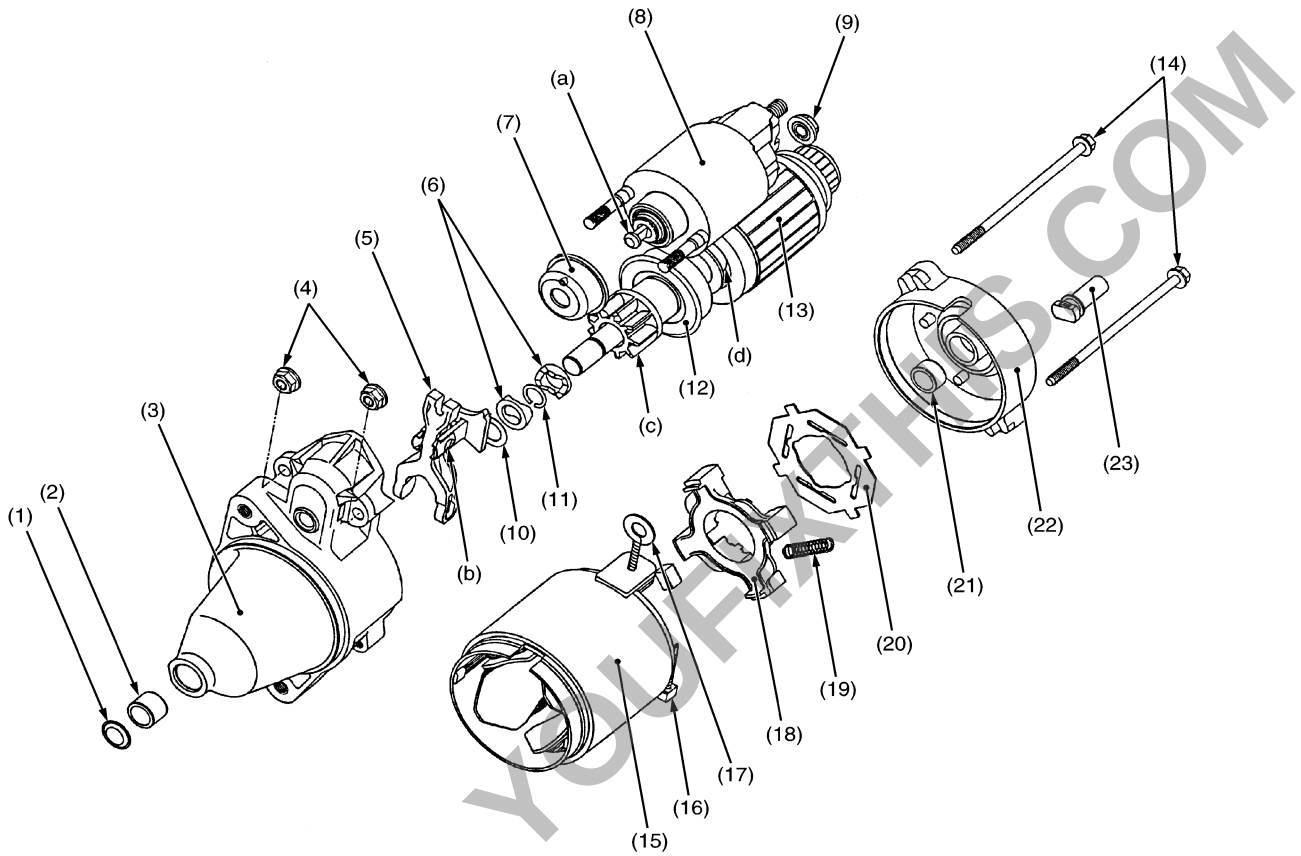
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(11)Starter

Disassembling Starter (OC60-E2)



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(1)	Plug	(6)	Pinion Stop Nut	(12)	Overrunning Clutch	(18)	Brush Holder
(2)	Bushing	(7)	Gasket	(13)	Armature	(19)	Brush Spring
(3)	Starter Drive Housing	(8)	Magnet Switch	(14)	Through Bolt	(20)	Insulator
(4)	Magnet Switch Mounting Nut	(9)	Nut	(15)	Yoke	(21)	Bushing
		(10)	Washer	(16)	Brush	(22)	End Frame
(5)	Drive Lever	(11)	Snap Ring	(17)	Connecting Lead	(23)	Cover

1. Unscrew the mounting nut (9), and disconnect the connecting lead (17).
2. Unscrew the magnet switch mounting nut (4).
3. Remove the magnet switch (8) by sliding it up so that it is disconnected from the drive lever (5).
4. Unscrew the two through bolts (14).
5. Remove the end frame (22).
6. Remove the insulator (20).
7. Remove the brush (16) and brush spring (19), and pull out the brush holder (18).
8. Draw out the yoke (15) from the starter drive housing (3).
9. Draw out the armature (13) with the drive lever (5).

CAUTION

- **When removing the insulator (20), from popping out like a bullet.**
- **When removing the brush (16), prevent the brush spring (19) from popping out like a bullet.**

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