For Kawasaki Discount Parts Call 606-678-9623 or 606-561-4983

Kawasaki

FB460V

4-stroke air-cooled gasoline engine

WORKSHOP MANUAL

www.mymowerparts.com

For Kawasaki Discount Parts Call 606-678-9623 or 606-561-4983

G.W.

www.mymowerparts.com

For Kawasaki Discount Parts Call 606-678-9623 or 606-561-4983

FOREWORD

This manual is designed for use by trained mechanics in a properly equipped shop.
In order to perform the work efficiently and to avoid costly mistakes, read the text, thoroughly familiarize yourself with the procedures **before** starting work, and then do the work carefully in a clean area. Whenever special tools or equipment are specified, do not use makeshift tools or equipment. Precision measurements can only be made if the proper instruments are used, and the use of substitute tools may adversely affect safe operation.

Whenever you see these **WARNING** and **CAUTION** symbols, heed their instructions!
Always follow safe operating and maintenance practices.

⚠ **WARNING: This warning symbol identifies special instructions or procedures which, if not correctly followed, could result in fire, personal injury, or loss of life.**

CAUTION: This idenfifies special instructions or procedures which, if not strictly observed, could result in equipment damage or destruction.

NOTE: Indicates message or points of particular interest for more efficient and convenient operation.

The term "Replace" and some abbreviations are used as follows:

Replace — usually means replace with a new part.

MIN	= Minimum
MAX	= Maximum
Ass'y	= Assembly
STD	= Standard
Illust.	= Illustration
Spec.	= Specification(s)
PTO	= Power take off
Approx.	= Approximately (Approximate)
Carb.	= Carburetor
Con-rod	= Connecting rod
Cyl.	= Cylinder

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted in any form or by any means, electronic mechanical photocopying, recording or otherwise, without the prior written permission of Engine Division/Kawasaki Heavy Industries, Ltd. No liability can be accepted for any inaccuracies or omissions in this publication, although every possible care has been taken to make it as complete and accurate as possible. All procedures and specifications subject to change without prior notice or obligation. Illustrations in this publication are intended for reference use only and may not depict actual model component parts.

www.mymowerparts.com

For Kawasaki Discount Parts Call 606-678-9623 or 606-561-4983

TABLE OF CONTENTS

Section 1
GENERAL INFORMATION

Before Servicing 1-1
Specifications 1-3
Performance Curves 1-4
Dimensional Specifications 1-5
Periodic Maintenance 1-7
4-Stroke Engine Theory 1-7
Construction (Internal Component) 1-8
Fuel System and Operation 1-9
Electrical System 1-10
Preliminary Engine Checks 1-11
Trouble Shooting 1-13
Tune-up Procedure 1-17
Overhaul Procedure 1-17

Section 2
IGNITION

Ignition System 2-1
Spark Check 2-1
Flywheel Removal 2-1
Flywheel Check 2-2
Ignition Coil Check 2-3
Control Unit Check 2-3
Flywheel Installation 2-3
Ignition Coil Air-gap Adjustment 2-3
Flywheel Housing Installation 2-4
Spark Plug Check and Cleaning 2-4

Section 3
AIR-CLEANER

Air cleaner Service 3-1
Air cleaner Housing Inspection 3-1
Air cleaner Installation 3-1

Section 4
CARBURETOR

Carburetor Operation 4-1
Carburetor Removal and Disassembly 4-1
Carburetor Cleaning 4-2
Carburetor Inspection 4-2
Carburetor Assembly 4-2
Carburetor Installation 4-3
Carburetor Adjustment 4-3

Section 5
GOVERNOR

Removal (Governor Related) 5-1
Governor Gear Disassembly 5-1
Governor Gear Inspection 5-2
Governor Reassembly 5-2
Reassembly (Governor Related) 5-2
Linkage Adjustment 5-2
Throttle Cable Installation and Adjustment 5-3
Choke Adjustment 5-3
Maximum Speed Adjustment 5-3
Idle Speed Adjustment 5-3

Section 6
COMPRESSION

Compression Check 6-1
Cylinder Head and Head Gasket Removal 6-1
Cylinder Head Tightening Procedure 6-1
Cylinder Head Check and Repair 6-2
Valve and Spring Removal 6-2
Valve Spring Inspection 6-2
To Analyze Valve 6-2
Valve Inspection 6-2
Valve Guide Check and Replacement 6-3
Valve Seat Reconditioning 6-4
Tappet Clearance Check and Repair 6-6

Section 7
LUBRICATION

Lubrication 7-1
Oil Warning System 7-1
Full Flow Oil Filter 7-1
Capacities 7-1
Oil Recommendation 7-2
Oil Level Check 7-2
Oil Change 7-2
Breather Check 7-2
Oil Pump Inspection 7-3
Oil Pump Installation 7-3

www.mymowerparts.com

For Kawasaki Discount Parts Call 606-678-9623 or 606-561-4983

Section 8
PISTON, PISTON RING, AND CON-ROD

Piston and Con-rod Removal 8-1
Piston Inspection 8-2
Piston Ring Thickness Inspection 8-2
Piston Ring End Gap Inspection 8-3
Piston Pin and Pin Hole Dia. Inspection 8-3
Con-rod Inspection 8-4
Piston and Con-rod Assembly 8-5
Piston Ring Installation 8-5
Piston and Con-rod Assembly Installation ... 8-5

Section 9
CRANKSHAFT AND CAMSHAFT

Crankshaft and Camshaft Removal 9-1
Crankshaft Inspection 9-1
Under Size Con-rod 9-2
Link Rod Inspection 9-2
Bushing Replacement 9-2
Balance Weight Inspection 9-3
Balancer Guide Inspection 9-3
Camshaft Inspection 9-3
Crankshaft and Camshaft Installation 9-4
Crankcase Cover Installation 9-5
Crankshaft End Play 9-5
Crankshaft End Play Adjustment 9-5

Section 10
CYLINDER BLOCK AND BEARING

Cylinder Block Inspection and Repair 10-1
Ball Bearing Removing 10-2
Ball Bearing Inspection 10-2
Plain Bearing Inspection 10-2
Ball Bearing Installation 10-3
Oil Seal Replacement 10-3

Section 11
ELECTRIC STARTER AND CHARGE

Starter Motor Circuit 11-1
Starter System Check 11-1
Starter Motor Check 11-2
Starter Solenoid Test 11-2
Starter Motor Diassembly 11-3
Starter Motor Inspection 11-4
Brush Holder Check 11-7
Pinion Clutch Inspection 11-7
Starter Motor Reassembly 11-7
Charging System Check 11-7
Trouble Shooting 11-9

Section 12
RECOIL STARTER

Recoil Starter Disassembly 12-1
Recoil Starter Reassembly 12-1
Recoil Starter Inspection 12-2

www.mymowerparts.com

For Kawasaki Discount Parts Call 606-678-9623 or 606-561-4983

Section 1
GENERAL INFORMATION

BEFORE SERVICING

Before starting to service a engine carefully read the applicable section to eliminate unnecessary work. However, a detailed account has limitations; a certain amount of basic knowledge is required for successful work. Especially note the following:

Mechanical Systems:

Adjustments
Adjustments shall be made in accordance with the Periodic Maintenance Chart or whenever troubleshooting or presence of symptoms indicate that adjustments may be required.

Edges
Watch for sharp edges, especially during major engine disassembly and assembly. Protect your hands with gloves or a piece of thick cloth when lifting the engine or turning it over.

Dirt
Before removal and disassembly, clean the engine. Any dirt entering the engine, carburetor, or other parts, will work as an abrasive and shorten the life of the engine. For the same reason, before installing a new part, clean off any dust or metal fillings.

Tightening Sequence
Where there is a tightening sequence indicated in this Service Manual, the bolts, nuts, or screws must be tightened in the order and method indicated. When installing a part with several bolts, nuts, or screws, they should all be started in their holes and tightened to a snug fit. Then tighten them evenly, according to the tightening sequence, to the specified torque. This is to avoid distortion of the part and/or causing gas or oil leakage. Conversely, when loosening the bolts, nuts, or screws, loosen all of them about a quarter of a turn and then remove them.

Torque
The torque values given in this Service Manual should always be adhered to. Either too little or too much torque may lead to serious damage. Use a good quality, reliable torque wrench.

Force
Common sense should dictate how much force is necessary in assembly and disassembly. If a part seems especially difficult to remove or install, stop and examine what may be causing the problem. Whenever tapping is necessary, tap lightly using a wooden or plastic-faced mallet. Use an impact driver for screws (particularly for the removal of screws held by a locking agent) in order to avoid damaging the heads.

Lubricant
Don't use just any oil or grease. Some oils and greases in particular should be used only in certain applications and may be harmful if used in an application for which they are not intended.

Battery Ground
Before performing any disassembly operations on the equipment, remove the ground (–) lead from the battery to prevent the possibility of accidentally turning the engine over while partially disassembled.

Lubrication
Engine wear is generally at its maximum while the engine is warming up and before all the rubbing surfaces have an adequate lubricative film. During assembly, oil or grease(whichever is more suitable) should be applied to any rubbing surfave which has lost its lubricative film. Old grease and dirty oil should be cleaned off. Deteriorated grease has lost its lubricative quality and may contain abrasive foreign particles.

Press
A part installed using a press or driver, such as a seal, should first be coated with oil on its outer or inner circumference so that it will go into place smoothly.

Oil Seal, Grease Seal
Replace any oil or grease seals that were removed with new ones, as removal generally damages seals. A seal guide is required for certain oil or grease seals during installation to avoid damage to the seal lips. Before a shaft passes through a seal, apply a little lubricant, preferably high temperature grease, to the lips to reduce rubber-to-metal friction.

Gasket, O-ring
When in doubt as to the condition of a gasket or O-ring, replace it with a new one. The mating surfaces around the gasket should be free of foreign matter and perfectly smooth to avoid oil or compression leaks.

www.mymowerparts.com

For Kawasaki Discount Parts Call 606-678-9623 or 606-561-4983

Liquid Gasket and Non-permanent Locking Agent
Follow manufacturer's directions for cleaning and preparing surfaces where these compounds will be used. Apply sparingly. Excessive amounts may block engine oil passages and cause serious damage. An examplge of a non-permanent locking agent commonly, available in North America is Loctite Lock'n Seal (Blue).

Ball Bearing Installation
When installing a ball bearing, the bearing race which is affected by friction should be pushed by a suitable driver. This prevents severe stress on the balls and races, and prevents races and balls from being dented. Press a ball bearing until it stops at the stop in the hole or on the shaft.

Circlip, Retaining Ring
Renew any circlips and retaining rings that were removed, as removal weakens and deforms them. When installing circlips and retaining rings, take care to compress or expand them only enough to install them.

High Flash-point Solvent
A high flash-point solvent is recommended to reduce fire danger. A commercial solvent commonly available in North America is Stoddard solvent (generic name). Always follow manufacturer and container directions regarding the use of any solvent.

Molybdenum Disulfide (MoS_2) Grease
This manual makes reference to molybdenum disulfide grease in the assembly of certain engine and chassis parts. Always check manufacturer recommendations before using such special lubricants.

Engine Rotation
When turning the crankshaft by hand, always turn it in the direction of normal rotation; which is clockwise, viewed from the front (flywheel end) of the engine. This will ensure proper adjustments.

Electrical Systems:

- Always minimize shock hazards when working on electrical equipment. Work in a clean, dry environment with dry hands. For maximum shock hazard protection, connect the equipment ground terminal to an earth ground.
- Do not reverse the battery lead connections. This will burn out the diodes in the electrical parts.
- Always check battery condition before condemning other parts of an electrical system. A fully charged battery is a must for conducting accurate electrical system tests.
- The electrical parts should never be struck sharply, as with a hammer, or allowed to fall on a hard surface. Such a shock to the parts can damage them.
- Do not disconnect the battery leads or any other electrical connections when the ignition switch is on, or while the engine is running, unless specifically noted.
- Never keep the starter engaged if the starter motor will not turn over, or the current may burn out the starter motor windings.
- Never replace a defective electrical component without determining what caused the failure. If the failure was brought on by some other item or items, they too must be repaired or replaced, or the new replacement will fail.
- Make sure all connectors in the circuit are clean and tight, and examine wires for signs of burning, fraying, etc. Poor wires and bad connections will affect electrical system operation.
- Measure coil and winding resistance when the part is cold (at room temperature).
- All the electrical leads are either single-color or two-color and, with only a few exceptions, must be connected to leads of the same color.
- When soldering or unsoldering connections, do not use a soldering iron of more than 40 watts capacity. Use 16 gauge (0.062 in.) 60/40 resin core solder when reconnecting wiring.

www.mymowerparts.com

For Kawasaki Discount Parts Call 606-678-9623 or 606-561-4983

SPECIFICATIONS

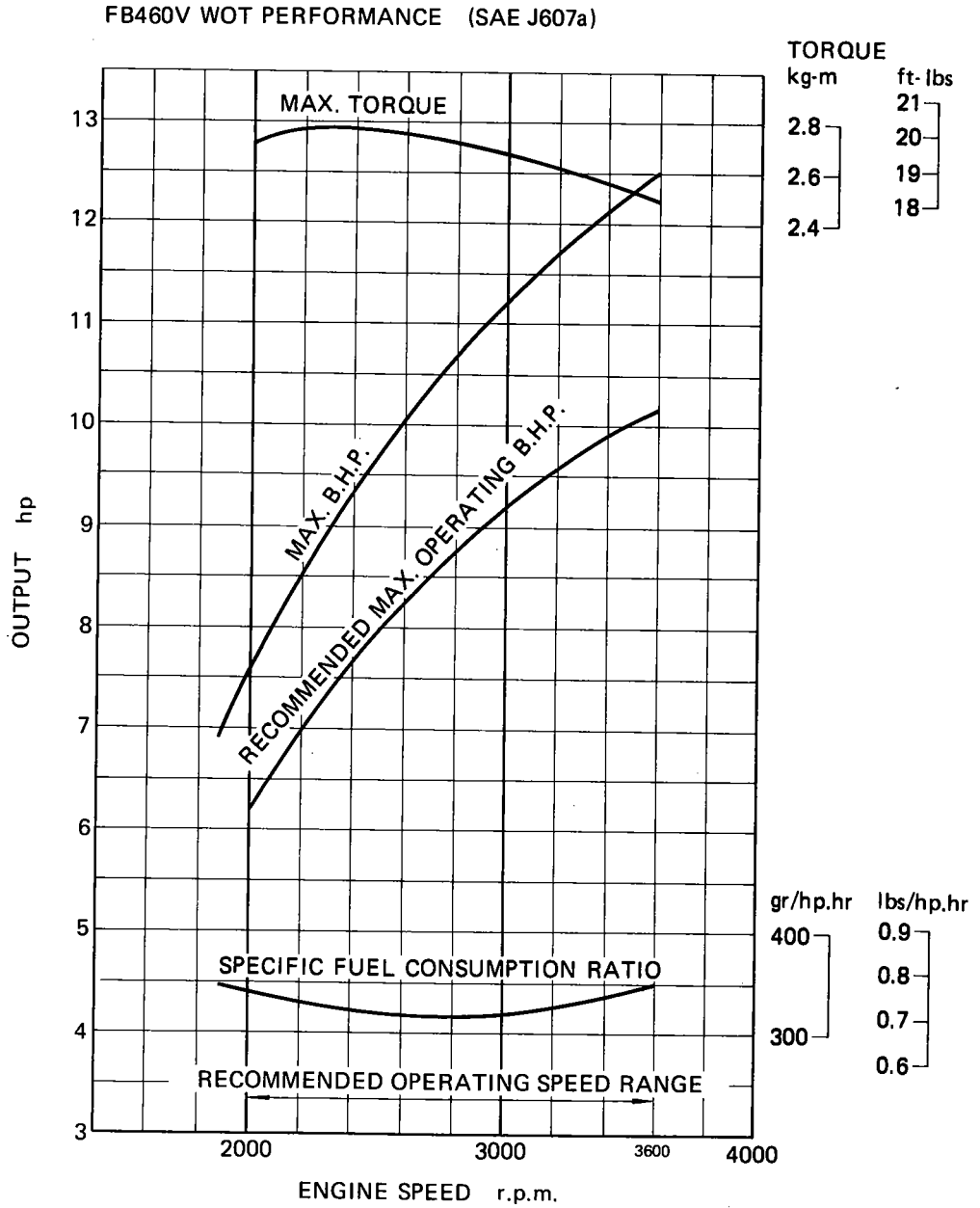
ENGINE MODEL	FB460V	
ENGINE TYPE	Forced Air Cooled, Vertical Shaft, 4-Stroke Gasoline Engine	
NUMBER OF CYLINDER	1	
PISTON DISPLACEMENT	460 cc (28.1 cu.in.)	
BORE x STROKE	89 mm x 74 mm (3.50 in. x 2.91 in.)	
COMPRESSION RATIO	6.4 : 1	
MAX. OUTPUT	12.5/3,600 r.p.m. (with JX156-K112-01 muffler)	
MAX. TORQUE	2.78 kg-m/2,300 r.p.m. (20.1 ft-lbs/2,300 r.p.m.)	
MIN. SPECIFIC FUEL CONSUMPTION RATIO	315 gr/hp-hr (0.694 lbs/hp-hr)	
DIRECTION OF ROTATION	Counter-Clockwise Facing the PTO Shaft	
FAST IDLE SPEED SETTING	3,350 r.p.m.	
SLOW IDLE SPEED SETTING	1,400 r.p.m.	
LUBRICATION	Pressurised Lubrication	
BALANCING	Reciprocating Weight	
THROTTLE CONTROL	Remote Cable	
CHOKE CONTROL	Automatic	
STARTER	Electric Starter or Recoil Starter	
CARBURETOR	Float Type Fixed Main Jet	
IGNITION	Transistorized-Fly-Wheel Magneto (Point Less)	
CHARGING COIL	12V—13A with Regulator (Electric Starter Model)	
RFI	per Canada and U.S.A. Requirement	
GOVERNOR	Mechanical Governor	
OIL FILL AND DIP STICK	Extended Above Engine	
OIL DRAIN	with Extention Pipe	
COOLING AIR INLET	Rotating Screen with Periphery Blade Protector	
COOLING SHROUDS	Noise Suppresive Layered Sheet	
AIR CLEANER	Semi Cyclone Type with Dual Element	
LUBRICANT	1.4ℓ API Service Classification : SD, SE, SE/CC, SF Class At temperatures below 0°C (32°F) : SAE 5W—20 At temperatures above 0°C (32°F) : SAE 30	
FUEL	Regular Grade Leaded or Unleaded Gasoline	
	(Electric Starter Model)	(Recoil Starter Model)
DIMENSION (H x W x L)	307 mm x 381 mm x 419.5 mm (12.08 in. x 15.00 in. x 16.51 in.)	356 mm x 365 mm x 511 mm (14.01 in. x 14.37 in. x 20.12 in.)
NET WEIGHT	36 kg (79.36 lbs)	36 kg (79.36 lbs)
OPTIONAL PARTS	Oil Warning System, Full Flow Oil Filter	

Specifications and dimensions are subject to change without notice.

www.mymowerparts.com

For Kawasaki Discount Parts Call 606-678-9623 or 606-561-4983

PERFORMANCE CURVES



The horsepower ratings shown herein are established in accordance with Society of Automotive Engineers Code J607a.

Power curves are corrected to standard conditions of sea level barometer and temperature of 15.6°C (60°F) and are developed from laboratory test engines equipped with standard air cleaner and muffler.

The "Maximum B.H.P." curve represents performance of laboratory test engines. Production engines will develop not less than 95% of the "Maximum B.H.P." when tested after run-in to reduce friction and after cleanout of combustion chamber, with valves, carburetor and ignition system adjusted to laboratory standards.

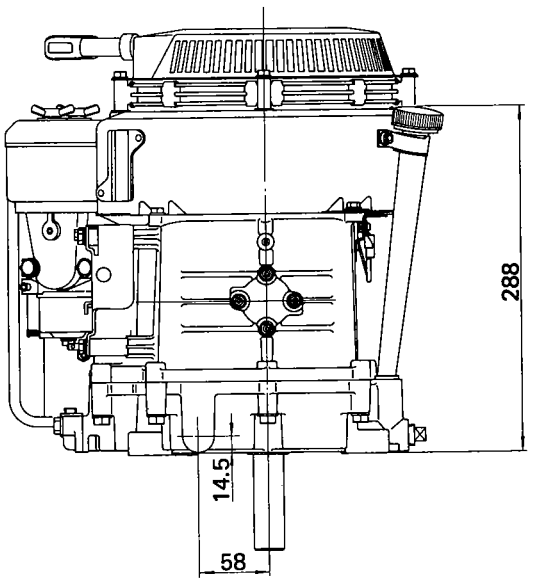
Engine power will decrease 3.5% for each 305m (1,000 ft.) above sea level and 1% for each 5.6°C (10°F) above standard temperature of 15.6°C (60°F).

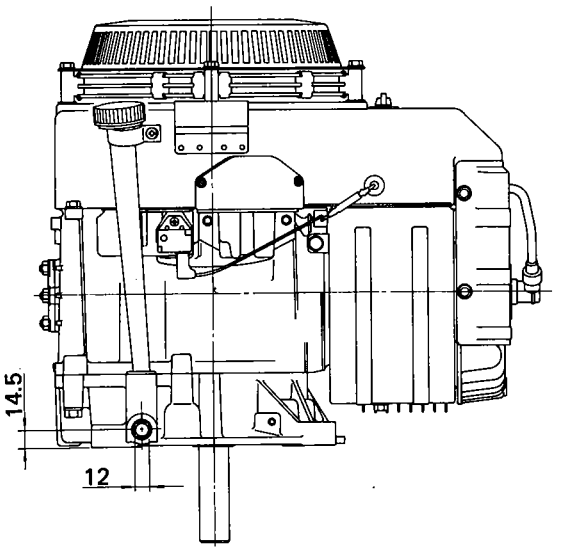
www.mymowerparts.com

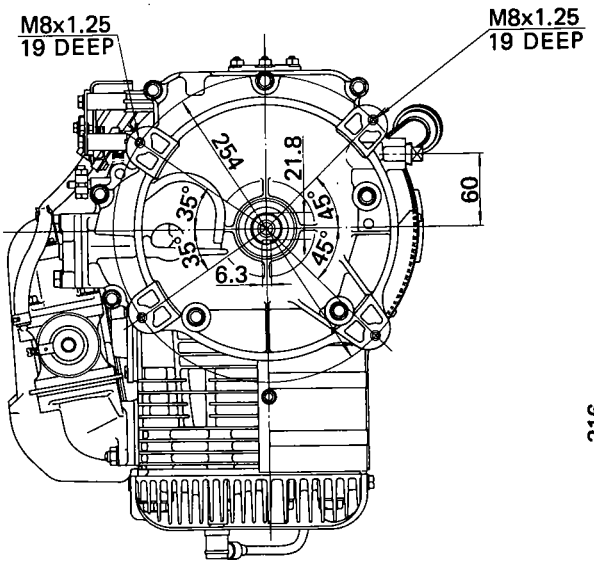
For Kawasaki Discount Parts Call 606-678-9623 or 606-561-4983

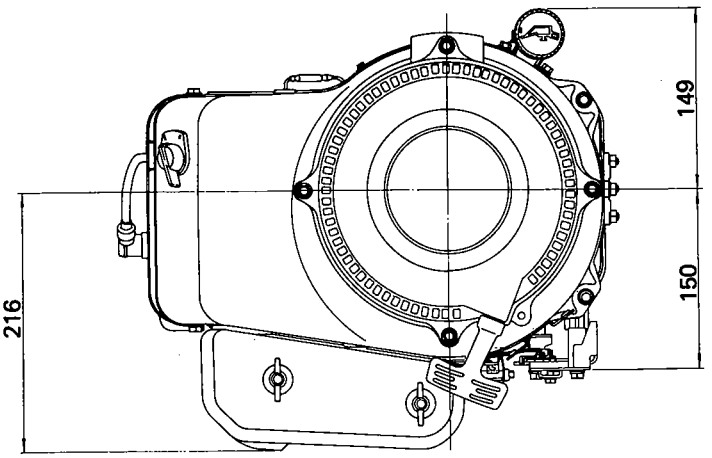
DIMENSIONAL SPECIFICATIONS

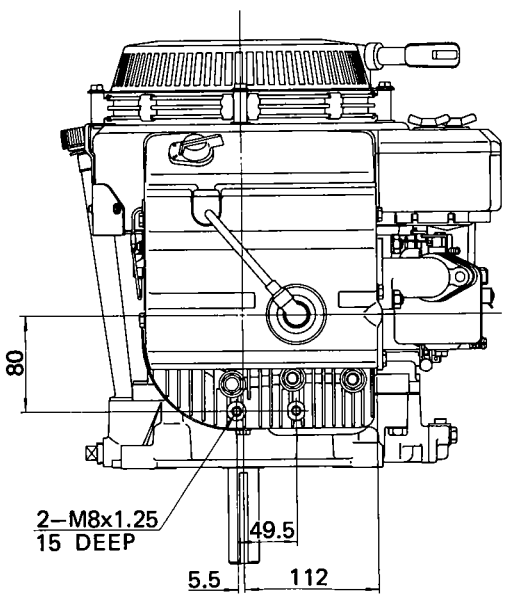
(Recoil Starter Model)

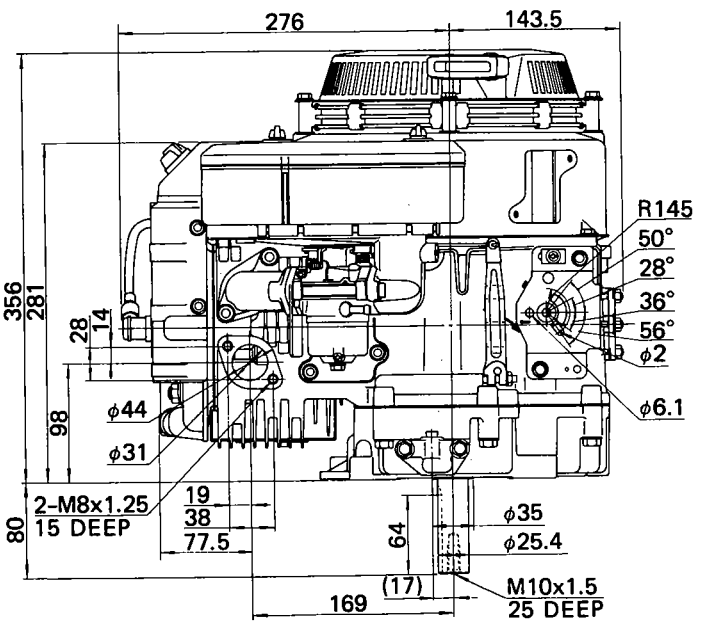








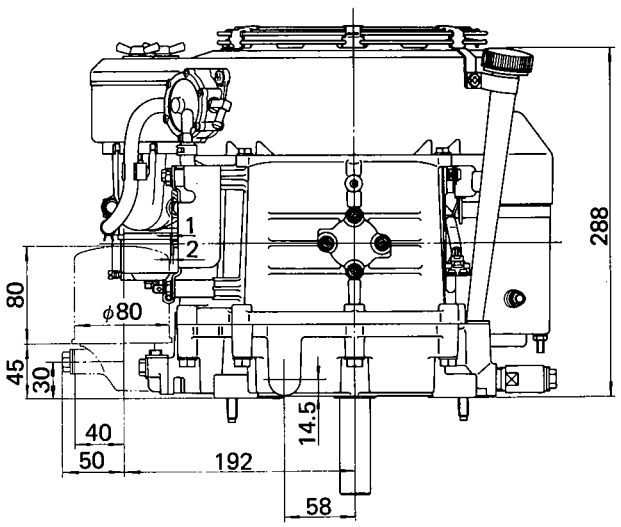


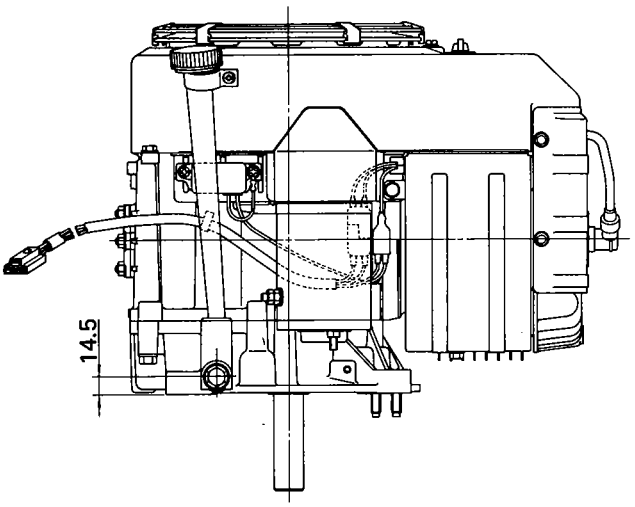


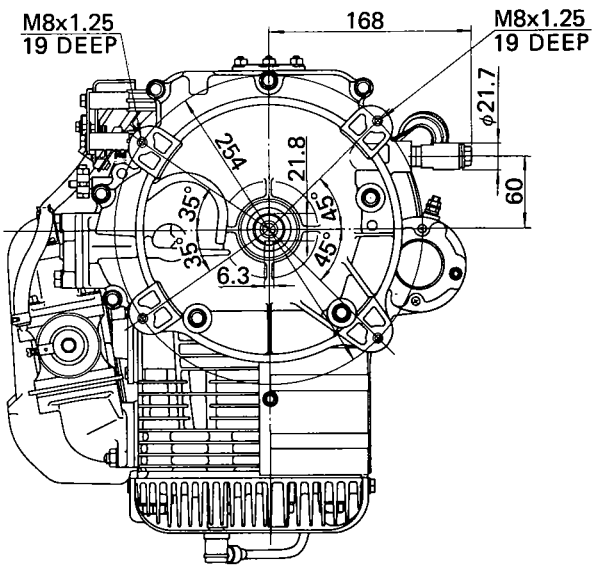
www.mymowerparts.com

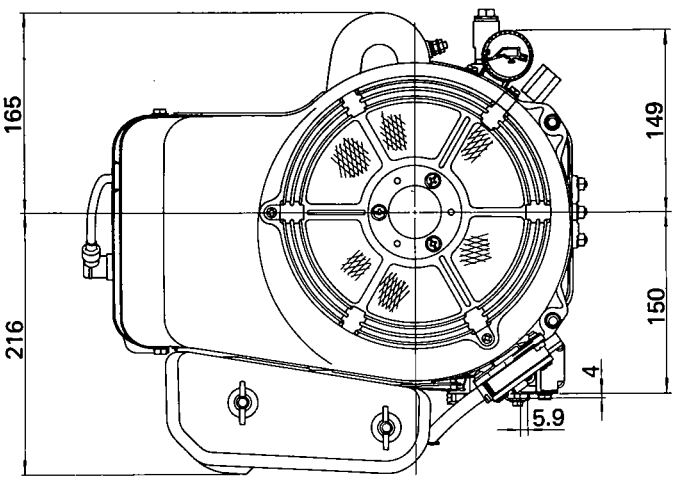
For Kawasaki Discount Parts Call 606-678-9623 or 606-561-4983

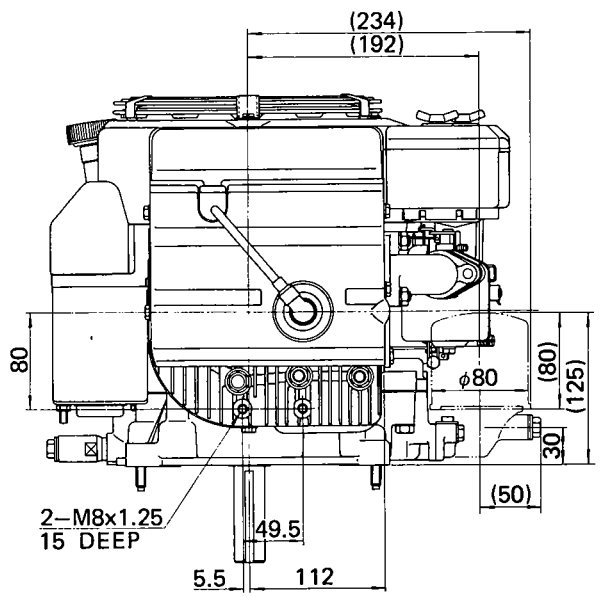
(Electric Starter Model)

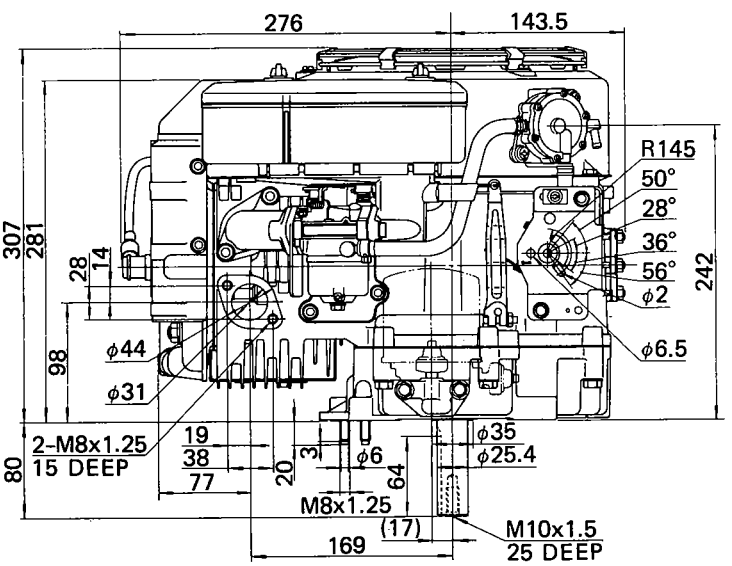












www.mymowerparts.com

For Kawasaki Discount Parts Call 606-678-9623 or 606-561-4983

PERIODIC MAINTENANCE

Engine Serial Number
The engine serial number is located on the front of the cylinder-head cover above the spark plug.

Periodic Maintenance Chart
To ensure satisfactory operation over an extended period of time, the engine requires normal maintenance at regular intervals.
The chart below shows periodic inspection and maintenance required and suitable interval designated with (✔).

	OPERATION	INTERVAL				
		Daily	Every 25hr	Every 50 hr	Every 100 hr	Every 300 hr
	Check fuel	✔				
	Check and add engine oil	✔				
	Check for loose or lost nuts and screws	✔				
	Check for fuel leakage	✔				
	Check for engine oil leakage	✔				
★	Check battery electrolytic level	✔				
	Check or clean air intake screen	✔				
★★	Tighten nuts and screws		✔		✔	
★★	Change engine oil (without oil filter)		✔			
★★	Change engine oil (with oil filter)			✔		
★★★	Clean air cleaner elements		✔			
	Change oil filter (optional)				✔	
	Clean and regap spark plug				✔	
	Clean dust and dirt from cylinder and cylinder head fins					✔
	Replace aircleaner paper element					✔
	Clean combustion chamber					✔
	Check and adjust valve clearance					✔
	Clean, and lap valve seating surface					✔
	Check carburetor adjustment					✔

★ Electric start models only.
★★ Perform these operations after the first 5 hours of use, then at the recommended interval.
★★★ Clean the air cleaner element more often when operating under dusty conditions.

Fuel
Use regular grade leaded or unleaded.

CAUTION: Gasohol is not recommended.
Don't use additives, such as carburetor cleaners, de-icers, or moisture-removing liquids in the gasoline.
Don't mix oil with gasoline. Always use a clean container.

Engine Oil
Use API classification SF, SE/CC, SE or SD. Use SAE 30 at temperatures above 0°C (32°F) and SAE 5W–20 at temperatures below 0°C (32°F). Don't put additives in the oil.

4-STROKE ENGINE THEORY

KAWASAKI FG Series engines are of the same basic "4-stroke cycle design" as used in automobiles, trucks and tractors. There are four strokes to one complete power cycle.

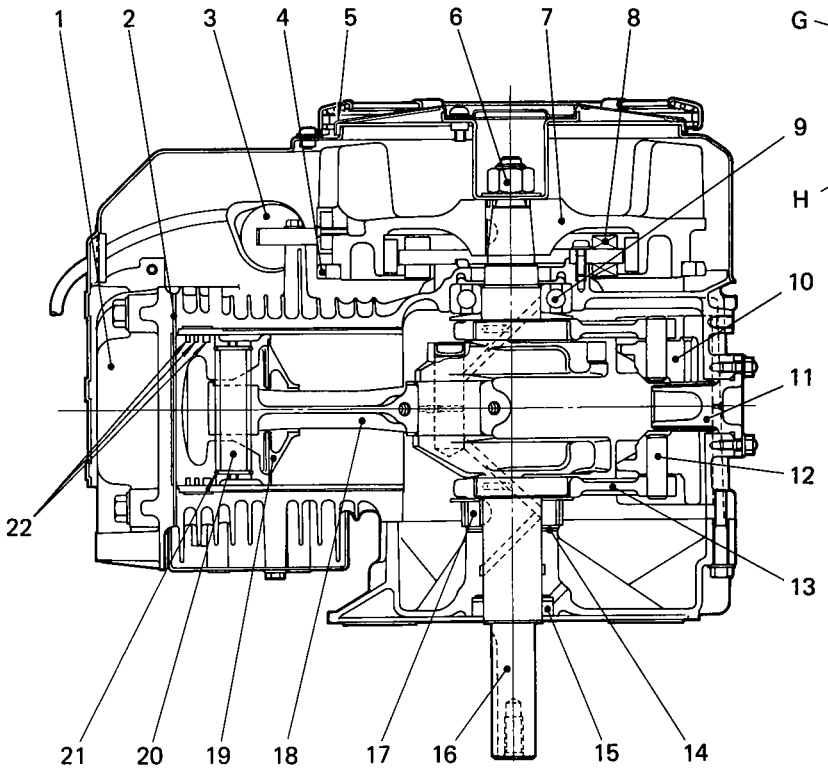
1. Intake Stroke:
   - The piston goes down, creating a vacuum in the cylinder which draws gas through open intake valve into the space above piston.
2. Compression Stroke:
   - The piston comes up with both valves closed, highly compressing the gas into the space left between the top of the piston and cylinder head.
3. Power Stroke:
   - At this point the magneto sends high tension current to the spark plug, firing or exploding the compressed gas and driving the piston down.
4. Exhaust Stroke:
   - Exhaust valve opens and the upward stroke of the piston forces out all of the burnt gases, thus completing the power cycle.

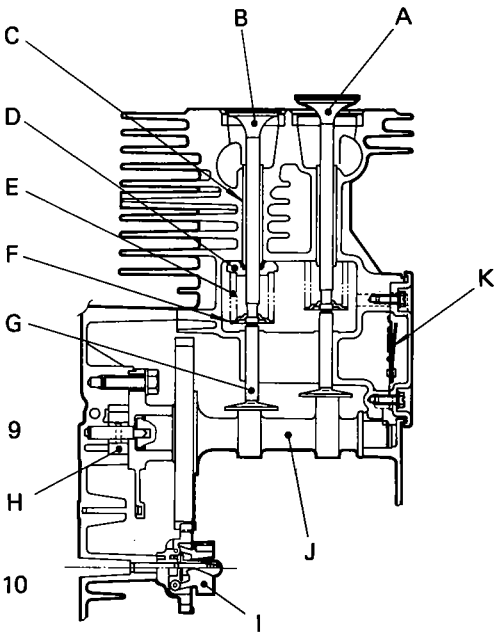
www.mymowerparts.com

For Kawasaki Discount Parts Call 606-678-9623 or 606-561-4983

CONSTRUCTION (INTERNAL COMPONENT)

1. Cylinder head
2. Gasket
3. Ignition coil
4. Ring gear
5. Rotating screen
6. Flywheel nut
7. Flywheel with blades
8. Charging stater coil
9. Ball bearing
10. Balance weight
11. Support shaft
12. Wrist pin
13. Link rod
14. Adjust shim
15. Oil seal
16. Crankshaft
17. Crankgear
18. Connecting rod
19. Piston
20. Piston pin
21. Snap ring
22. Piston rings





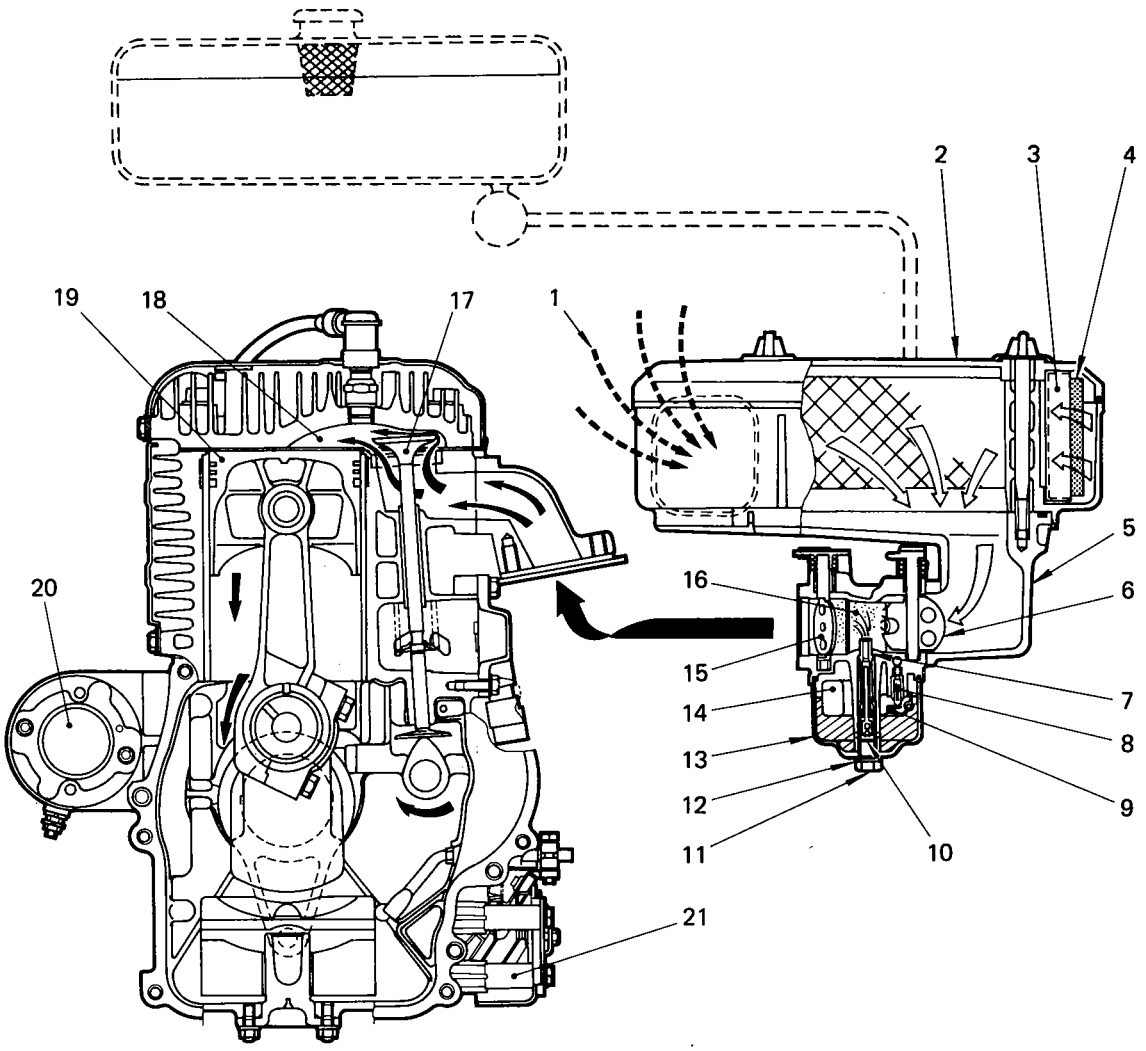
A. Intake valve
B. Exhaust valve
C. Valve guide
D. Valve rotater
E. Valve spring
F. Spring retainer
G. Tappet
H. Oil pump
I. Governor assembly
J. Camshaft
K. Breather valve

- The intake and exhaust valve guide are fitted with a bushing. The cylinder block and bushings can be reamed out to install service valve guide bushings and standard size valves, when valve guide wear exceeds the service-limit.
- A satellite exhaust valve with a rotator is used to prolong the life of the exhaust valve.
- The function of the breather is to create a vaccum in the crankcase which prevents oil from being forced out of the engine through piston rings, oil seals, or gaskets. Oil laden air in the crankcase passes through a maze created by the reed valve and expansion chambers where the oil is separated from the air and drained back to the crankcase. The air passes through a hose out to the aircleaner.
- Internal components for FB460V engine consist of the piston, connecting rod, camshaft, crankshaft, reciprocating balancer, tappets, oil pump and governor.
- Pressurized oil directly lubricates the PTO journal, crankpin, and link rod journals.
- A balance weight is mounted on crankshaft with link rods and reciprocating balance is accomplished in the exact line of the piston motion.
- The flyweight governor governs all speed ranges.
- Oversize pistons and rings 0.25 mm, 0.5 mm, 0.75 mm (0.01 in., 0.02 in., 0.03 in.) are available.
- Camshaft is gear-driven by the crankshaft. The camshaft lobs operate against the tappets, which raise and lower valves.

www.mymowerparts.com

For Kawasaki Discount Parts Call 606-678-9623 or 606-561-4983

FUEL SYSTEM AND OPERATION



1. Atomospheric pressure
2. Air cleaner
3. Paper element
4. Foam element
5. Intake pipe
6. Choke valve
7. Main nozzle
8. Needle valve
9. Tongue
10. Main jet
11. Bolt
12. Gasket
13. Float bowl
14. Float
15. Throttle valve
16. Venturi
17. Intake valve
18. Lower pressure
19. Piston
20. Starter motor
21. Control plate

- Fuel enters the carburetor bowl through the needle valve contolled by the float. The downward movement of the piston on the intake stroke creates negative pressure in the cylinder. Atomospheric pressure forces out side air through the air cleaner and venturi into the engine.
  Heigh speed air in the venturi creates negative pressure.

Atomospheric pressure in the bowl forces fuel up the main nozzle into the venturi, where the fuel mixes with air moving through the venturi. The choke valve controls the amount of air entering the venturi during starting operation.

The throttle valve controls the fuel-air mixture entering the engine.

www.mymowerparts.com

For Kawasaki Discount Parts Call 606-678-9623 or 606-561-4983

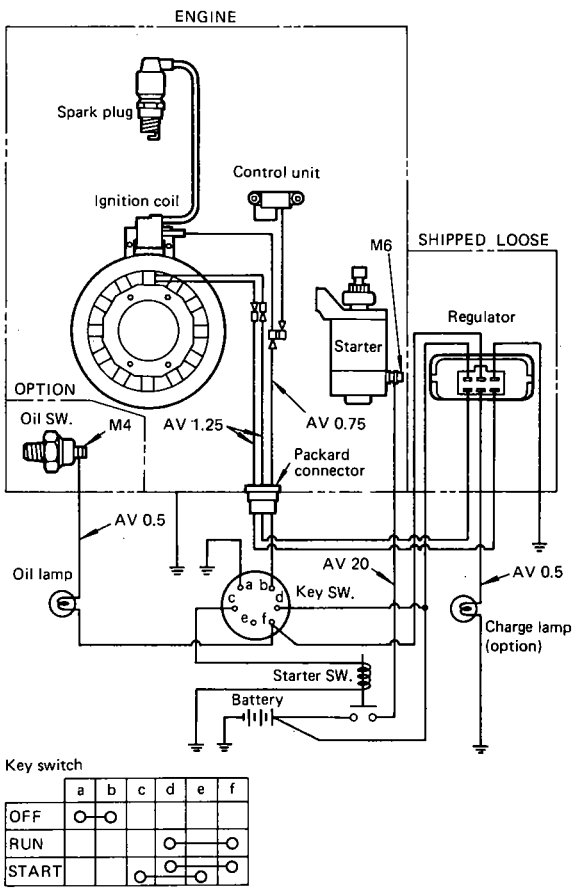
ELECTRICAL SYSTEM

The electrical system for FB460V consists of an ignition system, electric starting system, charging system and monitor system (optional).

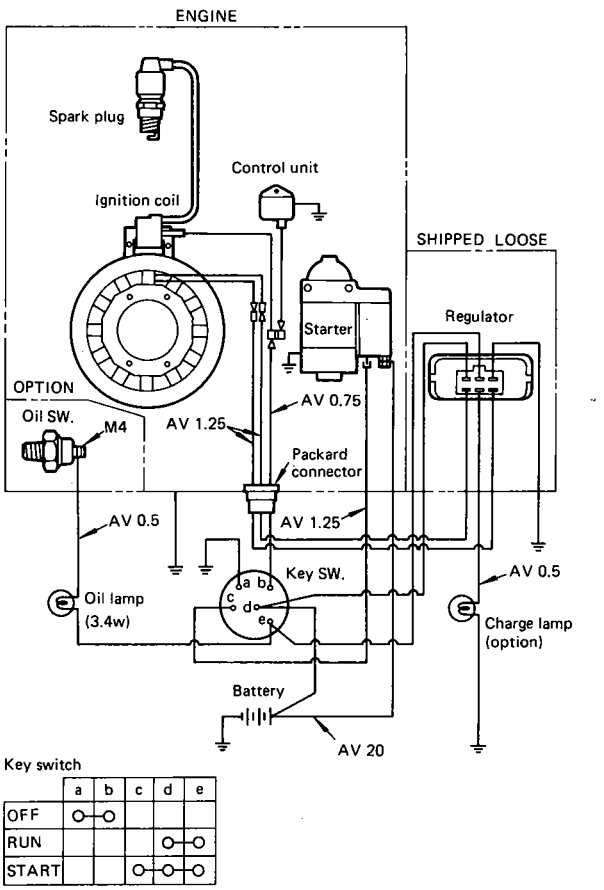
- The ignition system includes a flywheel, ignition coil, control unit, spark plug and engine stop switch (recoil starter model only).
- The starter system includes a key switch, solenoid and starting motor.
- The charging system consists of a flywheel stator and regulator to convert AC current to DC current. The stator out put is 12 amps at 3,350 rpm.
- The monitor system consists of an oil pressure sensor (oil switch), oil pressure warning lamp and charge lamp.

Wiring Diagram

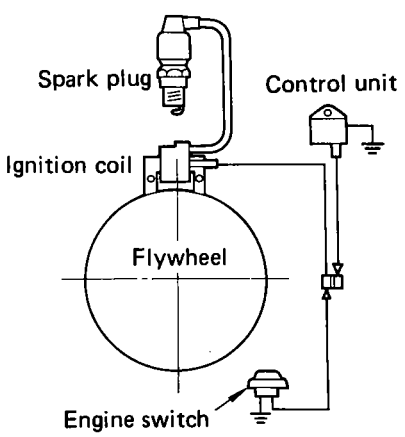
FB460V-AS. Model (Bendix Starter Motor)



FB460V-BS. Model (Shiftlever Starter Motor)



FB460V. (Recoil-Starter Model)



Specifications

Ignition System

ITEM	
Ignition system type	Flywheel magneto transistor ignition
Spark plug	NGK BMR-4A or CHAMPION RCJ-8
Plug air gap	0.6 to 0.7 mm (0.024 to 0.028 in.)
Primary coil resistance	0.4 to 0.8 Ω
Secondary coil resistance	10 to 18 kΩ
Control unit resistance	See CONTROL UNIT CHECK

www.mymowerparts.com

For Kawasaki Discount Parts Call 606-678-9623 or 606-561-4983

Electric Starter System (Bendix-type)

ITEM	
Battery rating	12 V/35 A.H. or more
Max charging current	One tenth of battery capacity
Starter-rating	12 V – 0.8 KW
Brush length	12 mm (0.47 in.) (MIN)
Commutator groove depth	0.2 mm (0.008 in.) (MIN)
Commutator diameter	32 mm (1.26 in.) (MIN)
Commutator Run-out	0.3 mm (0.012 in.) (MAX)
Current draw test	12 V, 7000 rpm (MIN) 60A (MAX)

Electric Starter System (Shiftlever-type)

ITEM	
Battery rating	12 A.H. / 35 A.H. or more
Max charging current	One-tenth of battery capacity
Starter-rating	12 V – 0.75 KW
Brush length	6 mm (0.24 in.) (MIN)
Commutator groove depth	0.2 mm (0.008 in.) (MIN)
Commutator diameter	27 mm (1.10 in.) (MAX)
Commutator run-out	0.4 mm (0.016 in.) (MAX)
Current draw test	11.5 V, 6000 rpm (MIN) 50A (MAX)

Charging System

ITEM	
Stator output	Approx. 12 amps / 3350 rpm
No-load voltage	34.5 V / 3350 rpm (MIN)
Regulator-type	12V system, constant voltage, regulator
Regulator resistance	See Regulator Inspection

Monitor System

ITEM	
Charge lamp rating	12V 3.4 W (MAX)
Oil pressure lamp rating	12V 3.4 W (MAX)
Oil pressure switch detect pressure	0.3 kg / cm^2 (4.27 psi.)

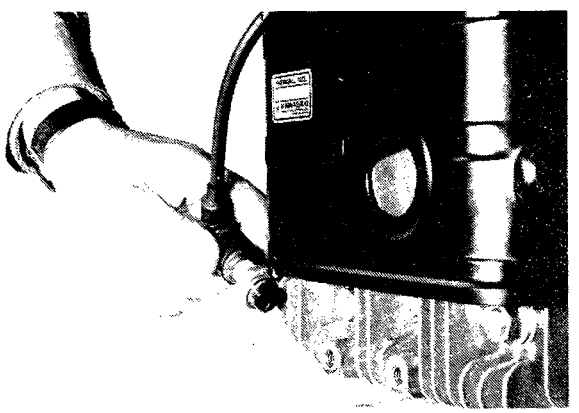
PRELIMINARY ENGINE CHECKS

Acomplete diagnosis of engine malfunctions appears in this section.
However, the majority of engine problems is normally due to ignition or fuel system difficulties.

1. If engine will not start with gasoline in the tank, remove spark plug and check spark by cranking engine while having the plug touched against engine block.

⚠ **WARNING: To avoid fire, do not hold spark plug in close positions to the plug hole. Keep the plug as far away as possible from the plug hole. To avoid an electric shock, do not hold the plug itself. Make sure to hold the plug cap.**

1-1. If there is good spark between electrodes, the ignition system is in good condition.



1-2. If there is no or a very weak spark, clean the plug and regap to 0.6 to 0.7mm (0.024 to 0.028 in.). Replace the plug if it's electrodes are of worn.

1-3. If there is still no spark refer to "IGNITION" section.

2. If engine still fails to start, check the fuel system for the tank to carburetor to be sure gas is getting to carburetor.
Check carb. adjustments and be sure choke and throttle controls are working properly. Refer to Section 4 for carb. information.

3. Check for a plugged air cleaner. Clean or replace if necessary.

4. If engine still will not start, or starts but does not run properly, perform the compression test that follows, and refer to "Diagnose Malfunction" in this Section.

www.mymowerparts.com

For Kawasaki Discount Parts Call 606-678-9623 or 606-561-4983

5. Test compression when engine loses power or runs erratically and fuel and ignition systems adjustments do not correct the problem.

CAUTION: Disconnect spark plug cap to prevent engine from starting during compression test.

6. Crank engine with electric or recoil starter and check the compression force.

7. If compression is low, it is usually the result of one or more of following:
   - Leaking cyl. head gasket.
   - Warped cyl. head.
   - Worn piston rings.
   - Worn cyl. bore.
   - Damaged piston.
   - Burned or warped valves.
   - Improper valve clearance.
   - Broken valve springs.

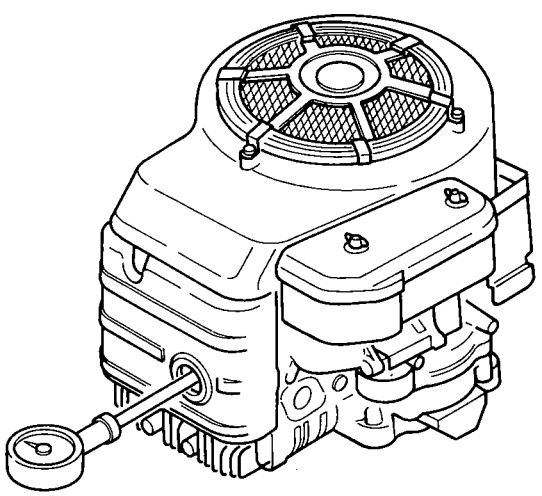
8. Use a compression gauge and test compression by:

8-1. Remove spark plug and screw compression gauge into the plug hole securely.

8-2. Crank engine with electric or recoil starter and take highest pressure gauge reading.

8-3. Cylinder compression should not be less than 380 KPa (55 psi).

8-4. If compression reading is too high, check for carbon built up in combustion chamber.



www.mymowerparts.com

For Kawasaki Discount Parts Call 606-678-9623 or 606-561-4983

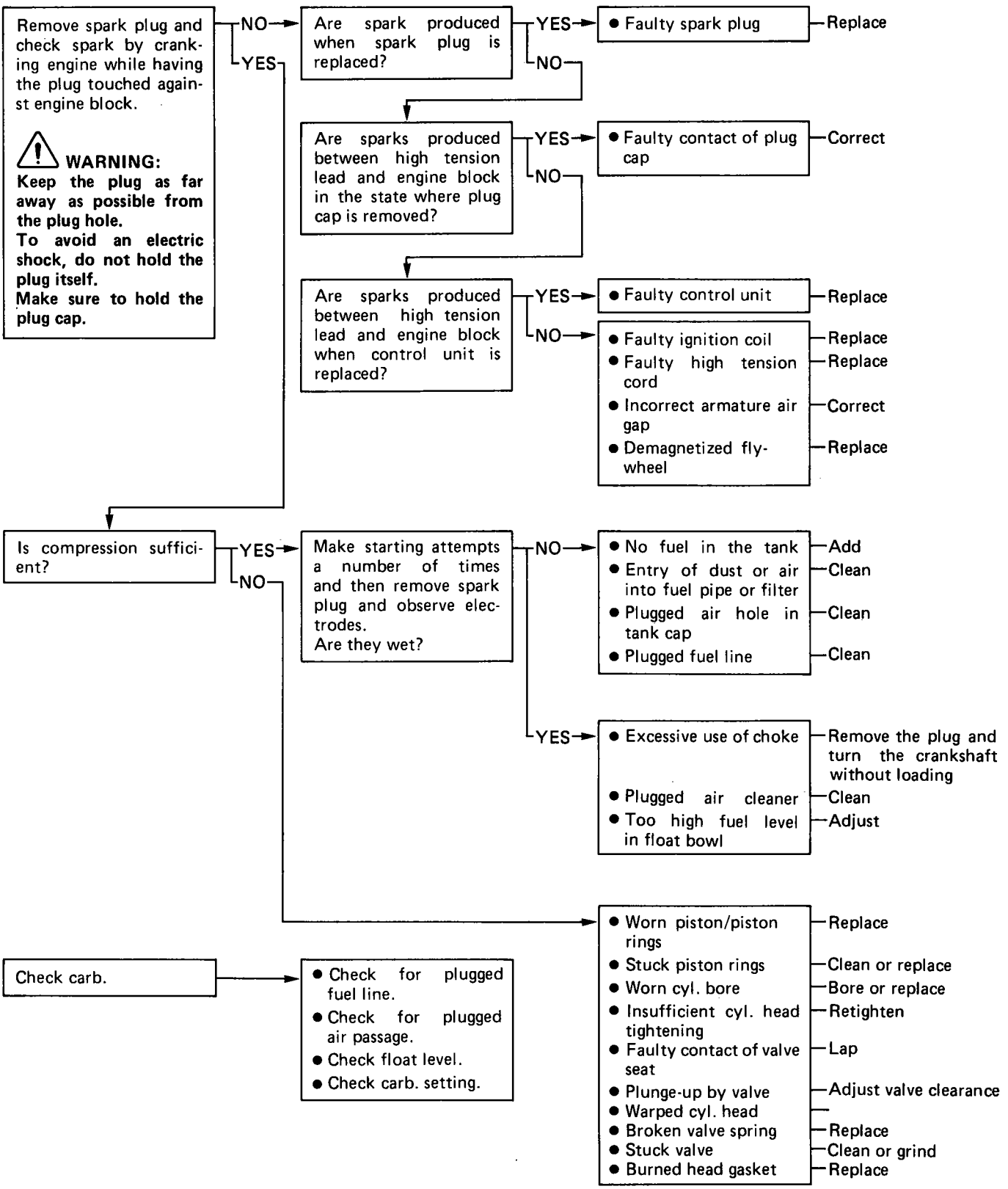
TROUBLE SHOOTING

If engine malfunctions, check if the way the engine is used is correct. If engine malfunctions even if engine is used correctly, systematically carry out troubleshooting starting with simple points.

This chart describes typical troubleshooting procedures.

Do not unnecessarily disassemble carburetor, magneto or engine unless it has been found to be the cause of malfunctioning.

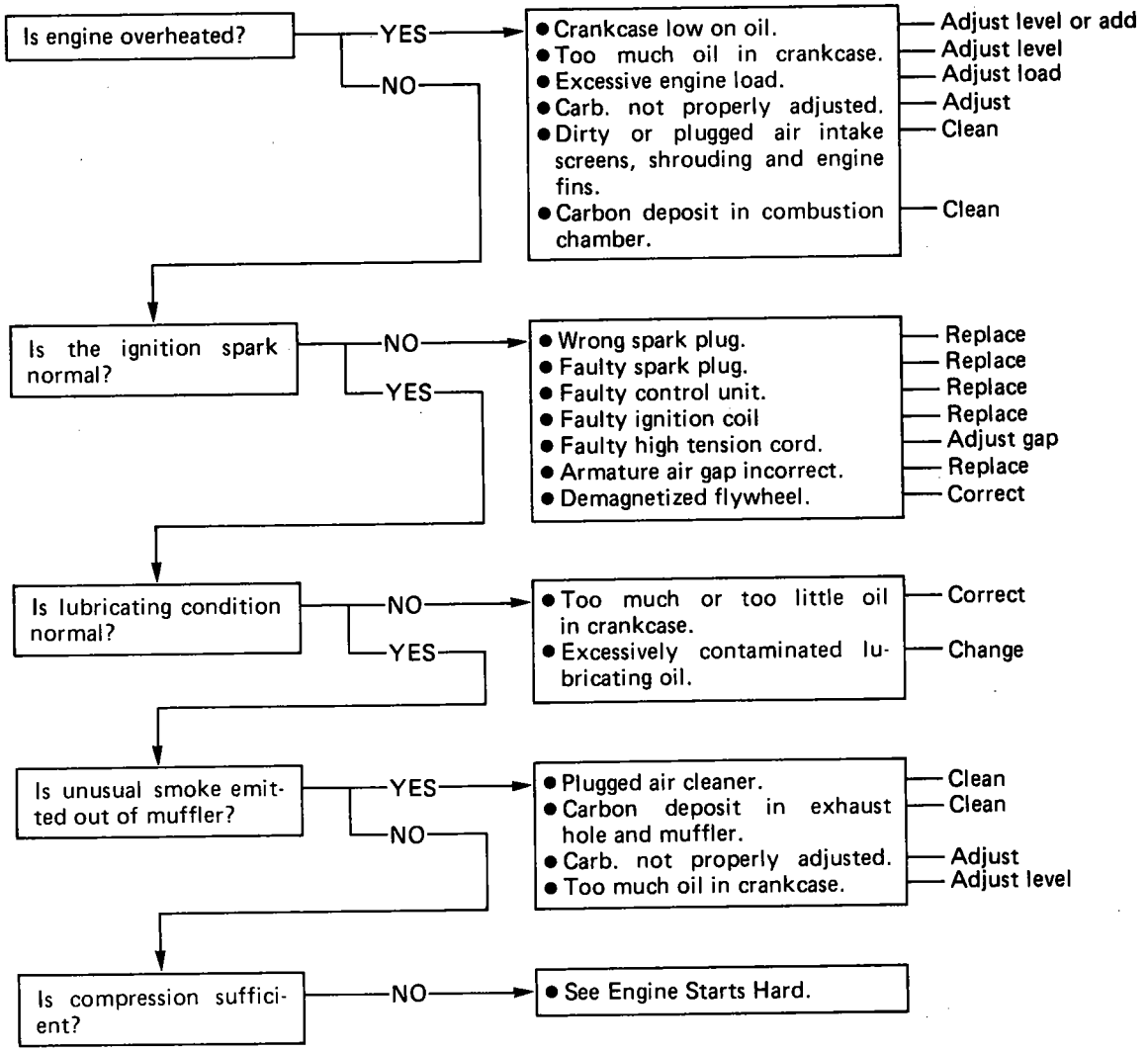
[Engine hard to start]



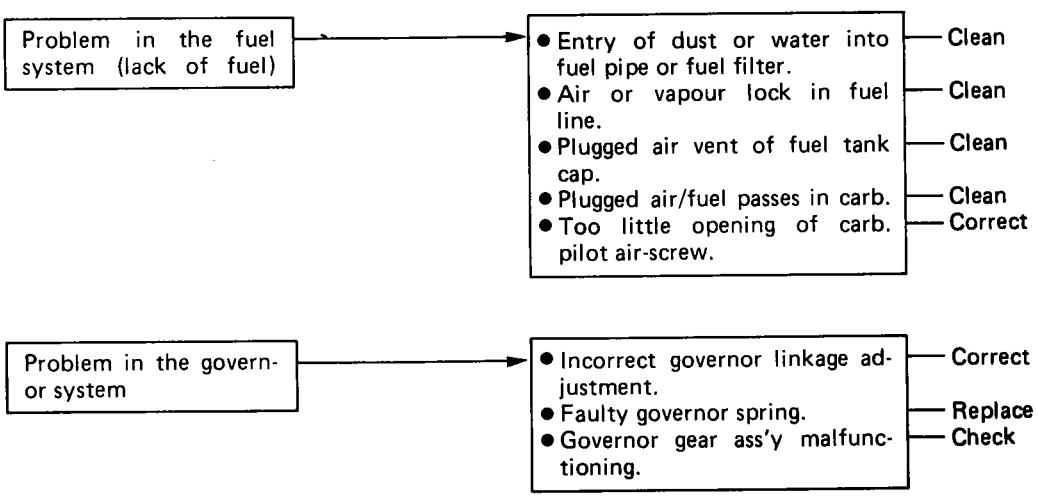
www.mymowerparts.com

For Kawasaki Discount Parts Call 606-678-9623 or 606-561-4983

[Engine loss power]



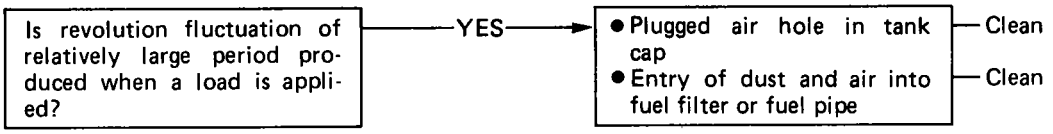
[Engine runs erratically]



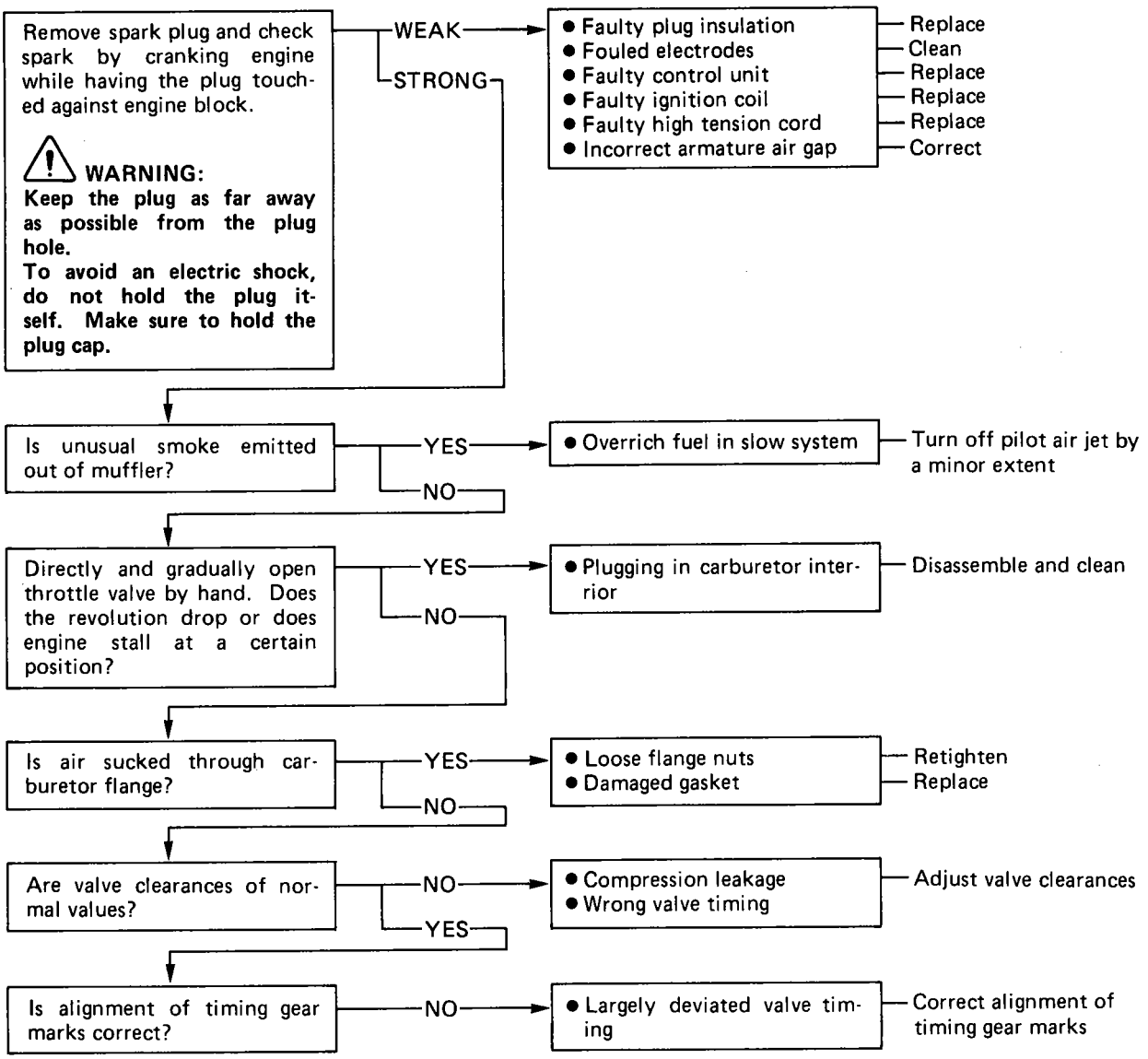
www.mymowerparts.com

For Kawasaki Discount Parts Call 606-678-9623 or 606-561-4983

[Engine malfunctions at high speed]



[Engine malfunctions at low speed]



www.mymowerparts.com

For Kawasaki Discount Parts Call 606-678-9623 or 606-561-4983

[Fuel consumption is excessive]

Is compression sufficient?

YES →
- High fuel level in carb. float chamber (including overflow) — Adjust
- Delay is ignition timing — Adjust
- High idling R.P.M. — Adjust
- Incomplete opening of choke valve — Open choke
- Excessively backed off carburator pilot air screw — Adjust

NO →
- Worn piston/piston rings — Replace
- Stuck piston — Clean or replace
- Worn cylinder bore — Bore or replace
- Insufficient cyl. head tighteness — Retighten
- Faulty valve seat contact — Lap
- Plunge-up of valve — Adjust valve clearance
- Wrong valve timing — Adjust
- Broken valve spring — Replace
- Stuck valve — Clean or grind

[Oil consumption is excessive]

Is compression sufficient?

YES →
- Plugged oil ring groove — Clean
- High oil level — Adjust
- Faulty valve seat contact — Lap
- Worn valve stems and valve guides — Replace
- Oil leakage along governor shaft — Replace
- Oil leakage from oil seal — Replace
- Oil leakage from mounting surface — Replace gasket
- Oil leakage from drain plug — Retighten or replace gasket
- Clogged breather valve — Clean
- Drain-back hole in tappet chamber plugged — Clean
- Incorrect oil viscosity — Correct

NO →
- Worn piston rings — Replace
- Stuck piston rings — Clean or replace
- Worn cylinder bore — Bore or replace
- Broken piston ring — Replace

[Engine runs erratically] →
- Dirt or water in fuel line — Clean
- Carb. not properly adjusted — Adjust
- Spark plug fould, pitted, or gapped incorrectly — Replace or adjust
- Carb. flange leaking at gasket — Tighten or replace
- Carb. body and throttle shaft warn — Replace
- Restricted gas tank vent — Clean
- Governor mulfunctioning — Adjust

[Engine backfires] →
- Loose carb. flange — Tighten
- Loose cyl. head or leaking head gasket. — Tighten
- Burned or sticking intake valve — Replace
- Incorrect armature air gap — Adjust
- Carb. not properly adjusted — Adjust

[Engine knocks] →
- Stale fuel — Change
- Excessive carbon deposit in engine — Clean
- Excessive engine load — Adjust
- Engine overheating — See low on power
- Faulty control unit — Replace

www.mymowerparts.com

For Kawasaki Discount Parts Call 606-678-9623 or 606-561-4983

TUNE-UP PROCEDURE

A "Tune-Up" (see the steps below) would normally be performed on relatively new engines brought in for minor difficulties. By performing these steps you will either be sure the engine is function properly or will know if and what major repairs should be performed.
The steps are also covered in the OVERHAUL PROCEDURE and will normally be performed as a part of the complete overhall.

1.	Remove fuel tank, clean tank and lines. Check oil level and drain.
2.	Remove air cleaner, check for proper servicing.
3.	Remove recoil starter, flywheel housing, and shrouds. Inspect rope, recoil starter assembly or pinion clutch (electric starter).
4.	Clean cooling fins and entire engine. Rock flywheel to check compression.
5.	Remove carb., disassemble and inspect for wear or damage. Wash in solvent, replace parts as necessary and assemble. Set initial adjustment.
6.	Inspect inlet and exhaust flange for damaged gaskets.
7.	Check governor linkage, spring, and speed control lever for damage or wear, also check adjustment.
8.	Remove flywheel, check for seal leakage, both flywheel and PTO shaft sides. Check flywheel key for damage.
9.	Check coil and control unit, inspect all wires for breaks damaged insulation. Be sure lead wires do not touch flywheel. Check stop switch and lead.
10.	Install flywheel. Set air gap. Check for spark.
11.	Remove cyl. head, check gasket, remove spark plug, and clean carbon, inspect valves for seating.
12.	Install cyl. head, torque to the specified torque, set spark plug gap or replace the plug if necessary.
13.	Replace oil and fuel, check muffler for restrictions or damage.
14.	Adjust speed control linkage and cable if used, for correct operation.
15.	Run and adjust idle (mixture), and MAX speed.

OVERHAUL PROCEDURE

The following overhaul procedure is intended to help you in systematic and sequential method of repairing a Kawasaki FB460V engine. Efficiency is obtained when the repair operations are performed in the same sequence every time. The exact procedure will vary according to the engine model being repaired.
This table can also be used as an index.
For detail information on how to perform each oepration refer to the section and page number listed.

Section	DISASSEMBLY
3	Drain engine oil
	Air cleaner assy
	Muffler ass'y
4	Carburetor, heat shield plate and gasket. Intake pipe.
	Carburetor and linkage.
	Disassemble carburetor.
11	Electric starter
12	Recoil starter
2	Dip stick and blower housing
6	Spin flywheel to check compression
2	Spark plug-adjust gap, clean and inspect.
12	Rope starter pulley.
2	Adjust armature air gap.
	Tappet chamber cover and breather pipe connector
6	Cylinder head and gasket
	Check valve-to-tappet clearance valve and spring.
2	Flywheel
7	Breather
2	Ignition coil and control unit
11	Starter motor disassembly
12	Recoil starter disassembly
5	Governor control base plate and governor arm
9	Crankcase cover
5	Damaged oil seal
	Damaged governor gear ass'y
	Oil pump and relief valve
9	Camshaft and gear
	Tappets
8	Con-rod and piston
9	Balance weight support shaft
	Crankshaft and balance weight ass'y
	Disassemble crankshaft ass'y

www.mymowerparts.com

For Kawasaki Discount Parts Call 606-678-9623 or 606-561-4983

Section	DISASSEMBLY
9	Crankshaft – inspect and check
10 6	Cylinder – check bore, main bearings, valve guides and valve seats.
	Disassemble connecting rod and piston.
8	Check piston, rings, connecting rod, piston pin.

Section	REPAIR
10	Resize cylinder bore to next over size.
6	Replace valve guide – intake, exhaust.
	Reface valves and seats and lap.
10	Replace main bearings.
	Replace oil seals.
5	Replace governor gear ass'y.
6	Cylinder head repair
2	Replace flywheel ring gear.
9	Replace bushing – link rod.

Section	REASSEMBLY
9	Assemble crankshaft, link rod and balance weight.
	Crankshaft ass'y and balance weight support shaft
8	Piston, piston pin, rings
	Connecting rod sub ass'y
9	Tappets, camshaft
5	Governor gear ass'y
7	Oil pump
9	Crankcase cover
5	Valves, valve springs, retainers
6	Adjust valve tappet clearance.
	Tappet chamber cover, breather pipe connector
7	Breather reed valve and cover
	Ignition coil
2	Control unit
	Charging stator coil
	Flywheel and pulley
	Adjust air gap : armature to flywheel.
	Check spark.
6	Cylinder head and gasket
	Cylinder head and cylinder cover
2	Blower housing. Oil dip stick
5	Inlet pipe.
	Governor control base plate.

Section	REASSEMBLY
4	Governor arm, spring and links.
	Inlet pipe, carburetor and linkage.
5	Set governor linkage.
3	Air cleaner
11	Electric starter
2	Intake air screen.
12	Recoil starter
2	Spark plug
4	Muffler
7	Fill crankcase with oil. (Fill with gasoline.)
	Start engine.
4	Adjust carburetor.
5	Set governor to obtain correct engine speed.

www.mymowerparts.com

For Kawasaki Discount Parts Call 606-678-9623 or 606-561-4983

Section 2
IGNITION

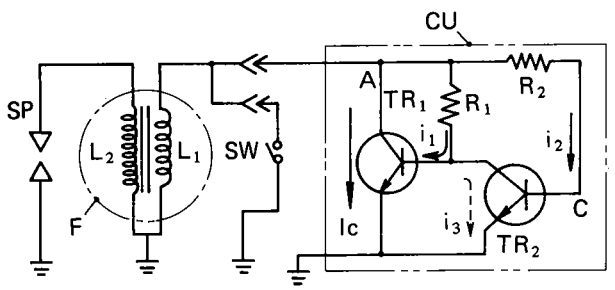
IGNITION SYSTEM

A transistor controlled ignition system is used for FB460V. This system consists of the following components.

- Ignition coil unit
- Control unit (Igniter)
- Permanent magnet flywheel
- Spark plug

The ignition coil unit is mounted outside the flywheel on the cylinder block.
Since the transistor ignition system contains no mechanical parts, no wear occurs and no periodic maintenance is required except for the spark plug.

Principle of Operation



L_1	: Primary coil	TR_1	: Transistor
L_2	: Secondary coil	TR_2	: Transistor
R_1	: Control Resister	F	: Flywheel
CU	: Control Unit (Igniter)	SP	: Spark plug
R_2	: Control Resister	SW	: Stop switch

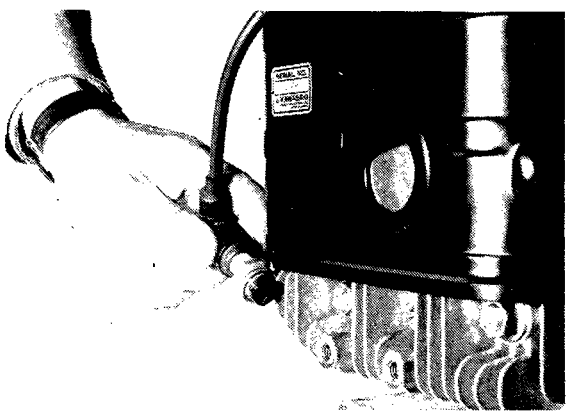
- When voltage at point (A) is plus, base current (i_1) flows into Transistor (TR_1). Then the Transistor (TR_1) is turned "ON" and allows large amplified current (Ic) to flow, during which the Transistor (TR_2) does not operate because Resister (R_2) lowers valtage at point C.
- As the flywheel continues to rotate, AC power is further generated in the primary coil (L_1). Then the Transistor (TR_2) is turned "ON" by high voltage at point (C).
  As soon as the Transistor (TR_2) is turned "ON", the base current (i_1) through Resistor (R_1) to Transistor (TR_1) changes its flow to (i_3) and to Transistor (TR_2), thus the Transistor (TR_1) is turned "OFF" because of voltage drop at point (B).
  This sudden current (Ic) change induces high voltage within the secondary coil (L_2), which fires the spark plug.

SPARK CHECK

Remove spark plug and check spark by cranking engine while having the plug touched against engine block.

⚠ **WARNING: Keep the plug as far away as possible from the plug hole. To avoid an electric shock do not hold the plug itself. Make sure to hold the plug cap.**

If there is good spark between electrodes, the ignition system is in good condition.



If there is no or very weak spark, clean spark plug and regap to 0.6 to 0.7mm (0.024 to 0.028 in.). Replace spark plug if electrodes are worn.
See "Spark Plug Check and Cleaning" section.

FLYWHEEL REMOVAL

1. Remove spiral case. (Flywheel housing)
2. Disconnect spark plug cap from spark plug.
3. Carefully remove the wire out of spiral case.

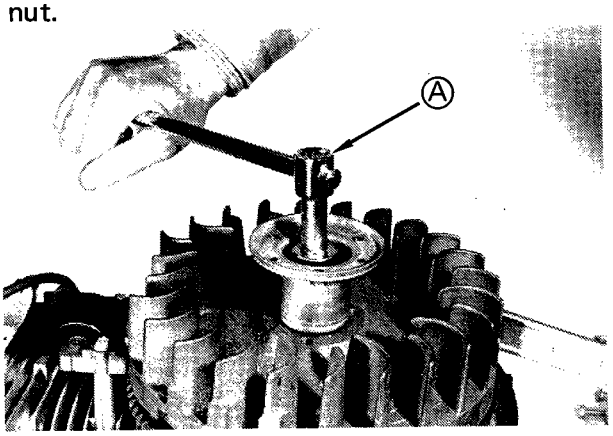
CAUTION: Flywheel nut has a left-hand thread.

4. Place a pry bar against the thick root of the blades to prevent the blades from breaking off.

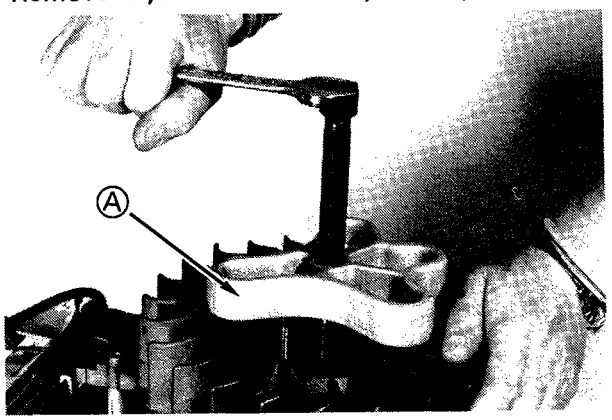
www.mymowerparts.com

For Kawasaki Discount Parts Call 606-678-9623 or 606-561-4983

5. Use a socket wrench (A), give an impact to the end of wrench bar and remove the retaining nut.



6. Remove flywheel with a flywheel puller (A).

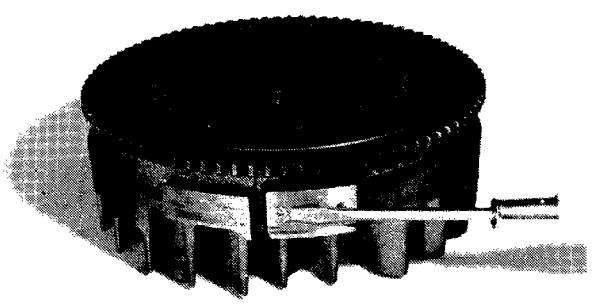


7. Remove and inspect flywheel key. Replace the key if it is bent or sheared.
8. Inspect crankshaft taper for nicks or burrs. If necessary, finish taper using fine emery paper.

FLYWHEEL CHECK

CAUTION: Do not give impact to magnet, as impact weakens magnetic force of it.

1. Put flywheel on a wooden surface.
2. Hold a metal tool about 25mm (1 in.) away from flywheel magnet. The metal tool should be attracted by magnet. If magnetic force is weak, replace flywheel.



Ring Gear Inspection (Electric starter Model)

(1) Inspect flywheel ring gear for worn or damaged teeth.
(2) Replace ring gear, if teeth are extremely worn or damaged.

Ring Gear Replacement (Electric starter Model)

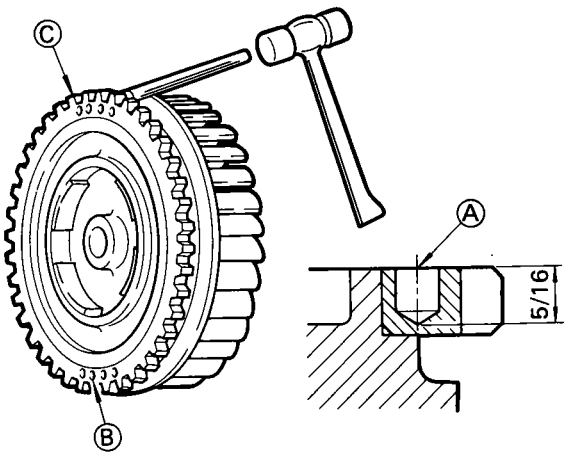
CAUTION: Do not give impact to magnet, as impact weakens magnetic force.

⚠ WARNING: Use heat shield gloves to prevent personal injury.

(1) Use 1/4 in. drill bit to drill 5/16 in. deep holes into ring gear (C) as shown (A) & (B).

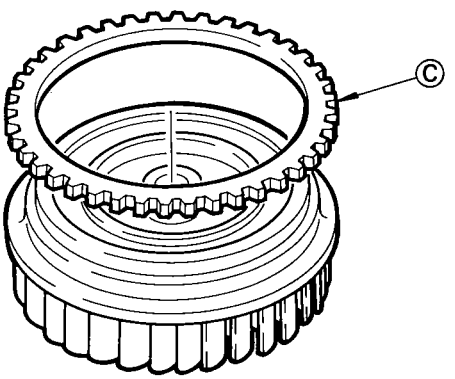
CAUTION: Do not cut flywheel by drilling too deep or too close.

(2) By using a hammer and bar, strike ring gear evenly to remove it.



Ⓐ 1/4 drill 5/16 deep Ⓑ (4~6) drill holes Ⓒ Ring gear

(3) Heat a new ring gear (C), evenly to an extent that expansion by heating facilitates following installation.
(4) With the beveled edge of the gear faced up, quickly install ring gear, quickly followed by tapping ring gear evenly to insure good seating.



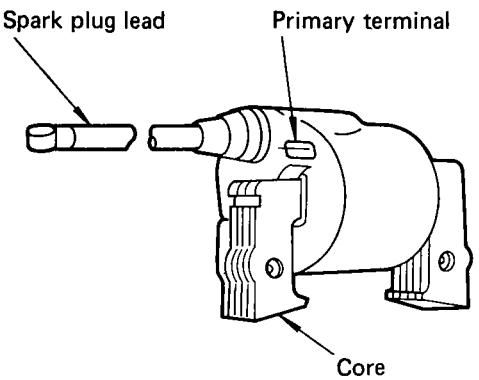
Ⓒ New ring gear

www.mymowerparts.com

For Kawasaki Discount Parts Call 606-678-9623 or 606-561-4983

IGNITION COIL CHECK

1. Remove two mounting screws and remove ignition coil.
2. Remove the plug cap from high tension cord.
3. Set KAWASAKI multimeter selector switch at a specified range and connect leads as shown in the chart below. If meter reading falls within the values shown in the chart, the coil is functioning properly.



Ignition Coil Resistance

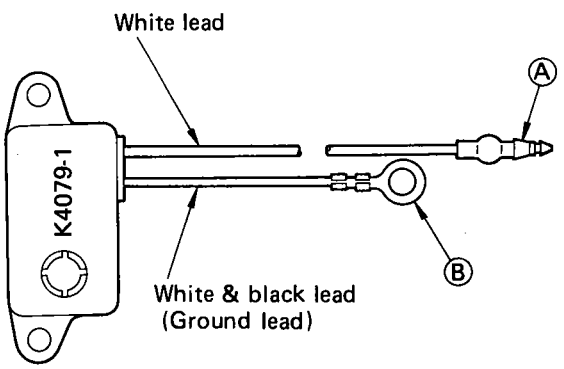
	Connection	Resistance
Primary coil	Primary terminal ⟷ core	0.4 to 0.8 Ω (R x 1 Ω Range)
Secondary coil	Plug lead ⟷ core	10 to 18 kΩ (R x 1 kΩ Range)

*Resistance value may vary with individual meters.

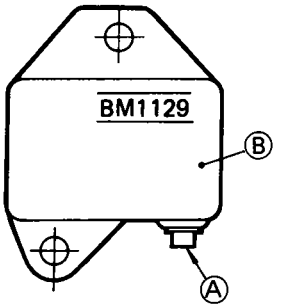
CONTROL UNIT CHECK

1. Unfasten connectors.
2. Unscrew mounting screws and remove control unit.
3. Set KAWASAKI multimeter selector switch at Rx1 Ω scale and connect leads as shown in the chart below. If meter reading falls within the values shown in the chart, the unit is functioning properly.

FB460V-AS. Model



FB460V-BS. Model



Ⓐ Terminal Ⓑ Core

Control Unit Resistance (AS. BS. Model)

Tester ⊖ / Tester ⊕	Terminal (A)	Case (B)
Terminal (A)		ON 10Ω to 40Ω
Case (B)	ON 4.0Ω to 3.0kΩ	

*Resistance value may vary with individual meters.
*Do not use a megger.

FLYWHEEL INSTALLATION

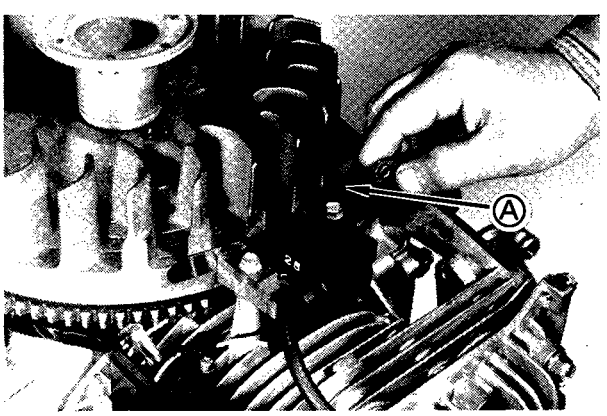
Be sure the key is in place when installing flywheel. To tighten flywheel nut, reverse the removal steps. Torque to spec. listed.

Flywheel Nut Tightening Torque

83 to 88 N-m (62 to 65 ft-lbs)

IGNITION COIL AIR-GAP ADJUSTMENT

(1) Leave ignition coil mounting screws loose so the coil can be moved for air gap adjustment.
(2) Inserting a 0.3mm (0.012 in.) – AIR GAP – thickness gauge (A) at each area in between coil legs on flywheel rim, move the coil to adjust AIR GAP.
(3) Tighten mounting screws firmly.



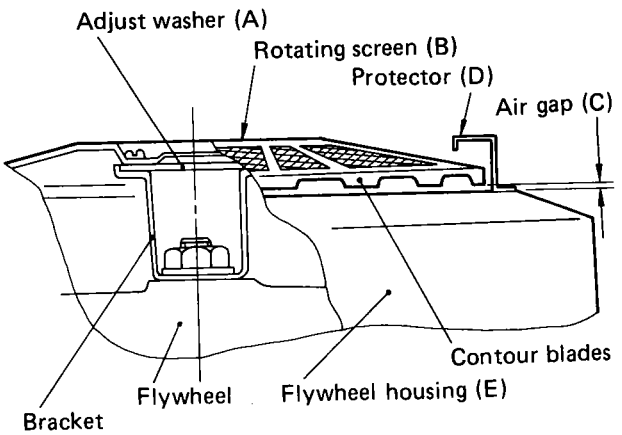
www.mymowerparts.com

For Kawasaki Discount Parts Call 606-678-9623 or 606-561-4983

FLYWHEEL HOUSING INSTALLATION

1. Install flywheel housing (E), rotating screen (B), protector (D) and tighten screws.

NOTE: The air gap (C) between contour blades (D) under screen and flywheel housing (E) should be not less than 1 mm (0.04 in.). Use washers (A) to adjust the air gap (C).



2. Install cylinder head cover and tighten screws.

NOTE: Push cylinder head cover firmly against flywheel housing to eliminate cooling air leakage.

3. Install dipstick and air cleaner assembly.

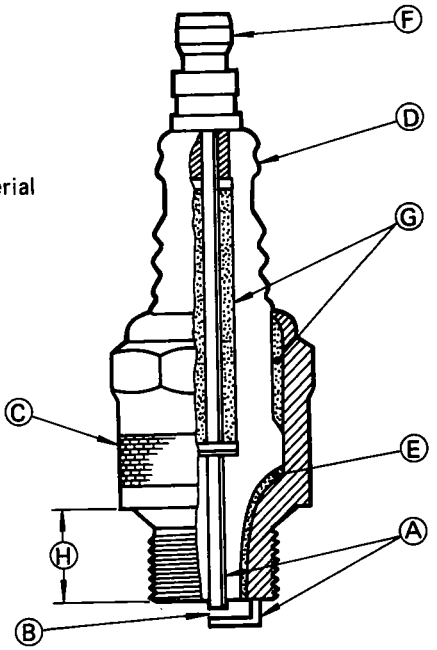
SPARK PLUG CHECK AND CLEANING

A spark plug consists of two electrodes (A) separated from each other by spark gap (B). The side electrode is connected to shell (C) of the spark plug. The center electrode is completely insulated from the shell.

The high voltage, produced in the secondary coil winding, is applied to the center electrode and causes a spark to jump the gap (B) to the side electrode. This spark ignites the fuel-air-mixture and starts the combustion process in the cylinder.

- Gap between electrodes affects the entire range of engine performance – starting, idling, accelerating, power and top speed.
- Spark plugs must operate within a specific temperature range to give good performance.

Ⓐ Electrodes
Ⓑ Spark gap
Ⓒ Shell
Ⓓ Porcelain
Ⓔ Gasket
Ⓕ Terminal
Ⓖ Sealing material
Ⓗ Reach



The plug can be cleaned using a high flash-point solvent and a wire brush or other suitable tool. If the spark plug electrodes are burn away or damaged, or if the porcelain is cracked, replace the plug. Use the following spark plug.

Specified Spark Plug

Spark plug	Gap
NGK BMR-4A	0.6 to 0.7 mm (0.024 to 0.028 in.)
CHAMPION RCJ-8	

Spark Plug Gap

(1) Measure the gap with a wire type thickness gauge. If the gap is incorrect, carefully bend the outer electrode with a needle nose plier to obtain the correct gap.

Spark Plug Tightening Torque

28 N-m (20 ft-lbs)

www.mymowerparts.com

For Kawasaki Discount Parts Call 606-678-9623 or 606-561-4983

Section 3
AIR CLEANER

A properly serviced air cleaner protects the internal parts of the engine from dust particles in the air. If the air cleaner instructions are not carefully followed, the dirt and dust which should be collected in the cleaner, will be drawn into the engine and become a part of the oil film, which is very detrimental to engine life; dirt in the oil forms an abrasive mixture which wears the moving parts.
The air cleaner on every engine brought in for a check up or repair should be examined and serviced.
An air cleaner element clogged with dirt chokes the air supply to the engine, resulting in an overly rich fuel/air mixture and inefficient combustion. This in turn causes reduced engine power and overheating due to carbon build-up in combustion chamber.

⚠ **WARNING: Do not run engine with air cleaner removed.**

AIR CLEANER SERVICE

A FB460V engine is equipped with a heavy duty air cleaner which has dual elements and an element housing.

Remove two wing bolts and lift off air cleaner completely.

CAUTION: Do not clean the element with solvent or compressed air.

1. Foam Element
   Visually examine element for turn, puncture and otherwise damaged. Replace element if necessary.

   Wash element in detergent and water and dry throughly.

   Immerse in new engine oil and squeeze out excess.

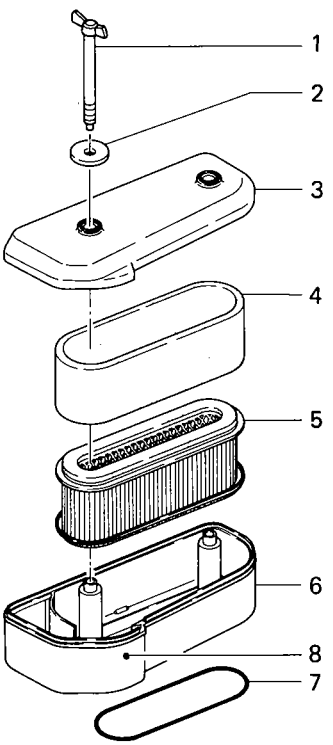
2. Paper Element
   Clean element by tapping gently to remove dust. If very dirty, wash in detergent and water, and dry throughly. Replace with a new paper element every 300 hours.

AIR CLEANER HOUSING INSPECTION

1. Check air cleaner housing for deformation or other damage. The housing must seal well and permit only filtered air to reach carburetor. Replace the housing if damaged.
2. Check no foreign material is obstructing the air passage.

AIR CLEANER INSTALLATION

1. Clean elements, housing, cover and other parts.
2. Elements and housing must be installed correctly.
3. Install o-ring, housing, elements cover, washers and tighten wing bolts.



1. Wing bolt
2. Washers
3. Cover
4. Element (Foam)
5. Element (Paper)
6. Housing
7. O-Ring
8. Element housing

www.mymowerparts.com

For Kawasaki Discount Parts Call 606-678-9623 or 606-561-4983

Section 4
CARBURETOR

CARBURETOR OPERATION

1. In the choke or start position, the choke valve is closed, and the only air entering the engine enters through opening around the valve. As the starting device is operated to start the engine, the air pressure in the carburetor is reduced as air drawn into the engine. Since the air passage is blocked by the choke valve, fuel is drawn from the main nozzle and from both idle fuel discharge ports and mixes with the air that passes through the throttle valve. This makes a very rich fuel mixture required to start a cold engine.
2. At idle a relatively small amount of fuel is required to operate the engine. The throttle is almost closed, shutting off the fuel supply from all except the one idle-fuel discharge orifice, so that the suction created by the engine draws fuel only from that orifice.
3. During intermediate operation, second and third orifices are uncovered as the throttle valve opens, and more fuel is allowed to mix with the air flowing into the engine.
4. During high speed operation, the throttle valve is fully opened. Air flows through the carburetor at high speed.
   The venturi, which decreases the air passage through carburetor, further accelerates the air flow. This high speed movement of the air decreases the air pressure, and fuel is drawn into the air stream through the main nozzle that opens into venturi, mixing with the air in the air passage. As the engine load increases, air is automatically bled into the main nozzle through the air jet located in the air horn.
   This allows fuel to be metered freely from the main nozzle and to be facilitated atomization.

Carburetor Specifications

ITEM \ Model	FB460V-AS	FB460V-BS
Main Jet	# 112.5	# 115
Pilot Jet	# 47.5	# 47.5
Pilot Screw (Turn out)	1-1/8	1-1/8
Float Valve	1.5 mm (0.059 in.)	1.5 mm (0.059 in.)
Low Idle Speed	1350 to 1450 rpm	1350 to 1450 rpm
Fast Idle Speed	3275 to 3425 rpm	3275 to 3425 rpm
Float Level	Float parallel to carburetor body-to-bowl mating surface.	

CARBURETOR REMOVAL AND DISASSEMBLY

⚠ **WARNING: Gasoline is dangerous. Avoid fires due to smoking or careless maintenance practices.**

1. Before removing for repair, check for signs of air leakage, or mounting gaskets that are loose, deteriorated, or otherwise damaged.

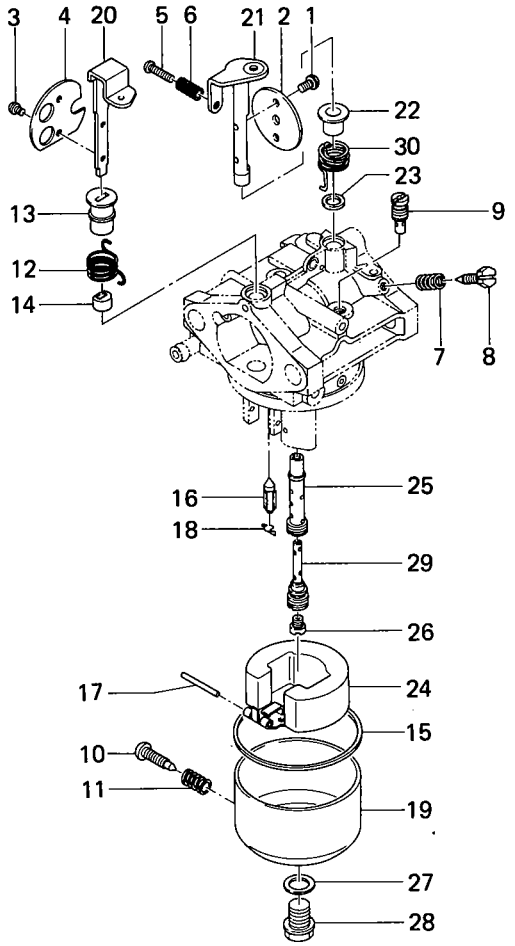
CAUTION: Do not bent the links or stretch.

2. Pull carb. free, and gently twist carb. to free link rod.
3. Remove governor link rod and link spring.
4. Disassemble carb. (See illust. below).

www.mymowerparts.com

For Kawasaki Discount Parts Call 606-678-9623 or 606-561-4983

Disassembly Carburetor (See: Illustration)



Ref. No.	Parts Name	Ref. No.	Parts Name
1	Screw	16	Needle valve
2	Throttle valve	17	Float pin
3	Screw	18	Clip
4	Choke valve	19	Float chamber
5	Screw	20	Choke shaft
6	Spring	21	Throttle shaft
7	Spring	22	Ring
8	Pilot screw	23	Seal
9	Pilot jet	24	Float
10	Drain screw	25	Main nozzle
11	Spring	26	Main jet
12	Spring	27	Washer
13	Ring	28	Bolt
14	Ring	29	Bleed pipe
15	Gasket	30	Spring

CARBURETOR CLEANING

CAUTION: Never clean holes or passages with small drill bits or wire.

1. Place carb. body and carb. parts in PT503 cleaner or its equivalent. Do not put gaskets and plastic parts in cleaner.
2. Parts should remain in cleaner for 1 or 2 hours. Remove and rinse with solvent.

   NOTE: Rinse carb. body in hot water to neutralize corrosive action of cleaner on aluminum.

3. Dry parts with compressed air. Be sure all holes are open. Do not use rags or paper to dry parts. Lint may plug hole or passages.

CARBURETOR INSPECTION

1. Inspect carb. body for damage. Flange sealing surfaces should be smooth and free of burrs and nicks.
2. Replace gasket if necessary.
3. Inspect pilot screw and drain screw for wear at the seating surface. Inspect for weak springs.
4. Inspect main jet, bleed pipe, main nozzle and pilot screw for damage.
5. Inspect inlet needle valve for wear or damage at the seating surface.
6. Inspect clip for damage.

   NOTE: Inspect the other parts of carb. for wear, damage.

CARBURETOR ASSEMBLY

Reassembly is the reverse of removal. Note the following points:

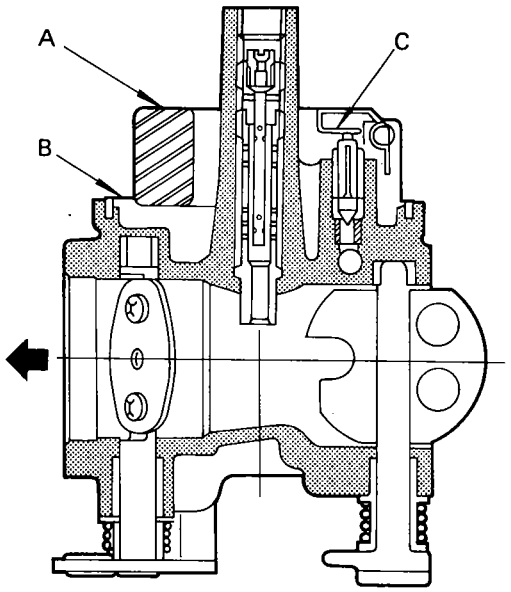
1. Install main nozzle, bleed pipe, and main jet by turning clockwise into carb. body. Do not over tighten screws.
2. Install pilot screw (mixture screw) and spring finger tight.
3. Install pilot jet screw by turning it clockwise into carb. body. Do not over tighten.
4. Install float and float pin.

CAUTION: Do not push on float or, inlet needle valve when adjusting float level.

5. When carburetor is upside down, float surface (A) must be parallel to carb. body (B). To adjust float surface angle, bend tang (C) with needle-nose pliers.

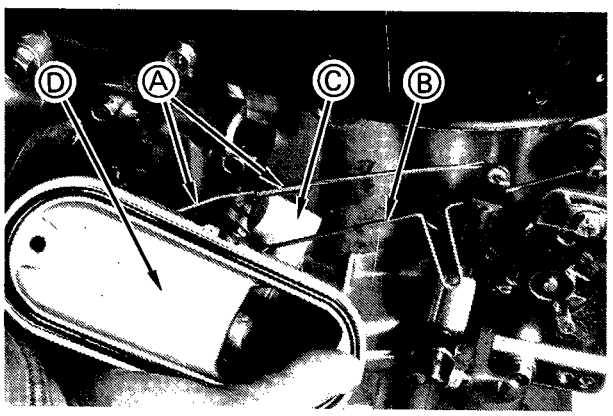
www.mymowerparts.com

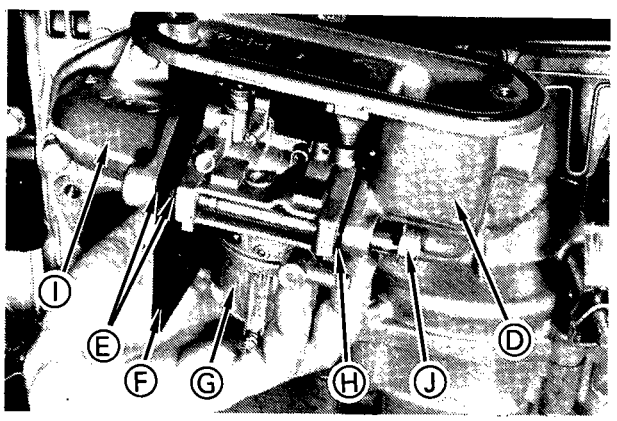
For Kawasaki Discount Parts Call 606-678-9623 or 606-561-4983



CARBURETOR INSTALLATION

1. Install throttle linkages (A) and choke linkage (B) on carburetor.
2. Install breather connector (C) on intake pipe (D).
3. Assembly gaskets (E), heat shield plate (F), carburetor (G), gasket (H) and intake pipe (D).
4. Install carb. ass'y on inlet pipe (I) with through bolts (J).





CARBURETOR ADJUSTMENT

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

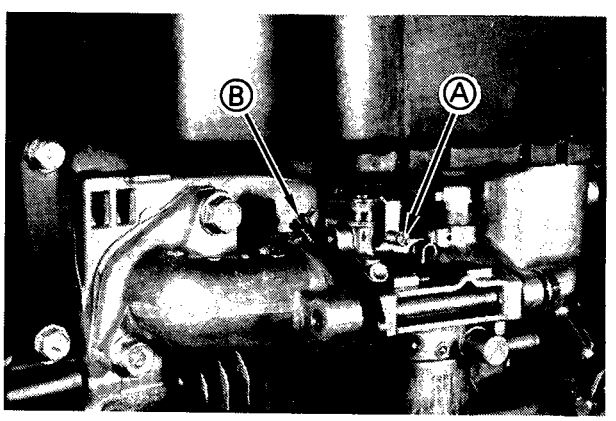
Adjust Idle Mixture

Air cleaner must be assembled to engine.

1. Turn idle mixture screw (B) in until it just seats, then back it out 1-1/8 turns.

CAUTION: Do not turn the screw in too far. The pointed end of valve seat is susceptible to damage.

2. Start and allow engine to warm. Move throttle lever on equipment to "IDLE POSITION".
3. Use a tachometer and adjust throttle stop screw (A) to obtain 1,350 to 1,450 rpm by turning it in or out while holding the end of the screw against carb. body.
4. Adjust idle mixture screw (B) by turning clockwise (lean) or counterclockwise (rich) to obtain the peak of idling.
5. Turn idle mixture screw (B) back out 1/4 turn more.
6. Use a tachometer and readjust throttle stop screw (A) to obtain and satisfy specified 1,350 to 1,450 rpm idling.
7. Stop engine.

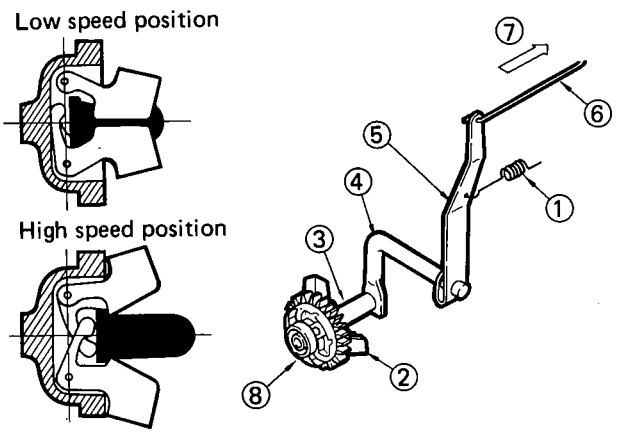


www.mymowerparts.com

For Kawasaki Discount Parts Call 606-678-9623 or 606-561-4983

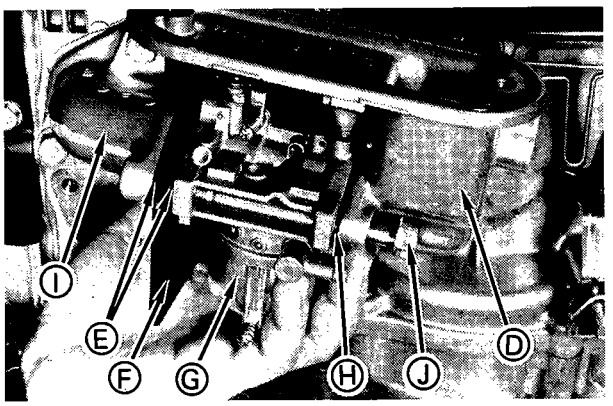
Section 5
GOVERNOR

The governor control regulates the engine speed by changing the governor spring (1) tension, thus allowing the governor to control the carb. throttle at all times and maintain any desired speed.
A FB460V engine is equipped with a mechanical flyweight type governor.
If the engine is carrying a load and running at rated speed, the speed will drop if the load increases even slightly. In responce to the decrease, governor weights (2) contact by corresponding amount. Their movement is transmitted through the sleeve (3) and governor shaft (4) to the arm (5). The arm then moves the link rod (6) (in the direction of the arrow) (7) which turns the throttle valve in the opening direction.
As speed increases it is sensed by the governor (8), and the rod turns the valve in the opposite direction. This action/reaction sequence soon creates a state of equilibrium which allows the engine to run at nearly the same speed as before while carrying a slightly greater load.
Dumping the load suddenly will cause a rapid increase in speed. But the interaction of the engine-governor-carb. protects the engine from over-revolution and speed soon settles at a constant level.

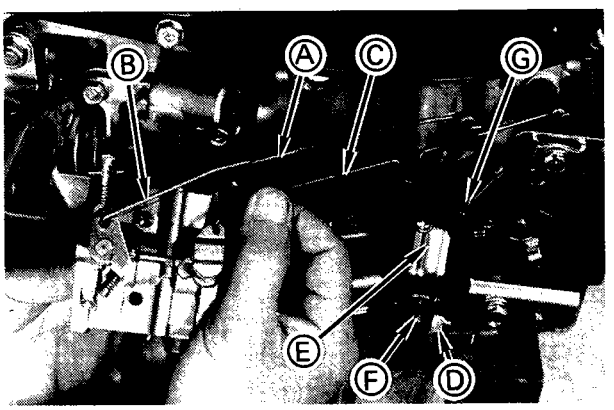


REMOVAL (GOVERNOR RELATED)

1. Remove air cleaner assembly.
2. Loosen clamp and disconnect fuel line from carburetor.
3. Remove through-bolts (J).
4. Remove intake pipe (D), gasket (H), carburetor (G), heat shield plate (F) and gaskets (E).
5. Disconnect breather connector from tappet chamber cover.



6. Remove link spring (A) and gently twist carburetor to free throttle linkage (B) and choke linkage (C). Remove linkage.



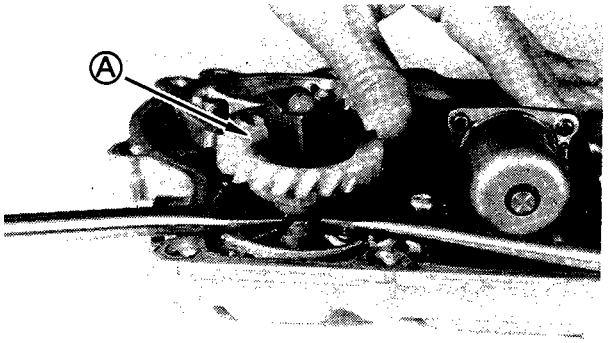
7. Loosen nut (D) and remove governor lever (E) from governor shaft (F). Remove governor spring (G).

GOVERNOR GEAR DISASSEMBLY

1. Unscrew mounting bolts in the order specified and remove crankcase cover from crankcase.
2. If necessary, remove governor ass'y (A) with a proper size screw driver.

www.mymowerparts.com

For Kawasaki Discount Parts Call 606-678-9623 or 606-561-4983



GOVERNOR GEAR INSPECTION

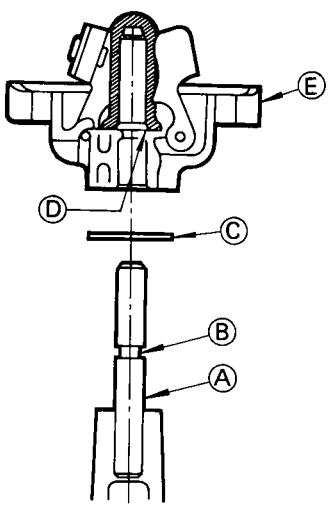
1. Inspect governor gear for worn and damage. Replace as an unit, if wear and damage exceed.

GOVERNOR REASSEMBLY

1. Install thrust washer (C) and stuff into new governor ass'y (E) to short stationary shaft (A) until inner flange (D) fitted into groove (B) of the shaft as shown.

CAUTION: The sleeve can not be installed after stuffed into the gear to the shaft. Do not reuse governor ass'y once removed.

2. After installed, governor ass'y should rotate freely on the shaft.



3. Install governor gear cover.
4. Place a new gasket on crankcase cover and put small amount of grease around oil seal lips.
5. Lubricate crankshaft bearing in crankcase cover with engine oil.
6. Suitably set the gear to be meshed with cam gear when installing crankcase cover.
7. Install crankcase cover and tighten cap screws in the tightening order to the specified torque.

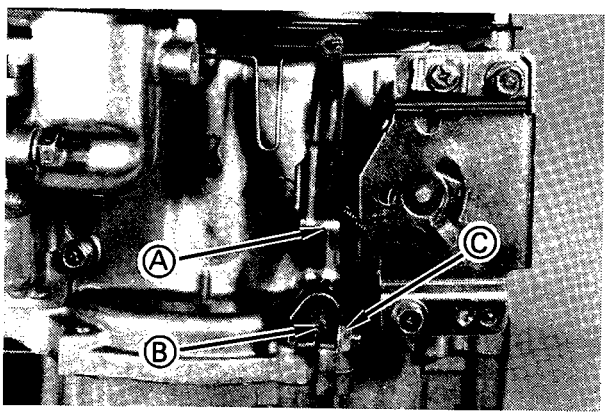
Crankcase Cover Tightening Torque

17 to 23 N-m (12 to 17 ft-lbs)

REASSEMBLY (GOVERNOR RELATED)

Reassembly is the reverse of removal. Note the following points:

1. Install governor lever (A) on governor shaft (B) and tighten nut (C) finger tight.



2. The throttle and choke linkages can not be installed on the carburetor after the intake pipe was installed.

LINKAGE ADJUSTMENT

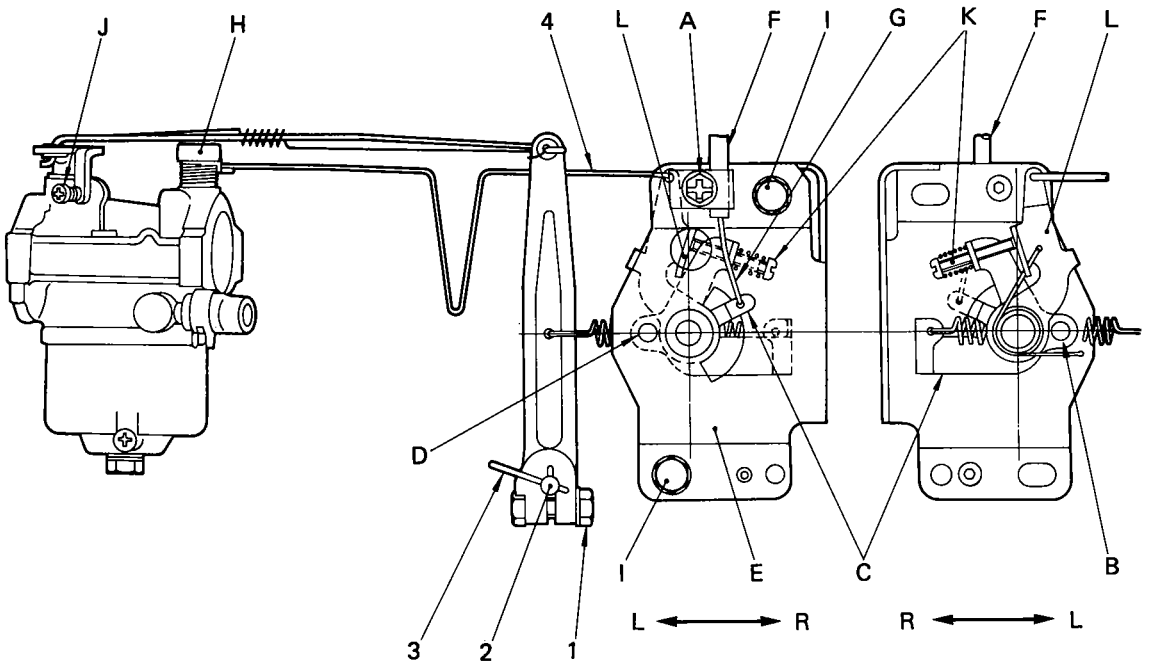
1. Place throttle lever on dash in "FAST" position. (Equipment side)
2. Loosen nut (1), that holds governor arm to governor shaft (2).
3. Turn governor shaft (2) clockwise to the end of travel by inserting needle (3) to shaft end hole and tighten nut (1).

NOTE: The throttle lever on the dash must be in "FAST" position when adjusting the governor.

4. Lower and raise throttle lever after adjustment to be sure linkage is not binding.
5. More throttle lever (on dash) up to "FAST" position. Speed control lever (C) should be in wide open throttle position [aligned hole (B) and (D)], but not enough to move choke link (4). If adjustment is necessary, loosen cable clamp bolt (A) and adjust cable.
6. Retighten clamp bolt (A).

www.mymowerparts.com

For Kawasaki Discount Parts Call 606-678-9623 or 606-561-4983



THROTTLE CABLE INSTALLATION AND ADJUSTMENT

Make sure that the throttle lever and cable on equipment have the speed control linkages with engine.

1. Leave cable clamp bolt (A) loose.
2. Align hole (B) of speed control lever (C) with hole (D) of control plate (E) moving the lever; insert a (6 mm) 0.24 in. dia. pin (or a 6 mm bolt) through the two holes.
3. Pull up outer housing (F) of throttle cable until the inner cable (G) has almost no slack, and tighten the cable clamp bolt.
4. Remove the 6 mm dia. pin.
   Be sure that carb. choke valve (H) is closed completely when throttle lever on equipment is moved to "CHOKE" position. If not, perform "CHOKE ADJUSTMENT" described below.

CHOKE ADJUSTMENT

1. Align hole (B) of speed control lever (C) with hole (D) of control plate (E) moving the lever; insert a 6 mm (0.24 in.) dia. pin (or a 6 mm dia. bolt) through the two holes.
2. Turn in choke setting screw (K) until its end just begins to touch the tongue of lever (L).
3. Remove the 6 mm dia. pin or bolt.

MAXIMUM SPEED ADJUSTMENT

Start engine and allow it warm.

1. Align hole (B) of speed control lever (C) with hole (D) of control plate (E) by moving the lever; insert a (6 mm) 0.24 in. dia. pin (or a 6 mm bolt) through the two holes.
2. Leave two control-plate-tightening-bolts (I) loose.
3. Use a tachometer and slide control plate (E) left or right to obtain specified 3,350 rpm. Be sure that the carb. choke valve is fully opened during adjustment.
4. Tighten two bolts (I) securely in a manner to avoid changing the specified speed.
5. Adjust choke per procedure previously mentioned.
6. Remove the 6 mm dia. pin or bolt.
7. Stop engine.

IDLE SPEED ADJUSTMENT

Before the following procedure, carb. adjustment must be performed.
(See CARBURETOR ADJUSTMENT)
Start engine and allow it warm.

1. Move throttle lever on equipment to farest IDLE position and leave it there.
2. Turning throttle stop screw (J) in or out to obtain specified idling 1,350 to 1,450 rpm.
3. Stop engine.

www.mymowerparts.com

For Kawasaki Discount Parts Call 606-678-9623 or 606-561-4983

Section 6
COMPRESSION

COMPRESSION CHECK

Before measuring compression pressure;
Check cyl. head to torque. Be sure battery is fully charged on electric starter models. Start engine and allow it to warm up. During warm up, check for leaks around cyl. head gasket. Stop engine.

1. Remove spark plug and screws compression gauge into the plug hole securely.
2. Crank engine with recoil or electric starting for several seconds and take highest pressure gauge reading. Cylinder compression should not be less than 3 kg/cm² (43 psi).
3. If compression reading is too high, check for carbon built up in combustion chamber. Carbon deposits in combustion chamber should be removed every 100 to 200 hours of use, or whenever cyl. head is removed.
4. If the compression pressure is less than specified, it is usually the result of one or more of:

- Leaking cyl. head gasket.
- Warped cyl. head.
- Worn piston rings.
- Damaged piston.
- Worn cyl. bore.
- Burned or warped valves.
- Improper valve clearance.
- Broken valve springs.
- To a great extent, compression can also be practically measured by:

⚠ **WARNING: Disconnect spark plug cap to prevent engine starting during compression test. Be careful not to get your fingers caught in flywheel fins during test.**

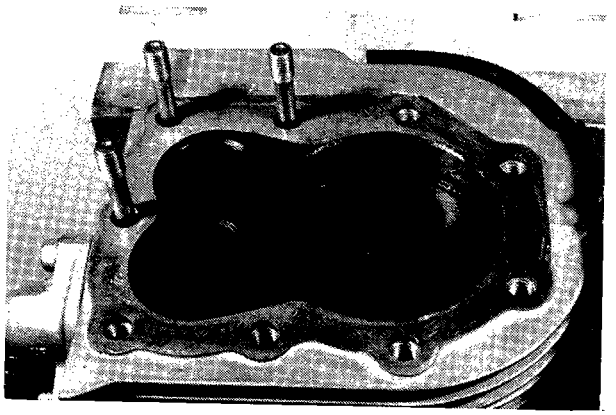
Spin flywheel counter clockwise (flywheel side) against the compression stroke; a sharp rebound indicates satisfactory compression. Slight or no rebound indicates poor compression.

CYLINDER HEAD AND HEAD GASKET REMOVAL

CAUTION: Always note the position of each cyl. head screw so they may be properly reassembled.

A FB460V has 3-heat-resistant high-tension studs in the exhaust valve side area to prevent loss of torque and maintain positive sealing of the combustion chamber.

1. Remove cyl. head and gasket.



CYLINDER HEAD TIGHTENING PROCEDURE

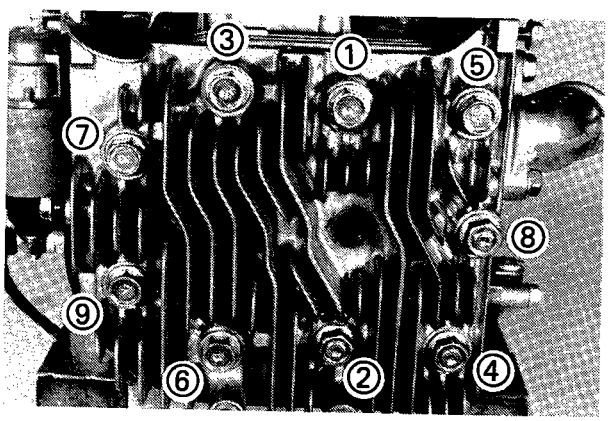
CAUTION: Do not use a sealer of any kind on gasket.

1. Coat head bolts threads with a light film of oil and install the bolts.
2. Tighten screws down evenly by hand.
3. Use a torque wrench and tighten head bolts in the sequence as shown, and to the specified torque.

Cylinder Head Tightening Torque

34 to 39 N-m (25 to 29 ft-lbs)

CAUTION: Do not turn one screw down completely before the others, as it may cause a warped cyl. head.



www.mymowerparts.com

For Kawasaki Discount Parts Call 606-678-9623 or 606-561-4983

CYLINDER HEAD CHECK AND REPAIR

1. Clean cyl. head.

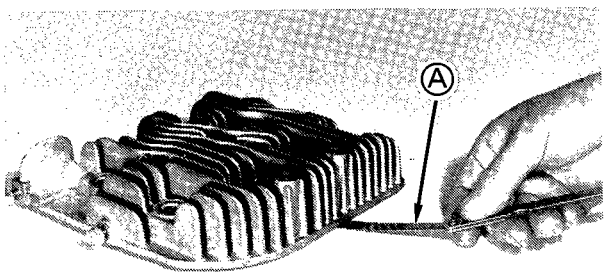
⚠ **WARNING: Be alert to fire if combustible cleaner is used.**

2. Check cyl. head flatness by placing cyl. head on a surface plate more than at six points.
3. Use a thickness gauge (A) to measure the space between surface plate and cyl. head.

Cyl. Head Warp (MAX)

0.4 mm (0.015 in.)

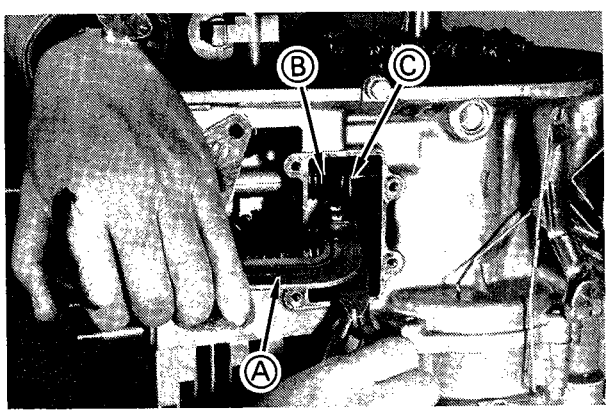
4. If cyl. head is warped more than specified, replace it.



5. If cyl. head is warped less than the specified limit, reface the head surface by rubbing on emery paper (first: No.200, then: No.400) placed on a surface plate.
6. Check cyl. head gasket for burn and trace of gas leakage. Replace gasket if necessary.

VALVE AND SPRING REMOVAL

1. To remove valves using a valve spring compressor (A), put screw head of compressor over the valve head and slip lower jaw between spring (B) and retainer (C).
2. Compress spring. Remove retainer by a needle nose plier. Pull out valve. Remove compressor and valve spring.



VALVE SPRING INSPECTION

1. Inspect valve springs for damage. Replace springs if necessary.
2. Measure the free length of springs. If shorter than specified, replace spring.

Valve Spring Free Length (MIN)	
Intake	43.3 mm (1.705 in.)
Exhaust	39.0 mm (1.535 in.)

TO ANALYZE VALVE

- When leaded gasoline is used, excessive lead deposits on the exhaust valve are caused by exhaust gas leakage past the valve. This indicates the valve is not seating properly.
- Clean the seating face and lap the valve into the seat. If worn severly, grind the valve and reface the seat to correct condition.

CAUTION: Be sure to reset valve-to-tappet clearance after grinding valve.

- Valve stem corrosion is caused by moisture in the engine. Moisture in the fuel-air mixture or combustion gases can condense inside the engine when the engine is stopped and cools down.
- Valve corrosion can also occur during storage. Fogging or pouring oil in combustion chamber before storing helps prevent valve corrosion.
- Corroded or pitted valves collect deposits and may cause sticking valves.
  Replace badly corroded or pitted valves.
- Poor engine cooling due to dirt or obstructions is a common cause for overheating an engine and the valves. Remove flywheel housing and clean cooling fins.
- Other causes for valves running hot are worn valve guides or valve springs, incorrect valve clearance, lean fuel-air mixture and incorrect or overheated plug.
- Use of old or stale gasoline is a common cause for sticky valves. This gummy deposit can be seen on the valve. When this condition exists, the carburetor may also contain gum deposits and will require a complete cleaning.

CAUSION: Always use fresh gasoline and drain fuel tank, lines and carburetor before storing equipment.

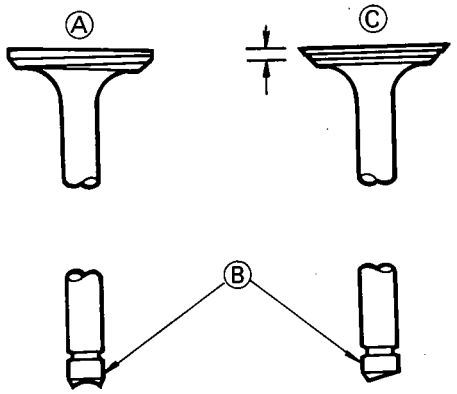
VALVE INSPECTION

1. Remove carbon from valve head, face and stem with a power-operated wire brush. Be sure carbon is removed and not merely burnished.

www.mymowerparts.com

For Kawasaki Discount Parts Call 606-678-9623 or 606-561-4983

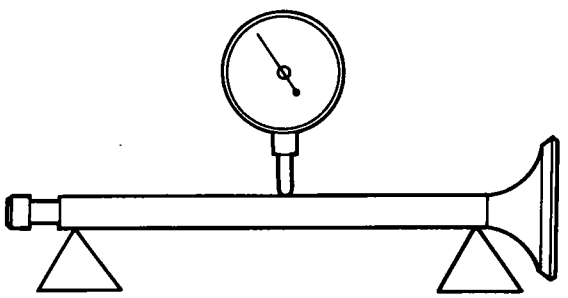
2. Check valve faces, heads and stem for defects. Look for bent valve stems and excessive corrosion causing pits on valve face or stem.
3. Replace valves with a warped head or with less than (0.6mm) 0.02 in. margin. Valve stem ends should be ground square before cheking valve-to-tappet clearance.



Ⓐ Warped Head
Ⓑ Worn or Improperly Ground Valve Stems
Ⓒ No Margin

Valve Stem Bend Check

(1) Support valve in V blocks at each end of the stem.



(2) Position a dial gauge perpendicular to the stem.
(3) Turn valve and read the variation on dial gauge.

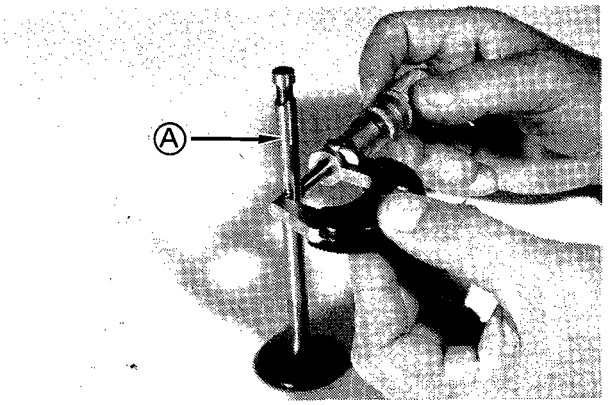
Valve Stem Bend (MAX)

0.03 mm (0.0012 in.)

- If the stem bend is greater than MAX, replace valve.

Valve Stem Diameter Check

(1) Measure the diameter of valve stem (A) in two directions at right angles, at four different positions on the stem.



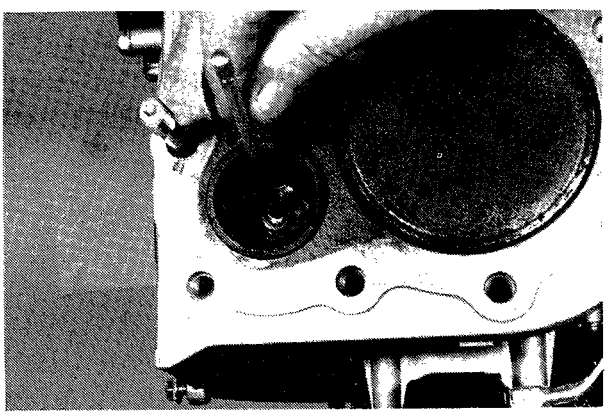
Valve Stem Diameter (MIN)

Valve Stem Diameter	
Intake	7.912 mm (0.3115 in.)
Exhaust	7.919 mm (0.3118 in.)

- If any single measurement is less than MIN, replace the valve.

VALVE GUIDE CHECK AND REPLACEMENT

1. Use valve guide cleaner to clean the inside of valve guides.
2. Measure inside diameter of valve guide with inside micrometer at several points.



Valve Guide Reject Size (MAX)

Valve Guide Inside Diameter	
Intake	8.062 mm (0.3174 in.)
Exhaust	8.062 mm (0.3174 in.)

- Replace valve guide if inside diameter exceeds MAX.

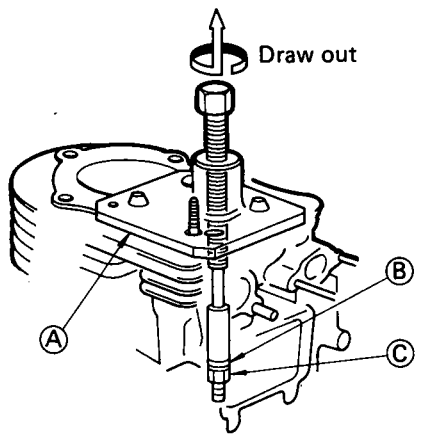
www.mymowerparts.com

For Kawasaki Discount Parts Call 606-678-9623 or 606-561-4983

To Replace Valve Guide

To Remove Valve Guide:

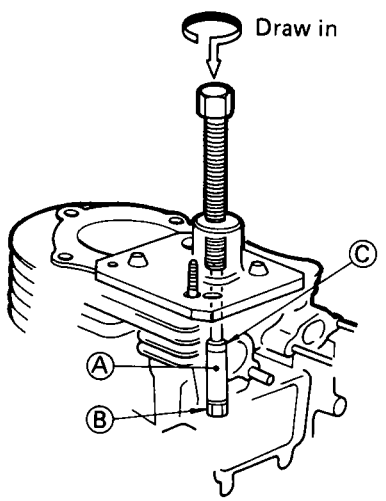
(1) Use a valve guide remover (A) to replace valve guide.
(2) Fix valve guide remover on cylinder with bolts and nuts.
(3) Put a coat of engine oil to the remover bolt threads and screw it in until the threads can be seen at valve guide lower end.
(4) Install thrust washer (B) and nut (C) (left hand thread) to the remover bolt.



(5) Turn out the bolt to remove valve guide bushing until it is completely removed from the guide.

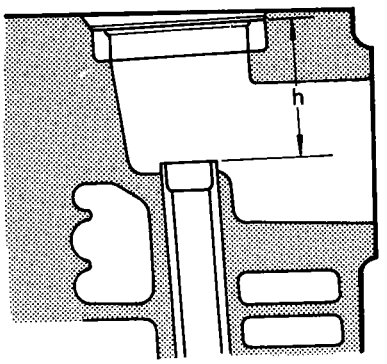
To Install Valve Guide:

(1) Use a valve guide remover to install valve guide.
(2) Apply a coat of engine oil to the outer surface of valve guide (A).
(3) Install thrust washer (B) and new valve guide (A) to the remover bolt and retain them with nut (C) as shown.

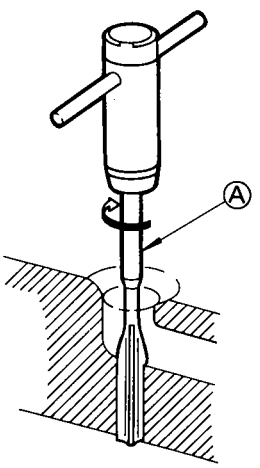


(4) Turning the remover bolt, drive new valve guide into the hole to proper depth.

Valve Guide Depth h	
Intake	30 mm (1.18 in.)
Exhaust	30 mm (1.18 in.)



(5) Use stanisol or kelosen lubricant to finish reaming by a valve guide reamer.
(6) Turn to finish specified reamer (A) clockwise.
(7) Throughly clean valve area before reassembling engine.

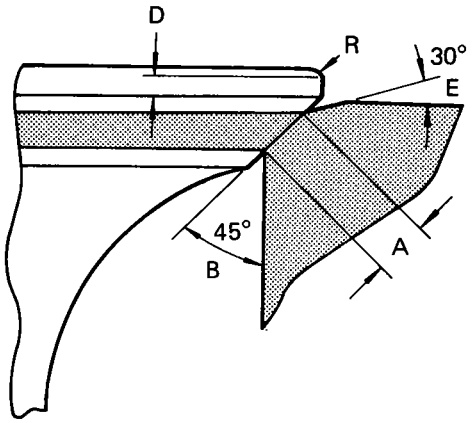


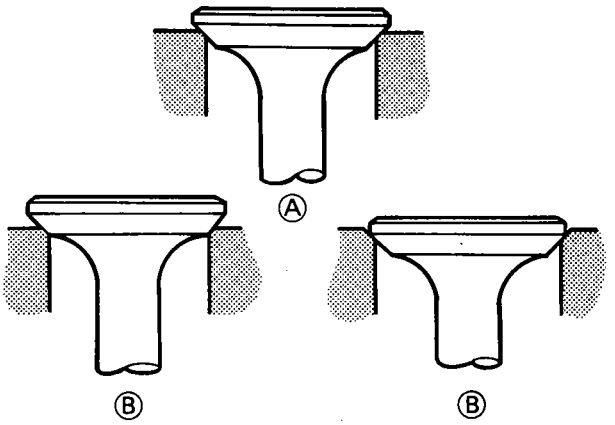
VALVE SEAT RECONDITIONING

1. Inspect valve seats for damage. If seats are warped or distorted by beyond reconditioning, replace cyl. block.
   Pitted or worn valve seats can be refaced. Lap valves to seats after refacing.
2. To repair the seats; first use 45° cutter (A) then 30° to obtain standard valve seat width and 45° again to finish.
   Check the seat for good contact all the way around with machinist's dye.

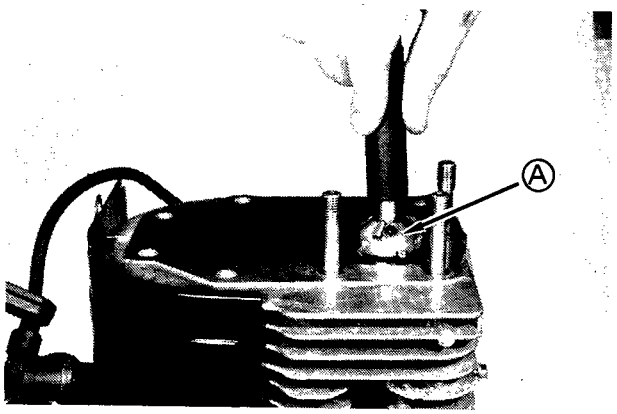
www.mymowerparts.com

For Kawasaki Discount Parts Call 606-678-9623 or 606-561-4983





Ⓐ: Right Ⓑ: Wrong



CAUTION: Loosen valve seat can be turned or moved up or down. If this appears;

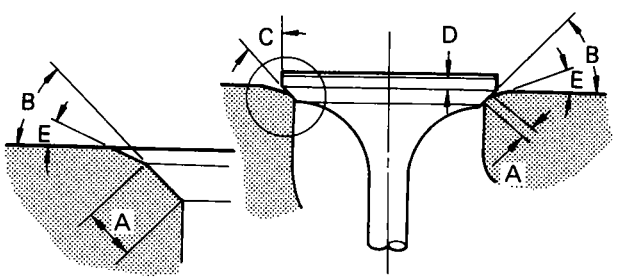
- **Use a center punch to tighten insert at three points equally spaced.**
- **Otherwise peen over edge around entire insert.**

STD Valve Seat Width

	Valve Seat Width
Intake	1.0 to 1.6 mm (0.039 to 0.063 in.)
Exhaust	1.0 to 1.6 mm (0.039 to 0.063 in.)

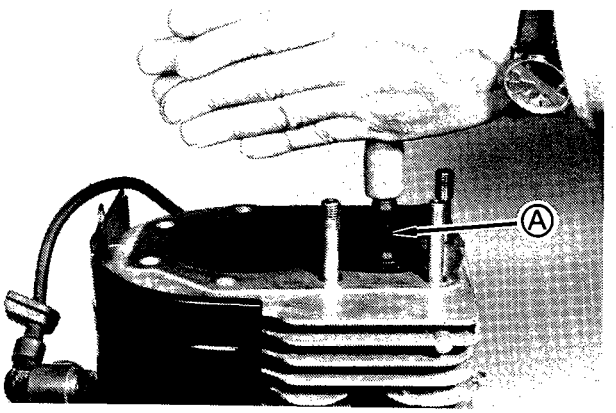
Valve Lapping

(1) If the seat does not make proper contact, lap valve into the seat with a vacuum cup tool.
(2) Coat face of valve sparingly with a fine lapping compound.
(3) Use vacuum cup tool (A), to grip top of valve. Rotate valve in a circular motion to lap to seat.
(4) Lift valve from seat every 8 to 10s strokes, continue lapping operation until an uniform ring appears around the entire surface of valve face.



Ⓐ : Valve Sealing Width.	See Table.
Ⓑ : Valve Seat Angle.	In.: 45°/ Ex.: 45°
Ⓒ : Valve Face Angle.	In.: 45°/ Ex.: 45°
Ⓓ : Valve Margin.	0.6mm (0.02 in.) MIN.
Ⓔ : Valve Narrowing Angle.	In.: 30°/ Ex.: 30°

3. Follow "Valve Lapping" procedure to keep the seat contact with the middle point of valve face (as shown).



(5) When lapping is completed, wash all the parts in solvent to remove lapping compound. Dry parts thoroughly.
(6) Note position of lapping mark on valve face. The lapping mark should appear on or near the center of the valve face.
(7) Check valve clearance after lapping.

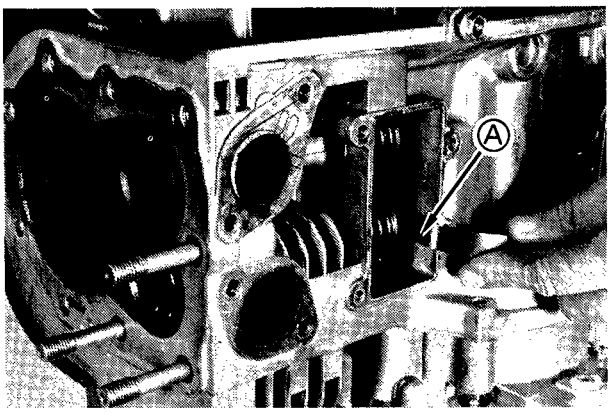
www.mymowerparts.com

For Kawasaki Discount Parts Call 606-678-9623 or 606-561-4983

TAPPET CLEARANCE CHECK AND REPAIR

Since valve repairs change tappet clearance (valve-to-tappet), check the clearances (intake and exhaust sides). Make sure to do this when engine is cold.

1. Insert valves in their respective positions in cyl. block.
2. Turn crankshaft until piston is at highest position in compression stroke. Then insert a thickness gauge (A) between valve stemsend and tappet to check tappet clearance.

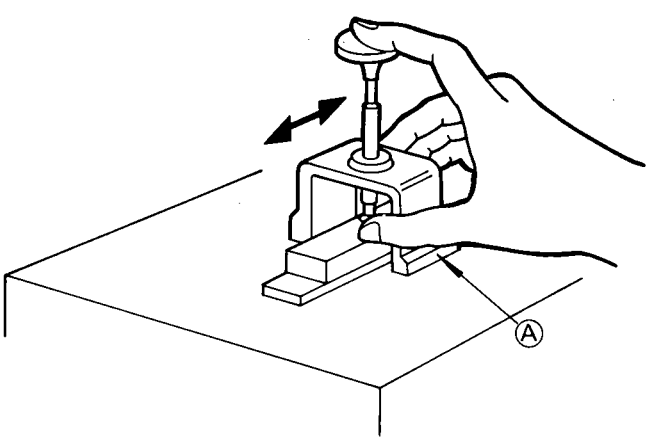


Specified Tappet Clearance (Cold)

	Tappet Clearance
Intake	0.1 to 0.16 mm (0.0039 to 0.0063 in.)
Exhaust	0.1 to 0.16 mm (0.0039 to 0.0063 in.)

3. If the clearance is less than specified, grind the end of valve stem to obtain the specified tappet clearance.

To Grind Valve Stem End:
Place valve in valve lapping guide (A) and slide the stem end over oil stone back and forth.



4. Install all parts related to valve repair.
- Reassembly is the reverse of removal.

CAUTION: After installing valves and springs, check retainers are positioned correctly. Do not use molybdenum dissulfied when installing valve in cyl. block.

www.mymowerparts.com

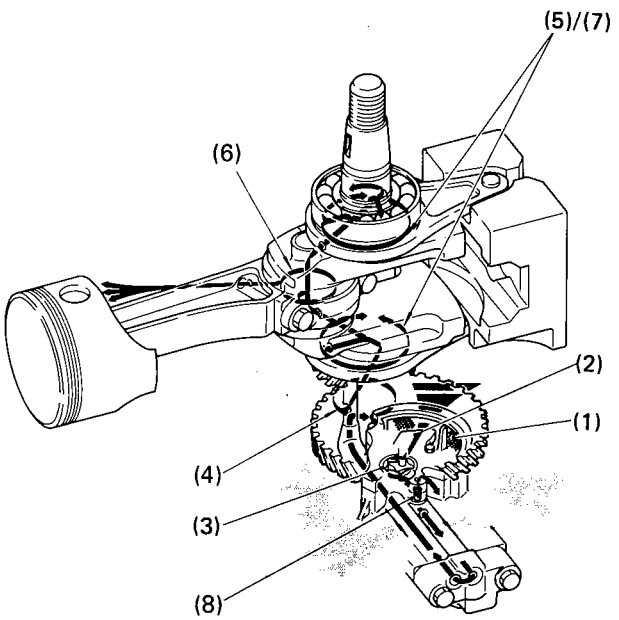
For Kawasaki Discount Parts Call 606-678-9623 or 606-561-4983

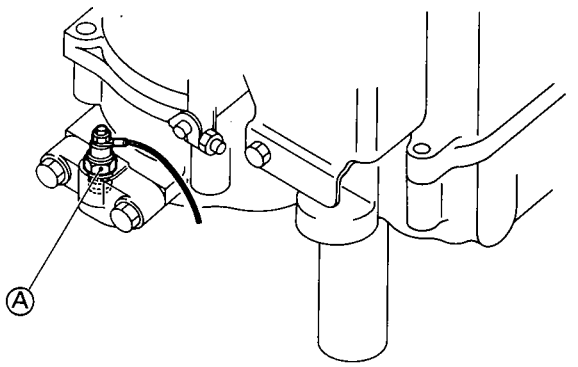
Section 7
LUBRICATION

LUBRICATION

Oil has four purposes. It cools, cleans, seals and lubricates.
A pressurized lubrication system used on the FB460V engine pressure-lubricates the crank pin, PTO main journal and balancer link.

The FB460V utilizes a camshaft driven trochoid pump to pressurize the lubrication system. Oil is first drawn through a filtering screen (1) then the inlet (2) and into the pump chamber (3). Oil pressure is adjusted by a relief valve (8) to a value of above (3 kg/cm^2) 42.6 psi at 3,000 rpm (Rated speed). The oil is then pumped to the PTO main journal (4) into crankshaft and lubricates the lower link rod (5), crank pin (6) and upper link rod journal (7). A portion of oil at the crank pin is passed through a metered orifice in the connecting rod and is sprayed on the piston to cool the piston and prevent ring sticking. The return oil mists then lubricates the magneto side ball bearing and others.

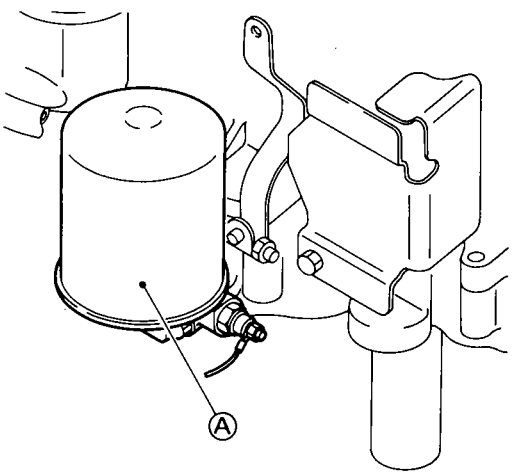




Ⓐ Oil pressure sensor

FULL FLOW OIL FILTER (Optional)

- The FB460V can accept an optional cartridge type full flow oil filter (A) which can extend oil change intervals to as mush as 50 hours. (STD intervals: 25 hours)



OIL WARNING SYSTEM
(Electric Starter Model only)

- Triggered by the sensor (A), a warning light comes on when pressure falls below (0.3 kg/cm^2) 4.26 psi lubrication problem.
(See ELECTRICAL SYSTEM)

CAPACITIES

Crankcase

1.4 ℓ (2.96 Pt US)

www.mymowerparts.com

For Kawasaki Discount Parts Call 606-678-9623 or 606-561-4983

OIL RECOMMENDATION

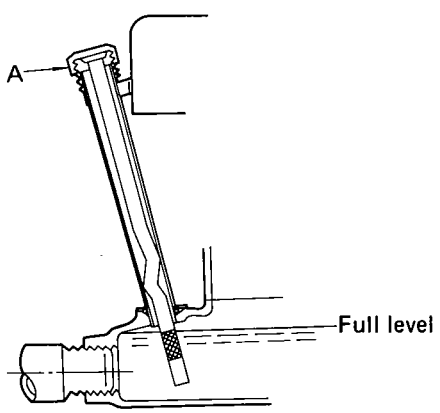
Use a high quality detergent engine oil classified "API Service SF, SE/CC, SE, or SD". Detergent engine oils keep the engine cleaner and delay the formation of gum and vernish deposits. Nothing should be added to the recommended oil.

Recommended SAE Viscosity Grades

Temperature	Below 0°C (32°F)	Above 0°C (32°F)
Viscosity	SAE 5W–20	SAE 30

OIL LEVEL CHECK

1. Put engine on a level surface.
2. Remove dipstick; wipe dipstick with a clean rag; insert dipstick into filler tube.
3. Let dipstick cap (A) threads rest on top of the tube. Do not screw dipstick in.
4. Remove dipstick to check oil level. Add if necessary. DO NOT overfill.
5. Install and tighten dipstick.
6. Check oil level and add regularly before operating equipment.



OIL CHANGE

Change oil after first 5 hours of operation. Thereafter 25 hours of operation: more often under dirty operating conditions.

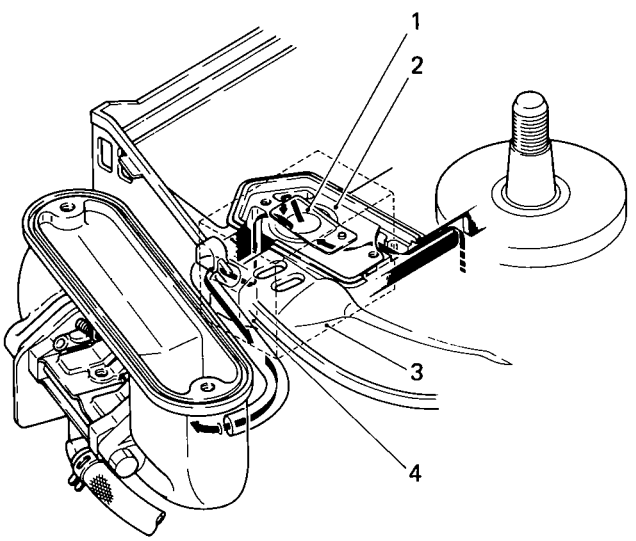
1. Put engine on a level surface.
2. Remove oil drain plug, and drain oil while engine is warm.
3. Install drain plug.
4. Remove dipstick and refill with new oil up to no higher than "Full" mark on dipstick. (See OIL LEVEL CHECK)
5. Install dipstick.

BREATHER CHECK

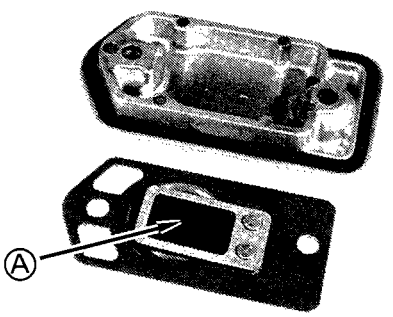
It is the breather's function to maintain a vacuum in the crankcase. The breather has a reed valve, which limits the direction of air flow caused by the piston movement of up and down. Air can flow out of the crankcase, but the "one way valve" blocks the return flow, thus maintaining a vacuum in the crankcase.

A partial vacuum must be maintained in the crankcase to prevent oil from being forced out of engine, at the piston rings, oil seals and gaskets.

The FB460V uses the combination of a reed valve and four expansion chambers (1 ~ 4) crankcase breather. Oil laden air in the crankcase passes through a maze by the reed valve and expansion chambers where the oil is separated from the air and drained back to the crankcase. The breather is vented through the air cleaner, to prevent dirt from entiring the crankcase.



1. Inspect reed valve for stuck and binding.
2. Inspect reed valve seating surface. They must not have any nicks or burrs.
3. Inspect reed valve for hair crack, distortion and broken.



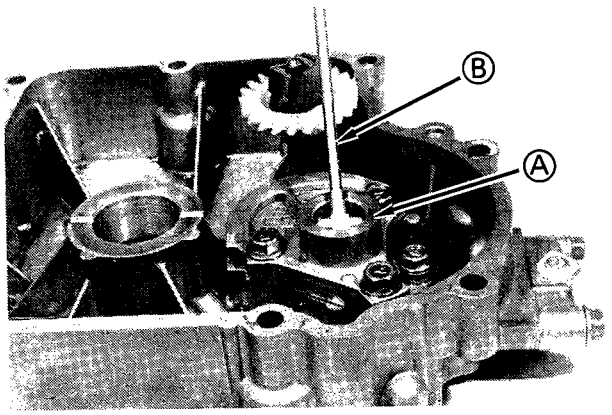
4. Check to be sure vent tube is not damaged and sealed properly.

www.mymowerparts.com

For Kawasaki Discount Parts Call 606-678-9623 or 606-561-4983

OIL PUMP INSPECTION

1. Remove crankcase cover from crankcase. (See Section 9 : Crankshaft Removal)
2. Measure camshaft bearing on oil pump cover (A) with an inside micrometer (B). The bearing is cast with oil pump cover and is not replaceable.



Bearing Inside Diameter (MAX)

20.071 mm (0.7902 in.)

- Replace pump cover, if inside diameter exceeds MAX.

3. Remove oil pump cover and inspect oil screen for broken mesh. Replace it, if necessary.
4. Inspect relief ball valve seating, they must not have any nicks or burrs.
5. Measure free length of ball valve spring.

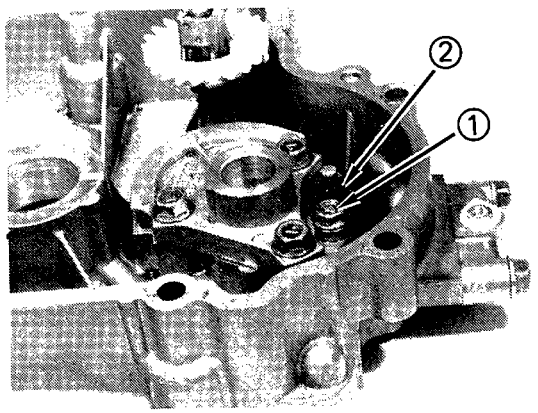
Free Length of Spring (MIN)

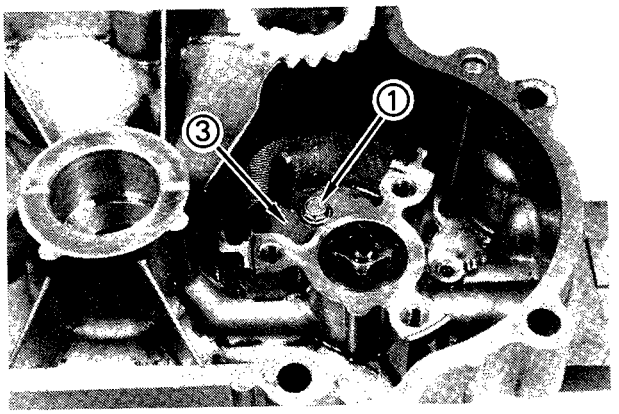
19.5 mm (0.768 in.)

- Replace spring if free length is less than MIN.

6. Inspect inner and outer oil pump rotors. Replace rotors if wear or damage is excessive.

NOTE: Do not unscrew bolts (1) which tighten relief valve cover (2) and oil induction guide plate (3). These bolts are applied locking bond.





OIL PUMP INSTALLATION

1. Install inner and outer rotors together.
2. Install oil screen.
3. Put relief-valve ball on valve seat.
4. Install oil pump cover with relief valve spring and tighten cap screws to specified torque.

Pump Cover Tightening Torque

17 to 23 N-m (12 to 17 ft-lbs)

- After installation, the oil pump should rotate freely in the housing.

5. Install crankcase cover on block. (See Section 9 : Crankcase Cover Installation)

www.mymowerparts.com

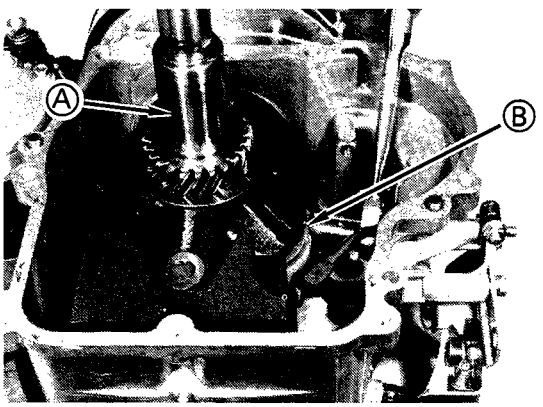
For Kawasaki Discount Parts Call 606-678-9623 or 606-561-4983

Section 8

PISTON, PISTON RING, AND CON-ROD

PISTON AND CON-ROD REMOVAL

1. Remove any carbon or ridge at the top of cyl. bore; this will help prevent piston rings from breaking.
2. To remove piston and con-rod from engine, rotate crankshaft (A) to expose con-rod bolts (B) as shown.
3. Remove rod bolts and con-rod cap.
4. Push piston and con-rod out through the top of cylinder.

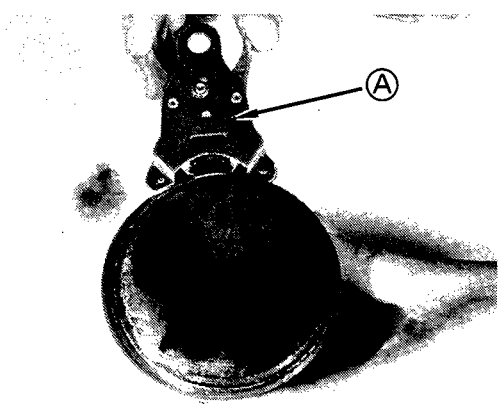


To Remove Piston From Con-Rod:

(1) Remove piston pin snap rings with thin nose pliers and slide out piston pin.

CAUTION: Do not reuse snap rings once removed. Removal weakens and deforms the rings.

(2) Remove piston rings one at a time, by slipping them over (A) ring lands. Use a ring expander (A) to prevent damage to rings and piston.



To Analyze Piston Ring Wear:

(1) Rings of the wrong size or rings having improper end gap will not conform to the shape of cylinder. This results in high oil consumption and excessive blow-by.

- Ring end gaps should be staggered on piston during installation. End gaps in alignment can cause oil consumption and blow-by.
- Light scuffing or scoring of both rings and piston occurs when unusually high friction and combustion temperatures approach the melting point of piston material. Probable causes of this condition one:
  - Dirty cooling shroud and cyl. head.
  - Lack of cylinder lubrication.
  - Improper combustion.
  - Wrong bearing or piston clearance.
  - Too much oil in crankcase causing fluid friction.

(2) An engine operating at abnormally high temperatures may cause varnish, lacquer or carbon deposists to form in the piston grooves making the rings stick.
When this happens, excessive oil consumption and blow-by will occur.

- Engine overheating and ring sticking is usually caused by one or more of:
  - Overloading.
  - Incorrect ignition timing.
  - Lean fuel mixture.
  - Dirty cooling fins.
  - Incorrect oil.
  - Low oil supply.
  - Stale fuel.

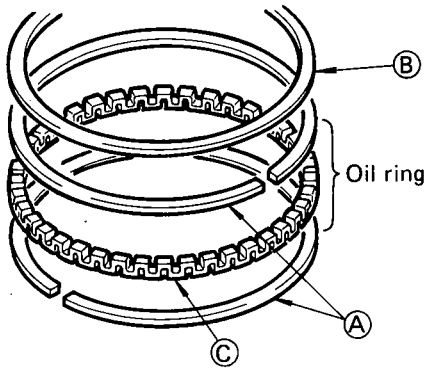
(3) Vertical scratches across piston rings are due to an abrasive in engine. Abrasives may be airborne, may have been left in engine during overhaul or may be loose lead and carbon deposits.

- When this exists, check for one or more of:
  - Damaged, collapsed or improperly installed air cleaner.
  - Loose connection or damaged gasket between air cleaner and carb.
  - Air leak around carburetor-to-cyl. block gasket.
  - Air leakage around throttle shaft.
  - Failure to properly clean cyl. bore after reconditioning engine.
- Scratches across oil side rails (A) are due to abrasive in engine oil.

www.mymowerparts.com

For Kawasaki Discount Parts Call 606-678-9623 or 606-561-4983

- In this condition and much use, compression rings (B) will also be worn.
- Oil inner spacer wear (C) and distorsion may cause increase oil up by pumping action of oil ring. This results in high oil consumption, increased deposit in combustion chamber and stick of rings.



PISTON INSPECTION

No need to proceed with the steps shown if cylinder is to be resigned or visual inspection of piston shows wear or scoring – which require replacing piston.

1. Remove all deposits from piston.
2. Clean carbon from piston ring grooves with a ring groove cleaner.

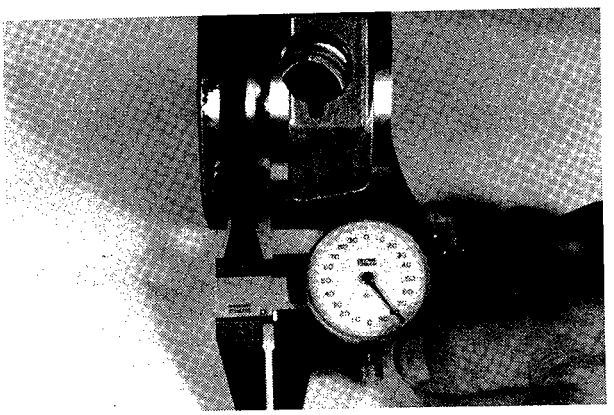
CAUTION: Do not use a caustic cleaning solution or a wire brush to clean piston.

3. Be sure oil return passages in ring grooves are open.

CAUTION: Never clean piston head with engine assembled. Carbon particles will fall between piston and cylinder, and may cause severe seizure.

4. Visually inspect rings and grooves for uneven wear or damage. Replace them if uneven wear or damage are excessive.

5. Measure piston ring groove width. Use a vernier caliper at several points around the piston.



Piston Ring Groove Width (MAX)

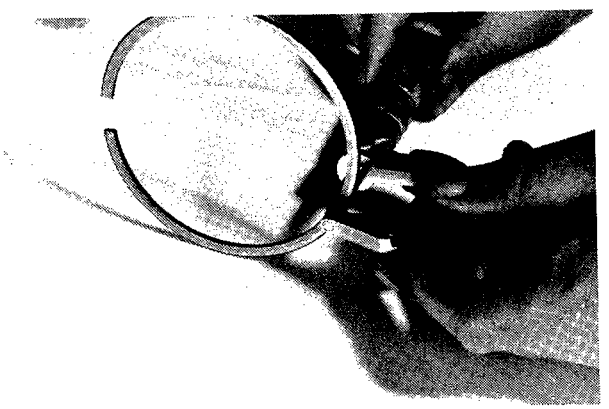
Ring	Groove Width
Top	2.120 mm (0.0835 in.)
2nd	2.095 mm (0.0825 in.)
Oil	4.055 mm (0.1596 in.)

- If the width of any of the grooves is wider than MAX at any point, replace piston.

6. Inspect piston for scoring or fractures at ring lands.

PISTON RING THICKNESS INSPECTION

- Use a micrometer to measure piston ring thickness at several points around rings.



Piston Ring Thickness (MIN)

Top	1.945 mm (0.0766 in.)
2nd	1.941 mm (0.0764 in.)

www.mymowerparts.com

For Kawasaki Discount Parts Call 606-678-9623 or 606-561-4983

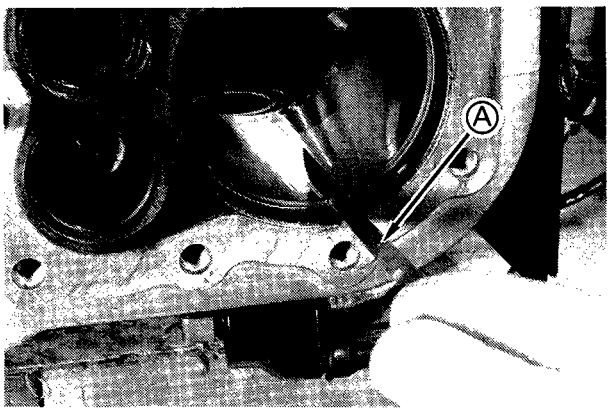
NOTE: Difficult to exactly measure oil ring thickness. Replace oil ring together with compression rings.

PISTON RING END GAP INSPECTION

1. Insert each ring in cyl. bore and check end gap.
2. Install ring squarely in the bore to a point approx. (25mm) 1 in. down from the top of cylinder.

NOTE: Use piston to push it in to be sure it is square.

3. Check ring end gap with feeler gauge (A).

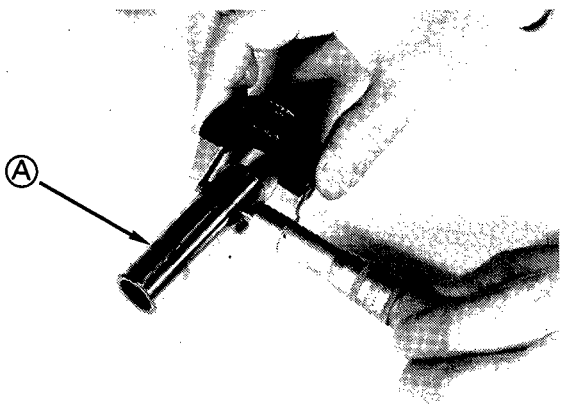


	End Gap (MAX)
Top	0.7 mm (0.028 in.)
2nd	0.7 mm (0.028 in.)

4. If the end gap of any ring is greater than MAX, replace the entire set of rings.

PISTON PIN AND PIN HOLE DIA. INSPECTION

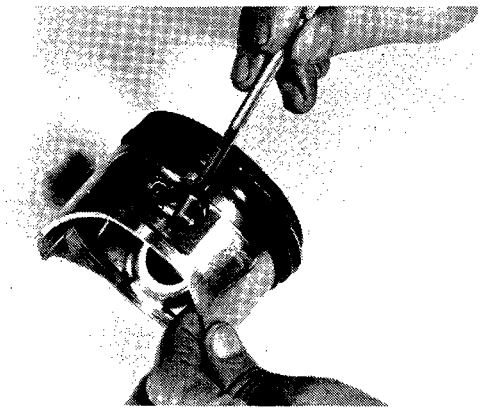
- Measure outside diameter of piston pin (A) with a micrometer at several points.
- If piston pin diameter is msaller than MIN, replace piston pin.



Piston Pin Dia. (MIN)

20.978 mm (0.8259 in.)

1. Measure inside diameter of piston pin hole in piston with an inside micrometer at several points.
2. If inside diameter exceeds MAX, replace piston.



Piston Pin Hole Dia. (MAX)

21.028 mm (0.8279 in.)

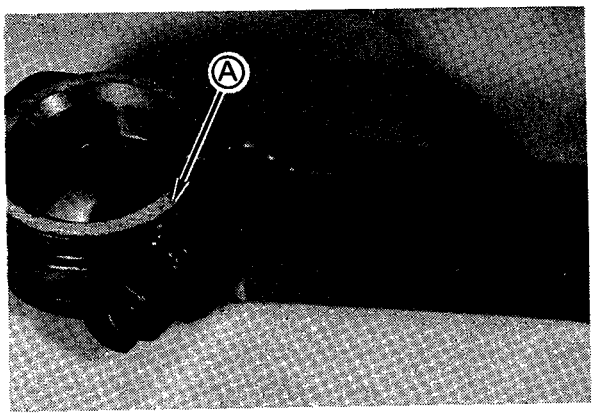
To Analyze Piston Wear:

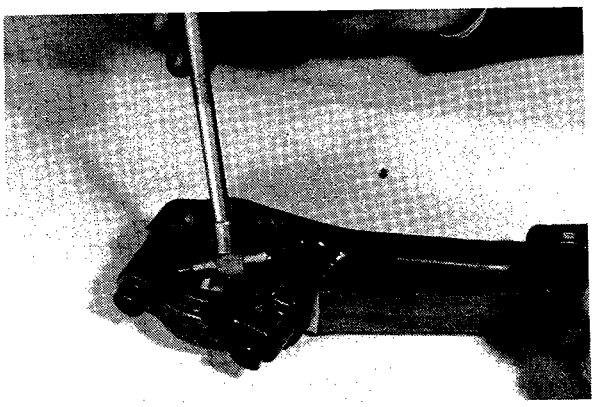
- Detonation can cause an extensive damage to piston, cyl. head, gasket or others. Detonation is abnormal combustion causing excessive temperature and pressure in the combustion chamber. Commonly called carbon knock, spark knock or timing knock, detonation occurs as the compressed fuel-air mixture ignites spontaneously to interrupt the normal ignition.
- Following is a list of possible cause for detonation:
  - Lean fuel mixture.
  - Low octane fuel.
  - Advanced ignition timing.
  - Engine lugging.
  - Build-up of carbon deposits on piston or cyl. head.
  - Wrong cyl. head or milling of head increasing compression ratio.
  - Poor cooling.
- Pre-ignition is the ignition of the fuel-air mixture prior to regular ignition spark. Pre-ignition causes internal shock, resulting in pings, vibration, detonation and power loss. Severe damage to piston, rings and valves results from pre-ignition.
  Check following for causes of pre-ignition:
  - Internal carbon deposits.
  - Incorrect spark plug.
  - Broken ceramic in spark plug.
  - Sharp edges on combustion chamber.
  - Poor cooling.

www.mymowerparts.com

For Kawasaki Discount Parts Call 606-678-9623 or 606-561-4983

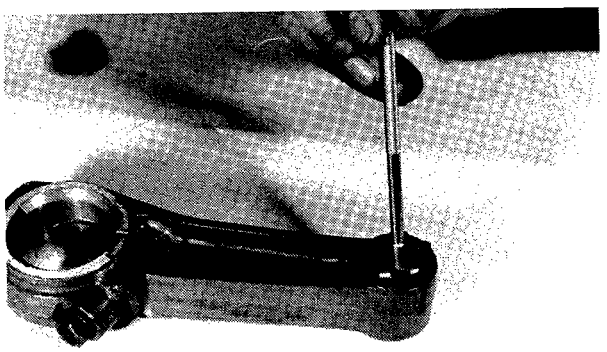
- Check con-rod and piston alignment when piston shows a diagonal wear pattern extending across the skirt of piston. Contact with the cyl. wall on bottom of skirt at left (or right) and ring lands on right (or left).
- A cylinder bored at an angle to crankshaft can also cause improper ring contact with cylinder.
  This condition causes:
  - Rapid piston wear.
  - Uneven piston wear.
  - Excessive oil consumption.





CON-ROD INSPECTION

1. Clean and inspect bearing surface on con-rod and cap. Replace parts if scored.
2. Measure inside diameter of the small end of con-rod at several points by a telescoping gauge.



Small End Inside Dia. (MAX)

21.039 mm (0.8283 in.)

3. If inside diameter is greater than specified, replace con-rod.
4. Place con-rod cap over con-rod big end to align pilot grooves (A) on the cap and rod. Screw cap bolts and tighten bolts to the specified torque shown.

Rod Cap Tightening Torque

19 to 20 N-m (14 to 15 ft-lbs)

5. Measure the inside diameter of big end at several points by a telescoping gauge or inside micrometer.

Big End Inside Dia. (MAX)

37.066 mm (1.4593 in.)

6. If inside diameter exceeds MAX, replace con-rod.

NOTE: A bent or twisted con-rod must be replaced.

To Analyze Con-Rod Wear:

- Check con-rod and cap for damage or unusual wear patterns.
- Lack of lubrication or improper lubrication can cause con-rod and cap to seize to crankshaft.
- When rod and cap seize to crankshaft, the con-rod and piston may both break causing other internal damage. Inspect the block carefully before rebuilding engine.
- Con-rod and crankshaft damage can result from:
  - Engine run low on oil or without oil.
  - Oil pump broken or damage.
  - Oil hole in con-rod plugged.
  - Oil not changed regularly.
  - Bearing cap installed incorrectly.

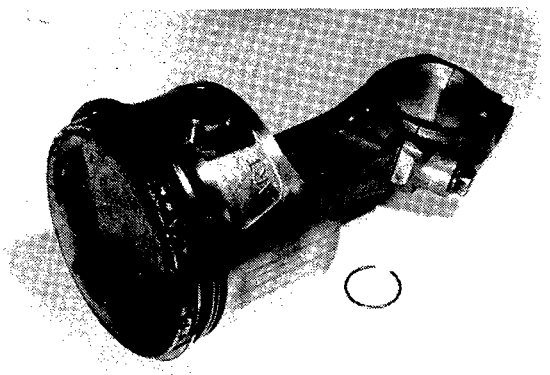
www.mymowerparts.com

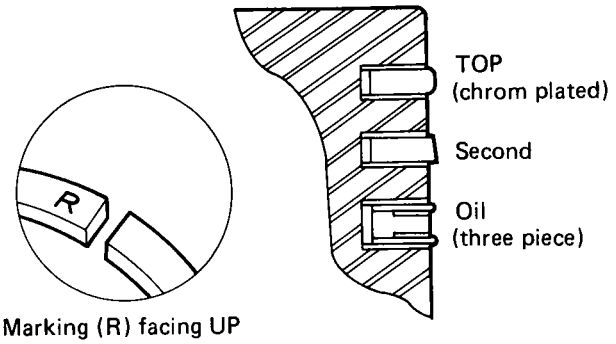
For Kawasaki Discount Parts Call 606-678-9623 or 606-561-4983

PISTON AND CON-ROD ASSEMBLY

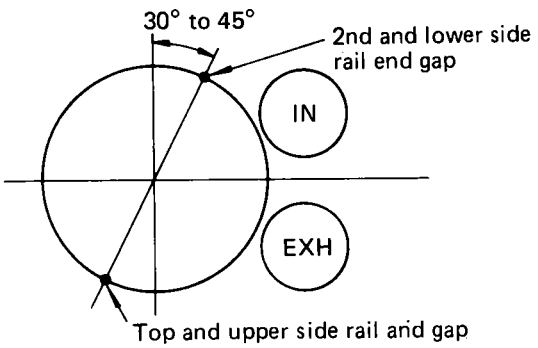
1. Aligning match mark " △ " on the piston head with "MADE IN JAPAN" on the con-rod, install piston over con-rod.
2. Coat piston pin with a light film of oil. Insert pin through piston and con-rod.
3. Install retaining rings in each end of piston pin bore. Rings should be seated firmly in retainer grooves in piston.

CAUTION: Do not reuse the rings which was removed. Removal weakens, deforms the rings and could fall out and score the cyl. wall.





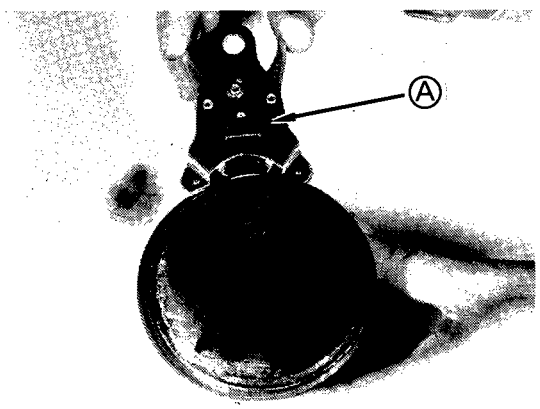
Marking (R) facing UP



Position Ring End Gaps

PISTON RING INSTALLATION

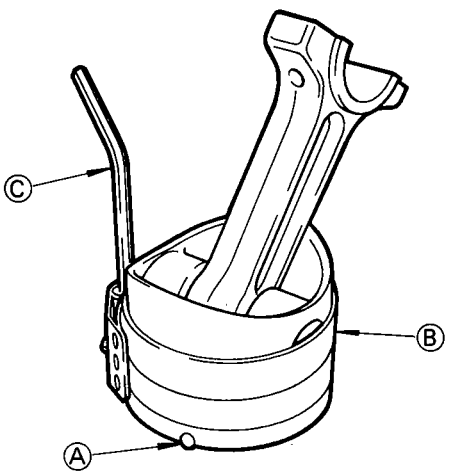
1. Be sure oil return holes are clean and carbon is removed from all grooves.
2. Use a ring expander to install rings as illustrated.



3. Make sure rings are installed as shown.
4. Install top and second rings with the markings facing up. (Oil ring steel rails have no "TOP" or "Bottom".) After installation, rings should rotate freely in the grooves.
5. Space top and second ring end gaps 180 degrees apart.
6. Space side rail and gaps 180° degrees a part respectively. See Illust.

PISTON AND CON-ROD ASSY INSTALLATION

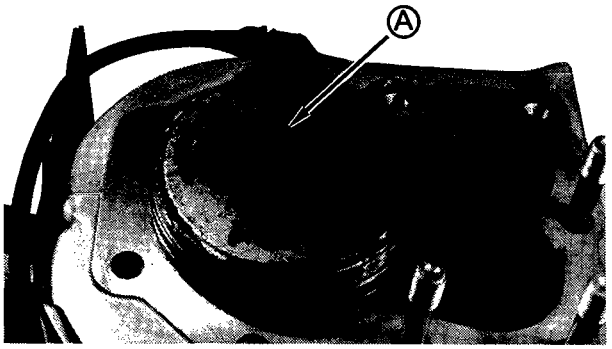
1. TO INSTALL RINGS TO PISTON:
   Place ring compressor (B) over piston with the projections (A) on compressor toward the top of piston.
   Push compressor down until it is flush with the top of piston. Tighten compressor with a wrench (C), then loosen slightly.



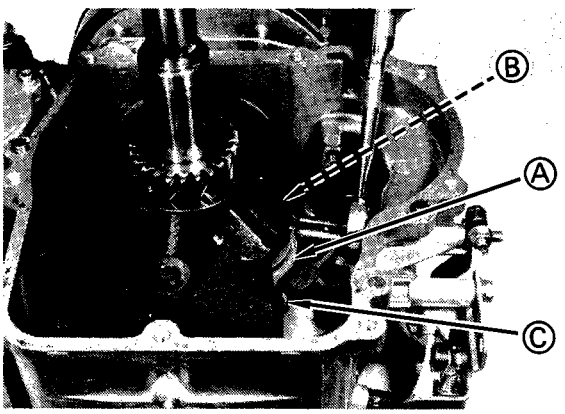
2. Coat the inside of cyl. bore with a light film of oil.
3. Align arrow mark (A) on piston head towards flywheel end and install con-rod and piston ass'y through the top of cyl. bore. Push piston into cyl. bore with a hammer handle.

www.mymowerparts.com

For Kawasaki Discount Parts Call 606-678-9623 or 606-561-4983



4. Turn crankshaft gently and place crankpin in lowest position. Then further insert piston into cylinder while leading big end bearing surface to place above crankpin. Turn cyl. block upside down on bench.
5. Coat the inside of big end bearing surface and cap screws with a light film of oil.
6. Install rod cap (A) so assembly pilot groove (B) align and tighten cap screws (C) to the specified torque as shown.



Con-Rod Bolt Tightening Torque

19 to 20 N-m (14 to 15 ft-lbs)

CAUTION: Tighten rod screws securely. After tightening rod screws, con-rod should be able to move sideway on crankpin of shaft. A torque wrench must be used to prevent loose or over-tight cap screws which may result in breakage and/ or scoring of rod.

www.mymowerparts.com

For Kawasaki Discount Parts Call 606-678-9623 or 606-561-4983

Section 9

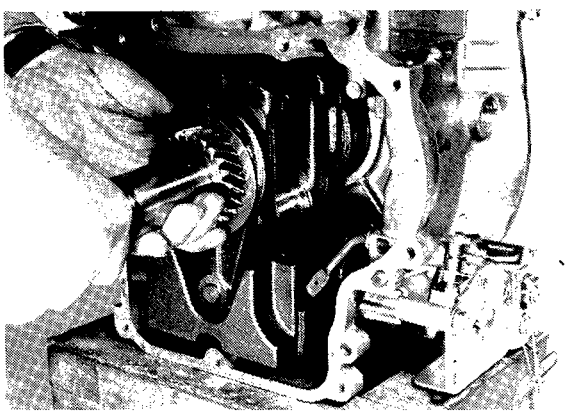
CRANKSHAFT AND CAMSHAFT

CRANKSHAFT AND CAMSHAFT REMOVAL

1. To remove crankshaft from cyl. block, remove rust or burrs from power take-off shaft end of crankshaft.
2. Lightly tapping the both ends near dowel alternately with a soft mallet, remove crankcase cover.
3. Turn cyl. block upside down on a bench.
4. Rotate crankshaft until timing marks on crankshaft gear and cam gear align.
5. Pull out the camshaft, then remove tappets.

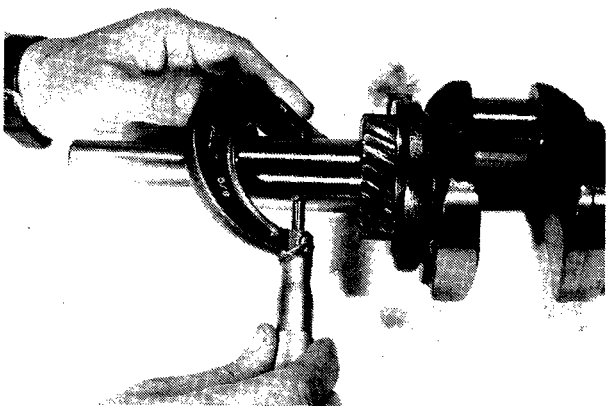
NOTE: Align timing marks to prevent damage to tappets when removing camshaft. Mark tappets so they can be installed in their original guides during assembly.

6. Remove con-rod and piston. (See Section 8)
7. Rotate crankshaft gently until the crank pin positioned opposite side of cylinder bore.
8. Remove balancer guide.
9. Remove crankshaft.



CRANKSHAFT INSPECTION

1. Clean and inspect bearing surfaces on crankshaft for scored. Inspect crankshaft gear(s) for cracked, scored or broken teeth. Replace parts if necessary.
2. With a micrometer, measure both main journals at several points around journal circumference.



PTO Main Journal Dia. (MIN)

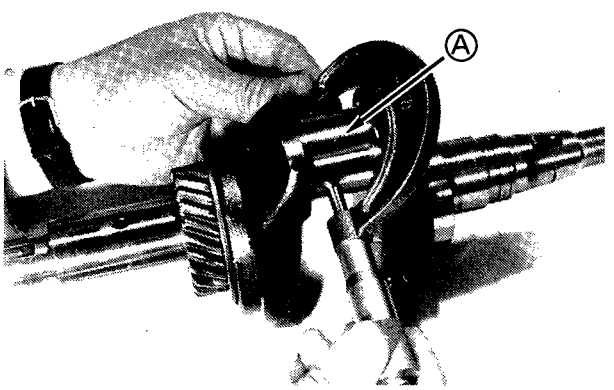
34.914 mm (1.3746 in.)

Mag. Side Journal Dia. (MIN)

34.945 mm (1.3757 in.)

- If journal diameter is less than MIN, replace crankshaft.

3. Measure con-rod big-end journal (A) at several point with a micrometer.



Con-Rod Big-End Journal Dia. (MIN)

36.934 mm (1.4541 in.)

If journal diameter is less than MIN, replace crankshaft.

4. Measure crankshaft link rod journals at several points with a dial-caliper.

Link Rod Journal Dia. (MIN)

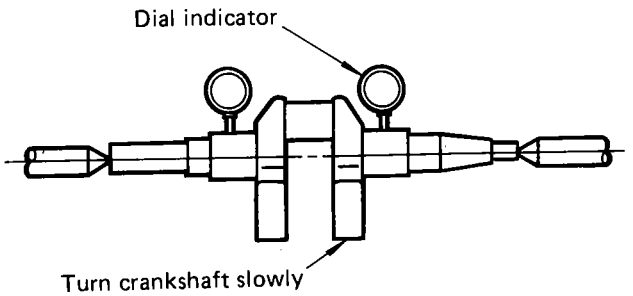
53.951 mm (2.12406 in.)

www.mymowerparts.com

For Kawasaki Discount Parts Call 606-678-9623 or 606-561-4983

- If journals diameter is less than MIN, replace crankshaft.

5. TO CHECK CRANKSHAFT ALIGNMENT: Place crankshaft into an alignment jig, rotate crankshaft slowly, and measure total indicated runout at locations shown.



Run Out (TIR) (MAX)

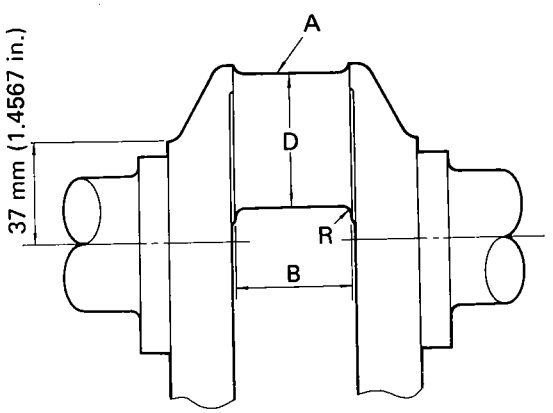
0.05 mm (0.002 in.)

If total run out exceeds MAX, replace crankshaft.

- Crankshaft damage can result from:
  - Engine runs with low oil or without oil.
  - Oil dipper broken or damaged.
  - Oil hole in con-rod plugged.
  - Oil not changed regularly.
  - Bearing cap installed incorrectly.

UNDER-SIZE CON-ROD

1. Con-rod journal can accept an under-size con-rod having 36.5 mm (1.437 in.) dia. Regrinding is required before using the under-size.
2. The final finishing diameter should be 36.48 to 36.467 mm (1.4362 to 1.4357 in.).



Under size dimentional spec.

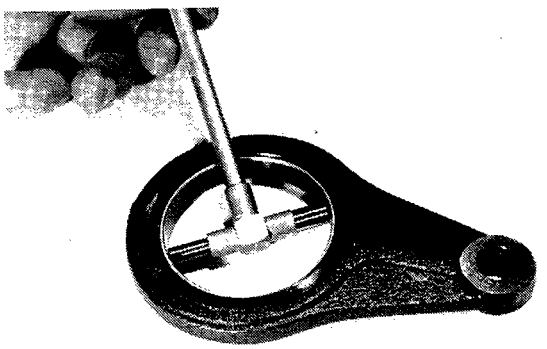
D= 36.480 to 36.467 mm (1.4362 to 1.4357 in.)
R= 2.30 to 2.70 mm (0.09 to 0.11 in.)
B= 32.3 mm MAX (1.272 in. MAX)

3. A-Surface must be concentric and parallel to each other within 0.005 mm (0.0002 in.) full indicator reading.

NOTE: Finish should be very smooth; use a super finishing stone.

LINK ROD INSPECTION

1. Clean and inspect bearing surfaces on link rod. If the bearing surface of small end is scored or damaged, replace the rod. Scored or damaged big end bearing (bushing) must be replaced with a new bushing.
2. With a micrometer, measure both inside bearing surfaces at several points.



Small End Inside Dia. (MAX)

12.059 mm (0.4748 in.)

- If the inside diameter exceeds MAX, replace the link rod.

Big End (bushing) Inside Dia. (MAX)

54.121 mm (2.13074 in.)

- If the inside diameter is greater than MAX, replace bushing.

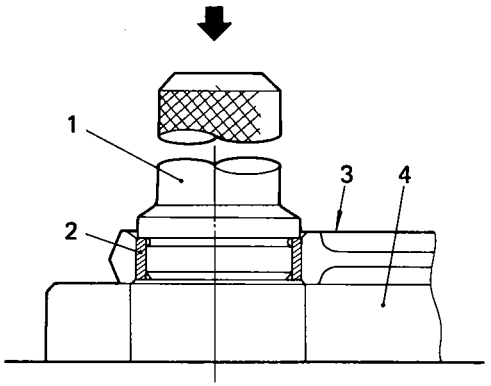
BUSHING REPLACEMENT

1. Place link rod on a bench plate (4) with radial oil-groove side up.
2. With a bearing driver (1), drive out bushing (2) as shown.

NOTE: Do not forget the direction of seam of the shell to reinstall new one.

www.mymowerparts.com

For Kawasaki Discount Parts Call 606-678-9623 or 606-561-4983

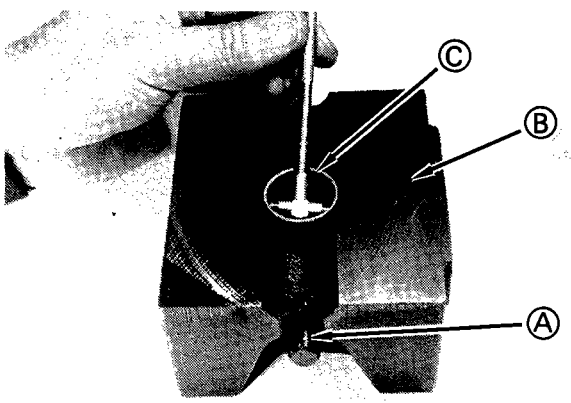


1. Bearing driver
2. Big end bushing
3. Link rod
4. Bench plate

3. Clean the parts in solvent throughly and dry them. Put a light coat of oil on a new bushing.
4. Re-install the bushing using an arbor press or bearing driver.
5. Press-in the bushing 0.5 mm (0.02 in.) below flange surface (3).

BALANCE WEIGHT INSPECTION

1. Clean and inspect bearing surface of bushing for worn or damage. Replace it, if necessary.
2. Wrist pins (A) are press fit on weight (B) strongly, and normally require no maintenance.
3. With a inside micrometer or telescoping gauge, measure bearing surface of bushing (C).



Bushing Inside Dia. (MAX)

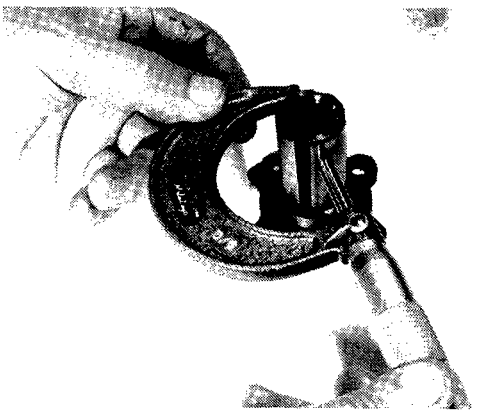
26.097 mm (1.02744 in.)

- If inside diameter exceeds the MAX replace bushing.
  Bushing can be replaced as the same procedure as that of link rod bushing.

NOTE: Align oil hole on bushing and oil passage on weight, when installing service bushing.

BALANCER GUIDE INSPECTION

1. Clean and inspect bearing surface on the shaft for worn or damage, replace it if necessary.
2. Measure bearing surface diameter at several point, using a micrometer.



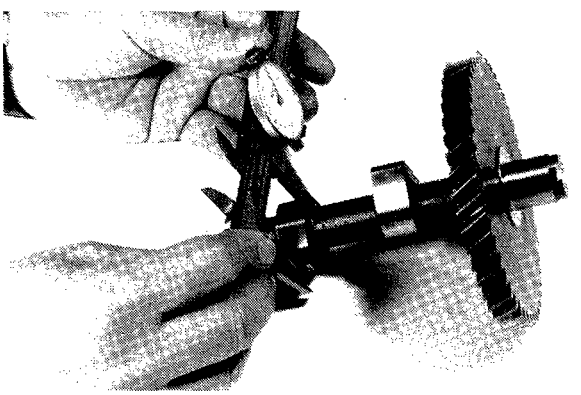
Support Shaft Dia. (MIN)

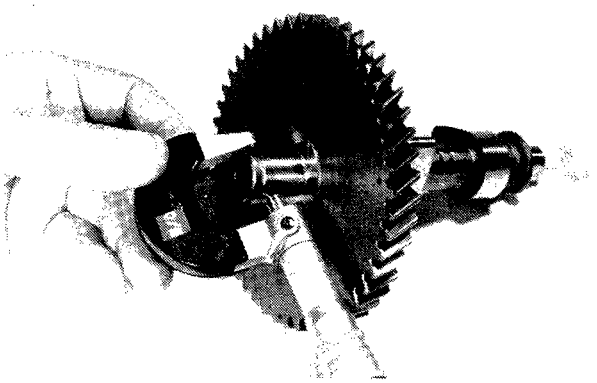
25.927 mm (1.0208 in.)

- If shaft diameter is less than MIN, replace support shaft.

CAMSHAFT INSPECTION

1. Inspect camshaft for worn or broken teeth.
2. Measure with a micrometer, camshaft bearing surfaces and camlobes at point shown.
3. Replace camshaft if worn or damaged.





www.mymowerparts.com

For Kawasaki Discount Parts Call 606-678-9623 or 606-561-4983

Bearing Surface Dia. (MIN)

PTO side	19.907 mm (0.7837 in.)
Magneto side	15.907 mm (0.6263 in.)

- If bearing surface diameter is less than MIN, replace camshaft.

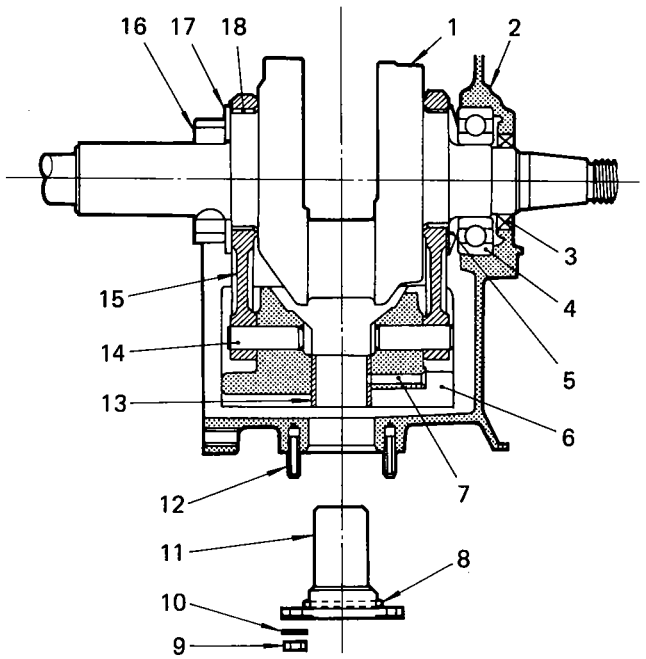
Lobe Height (MIN)

In.	35.40 mm (1.3937 in.)
Exh.	35.40 mm (1.3937 in.)

- If lobe height is less than MIN for either lobe, replace camshaft.

CRANKSHAFT AND CAMSHAFT INSTALLATION

1. Assemble crankshaft, link rods, collares, gear and balance weight as illustrated below.

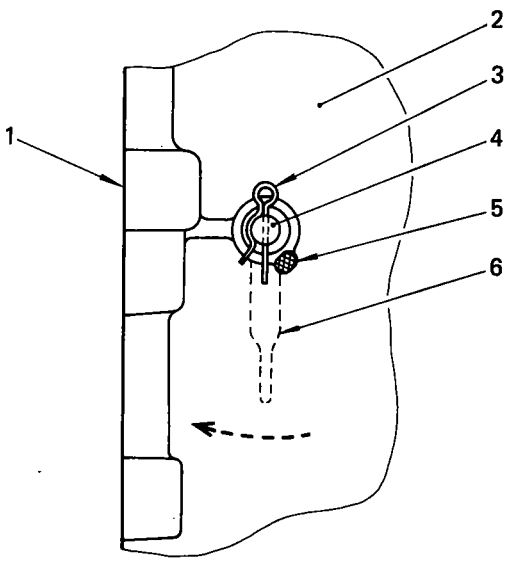


1. Crankshaft
2. Crankcase
3. Oil seal
4. Ball bearing
5. Collar
6. Balance weight
7. Oi hole
8. O-ring
9. Nut
10. Washer
11. Support shaft
12. Stud
13. Bushing
14. Wrist pin
15. Link rod
16. Crank gear
17. Collar
18. Bushing

NOTE: Radial oil-grooves of the link rods must be toward the outside of the crankwebs. Install balance weight to crankshaft with oil hole (7) facing flywheel side.

2. Cover key way on flywheel end of crankshaft with a tape to prevent seal damage when installing crankshaft.
3. Put a light film of oil on crankshaft bearing surfaces.
4. Pack preferably high temperature grease into oil seals.
5. Put crankpin at bottom dead center of engine. Install crankshaft carefully.
6. Align center hole of balance weight and support shaft hole in crankcase.
7. Install support shaft, O-ring and nuts.
8. Install con-rod and piston assembly. (See Section 8)
9. Install tappets in their respective guides from which they were removed.

NOTE: Push tappets all the way in to valve guides to prevent damage to tappets when installing camshaft.
Install governor shaft and snap pin by properly positioning the shaft, pin and projection-stopper as illustrated.

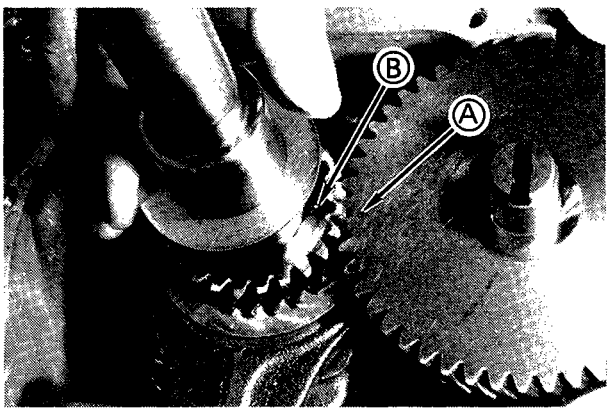


1. Case cover mounting face
2. Crankcase
3. Snap pin
4. Governor shaft
5. Stopper (projection)
6. Governor shaft in crankcase

www.mymowerparts.com

For Kawasaki Discount Parts Call 606-678-9623 or 606-561-4983

Rotate crankshaft until piston is positioned at top dead center. Install camshaft with timing mark (A) aligned with mark (B) on crankshaft gear.

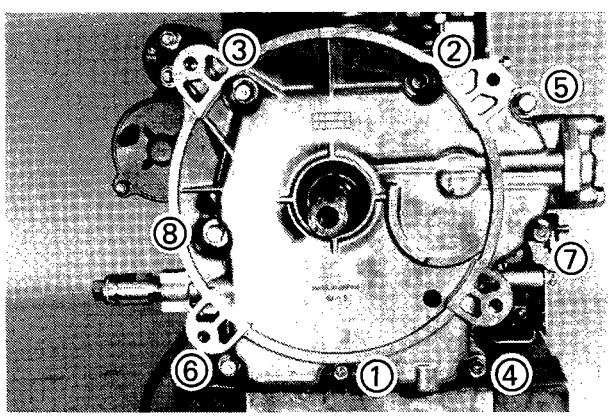


CRANKCASE COVER INSTALLATION

1. Clean gasket surface and put a new gasket on crankcase cover.
2. Pack preferably high temperature grease into oil seal.
3. Lubricate crankshaft bearing in case cover with engine oil.
4. Check governor weights closed.

NOTE: To make the installation easier, align oil pump shaft convex with camshaft end groove.

5. Be sure to suitably set governor gear to be meshed with cam gear when installing crankcase cover.
6. Install crankcase cover and tighten cap screws down evenly by hand.
   Use a torque wrench and tighten screws in the squence shown, and to the specified torque. Do not turn one screw down completely before the others, as it may cause a warped crankcase cover.

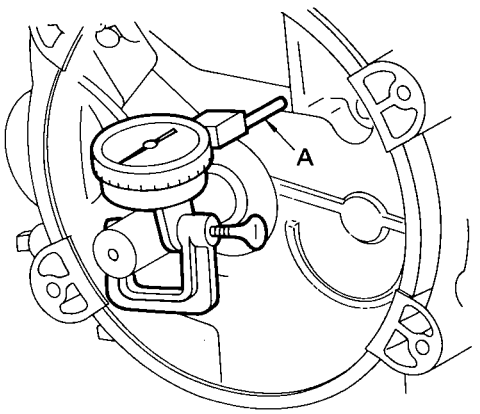


Crankcase Cover Tightening Torque

17 to 23 N-m (12 to 17 ft-lbs)

CRANKSHAFT END PLAY

1. Measure crankshaft end play with a dial indicator.
2. Install dial indicator (A) on crankshaft as shown. Move crankshaft in and out. End play must be 0.09 to 0.20 mm (0.035 to 0.0078 in.).

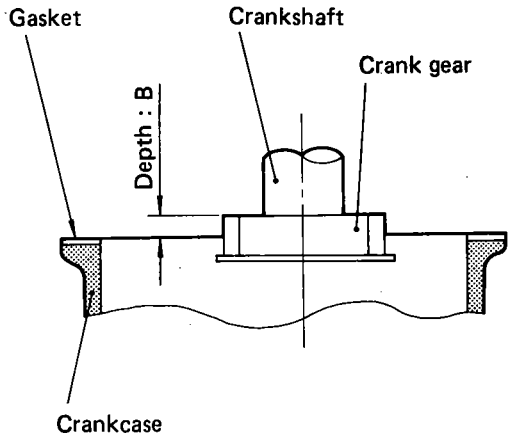


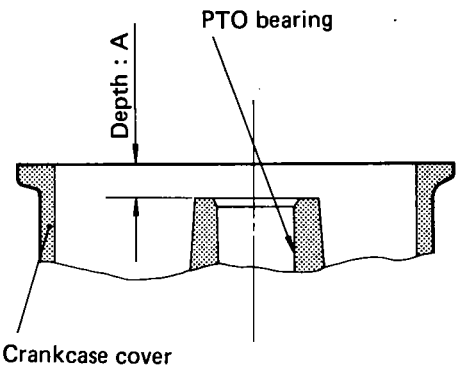
CRANKSHAFT END PLAY ADJUSTMENT

1. The end play should be 0.09 to 0.2 mm (0.0035 to 0.0078 in.) with the 0.5 mm (0.02 in.) gasket placed in-between crankcase cover and crankcase.
2. Check end play and adjust if necessary.
3. Measure depth (a); from crankcase cover mounting surface to PTO shaft bearing end as shown.
4. Measure depth (b); from crank gear end to crankcase gasket surface as shown.
5. Calculate (a—b), and select appropriately sized shim(s) from "Adjusting Shim Table" to correctly adjust end play.
6. Insert the shim(s) to PTO shaft and install crankcase cover.
7. Shim sizes (thickness) are provided in the range of 1.74 mm (0.0685 in.) to 1.18 mm (0.0464 in.) in 0.07 mm (0.0027 in.) increments as shown.

www.mymowerparts.com

For Kawasaki Discount Parts Call 606-678-9623 or 606-561-4983





Adjustment Shim

Difference in depth : A–B	Part Number of Shim	Thickness of Shim
1.92 to 1.99 mm (0.0755 to 0.0748 in.)	92025-2153	1.74 mm (0.0685 in.)
1.85 to 1.92 mm (0.0728 to 0.0755 in.)	92025-2152	1.67 mm (0.0657 in.)
1.78 to 1.85 mm (0.0700 to 0.0728 in.)	92025-2151	1.60 mm (0.0629 in.)
1.71 to 1.78 mm (0.0673 to 0.0700 in.)	92025-2150	1.53 mm (0.0602 in.)
1.64 to 1.71 mm (0.0645 to 0.0673 in.)	92025-2149	1.46 mm (0.0574 in.)
1.57 to 1.64 mm (0.0618 to 0.0645 in.)	92025-2148	1.39 mm (0.0547 in.)
1.50 to 1.57 mm (0.0590 to 0.0618 in.)	92025-2147	1.32 mm (0.0519 in.)
1.43 to 1.50 mm (0.0562 to 0.0590 in.)	92025-2146	1.25 mm (0.0492 in.)
1.36 to 1.43 mm (0.0535 to 0.0562 in.)	92025-2145	1.18 mm (0.0464 in.)

www.mymowerparts.com

For Kawasaki Discount Parts Call 606-678-9623 or 606-561-4983

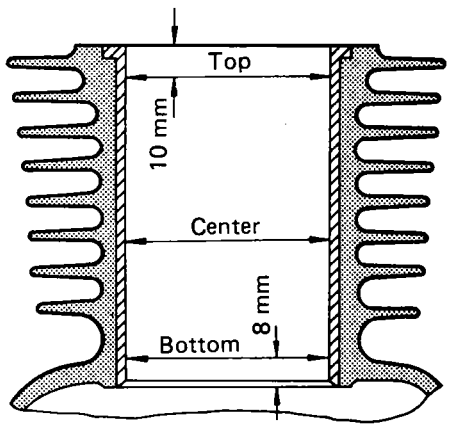
Section 10

CYLINDER BLOCK AND BEARING

CYLINDER BLOCK INSPECTION AND REPAIR

Visually inspect cyl. block, whenever engine is disassembled, to see if there are any cracks, stripped bolt holes, broken fins, or cyl. wall is scored.

- Use an inside micrometer, or telescoping gauge and micrometer to determine the size of cyl. bore. Measure parallel with crankshaft and at right angles to crankshaft at top, center and bottom of ring travel.
- If cyl. bore is more than the wear tolerance and/or the out of round, it must be resized.



Cylinder Bore Wear Tolerance (MAX)

0.076 mm (0.003 in.)

Out of Round Cylinder Bore (MAX)

0.063 mm (0.0025 in.)

Standard Bore Size Dia.

MAX	MIN
89.000 mm (3.5039 in.)	88.980 mm (3.5031 in.)

TO RESIZE Bore to Next Oversize:
Always resize to exactly 0.25mm (0.010 in.) or 0.50mm (0.02 in.) or 0.75mm (0.03 in.) over standard size as shown in table.
If this is done accurately, the stock oversize rings and pistons will fit perfectly and proper clearances will be maintained.

- Resize cyl. bore can be done by an authorized repair shop or by using a drill press and honing tool. Use a stone recommended by the hone manufacturer to produce the correct cyl. wall finish.

1. MACHINE THE BORE first according to the allowance table below.

Over size	Bore Dia.
0.25 mm	89.23 to 89.21 mm (3.5130 to 3.5122 in.)
0.50 mm	89.48 to 89.46 mm (3.5228 to 3.5220 in.)
0.75 mm	89.73 to 89.71 mm (3.5327 to 3.5319 in.)

2. TO FINISH THE BORE: Select and use a suitable stone (normally driven by a drill press)

CAUTION: Allow for a shrinkage (from the final size) of 0.006 to 0.008mm (0.00024 to 0.00031 in.) which will occur when engine cools down.

Over size	Final Bore Size Dia.
0.25 mm	89.250 to 89.230 mm (3.51378 to 3.51299 in.)
0.50 mm	89.500 to 89.480 mm (3.52362 to 3.52283 in.)
0.75 mm	89.750 to 89.730 mm (3.53346 to 3.53268 in.)

(1) Clean cylinder at top and bottom to remove burrs and pieces of base and head gasket.
(2) Anchor cyl. block on drill press table before honing.
(3) Align center of the cyl. bore to drill press center. Set the press to operate from 200 to 250 rpm.
(4) Connect drive shaft to hone and set stop on drill press so hone can only extend 20 to 25 mm (3/4 to 1 in.) from the top or bottom of cylinder.
(5) Rotate adjusting nut (knob) on hone with finger or small screw driver until stones contact snugly against cyl. wall at narrowest point. DO NOT FORCE.
(6) Turn stone by hand. If you cannot turn it, hone is too tight, Loosen hone until it can be turned by hand.

www.mymowerparts.com

For Kawasaki Discount Parts Call 606-678-9623 or 606-561-4983

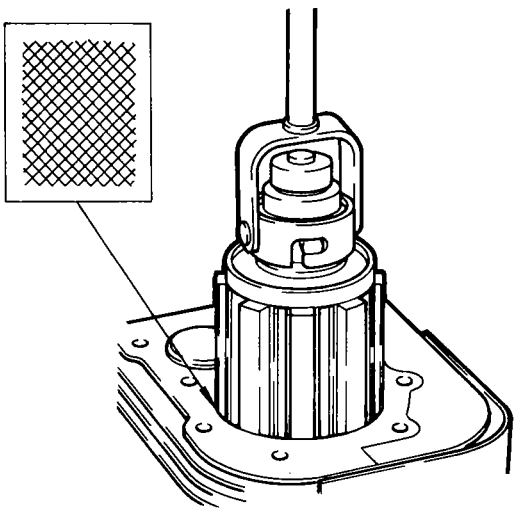
CAUTION: Be sure cylinder and hone are centered and aligned with drive shaft and drill spindle.

(7) Coat inside of cylinder with honing oil. Start drill press. Move hone up and down in cylinder spprox. 20 cycles-per-minute.
(8) Check diameter of cylinder regularly during honing, using an inside micrometer.

⚠ WARNING: Stop drill press before measuring, and remove hone from cylinder.

CAUTION: Finish should have a 40 to 60 degree cross-hatch pattern. Do not use solvent or gasoline.

(9) Clean cylinder thoroughly. Use soap, warm water and clean rags. Clean cyl. wall for a "white glove" inspection. A clean white rag should not show soil from the cyl. wall.
(10) Dry cylinder and coat with engine oil.

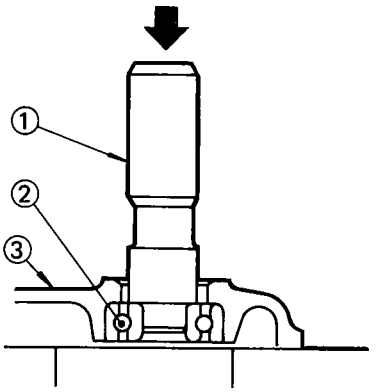


CAUTION: Cylinder must be thoroughly cleaned after honing to eliminate all grit.

BALL BEARING REMOVING

Ball bearings are press-fit into crankcase and case cover.

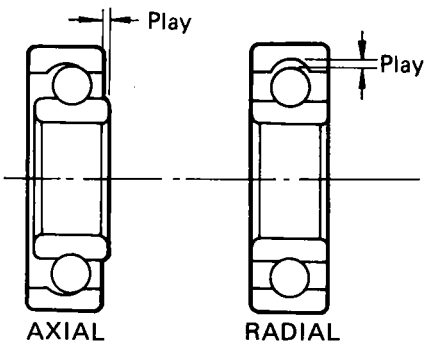
1. Remove oil seals on crankcase. Oil seal should not be reused once removed.
2. Place crankcase on a bench with oil seal side up.
3. Using a bearing driver, drive out bearings as shown.



① Bearing driver ② Ball bearing ③ Crankcase cover

BALL BEARING INSPECTION

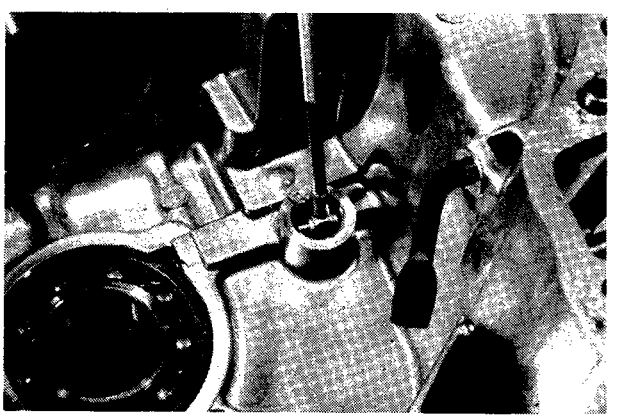
1. Clean bearing in high flash point solvent throughly and dry it.
2. Spin bearing by hand and check for play. Replace bearing if it is noisy, or does not smoothly spin, or has excessive play.



PLAIN BEARING INSPECTION

- The camshaft bearings and PTO journal bearing are cast with the cyl. block and covers.
- Cylinder block and covers should be replaced if scored or worn.

1. Measure camshaft bearing on block with an inside micrometer or telescoping gauge.



www.mymowerparts.com

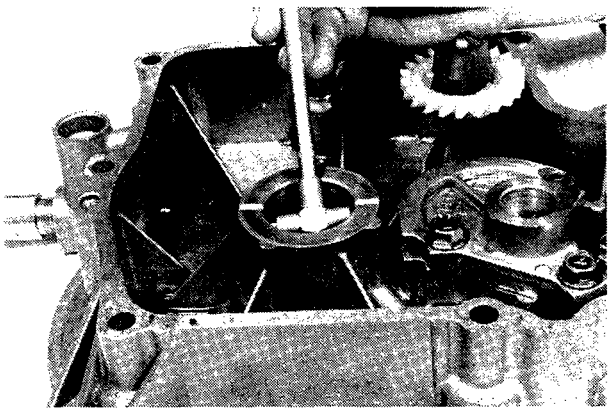
For Kawasaki Discount Parts Call 606-678-9623 or 606-561-4983

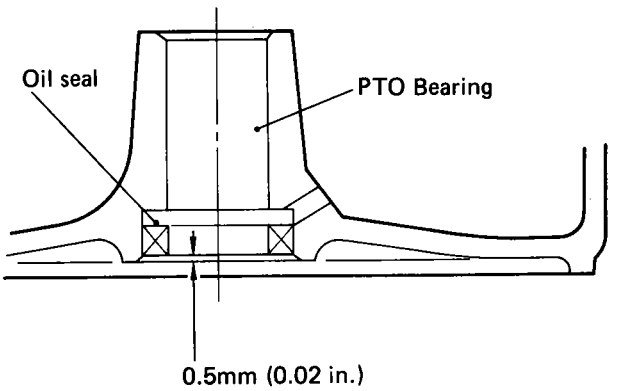
Camshaft Bearing Inside Dia. (MAX)

16.068 mm (0.6326 in.)

- Replace cyl. block, if inside diameter exceeds MAX.

2. Measure PTO and camshaft bearings on covers with an inside micrometer or telescoping gauge.





PTO Bearing Inside Dia. (MAX)

35.061 mm (1.3804 in.)

Camshaft Bearing Inside Dia. (MAX)

20.071 mm (0.7902 in.)

- Replace crankcase cover or oil pump cover, if inside diameter exceeds MAX.

BALL BEARING INSTALLATION

1. Clean cylinder/crankcase and the cover in high flash point solvent throughly and dry.
2. Put a light coat of oil on bearing surface.
3. Press-fit ball bearing into cylinder/crankcase and the cover with an arbor or bearing driver.

OIL SEAL REPLACEMENT (PTO SIDE)

1. Remove old oil seals by tapping them out with a screw-driver or punch from the inside.
2. Pack preferably high temperature grease into a new oil seal.
3. Press-in oil seal with sharp edge of oil seal lip toward inside of engine. (Dust seal lip outside.)
4. For flywheel side, press-in oil seal to be flush with housing.
5. For PTO side, press-in oil seal 0.5 mm (0.02 in.) below outside end most face of PTO bearing.

www.mymowerparts.com

For Kawasaki Discount Parts Call 606-678-9623 or 606-561-4983

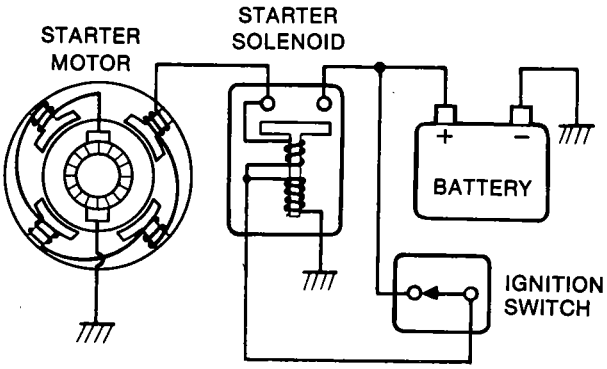
Section 11

ELECTRIC STARTER AND CHARGE

STARTER MOTOR CIRCUIT

The starter motor circuit includes the engine switch, starter solenoid, battery and starter motor. When the engine switch is turned to "Ⅱ" (START) position (See Wiring Diagram), a small amount of current flows through the switch and the solenoid. This current magnetizes the solenoid core, which then pull the plunger to it, closing solenoid contacts complete a circuit for the starter motor, and the starter armature rotates. At the same time plunger pull the shift lever end.
The pinion linkaged to the other end of the lever slides on the armature shaft, engaging the pinion with flywheel ring gear. As engine fires and speed up, starter armature is overrun, causing pinion to disengage. The key switch is returned to "I" (ON) position, cutting off the cranking system.
Starter motors used on FB460V are a Bendix type and shift lever type.

CAUTION: Because of a large amount of current, never hold engine switch in START position if starter motor will not turn over, or current may burn out starter motor windings.

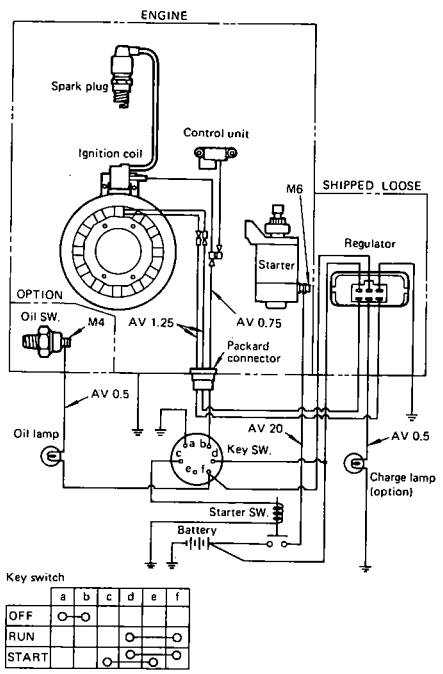


STARTER SYSTEM CHECK

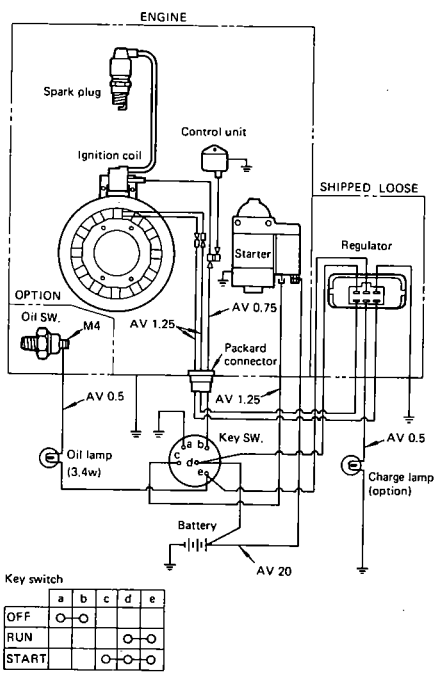
If a starting problem occurs, check engine thoroughly to be sure engine is not the cause of the problem. It is a good practice to remove spark plug and rotate crankshaft by hand, to be sure it rotates freely. Any belt, clutch or other load of this nature will affect cranking performance.
The Trouble Shooting (1-17) table should aid you in diagnosing problems.

Wiring Diagram

Bendix-Type (FB460V-AS Model)



Shift Lever-Type (FB460V-BS Model)



www.mymowerparts.com

For Kawasaki Discount Parts Call 606-678-9623 or 606-561-4983

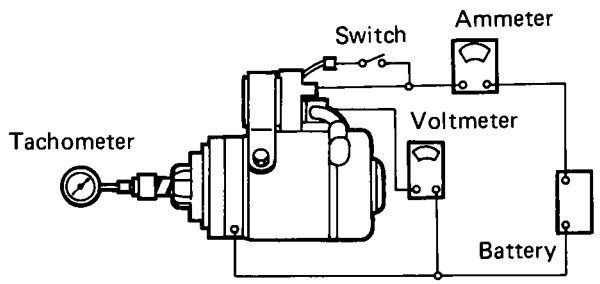
STARTER MOTOR CHECK

A performance test of starter motor can be made in the following manner.
Needed for the test are:

- A tachometer capable of reading 20,000 rpm.
- A 12V 32Ah (or more) battery.
- An ammeter capable of reading 200 amperes.

⚠ **WARNING: Battery electrolyte is poisonous and corrosive. It is injurious to eyes, skin and clothing. Handle it carefully. If electrolyte is spilled, flush immediately with a solution of one part baking soda to four parts water.**

1. Connect starter motor, battery and ammeter as shown in illust.



(Wiring diagram for performance test)

Starter motor should not be loaded. The test should be quickly conducted, as the rating is 30 seconds.

2. Insert tachometer in the end of starter motor and activate starter motor. A starter motor in good condition will be within the following spec.

Bendix Type (FB460V-AS Model)

• Terminal voltage	12 V
• Starter motor rpm	7,000 rpm (MIN)
• Current draw (A)	60 A (MAX)

Shift Lever Type (FB460V-BS Model)

• Terminal voltage	11.5 V
• Starter motor rpm	6,000 rpm (MIN)
• Current draw (A)	50 A (MAX)

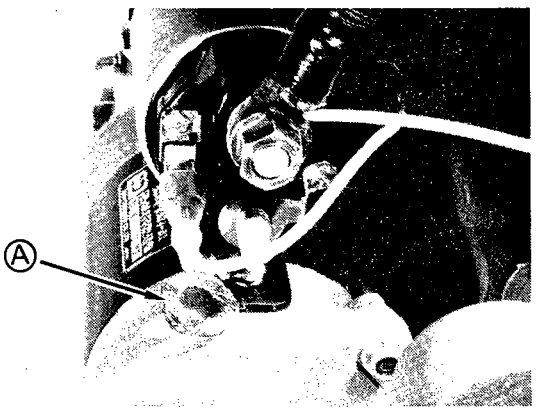
If not, check for the following and correct if necessary:

- A binding or seizing condition in the starter motor bearings.
- Starter motor brushes sticking in brush holders.
- A dirty or worn armature commutator or brushes.
- A shorted, open, or grounded armature or field coil.
- A defective starter motor switch.

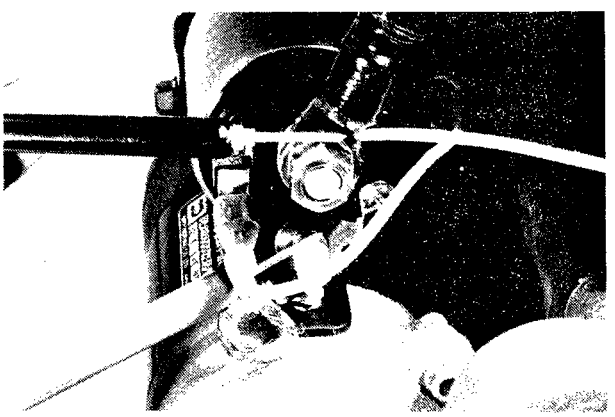
STARTER SOLENOID TEST

Use the same procedure for starter relay test for the Bendix starter and shift lever starter.

1. Disconnect lead (A) to starter motor as shown.



2. Measure the continuity of solenoid when activated.
3. Set a multimeter selector switch to Rx1Ω position and connect leads across the large terminals.



4. Turn engine switch to START and read the meter.

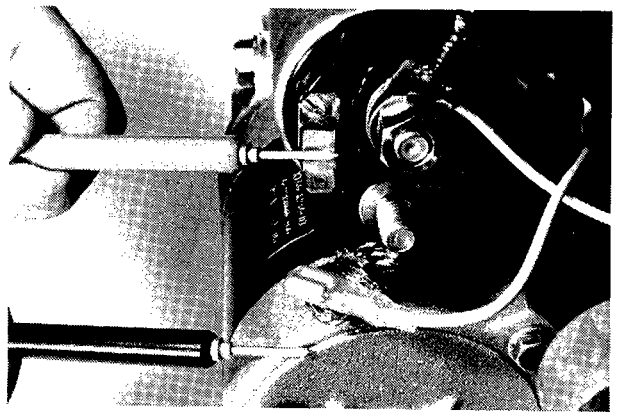
- If solenoid does not click or if the meter reads more than continuity, solenoid is faulty. Replace it.
- If solenoid makes a single clicking sound, the meter read continuity, and pinion gear moves outward (shift lever solenoid only), solenoid and the rest of the starter circuit are good.

www.mymowerparts.com

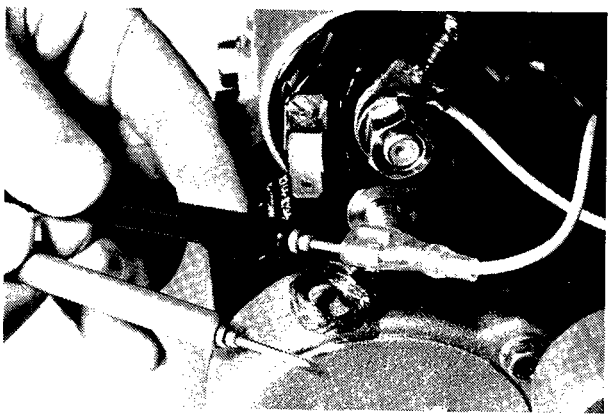
For Kawasaki Discount Parts Call 606-678-9623 or 606-561-4983

- If solenoid clicks once but the meter does not read continuity, solenoid is faulty. Replace it.
- If solenoid does not click at all, proceed with following.

5. Disconnect lead (BW) and set multimeter to Rx1Ω position and connect leads as shown.



- If the meter does not read close to continuity, solenoid is faulty. Replace it.
- If the meter reads close to continuity, solenoid may be good. Check the voltage to solenoid from engine switch.
- Set multimeter selector switch to 25VDC position and connect it as shown.

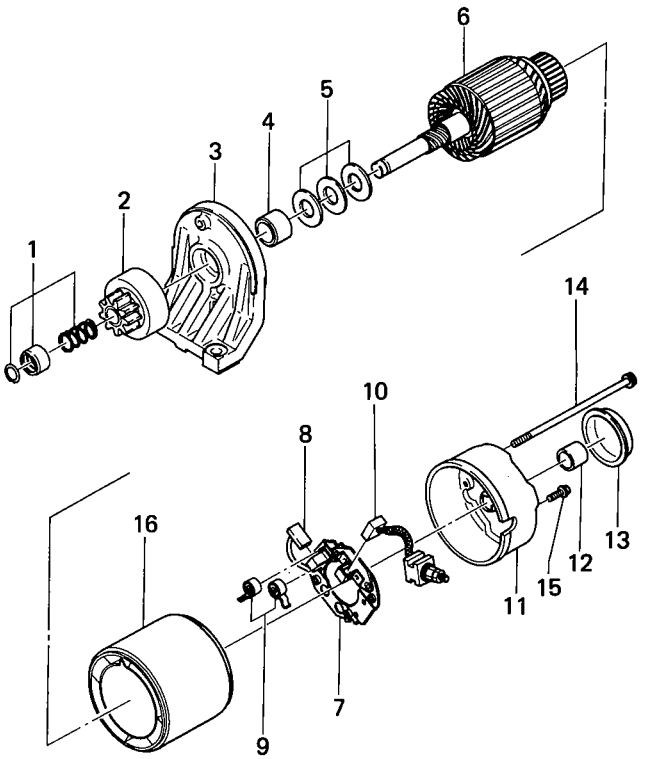


6. Turn engine switch to START and read the meter.
- If the meter reads battery voltage, the circuit is good. If solenoid would not click in the previous tests, it is faulty. Replace it.
- If the meter reads much less than battery voltage or no voltage at all, either the wiring or engine switch is faulty.

7. Test engine switch.
8. Inspect the wiring shown carefully for damaged or broken wires and replace as required.

STARTER MOTOR DISASSEMBLY

(Bendix Type)



Ref. No.	Parts Name	Ref. No.	Parts Name
1	Pinion stopper set	9	Brush springs
2	Pinion ass'y	10	Brush (+)
3	Front cover	11	Rear cover
4	Front cover metal	12	Rear cover metal
5	Thrust washers	13	Dust cover
6	Armature	14	Through bolts
7	Brush holder ass'y	15	Screws
8	Brush (—)	16	Yoke ass'y

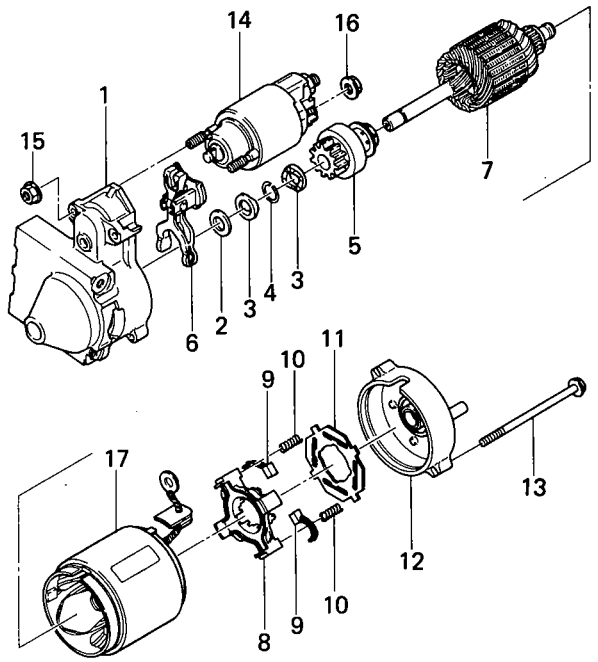
For disassembly, follow the steps below.

1. Pinion stopper set (1)
2. Pinion ass'y (2)
3. Through bolts (14) and screws (15)
4. Rear cover (11)
5. Brush holder ass'y (7)
6. Brush (10) and brush springs (9)
7. Yoke ass'y (16)
8. Armature (16)
9. Thrust washers (5)
10. Front cover (11)

www.mymowerparts.com

For Kawasaki Discount Parts Call 606-678-9623 or 606-561-4983

(Shift Lever Type)



Ref. No.	Parts Name	Ref. No.	Parts Name
1	Front cover	10	Brush spring
2	Washer	11	Insulator
3	Stopper	12	Rear cover
4	Snap ring	13	Bolt
5	Clutch ass'y	14	Solenoid
6	Shift lever	15	Nut
7	Armature	16	Nut
8	Brush holder	17	Yoke ass'y
9	Brush		

For disassembly, follow the steps below.

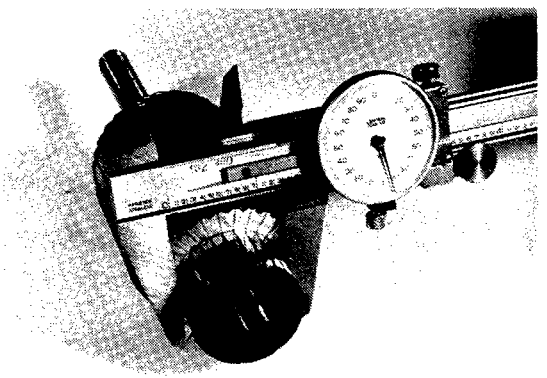
1. Nut (16)
2. Nuts and solenoid (14), (15)
3. Long bolts (13)
4. Rear cover (12)
5. Insulator (11)
6. Brush holder and spring (8), (10)
7. Yoke ass'y (9), (17)
8. Shift lever (6)
9. Armature (7)
10. Washer (2)
11. Stoppers and snap ring (3), (4)
12. Clutch ass'y (5)

STARTER MOTOR INSPECTION

1. Armature Inspection

- Inspect surface of commutator.
- If it has a scratch or is dirty, polish it with a piece of very fine emery paper (No.5000 to No.6000).

- Measure commutator outside diameter at several points around diameter circumference, using a vanier caliper.



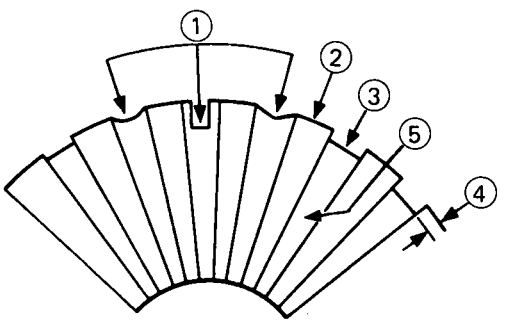
Commutator Outside Dia. (MIN)

Bendix Type	32 mm (1.26 in.)
Shift lever Type	27 mm (1.10 in.)

- If outside diameter is less than (MIN), replace armature.
- Measure depth of grooves between commutator segments.

Commutator Groove Depth (MIN)

Bendix Type	0.2 mm (0.01 in.)
Shift lever Type	0.2 mm (0.01 in.)



1. Bad
2. Segment
3. Good
4. 0.2 mm (0.08 in.) limit
5. Insulating Material

www.mymowerparts.com

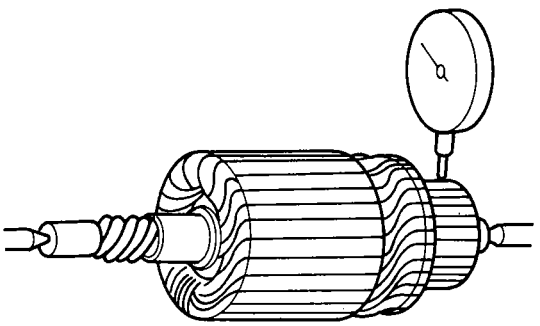
For Kawasaki Discount Parts Call 606-678-9623 or 606-561-4983

- If grooves are shallower than (MIN), under cut insulating material to standard depth using a thin file.

Standard Groove Depth

Bendix Type	0.5 to 0.8 mm (0.02 to 0.03 in.)
Shift lever Type	0.5 to 0.6 mm (0.02 to 0.023 in.)

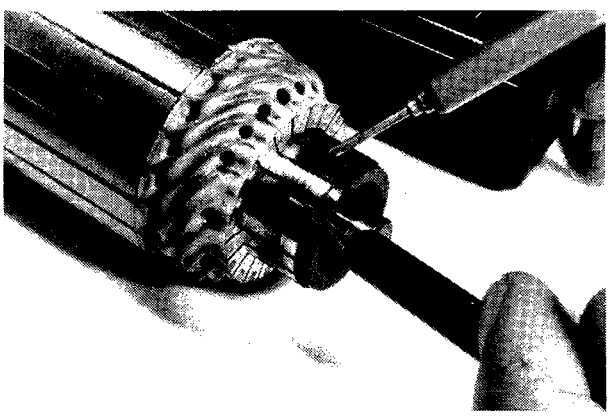
- If grooves are only dirty, clean them carefully.
- Support armature in tail stock at each end of shaft as shown. Position dial indicator perpendicular to commutator. Turn armature slowly and read run-out on dial indicator.



Commutator Run-Out (MAX)

Bendix Type	0.3 mm (0.012 in.)
Shift lever Type	0.4 mm (0.016 in.)

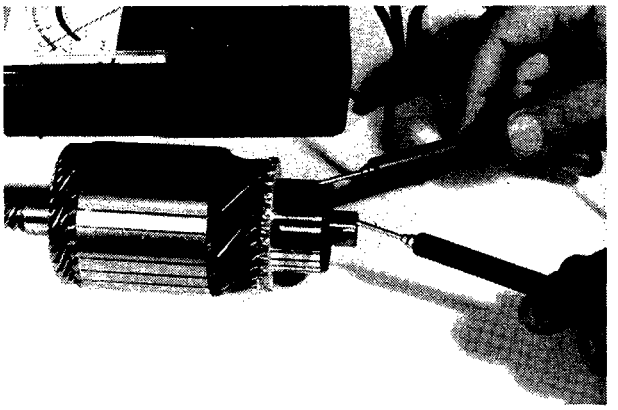
- If run-out is greater than (MAX), turn down commutator or replace starter motor.
- Set multimeter selector switch to R x 1Ω position and check resistance between each segment and all the others.



Armature Winding Resistance (Ω)

Very Low

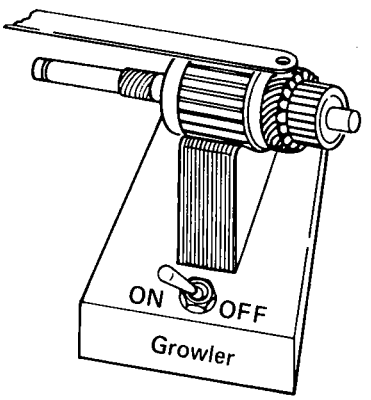
- If resistance is too high or even infinite, armature winding has an open circuit. Replace starter motor.
- Set multimeter selector switch to R x 1kΩ position and measure resistance between commutator and armature shaft.



Commutator-to-Shaft Resistance (Ω)

∞

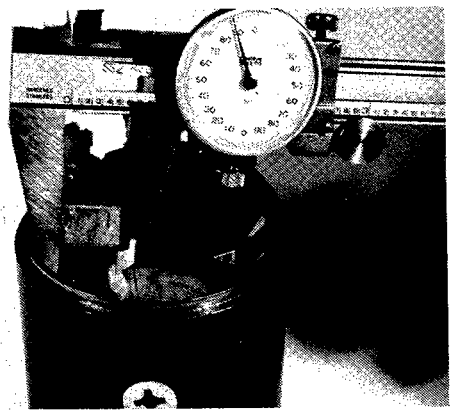
- If resistance is less than infinite, armature is shorted.
- Test armature windings for shorts.
- Place armature on a growler.
- Hold a thin metal strip (e.g., hack saw blade) on top of armature.



- Turn on growler and rotate armature one complete turn.
- If metal strip vibrates, windings are internally shorted to each other and starter motor must be replaced.

2. Brush Length Check

- Measure overall length of each brush.



www.mymowerparts.com

For Kawasaki Discount Parts Call 606-678-9623 or 606-561-4983

Brush Length (MIN)

Bendix Type	12 mm (0.47 in.)
Shift lever Type	6 mm (0.24 in.)

- If brushes are shorter than (MIN), replace them.

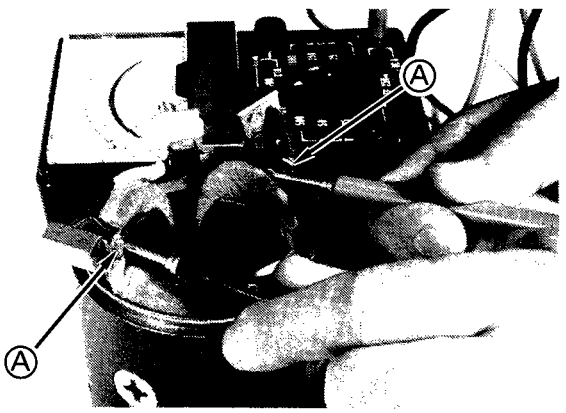
3. Brush Spring Check

- Inspect brush spring for damage. Replace springs if necessary.
- If brush spring are able to snap the brushes firmly into place, they may be considered serviceable. If they cannot, replace them.

4. Field Coil Check

4-1 Bendix-Type Starter Motor

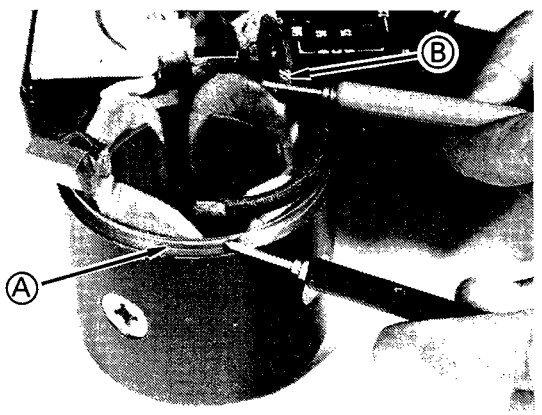
- Set multimeter selector switch to R x 1Ω position and measure resistance between field coils' terminals (A).



Terminal-to-Terminal Resistance (Ω)

Very Low

- If resistance is greater than indicated above (no continuity), replace yoke assembly.
- Set multimeter selector switch to R x 1kΩ position and measure resistance between yoke (A) and one terminal of each coil (B).



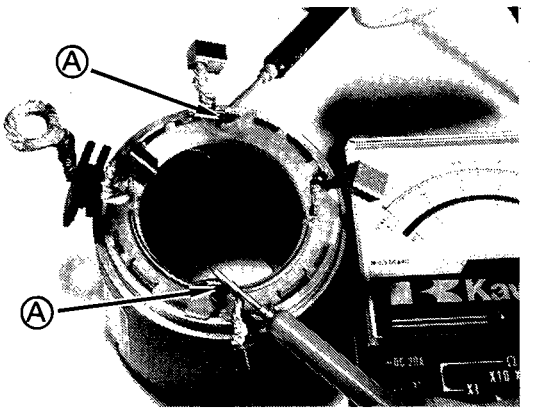
Terminal-to-Ground Resistance (Ω)

∞

- If resistance is less than infinite, field coil is shorted to ground. Replace yoke assembly.

4-2 Shift lever-Type Starter Motor

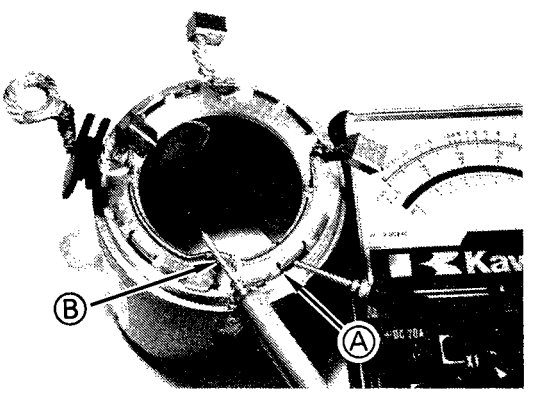
- Set multimeter selector switch to R x 1Ω position and measure resistance between field coils' terminals (A).



Terminal-to-Terminal Resistance (Ω)

Very Low

- If there is continuity field coil is still good.
- If resistance is greater than indicated above (no continuity). Replace yoke assembly.
- Set multimeter selector switch to R x 1Ω position and measure resistance between yoke (A) and one terminal of each coil (B).



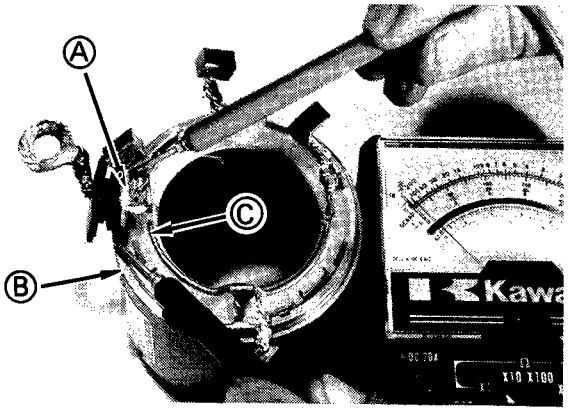
Terminal-to-Yoke Resistance (Ω)

Very Low

- If resistance is greater than indicated above (no continuity), replace yoke ass'y.
- Set multimeter selector switch to R x 1kΩ position and measure resistance between positibe brush (A) and starter motor yoke (B).

www.mymowerparts.com

For Kawasaki Discount Parts Call 606-678-9623 or 606-561-4983



Positive Brush-to-Yoke Resistance (Ω)

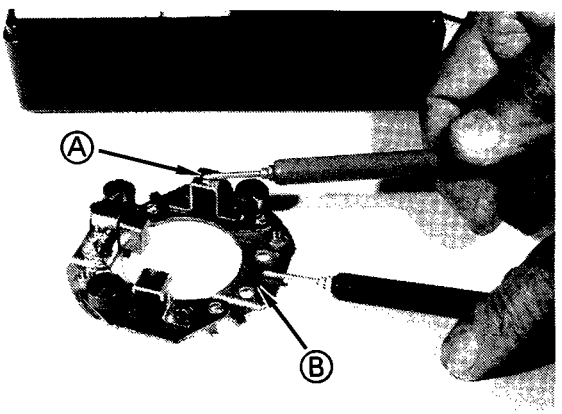
∞

- If resistance is less than infinite, positive brush is horted to ground. Replace entire positive brush ass'y (C).

BRUSH HOLDER CHECK

(Bendix-Type only)

- Set multimeter selector switch to R x 1kΩ position and measure resistance between brush holder (A) and its base (B).



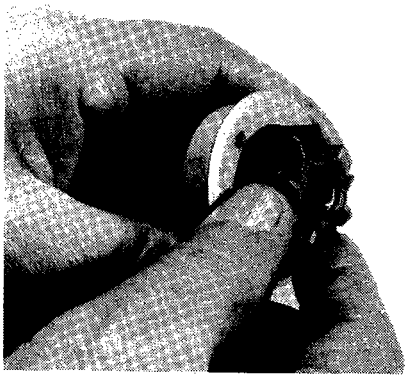
Positive Brush Holder-to-Ground Resistance (Ω)

∞

- If resistance is less than infinite, replace brush holder.

PINION CLUTCH INSPECTION

- Rotate pinion manually.
  While rotating pinion in direction of normal operation, smoothly reverse the direction of rotation to confirm that it locks.



- If any irregularity is noted, pinion clutch should be replaced.

STARTER MOTOR REASSEMBLY

- Reassembly is the reverse order of disassembly. Note the following points.
- Apply multi-purpose glease to:
  – Sliding surface of pinion and shaft's spline.
  – Dust seal lip.
  – Metal holding shaft at front and rear cover.
- Do not reuse retaining ring on shaft, which was removed.
  Removal weaken and deform the retaining ring.

Charging System

A charging system produces the current required to maintain the battery in good state of charge.

- The charging system consist of a flywheel magnet, charging coil (stater) and regulator.
  The charging coil output current is rectified (changed from AC to DC) and is maintained constant voltage for battery charging.
  Rated speed of AC generator is 3,350 rpm, and at lower speeds available output will be reduced relatively.

CHARGING SYSTEM CHECK

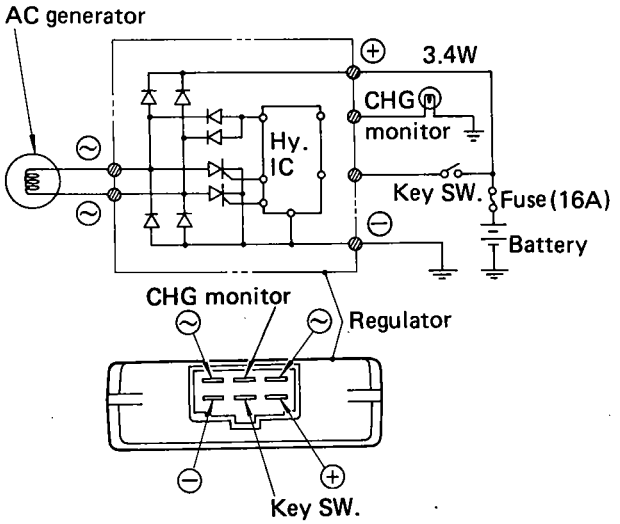
Be sure to perform more basic checks first such as;
1. Battery defective or not charged.
2. Eroded or loose terminals or connections.
3. Cracked insulation or brocken wires.
4. Wire grounding out the system.
5. Defective switch.

- Condition Found (Battery Run Down)
  Check battery polarity. Negative (–) side of battery should be grounded to engine or frame (equipment), positive (+) side of battery to regurator charge lead. (See Illustration)

www.mymowerparts.com

For Kawasaki Discount Parts Call 606-678-9623 or 606-561-4983

If the wiring is reversed, regulator will be damaged.



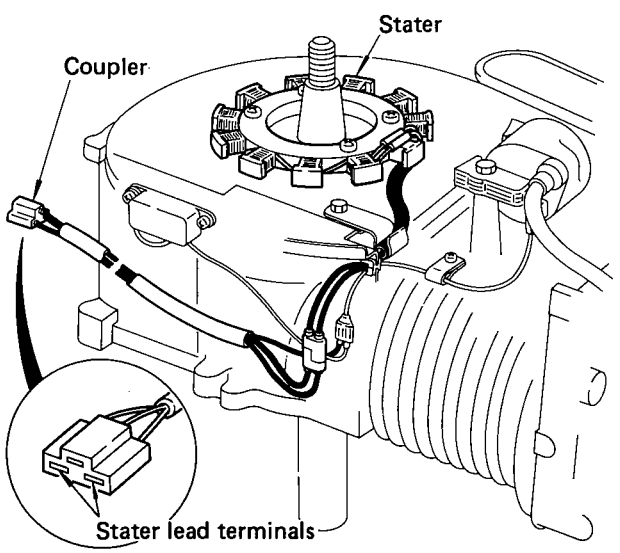
Out Put Test

- Start engine and allow it to warm up completely.
  Set multimeter selector switch to the 25V DC position. (Use KAWASAKI multimeter)
  Connect meter positive (+) lead to battery positive (+) terminal, and negative (—) meter lead to battery negative (—) terminal.

- Run engine at rated RPM (3,350 rpm), meter shoule show a minimum of 12 amps. If not, the system is defective and the components of the system should be checked.

Test Stater Out Put

- Start engine and allow it to warm up completely.
- Disconnect coupler from charging circuit.
- Connect voltmeter leads to stater lead terminals on coupler.
- Run engine at rated RPM (3,350 rpm). Output voltage should be as specified below.



Stater Unregulated Out Put (MIN)

34.5 volts / 3,350 rpm

If voltage is less than specified, replace stater.

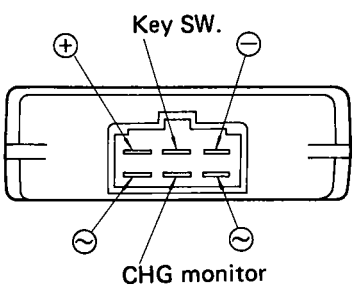
Regulator Resistance Measurement

- Remove all the wires from regulator.
- Set multimeter selector switch to R x 1 kΩ position.
- Connect tester leads to regulator connecter terminals using the table below.
- The resistance value should be specified.

OHM Meter Readings Connected Between

⊕ Tester ⊖	+	K.SW	—	~	~	CHG.M
+		∞	∞	∞	∞	∞
K.SW	4kΩ ~ 20kΩ		200Ω ~ 1kΩ	1kΩ ~ 5kΩ	1kΩ ~ 5kΩ	200kΩ ~ ∞
—	3kΩ ~ 15kΩ	200Ω ~ 1kΩ		1kΩ ~ 5kΩ	1kΩ ~ 5kΩ	200kΩ ~ ∞
~	1kΩ ~ 5kΩ	∞	∞		∞	∞
~	1kΩ ~ 5kΩ	∞	∞	∞		∞
CHG. M	10kΩ~ 50kΩ	1kΩ ~ 5kΩ	1.5kΩ ~ 7.5kΩ	4kΩ ~ 20kΩ	4kΩ ~ 20kΩ	

(by KAWASAKI TESTER)



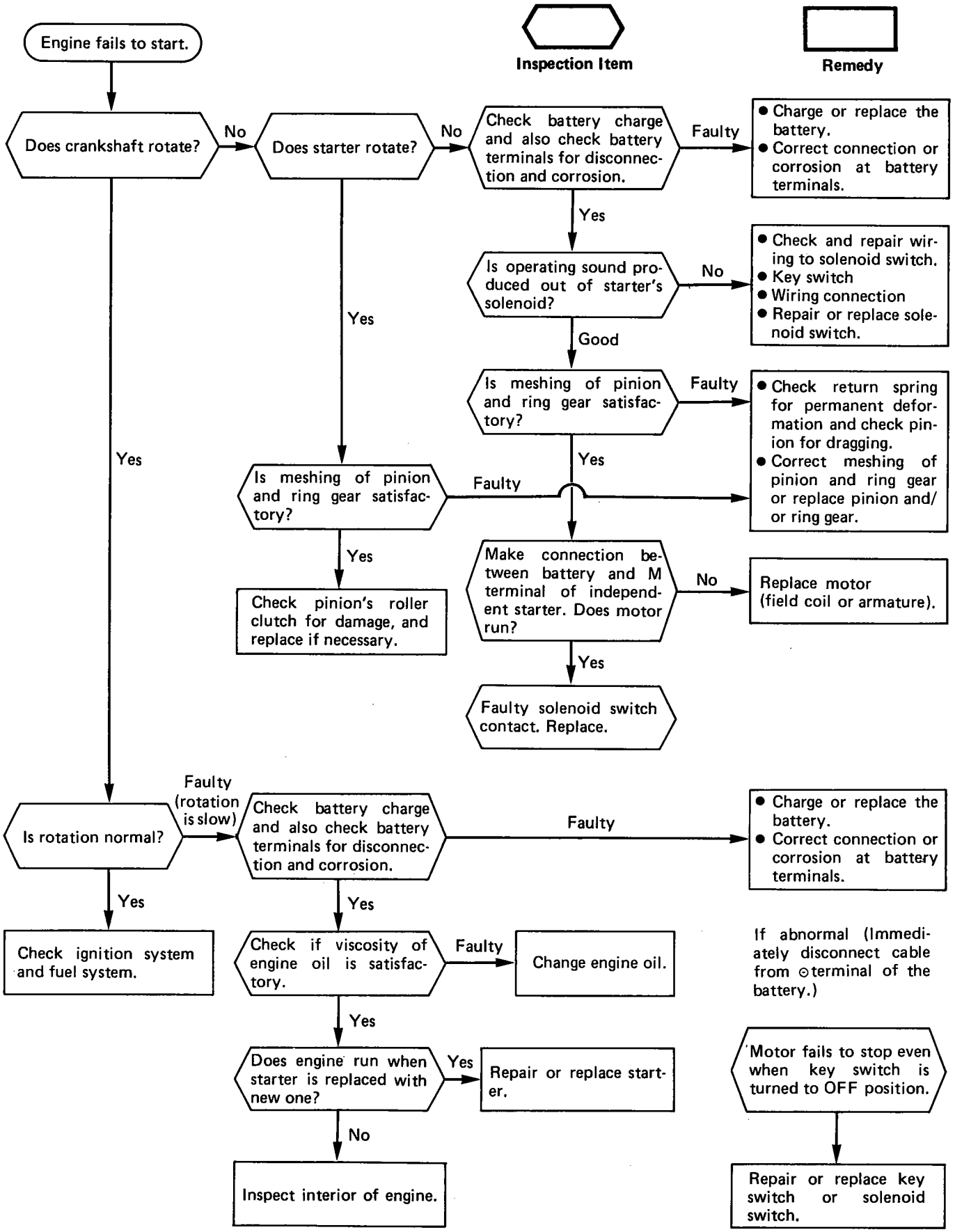
- If resistance is not as specified, replace the regulator.

NOTE: Resistance value may vary with individual meters.

www.mymowerparts.com

For Kawasaki Discount Parts Call 606-678-9623 or 606-561-4983

TROUBLESHOOTING



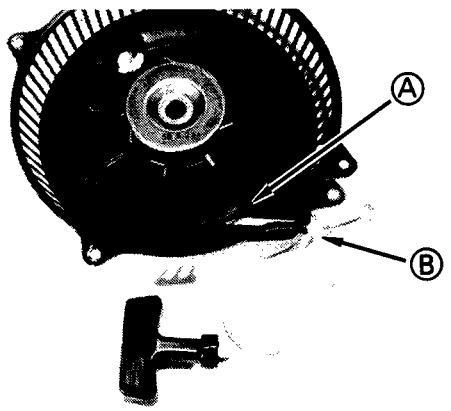
www.mymowerparts.com

For Kawasaki Discount Parts Call 606-678-9623 or 606-561-4983

Section 12
RECOIL STARTER

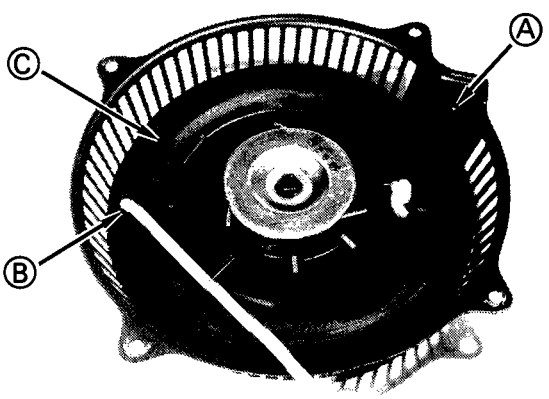
RECOIL STARTER DISASSEMBLY

1. Pull handle out about 10 to 12 inches or until notch (A) in pulley is near rope hole. Hold rope in place with knot (B).

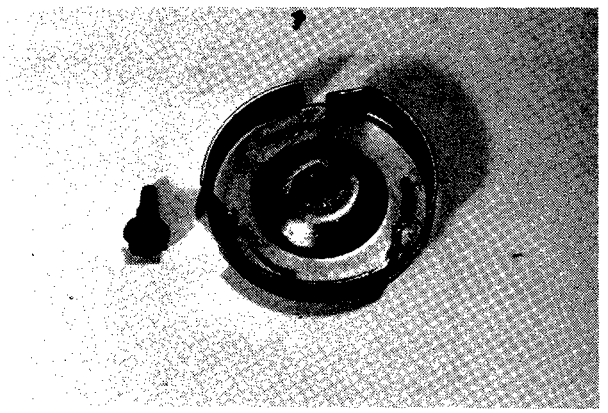


2. Pry knot out of handle and untie it. Pull handle off rope.
3. While carefully holding rotating parts with one hand, untie knot (B) with the other.
4. Pull rope in through rope hole (A) in housing and hold it in notch (B) in reel (C).
5. Allow spring tension slowly to unwind recoil mechanism.

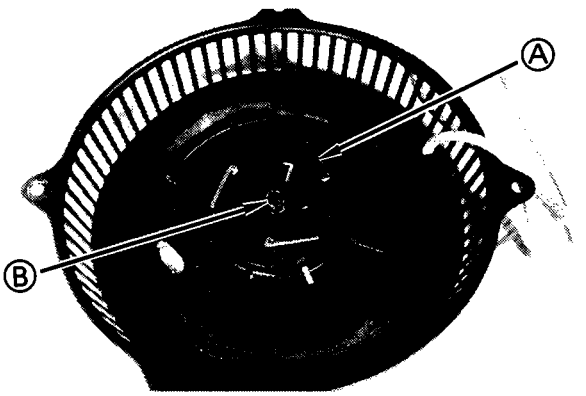
CAUTION: Do not let the rope wedge between the reel and the housing.



6. Remove bolt (A) and ratched cover (B).



7. Remove pawls (A) and spring (B).



8. Remove reel.

⚠ WARNING: Be careful that spring does not fly loose and injure you. It is under great pressure. Turn reel one-quarter turn counterclockwise past the rest position where no tension can be felt. Now, slowly lift reel straight up out of housing.

NOTE: There should be no spring tension on reel when removing reel. If tension is felt, push reel back into place and gently "wiggle" it until reel may be easily removed.

9. If necessary, remove spring.

RECOIL STARTER REASSEMBLY

Assembly is reverse of disassembly.
Note the following points.

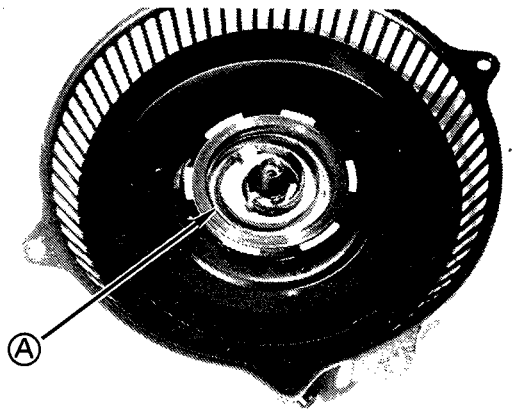
www.mymowerparts.com

For Kawasaki Discount Parts Call 606-678-9623 or 606-561-4983

- If spring was removed, it must be installed as shown. If it is not installed correctly, starter will not operate properly.

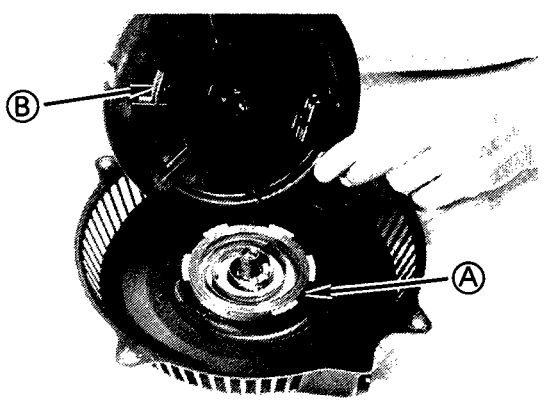
⚠ **WARNING: Spring must be put under great pressure during installation. Wear gloves to avoid injury.**

1. Lightly glease spring (A).

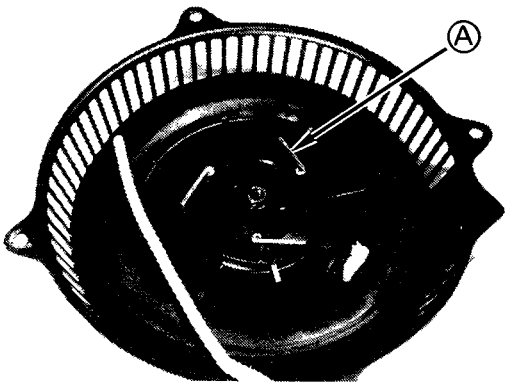


- If rope was unwound from reel, it must be wound clockwise (as shown) for correct starter operation.

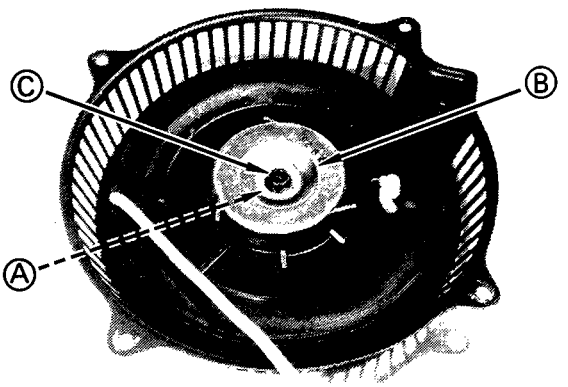
- Set reel into place so that slots (A) on spring case catch on tabs (B) on reel.



- Pawls (A) must be installed as shown for proper starter operation.



- Install coil spring (A), ratched cover (B) and tighten bolt (C).



- Rotate reel three turns counterclockwise to preload the spring.
- Pull rope in through rope hole in housing and install handle.

RECOIL STARTER INSPECTION

- Disassemble recoil starter.
- Immerse only metal parts in a bath of high flash-point solvent.

CAUTION: Do not clean any non-metalic parts in solvent as they may be damaged.

- Use compressed air to dry cleaned components.
- Check starter pawls for chips or excessive wear.
- Check starter rope for excessive wear or fraying.
- Check condition of recoil spring and ratched cover spring.
- Inspect springs for breaks, rust, distortion, or weakened condition.

www.mymowerparts.com

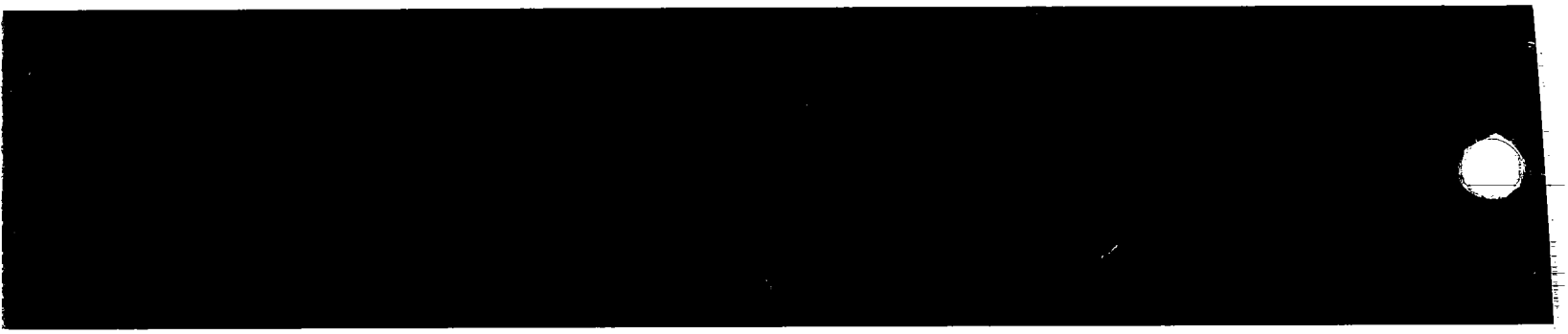
For Kawasaki Discount Parts Call 606-678-9623 or 606-561-4983

www.mymowerparts.com

For Kawasaki Discount Parts Call 606-678-9623 or 606-561-4983

www.mymowerparts.com

For Kawasaki Discount Parts Call 606-678-9623 or 606-561-4983



Kawasaki Motors Corp., U.S.A.
ENGINE DIVISION
P.O. BOX 888285
GRAND RAPIDS, MI 49588-8285

P/N 99924-2011

Printed in U.S.A.
1M-593-APC

www.mymowerparts.com