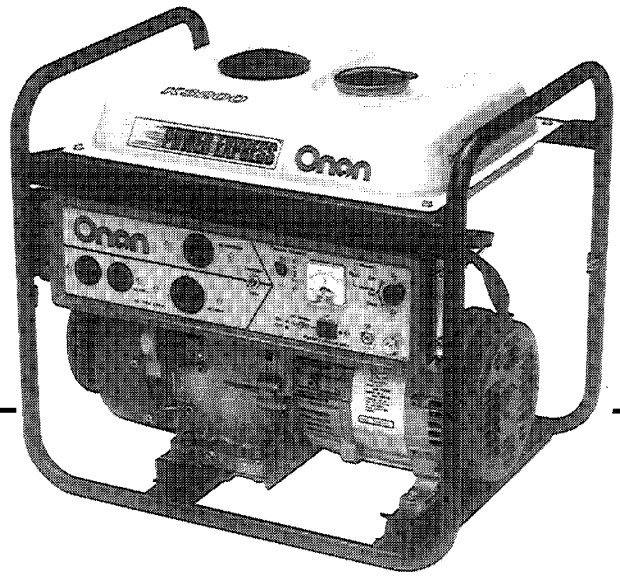
Onan

Service Manual

K3200
K3500

GenSets

- **Portable Generator**



K3200 GenSet
Onan A-0990 C-3881A

981-0509
2-90
Printed in U.S.A.

Safety Precautions

■ USE EXTREME CAUTION NEAR GASOLINE. A CONSTANT POTENTIAL EXPLOSIVE OR FIRE HAZARD EXISTS.

Do not fill fuel tank with hot engine or engine running. Do not smoke or use open flame near the unit or the fuel tank.

Do not store or transport the generator set without first removing the fuel from the fuel tank.

Have a fire extinguisher nearby. Be sure extinguisher is properly maintained and be familiar with its proper use. Extinguishers rated ABC by the NFPA are appropriate for all applications. Consult the local fire department for the correct type of extinguisher for various applications.

■ GUARD AGAINST ELECTRIC SHOCK

Disconnect electric power before removing protective shields or touching electrical equipment. Use rubber insulative mats placed on dry wood platforms over floors that are metal or concrete when around electrical equipment. Do not wear damp clothing (particularly wet shoes) or allow skin surfaces to be damp when handling electrical equipment.

Jewelry is a good conductor of electricity and should be removed when working on electrical equipment.

DO NOT PLUG PORTABLE GENERATOR SET DIRECTLY INTO A HOUSE RECEPTACLE TO PROVIDE EMERGENCY POWER. It is possible for current to flow from generator into the utility line. This creates extreme hazards to anyone working on lines to restore power. Consult an electrician in regard to emergency power use.
Use extreme caution when working on electrical components. High voltages can cause severe injury or death.

Follow all state and local electrical codes. Have all electrical installations performed by a qualified licensed electrician.

■ DO NOT SMOKE WHILE SERVICING BATTERIES

Batteries emit a highly explosive gas that can be ignited by electrical arcing or by smoking.

■ EXHAUST GASES ARE TOXIC

Engine exhaust contains CARBON MONOXIDE, a dangerous gas that is potentially lethal. Avoid carbon monoxide inhalation by operating the generator set outdoors where exhaust gases can be discharged directly into the open air.

Do not operate the generator set in any type of enclosure that could allow exhaust gases to accumulate. Direct exhaust away from areas where people are gathered and away from buildings or enclosures.

■ KEEP THE UNIT AND SURROUNDING AREA CLEAN

Remove all oil deposits. Remove all unnecessary greases and oil from the unit. Accumulated grease and oil can cause overheating and subsequent engine damage and may present a potential fire hazard.

Do NOT store anything on the generator set such as oil cans, oily rags, chains, wooden blocks, etc. A fire could result or operation may be adversely affected. Keep clean and dry.

■ PROTECT AGAINST MOVING PARTS

Avoid moving parts of the unit. Loose jackets, shirts or sleeves should not be worn because of the danger of becoming caught in moving parts.

Make sure all nuts and bolts are secure. Keep power shields and guards in position.

If adjustments must be made while the unit is running, use extreme caution around hot exhaust, moving parts, etc.

Do not work on this equipment when mentally or physically fatigued.

■ FIRE PREVENTION

(1) Always stop the engine before refueling.
- Do not spill fuel.
- Wipe away any spilled gasoline and make sure its residue has evaporated before restarting.
- Do not handle gasoline while smoking.
- Pay careful attention to nearby fires.

(2) Do not place inflammable items (oil, fats, plastics paper, wood etc.) around the generator.
(3) Do not tilt or move a running generator or it may overturn.
(4) Do not operate the generator covered with a tarp or enclosed with box or other object.
(5) Do not operate the generator indoors.
(6) Keep running generators one meter or more away from buildings and other installations.
(7) Do not cover the generator with a tarp after operation until it is cooled.

■ EXHAUST GAS

Because exhaust gas is toxic, special attention must be paid to prevent persons and animals from potential ill effects.
(1) Do not operate the generator in poorly ventilated places such as rooms, warehouses, tunnels, and holds.
(2) Do not use the generator in a poorly ventilated place such as one surrounded by buildings or other objects which can prevent proper dispersion of exhaust gas.
(3) Do not point the exhaust outlets toward persons or houses when the generator is running.

■ HANDLING ELECTRICITY

Electricity is invisible. Lack of care may result in serious accidents. Pay careful attention to the following points.
(1) Do not use the generator in the rain.
The generator and electrical loads will be harmed.
Handling the loads with wet hands is dangerous due to electric shocks.
(2) Do not connect the generator to house wiring, since wiring, loads and generator can be damaged and leaks may occur.

■ OTHER PRECAUTIONS

(1) Throughly read the operating instructions and familiarize yourself with proper operating and handling procedures.
(2) Mount the machine on a level surface.
(3) Stop the engine before checking, servicing, and cleaning.
Do not splash water directly on the generator when washing with water.
(4) If abnormal sounds, odors, or vibrations occur during operation, immediately stop the engine and call your Onan dealer.
(5) Do not touch hot parts, such as a muffler, during and just after operation.
Let the generator become cool before checking and servicing.
(6) Do not operate the generator with its cover removed. Hands or feet may be injured or wire disconnections and other troubles may occur.
(7) Make sure all operators have read the operating instructions and are familiar with all operating, handling, and safety procedures.

TO THE READER

This Workshop Manual has been prepared to provide service personnel with information on the mechanism, service and maintenance of **Onan Generator K3200 and K3500.** It is divided into two parts, "Mechanism" and "Disassembling and Servicing."

■ **Mechanism**

Information on construction and functions are included for each generator section. This part should be understood before proceeding with troubleshooting, disassembling and servicing.

■ **Disassembling and Servicing**

Under the heading "General" comes general precautions, check and maintenance and special tools. For each generator section, there are troubleshooting, servicing, specification lists, checking and adjusting, disassembling and assembling, and servicing which cover procedures, precautions, factory specifications and allowable limits.

All information, illustrations and specifications contained in this manual are based on the latest product information available at the time of publication. The right is reserved to make changes in all information at any time without notice.

Particularly important information is distinguished in this manual by the following notations:

DANGER ⚠ This symbol if used warns of immediate hazards which will result in severe personal injury or death.

WARNING ⚠ This symbol refers to a hazard or unsafe practice which can result in severe personal injury or death.

CAUTION ⚠ This symbol refers to a hazard or unsafe practice which can result in personal injury or product or property damage.

CONTENTS

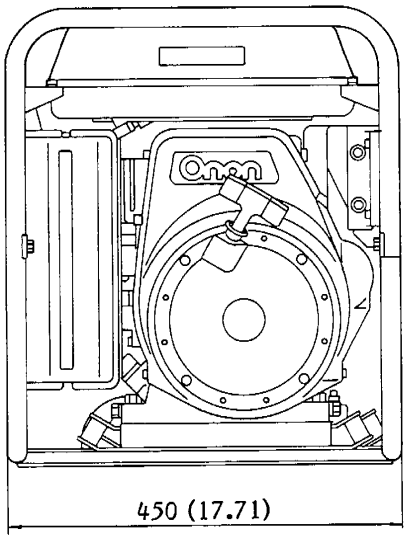
MECHANISM

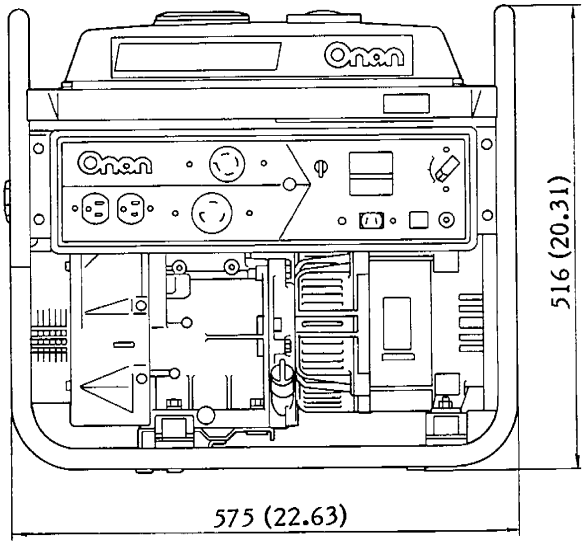
DISASSEMBLING AND SERVICING

SPECIFICATIONS

Item		Unit	K3200	K3500
Dimensions	Overall length	mm (in.)	575 (22.63)	
	Overall width	mm (in.)	450 (17.71)	
	Overall height	mm (in.)	516 (20.31)	
	Dry weight	Kg (lbs.)	60 (132.1)	62 (136.71)
Engine	Type	———	Air-cooled 4-cycle gasoline engine	
	Model	———	GS280-2DG-A3-B4	
	Number of cylinders	———	1	
	Bore x stroke	mm (in.)	73 x 66 (2.87 x 2.60)	
	Total displacement	cc (Cu. in.)	276 (16.84)	
	Rated output	KW, (HP)/rpm	3.31 (4.5)	
	Maximum output	KW, (HP)	5.14 (7.0)	
	Maximum torque	N.m,Kgf.m,ft-lbs/rpm	29.4, 3.0, 21.7/2600	
	Compression ratio	———	6.15	
	Ignition system	———	No contact magneto	
	Spark plug	———	BPR4HS (NGK), W14FR-U (Denso)	
	Carburetor	———	Horizontal type, butterfly valve	
	Air cleaner	———	Semi - Dry type	
	Governor	———	Centrifugal flywheel type	
	Starting system	———	Recoil starter	
	Engine stop type	———	Shorting ignition primary	
	Lubricating system	———	Splash type	
	Engine oil type	———	API SE, SF class (Refer to S-3)	
	Engine oil capacity	l(U.S.qts, Imp.qts)	0.9 (0.95, 0.79)	
	Fuel type	———	Regular automobile gasoline	
	Fuel tank capacity	l(U.S.qts, Imp.qts)	12.8 (13.52, 11.23)	
	Capacity in rated output	Hr	Approx. 6.5	Approx.6.0
Generator unit	Generating system	———	Rating-field type	
	Excitation	———	Static self-exciting	
	Voltage regulation system	———	Automatic	
	Number of phase	Phase	1	
	Frequency	Hz	60	
	Maximum output	KVA	3.2	3.5
	Rated output	KVA	2.5	3.0
	Efficiency	%	77	
	AC output	V	120/240	
	AC rated current	A	20.8/10.4	25/12.5
	DC output	W	120	
	DC voltage x current	V x A	12 x 10	
	Power factor	%	100	
	Overcurrent protection	———	AC Circuit breaker, DC circuit protector	
	AC breaker capacity	A	11.5	14
	DC protector capacity	A	20	
	Indicator	———	Pilot lamp (standard), V-F indictor (X type)	
	Insulation class	———	B	

DIMENSIONS



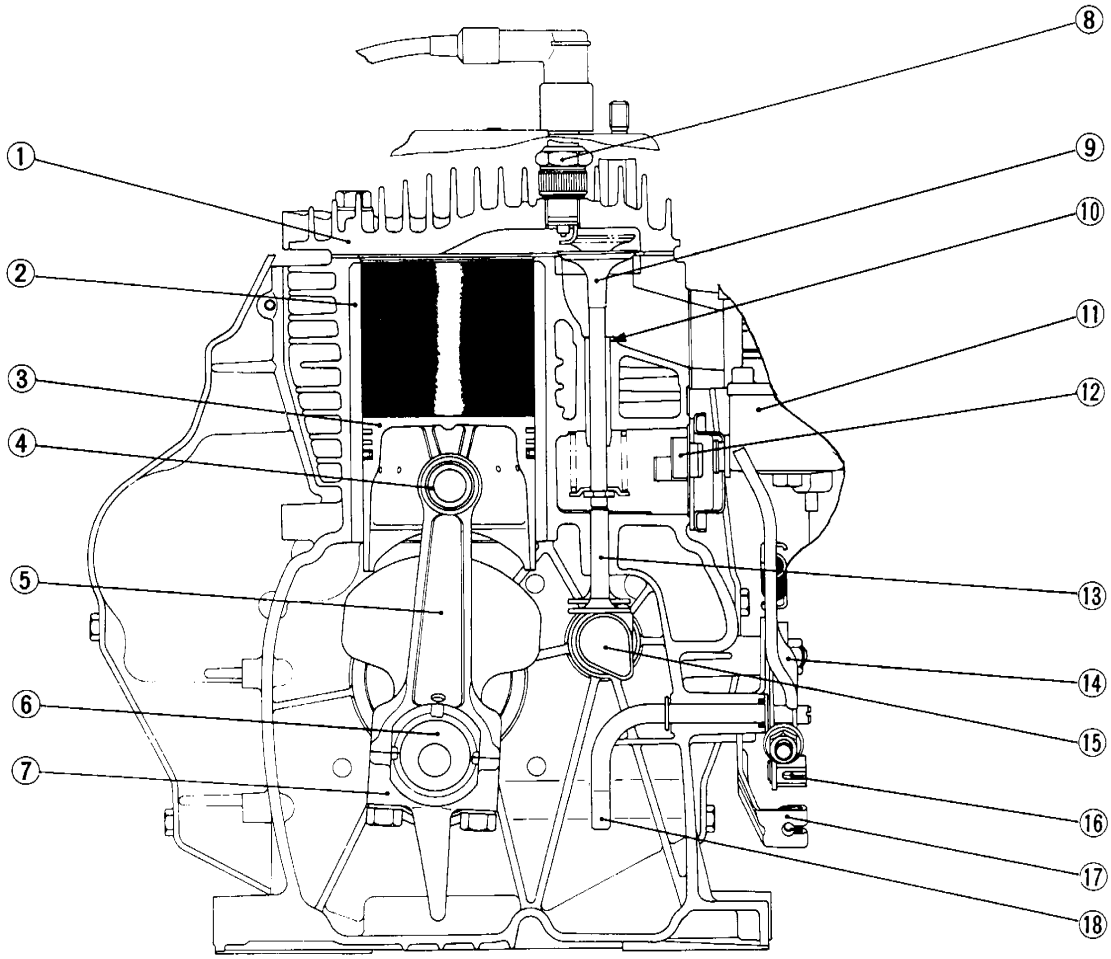


Unit: mm (in.)

MECHANISM

ENGINE

[1] FEATURE



0603F013

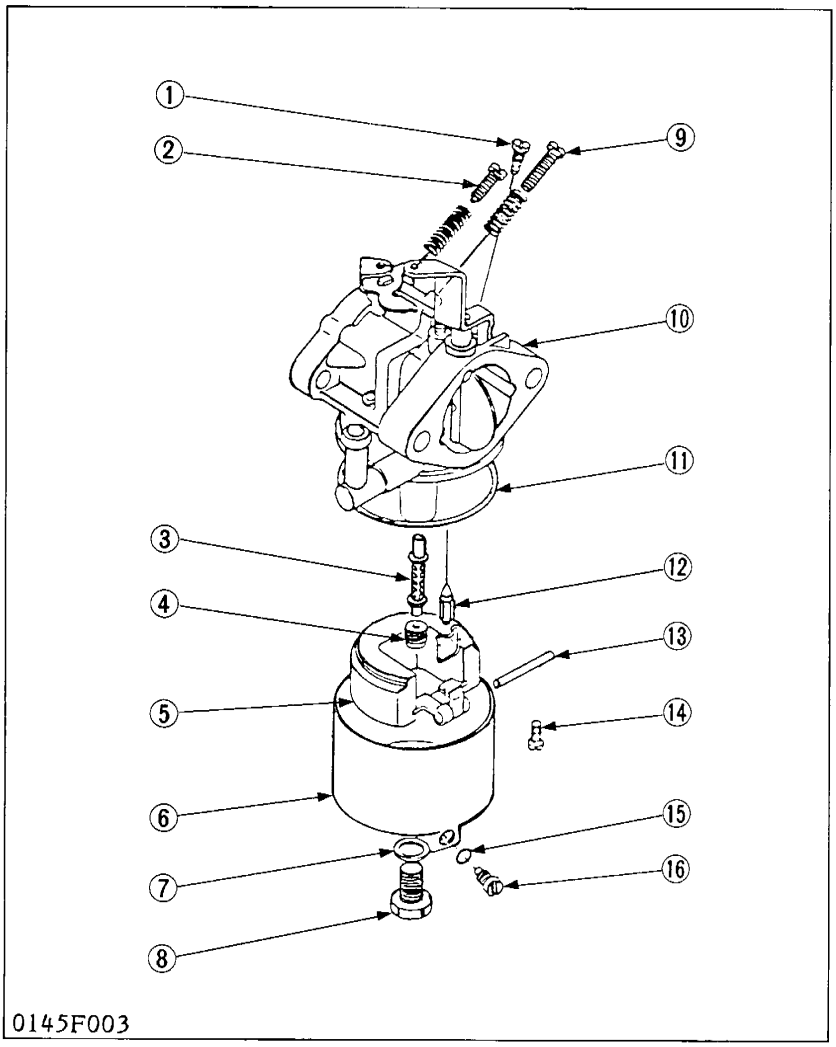
(1) Cylinder Head
(2) Cylinder Liner
(3) Piston
(4) Piston Pin
(5) Connecting Rod
(6) Crankshaft
(7) Connecting Rod Cap
(8) Spark Plug
(9) Valve
(10) Valve Guide
(11) Carburetor
(12) Breather
(13) Tappet
(14) Governor Lever
(15) Camshaft
(16) Speed Control Lever
(17) Speed Control Plate
(18) Governor Lever Shaft

The GS280 is a forced air-cooled, 4-cycle single-cylinder, side-valve gasoline engine.

This electronic engine incorporates a maintenance-free, transistor-controlled, pointless ignition system.

[2] FUEL SYSTEM

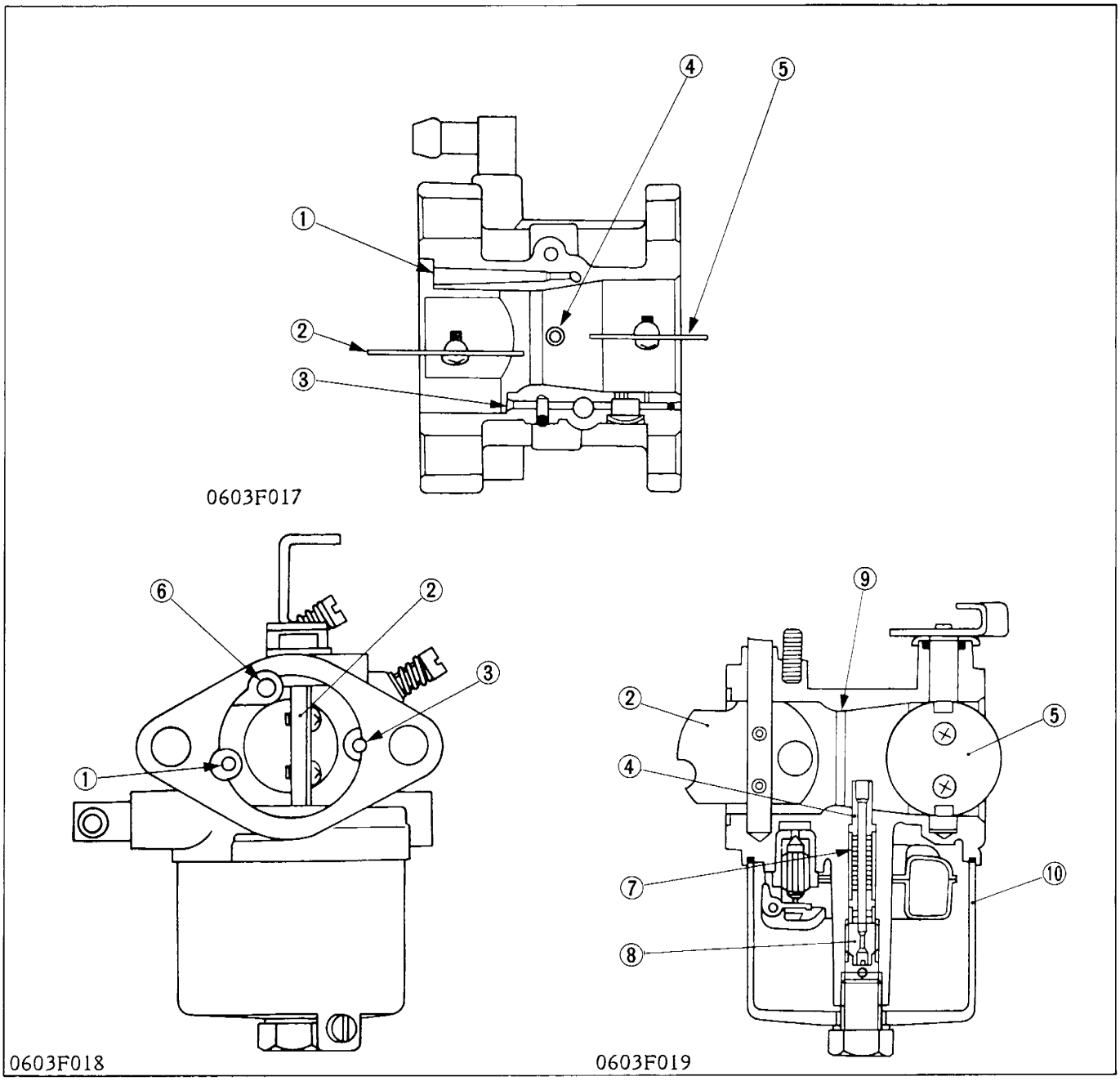
(1) Carburetor



(1) Pilot Jet
(2) Pilot Screw
(3) Main Nozzle
(4) Main Jet
(5) Float
(6) Float Chamber
(7) Gasket
(8) Float Chamber Mounting Screw
(9) Throttle Stopper Adjusting Screw
(10) Carburetor Body
(11) Seal Ring
(12) Needle Valve
(13) Float Pin
(14) Screw
(15) O-ring
(16) Drain Screw

The carburetor atomizes gasoline to be mixed with air and then supplies the air-fuel mixture to the cylinder.

■ Main Circuit



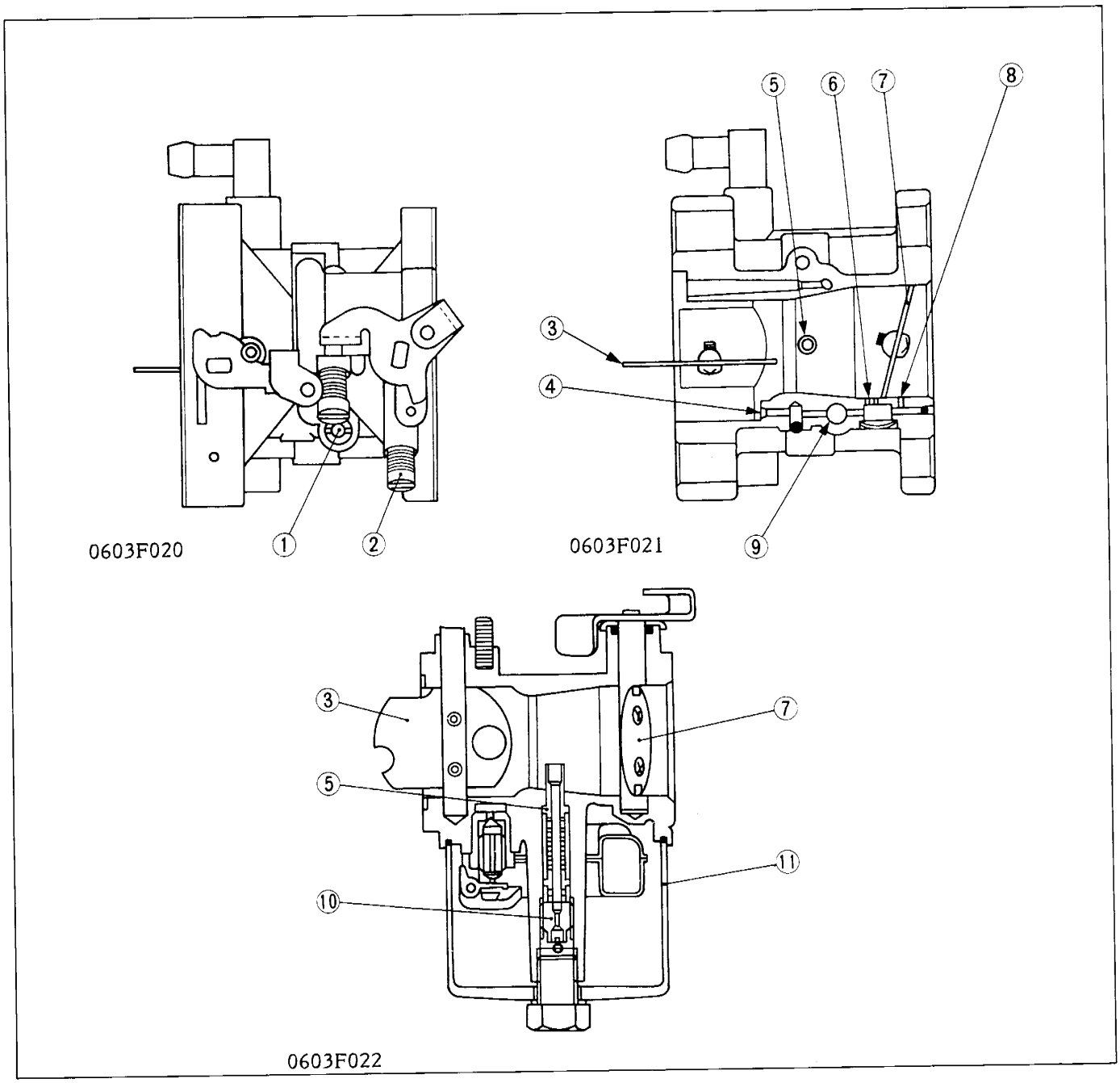
(1) Main Air Jet
(2) Choke Valve
(3) Pilot Air Jet
(4) Main Nozzle
(5) Throttle Valve
(6) Air Vent
(7) Bleeder Hole
(8) Main Jet
(9) Venturi
(10) Float Chamber

When the engine starts and the throttle valve (5) is opened, enough air is moving through the carburetor air horn to produce an appreciable vacuum in the venturi (9).

Since the air flows into the float chamber (10) through the air vent (6), the air pressure pushes gasoline in the float chamber out into the main nozzle (4) via the main jet (8).

As the air flows past the main air jet (1), it meets gasoline moving through the bleeder hole (7). They mix and flow past the main nozzle. This mixture has a high proportion of gasoline. It leans out as it mixes with other air flowing through the air horn to produce the final mixture.

■ Slow Circuit



(1) Pilot Jet
(2) Pilot Screw
(3) Choke Valve
(4) Pilot Air Jet
(5) Main Nozzle
(6) Bypass
(7) Throttle Valve
(8) Pilot Outlet
(9) Passage
(10) Main Jet
(11) Float Chamber

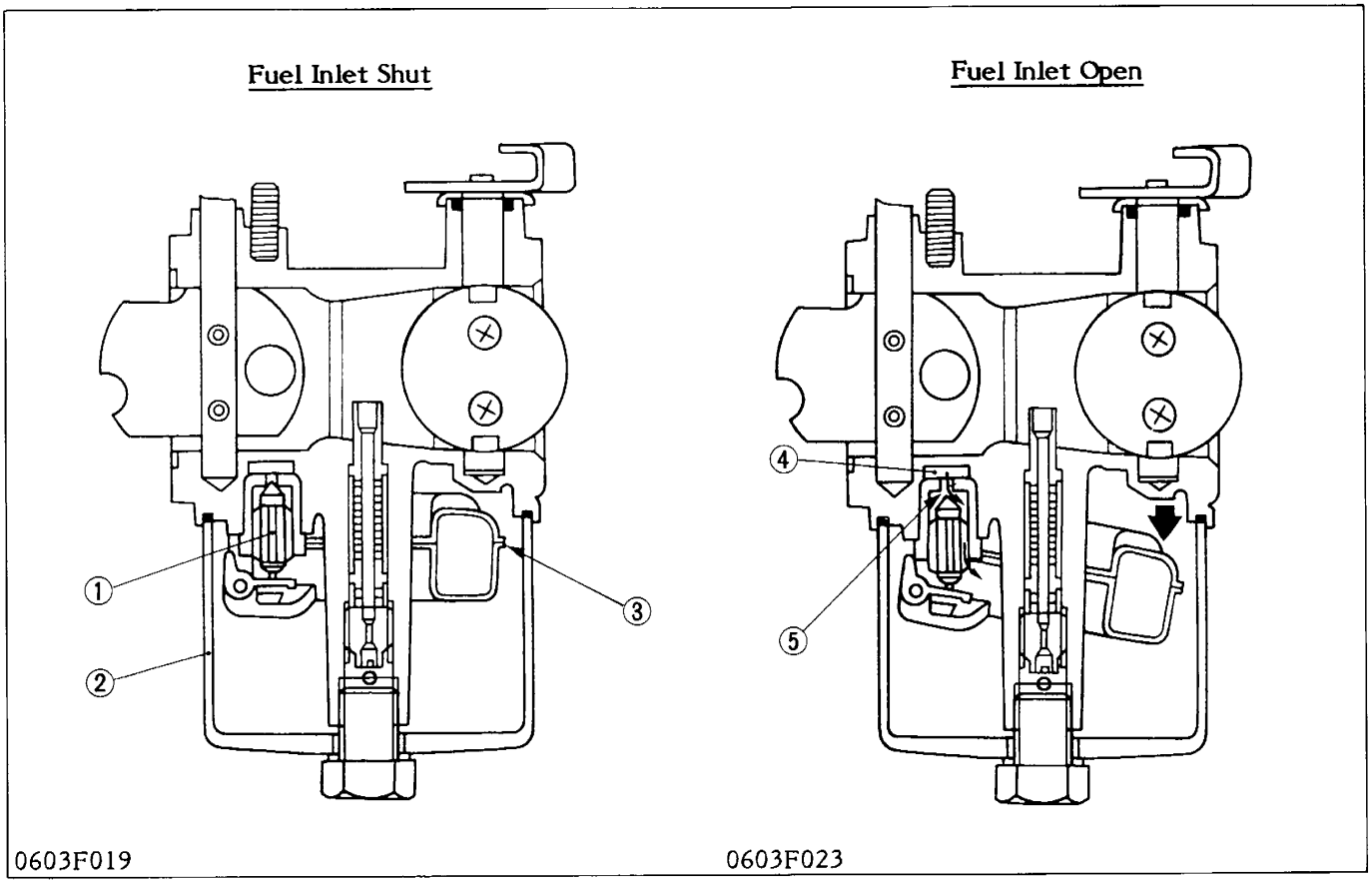
When the throttle valve (7) is closed, a vacuum is produced in the pilot outlet (8) and the bypass (6). Under this condition, gasoline in the float chamber (11) is pushed out, flowing through the main jet (10) into the passage (9).

The pilot jet (1) meters the gasoline as it passes through it. The metered gasoline then meets air that enters via the pilot air jet (4). They mix, and flow past the bypass and pilot outlet into the carburetor air horn.

This mixture also has a high proportion of gasoline. As the mixture discharges into the air horn, it mixes with other air moving through the air horn, thereby producing the final mixture for slow speed operation.

The slow speed of the engine is controlled by changing the jet area with the pilot screw (2).

■ Float Chamber



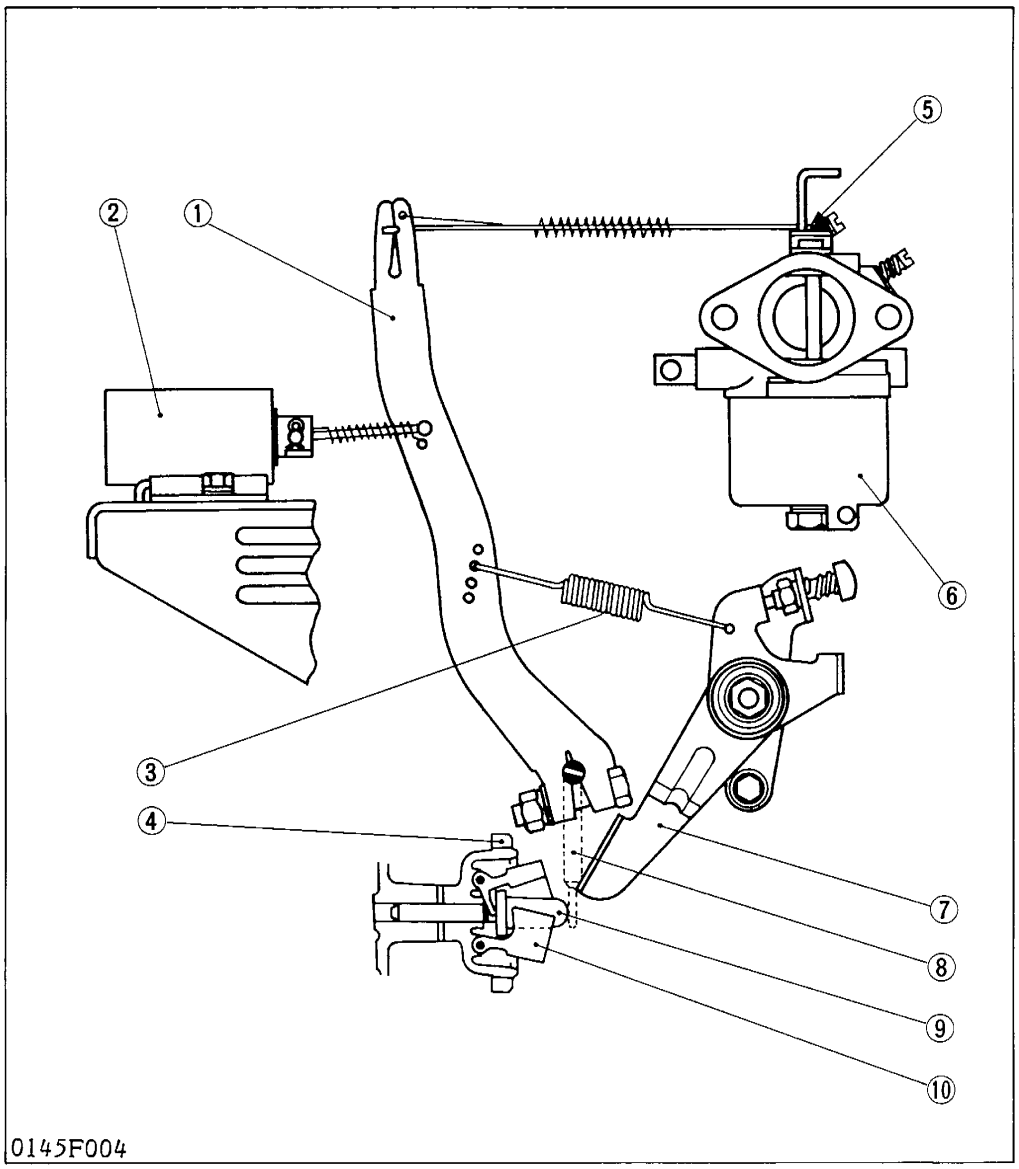
(1) Needle Valve
(2) Float Chamber
(3) Float
(4) Fuel Passage
(5) Fuel Inlet

The gasoline from the fuel tank flows past the fuel passage (4) and needle valve (1) into the float chamber (2). The float (3) then moves up and pushes up the needle valve. This shuts the fuel inlet (5) so that no gasoline can enter.

When the fuel level is lowered, the float moves down, and the needle valve moves down to open the fuel inlet.

Repetition of this sequence of events assures a constant level.

(2) Governor



(1) Governor Lever
(2) Auto Idler Solenoid
(3) Governor Spring
(4) Governor Gear
(5) Throttle Lever
(6) Carburetor Body
(7) Speed Control Lever
(8) Governor Lever Shaft
(9) Governor Sleeve
(10) Governor Weight

The engine is equipped with a centrifugal governor which activates the throttle in response to engine speed.

When the engine is carrying a load and running at rated speed, the speed will drop if the load is increased even slightly. In this case, the governor automatically opens the throttle valve of the carburetor to maintain the original speed.

Dumping the load suddenly will cause a rapid increase in speed. In this case, the governor automatically moves the throttle valve in closing direction to prevent the engine from increasing its speed.

■ When engine is carrying a load and running at rated speed

When there is no change in load, the centrifugal force of the governor weight (10) which is attached to the governor gear (4) balances with the tensile force of the governor spring (3) via governor sleeve (9), governor lever shaft (8) and governor lever (1). The engine speed and output are thus kept constant.

■ When load is applied to engine

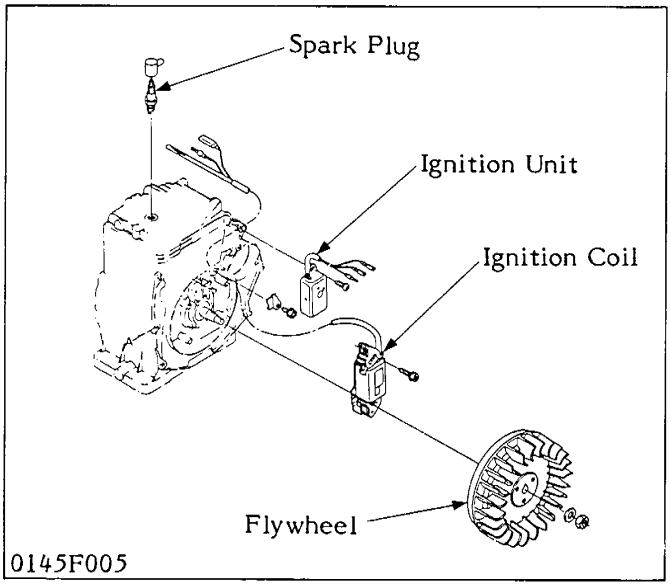
When the load is applied to the engine running at rated speed, the speed of the governor gear (4) which is connected to the cam gear decreases. As a result, the centrifugal force of the governor weight (10) becomes smaller. The tensile force of the spring (3) overcomes the centrifugal force and the governor lever (1) causes the throttle lever (5) to move in the open direction. The original engine speed is thus maintained.

■ When load is dumped

When the load is dumped suddenly, the centrifugal force of the governor weight (10) overcomes the tensile force of the spring (3). As a result, the governor lever (1) causes the throttle lever (5) to move in the shut direction and prevents the engine from increasing its speed.

[3] IGNITION SYSTEM

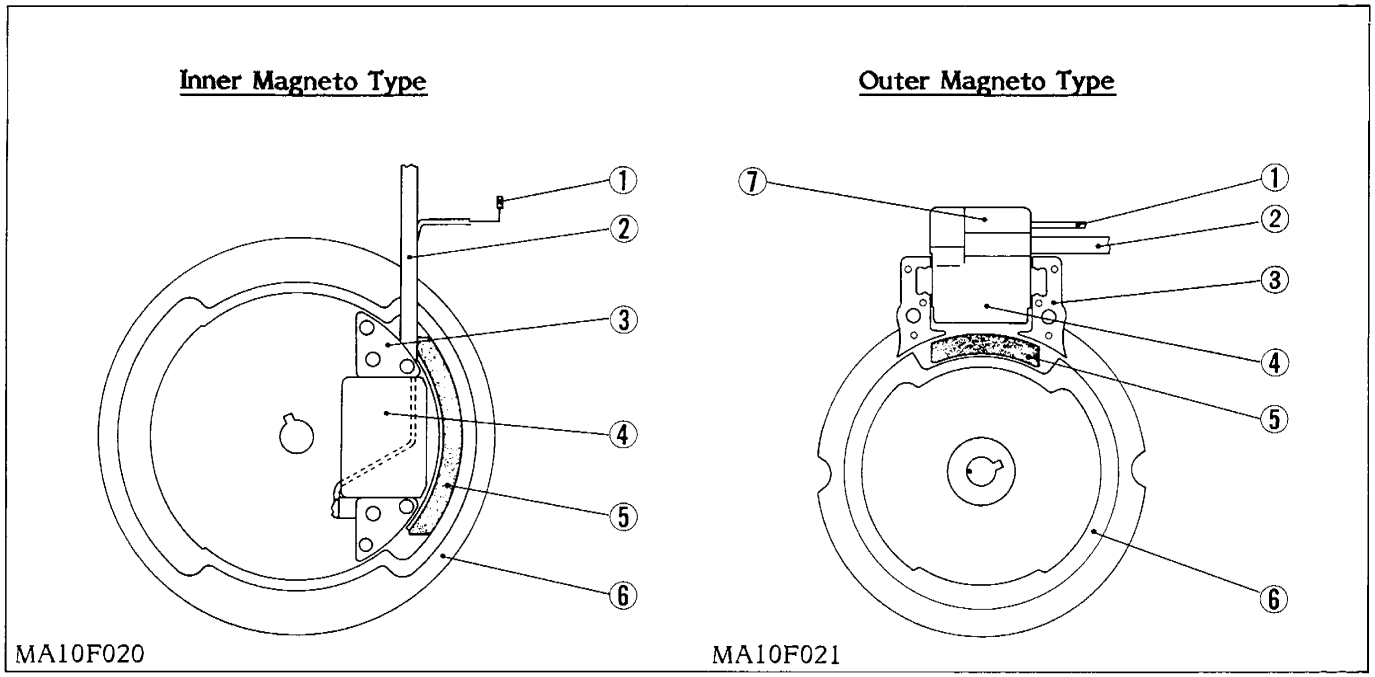
(1) Magnet Ignition System



The magnet ignition system consists of the flywheel, ignition unit, ignition coil, spark plug and stop switch.

A permanent magnet is attached to the flywheel which also serves as a cooling fan. The magnet induces an electromotive force in the ignition coil.

■ Magnet



(1) Primary Coil Terminal
(2) Secondary Coil Terminal (High Voltage Cord)
(3) Core
(4) Primary and Secondary Coil
(5) Permanent Magnet
(6) Flywheel
(7) Ignition Timing Pickup

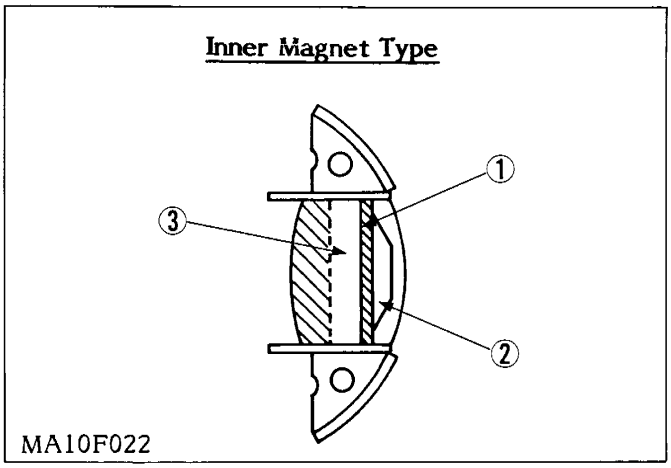
There are two types of magnet ignition systems. One is the inner magnet type, the other is the outer magnet type.

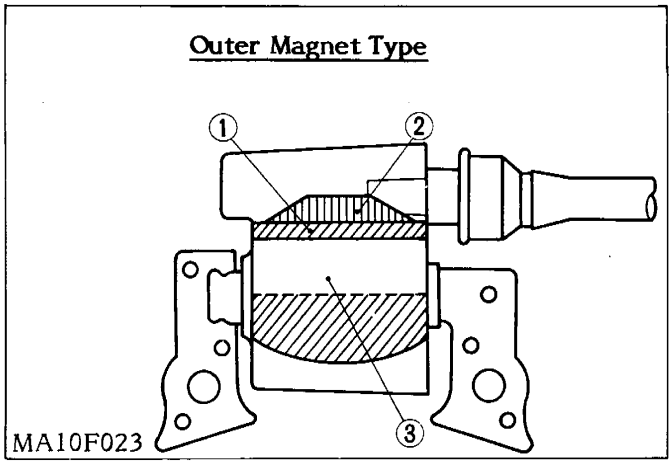
In the inner magnet type, a permanent magnet is attached along the internal periphery of the flywheel to induce high voltage in the ignition coil which is fixed inside.

In the outer magnet type, a permanent magnet is attached along the external periphery of the flywheel to induce high voltage in the ignition unit which is fixed outside.

The GS280 gasoline engine is equipped with the inner magnet ignition type.

■ Ignition Coil





(1) Primary Coil
(2) Secondary Coil
(3) Core

The ignition coil induces a high voltage, which is applied to the spark plug to produce a spark. A sudden current change in the primary coil generates a high voltage in the secondary coil due to mutual induction.

The figure at left shows the construction of an ignition coil. The core (3) at the center is laminated with thin silicon steel, around which the primary coil (1) and secondary coil (2) are wound in several layers. In such an ignition coil, the potential in the secondary coil becomes higher at the higher layer. Therefore the coil winding width is narrower on the higher layer to prevent high voltage from leaking to the core. Insulation paper is inserted between the two coils and between the layers of each winding. The coil is wrapped in cloth tape and treated by a varnish immersion process or polyester forming for insulation.

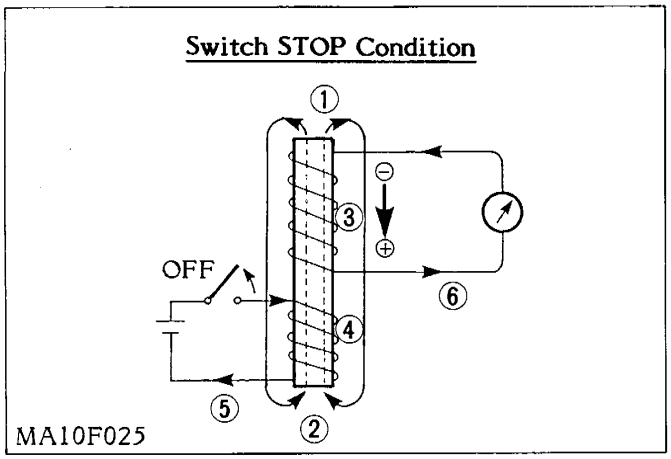
■ Ignition Control Circuit

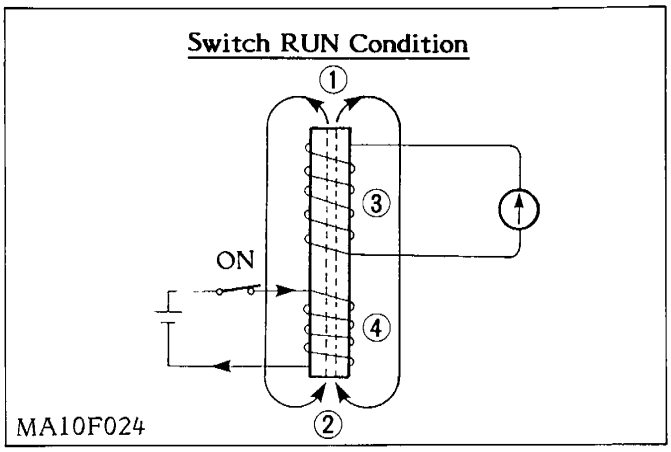
The ignition timing is indicated (to shut off the primary current) by a contactless, transistor control. The switch **ON** and **OFF** of the primary coil for generating a self-induced electromotive force are controlled by a transistor which has excellent switching characteristics.

The advantages of a transistor magnet can be summarized as follows.

1. Since it does not include contact points, it is free of trouble caused by water, dust or rust. It thus reduces engine malfunctions.
2. Since it does not have wearing parts, it does not require adjustment once it is installed accurately.
3. The secondary voltage is high enough to ignite the spark plug accurately. It starts the engine more easily and can maintain a stable engine at a low speed.
4. Since the circuit is molded in resin, it withstands water or vibration, thus reducing engine malfunctions.

(2) High Voltage Generation Principle





The primary coil (4) which is connected to the power source and secondary coil (3) are wound around the same magnetic substance (core).

When the primary coil circuit is opened;

- An electromotive force is generated in the primary coil in the direction in which it tends to prevent the magnetic field from changing. This phenomenon is called self-induction.
- The change in the magnetic field in the primary coil, in turn, generates another electromotive force in the secondary coil which is also wound around the core. This phenomenon is called mutual induction.

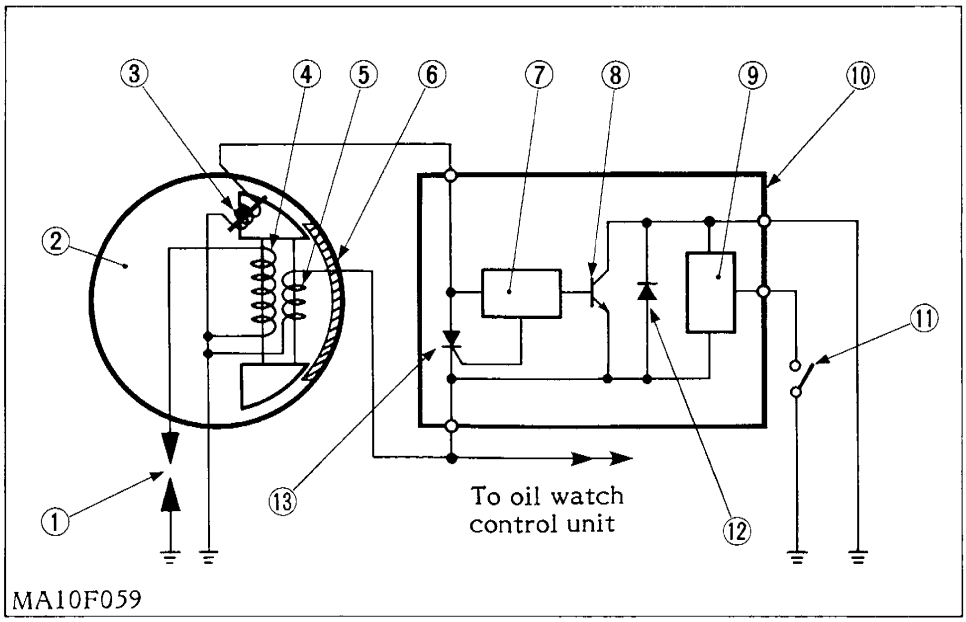
The voltage generated in the secondary coil is greater than the primary coil voltage. The electromotive force generated in the secondary coil is proportional to the turn ratio (the turns of the primary coil/the turns of the secondary coil). The ignition coil of the ignition system combines those inductions to generate high voltage and thus ignites the spark plug which is located at the tip of the secondary coil.

The transistor magnet has turn ratios ranging from 1:200 to 1:400. A 20 to 30 kV voltage is generated in the secondary coil.

(1) **N** Field
(2) **S** Field
(3) Secondary Coil
(4) Primary Coil
(5) Self-induced Electromotive Force
(6) Mutually Induced Electromotive Force

(3) Transistor Magnet Ignition Principle

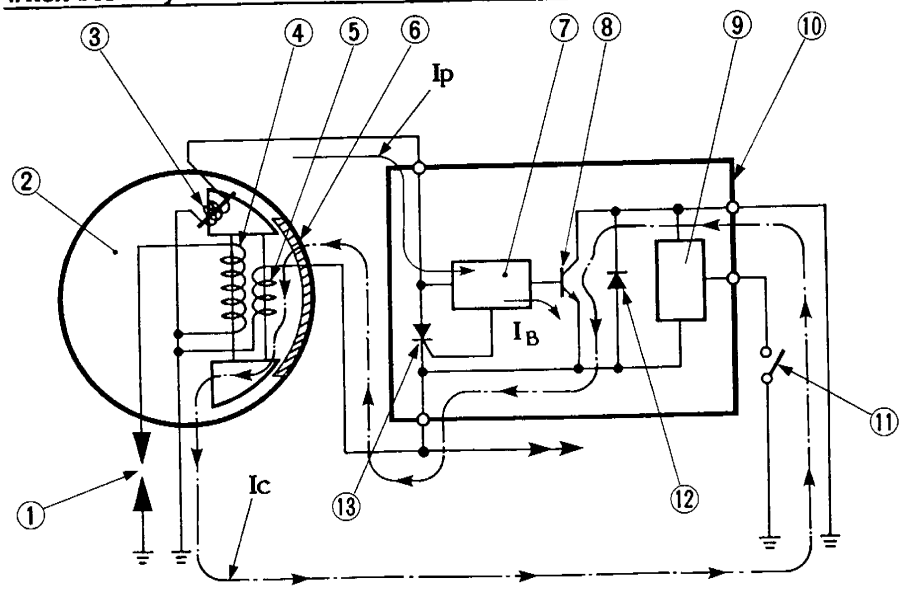
■ Ignition Circuit



(1) Spark Plug
(2) Flywheel
(3) Pickup Coil
(4) Secondary Coil
(5) Primary Coil
(6) Permanent Magnet
(7) Ignition Controller
(8) Power Transistor
(9) Engine Stop Controller
(10) Ignition Control Unit
(11) Stop Switch
(12) Diode
(13) SCR

■ Circuit Operation

When Primary Current Flows in Primary Coil



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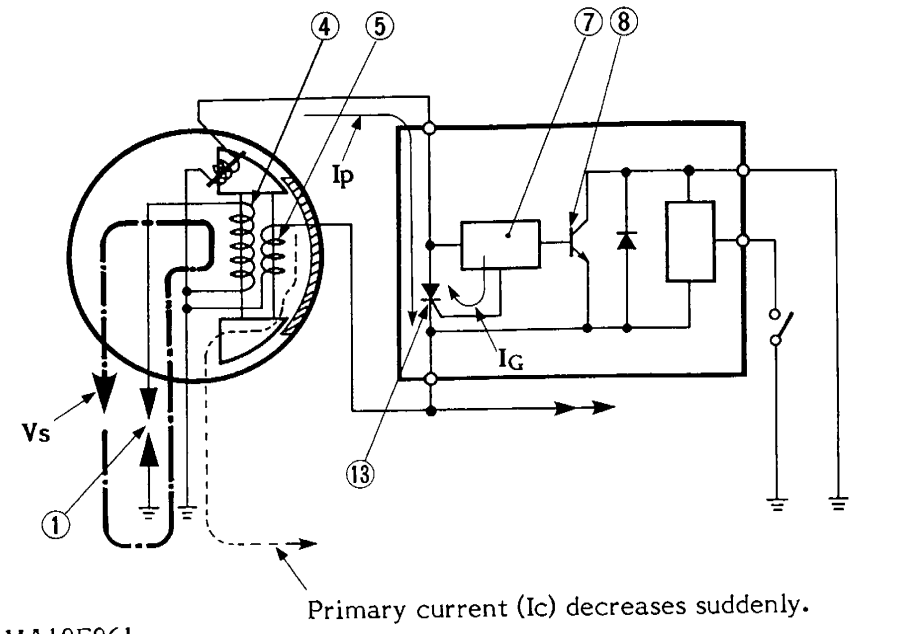
(1) Spark Plug
(2) Flywheel
(3) Pickup Coil
(4) Secondary Coil
(5) Primary Coil
(6) Permanent Magnet
(7) Ignition Controller
(8) Power Transistor
(9) Engine Stop Controller
(10) Ignition Control Unit
(11) Stop Switch
(12) Diode
(13) SCR

When Spark Is Discharged from Spark Plug



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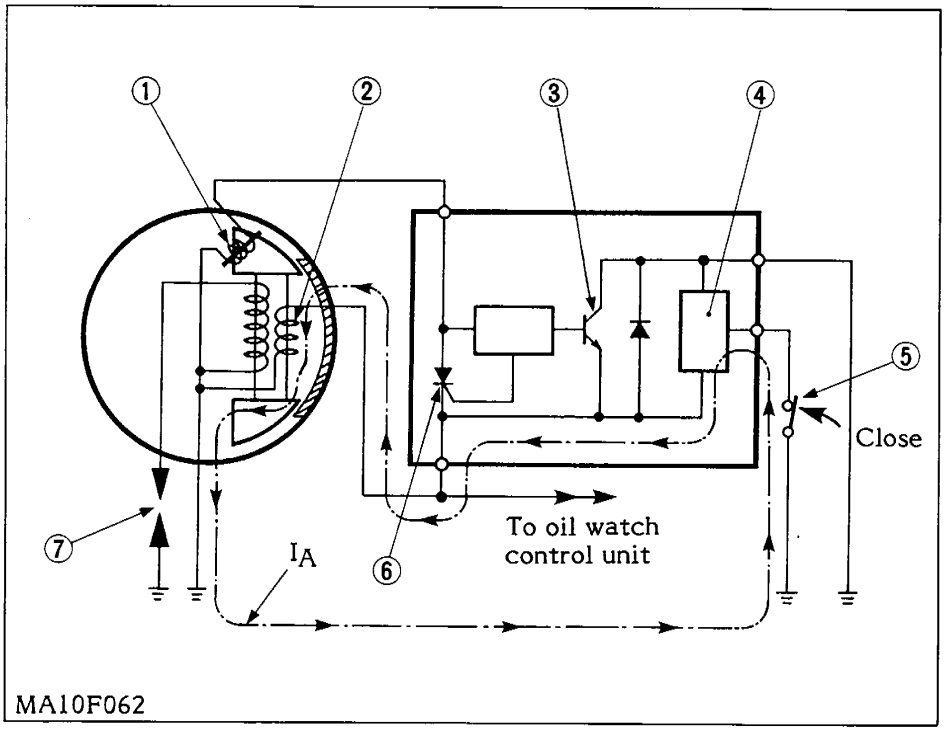
Each time the flywheel (2) makes a full turn, an electromotive force is induced in the primary coil (5) and the pickup coil (3).

1. At the initial stage, when the electromotive force is induced in the pickup coil and the primary coil by the magnet force of the permanent magnet (6), the current (Ip) created in the pickup coil forms the base current (I_B) for the power transistor (8) and turns on the power transistor (8).
2. The current (Ic) induced in the primary coil is allowed to flow into the circuit. (Refer to the first figure above.)
3. As the permanent magnet moves further to reach the preset spark discharge timing, the current (Ip) that formed the base current (I_B) then forms the gate current (I_G) for SCR (13) inside the ignition controller (7).
4. At this time, the current (Ip) is allowed to flow into the SCR to turn off the power transistor (8).
5. Then, a high voltage (Vs) is induced in the secondary coil (4) when the current (Ic) flowing into the primary coil (5) is suddenly decreased. A spark is then discharged from the spark plug (1). (Refer to the second figure above.)

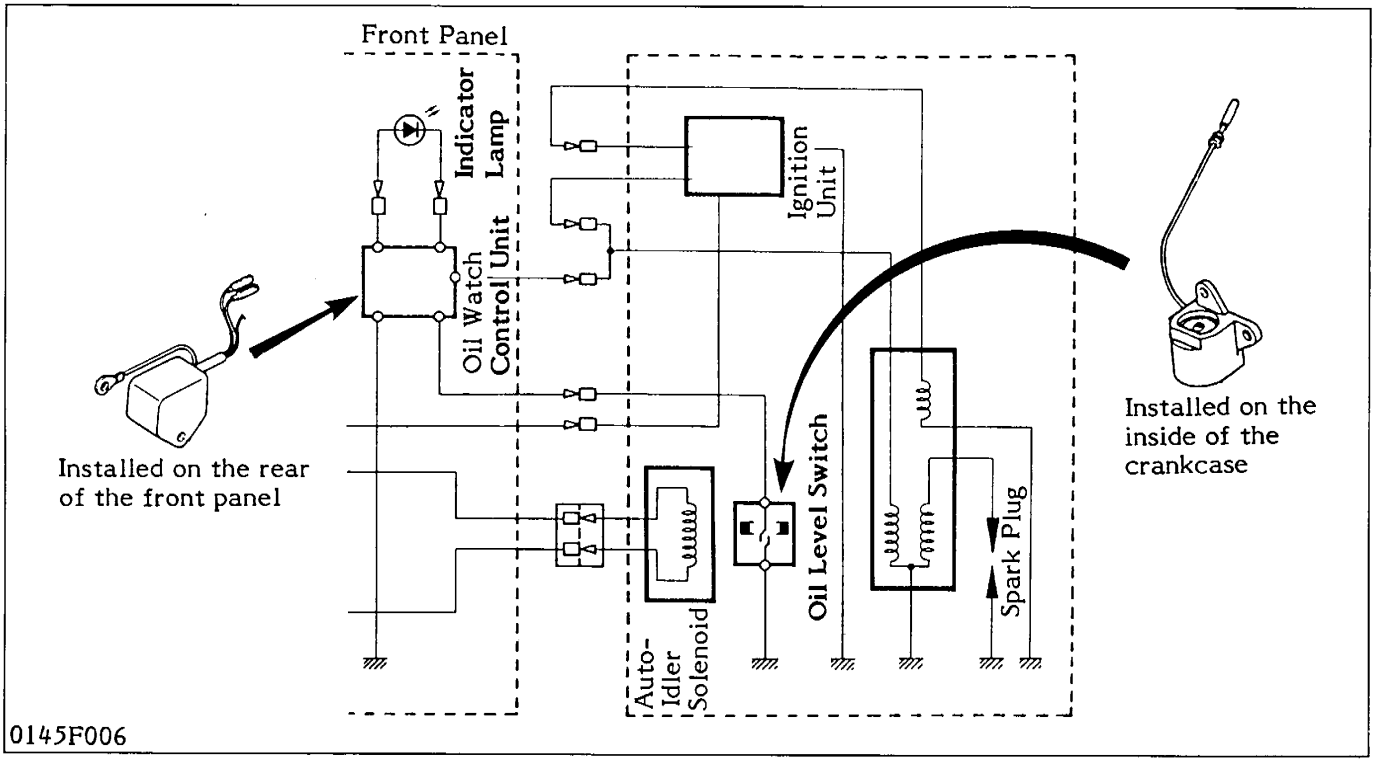
(4) Engine Stop Principle

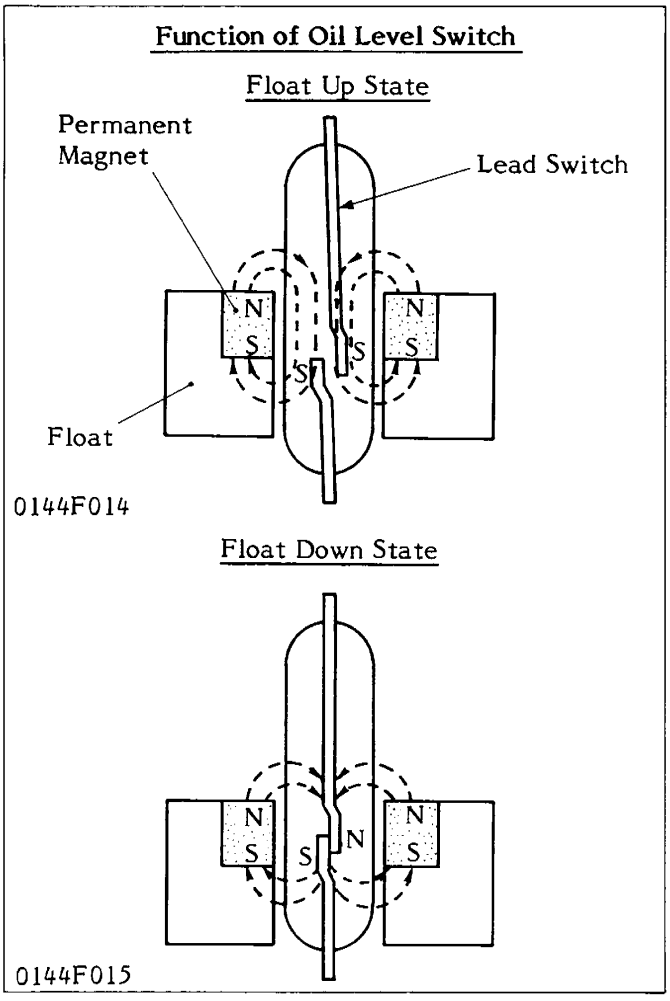


(1) Pickup Coil
(2) Primary Coil
(3) Power Transistor
(4) Engine Stop Controller
(5) Engine Stop Switch
(6) SCR
(7) Spark Plug

1. When the stop switch (5) is turned to the close position, the primary current (I_A) is allowed to flow through the circuit formed by the stop switch (5), the engine stop controller (4) and the primary coil (2). The primary circuit is kept closed so long as the stop switch (5) remains closed.
2. In this condition, the current (I_A) flowing through the primary coil (2) remains stable, even if the condition of the power transistor (3) or the SCR (6) is changed by a signal from the pickup coil (1). The spark plug (7) cannot discharge a spark, thus preventing the engine from operating.
3. The engine is stopped when the oil watch switch is closed and then the primary coil is short-circuited even if the engine is running with the engine stop switch (5) in the "open" position. (Refer to page M-12.)

[4] OIL WATCH SYSTEM





The oil watch system automatically stops the engine when the engine oil level drops below the specified level.

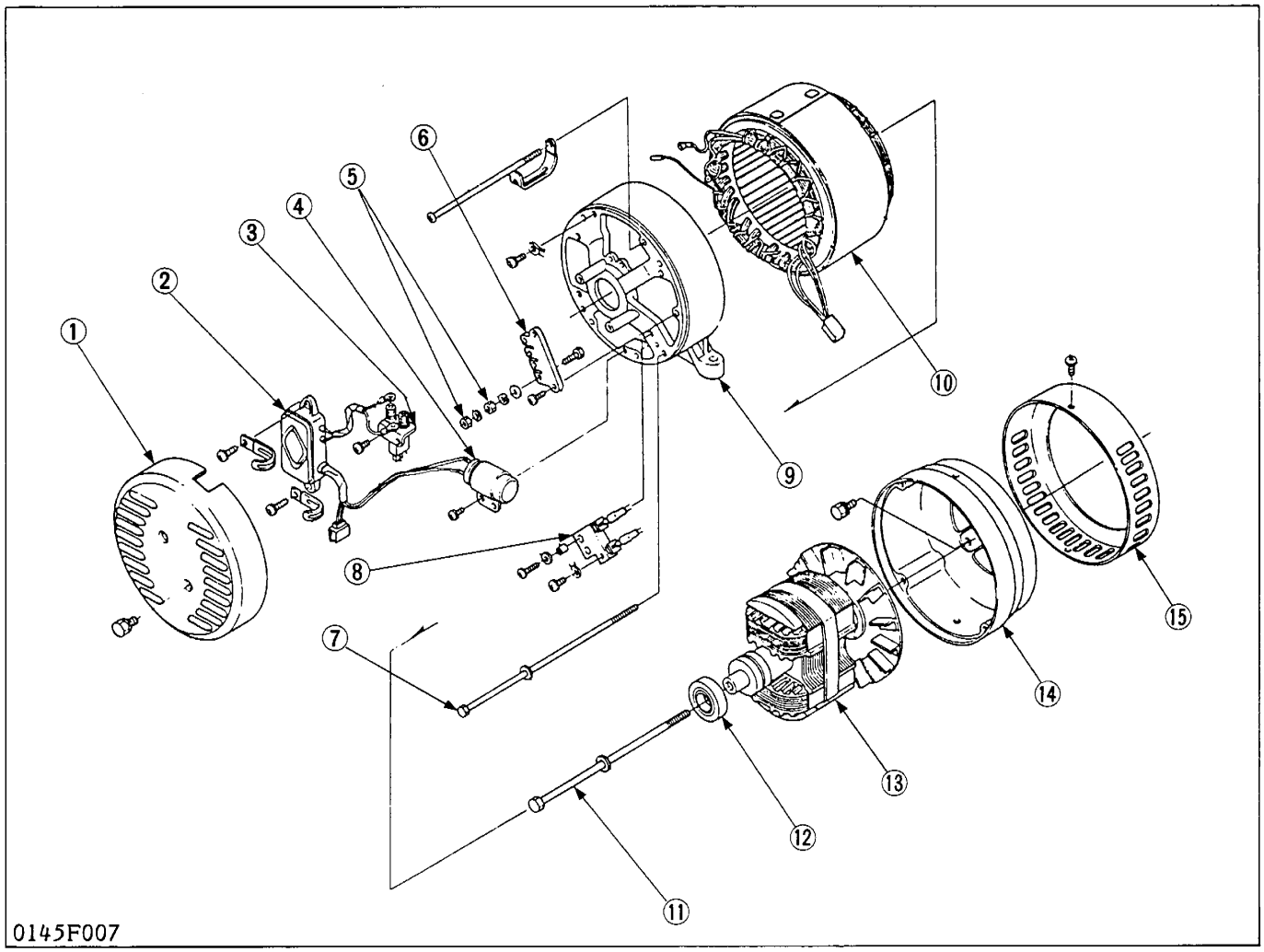
It consists of a control unit, oil level switch, indicator lamp and wiring cables.

The oil-watch system provides the following functions.

1. The oil level switch has a lead switch in the center surrounded with a float which moves up and down as the oil level rises and falls. A permanent magnet insert is embedded in the float. When the oil level is equal to or above the specified level, the magnetic force of the permanent magnet insert magnetizes the contact points of the lead switch and opens the switch.
2. When the oil level falls below the specified level, the contact points differ in polarity and close the switch. As the lead switch closes in this way, the control unit closes the shunt circuit, grounding the induced voltage in the primary coil, thus stopping the engine.

GENERATOR UNIT

[1] GENERATOR COMPONENTS



(1) Clear Cover
(2) A.V.R.
(3) Brush Holder
(4) Capacitor
(5) Terminal Nut
(5) Terminal Nut
(7) Stator Mounting Screw
(8) Diode Stack
(9) Rear Bracket
(10) Stator
(11) Rotor Mounting Screw
(12) Bearing
(13) Rotor
(14) Front Bracket
(15) Fan Cover

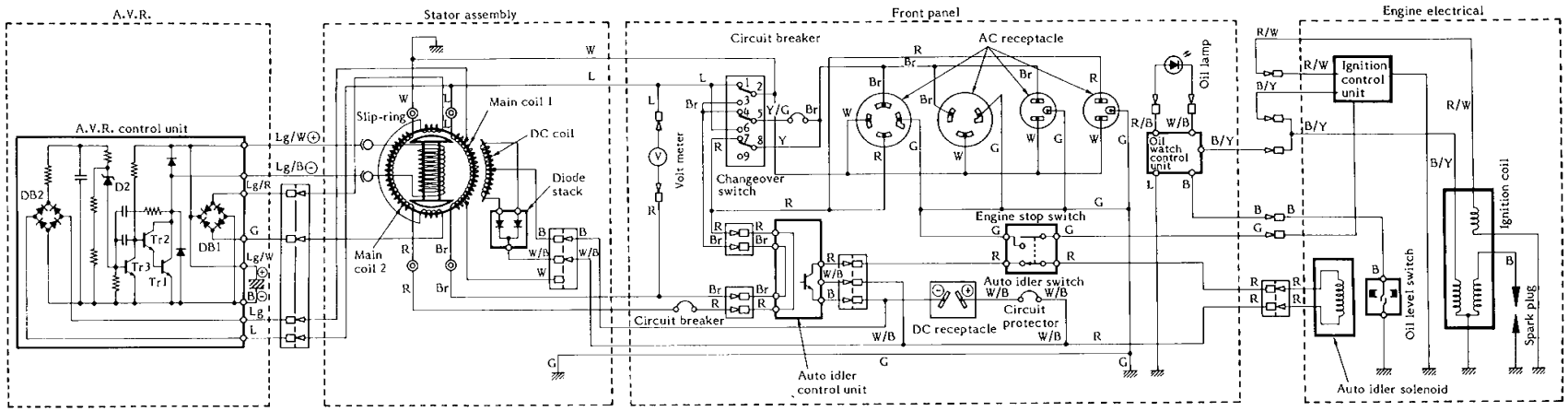
The stator is located inside the bracket. The magnetized rotor within the stator is rotated at high speed by the engine. This generates an alternating current in the main coils, sub-coil and DC coil of the stator.

Once the voltage is stabilized at a specific level, the current is outputted as alternating current and is also rectified and outputted as direct current.

These two currents are then supplied to the external electric motors and lamps.

[2] WIRING DIAGRAM

■ K3200 K3500



Color of wirning
B: Black
L: Blue
W: White
R: Red
G: Green
Br: Brown
Lg: Light-green
Y: Yellow

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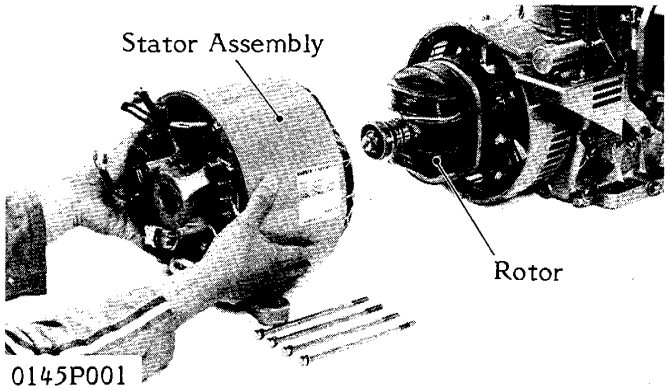
[3] FUNCTIONS OF MAJOR COMPONENTS

(1) Stator and Rotor



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The stator, located inside the bracket, is composed of a stator core, main coil 1, main coil 2, sub-coil, DC coil and diode. The magnetized rotor rotates within the stator at a high speed to generate alternating current in the main coils and DC coil. Electricity is then outputted as both alternating and direct current.

The sub-coil is used to magnetize the rotor which rotates within the stator. The sub-coil outputs no electricity.

The stator core has many slots along its inside circumference. The main coils and sub-coil are wound around the core projections perpendicularly to each other.

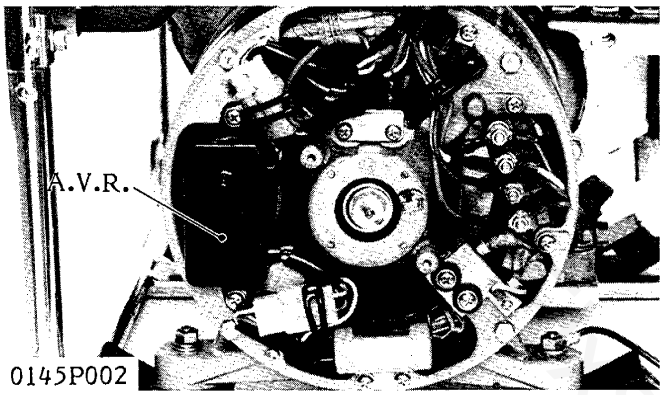
A diode stack is provided to rectify alternating current generated by the DC coil.

The rotor is composed of a rotor core, rotor coil (field coil), slip ring and permanent magnet. It rotates at a high speed within the stator and generates alternating current in the main coil, the sub-coil and the DC coil of the stator.

The alternating current generated in the sub-coil is rectified by the diode stack into direct current. The direct current then flows through the slip ring to the rotor coil to magnetize the rotor poles.

A permanent magnet is provided for initial excitation.

(2) A.V.R. (Automatic Voltage Regulator)



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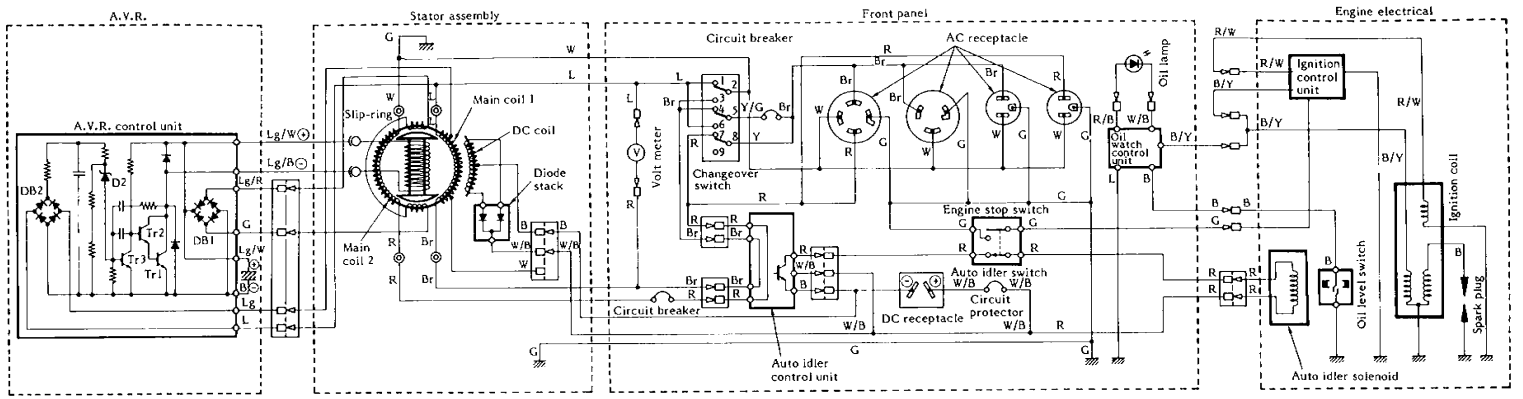
The A.V.R automatically adjusts the current flowing from the sub-coil to the rotor coil. The adjustment depends on the voltage applied to the main coil and helps stabilize the voltage generated in the main coils.

In other words, when the voltage generated in the main coil exceeds the predetermined value, the magnetization of the rotor coil is decreased. When the voltage drops below the predetermined value, the magnetism is increased.

This adjustment is controlled by transistors to ensure a stable performance even when the load fluctuates.

(3) Generating Principle and A.V.R. Operation

■ K3200 K3500



The generator converts the engine's rotation power into alternating current and direct current as described below.

1. When the rotor begins to rotate within the stator, a minute AC voltage is induced in the sub-coil of the stator by the permanent magnet in the rotor.
2. The alternating current created is full-wave rectified by a diode bridge (**DB1**) and then fed to the bases of transistors **Tr2** and **Tr1** to turn them on.
3. The alternating current induced in the sub-coil is full-wave rectified by the diode bridge and fed to the rotor coil.
4. When the rotor coil is intensely magnetized and rotated, an alternating current is induced in the main coil and DC coil of the stator. As the rotor rotation speed increases, a higher voltage is generated.
5. The alternating current induced in the main coils is outputted to the AC receptacles. The alternating current induced in the DC coil is rectified by the diode stack and output to the DC receptacle.

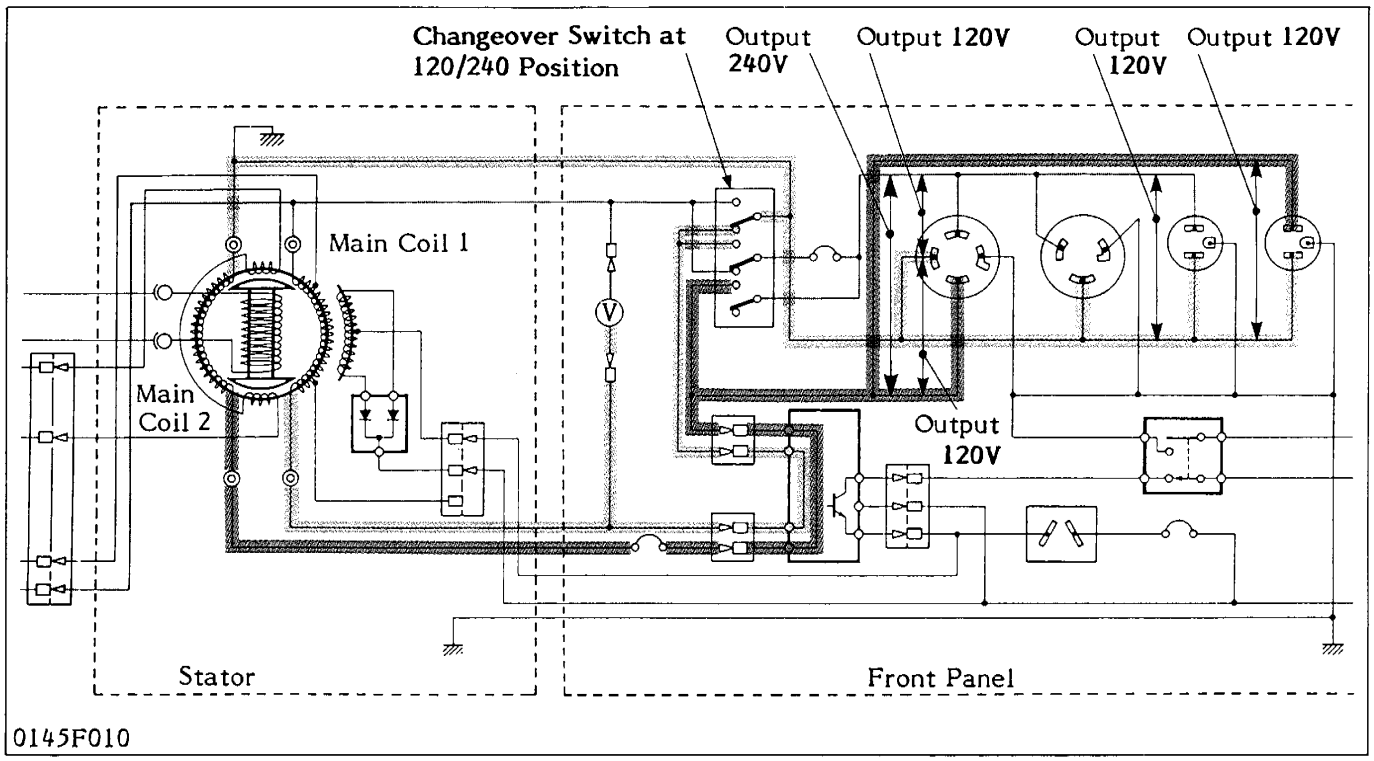
When the rotor of the generator rotates at 2,000 to 2,500 rpm, a rated voltage is generated in the main coils. A excessively high voltage is generated in the frequency of 60 Hz (3,600 rpm). To control the voltage, an A.V.R. (Automatic Voltage Regulator) is installed.

The **A.V.R.** controls the voltage generated in the main coil as described below.

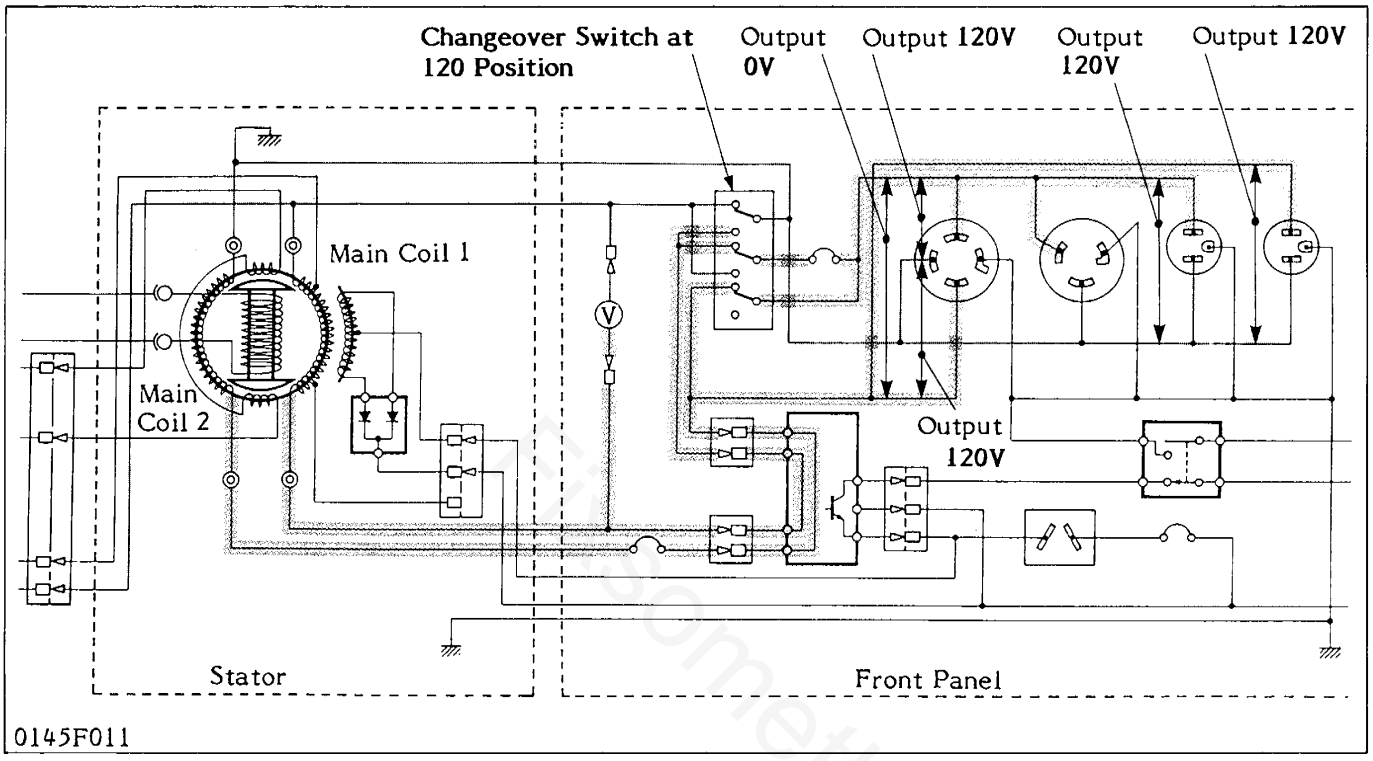
1. If the voltage generated in the main coil is less than the rated value, the alternating current generated in the sub-coil is rectified by the diode (**DB1**). This excites the rotor coil and turns on transistors **Tr1** and **Tr2**.
2. When the voltage generated in the main coil reaches the rated value, a current flows from the cathode to the anode of Zener diode **D2**.
3. A current then flows from the base to the emitter of transistor **Tr3**. Transistor **Tr3** is turned on and transistors **Tr1** and **Tr2** are turned off.
4. When transistors **Tr1** and **Tr2** are turned off, the rotor coil excitation current stops and power from the main coil is no longer generated.
5. If the voltage generated in the main coil decreases abruptly, Zener diode **D2** is turned off and transistors **Tr1** and **Tr2** are turned on.
6. The **A.V.R.** repeats the above steps to stabilize the voltage generated in the main coil.

[4] CHANGEOVER SYSTEM

■ **AC voltage is produced when the changeover switch is set at the 120 V/240 V position**



■ **AC voltage is produced when the changeover switch is set at the 120 V position**

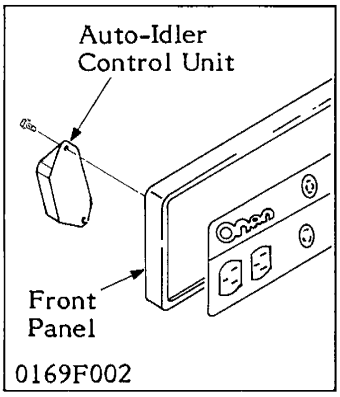


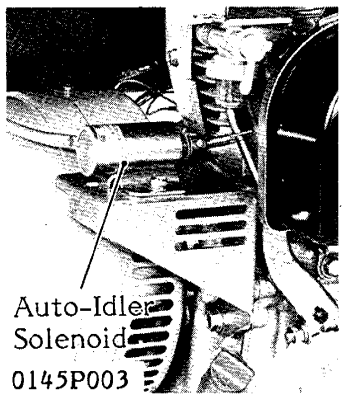
This system is able to select the output (AC 120 voltage or 240 voltage) from the 4-terminal receptacle on the front panel and switches them with the changeover switch on the front panel.

From the other 120V receptacles 120 volts is always produced.
Voltages in the figure above are supplied to each receptacle by moving the changeover switch.

[5] AUTO IDLER

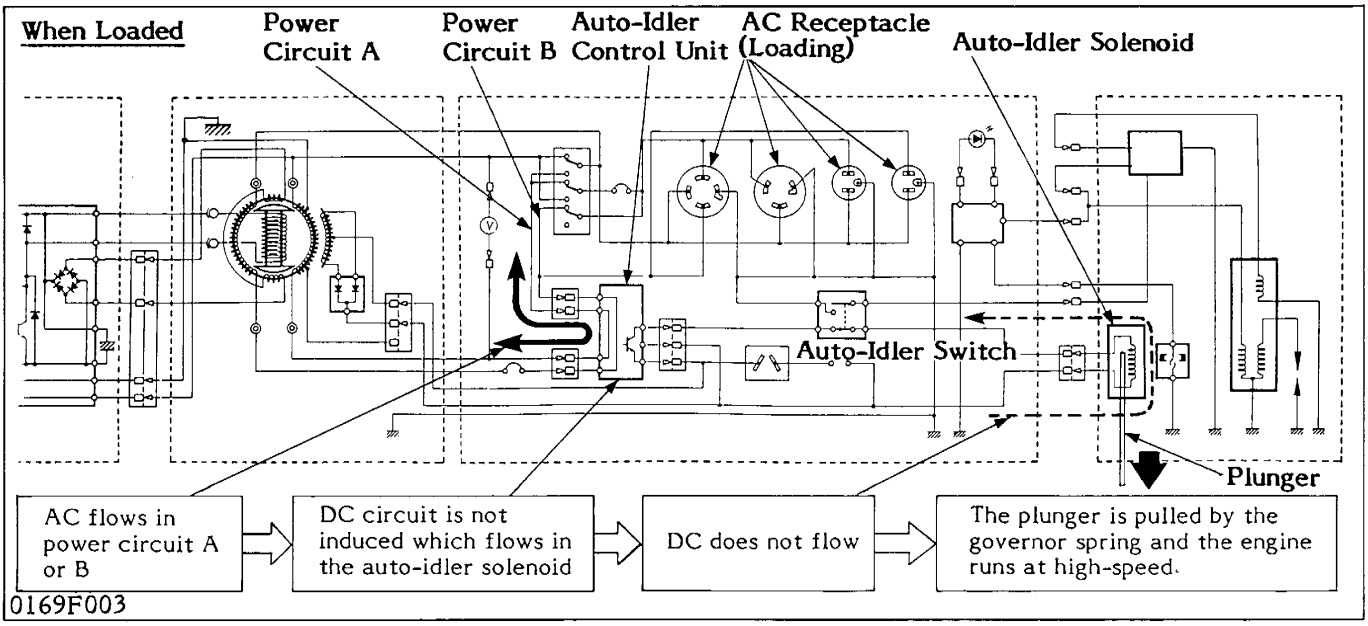
(1) Function and Operation of the Auto-Idler System

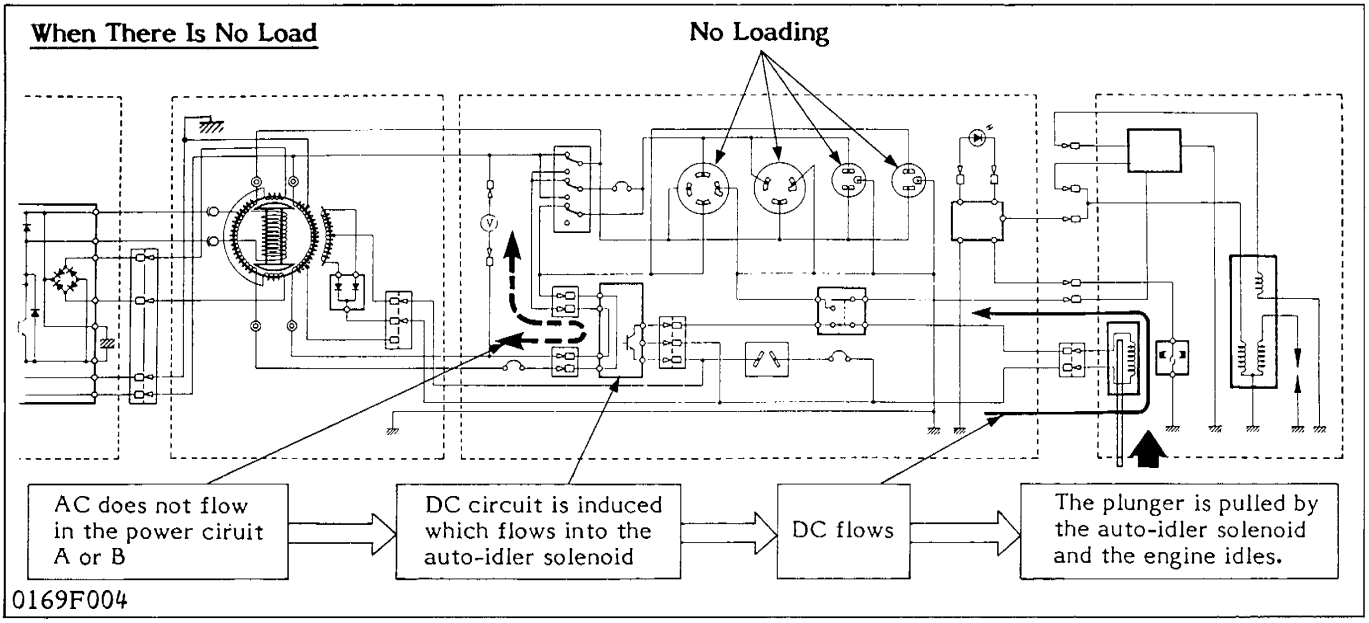




The auto-idler detects the presence of an AC load and automatically controls engine speed. When an AC load current is present, it maintains the engine speed at the rated rpm and reduces the engine to the idling speed as the load current disappears. In this way, the system reduces fuel consumption and engine noise.

The auto-idler system consists of the control unit and auto-ilder solenoid, which connects the AC/DC circuit of the generator and the governor lever of the engine.



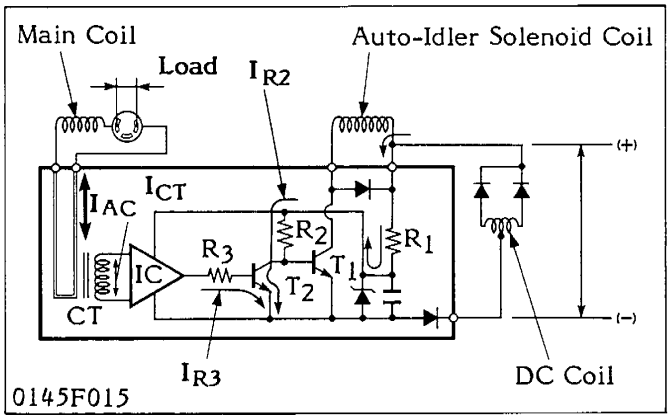


When there is an AC load on either one of the AC receptacles provided for circuit A or B, a load current is allowed to flow into the auto idler control unit. As long as this load current is detected, an electric circuit is formed within the control unit. This causes the DC circuit exciting the power solenoid to "open". As a result, the engine is allowed to continue running at the specified speed. (Note, however, that in this case no DC current is allowed to flow into the auto idler solenoid.)

When the AC load on the AC receptacles provided for circuit A or B stops, no AC current flows into the auto-idler control unit. At this time, another electric circuit is formed in the control unit which "closes" the power solenoid that excites the DC current circuit. The solenoid spool is shifted to keep the engine governor lever at the idling speed. (In this case, DC current flows into the auto-idler solenoid.)

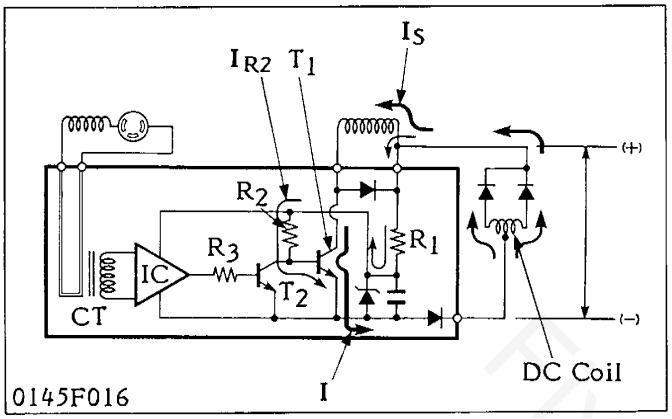
The auto-idler switch should be turned when current is drawn from the DC receptacle or whenever the auto-idler function is not in use.

(2) Operation of The Auto-Idler Control Unit



■ When there is a load at the receptacle

1. The power AC (I_{AC}) flows in the current transformer (CT), then the induced current (I_{CT}) flows.
2. The induced current (I_{CT}) increases more than the reference current, the current comparator (IC) sends out the base current (I_{R3}) to the transistor (T_2).
3. The transistor (T_2) turns on and DC (I_{R2}) flows to the transistor (T_2) via resistances (R_1 and R_2). Therefore, DC does not flow into the auto-idler solenoid.



■ When there is no load at the receptacle

1. No AC or only a little flows in the current transformer (CT). The induced current (I_{CT}) decreases to less than the reference current.
2. The base current (I_{R3}) from the comparator (IC) becomes zero.
3. The transistor (T_2) turns off, the DC (I_{R2}) becomes the base current of the transistor (T_1) via the resistances (R_1 and R_2) and turns on the transistor (T_1).
4. Therefore, DC (I_S) flows from the auto-idler solenoid to the transistor (T_1) and the plunger pulls the governor lever to the engine idling position.

DISASSEMBLING AND SERVICING

GENERAL

[1] GENERAL PRECAUTIONS

(when servicing the engine)

- During disassembly, carefully arrange removed parts in a clean area to prevent confusion later. Screws, bolts and nuts should be replaced in their original position to prevent reassembly errors.
- When special tools are required, use Onan genuine special tools. Special tools which are not frequently used should be made according to the drawings provided.
- Remove oil and dirt from parts before measuring.
- Use only Onan genuine parts for replacement to maintain engine performance and to assure safety.
- Gaskets and O-rings must be replaced during reassembly. Apply grease to new O-rings or oil seals before assembling.
- Use specified engine oil and fuel.
- The engine must be stopped and/or cooled before inspection or servicing can start unless the engine needs to be running for a specific purpose such as engine speed adjustment.
- The air must be ventilated sufficiently, especially when the engine is run in a small room.
- Use cleaning detergents for industrial parts to clean engine parts. To prevent pollution, gas, oil, and the like should not be used .

(When servicing the generator unit)

- During disassembly, carefully arrange removed parts in a clean area to prevent confusion later. Screws, bolts and nuts should be replaced in their original position to prevent reassembly errors.
- The rotor and stator must be protected when they are stored.
  If they are damaged, no power can be generated.
- To maintain the generator's performance and ensure safety, use only Onan genuine parts for replacement.
- Measuring instruments must be used properly if voltage, current and resistance are measured while the generator is moving. Otherwise, you may receive an electric shock or the measuring instruments may be broken.

[2] MAINTENANCE CHECK LIST

To maintain long-lasting and safe engine performance, make it a rule to carry out regular inspections by following the table below.

Service Interval	Check Points	Reference Page
Daily check	• Clean each part and tighten • Check the engine oil level	— S - 3
Initial 20 hours	• Change the engine oil	S - 3
Every 50 hours	• Change the engine oil • Clean the air cleaner element • Clean the spark plug	S - 3 S - 4 S - 4
Every 200 hours	• Clean the fuel filter • Check the spark plug gap	S - 5 S - 5
Every 500 hours	• Clean the carburetor and fuel tank • Check the cylinder head (removal of deposited carbon) • Check the carbon brush and slip-ring • Check the valve seat and valve clearance	S - 5 S - 6 S - 6 S - 7
Every 1000 hours	• Check the generator side bearing	S - 7
Every year or every 6 times of cleaning	• Replace the air cleaner element	——
Every year	• Replace the fuel hose	S - 7

■ **Note: (1) Use only Onan genuine parts for replacement.**
(2) Use only specified engine oil.
Select viscosity according to ambient temperature. (See page S-3.)

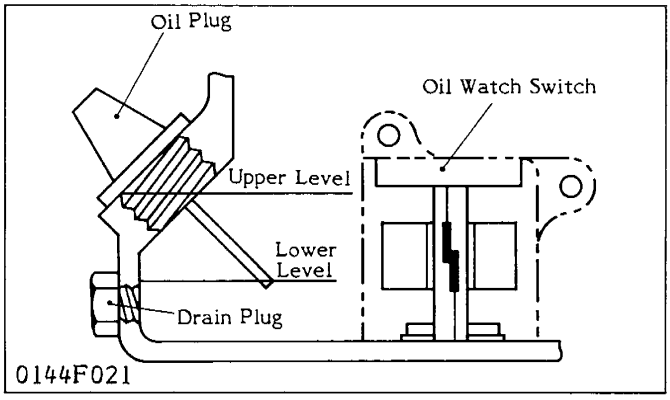
Care before Prolonged Storage

1. Drain off gasoline from the fuel tank and float chamber in the carburetor.
2. Change the engine oil with new oil and clean all the engine parts.
3. Apply oil to the frictional and sliding parts.
4. Clean the air cleaner element thoroughly.
5. So that the engine will not become difficult to start due to moisture in the cylinder, pull the recoil starter grip to set the cylinder in the compression position.
6. Cover the unit and keep the Genset in a dry, dust-free place.

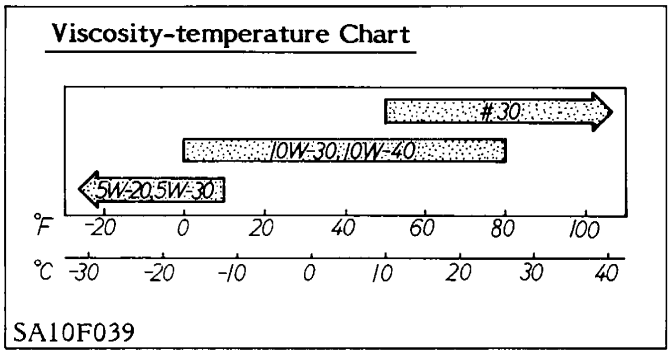
WARNING ⚠ Hot engine and exhaust parts present the hazard of fire which can result in severe personal injury or death. Before covering the unit, make sure the engine is cold.

[3] CHECK AND MAINTENANCE

(1) Daily Check Points Before Use



(1) Oil Plug (2) Drain Plug



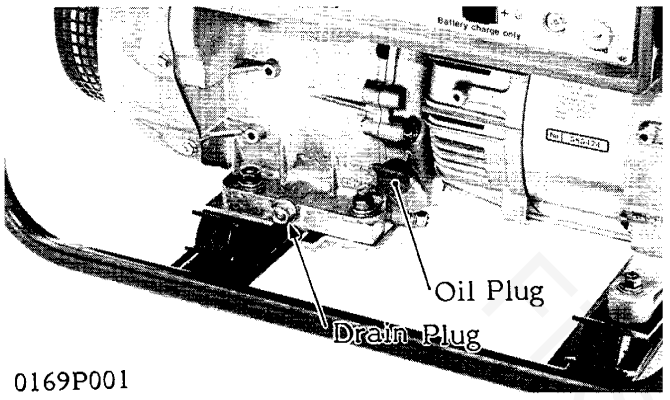
Checking Engine Oil Level

1. Level the generator
2. To check the oil level, remove the oil plug, wipe it clean, reinstall it, and remove it again. Check to see if the oil level lies between the upper and lower oil level limits.
3. If the level is too low, add new oil to the specified level.

■ IMPORTANT

- **When using oil of a different maker or viscosity from the previous one, drain all oil. Never mix two different types of oil.**
- **Engine oil should have the properties of API Service Classification SE or SF. Use the SAE viscosity recommended in the table at left depending on the lowest expected atmospheric temperature.**

(2) Check Points at Initial 20 Hours



Changing Engine Oil

1. After warming up, stop the engine.
2. Place an oil pan underneath the engine.
3. Remove the oil plug and drain plug, and drain the used oil.
4. Level the generator and reinstall the drain plug.
5. Fill the new oil up to the specified level.
6. Reinstall the oil plug.

(When reassembling)

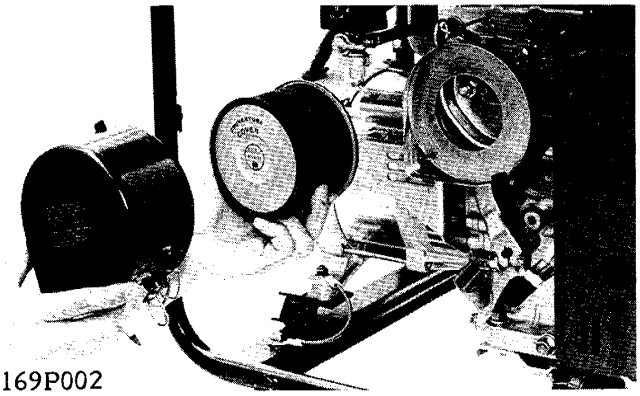
Tightening torque	Drain plug	6.9 to 9.8 N·m 0.7 to 1.0 kgf-m 5.1 to 7.2 ft-lbs

Engine crank-case capacity	0.9 ℓ (0.95 U.S.qts, 0.79 Imp.qts.)

■ IMPORTANT

- **When using oil of a different manufacturer or viscosity different from the previous one, drain all the old oil. Never mix two different types of oil.**
- **Use the proper SAE Engine Oil according to the ambient temperature.**
  Refer to the above section.

(3) Check Points Every 50 Hours



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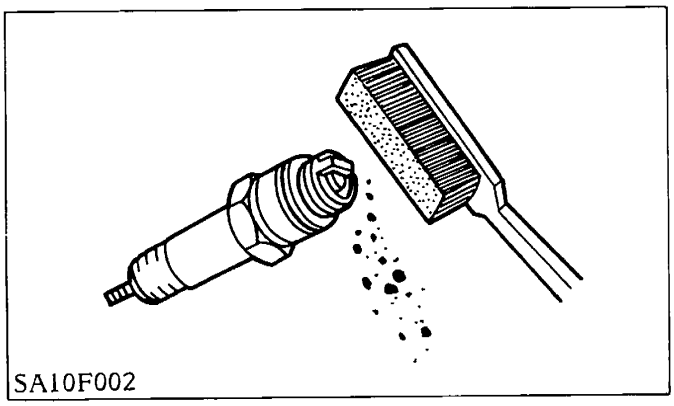
Changing Engine Oil

- See the page, S-3.

Cleaning Air Cleaner Element

1. Remove the air cleaner cover and take out the element.
2. Clean the element in kerosene.
3. Shake off the kerosene and dip it in mixed oil (kerosene 2 to 4: engine oil 1) and shake it again.
4. Dip the urethane foam element in mixed oil and then wring it out fully.
5. Wipe off dust from the air cleaner body and plate.



SA10F002

Cleaning Spark Plug

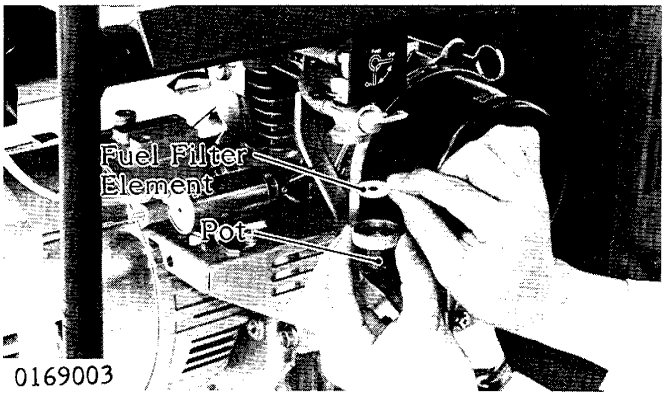
1. Remove the spark plug and remove carbon from the electrode with a wire brush.
2. Check the spark plug and spark plug cap.
3. If the electrode or insulator is deformed or cracked, replace the plug.
4. If the spark plug cap is defective, replace the cap.

Tightening torque	Spark plug	9.8 to 24.5 N·m 1.0 to 2.5 kgf-m 7.2 to 18.1 ft-lbs

■ **IMPORTANT**

- **When replacing the spark plug, be sure to use a resistor spark plug.**

(4) Check Points Every 200 Hours

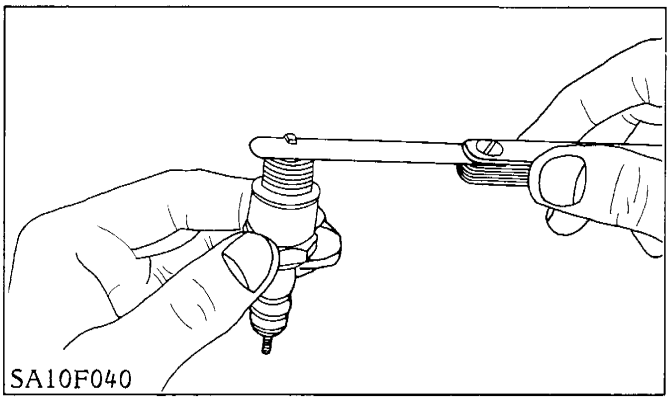


Cleaning Fuel Filter Element and Pot

1. Close the fuel cock.
2. Remove the filter pot.
3. Remove impurities and water that have collected at the bottom of the pot and wipe the inside of the pot well.
4. Take out the fuel filter element and clean it.
5. Assemble the parts in their original positions.

■ **NOTE**

- **After assembling the fuel filter, open the fuel cock and check that fuel does not leak.**



Checking Spark Plug Gap

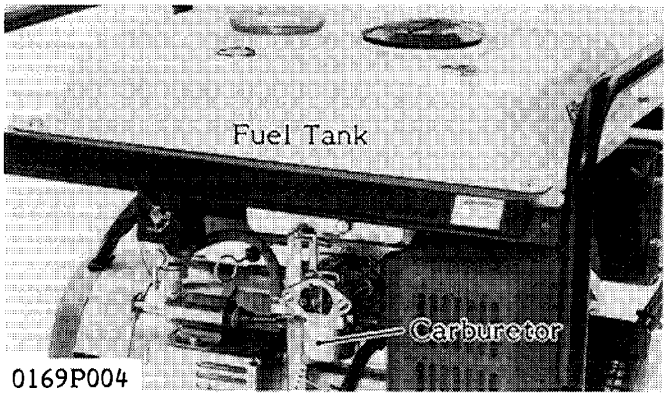
1. Remove the spark plug, and remove carbon from the electrode with a wire brush.
2. Measure the spark plug gap with a feeler gauge.
3. If the measurement is not within the factory specifications, repair or replace it.
4. If the electrode or insulator is deformed or cracked, replace the plug.
5. If the spark plug cap is defective, replace the cap.

Spark plug gap	Factory spec.	0.6 to 0.7 mm 0.024 to 0.028 in.
Tightening torque	Spark plug	9.8 to 24.5 N·m 1.0 to 2.5 kgf-m 7.2 to 18.1 ft-lbs

■ **IMPORTANT**

- **When replacing the spark plug, be sure to use a resistor spark plug.**

(5) Check Points Every 500 Hours



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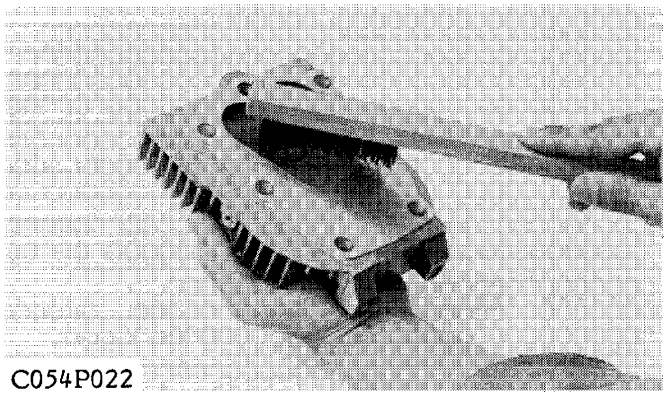
Cleaning Carburetor and Fuel Tank

1. Drain off the fuel and remove impurities and water from the fuel tank.
2. Drain off the fuel and remove impurities and water from the carburetor.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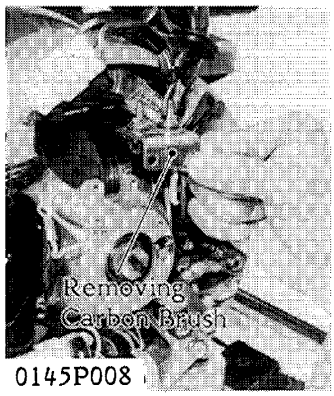
Cleaning Cylinder Head

1. Remove the cylinder head.
2. Remove carbon from the combustion chamber in the cylinder head with a wire brush.

CAUTION ⚠ Do not damage the cylinder head when cleaning with a wire brush.



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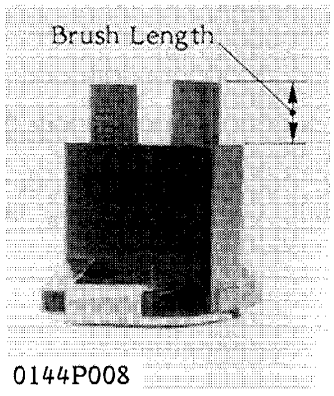
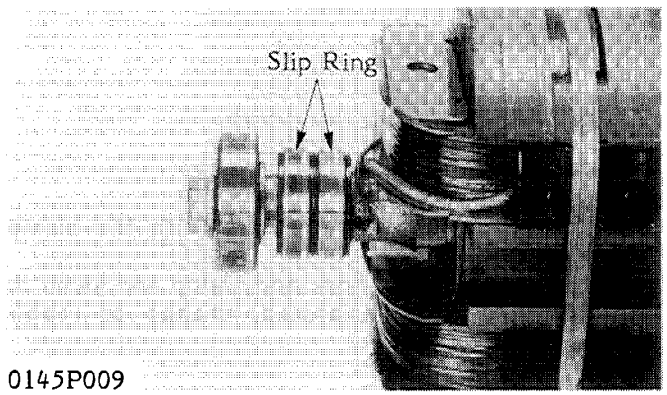


0144P008

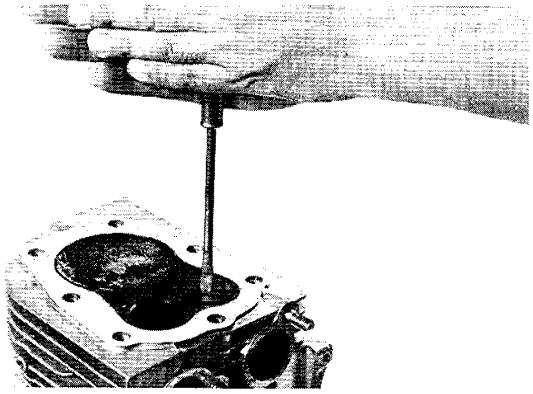
Checking Carbon Brush and Slip-ring

1. Remove the brush.
2. Clean the brush sliding surface.
3. Measure the length from the brush holder to the brush sliding surface.
4. If the brush length exceeds the allowable limit, replace the brush.
5. Remove oil, dirt and other contaminants sticking to the slip-rings.

Brush length	Allowable limit	3.5 mm 0.138 in.



0145P009

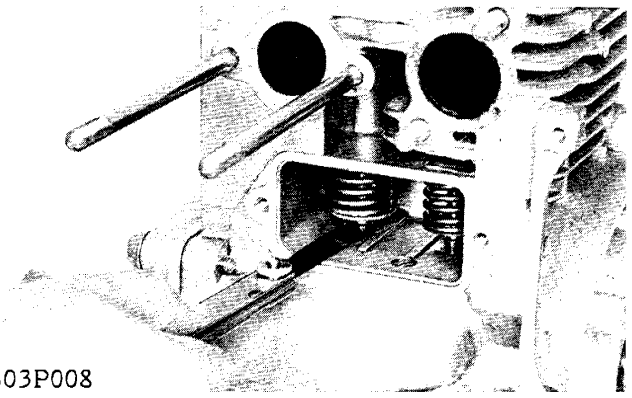


0602P010

Checking Valve Seat

1. Clean the valve seat and valve face.
2. Apply a thin film of red lead between the valve seat and valve face and fit them with a valve flapper.
3. If the valve sealing rate is less than the factory specification, apply a thin film of compound between the valve face and the valve seat and fit them with a valve flapper.
4. Repeat steps 2 and 3 until the correct valve sealing rate is achieved.
5. After valve lapping, check the valve clearance.

Valve sealing rate	Factory spec.	More than 70 %



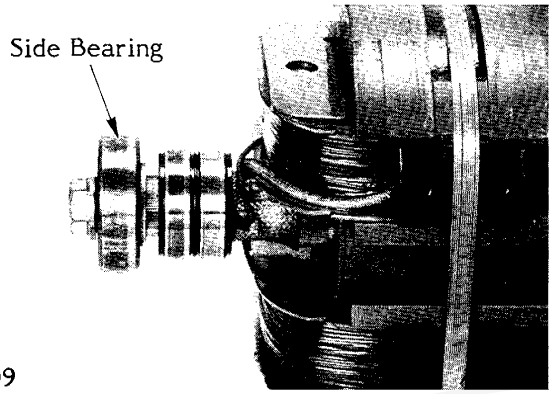
0603P008

Checking Valve Clearance

1. Remove the tappet chamber cover and breather.
2. Put the piston in the compression top dead center.
3. Measure the clearance between the tip of the intake valve stem and the tappet and between the tip of the exhaust valve stem and the tappet with a feeler gauge.
4. If the measurement is less than the factory specifications, remove the valve and grind the tip of the valve stem using an oil stone.
5. If the measurement exceeds the factory specifications, replace the valve or the tappet.

Valve clearance (IN. and EX.)	Factory spec.	0.08 to 0.13 mm 0.0031 to 0.0051 in.

(6) Check Points every 1000 Hours

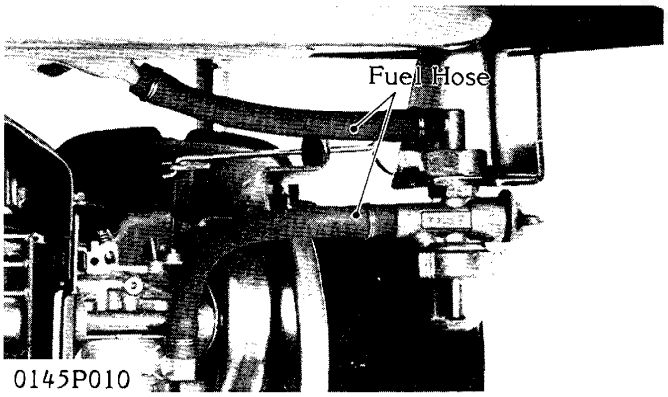


0145P009

Checking Generator Side Bearing

1. Remove the bracket.
2. Make sure that the side bearing rotates smoothly.
3. If the side bearing does not rotate smoothly, replace it.

(7) Check Points Every Year

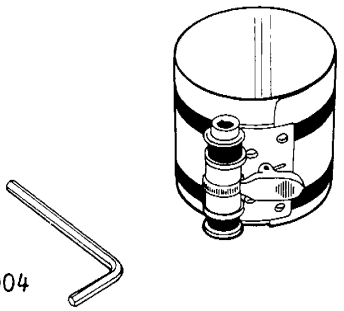


0145P010

Replacing Fuel Hose

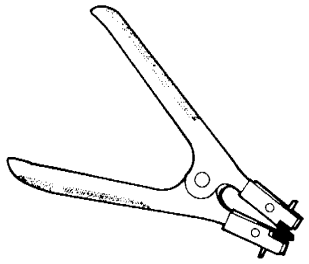
1. Replace the fuel hoses together with the clamp every year.
2. However, if the fuel hose and clamp are found to be damaged or deteriorated, change or repair them immediately.

[4] SPECIAL TOOLS



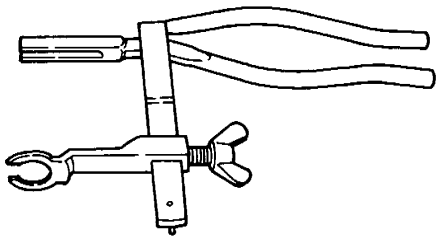
ST10F004

Piston Ring Compressor
Application : Use for pushing in the piston.



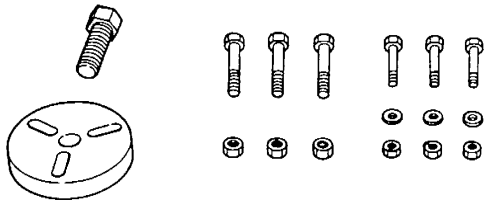
ST10F005

Piston Ring Tool
Application : Use for removing or installing the piston ring.



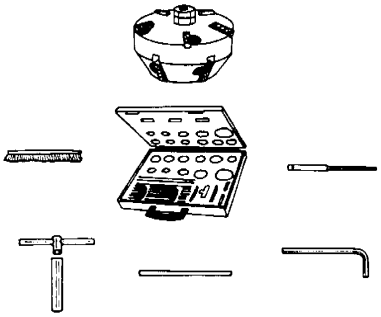
ST10F101

Valve Lifter
Application : Use for removing or installing the valve spring collet.



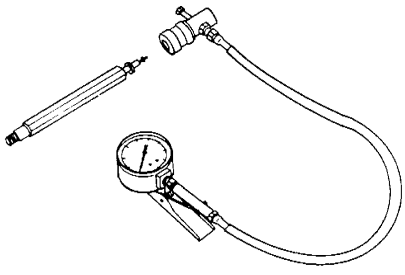
ST10F102

Flywheel Puller
Application : Use to pull out the flywheel of air cooled gasoline engines.



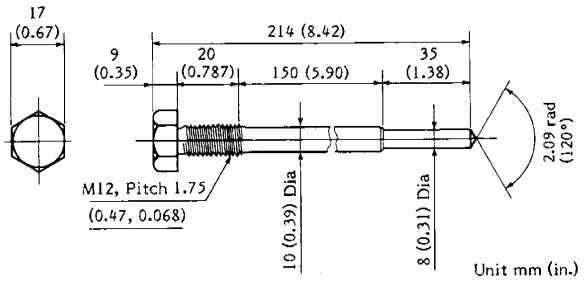
ST10F009

Valve Seat Cutter
Application : Use to reseat valves.
Angle : 0785 rad. (45°)
: 0.262 rad. (15°)
Diameter : 28.6 mm (1.126 in.)
: 31.6 mm (1.244 in.)
: 35.0 mm (1.378 in.)
: 38.0 mm (1.496 in.)
: 41.3 mm (1.626 in.)
: 50.8 mm (2.000 in.)



ST10F112

Air-Cooled Compression Tester
Application : Use to measure air-cooled engine compression and diagnose the need for major overhaul.

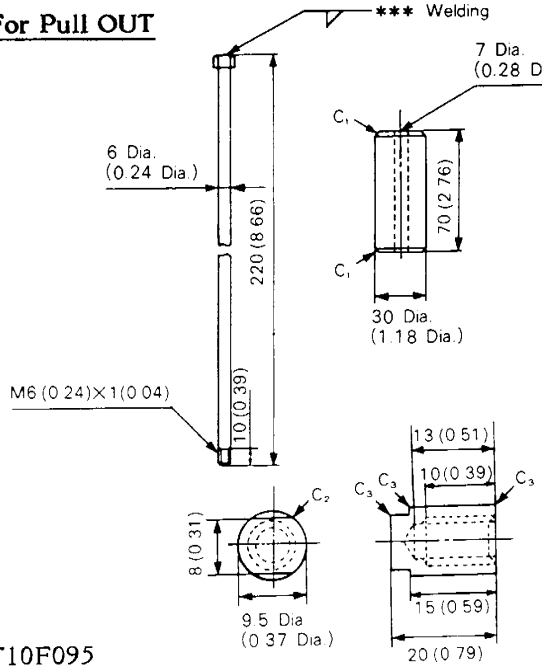


ST10F113

Rotor Pull Tool

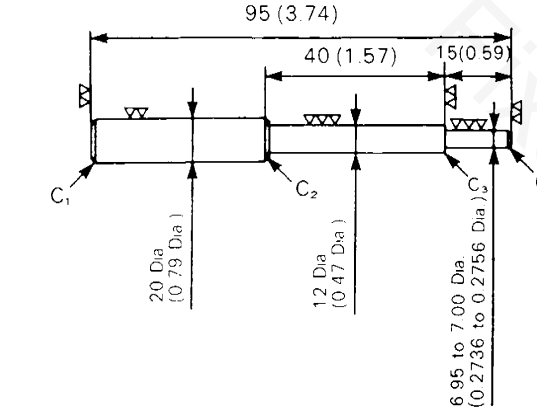
Application : Use for removing the rotor.

For Pull OUT



ST10F095

For Press-fit



**Unit: mm (in.)

*Chamfer	mm	in
C_1	2.0	0.079
C_2	1.0	0.039
C_3	0.3	0.012

ST10F049

Valve Guide Replacing Tool

Application: Use to pull out and to press-fit the valve guide.

■ **NOTE**

- **These tools are not provided so make them by referring to the figures at left.**

Finishing Roughness

Unit: μm (μin.)

JIS (Japanese Industrial Standards)	American Standard
▽▽▽	6.3 (250)
▽▽	12.5 (500)

Symbol	Standard of application	Method of manufacturing
6.3S ▽▽▽	Surfaces, where surface roughness is of utmost importance, such as surfaces requiring a very high oil tightness, or rotating or sliding surfaces requiring precision under high speed or heavy load. This standard applies to surfaces which, for functional reasons, absolutely require such a very high precision regardless of the high manufacturing cost requirement.	High speed, precision feed and light-duty cutting using a sharp cutter under a good production control.
12.5S ▽▽	Ordinary fitting surfaces, surfaces requiring oil tightness and other surfaces where consideration is needed for surface roughness, and where smoothness is of special importance in regard to performance as well as appearance.	Relatively high speed and precision feed, and light-duty cutting using a cutter having an appropriate sharpness.

SEPARATION

TIGHTENING TORQUES

[1] Specified Screws, Bolts and Nuts

Item	Size x Pitch	Tightening Torque		
		N·m	kgf·m	ft-lbs
Cushion rubber mounting nut	M10 x 1.25	39.2 to 45.1	4.0 to 4.6	28.7 to 33.3
Cushion rubber mounting nut	M8 x 1.25	17.7 to 20.6	1.8 to 2.1	13.0 to 15.2
Speed control lever mounting nut	M8 x 1.25	5.88 to 6.76	0.6 to 0.9	4.34 to 4.99
Main coil terminal nut	M5 x 0.9	1.86 to 2.45	0.19 to 0.25	1.37 to 1.81
Stator mounting screw	M6 x 1.0	5.9 to 8.8	0.6 to 0.9	4.3 to 6.5
Rotor mounting screw	M10 x 1.25	31.4 to 43.2	3.2 to 4.4	22.9 to 31.5
Fuel tank mounting screw	M6 x 1.0	9.81 to 11.28	1.0 to 1.15	7.23 to 8.32
Control box mounting screw	M6 x 1.0	9.81 to 11.28	1.0 to 1.15	7.23 to 8.32
Pipe frame 1 mounting screw	M8 x 1.25	23.5 to 27.5	2.4 to 2.8	17.4 to 20.3

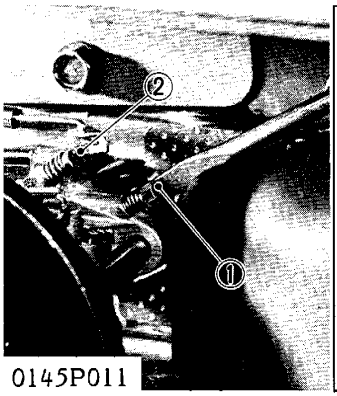
[2] General-use Screws, Bolts and Nuts

When the tightening torques are not specified, tighten the screws, bolts and nuts according to the table below.

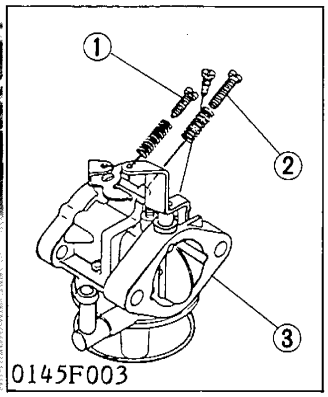
Grade / Unit / Nominal Diameter	No-grade (⬡ or ④)			7T (⑦)		
	N·m	kgf·m	ft-lbs	N·m	kgf·m	ft-lbs
M6	7.85 to 9.32	0.80 to 0.95	5.79 to 6.87	9.81 to 11.28	1.00 to 1.15	7.23 to 8.32
M8	17.65 to 20.59	1.80 to 2.10	13.02 to 15.19	23.54 to 27.46	2.40 to 2.80	17.36 to 20.25
M10	39.23 to 45.11	4.00 to 4.60	28.93 to 33.27	48.05 to 55.90	4.90 to 5.70	35.44 to 41.23
M12	62.76 to 72.56	6.40 to 7.40	46.29 to 53.52	77.47 to 90.22	7.90 to 9.20	57.14 to 66.54

ADJUSTING

[1] IDLING SPEED



0145P011



0145F003

(1) Pilot Screw
(2) Throttle Stopper Adjusting Screw
(3) Carburetor Body

Preparation

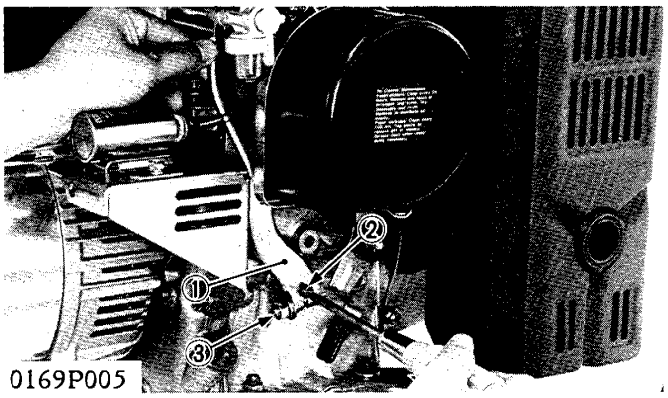
1. Turn the auto-idler switch to the "OFF" position.
2. Warm up the engine at a medium speed for 20 to 30 minutes, then stop the engine .
3. Disconnect the rod and spring which are located between the auto-idler solenoid and governor lever.

Adjusting Pilot Screw (carburetor)

1. Fully loosen the throttle stopper adjusting screw (2) on the carburetor.
2. Tighten the pilot screw (1) on the carburetor completely, then loosen it by 1 to 1.5 turns.

■ NOTE

- **Do not overly tighten the pilot screw (1) or the taper may become stepped.**



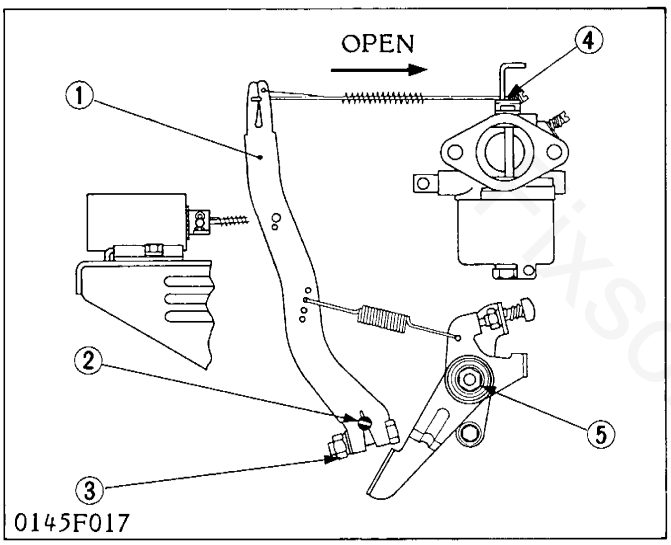
0169P005

Assembling Governor Lever and Shaft

1. Slightly loosen the speed control lever nut (5) and set the lever to the lowest position.
2. Loosen the nut (3) at the lever end of the governor lever (1).
3. Press the throttle valve (4) on the carburetor to the fully open (to high speed) position with the governor lever (1). Turn the groove of the governor lever shaft (2) fully clockwise with a screw-driver then tighten the nut (3) in that position.

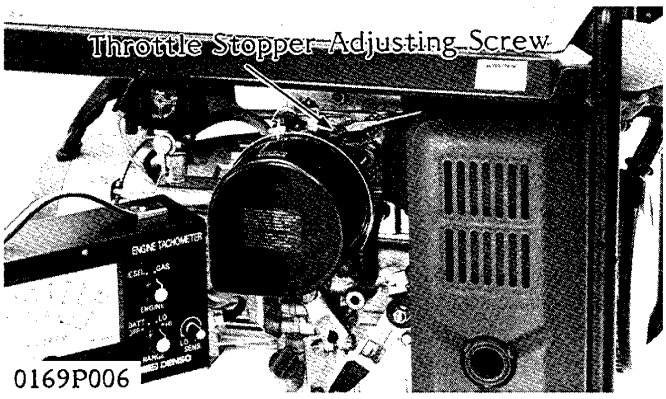
(When reassembling)

Tightening torque	Governor lever mounting nut (3)	10.8 to 19.6 N·m 1.1 to 2.0 kgf·m 8.0 to 14.5 ft-lbs



0145F017

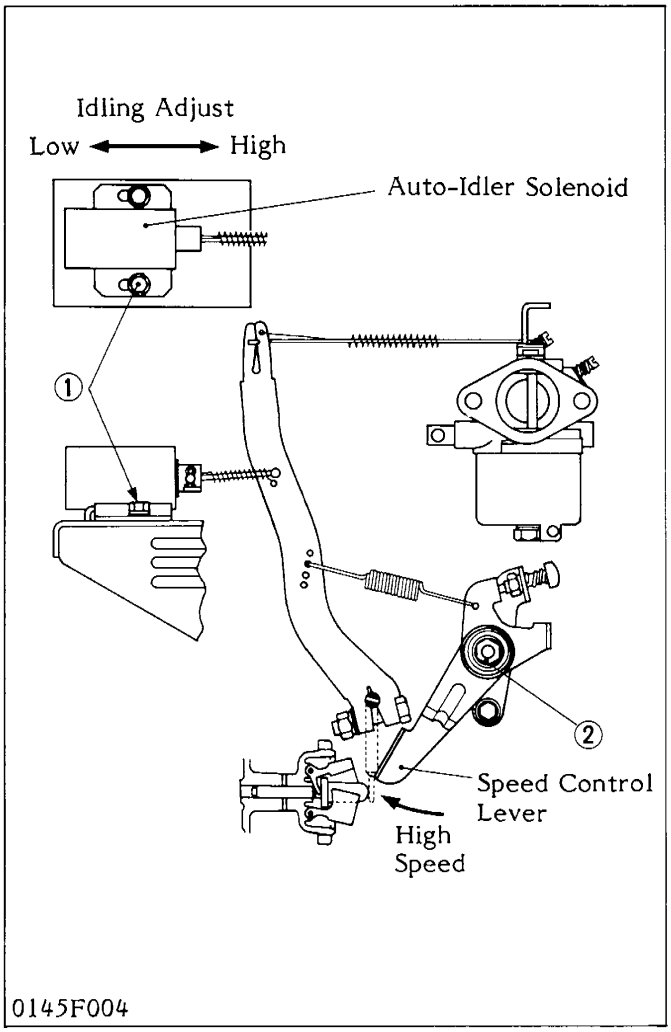
(1) Governor Lever
(2) Governor Lever Shaft
(3) Governor Lever Nut
(4) Throttle Valve
(5) Speed Control Lever Nut



Adjusting Lowest Engine Speed

1. Run the engine.
2. Set the speed control lever to the lowest speed position.
3. Adjust the idling speed with the throttle stopper adjusting screw in such a way that the engine maintains the lowest speed.

Lowest engine speed (when the auto-idler solenoid is not mounted)	Factory spec.	1550 to 1750 rpm



(1) Solenoid Unit Mounting Screw
(2) Speed Control Lever Mounting Nut

Adjusting Generator Idling Speed

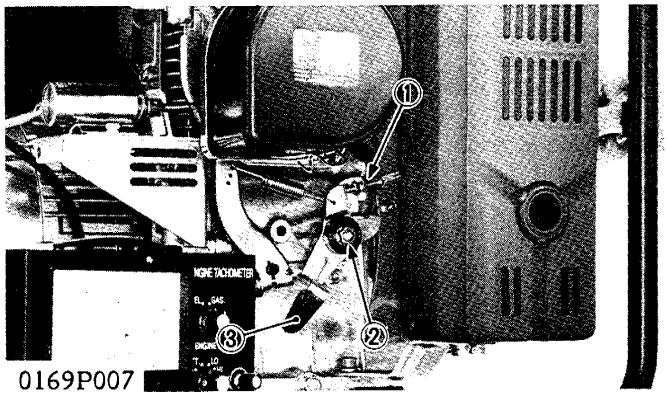
1. Connect the auto-idler solenoid unit and the governor lever and temporarily tighten the solenoid unit mounting screws (1) as shown in the figure.
2. Connect the lead of the auto-idler solenoid unit.
3. Set the speed control lever to the highest speed position and tighten the mounting nut (2) to the specified torque.
4. Run the engine.
5. Turn the auto-idler switch to the "ON" position, and adjust the idling speed by moving the auto-idler solenoid unit in such a way that the generator maintains the idling speed.
6. Tighten the auto-idler solenoid mounting screws (1) to the specified torque.
7. Check the auto-idler operation which changes the auto-idler switch to the "ON" and "OFF" position.

(When reassembling)

Tightening torque	Speed control lever mounting nut (2)	5.88 to 6.76 N·m 0.6 to 0.9 kgf·m 4.34 to 4.99 ft-lbs
	Auto-idler solenoid unit mounting screw (1)	9.81 to 11.28N·m 1.0 to 1.15 kgf·m 7.23 to 8.32 ft-lbs

Generator idling speed (when the auto-idler solenoid is mounted)	Factory spec.	2000 to 2200 rpm

[2] MAXIMUM NO-LOAD SPEED



0169P007

(1) High-speed Adjusting Screw
(2) Speed Control Lever Mounting Nut
(3) Speed Control Lever

Checking Generator Idling Speed
● See page S-11 to S-12.

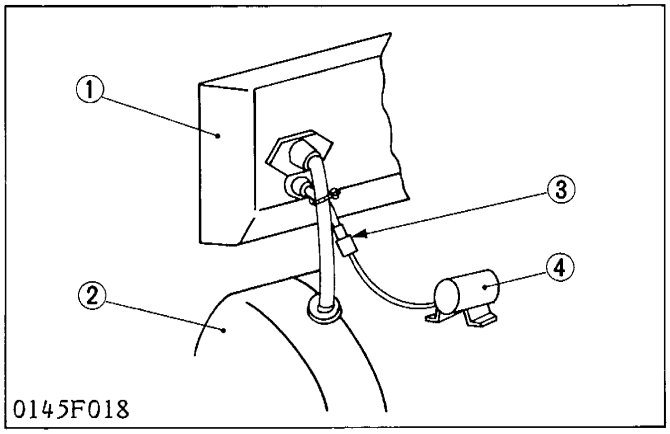
Adjusting Generator Maximum Speed
1. Slightly loosen the speed control lever mounting nut (2).
2. Set the auto-idler switch to the "OFF" position.
3. Start the engine and press the speed control lever (3) at the highest-speed position while adjusting the high-speed adjusting screw (1) with a screwdriver until the generator speed reaches its maximum speed.
4. Tighten the speed control lever mounting nut (2) to the specified torque.

Generator maximum speed	Factory spec.	less than 3960 rpm

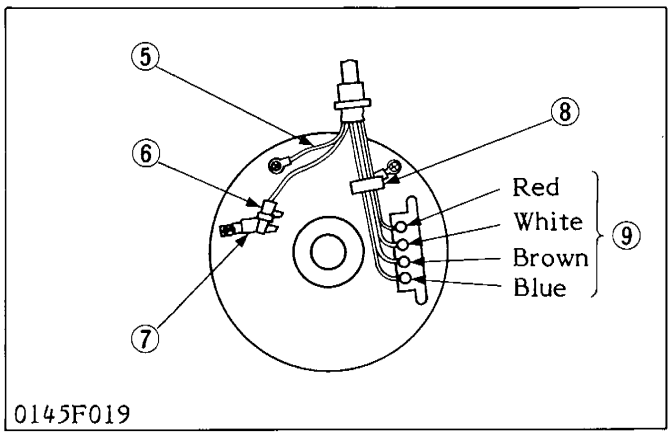
Tightening torque	Speed control lever mounting nut	5.88 to 7.76 N·m 0.6 to 0.9 kgf·m 4.34 to 4.99 ft-lbs

DISASSEMBLING AND ASSEMBLING

[1] GENERATOR EXTERIOR



0145F018



0145F019

(1) Control Box
(2) Cleaner Cover
(3) 2P Connector
(4) Auto-Idler Solenoid
(5) Grounding Lead
(6) 4P Connector
(7) Clamp
(8) Clamp
(9) Main Coil Terminal Screws

Wiring Leads between control Box and Generator Unit

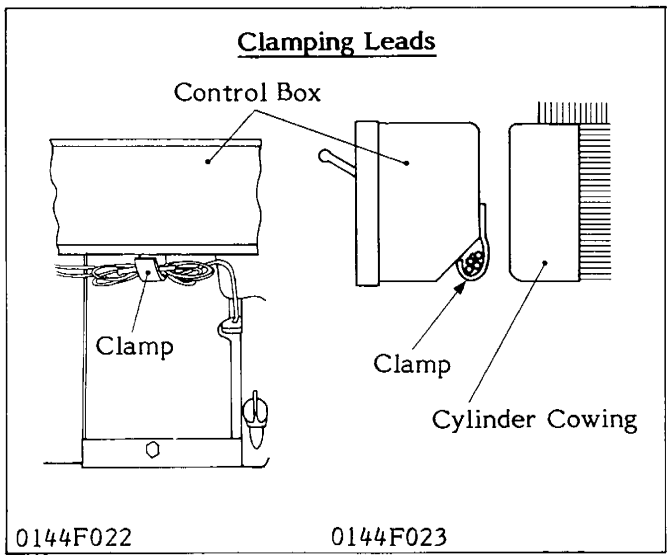
1. Remove the cleaner cover (2).
2. Disconnect the 2P connector (3) between the control box and the auto-idler solenoid (4).
3. Remove the clamps (7), (8).
4. Disconnect the 4P connector (6) for DC current between the control box and the generator unit.
5. Remove the grounding lead (5).
6. Remove the main coil terminal screws (9).

(When reassembling)

Tightening torque	Main coil lead terminal screw (9)	1.86 to 2.45 N·m 0.19 to 0.25 kgf·m 1.37 to 1.81 ft-lbs

■ **NOTE**

- **Make sure that the leads do not come in contact with the edge of parts.**
- **Connect the main coil leads and correct the position. (Refer to the figure).**



0144F022 0144F023

Wiring Leads between Control Box and Engine

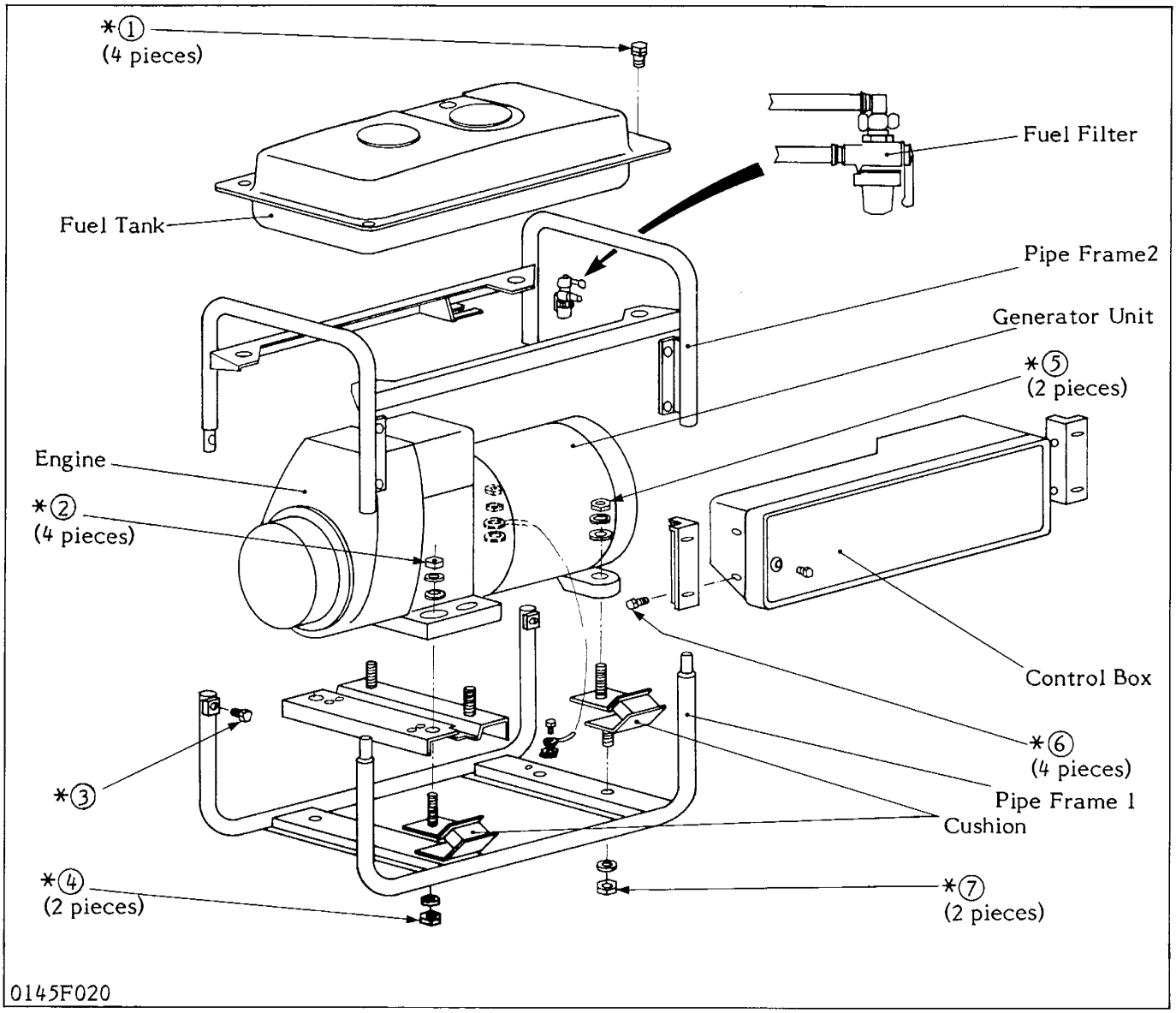
1. Remove the leads from the clamp under the the control box.
2. Disconnect the 1P connector of the green color leads going to the engine stop circuit.
3. Disconnect the 1P connector of the black/yellow color leads going to the oil watch circuit.
4. Disconnect the 1P connector of the black leads going to the oil watch sensor circuit.

(When reassembling)

■ **NOTE**

- **Make sure that the leads do not come in contact with the edge of parts and do not get caught between the control box and the cylinder cowling. (Refer to the figure.)**

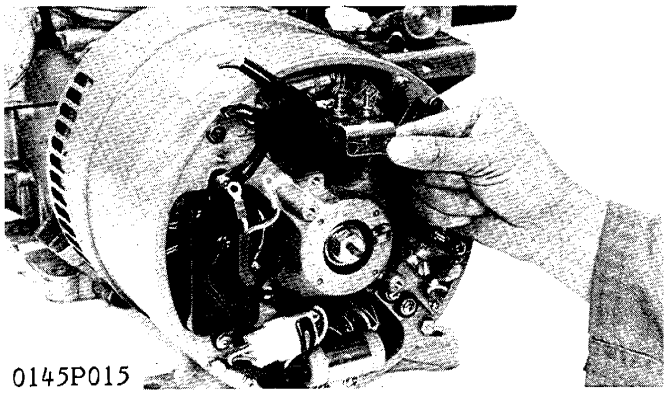
Fuel Tank, Pipe Flame, Control Box and Others



(When reassembling)
Screws and nuts marked * should be tightened to the torques shown below.

No.	N·m	kgf·m	ft-lbs
1	9.81 to 11.28	1.0 to 1.15	7.23 to 8.32
2	39.2 to 45.1	4.0 to 4.6	28.9 to 33.3
3	23.5 to 27.5	2.4 to 2.8	17.4 to 20.3
4	39.2 to 45.1	4.0 to 4.6	28.9 to 33.3
5	17.7 to 20.6	1.8 to 2.1	13.0 to 15.2
6	9.81 to 11.28	1.0 to 1.15	7.23 to 8.32
7	17.7 to 20.6	1.8 to 2.1	13.0 to 15.2

[2] GENERATOR UNIT AND ENGINE



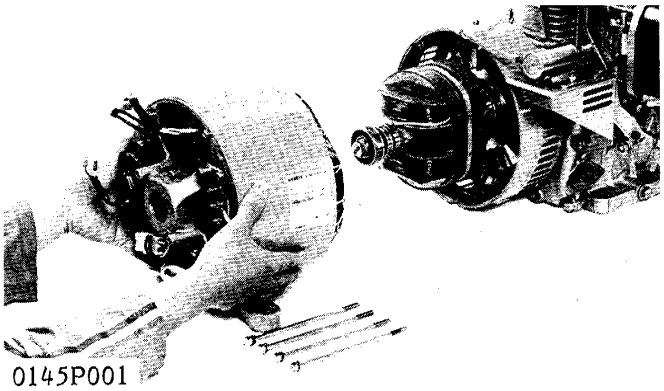
0145P015

Brush Holder

1. Remove the cleaner cover.
2. Remove the two wiring leads from the brush holder.
3. Remove the brush holder from the bracket.

(When reassembling)

1. Connect the light green/white lead to the "+" mark on the brush holder.
2. Remove dust from the brush sliding surface and slip ring surface.



0145P001

Stator

1. Remove the stator mounting screws.
2. Make sure that the brush holder is removed and remove the stator assembly and bracket as one assembly.

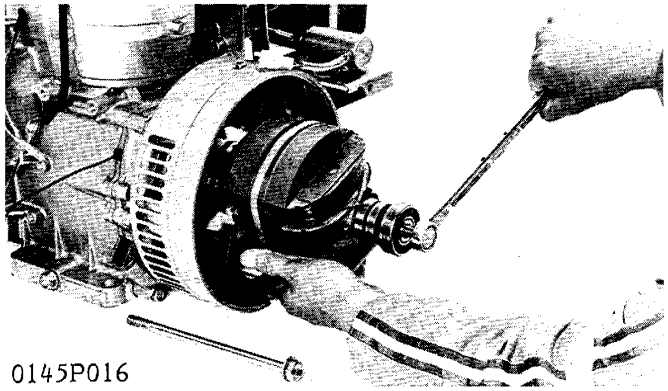
■ NOTE

- **Handle the stator assembly so as not to damage the winding.**

Tightening torque	Stator mounting screw	5.9 to 8.8 N·m 0.6 to 0.9 kgf·m 4.3 to 6.5 ft-lbs

(When reassembling)

1. Remove all dirt and oil from the slip ring surfaces.
2. Remove dirt from around the fitting area and the surface of the bearing.



0145P016

Rotor

1. Remove the rotor mounting screw.
2. Remove the rotor assembly from the crankshaft of the engine using the rotor pull tool.

■ NOTE

- **Handle the rotor assembly so as not to damage the winding.**

(When reassembling)

1. Remove all dirt and oil from the tapered area of the crankshaft and the rotor shaft.

Tightening torque	Rotor mounting screw	31.4 to 43.2 N·m 3.2 to 4.4 kgf·m 22.9 to 31.5 ft-lbs

ENGINE

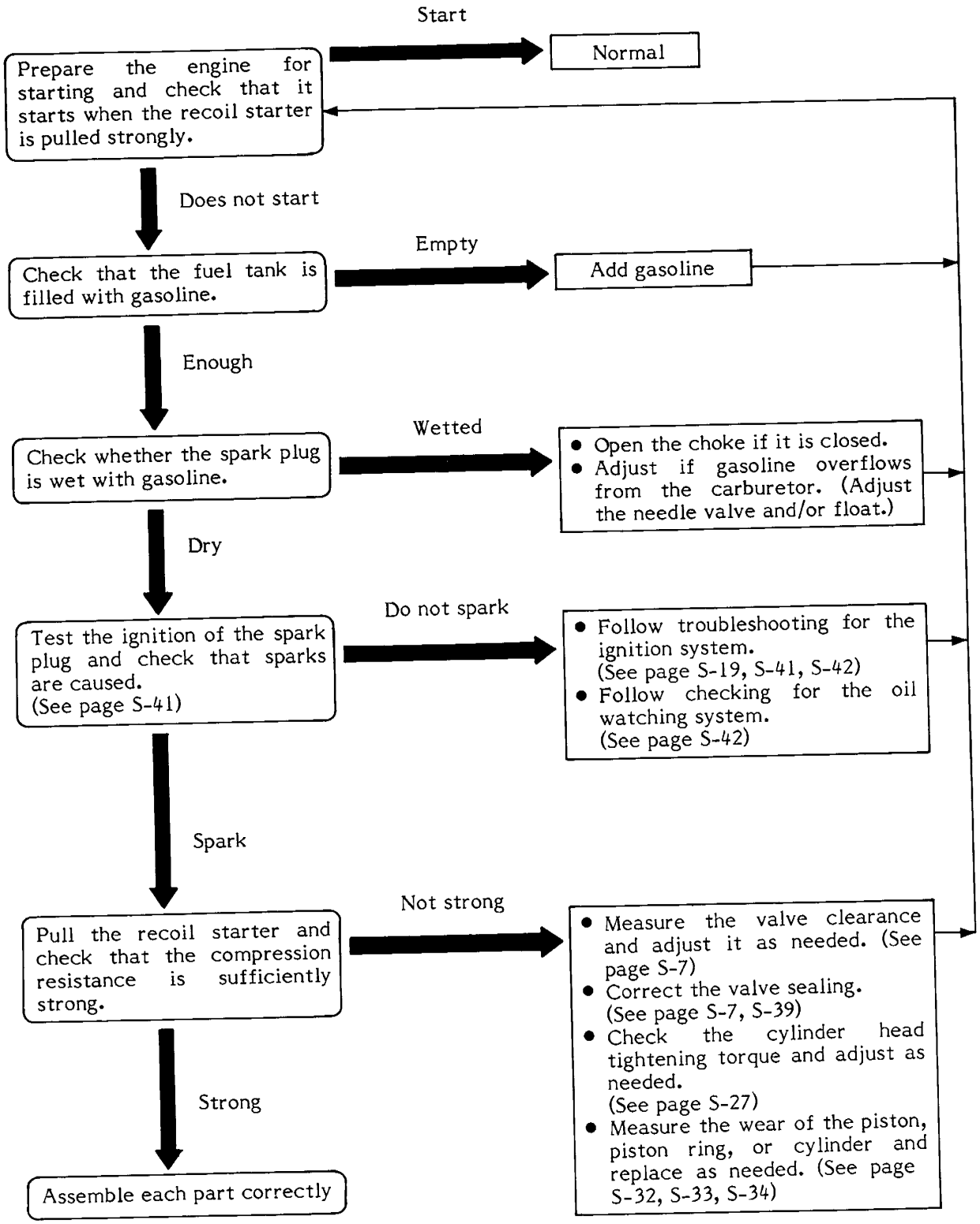
TROUBLESHOOTING

[1] TYPICAL PROBLEMS, CAUSES, AND SOLUTIONS

Symptom	Probable Cause	Solution	Reference Page
Engine Will Not Turn Over	• Malfunctioning recoil starter	Repair or replace	S-43, S-44, S-45
	• Engine jammed	Check engine to find the problem and repair it	—
Engine Turns Over Slowly but Does Not Start	• Malfunctioning recoil starter	Repair or replace	S-43,S-44, S-45
	• Increased resistance of moving parts	Repair or replace	—
	• Excessively high viscosity of engine oil at low temperature	Use specified engine oil	S-24
Engine Turns Over at Normal Speed but Does Not Start	• No fuel	Replenish fuel	—
	• Compression leak from cylinder (Compression pressure too low)	Replace head gasket and tighten cylinder head screw, or check cylinder and piston ring	S-23
	• Piston ring and cylinder worn	Replace	S-32, S-33, S-34
	• Improper valve clearance	Adjust	S-23
	• Defective ignition unit	Replace	S-42
	• Defective spark plug	Adjust spark plug gap or replace	S-41
	• Defective fuel system	Check fuel line and carburetor, and repair	S-39
	• Overchoking	Clean spark plug	—
	• Flooding from carburetor	Check carburetor and repair	—
	• Clogged air cleaner	Clean or replace	S-4
Rough Low-speed Running and Idling	• Defective ignition unit	Replace	S-42
	• Defective spark plug	Adjust spark plug gap or replace	S-41
	• Incorrect carburetor idle adjustment	Adjust	S-12
	• Incorrect governor adjustment	Adjust	S-12
	• Improper valve clearance	Adjust	S-23
Rough High-speed Running	• Defective ignition unit	Replace	S-42
	• Defective spark plug	Adjust spark plug gap or replace	S-41
	• Incorrect governor adjustment	Adjust	S-12
Engine Speed Does Not Increase	• Defective ignition unit	Replace	S-42
	• Incorrect carburetor adjustment	Adjust	—
Deficient Output	• Improper intake or exhaust valve sealing	Repair	S-23, S-39
	• Defective spark plug	Adjust spark plug gap or replace	S-41
	• Excessive carbon in engine	Remove carbon	S-6
	• Improper valve clearance	Adjust	S-23
	• Piston ring and cylinder worn	Replace	S-32, S-33
Engine Is Noisy	• Improper valve clearance	Adjust	S-23
	• Spark knock due to low-octane fuel or carbon	Use higher-octane fuel and remove carbon	—
	• Rattles from loosely mounted external components	Retighten	—
Hard Vibration	• Loosen engine mounting screw	Retighten	

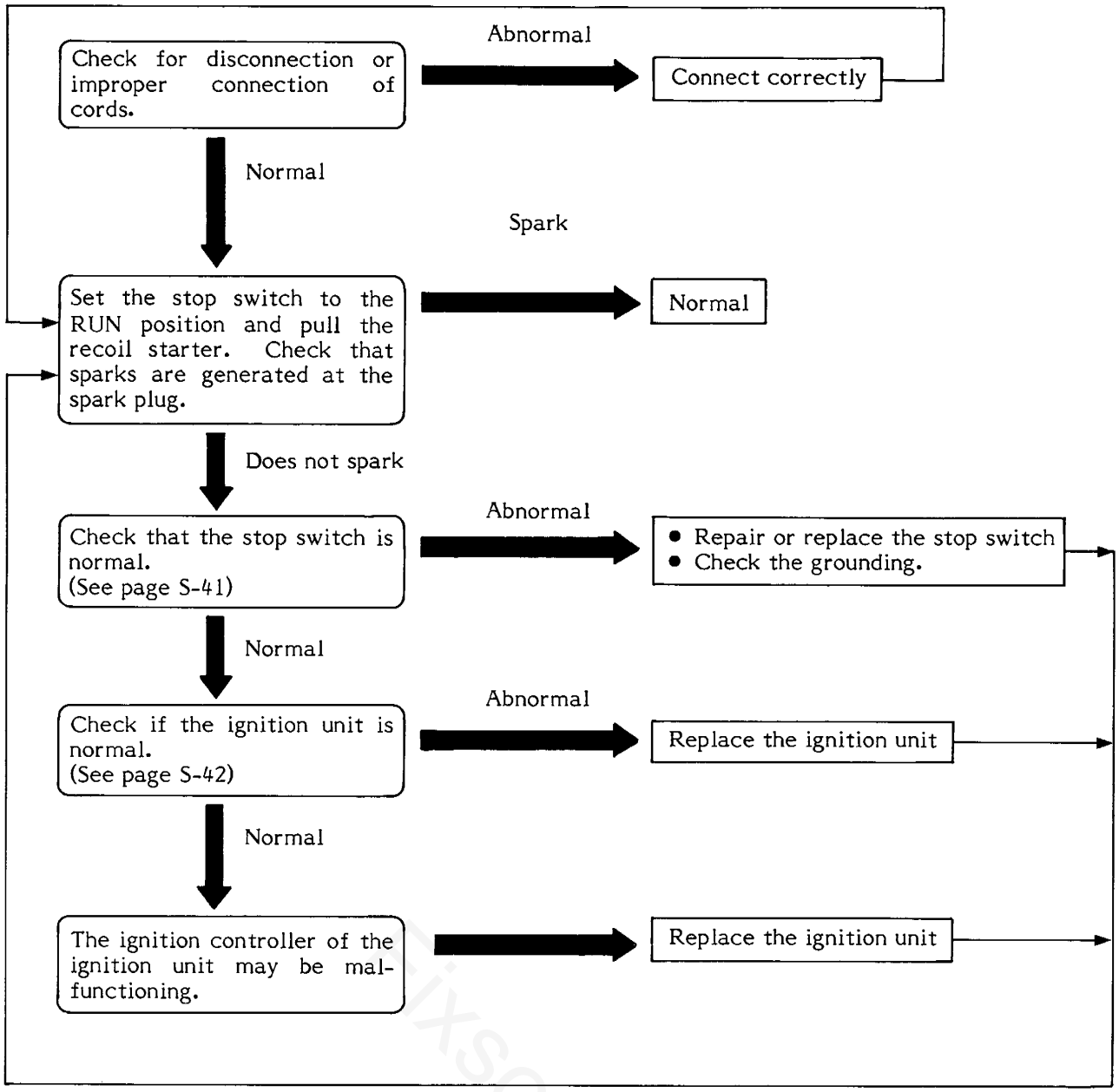
[2] TROUBLESHOOTING AND REMEDIES FOR POOR ENGINE STARTING

This special section is provided because difficulties in starting the engine are the most frequent problems associated with air-cooled engines.



[3] TROUBLESHOOTING AND REMEDIES FOR IGNITION SYSTEM

When the cause of an engine malfunction is found to be in the ignition system, follow the procedure below.



SERVICING SPECIFICATIONS

ENGINE BODY

Item		Factory Specification	Allowable Limit
Compression Pressure		490 kPa or more 5.0 kgf/cm^2 or more 71 psi or more	-
Cylinder Head	Surface Flatness	-	0.04 mm 0.0016 in.
Cylinder Liner	I.D.	73.00 to 73.02 mm 2.8740 to 2.8748 in.	73.12 mm 2.8787 in.
Oversize Cylinder Liner	I.D.	73.50 to 73.52 mm 2.8937 to 2.8945 in.	73.62 mm 2.8984 in.
Piston	O.D.	72.94 to 72.96 mm 2.8713 to 2.8724 in.	72.85 mm 2.8681 in.
Oversize Piston	O.D.	73.44 to 73.46 mm 2.8913 to 2.8921 in.	73.35 mm 2.8878 in.
Top Compression Ring Second Compression Ring	Gap	0.2 to 0.4 mm 0.008 to 0.016 in.	0.9 mm 0.035 in.
Oil Ring	Gap	0.2 to 0.9 mm 0.008 to 0.035 in.	-
Top Compression Ring Second Compression Ring	Thickness	1.97 to 1.99 mm 0.0776 to 0.0783 in.	1.95 mm 0.0768 in.
Oil Ring	Thickness	4 mm 0.157 in.	-
Piston Ring to Ring Groove Top Compression Ring Second Compression Ring	 Clearance Clearance	 0.05 to 0.09 mm 0.0020 to 0.0035 in. 0.02 to 0.06 mm 0.0008 to 0.0024 in.	 0.13 mm 0.005 in. 0.1 mm 0.004 in.
Piston Pin Hole	I.D.	17.994 to 18.002 mm 0.7085 to 0.7087 in.	18.04 mm 0.7102 in.
Piston Pin to Connecting Rod Small End Bore	Clearance	0.010 to 0.025 mm 0.0004 to 0.0010 in.	0.10 mm 0.004 in.
Piston Pin	O.D.	18.000 to 18.005 mm 0.7087 to 0.7089 in.	-
Connecting Rod Small End Bore	I.D.	18.015 to 18.025 mm 0.7093 to 0.7096 in.	-
Connecting Rod on Crank Pin	Side Clearance	0.4 to 1.1 mm 0.016 to 0.043 in.	1.5 mm 0.059 in.
Cam (Intake and Exhaust)	Height	30.200 to 30.215 mm 1.1890 to 1.1895 in.	30.1 mm 1.185 in.
Camshaft	Side Clearance	0.016 to 0.052 mm 0.0006 to 0.0020 in.	0.2 mm 0.008 in.
Crank Pin to Connecting Rod Big End Bore	Clearance	0.018 to 0.054 mm 0.0007 to 0.0021 in.	0.1 mm 0.004 in.
Crank Pin	O.D.	29.967 to 29.982 mm 1.1798 to 1.1804 in.	-
Connecting Rod Big End Bore	I.D.	30.000 to 30.021 mm 1.1811 to 1.1819 in.	-

ENGINE BODY (Continued)

Item		Factory Specification	Allowable Limit
Crankshaft	Side Clearance	0.02 to 0.1 mm 0.0008 to 0.0039 in.	0.2 mm 0.008 in.
Valve Clearance		0.07 to 0.13 mm 0.0028 to 0.0051 in.	-
Valve Spring	Free Length	32.8 to 33.3 mm 1.291 to 1.311 in.	32.5 mm 1.280 in.
Valve Stem (Intake Valve)	O.D.	6.960 to 6.975 mm 0.2740 to 0.2746 in.	6.860 mm 0.2701 in.
(Exhaust Valve)	O.D.	6.950 to 6.965 mm 0.2736 to 0.2742 in.	6.850 mm 0.2697 in.
Valve to Valve Guide (Intake Valve Side)	Clearance	0.035 to 0.075 mm 0.0014 to 0.0029 in.	0.1 mm 0.004 in.
(Exhaust Valve Side)	Clearance	0.045 to 0.085 mm 0.0018 to 0.0033 in.	0.1 mm 0.004 in.
Seat Surface	Grounding Width	1.0 to 1.3 mm 0.039 to 0.051 in.	1.7 mm 0.067 in.

IGNITION SYSTEM

Spark Plug	Gap	0.6 to 0.7 mm 0.024 to 0.028 in.	-
Ignition Coil	Primary Coil Resistance	Approx. 0.6 ohm	-
	Secondary Coil Resistance	Approx. 6.5 k ohm	-
	Pickup Coil	Approx. 50 ohm	-

TIGHTENING TORQUES

[1] Specified Screws, Bolts and Nuts for Engine

Item		Size x Pitch	Tightening Torque		
			N·m	kgf·m	ft-lbs
● Connecting rod screws		M8 x 1.25	16.7 to 22.6	1.7 to 2.3	12.3 to 16.6
● Flywheel mounting nut		M14 x 1.5	63.7 to 73.5	6.5 to 7.5	47.0 to 54.2
● Crankcase 2 mounting screws		M8 x 1.25	13.7 to 19.6	1.4 to 2.0	10.1 to 14.5
Drain plug		M12 x 1.25	6.9 to 9.8	0.7 to 1.0	5.1 to 7.2
Spark plug		M14 x 1.25	9.8 to 24.5	1.0 to 2.5	7.2 to 18.1
● Cylinder head screws		M10 x 1.5	34.3 to 46.1	3.5 to 4.7	25.3 to 34.0
Governor lever nut		M8 x 1.25	10.8 to 19.6	1.1 to 2.0	8.0 to 14.5
Speed control lever mounting nut		M8 x 1.25	5.88 to 6.76	0.6 to 0.9	4.34 to 4.99
Carburetor	Drain screw	-	1.08 to 1.86	0.11 to 0.19	0.80 to 1.37
	Float chamber mounting screw	M8 x 1.0	6.86 to 10.79	0.70 to 1.10	5.06 to 7.96
	Main jet	-	0.78 to 1.96	0.08 to 0.20	0.58 to 1.45

■ NOTE
- For "●" marked screws, bolts and nuts on the table, apply engine oil to their threads and seats before tightening.
- The letter "M" in Size x Pitch means that the screw, bolt or nut dimension is metric. The size is the nominal outside diameter in mm of the threads. The pitch is the nominal distance in mm between two threads.

[2] GENERAL USE SCREWS, BOLTS AND NUTS

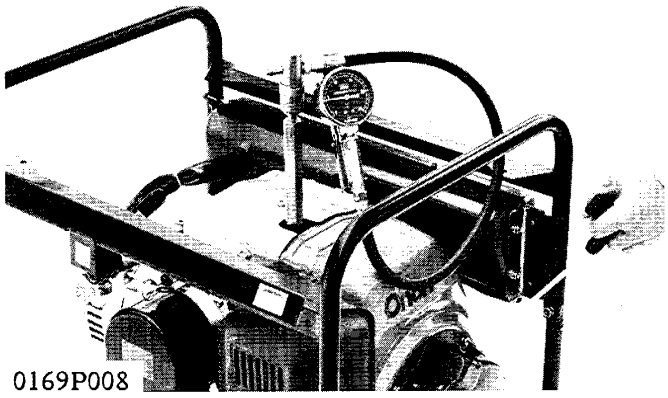
When the tightening torques are not specified, tighten the screws, bolts and nuts according to the table below.

Grade / Unit / Nominal Diameter	No-grade (⬡ or ④)			7T (⑦)		
	N·m	kgf·m	ft-lbs	N·m	kgf·m	ft-lbs
M6	7.85 to 9.32	0.80 to 0.95	5.79 to 6.87	9.81 to 11.28	1.00 to 1.15	7.23 to 8.32
M8	17.65 to 20.59	1.80 to 2.10	13.02 to 15.19	23.54 to 27.46	2.40 to 2.80	17.36 to 20.25
M10	39.23 to 45.11	4.00 to 4.60	28.93 to 33.27	48.05 to 55.90	4.90 to 5.70	35.44 to 41.23
M12	62.76 to 72.57	6.40 to 7.40	46.29 to 53.52	77.47 to 90.22	7.90 to 9.20	57.14 to 66.54

CHECKING, DISASSEMBLING AND SERVICING

[1] ENGINE BODY

CHECKING



0169P008

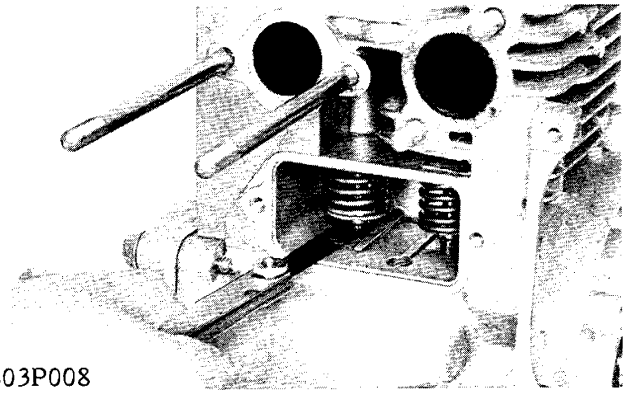
Compression Pressure

1. Run the generator until it is warmed up.
2. Stop the generator
3. Remove the fuel tank.
4. Remove the spark plug and connect the air-cooled compression tester to the plug hole.
5. Pull the recoil starter a full stroke several times and read the gauge.
6. Measure the compression pressure several times.
7. If the measurement is below the factory specification, check the valve seat contact and measure the compression pressure again.
8. If the reading does not improve, check the cylinder wall, valves and piston rings.

■ NOTE

- **Check the compression pressure with the specified valve clearance.**

Compression pressure	Factory spec.	490 kPa or more 5.0 kgf/cm^2 or more 71 psi or more



0603P008

Checking Valve Clearance

1. Remove the muffler, air cleaner, carburetor, tappet chamber cover and breather.
2. Put the piston in the compression top dead center.
3. Measure the clearance between the tip of the intake valve stem and the tappet and between the tip of the exhaust valve stem and the tappet with a feeler gauge.
4. If the measurement is less than the factory specifications, remove the valve and grind the tip of the valve stem using an oil stone.
5. If the measurement exceeds the factory specifications, replace the valve or the tappet.

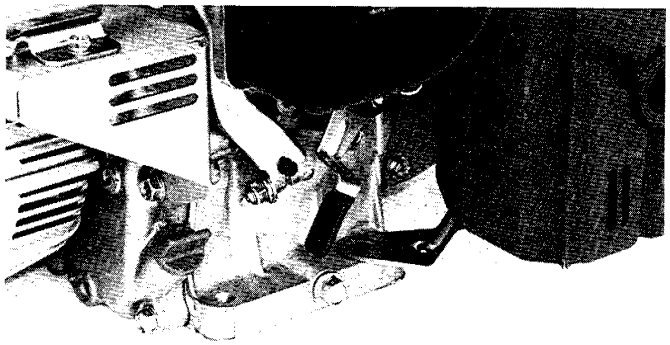
Valve clearance (IN. and EX.)	Factory spec.	0.08 to 0.13 mm 0.0031 to 0.0051 in.

■ NOTE

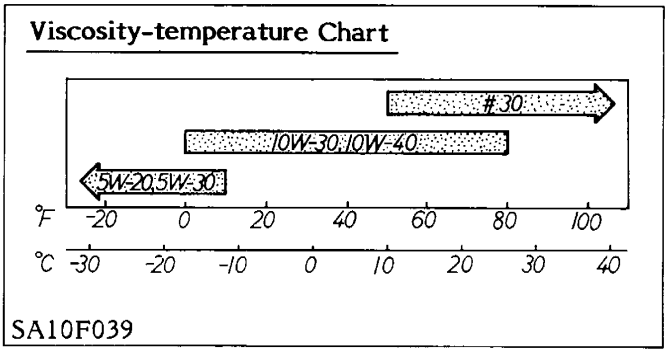
When replacing the valve, correct the valve sealing rate. (Refer to the page S-7)

DISASSEMBLING AND ASSEMBLING

(1) External Components



0169P009



SA10F039

Draining Engine Oil

1. Remove the oil plug and drain plug, and tilt the engine toward the drain plug to drain all the old oil completely.

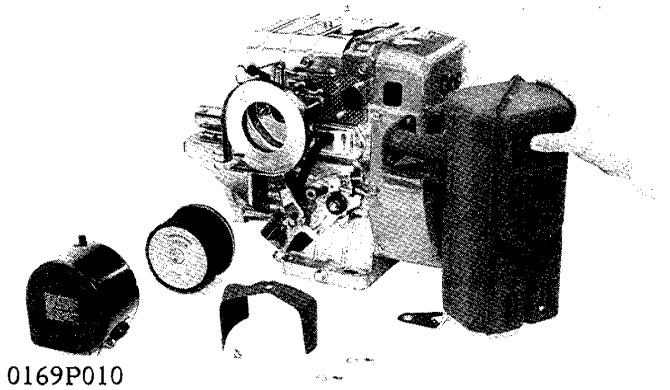
(When reassembling)

Tightening torque	Drain plug	6.9 to 9.8 N·m 0.7 to 1.0 kgf·m 5.1 to 7.2 ft-lbs

Engine crank-case capacity	0.9 ℓ (0.95 U.S.qts., 0.79 Imp.qts.)

■ IMPORTANT

- **When using oil of a different manufacturer or viscosity from the previous one, drain all the old oil. Never mix two different types of oil.**
- **The engine oil should have the properties of API service classification SE or SF. SAE viscosity recommended in the table at left depending on the lowest expected atmospheric temperature.**



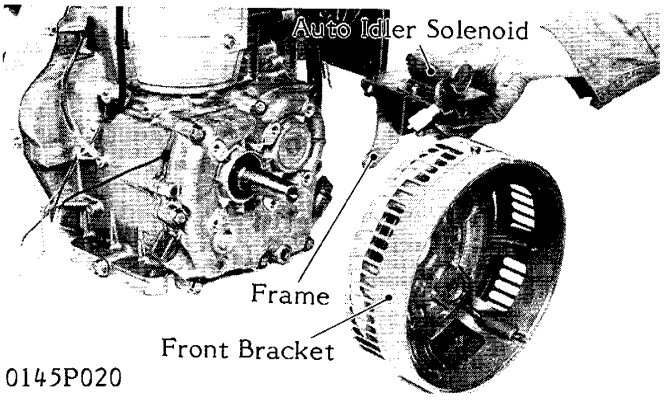
0169P010

Muffler and Air Cleaner

1. Remove the muffler and air cleaner.

(When reassembling)

- Replace the air cleaner elbow gasket with a new one.



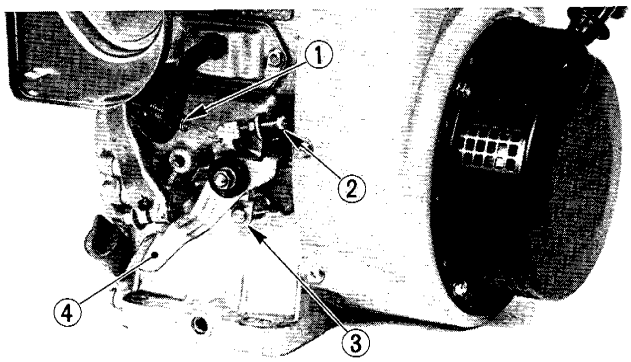
0145P020

Front Bracket and Auto Idler Solenoid

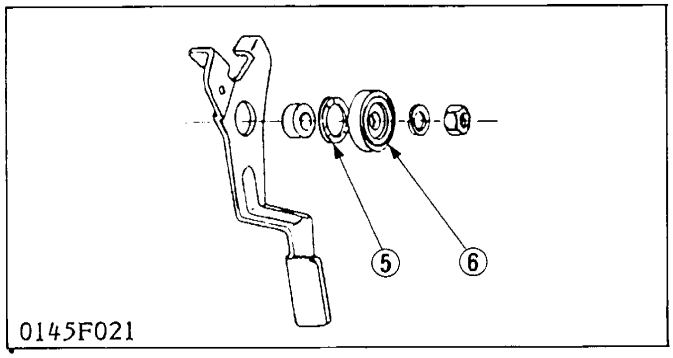
1. Remove the front bracket.
2. Remove the auto-idler solenoid frame and solenoid as one assembly.

■ NOTE

- **Do not remove the auto-idler solenoid from the frame needlessly. If the auto-idler solenoid is removed from the frame, install it by referring to page S-12.**

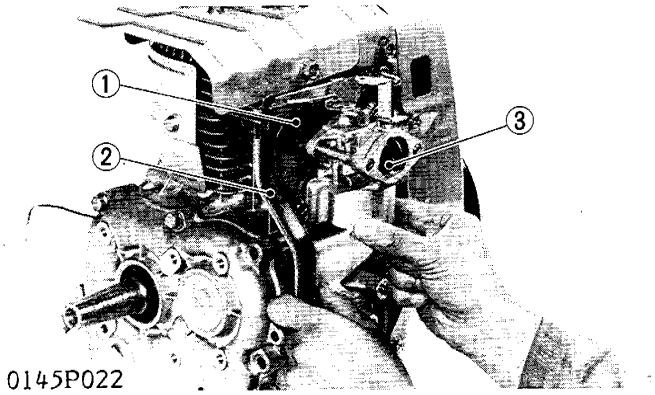


0145P021



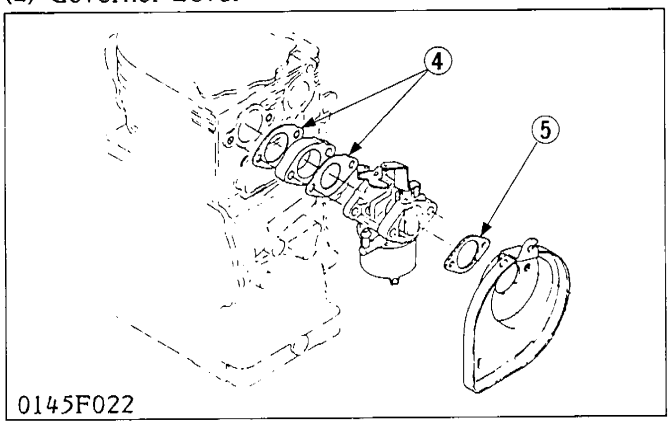
0145F021

(1) Governor Spring
(2) High-speed Adjusting Screw
(3) Speed Control Plate
(4) Speed Control Lever
(5) Spring Washer
(6) Pressure Plate



0145P022

(1) Carburetor Flange
(2) Governor Lever
(2) Carburetor



0145F022

(4) Gasket Flange
(5) Gasket Air Cleaner

Speed Control Lever and Speed Control Plate

1. Remove the governor spring (1).
2. Remove the speed control lever (4)and speed control plate (3).

(When reassembling)

- Install the spring washer (5) and pressure plate (6) as shown in the figure.
- Install the speed control lever (4) at the maximum position.
- Do not adjust the high-speed adjusting screw (2) needlessly. When adjusting, refer to S-13.

Tightening torque	Speed control lever mounting nut	5.88 to 6.76 N·m 0.6 to 0.9 kgf·m 4.34 to 4.99 ft-lbs

Carburetor and Governor Lever

1. Loosen the governor lever nut (7). (Refer to the next page.)
2. Remove the carburetor (3) with the governor lever (2).
3. Remove the carburetor flange (1).

■ NOTE

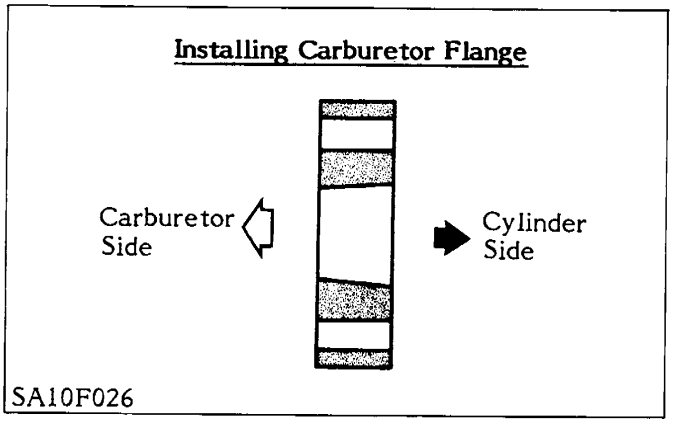
- **Remove the carburetor carefully to prevent the governor connecting rod and the spring from deforming.**
- **Put the carburetor in a clean place to protect it from dust.**

(When reassembling)

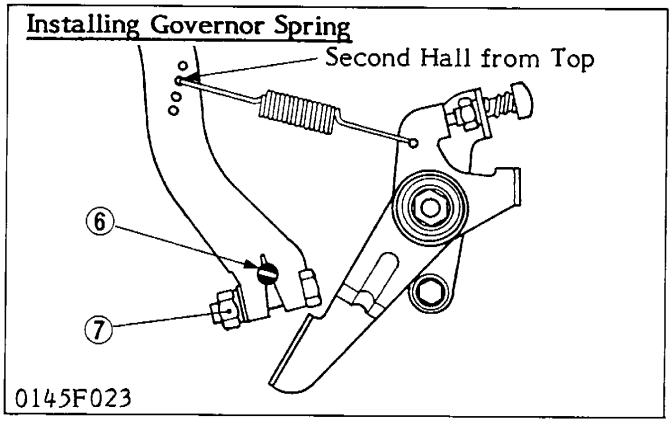
- Replace the gaskets (4), (5) with new ones.
- Install the carburetor flange as shown on the figure. (Refer to the next page.)
- Install the governor spring in the second hole from the top of the governor lever. (Refer to the next page.)
- When assembling the governor lever (2) and governor lever shaft (6.) (Refer to the page S-11.)

Tightening torque	Governor lever nut	10.8 to 19.6 N·m 1.1 to 2.0 kgf·m 8.0 to 14.5 ft-lbs

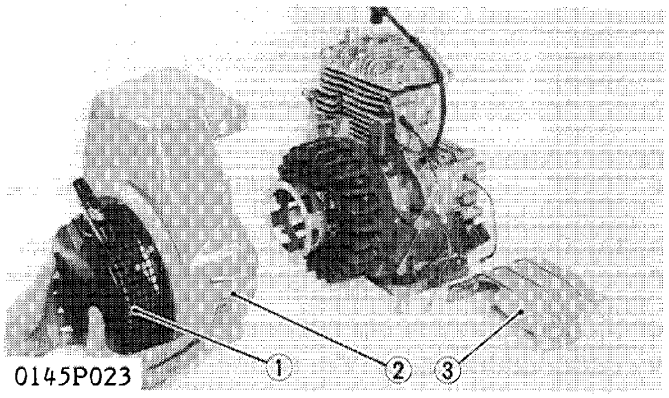
Installing Carburetor Flange



Installing Governor Spring



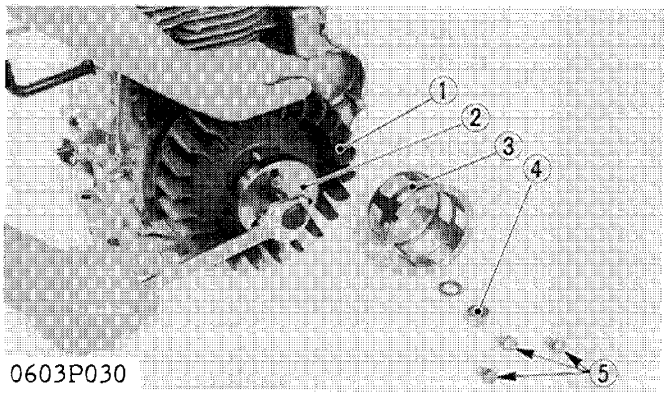
(6) Governor Lever Shaft (7) Governor Lever Nut



(1) Recoil Starter (3) Cylinder Head Cover
(2) Spiral Case

Cylinder Head Cover and Spiral Case

1. Remove the cylinder head cover (3).
2. Remove the spiral case (2) with the recoil starter (1).



(1) Flywheel (4) Flywheel Mounting Nut
(2) Flywheel Puller (5) Start Pulley Mounting Screw
(3) Start Pulley

Flywheel (rotor)

1. Unscrew the flywheel mounting nut (4).
2. Unscrew the start pulley mounting screws (5) and remove the start pulley (3).
3. Set the flywheel puller (2) to the flywheel and remove the flywheel (1).
4. Remove the woodruff key.

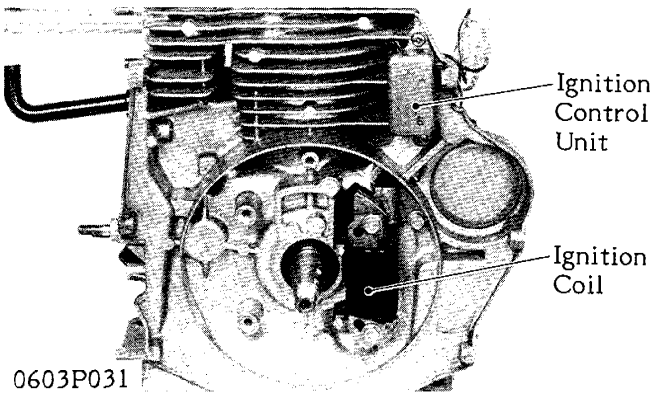
■ NOTE

- **Do not apply shock to the flywheel's fins.**
- **The tapered section of the flywheel must be free of oil, etc.**

(When reassembling)

- Apply engine oil to the flywheel mounting nut.

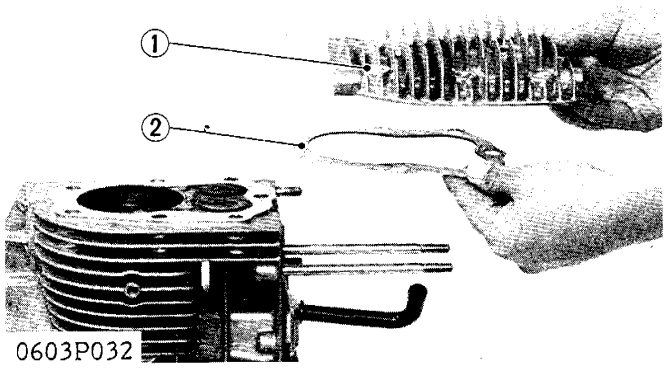
Tightening torque	Flywheel mounting nut	63.7 to 73.5 N·m 6.7 to 7.5 kgf·m 47.0 to 54.2 ft-lbs

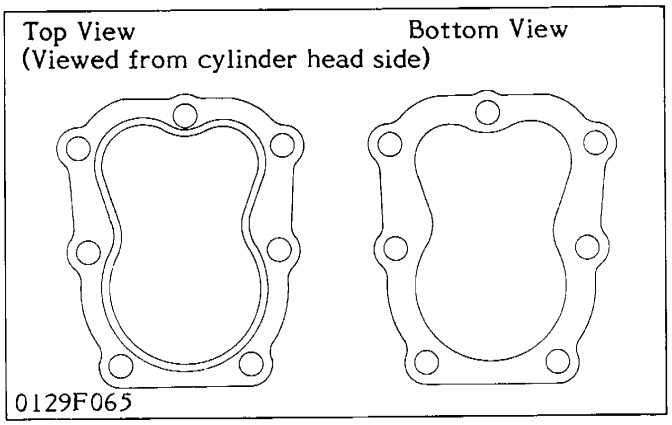


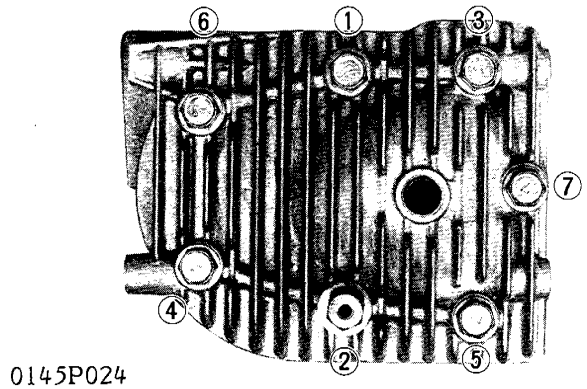
Ignition Coil and Ignition Unit

1. Remove the ignition coil
2. Remove the ignition unit

(2) Cylinder Head







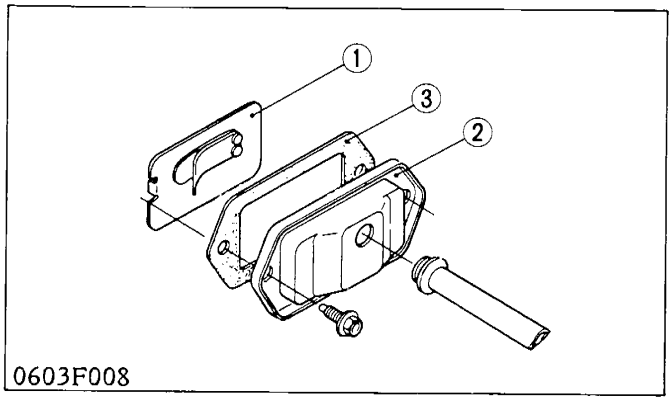
Spark Plug and Cylinder Head

1. Remove the cylinder cowling
2. Remove the spark plug
3. Remove the cylinder head and head gasket.

(When reassembling)

- Remove carbon in the combustion chamber of the cylinder head.
- Replace the cylinder head gasket with a new one.
- Install the cylinder head gasket as shown in the figure.
- Apply engine oil to the cylinder head screws.
- After tightening all the screws to approx. 19.6 N·m (2.0 kgf·m, 14.5 ft-lbs), retighten them to the specified torque in the order as shown in the photograph.

Tightening torque	Cylinder head screw	34.3 to 46.1 N·m 3.5 to 4.7 kgf·m 25.3 to 34.0 ft-lbs
	Spark plug	9.8 to 24.5 N·m 1.0 to 2.5 kgf·m 7.2 to 18.1 ft-lbs



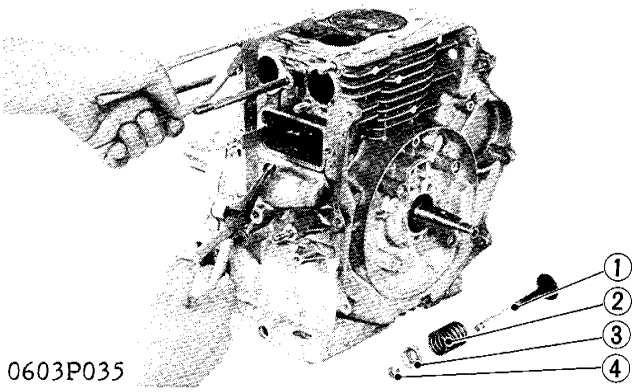
(1) Breather
(2) Tappet Chamber Cover
(3) Gasket

Breather

1. Remove the tappet chamber cover (2) and breather (1).

(When reassembling)

- Replace the tappet chamber cover gasket (3) with a new one.
- Install the tappet chamber cover in the order as shown in the figure.



(1) Exhaust Valve
(2) Valve Spring
(3) Valve Spring Retainer
(4) Collet

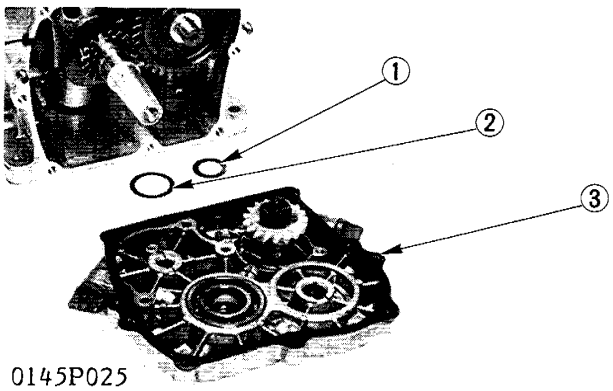
Intake and Exhaust Valves

1. Turn the crankshaft to lower the tappets and free the intake and exhaust valves from the tappets.
2. Compress the valve spring with a valve lifter and pull out the collet (4) with pliers.
3. Remove the exhaust valve (1).
4. Take out the valve spring (2) and valve spring retainer (3).
5. Remove the intake valve as above.

(When reassembling)

- Apply engine oil to the valve stem.

(3) Piston and Connecting Rod



(1) Cam Shaft Shim
(2) Crank Shaft Shim
(3) Crank Case 2

Crankcase 2

1. Remove the key and unscrew the crankcase 2 mounting screws.
2. Tap the crankcase 2 (3) with a plastic hammer to remove it.
3. Remove the crankshaft shim (1), and the camshaft shim (2).

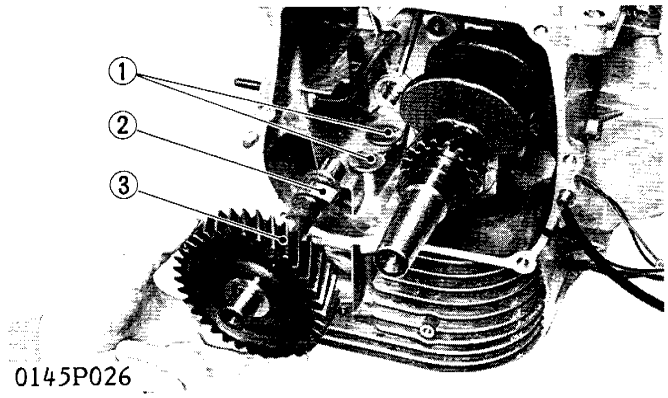
■ **NOTE**

- **Crankcase 2 is fixed at two places by dowel pins, and thus cannot be easily removed. Never try to pry it open with a screwdriver, etc.**

(When reassembling)

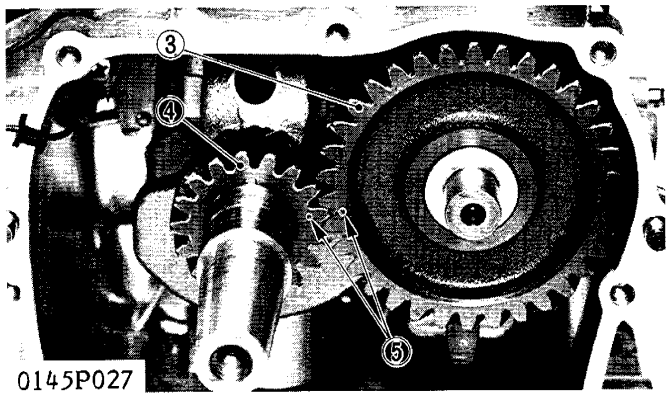
- Replace the crankcase 2 gasket with a new one.
- Apply engine oil to the crankcase 2 mounting screws.
- Install the shims in the original position

Tightening torque	Crankcase 2 mounting screw	13.7 to 19.6 N·m 1.4 to 2.0 kgf·m 10.1 to 14.5 ft-lbs



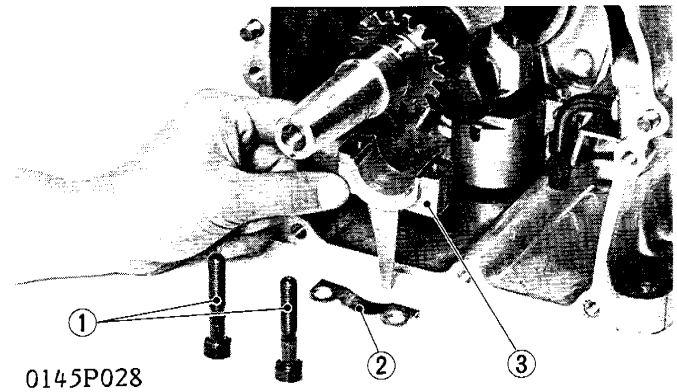
0145P026

(1) Tappet
(2) Cam Shaft
(3) Cam Gear



0145P027

(3) Cam Gear
(4) Crank Gear
(5) Alignment Marks



0145P028

(1) Connecting Rod Screw
(2) Connecting Rod Screw Washer
(3) Connecting Rod Cap

Camshaft and Tappet

1. Place the cylinder block upside down.
2. Pull out the camshaft (2) and cam gear (3) as one unit.
3. Remove the tappets (1).

(When reassembling)

- Apply engine oil to the tappet and the tooth surface of the cam gear.
- Install the tappets in their original position.
- The alignment marks (5) of the crank gear (4) and the cam gear (3) must come together when the cam gear is installed.

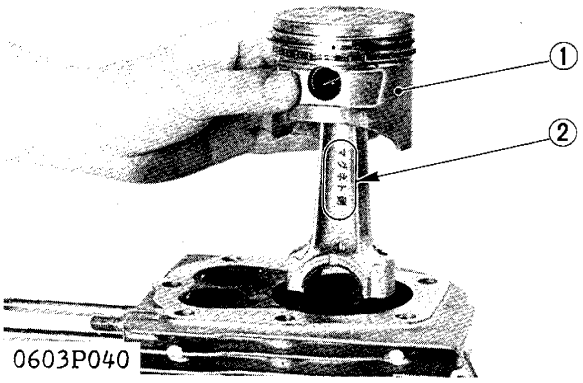
Connecting Rod Cap

1. Unscrew the connecting rod screws (1) and remove the connecting rod screw washer (2) and connecting rod cap (3).

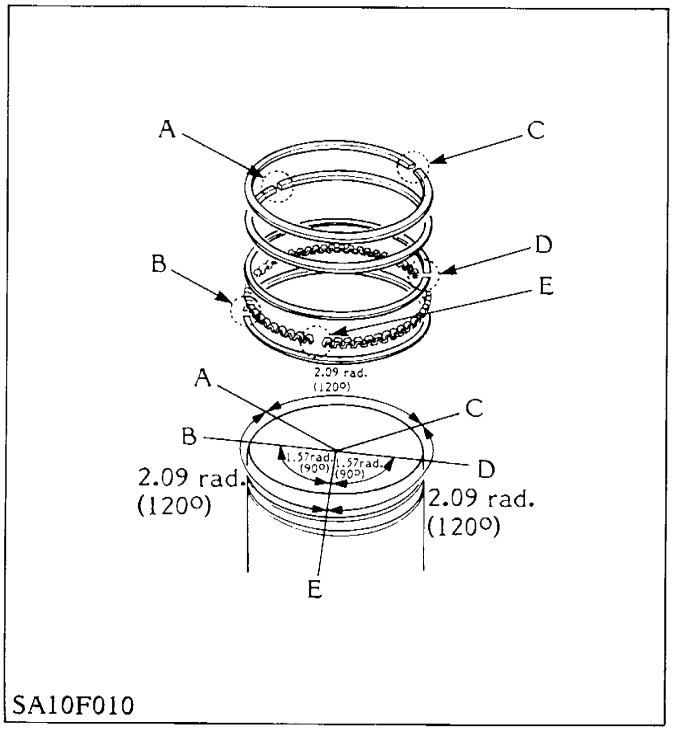
(When reassembling)

- Apply engine oil to the inner periphery of the connecting rod cap.
- Apply engine oil to the connecting rod screws.
- Align the machined surfaces of the connecting rod and connecting rod cap.

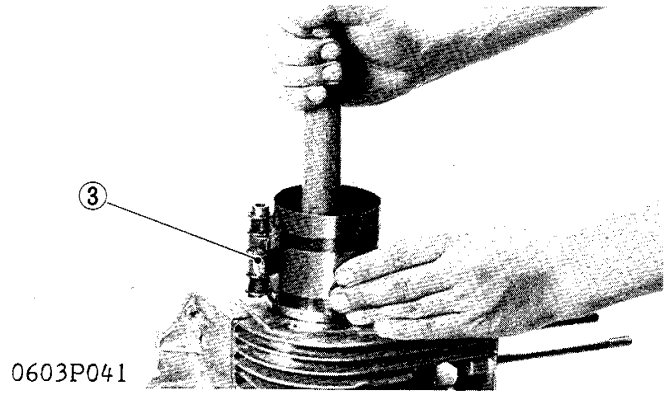
Tightening torque	Connecting rod screw	16.7 to 22.6 N·m 1.7 to 2.3 kgf·m 12.3 to 16.6 ft-lbs



(1) Piston (2) Casting Mark



(A) Second Compression Ring Gap
(B) Side Rail Gap
(C) Top Compression Ring Gap
(D) Side Rail Gap
(E) Spacer Gap



(3) Piston Ring Compressor

Piston

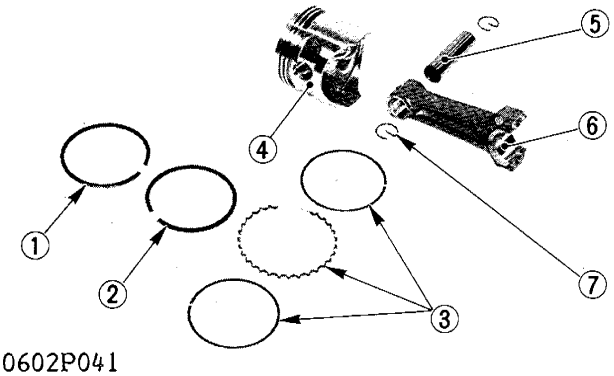
1. Pull out the piston (1) towards the cylinder head side.

(When reassembling)

- Before inserting the piston into the cylinder, apply enough engine oil to the cylinder.
- Be sure to install the piston into the cylinder so that the casting mark as shown (2) of the connecting rod faces toward the flywheel.

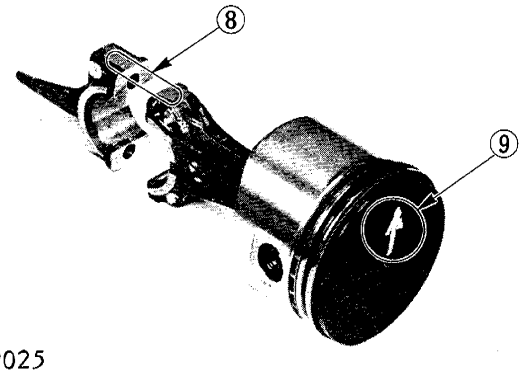
■ IMPORTANT

- **When inserting the piston into the cylinder, place the gap (C) of the top compression ring on the opposite side of the intake and exhaust valves and stagger the gaps (A), (E) of the second compression ring and spacer making 2.09 rad. (120°) from the gap of the top compression ring. Further, stagger the gaps (D), (B) of the upper and lower side rail making 1.57 rad. (90°) from the gap of the spacer.**
- **Carefully insert the piston using a piston ring compressor (3) (Code No. 07909-32111).**



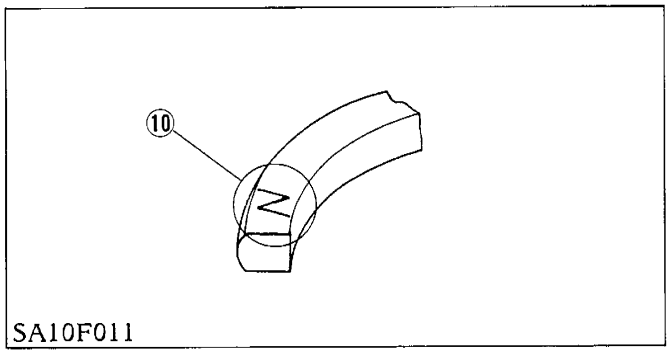
0602P041

(1) Top Compression Ring
(2) Second Compression Ring
(3) Oil Ring
(4) Piston
(5) Piston Pin
(6) Connecting Rod
(7) Piston Pin Snap Ring



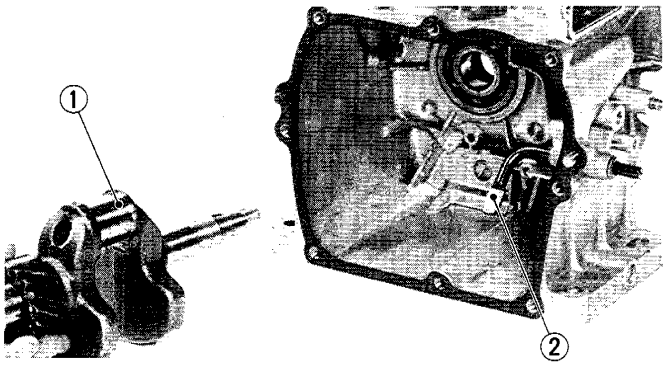
0129P025

(8) Machined Surface
(9) Parting Mark



SA10F011

(10) Manufacturer's Mark



0603P042

(1) Crankshaft
(2) Governor Lever Shaft

Piston Ring and Connecting Rod

1. Remove the piston rings using a piston ring tool
2. Put the parting mark (for example, ↑) (9) on the piston head as shown in the photograph.
3. Remove the piston pin (5) and separate the connecting rod (6) from the piston (4).

(When reassembling)

- When installing the rings, assemble them so that the manufacturer's mark (10) near the gap faces the top of the piston.
- Apply engine oil to the piston pin.
- Immerse the piston in 100°C (212°F) oil for 10 to 15 minutes and insert the piston pin into the piston.
- When installing the connecting rod to the piston, align the machined surface (8) on the connecting rod with the parting mark (9).

Crankshaft and Governor Lever Shaft

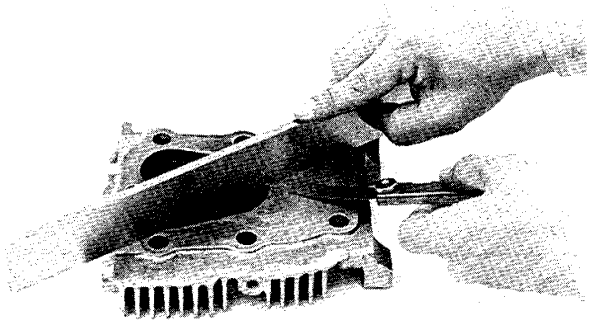
1. Remove the crankshaft (1).
2. Remove the snap ring and pull out the governor lever shaft (2).

(When reassembling)

- Apply engine oil to the governor lever shaft and the tooth surface of the crank gear.
- Push in the crankshaft carefully until it contacts the bearing surface to prevent damage to the oil seal.

SERVICING

(1) Cylinder Head and Cylinder Liner

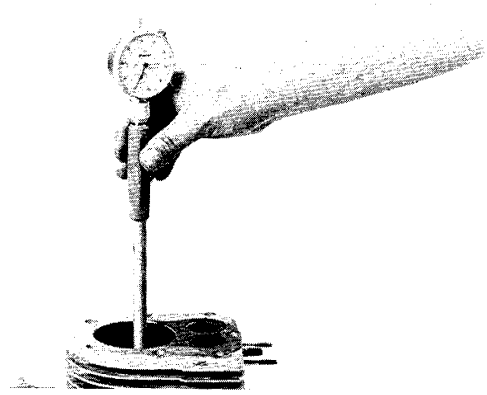


0117P022

Cylinder Head Surface Flatness

1. Clean the cylinder head surface.
2. Place a straight edge on the cylinder head and measure the clearance with a feeler gauge.
3. If the measurement exceeds the allowable limit, replace it.

Cylinder head surface flatness	Allowable limit	0.04 mm 0.0016 in.

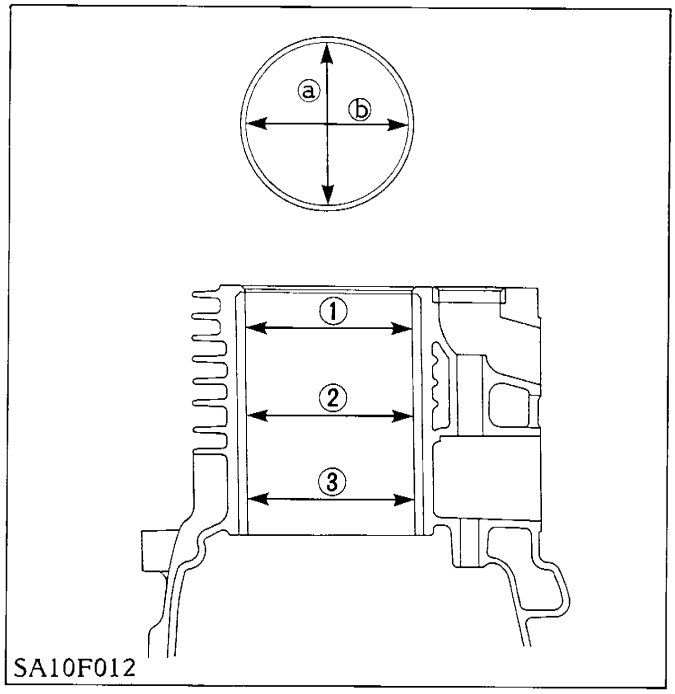


0129P026

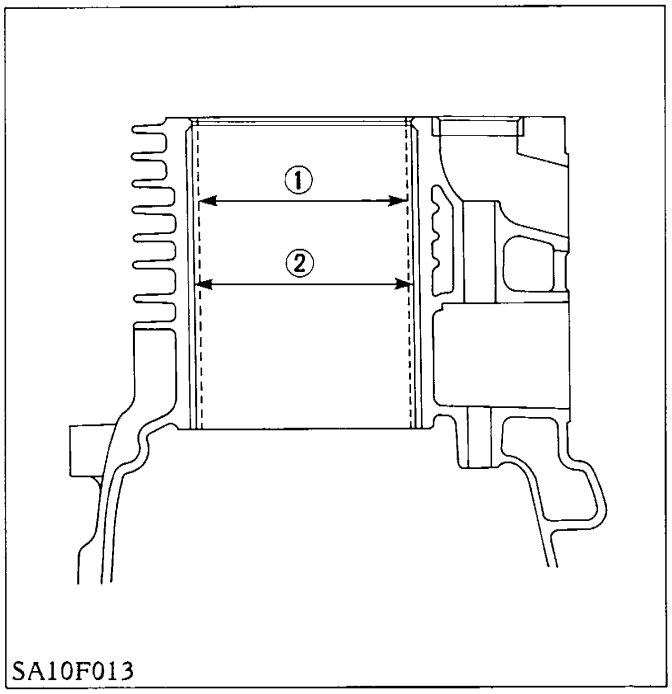
Cylinder Liner Wear

1. Measure the cylinder liner I.D. at the six positions (see figure) with a cylinder gauge to find out the maximum wear.
2. If the measurement exceeds the allowable limit, bore and hone the cylinder liner. (Refer to the page S-33.)

Cylinder liner I.D.	Factory spec.	73.00 to 73.02 mm 2.8740 to 2.8748 in.
	Allowable limit	73.12 mm 2.8787 in.



SA10F012



SA10F013

(1) Cylinder Liner I.D. (Before Correction)
(2) Oversize Cylinder Liner I.D.

Correcting Cylinder Liner

1. When the cylinder liner is worn beyond the allowable limit, bore and hone it to the factory specifications.

Oversize cylinder liner I.D.	Factory spec.	73.50 to 73.52 mm 2.8937 to 2.8945 in.

2. A cylinder with an oversized cylinder liner must use a piston and a ring of the same size.

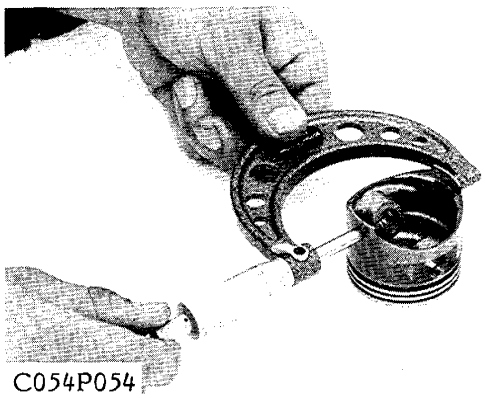
Oversize	Part Name	Mark
0.5 mm 0.020 in.	Piston(+0.5)	0.50
	Piston ring assembly(+0.5)	0.5

■ **NOTE**

- **When an oversized cylinder liner is worn beyond the allowable limit, replace the cylinder.**

Oversize cylinder liner I.D.	Allowable limit	73.62 mm 2.8984 in.

(2) Piston and Connecting Rod


C054P054

Piston O.D.

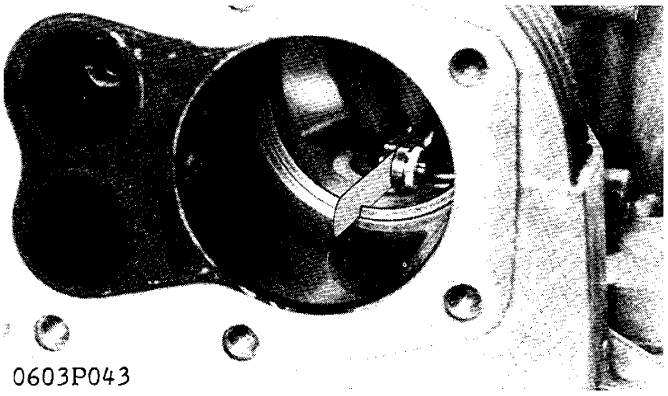
1. Measure the piston skirt O.D. with an outside micrometer. [Measure the O.D. 18 mm (0.71 in.) above the bottom of the skirt.]
2. If the measurement is less than the allowable limit, replace it.

Piston O.D.	Factory spec.	72.94 to 72.96 mm 2.7134 to 2.7142 in.
	Allowable limit	72.85 mm 2.8681 in.

(Reference)

- **Oversize Piston**

Oversize piston O.D.	Factory spec.	73.44 to 73.46 mm 2.8913 to 2.8921 in.
	Allowable limit	73.35 mm 2.8878 in.


0603P043

Piston Ring Gap

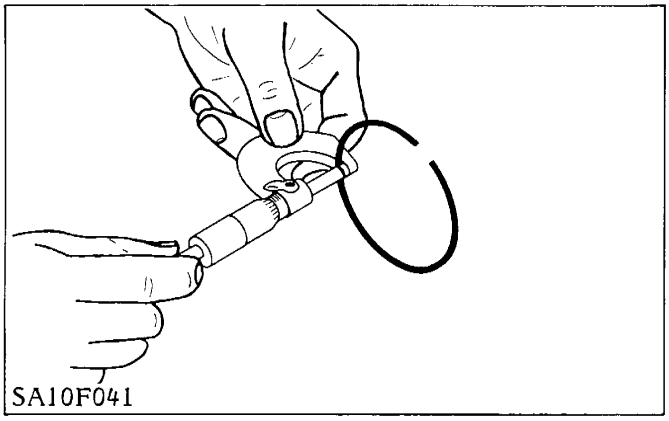
1. Insert the piston ring into the lower part of the liner (the least worn-out part) using the piston ring compressor and the piston.
2. Measure the ring gap with a feeler gauge.
3. If the measurement exceeds the allowable limit, replace it.

[Top Compression Ring, Second Compression Ring]

Piston ring gap	Factory spec.	0.2 to 0.4 mm 0.008 to 0.016 in.
	Allowable limit	0.9 mm 0.035 in.

[Oil Ring]

Piston ring gap	Factory spec.	0.2 to 0.9 mm 0.008 to 0.035 in.
	Allowable limit	-


SA10F041

Piston Ring Thickness

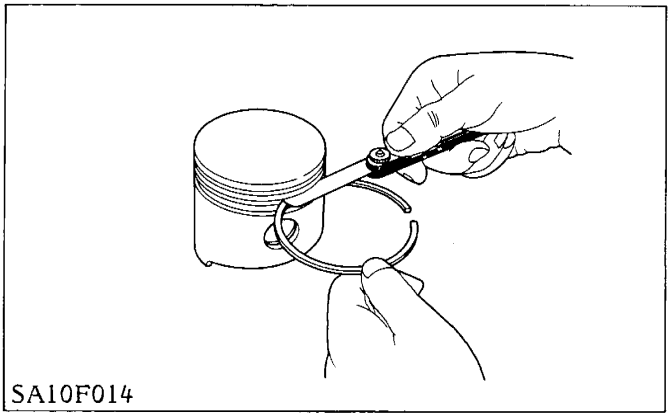
1. Measure the piston ring thickness with an outside micrometer.
2. If the thickness is less than the allowable limit, replace it.

[Top Compression Ring, Second Compression Ring]

Piston ring thickness	Factory spec.	1.97 to 1.99 mm 0.0776 to 0.0783 in.
	Allowable limit	1.95 mm 0.0768 in.

[Oil Ring]

Piston ring thickness	Factory spec.	4 mm 0.157 in.
	Allowable limit	-


SA10F014

Clearance between Piston Ring and Ring Groove

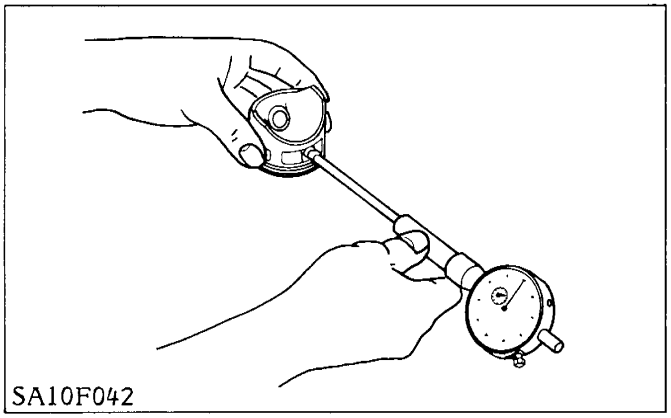
1. Clean the ring groove.
2. Insert the piston ring into the ring groove and measure the clearance with a feeler gauge at several points.
3. If the clearance exceeds the allowable limit, replace the piston ring.

[Top Compression Ring]

Clearance between piston ring and ring groove	Factory spec.	0.05 to 0.09 mm 0.0020 to 0.0035 in.
	Allowable limit	0.13 mm 0.005 in.

[Second Compression Ring]

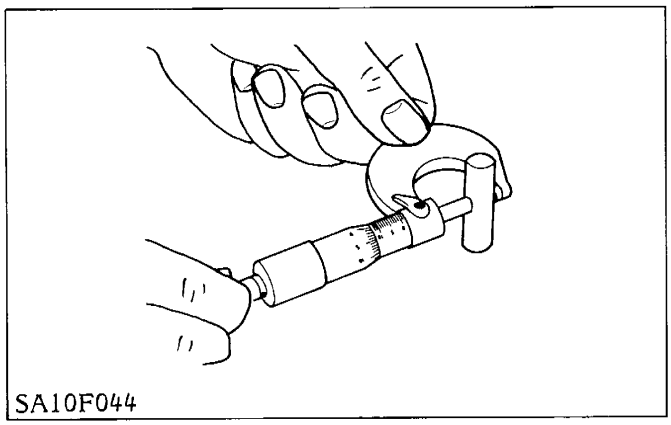
Clearance between piston ring and ring groove	Factory spec.	0.02 to 0.06 mm 0.0008 to 0.0024 in.
	Allowable limit	0.1 mm 0.004 in.


SA10F042

Piston Pin Hole

1. Measure the piston pin hole I.D. in both the vertical and horizontal directions with a cylinder gauge.
2. If the measurement exceeds the allowable limit, replace it.

Piston pin hole I.D.	Factory spec.	17.994 to 18.002 mm 0.7085 to 0.7087 in.
	Allowable limit	18.04 mm 0.7102 in.

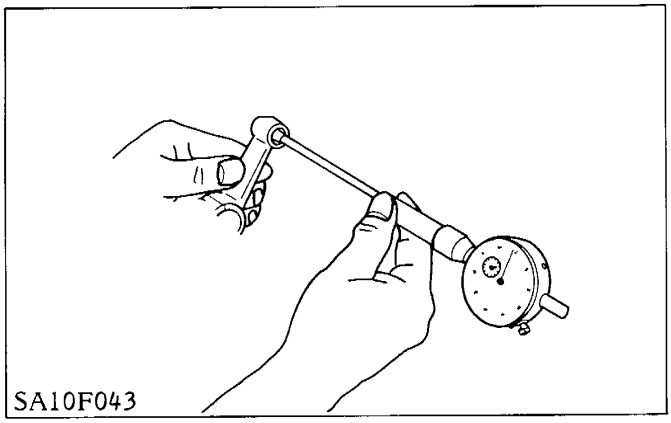

SA10F044

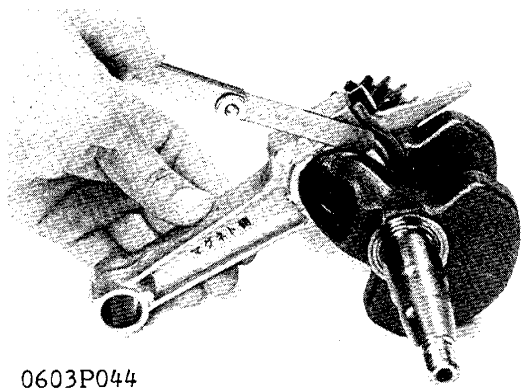
Clearance between Piston Pin and Connecting Rod Small End Bore

1. Measure the piston pin O.D. with an outside micrometer.
2. Measure the connecting rod small end bore I.D. with an inside micrometer and calculate the clearance.
3. If the clearance exceeds the allowable limit, replace them.

Clearance between piston pin and connecting rod small end bore	Factory spec.	0.010 to 0.025 mm 0.0004 to 0.0010 in.
	Allowable limit	0.10 mm 0.004 in.

Piston pin O.D.	Factory spec.	18.000 to 18.005 mm 0.7087 to 0.7089 in.
Connecting rod small end bore	Factory spec.	18.015 to 18.025 mm 0.7093 to 0.7096 in.


SA10F043

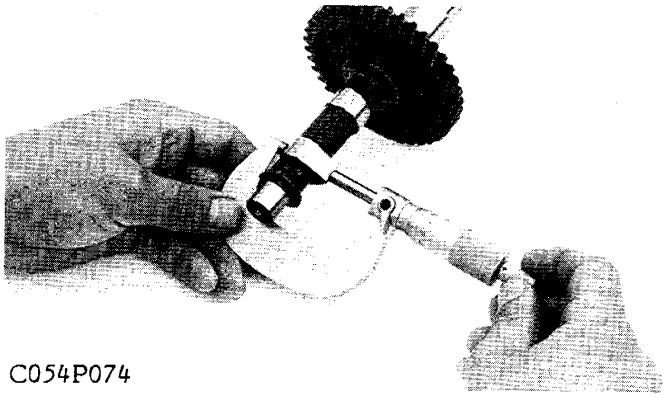

0603P044

Side Clearance of Connecting Rod on Crank Pin

1. Set the connecting rod to the crankshaft.
2. Measure the side clearance of the connecting rod with a feeler gauge.
3. If the clearance exceeds the allowable limit, replace it.

Side clearance of connecting rod on crank pin	Factory spec.	0.4 to 1.1 mm 0.016 to 0.043 in.
	Allowable limit	1.5 mm 0.059 in.

(3) Camshaft and Crankshaft

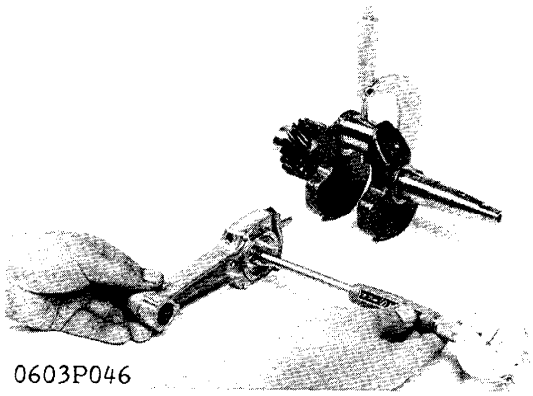


C054P074

Cam Heights of Intake and Exhaust

1. Measure the height of the cam at its highest point with an outside micrometer.
2. If the measurement is less than the allowable limit, replace the camshaft.

Cam heights of intake and exhaust	Factory spec.	32.8 to 33.3 mm 1.291 to 1.311 in.
	Allowable limit	32.5 mm 1.280 in.

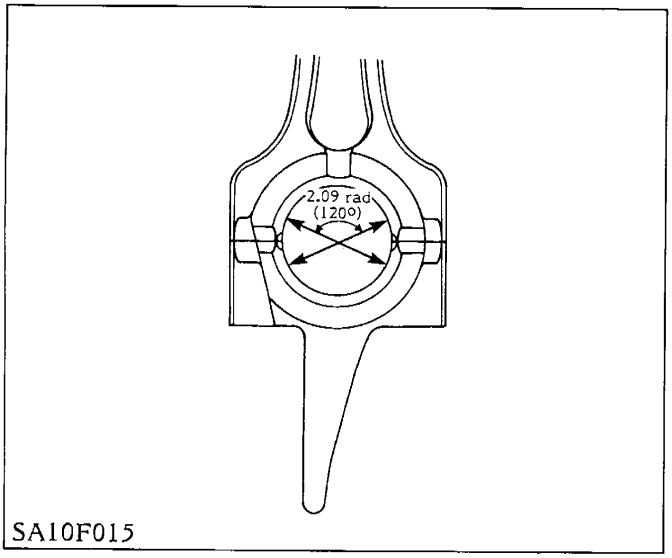


0603P046

Clearance between Crank Pin and Connecting Rod Big End Bore

1. Measure the crank pin O.D. with an outside micrometer.
2. Tighten the connecting rod screws to the specified torque. (See page S-29)
3. Measure the connecting rod big end bore with a cylinder gauge and calculate the clearance.
4. If the clearance exceeds the allowable limit, replace them.

Clearance between crank pin and connecting rod big end bore	Factory spec.	0.018 to 0.054 mm 0.0007 to 0.0021 in.
	Allowable limit	0.1 mm 0.004 in.

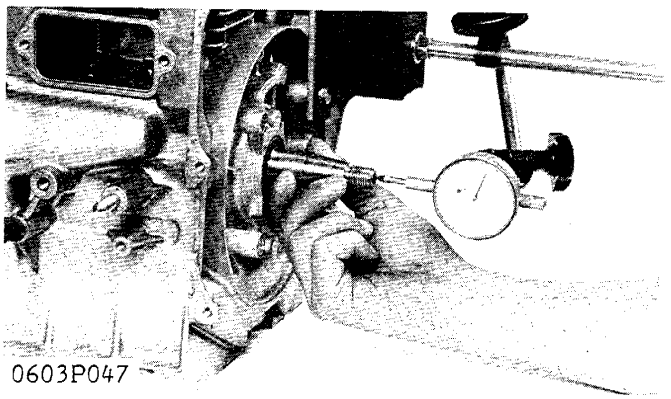


SA10F015

Crank pin O.D.	Factory spec.	29.967 to 29.982 mm 1.1798 to 1.1804 in.
Connecting rod big end bore	Factory spec.	30.000 to 30.021 mm 1.1811 to 1.1819 in.

■ **NOTE**

- **Measuring points of the connecting rod big end bore are shown in the figure.**



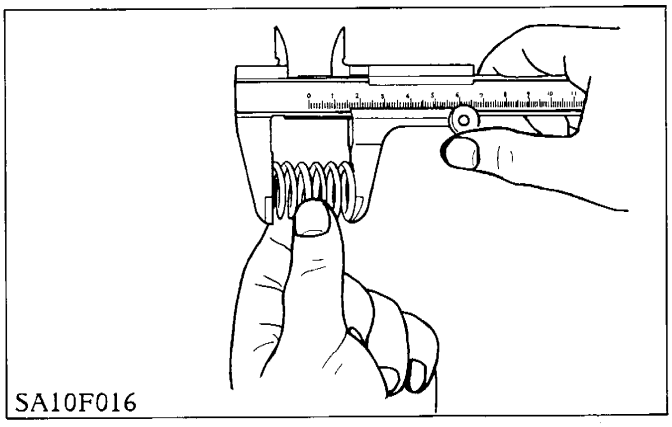
0603P047

Side Clearance of Crankshaft

1. Attach a metal plate to the cylinder.
2. Set a dial indicator to the crankshaft.
3. Measure the side clearance by moving the crankshaft to the front and rear.
4. If the side clearance exceeds the allowable limit, adjust it with shims.

Side clearance of crankshaft	Allowable limit	0.2 mm 0.008 in.

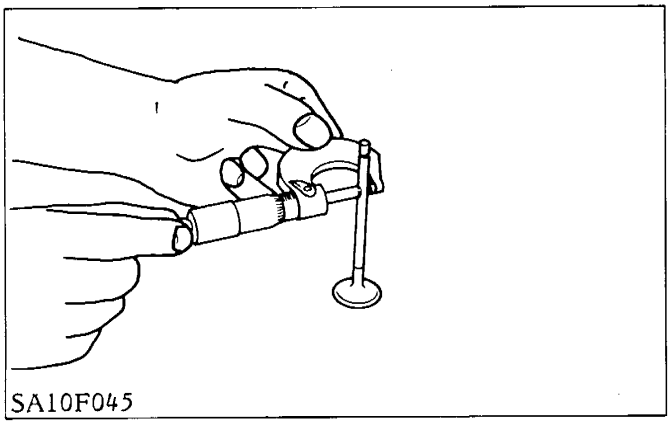
(4) Valves


SA10F016

Valve Spring Free Length

1. Measure the valve spring with vernier calipers.
2. If the measurement is less than the allowable limit, replace it.

Valve spring free length	Factory spec.	32.8 to 33.3 mm 1.291 to 1.311 in.
	Allowable limit	32.5 mm 1.280 in.


SA10F045

Valve Stem O.D.

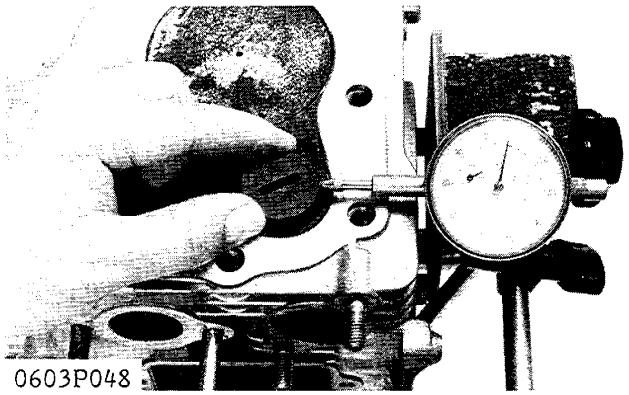
1. Measure the valve stem O.D. with an outside micrometer.
2. If the measurement is less than the allowable limit, replace it.

[Intake Valve]

Valve stem O.D.	Factory spec.	6.960 to 6.975 mm 0.2740 to 0.2746 in.
	Allowable limit	6.860 mm 0.2701 in.

[Exhaust Valve]

Valve stem O.D.	Factory spec.	6.950 to 6.965 mm 0.2736 to 0.2742 in.
	Allowable limit	6.850 mm 0.2697 in.


0603P048

Clearance between Valve and Valve Guide

1. Remove carbon from the valve guide.
2. Check that the valve stem is not bent against the valve.
3. Attach a metal plate to the cylinder and set a dial indicator in place.
4. Measure the clearance at the point where the valve contacts the valve guide.
5. If the measurement exceeds the allowable limit, replace the valve and valve guide.

[Intake Valve Side]

Clearance between valve and valve guide	Factory spec.	0.035 to 0.075 mm 0.0014 to 0.0029 in.
	Allowable limit	0.1 mm 0.004 in.

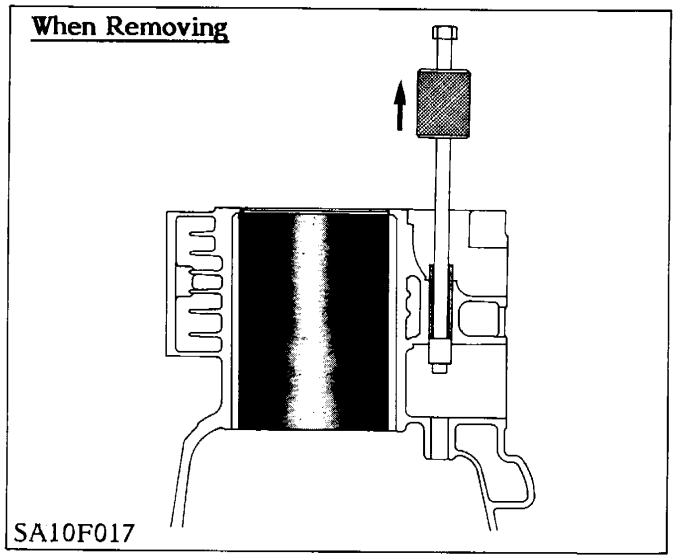
Valve stem O.D.	Factory spec.	6.960 to 6.975 mm 0.2740 to 0.2746 in.
Valve guide I.D.	Factory spec.	7.010 to 7.035 mm 0.2760 to 0.2770 in.

[Exhaust Valve Side]

Clearance between valve and valve guide	Factory spec.	0.045 to 0.085 mm 0.0018 to 0.0033 in.
	Allowable limit	0.1 mm 0.004 in.

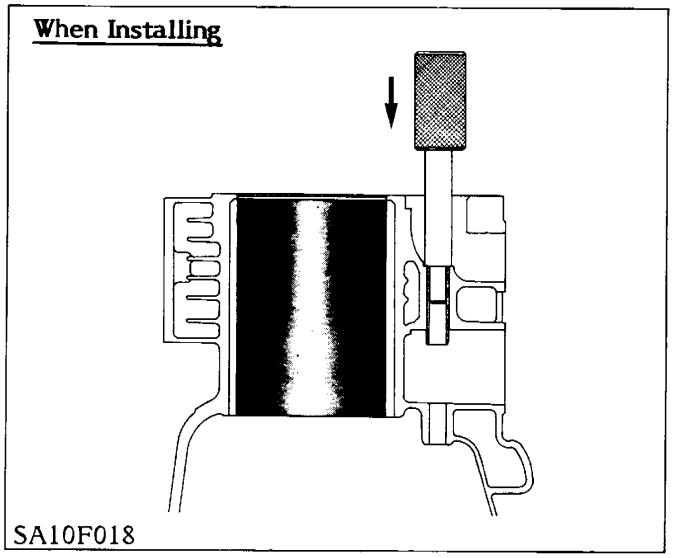
Valve stem O.D.	Factory spec.	6.950 to 6.965 mm 0.2736 to 0.2742 in.
Valve guide I.D.	Factory spec.	7.010 to 7.035 mm 0.2760 to 0.2770 in.

When Removing

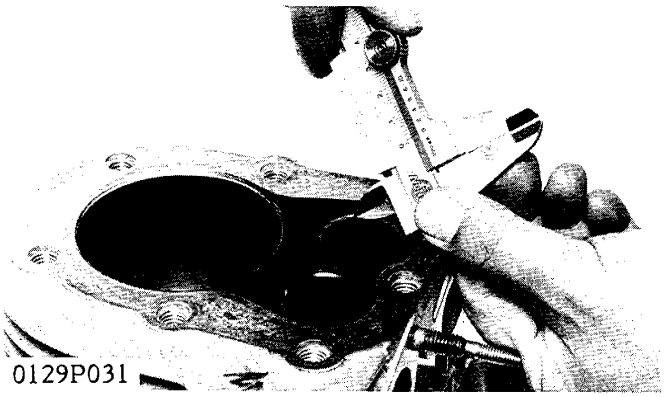


SA10F017

When Installing



SA10F018



0129P031

Replacing Valve Guide

1. Pull out the used valve guide from the cylinder block's upper side with a valve guide replacing tool. (See page S-9)
2. Apply engine oil to the outer surface of a new valve guide and press fit it from the cylinder block's upper side.

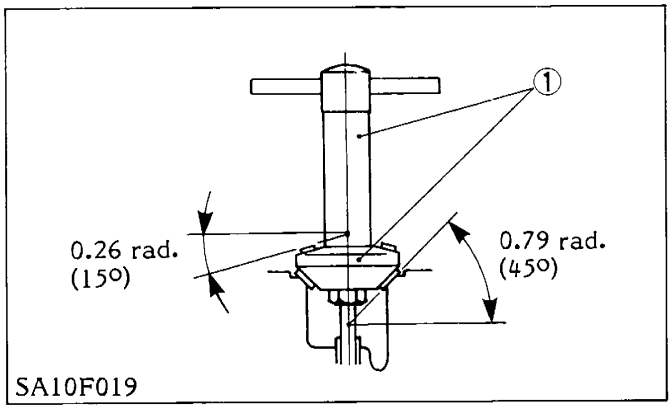
■ NOTE

- **Be careful not to strike the valve guide with a hammer, etc. during replacement.**

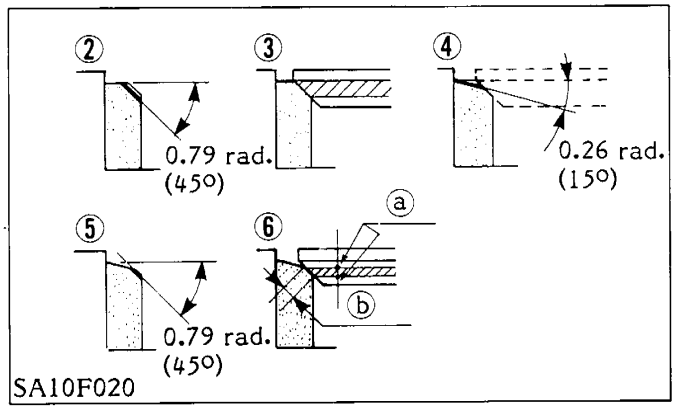
Seat Surface Grounding Width

1. Clean the valve seat surface.
2. Measure the seat width with vernier calipers.
3. Apply red lead to the valve surface to check for scratches and unevenness.
4. If the measurement is within the allowable limit, check the seating ratio. If the ratio is less than 70%, it needs to be refit. (See page S-7, S-39)
5. If the measurement exceeds the allowable limit, replace the cylinder and the valve and refit or repair the valve seat.

Seat surface grounding width	Factory spec.	1.0 to 1.3 mm 0.039 to 0.051 in.
	Allowable limit	1.7 mm 0.067 in.



SA10F019



SA10F020

(1) Valve Seat Cutter
(2) 0.79 rad. (45°) Valve Seat Cutter
(3) Contact Check
(4) 0.26 rad. (15°) Valve Seat Cutter
(5) 0.79 rad. (45°) Valve Seat Cutter
(6) Contact Check
(a) Identical Dimensions
(b) Seat Surface Width

Correcting Procedure for Valve Seat

1. Correct the valve seat surface with a 0.79 rad. (45°) valve seat cutter (Valve seat cutter set).
2. Replace the valve and visually check the contact position between the valve face and valve seat with red lead.
   (If the valve has been used for a long time, the seat tends to come in contact with the upper side of the valve face.)
3. Cut the upper surface of the valve seat with a 0.26 rad. (15°) valve seat cutter until the valve seat touches the center of the valve face (so that **a** equals **b** as shown in the figure).
4. Cut the seat with a 0.79 rad. (45°) valve seat cutter again and visually recheck the contact between the valve and seat.
5. Repeat steps 3 and 4 until the correct contact is achieved.
6. Continue lapping until the seated rate becomes more than 70% of the total contact area.

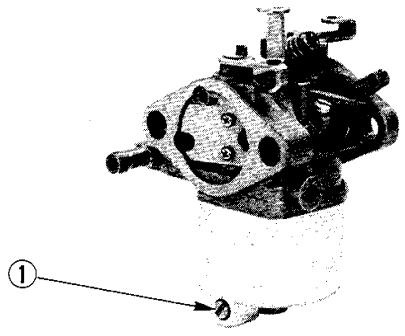
[2] FUEL SYSTEM

CHECKING AND ADJUSTING

- To adjust the idling speed and maximum speed of the engine, refer to S-11, S-12, and S-13.

DISASSEMBLING AND ASSEMBLING

(1) Carburetor



0603P054

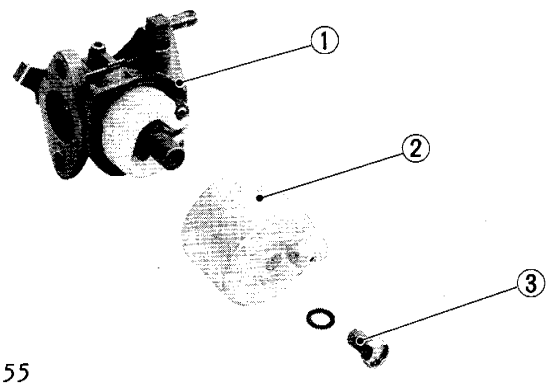
(1) Drain Screw

Draining Fuel

1. Loosen the drain screw (1) and drain the fuel from the float chamber.

(When reassembling)

Tightening torque	Drain screw	1.08 to 1.86 N·m 0.11 to 0.19 kgf·m 0.80 to 1.37 ft-lbs



0603P055

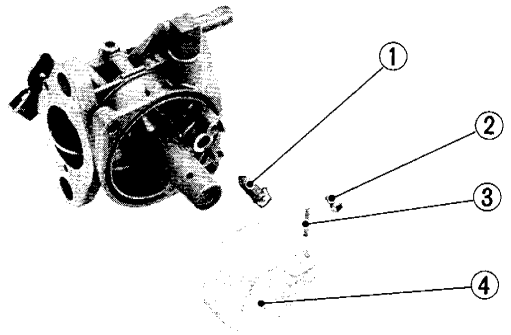
(1) Carburetor Body
(2) Float Chamber
(3) Float Chamber Mounting Screw

Float Chamber

1. Remove the float chamber mounting screw (3).
2. Separate the float chamber (2) from the carburetor body (1).

(When reassembling)

Tightening torque	Float chamber mounting screw	6.86 to 10.79 N·m 0.70 to 1.10 kgf·m 5.06 to 7.96 ft-lbs



0603P057

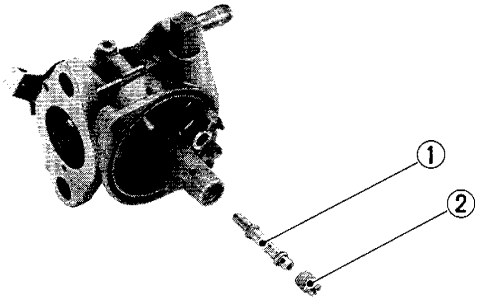
(1) Needle Valve
(2) Screw
(3) Float Pin
(4) Float

Float and Needle Valve

1. Remove the float pin (3).
2. Remove the float (4) with the needle valve (1).

(When reassembling)

- Overflow may result when there is dust between the needle valve (1) and the valve seat. Remove the dust carefully.



0603P056

(1) Main Nozzle
(2) Main Jet

Main Jet and Main Nozzle

1. Remove the main jet (2).
2. Remove the main nozzle (1).

(When reassembling)

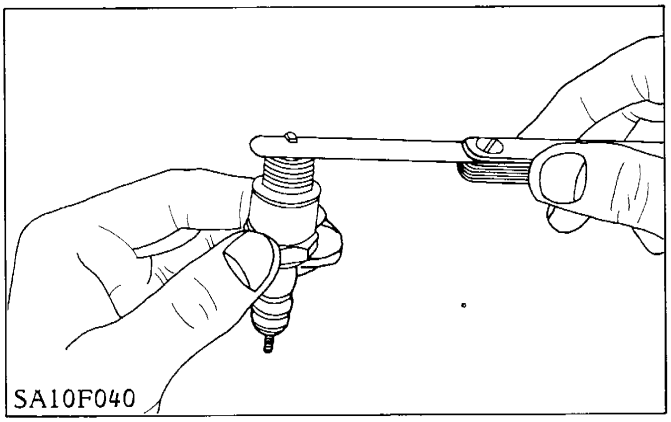
- Clean the parts and air passages inside the carburetor body with compressed air before reassembling the parts.

Tightening torque	Main jet	0.78 to 1.96 N·m 0.08 to 0.20 kgf·m 0.58 to 1.45 ft-lbs

[3] IGNITION SYSTEM

CHECKING AND ADJUSTING

(1) Spark Plug



Spark Plug Gap

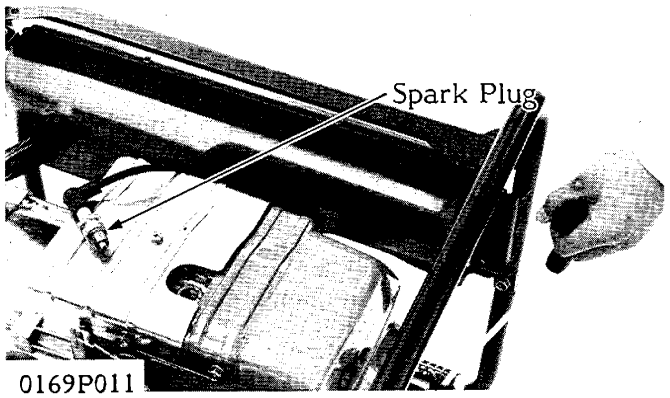
1. Remove the spark plug and remove carbon from the electrode with a wire brush.
2. Measure the spark plug gap with a feeler gauge.
3. If the measurement is not within the factory specifications, repair or replace it.
4. If the electrode or insulator is deformed or cracked, replace the plug.
5. If the spark plug cap is defective, replace the cap.

Spark plug gap	Factory spec.	0.6 to 0.7 mm 0.024 to 0.028 in.

Tightening torque	Spark plug	9.8 to 24.5 N·m 1.0 to 2.5 kgf·m 7.2 to 18.1 ft-lbs

■ IMPORTANT

- **When replacing the spark plug, be sure to use a resistor spark plug.**
- **When replacing the spark plug cap, be sure to use a resistor plug cap.**



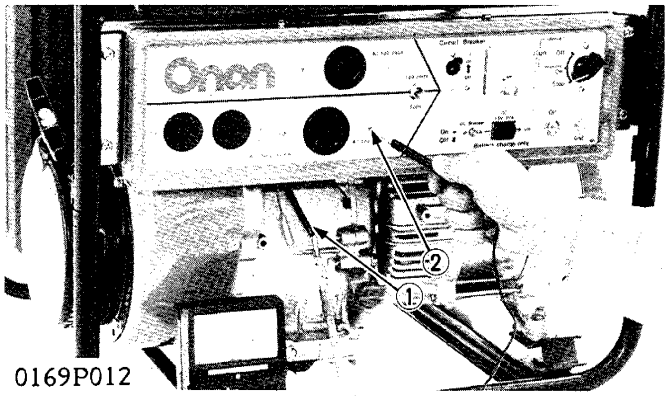
Spark Test

1. Remove the spark plug, insert it firmly inside the high voltage lead cap, and then ground the threaded section to the engine body (not to painted or resin parts).
2. Set the stop switch at the **Run** position.
3. Pull the recoil starter strongly and check that the plug sparks.

WARNING ⚠

- **Never hold the voltage lead in your hand while performing this test.**
- **Make sure that no fuel has been spilled on the engine.**
- **To avoid fire hazards, do not allow the spark near the plug hole.**

(2) Stop Switch



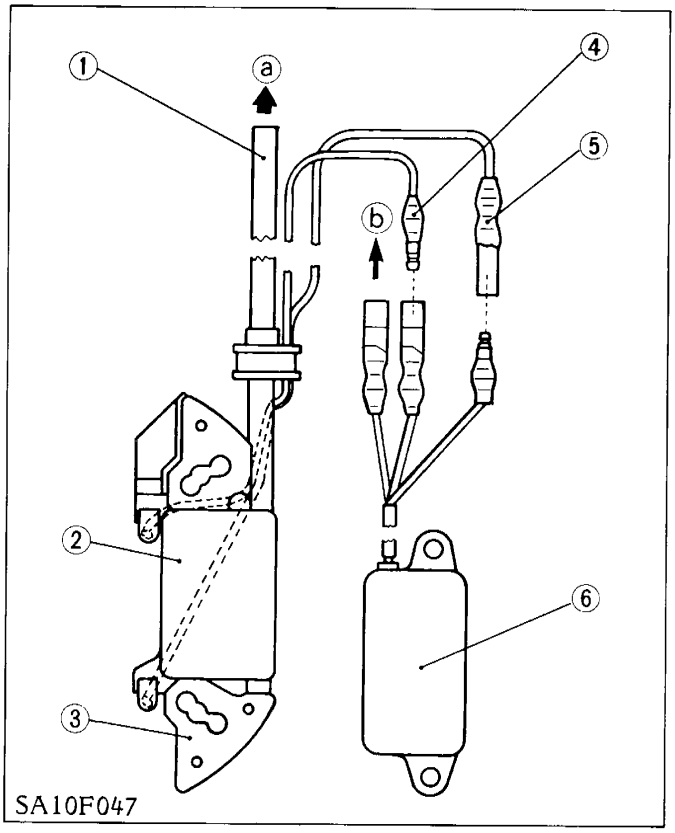
(1) Lead Terminal (2) Ground

Switch Continuity

1. Disconnect the stop switch lead connector.
2. Measure the resistance with an ohmmeter across the green lead terminal (1) on the front panel and ground (2) when the stop switch is set at the **RUN** and **STOP** position.
3. If the specified value is not indicated, replace the stop switch.

Resistance across the lead terminal (1) and ground(2)	Factory spec.	Stop switch at **RUN** position	Infinity
		Stop switch at **STOP** position	0 ohm

(3) Ignition Coil



(1) High Voltage Lead
(2) Ignition Coil
(3) Ground
(4) Pickup Circuit Connector (Red/White)
(5) Primary Circuit Connector (Black/Yellow)
(6) Ignition Controller
(a) To Spark Plug
(b) To Stop Switch

Coil Test (Simplified Test with Ohmmeter)

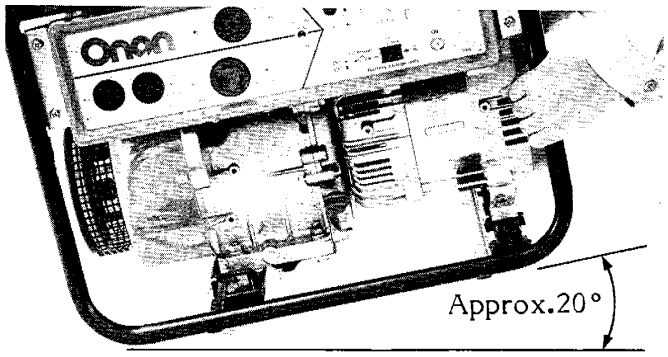
1. Disconnect the primary circuit connector, pickup circuit connector and the high voltage cord from the spark plug.
2. Measure the resistance across the primary circuit connector (5) and ground (3) or the engine body.
3. Measure the resistance across the high voltage cord (1) and ground (3).
4. Measure the resistance across the pickup circuit connector (4) and ground (3).
5. Replace the ignition coil if the factory specification is not indicated.

Resistance across primary circuit connector (5) and ground (3)	Factory spec.	Approx. 0.6 ohm
Resistance across high voltage cord (1) and ground (3)	Factory spec.	Approx. 6.5 k ohm
Resistance across pickup circuit connector (4) and ground (3)	Factory spec.	Approx. 50 ohm

■ NOTE

- **The primary and secondary coils can be checked only from the outside. When the spark fails even though the measured resistances of the primary and secondary coils are normal, the trouble may result from a defective ignition controller. When the controller is defective, the entire ignition controller needs to be replaced.**

(4) Testing Oil Watch System



0169P013

Inclination of generator	Resistance
0 to approx. 20 degrees	Infinty
More than approx. 20 degrees (in all directions: refer to the above photograph)	Continuty

Oil Watch System Test

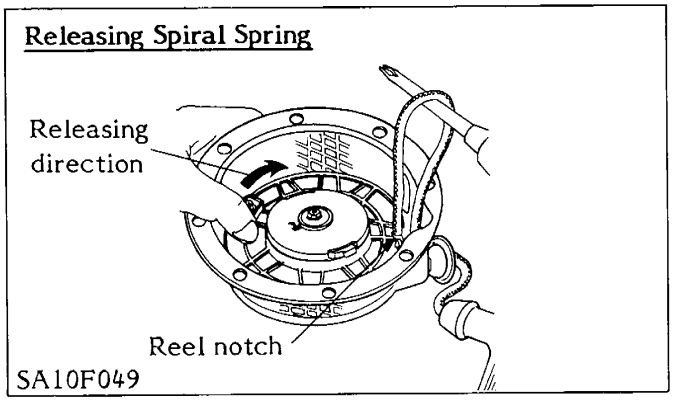
1. Pour in 280 cc to 330 cc of engine oil and run the engine.
2. Set the stop switch to the **ON** position.
3. Lift the front panel of the generator and incline it approx. 20 degrees.
4. Lift the side cover of the generator and incline it approx. 20 degrees.
5. If the engine does not stop in either case, check the wire harness or replace the oil watch unit.

Oil Watch Level Switch (Sensor) Test

1. Pour in 280 cc to 330 cc of engine oil to the crankcase.
2. Disconnect the oil watch switch lead and measure the resistances between the lead terminal and the engine body with an ohmmeter by referring to the table at left.
3. If the specified values are not indicated in the table, replace the level switch.

[4] RECOIL STATOR

DISASSEMBLING AND ASSEMBLING

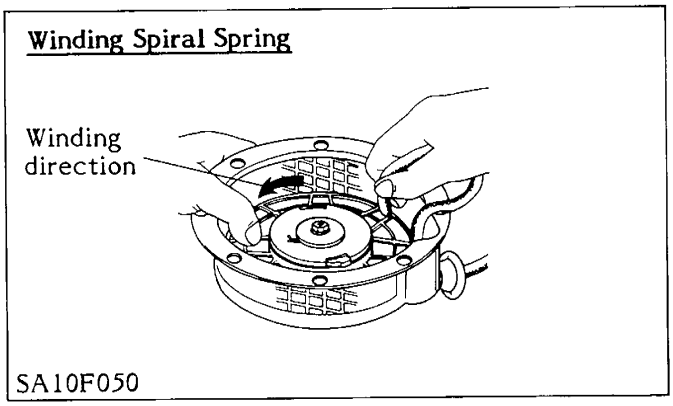


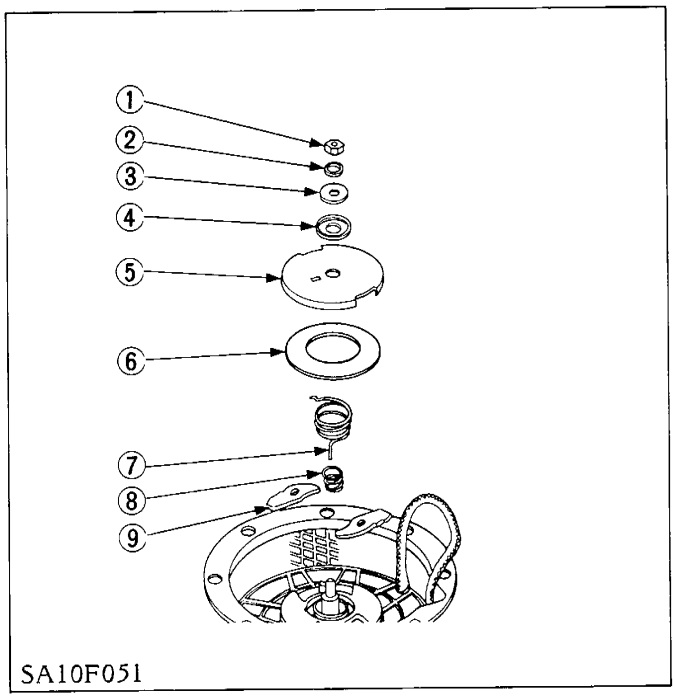
Releasing Spiral Spring

1. Pull the starter rope approx. 300 to 400 mm (12 to 16 in.) and find the reel position where the rope can be seen below the reel notch. Then hold the reel.
2. Hook the rope to the reel notch and pull it with a screwdriver as shown in the figure.
3. Turn the reel clockwise slowly until the spiral spring is completely released.

(When reassembling)

1. Turn the reel counterclockwise approx. six times to ensure a strong returning force of the spiral spring.





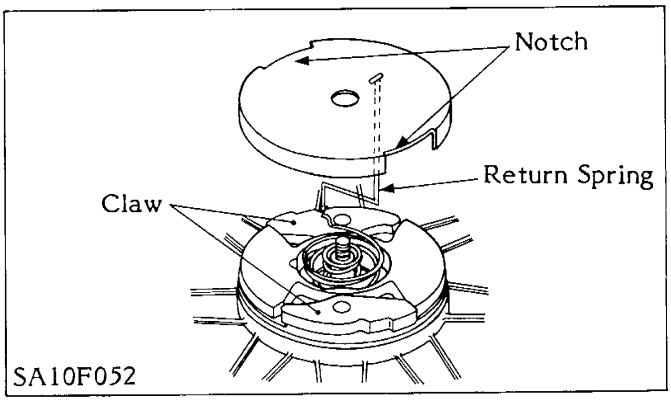
(1) Nut
(2) Spring Washer
(3) Plate Washer
(4) Pressure Plate
(5) Friction Plate
(6) Pad
(7) Return Spring
(8) Spring
(9) Claw

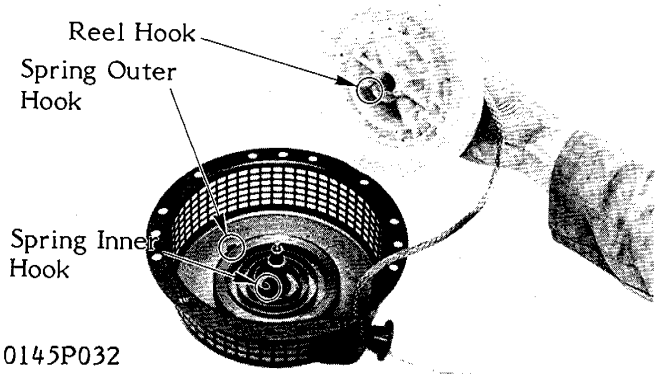
Friction Plate and Claw

1. Remove the friction plate (5), claws (9) and other parts as shown in the figure at left.

(When reassembling)

- When installing the friction plate, insert the return spring in the friction plate and turn the friction plate clockwise until it fits in the notches of the friction plate and the claws.





0145P032

Reel

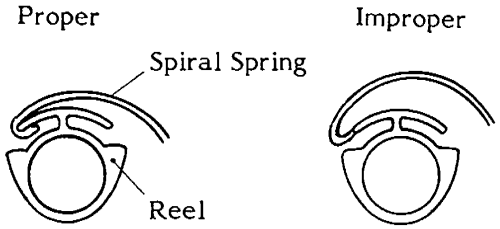
1. Pull out the reel while slowly turning left and right to separate the notch of the reel from the inner hook of the spiral spring.

WARNING **The spiral spring can pop out and cause severe personal injury if not done with care. Do not pull out the reel quickly.**

(When reassembling)

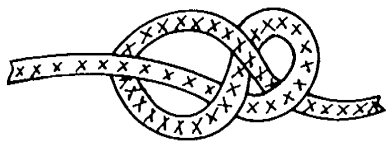
- Make sure that the notch on the reel hitches onto the inner hook of the spiral spring.

Installing Reel Notch



SA10F053

Knot in Rope End


SA10F035

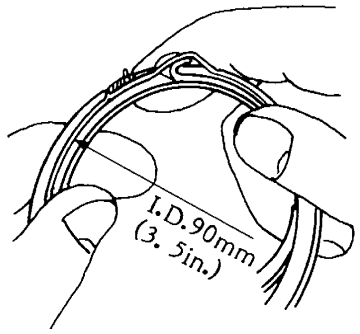
Spiral Spring and Rope

1. Remove the spiral spring from the spiral case slowly.
2. Untie the knot in the rope at knob side.

(When reassembling)

- Apply grease to the spiral spring.
- Be sure to hitch the outer hook of the spiral spring onto the notch of the spiral case.
- Tie the rope end as shown in the figure.

Wind a Wire for Inserting Spiral Spring

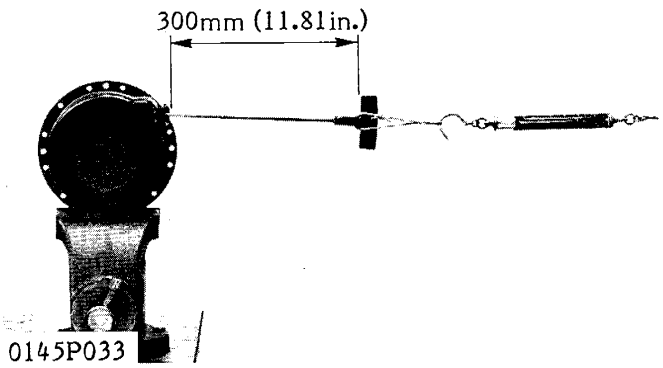


SA10F054

■ NOTE

- **If it is difficult to install the spiral spring into the spiral case, wind a wire as shown in the figure.**

SERVICING



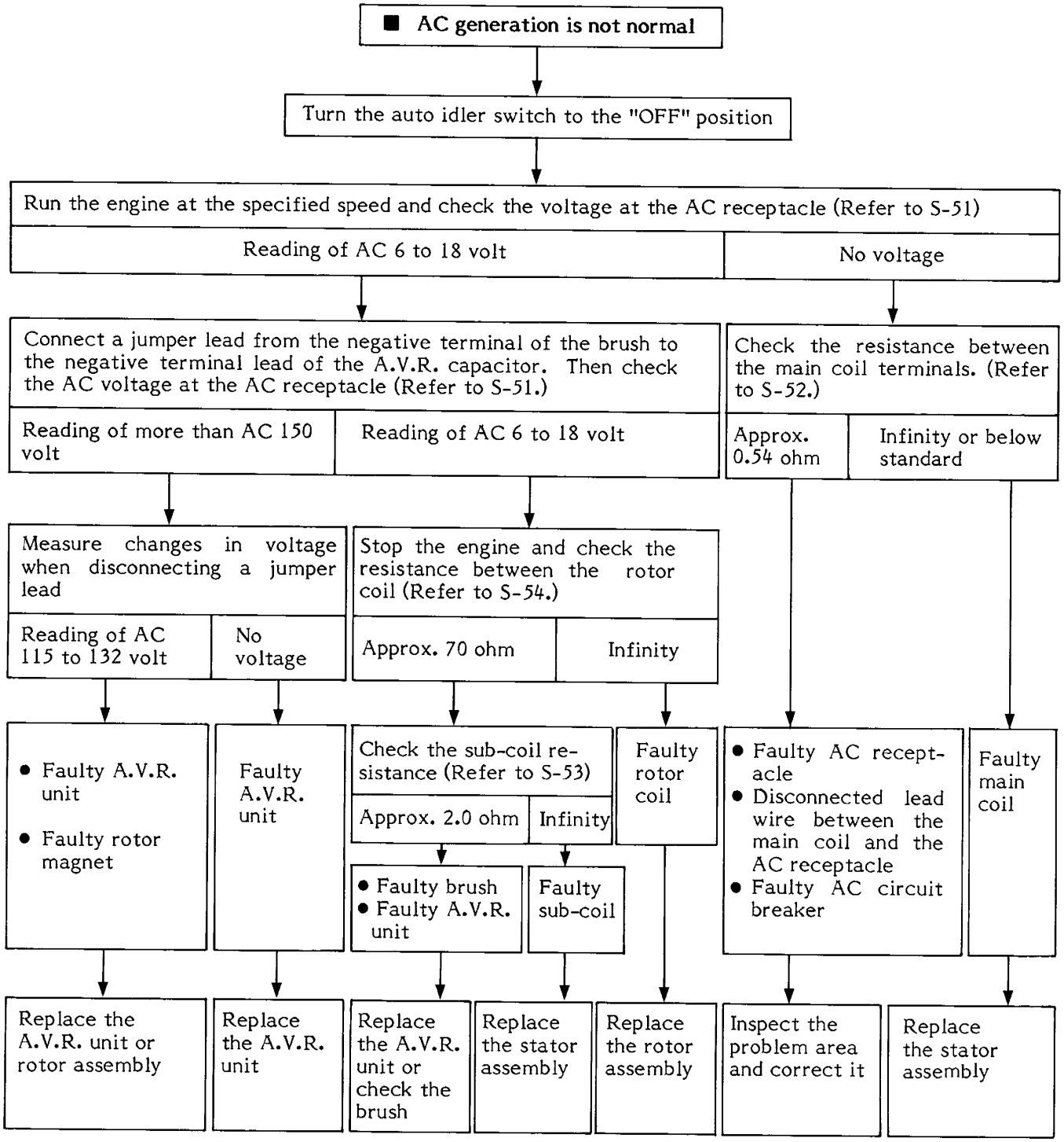
Adjusting Spiral Spring Tension

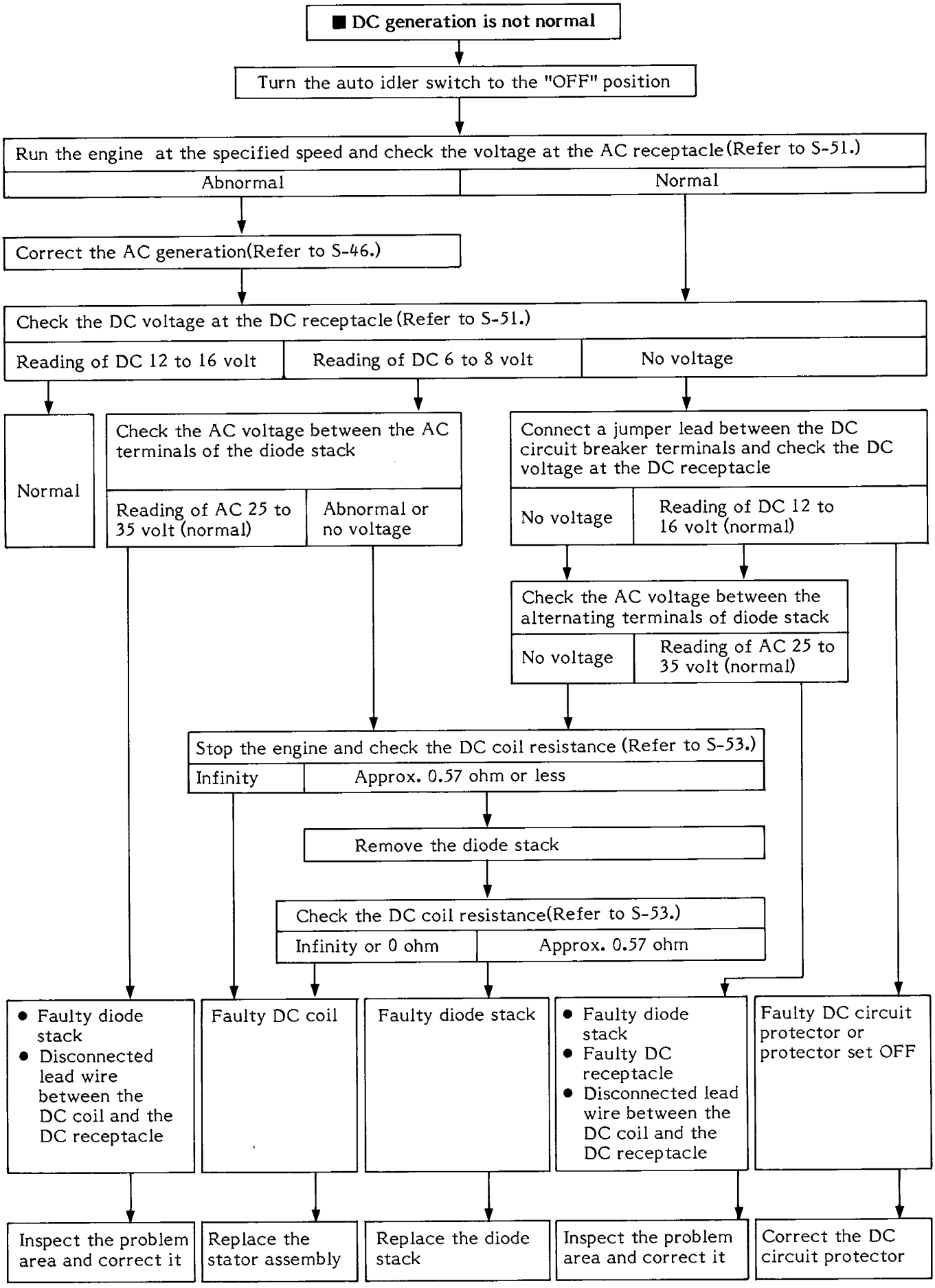
1. Secure the recoil starter assembly in a vise.
2. Pull and release the rope several times.
3. If the rope does not move smoothly, check the assembled parts.
4. Attach a spring balance to the rope end.
5. Pull the rope approx. 300mm (11.81in.) to measure the spring tension.
6. If the spring tension is not within the factory specifications, adjust the tension by adding or removing a few turns to the spiral spring. (Refer to S-43.)

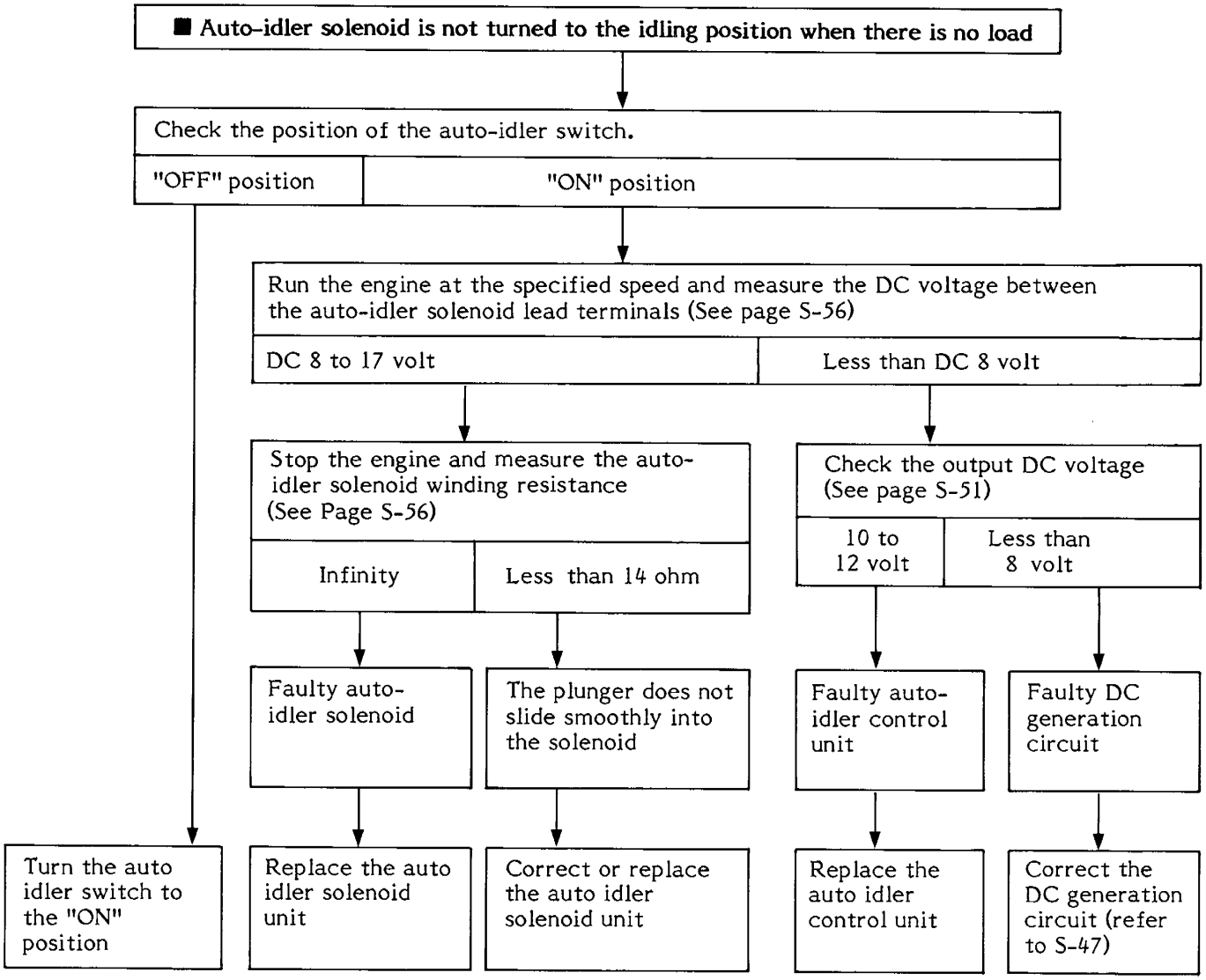
Spiral spring tension	Factory spec.	6.9 to 16.7 N. 0.7 to 1.7 kgf 1.5 to 3.7 lbs

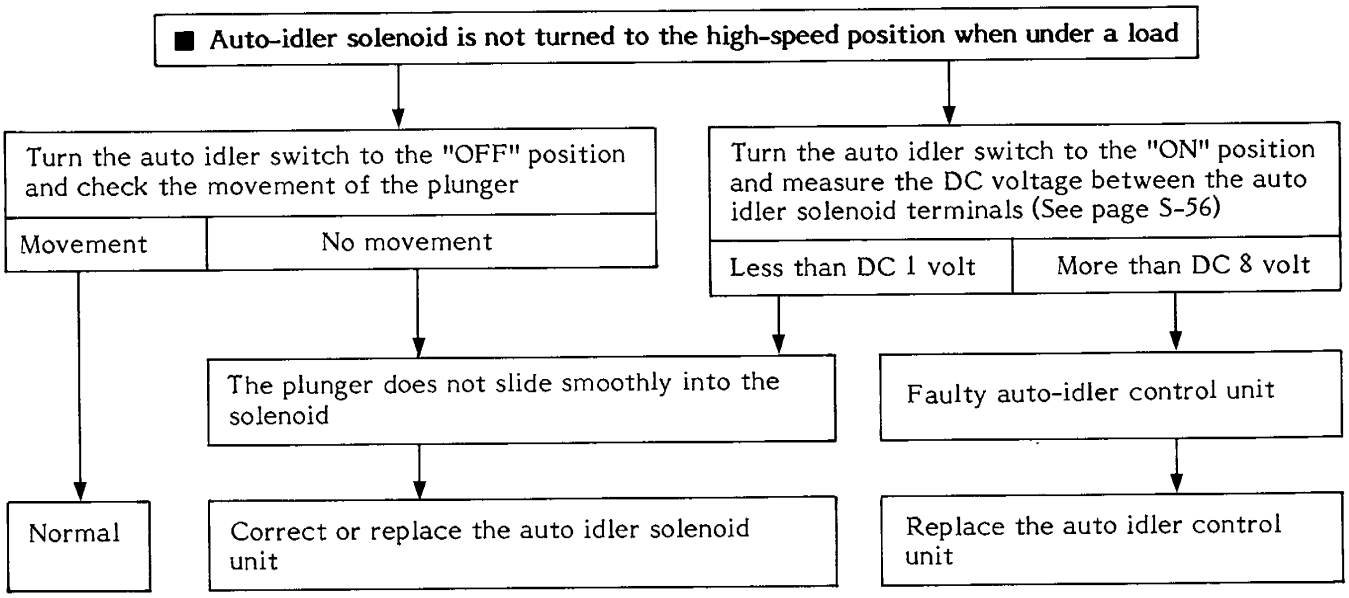
GENERATOR UNIT

TROUBLESHOOTING




■ DC generation is not normal
Turn the auto idler switch to the "OFF" position
Run the engine at the specified speed and check the voltage at the AC receptacle (Refer to S-51.)
Abnormal
Normal
Correct the AC generation (Refer to S-46.)
Check the DC voltage at the DC receptacle (Refer to S-51.)
Reading of DC 12 to 16 volt
Reading of DC 6 to 8 volt
No voltage
Normal
Check the AC voltage between the AC terminals of the diode stack
Reading of AC 25 to 35 volt (normal)
Abnormal or no voltage
Connect a jumper lead between the DC circuit breaker terminals and check the DC voltage at the DC receptacle
No voltage
Reading of DC 12 to 16 volt (normal)
Check the AC voltage between the alternating terminals of diode stack
No voltage
Reading of AC 25 to 35 volt (normal)
Stop the engine and check the DC coil resistance (Refer to S-53.)
Infinity
Approx. 0.57 ohm or less
Remove the diode stack
Check the DC coil resistance (Refer to S-53.)
Infinity or 0 ohm
Approx. 0.57 ohm
• Faulty diode stack
• Disconnected lead wire between the DC coil and the DC receptacle
Faulty DC coil
Faulty diode stack
• Faulty diode stack
• Faulty DC receptacle
• Disconnected lead wire between the DC coil and the DC receptacle
Faulty DC circuit protector or protector set OFF
Inspect the problem area and correct it
Replace the stator assembly
Replace the diode stack
Inspect the problem area and correct it
Correct the DC circuit protector


■ Auto-idler solenoid is not turned to the idling position when there is no load
Check the position of the auto-idler switch.
"OFF" position
"ON" position
Run the engine at the specified speed and measure the DC voltage between the auto-idler solenoid lead terminals (See page S-56)
DC 8 to 17 volt
Less than DC 8 volt
Stop the engine and measure the auto-idler solenoid winding resistance (See Page S-56)
Infinity
Less than 14 ohm
Check the output DC voltage (See page S-51)
10 to 12 volt
Less than 8 volt
Faulty auto-idler solenoid
The plunger does not slide smoothly into the solenoid
Faulty auto-idler control unit
Faulty DC generation circuit
Turn the auto idler switch to the "ON" position
Replace the auto idler solenoid unit
Correct or replace the auto idler solenoid unit
Replace the auto idler control unit
Correct the DC generation circuit (refer to S-47)


■ Auto-idler solenoid is not turned to the high-speed position when under a load
Turn the auto idler switch to the "OFF" position and check the movement of the plunger
Movement
No movement
Turn the auto idler switch to the "ON" position and measure the DC voltage between the auto idler solenoid terminals (See page S-56)
Less than DC 1 volt
More than DC 8 volt
Normal
The plunger does not slide smoothly into the solenoid
Faulty auto-idler control unit
Correct or replace the auto idler solenoid unit
Replace the auto idler control unit

SERVICING SPECIFICATIONS

Item	Unit	K3200	K3500
Frequency	Hz	60	
Rated AC voltage	V	120,120/240	
Rated DC voltage	V	12	
Main coil resistance for generation	Ohm	1.2	1.0
Main coil resistance for A.V.R.	Ohm	0.19	0.18
Sub-coil resistance	Ohm	2.1	1.9
Sub-coil voltage	V	AC 85 to 90	
DC coil resistance	Ohm	0.57	0.58
Rotor coil resistance	Ohm	68	70
Rotor coil voltage	V	DC 75 to 80	
Rotor air gap	mm (in.)	0.5 (0.019)	
Slip ring O.D.	mm (in.)	38 (1.49)	
Brush length	mm (in.)	6.5 (0.256)	
Circuit breaker capacity for AC	A	11.5	14
Circuit protector capacity for DC	A	20	
Auto-idler solenoid coil resistance	Ohm		

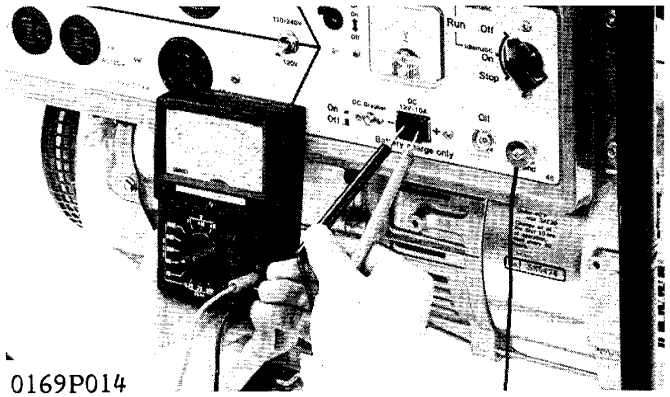
TIGHTENING TORQUE

Rotor mounting screw	31.4 to 43.2 N·m	3.2 to 4.4 kgf·m	22.9 to 31.5 ft-lbs
Stator mounting screw	5.9 to 8.8 N·m	0.6 to 0.9 kgf·m	4.3 to 6.5 ft-lbs

CHECKING, DISASSEMBLING AND SERVICING

CHECKING

[1] NORMAL GENERATION VOLTAGES

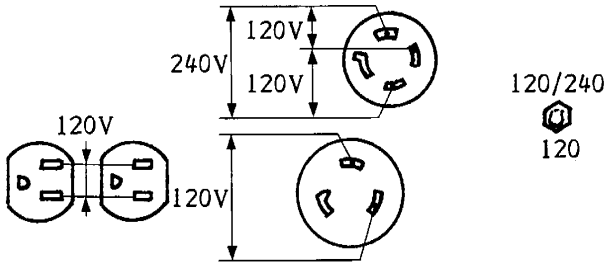


0169P014

Output AC Voltage of Receptacles

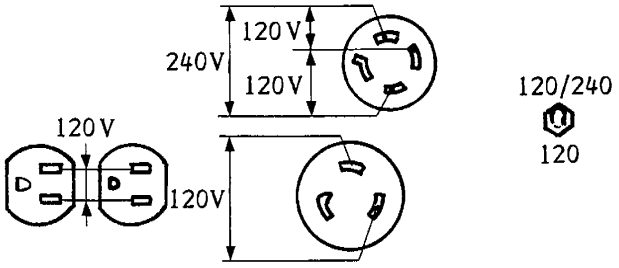
1. Turn the auto-idler switch to the "OFF" position.
2. Run the generator at the specified rpm.
3. Turn the circuit breaker switch to the "ON" position.
4. Measure the AC voltage between the terminals of the receptacle using a voltmeter. (Refer to the table below.)
5. If the voltages specified are not indicated, correct by following the troubleshooting guide. (See the page S-46.)

Changeover Switch at "**120 V**" Position

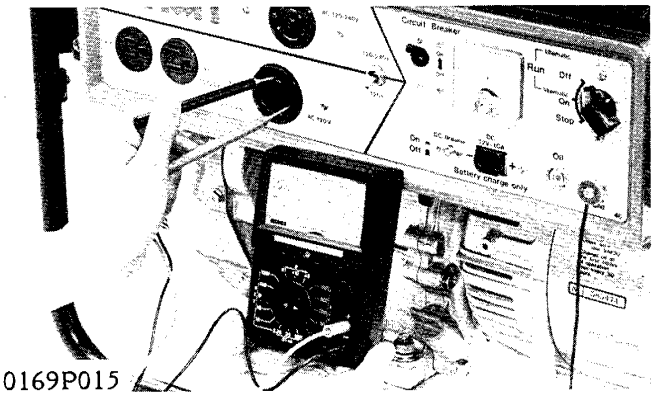


0169F005

Changeover Switch at "**120/240 V**" Position



0169F006

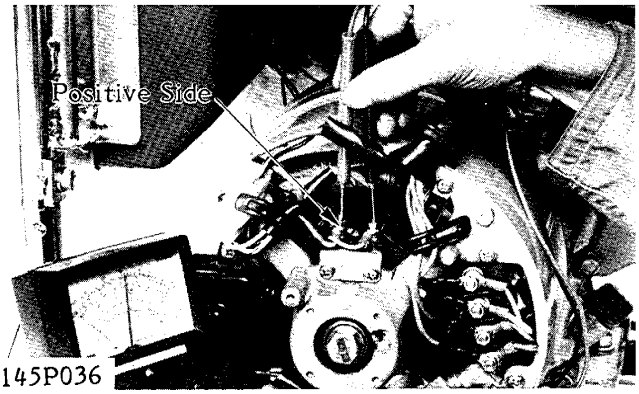


0169P015

Output DC Voltage

1. Run the generator at the specified speed.
2. Turn the auto-idler switch to the "OFF" position.
3. Measure the DC voltage between the terminals of the DC receptacle using a voltmeter.
4. If the voltage specified is not indicated, correct by following the troubleshooting guide. (See page S-47.)

DC Voltage	10 to 12 volt

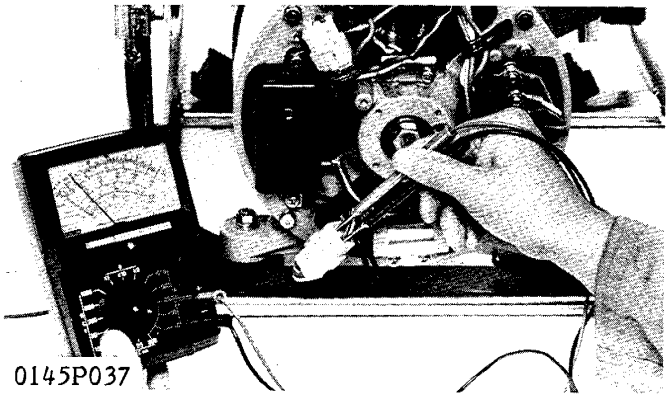


0145P036

Field Voltage (Rotor Coil Voltage)

1. Remove the cleaner cover.
2. Run the generator at the specified rpm.
3. Measure the DC voltage between the brush terminals using a voltmeter.
4. If the specified voltage is not indicated, the brush, slip rings or rotor coil is faulty.

Field coil voltage	K3200	Approx. DC 75 to 80 volt
	K3500	Approx. DC 75 to 80 volt

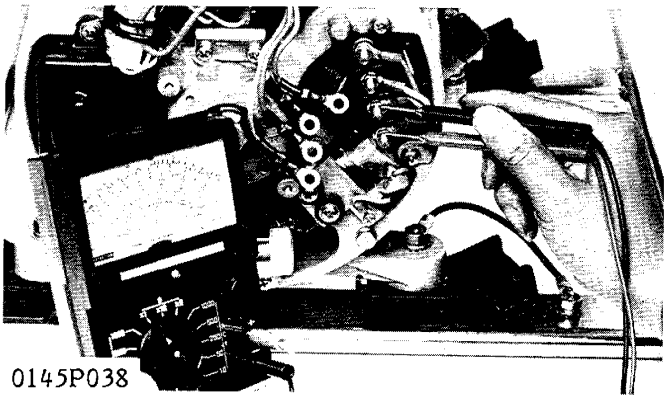

0145P037

Sub-coil Terminal Voltage

1. Remove the cleaner cover.
2. Turn the auto-idler switch to the "OFF" position.
3. Run the generator at the specified rpm and turn the circuit breaker switch to the "ON" position.
4. Measure the AC voltage between the sub-coil lead terminals(light green/red and green leads for the AVR connector) using an ohmmeter.
5. If the specified voltage is not indicated, the sub-coil is faulty or a layer short.

Sub-coil voltage	K3200	Approx. AC 85 to 90 volt
	K3500	Approx. AC 85 to 90 volt

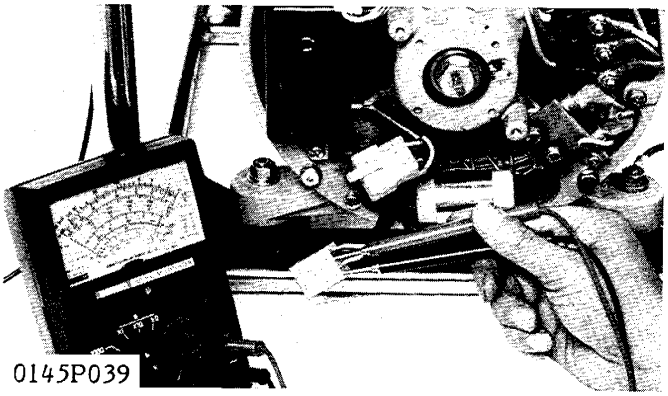
[2] STATOR


0145P038

Main Coil Winding Resistance for Generation Circuit

1. Remove the cleaner cover.
2. Remove the 4 terminals of the main coils.
3. Measure the resistance between the main coil 1 terminals (blue and brown leads) using an ohmmeter.
4. Measure the resistance between the main coil 2 terminals (white and red leads).
5. If the specified resistances are not indicated, the main coil 1 or 2 is faulty or a layer short.

Main coil 1 resistance for generation	K3200	Approx. 1.2ohm
	K3500	Approx. 1.0ohm
Main coil 2 resistance for generation	K3200	Approx. 1.2ohm
	K3500	Approx. 1.0ohm


0145P039

Main coil winding resistance for A.V.R.

1. Remove the cleaner cover.
2. Disconnect the 4P connector located between the main coil and the A.V.R. control unit.
3. Measure the resistance between the main coil side terminals (blue and light green lead) using an ohmmeter.
4. If the resistance specified below is not indicated, the main coil is faulty.

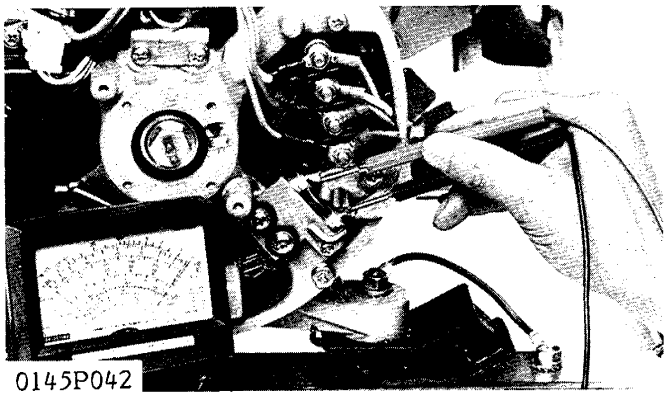
Main coil resistance for A.V.R.	K3200	Approx. 0.19 ohm
	K3500	Approx. 0.18 ohm


0145P041

Sub-coil Winding Resistance

1. Remove the cleaner cover.
2. Disconnect the 4P connector between the A.V.R. and the sub-coil.
3. Measure the resistance between the sub-coil terminals (green and light green/red leads) using an ohmmeter.
4. If the resistance specified below is not indicated, the sub-coil is faulty or a layer short.

Sub-coil resistance	K3200	Approx. 2.1 ohm
	K3500	Approx. 1.9 ohm

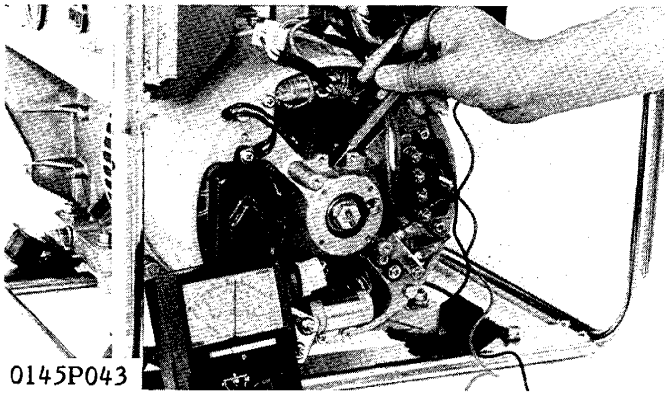

0145P042

DC Coil Winding Resistance

1. Remove the cleaner cover.
2. Measure the resistance between the brown lead terminals of the diode stack using an ohmmeter.
3. If the resistance specified below is not indicated, the DC coil is faulty or a layer short.

DC coil resistance	K3200	Approx. 0.57 ohm
	K3500	Approx. 0.58 ohm

[3] ROTOR

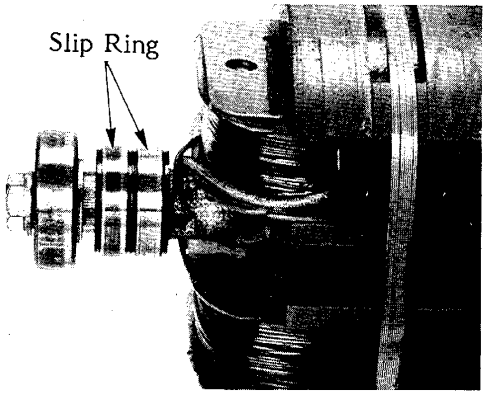


0145P043

Rotor Coil Winding Resistance

1. Remove the cleaner cover and brush.
2. Measure the resistance between the slip rings' surface with an ohmmeter.
3. If the resistance specified below is not indicated, the rotor coil is faulty or a layer short.

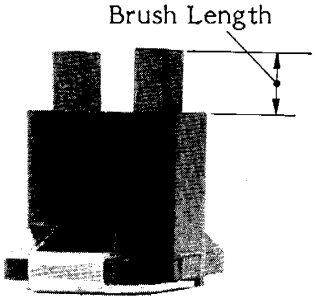
Rotor coil resistance	K3200	Approx. 68 ohm
	K3500	Approx. 70 ohm



0145P009

Checking Slip Ring

1. Remove the cleaner cover, brush and stator assembly.
2. Visually check for oil, dirt and other contamination.
3. Visually check the roughness along the brush's sliding surface.
4. If there is dirt, contamination or roughness, clean the surface of the slip rings.



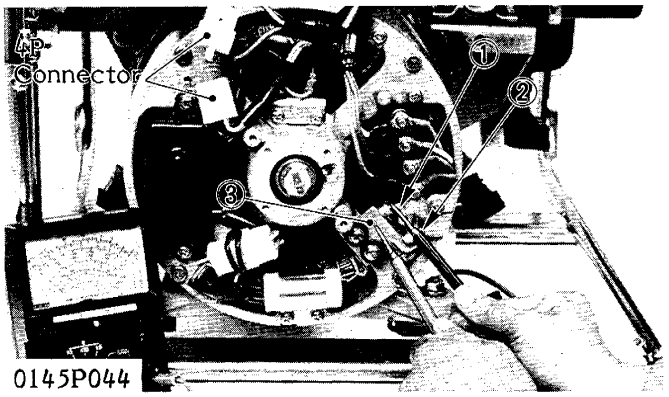
0144P008

Checking Brush

1. Remove the brush and measure the length from the brush holder to the brush's sliding surface.
2. If the brush length is less than the allowable limit, replace the brush.

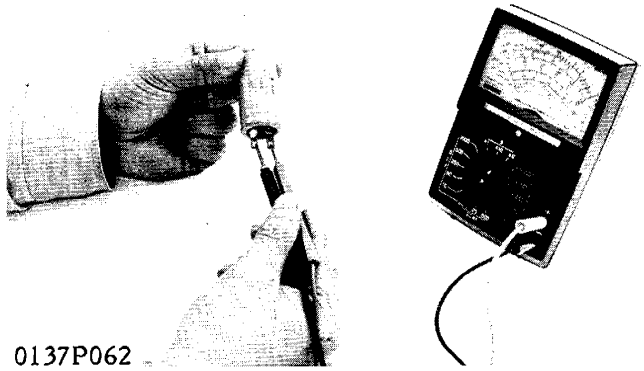
Brush length	Allowable limit	3.5 mm 0.138 in.

[4] DIODE STACK AND A.V.R.



0145P044

(1) Anode
(2) Anode
(3) Cathode (holder)



0137P062

Checking Diode Stack

1. Remove the cleaner cover.
2. Disconnect the 4P connector located between the DC coil and the front panel.
3. Measure the resistance between the anode terminals (1), (2) and the cathode (3) of diode using an ohmmeter as indicated by the table below.
4. If the resistances specified below are not indicated, the diode stack is faulty.

Ohmmeter probe low voltage side	Ohmmeter probe high voltage side	Specification
3	1	Low resistance
3	2	Low resistance
1	3	Infinity
2	3	Infinity

■ **NOTE**

- **Use a 1.5 volt ohmmeter**

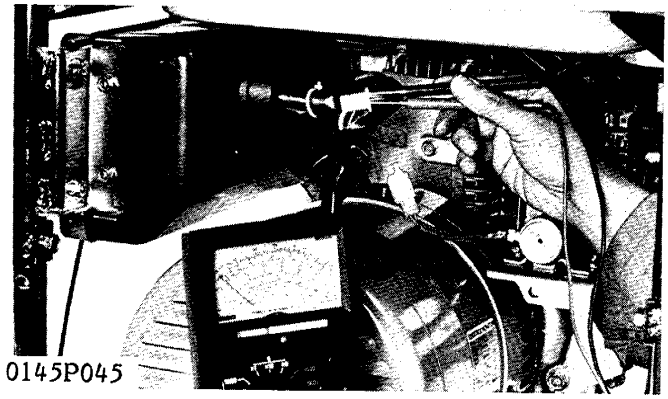
Checking A.V.R. Capacitor

1. Unsolder the capacitor.
2. Connect an ohmmeter's probes to the positive (+) and negative (-) sides of the capacitor.
3. Reverse the probe connection.
4. If there is no conduction at first, the capacitor is faulty.
5. If there is conduction at first, but infinity is not indicated after a few seconds, the capacitor is faulty.

A.V.R.

A special measuring instrument is necessary. Quality verification with a discrete A.V.R. is difficult. When an A.V.R. failure is suspected, replace the A.V.R. with a new one.

[5] AUTO IDLER


0145P045

DC Voltage Solenoid Lead Terminals (With No Load)

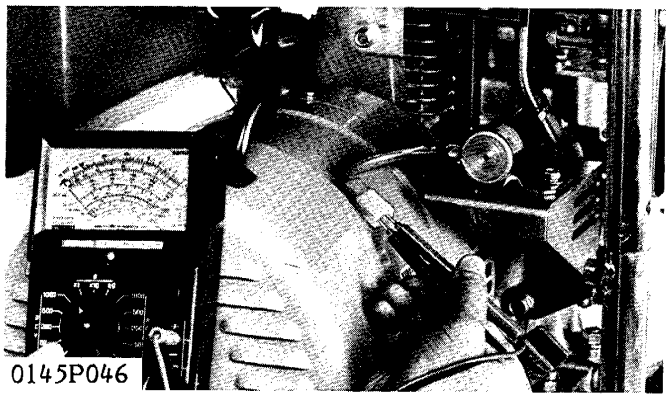
1. Disconnect the 2P connector located between the auto-idler solenoid unit and the control box.
2. Run the generator at approx. 2,000 rpm.
3. Turn the auto-idler switch to the "ON" position.
4. Measure the DC voltage between the red lead terminals.
5. If the voltage specified below is not indicated, the auto-idler control unit, auto-idler switch or DC generation circuit is faulty.

DC voltage auto-idler solenoid terminals (when no load)	8 to 17 volts

DC Voltage Solenoid Terminals (With Load)

1. Disconnect the 2P connector located between the auto-idler solenoid unit and the control box.
2. Run the generator at 3,600 rpm.
3. Turn the auto-idler switch to the "ON" position.
4. Connect a load over 0.8A to one of the four AC receptacles.
5. Measure the DC voltage between the red lead terminals.
6. If the voltage specified below is not indicated, the auto-idler control unit is faulty.

DC voltage auto-idler solenoid terminals (with load)	Less than 1 volt

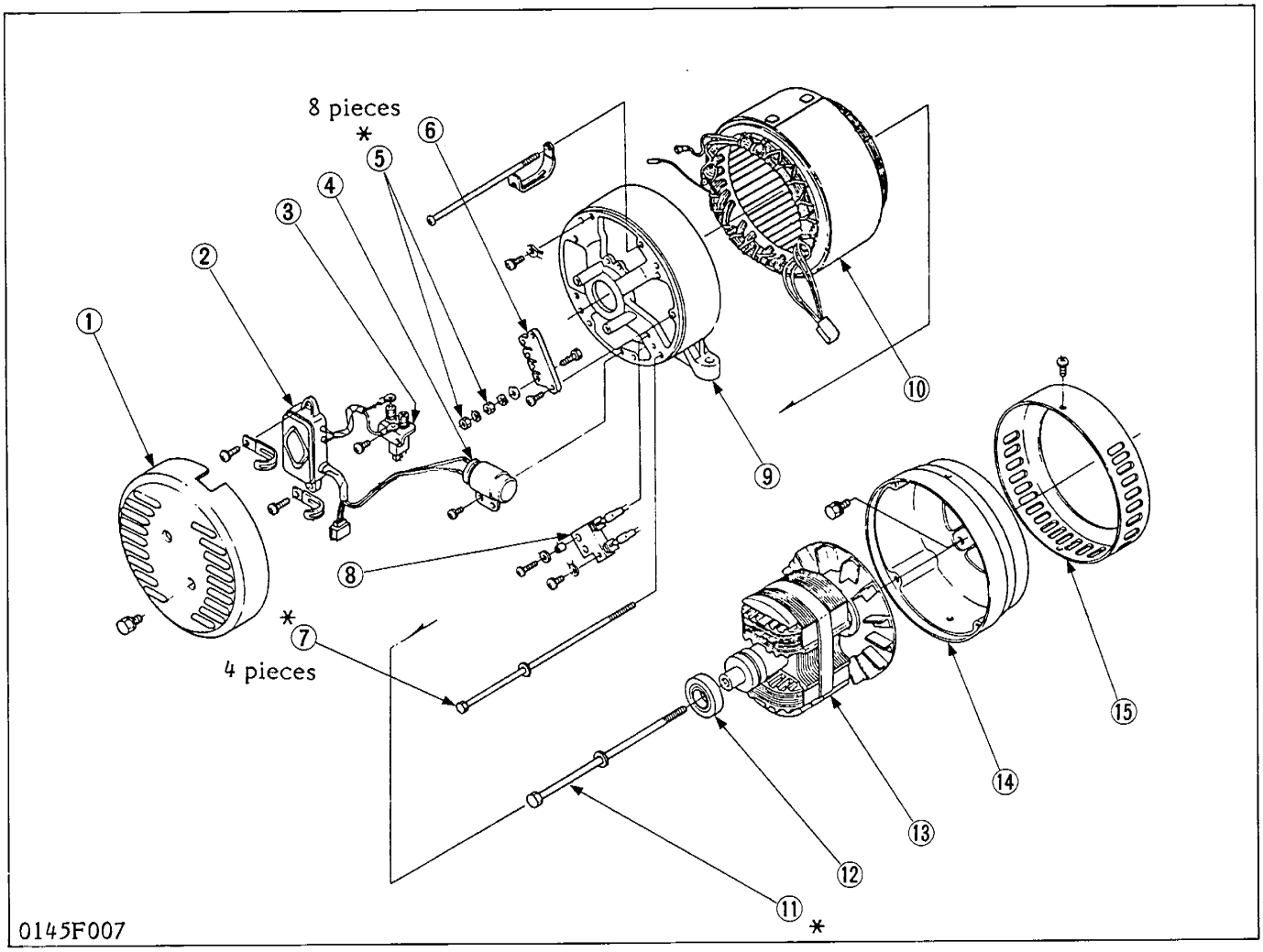

0145P046

Auto-Idler Solenoid Winding Resistance

1. Disconnect the 2P connector located between the auto-idler solenoid unit and the control box.
2. Measure the resistance between the auto-idler solenoid's lead terminals.
3. If the resistance specified below is not indicated, the auto-idler solenoid is faulty.

Auto-idler solenoid winding resistance	Approx. 14 ohm

DISASSEMBLING AND ASSEMBLING



(1) Cleaner Cover
(2) A.V.R.
(3) Brush Holder
(4) Capacitor
(5) Terminal Nut
(6) AC Terminal
(7) Stator Mounting Screw
(8) Diode Stack
(9) Rear Bracket
(10) Stator
(11) Rotor Mounting Screw
(12) Bearing
(13) Rotor
(14) Front Bracket
(15) Fan Cover

(When reassembling)
Screws and nuts marked "*" should be tightened to the torques shown in the table below.

No.	N·m	kgf·m	ft-lbs
(5)	1.86 to 2.45	0.19 to 0.25	1.37 to 1.81
(7)	5.9 to 8.8	0.6 to 0.9	4.3 to 6.5
(11)	31.4 to 43.2	3.2 to 4.4	22.9 to 31.5

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