

Section 40

FC290V/FC400V/FC420V/FC540V

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Group 00

Engine Application and Repair Specifications

ENGINE APPLICATIONS CHART

Refer to the engine application chart to identify product-model/engine type-model relationship.

LAWN TRACTORS

Machine	Engine Model No.
130 (Engine S.N. —060824)	FC290V-AS00
(Engine S.N. 060825—)	FC290V-BS00
170/175 (Engine S.N. —006515)	FC420V-AS00
(Engine S.N. 006516—009053)	FC420V-BS00
(Engine S.N. 009054—028504)	FC420V-CS00
(Engine S.N. 028505—)	FC420V-DS00
180/185 (Engine S.N. —058710)	FC540V-AS00
(Engine S.N. 058711—105580)	FC540V-BS00
(Engine S.N. 105581—)	FC540V-CS00
LX172/176	FC420V-AS10
LX186	FC540V-AS10

LAWN AND GARDEN TRACTORS

GT242	FC420V-AS10
240 (Engine S.N. —028504)	FC420V-CS00
(Engine S.N. 028505—124169)	FC420V-DS00
(Engine S.N. 124170—)	FC420V-ES00
245	FC420V-FS00
260/265 (Engine S.N. —105580)	FC540V-BS00
(Engine S.N. 105581—163399)	FC540V-CS00
(Engine S.N. 163400—)	FC540V-DS00
GT262	FC540V-AS10

RIDING MOWERS

RX73 (Engine S.N. —061534)	FC290V-AS01
(Engine S.N. 061535—106800)	FC290V-BS01
(Engine S.N. 106801—)	FC290V-CS01
RX75 (Engine S.N. —060604)	FC290V-AS02
(Engine S.N. 080518—113843)	FC290V-AS10
(Engine S.N. 113944—)	FC290V-BS10
SX75 (Engine S.N. —060604)	FC290V-AS02
(Engine S.N. 060605—113943)	FC290V-BS02 or FC290V-BS02-01
(Engine S.N. 113944—)	FC290V-BS10
GX70/75	FC290V-BS10
SRX75	FC290V-CS10

COMMERCIAL WALK-BEHIND MOWERS

38/48-Inch	FC400V-AS05
48/52-Inch (Engine S.N. —067591)	FC540V-AS01
(Engine S.N. 067592—)	FC540V-BS01
48/54-Inch	FC420V-AS11 or FC540V-AS11

FRONT MOUNT MOWERS

F710	FC540V-AS12
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MX,4000A1,1 -19-21OCT92

FC290V REPAIR SPECIFICATIONS**GROUP 05—FUEL AND AIR SYSTEMS**

Item	Specification
Breather	
Maximum Air Gap	0.20 mm (0.008 in.)

GROUP 10—BLOWER HOUSING AND FLYWHEEL

Flywheel Nut Torque	85 N·m (63 lb·ft)
Minimum Flywheel Screen Gap	1.50 mm (0.059 in.)

GROUP 15—CYLINDER HEAD AND VALVES

Valve Clearance	0.15 mm (0.006 in.)
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Rocker Arm	
Minimum Shaft O.D.	12.94 mm (0.509 in.)
Maximum Bearing I.D.	13.07 mm (0.515 in.)

Push Rod	
Maximum Bend	0.30 mm (0.012 in.)
Intake Pushrod Lift	5.313 mm (0.2092 in.)
	(wear min.) 5.048 mm (0.1987 in.)
Exhaust Pushrod Lift	5.388 mm (0.2121 in.)
	(wear min.) 5.118 mm (0.2015 in.)

Valves and Springs	
Minimum Spring Free Length	31.00 mm (1.220 in.)
Valve Guide I.D.	(min.) 7.000 mm (0.2756 in.)
	(max.) 7.015 mm (0.2762 in.)
Intake Valve Stem O.D.	(min.) 6.960 mm (0.2740 in.)
	(max.) 6.975 mm (0.2746 in.)
Intake Valve-To-Guide Clearance	(min.) 0.025 mm (0.0010 in.)
	(max.) 0.055 mm (0.0022 in.)
Exhaust Valve Stem O.D.	(min.) 6.950 mm (0.2736 in.)
	(max.) 6.965 mm (0.2742 in.)
Exhaust Valve-To-Guide Clearance	(min.) 0.035 mm (0.0014 in.)
	(max.) 0.065 mm (0.0026 in.)
Intake Valve Lift (W/Clearance set at 0.00)	6.923 mm (0.2726 in.)
	(wear min.) 6.578 mm (0.2590 in.)
Exhaust Valve Lift (W/Clearance set at 0.00)	7.021 mm (0.2764 in.)
	(wear min.) 6.670 mm (0.2626 in.)
Maximum Valve Stem Bend	0.03 mm (0.001 in.)
Valve Seating Surface	0.50—1.10 mm (0.020—0.043 in.)
Valve Seat and Face Angle	45°
Minimum Valve Margin	0.60 mm (0.020 in.)
Valve Narrowing Angle	30°

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MX,4000A1,A2 -19-21OCT92

GROUP 20—CYLINDER BLOCK AND INTERNAL COMPONENTS

Item	Specification
Cylinder Head	
Cylinder Head Flatness	0.05 mm (0.002 in.)
Cap Screw Torque In Sequence (Lubricated)	
Initial Torque	18 N·m (159 lb-in.)
Final Torque	24 N·m (212 lb-in.)
Spark Plug Torque	20 N·m (177 lb-in.)
Crankcase Cover	
Oil Capacity	1.0 L (2.11 pt)
Cap Screw Torque	20 N·m (177 lb-in.)
Camshaft	
Minimum End Journal O.D.	
PTO Side	13.92 mm (0.548 in.)
Flywheel Side	15.92 mm (0.627 in.)
Minimum Lobe Height	27.08 mm (1.066 in.)
Maximum Bearing I.D.	
Crankcase	16.06 mm (0.632 in.)
Crankcase Cover	14.05 mm (0.553 in.)
Reciprocating Balancer	
Link Rod	
Minimum Journal O.D.	46.86 mm (1.845 in.)
Maximum Small End I.D.	12.06 mm (0.475 in.)
Maximum Large End I.D.	47.12 mm (1.855 in.)
Bushing Depth	1 mm (0.040 in.)
Balancer Weight	
Maximum Bearing I.D.	26.10 mm (1.027 in.)
Support Shaft	
Minimum Shaft O.D.	25.93 mm (1.021 in.)
Balancer Bushing Assembly Torque	7.3 N·m (65 lb-in.)
Piston	
Maximum Ring Groove Clearance	
Top Ring	0.16 mm (0.006 in.)
Second Ring	0.14 mm (0.005 in.)
Oil Control Ring	0.19 mm (0.007 in.)
Minimum Ring End Gap	0.18 mm (0.007 in.)
Maximum Ring End Gap	
Compression Rings	0.71 mm (0.028 in.)
Oil Ring Side Rails	1.20 mm (0.047 in.)
Minimum Pin O.D.	18.98 mm (0.747 in.)
Maximum Pin Bore I.D.	19.03 mm (0.749 in.)
Maximum Piston-to-Piston Pin Clearance	0.05 mm (0.002 in.)
Piston O.D.	77.85—77.87 mm (3.0649—3.0657 in.)
Piston-to-Cylinder Bore Clearance	0.110—0.142 mm (0.0043—0.0056 in.)

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MX,4000A1,A3 -19-21OCT92

GROUP 20—CYLINDER BLOCK AND INTERNAL COMPONENTS—CONTINUED

Item	Specification
Connecting Rod	
Maximum Crankshaft Bearing I.D.	35.57 mm (1.400 in.)
Maximum Piston Pin Bearing I.D.	19.06 mm (0.750 in.)
Maximum Connecting Rod-to-Piston Pin Clearance	0.08 mm (0.003 in.)
Maximum Connecting Rod-to-Crankpin Clearance	0.14 mm (0.006 in.)
End-Cap Screw Torque	20 N·m (177 lb-in.)
Crankshaft	
Minimum PTO Side Journal O.D.	29.92 mm (1.178 in.)
Minimum Connecting Rod Journal O.D.	35.43 mm (1.395 in.)
Maximum Crankcase Cover Plain Bearing I.D.	30.13 mm (1.186 in.)
Maximum T.I.R.	0.05 mm (0.002 in.)
End Play	0.09—0.22 mm (0.004—0.009 in.)
Cylinder Bore	
Standard Cylinder Bore I.D.	77.98—78.00 mm (3.070—3.071 in.)
Maximum Cylinder Bore I.D.	78.07 mm (3.074 in.)
Rebore Cylinder	
Oversize Diameter	
0.25 mm	78.21—78.23 mm (3.079—3.080 in.)
0.50 mm	78.46—78.48 mm (3.089—3.090 in.)
0.75 mm	78.71—78.73 mm (3.099—3.100 in.)

GROUP 25—IGNITION AND CHARGING SYSTEM

Ignition Coil Air Gap	0.30 mm (0.012 in.)
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See Ignition Tests in this Group.

GROUP 30—STARTING SYSTEMS

Electric Starter	
See Starter Specifications in this Group.	

MX,4000A1,A4 -19-21OCT92

FC400V/FC420V REPAIR SPECIFICATIONS**GROUP 05—FUEL AND AIR SYSTEMS**

Item	Specification
Breather	
Air Gap	1—2 mm (0.040—0.080 in.)

GROUP 10—BLOWER HOUSING AND FLYWHEEL

Flywheel Nut Torque	137 N·m (101 lb-ft)
Minimum Flywheel Screen Gap	1.50 mm (0.059 in.)

GROUP 15—CYLINDER HEAD AND VALVES

Valve Clearance	0.15 mm (0.006 in.)
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Rocker Arm	
Minimum Shaft O.D.	12.94 mm (0.509 in.)
Maximum Bearing I.D.	13.07 mm (0.515 in.)

Push Rod	
Intake Pushrod Lift	6.903 mm (0.2718 in.)
	(wear min.) 6.558 mm (0.2582 in.)
Exhaust Pushrod Lift	6.903 mm (0.2718 in.)
	(wear min.) 6.558 mm (0.2582 in.)
Maximum Bend	0.30 mm (0.012 in.)

Valves and Springs	
Minimum Spring Free Length	37.50 mm (1.476 in.)
Valve Guide I.D.	(min.) 7.000 mm (0.2756 in.)
	(max.) 7.015 mm (0.2762 in.)

Intake Valve Stem O.D.	(min.) 6.972 mm (0.2745 in.)
	(max.) 6.987 mm (0.2751 in.)

Intake Valve-To-Guide Clearance	(min.) 0.013 mm (0.0005 in.)
	(max.) 0.043 mm (0.0017 in.)

Exhaust Valve Stem O.D.	(min.) 6.965 mm (0.2742 in.)
	(max.) 6.980 mm (0.2748 in.)

Exhaust Valve-To-Guide Clearance	(min.) 0.020 mm (0.0008 in.)
	(max.) 0.050 mm (0.0020 in.)

Intake Valve Lift (W/Clearance set at 0.00)	8.995 mm (0.3541 in.)
	(wear min.) 8.545 mm (0.3365 in.)

Exhaust Valve lift (W/Clearance set at 0.00)	8.995 mm (0.3541 in.)
	(wear min.) 8.545 mm (0.3365 in.)

Maximum Valve Stem Bend	0.03 mm (0.001 in.)
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Valve Seating Surface	1.10—1.46 mm (0.043—0.057 in.)
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Valve Seat and Face Angle	45°
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Minimum Valve Margin	0.60 mm (0.020 in.)
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Valve Narrowing Angle	30°
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MX,4000A1,A5 -19-21OCT92

GROUP 20—CYLINDER BLOCK AND INTERNAL COMPONENTS

Item	Specification
Cylinder Head	
Cylinder Head Flatness	0.05 mm (0.002 in.)
Cap Screw Torque In Sequence (Lubricated)	
Initial Torque	32 N·m (24 lb-ft)
Final Torque	52 N·m (38 lb-ft)
Spark Plug Torque	20 N·m (177 lb-in.)
Crankcase Cover	
Oil Capacity	
With Filter	1.5 L (3.17 pt)
Without Filter	1.3 L (2.75 pt)
Cap Screw Torque	26 N·m (230 lb-in.)
Camshaft	
Minimum End Journal O.D.	
PTO Side	20.91 mm (0.823 in.)
Flywheel Side	19.91 mm (0.784 in.)
Minimum Lobe Height	36.75 mm (1.447 in.)
Maximum Bearing I.D.	
Crankcase	20.08 mm (0.790 in.)
Crankcase Cover	21.08 mm (0.830 in.)
Reciprocating Balancer	
Link Rod	
Minimum Journal O.D.	53.95 mm (2.124 in.)
Maximum Small End I.D.	12.60 mm (0.475 in.)
Maximum Large End I.D.	54.12 mm (2.131 in.)
Bushing Depth	0.50 mm (0.020 in.)
Balancer Weight	
Maximum Bearing I.D.	26.10 mm (1.027 in.)
Support Shaft	
Minimum Shaft O.D.	25.93 mm (1.021 in.)
Piston	
Maximum Ring Groove Clearance	
Top Ring	0.17 mm (0.007 in.)
Second Ring	0.15 mm (0.006 in.)
Oil Ring	0.20 mm (0.008 in.)
Minimum Ring End Gap	0.18 mm (0.007 in.)
Maximum Ring End Gap	
Compression Rings	0.90 mm (0.035 in.)
Oil Ring Side Rails	1.30 mm (0.051 in.)
Minimum Pin O.D.	21.98 mm (0.865 in.)
Maximum Pin Bore I.D.	22.04 mm (0.868 in.)
Maximum Piston-to-Piston Pin Clearance	0.06 mm (0.002 in.)
Piston O.D.—FC400V	86.83—86.85 mm (3.4185—3.4192 in.)
Piston O.D.—FC420V	88.83—88.85 mm (3.4885—3.498 in.)
Piston-to-Cylinder Bore Clearance	0.13—0.17 mm (0.005—0.0067 in.)

Continued on next page

MX,4000A1,A6 -19-21OCT92

GROUP 20—CYLINDER BLOCK AND INTERNAL COMPONENTS—CONTINUED

Item	Specification
Connecting Rod	
Maximum Crankshaft Bearing I.D.	41.07 mm (1.617 in.)
Maximum Piston Pin Bearing I.D.	22.06 mm (0.868 in.)
Maximum Connecting Rod-to-Piston Pin Clearance	0.08 mm (0.003 in.)
Maximum Connecting Rod-to-Crankpin Clearance	0.14 mm (0.006 in.)
End-Cap Screw Torque	20 N·m (177 lb-in.)
Crankshaft	
Minimum PTO Side Journal O.D.	34.92 mm (1.376 in.)
Minimum Connecting Rod Journal O.D.	40.93 mm (1.611 in.)
Maximum Crankcase Cover Plain Bearing I.D.	35.06 mm (1.380 in.)
Maximum T.I.R.	0.05 mm (0.002 in.)
End Play	0.09—0.22 mm (0.004—0.009 in.)
Cylinder Bore	
Standard Cylinder Bore I.D.—FC400V	86.98—87.00 mm (3.424—3.425 in.)
Standard Cylinder Bore I.D.—FC420V	88.98—89.00 mm (3.503—3.504 in.)
Maximum Cylinder Bore I.D.—FC400V	87.08 mm (3.428 in.)
Maximum Cylinder Bore I.D.—FC420V	89.08 mm (3.507 in.)
Rebore Cylinder	
Oversize Diameter	
0.25 mm	89.23—89.25 mm (3.513—3.514 in.)
0.50 mm	89.48—89.50 mm (3.523—3.524 in.)
0.75 mm	89.73—89.75 mm (3.533—3.534 in.)
Oil Pump	
Minimum Rotor Shaft O.D.	
Large O.D.	12.63 mm (0.497 in.)
Small O.D.	7.94 mm (0.313 in.)
Maximum Rotor Shaft Bearing I.D.	
Oil Pump Cover	12.76 mm (0.502 in.)
Crankcase Cover	8.07 mm (0.318 in.)
Outer Rotor	
Minimum Thickness	11.92 mm (0.470 in.)
Minimum O.D.	28.95 mm (1.140 in.)
Outer Rotor Bearing	
Maximum Depth	12.14 mm (0.478 in.)
Maximum I.D.	29.20 mm (1.149 in.)
Minimum Valve Spring Free Length	19.00 mm (0.750 in.)

GROUP 25—IGNITION AND CHARGING SYSTEM

Ignition Coil Air Gap 0.30 mm (0.012 in.)

See Ignition Tests in this Group.

GROUP 30—STARTING SYSTEMS

Electric Starter

See Starter Specifications in this Group.

MX,4000A1,A7 -19-21OCT92

FC540V REPAIR SPECIFICATIONS**GROUP 05—FUEL AND AIR SYSTEMS**

Item	Specification
Breather	
Air Gap	1—2 mm (0.040—0.080 in.)

GROUP 10—BLOWER HOUSING AND FLYWHEEL

Flywheel Nut Torque	172 N·m (127 lb-ft)
Minimum Flywheel Screen Gap	1.5 mm (0.059 in.)

GROUP 15—CYLINDER HEAD AND VALVES

Valve Clearance	0.15 mm (0.006 in.)
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Rocker Arm	
Minimum Shaft O.D.	12.94 mm (0.509 in.)
Maximum Bearing I.D.	13.07 mm (0.515 in.)

Push Rod	
Intake Pushrod Lift	7.240 mm (0.2850 in.)
	(wear min.) 6.878 mm (0.2708 in.)
Exhaust Pushrod Lift	7.240 mm (0.2850 in.)
	(wear min.) 6.878 mm (0.2708 in.)
Maximum Bend	0.30 mm (0.012 in.)

Valves and Springs	
Intake Valve Lift (W/Clearance set at 0.00)	9.343 mm (0.3714 in.)
	(wear min.) 8.962 mm (0.3528 in.)
Exhaust Valve Lift (W/Clearance set at 0.00)	9.343 mm (0.3714 in.)
	(wear min.) 8.962 mm (0.3528 in.)
Minimum Spring Free Length	37.50 mm (1.476 in.)
Maximum Valve Guide I.D.	7.07 mm (0.278 in.)
Maximum Valve Stem Bend	0.03 mm (0.001 in.)
Valve Seating Surface	1.10—1.46 mm (0.043—0.057 in.)
Valve Seat and Face Angle	45°
Minimum Valve Margin	0.60 mm (0.020 in.)
Valve Narrowing Angle	30°

Continued on next page

MX,4000A1,A8 -19-21OCT92

GROUP 20—CYLINDER BLOCK AND INTERNAL COMPONENTS

Item	Specification
Cylinder Head	
Cylinder Head Flatness	0.05 mm (0.002 in.)
Cap Screw Torque In Sequence (Lubricated)	
Initial Torque	32 N·m (24 lb-ft)
Final Torque	52 N·m (38 lb-ft)
Spark Plug Torque	20 N·m (177 lb-in.)
Crankcase Cover	
Oil Capacity	
With Filter	1.8 L (3.80 pt)
Without Filter	1.6 L (3.40 pt)
Cap Screw Torque	20 N·m (177 lb-in.)
Camshaft	
Minimum End Journal O.D.	20.91 mm (0.823 in.)
Minimum Lobe Height	37.10 mm (1.461 in.)
Maximum Bearing I.D.	21.08 mm (0.830 in.)
Reciprocating Balancer	
Link Rod	
Minimum Journal O.D.	57.94 mm (2.281 in.)
Maximum Small End I.D.	12.60 mm (0.475 in.)
Maximum Large End I.D.	58.15 mm (2.289 in.)
Bushing Depth	1.00 mm (0.040 in.)
Balancer Weight	
Maximum Bearing I.D.	26.10 mm (1.027 in.)
Bushing Depth	0.50 mm (0.02 in.)
Support Shaft	
Minimum Shaft O.D.	25.93 mm (1.021 in.)
Balancer Bushing Assy. Torque	7.3 N·m (65 lb-in.)
Piston	
Maximum Ring Groove Clearance	
Top Ring	0.17 mm (0.007 in.)
Second Ring	0.15 mm (0.006 in.)
Oil Ring	1.30 mm (0.051 in.)
Minimum Ring End Gap	0.8 mm (0.007 in.)
Maximum Ring End Gap	
Compression Rings	0.90 mm (0.035 in.)
Oil Ring Side Rails	0.20 mm (0.008 in.)
Minimum Pin O.D.	21.98 mm (0.865 in.)
Maximum Pin Bore I.D.	22.04 mm (0.868 in.)
Maximum Piston-to-Piston Pin Clearance	0.06 mm (0.003 in.)
Piston O.D.	88.83—88.864 mm (3.4885—3.4984 in.)
Piston-to-Cylinder Bore Clearance	0.110—0.151 mm (0.0043—0.0059 in.)

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MX,4000A1,A9 -19-21OCT92

GROUP 20—CYLINDER BLOCK AND INTERNAL COMPONENTS—CONTINUED

Item	Specification
Connecting Rod	
Maximum Crankshaft Bearing I.D.	41.07 mm (1.617 in.)
Maximum Piston Pin Bearing I.D.	22.06 mm (0.868 in.)
Maximum Connecting Rod-to-Piston Pin Clearance	0.08 mm (0.003 in.)
Maximum Connecting Rod-to-Crankpin Clearance	0.14 mm (0.006 in.)
End-Cap Screw Torque	20 N·m (177 lb-in.)
Crankshaft	
Minimum PTO Side Journal O.D.	37.90 mm (1.492 in.)
Minimum Connecting Rod Journal O.D.	40.93 mm (1.611 in.)
Maximum Crankcase Cover Plain Bearing I.D.	38.06 mm (1.498 in.)
Maximum T.I.R.	0.05 mm (0.002 in.)
End Play	0.09—0.22 mm (0.004—0.009 in.)
PTO Side Oil Seal Depth	0.50 mm (0.020 in.)
Cylinder Bore	
Standard Cylinder Bore I.D.	89.98—89.00 mm (3.503—3.504 in.)
Maximum Cylinder Bore I.D.	89.08 mm (3.507 in.)
Rebore Cylinder	
Oversize Diameter	
0.25 mm	89.21—89.23 mm (3.512—3.513 in.)
0.50 mm	89.46—89.48 mm (3.522—3.523 in.)
0.75 mm	89.71—89.73 mm (3.532—3.533 in.)
Oil Pump	
Minimum Rotor Shaft O.D.	12.63 mm (0.497 in.)
Maximum Rotor Shaft Bearing I.D.	12.76 mm (0.502 in.)
Outer Rotor	
Minimum Thickness	9.92 mm (0.391 in.)
Minimum O.D.	40.47 mm (1.596 in.)
Outer Rotor Bearing	
Minimum Depth	10.17 mm (0.401 in.)
Maximum I.D.	40.77 mm (1.605 in.)
Minimum Valve Spring Free Length	19.00 mm (0.750 in.)

GROUP 25—IGNITION AND CHARGING SYSTEM

Ignition Coil Air Gap	0.30 mm (0.012 in.)
---------------------------------	---------------------

See Ignition Tests in this Group.

GROUP 30—STARTING SYSTEMS

Electric Starter

See Starter Specifications in this Group.

SERVICE PARTS KITS

The following kits are available through your parts catalog:

Fuel Pump Gasket Kit—FC400V/FC420V/FC540V

Carburetor

Gasket Kit

Needle Valve

Float Kit

Choke Shaft Kit

Throttle Shaft Kit

Breather Valve Kit

Air Cleaner Assembly

Main Jet High Altitude Kit

MX,4005A1,A1 -19-21OCT92

REMOVE AND INSTALL FUEL PUMP

CAUTION: Gasoline is dangerous. Avoid fires due to smoking or careless maintenance practices.

1. Disconnect vacuum line (A) and fuel lines (B). Close all openings using caps and plugs.
2. Remove fuel pump.
3. Inspect pump for wear or damage. Repair or replace as necessary.
4. Install fuel pump.
5. Connect vacuum and fuel lines.

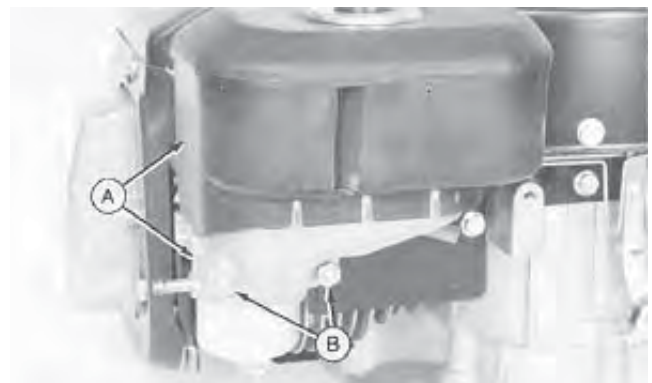


M54481 -UN-25SEP90

MX,4005A1,A2 -19-21OCT92

REMOVE AND INSTALL CARBURETOR—FC290V

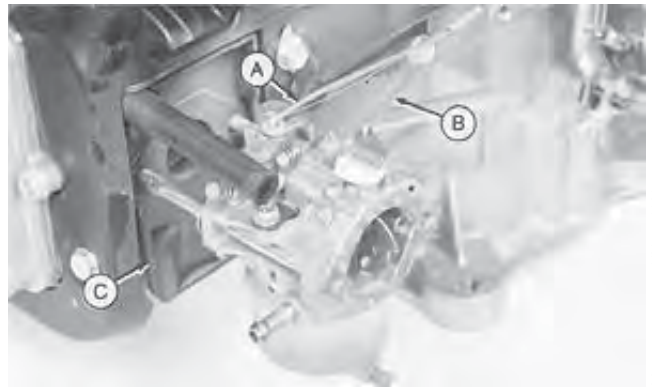
1. Remove two nuts (B) and air cleaner assembly (A).



M80000 -UN-09JAN91

MX,4005A1,A3 -19-21OCT92

2. Separate carburetor from heat shield (C). Remove carburetor.
3. Disconnect choke linkage (B) and throttle linkage (A).
4. Remove heat shield (C) and gaskets.
5. Make repairs as necessary. (See procedure in this group.)
6. Install gaskets and heat shield.
7. Connect linkage and install carburetor.
8. Install air cleaner assembly.



M80001
-UN-09JAN91



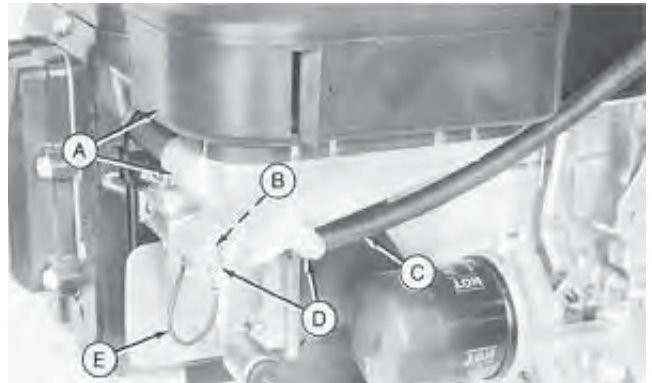
M80002
-UN-09JAN91

MX,4005A1,A4 -19-21OCT92

REMOVE AND INSTALL CARBURETOR—FC400V/FC420V

1. Disconnect fuel hose (C).
2. Remove two nuts (D) and washer (B).
3. Disconnect wiring lead (E).
4. Remove air cleaner assembly (A).

A—Air Cleaner Assembly
B—Washer
C—Fuel Hose
D—Nuts
E—Ground Wiring Lead



M80003
-UN-09JAN91

MX,4005A1,A5 -19-21OCT92

5. Separate carburetor from heat shield (C). Remove carburetor.

6. Disconnect choke linkage (B) and throttle control linkage (A).

7. Remove heat shield (C) and gaskets.

8. Make repairs as necessary. (See procedure in this group.)

9. Install gaskets and heat shield.

10. Connect linkage and install carburetor.

NOTE: Install gasket (D) with hole (E) pointing toward fuel inlet side of carburetor and tab (F) pointing up.

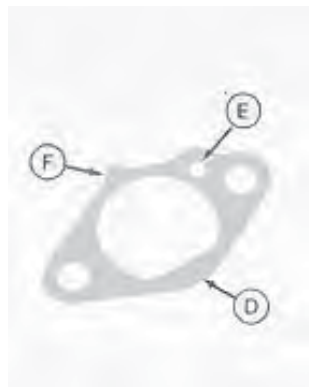
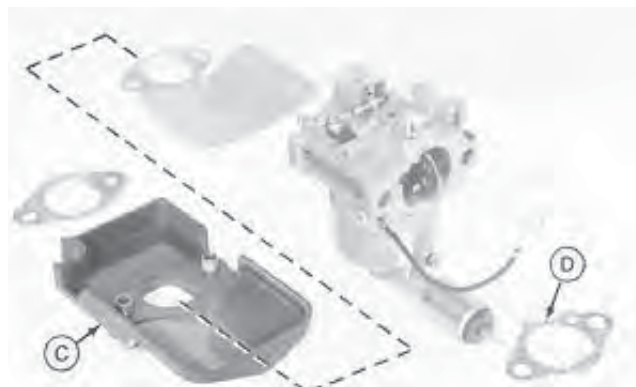
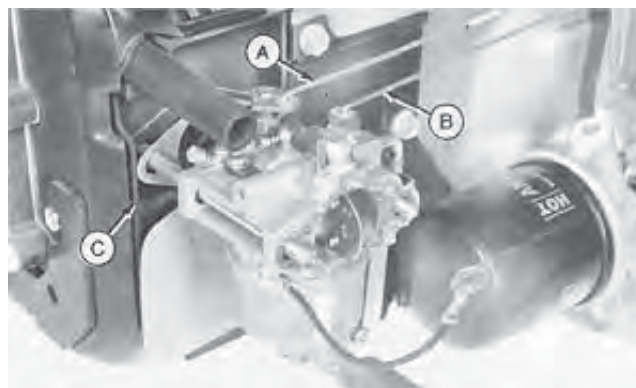
11. Install gasket (D) and air cleaner assembly.

12. Connect wiring lead.

13. Install washer and two nuts.

14. Connect fuel hose.

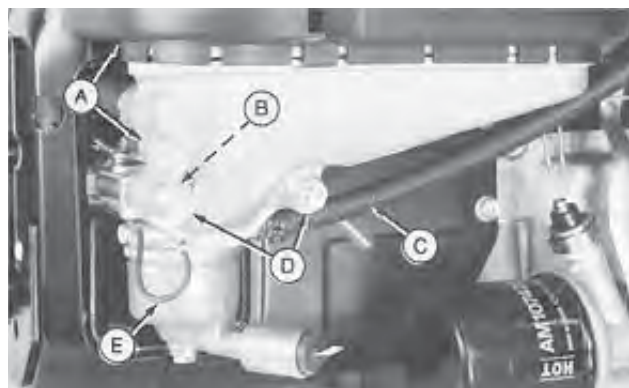
A—Throttle Control Linkage
B—Choke Linkage
C—Heat Shield
D—Gasket
E—Hole
F—Tab



REMOVE AND INSTALL CARBURETOR—FC540V

1. Disconnect fuel hose (C).
2. Remove two nuts (D) and washer (B).
3. Disconnect wiring lead (E).
4. Remove air cleaner assembly (A).

A—Air Cleaner Assembly
B—Washer
C—Fuel Hose
D—Nuts
E—Ground Wiring Lead



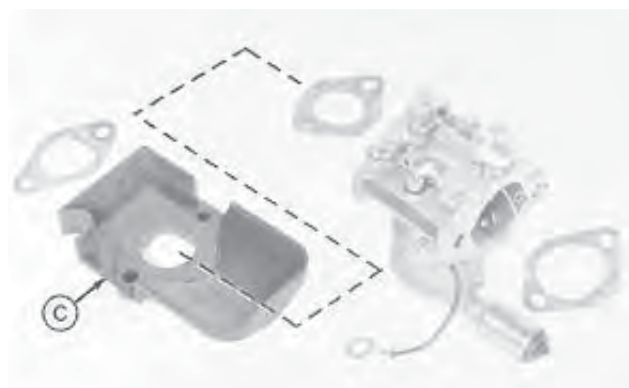
M54484
-UN-09JAN91

MX,4005A1,A7 -19-21OCT92

5. Separate carburetor from heat shield (C). Remove carburetor.
6. Disconnect choke linkage (B) and throttle control linkage (A).
7. Remove heat shield (C) and gaskets.
8. Make repairs as necessary. (See procedure in this group.)
9. Install gaskets and heat shield.
10. Connect linkage and install carburetor.
11. Install air cleaner assembly.
12. Connect wiring lead.
13. Install washer and two nuts.
14. Connect fuel hose.



M54485
-UN-09JAN91



M80007
-UN-20DEC90

MX,4005A1,A8 -19-21OCT92

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DISASSEMBLE, CLEAN, INSPECT AND ASSEMBLE CARBURETOR

NOTE: FC400V, FC420V and FC540V engines are equipped with a fuel control solenoid.

FC540V engines with engine tag number BS00, pilot jet is pressed in.

IMPORTANT: To remove float, use a long nosed pliers on end of pin. Do not strike opposite end of pin. Damage to pin holder may result.

Do not clean holes or passages with small drill bits or wire.

1. Soak carburetor body and all parts, except gaskets, float and plastic rings, in carburetor cleaning solvent for 1/2 hour maximum.

2. Spray all passages with a carburetor cleaning spray to verify that all internal passages are open.

IMPORTANT: Rinse carburetor body in warm water to neutralize corrosive action of cleaner on aluminum.

3. Rinse carburetor with warm water and dry with compressed air. Do not use rags or paper to dry parts: lint may plug holes or passages.

4. Inspect all parts for wear or damage, replace as necessary.

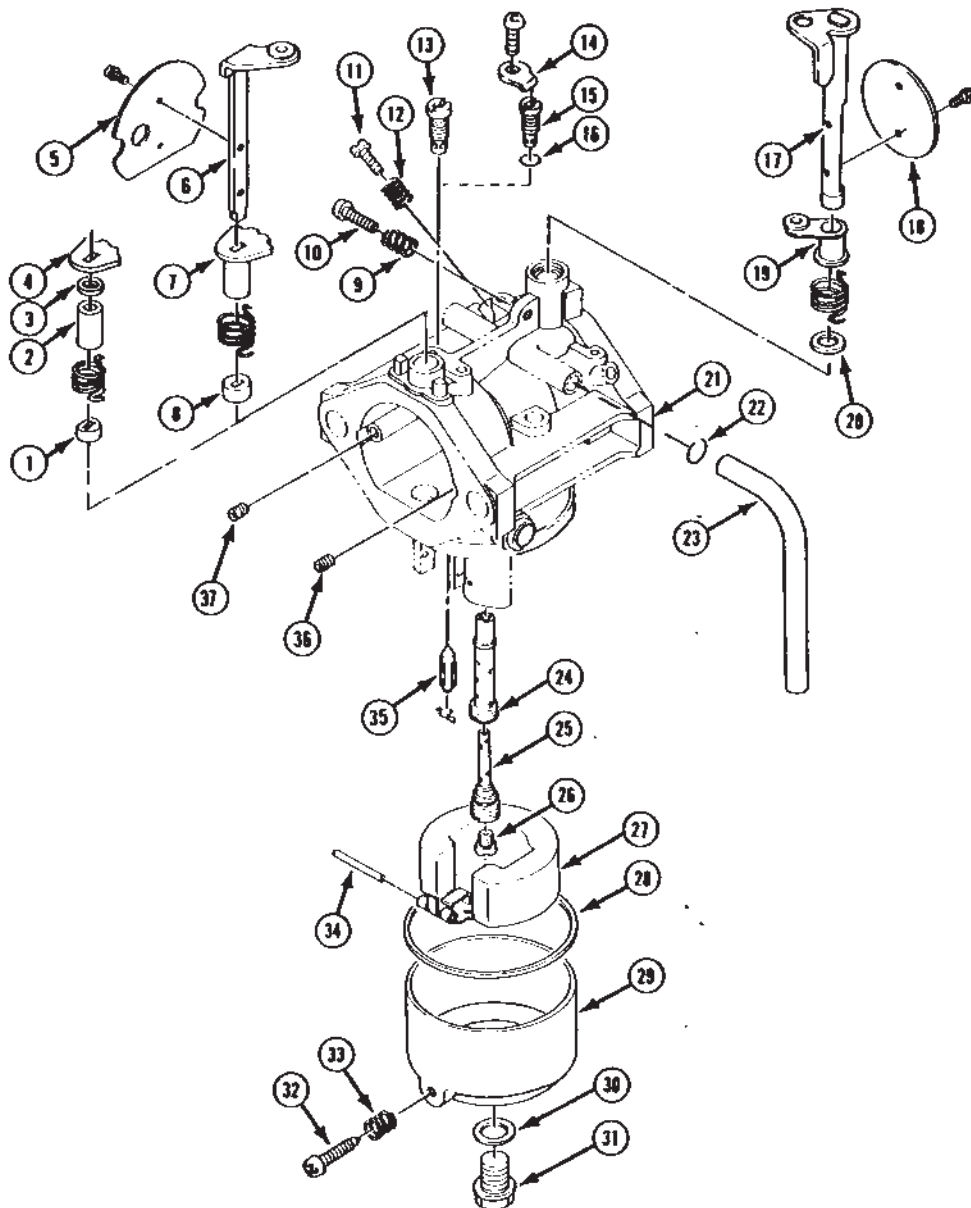
NOTE: Main jet high altitude kits are available.

Float is plastic. The float cannot be adjusted. Replace if necessary.

Use this procedure when referring to the following three exploded views.

MX,4005A1,A12 -19-21OCT92

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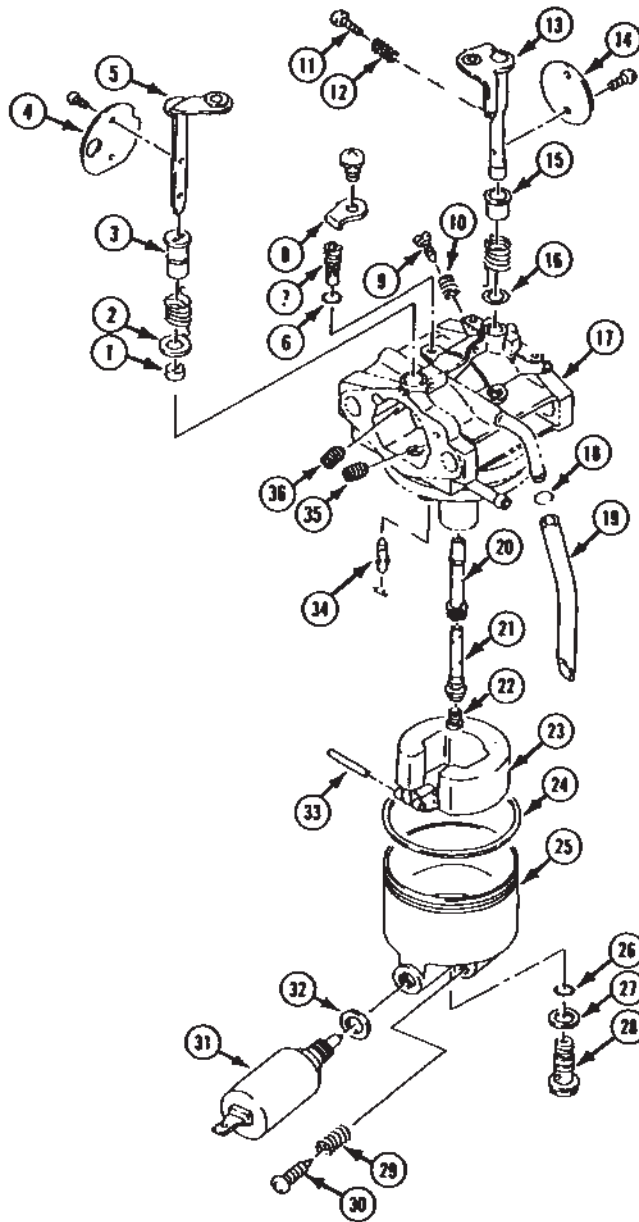
- | | | | |
|---------------|----------------------|--------------------|------------------|
| 1—Collar* | 11—Pilot Screw | 20—Seal | 29—Float Chamber |
| 2—Collar | 12—Spring | 21—Carburetor Body | 30—Washer |
| 3—Seal | 13—Pilot Jet* | 22—Clamp | 31—Plug |
| 4—Plate* | 14—Plate | 23—Hose | 32—Drain Screw |
| 5—Choke Plate | 15—Fixed Pilot Jet** | 24—Main Nozzle | 33—Spring |
| 6—Choke Shaft | 16—O-Ring | 25—Bleed Pipe | 34—Float Pin |
| 7—Plate** | 17—Throttle Shaft | 26—Main Jet | 35—Needle Valve |
| 8—Collar** | 18—Throttle Plate | 27—Float | 36—Air Jet |
| 9—Spring | 19—Ring | 28—Gasket | 37—Pilot Air Jet |
| 10—Idle Screw | | | |

FC290V

* Used without fixed pilot jet

** Used with fixed pilot jet

40-05-6
M80008 -UN-09/JAN/91

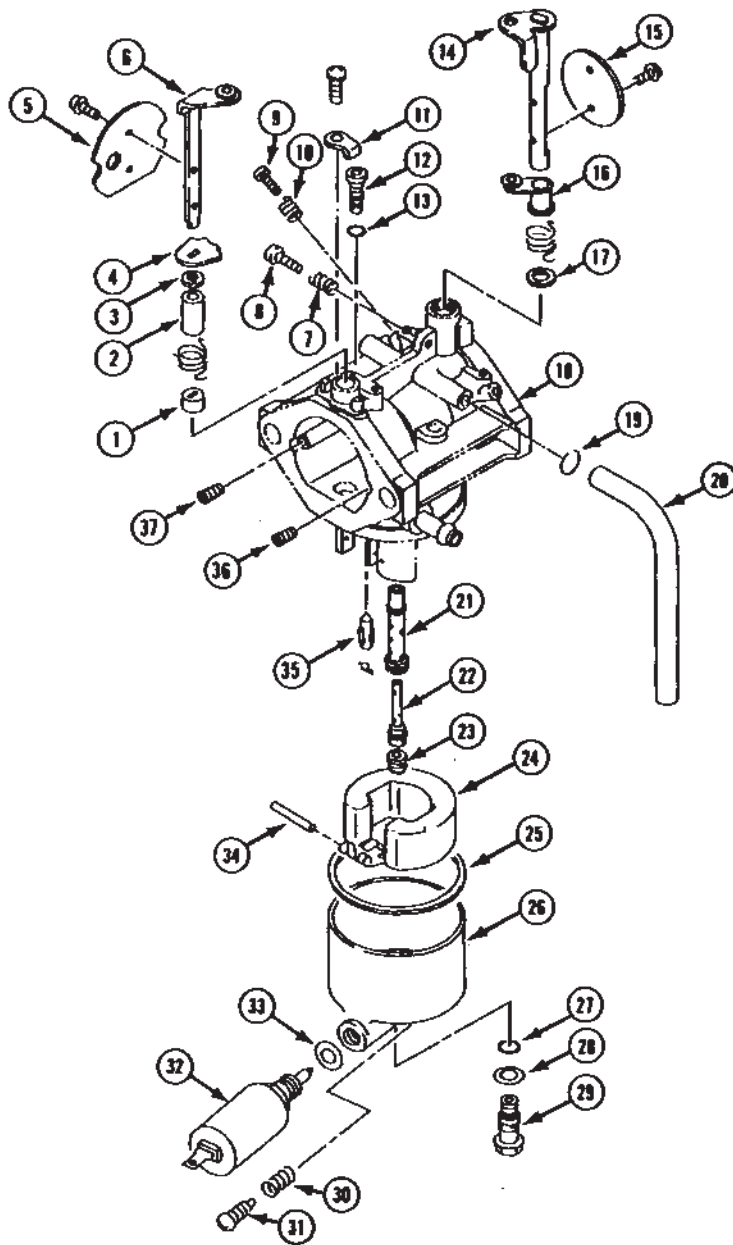


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|---------------|--------------------|------------------|--------------------------|
| 1—Collar | 10—Spring | 19—Hose | 28—Plug |
| 2—Seal | 11—Idle Screw | 20—Main Nozzle | 29—Spring |
| 3—Collar | 12—Spring | 21—Bleed Pipe | 30—Drain Screw |
| 4—Choke Plate | 13—Throttle Shaft | 22—Main Jet | 31—Fuel Shutoff Solenoid |
| 5—Choke Shaft | 14—Throttle Plate | 23—Float | 32—Washer |
| 6—O-Ring | 15—Ring | 24—Gasket | 33—Float Pin |
| 7—Pilot Jet | 16—Seal | 25—Float Chamber | 34—Needle Valve |
| 8—Plate | 17—Carburetor Body | 26—O-Ring | 35—Air Jet |
| 9—Pilot Screw | 18—Clamp | 27—Washer | 36—Pilot Air Jet |

FC400V/FC420V

JUN-09/JAN-91
40-05-7
M80009

MX,4005A1,A10 -19-21OCT92



- | | | | |
|---------------|--------------------|------------------|--------------------------|
| 1—Collar | 11—Plate | 20—Hose | 29—Plug |
| 2—Collar | 12—Pilot Jet | 21—Main Nozzle | 30—Spring |
| 3—Seal | 13—O-Ring | 22—Bleed Pipe | 31—Drain Screw |
| 4—Plate | 14—Throttle Shaft | 23—Main Jet | 32—Fuel Shutoff Solenoid |
| 5—Choke Plate | 15—Throttle Plate | 24—Float | 33—Washer |
| 6—Choke Shaft | 16—Ring | 25—Gasket | 34—Float Pin |
| 7—Spring | 17—Seal | 26—Float Chamber | 35—Needle Valve |
| 8—Idle Screw | 18—Carburetor Body | 27—O-Ring | 36—Air Jet |
| 9—Pilot Screw | 19—Clamp | 28—Washer | 37—Pilot Air Jet |
| 10—Spring | | | |

FC540V

M80010 -UN-09/JAN91

MX,4005A1,A11 -19-21OCT92

SERVICE BREATHER

NOTE: Breather is located in cylinder block of FC290V engine, and in cylinder heads of FC400V, FC420V and FC540V engines.

1. FC290V: Remove blower housing. (See Group 10.)

Remove breather cover.

FC400V/FC420V/FC540V: Remove rocker arm cover.

2. Measure air gap between reed valve (A) and valve seat (B) at valve tip. Replace reed valve if gap exceeds specification.

3. Remove breather valve (C).

4. Inspect breather for sticking, binding, cracks or distortion. Replace breather if worn or damaged.

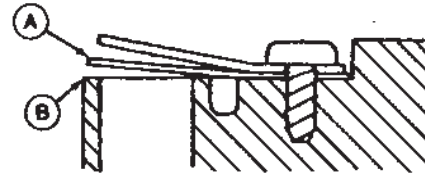
5. Inspect valve seating surface. Surface must be free of nicks or burrs.

NOTE: On FC290V engine, check that drain back slot in breather chamber is open.

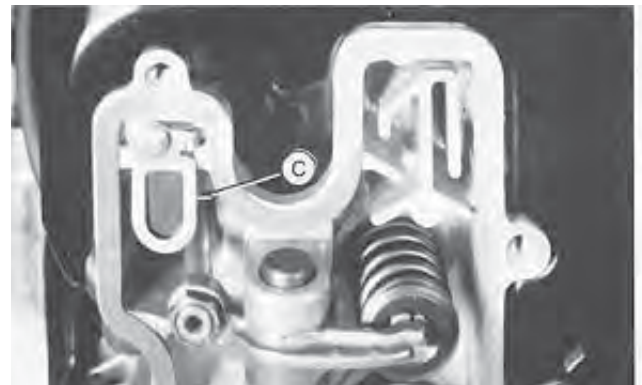
6. Install breather assembly.

AIR GAP SPECIFICATIONS (MAX)

FC290V	0.20 mm (0.008 in.)
FC400V/FC420V/FC540V	1—2 mm (0.040—0.080 in.)



FC290V



FC400V/FC420V/FC540V

MX,4005A1,A13 -19-21OCT92

-UN-07SEP88

M51757

-UN-09JAN91

M54498

-UN-09JAN91

M54486

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SERVICE AIR CLEANER

NOTE: Replace elements yearly or every 25 hours as required.

1. Remove and disassemble air cleaner.

IMPORTANT: Do not clean elements with solvent or compressed air.

2. Wash foam element (A) in detergent and water. Dry element.

3. Put 12—15 drops of engine oil on foam element (A). Squeeze out excess oil.

4. Gently tap paper element (B) to remove dust:
 - Element is still usable if you can see light through element and paper appears clean.
 - Install new element if element is oily, dirty, bent, torn, crushed, or obstructed in any way.

5. Inspect body (C), gasket (D), and base (E) for damage. Replace if necessary.

IMPORTANT: Any time air cleaner base is removed, check for free choke operation during reassembly.

6. Assemble and install air cleaner.



FC290V



FC400V/FC420V/FC540V

A—Foam Element
B—Paper Element
C—Body
D—Gasket
E—Base

-UN-09JAN91

M54487

-UN-09JAN91

M80157

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05
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MX,4005A1,A14 -19-21OCT92

SERVICE PARTS KITS

The following kits are available through your parts catalog:

Blower Housing Engine Cover Kit

Decal Kit

Flywheel Screen and Spacer Kit

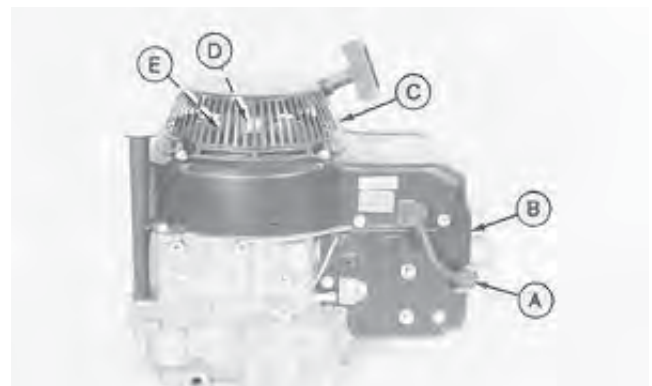
Dipstick Tube Kit

MX,4010A1,A0 -19-21OCT92

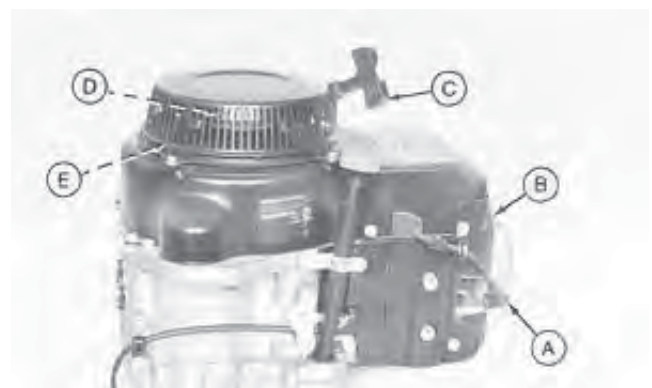
REMOVE AND INSTALL BLOWER HOUSING—RECOIL START

1. Disconnect spark plug cap (A).
2. Remove air cleaner assembly.
3. FC400V/FC420V: Remove fuel pump. (See Group 05.)
4. Remove cover (B).
5. Remove recoil starter (C), cup (D), screen (E) and spacer(s).
6. Remove blower housing and dipstick tube.
7. Install dipstick tube, blower housing, spacer(s) screen and cup.
8. Adjust flywheel screen. (See this group.)
9. Install recoil starter and cylinder head cover.
10. FC400V/FC420V: Install fuel pump.
11. Install air cleaner assembly.

A—Spark Plug Cap
B—Cover
C—Recoil Starter
D—Starter Cup
E—Screen



FC290V



FC400V/FC420V

M51481 -UN-31AUG88

M80158 -UN-09JAN91

MX,4010A1,A1 -19-21OCT92

REMOVE AND INSTALL BLOWER HOUSING—ELECTRIC START

1. Disconnect spark plug cap (A).
2. Remove air cleaner assembly.
3. Remove fuel pump. (See Group 05.)
4. Remove cover (B).

NOTE: On FC290V, remove dipstick tube after blower housing removal.

5. Remove dipstick tube (C).
6. Remove protector (D) and screen (E).
7. Remove blower housing (F).
8. Install blower housing, screen and protector.
9. Adjust flywheel screen. (See this group.)
10. Install cylinder head cover and dipstick tube.
11. Install fuel pump.
12. Install air cleaner assembly.



FC290V



FC400V/FC420V/FC540V

A—Spark Plug Cap
B—Cylinder Head Cover
C—Dipstick Tube
D—Protector
E—Screen
F—Blower Housing

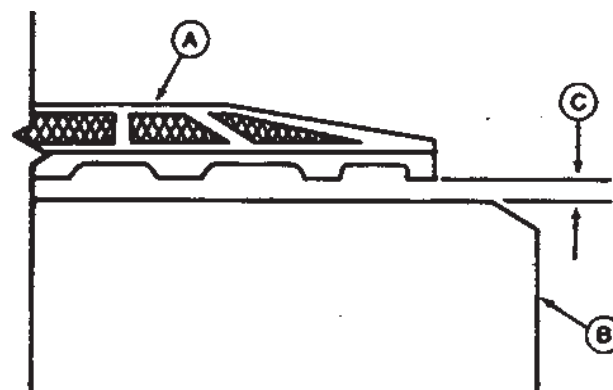
MX,4010A1,A2 -19-21OCT92

FLYWHEEL SCREEN ADJUSTMENT

Adjust gap (C) between the blades under screen (A) and blower housing (B) to specifications using spacers.

SPECIFICATIONS

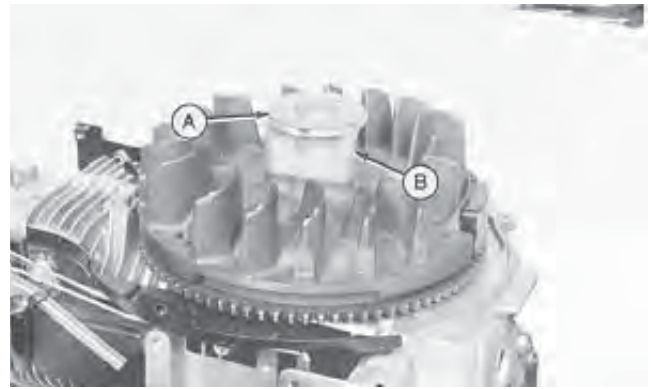
Minimum Gap 1.5 mm (0.059 in.)



MX,4010A1,A2A -19-21OCT92

REMOVE AND INSTALL FLYWHEEL—FC290V

1. Remove armature with coil. (See Group 25.)
2. Remove shims (A) and bracket (B).
3. Hold flywheel and remove nut and washer.
4. Remove flywheel using a flywheel puller.
5. Install flywheel, washer and nut. Tighten nut to 85 N·m (63 lb-ft).
6. Install bracket and shims.
7. Install armature with coil.

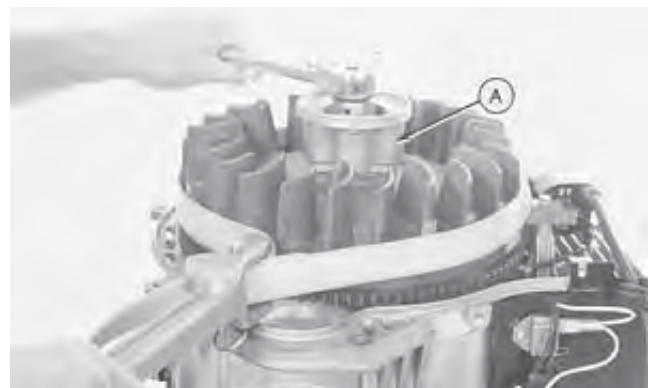


M80160 -UN-09JAN91

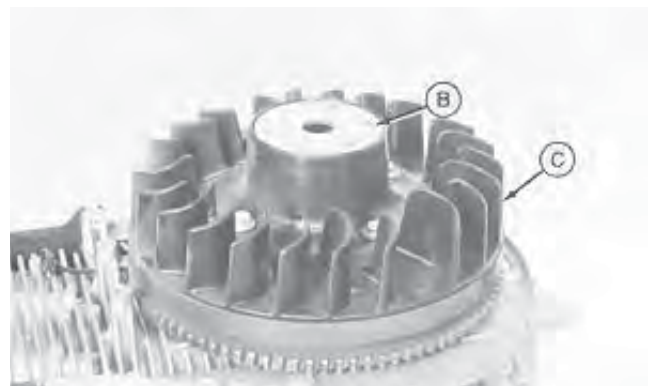
MX,4010A1,A3 -19-21OCT92

REMOVE AND INSTALL FLYWHEEL—FC400V/FC420V/FC540V

1. Remove armature with coil. (See Group 25.)
2. Remove shims (B).
3. Hold flywheel and remove nut.
4. Remove bracket (A) or fan (C), if equipped.
5. Remove flywheel using a flywheel puller.
6. Install flywheel and bracket, if equipped.
7. Install nut. Tighten nut to specifications.
8. Install fan, if equipped.
9. Install shims.
10. Install armature with coil.



M50051 -UN-31AUG88



M80161 -UN-09JAN91

TORQUE SPECIFICATIONS

FC400V/FC420V	137 N·m (101 lb-ft)
FC540V	172 N·m (127 lb-ft)

MX,4010A1,A3A -19-21OCT92

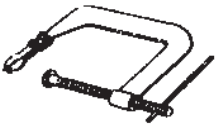
SPECIAL OR ESSENTIAL TOOLS

NOTE: Order tools according to information given in the U.S. SERVICE-GARD™ Catalog or in the European Microfiche Tool Catalog (MTC).

DX,TOOLS -19-05JUN91

Valve Spring Compressor JDM70

Remove and install valve springs.



MX,JDM70 -19-21OCT92

Valve Guide Driver Tool JDG504

Replace valve guide bushings.

MX,JDG504 -19-21OCT92

OTHER MATERIAL

Number	Name	Use
	SCOTCH-BRITE® Abrasive Sheets/Pads	Clean Cylinder Head
	Valve Guide Cleaner	Clean Valve Guides
	Stanisol (or Kerosene)	Finish Ream Valve Guide
	Prussian Blue Compound	Check Valve Seat Contact

SCOTCH-BRITE is a trade mark of the 3M Company.

MX,4015A1,A1 -19-21OCT92

SERVICE PARTS KITS

The following kits are available through your parts catalog:

Rocker Arm and Shaft Kit

Intake Valve Kit

Exhaust Valve Kit

MX,4015A1,A1 -19-21OCT92

REMOVE AND INSTALL ROCKER ARM ASSEMBLY

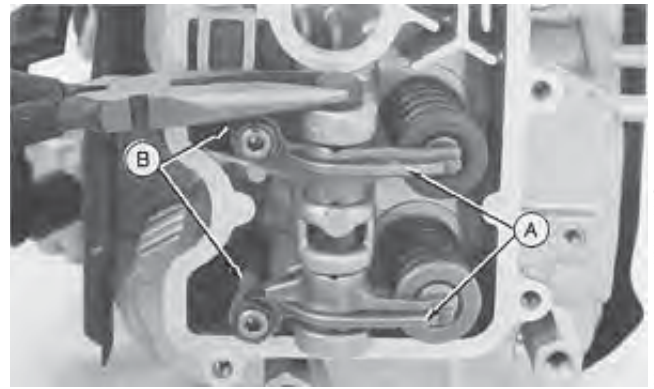
1. Remove rocker arm cover.
2. Turn crankshaft until piston is at highest position in compression stroke.
3. Remove rocker shaft and arms (A).

IMPORTANT: Mark push rods for reassembly in original locations.

4. Remove push rods (B).

IMPORTANT: Align rocker arms over push rods during assembly.

5. Install push rods and rocker arm assemblies.
6. Check valve clearance. (See this group.)



M50027
-UN-31AUG88

MX,4015A1,A2 -19-21OCT92

INSPECT ROCKER ARM ASSEMBLY

Measure outside diameter of rocker shaft and inside diameter of rocker arm bearing. Replace if not according to specifications.

SPECIFICATIONS

Minimum Shaft O.D.	12.94 mm (0.509 in.)
Maximum Arm I.D.	13.07 mm (0.515 in.)



M50028
-UN-31AUG88



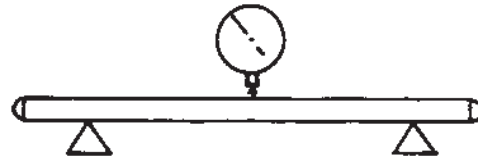
M50029
-UN-31AUG88

MX,4015A1,A3 -19-21OCT92

Inspect push rod for bend using V-blocks and a dial indicator. Turn rod slowly and read variation on indicator. Replace if variation is greater than specification.

SPECIFICATION

Push Rod Bend (MAX) 0.30 mm (0.012 in.)



MX,4015A1,A3A -19-21OCT92

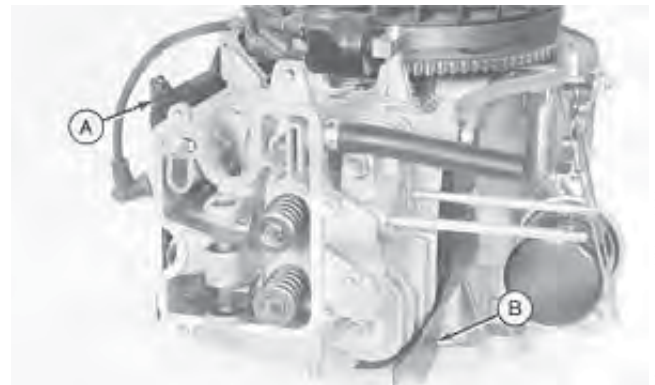
M50044 -UN-31AUG88

REMOVE AND INSTALL CYLINDER HEAD ASSEMBLY

1. Remove blower housing. (See Group 10.)
2. Remove carburetor. (See Group 05.)
3. Remove rocker arm assembly. (See this group.)
4. Remove shields (A and B).
5. Remove spark plug.
6. Remove cylinder head assembly.
7. Make repairs as necessary. (See procedures in this group.)



FC290V



FC400V/FC420V/FC540V

MX,4015A1,A4 -19-21OCT92

M54488 -UN-09JAN91

M80162 -UN-09JAN91

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IMPORTANT: Gasket surfaces are coated with sealant. Do not damage surfaces or gasket during installation.

8. Install cylinder head assembly with new gasket. Install cap screws and tighten finger tight.

9. Tighten cap screws in sequence shown. Tighten to initial torque specifications.

10. On FC290V continue in sequence, 3 N·m (27 lb-in.) at a time, until final torque is as specified.

On FC400V, FC420V and FC540V, continue in sequence, 7 N·m (62 lb-in.) at a time, until final torque is as specified.

11. Install spark plug and tighten to specification.

12. Install shields.

13. Check valve clearance. (See this group.)

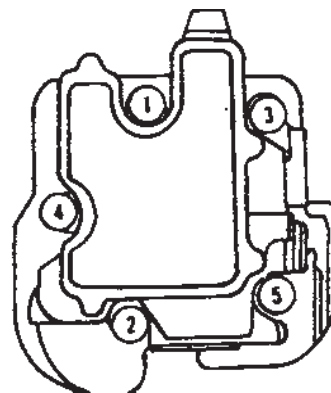
TORQUE SPECIFICATIONS

Initial Torque

FC290V	18 N·m (159 lb-in.)
FC400V/FC420V/FC540V	32 N·m (24 lb-ft)

Final Torque

FC290V	24 N·m (212 lb-in.)
FC400V/FC420V/FC540V	52 N·m (38 lb-ft)
Spark Plug	20 N·m (177 lb-in.)



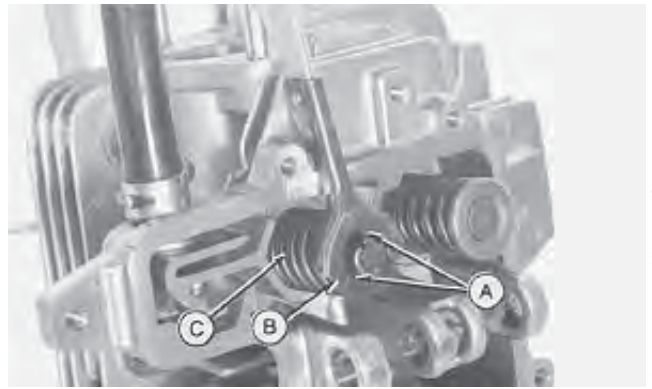
-UN-31AUG88

M50046

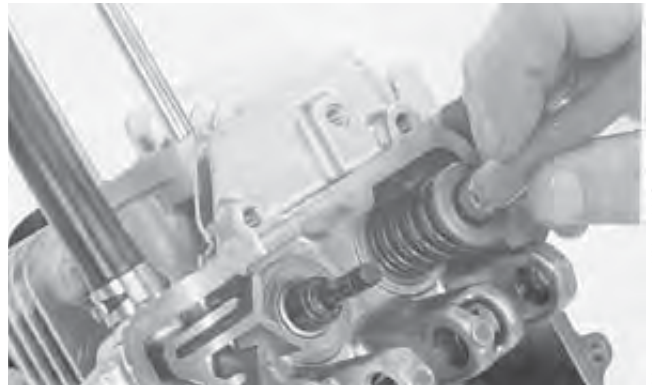
MX,4015A1,A5 -19-21OCT92

REMOVE AND INSTALL VALVES AND SPRINGS

1. Remove cylinder head. (See this group.)
2. Compress intake valve spring with JDM70 Valve Spring Compressor and remove collet halves (A).
3. Remove spring retainer (B) and spring (C).
4. Remove exhaust valve rotator with a magnet.
5. Support exhaust valve from below and press down on spring retainer.
6. Remove retainer, spring and valves.
7. Inspect and replace stem seals as necessary. (See this group.)
8. Inspect and analyze valves. (See Section 100, Group 05.)
9. Inspect springs, valves, guides and seats. (See procedures in this group.)
10. Install valves, springs, and retainers.



M50033 -UN-31AUG88



M50034 -UN-31AUG88

MX,4015A1,A6 -19-21OCT92

INSPECT AND REPLACE STEM SEALS

Remove valves and springs. (See this group.)

IMPORTANT: Bottom spring retainer can only be removed with valve stem seal. Removal of retainer or seal damages stem seal. Inspect seal. If seal is not damaged, do not remove it.

If necessary to replace stem seal, remove with screwdriver.



M50111 -UN-31AUG88

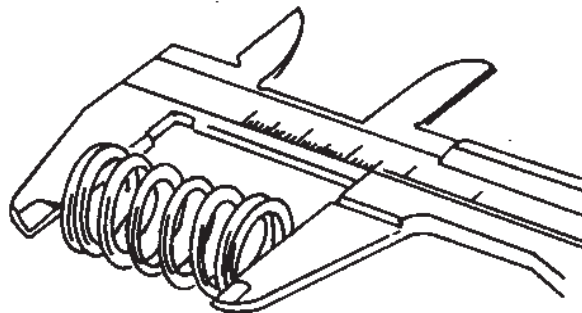
MX,4015A1,A7 -19-21OCT92

INSPECT SPRINGS

Inspect spring free length. Replace if damaged or if less than specifications.

FREE LENGTH SPECIFICATIONS (MIN)

FC290V	31.00 mm (1.220 in.)
FC400V/FC420V/FC540V	37.50 mm (1.476 in.)



M50036 -UN-31AUG88

MX,4015A1,A8 -19-21OCT92

INSPECT CYLINDER HEAD

1. Remove carbon deposits from combustion chamber and gasket surface using SCOTCH-BRITE abrasive pads or an equivalent.
2. Clean head with solvent.
3. Inspect for cracks or broken cooling fins.
4. Inspect gasket surface for burrs and nicks.
5. Inspect head gasket for burns and traces of gas leakage. Replace if necessary.
6. Check that oil drainback passages are not plugged.
7. Put cylinder head on a surface plate. Check for distortion at several points around the head using a feeler gauge. Replace head if distortion is more than specifications.



M50032 -UN-31AUG88

SPECIFICATIONS

Cylinder Head Distortion (Max)	0.05 mm (0.002 in.)
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MX,4015A1,A9 -19-21OCT92

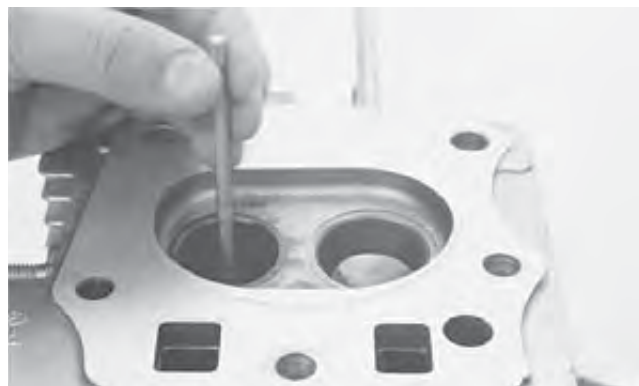
INSPECT VALVE GUIDES

Clean inside of valve guides with valve guide cleaner.

Measure inside diameter of valve guides or bushings. Replace bushing if inside diameter is greater than specifications. (See this group.)

SPECIFICATIONS (MAX) I.D.

Intake and Exhaust	7.07 mm (0.278 in.)
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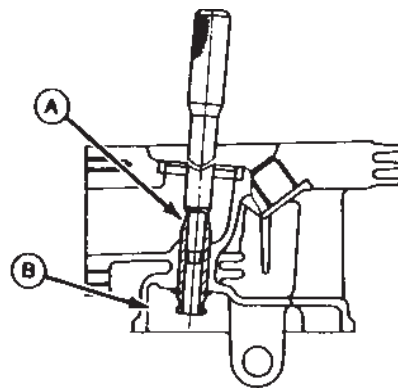


M50037 -UN-31AUG88

MX,4015A1,A10 -19-21OCT92

REPLACE VALVE GUIDE BUSHINGS

1. Drive valve guide bushing (A) into valve chamber (B) using JDG-504 Valve Guide Driver.

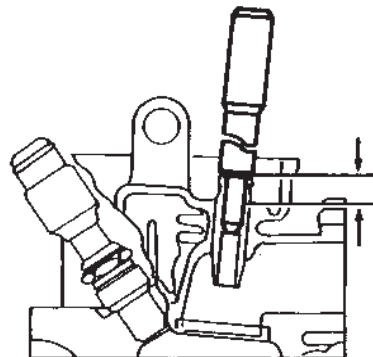


MX,4015A1,A10A -19-21OCT92

M50038
-UN-06APR91

2. Clean carbon deposits from valve guide port.

3. Install new bushing with valve guide driver. Drive in from valve chamber side to an installation depth of 12 mm (0.472 in.) for the FC400V/FC420V and 9.5 mm (0.37 in.) for the FC540V.



MX,4515A1,A9A -19-21OCT92

M50039
-UN-15OCT92

4. Finish reaming valve guide bushings with stanisol or kerosene lubricant and a 7 mm valve guide reamer. Turn reamer clockwise.

5. Thoroughly clean valve area before assembly.

BUSHING FINISHED I.D. SPECIFICATIONS

Valve Guide 7—7.02 mm (0.275—0.276 in.)



M98,2015A,A21 -19-21OCT92

M50040
-UN-31AUG88

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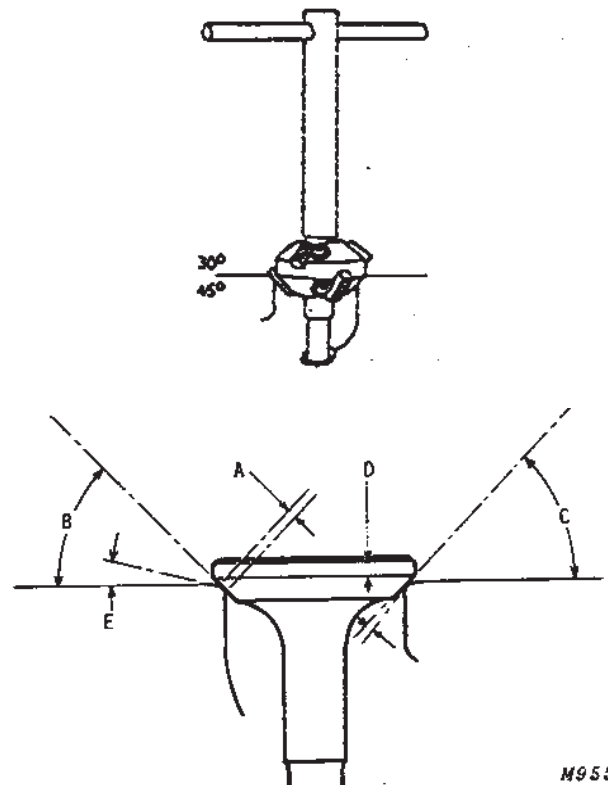
RECONDITION VALVE SEATS

1. Inspect valve seats for damage. If seats are loose, warped or distorted beyond reconditioning, replace cylinder head. Pitted or worn seats can be refaced using a seat cutter.
2. To recondition valve seat, cut at 45° angle (B) to clean up seat. Cut narrowing angle (E) at 30°. Finish cut at 45° (B) to establish seating surface width (A).
3. Cut valve seating surface (A) as close as possible to specifications.
4. Lap valves to seats after refacing. (See Section 100, Group 05.)

SPECIFICATIONS

A—Valve Seating Surface:

FC290V	0.50—1.10 mm (0.020—0.043 in.)
FC400V/FC420V	1.10—1.46 mm (0.043—0.057 in.)
FC540V	1.10—1.46 mm (0.043—0.057 in.)
B—Valve Seat Angle	45°
C—Valve Face Angle	45°
D—Valve Margin	0.60 mm (0.020 in.)
E—Valve Narrowing Angle	30°

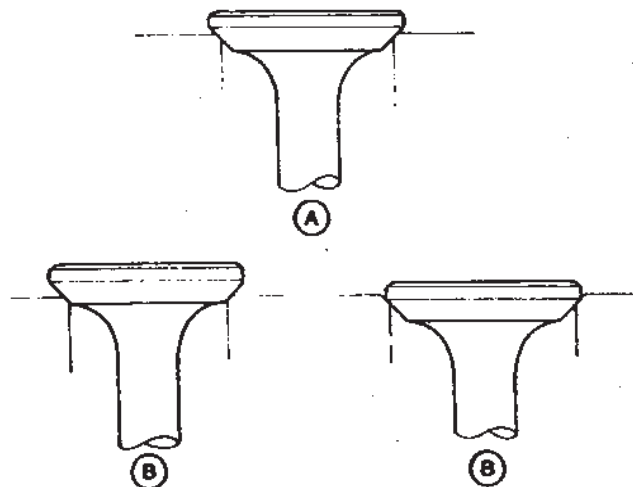


M955

MX,4015A1,A11 -19-21OCT92

5. Center valve seat on the valve face:
—(A) shows correct position.
—(B) shows incorrect.

6. Check seat for good contact using Prussion Blue Compound.



M18615

-UN-07SEP88

M9552

-UN-01SEP88

M51558

-UN-31AUG88

CHECK VALVE CLEARANCE

NOTE: Valve repair changes valve clearance. Check valve clearance. Adjust if needed.

- 1. Turn crankshaft until piston is at highest position in compression stroke.
- 2. Measure clearance.



M50048 -UN-31AUG88

M98,2015A,AJ -19-26MAR86

- 3. If necessary, adjust clearance to specifications.

SPECIFICATIONS

Valve Clearance 0.15 mm (0.006 in.)



M50049 -UN-31AUG88

MX,4015A1,A12 -19-21OCT92

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OTHER MATERIAL

Number	Name	Use
	Lithium Base Grease	Pack oil seals.
	Zinc Oxide/Wood Alcohol	Check block for cracks.

MX,4020A1,A1 -19-21OCT92

SERVICE PARTS KITS

The following kits are available through your parts catalogue.

Camshaft and Tappet Kt

Camshaft Axial Play Shim Kit—FC290V and FC540V

Piston Ring Kit

Oversized Pistons

Oversized Piston Rings

Undersized Connecting Rod

Crankshaft End Play Shim Kit

Cylinder Block

Overhaul Gasket Kit

Short Block Kit

Oil Slinger Kit—FC290V

Oil Pump Kit—FC400V, FC420V and FC540V

Governor and Shaft Kit

MX,4020A1,A2 -19-21OCT92

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1

REMOVE AND INSTALL CRANKCASE COVER

NOTE: Approximate crankcase oil capacity is:

FC290V1.0L (2.11 pt)

FC400V/FC420V

Without Filter1.3L (2.74 pt)

With Filter1.5L (3.17 pt)

FC540V

Without Filter1.6L (3.38 pt)

With Filter1.8L (3.80 pt)

1. Drain crankcase.
 2. Remove crankcase cover and gasket.
 3. Clean crankcase and crankcase cover gasket surfaces.
- NOTE:** Do not force cover. Gears must mesh for proper positioning.
4. Install gasket and cover. Tighten cap screws using the sequence shown.

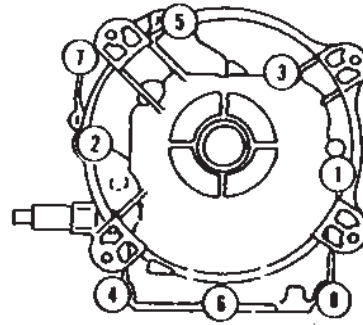
TORQUE SPECIFICATIONS

Mounting Cap Screws

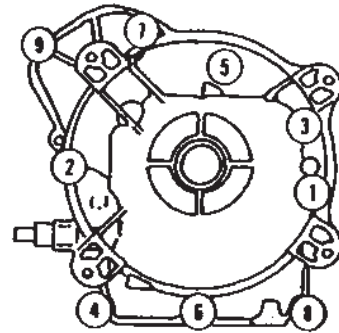
FC290V 20 N·m (177 lb-in.)

FC400V/FC420V/FC540V 26 N·m (230 lb-in.)

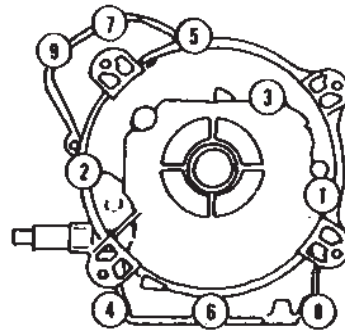
Oil Drain Plug 23 N·m (200 lb-in.)



FC290V



FC400V/FC420V



FC540V

MX,4020A1,A3 -19-21OCT92

-UN-09JAN91

M54489

-UN-09JAN91

M54490

-UN-06APR91

M80237

REMOVE AND INSTALL CAMSHAFT

1. Remove crankcase cover. (See this group.)

IMPORTANT: Align timing marks to prevent damage to tappets when removing camshaft.

2. Rotate crankshaft until timing marks (A) align.

3. Remove camshaft (B).

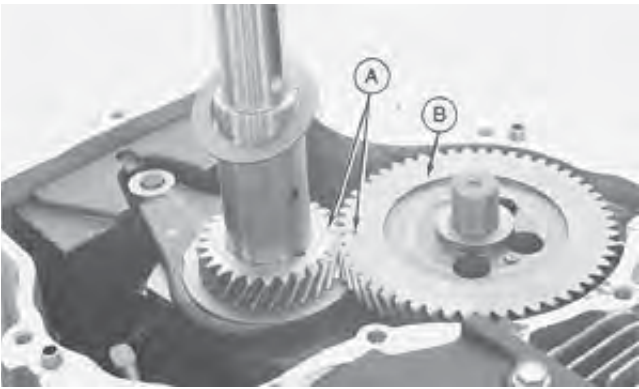
4. Inspect camshaft. (See this group.)

5. Apply clean engine oil to camshaft lobes and journals.

6. Align timing marks and install camshaft.

7. On FC540V (S/N —014454) and FC290V engines, adjust camshaft axial play. (See this group.)

8. Install crankcase cover.



M50056
-UN-31AUG88

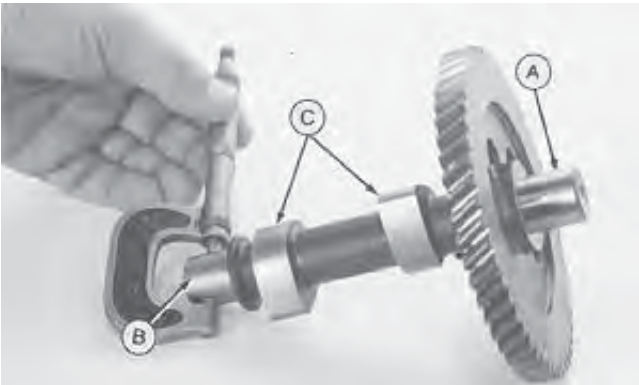
MX,4020A1,A4 -19-21OCT92

INSPECT CAMSHAFT

Inspect camshaft for worn or broken teeth.

*NOTE: Camshaft and tappets are a matched set.
Replace both camshaft and tappets if necessary.*

Measure PTO side journal (A), flywheel side journal (B), and lobes (C). Replace camshaft and tappets if less than specifications.



M50057
-UN-31AUG88
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SPECIFICATIONS (MIN)

	PTO Side Journal	Flywheel Side Journal	Cam Lobes
FC290V	13.92 mm (0.548 in.)	15.92 mm (0.627 in.)	27.08 mm (1.066 in.)
FC400V/ FC420V	20.91 mm (0.823 in.)	19.91 mm (0.784 in.)	36.75 mm (1.447 in.)
FC540V	20.91 mm (0.823 in.)	20.91 mm (0.823 in.)	37.10 mm (1.461 in.)

MX,4020A1,A5 -19-21OCT92

INSPECT CAMSHAFT PLAIN BEARINGS

1. Remove camshaft. (See this group.)
2. Measure camshaft bearings in cylinder block and crankcase cover. Replace block or cover if diameter is greater than specification.
3. Install camshaft.

SPECIFICATIONS (MAX)

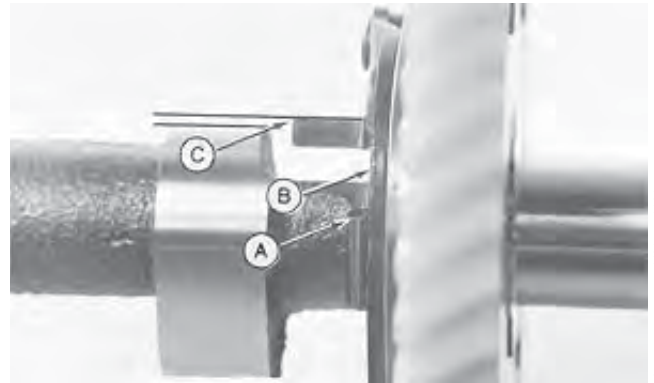
	Cylinder Block Bearing	Crankcase Cover Bearing
FC290V	16.06 mm (0.632 in.)	14.05 mm (0.553 in.)
FC400V/ FC420V	20.08 mm (0.790 in.)	21.08 mm (0.830 in.)
FC540V	21.08 mm (0.830 in.)	21.08 mm (0.830 in.)

*Cylinder Block**Crankcase Cover*

MX,4020A1,A6 -19-21OCT92

-UN-09JAN91
M54492-UN-09JAN91
M54491**INSPECT AUTOMATIC COMPRESSION RELEASE (A.C.R.)**

1. Remove camshaft. (See this group.)
2. Inspect automatic compression release (A.C.R.) for damage.
3. Inspect spring (A). Replace if worn or damaged.
4. Move weight(s) (B) by hand to check for proper operation.
5. On FC400V, FC420V and FC540V engines, check that tab (C) sits slightly above cam lobe when weights are released. Tab should drop below cam when weights are operated.

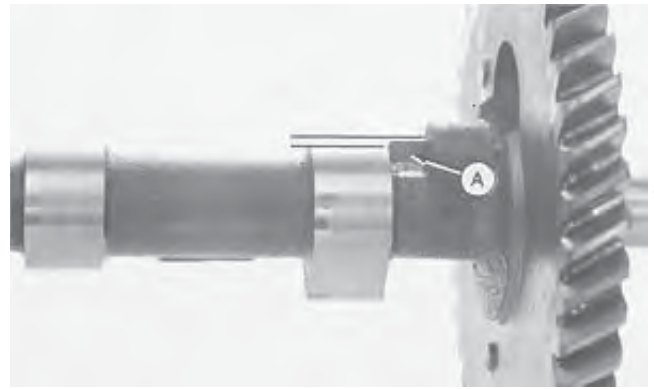
-UN-09JAN91
M54493

MX,4020A1,A7 -19-21OCT92

6. On FC290V engines, check that tab (A) sits just above cam lobe when weight is released. Tab should rotate 90° and drop below cam lobe when weight is operated.

7. Replace camshaft if it does not operate properly.

8. Install camshaft.



MX,4020A1,A8 -19-21OCT92

M50058
-UN-31AUG88

REMOVE, INSPECT AND INSTALL TAPPETS

1. Remove camshaft. (See this group.)

NOTE: Mark tappets so they can be installed in their original bores during assembly.

2. Remove tappets (A).

3. Inspect tappets for wear or damage. Replace if necessary.

4. Apply clean engine oil to tappets and bores.

5. Install tappets in original bores.

6. Install camshaft.



MX,4020A1,A9 -19-21OCT92

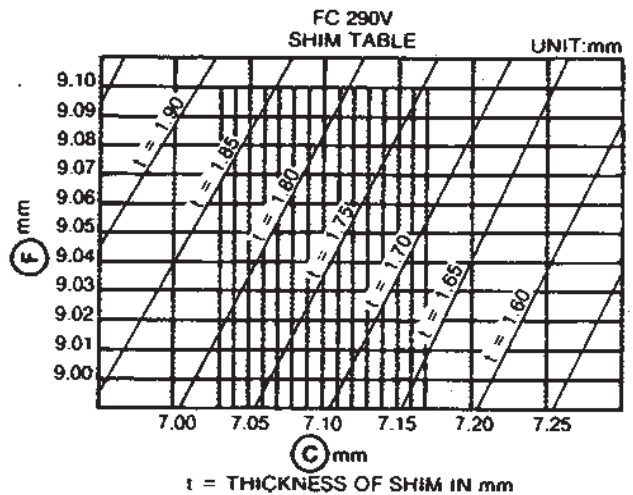
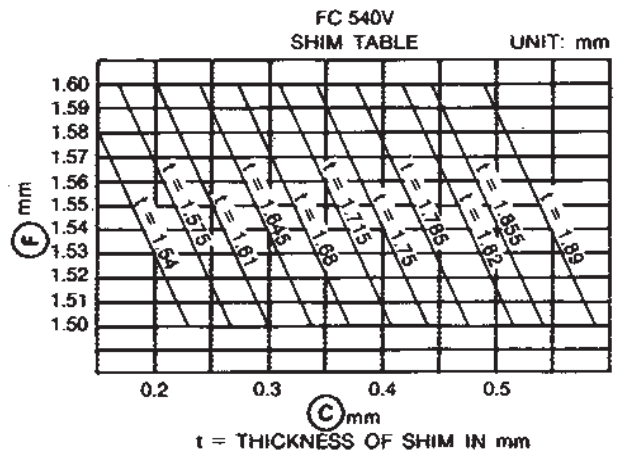
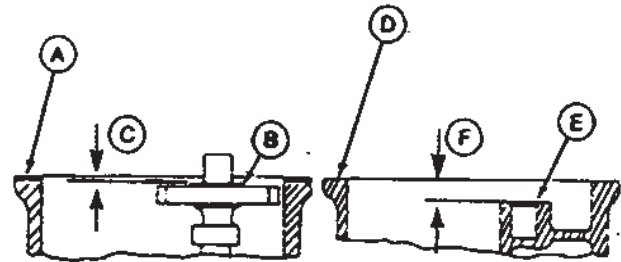
M38092
-UN-29AUG88

ADJUST CAMSHAFT AXIAL PLAY—FC290V AND FC540V

1. With gasket (A) installed on crankcase, measure from gasket surface to cam gear timing flange (B). Record this measurement (C).
2. Measure from crankcase cover mounting face (D) to camshaft bearing end (E). Record this measurement (F).
3. Locate measurements on appropriate table. Follow lines to where recorded measurements intersect. Choose the next smaller shim from the table.

Install shim to cam gear timing flange (B).

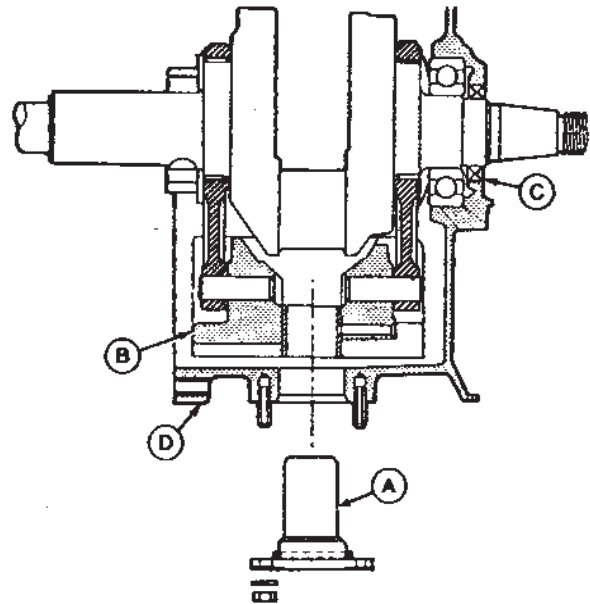
- A—Gasket
B—Timing Flange
C—Measurement
D—Cover Mounting Face
E—Bearing End
F—Measurement



MX,4020A1,A10 -19-21OCT92

REMOVE AND INSTALL RECIPROCATING BALANCER

1. Remove flywheel. (See Group 10.)
2. Remove camshaft. (See this group.)
3. Remove piston. (See this group.)
4. Remove support shaft (A).
5. Remove crankshaft with balancer assembly (B).
6. Make repairs as necessary. (See procedures in this group.)
7. Inspect oil seals. (See this group.)
8. Cover keyway on flywheel end of crankshaft with tape to prevent damage to seal (C) when installing assembly.
9. Put light film of oil on crankshaft bearing surfaces.
10. Install balancer assembly with crankshaft into crankcase (D).
11. Tighten balancer nut to 7 N·m (65 lb-in.).
12. Align balancer weight in crankcase and install support shaft.
13. Adjust crankshaft end play. (See this group.)



A—Support Shaft
B—Balancer Assembly
C—Seal
D—Crankcase

M51758 -JUN-07SEP88

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MX,4020A1,A11 -19-21OCT92

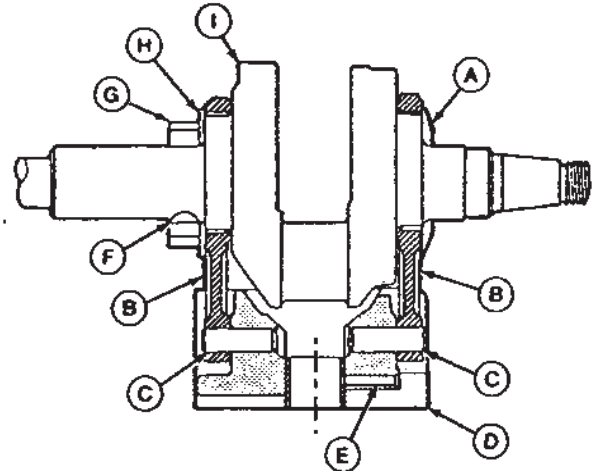
DISASSEMBLE AND ASSEMBLE RECIPROCATING BALANCER

NOTE: On FC290V engine, spacer (H) is governor drive gear.

1. Remove collar (A), gear (G) key (F) and gear or spacer (H).
2. Remove rods (B) and crankshaft (I).
3. Inspect crankshaft. (See this group.)
4. Inspect balancer assembly. (See this group.)
5. Put a light film of oil on bearing surfaces.

NOTE: Oil grooves of link rods (B) must face away from crankwebs.

6. Install balance weight to crankshaft with oil hole (E), if equipped, facing flywheel side.
7. Install collar (A).
8. Install gear or spacer (H) with chamfered face toward link rod.
9. Install key and crank gear.



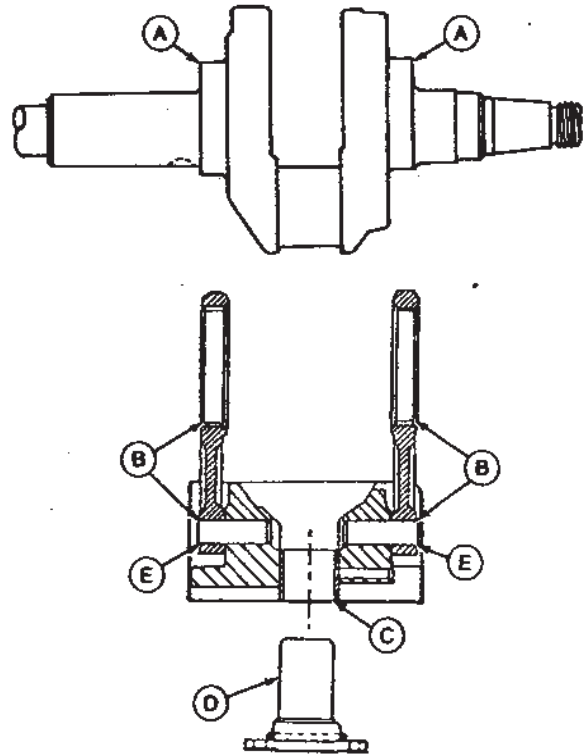
- A—Collar
- B—Link Rod
- C—Wrist Pin
- D—Balance Weight
- E—Oil Hole
- F—Woodruff Key
- G—Crank Gear
- H—Spacer or Gear
- I—Crankshaft

M51759 -UN-07SEP88

MX,4020A1,A12 -19-21OCT92

INSPECT BALANCER ASSEMBLY

1. Clean and inspect all parts for wear or damage. Replace parts, if necessary.
 2. Measure crankshaft journals (A). Replace crankshaft if diameter is less than specifications.
 3. Measure inside diameter of bearings (B). Replace link rod if small end is greater than specifications. Replace bushing if large end is greater than specifications. (See this group.)
- NOTE: FC290V engine is not equipped with a replaceable support shaft bushing. If bearing is worn, replace weight.*
4. Measure inside diameter of support shaft bearing (C). If bearing is greater than specifications, replace bushing, if equipped. (See this group.)
 5. Measure support shaft diameter (D). Replace shaft if diameter is less than specification.
 6. Inspect wrist pins (E) for any damage. If necessary, replace weight.



DIAMETER SPECIFICATIONS

Link Rod Journal O.D. (MIN)	
FC290V	46.86 mm (1.845 in.)
FC400V/FC420V	53.95 mm (2.124 in.)
FC540V	57.94 mm (2.281 in.)
Link Rod Small End I.D. (MAX)	
All	12.06 mm (0.475 in.)
Link Rod Large End I.D. (MAX)	
FC290V	47.12 mm (1.855 in.)
FC400V/FC420V	54.12 mm (2.131 in.)
FC540V	58.15 mm (2.289 in.)
Support Shaft O.D. (MIN)	
All	25.93 mm (1.021 in.)
Support Shaft Bearing I.D. (MAX)	
All	26.10 mm (1.027 in.)

A—Link Rod Journals
 B—Link Rod Bearings
 C—Shaft Bearing
 D—Support Shaft
 E—Wrist Pins

MX,4020A1,A13 -19-21OCT92

M51760 -JUN-07SEP88

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REPLACE BALANCER BUSHINGS

NOTE: Remove bushings with a bearing driver or a press.

Remove link rod bushings with oil groove side facing up.

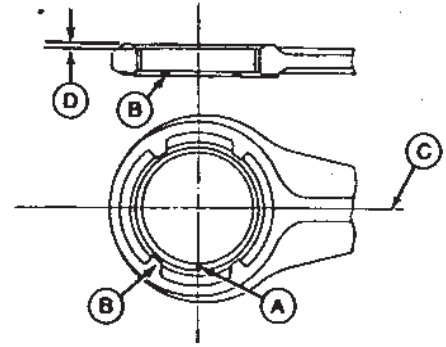
1. Remove bushings.
2. Install link rod bushings with seam (A) at a 90° angle to centerline (C).

NOTE: On FC400V, FC420V and FC540V engines, install bushing from opposite side of oil grooves (B).

3. Install bushing below surface to specifications.

SPECIFICATIONS

Bushing Depth (D) 1.00 mm (0.040 in.)



A—Bushing Seam
B—Oil Grooves
C—Link Rod Centerline
D—Measurement

MX,4020A1,A14 -19-21OCT92

M51681 -UN-31AUG88

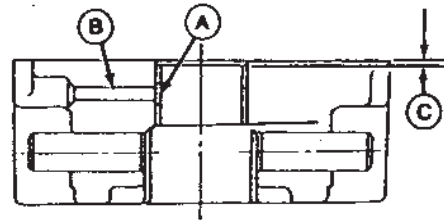
FC400V, FC420V and FC540V:

4. Align oil hole (A) in bushing and oil passage (B) in weight. Install bushing.

5. Install bushing below surface to specifications.

SPECIFICATIONS

Bushing Depth (C) 0.50 mm (0.020 in.)

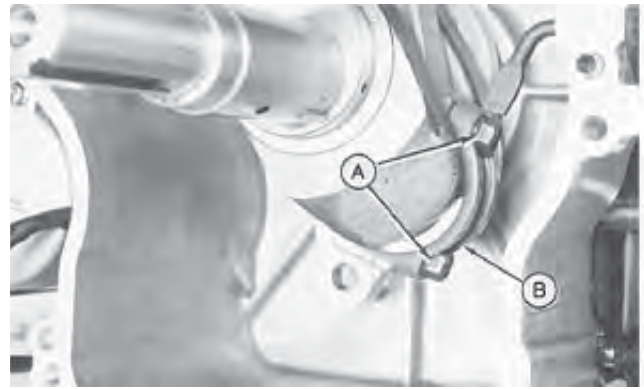


M98,2030A,A7 -19-21OCT92

M51725 -UN-07SEP88

REMOVE AND INSTALL PISTON AND CONNECTING ROD

1. Remove cylinder head. (See Group 15.)
2. Remove crankcase cover. (See this group.)
3. Remove carbon and varnish from top of cylinder bore with a ridge reamer.
4. Remove cap screws (A) and connecting rod cap (B).
5. Push piston and connecting rod from cylinder bore.
6. Make repairs as necessary. (See procedures in this group.)



M54494 -UN-09JAN91

MX,4020A1,A15 -19-21OCT92

7. Deglaze cylinder bore. (See Section 100, Group 15.)
8. Stagger piston ring end gaps 180° apart, but do not align with oil ring side rail end gaps.
9. Apply a light film of oil to piston and rings. Compress rings with a ring compressor.
10. Apply a light film of oil to cylinder bore, connecting rod bearing surface and cap screws.
11. Install piston assembly in cylinder bore with engraved match mark/arrow on piston head facing flywheel side of engine.
12. Install connecting rod cap and cap screws. Tighten cap screws to specifications.



M50074 -UN-31AUG88

TORQUE SPECIFICATIONS

All 20 N·m (177 lb-in.)

MX,4020A1,A16 -19-21OCT92

DISASSEMBLE, INSPECT AND ASSEMBLE PISTON AND CONNECTING ROD

1. Remove circlip, piston pin (A) and connecting rod (B).
2. Inspect all parts for wear or damage. Replace as necessary. (See procedures in this group.)
3. Apply a light film of oil to piston pin and connecting rod bearing.



MX,4020A1,A17 -19-21OCT92

M50063 -UN-31AUG88

4. Align arrow match mark (A) on piston head with MADE IN JAPAN (B) on connecting rod, or if piston is marked with R and L align the R on the piston with the Japanese characters on the connecting rod.
5. Install piston pin and circlip.



MX,4020A1,A18 -19-21OCT92

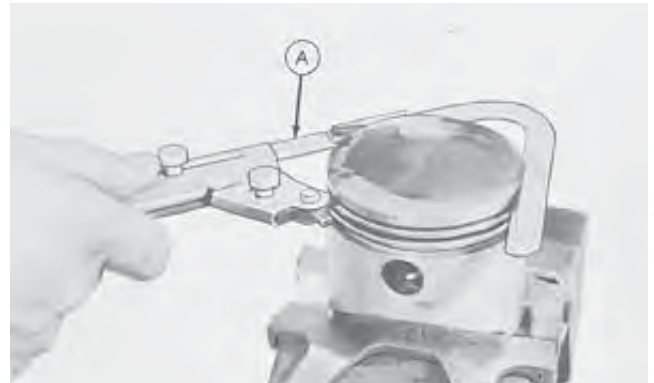
M38111 -UN-29AUG88

INSPECT PISTON

1. Analyze piston and piston ring wear. (See Section 100, Group 10.)
2. Remove piston rings. (See this group.)

IMPORTANT: Do not use a caustic cleaning solution or a wire brush to clean piston.

3. Remove all deposits from the piston.
4. Clean carbon from piston ring grooves with a ring groove cleaner (A). If cleaning tool is not available, break an old ring and use it carefully to clean groove.
5. Check that oil return passages in grooves are open.



MX,4020A1,A19 -19-21OCT92

M29946 -UN-06SEP88

6. Inspect piston for scoring or fractures. Replace piston if damaged.

NOTE: Inspect clearance visually. Replace piston if clearance appears excessive.

7. Check ring grooves for wear at several points around piston. Replace piston if clearance is greater than specification.

CLEARANCE SPECIFICATION (MAX)

	Top Ring	Second Ring	Oil Control Ring
FC290V	0.16 mm (0.006 in.)	0.14 mm (0.005 in.)	0.19 mm (0.007 in.)
FC400V/ FC420V/ FC540V	0.17 mm (0.007 in.)	0.15 mm (0.006 in.)	0.20 mm (0.008 in.)



M38102 -UN-29AUG88

MX,4020A1,A20 -19-21OCT92

8. Measure piston pin outer diameter. Replace if less than specification.

9. Measure piston pin bore. Replace piston if measurement is greater than specification.

SPECIFICATIONS

	Piston Pin O.D. (MIN)	Piston Bore I.D. (MAX)
FC290V	18.98 mm (0.747 in.)	19.03 mm (0.749 in.)
FC400V/ FC420V/ FC540V	21.98 mm (0.865 in.)	22.04 mm (0.868 in.)



M50064 -UN-31AUG88



M50065 -UN-31AUG88

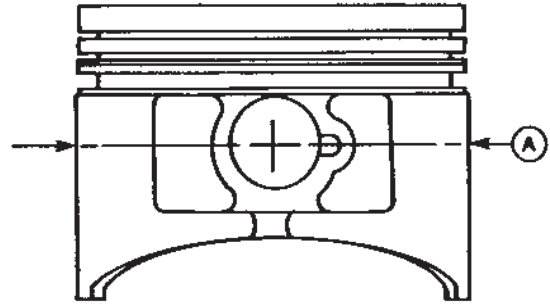
MX,4020A1,A21 -19-21OCT92

10. Measure piston O.D. (A) perpendicular to piston pin bore.

11. Measure cylinder bore. (See Inspect Block in this group.)

12. Subtract piston O.D. measurement (A) from cylinder bore measurement to determine piston-to-cylinder bore clearance.

13. Replace piston and/or rebore cylinder block if not within specifications. (See this group.)



SPECIFICATIONS

Piston O.D. (A)

FC290V	77.85—77.87 mm (3.0649—3.0657 in.)
FC400V	86.83—86.864 mm (3.4185—3.4192 in.)
FC420V	88.83—88.85 mm (3.4885—3.498 in.)
FC540V	88.83—88.864 mm (3.4885—3.4984 in.)

Piston-to-Cylinder Bore Clearance

FC290V	0.142 mm (0.0056 in.)
FC400V	0.13—0.151 mm (0.005—0.0059 in.)
FC420V	0.13—0.151 mm (0.005—0.0059 in.)
FC540V	0.110—0.151 mm (0.0043—0.0059 in.)

MX,4020A1,A21A -19-21OCT92

-UN-06APR91
M80398

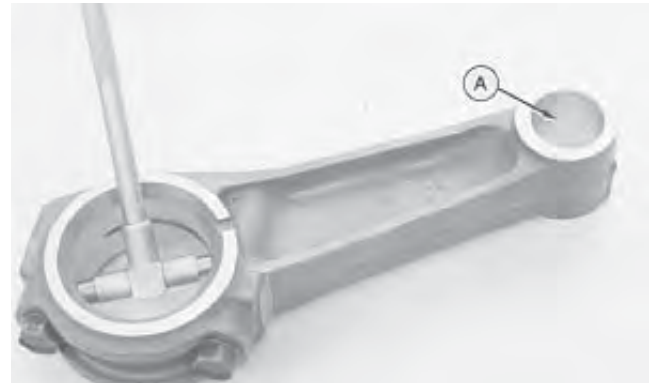
INSPECT CONNECTING ROD

1. Clean and inspect rod. Replace if scored.

2. Analyze crankshaft and connecting rod wear. (See Section 100, Group 10.)

3. Install connecting rod cap. Tighten to 20 N·m (177 lb-in.).

4. Measure connecting rod crankshaft bearing and piston bearing (A). Replace connecting rod if either measurement is greater than specifications.



BEARING I.D. SPECIFICATIONS (MAX)

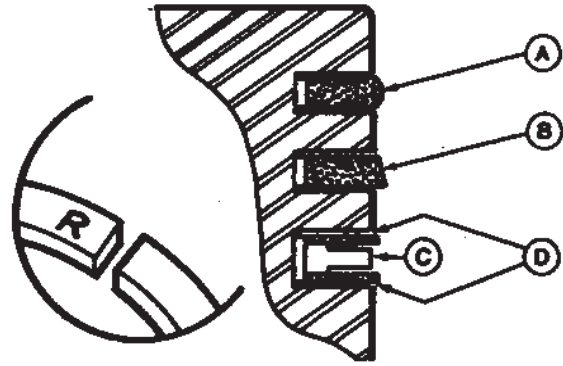
	Crankshaft Bearing	Piston Bearing
FC290V	35.57 mm (1.400 in.)	19.06 mm (0.750 in.)
FC400V/ FC420V/ FC540V	41.07 mm (1.617 in.)	22.06 mm (0.868 in.)

MX,4020A1,A22 -19-21OCT92

-UN-31AUG88
M50066

REMOVE AND INSTALL PISTON RINGS

1. Remove piston rings with a piston ring expander.
2. Inspect piston. Clean piston ring grooves. (See this group.)
3. Check piston ring end gap. (See this group.)
4. Install top ring (A) and second ring (B) with R or NPR mark facing up. Rings should turn freely in grooves.
5. Oil ring is an assembly. Install spacer (C), then side rails (D). Put side rail end gaps 180° apart.



A—Top Ring
B—Second Ring
C—Spacer
D—Side Rails

MX,4020A1,A23 -19-21OCT92

M38074 -UN-29AUG88

CHECK PISTON RING END GAP

1. Before installing rings on piston, check end gap in cylinder bore.
2. Install each ring squarely in bore approximately 25.4 mm (1.0 in.) down from top of cylinder.
3. Check end gap. Replace ring if end gap is more than specifications.

END GAP SPECIFICATIONS

Minimum End Gap	0.18 mm (0.007 in.)
Maximum End Gap	
Compression Rings	
FC290V	0.71 mm (0.028 in.)
FC400V/FC420V/FC540V	0.90 mm (0.035 in.)
Oil Ring Side Rails	
FC290V	1.20 mm (0.047 in.)
FC400V/FC420V/FC540V	1.30 mm (0.051 in.)



M50073 -UN-31AUG88

MX,4020A1,A24 -19-21OCT92

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REMOVE, INSPECT AND INSTALL CRANKSHAFT

1. Remove camshaft. (See this group.)
2. Remove piston and connecting rod. (See this group.)
3. Remove balancer. (See this group.)
4. Remove crankshaft.

IMPORTANT: A bent crankshaft must be replaced; it cannot be straightened.

5. Check crankshaft alignment (T.I.R.). (See this group.)
6. Clean and inspect crankshaft. Replace if parts are scratched or damaged.
7. Analyze crankshaft and connecting rod wear. (See Section 100, Group 10.)
8. Measure crankshaft main bearing journals and connecting rod journal. Replace crankshaft if measurements are less than specifications.



M54495 -UN-09JAN91

JOURNAL SPECIFICATIONS (MIN)

	Main Bearing Journal PTO Side	Journal Flywheel Side	Connecting Rod Journal
FC290V	29.92 mm (1.178 in.)	—	35.43 mm (1.395 in.)
FC400V/ FC420V	34.92 mm (1.376 in.)	—	40.93 mm (1.611 in.)
FC540V	37.90 mm (1.492 in.)	—	40.93 mm (1.611 in.)

MX,4020A1,A25 -19-21OCT92

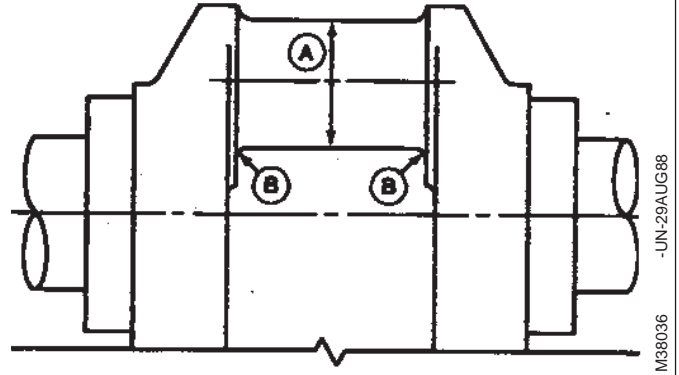
NOTE: An under-sized connecting rod is available through the parts catalog, if necessary.

9. Connecting rod journal (A) can be resized to accept under-sized rod. Have grinding done by a reliable repair shop. Before sending crankshaft for grinding, inspect journal radii (B) for cracks.

10. Cover keyway on flywheel end of crankshaft with tape to prevent seal damage when installing crankshaft.

11. Put a light film of oil on crankshaft bearing surfaces.

12. Pack grease in oil seals and install crankshaft.



MX,4020A1,A25A -19-21OCT92

INSPECT CRANKSHAFT PLAIN BEARING

NOTE: FC290V crankcase cover is fitted with a replaceable shell.

1. Remove crankshaft. (See this group.)
2. Measure crankshaft bearing in crankcase cover. Replace cover or shell, if equipped, if diameter is greater than specifications. (See this group.)
3. Install crankshaft.



BEARING I.D. SPECIFICATIONS (MAX)

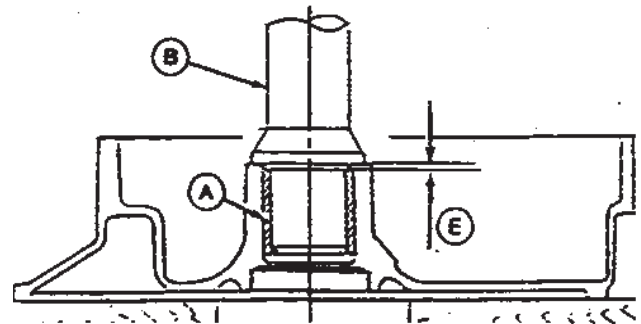
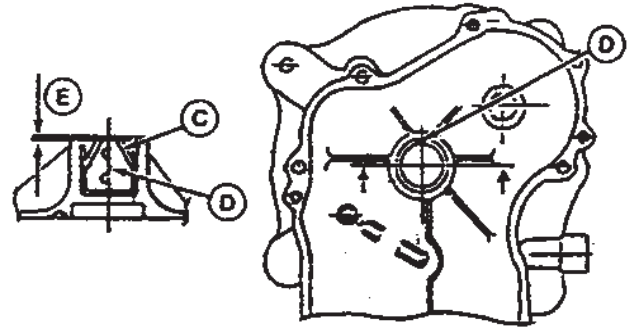
FC290V	30.13 mm (1.186 in.)
FC400V/FC420V	35.07 mm (1.381 in.)
FC540V	38.06 mm (1.498 in.)

MX,4020A1,A26 -19-21OCT92

REPLACE CRANKSHAFT BEARING SHELL—FC290V

1. Remove oil seal. (See Inspect Oil Seals in this group.)
2. Drive old bearing (A) from cover using an appropriate bushing tool (B) and an arbor press.
3. Align new bearing with oil grooves (C) facing out of cover and with seam (D) facing top of cover
4. Install new bearing to depth (E) 1 mm (0.039 in.) below flange surface.
5. Install new oil seal.

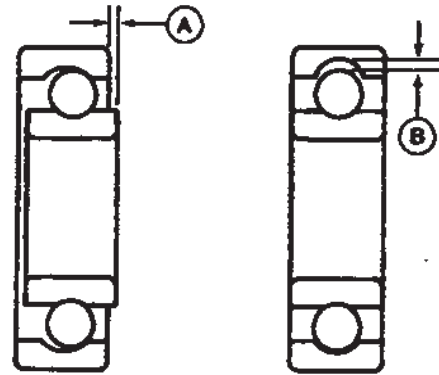
A—Bearing Shell
B—Bushing Tool
C—Oil Grooves
D—Seam
E—Installation Depth



MX,4020A1,A27 -19-21OCT92

INSPECT CRANKSHAFT BALL BEARING

1. Remove flywheel and oil seal. (See Inspect Oil Seals in this group.)
2. Remove crankshaft bearing using a bearing, bushing and seal driver set.
3. Thoroughly clean bearing in solvent. Dip bearing in light weight oil.
4. Spin the bearing by hand and check for axial (A) and radial (B) free play.
5. Replace the bearing if it is noisy or has too much play.
6. Install bearing flush to inside of crankcase using a bearing, bushing and seal driver set.
7. Install oil seal.



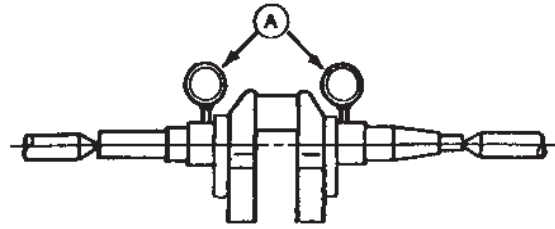
MX,4020A1,A28 -19-21OCT92

CHECK CRANKSHAFT ALIGNMENT (TIR)

Place crankshaft into an alignment jig and rotate crankshaft slowly. Use dial indicators (A) to measure maximum total indicated runout (TIR). If not according to specification replace crankshaft.

SPECIFICATIONS

Maximum TIR 0.05 mm (0.002 in.)



MX,4020A1,A29 -19-21OCT92

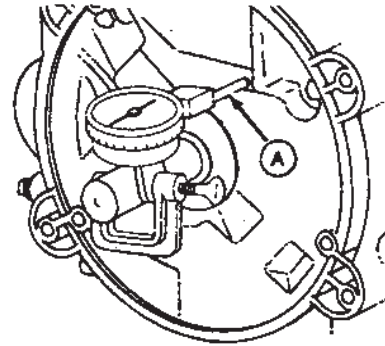
M80432 -UN-08MAY91

MEASURE CRANKSHAFT END PLAY

1. Measure end play using dial indicator (A). Record this measurement.
2. Move crankshaft in and out. Remove crankcase cover and adjust end play if not within specifications. (See this group.)

SPECIFICATIONS

End Play 0.09—0.22 mm (0.004—0.009 in.)



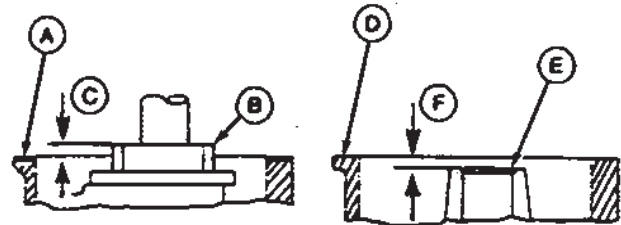
MX,4020A1,A30 -19-21OCT92

M30048 -UN-06SEP88

ADJUST CRANKSHAFT END PLAY

1. With gasket (A) installed on crankcase, measure from gasket surface to crankshaft gear surface (B). Record measurement (C).
2. Measure from crankcase cover mounting face (D) to PTO bearing end (E). Record measurement (F).

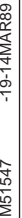
- A—Gasket
- B—Crank Gear Surface
- C—Measurement
- D—Crankcase Cover Mounting Face
- E—PTO Bearing End
- F—Measurement



MX,4020A1,A31 -19-21OCT92

M51545 -UN-31AUG88

- M51548 -19-14MAR89



MX,4020A1,A31A -19-21OCT92

INSPECT OIL SEALS

NOTE: Pack lithium base grease in new or used seals.

1. Remove flywheel. (See Group 10.)
2. Inspect oil seals (A and B) at flywheel end and PTO end. Replace if necessary.
3. Remove crankshaft. (See this group.)
4. Remove worn or damaged seals with a screwdriver.
5. Install seals with lip to inside of engine using a bearing, bushing and seal driver set. Press seals in until flush with hub.

On FC540V engine, press in seal on PTO side to specification, below crankcase cover flange surface.

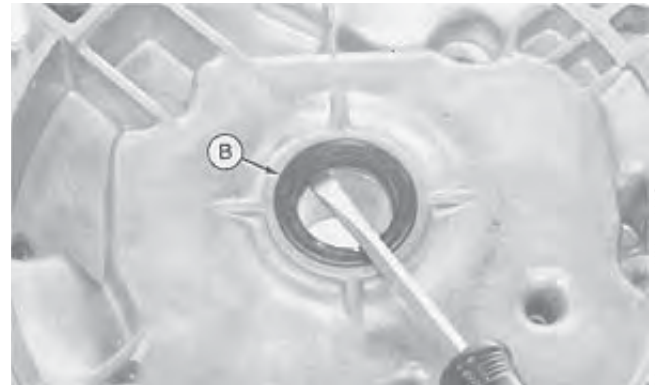
6. Install crankshaft.

SPECIFICATIONS

FC540V Seal Depth 0.50 mm (0.020 in.)



Flywheel End



PTO End

MX,4020A1,A32 -19-21OCT92

M38104 -UN-29AUG88

M50071 -UN-31AUG88

INSPECT CYLINDER BLOCK

1. Remove crankshaft.
2. Clean and check block for cracks.
3. Cracks not visible to the eye may be detected by coating the suspected area with a mixture of 25 percent kerosene and 75 percent light engine oil.
4. Wipe area dry and immediately apply coating of zinc oxide dissolved in wood alcohol. If crack is present, coating becomes discolored at the defective area. Replace block if any cracks are found.

MX,4020A1,A33 -19-21OCT92

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21

NOTE: A bare block is available for service.

5. Measure cylinder bore parallel with crankshaft and right angles to crankshaft at top and bottom of ring travel.

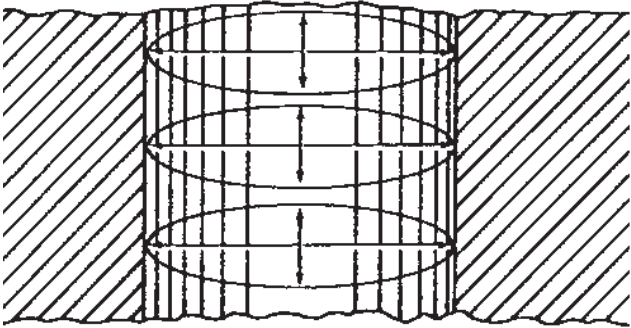
6. If cylinder bore exceeds wear limit, replace cylinder block or rebore cylinder. (See this group.)

NOTE: If cylinder is rebored, oversize piston and rings must be installed.

7. Install crankshaft.

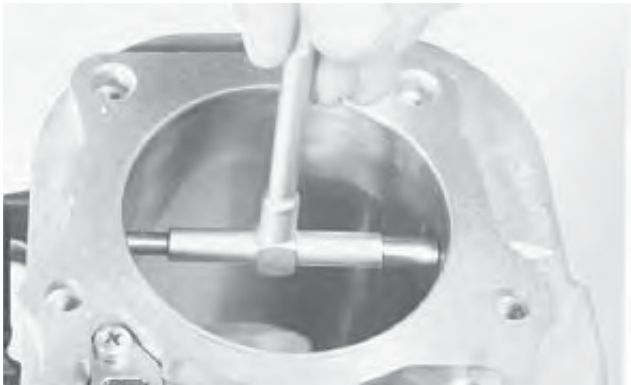
CYLINDER BORE SPECIFICATIONS

	Standard	Wear Limit
FC290V	77.98—78.00 mm (3.070—3.071 in.)	78.07 mm (3.074 in.)
FC400V	86.98—87.00 mm (3.424—3.425 in.)	87.08 mm (3.428 in.)
FC420V	88.98—89.00 mm (3.503—3.504 in.)	89.08 mm (3.507 in.)
FC540V	88.98—89.00 mm (3.503—3.504 in.)	89.08 mm (3.507 in.)



-UN-23FEB89

M51745



-UN-09JAN91

M54496

MX,4020A1,A34 -19-21OCT92

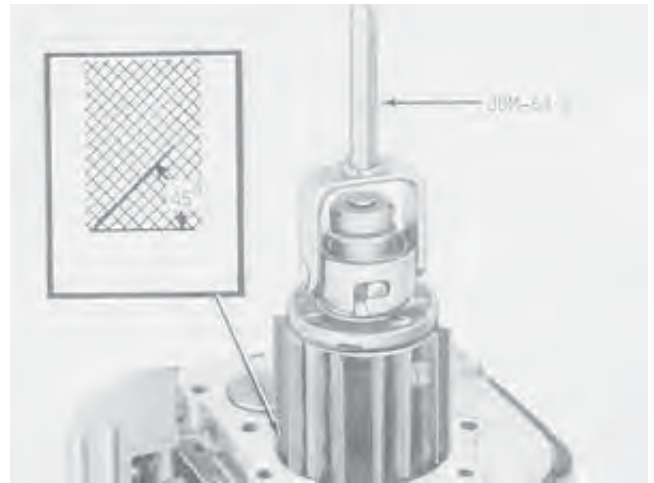
REBORE CYLINDER BLOCK

NOTE: The cylinder block can be rebored to use 0.25, 0.50 or 0.75 mm (0.010, 0.020 or 0.030 in.) oversize pistons and rings. Have a reliable repair shop rebore the block, or use the drill press and honing tool.

1. Rebore cylinder with a honing tool to initial and final bore specifications.
2. Align center of bore to press center. Set the press to operate from 200—250 rpm.
3. Lower and raise hone until ends extend 20—25 mm (0.75—1.0 in.) past ends of cylinder.
4. Turn adjusting nut on one hone until stones contact cylinder wall at narrowest point.
5. Coat inside of cylinder with honing oil. Turn hone by hand. If you cannot turn it, hone is too tight.
6. Start drill press. Move hone up and down in cylinder approximately 20 times per minute.
7. Check cylinder diameter regularly during honing. Stop press before measuring. Remove hone from cylinder.

NOTE: Finish should not be smooth, but have a 40—60° cross-hatch pattern.

IMPORTANT: Check stone for wear or damage. Use correct stone for the job.



MX,4020A1,A35 -19-21OCT92

40
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23

CYLINDER INITIAL BORE SPECIFICATIONS

Piston Oversize:
0.25 mm
(0.010 in.)

FC290V
 78.21—78.23 mm
 (3.079—3.080 in.)

FC400V
 87.23—87.25 mm
 (3.434—3.435 in.)

FC420V
 89.23—89.25 mm
 (3.513—3.514 in.)

FC540V
 89.21—89.23 mm
 (3.512—3.513 in.)

Piston Oversize:
0.50 mm
(0.020 in.)

78.46—78.48 mm
 (3.089—3.090 in.)

87.48—87.50 mm
 (3.444—3.4448 in.)

89.48—89.50 mm
 (3.523—3.524 in.)

89.46—89.48 mm
 (3.522—3.523 in.)

Piston Oversize:
0.75 mm
(0.030 in.)

78.71—78.73 mm
 (3.099—3.100 in.)

87.73—87.75 mm
 (3.453—3.454 in.)

89.73—89.75 mm
 (3.533—3.534 in.)

89.72—89.73 mm
 (3.532—3.533 in.)

MX,4020A1,A36 -19-21OCT92

8. Hone the cylinder an additional 0.028—0.030 mm (0.0011—0.0012 in.) for final bore specifications. This allows for 0.020 mm (0.0008 in.) shrinkage when cylinder cools.

IMPORTANT: DO NOT use gasoline or commercial solvents to clean cylinder bores. Solvents will not remove metal particles produced during honing.

9. Clean the cylinder thoroughly using soap, warm water and clean rags. Continue to clean cylinder until white rags show no discoloration.

10. Dry the cylinder. Apply engine oil to cylinder wall.

M98,2040A,A9 -19-21OCT92

INSPECT AND REPLACE OIL SLINGER—FC290V

1. Remove crankcase cover. (See this group.)
2. Remove oil slinger (A).
3. Inspect oil slinger. Replace if worn or damaged.
4. Install oil slinger.



MX,4020A1,A37 -19-21OCT92

M50078 -UN-31AUG88

DISASSEMBLE AND ASSEMBLE OIL PUMP—FC400V/FC420V

1. Remove crankcase cover. (See this group.)
2. Remove oil pump gear (A).

IMPORTANT: Remove rotor shaft and oil pump cover together to avoid damaging governor.

3. Remove oil pump assembly (B).
4. Remove relief spring and ball (C).
5. Inspect all parts. (See this group.)

NOTE: Install gear (A) with recess facing away from crankcase cover.

6. Install oil pump assembly.



MX,4020A1,A38 -19-21OCT92

M80018 -UN-09JAN91

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INSPECT OIL PUMP—FC400V/FC420V

1. Inspect all parts for wear or damage. Replace as necessary.

- A—Plate
- B—Spring
- C—Ball
- D—Gear
- E—Cover
- F—Screen
- G—Outer Rotor
- H—Rotor Shaft



MX,4020A1,A39 -19-21OCT92

2. Measure outside diameters of shaft. Replace both shaft and outer rotor if less than specification.

SPECIFICATIONS

Minimum Shaft O.D.	
Large O.D.	12.63 mm (0.497 in.)
Small O.D.	7.94 mm (0.313 in.)

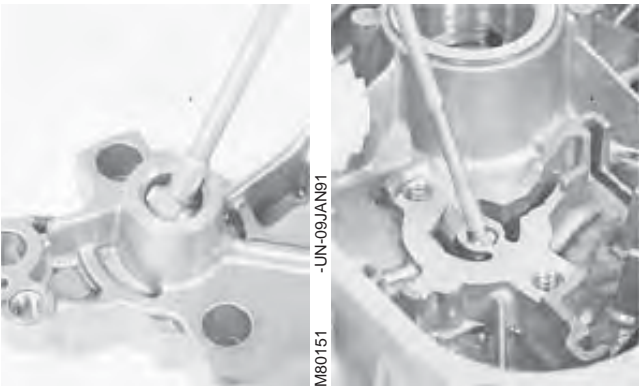


MX,4020A1,A40 -19-21OCT92

3. Measure rotor shaft bearings. Replace oil pump cover or crankcase cover if greater than specifications.

SPECIFICATIONS

Maximum Rotor Shaft Bearing I.D.	
Oil Pump Cover	12.76 mm (0.502 in.)
Crankcase Cover	8.07 mm (0.318 in.)

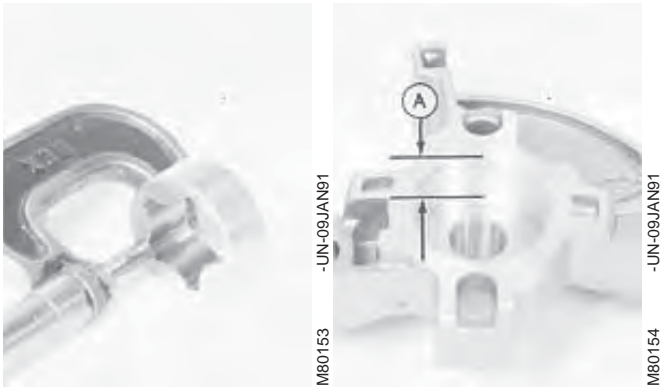


MX,4020A1,A41 -19-21OCT92

4. Measure thickness of outer rotor. Replace both outer rotor and shaft if less than specifications.
5. Measure out rotor bearing depth (A). Replace oil pump cover if greater than specifications.

OUTER ROTOR SPECIFICATIONS

Minimum Rotor Thickness	11.92 mm (0.470 in.)
Maximum Bearing Depth	12.14 mm (0.478 in.)

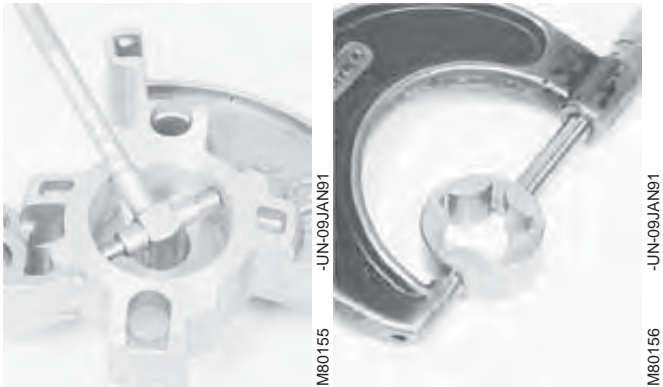


MX,4020A1,A42 -19-21OCT92

6. Measure inside diameter of rotor bearing. Replace oil pump cover if greater than specifications.
7. Measure outside diameter of rotor. Replace both rotor and shaft if less than specifications.

OUTER ROTOR SPECIFICATIONS

Maximum Bearing I.D.	29.20 mm (1.149 in.)
Minimum Rotor O.D.	28.95 mm (1.140 in.)



MX,4020A1,A43 -19-21OCT92

8. Measure relief valve spring. Replace if free length is less than specification.

SPECIFICATIONS

Minimum Spring Length	19.00 mm (0.750 in.)
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MX,4020A1,A44 -19-21OCT92

DISASSEMBLE AND ASSEMBLE OIL PUMP—FC540V

1. Remove crankcase cover. (See this group.)
2. Remove oil pump gear (A).

IMPORTANT: Remove rotor shaft and oil pump cover together to avoid damaging governor.

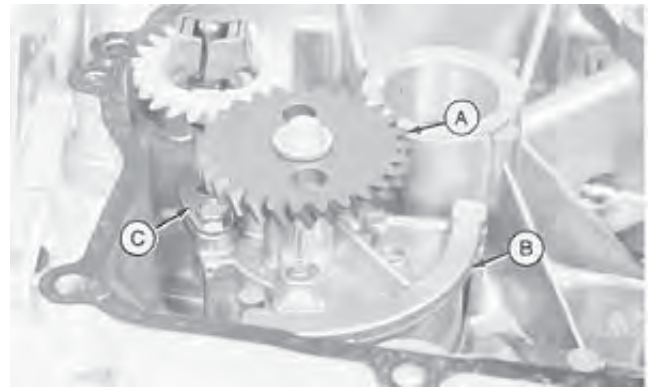
3. Remove oil pump assembly (B).
4. Remove relief spring and ball (C).
5. Inspect all parts. (See this group.)

IMPORTANT: Install outer rotor with dimple (D) facing away from crankcase cover, to avoid oil pump damage.

NOTE: Install gear (A) with recess facing away from crankcase cover.

6. Install oil pump assembly.

A—Oil Pump Gear
B—Oil Pump Assembly
C—Relief Spring and Ball
D—Dimple



M80011 -UN-09JAN91



M80012 -UN-09JAN91

MX,4020A1,A45 -19-21OCT92

INSPECT OIL PUMP—FC540V

1. Inspect all parts for wear or damage. Replace as necessary.

- A—Plate
- B—Spring
- C—Ball
- D—Gear
- E—Cover
- F—Screen
- G—Rotor Shaft
- H—Outer Rotor



MX,4020A1,A46 -19-21OCT92

M80013 -JUN-09/JAN91

2. Measure outside diameters of shaft. Replace both shaft and outer rotor if less than specification.

SPECIFICATIONS

Minimum Shaft O.D. 12.63 mm (0.497 in.)



MX,4020A1,A47 -19-21OCT92

M50084 -JUN-31/AUG88

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29

3. Measure rotor shaft bearings. Replace oil pump cover or crankcase cover if greater than specifications.

SPECIFICATIONS

Maximum Rotor Shaft Bearing I.D. 12.76 mm (0.502 in.)



M50089 -UN-31AUG88



M80014 -UN-09JAN91

MX,4020A1,A48 -19-21OCT92

4. Measure thickness of outer rotor. Replace both outer rotor and shaft if less than specifications.

5. Measure outer rotor bearing depth (A). Replace crankcase cover if greater than specifications.

OUTER ROTOR SPECIFICATIONS

Minimum Rotor Thickness 9.92 mm (0.391 in.)
Maximum Bearing Depth 10.17 mm (0.401 in.)



M80015 -UN-22JAN91



M80016 -UN-09JAN91

MX,4020A1,A49 -19-21OCT92

6. Measure inside diameter of rotor bearing. Replace crankcase cover if greater than specifications.

7. Measure outside diameter of rotor. Replace both rotor and shaft if less than specifications.

OUTER ROTOR SPECIFICATIONS

Maximum Bearing I.D.	40.77 mm (1.605 in.)
Minimum Rotor O.D.	40.47 mm (1.596 in.)



M50090 -UN-31AUG88



M80017 -UN-09JAN91

MX,4020A1,A50 -19-21OCT92

8. Measure relief valve spring. Replace if free length is less than specification.

SPECIFICATIONS

Minimum Spring Length	19.00 mm (0.750 in.)
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M50083 -UN-31AUG88

MX,4020A1,A44 -19-21OCT92

REMOVE, INSPECT AND INSTALL OIL FILTER MANIFOLD—IF EQUIPPED

1. Remove oil filter and manifold.
2. Inspect oil filter. Replace if excessively contaminated or damaged.
3. Inspect oil passages for clogs. Clean if needed.
4. Inspect rubber gaskets. Replace if worn or damaged.
5. Install filter and manifold.



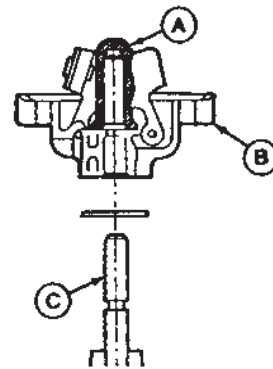
M50077 -UN-31AUG88

MX,4020A1,A51 -19-21OCT92

INSPECT AND REPLACE GOVERNOR

IMPORTANT: Removal damages governor. If not damaged, do not remove.

1. Remove crankcase cover. (See this group.)
2. Inspect governor. If necessary to replace, remove with screwdriver.
3. If removed, press shaft (C) back into block until it protrudes 32.2—32.8 mm (1.267—1.291 in.).



M51762 -UN-07SEP88

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NOTE: Assemble sleeve and gear before installing assembly on shaft.

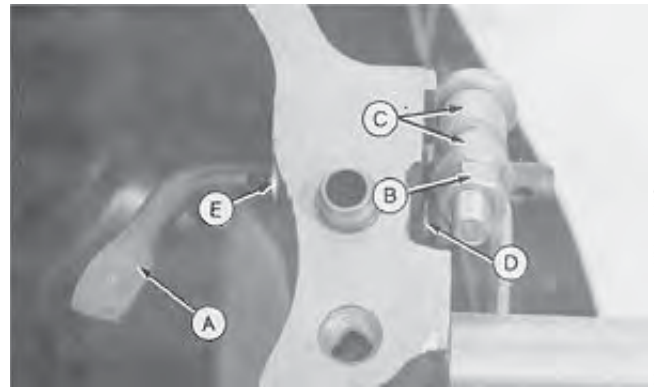
4. Install sleeve (A) onto governor gear (B).
5. Install governor assembly onto shaft. Push down on assembly until it snaps into place.

MX,4020A1,A52 -19-21OCT92

INSPECT AND REPLACE GOVERNOR SHAFT

NOTE: It is not necessary to remove governor shaft unless damaged.

1. Remove crankcase cover. (See this group.)
2. Inspect shaft (A). Replace if damaged.
3. To replace shaft, loosen nut (B) on lever (C).
4. Remove retaining pin (D), governor shaft and washer (E).
5. Install washer, shaft and retaining pin. Tighten nut.



A—Governor Shaft
B—Nut
C—Governor Lever
D—Retaining Pin
E—Washer

MX,4020A1,A53 -19-21OCT92

M50094 -UN-31AUG88

REMOVE AND INSTALL STATOR

1. Remove flywheel. (See Group 10.)
2. Disconnect stator lead.
3. Remove screws (A) and stator (B).
4. Install stator.
5. Connect stator lead.
6. Install flywheel.

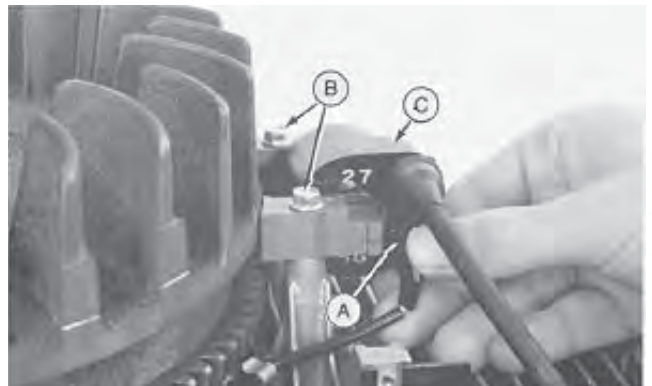


M50146
-UN-31AUG88

MX,4025A1,A1 -19-21OCT92

REMOVE AND INSTALL ARMATURE WITH COIL

1. Remove blower housing. (See Group 10.)
2. Disconnect wiring lead (A).
3. Remove cap screws (B) and armature with coil (C).
4. Loosely install armature with coil.
5. Connect wiring lead.
6. Adjust armature air gap. (See this group.)
7. Install blower housing.



M50147
-UN-23FEB89

MX,4025A1,A2 -19-21OCT92

ADJUST ARMATURE AIR GAP

1. Turn flywheel magnet away from armature.
2. Insert feeler gauge, between flywheel and armature.
3. Push armature against flywheel and tighten screws (A).
4. Turn flywheel to remove feeler gauge.

AIR GAP SPECIFICATIONS

Feeler Gauge Blade 0.30 mm (0.012 in.)



M50148
-UN-31AUG88

MX,4025A1,A3 -19-21OCT92

OTHER MATERIAL

Number	Name	Use
	Mineral Spirits	Clean Armature
	Multipurpose Grease	Grease Starter Parts

M98,2030A,ZB -19-21OCT92

SERVICE PARTS KITS

The following kits are available through your parts catalog:

- Recoil Starter—FC290V
 - Spring and Case
 - Pawl and Spring Kit
 - Complete Starter
- Recoil Starter—FC400V/FC420V
- Electric Starter
 - Brush Kit
 - Clutch Kit
 - Complete Starter
 - Complete Solenoid—FC400V/FC420V/FC540V

MX,4030A1,A0 -19-21OCT92

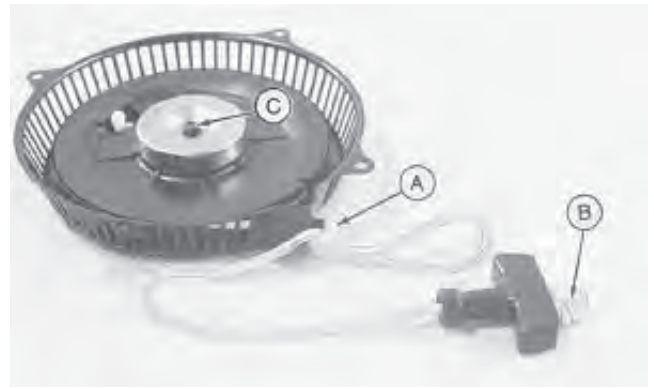
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DISASSEMBLE RECOIL STARTER—FC290V/FC400V/FC420V

1. Remove starter.
2. Pull handle out about 30 cm (1 ft). Tie knot (A) to prevent rope from winding back onto reel.
3. Pry knot (B) out of handle and untie.
4. Remove handle from rope.
5. While holding reel with thumb, untie knot (A). Slowly release reel tension. Do not let rope get wedged between reel and housing.

CAUTION: Wear gloves and protective goggles for remaining steps.

6. Remove screw (C) and ratchet cover.



TY13495 -UN-23FEB89

MX,4030A1,A1 -19-21OCT92

CAUTION: A loaded spring operates under great pressure. Make sure spring tension between reel and housing is released before removing reel.

7. Turn the reel one half turn clockwise so no spring tension can be felt.



FC290V

M54499 -UN-09JAN91



FC400V/FC420V

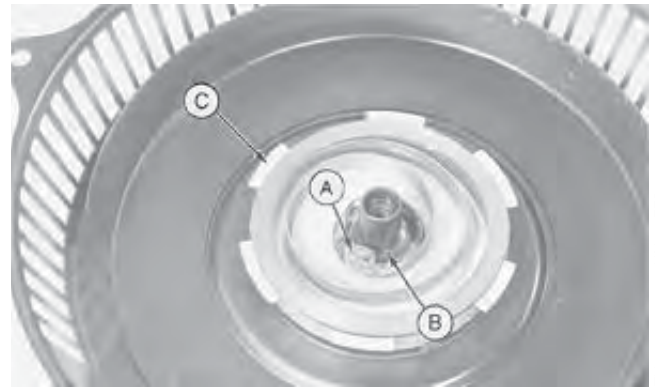
TY13496 -UN-23FEB89

MX,4030A1,A1A -19-21OCT92

8. Spring is stored in spring case (C) in housing. Lift reel straight up so spring remains seated in housing.

9. Carefully unhook spring tang (A) from catch (B).

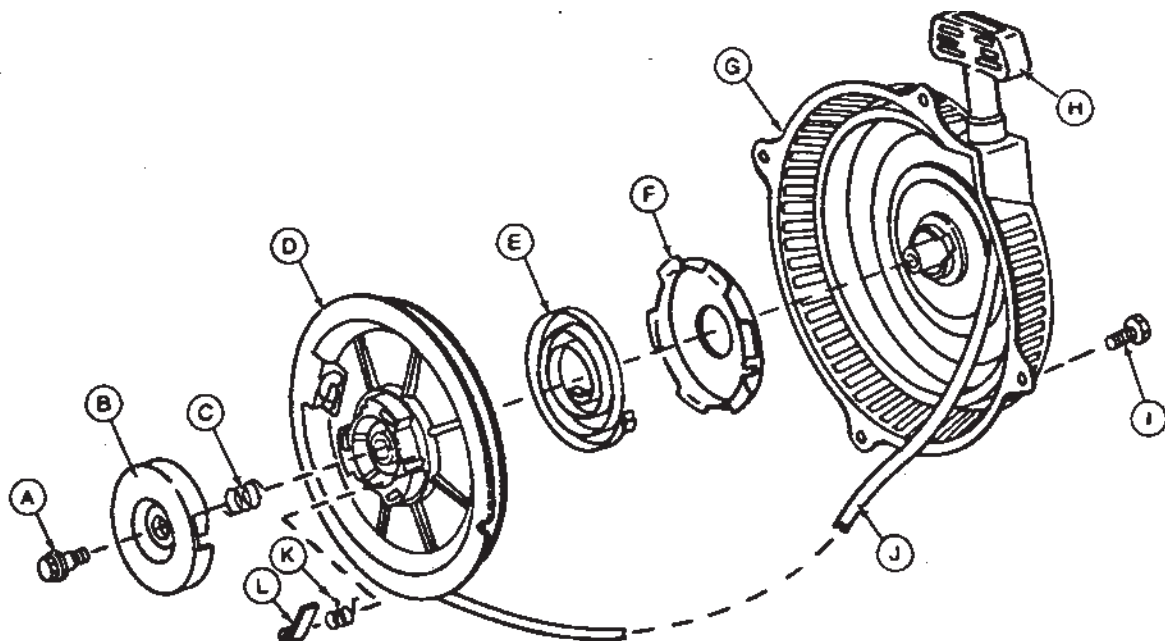
10. Remove spring case from housing.



MX,4030A1,A2 -19-21OCT92

TY13497 -UN-23FEB89

INSPECT RECOIL STARTER—FC290V/FC400V/FC420V



A—Screw
B—Retainer
C—Spring
D—Reel

E—Spring
F—Case (If Equipped)
G—Housing
H—Handle

I—Screw (4 used)
J—Rope
K—Spring (2 used—FC290V)
(3 used—FC400V/420V)

L—Pawl (2 used—FC290V)
(3 used—FC400V/420V)

Inspect and replace all damaged or worn parts.

MX,4030A1,A3 -19-21OCT92

TY13498 -UN-23FEB89

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REPLACE SPRING

CAUTION: Spring is wound under great tension in reel or spring case. Do not let spring fly loose. Hold spring firmly in place while replacing.

1. Working from the center out, carefully unwind spring from spring case or reel.
2. Hook outside spring tang in reel or case. Wind spring into reel or spring case, working toward center.

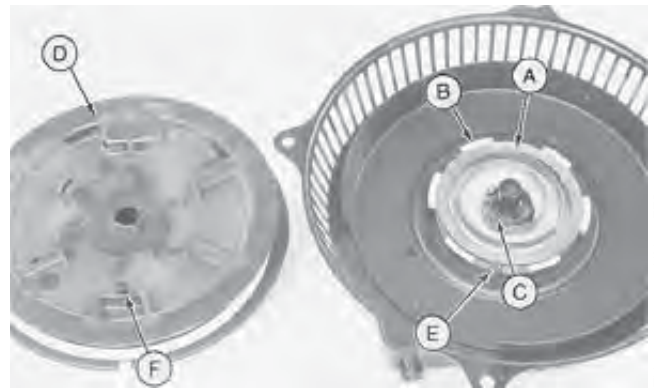


M54497 -UN-09JAN91

MX,4030A1,A4 -19-21OCT92

ASSEMBLE RECOIL STARTER—FC290V/FC400V/FC420V

1. Wind rope counterclockwise onto reel.
2. Place spring case (B) into housing with spring tang over catch (C).
3. Install reel in spring case, with round peg (E) aligned with end of spring (F).
4. Turn reel counterclockwise until you feel tang hook on catch.



TY13499 -UN-23FEB89

A—Spring
B—Case
C—Catch
D—Reel
E—Round Peg
F—End of Spring

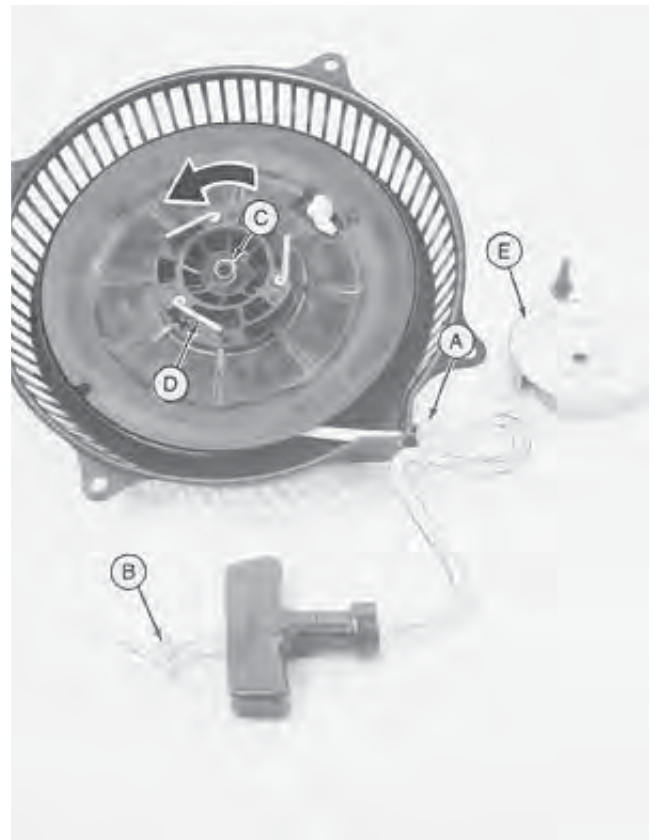
MX,4030A1,A5 -19-21OCT92

5. Turn reel two turns counterclockwise to preload spring.
6. While holding reel to keep it from unwinding, feed end of rope through hole. Tie knot (A) to hold rope.
7. Install handle and secure with knot (B).
8. Remove knot (A).
9. Install spring (C) and ratchet cover (E) with opening(s) in cover over pawl(s) (D). Check for free movement of pawls.
10. Pull rope to check for proper operation.
11. Install recoil starter on engine.

A—Knot
B—Knot
C—Spring
D—Pawls
E—Retainer



FC290V



FC400V/FC420V

MX,4030A1,A5A -19-21OCT92

ANALYZE ELECTRIC STARTER CONDITION

1. The starter overheats because of:

- Long cranking.
- Armature binding.

2. The starter operates poorly because of:

- Armature binding.
- Dirty or damaged starter drive.
- Badly worn brushes or weak brush springs.
- Excessive voltage drop in cranking system.
- Battery or wiring defective.
- Shorts, opens, or grounds in armature.

NOTE: Starter repair is limited to brushes, end caps, and starter drive. Fields in starter are permanent magnets and are not serviceable. If housing or armature is damaged, replace starter.

MX,4030A1,A6 -19-21OCT92

BENCH TEST SOLENOID DRIVE STARTER—FC400V/FC420V/FC540V

NOTE: Perform bench test before disassembling starter motor to determine cause of problem.

IMPORTANT: Never operate motor longer than 20 seconds. Allow at least two minutes for cooling and battery recovery before operating again. Overheating, caused by excessive operation, will seriously damage starting motor.

1. Disconnect battery leads from battery.
2. Remove starter from engine.
3. Connect 12-volt battery (A) to starter battery terminal (B) and starter frame (C) using heavy duty cables.
4. Connect remote start switch (D) between switch terminal (E) and battery terminal (B).

NOTE: A short piece of wire with a small clip on the end will allow a more positive connection at the switch terminal.

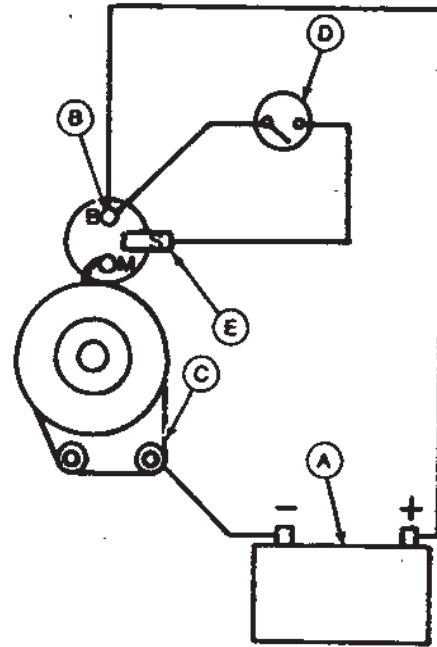
When switch is activated, starter should engage and run.

IF SOLENOID CHATTERS; hold-in winding is open-circuited.

IF NOTHING HAPPENS; either the solenoid pull-in winding is open-circuited or mechanical parts are sticking.

IF SOLENOID ENGAGES, BUT MOTOR DOES NOT RUN; check solenoid switch continuity, brushes, armature and field windings.

Solenoid cannot be repaired, replace it.



A—12-Volt Battery
B—Battery Terminal
C—Starter Frame
D—Remote Start Switch
E—Switch Terminal

MX,4030A1,A7 -19-21OCT92

M37149 -JUN-29AUG88

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TEST SOLENOID—FC400V/FC420V/FC540V

NOTE: If bench test indicated solenoid problems, use an ohmmeter or test light to check solenoid.

1. Test solenoid terminals (A and B) for continuity. There should be no continuity.
2. Depress switch arm (C). There should be continuity when arm is fully depressed.
3. Test for open circuits between terminal (B) and tang (D). There should be continuity.
4. Test for open circuits between tang (D) and body (E). There should be continuity.

If solenoid fails any test, it is defective and must be replaced.



A—Terminal
B—Terminal
C—Switch Arm
D—Tang
E—Solenoid Body

M51705 -UN-31AUG88

MX,4030A1,A8 -19-21OCT92

CHECK STARTER ARMATURE ROTATION

1. FC290V: Remove air cleaner and blower housing. (See Groups 05 and 10.)
2. Remove starter.
3. Rotate armature (A).

If armature does not rotate freely, armature may be bent or bearings may be worn. Disassemble, inspect and clean starter. (See this group.)



FC290V

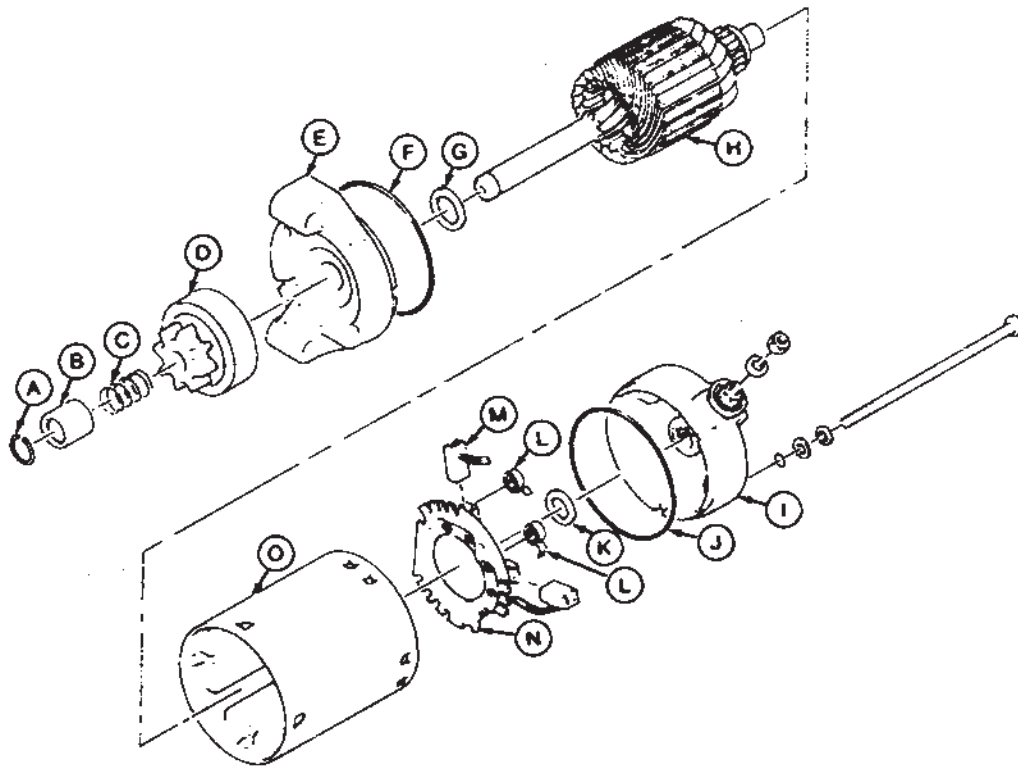


FC400V/FC420V/FC540V

MX,4030A1,A9 -19-21OCT92

M80163 -UN-09JAN91

M53972 -UN-18APR90

INSPECT STARTER—FC290V

A—Snap Ring
B—Pinion Stopper
C—Spring
D—Pinion Assembly

E—Front Cover
F—O-Ring
G—Washer
H—Armature

I—End Cover
J—O-ring
K—Washer
L—Brush Spring

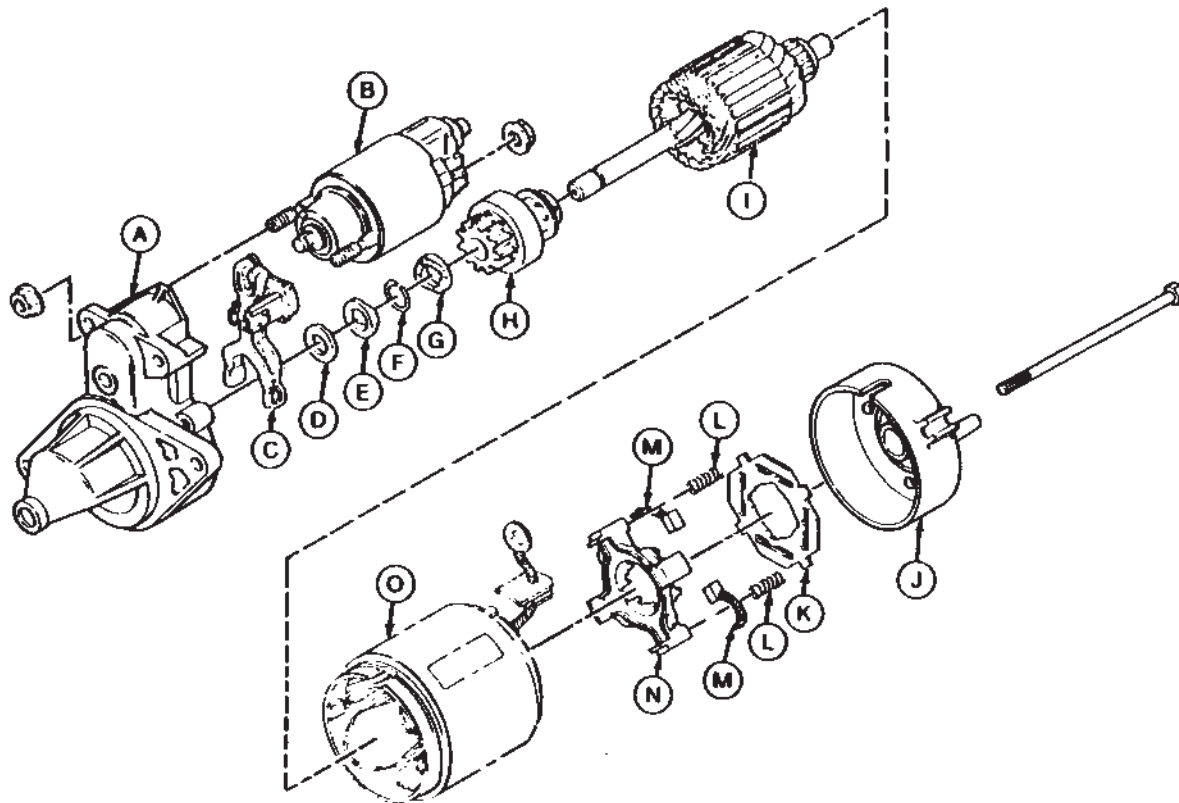
M—Brush
N—Brush Holder
O—Body

1. Mark body and covers for correct alignment during reassembly.
2. Remove nuts and washers from terminal to remove end cover (I).
3. Push pinion stopper (B) toward pinion (D) to remove snap ring (A).
4. Inspect parts for wear or damage.
5. Check magnets in body (O). Replace body if magnetic pull is weak.

6. Measure brushes. Replace brushes as a set if length of any one is less than 8.5 mm (0.335 in.).
7. Test starter armature and brushes. (See this group.)
8. Apply a thin coat of multipurpose grease to:
 - sliding surfaces of armature.
 - armature shaft spline.
 - points where shaft contacts cover.
9. Assemble starter.

M50128 -UN-31AUG88

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INSPECT STARTER—FC400V/FC420V

A—Front Cover
B—Solenoid
C—Shift Lever
D—Washer

E—Pinion Stopper Half
F—Retaining Clip
G—Pinion Stopper Half
H—Pinion

I—Armature
J—End Cover
K—Insulator
L—Brush Spring

M—Brush
N—Brush Holder
O—Body

1. Mark body and covers for correct alignment during reassembly.

2. Separate pinion stopper halves (E and G) to remove retaining clip (F).

3. Inspect parts for wear or damage.

4. Measure brushes. Replace brushes as a set if length of any one is less than 6 mm (0.240 in.).

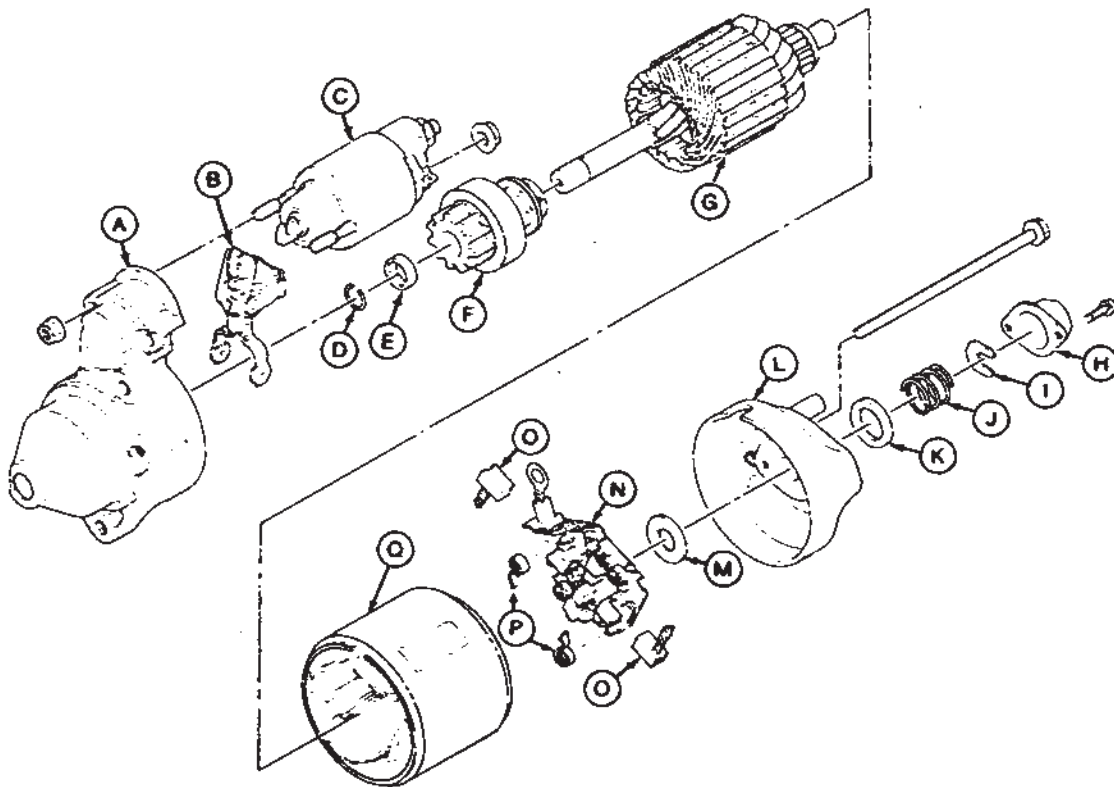
5. Test starter armature and brushes. (See this group.)

6. Apply a thin coat of multipurpose grease to:
—sliding surfaces of armature and solenoid shift lever.
—armature shaft spline.
—points where shaft contacts cover.

7. Assemble starter.

MX,4030A1,A11 -19-21OCT92

M53943 -JUN-19JUN90

INSPECT STARTER—FC540V

A—Front Cover
B—Shift Lever
C—Solenoid
D—Retaining Clip
E—Pinion Stopper

F—Pinion
G—Armature
H—Dust Cap
I—Clip

J—Spring
K—Washer
L—End Cover
M—Washer

N—Brush Holder
O—Brush
P—Brush Spring
Q—Body

1. Mark body and covers for correct alignment during reassembly.
2. Push pinion stopper (E) toward pinion (F) to remove retaining clip (D).
3. Inspect parts for wear or damage.
4. Measure brushes. Replace brushes as a set if length of any one is less than 10.5 mm (0.413 in.).

5. Test starter armature and brushes. (See this group.)
6. Apply a thin coat of multipurpose grease to:
 - sliding surfaces of armature and solenoid shift lever.
 - armature shaft spline.
 - points where shaft contacts cover.
7. Assemble starter.

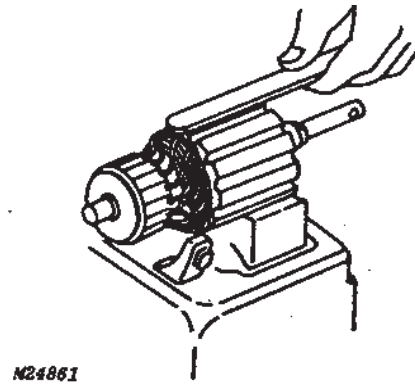
M50120 -JUN-31AUG88

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TEST STARTER ARMATURE

IMPORTANT: Do not clean armature with solvent. Solvent can damage insulation on windings. Use only mineral spirits and a brush.

1. Locate short circuits by rotating armature on a growler while holding a hacksaw blade or steel strip on armature. The hacksaw blade will vibrate in area of short circuit.
2. Shorts between bars are sometimes caused by dirt or copper between bars. Inspect for this condition.
3. If test indicates short circuited windings, clean the commutator of dust and fillings. Check armature again. If test still indicates short circuit, replace armature.



M24861 -UN-25AUG88

M98,2030A,K -19-21OCT92

4. Test for grounded windings using an ohmmeter or test light.

Armature windings are connected in parallel, so each commutator bar needs to be checked.

If test shows continuity, a winding is grounded and the armature must be replaced.



M50112 -UN-31AUG88

M98,2030A,AH -19-21OCT92

5. Test for open circuited windings using an ohmmeter or test light.

If test shows no continuity, there is an open circuit and armature must be replaced.



M50113 -UN-31AUG88

M98,2030A,M -19-21OCT92

TEST FIELD COIL

*NOTE: Continuity tests are similar for all units.
Illustrations are representative only.*

If equipped with brushes on body:

Replace field coil if not according to specifications.

CONTINUITY TEST

Brush-to-Housing Continuity

Brush-to-Brush Continuity



M50115 -UN-31AUG88



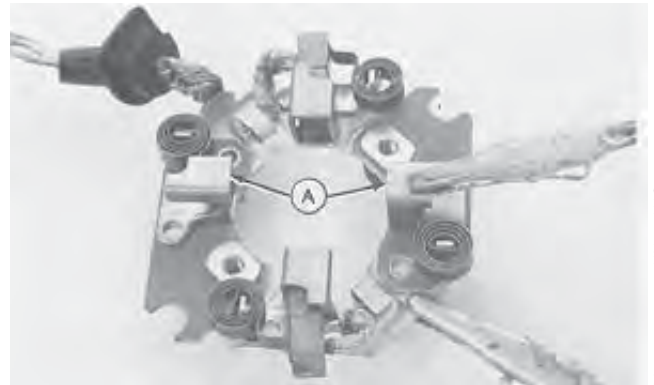
M50116 -UN-31AUG88

MX,4030A1,A13 -19-21OCT92

FC290V:

Test for continuity between each negative brush holder (A) and brush plate. Replace brush holder assembly if there is continuity.

Test for continuity between each positive brush holder and brush plate. Replace brush holder assembly if there is not continuity.



M50114 -UN-31AUG88

MX,4030A1,A14 -19-21OCT92

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