

Onan



WORKSHOP MANUAL
ONAN GENERATOR SETS
K-SERIES

981-0504
(Reprinted 10-95)
Printed in U.S.A.

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GENERATOR SET

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1. Introduction

1.1 Specifications

| Model | | K400 | | | K450 | | K800 | | | |
|------------------------------|--|---|--|-----|------|---|---|--|-----|-----|
| Generator | Excitation | | Static self-exciting | | | | | | | |
| | Frequency (Hz) | | 50 | | | 60 | | 50 | | |
| | Max. output (kVA) | | 0.40 | | | 0.45 | | 0.80 | | |
| | Rated output (kVA) | | 0.35 | | | 0.40 | | 0.65 | | |
| | A.C. | Voltage (V) | 220 | 230 | 240 | 120 | | 220 | 230 | 240 |
| | | Rated current (A) | 1.6 | 1.5 | 1.4 | 3.3 | | 2.9 | 2.8 | 2.7 |
| | D.C. | Watt (W) | 100 (100/200) | | | | | | | |
| | | (V) x (A) | 12 x 8.3 (12/24 x 8.3) | | | | | | | |
| | Power factor (%) | | 100 | | | | | | | |
| | Over current protection | | Circuit breaker | | | | | | | |
| Engine | Type | | Air-cooled 4 cycle gasoline engine | | | | | | | |
| | Model | | GN550-DG-A3 | | | | | GS130-DG-A-2-3 | | |
| | Displacement | | 3.36 cu.in. (55cc) | | | | | 7.93 cu.in. (130cc) | | |
| | Max. output | | 1.18HP (1.2PS, 0.88kW) | | | | | 3.35HP (3.4PS, 2.50kW) | | |
| | Rated output | | 0.69HP/3000rpm 0.7PS/3000rpm 0.51kW/3000rpm | | | 0.79HP/3600rpm 0.8PS/3600rpm 0.59kW/3600rpm | | 1.28HP/3000rpm 1.3PS/3000rpm 0.96kW/3000 rpm | | |
| | Fuel tank capacity | | 2ℓ (2.11 U.S. qts.) | | | | | 3ℓ (3.17 U.S. qts.) | | |
| | Capability in rated output (approx. hours) | | 5 ~ 6 | | | 3.5 ~ 4.5 | | 4 ~ 5 | | |
| | Fuel | | Regular automobile gasoline | | | | | | | |
| | Lubricating oil | | API type SE, SF class engine oil (below 14°F (−10°C): 10W30, below 59°F (+15°C): SAE #20, above 59°F (+15°C): SAE # 30) | | | | | | | |
| | Starting system | | Recoil starter | | | | | | | |
| | Total dry weight | | 38.58lb (17.5kg) | | | | | 57.32lb (26kg) | | |
| Total dimensions (L x W x H) | | 15.94 x 11.18 x 13.27 in. 405 x 284 x 337 mm | | | | | 17.32 x 12.60 x 16.30 in. 440 x 320 x 414 mm | | | |

| K1000 | K1200 | | K1400 |
|---|---|-----|---|
| Static self-exciting | | | |
| 60 | 50 | | 60 |
| 1.0 | 1.2 | | 1.4 |
| 0.80 | 1.0 | | 1.2 |
| 120 | 220 | 230 | 120 |
| 6.7 | 4.6 | 4.4 | 10.0 |
| 100 (100/200) | 100 | | |
| 12 x 8.3 (12/24 x 8.3) | 12 x 8.3 | | |
| 100 | | | |
| Circuit breaker | | | |
| Air-cooled 4 cycle gasoline engine | | | |
| GS130-DG-A-2-3 | GS130-1-DG-A3 | | |
| 7.93 cu.in. (130cc) | | | |
| 3.35HP (3.4PS, 2.50kW) | | | |
| 1.58HP/3600rpm (1.6PS/3600rpm 1.18kW/3600rpm) | 1.87HP/3000rpm (1.9PS/3000rpm 1.40kW/3000rpm) | | 2.27HP/3600rpm (2.3PS/3600rpm 1.69kW/3600rpm) |
| 2ℓ (2.11 U.S. qts) | 8ℓ (8.45 U.S. qts) | | |
| 3 ~ 4 | 8 ~ 9 | | 6.5 ~ 7.5 |
| Regular automobile gasoline | | | |
| API type SE, SF class engine oil (below 14° F (−10° C): 10W30, below 59° F (+15° C): SAE #20, above 59° F (+15° C): SAE #30) | | | |
| Recoil starter | | | |
| 57.32lb (26kg) | 72.75lb (33kg) | | |
| 17.32 x 12.60 x 16.30 in. 440 x 320 x 414 mm | 19.25 x 14.41 x 17.44 in. 489 x 366 x 443 mm | | |

| Model | | K1800 | K2100 | K2500 | |
|------------------------------|--|--|---|---|---|
| Generator | Excitation | | Static self-exciting | | |
| | Frequency (Hz) | | 50 | 60 | 50 |
| | Max. output (kVA) | | 1.8 | 2.1 | 2.5 |
| | Rated output (kVA) | | 1.5 | 1.8 | 2.0 |
| | A.C. | Voltage (V) | 220 | 120 | 220 |
| | | Rated current (A) | 6.8 | 15.0 | 9.1 |
| | D.C. | Watt (W) | 100 | | |
| | | (V) x (A) | 12 x 8.3 | | |
| | Power factor (%) | | 100 | | |
| | Over current protection | | Circuit breaker | | |
| Engine | Type | | Air-cooled 4 cycle gasoline engine | | |
| | Model | | GN1850-DG-A3 | | GN2500-DG-A3 |
| | Displacement | | 11.17 cu.in. (183cc) | | 15.38 cu.in. (252cc) |
| | Max. output | | 4.73HP (4.8PS, 3.53kW) | | 6.7HP (6.8PS, 5.00kW) |
| | Rated output | | 2.96HP/3000rpm (3.0PS/3000rpm) (2.21kW/3000rpm) | 3.45HP/3600rpm (3.5PS/3600rpm) (2.57kW/3600rpm) | 4.14HP/3000rpm (4.2PS/3000rpm) (3.09kW/3000rpm) |
| | Fuel tank capacity | | 8ℓ (8.45 U.S. qts) | | |
| | Capability in rated output (approx. hours) | | 7.5 ~ 8.5 | 5.5 ~ 6.5 | 5.5 ~ 6.5 |
| | Fuel | | Regular automobile gasoline | | |
| | Lubricating oil | | API type SE, SF class engine oil (below 14° F (−10° C): 10W30, below 59° F (+15° C): SAE #20, above 59° F (+15° C): SAE #30) | | |
| | Starting system | | Recoil starter | | |
| Total dry weight | | 94.80lb (43kg) | | 123.46lb (56kg) | |
| Total dimensions (L x W x H) | | 21.42 x 14.84 x 18.62 in. 544 x 377 x 473mm | | 22.72 x 16.81 x 20.59 in. 577 x 427 x 523mm | |

| K3000 | | | | K3050 | | K3500 | | | |
|---|-----------|---|--|---|------|---|-----------|---|--|
| Dual (1) | | Dual (2) (USA) | | | | Dual (1) | | Dual (2) (USA) | |
| Static self-exciting | | | | | | | | | |
| 50 | | 60 | | 50 | | 50 | | 60 | |
| 2.5/3.0 | | 3.0 | | 3.05 | | 3.05/3.5 | | 3.5 | |
| 2.0/2.5 | | 2.5 | | 2.4 | | 2.4/3.0 | | 3.0 | |
| 110/220 | | 120/240 | | 220 | 230 | 110/220 | | 120/240 | |
| 110V | 18.2/22.7 | 20.8/10.4 | | 10.9 | 10.4 | 110V | 21.8/27.2 | 25/12.5 | |
| 220V | 9.1/11.4 | | | | | 220V | 10.9/13.6 | | |
| 100 | | | | | | | | | |
| 12 x 8.3 | | | | | | | | | |
| 100 | | | | | | | | | |
| Circuit breaker | | | | | | | | | |
| Air-cooled 4 cycle gasoline engine | | | | | | | | | |
| GN2500-DG-A3 | | | | GS280-DG-A3 | | | | | |
| 15.38 cu.in. (252cc) | | | | 16.84 cu.in. (276cc) | | | | | |
| 6.7HP (6.8PS, 5.00kW) | | | | 7.39HP (7.5PS, 5.52kW) | | | | | |
| 4.14HP/3000rpm 4.2PS/3000rpm (3.09kW/3000rpm) | | 4.93HP/3600rpm 5.0PS/3600rpm (3.68kW/3600rpm) | | 4.34HP/3000rpm 5.0PS/3000rpm (4.05kW/3000rpm) | | 4.34HP/3000rpm 4.4PS/3000rpm (3.24kW/3000rpm) | | 5.42HP/3600rpm 5.5PS/3600rpm (4.05kW/3600rpm) | |
| 8ℓ (8.45 U.S. qts.) | | | | | | | | | |
| 5.5 ~ 6.5/4.5 ~ 5.5 | | 4.5 ~ 5.5 | | 4.5 ~ 5.5 | | 4.5 ~ 5.5/3.5 ~ 4.5 | | 3.5 ~ 4.5 | |
| Regular automobile gasoline | | | | | | | | | |
| API type SE, SF class engine oil (below 14°F (−10°C): 10W30, below 59°F (+15°C): SAE #20, above 59°F (+15°C): SAE #30) | | | | | | | | | |
| Recoil starter | | | | | | | | | |
| 123.46lb (56kg) | | | | | | | | | |
| 22.72 x 16.81 x 20.59 in. 577 x 427 x 523mm | | | | 25.87 x 16.85 x 21.06 in. 657 x 428 x 535mm | | | | | |

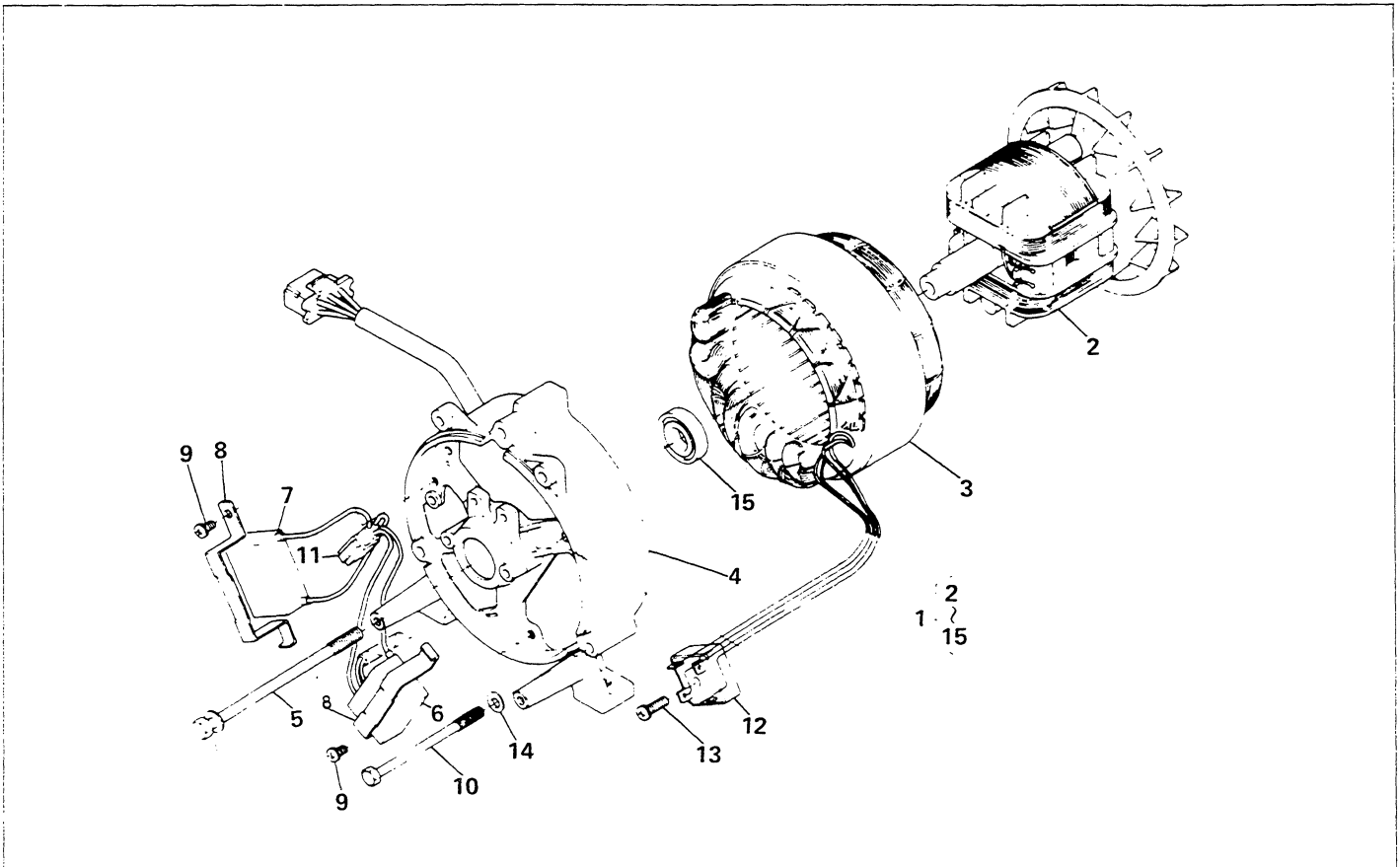
2. Generator Construction and Operating Principles

K450 [K400] and K1000 [K800]

2.1 Generator construction

K450, K1000
[K400] [K800]

■ GENERATOR COMPONENTS



1. Generator assembly

2. Rotor assembly

3. Stator assembly

4. Front bracket

5. Center bolt

6. Capacitor

7. Capacitor

8. Holder

9. Screw and washer

10. Bolt

11. Coupler

12. Diode assem.

13. Screw and washer

14. Plain washer

15. Bearing

■ FUNCTIONS OF MAJOR COMPONENTS

(1) Stator assembly

The main coil and sub coil for power generation are wound in the slots provided on the core. The main coil generates the AC output and takes the DC output after rectification. The sub coil, working as an excitation coil, magnetizes the rotor.

(2) Rotor assembly

The rotor coils connected with the diodes are wound around the two poles. The sub coil on the stator and the rotor coil magnetize the core.

(3) Capacitor

Capacitors are connected to the main coil and sub coil respectively. The purpose of the capacitors is to establish a voltage by causing a leading current to flow through the coil, and to compensate for voltage changes.

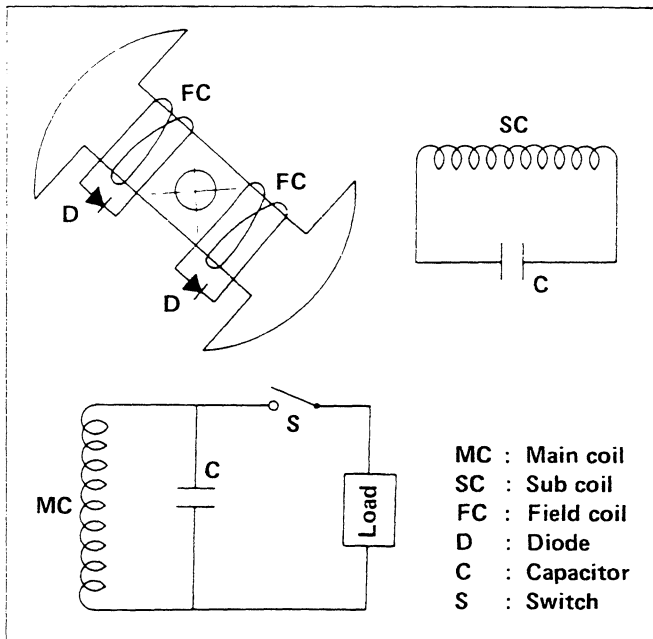
(4) Diode

AC output taken from the main coil is subjected to full-wave rectification to provide a 12V DC output

2.2 Generator operating principles

K450, K1000
[K400] [K800]

■ CIRCUIT DIAGRAM



As shown in the above figure, the stator has two windings, the MAIN COIL and SUB COIL. They are placed at a phase difference corresponding to a space angle of 90° and connected in parallel with capacitors. The main coil is connected with an external load through the switch. The rotor is of the two-pole salient type, with each pole having a field coil connected with a rectifying diode. The rotor is of brushless construction.

■ OPERATION

When the rotor begins to rotate, its residual magnetism generates a minute voltage across the main coil and sub coil. Through the capacitor connected with the coils, the voltage causes a leading current to flow through the coils, thereby generating magnetism at the two coils.

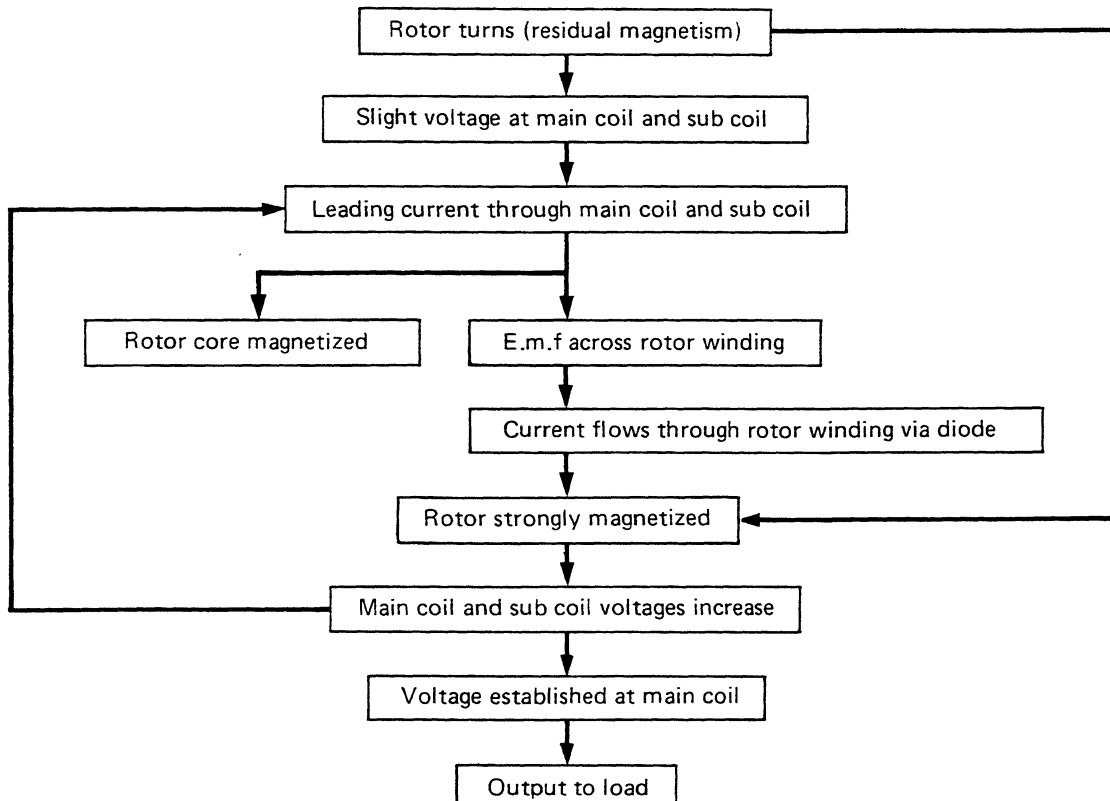
This magnetism magnetizes the revolving rotor to induce an electromotive force across the rotor coils. The electromotive force at the rotor coil is rectified by the diodes connected with the coils to produce a DC current through the coil. In this way, the rotor magnetizes itself to assist the residual magnetism and make the rotor a more powerful magnet.

The strongly magnetized rotor raises the voltage at the main coil and sub coil to cause a larger leading current to flow through the coils. The above process is repeated automatically and instantaneously to establish a constant voltage.

If an external load is connected to the main coil, the load current produces a much stronger magnetism at the main coil to make the rotor a much stronger electromagnet. In principle, the load current through the main coil produces a voltage drop across the impedance component (AC resistance) of the winding to drop the generator terminal voltage, but this drop is compensated for in the above way to maintain voltage at the rated value.

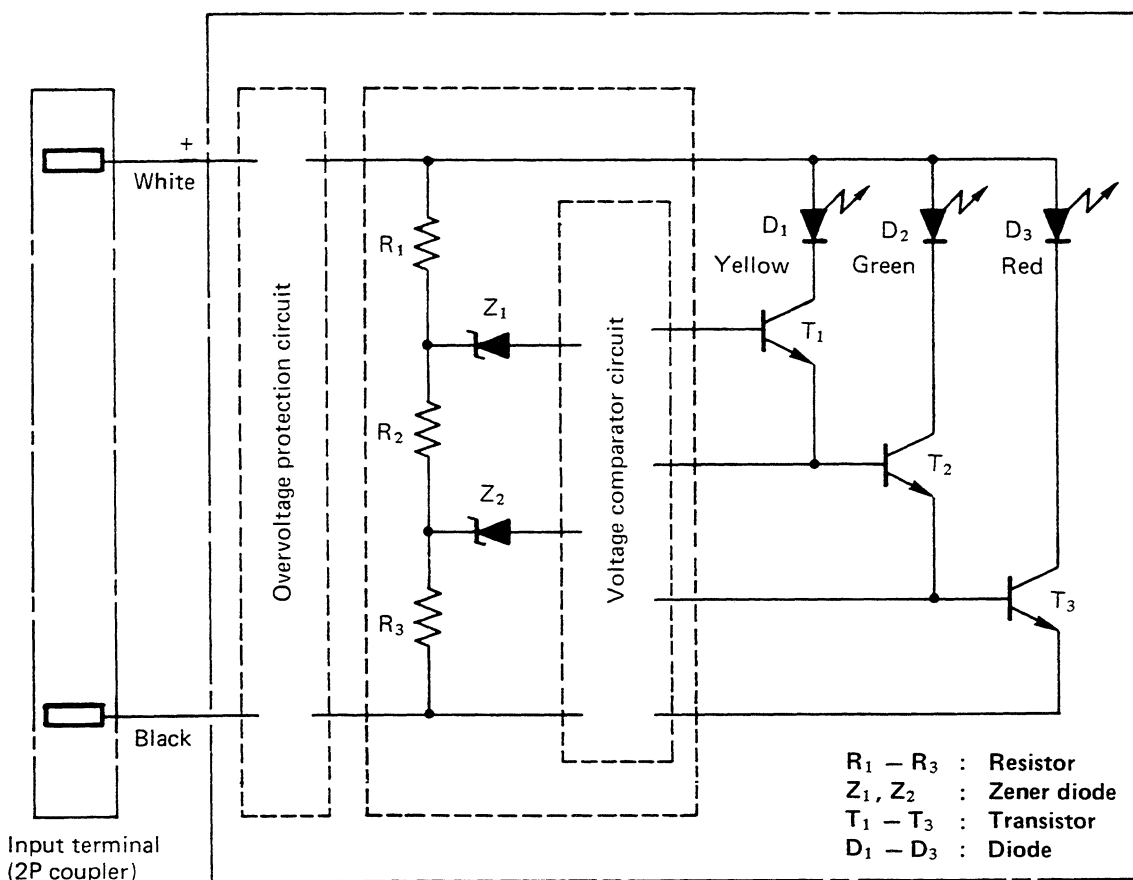
The leading current caused by the capacitor connected to the main coil reduces the winding impedance to a level below, the terminal voltage under no-load condition; and the current, coupled with the load current, increases the main coil magnetism to compensate for the voltage drop due to the load under a loaded condition.

In the above way, a constant voltage can be generated without a voltage regulator.



2.3 Operation of voltage indicator

K450, K1000
[K400] [K800]



The voltage indicator uses LEDs to indicate the output voltage condition.

As shown in the above figure, the indicator circuit consists of resistors, Zener diodes, transistors, LEDs, and capacitors. DC voltage, which is proportional to the generator output voltage, is supplied to the input section voltage indication.

In the above figure, if the established generator voltage is within the range set by R_1 to R_3 for lighting D_2 (green), Z_1 and T_2 turn on (Z_2 , T_1 and T_3 turn off) to light D_2 (green).

If the voltage is below the range, Z_1 and Z_2 are cut off and T_1 turns on to light D_1 (yellow). If the voltage is above the range, Z_1 and Z_2 turn on (T_1 and T_2 turn off) and T_3 turns on to light D_3 (red). The overvoltage protection circuit operates to protect the internal components against over-voltage inputs if the rotational frequency (rpm) increases above approximately 1.2 times the voltage rating due to over step.

In the above way, the circuit indicates the voltage by lighting the LEDs.

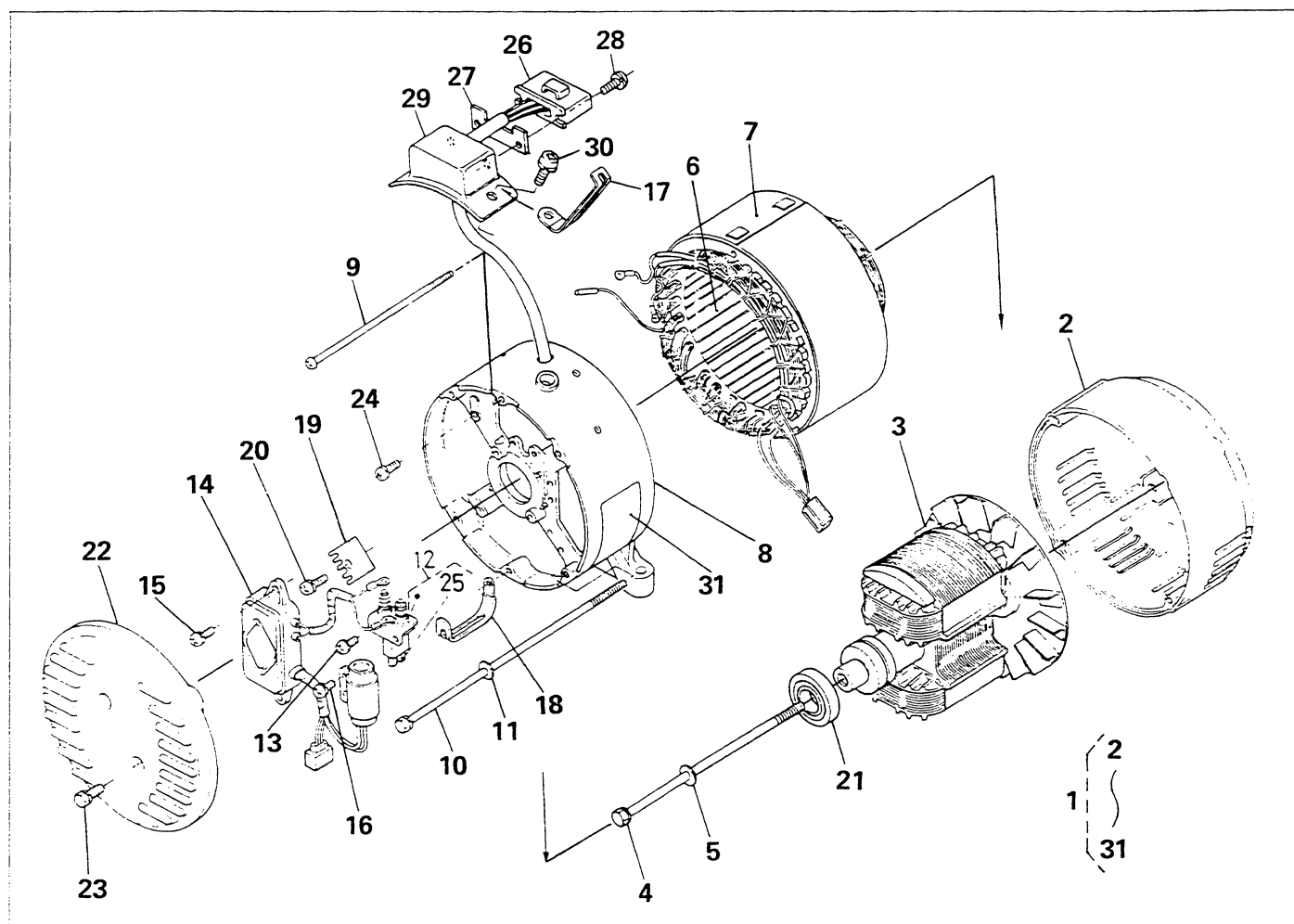
- (1) Temporary "HIGH" or "LOW" indication immediately after turning a load on or off is caused by temporary fluctuation in rotation (rpm) and is not abnormal.
- (2) "LOW" indication in DC operation is not abnormal, either.



LED is an abbreviation for light emitting diode. LEDs are on the principle that the PN junction of gallium phosphide (GaP) or gallium arsenide (GaAs) emits light when a forward current passes through the junction. The color of the available light (red, green, their combinations, and invisible infrared) depends on the semiconductor material. LEDs feature outstanding durability, long life, and high brightness.

2.1 Generator construction

■ GENERATOR COMPONENTS



- | | | | |
|-----------------------|-------------------------------|--------------------|-------------------|
| 1. Generator assembly | 9. Screw | 17. Plate | 25. Brush |
| 2. Front bracket | 10. Bolt | 18. Plate | 26. Coupler |
| 3. Rotor assembly | 11. Plain washer | 19. Diode assembly | 27. U plate |
| 4. Center bolt | 12. Brush holder assembly | 20. Screw | 28. Screw |
| 5. Plain washer | 13. Screw | 21. Ball bearing | 29. Coupler cover |
| 6. Stator assembly | 14. Control assembly (A.V.R.) | 22. Cleaner cover | 30. Screw |
| 7. Cover band | 15. Screw | 23. Bolt | 31. Nameplate |
| 8. Rear bracket | 16. Screw | 24. Screw | |

■ FUNCTIONS OF MAJOR COMPONENTS

(1) Stator assembly

The main coil and sub coil for power generation are wound in the slots provided in the core. The main coil generates the AC output and supplies the A.V.R. with a sensing voltage. The sub coil, working as an excitation coil, supplies the field current to the rotor.

(2) Rotor assembly

Permanent magnets used for initial excitation are placed

at the top of the two salient poles. The coils are wound to magnetize the entire core.

(3) Brush holder assembly

The excitation voltage from the sub coil of the stator assembly is applied to the rotor coil through the A.V.R. rectifying circuit and the brush holder assembly.

(4) A.V.R.

The A.V.R. maintains the AC output voltage at a constant level.

2.2 Operation of generator

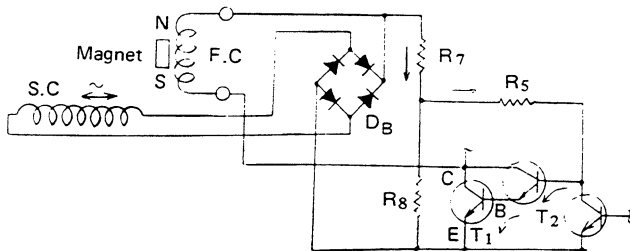
K1400, K2100, K3000, K3500
[K1200] [K1800] [K2500] [K3050]

■ EXCITATION CIRCUIT FUNCTION

(1) A.V.R. bias current path

When the engine starts and the rotor starts rotating, the permanent magnets mounted on the rotor induce an AC voltage of 4 to 6V across the stator sub coil. The AC voltage is converted into a bias current after full-wave rectification by the diode bridge DB. The current, as shown in the figure, goes through the bases and emitters of transistors T_1 and T_2 to cause conduction between the emitter and collector of T_1 .

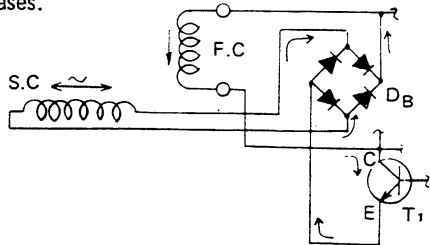
To generate a voltage of 4 to 6V at the stator sub coil without a permanent magnet and with only the residual magnetism of the rotor, an extremely high rpm is required. But with the permanent magnet, generation can be initiated at a low speed. Also the permanent magnets insure a reliable buildup under all conditions.



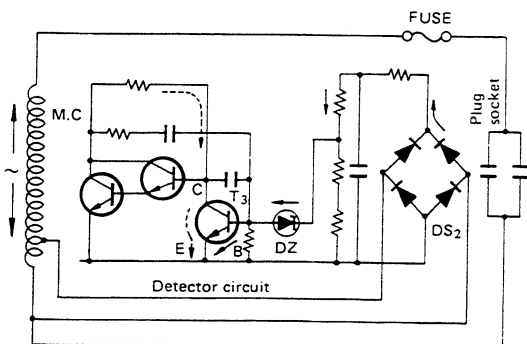
(2) Excitation current path from the sub coil to rotor

When the bias current is applied to the A.V.R. and the transistor T_1 conducts between C and E, the AC voltage induced at the sub coil is subject to full-wave rectification by the diode bridge (DB) and applied to the rotor field coil (FC).

As the current flows through the field coil (FC), it makes magnetic force lines which induce an AC voltage at the stator's main coil (MC), which increases as rpm increases.



(3) AC output circuit and A.V.R. operation



The AC voltage is fed to the external load through the control box plug socket. Since the voltage reaches its

rated level at a generator rpm of 2000 to 2500 rpm, voltage would become much higher than the rating at the rated rotation speed (3600 rpm at 60 Hz) if an A.V.R. is not provided. As shown in the above figure, the A.V.R. controls the AC voltage as follows.

When the voltage generated at the main coil exceeds the rated voltage, the Zener diode (Dz), which has previously been cut off, conducts and the bias current (indicated by the solid line) flows into the base of transistor T_3 to establish conduction between the collector and emitter of T_3 . Thus, the bias current of T_2 is diverted (toward the direction indicated by the broken line). Then, the bias current of T_1 stops and T_1 is cut off between its collector and emitter to stop the energizing current from flowing into the field coil through T_1 .

Without the energizing current, the voltage generated by the main coil would decrease instantly. With the lowered voltage, the detection circuit voltage (applied to the A.V.R.) also lowers to cut off the Zener diode. The bias current of T_3 then stops and T_2 and T_1 again turn on to resume the energizing current flow and the output voltage increases. By repeating the above operation, the rated voltage is held constant.

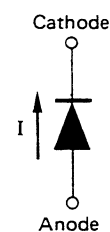
■ TRANSISTOR-TYPE A.V.R.

Voltage variations due to load variations are compensated for by CT, diode or transistor type A.V.Rs. Since conventional CT and diode types cannot compensate for rotation-speed variations, they are equipped with a voltmeter to monitor the voltage by adjusting the rpm.

The transistor type A.V.R. used in the K series has a voltage control function which can compensate for variations in the load and rotation speed. Therefore, no user adjustment is required, and voltage equivalent to the commercial power source is available within the rated output range. Instruct users not to use the generator at high load and at a frequency lower than 50Hz, since this drives the A.V.R. out of its operating range and output voltage is reduced.

(1) Diode

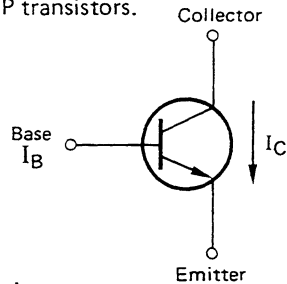
A diode permits a current to flow freely in the direction indicated by the triangle, but has an extremely high resistance in the opposite direction to prevent reverse current. Diodes are usually used as a rectifier for AC-to-DC conversion.



(2) Transistor

If a base current (I_B) flows in a transistor, a collector current (I_C), which is larger than and proportional to I_B , flows. In other words, the transistor has a current amplifying function expressed as the current amplification factor I_C/I_B .

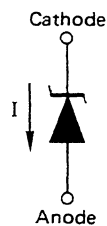
The collector current does not flow when the base voltage is zero or negative (–) in NPN transistors and positive (+) in PNP transistors.



(3) Zener diode

A Zener diode, also called a voltage regulator diode, has a reverse characteristic different from normal diodes.

When the reverse voltage applied to the cathode is raised to a certain point, a large current suddenly flows, and the reverse voltage at which the current flows rapidly is called the "Zener voltage". As the reverse voltage is reduced and when it reaches below the Zener voltage, the reverse current becomes almost zero. Making use of the characteristic, Zener diodes are generally used for constant-voltage circuits.



EX.

Suppose a zener is rated at 10 volts.

At voltages up to 10V, the zener acts like any diode. If the applied voltage exceeds 10V, the zener will pass current to maintain the 10V level. If 15V is applied, 5V will be shunted to ground while 10V will be permitted to pass. A zener provides protection against overvoltage.

2.3 Inspection and maintenance

K1400, K2100, K3000, K3500
[K1200] [K1800] [K2500] [K3050]

■ PRE-OPERATIONAL CHECK

Make sure to check the generator before starting and carefully examine overall condition to prevent trouble.

| Item | Check |
|------------------|---------------------------------------|
| Gasoline level | Check fuel level and add as required. |
| Engine oil level | Check oil level. |
| Bolts and nuts | Check tightness. |
| Oil and fuel | Check for leaks. |

■ SERVICE BEFORE EXTENDED STORAGE

To keep the generator in good condition, observe the following before storing for an extended period.

- (1) Drain gasoline from the fuel tank.
- (2) Drain the gasoline from the carburetor float chamber.
- (3) Clean the fuel cock.
- (4) Replace the crankcase oil.
- (5) Pull the recoil starter handle slowly and stop it at the point where drag or response is obtained (compression point).
- (6) Store the generator in a clean, dry place.

■ PERIODICAL INSPECTION AND MAINTENANCE

Malfunctions and machine life are directly related to proper care. Perform periodical service to insure troublefree operation and a longer service life.

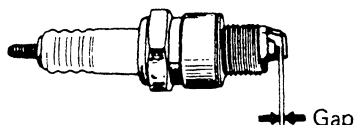
★ mark: replace if exceeding allowable limit.

| Servicing item | First 10 hrs. | First 20 hrs. | 50 hrs. | 200 hrs. | 300 hrs. | 500 hrs. | 1000 hrs. | |
|---|------------------|------------------|------------|-------------|-------------|-------------|--------------|---|
| Engine oil change | ○ | | ○ | | | | | |
| Air cleaner element check and cleaning | | | ○ | | | | | |
| Spark plug cleaning | | | ○ | | | | | |
| Fuel filter cleaning | | ○ | | ○ | | | | |
| Fuel tank cleaning | | | | | | ○ | | |
| Carbon brush check | | | | | | ○ | | ★ |
| Slip-ring check | | | | | | ○ | | |
| Spark plug gap adjustment | | | | ○ | | | | |
| Air cleaner element replacement (every six cleanings or every year) | | | | | | ○ | | |
| Generator side bearing check | | | | | | | ○ | |
| Intake/exhaust seat check and fitting | | | | | | | ○ | ★ |

Note: Use only Onan genuine parts for replacement.

■ SPARK PLUG

If the spark plug electrodes and insulator are dirty or have carbon attached, engine troubles will occur. Dirt and carbon can be easily removed with a wire brush. Adjust gap after cleaning.



| Gap of Spark Plug | | | |
|------------------------|-----------------------|-----------------|-----------------------|
| K1400 [K1200] | K2100 [K1800] | K3000 [2500] | K3500 [K3050] |
| 0.0276 in. (0.7 mm) | 0.0394 in. (1.0mm) | | 0.0276 in. (0.7mm) |

■ AIR CLEANER

- (1) Loosen the air cleaner cover.
- (2) Take out the air cleaner element.
- (3) Remove the foam wrapper, and wash it in detergent and water. Dry thoroughly when finished.
- (4) Re-oil the foam wrapper and squeeze out excess oil.
- (5) Shake and tap the cartridge-type element to remove the dust and dirt. If still dirty, install new element.
- (6) Install the foam wrapper back onto the cartridge-type element.
- (7) Clean out the air cleaner housing and cover.
- (8) Re-install the element into the housing and put on the air cleaner cover.

3.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 spilt 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) Thoroughly 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.

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■ 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. 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.

4. Generator Disassembly and Troubleshooting

(Notes)

- (1) The table below shows basic assembly procedures, which should be reversed for disassembly.
- (2) Take proper measures to prevent damage to the machined surfaces of removed parts.
- (3) Handle and place the rotor and stator carefully to prevent damage to the windings.
- (4) Use only **ONAN** genuine parts for replacement.
- (5) Perform insulation resistance after reassembly.

K450 [K400] and K1000 [K800]

4.1 Disassembly and reassembly of generator parts

■ ASSEMBLY 1: ROTOR ASSEMBLY

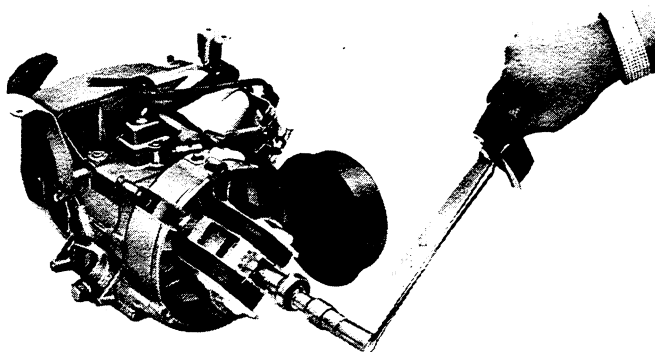
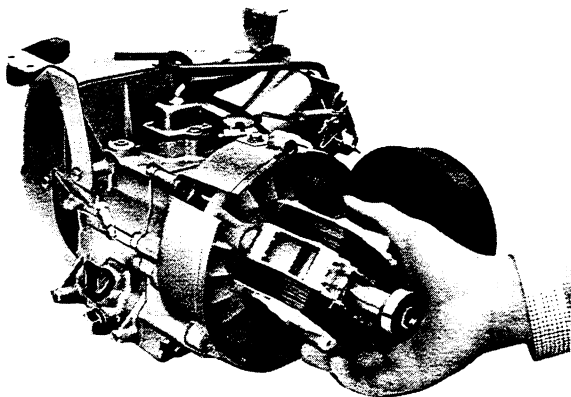
Tools; Torque wrench

Remove dirt and oil from the tapered portion.
Place the rotor assembly onto the engine output shaft.

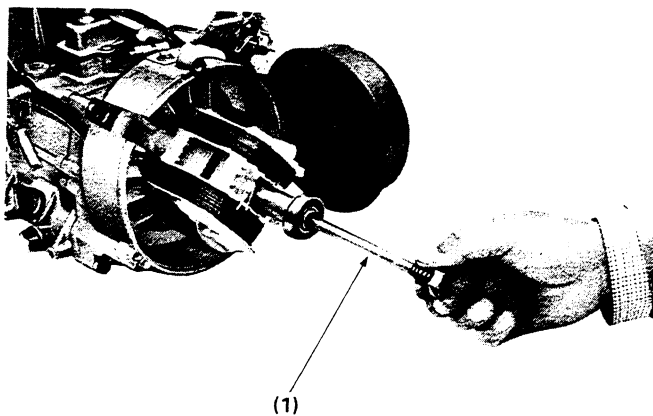
Center bolt tightening torque:

K450[K400]: 104.1 ~ 138.9 lbf·in
(120 ~ 160 kgf·cm 11.77 ~ 15.69 N·m)

K1000[K800]: 138.9 ~ 182.3 lbf·in
(160 ~ 210 kgf·cm 15.69 ~ 20.59 N·m)



Use a rotor removing bolt for rotor disassembly.



(1) Rotor removing bolt

Reassembling precautions

- Tapered portion must be free of dirt and oil.
- Handle the rotor assembly carefully to prevent damage to the winding.

Disassembling precautions

- Use a rotor removing tool for disassembly of rotor assembly.
- When removing, use care not to allow the rotor assembly to drop or hurt your hand.
- Handle and place the rotor assembly carefully to prevent damage to the winding.

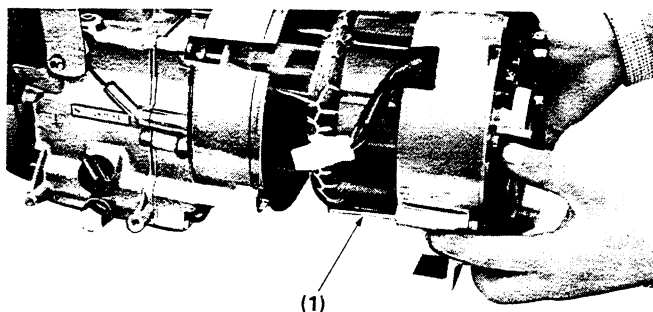
■ ASSEMBLY 2: BRACKET, STATOR ASSEMBLY

Tools; Torque wrench

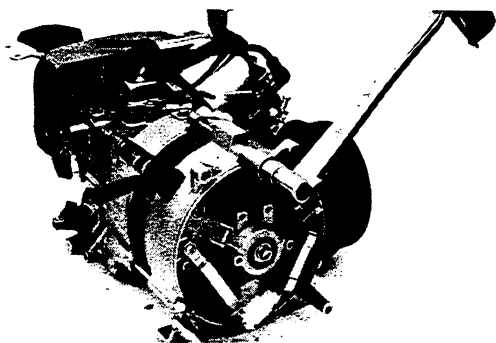
Install the stator assembly and bracket, aligning the rotor bearing with crankcase fitting area.
Tighten the three thru bolts to the specified torque.

Bolt tightening torque:

52.1 ~ 78.1 lbf·in (60 ~ 90 kgf·cm 5.88 ~ 8.83 N·m)



(1) Thru bolt



Reassembling precautions

- Remove dirt from the fitting area and periphery of the bearing.
- Handle carefully to prevent damage to the winding.
- After reassembly, pull the recoil starter handle to check if the rotor rotates smoothly.

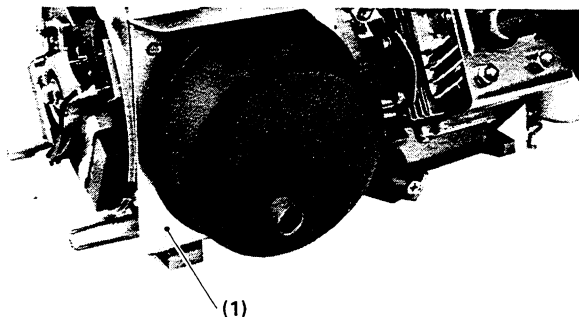
Disassembling precautions

- When removing the stator assembly, use care not to allow it to drop or hurt your hand.
- Handle and place the stator assembly to prevent damage to the winding.

■ ASSEMBLY 3: HEAT INSULATION COVER

Tools; + screwdriver

Insert the heat insulation cover between the generator and muffler. Tighten the mounting leg on the engine side to the muffler.

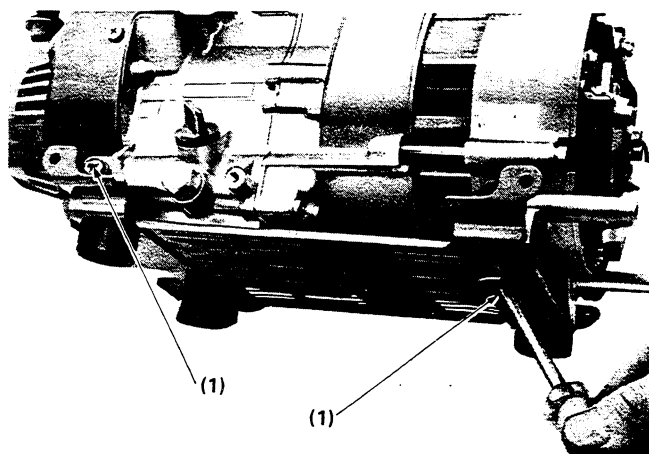


(1) Heat insulation cover

■ ASSEMBLY 4: ENGINE BASE

Tools; + screwdriver

Mount the engine base with bolts at two positions on the engine side and two positions on the generator side.

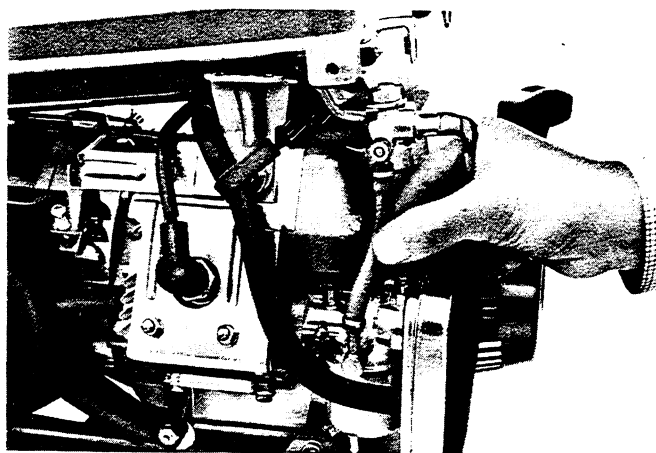


(1) Mounting bolt

■ ASSEMBLY 5: FUEL TANK, FUEL COCK

Tools; + screwdriver

Connect the fuel pipe to the fuel tank and carburator and temporarily install the tank on the bracket at top of the engine. Insert the fuel pipes completely and lock securely with snap rings.



Reassembling precautions

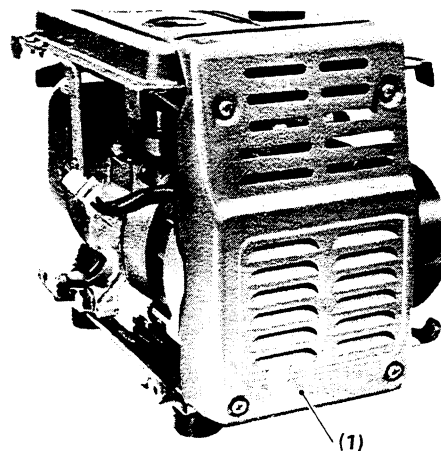
- Check for cracks in the pipe and for fuel leakage.

■ ASSEMBLY 6: SIDE COVER (1)

Tools; + screwdriver

Attach the side cover (1) to the fuel tank and generator with cross recessed head screws. (Phillips head)

At the same time, firmly secure the fuel tank which has been temporarily held.

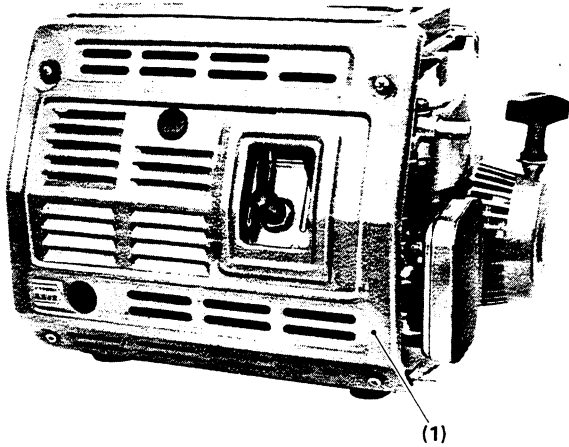


(1) Side cover

■ ASSEMBLY 7: REAR COVER

Tools; + screwdriver

Attach the rear cover to the fuel tank and engine base with cross recessed head screws. (Phillips head)



(1) Rear cover

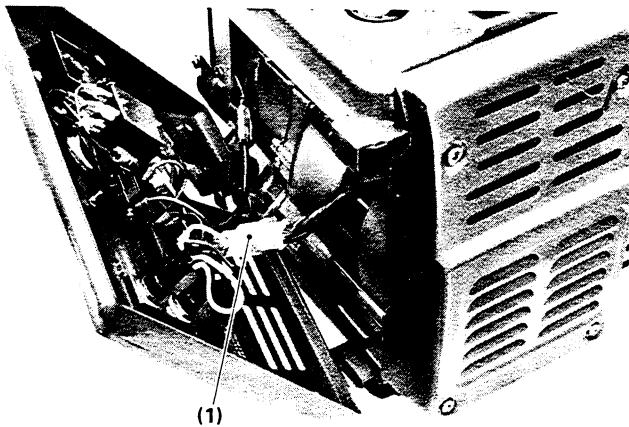
Reassembling precautions

- Make sure that the high voltage cord of the magneto does not contact any sharp edge of components.
- Align the muffler exhaust port with the square opening in the rear cover.

■ ASSEMBLY 8: FRONT COVER

Tools; Phillips screwdriver

Connect the coupler of the front cover to the generator coupler and attach the front cover to the fuel tank and engine base using cross recessed head screws. (Phillips head)



(1) Connect the couplers

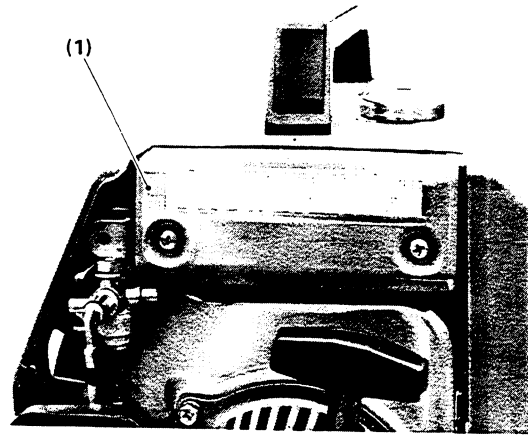
Reassembling precautions

- Do not pinch lead wires.

■ ASSEMBLY 9: SIDE COVER (2)

Tools; + screwdriver

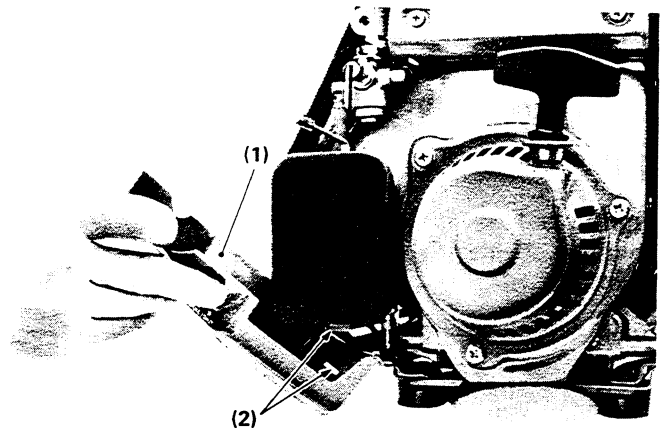
Attach the side cover 2 to the fuel tank with cross recessed head screws. (Phillips head)



(1) Side cover 2

■ ASSEMBLY 10: AIR CLEANER COVER

Place the fuel cock lever to OPEN and the choke lever to OPEN, lock the bottom groove of the air cleaner cover on the lug of the air cleaner and secure it with the knob bolt.



(1) Air cleaner cover
(2) Lock

4.2 Servicing standards list

K450, K1000
[K400] [K800]

■ GENERATOR

| Model | | K400 | | K450 | K800 | | K1000 |
|------------------------------|---------------------|------------------|-------|-------|-----------------|------|-------|
| Frequency | | 50Hz | | 60Hz | 50Hz | | 60Hz |
| Voltage | | 220V | 240V | 120V | 220V | 240V | 120V |
| Stator coil resistance | Output side [M.C.] | 9.3Ω | 10.3Ω | 2.43Ω | 5.45Ω | 5.6Ω | 1.3Ω |
| | Main capacitor coil | 14.6Ω | | | 10.2Ω | | |
| | Sub coil [S.C.] | 12.5Ω | | 10.5Ω | 8.8Ω | | 7.4Ω |
| Rotor coil resistance [F.C.] | | 13.9Ω | | | 16.5Ω | | |
| Rotor air gap | | 0.0157 in. 0.4mm | | | | | |
| Capacitor (M.C.) | Rating | 6μF ±5% 250VAC | | | 9μF ±5% 250VAC | | |
| Capacitor (S.C.) | Rating | 9μF ±5% 250VAC | | | 10μF ±5% 300VAC | | |

■ CONTROL PANEL

| Model | K400 | | K450 | | K800 | | K1000 |
|--------------------------|------|-----------------------|----------|------------|----------------|----------------|-----------------|
| Output receptacle | AC | 250Vx15A | 250Vx15A | 125V – 15A | 250Vx15A x2 | 250Vx15A x2 | 125 – 15A x2 |
| | DC | /\ -shaped receptacle | | | | | |
| Circuit breaker capacity | AC | 2A | 2A | 3.5A | 4A | 3A | 8A |
| | DC | 10A | | | | | |

■ TIGHTENING TORQUE

| Model | K450[K400] | K1000[K800] |
|------------------|---|---|
| Rotor thru bolt | 104.1 ~ 138.9 lbf.in 120 ~ 160 kgf.cm 11.77 ~ 15.69 N.m | 138.9 ~ 182.3 lbf.in 160 ~ 210 kgf.cm 15.69 ~ 20.59 N.m |
| Stator thru bolt | 52.1 ~ 78.1 lbf.in 60 ~ 90 kgf.cm 5.88 ~ 8.83 N.m | 52.1 ~ 78.1 lbf.in 60 ~ 90 kgf.cm 5.88 ~ 8.83 N.m |

■ SPEED ADJUSTMENT STANDARD

| | K400 | K450 | K800 | K1000 |
|--------------------|--------------------------------|--------------------------------|--------------------------------|--------------------------------|
| Frequency | 50Hz | 60Hz | 50Hz | 60Hz |
| Max. no-load speed | 53.5±1.5Hz (3120 ~ 3300rpm) | 63.5±1.5Hz (3720 ~ 3900rpm) | 53.5±1.5Hz (3120 ~ 3300rpm) | 63.5±1.5Hz (3720 ~ 3900rpm) |
| Idling speed | | | | 1600±200rpm |

4.3 Generator troubleshooting

K450, K1000
[K400] [K800]

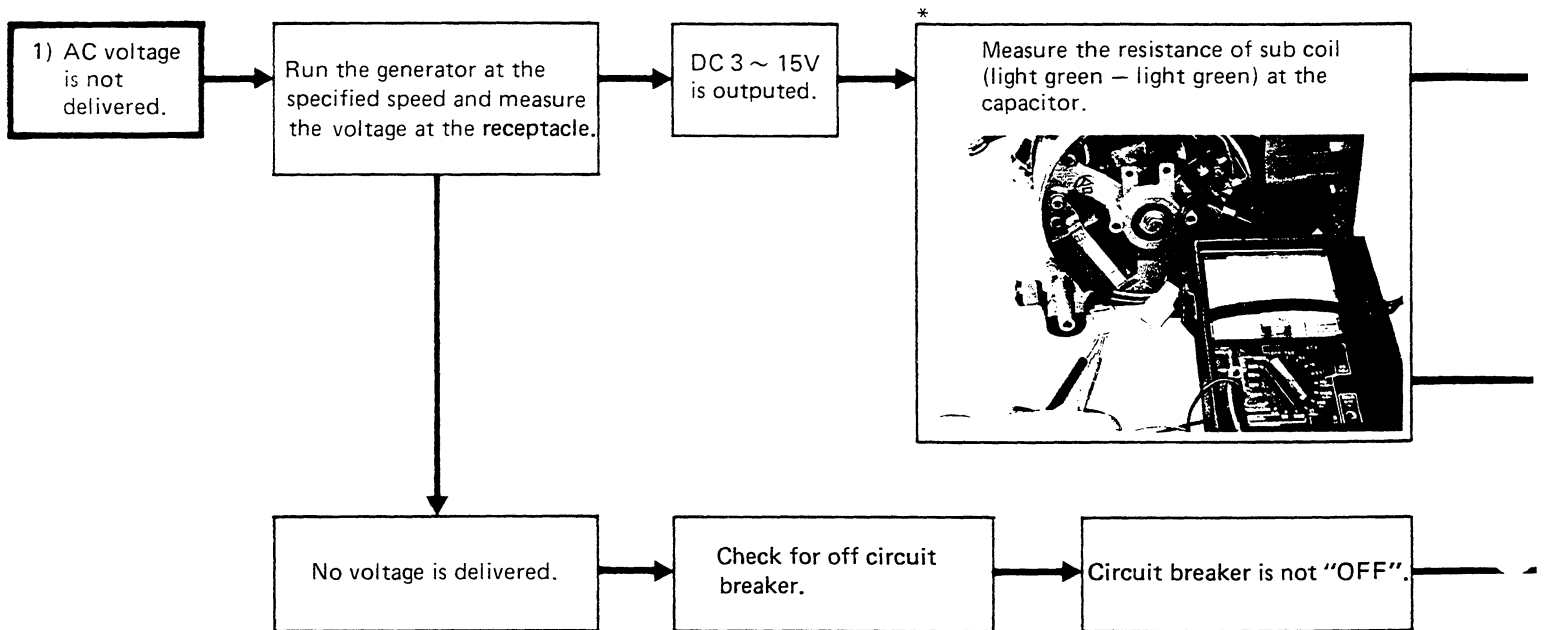
Safety points

- (1) When checking terminal voltage during operation, be careful not to be shocked.
- (2) Do not touch the tester probes directly with your fingers.

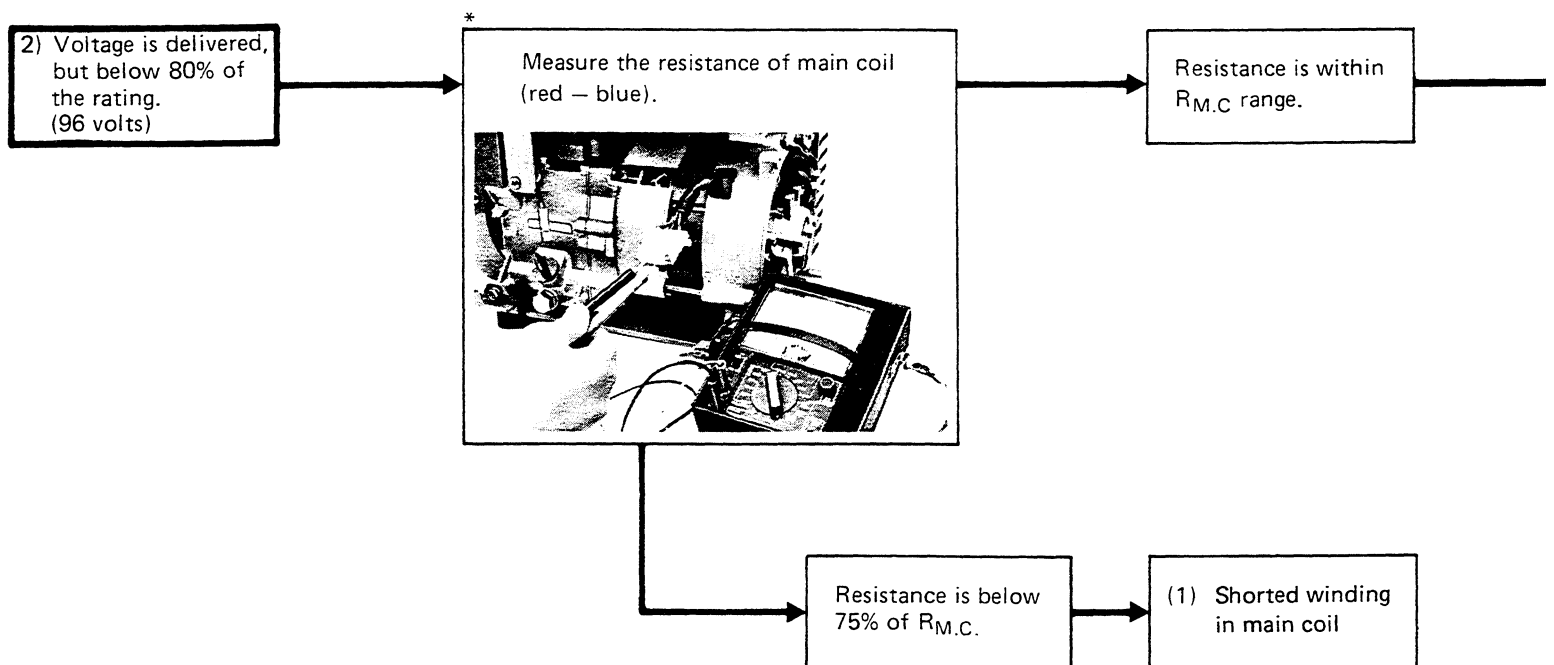
4.3.1 Troubles, possible causes, and countermeasures

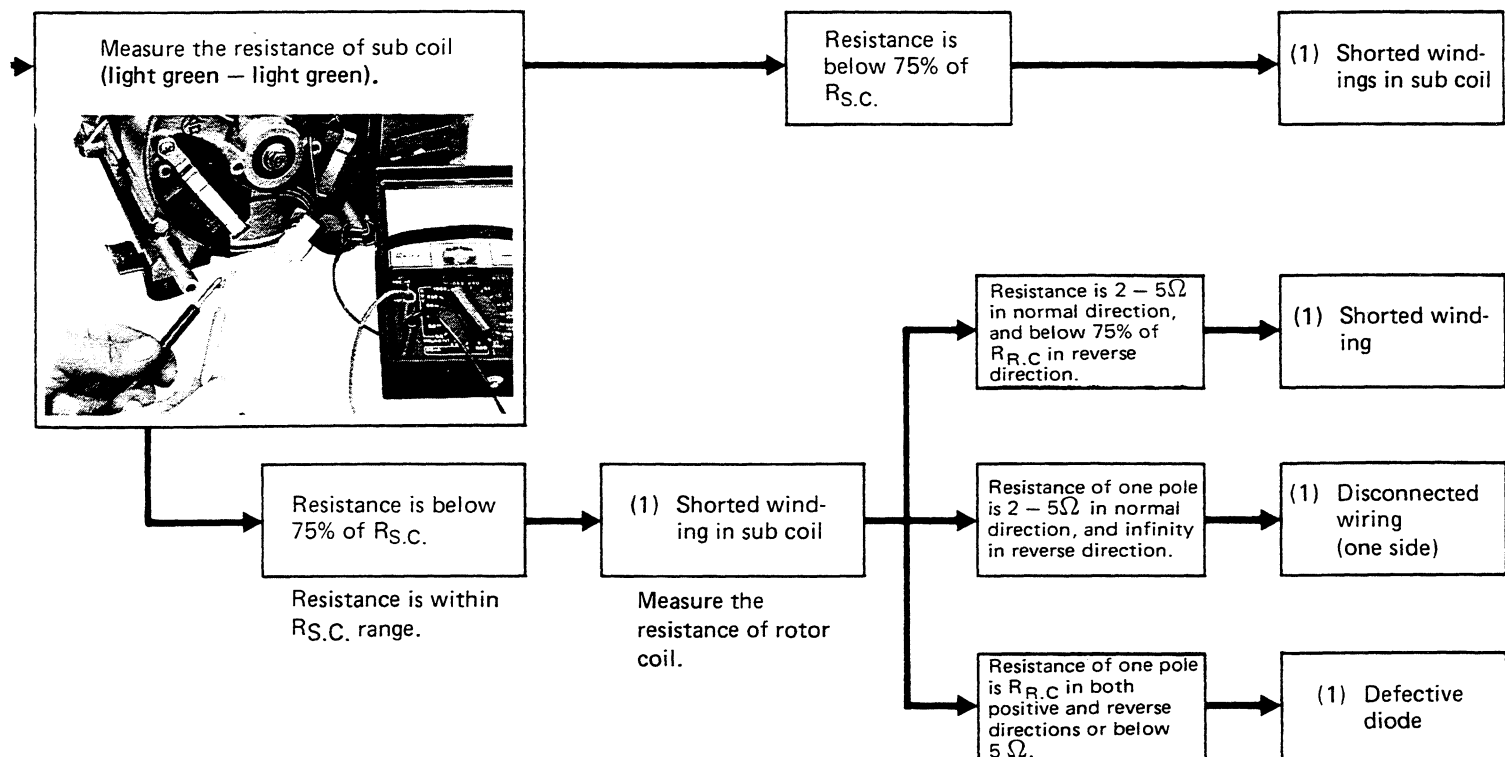
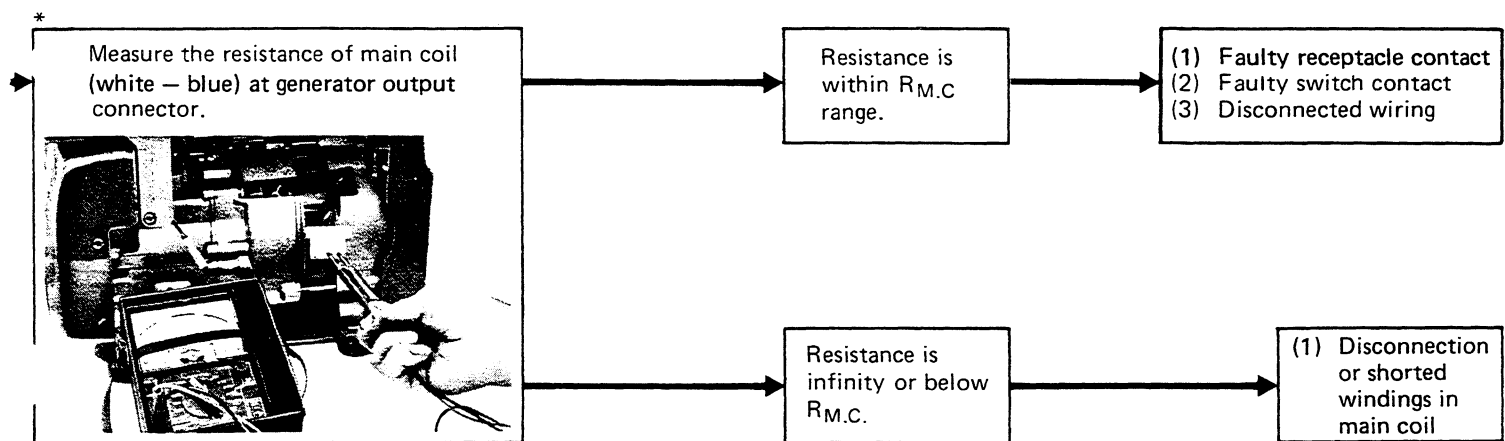
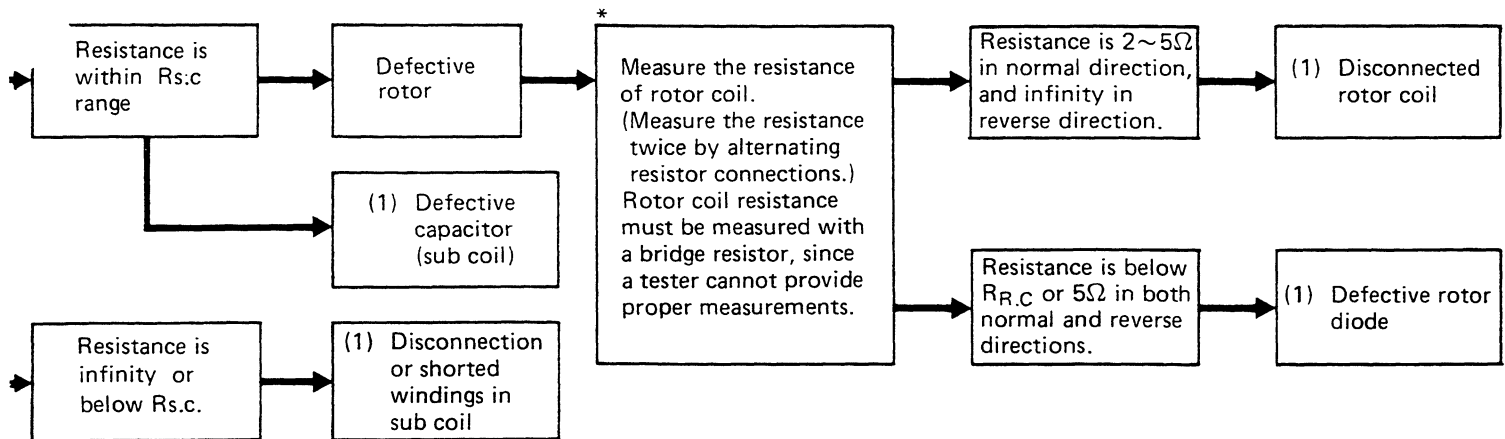
| Trouble | Checking method | Measurement/ operating condition | Possible cause | Countermeasures |
|--|---|---|--|---|
| Generator does not operate when load is connected. | Voltage indication lamp lights, but output voltage is not delivered. | Output voltage: 0V | Switch is not at (DC/AC) position. | Set the switch to the desired position. |
| | | | Disconnected main coil | Repair or replace. |
| | | | Blown fuse | Locate the cause (short circuit caused by overloaded wiring, etc.) and remove it. Then, replace fuse. |
| | | | Improper contact of receptacle | Repair or replace. |
| | | | Improper switch contact | Repair or replace. |
| | | | Disconnected wiring (rear side of control panel) | Check wiring. Repair. |
| | Voltage indication lamp does not light and output voltage is not delivered. | Output voltage: 0V Only slight output voltage is delivered. (3 ~ 10V) | Disconnected main coil | Repair or replace. |
| | | | Disconnected rotor coil | Repair or replace. |
| | | | Disconnected rotor diode wire | Replace. |
| | | | Defective capacitor | Replace. |
| | | | Disconnected sub coil | Repair or replace. |
| Load is available, but an abnormality exists. | Rated output is not available. | Output voltage is below 80% of the rated voltage. (96 volts) (DC only) | Shorted stator coil (including sub coil) | Repair or replace. |
| | | | Disconnected or shorted rotor coil | Repair or replace. |
| | | | One of rotor diodes defective | Replace. |
| | | | Defective diode stack | Replace. |
| | Large difference between voltages with load and without load | More than 130% with no load. | Disconnected main capacitor coil | Repair or replace. |
| | | | Defective main capacitor | Replace. |
| | Voltage indication lamp does not light. | Normal | Defective voltage indicator | Replace. |
| | Fuse blows frequently. | Normal | Overload, short circuit of wiring. | Remove overload or repair. |
| | | | Abnormal load | Repair load. |

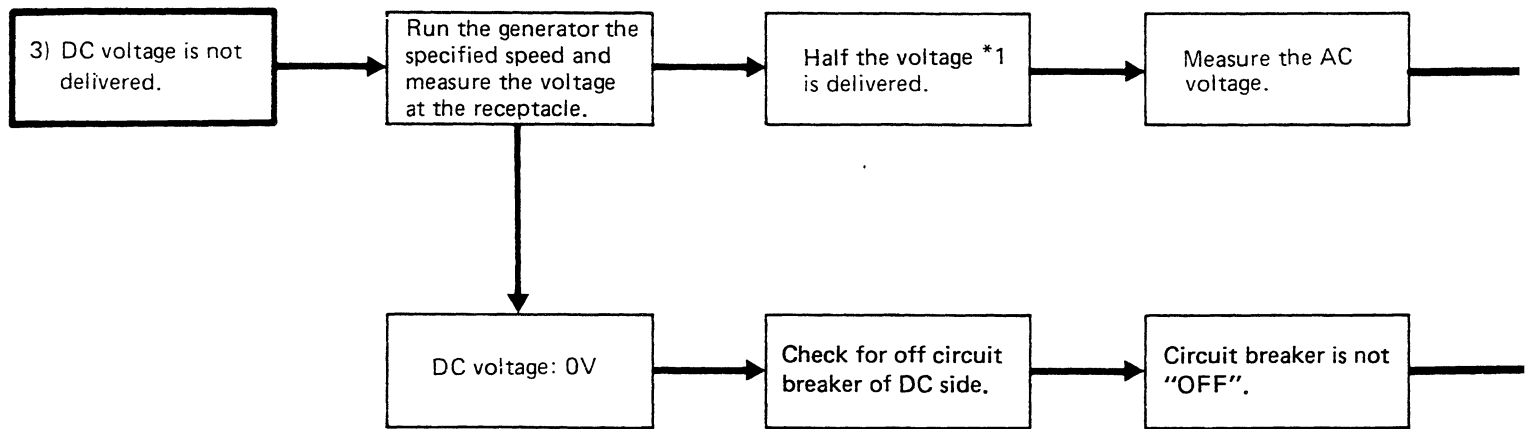
4-3-2. Inspection procedures for troubleshooting

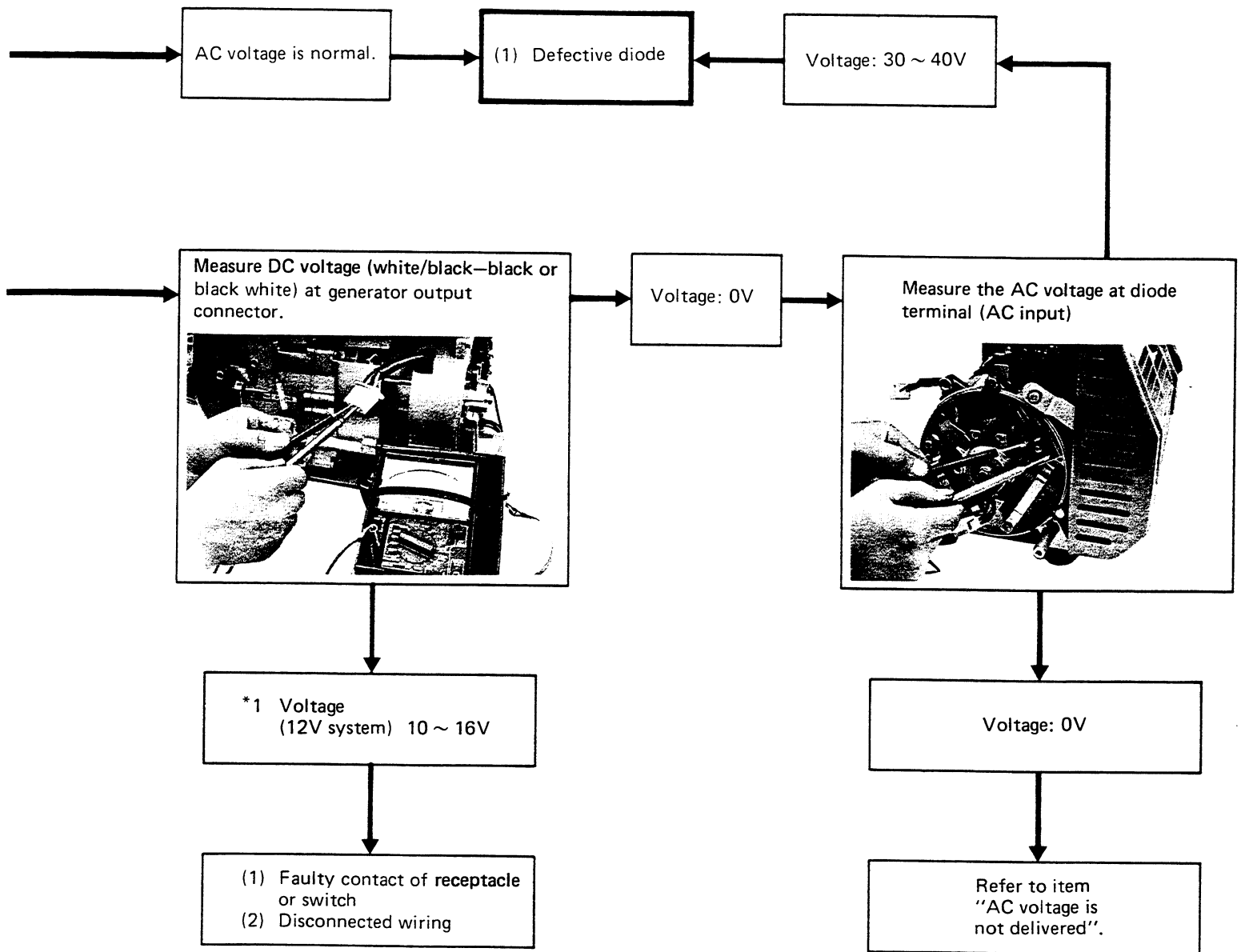


* Check for short to ground condition. Test meter set on RX10,000 or highest scale on meter. Measure between winding and ground. No meter movement should take place.









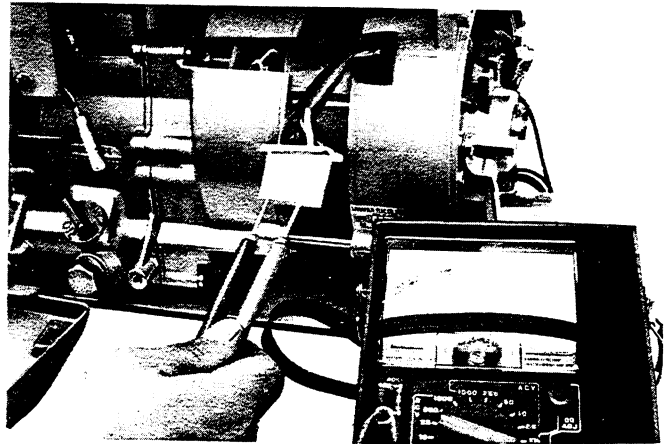
4.3.3 Generator parts quality varification

■ NORMAL VOLTAGES BETWEEN TERMINALS

Output terminal (AC120V)

- (1) Set the selector switch to AC120V, and measure the voltages between terminals of receptacle using a tester.
- (2) Remove the panel, and measure the voltage between terminals white and blue of 6P coupler.

AC108 ~ 144V (common)

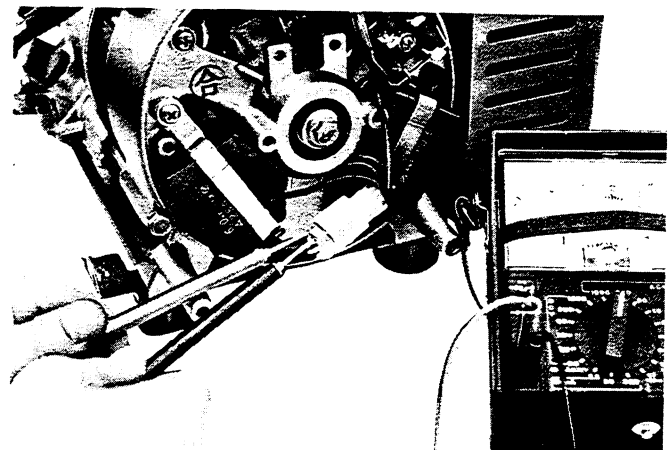
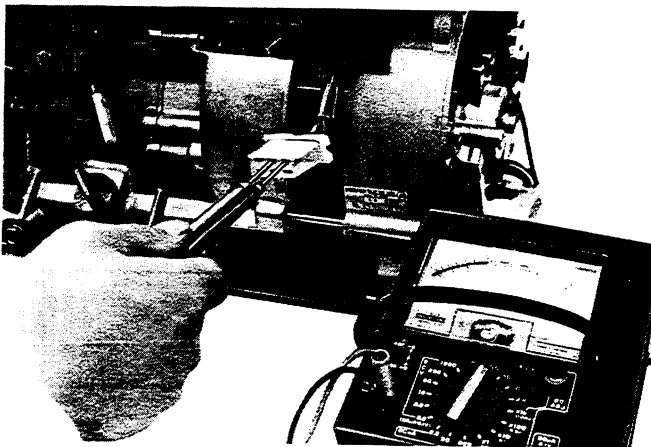


Capacitor terminal voltage

Remove the side cover (1), and measure the voltage between capacitor terminals.

(Lead wires: yellow — yellow
light green — light green)

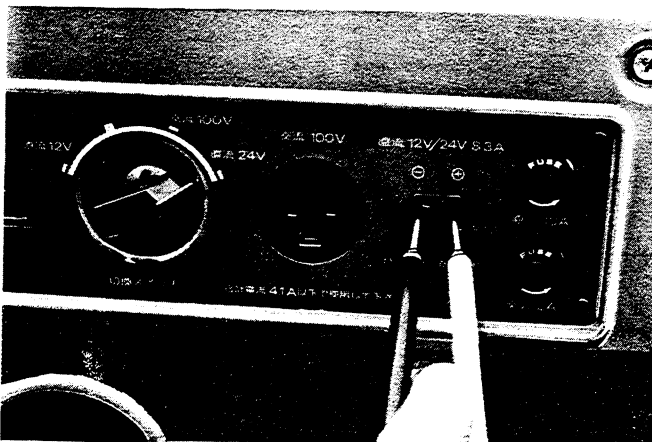
AC 200 ~ 250V (common)



Output terminal (DC12V)

- (1) Set the selector switch to DC12V, and measure the voltages between terminals of the /\\-shaped receptacle.
- (2) Remove the panel, and measure the voltage between terminals white/black and black of 6P coupler.

DC10 ~ 16V (common)



■ STATOR ASSEMBLY

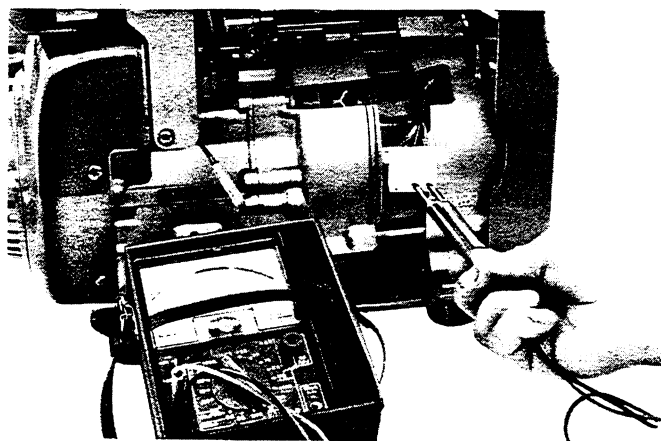
Winding resistance

- (1) Main coil

Remove 6P coupler, and measure the winding resistance between white and blue lead wires.

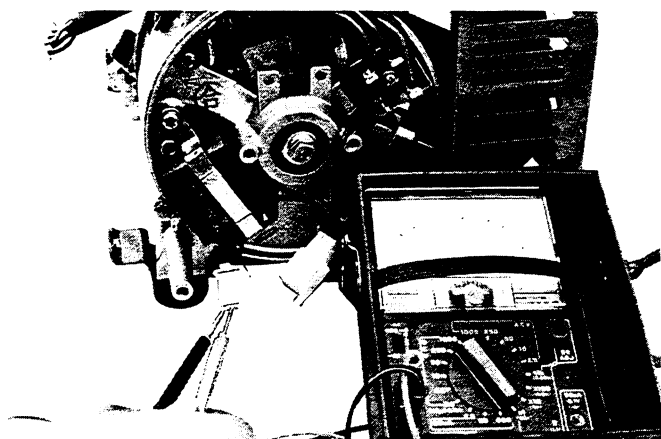
K450[K400] = $2.43\Omega \pm 5\%$

K1000[K800] = $1.30\Omega \pm 5\%$



- (2) Sub coil
Remove 4P coupler, and measure the winding resistance between light green and light green lead wires.

K450[K400] = $10.5\Omega \pm 5\%$
K1000[K800] = $7.4\Omega \pm 5\%$



Measure winding resistance with generator stopped at normal temperature of winding. Given at left are standard resistances at 68°F (20°C).

- (3) Main capacitor coil
Remove 4P coupler, and measure the winding resistance between yellow and yellow lead wires.

K450[K400] = $14.6\Omega \pm 5\%$
K1000[K800] = $10.2\Omega \pm 5\%$

■ ROTOR ASSEMBLY

Winding resistance, Field coil

Measure the resistance of rotor coil using a bridge resistor. (Measure the resistance twice by alternating resistor connections.)

K450[K400] = 13.9Ω
K1000[K800] = 16.5Ω

Rectifier

Measure the resistance of rotor coil using a bridge resistor. (Measure the resistance twice by alternating resistor connections.)

If resistance is $R_{R,C}$ and below 5Ω

Use a bridge resistor, since a tester cannot provide accurate measurement.

■ BEARING

Side clearance between inner and outer races

Measure the side clearance of outer race.

Side clearance must be within 0.020 in (0.5 mm). Common

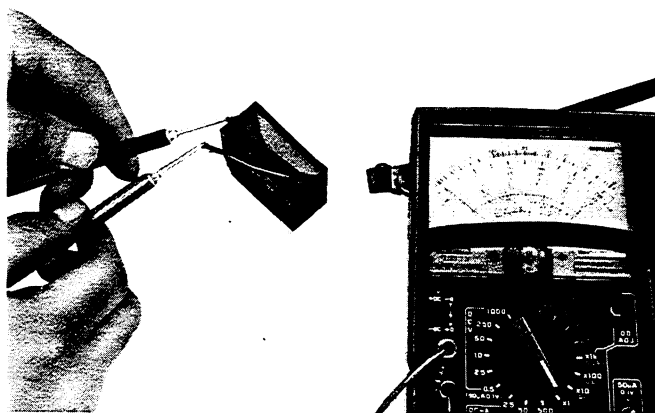
■ CAPACITOR

Conduct the following tests with a tester.

Tester is in R x 1 range.

1. Remove the capacitor from 4P coupler.
2. Connect tester probes to the + and - sides of the capacitor.
3. Reverse the tester probe connections.

Resistance will be infinity. The pointer swings and the resistance will be infinity.

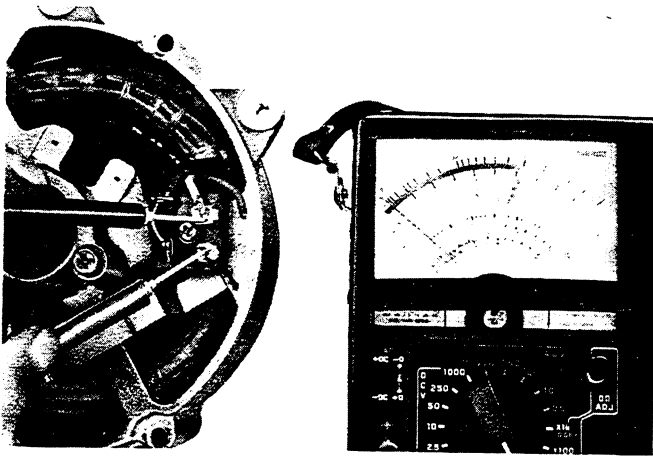


■ DIODE STACK

Conduction

- (1) Remove one lead wire of 6P coupler and one of AC input lead wires, and check for conduction.
- (2) Alternately contact sets of adjacent terminals with the + and - probes of the tester.

| | Tester probe (+) | Tester probe (-) | Pointer of tester |
|------------------|------------------|------------------|-------------------|
| Rectifier symbol | AC terminal | + | Does not swing |
| | + | AC terminal | Swings |
| | AC terminal | - | Swings |
| | - | AC terminal | Does not swing |



■ VOLTAGE INDICATOR

Output voltage (AC100V)

Check lighting of indication lamp and range of output voltage.

| Indicator lamp | AC output voltage |
|---------------------|-------------------|
| Green lamp lights. | AC108 ~ 144V |
| Yellow lamp lights. | Below AC108V |
| Red lamp lights. | Above AC144V |

Voltage indicator is inoperative when the protective device functions due to 1.2 times the rated rpm.

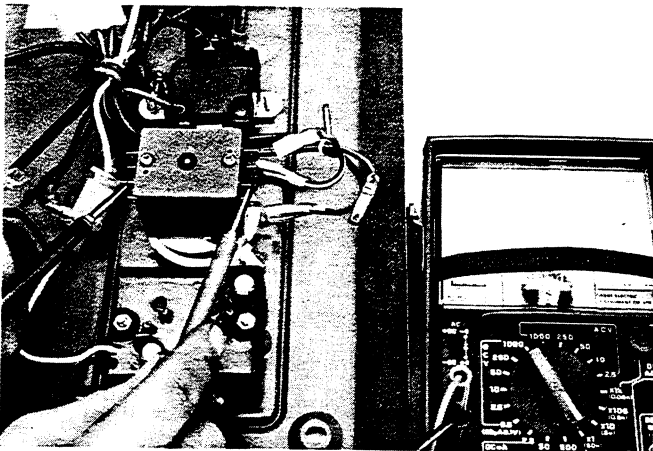
Perform this measurement for both AC terminals.

■ SELECTOR SWITCH

Conduction

Change the switch position to check conduction between terminals.

| Switch position | Terminal number | Pointer of tester |
|-----------------|-----------------|-------------------|
| Engine stop | 5 — 8 | Swings |
| AC 120V | 6 — 7 | Swings |
| DC 12V | 1 — 4 | Swings |



Pointer of tester does not swing with other combination of terminal No's described at above.

(Notes)

- (1) The procedure below shows basic assembly procedures, which should be reversed for disassembly.
- (2) Take proper measures to prevent damage to the machined surfaces of removed parts.
- (3) Handle and place the rotor and stator carefully to prevent damage to the windings. Otherwise, the generator will not function.
- (4) Use only ONAN genuine parts for replacement.
- (5) Perform insulation resistance tests after reassembly.

K1400 [K1200], K2100 [K1800], K3000 [K2500], K3500 [K3050]

4.1 Disassembly and reassembly of generator parts

■ ASSEMBLY 1: BRACKET FRONT

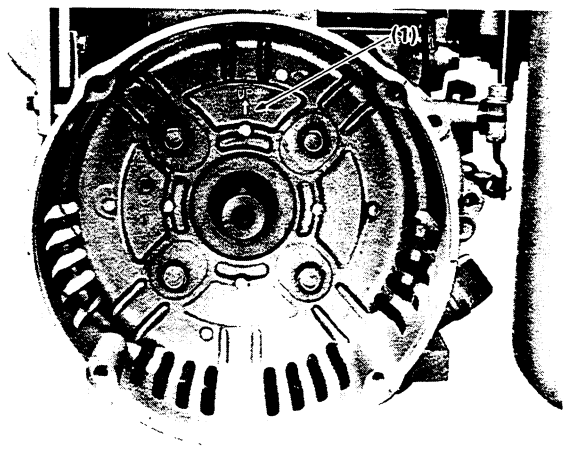
Tools; Torque wrench

Position the bracket front correctly so that it seats around the outer periphery of engine oil seal.
Install the bracket front so that its arrow mark faces up.

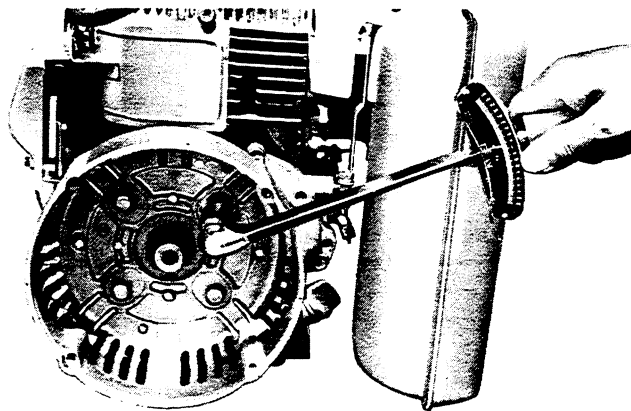
Bolt tightening torque:

156.2 ~ 191.0 lbf·in

(180 ~ 220 kgf·cm 17.65 ~ 21.58 N·m)



(1) Arrow



Reassembling precautions

- Check that fitting portion is properly fitted.
If distorted, it may cause the crank-shaft to break due to the inclined bracket front.
- Tighten the bolts evenly to prevent partial tightening.

■ ASSEMBLY 2: ROTOR ASSEMBLY

Tools; Torque wrench

Remove all dirt and oil from the tapered area.
Place the rotor assembly onto the engine output shaft.

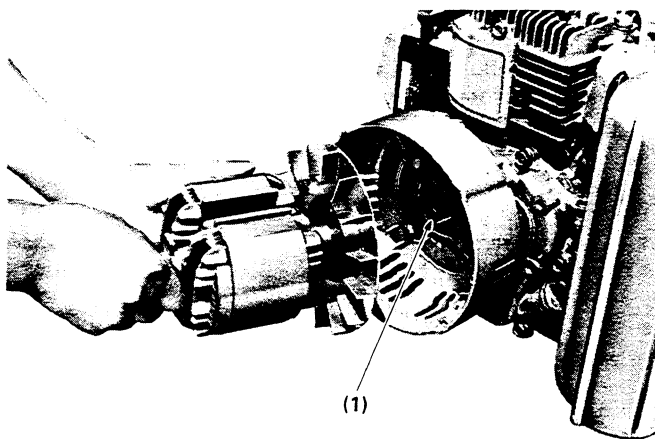
Center bolt tightening torque:

K1400, K2100 : 138.9 ~ 182.3 lbf·in

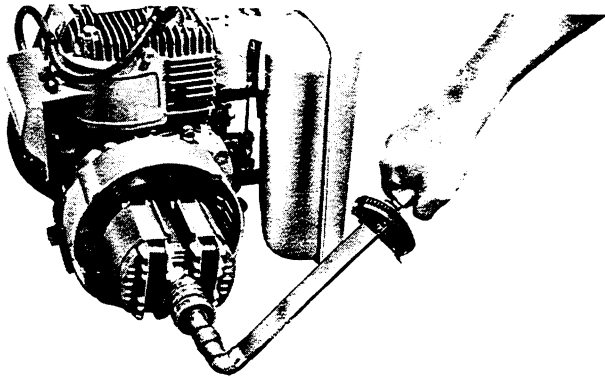
(160 ~ 210 kgf·cm 15.69 ~ 20.59 N·m)

K3000, K3500 : 277.7 ~ 381.9 lbf·in

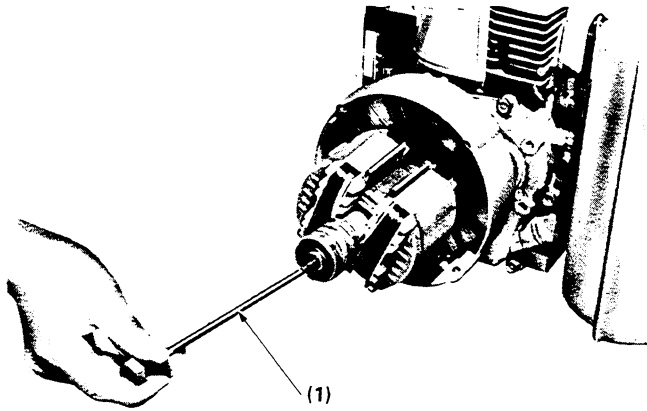
(320 ~ 440 kgf·cm 31.38 ~ 43.15 N·m)



(1) Output shaft



Use a rotor removing bolt for disassembly of rotor.



(1) Rotor removing bolt

Reassembling precautions

- Tapered portion must be free of dirt and oil.
- Handle the rotor assembly carefully to prevent damage to the winding.

Disassembling precautions

- Use a rotor removing tool for disassembly of rotor assembly.
- When removing, use care not to allow the rotor assembly to drop or hurt your hand.
- Handle and place the rotor assembly carefully to prevent damage to the winding.

■ ASSEMBLY 3: BRACKET, STATOR ASSEMBLY

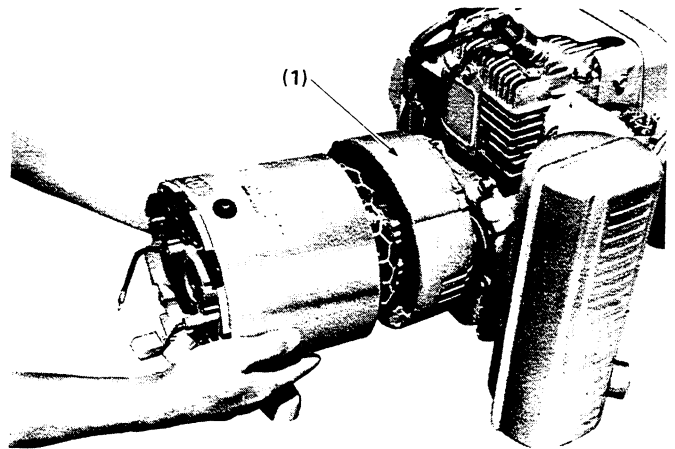
Tools; Torque wrench

Install the stator assembly and bracket, aligning with the rotor bearing with bracket front fitting areas.
Before assembly, make sure that brush holder is removed.
Tighten the four thru bolts to the specified torque.

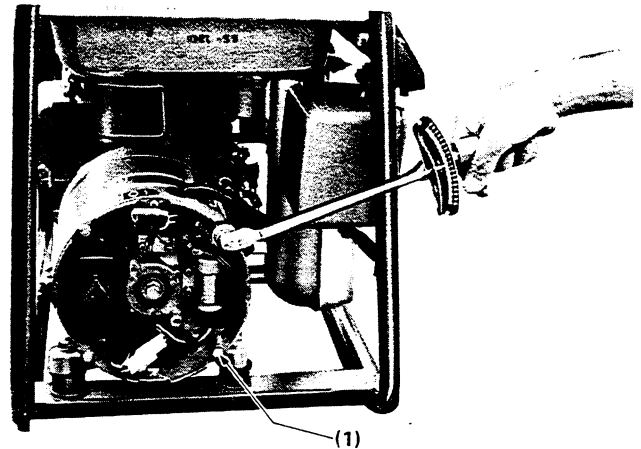
Bolt tightening torque:

52.1 ~ 78.1 lbf-in (60 ~ 90 kgf-cm 5.88 ~ 8.83 N-m)

Note: When disassembling and assembling with the engine mounted on a pipe frame, place a block under the bracket front for convenience.



(1) Bracket front



(1) Stator thru bolt

Reassembling precautions

- Remove dirt around the fitting area and periphery of bearings.
- Completely remove dirt and oil from the slip ring periphery, since they can affect the life of the generator.
- Handle carefully to prevent damage to the winding.

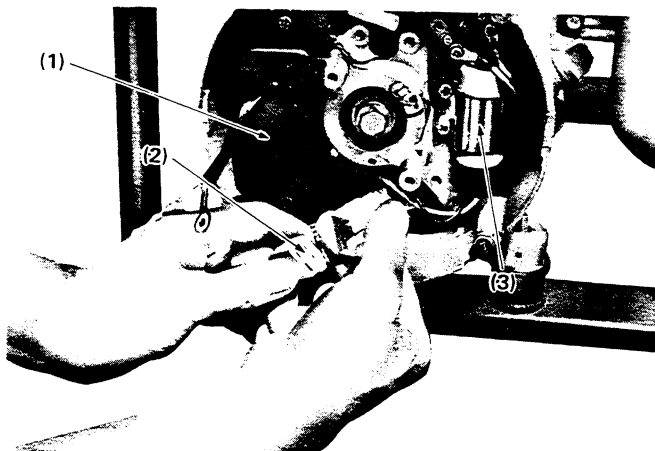
Disassembling precautions

- When removing the stator assembly, use care not to allow it to drop or hurt your hand.
- Handle and place the stator assembly to prevent damage to the winding.
- Brush must be removed before disassembly. If the brush is forced, brush will break.

■ ASSEMBLY 4: CONTROL ASSEMBLY CAPACITOR (WHEN REMOVED)

Tools; + screwdriver

Mounted the control assembly and capacitor on the rear of the bracket, and securely connect 4P coupler. Clamp the lead wire and coupler.

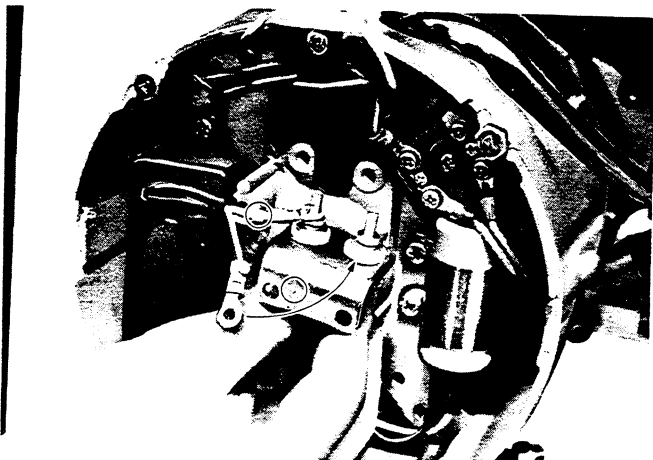


(1) Control assembly (2) 4P coupler (3) Capacitor

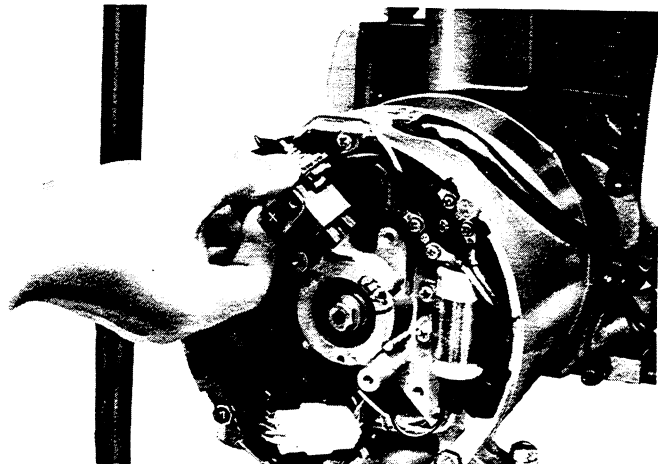
■ ASSEMBLY 5: BRUSH ASSEMBLY

Tools; + screwdriver

- (1) Connect the two AVR lead wires. Connect the + lead wire with + terminal of the brush holder.



- (2) Remove dust from the brush sliding surface and slip ring surface, and install the brush assembly in the rear of the bracket.



■ ASSEMBLY 6: WIRE HARNESS CONNECTION

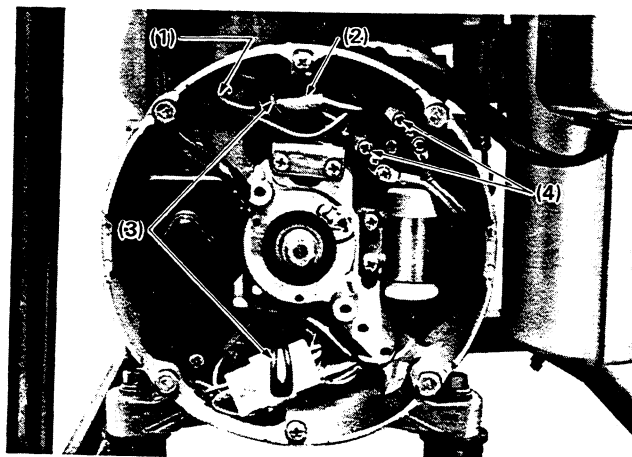
Tools; + screwdriver

Pass the wires through rubber grommet, and connect them to their destinations at the generator.

Grounding wire : one

Output wire : two

After connection, clamp securely.



- (1) Ground wire
- (2) F meter output wire (If used)
- (3) Clamp
- (4) Output wire

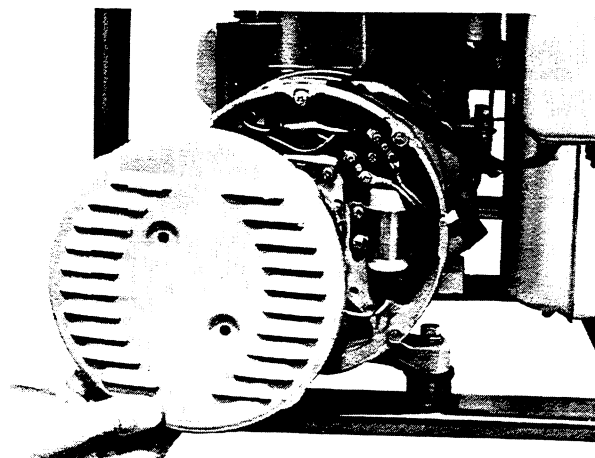
Reassembling precautions

- The output wires must be matched according to color.
- After clamping, do not press the wire bundle to cause it to touch rotating part of stator winding.
- Insert wire harness tubes into the rubber bushings.

■ ASSEMBLY 7: CLEANER COVER

Tools; + screwdriver

Mount the cleaner cover with its windows facing down.



4.2 Servicing standards list

K1400, K2100, K3000, K3500
[K1200] [K1800] [K2500] [K3050]

■ GENERATOR

| Model | | K1200 | K1400 | K1800 | K2100 |
|------------------------------|------------------------|--|-------|-------|-------|
| Frequency | | 50Hz | 60Hz | 50Hz | 60Hz |
| Voltage | | 220V | 120V | 220V | 120V |
| Stator coil resistance | Output side [M.C.] | 6.4Ω | 1.7Ω | 3.8Ω | 0.94Ω |
| | Sub coil [S.C.] | 3.1Ω | 3.1Ω | 2.6Ω | 2.6Ω |
| Rotor coil resistance [F.C.] | | 45Ω | | 54Ω | |
| Rotor air gap | | 0.0157 in (0.4 mm) | | | |
| Slip ring | Standard O.D. | ϕ1.50 in (38 mm) | | | |
| | Allowable limit | ϕ1.42 in (36 mm) | | | |
| | Standard runout | 0.0012 in (0.03 mm) or less | | | |
| | Allowable runout limit | 0.0039 in (0.03 mm) or less | | | |
| Brush | Standard height | More than 0.256 in or 6.5 mm (overhang from holder) | | | |
| | Allowable limit | Less than 0.1378 in or 3.5 mm (overhang from holder) | | | |
| Brush spring | Standard height | 9.967 oz (310 gr) | | | |
| | Allowable limit | 2.572 oz (80 gr) | | | |
| Bearing model | | 6203-2RU | | | |

| Model | | K2500 | K3000 | | K3050 | K3500 | |
|------------------------------|------------------------|--|----------|------------|-------|----------|------------|
| | | | Dual (1) | Dual (2) | | Dual (1) | Dual (2) |
| Frequency | | 50Hz | 50Hz | 60Hz | 50Hz | 50Hz | 60Hz |
| Voltage | | 220V | 110/220V | 120/240V | 220V | 110/220V | 120/240V |
| Stator coil resistance | Output side [M.C.] | 2.2Ω | 0.8/2.4Ω | 1.31/1.31Ω | 1.8Ω | 0.65/2Ω | 1.06/1.06Ω |
| | Sub coil [S.C.] | 2.4Ω | 2.55Ω | 2.2Ω | 2.3Ω | | |
| Rotor coil resistance [F.C.] | | 68Ω | | 70Ω | | | |
| Rotor air gap | | 0.0157 in (0.4 mm) | | | | | |
| Slip ring | Standard O.D. | φ1.50 in (38 mm) | | | | | |
| | Allowable limit | φ1.42 in (36 mm) | | | | | |
| | Standard runout | 0.0012 in (0.03 mm) or less | | | | | |
| | Allowable runout limit | 0.0039 in (0.1 mm) or less | | | | | |
| Brush | Standard height | More than 0.256 in or 6.5 mm (overhang from holder) | | | | | |
| | Allowable limit | Less than 0.1378 in or 3.5 mm (overhang from holder) | | | | | |
| Brush spring | Standard height | 9.967 oz (310 gr) | | | | | |
| | Allowable limit | 2.572 oz (80 gr) | | | | | |
| Bearing model | | 6204-2RU | | | | | |

■ CONTROL PANEL

| Model | | K1200 | K1400 | K1800 | K2100 |
|--------------------------|----|------------------------|---------------|----------------|----------------|
| Output receptacles | AC | 250V x 15A x 2 | 125 – 15A x 2 | 250V x 15A x 2 | 125V – 15A x 2 |
| | DC | / \ -shaped receptacle | | | |
| Circuit breaker capacity | AC | 5A | 10A | 8A | 20A |
| | DC | 10A | | | |
| Pilot lamp | | 250V | 125V | 250V | 125V |

| Model | | K2500 | K3000 | | K3050 | K3500 | |
|--------------------------|----|------------------------|----------------------------------|--|----------------|----------------------------------|--|
| | | | Dual (1) | Dual (2) | | Dual (1) | Dual (2) |
| Output receptacles | AC | 250V x 15A x 2 | 125V x 15A x 2 250V x 15A x 2 | 125V – 15A 125/250V – 20A 125V – 30A | 250V – 15A x 2 | 125V x 15A x 2 250V x 15A x 2 | 125V – 15A 125/250V – 20A 125V – 30A |
| | DC | / \ -shaped receptacle | | | | | |
| Circuit breaker capacity | AC | 10A | 25A 15A | 12A x 2 | 15A | 25A 15A | 15A x 2 |
| | DC | 10A | | | | | |
| Pilot lamp | | 250V | 250V | 125V | 250V | 250V | 125V |

■ TIGHTENING TORQUE

| Model | K1200, K1400 | K1800, K2100 | K2500 K3000 Dual (1)(2) | K3050 K3500 Dual (1) (2) |
|---------------------|--|--------------|--|-----------------------------|
| Rotor set bolt | 138.9 ~ 182.3 lb·in 160 ~ 210 kgf·cm 15.69 ~ 20.59 N·m | | 277.8 ~ 382.0 lb·in 320 ~ 440 kgf·cm 31.38 ~ 43.15 N·m | |
| Stator thru bolt | 52.1 ~ 78.1 lbf·in 60 ~ 90 kgf·cm 5.88 ~ 8.83 N·m | | | |
| Output terminal nut | 16.5 ~ 21.7 lbf·in 19 ~ 25 kgf·cm 1.86 ~ 2.45 N·m | | | |

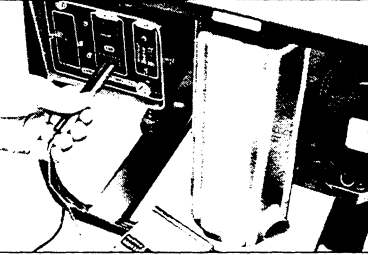
■ SPEED ADJUSTMENT STANDARDS

| Model | K1200, K1400 | K1800, K2100 | K2500 K3000 Dual (1)(2) | K3050 K3500 Dual (1) (2) |
|--------------------|--------------|------------------------------|----------------------------|-----------------------------|
| Frequency | 50Hz | 60Hz | | |
| Max. no-load speed | 53.5±1.5Hz | 63.5±1.5Hz (3720 ~ 3900 rpm) | | |
| Idling speed | 1600±200 rpm | | | |

4.3 Generator troubleshooting

K1400, K2100, K3000, K3500
[K1200] [K1800] [K2500] [K3050]

4.3.1 Troubles, possible causes, and countermeasures

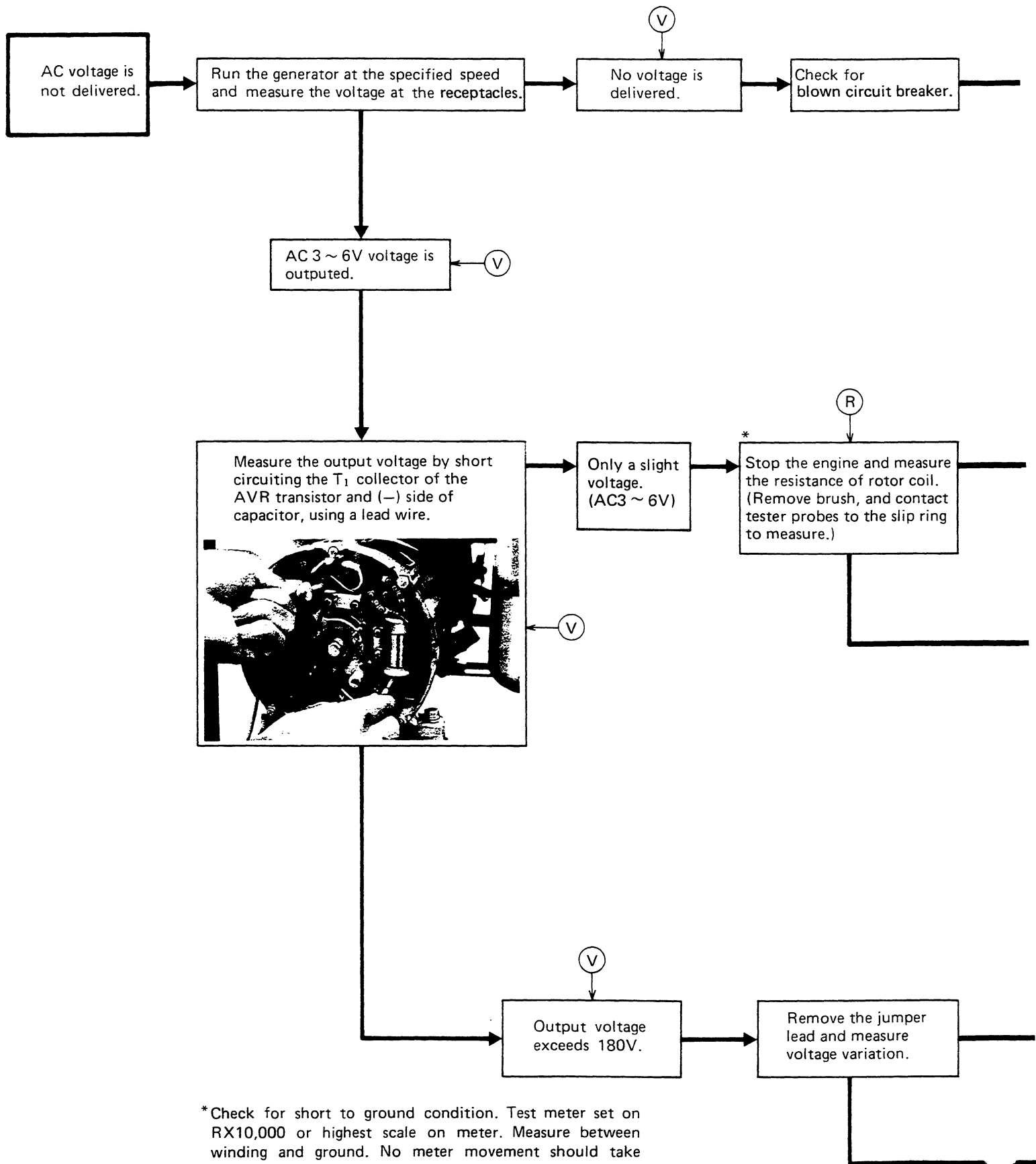
| Trouble | | Checking method | Measurement/ operating condition | Possible cause | Countermeasures |
|--|--|--|--|---|---|
| Generator does not operate when load is connected. | Pilot lamp lights but output voltage is not delivered. | (1) Measure the voltage between terminals of receptacle using a tester. (AC250V range) | Output voltage: 0V | Faulty contact of receptacles | Repair or replace. |
| | |  | | Disconnected wiring (inside of control box) | Checking wiring. Repair. |
| | Pilot lamp does not light and output voltage is not delivered. | Same as (1). | Output voltage: 0V | Circuit breaker "OFF" | Locate the cause (overload, short circuit of wiring). Replace circuit breaker after removing the cause. |
| | | | | Disconnected output coil | Repair or replace stator. |
| | | | | Demagnetization of permanent magnet | Replace. |
| | | | | Disconnected wiring | Repair. |
| | | | Only slight output voltage is delivered (3 ~ 6V) | Disconnected rotor coil | Repair or replace. |
| | | | | Worn brush or faulty contact | Clean brush contact surface and slip ring or replace brush. |
| | | | | Disconnected sub coil | Repair or replace. |
| | | | | AVR failure | Replace. |

| | Trouble | Checking method | Measurement/ operating condition | Possible cause | Countermeasures |
|---|---------------------------------|---|---|--|--|
| Load is available, but an abnormality exists. | Circuit breaker blows | Same as (1). | Output voltage is normal. (S.T.D. voltage $\pm 10\%$) | Abnormal load circuit | Remove abnormality in load circuit (overload, short circuit) and replace fuse. |
| | Rated output is not available. | Measure the difference between speeds at loaded and no-load conditions, or measure the difference between frequencies at loaded and no-loaded conditions (tachometer or frequency meter). | Fluctuation of engine revolution is normal. Revolution decrease is within 10% (frequency). | Disconnected or punctured AVR capacitor (220 μ F). | Replace capacitor. |
| | | | | Faulty contact of AVR connector | Repair. |
| | | | | Faulty brush contact | Check for wear, wear amount, and contamination of contacting surface of brush and clean if necessary. Repair or replace. |
| | | | Fluctuation of engine revolution is substantial. Revolution decrease is more than 10% (frequency). | Excessive initial current | Locate the cause (overload) and remove it. |
| | | | | Low engine output | Repair engine. |
| | | | | Faulty engine governor | Repair engine. |
| | Rated voltage is not available. | Same as (1). | Output voltage lower than S.T.D. voltage by 20%. | Low engine revolution (below 2500 rpm) | Set the accelerator lever to the operating position. |
| | | | | Shorted stator coil (including sub coil) | Repair or replace. |
| | | | | Shorted rotor coil | Repair or replace. |
| | | | | Defective AVR | Replace. |
| | | | Output voltage is more than S.T.D. voltage by 30%. | Defective AVR | Replace. |

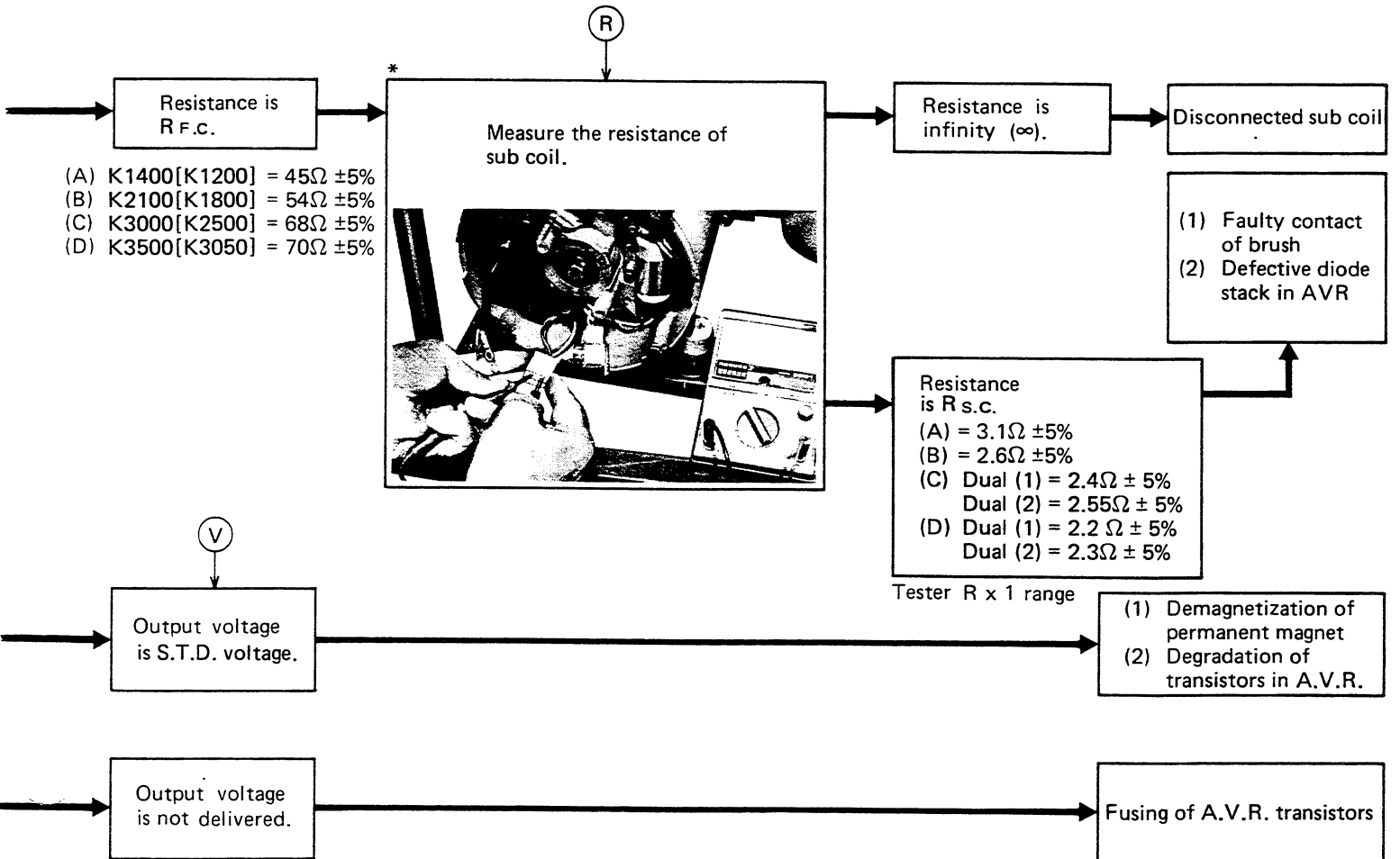
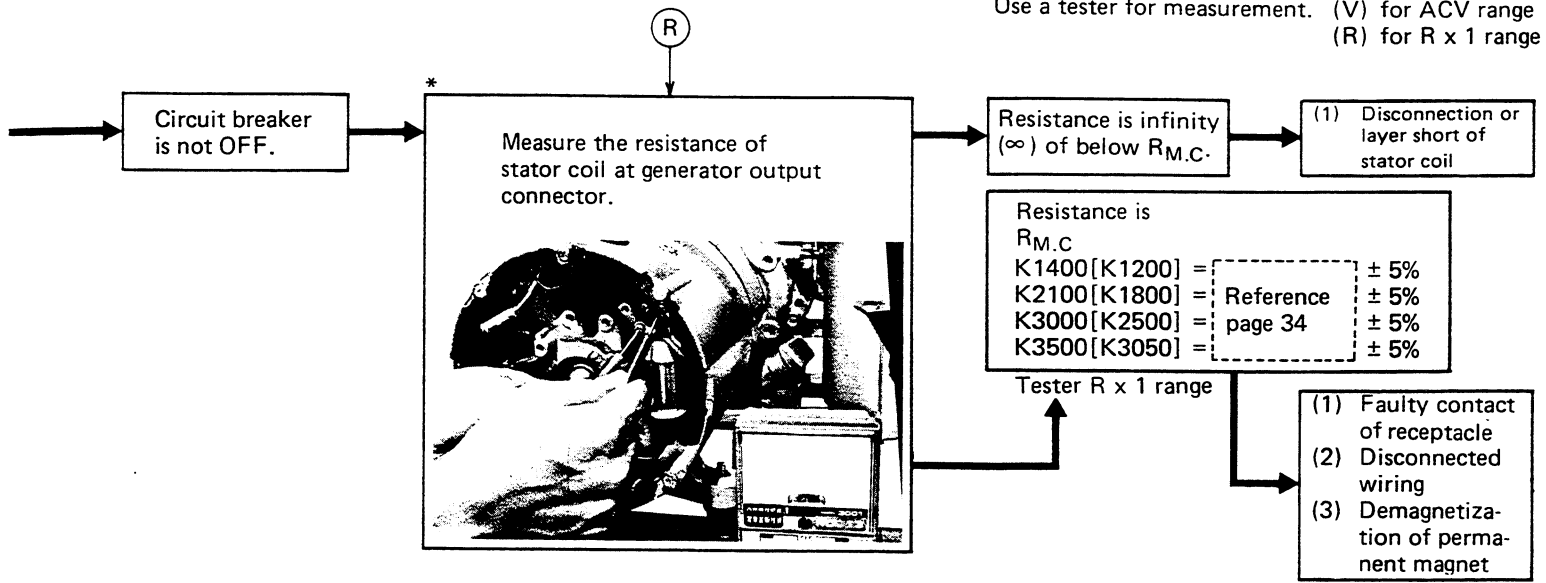
Notes: 1. Refer to the table on page 34 for parts quality verification.

2. A general practice used to test A.V.R. operation is to temporarily replace with a new AVR, since its quality verification is difficult. (Before checking A.V.R., measure the resistance of rotor. If rotor coil is shorted, an overcurrent will flow into the AVR, causing damage.)

4-3-2. Inspection procedures for troubleshooting



Use a tester for measurement. (V) for ACV range
(R) for R x 1 range



4.3.3 Generator parts quality varification

■ NORMAL VOLTAGES BETWEEN TERMINALS (WITH NO LOAD)

Output terminal

Measure the voltage between terminals of the receptacle with a tester.

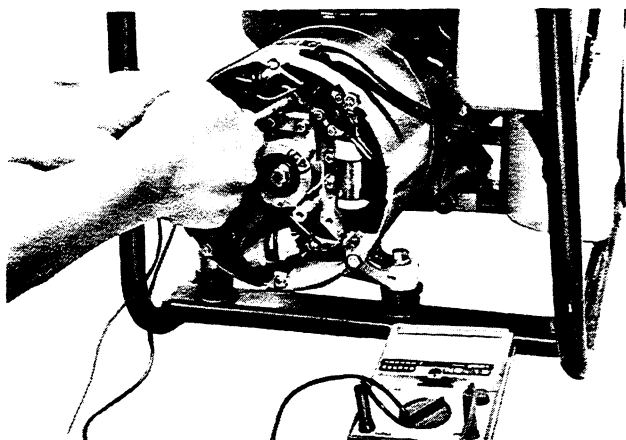
AC S.T.D. voltage by $\pm 20\%$



Field voltage

Measure the voltage between terminals K-J.

K1400[K1200] =
K2100[K1800] = DC15 ~ 35V
K3000[K2500] =
K3500[K3050] =

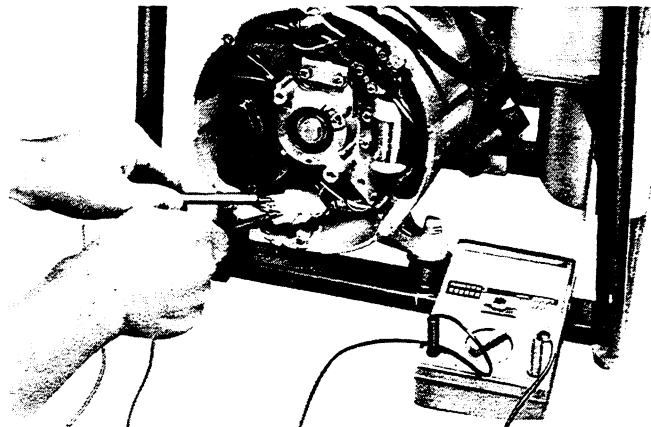


- Connect the (+) probe of a tester with (+) side of brush terminal. Measurement must be made with complete connections.

Sub coil terminal voltage

Measure the voltage between terminals (1) and (2).

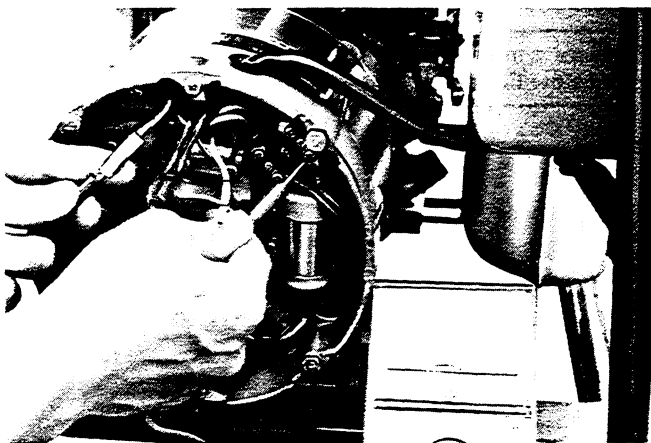
K1400[K1200] =
K2100[K1800] = AC50 ~ 60V
K3000[K2500] =
K3500[K3050] =



Frequency meter output terminal voltage (if used)

Measure the voltage between terminals V and (5).

AC17 ~ 18V



■ STATOR ASSEMBLY

Winding resistance

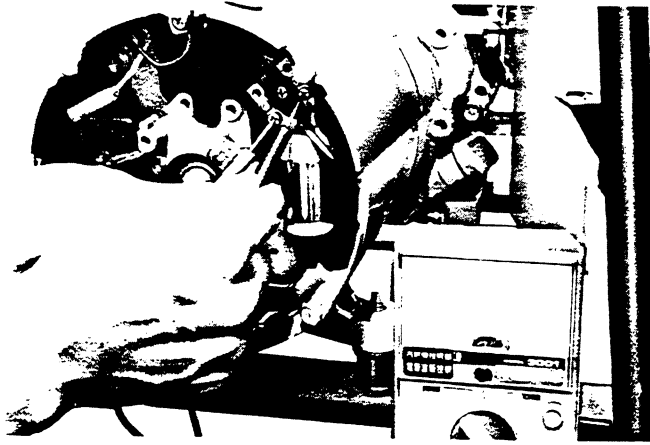
(1) Main coil (M.C)

Measure the resistance between terminals U and V of generator output connector.

(Remove lead wire on box side.)

Tester in R x 1 range

| | | |
|----------------|----------------------|-----|
| K1400[K1200] = | Reference page 34 | ±5% |
| K2100[K1800] = | | ±5% |
| K3000[K2500] = | | ±5% |
| K3500[K3050] = | | ±5% |



(2) Sub coil (S.C)

Remove 4P coupler, and measure the resistance between terminals (1) and (2).

Tester in R x 1 range

K1400[K1200] = $3.1\Omega \pm 5\%$

K2100[K1800] = $2.6\Omega \pm 5\%$

K3000[K2500] Dual (1) = $2.4\Omega \pm 5\%$

K3500[K3050] Dual (2) = $2.2\Omega \pm 5\%$

K3000 Dual (2) = $2.55\Omega \pm 5\%$

K3500 Dual (2) = $2.3\Omega \pm 5\%$



■ ROTOR

Winding resistance Field coil (F.C.)

Measure the resistance of winding between the slip rings.
(Remove the brush lead wire.)

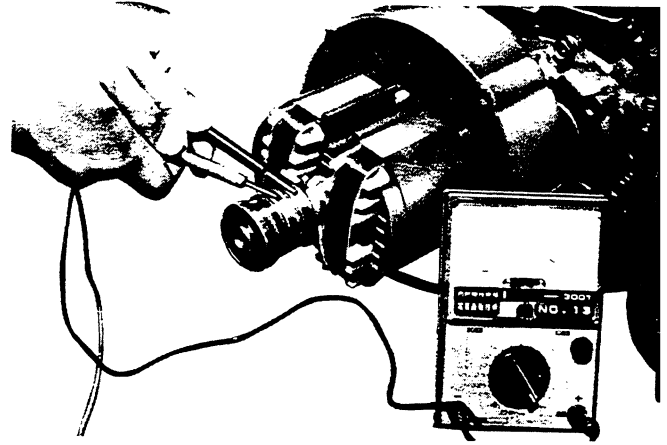
Tester in R x 1 range

K1400[K1200] = $45\Omega \pm 5\%$

K2100[K1800] = $54\Omega \pm 5\%$

K3000[K2500] = $68\Omega \pm 5\%$

K3500[K3050] = $70\Omega \pm 5\%$



Slip ring

Visually check for oil, dirt and other similar contamination.
Also, check visually for roughness of brush sliding surface.

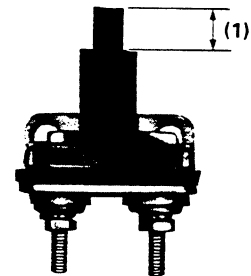
There should be no dirt, oil, etc.

There should be no abnormal roughness.

■ BRUSH ASSEMBLY

Brush length

Remove the brush assembly, and measure the length from brush holder to the brush sliding surface.



(1) More than 0.138 in (3.5 mm)

Contact area

Remove brush assembly, and visually check the contact area.

Min. contact area is 20%.

■ BEARING

Side clearance of inner and outer races

Measure the side clearance of outer race.

Side clearance must be within 0.020 in (0.5 mm).

■ CAPACITOR (EXTERNALLY CONNECTED)

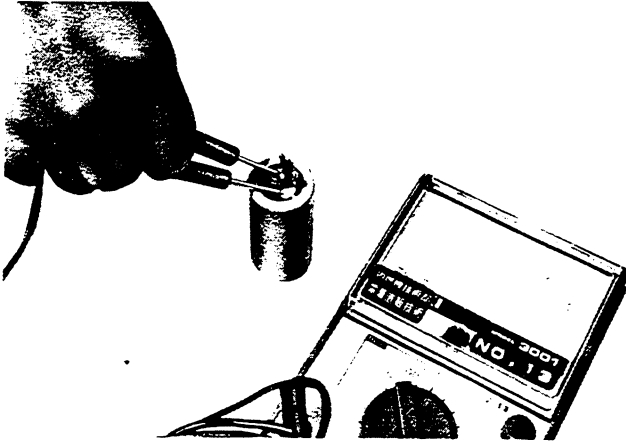
Conduct the following tests with a tester.

Tester in R x 1 range

1. Unsolder the capacitor to make it discrete.
2. Connect tester probes to the (+) and (–) sides of the capacitor.
3. Reverse the tester probe connection.

Resistance will be infinity.

The pointer will swing and the resistance will be infinity.



■ AVR

A special measuring instrument is necessary. Quality verification with a discrete AVR is difficult.

When an AVR failure is suspected, replace with a new AVR and see if the abnormality persists.

5.Oil Watch

5.1 Oil watch operation

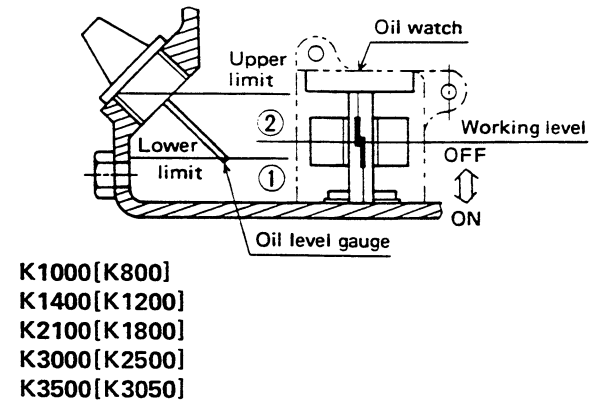
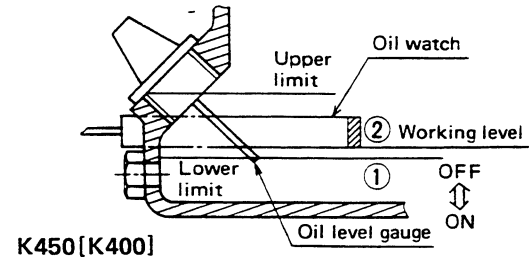
When attempting to start or restart engine flashing light indicates low oil level.

Add oil to unit.

Working of Oil Watch

You can find some distances between

- (1) lower limit level and
- (2) oil watch working level



■ OIL WATCH WORKING OIL LEVEL

| Model \ Item | Upper limit | Working level | (From upper limit to working level) | Consumption hours |
|---------------|--------------------------|--------------------------|-------------------------------------|-------------------|
| K450 [K400] | 320 cc 0.34 U.S. qts. | 180 cc 0.19 U.S. qts. | 140 cc 0.15 U.S. qts. | 55 to 63 Hr |
| K100 [K800] | 550 cc 0.58 U.S. qts. | 320 cc 0.34 U.S. qts. | 230 cc 0.24 U.S. qts. | 46 to 56 Hr |
| K1400 [K1200] | 550 cc 0.58 U.S. qts. | 320 cc 0.34 U.S. qts. | 230 cc 0.24 U.S. qts. | 32 to 38 Hr |
| K2100 [K1800] | 600 cc 0.64 U.S. qts. | 290 cc 0.31 U.S. qts. | 310 cc 0.33 U.S. qts. | 28 to 33 Hr |
| K3000 [K2500] | 850 cc 0.90 U.S. qts. | 380 cc 0.40 U.S. qts. | 470 cc 0.50 U.S. qts. | 30 to 36 Hr |
| K3500 [K3050] | 900 cc 0.95 U.S. qts. | 520 cc 0.55 U.S. qts. | 380 cc 0.40 U.S. qts. | 27 to 30 Hr |

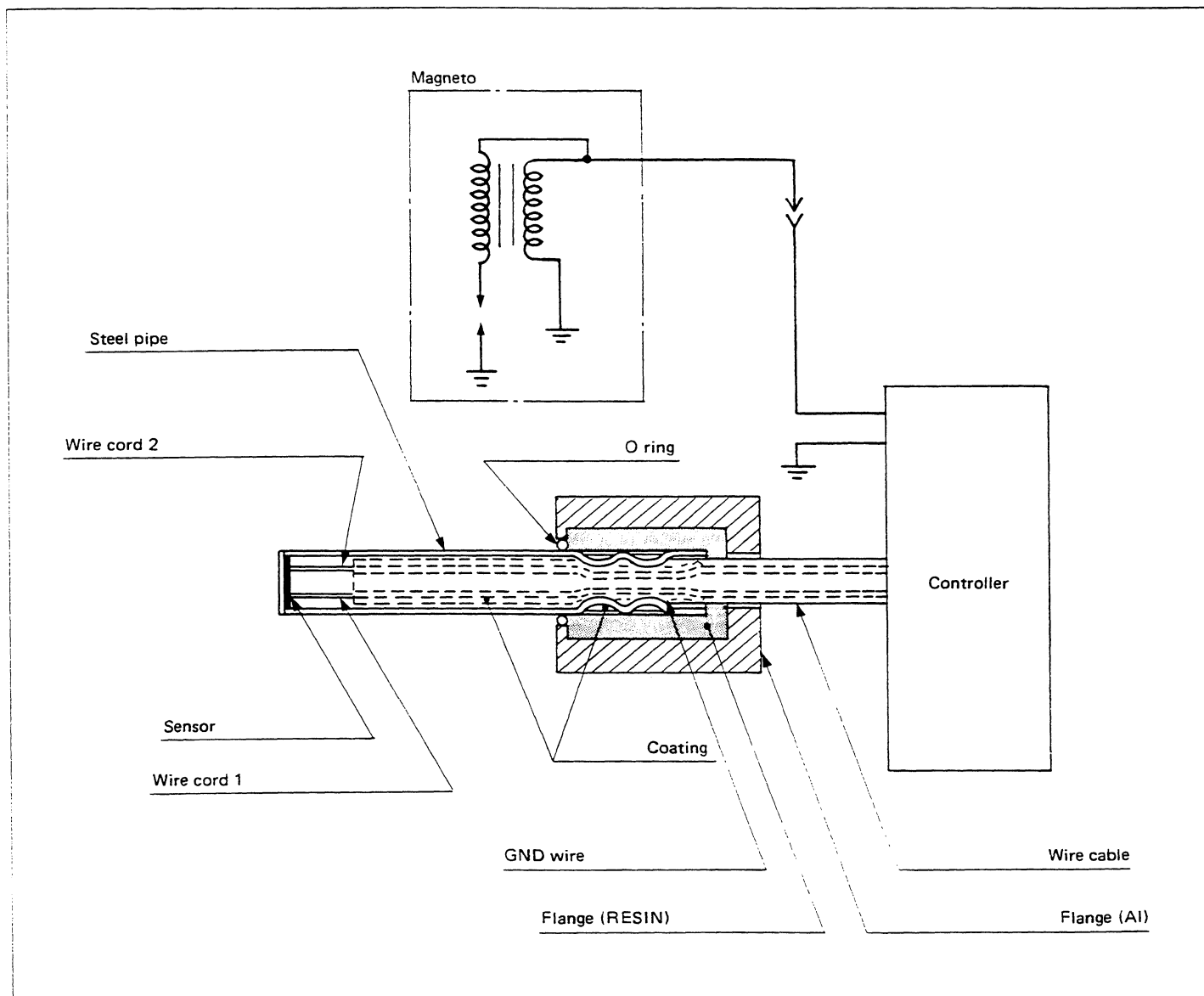
Note: ● This quantity is measured with the unit level.

● Don't operate on the slope.

● The first oil should be changed after 10 hours' operation.
After this change, every 50 hours' operation.

5.2 Block diagram

■ K450[K400]



Explanation of mechanism

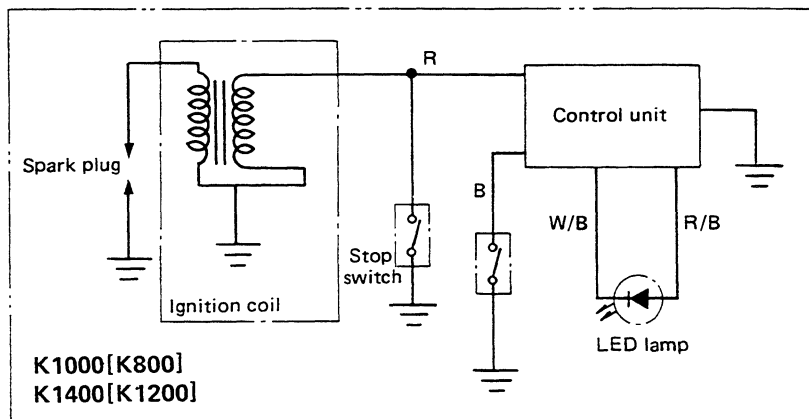
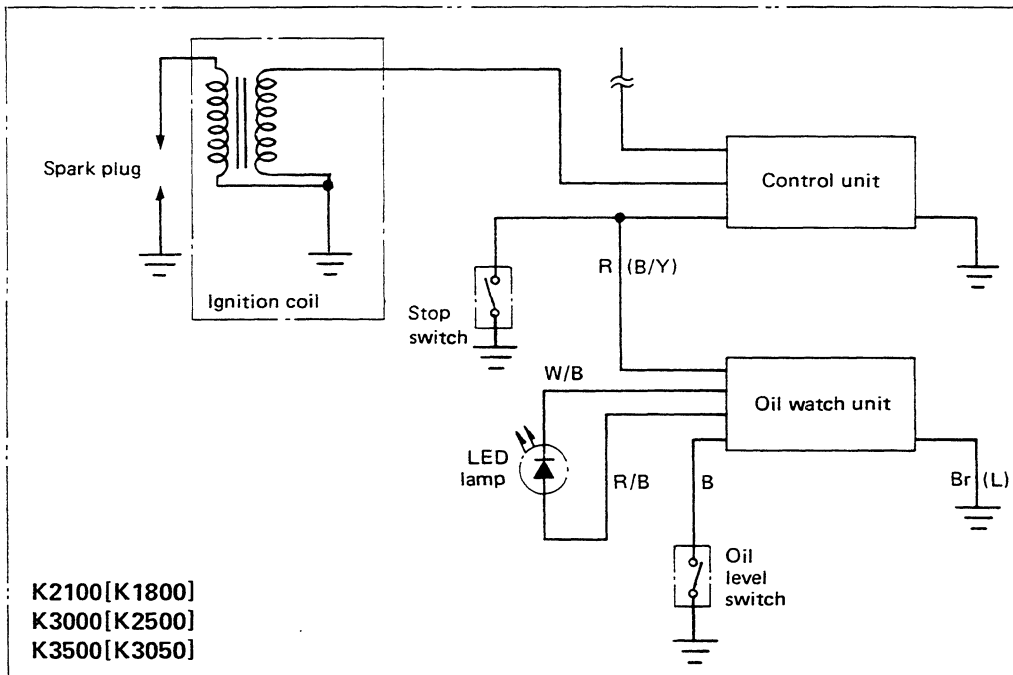
Sensor, which is attached at the end of steel pipe, has vibrating plate which consists of piezo-electric magnet. Once the plate is pressed by a liquid body, Sensor will perceive the surface of liquid body. Controller will judge these actions. And timer circuit will delay these as needed.

Then the signal will be taken out and go to the circuit of stopping engine (Magnet is grounded).

Wire cord (1) – to input the AC voltage to dispatch

Wire cord (2) – to pick up the dispatch

- K1000[K800], K1400[K1200], K2100[K1800]
K3000[K2500], K3500[K3050]



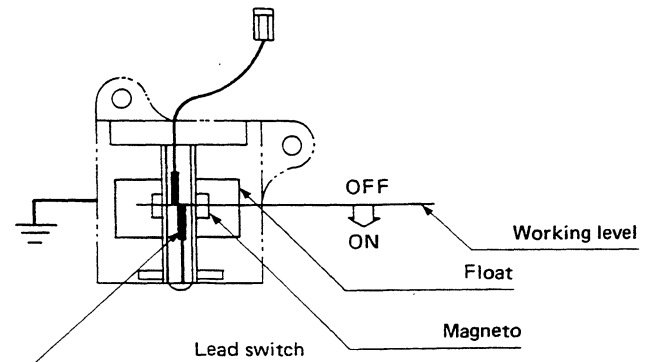
Wire Color
R : Red
L : Blue
Br : Brown
W : White
Y : Yellow
B : Black

() K3500

Explanation of mechanism

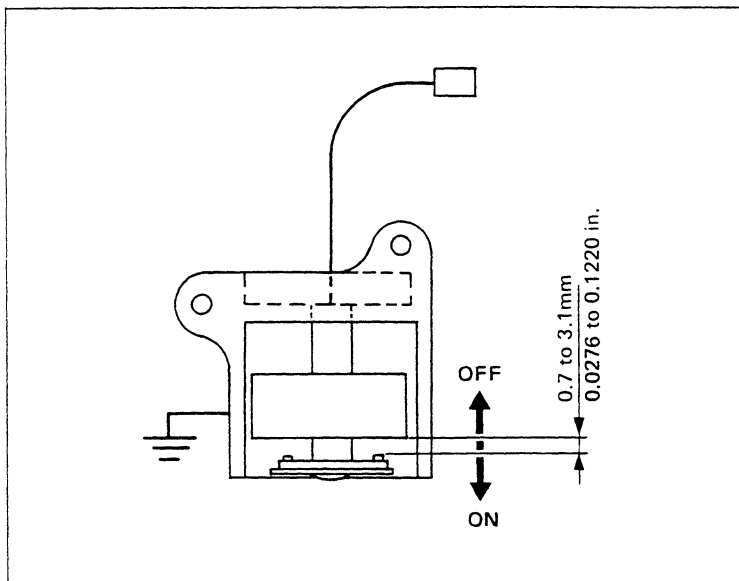
Float switch is used for detection of oil level. Inner configuration of float switch is shown as per below figure. Lead switch sealed in stem functions subject to magnetism of magneto in the float. When float is in a position over working level, lead switch is OFF and engine can be run. If float goes down to below working level due to decrease of engine oil, lead switch becomes ON, which shorts circuit of primary voltage for ignition coil. And then engine will be stopped with led lamp on by using this electricity.

Oil level switch



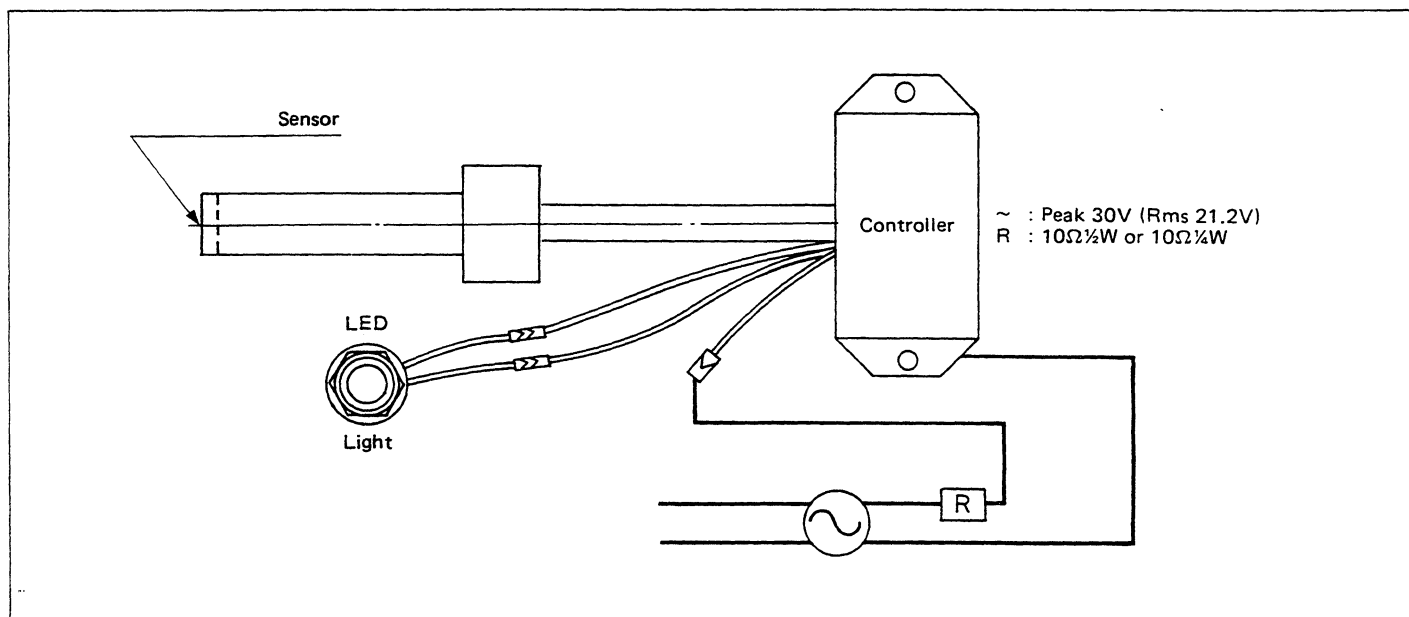
5.3 Testing method of oil level switch

■ FLOAT TYPE



| Level gauge | Test meter R scale |
|-------------|-----------------------|
| OFF | Infinity (∞) |
| ON | 1 |

■ OSCILLATING TYPE

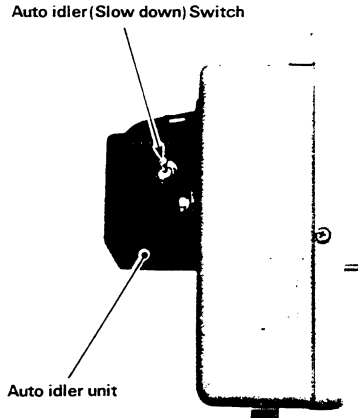


| Sensor | LED light | Judgment |
|-----------|--------------|----------|
| Open cell | Lighting | Good |
| Closing | Not lighting | Good |
| Open cell | Not lighting | Not good |
| Closing | Lighting | Not good |

6.Auto Idler

If you keep the auto idler switch to ON auto idler operate automatically.

- The auto idler switch must be kept to OFF, if you use the engine at interrupted load or low load under 0.8A.



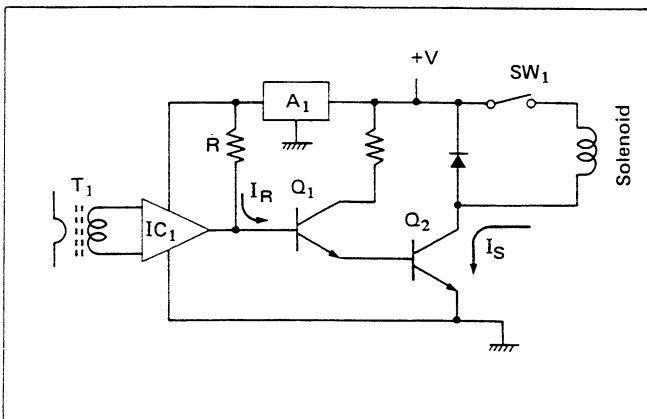
■ CONFIGURATION

Auto idler unit has following 4 main functions.

- (1) Current trans (T1) to detect load current.
- (2) Comparative circuit (IC1) to set output terminal connected or open according to whether current is excessive or not in comparison with standard value which is detected by Current trans (T1).
- (3) Transistor (Q1 & Q2) to operate solenoid in accordance with output signal of Comparative circuit (IC1).
- (4) Constant voltage electric power unit (A1) to make power source of control circuit to constant voltage.

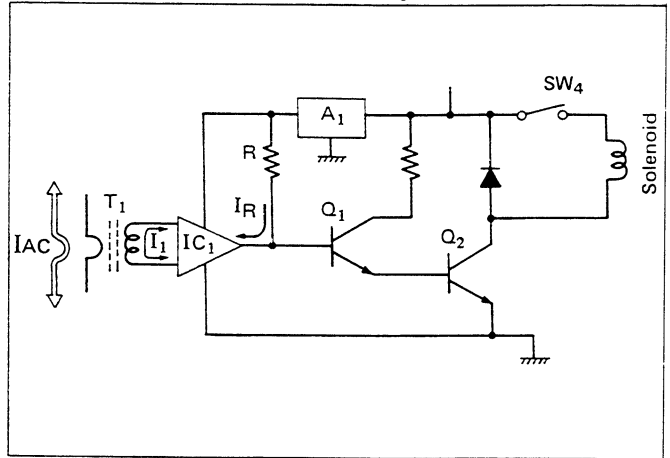
■ MECHANISM

(A) At no load : Solenoid "ON" (Idling)



Since AC load current is not delivered at no-loaded condition, no current is delivered to Current trans (T1). Due to no input in Comparative circuit (IC1), output terminal becomes open and current I_R in resistance R is delivered to base emitter of Transistor (Q1 & Q2) where the current is increased and make Transistor (Q2) "ON" to deliver current I_S and operate solenoid. Solenoid plunger moves governor lever to make engine run to be idling.

(B) With load : Solenoid "OFF" (High revolution)



AC load current is delivered to primary coil of Current trans (T1) at loaded condition and the current I_T which occurred in secondary coil is added to input terminal of Comparative circuit (IC1). when this current I_T is excessive than standard value, then output terminal of Comparative circuit (IC1) is connected and the current I_R in resistance R is delivered to output terminal of Comparative circuit (IC1) to set Transistor (Q1 & Q2) CUT OFF. As a result, due to no current, solenoid does not work and governor lever is not affected from solenoid, which leads to high engine revolution.

■ SOLENOID TERMINAL VOLTAGE

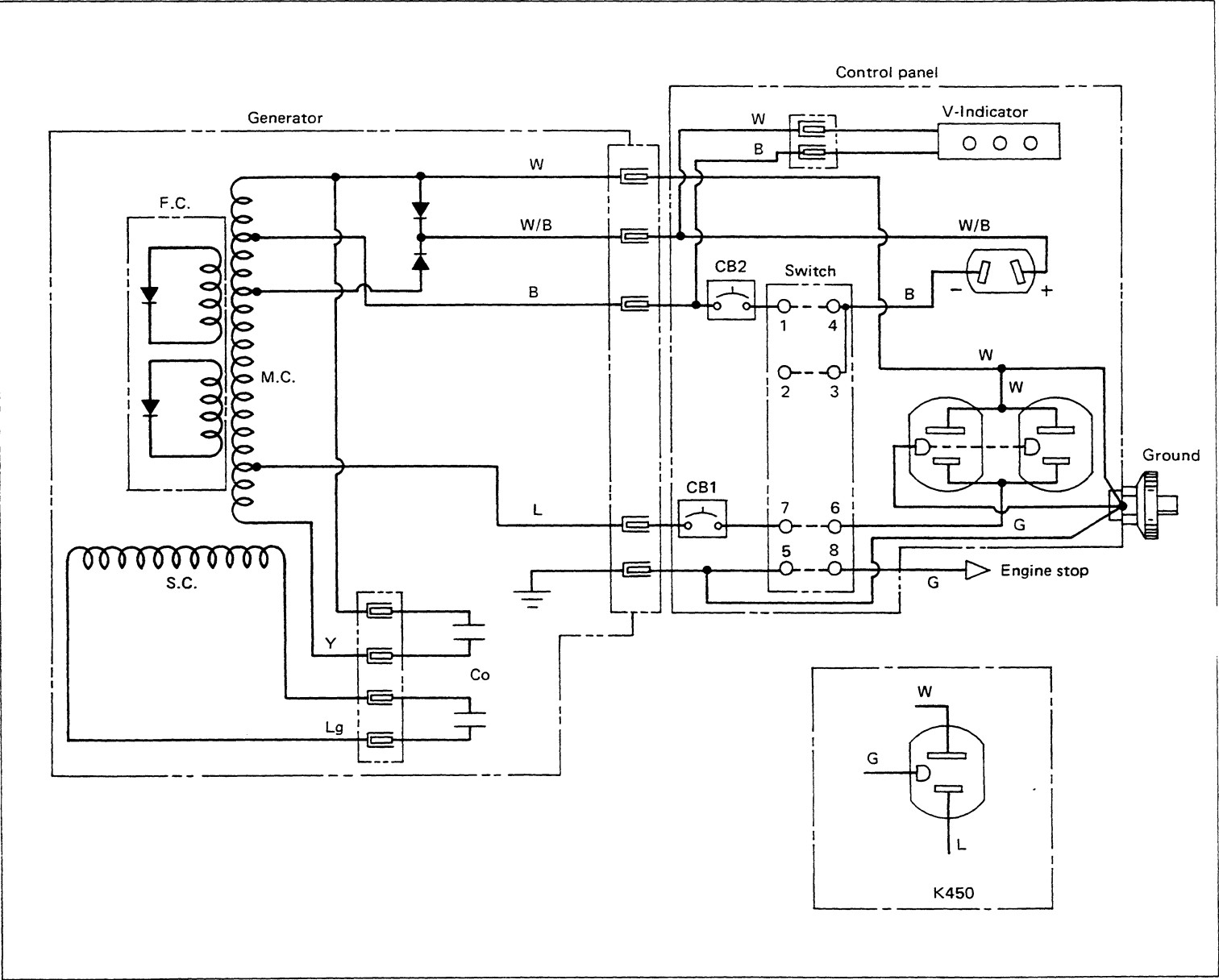
- (A) At no load (Engine revolution at 2000 rpm (33Hz))
 Normal : DC9 – 17V
 Abnormal : DC 9V below
- (B) With load (Over 100 Watt, at frequency of 60Hz)
 (However, measure as solenoid is connected)
 Normal : DC 1V under
 Abnormal : DC 9V below

■ TROUBLES AND COUNTERMEASURES

- (A) No idling at no-loaded condition
- a) Switch of auto idler (slow down) is "OFF".
Set auto idler switch to "ON".
 - b) Voltage of solenoid terminal is over DC 9V.
Replace the solenoid.
 - c) Voltage of solenoid terminal is under DC 9V.
If no loose contact in wiring, replace control circuit.
- (B) No high speed operation at loaded condition
- a) No high speed operation even if auto idler switch is "OFF". Repair a "catch" in solenoid plunger.
 - b) Voltage of solenoid terminal is over DC 9V.
Replace control circuit.

7.Connection Diagram

■ K450, K1000



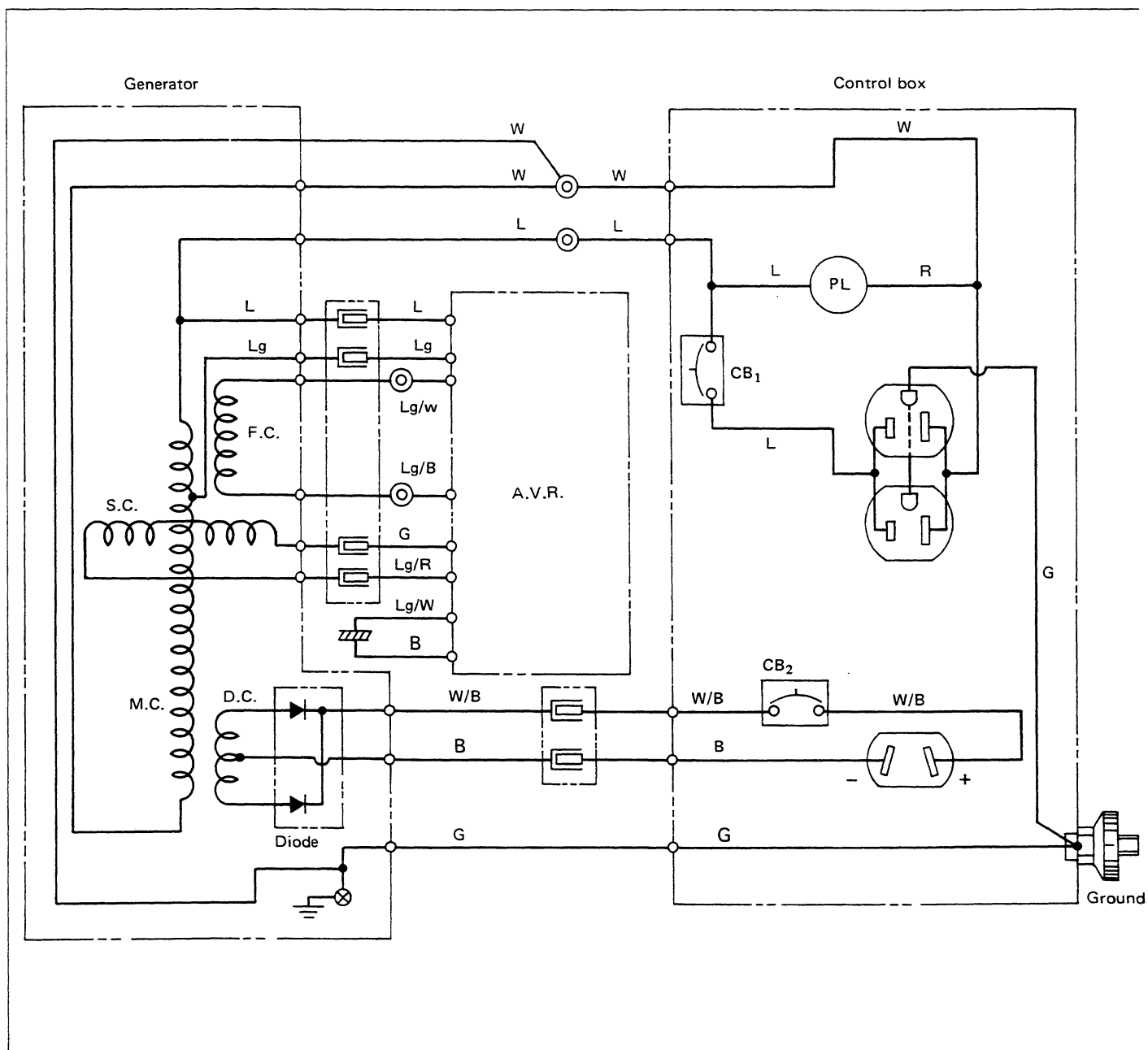
CB : CIRCUIT BREAKER

| | K450 | K1000 |
|------|------|-------|
| CB 1 | 3.5A | 8A |
| CB 2 | 10A | 10A |

- Wire color
- W/B : White/Black
 - L : Blue
 - Lg : Light Green
 - W : White
 - B : Black
 - G : Green
 - Y : Yellow

- Winding sign
- M.C. : Main coil
 - S.C. : Sub coil
 - F.C. : Field coil

■ K1400, K2100



CB : CIRCUIT BREAKER

| | K1400 | K2100 |
|------|-------|-------|
| CB 1 | 10A | 20A |
| CB 2 | 10A | 10A |

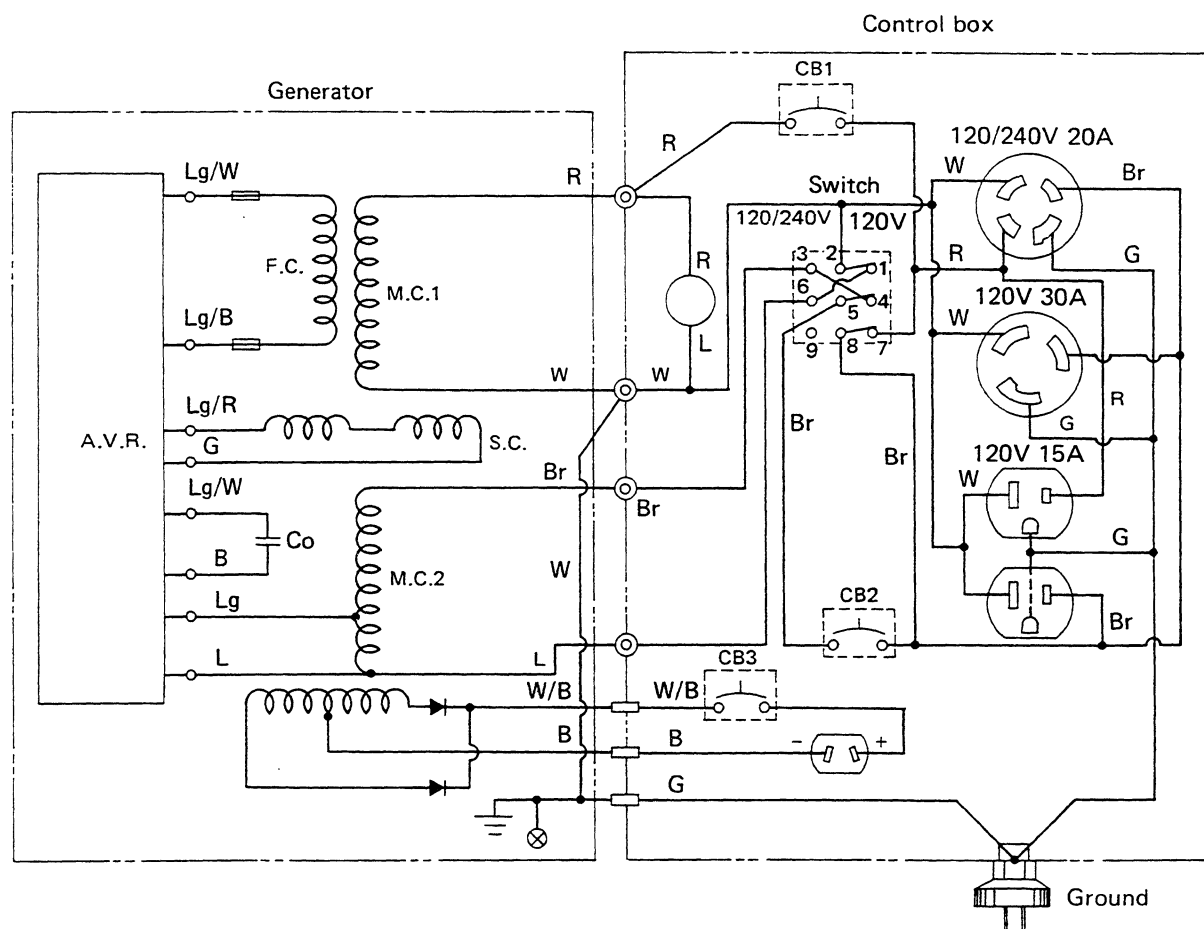
■ Wire color

Lg : Light green
 Lg/W : Light green/White
 R : Red
 L : Blue
 Y : Yellow
 W : White
 B : Black
 G : Green
 Lg/B : Light green/Black
 Lg/R : Light green/Red
 W/B : White/Black

■ Winding sign

PL : Pilot lamp
 M.C. : Main coil
 S.C. : Sub coil
 F.C. : Field coil

■ K3000, K3500



CB : CIRCUIT BREAKER

| | K3000 | K3500 |
|------|-------|-------|
| CB 1 | 12A | 15A |
| CB 2 | 12A | 15A |
| CB 3 | 10A | 10A |

■ Wire color

R : Red
 L : Blue
 Lg : Light green
 W : White
 B : Black
 G : Green
 Lg/R : Light green/
 Red
 Lg/W : Light green/
 White
 Lg/B : Light green/
 Black
 W/B : White/Black
 Y : Yellow
 Br : Brown

ENGINE

| Generator Set | Engine |
|---------------|--------|
| K450[K400] | GN550 |
| K1000[K800] | GS130 |
| K1400[K1200] | GS130 |
| K2100[K1800] | GN1850 |
| K3000[K2500] | GN2500 |
| K3500[K3050] | GS280 |

SECTION I

General Information of Ignition System

| | |
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| GENERAL | 54 |
| MAGNETO | 55 |
| NON-CONTACT TYPE MAGNETO | 57 |
| 1. CDI (CAPACITOR DISCHARGE IGNITION) MAGNETO | 59 |
| 2. TRANSISTOR MAGNETO | 63 |

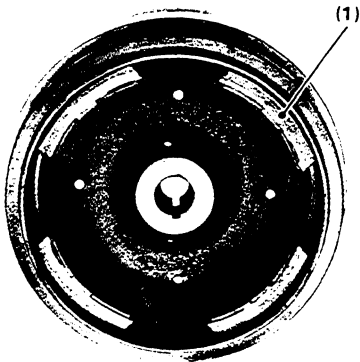
GENERAL

Ignition systems can be classified two ways. One way is according to the source of electric power: battery ignitions or magneto ignitions. A battery ignition system uses a battery as the high-voltage source, while magneto ignition system uses its own generator to develop high voltage. Both systems have their own advantages and disadvantages. However, the magneto system is used for general-purpose and farm machinery small engines since it is simpler and generally more reliable for such applications. The other is according to the existence of breaker points. But farm machinery is often used under moist circumstance and intermittently. Breaker points tend to become oxidized or contaminated, causing malfunctions. To prevent this, no-contact ignition systems with an electronic ignition device have been developed.

| Power source | Contact or non-contact | Contact system | Non-contact system |
|--------------|------------------------|--------------------------|---|
| | | | |
| Battery | | Contact-type distributor | Transistor ignition |
| Magneto | | Contact-type magneto | Transistor magneto CDI (Capacitor Discharge Ignition) magneto |

MAGNETO

The magneto is basically composed of a stator which is stationary and a rotor which rotates. In inner-rotor types, the rotor rotates inside the stator. While in outer-rotor type, the rotor rotates outside the stator. The outer-rotor type is used in most cases since it can supplement inertia moment required for the engine. The outer rotor type is also referred to as flywheel magneto.



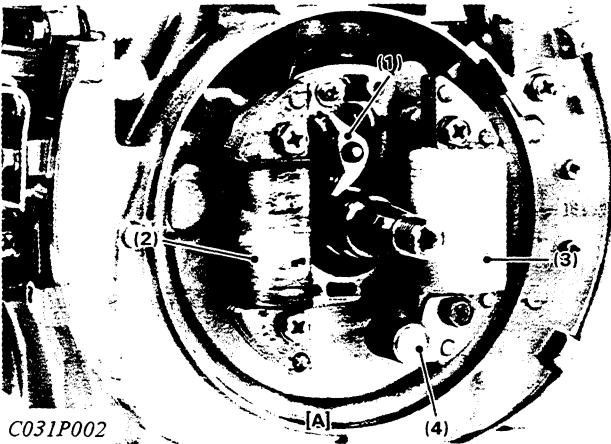
C031P001

[A]

(1) Rotor

The rotor includes a permanent magnet, and is attached to the engine crankshaft to rotate and thereby induce electromotive force in each coil in the stator. The rotor also serves as a flywheel which forces air in for cooling.

[A] Rotor
(1) Magnet



C031P002

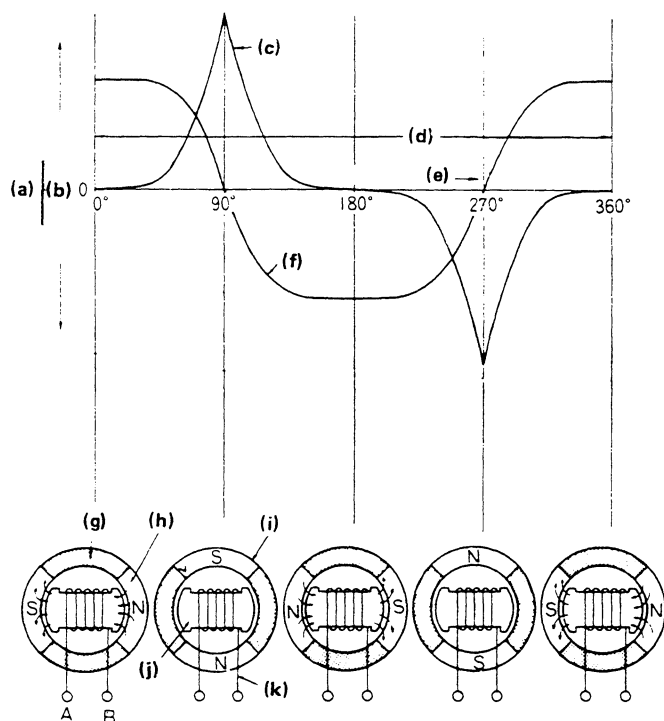
[A]

(2) Stator

The stator of contact types includes an ignition coil, which serves as ignition power source, and a breaker. The stator of CDI (Capacitor Discharge Ignition) types includes a capacitor charging coil and timing (signal) coil. The stator of transistor types includes an ignition coil. In some cases, a lamp coil and a charge coil are included to light lamps and charge batteries.

[A] Stator
(1) Breaker
(2) Lamp coil
(3) Ignition coil
(4) Capacitor

[A] Change in magnetic flux and induced voltage across the coil.



C031F007

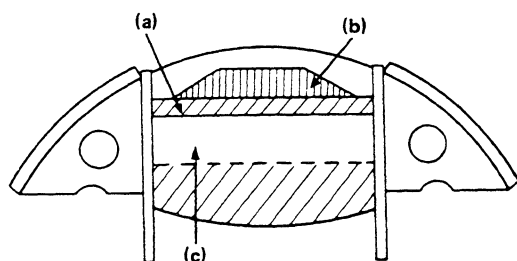
[Magneto operation and characteristics]

A magneto is a power generator which, unlike general generators, only generates a high voltage at the end of the compression stroke, when the engine requires a spark. To accomplish this, the rotor, ignition coil, and ignition timing units (breaker, ignition signal circuit, etc.) are interlocked. As shown in the figure at left, when a twopole rotor rotates around a coil core, magnetic flux passing through the core changes by one cycle per rotation of the core. In the case of a 4-pole rotor, magnetic flux changes by two cycles per rotation. With 6-pole rotors, magnetic flux changes at the rate of three cycles per rotation. That is, changes in magnetic flux equal number of poles \times 1/2 cycle(s).

As stated above, when magnetic flux passing through a core changes, a voltage is generated across the terminals A and B of the coil wound around the core in the same cycle as that of the magnetic flux change. Change in magnetic flux passing through the core is affected by the shape of the poles, being virtually a rectangular wave in this case. Therefore, at the points of 90° and 270°, where magnetic flux change is the greatest, the voltage curve reaches a peak. When the voltage is generated across coil terminals A and B, ignition timing signal creates a short circuit between A and B to cause a flow of current. This current is the primary current of the ignition coil.

- | | | |
|--------------------------|-------------------|-----------|
| (a) Magnetic flux | (f) Magnetic flux | (i) Rotor |
| (b) Voltage | (g) Magnet | (j) Core |
| (c) Induced voltage | (h) Magnetic flux | (k) Coil |
| (d) 1 cycle | | |
| (e) Rotor rotation angle | | |

[A] Ignition coil



C031F008

(3) Ignition Coil

The ignition coil is used to produce a secondary high voltage which is supplied to the spark plug to produce a spark. As stated above, 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 at the center is laminated with thin silicon steel, around which the primary and secondary coils are wound. In such an ignition coil, voltage 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.

- | |
|--------------------|
| (a) Primary coil |
| (b) Secondary coil |
| (c) Core |

NON-CONTACT TYPE MAGNETO

As described in the former paragraph, the non-contact type magnetos (such as CDI (Capacitor Discharge Ignition) magneto and transistor magneto) have been developed to eliminate troubles related to breaker points. The features of these non-contact magnetos are:

(1) Eliminate troubles of contact-type magneto

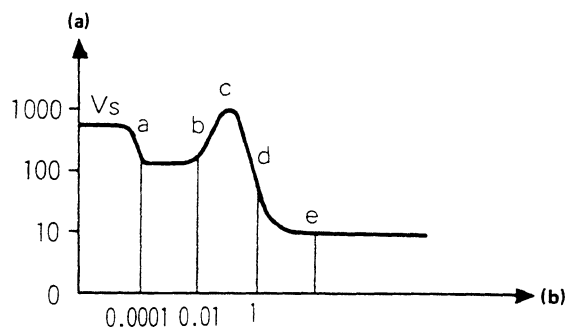
1. Eliminate troubles caused by contaminated contacts.
2. Stable secondary voltage generated
These magnetos are free from arc discharge at points. Therefore, secondary generated voltage is stabilized over the entire range from low to high speeds. Free from sparking errors, they feature good starting and excellent performance at low speeds.
3. Easy maintenance and inspection
Free from point and heel wear, periodic inspection and maintenance are easy.
4. Reduced electrical troubles and long life
Non-contact types are not affected by water, foreign matter or other matter which has adverse effects on contacts.
5. Stable ignition timing
Free from point and heel wear, ignition timing is constant without fluctuation caused by time and without being affected by engine vibration at high speeds.

(2) Hotter spark assures better ignition

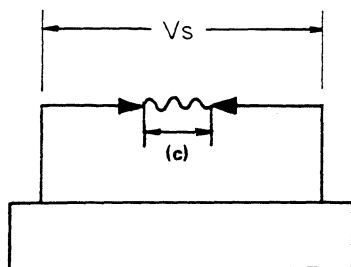
High secondary generated voltage and short rise time assure positive ignition.

(3) Outstanding water-proof, vibration-proof

These magnetos have no points, and their internal circuits are protected with resin mold from water and vibration.



C031F012



C031F013

■ Arc discharge

Assume that discharge starts at voltage V_s between poles with air gap. A current starts flowing, gradually increases, and acts as shown in the figure. The range a-b-c in the figure is referred to as glow discharge region, and the range d-e as arc discharge region. In the arc discharge region as shown in the figure, there is an extremely large current flow. After the arc discharge begins, it continues even when the voltage decreases.

In contact-type magnetos, arc discharge starts before the contact is completely opened. Therefore, primary current is not cut off instantaneously. As a result, sufficiently high voltage can not be induced and also contact durability is shortened.

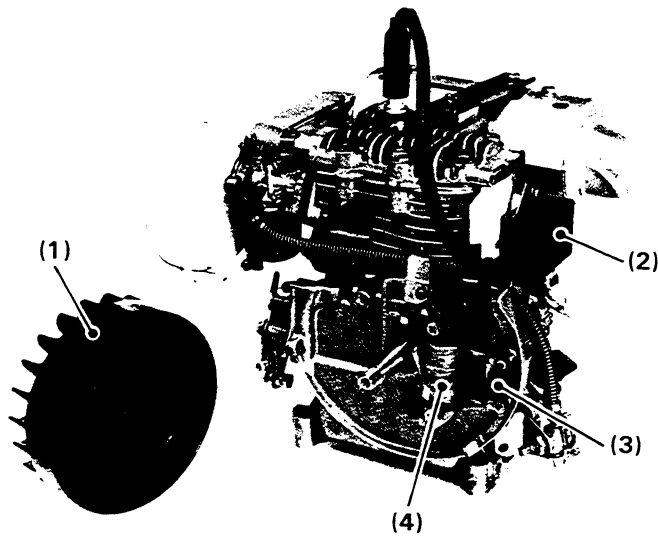
To compensate for this, a contact-type magneto has a capacitor connected parallel to it.

(a) Voltage

(b) Current between poles

(c) Air gap

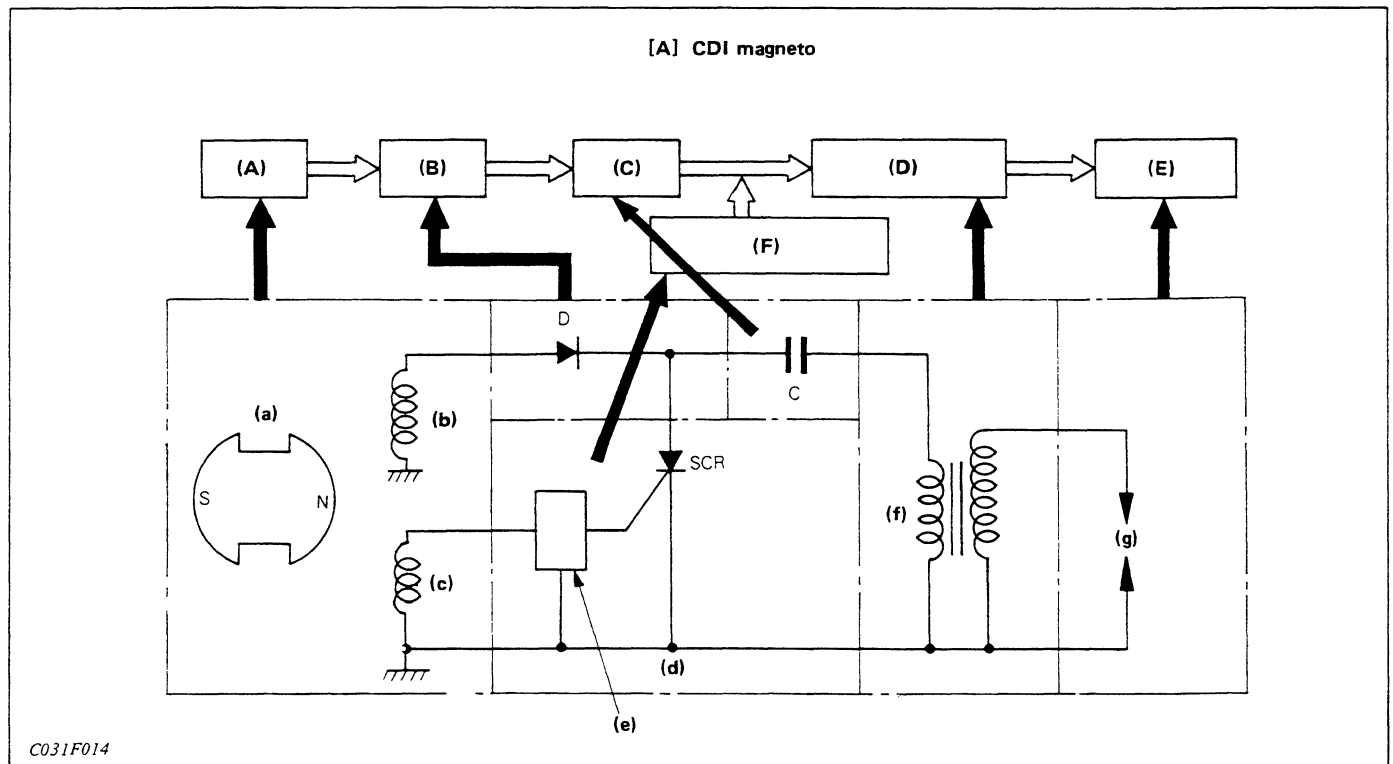
1. CDI (CAPACITOR DISCHARGE IGNITION) MAGNETO



C031P004

The operating principle of CDI (Capacitor Discharge Ignition) magneto is completely different from that of contact-type magnetos or transistor magnetos which are described later. In these ignition units, a high voltage is generated in the secondary coil by turning off the primary current of ignition coil (Primary current shutoff method). However, in a CDI magneto, voltage generated in the magneto is charged in a capacitor, and is applied momentarily to the primary side of the ignition coil according to ignition signal, generating a high voltage in the secondary coil. This system is referred to as voltage application system.

- (1) Rotor
- (2) CDI unit
(including ignition coil)
- (3) Timing (signal) coil
- (4) Capacitor charging coil



C031F014

- (A) Power generation
- (B) Rectification
- (C) Charging
- (D) High voltage generation
- (E) Spark generation
- (F) Ignition timing indication

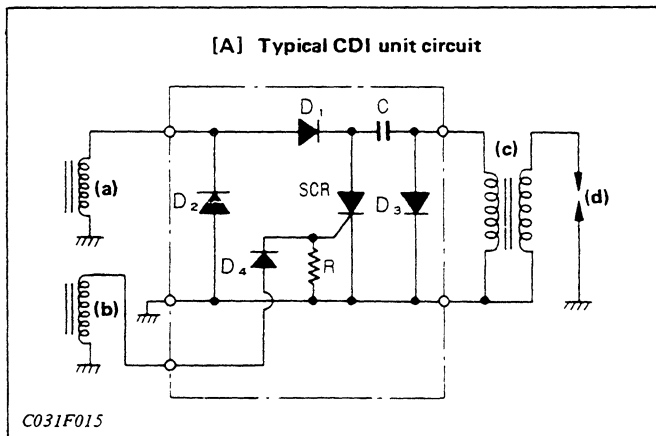
- (a) Rotor
- (b) Charging coil
- (c) Timing coil
- (d) CDI unit
- (e) Ignition signal circuit
- (f) Ignition coil
- (g) Spark plug

(1) CDI Magneto Operation

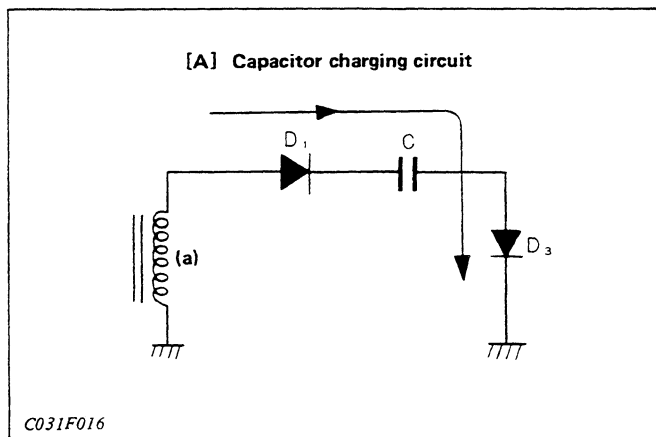
1. The rotor generates a voltage in the charging coil.
2. The output is rectified by the diode (D) and charged temporarily in the capacitor (C).
3. When the specified ignition timing of the engine is reached, a signal is provided from the ignition signal circuit, conducting the SCR.
4. Conduction of the thyristor leads to discharge of electricity in the capacitor to the primary coil of the ignition coil.
5. A sudden voltage change in the primary side induces a high voltage in the secondary coil, generating a spark in the plug.

(2) CDI Unit

The CDI unit uses a capacitor, diodes and a thyristor to compose three circuits: 1. capacitor charging circuit, 2. ignition signal circuit, and 3. capacitor discharging circuit.



- (a) Charging coil
- (b) Timing coil
- (c) Ignition coil
- (d) Spark plug

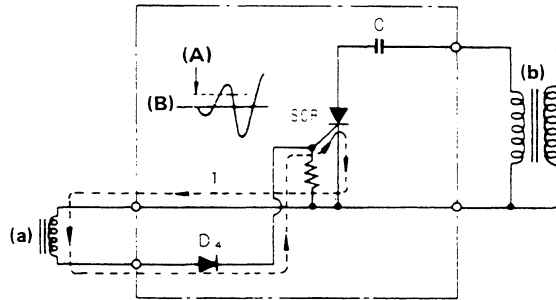


1. Capacitor Charging Circuit

As the rotor of the magneto rotates, a coil charging voltage is induced in the stator (charging) coil. Then charging current flows through the circuit, as shown in the figure, (charging coil through diode D_1 → capacitor C → diode D_3 → charging coil). By this circuit the capacitor is charged.

- (a) Charging coil

[A] Ignition signal circuit



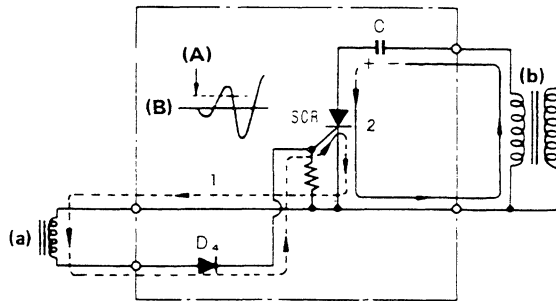
C031F017

2. Ignition Signal Circuit

In the timing (signal) coil also, a certain voltage is induced. This voltage is applied to the gate of SCR and reaches its triggering level the SCR conducts.

- (A) SCR gate triggering level
- (B) Signal coil voltage
- (a) Timing coil
- (b) Ignition coil

[A] Capacitor discharging circuit



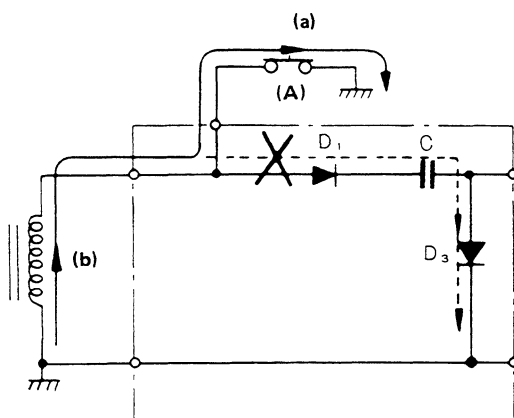
C031F018

3. Capacitor Discharging Circuit

When the SCR turns on, electric charge stored in the capacitor is abruptly discharged through the circuit (2), as shown in the figure (capacitor C → SCR → ignition coil → capacitor C). As a result, a high voltage of short rise time is induced in the secondary winding of the ignition coil, generating sparks in the plug.

- (A) SCR gate triggering level
- (B) Signal coil voltage
- (a) Timing coil
- (b) Ignition coil

[A] Engine stop circuit



C031F019

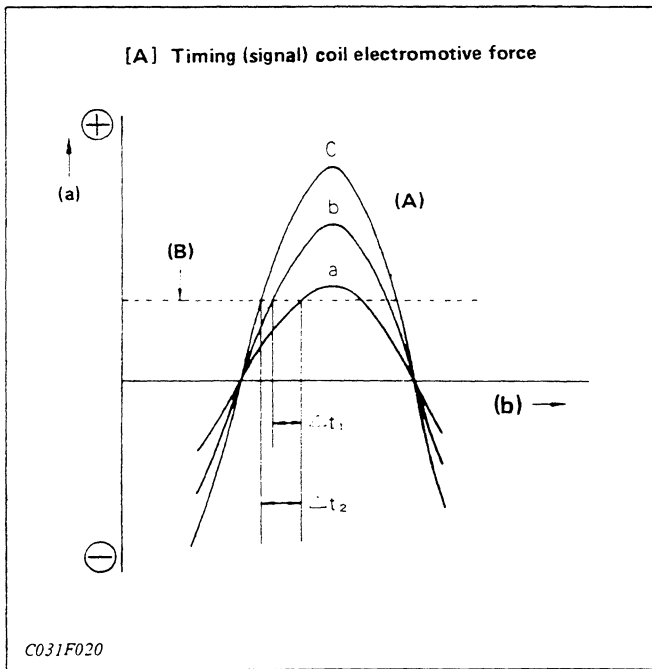
(3) Engine Stop Circuit

In CDI system, the engine is stopped by shorting an electromotive force induced in the charging coil via the stop switch to prevent the capacitor from being charged. Since no voltage is applied to the capacitor, any voltage is not applied, the plug does not spark, even though the SCR turns on.

- (A) ON
- (a) Stop switch
- (b) Charging coil

(4) Ignition Timing (Electric Spark Advancing)

The conventional spark advancing system uses the centrifugal force of the governor to move a cam mechanically for advancing ignition timing. In the CDI system, however, ignition timing is advanced by variation in rise time of an electromotive force generated in the timing (signal) coil. As shown in the figure at left, as the rotor speed increases, the induced voltage rises. Therefore, the rotating angle required for the electromotive force to reach the triggering level of SCR decreases. Advancing ignition timing and advancing angle are shown in the figure by rotating angle Δt . This operation is referred to as electric spark advancing.



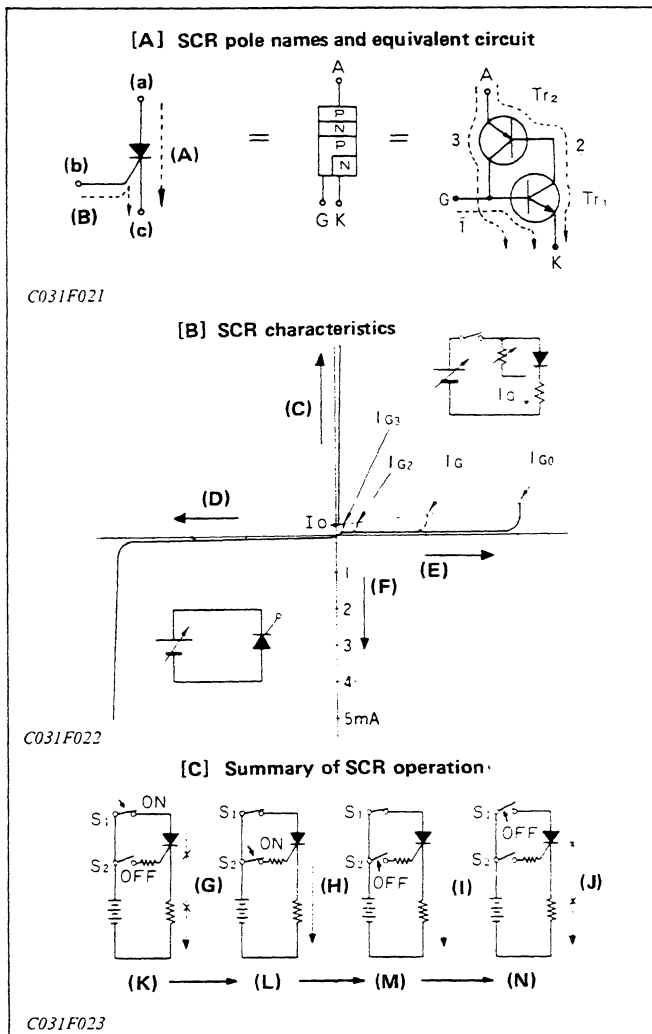
- (A) Rotating speed (a) < (b) < (c)
- (B) SCR triggering level
- (a) Voltage (V)
- (b) Rotating angle (°)

■ SCR

SCR is the abbreviation for silicon controlled rectifier, a one-way three-terminal switching element that takes only two states: non-conduction or conduction.

As shown in the figure at left, the SCR forms PNPN junction.

1. When a forward voltage is applied between the anode and the cathode without providing a signal to the gate, between the anode and cathode is off.
2. If a positive voltage is applied between gate and cathode, this device turns on.
3. Once it turns on, and if the current flowing from the anode to the cathode is at or over the level of holding current (I_0 in the figure), the SCR remains on even after the voltage to the gate is removed.
4. To turn off the SCR, current flowing from the anode to the cathode, must be reduced to zero in a short time or anode potential must be dropped to or below the cathode potential.



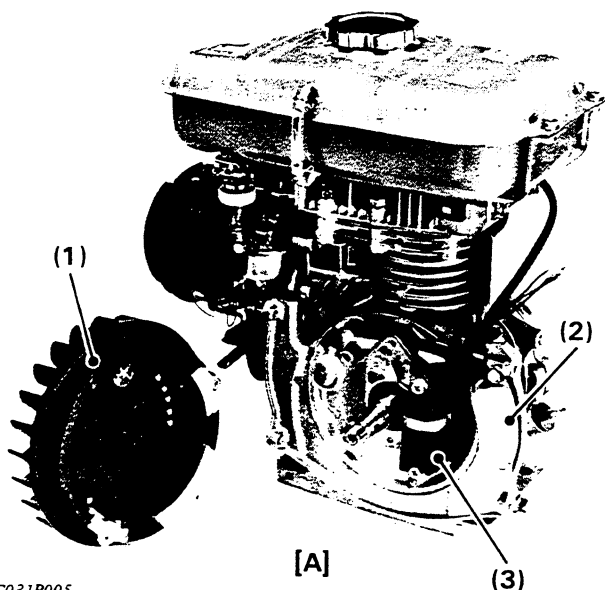
- (A) Forward current (anode current)
- (B) Gate current
- (C) Forward current (A)
- (D) Reverse biased voltage (V)
- (E) Forward biased voltage (V)
- (F) Reverse current

- (G) Turns off
- (H) Turns on
- (I) Remains on
- (J) Turns off
- (K) Only S1 is on. (L) S2 is also on.
- (M) Only S2 is off. (N) S1 is also off.

- (a) Anode A
- (b) Gate G
- (c) Cathode K

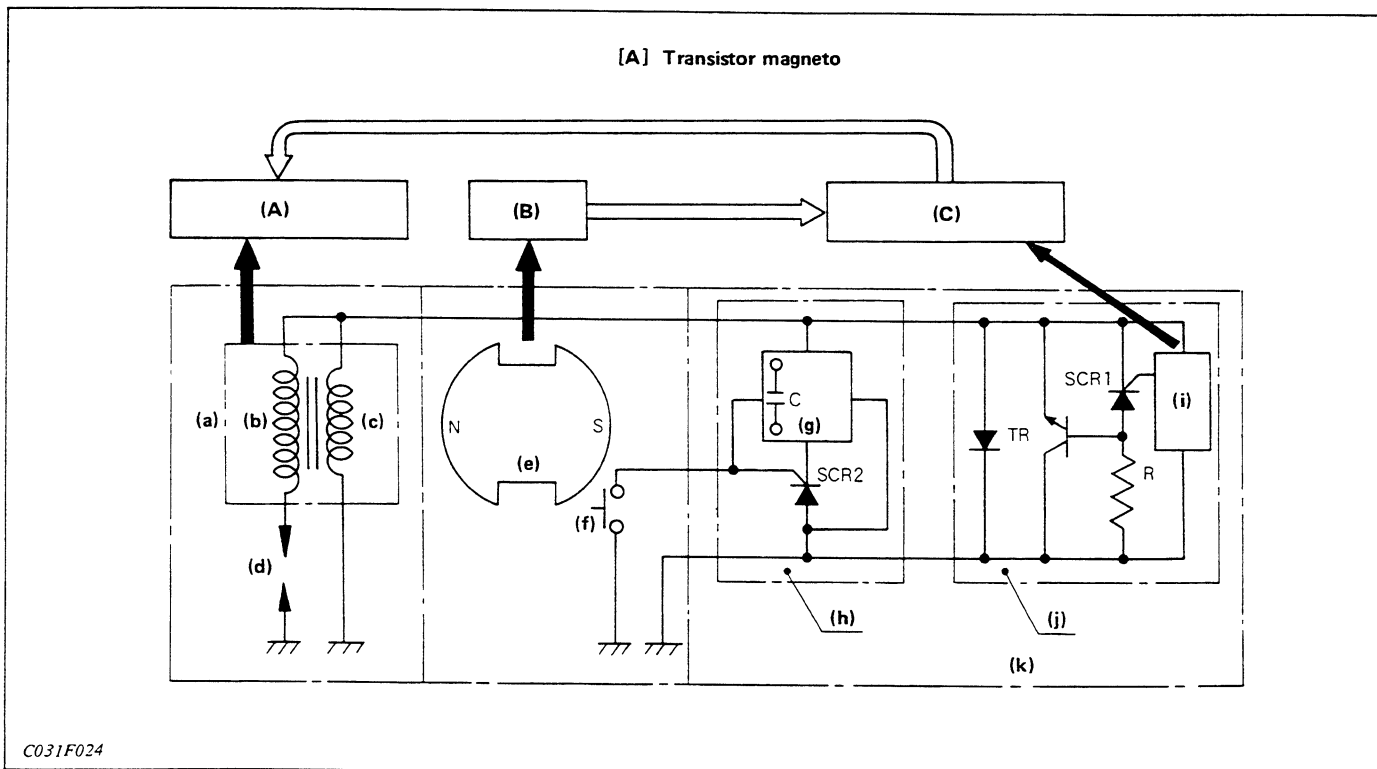
2. T.I.(TRANSISTOR IGNITION)MAGNETO

Transistor magneto employs the primary current shutoff system: a high voltage is generated in the secondary winding by breaking off the current across the primary winding of the ignition coil. In the case of contact-type magneto, the breaker controls the flow of current. The transistor magneto system has no contacts, the transistor controls the primary current.



C031P005

[A] Transistor magneto
(1) Rotor
(2) Control unit
(3) Ignition coil



C031F024

(A) High voltage spark generation
(B) Power generation
(C) Ignition timing indication

(a) Ignition coil
(b) Secondary winding
(c) Primary winding
(d) Spark plug
(e) Rotor
(f) Engine stop switch

(g) Hold circuit
(h) Stop circuit
(i) Ignition control circuit block
(j) Ignition circuit
(k) Control unit (transistor magneto type)

(1) Transistor Magneto Features

This section describes the features of the transistor magneto, compared to the CDI system.

1. Free from capacitor and timing (signal) coil, it is compact and simple in construction.
2. Low secondary voltage is advantageous to suppress wave interference and corona discharge.

CDI system: 20kV or more

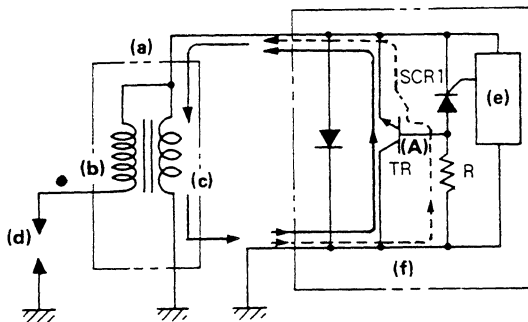
Transistor system: 13 to 16kV

(2) Transistor Magneto Operation

1. Ignition circuit

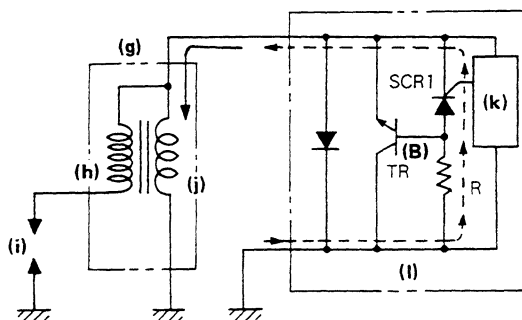
1. The rotor induces a voltage in the primary coil.
2. This power source supplies a base-to-emitter current through resistor (R) to transistor (TR), and turns on the transistor.
Then, an electromotive force in the primary coil is virtually shorted through the transistor.
3. In the ignition control block, the induced voltage in the primary coil is referred to a specified valve, at ignition timing, the induced voltage is reached, and SCR control signal is put out. (Electric spark advancing is made by the same principle described in the paragraph on the CDI system.)
4. This signal turns on the SCR. SCR cuts the base current which has been flowing through the transistor and turns off the transistor.
5. At that moment, the current flowing through the primary coil and the transistor is abruptly shut off to induce a high voltage in the secondary coil due to mutual induction, and the plug sparks.

[A] Ignition circuit



C031F025

[B] Ignition circuit



C031F026

(A) ON

(B) OFF

(a) Ignition coil

(b) Secondary winding

(c) Primary winding

(d) Spark plug

(e) Ignition control circuit block

(f) Ignition circuit

(g) Ignition coil

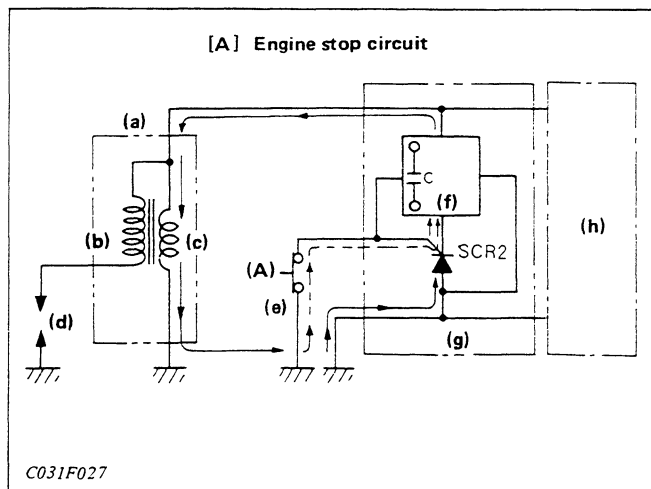
(h) Secondary winding

(i) Primary winding

(j) Spark plug

(k) Ignition control circuit block

(l) Ignition circuit



2. Engine Stop Circuit

1. When the engine stop switch is pressed while engine is running, the induced voltage is applied to the gate of SCR2 in the engine stop circuit through the switch, and turns on the SCR2.
2. When SCR2 turns on, capacitor C is charged in the hold block of the circuit.
3. The current to flow through the ignition circuit is cut by SCR2, therefore the ignition circuit stop its operation.
4. Even after the engine stop switch is released, capacitor C keeps the gate voltage at trigger level and prevents the SCR2 being turned off at reverse-biased cycle. Thus the above operation is kept and the engine remains stopped.

- (A) ON
- (a) Ignition coil
- (b) Secondary winding
- (c) Primary winding
- (d) Spark plug
- (e) Engine stop switch
- (f) Hold circuit block
- (g) Stop circuit
- (h) Ignition circuit

SECTION II

Troubleshooting

| | |
|--|-----------|
| NON-CONTACT IGNITION SYSTEM | 68 |
| GS130 C.D.I. (CAPACITOR DISCHARGE IGNITION) MAGNETO | 69 |
| GS130 T.I. (TRANSISTOR IGNITION) | |
| MAGNETO (K1000[K800] , K1400[K1200]) | 70 |
| GS280 T.I. (TRANSISTOR IGNITION) | |
| MAGNETO (K3500[K3050]) | 71 |
| GN1850/GN2500 C.D.I. MAGNETO (K2100[K1800] ,K3000[K2500]) | 72 |

NON-CONTACT IGNITION SYSTEM

TROUBLESHOOTING PROCEDURE FOR IGNITION SYSTEM IS DESCRIBED BELOW.

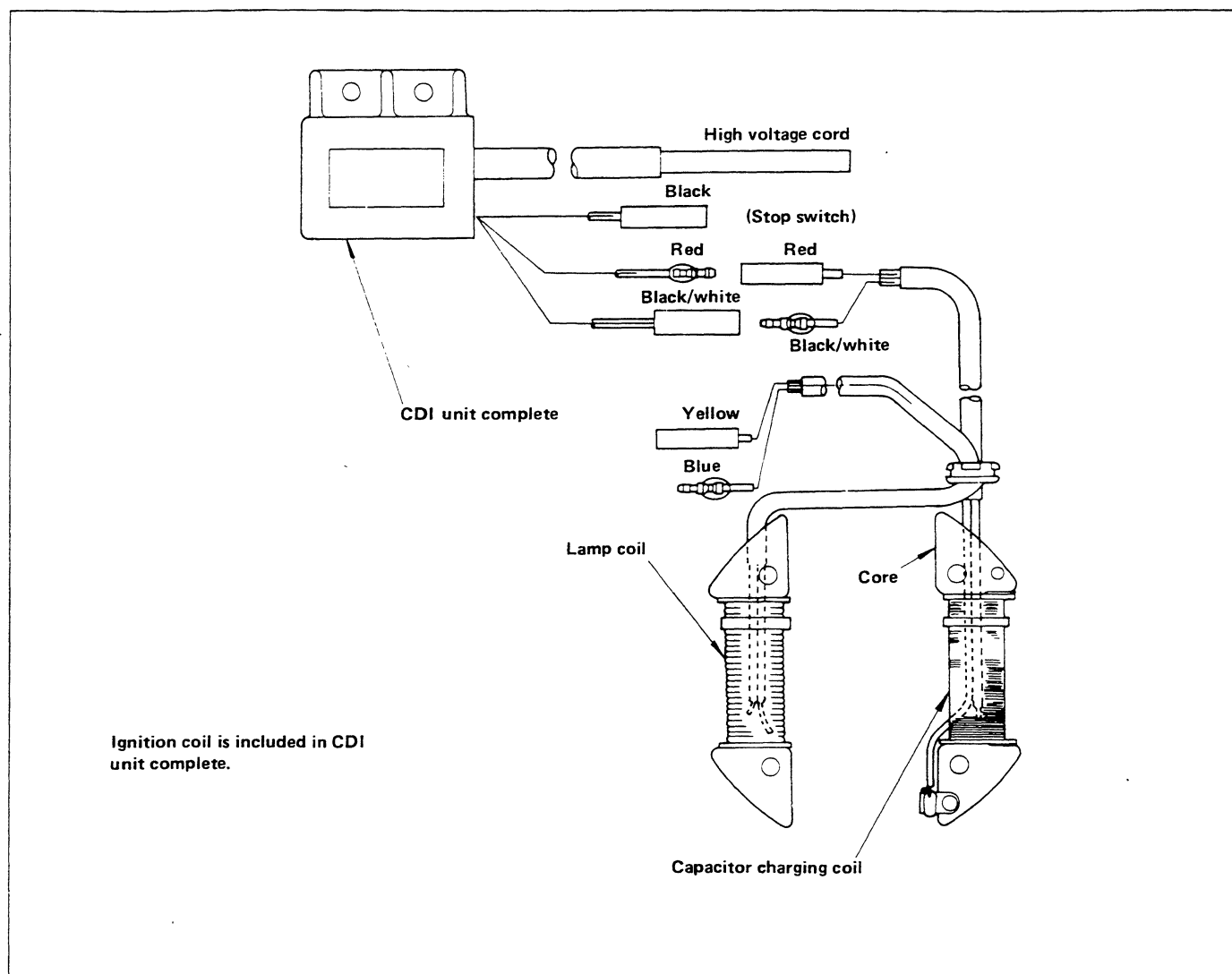
- (1) Before measurement, check that all lead wires are connected properly.
- (2) Measure resistance of each ignition system using a circuit tester. "ON" in the standard value column means conduction state. Values are reference values which differ dependent on types of circuit testers. "OFF" means infinite (∞).
- (3) Before measurement, properly connect (+) and (−) terminals of the tester.
- (4) Short-circuit connection terminals once before measuring values marked "※" in the standard value column (to discharge capacitors).

Magneto types classified by engine types

| Engine type | Magneto type | Model |
|-------------|--|-------------------|
| GS130 | CDI (Capacitor Discharge Ignition) magneto | K1400, DG-A |
| | Transistor magneto | K1000-K1400, DG-A |
| GN550 | Transistor magneto | K450 |
| GS280 | Transistor magneto | K3500 |
| GN1850 | CDI (Capacitor Discharge Ignition) magneto | K2100 |
| GN2500 | | K3000 |

GS130 C.D.I. (CAPACITOR DISCHARGE IGNITION) MAGNETO

Check point



Reference value

Capacitor charging coil

| Check point | Procedure | Connection | Resistance |
|-------------------------|-----------|-------------------|--------------|
| Capacitor charging coil | | Red ↔ Black/White | Approx. 140Ω |

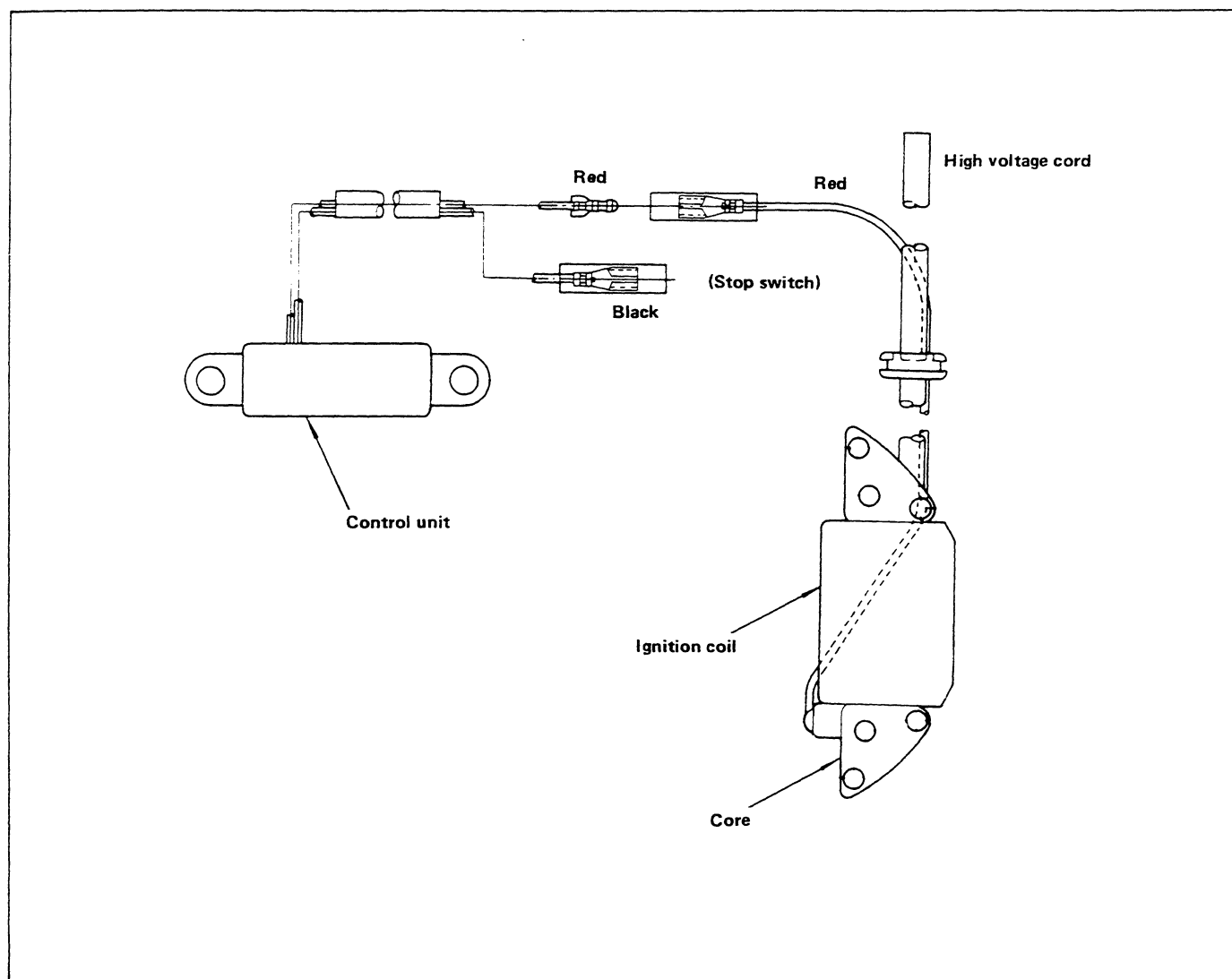
CDI unit complete

| (-) Tester terminal | Capacitor charging terminal (Red) | Stop terminal (black) | Ground terminal (black/white) | High voltage cord |
|-----------------------------------|-----------------------------------|----------------------------------|-------------------------------|-------------------|
| (+) Tester terminal | | | | |
| Capacitor charging terminal (Red) | | * ON state once ∞ as time passes | ON (2 ~ 9kΩ) | ON (3.5 ~ 15kΩ) |
| Stop terminal (black) | OFF (∞) | | OFF (∞) | OFF (∞) |
| Ground terminal (black/white) | * ON state once ∞ as time passes | * ON state once ∞ as time passes | | ON (0.8 ~ 3kΩ) |
| High voltage cord | * ON state once ∞ as time passes | * ON state once ∞ as time passes | ON (0.8 ~ 3kΩ) | |

■ "ON" means conduction state. Values are reference values which differ dependent on types of circuit tester.

GS130 T.I. (TRANSISTOR IGNITION) MAGNETO (K1000[K800],K1400[K1200])

Check point



Reference value

Ignition coil

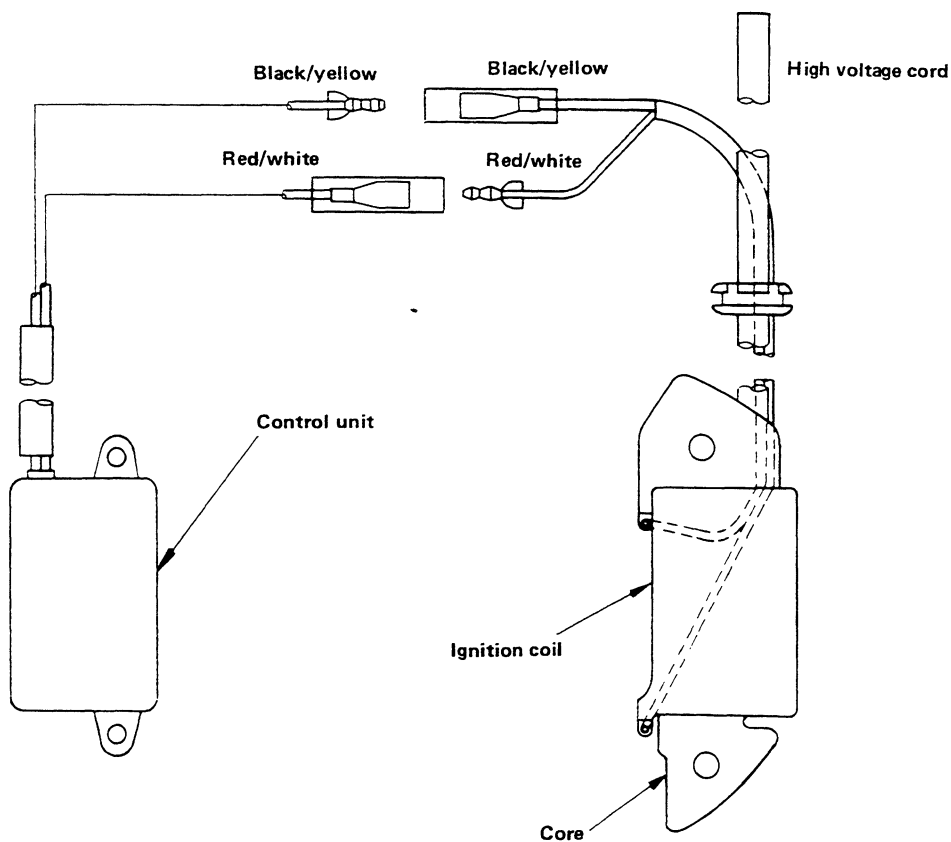
| Check point | Procedure | Connection | Resistance |
|----------------|-----------|--------------------------|------------|
| Primary coil | | Red ↔ Core | 0.5 ~ 1.5Ω |
| Secondary coil | | High voltage cord ↔ Core | 10 ~ 17kΩ |

Control unit

| (+) Tester terminal | (-) Tester terminal | Engine body (core) | Primary terminal (red) | Stop terminal (black) |
|------------------------|---------------------|--------------------|------------------------|-----------------------|
| Engine body (core) | | | ON (0.5 ~ 4kΩ) | ON (0.5 ~ 4kΩ) |
| Primary terminal (red) | | ON (0.5 ~ 4kΩ) | | ON (10 ~ 50Ω) |
| Stop terminal (black) | | ON (0.5 ~ 4kΩ) | ON (10 ~ 50Ω) | |

GS280 T.I. (TRANSISTOR IGNITION) MAGNETO (K3500[K3050])

Check point



Reference value

Ignition coil

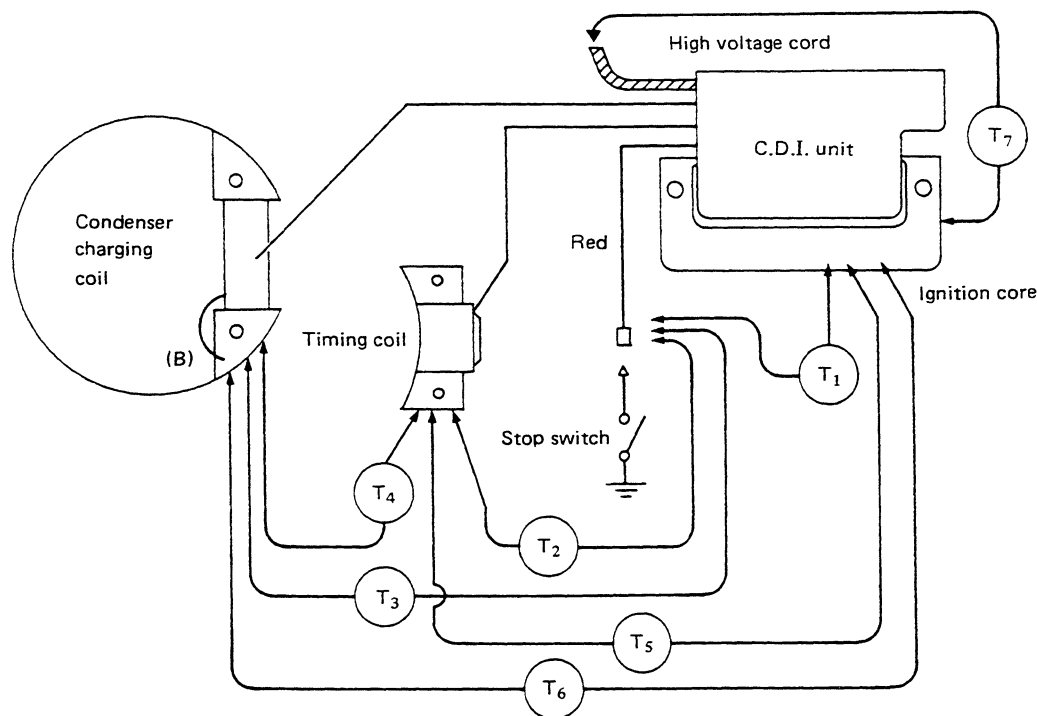
| Check Point | Procedure | Connection | Resistance |
|----------------|-----------|--------------------------|---------------|
| Primary coil | | Black/yellow ↔ Core | Approx. 0.6Ω |
| Secondary coil | | High voltage cord ↔ Core | Approx. 6.5kΩ |
| Pickup coil | | Red/white ↔ Core | Approx. 50Ω |

Control unit

| (+) Tester terminal | (-) Tester terminal | Engine body (core) | Primary terminal (black/yellow) | Pickup terminal (red/white) |
|---------------------------------|---------------------|--------------------|---------------------------------|-----------------------------|
| Engine body (core) | | | ON (Approx. 3kΩ) | ON (Approx. 3kΩ) |
| Primary terminal (black/yellow) | | OFF (∞) | | ON (Approx. 900Ω) |
| Pickup terminal (red/white) | | OFF (∞) | ON (Approx. 900Ω) | |

GN1850/GN2500 C.D.I. MAGNETO (K2100[K1800],K3000[K2500])

Check point



If the acceptance criteria (A) and (B) given below are obtained in testing with the commercially available tester, there is no trouble.

| | No. | Tester | | Checking item |
|---|-----|--|---|-------------------------------------|
| | | Acceptance criterion (A) | Acceptance criterion (B) | |
| To be set in engine | T0 | Ignition core \oplus R lead (red) \ominus The meter pointer swings once and indicates approx. 1 M Ω (con) | Ignition core \ominus R lead (red) \oplus Continuity is ensured. (on) | Applicability of whole circuit |
| To be removed from engine (on insulation plate) | T1 | R lead (red) \oplus Ignition core \ominus Continuity is ensured. (on) | R lead (red) \ominus Ignition core \oplus The meter pointer swings once and indicates approx. 1 M Ω (con) | Mainly charging coil and unit body |
| | T2 | R lead (red) \oplus Timing core surface \ominus Continuity is ensured. (on) | R lead (red) \ominus Timing core surface \oplus The meter pointer swings once and returns to ∞ . (con) | Applicability of whole circuit |
| | T3 | R lead (red) \oplus (B) core surface \ominus Continuity is ensured. (on) | R lead (red) \ominus (B) core surface \oplus The meter pointer swings once and indicates approx. 1 M Ω (con) | Mainly charging coil |
| | T4 | Timing core surface \oplus (B) core surface \ominus Continuity is ensured. (on) | Timing core surface \ominus (B) core surface \oplus Continuity is ensured. (on) | Applicability of whole circuit |
| | T5 | Ignition core \oplus Timing core surface \ominus Continuity is ensured. (on) | Ignition core \ominus Timing core surface \oplus Continuity is ensured. (on) | Applicability of whole circuit |
| | T6 | Ignition core \oplus (B) core surface \ominus Continuity is ensured. (on) | Ignition core \ominus (B) core surface \oplus Continuity is ensured. (on) | Applicability of whole circuit |
| | T7 | High voltage cord \oplus Ignition core \ominus Continuity is ensured. (on) | | High voltage cord and ignition coil |

\oplus and \ominus are terminal marks of tester.

- Notes: (1) The tester should be used with its highest multiplying factor (M Ω measuring range).
 (2) (on) indicates the diode forward characteristics which differ from short-circuiting state.
 (3) (con) indicates the condenser characteristics; namely the meter pointer swings once and gradually returns to the ∞ direction.
 (4) Short-circuit the (con) part before checking.

SECTION III

Disassembly and Service

| | |
|--|-----|
| DISASSEMBLY | 80 |
| ENGINE BODY | 80 |
| CARBURETOR | 89 |
| RECOIL STARTER | 91 |
| SERVICE | 92 |
| CYLINDER HEAD AND CYLINDER PARTS | 92 |
| PISTON AND CONNECTING ROD | 93 |
| CRANKSHAFT AND CAMSHAFT GEAR | 95 |
| VALVES | 97 |
| SPARK PLUG | 100 |
| RUNNING CHECK | 100 |

■ 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.

■ 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.

■ Keep the Unit and Surrounding Area Clean

Remove all oil deposits. Remove all unnecessary grease 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.

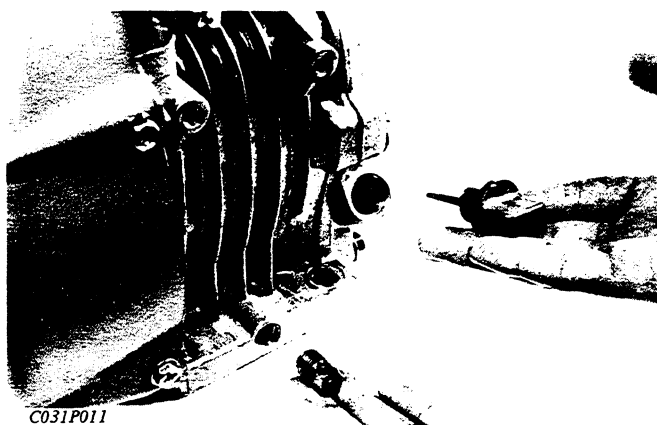
Make sure all nuts and bolts are secure. Keep power shields and guards in position.

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.

DISASSEMBLY

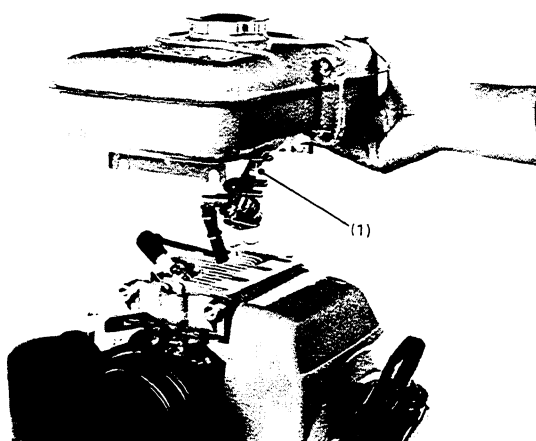
ENGINE BODY



1 Draining Engine Oil

- 1) Remove the dipstick.
- 2) Remove the drain plug.
- 3) Drain engine oil.

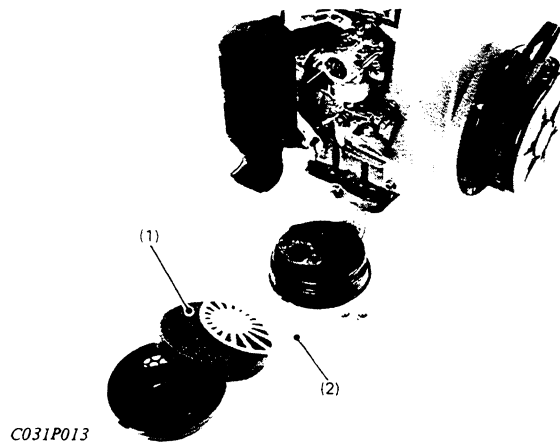
| Model | Oil capacity | Drain plug tightening torque |
|--------|--------------------------|--|
| GS130 | 0.55 ℓ 0.58 U.S. qts. | 19.6 to 29.4 Nm 2 to 3 kgf·m 14.5 to 21.7 ft-lbs |
| GS280 | 0.9 ℓ 0.95 U.S. qts. | 6.9 to 9.8 Nm 0.7 to 1 kgf·m 5.1 to 7.2 ft-lbs |
| GN550 | 0.32 ℓ 0.34 U.S. qts. | 19.6 to 29.4 Nm 2 to 3 kgf·m 14.5 to 21.7 ft-lbs |
| GN1850 | 0.6ℓ 0.63 U.S. qts. | 6.9 to 9.8 Nm 0.7 to 1 kgf·m 5.1 to 7.2 ft-lbs |
| GN2500 | 0.85ℓ 0.9 U.S. qts. | |



2 Removing Fuel Tank and Fuel Filter

- 1) Close the fuel filter cock.
- 2) Disconnect the fuel pipe connecting the fuel filter and the carburetor at the carburetor side.
- 3) Loosen the tightening bolt which holds the fuel filter to the fuel tank, and remove the filter from the tank body.
- 4) Remove four fuel tank tightening bolts.
- 5) Remove the fuel tank with the filter connected.

(1) Fuel filter tightening bolt



③ Removing Air Cleaner

K450/K1000[K400/K800]

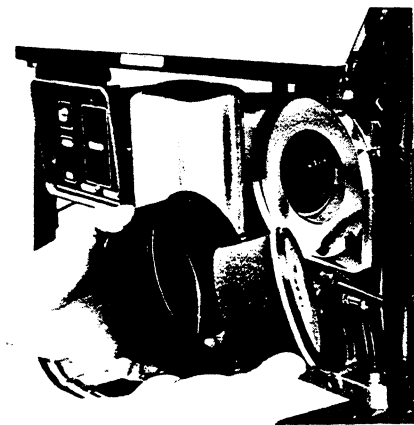
- 1) Remove the air cleaner cover fixtures.
- 2) Remove the air cleaner cover, element, and plate.
- 3) Remove two air cleaner body tightening nuts, and remove the air cleaner body.

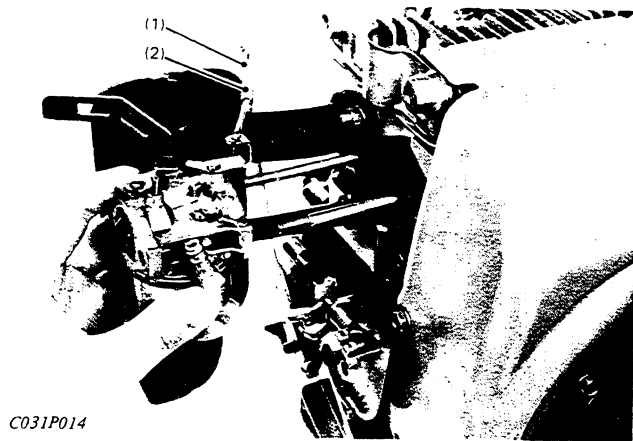
(1) Element
(2) Plate



K1400/K2100/K3000/K3500 [K1200/K1800/K2500/K3050]

- 1) Loosen the air cleaner cover.
- 2) Take out the air cleaner element.
- 3) Remove the foam wrapper, and wash it in detergent and water. Dry thoroughly when finished.
- 4) Re-oil the foam wrapper and squeeze out excess oil.
- 5) Shake and tap the cartridge-type element to remove the dust and dirt. If still dirty, install new element.
- 6) Install the foam wrapper back onto the cartridge-type element.
- 7) Clean out the air cleaner housing and cover.
- 8) Re-install the element into the housing and put on the air cleaner cover.



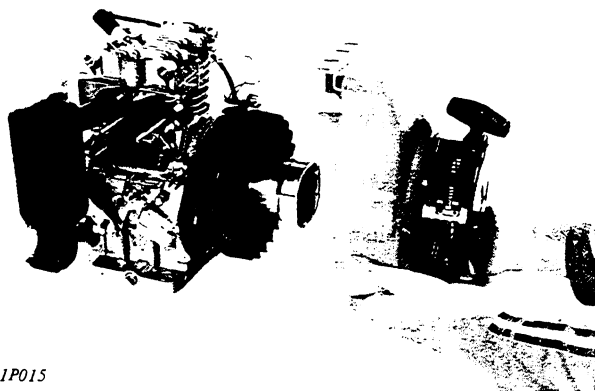


C031P014

4 Removing Carburetor, Governor Connecting Rod and Spring

- 1) Remove the carburetor.
- 2) Remove the governor connecting rod and spring.

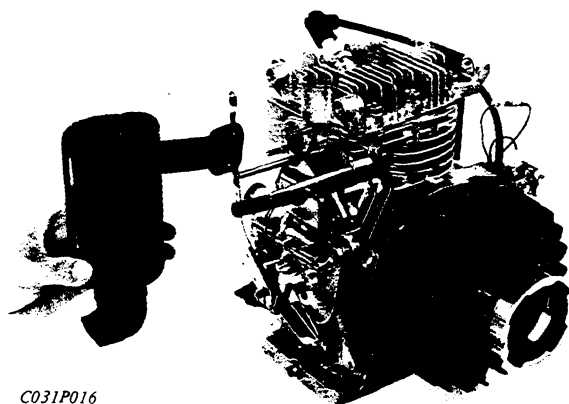
- (1) Governor connecting rod
- (2) Spring



C031P015

5 Removing Spiral Case and Cylinder Cowling

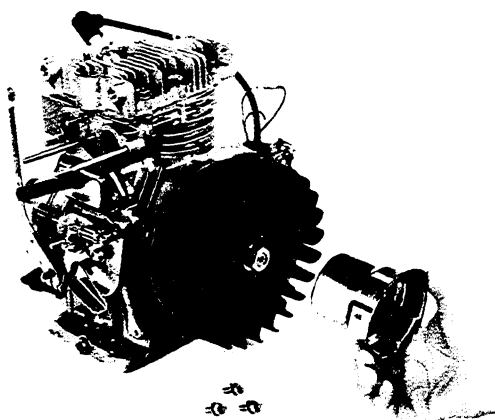
- 1) Disconnect the stop switch connecting wire.
- 2) Remove the spiral case with the recoil starter installed.
- 3) Remove the cylinder cowling.



C031P016

6 Removing Muffler and Muffler Gasket

- 1) Remove the muffler.
- 2) Remove the muffler gasket.



C031P017

7 Removing Start Pulley

- 1) Remove the start pulley.



C031P018

8 Removing Flywheel

- 1) Remove the flywheel tightening nut.
- 2) Remove the flywheel.
- 3) Remove the woodruff key.

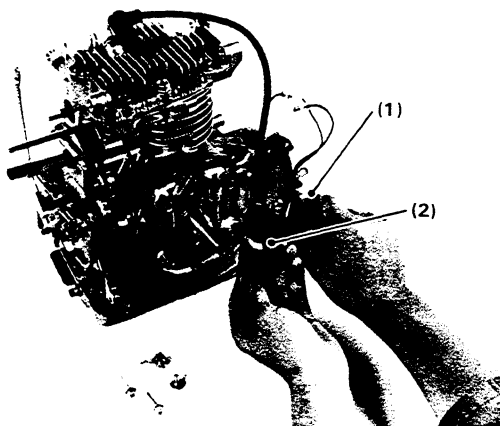
- When disassembling the flywheel, always use an air cooled engine flywheel puller.
- When disassembling the flywheel, do not damage to the fins.

(Note for reassembling)

- Flywheel tightening nut torque.

| | |
|------------------|--|
| GS130 | 29.4 to 44.1 Nm 3 to 4.5 kgf·m 21.7 to 32.5 ft-lbs |
| GS280 | 63.7 to 73.5 Nm 6.5 to 7.5 kgf·m 47.0 to 54.2 ft-lbs |
| GN550 | 19.6 to 24.5 Nm 2 to 2.5 kgf·m 14.5 to 18 ft-lbs |
| GN1850 GN2500 | 58.8 to 68.6 Nm 6 to 7 kgf·m 43.4 to 50.6 ft-lbs |

(1) Air-cooled-engine flywheel puller

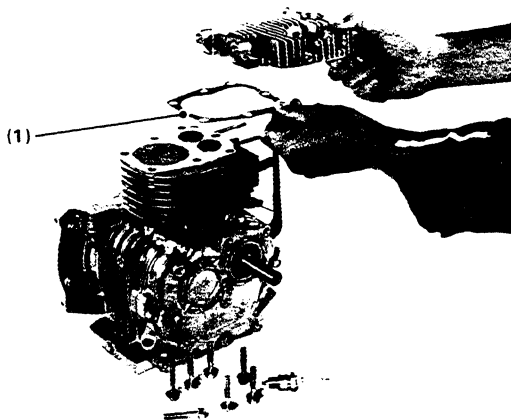


C031P019

9 Removing Ignition Coil and Unit Complete

- 1) Remove the spark plug cap.
- 2) Remove the ignition coil.
- 3) Remove the unit.

- (1) Unit complete
(2) Ignition coil



C031P020

The model is a little different from the actual one.

10 Removing Spark plug, Cylinder head and Head Gasket

- 1) Remove the spark plug.
- 2) Remove the cylinder head.
- 3) Remove the head gasket.

- When removing the cylinder head, check the assembling direction of the gasket.

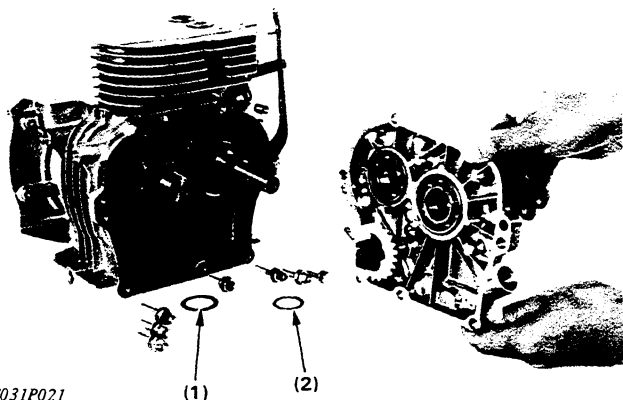
(Note for reassembling)

- When reassembling the cylinder gasket, face the smoother surface down (cylinder side).

- Tightening torque.

| Model | Cylinder head bolt | Spark plug |
|--------|--|--|
| GS130 | 19.6 to 29.4 Nm 2 to 3 kgf·m 14.5 to 21.7 ft-lbs | 9.8 to 24.5 Nm 1 to 2.5 kgf·m 7.2 to 18.1 ft-lbs |
| GS280 | 34.3 to 46.1 Nm 3.5 to 4.7 kgf·m 25.3 to 34.0 ft-lbs | |
| GN550 | 8.7 to 8.9 Nm 0.89 to 0.91 kgf·m 6.4 to 6.6 ft-lbs | |
| GN1850 | 19.6 to 29.4 Nm 2 to 3 kgf·m 14.5 to 21.7 ft-lbs | |
| GN2500 | 34.3 to 39.2 Nm 3.5 to 4 kgf·m 25.3 to 29.0 ft-lbs | |

(1) Head gasket



C031P021

The model is a little different from the actual one.

11 Removing Crankcase 2, Crankcase Gasket and Shim (Crankshaft) (Camshaft)

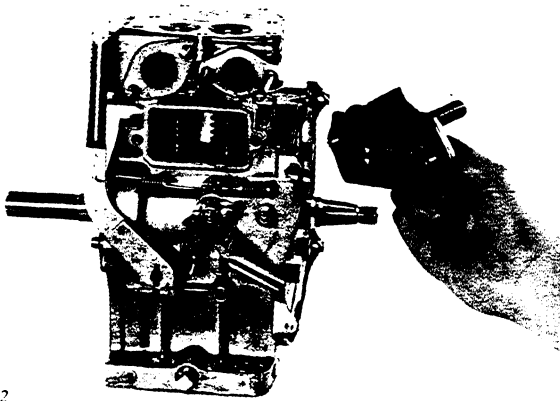
- 1) Sandpaper the burrs on the camshaft key groove.
- 2) Remove the crankcase tightening bolts.
- 3) Hold the crankcase 2 with hand and tap the shaft end with a hammer to remove the crankcase 2.
- 4) Remove the crankcase gasket.
- 5) Remove the shim.

- Crankcase 2 tightening bolt torque.

| | |
|------------------|--|
| GS130 | 7.8 to 12.7 Nm 0.8 to 1.3 kgf·m 5.6 to 9.4 ft-lbs |
| GS280 | 13.7 to 19.6 Nm 1.4 to 2 kgf·m 10.1 to 14.5 ft-lbs |
| GN550 | 2.8 to 3 Nm 0.29 to 0.31 kgf·m 2.1 to 2.3 ft-lbs |
| GN1850 GN2500 | 13.7 to 19.6 Nm 1.4 to 2 kgf·m 10.1 to 14.5 ft-lbs |

- Shim thicknesses differ. Therefore, they must be reassembled in their original position.

- (1) Crankshaft shim
- (2) Camshaft shim



C031P022

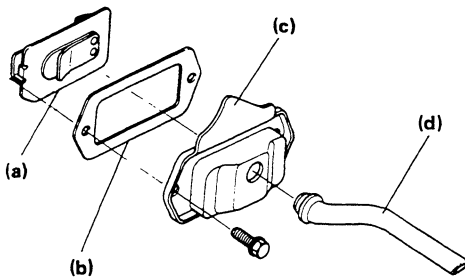
The model is a little different from the actual one.

12 Removing Tappet Chamber Cover and Breathe

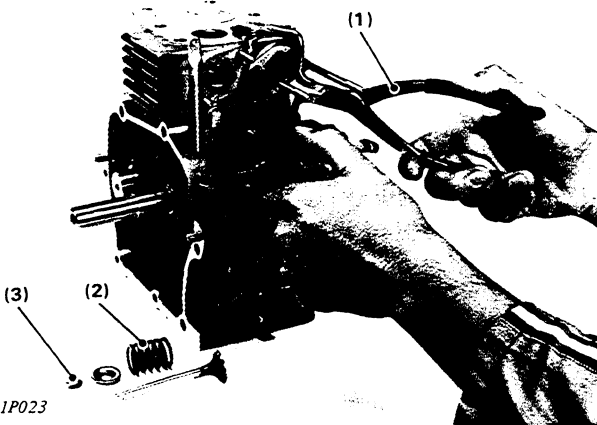
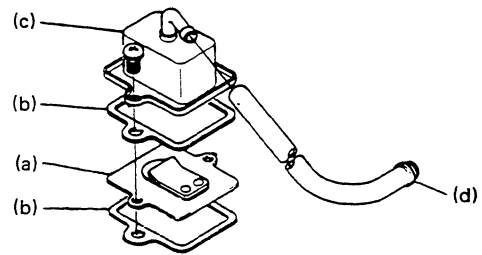
- 1) Remove the tappet chamber cover.
- 2) Remove the breather.

- (a) Breather
- (b) Tappet chamber gasket
- (c) Tappet chamber cover
- (d) Breather pipe

[A] Tappet chamber disassembly diagram



C031F051



C031P023

The model is a little different from the actual one.

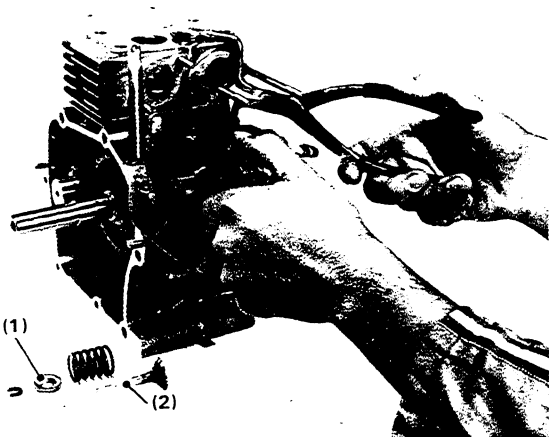
13 Removing Valve Spring Collet

- 1) Remove the valve spring collet

● Valve clearance

| | |
|--------|---|
| GS130 | 0.08 to 0.14 mm 0.0031 to 0.0055 in. |
| GS280 | 0.07 to 0.13 mm 0.0028 to 0.0051 in. |
| GN550 | 0.08 to 0.15 mm 0.0035 to 0.0059 in. |
| GN1850 | 0.09 to 0.15 mm 0.0035 to 0.0059 in. |
| GN2500 | 0.07 to 0.13 mm 0.0028 to 0.0051 in. |

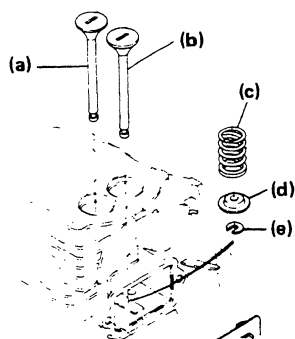
- (1) Valve lifter
- (2) Spring
- (3) Collet



C031P023

The model is a little different from the actual one.

[A] Inlet and exhaust valves disassembly diagram



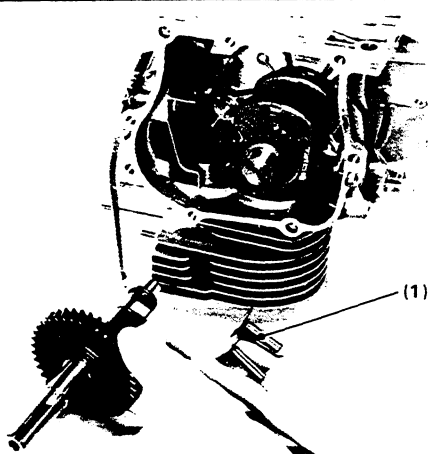
C031F052

14 Removing Inlet Valve, Exhaust Valve, Valve Spring Retainer and Valve Spring

- 1) Remove the inlet and exhaust valves.
- 2) Remove the valve spring retainer.
- 3) Remove the valve spring.

- (1) Retainer
(2) Exhaust valve

- (a) Exhaust valve
(b) Inlet valve
(c) Valve spring
(d) Retainer
(e) Collet



C031P024

The model is a little different from the actual one.

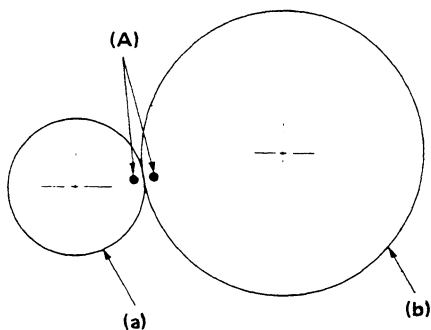
15 Removing Camshaft, Cam Gear and Tappet

- 1) Put the cylinder body upside down.
- 2) Pull out the camshaft and the cam gear as a unit.
- 3) Remove the tappet.

(Note for reassembling)

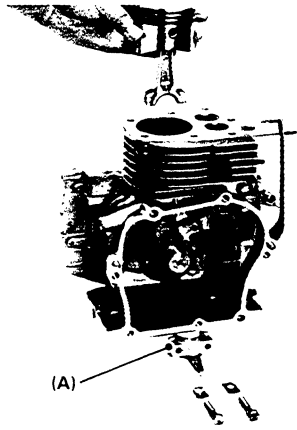
- When reassembling the cam gear and the crank gear, align the marks.
- Tappet clearances differ. Therefore, they must be reassembled in the original position. Put marks on them to prevent improper reassembly.

- (1) Tappet

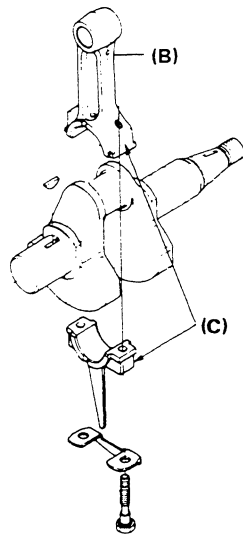


C031F053

- (A) Alignment marks
(a) Crank gear
(b) Cam gear



C031P025



C031F054

16 Removing Piston

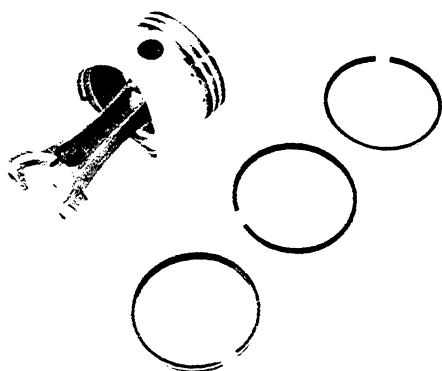
- 1) Extend the bent portion of the rod bolt washer.
- 2) Remove the connecting rod bolt.
- 3) Remove the cap at the large end of the connecting rod.
- 4) Pull out the piston to the cylinder head side.

(Important)

- Be careful of the flywheel side direction and the mark on the connecting rod.
- Fit the worked surfaces of the upper and lower caps at the larger end of the connecting rod.
- Connecting rod bolt tightening torque.

| | |
|---------|--|
| GS130 | 9.8 to 13.7 Nm 1.0 to 1.4 kgf·m 7.2 to 10.1 ft-lbs |
| GS280 | 16.7 to 22.6 Nm 1.7 to 2.3 kgf·m 12.3 to 16.6 ft-lbs |
| GN550 | 3.9 to 5.9 Nm 0.4 to 0.6 kgf·m 2.9 to 4.4 ft-lbs |
| GN1850 | 13.7 to 19.6 Nm 1.4 to 2.0 kgf·m 10.1 to 14.5 ft-lbs |
| GN 2500 | 16.7 to 22.6 Nm 1.7 to 2.3 kgf·m 12.3 to 16.6 ft-lbs |

- (A) Worked surface
(B) Flywheel side
(C) Worked surface



C031P026

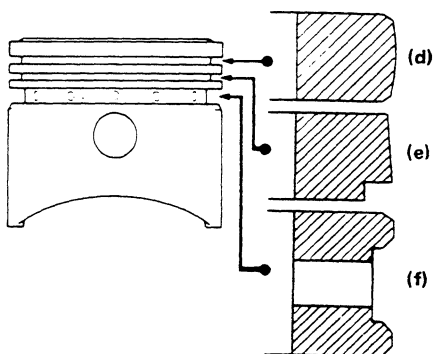
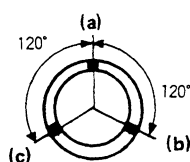
17 Removing Piston Rings

1) Remove three piston rings.

(Note for reassembling)

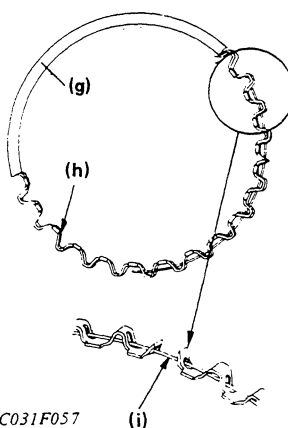
- Face the N mark towards the head.
- Reassemble the piston rings by shifting the gap so that they are at 120° to each other.

C031F055



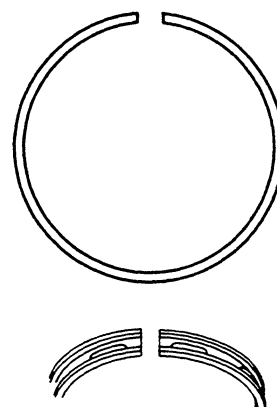
C031F056

[A] Oil ring (GS280)



C031F057

[B] Oil ring



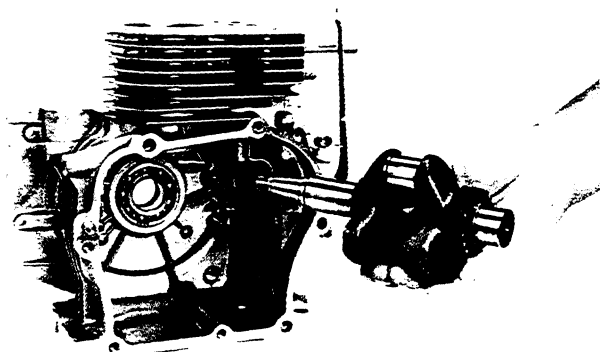
C031F084

- (a) No. 1 gap
- (b) No. 2 gap
- (c) No. 3 gap
- (d) Plane ring
- (e) Undercut ring

- (f) Oil ring
- (g) Side rail
- (h) Space expander
- (i) Split joint

18 Removing Crankshaft

1) Tap and remove the crankshaft.

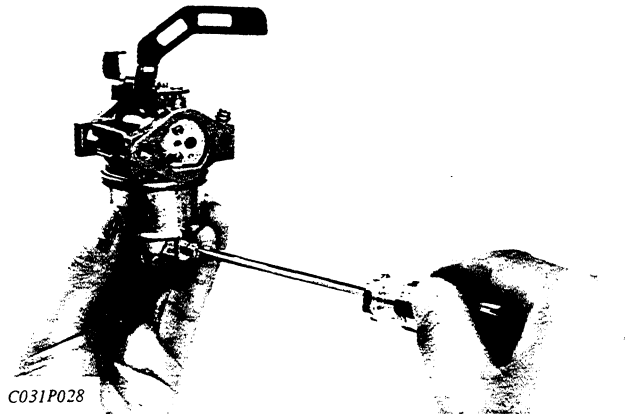


C031P027

CARBURETOR

1 Draining Fuel

1) Loosen the drain screw and drain fuel in the float-chamber

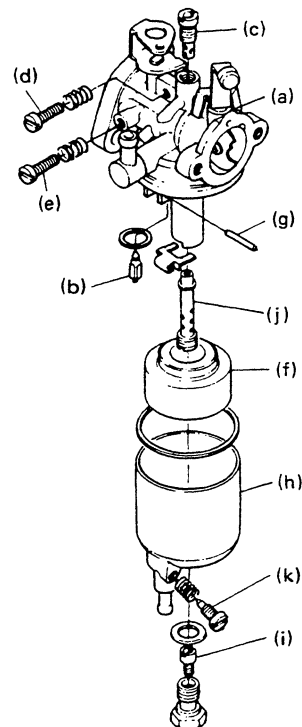
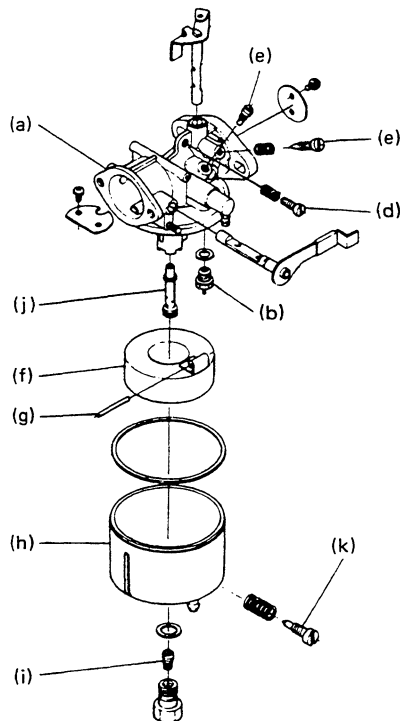
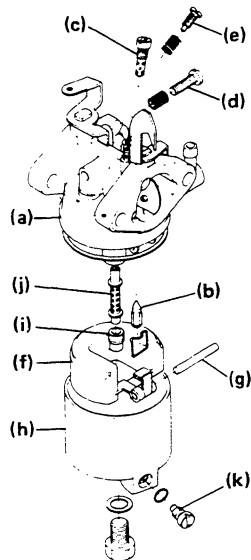


[A] Carburetor disassembly view

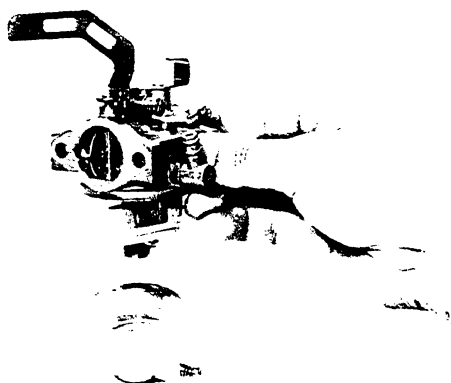
GS130 · GS280

GN1850 · GN2500

GN550



- (a) Carburetor body
- (b) Needle valve
- (c) Pilot jet
- (d) Idle screw
- (e) Pilot screw
- (f) Float
- (g) Float pin
- (h) Float chamber
- (i) Main jet
- (j) Main nozzle
- (k) Drain screw



C031P029

2 Removing Float Chamber

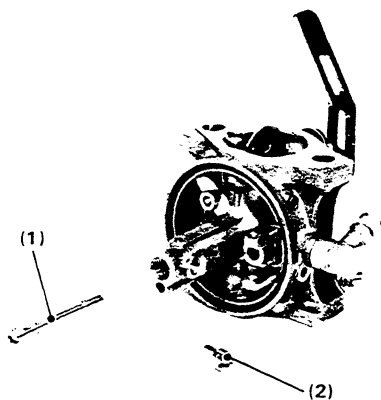
- 1) Remove the bolt and the float chamber.



C031P030

3 Removing Float and Needle Valve

- 1) Remove the arm pin and the float.
- 2) Remove the needle valve with the float as a unit.



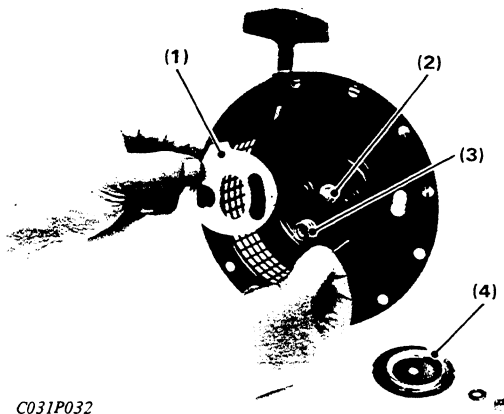
C031P031

4 Removing Main Jet and Main Nozzle

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

- (1) Main nozzle
(2) Main jet

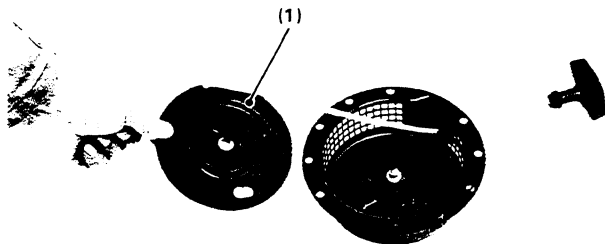
RECOIL STARTER



1 Disassembling Claw

- 1) Remove the nut.
- 2) Remove the pressure plate, claw, spring, and thrust washer.

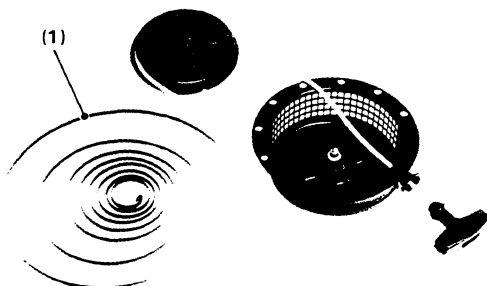
- (1) Claw
- (2) Thrust washer
- (3) Spring
- (4) Pressure plate



2 Removing Reel

- 1) Attach a rope to the notched section of the reel.
- 2) Lift the reel.

- (1) Reel

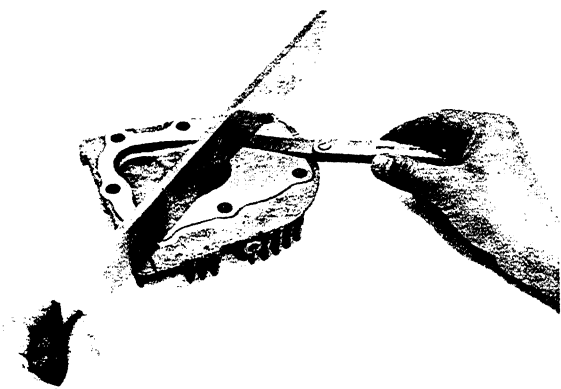


3 Removing Spiral Spring

- 1) Remove the spiral spring from the reel.

- (1) Spiral spring

CYLINDER HEAD AND CYLINDER PARTS

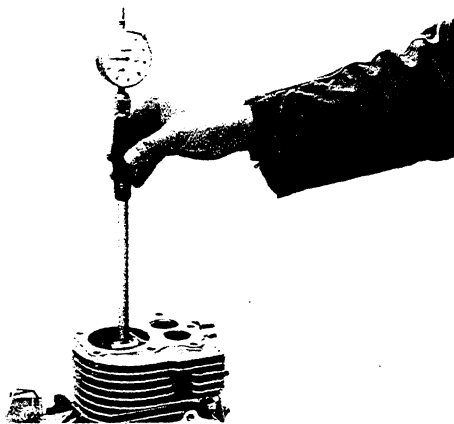


C031P035

1 Checking Cylinder Head Surface Distortion

- 1) Clean the cylinder head surface.
- 2) Lay a straight edge on the projected surface of the cylinder head and insert a feeler gauge into the clearance.
- 3) The largest thickness of gauge which can be inserted into the clearance is the dimension of distortion.
- 4) When distortion exceeds the allowable limit, polish the surface with a plane grinder.

| | |
|-----------------|---------------------------|
| Allowable limit | Max. 0.4 mm 0.0157 in. |
|-----------------|---------------------------|



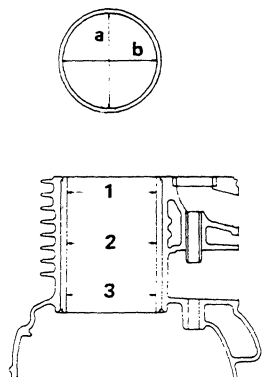
C031P036

2 Checking Cylinder Bore

- 1) Set a cylinder gauge and adjust to the reference dimension with an outside micrometer. Measure at 6 points as shown in the figure to obtain the maximum wear.
- 2) When the allowable limit is exceeded, replace the cylinder.

| Model | Reference value | Allowable limit |
|--------|---|------------------------|
| GS130 | 60.00 to 60.02 mm 2.3622 to 2.3630 in. | 60.12 mm 2.3669 in. |
| GS280 | 73.00 to 73.02 mm 2.8740 to 2.8748 in. | 73.12 mm 2.8787 in. |
| GN550 | 42.000 to 42.025 mm 1.6535 to 1.6545 in. | 42.2 mm 1.6614 in. |
| GN1850 | 67.000 to 67.025 mm 2.6378 to 2.6388 in. | 67.2 mm 2.6457 in. |
| GN2500 | 71.98 to 72.00 mm 2.8339 to 2.8346 in. | 72.2 mm 2.8425 in. |

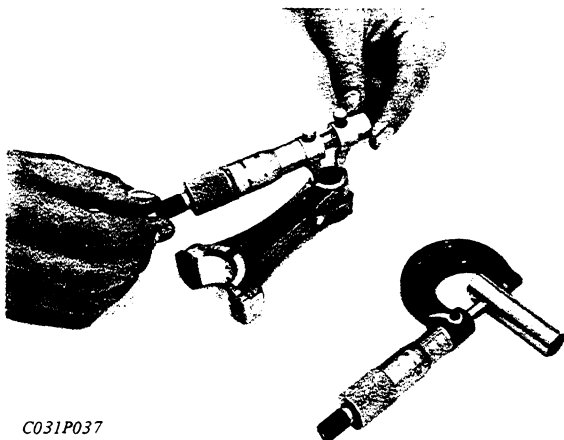
[A] Cylinder liner measuring points



C031F060

- a. Vertical to the piston pin
- b. Piston pin direction
- 1. Upper side
- 2. Center portion
- 3. Lower skirt section

PISTON AND CONNECTING ROD



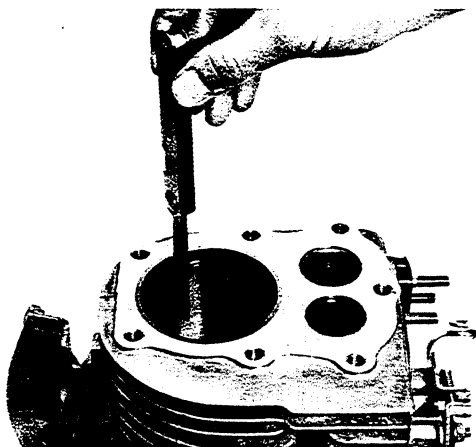
C031P037

① Checking Clearance between Piston Pin and Connecting Rod Small-End Bore

- 1) Measure the piston pin O.D. and connecting rod small-end bore I.D. with a micrometer. Then, calculate the clearance.
- 2) When the allowable limit is exceeded, replace.

| Model | Reference value | Allowable limit |
|--------|---|-----------------------|
| GS130 | 0.010 to 0.025 mm | 0.1 mm |
| GS280 | 0.0004 to 0.0010 in. | 0.0039 in. |
| GN550 | 0.026 to 0.046 mm 0.0010 to 0.0018 in. | 0.08 mm 0.0031 in. |
| GN1850 | 0.015 to 0.030 mm 0.0006 to 0.0012 in. | 0.1 mm 0.0039 in. |
| GN2500 | 0.010 to 0.033 mm 0.0004 to 0.0013 in. | |

| Model | Piston pin O.D. | Connecting rod small-end bore I.D. |
|--------|---|---|
| GS130 | 13.000 to 13.005 mm 0.5118 to 0.5120 in. | 13.015 to 13.025 mm 0.5124 to 0.5128 in. |
| GS280 | 18.000 to 18.005 mm 0.7087 to 0.7089 in. | 18.015 to 18.025 mm 0.7093 to 0.7096 in. |
| GN550 | 13.001 to 13.009 mm 0.5119 to 0.5121 in. | 13.025 to 13.035 mm 0.5128 to 0.5132 in. |
| GN1850 | 15.000 to 15.005 mm 0.5906 to 0.5907 in. | 15.015 to 15.025 mm 0.5911 to 0.5915 in. |
| GN2500 | 16.495 to 16.500 mm 0.6494 to 0.6496 in. | 16.510 to 16.528 mm 0.6500 to 0.6507 in. |



C031P038

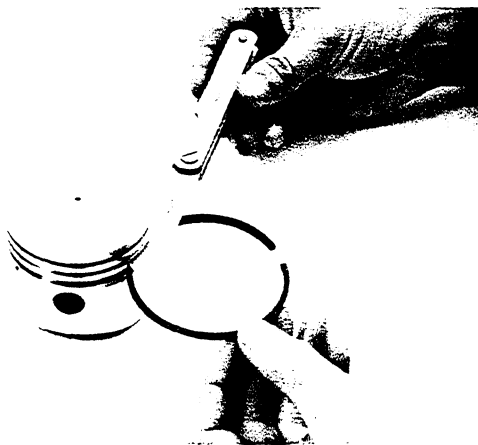
② Checking Piston Ring Gap

- 1) Insert the piston ring into the cylinder bore, turn the piston upside down and push the piston ring into the cylinder.
- 2) Measure the ring gap at the lower skirt section.
- 3) When the allowable limit is exceeded, replace the piston ring.

(Note for measurement)

- Use a new cylinder or an unworn lower skirt section.

| Model | Reference value | | Allowable limit |
|--------|---|---|----------------------|
| | Top ring, 2nd ring | 3rd ring (Oil ring) | |
| GS130 | 0.25 to 0.45 mm 0.0098 to 0.0177 in. | 0.2 to 0.4 mm 0.0079 to 0.0157 in. | 0.9 mm 0.0354 in. |
| GS280 | 0.2 to 0.4 mm 0.0079 to 0.0157 in. | 0.2 to 0.4 mm 0.0079 to 0.0157 in. | 0.9 mm 0.0354 in. |
| GN550 | 0.15 to 0.35 mm 0.0059 to 0.0137 in. | 0.15 to 0.35 mm 0.0059 to 0.0137 in. | 0.5 mm 0.0196 in. |
| GN1850 | 0.2 to 0.4 mm 0.0079 to 0.0157 in. | 0.2 to 0.4 mm 0.0079 to 0.0157 in. | 0.9 mm 0.0354 in. |
| GN2500 | | | |

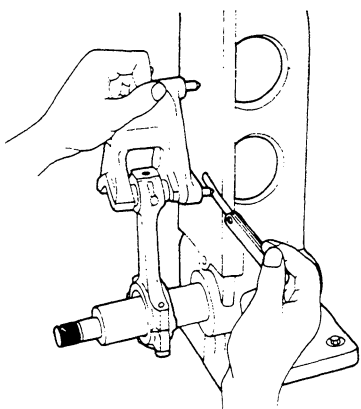


C031P039

3 Checking Clearance between Piston Ring and Ring Groove

- 1) Clean the piston ring groove and insert the piston ring.
- 2) Measure each ring clearance with a feeler gauge at several positions on the ring circumference.
- 3) When the allowable limit is exceeded, replace the piston ring.

| Model | Reference value | | Allowable limit |
|--------|---|---|----------------------|
| | Top ring, 2nd ring | 3rd ring (Oil ring) | |
| GS130 | 0.02 to 0.06 mm | 0.02 to 0.05 mm | 0.1 mm 0.0039 in. |
| GS280 | 0.0008 to 0.0024 in. | 0.0008 to 0.0020 in. | |
| GN550 | 0.015 to 0.050 mm 0.0006 to 0.0019 in. | 0.010 to 0.045 mm 0.0004 to 0.0018 in. | |
| GN1850 | 0.02 to 0.06 mm 0.0008 to 0.0024 in. | 0.02 to 0.06 mm 0.0008 to 0.0024 in. | |
| GN2500 | 0.05 to 0.07 mm 0.0019 to 0.0028 in. | 0.02 to 0.06 mm 0.0008 to 0.0024 in. | |



C019F056

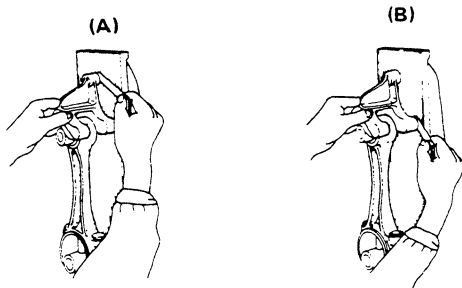
4 Checking Connecting Rod Distortion

- 1) Attach the connecting rod to the connecting rod aligner.
- 2) Place the gauge on the piston pin and measure clearance between the gauge pin and the aligner's flat surface.
- 3) If the allowable limit is exceeded, replace.

(Note for measurement)

- The large-end bore and small-end bore are used as references for straightness of the connecting rod. Check carefully for wear.

[A] Connecting rod bend and twist measurement



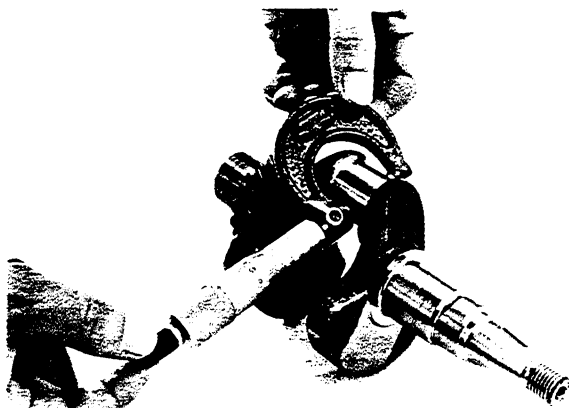
C031F076

Allowable limit

0.04mm
0.0016in

(A) Bend
(B) Twist

CRANKSHAFT AND CAMSHAFT GEAR



C031P040

① Checking Crank Pin O.D.

- 1) Measure O.D. with an outside micrometer.
- 2) If the allowable limit is exceeded, replace.

| Model | Reference value | Allowable limit |
|--------|---|------------------------|
| GS130 | 23.967 to 23.982 mm 0.9436 to 0.9442 in. | 23.92 mm 0.9417 in. |
| GS280 | 29.967 to 29.982 mm 1.1798 to 1.1804 in. | 29.92 mm 1.1780 in. |
| GN550 | 17.973 to 17.984 mm 0.7076 to 0.7080 in. | 17.92 mm 0.7055 in. |
| GN1850 | 25.467 to 25.482 mm 1.0026 to 1.0032 in. | 25.4 mm 1.00 in. |
| GN2500 | 26.967 to 26.982 mm 1.0617 to 1.0622 in. | 26.9 mm 1.059 in. |

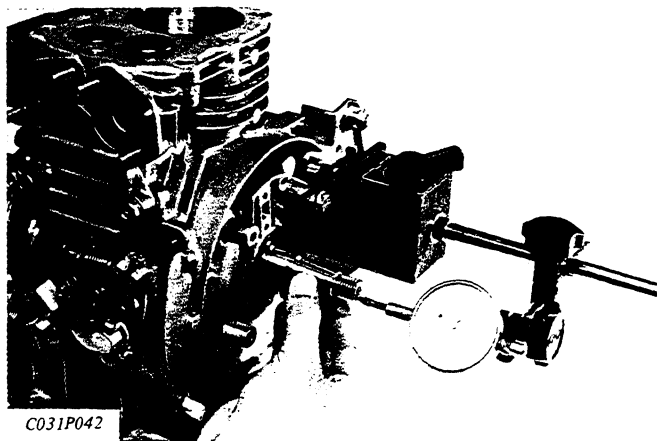


C031P041

② Checking Clearance between Crank Pin and Connecting Rod Large-End Bore

- 1) Measure the crank pin O.D. and the connecting rod large-end bore with a micrometer, and calculate the clearance.
- 2) If the allowable limit is exceeded, replace.

| Model | Connecting rod large-end bore reference value | Clearance | Clearance allowable limit |
|--------|---|---|---------------------------|
| GS130 | 24.000 to 24.021 mm 0.9449 to 0.9457 in. | 0.018 to 0.054 mm 0.0007 to 0.0021 in. | 0.1 mm 0.0039 in. |
| GS280 | 30.000 to 30.025 mm 1.1811 to 1.1821 in. | 0.018 to 0.058 mm 0.0007 to 0.0023 in. | |
| GN550 | 18.000 to 18.018 mm 0.7087 to 0.7094 in. | 0.016 to 0.045 mm 0.0006 to 0.0018 in. | |
| GN1850 | 25.500 to 25.521 mm 1.0039 to 0.9851 in. | 0.018 to 0.054 mm 0.0007 to 0.0021 in. | |
| GN2500 | 27.000 to 27.021 mm 1.0629 to 1.0638 in. | 0.018 to 0.054 mm 0.0007 to 0.0021 in. | |



3 Checking Side Clearance of Crankshaft

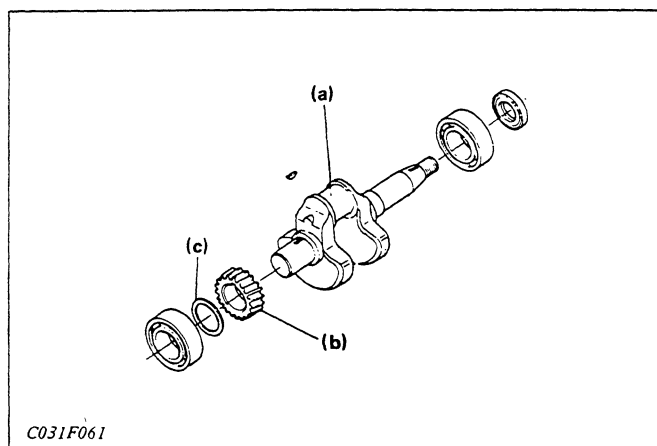
- 1) Attach a metal plate to the cylinder.
- 2) Set a dial gauge and push the shaft and measure the side clearance.
- 3) If the allowable limit is exceeded, adjust with shims.

| | |
|-----------------|--|
| Reference value | 0.02 to 0.1 mm 0.0008 to 0.0039 in. |
| Allowable limit | 0.2 mm 0.0079 in. |

● Crankshaft shim

| Model | GS130 | GS280 | GN550 | GN1850 | GN2500 |
|-----------------------|--------------|--------------|--------------|--------------|--------------|
| Thickness | | | | | |
| 0.20 mm 0.0079 in. | 13904-1665-0 | 13641-2368-0 | — | 13621-2372-0 | 13641-2368-0 |
| 0.25 mm 0.0098 in. | 13904-1656-0 | 13641-1655-0 | — | 13621-2363-0 | 13641-1655-0 |
| 0.30 mm 0.0118 in. | 13904-1657-0 | 13641-2362-0 | 13601-1655-0 | 13621-2364-0 | 13641-2362-0 |
| 0.35 mm 0.0138 in. | 13904-1658-0 | 13641-1656-0 | — | 13621-2362-0 | 13641-1656-0 |
| 0.40 mm 0.0157 in. | 13904-1659-0 | 13641-2363-0 | 13601-1656-0 | 13621-2365-0 | 13641-2363-0 |
| 0.50 mm 0.0197 in. | — | — | 13601-1657-1 | 13621-2367-0 | 13641-2365-0 |
| 0.60 mm 0.0236 in. | — | — | 13601-1659-1 | — | — |

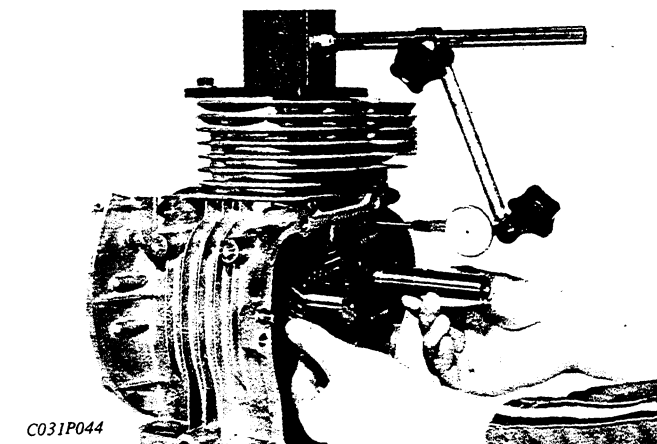
- (a) Crankshaft
- (b) Crankgear
- (c) Shim



4 Checking Gear Backlash (Cam Gear/Crankgear)

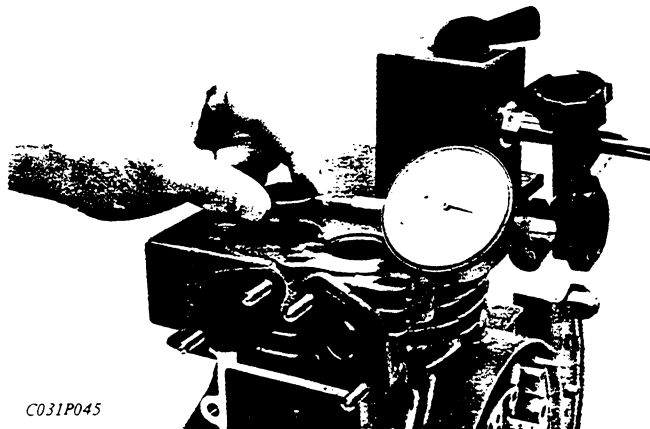
- 1) Attach a metal plate to the cylinder.
- 2) Set the lever tester perpendicular to the gear tooth surface.
- 3) Fix one gear and turn the other gear to measure backlash.
- 4) If the allowable limit is exceeded, replace both gears.

| Model | Reference value | Allowable limit |
|----------------|---|----------------------|
| GS130 | 0.023 to 0.128 mm 0.0008 to 0.0050 in. | 0.2 mm 0.0079 in. |
| GS160 GS200 | 0.029 to 0.141 mm 0.0011 to 0.0056 in. | |
| GS280 | 0.033 to 0.135 mm 0.0013 to 0.0053 in. | |
| GN550 | 0.033 to 0.119 mm 0.0013 to 0.0047 in. | |
| GN1850 | 0.03 to 0.12 mm 0.0018 to 0.0047 in. | |
| GN2500 | 0.029 to 0.123 mm 0.0011 to 0.0056 in. | |



The model is a little different from the actual one.

VALVES

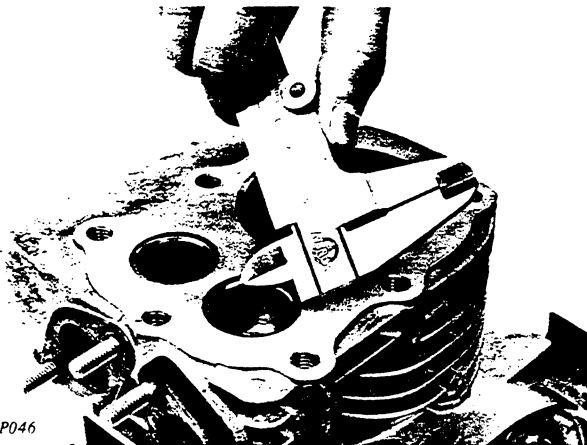


C031P045

① Checking 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 gauge.
- 4) Measure the clearance at the point where the valve contacts the valve guide.

| Model | Reference value | | Allowable limit |
|--------|---|---|----------------------|
| | Intake | Exhaust | |
| GS130 | 0.030 to 0.067 mm 0.0012 to 0.0026 in. | 0.050 to 0.095 mm 0.0020 to 0.0037 in. | 0.1 mm 0.0039 in. |
| GS280 | 0.035 to 0.075 mm 0.0014 to 0.0030 in. | 0.045 to 0.085 mm 0.0018 to 0.0033 in. | |
| GN550 | 0.020 to 0.044 mm 0.0008 to 0.0017 in. | 0.020 to 0.044 mm 0.0008 to 0.0017 in. | |
| GN1850 | 0.035 to 0.075 mm 0.0014 to 0.0030 in. | 0.045 to 0.085 mm 0.0018 to 0.0033 in. | |
| GN2500 | 0.025 to 0.055 mm 0.0010 to 0.0022 in. | 0.035 to 0.065 mm 0.0014 to 0.0026 in. | |



C031P046

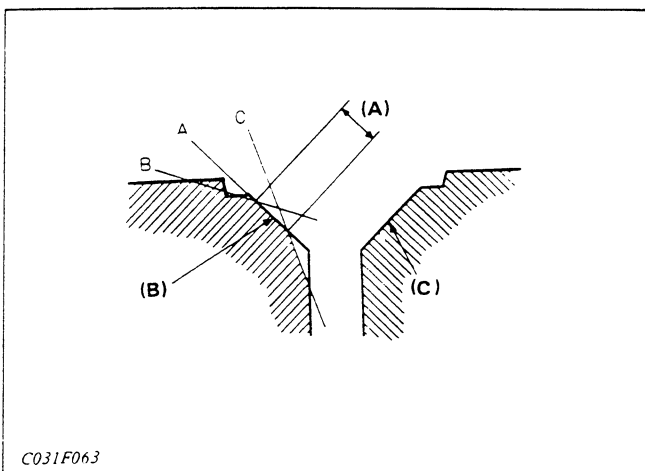
② Checking Seat Surface Grinding Width

- 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.

Regrinding seat surface

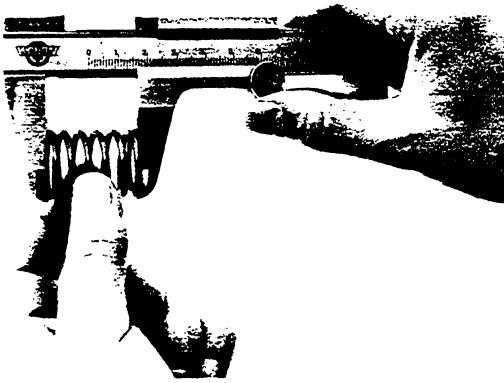
- 1) Grind valve seat surface width with a cutter.
- 2) Use a cutter appropriate for the valve seat surface and valve guide diameter.
- 3) Valve seat surface width becomes wider with use. Cut and readjust the width with a 15° cutter.
- 4) Grind the seat surface scratches and unevenness with a 45° cutter.
- 5) Grind the inner surface with 65° to 70° cutter to finish the seat width to the specified dimension.
- 6) Use a grinding compound to finish the seat surface.

| | |
|-----------------|---------------------------------------|
| Reference value | 1.0 to 1.3 mm 0.0394 to 0.0512 in. |
| Allowable limit | 1.5 mm 0.0591 in. |



C031F063

- (A) Contact surface with valve
 (B) Valve seat surface before readjustment
 (C) Valve seat surface after readjustment
 A. 45° cutter B. 15° cutter C. 70° cutter

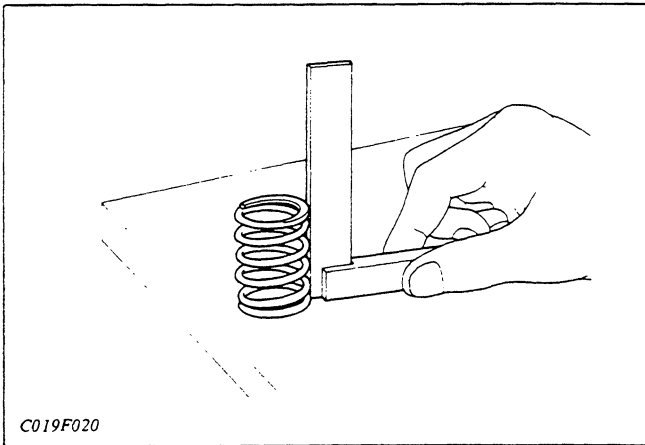


C031P047

3 Checking Valve Spring Free Length

- 1) Measure the valve spring with vernier calipers.
- 2) If the allowable limit is exceeded, replace.

| Model | Reference value | Allowable limit |
|--------|---------------------------------------|----------------------|
| GS130 | 30.8 to 31.3 mm 1.213 to 1.232 in. | 30.5 mm 1.201 in. |
| GS280 | 32.8 to 33.3 mm 1.291 to 1.311 in. | 32.5 mm 1.280 in. |
| GN550 | 21.2 to 21.8 mm 0.835 to 0.858 in. | 19.9 mm 0.783 in. |
| GN1850 | 29.5 to 30 mm 1.161 to 1.181 in. | 29.2 mm 1.150 in. |
| GN2500 | 32.8 to 33.3 mm 1.291 to 1.311 in. | 32.5 mm 1.280 in. |



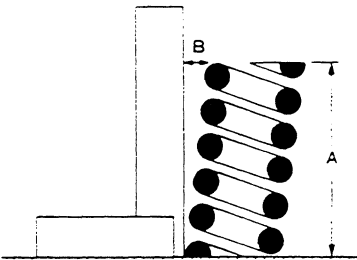
C019F020

4 Checking Valve Spring Squareness

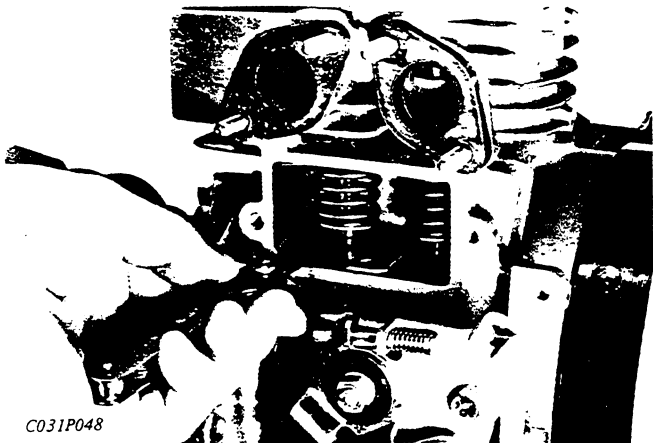
- 1) Place the spring on a surface plate and use a square to check squareness of the spring around its entire circumference.
- 2) Turn the spring and measure to obtain the greatest dimension B.
- 3) Check for spring damage and scratches.
- 4) If the allowable limit is exceeded, replace.

| | |
|-----------------|----------------------|
| Allowable limit | 1.5 mm 0.0591 in. |
|-----------------|----------------------|

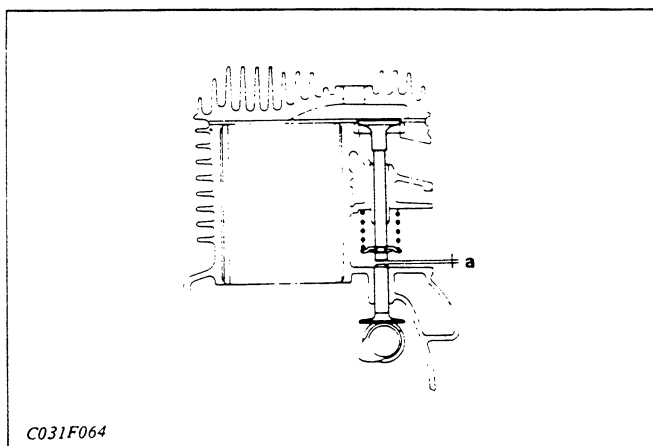
[A] Valve spring squareness measurement



C019F021



C031P048



C031F064

5 Checking Valve Clearance

- 1) Set the piston at the top dead center.
- 2) Measure the clearance with a feeler gauge.
- 3) If the clearance is under the reference value, grind the valve stem to adjust.

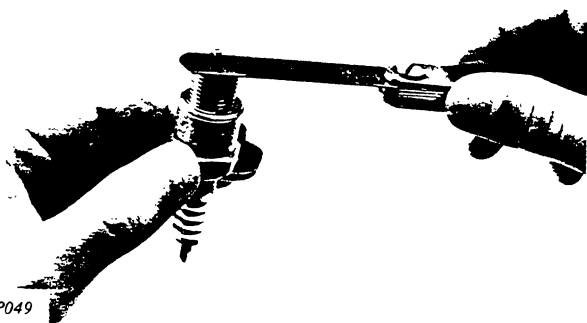
| Model | Reference value |
|--------|---|
| GS130 | 0.08 to 0.14 mm 0.0031 to 0.0055 in. |
| GS280 | 0.07 to 0.13 mm 0.0028 to 0.0051 in. |
| GN550 | 0.08 to 0.15 mm 0.0031 to 0.0059 in. |
| GN1850 | 0.09 to 0.15 mm 0.0035 to 0.0059 in. |
| GN2500 | 0.07 to 0.13 mm 0.0028 to 0.0051 in. |

a. Clearance

SPARK PLUG

① Checking Ignition Plug Gap

- 1) Remove carbon.
- 2) Measure clearance with a feeler gauge.
- 3) If the clearance is out of the reference value, readjust.



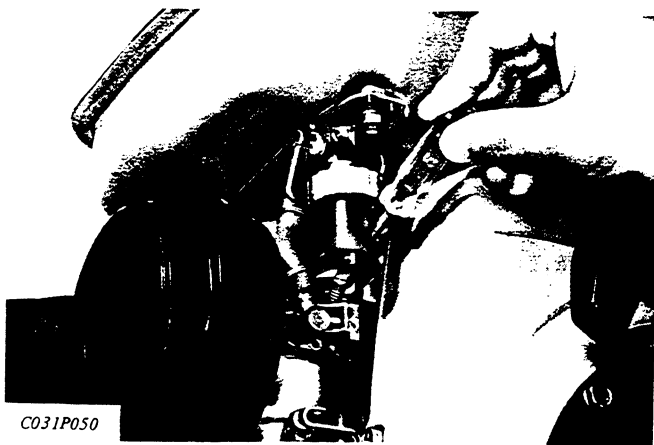
C031P049

| Model | Reference value |
|-------------------------|---------------------------------------|
| GS130 GS280 GN550 | 0.6 to 0.7 mm 0.0236 to 0.0276 in. |
| GN1850 GN2500 | 0.9 to 1.0 mm 0.0354 to 0.0394 in. |

RUNNING CHECK

① Adjusting Pilot Screw Opening Degree

- 1) Tighten the pilot screw completely, and then loosen it according to the reference value.



C031P050

| Model | Reference value |
|--------|-----------------|
| GS130 | 1-3/8 turns |
| GS280 | 1-1/4 turns |
| GN550 | 1 turns |
| GN1850 | 1 turns |
| GN2500 | 1-1/4 turns |

SECTION IV

Service Specifications

| | |
|-------------------------------------|------------|
| SERVICE SPECIFICATIONS | 96 |
| BOLT TORQUES | 100 |
| ENGINE TROUBLESHOOTING | 101 |

SERVICE SPECIFICATIONS

| Generator Set Model | | K1000 [K800] | K1400 [K1200] | K3500 [K3050] | K450 [K400] | K2100 [K1800] | K3000 [K2500] |
|--|---|--|--|--|--|--|------------------|
| Engine Model | | | | | | | |
| Item | | | | | | | |
| Cylinder Head Cylinder head deformation limit | | 0.4/100mm 0.0157/3.9370 in. | | | | | |
| | | 19.6 to 29.4 Nm 2.00 to 3.00 kgf-m 14.5 to 21.7 ft-lbs | 34.3 to 46.1 Nm 3.50 to 4.70 kgf-m 25.3 to 34.0 ft-lbs | 8.7 to 8.9 Nm 0.89 to 0.91 kgf-m 6.4 to 6.6 ft-lbs | 19.6 to 29.4 Nm 2 to 3 kgf-m 14.5 to 21.7 ft-lbs | 34.3 to 39.2 Nm 3.5 to 4 kgf-m 25.3 to 29.0 ft-lbs | |
| Bolt/nut tightening torque | | | | | | | |
| | | | | | | | |
| Valve | | 45° | | | | | |
| | | 45° | | | | | |
| Valve face angle | Intake Exhaust | | | | | | |
| Valve stem dial | Intake | 5.968 to 5.980 mm 0.2350 to 0.2354 in. | 6.960 to 6.975 mm 0.2740 to 0.2746 in. | 3.968 to 3.980 mm 0.1562 to 0.1567 in. | 6.960 to 6.975 mm 0.2740 to 0.2746 in. | | |
| | Exhaust | 5.94 to 5.96 mm 0.2339 to 0.2346 in. | 6.950 to 6.965 mm 0.2736 to 0.2742 in. | 3.968 to 3.980 mm 0.1562 to 0.1567 in. | 6.950 to 6.965 mm 0.2740 to 0.2746 in. | | |
| Valve guide I.D. | Intake | 6.010 to 6.035 mm 0.2366 to 0.2376 in. | 7.010 to 7.035 mm 0.2760 to 0.2770 in. | 4.000 to 4.012 mm 0.1575 to 0.1580 in. | 7.010 to 7.035 mm 0.2760 to 0.2770 in. | | |
| | Exhaust | 6.010 to 6.035 mm 0.2366 to 0.2376 in. | 7.010 to 7.035 mm 0.2760 to 0.2770 in. | 4.000 to 4.012 mm 0.1575 to 0.1580 in. | 7.010 to 7.035 mm 0.2760 to 0.2770 in. | | |
| Clearance between valve and guide stem | Intake | 0.030 to 0.067 mm 0.0012 to 0.0026 in. | 0.035 to 0.075 mm 0.0014 to 0.0030 in. | 0.020 to 0.044 mm 0.0008 to 0.0017 in. | 0.035 to 0.075 mm 0.0014 to 0.0030 in. | | |
| | Exhaust | 0.050 to 0.095 mm 0.0020 to 0.0037 in. | 0.045 to 0.085 mm 0.0018 to 0.0033 in. | 0.020 to 0.044 mm 0.0008 to 0.0017 in. | 0.045 to 0.085 mm 0.0018 to 0.0033 in. | | |
| Allowable limit | | 0.1 mm 0.0039 in. | | | | | |
| Valve clearance | Intake | 0.08 to 0.14 mm 0.0031 to 0.0055 in. | 0.07 to 0.13 mm 0.0028 to 0.0051 in. | 0.08 to 0.15 mm 0.0035 to 0.0059 in. | 0.09 to 0.15 mm 0.0035 to 0.0059 in. | | |
| | Exhaust | 0.08 to 0.14 mm 0.0031 to 0.0055 in. | 0.07 to 0.13 mm 0.0028 to 0.0051 in. | 0.08 to 0.15 mm 0.0035 to 0.0059 in. | 0.09 to 0.15 mm 0.0035 to 0.0059 in. | | |
| Valve opening/ closing timing (when cool) | Opening (before top dead center) | 58° to 70° | 70° to 84° | 25° to 39° | 62° to 78° | 64° to 81° | |
| | Intake Closing (after bottom dead center) | 98° to 110° | 138° to 152° | 54° to 61° | 102° to 116° | 138° to 152° | |
| | Opening (before bottom dead center) | 98° to 110° | 106° to 120° | 72° to 86° | 102° to 116° | 107° to 121° | |
| | Exhaust Closing (after top dead center) | 58° to 70° | 66° to 80° | 25° to 39° | 62° to 78° | 40° to 54° | |
| Valve Spring | Reference value | 30.8 to 31.3 mm 1.2126 to 1.2323 in. | 32.8 to 33.3 mm 1.291 to 1.311 in. | 21.2 to 21.8 mm 0.835 to 0.858 in. | 29.5 to 30.0 mm 1.161 to 1.181 in. | 32.8 to 33.3 mm 1.291 to 1.311 in. | |
| | Allowable limit | 30.5 mm 1.2008 in. | 32.5 mm 1.2795 in. | 19.9 mm 0.783 in. | 29.2 mm 1.150 in. | 32.5 mm 1.280 in. | |
| Free height | Reference value | 6.8 kgf/24.5 mm 15.0 lbs/0.9446 in. | 8.7 kgf/27.3 mm 19.2 lbs/1.0748 in. | 3.7 kgf/16 mm 8.2 lbs/0.6299 in. | 4.5 kgf/ 9.9 lbs/ | 7.6 kgf/ 16.8 lbs/ | |
| | Allowable limit | 6.1 kgf/24.5 mm 13.4 lbs/0.9646 in. | 7.8 kgf/27.3 mm 17.2 lbs/1.0748 in. | 3.3 kgf/16 mm 7.3 lbs/0.6299 in. | 4.1 kgf/ 9.0 lbs/ | 6.84 kgf/ 15.1 lbs/ | |
| Allowable squareness limit | | 1.5 mm 0.0591 in. | | | | | |
| Valve Seat | Reference value | 1.0 to 1.3 mm 0.0394 to 0.0512 in. | 0.6 to 0.8 mm 0.0236 to 0.0315 in. | 0.9 to 1.13 mm 0.0445 in. | 1.0 to 1.5 mm (1.13 mm) 0.0394 to 0.0591 in. (0.0445 in.) | | |
| | Allowable limit | 1.5 mm 0.0591 in. | 1.0 mm 0.0394 in. | 1.4 mm 0.0551 in. | 1.6 mm 0.0630 in. | | |

| Generator Set Model | | K1000 [K800] | K1400 [K1200] | K3500 [K3050] | K450 [K400] | K2100 [K1800] | K3000 [K2500] |
|---|--|--|------------------|------------------|----------------|------------------|------------------|
| Engine Model | | | | | | | |
| Item | | GS130 | | | | | |
| Tappet | Outer dia. | 5.968 to 5.980 mm 0.2350 to 0.2354 in. | | | | | |
| | Reference value | 7.96 to 7.975 mm 0.3134 to 0.3140 in. | | | | | |
| | Allowable limit | 0.025 to 0.060 mm 0.0010 to 0.0024 in. | | | | | |
| Rod/ler Arm | | — | | | | | |
| Clearance limit between arm and bushing | | — | | | | | |
| Camshaft | Gear side | 19.980 to 19.993 mm 0.7866 to 0.7871 in. | | | | | |
| | Flywheel side | 13.966 to 13.984 mm 0.5498 to 0.5506 in. | | | | | |
| | Clearance between camshaft and journal bearing (flywheel side) | 0.016 to 0.052 mm 0.0006 to 0.0020 in. | | | | | |
| Cam height | Intake | 24.65 mm 0.9705 in. | | | | | |
| | Exhaust | 24.65 mm 0.9705 in. | | | | | |
| | Allowable limit | 24.55 mm 0.9665 in. | | | | | |
| Allowable side clearance limit | Intake | 24.55 mm 0.9665 in. | | | | | |
| | Exhaust | 24.55 mm 0.9665 in. | | | | | |
| | Allowable limit | 24.55 mm 0.9665 in. | | | | | |
| Bending limit | | 0.02 mm 0.0009 in. | | | | | |
| Timing Gear | Reference value | 0.023 to 0.128 mm 0.0009 to 0.0050 in. | | | | | |
| | Allowable limit | 0.033 to 0.135 mm 0.0013 to 0.0053 in. | | | | | |
| | Backlash | 0.02 mm 0.0009 in. | | | | | |
| Cylinder | Reference value | 60.00 to 60.02 mm 2.3622 to 2.3701 in. | | | | | |
| | Allowable limit | 73.00 to 73.02 mm 2.8740 to 2.8748 in. | | | | | |
| | Inner dia. | Difference between max. and min. wear portions | | | | | |
| Piston | Min. clearance between cylinder and piston | 0.04 to 0.08 mm 0.0016 to 0.0031 in. | | | | | |
| | Outer dia. (skirt dia.) | 59.94 to 59.96 mm 2.3598 to 2.3606 in. | | | | | |
| | Piston Ring | Top and 2nd ring 0.25 to 0.45 mm 0.0098 to 0.0177 in. | | | | | |
| Gap | Reference value | 72.94 to 72.96 mm 2.8716 to 2.8724 in. | | | | | |
| | Allowable limit | Top and 2nd ring 0.2 to 0.4 mm 0.0079 to 0.0157 in. | | | | | |
| | Allowable limit | 3rd ring (oil ring) 0.2 to 0.4 mm 0.0079 to 0.0157 in. | | | | | |
| Allowable limit | | 0.15 to 0.35 mm 0.0059 to 0.0137 in. | | | | | |
| Allowable limit | | 0.05 mm 0.0196 in. | | | | | |

| Generator Set Model | | | | | | |
|--------------------------|--|--|--|--|--|--|
| Engine Model | | | | | | |
| Item | K1000 [K800] | K1400 [K1200] | K3500 [K3050] | K450 [K400] | K2100 [K1800] | K3000 [K2500] |
| Piston Ring | GS130 | | GS280 | GN550 | GN1850 | GN2500 |
| | Top and 2nd ring Reference value | | 0.02 to 0.06 mm 0.0008 to 0.0024 in. | 0.015 to 0.050 mm 0.0006 to 0.0019 in. | 0.02 to 0.06 mm 0.0008 to 0.0024 in. | 0.05 to 0.07 mm 0.0019 to 0.0028 in. |
| | Clearance between ring and ring groove (oil ring) | | 0.02 to 0.05 mm 0.0008 to 0.0020 in. | 0.010 to 0.045 mm 0.0004 to 0.0018 in. | 0.02 to 0.06 mm 0.0008 to 0.0024 in. | 0.02 to 0.06 in. 0.0008 to 0.0024 in. |
| Piston Pin | 0.1 mm 0.0039 in. | | | | | |
| | Outer dia. | 13.000 to 13.005 mm 0.5118 to 0.5120 in. | 18.000 to 18.005 mm 0.7087 to 0.7089 in. | 13.001 to 13.009 mm 0.5119 to 0.5121 in. | 15.000 to 15.005 mm 0.5906 to 0.5907 in. | 16.495 to 16.500 mm 0.6494 to 0.6496 in. |
| Connecting Rod Small-end | Inner dia. | 13.015 to 13.025 mm 0.5124 to 0.5128 in. | 18.015 to 18.025 mm 0.7093 to 0.7096 in. | 13.025 to 13.035 mm 0.5128 to 0.5132 in. | 15.015 to 15.025 mm 0.5911 to 0.5915 in. | 16.510 to 16.528 mm 0.6500 to 0.6507 in. |
| | Clearance between small-end and piston pin | 0.010 to 0.025 mm 0.0004 to 0.0010 in. | | 0.026 to 0.046 mm 0.0010 to 0.0018 in. | 0.015 to 0.030 mm 0.0006 to 0.0012 in. | 0.010 to 0.033 mm 0.0004 to 0.0013 in. |
| Connecting Rod | Allowable limit | 0.1 mm 0.0039 in. | | 0.08 mm 0.0031 in. | 0.1 mm 0.0039 in. | |
| | Bending limit | 0.04 mm 0.0016 in. | | 0.02 mm 0.0008 in. | | |
| Torsion limit | 0.04 mm 0.0016 in. | | | | | |
| | Bolt tightening torque | 9.8 to 13.7 Nm 1.0 to 1.4 kgf-m 7.2 to 10.1 ft-lbs | 16.7 to 22.6 Nm 1.7 to 2.3 kgf-m 12.3 to 16.6 ft-lbs | 3.9 to 5.9 Nm 0.4 to 0.6 kgf-m 2.9 to 4.4 ft-lbs | 13.7 to 19.6 Nm 1.4 to 2.0 kgf-m 10.1 to 14.5 ft-lbs | 16.7 to 22.6 Nm 1.7 to 2.3 kgf-m 12.3 to 16.6 ft-lbs |
| Crankshaft | Pin dia. | 23.967 to 23.982 mm 0.9436 to 0.9442 in. | 29.967 to 29.982 mm 1.1798 to 1.1804 in. | 17.973 to 17.984 mm 0.7076 to 0.7080 in. | 25.467 to 25.482 mm 1.0026 to 1.0032 in. | 26.967 to 26.982 mm 1.0617 to 1.0622 in. |
| | Wear limit | 23.92 mm 0.9417 in. | 29.92 mm 1.1780 in. | 17.92 mm 0.7055 in. | 25.4 mm 1.00 in. | 26.9 mm 1.059 in. |
| | Reference value | 0.018 to 0.054 mm 0.0007 to 0.0021 in. | | 0.016 to 0.045 mm 0.0006 to 0.0018 in. | | |
| Crank pin oil clearance | Allowable limit | 0.1 mm 0.0039 in. | | | | |
| | Journal dia. | 19.980 to 19.993 mm 0.7866 to 0.7871 in. | Gear side 29.984 to 29.993 mm 1.1805 to 1.1808 in. Flywheel side 24.984 to 24.993 mm 0.9836 to 0.9840 in. | 17.983 to 17.984 mm 0.70799 to 0.70803 in. | 23.967 to 23.982 mm 0.9436 to 0.9442 in. | 26.967 to 26.982 mm 1.0617 to 1.0623 in. |
| Side clearance | Wear limit | 19.9 mm 0.7835 in. | 29.9 mm, 24.9 mm 1.1772 in., 0.9803 in. | 17.9 mm 0.7047 in. | 23.9 mm 0.9409 in. | 26.9 mm 1.0591 in. |
| | Reference value | 0.02 to 0.10 mm 0.0008 to 0.0039 in. | | | | |
| Bending limit | Allowable limit | 0.2 mm 0.0079 in. | | | | |
| | | 0.02 mm 0.0008 in. | | | | |
| Axial play | Reference value | 0 to 0.1 mm 0 to 0.0039 in. | | | | |
| | Allowable limit | 0.2 mm 0.0079 in. | | | | |

| Generator Set Model | | K1000 [K800] | K1400 [K1200] | K3500 [K3050] | K450 [K400] | K2100 [K1800] | K3000 [K2500] |
|---------------------|-------------------|--|--|--|--|--|------------------|
| Engine Model | | | | | | | |
| Item | | GS130 | | | | | |
| Flywheel | Deflection limit | 0.1 mm 0.0039 in. | | | | | |
| | Tightening torque | 29.4 to 44.1 Nm 3.00 to 4.50 kgf·m 21.7 to 32.5 ft-lbs | 63.7 to 73.5 Nm 6.50 to 7.50 kgf·m 47.0 to 54.2 ft-lbs | 19.6 to 24.5 Nm 2.00 to 2.50 kgf·m 14.5 to 18.1 ft-lbs | 51.0 to 70.1 Nm 5.20 to 7.15 kgf·m 37.6 to 51.7 ft-lbs | 58.8 to 64.7 Nm 6.00 to 6.60 kgf·m 43.4 to 47.7 ft-lbs | |
| Ignition Plug | Standard Gap | 0.6 to 0.7 mm 0.236 to 0.276 in. | | | | | |
| | Carburetor | 0.9 to 1.0 mm 0.0354 to 0.0394 in. | | | | | |
| Pilot screw opening | | 1-3/8 turn | 1-1/4 turn | 1 turn | 1-1/4 turn | 1-1/4 turn | |

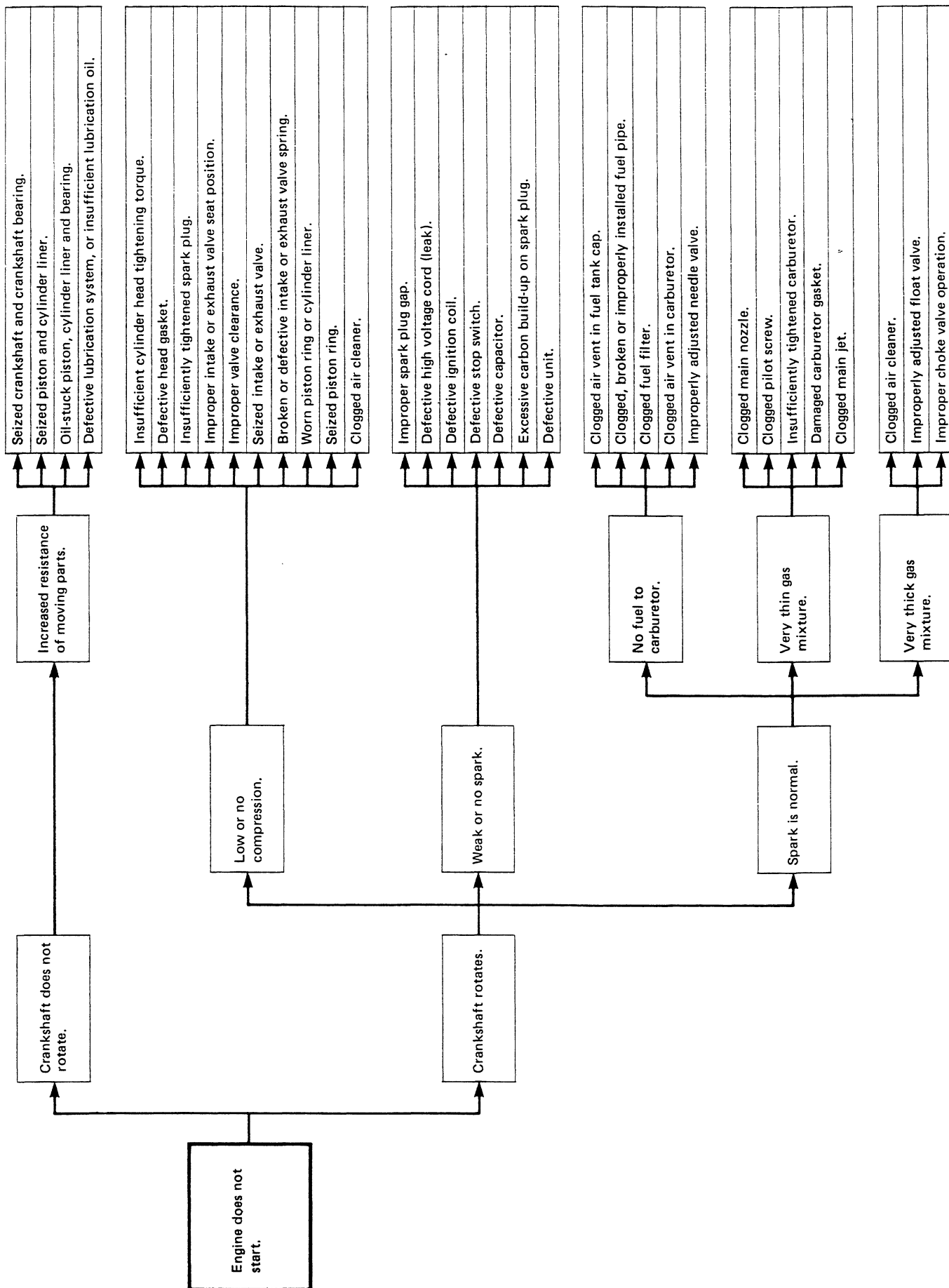
BOLT TORQUES

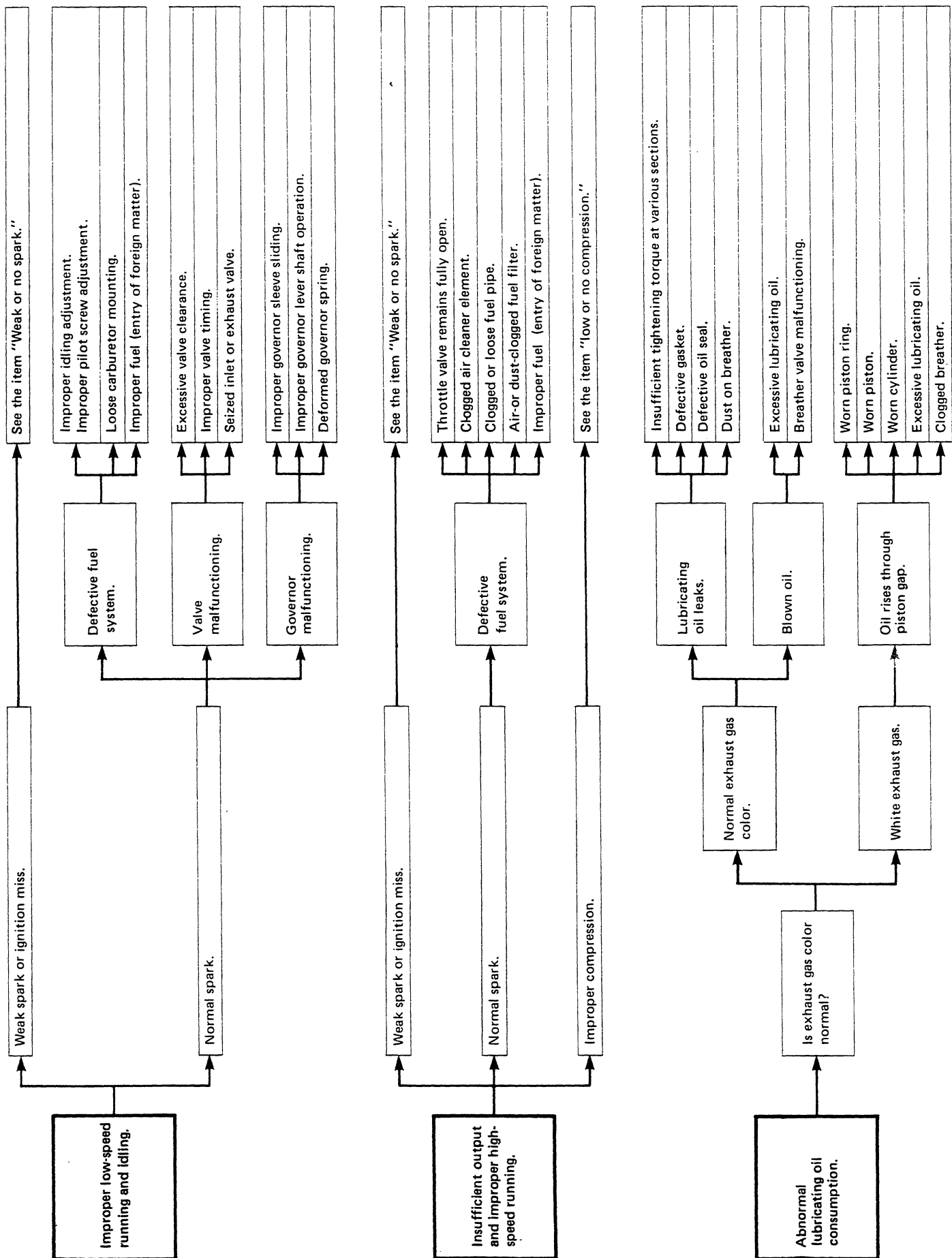
| Material Grade Nominal Dia. | Standard Bolt | Special Bolt | Special Bolt |
|------------------------------------|--|--|--|
| | SS41, S20C | S43C, S48C (Refined) | SCr435, SCM435 (Refined) |
| M 6 | 7.8 – 9.3 N·m 0.80 – 0.95 kgf·m 5.8 – 6.9 lb.ft. | 9.8 – 11.3 N·m 1.00 – 1.15 kgf·m 7.2 – 8.3 lb.ft. | 12.3 – 14.2 N·m 1.25 – 1.45 kgf·m 9.0 – 10.5 lb.ft. |
| M 8 | 17.7 – 20.6 N·m 1.80 – 2.10 kgf·m 13.0 – 15.2 lb.ft. | 23.5 – 27.5 N·m 2.40 – 2.80 kgf·m 17.4 – 20.3 lb.ft. | 29.4 – 34.3 N·m 3.00 – 3.50 kgf·m 21.7 – 25.3 lb.ft. |
| M10 | 39.2 – 45.1 N·m 4.00 – 4.60 kgf·m 28.9 – 33.3 lb.ft. | 48.0 – 55.9 N·m 4.90 – 5.70 kgf·m 35.4 – 41.2 lb.ft. | 60.8 – 70.6 N·m 6.20 – 7.20 kgf·m 44.8 – 52.1 lb.ft. |
| M12 | 62.8 – 72.6 N·m 6.40 – 7.40 kgf·m 46.3 – 53.5 lb.ft. | 77.5 – 90.2 N·m 7.90 – 9.20 kgf·m 57.1 – 66.5 lb.ft. | 103.0 – 117.7 N·m 10.50 – 12.00 kgf·m 75.9 – 86.8 lb.ft. |
| M14 | 107.9 – 125.5 N·m 11.00 – 12.80 kgf·m 79.6 – 92.6 lb.ft. | 123.6 – 147.1 N·m 12.60 – 15.00 kgf·m 91.1 – 108.5 lb.ft. | 166.7 – 196.1 N·m 17.00 – 20.00 kgf·m 123.0 – 144.7 lb.ft. |
| M16 | 166.7 – 191.2 N·m 17.00 – 19.50 kgf·m 123.0 – 141.0 lb.ft. | 196.1 – 225.5 N·m 20.00 – 23.00 kgf·m 144.7 – 166.4 lb.ft. | 259.9 – 304.0 N·m 26.50 – 31.00 kgf·m 191.7 – 224.2 lb.ft. |
| M18 | 245.2 – 284.4 N·m 25.00 – 29.00 kgf·m 180.0 – 209.8 lb.ft. | 274.6 – 318.7 N·m 28.00 – 32.50 kgf·m 202.5 – 235.1 lb.ft. | 343.2 – 402.0 N·m 35.00 – 41.00 kgf·m 253.2 – 296.5 lb.ft. |
| M20 | 333.4 – 392.2 N·m 34.00 – 40.00 kgf·m 245.9 – 289.3 lb.ft. | 367.7 – 431.5 N·m 37.50 – 44.00 kgf·m 271.2 – 318.2 lb.ft. | 490.3 – 568.7 N·m 50.00 – 58.00 kgf·m 361.6 – 419.5 lb.ft. |

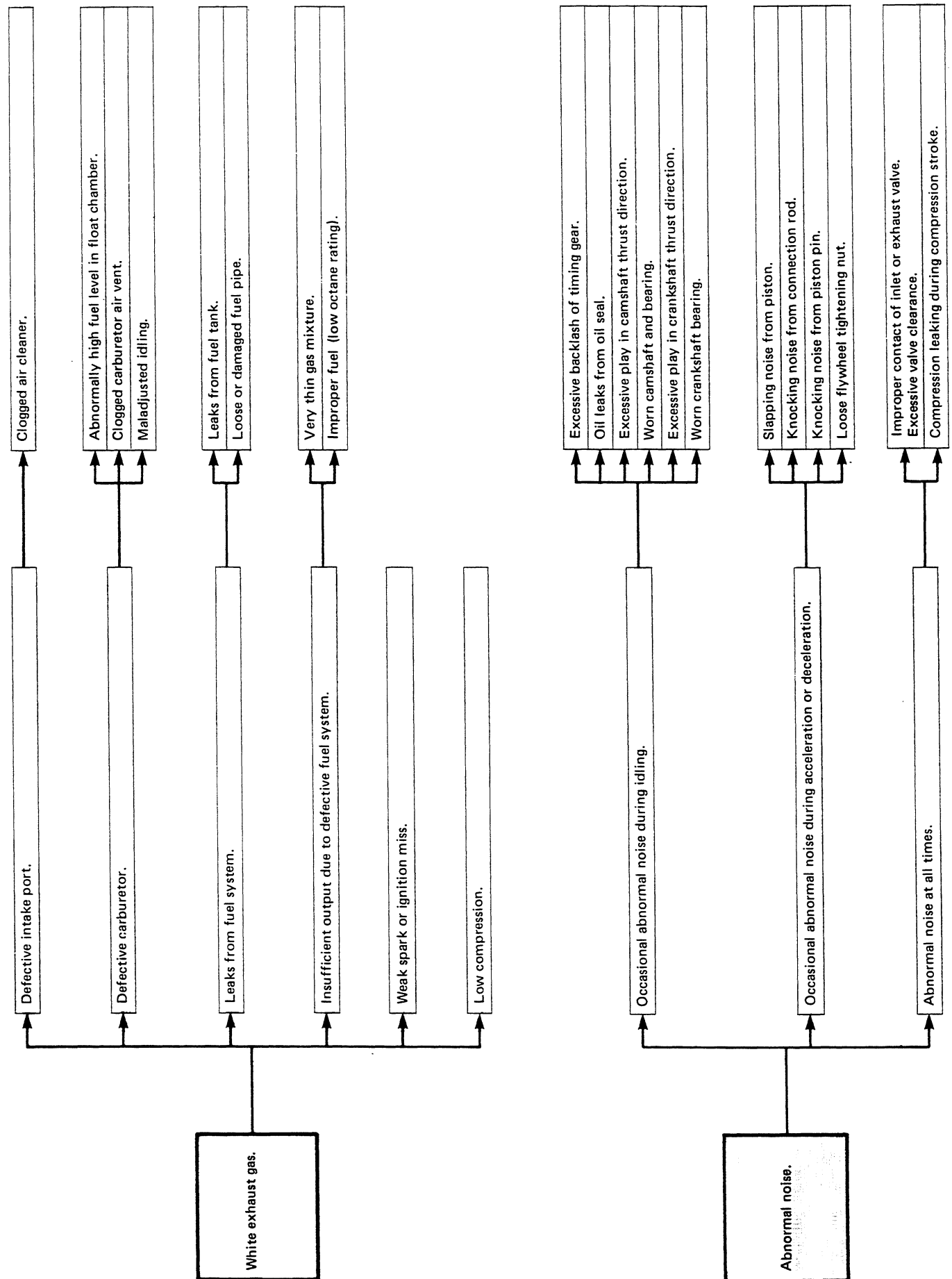
Bolt material grades are shown by numbers punched on the bolt heads. Prior to tightening, be sure to check out the numbers as shown below:

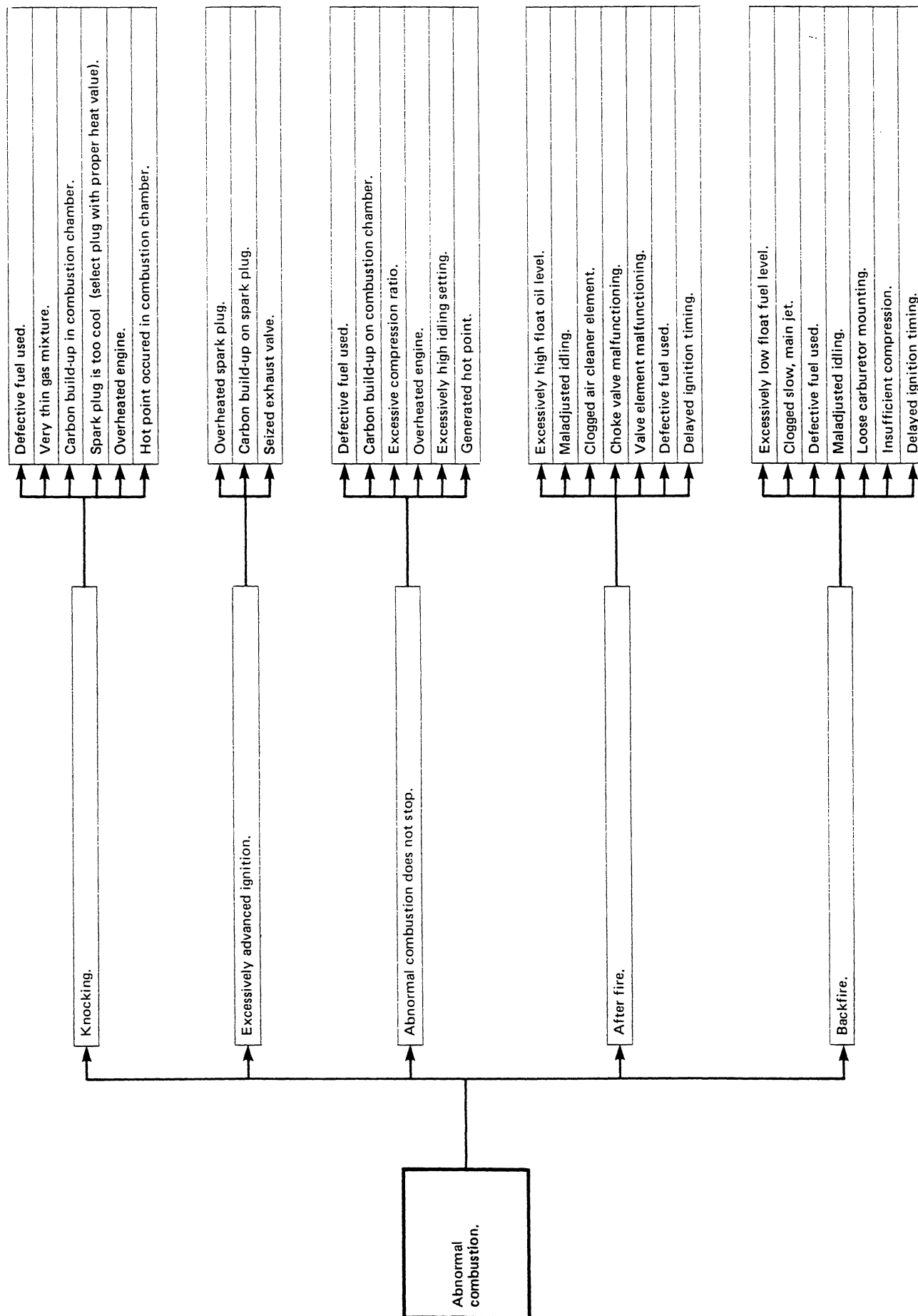
| Punched Number | Bolt Material Grade |
|----------------|---|
| None | Standard Bolts SS41, S20C |
| 7 | Special Bolts S43C, S48C (Refined) |
| 9 | Special Bolts SCM435, SCr435 (Refined) |

ENGINE TROUBLESHOOTING











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