ISUZU

Bellett

ELECTRICAL SYSTEM

ENGINE SERIES

PART 10

INTRODUCTION

ISUZU MOTORS LIMITED

TOKYO, JAPAN

PART 10 ELECTRICAL SYSTEM

CONTENTS

PART 10 ELECTRICAL SYSTEM

10-1 ALTERNATOR (HITACHI)

The model LT 123-16 is a 3-phase alternator comprises a rotor with the field coil and is not equipped with a commutator. The alternator is provided with a silicone diode which serves to rectify the current generated by the alternator automatically. It has been skillfully designed to provide maximum of service life with the minimum of maintenance. Compactly built alternator readily provides the stabilized charging current in various operating conditions from low-speeds to high-speeds and hence, it is best suited for use in automobiles subjected to stop-and-go operation. Fig. 10-1 illustrates the external view of the alternator model LT 123-16.

LT 123-16 ALTERNATOR AND TLIZ-08 VOLTAGE REGULATOR

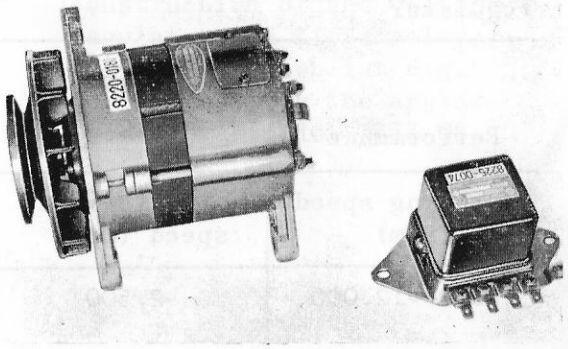


Fig. 10-1

10-1-1 Specifications

The alternator is used in combination with a tirril type voltage regulator, the details of which are given below.

Specifications

Parts name	Type	Battery voltage (V)	Ground polarity	Output	Weight (kg)	Remarks
AC Alternator	LT123-16	12	-	300W	5.3	Clockwise rotation as viewed from the side of the pulley
Voltage regulator	TLIZ-08	12	-	Above 23A	0.5	

Performance

Operating speed (rpm)	Rated rotating speed (rpm)	Non-load voltage (V)	Output current (A)
1,000~12,000	2,500	14 ± 0.5 (at 2,500 rpm)	Above 23 (at 2,500 rpm with the voltage held to 13V)

Note: The output speed characteristic curve is shown in Fig. 10-2.

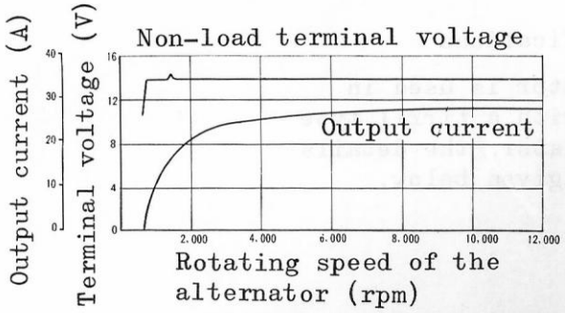


Fig. 10-2

10-1-2 Construction

(1) Alternator

The construction of the alternator model LT 123-16 is illustrated in Fig. 10-6. The alternator comprises a rotor, a stator, a front cover, a rear cover and a pulley. The rear cover is provided with six (6) silicone diodes which serves to rectify the current generator by the alternator to DC.

(2) Voltage regulator

The voltage regulator serves to control the voltage generated by the alternator and holds it in constant irrespective of the travel speed of automobile. The Bellett engine is equipped with a tirril type voltage regulator having a pair of contact points as illustrated in Fig. 10-3. The model TLIZ-08 voltage regulator is provided with a field relay. Figs. 10-3 and 10-4 illustrate the construction of the voltage regulator and field relay, respectively, whilst Fig. 10-5 is showing the appearance of the model TLIZ-08.

Construction of the voltage regulator

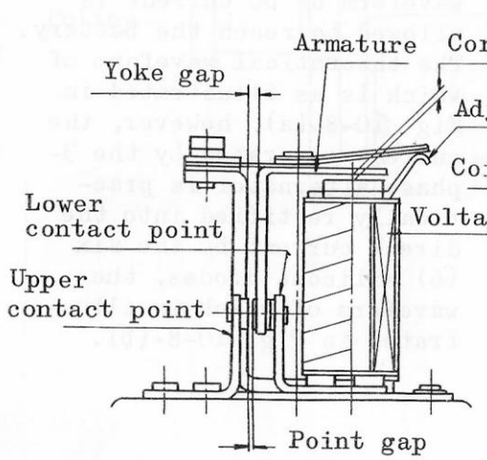


Fig. 10-3

Construction of the field relay

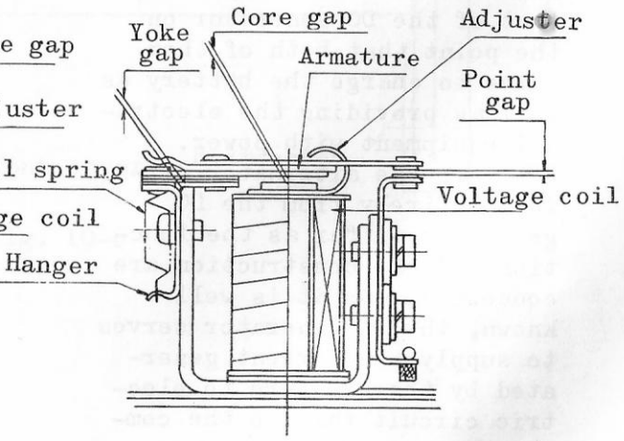


Fig. 10-4

Voltage regulator
model TLIZ-08

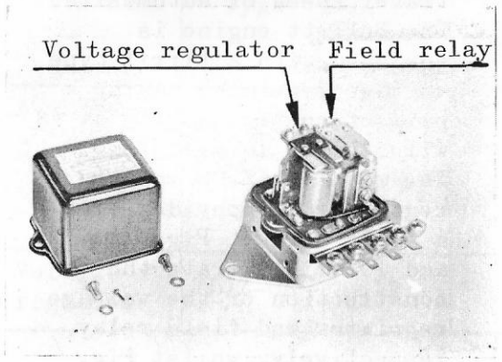


Fig. 10-5

10-1-3 Function and operating principle

(1) Alternator

The operation of the alternator is substantially same to that of the DC generator on the point that both of them serve to charge the battery as well as providing the electrical equipment with power. However, the alternator differs entirely from the DC generator as far as the function and the construction are concerned. As it is well known, the DC generator serves to supply the current generated by the armature to electric circuit through the commutator and carbon brushes, whereas, in the alternator, the magnet is excited through the slip ring and rotated to induce the current in the stator coil held statically around the rotor, the operating principle of which is illustrated in Fig. 10-7.

The conductors C. and C' would on the stator are held statically and the rotor provided with N. and S. is rotated in direction indicated by an arrow marking. As the rotor is turned, the current induced flows through the conductor in a direction indicated by arrow and reaches the battery via the diode. When the rotor is turned half a way, the induced current tends to flow in a counter-clockwise direction as represented by the dotted line in Fig. 10-7-(b) in the conductor, however, it is held from flowing in a reverse direction by the inherent characteristic of the diode and thus, only the rectified current having the waveform of DC current is allowed to reach the battery. The theoretical waveform of which is as illustrated in Fig. 10-8-(a), however, the current generated by the 3-phase alternator is practically rectified into the direct current by the six (6) silicone diodes, the waveform of which is illustrated in Fig. 10-8-(b).

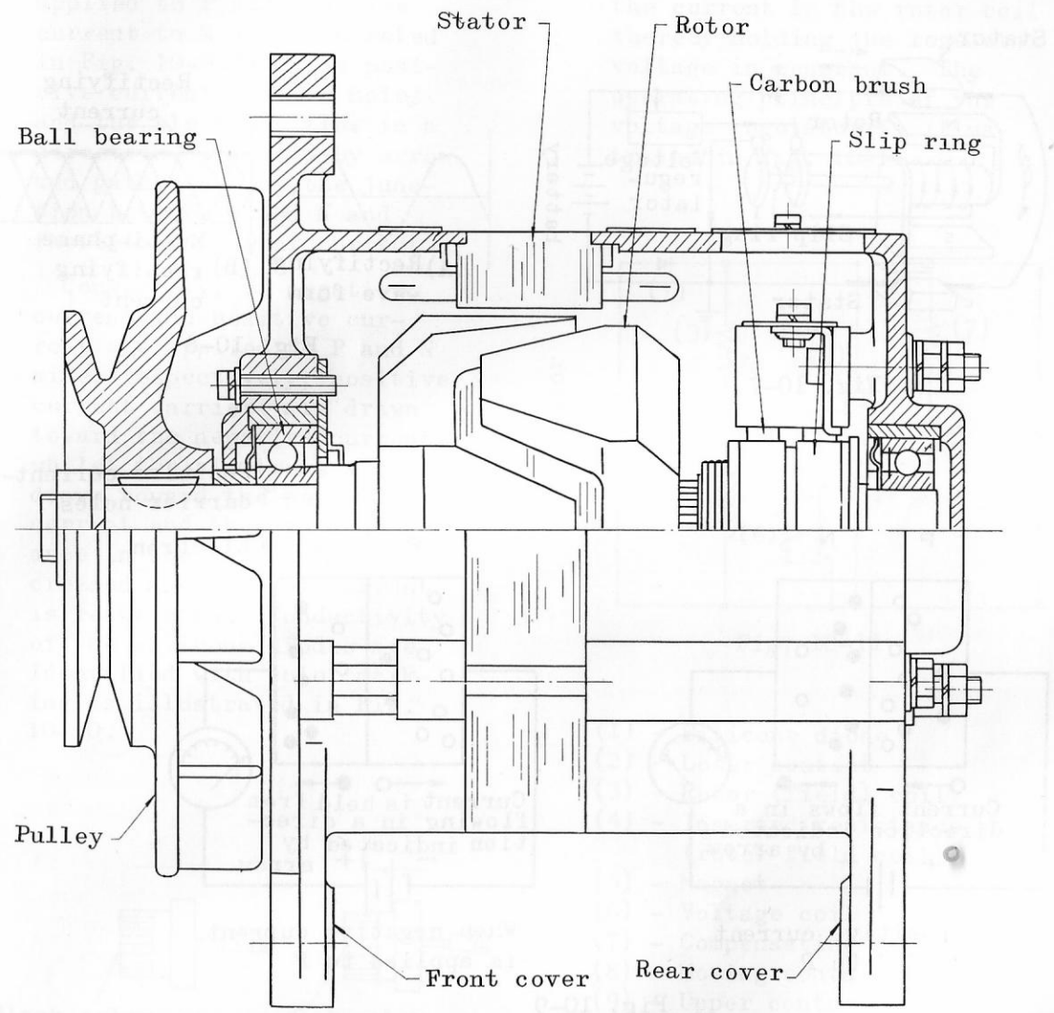


Fig. 10-6

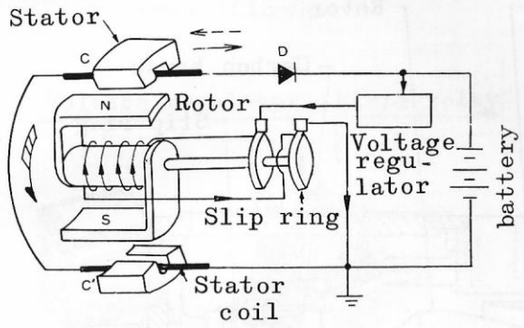


Fig. 10-7

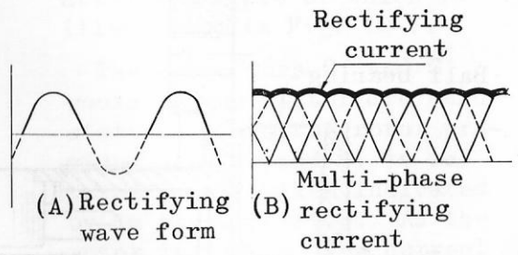


Fig. 10-8

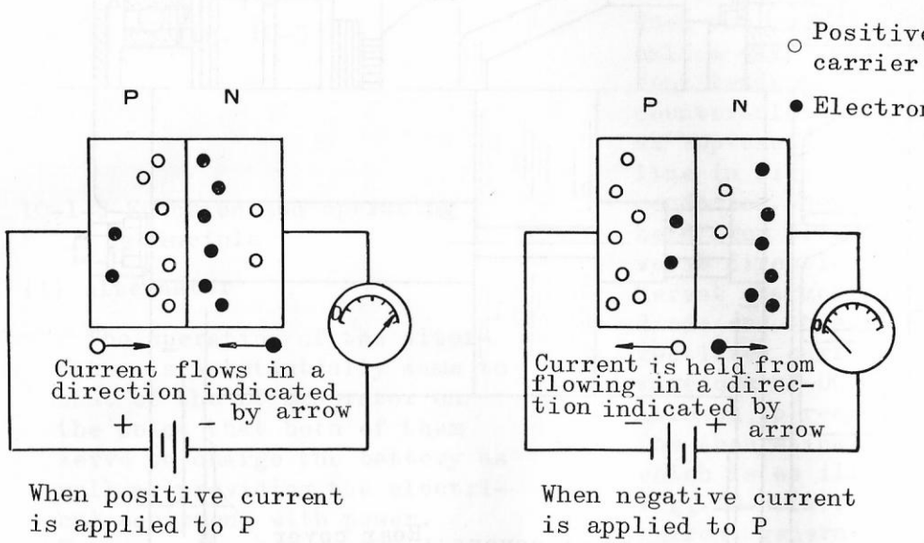


Fig. 10-9

(2) Silicone diode

The silicone diode has an inherent characteristic that it permits the current to flow therethrough in a certain direction but blocks the current which tends to flow in reverse direction and thus, it serves as an ordinary cut-out relay. As may be understood from Fig. 10-9, the silicone diode comprises a P-type semi-conductor having positive current-carrier holes and N-type semi-conductor having negative current-carrier electrons.

When positive current is applied to P and negative current to N as illustrated in Fig. 10-9-(a), the positive current-carrier holes and the electrons flow in a direction indicated by arrow and gather around the junction between P and N and facilitate flow of current.

Conversely, if negative current and positive current are applied to P and N side, respectively, positive current carriers are drawn toward the negative current whilst the electrons are drawn toward the positive current and thus the resistance in the junction is increased and flow of current is restricted. Conductivity of the silicone diodes are identified with color marking as illustrated in Fig. 10-10.

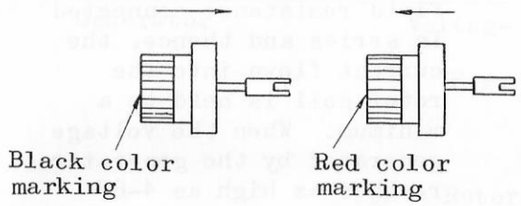


Fig. 10-10

(3) Voltage regulator

The voltage regulator comprises a rotor coil (field coil) having a resistance RF inserted in series thereto through a contact which serves to cut-in and out the resistance RF for controlling the current in the rotor coil thereby holding the regulator voltage in constant. The operating principle of the voltage regulator is illustrated in Fig. 10-11.

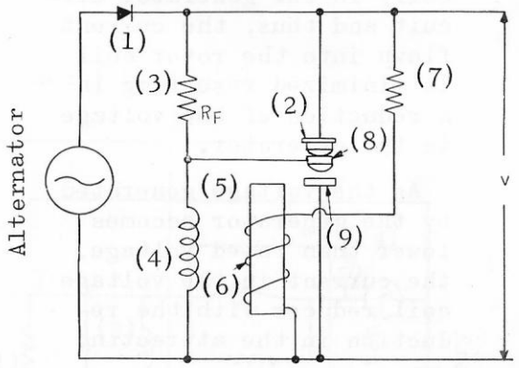


Fig. 10-11

(1) - Silicone diode
(2) - Lower contact
(3) - Rotor (field) coil
(4) - Inserted resistance (rotor field coil)
(5) - Magnet
(6) - Voltage coil
(7) - Compensating resistance
(8) - Moving contact
(9) - Upper contact

1) When the voltage in the generator increases beyond the rated voltage, the force of the magnet in the regulator overcomes the tensile force of the spring and attract the armature as the voltage coil in the voltage regulator is provided with

the current proportional to the voltage generated by the generator. When the armature is attracted by the magnet, the moving contact releases from the lower contact thereby inserting the resistance RF into the rotor coil (field coil) in the generator circuit and thus, the current flown into the rotor coil is minimized resulting in a reduction of the voltage in the generator.

As the voltage generated by the generator becomes lower than rated voltage, the current in the voltage coil reduces with the reduction in the attracting force of the magnet. Thus, the armature is released from the magnet by the tensile force of the return spring and brings the moving contact into engagement with the lower contact. Then, the resistance RF is short-circuitted with the result of increased current in the rotor coil and the voltage in the generator being allowed to increase. When the rotation of the generator is not sufficiently high or it is subjected to excess load, this operation is automatically repeated to hold the voltage constant.

2) When the rotation of the generator further increases, the voltage is allowed to increase irrespective of the resistance RF inserted as the capacity of the resistance is considerably small. Thus, the current in the voltage coil also increases and strongly attracts the armature and closes the moving contact and upper contact. Thence, the rotor coil is short-circuitted and the voltage in the generator circuit is reduced. When the generator is rotated at high speeds, this operation is repeated to hold the voltage from being increased.

3) Field relay

The field relay serves to minimize the current flown into the rotor coil when the ignition key is held turned on whilst the engine operation is stopped. As the contact points of the field relay are held open whilst the generator is not operated, the rotor coil is provided with the field resistance connected in series and thence, the current flown into the rotor coil is held to a minimum. When the voltage generated by the generator reaches as high as 4-6V when measured at N terminal, the field relay points are held closed putting the rotor coil circuit back into normal operating condition.

10-1-4 Connection

The internal connections of the generator, regulator and their associated parts are illustrated in Fig. 10-12 while the method of connection for adjustment is illustrated in Fig. 10-13. All the terminals should be tightly fastened to their corresponding leads noting their marks.

Connections (for generator model LT123-16)

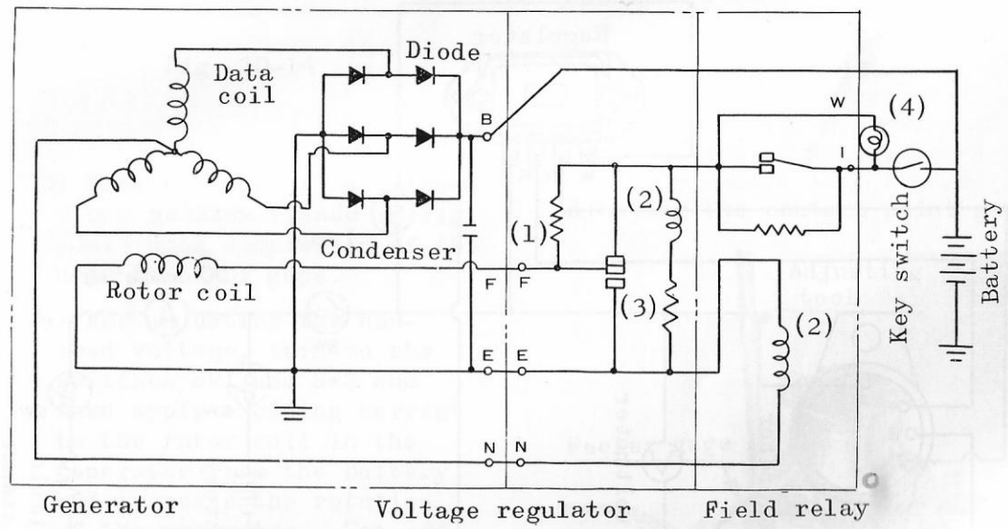


Fig. 10-12

(1) - Rotor coil inserting resistance
(2) - Voltage coil
(3) - Compensating resistance
(4) - Charge warning lamp

10-1-5 Adjusting method

(1) Voltage regulator

The voltage regulator should be adjusted in the following manner with the aid of DC voltmeter, ammeter and tachometer.

1) Dismantle the regulator from the automobile and check the contact points for fouling. The contaminated contact points may be cleaned and rectified with use of fine abrasive paper.

Connections for adjustment
(for model TLIZ-08)

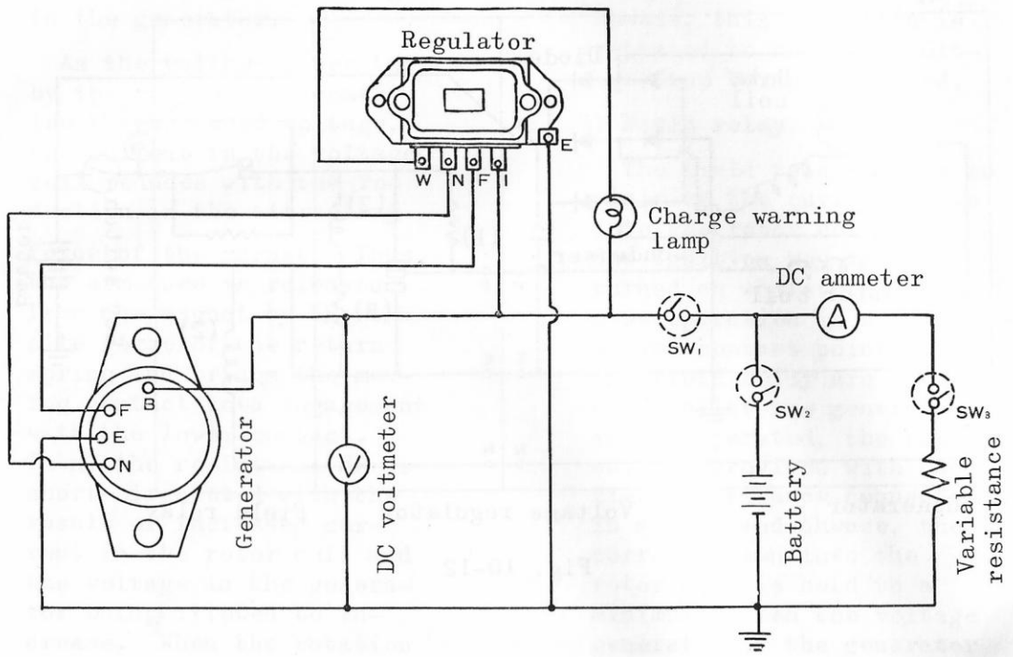


Fig. 10-13

2) Check the point gaps and if necessary adjust them according to "maintenance Standard" (See Figs. 10-14 through 10-16). The adjustment should be made in the sequence of Yoke gap, core cap and point gap.

Measuring the yoke gap

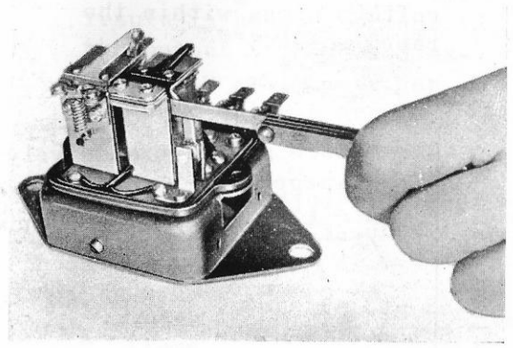


Fig. 10-14

Adjusting the core gap

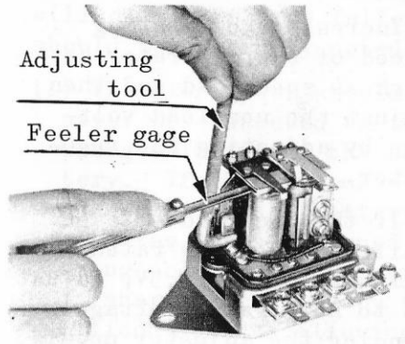


Fig. 10-15

3) Make the necessary connections as illustrated in Fig. 10-13 upon completion of the adjustment of gaps.

4) For adjusting the non-load voltage, turn-on the switches SW1 and SW2 and then apply exciting current to the rotor coil in the generator from the battery and increase the rotation of the generator. Cut-off the switch SW1 when the rotation of the generator increases as high as about 1,000 rpm. (Also cut-off the switches SW2 and SW3).

Note: For DC generator, the output voltage increases with the increase in the rotating speed of the generator but, for alternator, the voltage fails to increase as rated unless the rotor coil is initially excited by the

Adjusting the contact point gap

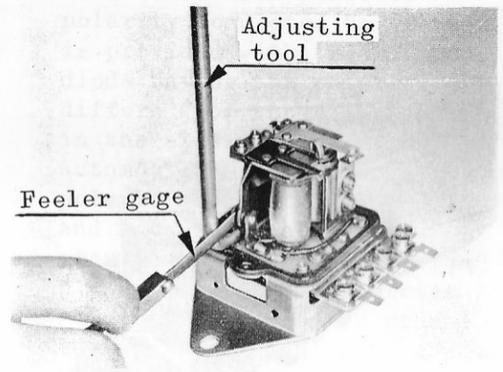


Fig. 10-16

current supplied from the battery. When the generator is once brought into a stop and again operated, the switch SW1 should be turned-on and turned-off after the generator started gener-

ating the rated current, then check the non-load voltage.

5) Increase the rotating speed of the generator as high as specified and then adjust the non-load voltage by adjusting the regulator.

6) If the non-load voltage fails to meet the rated value which is 13.5V, adjust it to hold rated voltage by bending the adjuster upward.

7) If the non-load voltage is in excess of rated voltage of 14.5V, bring it down to rated level by bending the adjuster downward. (See Fig. 10-17)

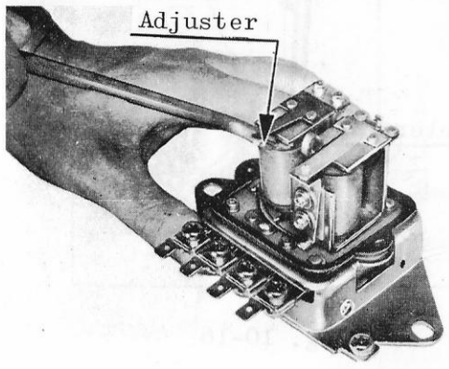


Fig. 10-17

8) The above adjustments will suffice the necessary adjustment required on the voltage regulator, but to make sure that it is properly adjusted, bring the generator to a full stop and again operate it at rated speed and check to see if the output voltage comes within the rated value.

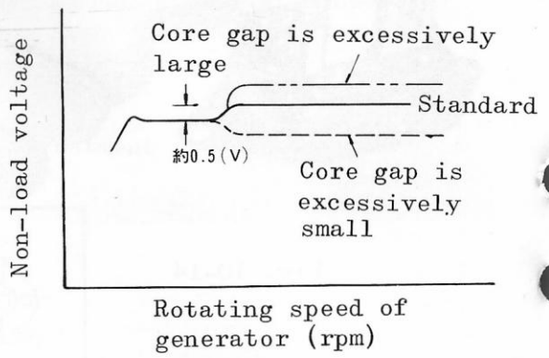


Fig. 10-18

9) When the generator is properly adjusted, the output voltage becomes as illustrated in Fig. 10-18.

The output voltage tends to vary when the rotating speed of the generator increases and the operation of the contact is shifted from lower contact to upper but this is not detrimental to normal charging operation. The adjustment should preferably be made in such a manner that the output voltage increases by some 0.5V when the rotating speed of the generator is increased.

10) If the output voltage increases beyond 0.5V or tends to drop when the generator rotating speed is increased recheck and adjust the core gap. Excessively large core gap will result in undue increase in the output voltage and excessively small core gap leads to voltage drop.

(2) Field relay

1) Check and adjust the gap with reference to subparagraph (1)-1) and 2).

2) Apply voltage to the regulator terminals N and E, and check the armature attracting voltage.

3) If the armature attracting voltage is maladjusted, readjust it by adjusting the tension of the coil spring as illustrated in Fig. 10-19.

Adjusting the armature attracting voltage of the field relay

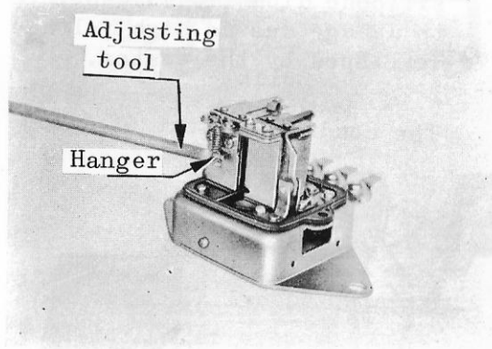


Fig. 10-19

10-1-6 Cautions for handling

As the alternator comprises silicone diode, the following should be carefully noted.

(1) The alternator should never be connected to the wrong polarity of the battery. If the alternator is connected to the battery with the leads fastened to wrong polarity, the battery is short-circuitted by the silicone diodes allowing excessive current to flow through the alternator and results in damaged silicone diode and burnt-down wire harnesses.

Alternators for use in automobile with positive polarity connected to ground is provided with the silicone diode having the polarity differs from those installed in the alternators for use in automobile with the negative polarity connected to ground and hence, the alternator provided with identification plate in which the positive polarity connected to ground is specified should be prepared for use in automobile with positive polarity connected to ground.

(2) The terminals should be properly connected to their corresponding leads.

(3) Avoid rotating the alternator at high speed with the terminal B disconnected, as the silicone diodes may be damaged by the high tension generated by the alternator.

(4) Disconnect the terminal B from the alternator, before the battery is connected to the battery charger for recharging.

10-1-7 Inspecting

(1) The alternator should be mounted securely in position with the nuts and bolts. The fan belt tension should be properly adjusted to give extended service life to the fan belt and the ball bearing in the alternator. When the fan belt gives lateral deflection of about 20mm on its longest portion when depressed by the finger, the fan belt tension may be regarded as normal.

(2) Check the carbon brush in the brush holder for operating failure and fouling after every 6,000 km of travel distance and make necessary cleaning or rectification. The slip ring should also be checked and cleaned after every 6,000 km of travel.

(3) Check the regulator for non-load voltage after every 12,000 km of travel distance and adjust it in the manner introduced in the foregoing paragraph if the voltage is less than 13.5V.

(4) The alternator is provided with ball bearing which does not often require lubrication. It is recommended that the ball bearings should be checked after every 24,000 km of travel distance and replenished with "HITACHI generator grease" if necessary.

(5) Wear of the carbon brushes is considerably small when compared with ordinary DC generator but they should be regarded due for replacement if their length is less than 6.5mm.

(6) Failure of the silicone diode may be checked in the following manner. Disconnect the lead from the stator coil in the alternator from the silicone diode and check the conductivity of the silicone diode both in positive and negative direction with use of a tester. If the test results show that the diode has good conductivity in the positive direction, the diode may be regarded as normal.

Note: The use of Megger should be definitely avoided for the silicone diode is susceptible to damage due to high voltage developed by the tester.

The conduction test of diode

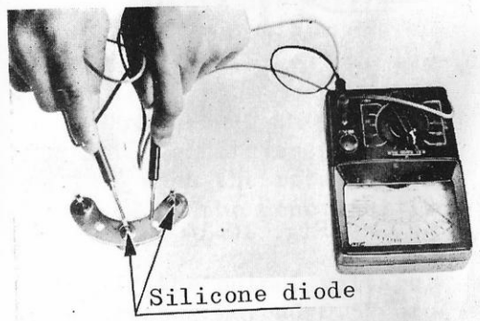


Fig.10-20

(7) The rotor coil should be checked for insulation. The tester may be connected between the slip ring and the shaft or the core to see if conduction takes place. If so, it is that the slip ring or the coil is grounded. (See Fig. 10-21) If conduction does not takes place between two slip rings, the coil is disconnected. For its resistance, refer the paragraph "Maintenance Standard".

The earth test of rotor coil

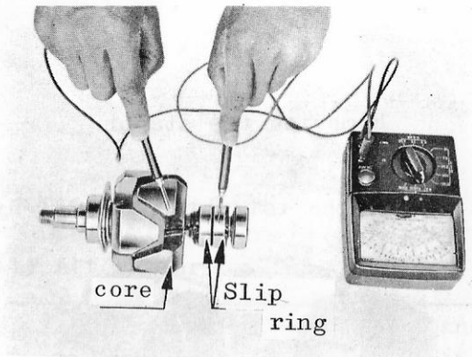


Fig. 10-21

(8) The stator coil should be checked for proper connection. Conduction test may be made between the stator coil and the core, and if conduction takes place, the coil is grounded. If the conduction does not takes place between the three terminals, the trouble may be regarded to disconnection.

(9) If the capacity gage is not available, the condenser may be tested in the following manner. Shift the dial on the tester to the range for measuring large capacity and check the gage pointer. If the pointer of the tester deflects and gradually moves to the extreme and of the division in which the capacity increases to maximum, the condenser may be regarded as normal. If the pointer is held deflecting or held still, the condenser should be replaced.

10-1-8 Dismantling and reassembling

The alternator should be disassembled in the following manner.

Removing the pulley

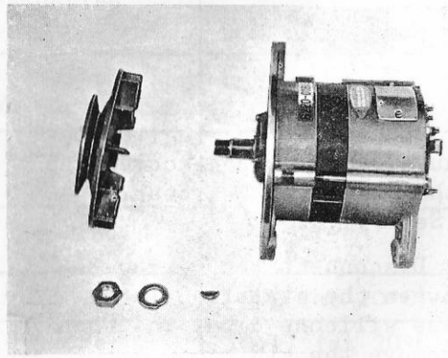


Fig. 10-22

(1) Remove the pulley clamping nut and then remove the pulley. Remove the brush cover on the rear cover and take out the brush. (See Fig. 10-22)

(2) Remove the through bolts and then remove the front cover. (See Fig. 10-23)

Removing the front cover

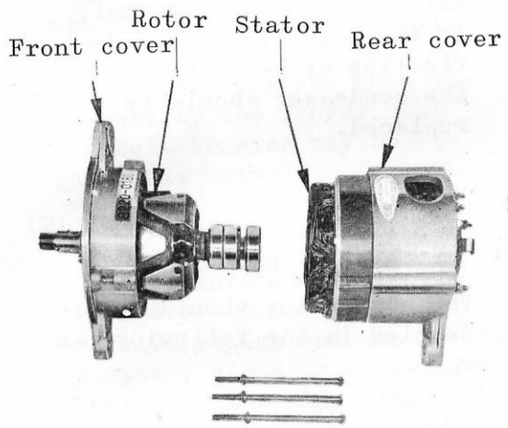


Fig. 10-23

(3) Remove the bearing retainer nut from the front cover and then, remove the rotor. (See Fig. 10-24)

(4) Disconnect the wiring between the stator coil and the silicone diode and then remove the stator and rear cover (See Fig. 10-26)

Removing the rotor

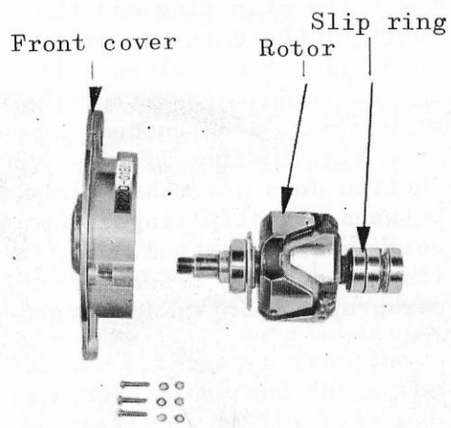


Fig. 10-24

Removing the stator

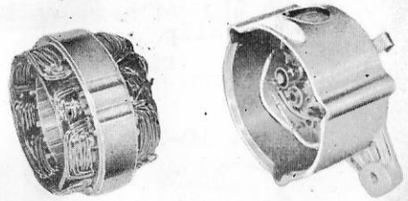


Fig. 10-25

(5) The alternator may be reassembled in the sequence converse to dismantling.

Operation of the carbon brushes and thrust on the rotor should be carefully checked before the component parts are put together.

Parts of the alternator as dismantled

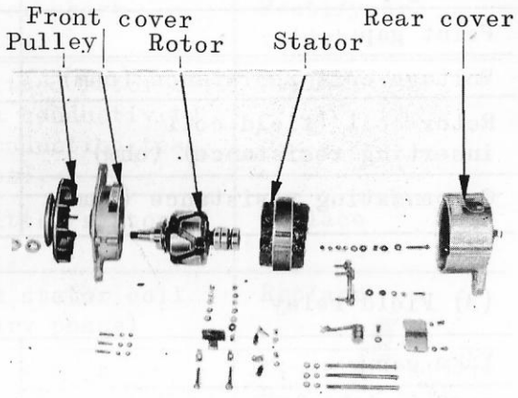


Fig. 10-26

10-1-9 Standards for correction and repair

(1) Alternator

All the values are given in the metric system

Carbon brush		Standard height Limit of reduction in height	14.5 5
Brush spring		Standard tensile strength (kg)	0.3
Shaft	Front side	Standard measurement of bearing	17ø 6203ZN
	Rear side	Standard measurement of bearing	15ø 6202ZN
Rotor coil (field coil) resistance value (ohm)			5.2 (at 20°C)
Stator coil resistance value (single phase)			0.17 (at 20°C)

(2) Regulator	All the values are given in the metric system
Yoke gap	0.9~1.0
Core gap	0.8~1.2
Point gap	0.4~0.5
Voltage coil resistance (ohm)	9.9 (at 20°C)
Rotor coil (field coil inserting resistance) (ohm)	10
Compensating resistance (ohm)	25

(3) Field relay	All the values are given in the metric system
Yoke gap	0.2
Core gap	0.5~0.6
Point gap	0.4~0.5
Attracting voltage (V)	4 6 (Terminal A)
Field resistance (ohm)	18
Voltage coil resistance (ohm)	21.7 (at 20°C)

10-1-10 Alternator trouble-shooting

(1) Charging current is not generated

Trouble	Cause	Correction
Wiring and ammeter	Disconnection, short-circuitted or loosened connection	Rectify or replace
Generator (Alternator)	1. Coils disconnected, short-circuitted or grounded	Replace
	2. Terminal short-circuitted	Rectify
	3. Faulty silicone diode	Replace
	4. Faulty condenser	Replace
Regulator	1. Short-circuitted or disconnected lead wire	Rectify or replace
	2. Non-load voltage is lower than rated voltage	Readjust

(2) Battery is discharging due to insufficient charging

Trouble	Cause	Correction
Wiring	Loosened joint or short-circuitted wiring	Rectify or retighten
Alternator	1. Short-circuitted rotor coil layer (Check conductivity by making conduction test with a tester)	Replace
	2. Short-circuitted stator coil layer	Replace
	3. Disconnected stator coil phase (primary phase)	Replace
	4. Slip ring fouling	Clean or replace and rectify by grinding
	5. Poorly contacted carbon brush	Rectify
	6. Silicone diode failure	Replace
Regulator	1. No-load voltage is lower than rated voltage	Readjust
	2. Contact point fouling or foreign particle deposit	Clean or regrind
	3. Short-circuitted coil or condenser	Replace
Battery	1. Insufficient battery electrolyte	Top-up with distilled water
	2. Faulty plates	Replace

(3) Over-charging

Trouble	Cause	Correction
Wiring	Alternator operate as "shunt generator" due to B and F terminal circuit short-circuitted	Rectify
Battery	Short-circuit in cell	Replace
Voltage regulator	1. Abnormally elevated non-load voltage	Rectify
	2. Poorly grounded regulator	Properly connect it to ground
	3. Disconnected field coil	Repair or replace
	4. Field relay points fails to close. Attracting voltage is excessively high	Readjust

(4) Irregular charging current

Trouble	Cause	Correction
Wiring	Named wire causes short-circuit due to travel shock, or disconnected wire sometimes comes in contact on account of vibration	Replace or rectify
Alternator	1. Short-circuitted layer (Primary state of short-circuitting between layers)	Replace
	2. Worn or broken brush spring	Replace
	3. Slip ring fouling	Replace
Regulator	1. Disconnected coil	Rectify or replace
	2. Disordered adjusting voltage	Readjust
	3. Ignition switch failure	Replace
	4. Contact points fouling	Clean

10-1-11 Parts numbers

Serial numbers for major component parts are given below

(1) Alternator

Parts name	Parts number
Rotor assembly	LT123-2100
Stator assembly	L 123-2200
Rear cover assembly	L123I-1300
SR holder assembly	L123B-1303
Brush assembly	L 123-1326
Front cover	L 123-1401
Pulley	L123I-1501

(2) Regulator

Parts name	Parts number
Voltage regulator coil	TL131-1100
Voltage regulator yoke	T 111-1200
Voltage regulator armature	T115H-1300
Lower regulator contact	T115H-1601
Upper regulator contact	T115H-1602
Field relay coil	TL131-1101
Field relay yoke	TL115-1201
Field relay armature	TL131-1301
Field relay contact	TL115-1802
Base Assembly	TL1Z-4600

10-1-12 Interchangeability of the parts

Alternator model LT 123-16 has no other parts available which can be interchanged with the parts of this alternator.

The regulator model TLIZ-08 is same in specification and dimension to the regulator model TL 131-05.

10-2 STARTER (HITACHI)

10-2-1 Specifications

Model		S114-54
Voltage		12
Output (KW)		1.0
Weight (kg)		4.8
Direction of rotation as viewed from the pinion side		right
Pinion	D P	10/12
	Pressure angle (°)	20
	Number of teeth	9
	Pitch diameter (mm)	22.86ø
	Tooth tip diameter (mm)	29.6ø
	Amount of shift	1.27
	Hardness (RC)	52 56

Performance

Performance	No-load	Terminal voltage (V)	12
		Current (A)	below 40
		Revolution (rpm)	Above 7,000
	Load	Terminal voltage (V)	6.3
		Current (A)	below 420
		Torque (m-kg)	Above 1.0
Pinion sliding-out voltage			8
Dumper			2-stages

Starter

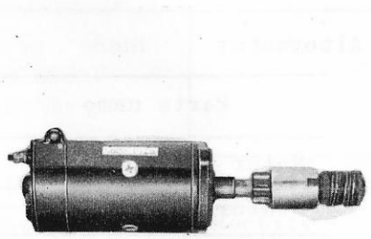


Fig. 10-27

Hold the brush lifted

Fig. 10-28

10-2-2 Dismantling

The starter should be dismantled in the following sequence.

(1) Remove the brush cover and hold the carbon brushes lifted to prevent them from being damaged while the starter is dismantled.

(2) Pull out the split pin as illustrated in Fig. 10-29 and remove the spring stopper nut and then dismount the pinion assembly.

Removing the pinion assembly

Fig. 10-29

(3) The pinion assembly should be dismantled after the clip is removed. Fig. 10-30 illustrates the pinion assembly as dismantled.

(4) Pull out the through bolts and remove the front cover and armature assembly.

(5) Remove the carbon brushes and nut clamping the terminal screw. Then the rear cover assembly and yoke assembly can be dismantled as illustrated in Fig. 10-31.

Pinion as dismantled

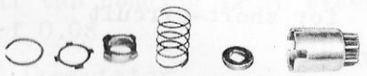


Fig. 10-30

Removing the rear cover

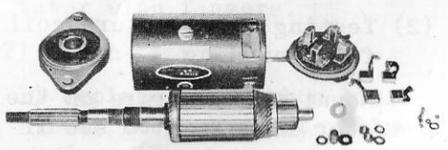


Fig. 10-31

10-2-3 Inspecting and repairing

(1) Testing the armature for short-circuit

Mount the armature on the tester and hold a piece of hacksaw blade right against the armature and then turn the armature with finger.

If the armature is short-circuitted, the hacksaw is either magnetized or vibrates. Replace the armature as necessary. (Fig. 10-32)

Testing the armature for short-circuit

Fig. 10-32

(2) Testing the armature coil for grounding

Mount the armature on the tester and check to see if conduction takes place between the commutator and core. The pilot lamp on the tester lights as the conduction takes place. Rectify or replace the armature is faulty. (See Fig. 10-33)

(3) Checking the armature coil for disconnection

Mount the armature on the tester, and measure the current induced in the coils with use of ammeter. If the induced current tends to

Testing the armature coil for grounding

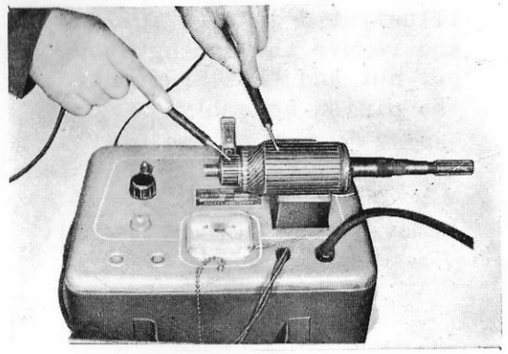


Fig. 10-33

decrease suddenly when the test nozzle comes to a certain point on the armature, the trouble may be regarded as attributed to poor conduction, short-circuitted or disconnected. In such instance, the armature should be rectified or replaced. (See Fig. 10-34)

Checking the armature coil for disconnection

Fig. 10-34

(4) Field coil

1) Test the field coil for grounding

If conduction takes place between one end of the field coil and yoke, check the coil for grounding and rectify as necessary.

Testing the field coil for grounding

Fig. 10-35

Checking the armature shaft for bending

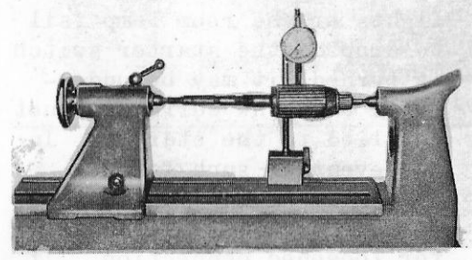


Fig. 10-36

(5) Armature shaft

Hold the both ends of the armature in a suitable support, check the shaft for distortion or bending with the aid of a dial gage. Rectify with a press machine if the bending is in excess of 0.08.

(6) Commutator

If the deflected wear of the commutator is in excess of 0.4mm, or reduction in the depth of mica is in excess of 0.2mm, the commutator should be regarded as due for correction or repair. Allowable reduction in the outside diameter of the commutator is 2mm. Fouling or foreign particle deposit on the commutator may be removed and cleaned with fine abrasive paper by turning the commutator with fingers.

(7) Brush

1) Replace the carbon brush if it becomes shorter than 9.5mm. (The original length is standard at 14mm)

2) Measuring the tensile strength of the brush spring

Measure the tensile strength of the brush spring with use of spring tension tester. The tensile strength is normal at 0.8kg. (See Fig. 10-37)

Measuring the tensile strength of the brush spring

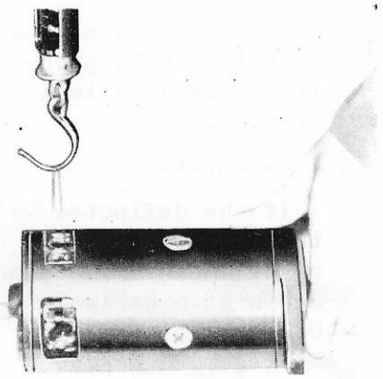


Fig. 10-37

10-2-4 Lubrication

(1) Front and rear cover are provided with oilless bearings. Lubricate the front cover bearing, sliding part of the pinion and rear cover bearing with spindle oil. Grease the rear cover bearing preferably with HITACHI motor grease or MARUZEN No. 29 grease. Apply engine oil 10W-30W to the sliding part of the pinion and helical spline at the time of dismantling or reassembling.

10-2-5 Starter trouble-shooting

As the operation of the starter relies upon the power of the battery, the trouble may be classified into the following.

1) Charging operation failure
2) Disconnected wiring
3) Loosened terminal connections
4) Starter failure
5) Starter switch and starter relay failure

10-2-6 Inspecting the starter as mounted in position

(1) Turn on the head-lights or room lamp and turn the starter switch to see if starter fails to operate and the power of the head-lights or room lamp tends to drop temporarily. This indicates that the current is supplied to the starter. In the event of such trouble, check the battery failure (measuring the specific gravity of the electrolyte) and wiring for loosened connections. If the battery and the wiring are free of trouble, the starter may be regarded as source of trouble.

(2) If the power of the head-lights or the room lamp fail to drop as the starter switch is turned, it may be understood that the current is not supplied to the starter. In the event of such failure, check the starter switch for operating failure and wiring for loosened connection. If the starter switch is free of trouble, hold the starter switch turned and check the starter circuit commencing with the part close to the battery. The trouble spot may be detected as the voltmeter fails to indicate the current when the voltmeter lead is brought into contact with the wiring with trouble. If the starter switch and the wiring are free of trouble, dismantle the starter motor and check for failure.

10-2-7 Inspecting the starter after dismounted

(1) Turn the pinion with finger to see if it operates smoothly.

(2) Mount the starter on the bench and connect it to 12V-battery, and then apply the rotary current to make sure that it operate smoothly at the speed of above 7,000 r.p.m., at which time the current should be held less than 40A.

10-2-8 Trouble-shooting

(1) Pinion fails to come into engagement with the ring gear when the ignition switch is turned on.

Trouble	Cause	Correction
Wiring	Disconnected battery connection or loosened switch terminals	Retighten or rectify
Starter switch	Current fails to flow due to poor contact	Rectify or replace the parts
Starter	Foreign particle deposit on the sliding portion of the pinion on the armature shaft or the operation of the pinion is restricted due to lack of lubricant	Clean or lubricate

(2) The starter fails to stop when the starter switch is turned-off after the engine is started.

Trouble	Cause	Correction
Starter switch	Current still flows after the switch is turned-off	Rectify or replace the parts
Magnetic switch	Contactor is decentralized and held in contact with the corresponding contacting piece	Rectify or replace

10-2-9 Maintenance standard

The maintenance standard and the standard measurements are given below

(All the numerical values are presented in metric system)

Carbon brush		Standard height	14
		Limit of reduction in height	4.5
Brush spring		Standard tensile strength (kg)	0.8
Commutator	Outside diameter	Standard measurement	23ø
		Limit of reduction	2
	Difference between maximum and minimum diameter	Correction limit	0.4
		Correction accuracy	0.05
	Depth of insulating mica	Correction limit	0.2
		Correction accuracy	0.5~0.8
Clearance between the shaft and bearing		Correction limit	0.2
		Correction accuracy	0.03~0.1
Limit of reduction in shaft diameter			0.1
Limit of correcting the bending of the shaft			0.08

Brush side	Outside diameter of the shaft	11.5øe7
	Inside diameter of the bore	$11.5\phi_{0}^{+0.021}$
Pinion side	Diameter of the shaft	$20\phi_{0}^{+0.021}$
	Diameter of the bore	$20\phi_{0}^{+0.025}$
Sliding portion of the pinion	Outside diameter of the shaft	$16\phi_{-0.111}^{-0.100}$
	Inside diameter	16ø H7

Component part of the starter

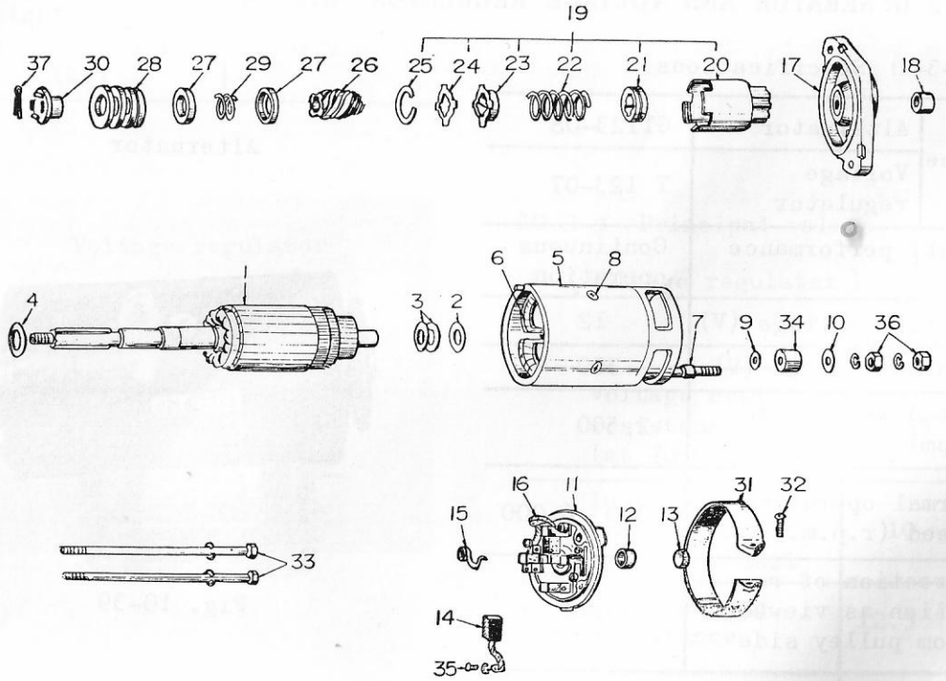


Fig. 10-38

(1) - Armature assembly
(2) - Thrust washer
(3) - Thrust washer
(4) - Thrust washer
(5) - Yoke assembly
(6) - Field coil assembly
(7) - Terminal screw
(8) - Pole core set screw
(9) - Washer
(10) - Washer
(11) - Rear cover assembly
(12) - Gear case metal
(13) - Bearing cover
(14) - Brush (Negative)
(15) - Brush spring
(16) - Brush (Positive)
(17) - Front cover
(18) - Bearing metal
(19) - Pinion assembly
(20) - Pinion
(21) - Spring stopper
(22) - Return spring
(23) - Pinion guide
(24) - Pinion washer
(25) - Pinion clip

10-3 GENERATOR AND VOLTAGE REGULATOR (HITACHI)

10-3-1 Specifications

Type	Alternator	GT123-08
	Voltage regulator	T 123-07
Conti performance		Continuous operation
Battery voltage (V)		12
Nominal output (W)		300
Rated revolution (rpm)		2,500
Normal operating speed (r.p.m.)		1,300 6,000
Direction of rotation as viewed from pulley side		right

Alternator

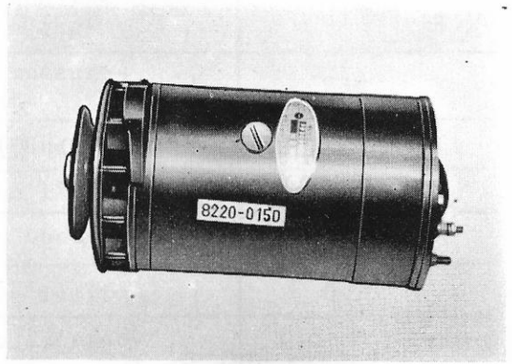


Fig. 10-39

Non-load voltage (V)	14~15 at 1,700 rpm
	13.5~15.5 at 2,500 rpm
Output current (A)	24~27
Cut-in voltage (V)	12.7~13.7
Cut-in speed (rpm)	Below 1,300
Reverse Current (A)	Below 8
Polarity of the battery	Negative (-) polarity connected to ground
Weight of alternator (kg)	9
Weight of voltage regulator (kg)	0.9

Voltage regulator

Fig. 10-40

10-3-2 Principal values (alternator)

Outside diameter of yoke (mm)	113ø
Outside diameter of armature (mm)	71ø
Field coil resistance (at 20°C)	6.6
Number of field coils	2
Carbon brush material	GH-45
Type of pulley drive belt	M single
Reduction ratio of pulley	1.71

10-3-3 Principal values (Voltage regulator)

Voltage coil resistance (at 20°C)	9.85
Inserted resistance for rotor coil	10
Compensating resistance	12.5
Current limiter	

Inserted resistance for field coil (at 20°C)	20
Cut-out relay	
Voltage coil resistance (at 20°C)	9.85
Compensating resistance	12.5

10-3-4 Inspecting and repairing

Driving test

Performance of the alternator, voltage regulator and their associated parts should be tested by driving the automobile before the parts are dismantled.

(1) With use of fully charged 12V battery, short-circuit the terminals F and A and then, connect the ammeter between the terminal A and the battery. The alternator and its associated parts may be regarded as normal if the alternator operates smoothly without abnormal operating noise and measurements indicate between 4A - 6A when the alternator is rotated at speeds within 750 rpm to 950 rpm. (See Fig. 10-42)

Interior of the voltage regulator

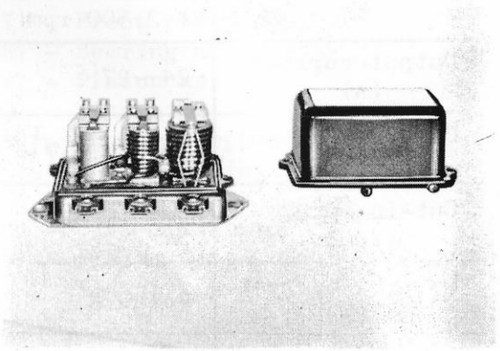


Fig. 10-41

(2) If the charging current is in excess of specified value, the trouble may be attributed to the following.

1) Mechanical trouble (undue friction)

2) Internal short-circuit

(3) Unsmooth operation

1) Short-circuitted armature

(4) If the operation is not fast enough

1) Short-circuitted field coil

(5) If the charging current is insufficient to the specified value.

1) Poor internal contact

2) Poorly soldered armature coil

3) Resistance is excessively high

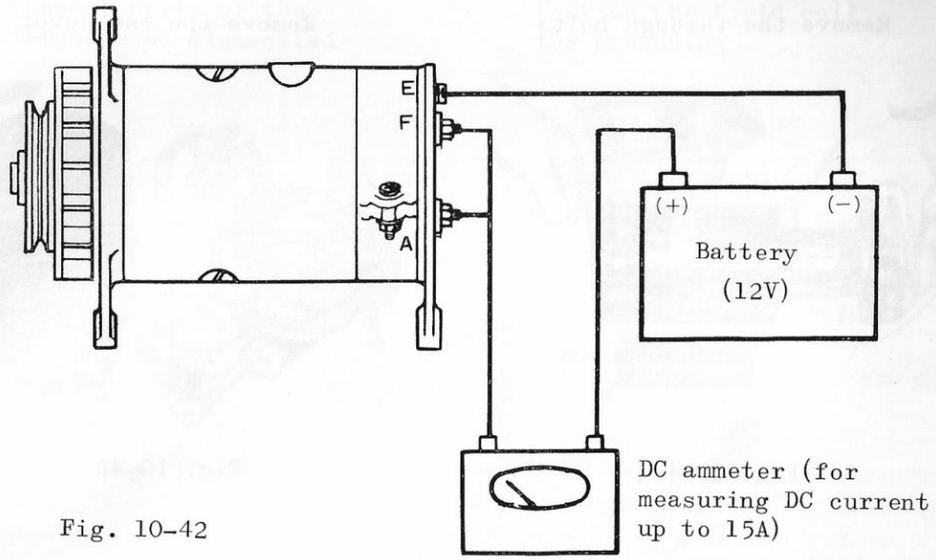


Fig. 10-42

Operating test

10-3-5 Dismantling

(1) Remove the brush cover and then take out the carbon brushes. (See Fig. 10-43)

Remove the carbon brush

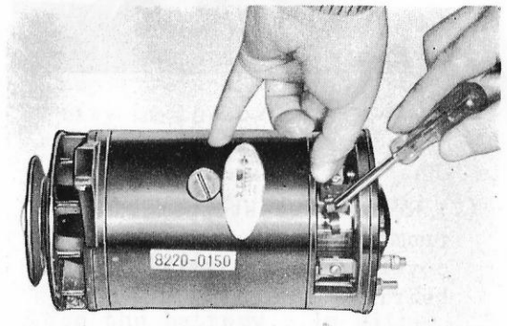


Fig. 10-43

(2) Remove all the through bolts fastening the front and rear cover to the body.

(3) Remove the front cover and armature together with the pulley by lightly hitting the front cover with wooden hammer or hide mallet. (See Fig. 10-44)

(4) Remove the screw on the joint portion of the field coil to the carbon brush and then slacken the nuts on the terminal. Then remove these parts from the yoke by lightly hitting the end cover with a wooden hammer or hide mallet. (See Figs. 10-45 and 10-46)

Remove the through bolts

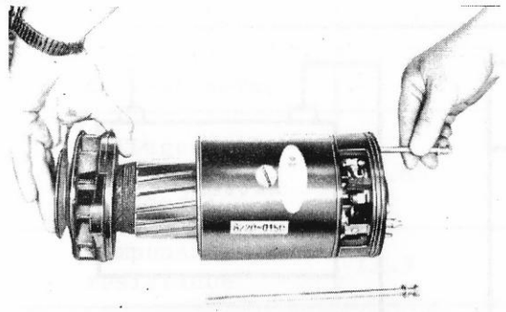


Fig. 10-44

Disconnect the joint between field coil and carbon brush

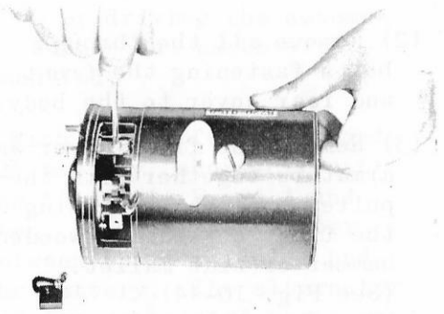


Fig. 10-45

(5) Remove the pulley nut and then remove the pulley.

(6) Remove the key and then dismount the front cover from the armature shaft with the aid of puller or press machine. (See Fig. 10-47)

Remove the end cover

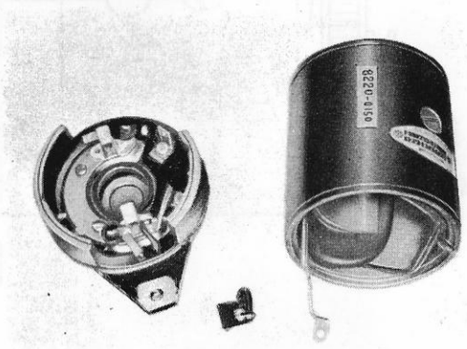


Fig. 10-46

Remove the front cover

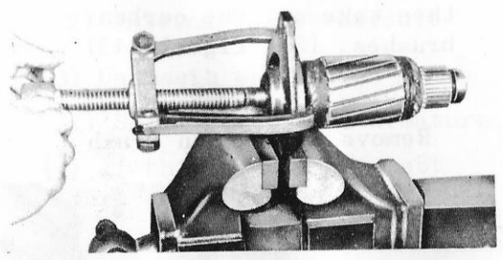


Fig. 10-47

(7) Remove the stopper ring from the bearing on the front cover and then remove the bearing. (See Fig. 10-48)

(8) Remove the pole core setting bolt and then take out the field coil.

Component parts of the alternator as dismantled

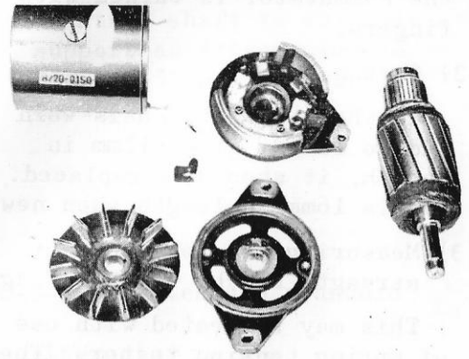


Fig. 10-48

Testing the field coil for grounding

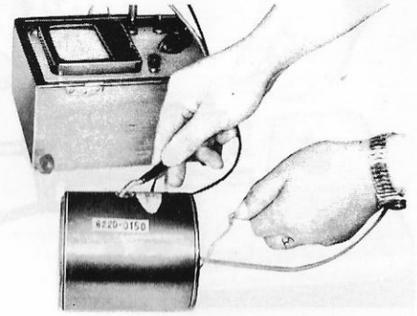


Fig. 10-49

10-3-6 Testing method

(1) Testing the field coil

Check to see if conduction takes place between the field coil and the yoke. The field coil may be regarded as due for rectification or replacement if short-circuitting is indicated. (See Fig. 10-49)

(2) Connect the coil and ammeter in series between the positive and negative polarity of the battery. Short-circuitting is indicated by excessive current flow and disconnection in the coil may be known as the ammeter fails to give any response as it is connected to the battery. In either cases, the coil may be regarded due for repair or replacement.

(3) Testing the armature circuit

Mount the armature on the tester and turn it with fingers while a piece of hacksaw blade is held right against the armature core. If the armature is short-circuitted, the steel piece is either magnetized or vibrates. In the event of short-circuit, the armature coil may be repaired or replaced. (See Fig. 10-50)

(4) Grounding test

Check to see if conduction takes place between the core in the armature and commutator. Conduction takes place only when the armature coil is short-circuitted. (See Fig. 10-51)

Testing the armature circuit

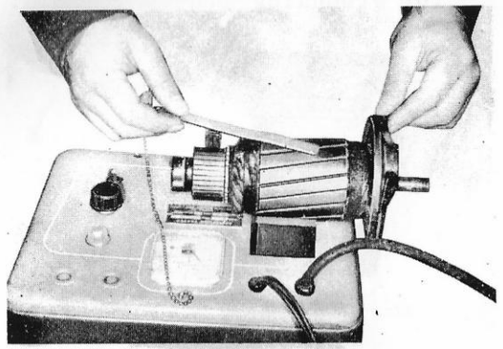


Fig. 10-50

Testing the armature coil for grounding

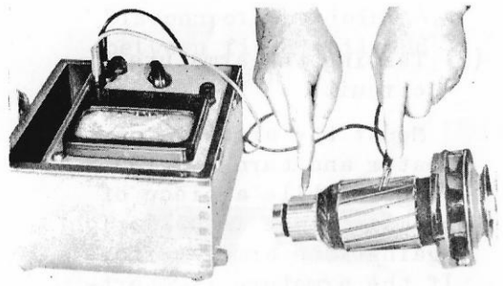


Fig. 10-51

10-3-7 Inspecting and repairing

(1) Commutator

If the partial wear on the commutator face is in excess of 0.3mm or the depth of mica insulator in the commutator exceeds 0.2mm, the commutator should be regarded due for repair. The limit of reduction in the outside diameter of the commutator is 2mm. Fouled or scuffed commutator face may be cleaned with fine abrasive paper while the commutator is turned with fingers.

(2) Carbon brush

If the carbon brush is worn and no longer gives 11mm in length, it should be replaced. (It is 16mm in length when new).

(3) Measuring the tensile strength of the brush spring

This may be tested with use of spring tension tester. The tensile strength is standard at 0.7kg

(4) Checking the armature shaft bending

Hold the both ends of the armature shaft in suitable support as illustrated in Fig. 10-52 and measure the bending on the shaft with a dial gage. If bending is in excess of 0.08mm, the shaft should be regarded due for repair.

Measuring the armature shaft for bending

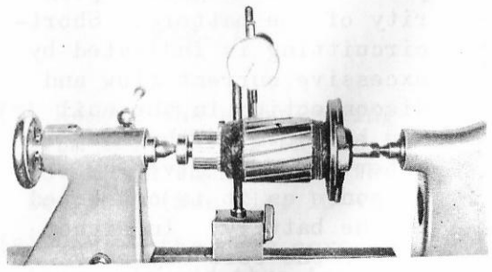


Fig. 10-52

(4) Checking the armature shaft bending

Hold the both ends of the armature shaft in suitable support as illustrated in Fig. 10-52 and measure the bending on the shaft with a dial gage. If bending is in excess of 0.08mm, the shaft should be regarded due for repair.

10-3-8 Maintenance standard

Alternator

Shunt voltage		Voltage (V) Rotating speed (rpm)	Above 10 1,000
Motoring test		Current (A) Rotating speed (rpm)	4 - 6 750 - 950
Tensile strength of the brush spring at standard (kg)			0.7
Carbon brush		Standard height Limit for reduction	16 5
Commutator	Outside diameter	Standard measurement Limit for reduction	45ø 2
	Difference between maximum and minimum diameter	Correction limit Correction accuracy	0.3 Below 0.05
	Depth of the mica insulator	Correction limit Correction accuracy	0.2 0.5 - 0.8
Shaft	Pulley side	Standard measurement Ball bearing	17 6203
	Carbon brush side	Standard measurement Ball bearing	15 6202Z

10-3-9 Trouble-shooting

(1) No charging takes place

Trouble	Cause	Correction
Carbon brush	Poor contact due to wear	Rectify or replace
Brush spring	Brush floating due to insufficient spring force	Rectify or replace
Commutator	Poor brush contact due to worn commutator face	Rectify
	Short-circuitted segments	Rectify
	Grounded	Rectify
Armature	Poor soldering on the riser	Rectify
	Short-circuitted layer	Rectify
	Grounded	Rectify
Field coil	Grounded	Rectify
	Disconnection	Rectify
	Demagnetized	Flow current for a short period of time
Terminal	Grounded	Rectify
Brush holder	Grounded brush holder	Rectify
Wiring	Disconnected	Replace
Voltage regulator	Cut-out relay point fails to close or coil is not provided with attracting force	Replace

Voltage regulator	Cut-in voltage is higher than non-load voltage	Readjust relay
	Non-load voltage is lower than rated cut-in voltage	Readjust
	Current fails to flow even while the contact points are held closed	Rectify
	Fouled contact points or foreign particle on the points	Grind
	Others	

(2) Battery is discharging due to insufficient charging

Trouble	Cause	Correction
Carbon brush	Poor contact due to wear	Replace
Brush spring	Brush floating due to insufficient spring force	Replace
Armature coil	Short-circuitted layer	Rectify or replace
Commutator	Roughened commutator face or poorly soldered risers	Rectify
Field coil	Coil is partially disconnected	Rectify or replace
External wiring	Partially disconnected	Replace
Belt	Loosened tension	Readjust
Voltage regulator	Cut-out relay points fouling	Grind
	Reduction in the non-load voltage	Adjust

10-3-10 Method for measuring the voltage regulator

Tachometer, volt meter, ammeter and a complete set of adjusting tools should be prepared for adjusting the voltage regulator.

DC voltmeter		DC ammeter	
Battery voltage	Measurable range of volt meter	Cut-out current	Measurable range of ammeter
12V	0 ~ 30V	0 ~ 30A	0 ~ 50A

10-3-11 Voltage regulator

(1) Check the contact points and clean them with fine abrasive paper if fouling is notable.

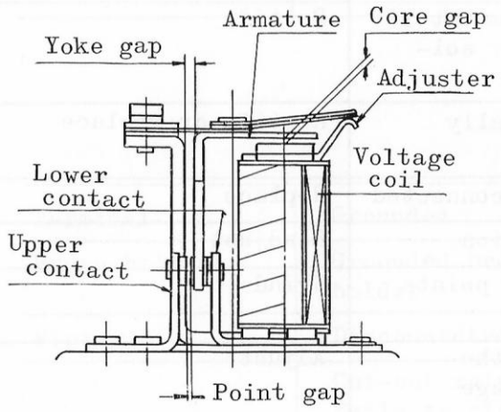


Fig. 10-53

(2) Check and adjust all the contact points gaps in the sequence of 1) yoke gap, 2) core gap and 3) points gap. (See Fig. 10-53)

(3) Yoke gap

The screw 3ø should be turned loose for adjusting the yoke gap.

Adjusting the yoke gap

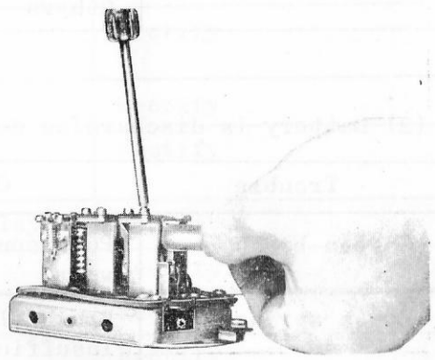


Fig. 10-54

(4) Core gap

Core gap may be adjusted by bending the lower contact in the manner illustrated in Fig. 10-55.

(5) Point gap

Point gap may be adjusted by bending the upper contact in the manner illustrated in Fig. 10-56.

Adjusting the core gap

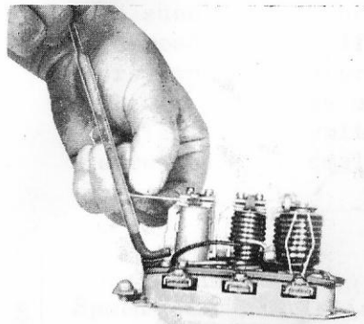


Fig. 10-55

Adjusting the point gap

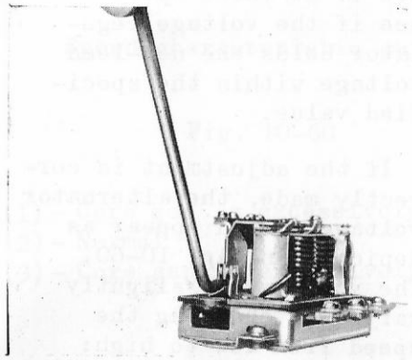


Fig. 10-56

Voltage regulator	Yoke gap	0.9~1.0mm
	Core gap	0.9~1.0mm
	Point gap	0.4~0.5mm

When the gaps are adjusted, rotate the alternator at the rated speed (See specifications).

Connections of the Meters for Adjusting the Non-load Voltage

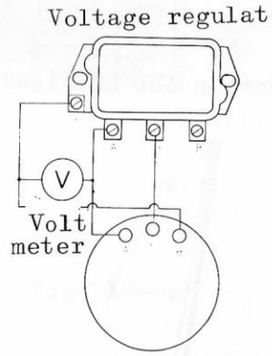


Fig. 10-57

10-3-12 Adjusting the non-load voltage

1. Wiring

Connections of the meters for adjusting the voltage are illustrated in Fig. 10-57. Connect the alternator terminals to corresponding terminals on the voltage regulator. Hold the terminal B on the voltage regulator free of load and connect DC volt meter to the line between terminals A and E.

(1) Check to make sure that the non-load voltage falls within the specified value

and if it is lower than specified value, adjust it by bending the adjuster upward as illustrated in Fig. 10-58. Bending the adjuster downward if the non-load voltage is higher than specified value.

Adjusting the Non-load Voltage

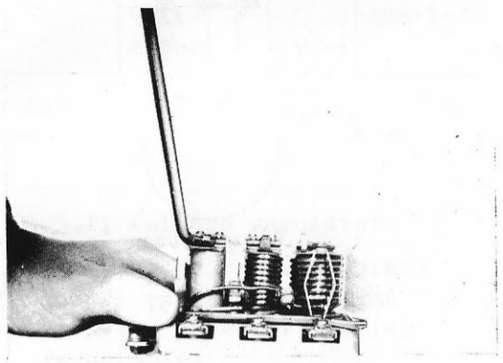


Fig. 10-58

(2) If the deformation of the yoke is serious and bending the adjuster no longer adjusts the non-load voltage, rectify the angle of the yoke with the aid of a tool in the manner illustrated in Fig. 10-59. When the parts is replaced, readjust the gaps before adjusting the voltage. Adjustment on the voltage regulator may be considered complete when the above adjustments are made however, to make double sure that the adjustments are properly made, stop the rotation of the alternator and again operate it at rated speed to see if the voltage regulator holds the non-load voltage within the specified value.

Adjusting the Angle of the Yoke

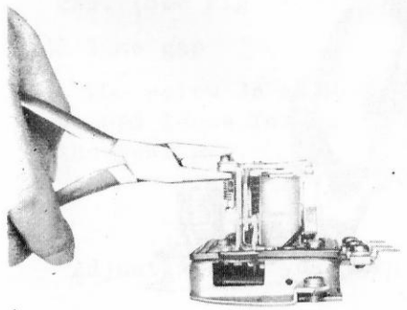
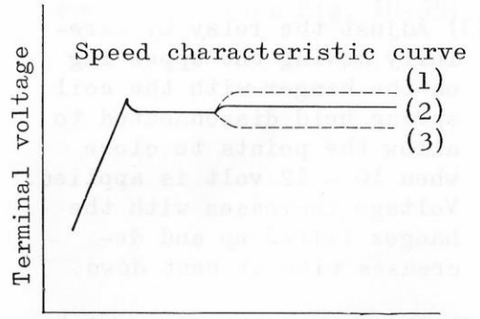


Fig. 10-59

(3) If the adjustment is correctly made, the alternator voltage should appear as depicted in Fig. 10-60. The voltage may slightly vary when changing the speed from low to high: i.e., from the lower contact to the upper contact operation, but this is not detrimental to normal charging operation. Some increase in the voltage when switching the operation to high speed are rather desirable. In the event if the voltage varies over 0.5V or more,

or decreases when the rotation of the alternator is increased, the core gap should be rechecked and readjusted. If the core gap is greater, the voltage increases and similarly, the voltage decreased with smaller core gap.



Speed characteristic curve

Fig. 10-60

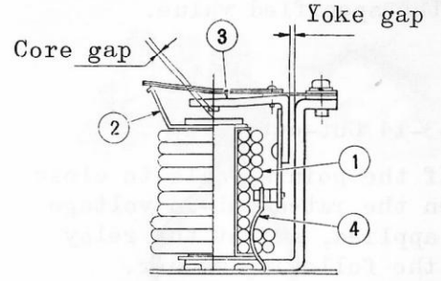
(1) - Core gap is excessively large
(2) - Normal
(3) - Core gap is excessively small

(4) As the voltage regulator may become maladjusted when the cover is put back into place, make double check after the cover is refitted.

10-3-13 Current controller

(1) Adjust the gaps in the same manner as applied for adjusting the voltage regulator. (See Fig. 10-61)

Construction of the Current Controller



(1) - Current coil
(2) - Adjuster
(3) - Armature
(4) - Current contact

Fig. 10-61

When gaps are adjusted, connect the meters as illustrated in Fig. 10-62.

Current controller	Yoke gap	0.9 ~ 1.0mm
	Core gap	0.6 ~ 0.7mm

Connections for adjusting the output current

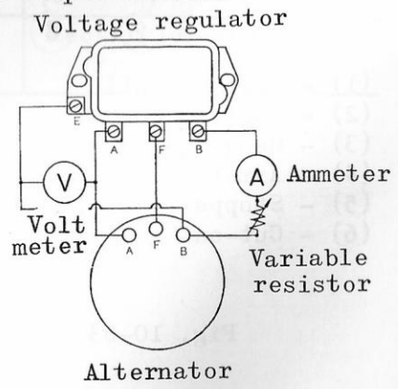


Fig. 10-62

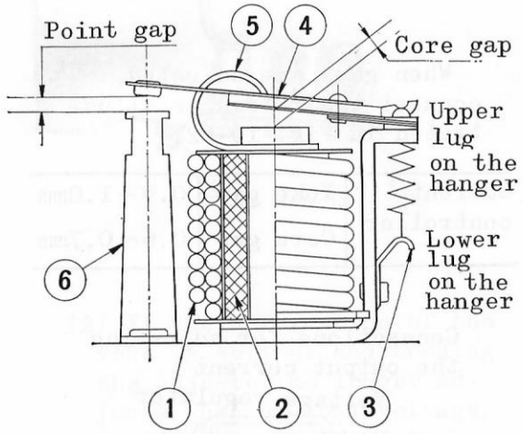
(2) Operate the alternator at rated speed and check to see if the output current meets the specified value.

10-3-14 Cut-out relay

If the points fails to close when the rated cut-in voltage is applied, adjust the relay in the following manner.

(1) If the points are fouled, clean and grind them with fine abrasive paper.

Construction of cut-out relay



(1) - Voltage coil
(2) - Current coil
(3) - Hanger
(4) - Armature
(5) - Stopper
(6) - Cut-out relay contactor

Fig. 10-63

(2) Adjust the gaps in the sequence of core gap and point gap.

Cut-out relay	Yoke gap	0.2~0.3mm
	Core gap	0.9~1.0mm
	Point gap	0.6~0.7mm

(3) Adjust the relay by carefully moving the upper lug on the hanger with the coil spring held disconnected to allow the points to close when 10 - 12 volt is applied. Voltage increases with the hanger lifted up and decreases with it bent down.

(4) Refit the coil spring into place and adjust the hanger to bring the cut-in voltage within the rated value. If the cut-in voltage is lower than rated value, strengthen

Adjusting the Current

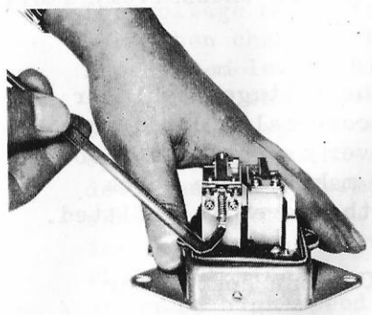


Fig. 10-64

the tensile force of the coil spring by bending the hanger downward and in the similar manner, bend the hanger upward to weaken the spring force if the cut-in voltage is higher than the rated value.

(5) Adjust the point gap by adjusting the cut-out relay contactor. (See Fig. 10-65)

Adjusting the Point Gap

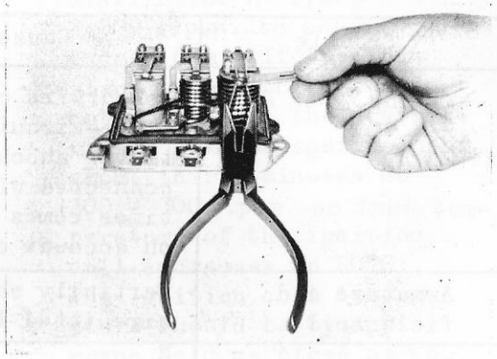


Fig. 10-65

(6) Over-charging

Trouble	Cause	Correction
Wiring	Short-circuitted armature and field coil	Rectify
	Undue increase in the non-load voltage	Adjust
Voltage regulator	Poorly grounded voltage regulator	Properly fasten the ground lead
	Disconnected lead for voltage coil	Rectify or replace

(7) Irregular charging current

Trouble	Cause	Correction
Wiring	Naked wire causes short-circuit due to travel shock, or disconnected wire sometimes comes in contact on account of vibration	Rectify or replace
Armature and field coil	Partially short-circuitted layer	Rectify or replace
Brush spring	Broken	Replace
Commutator	Mica insulator	Rectify
Voltage regulator	Fouled cut-out relay points or partially disconnected coil	Rectify or replace
	Unstable voltage in the regulator	Readjust
	Disconnected stabilizing resistance	Replace

10-4 IGNITION COIL (HITACHI)

10-4-1 Specifications

12V, C1Z-14 (-) Ground

Primary voltage: 12V

Secondary voltage:
1,500 r.p.m. 15,000V

Primary resistance: 3.5Ω

Secondary resistance: 10KΩ

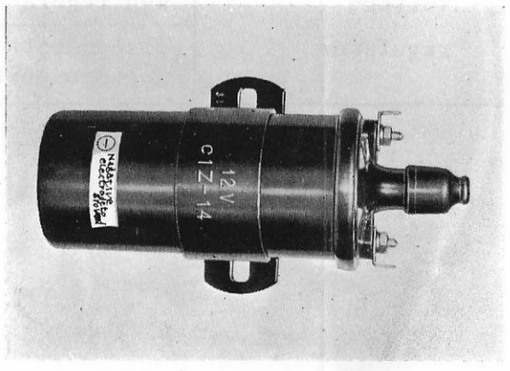


Fig. 10-66

10-4-2 Testing method

(1) Primary conduction test

With use of a tester check to see if conduction takes place between primary terminals on the ignition coil. Replace if conduction does not takes place. The resistance for primary coil is between 3.5 ohms - 4.5 ohms.

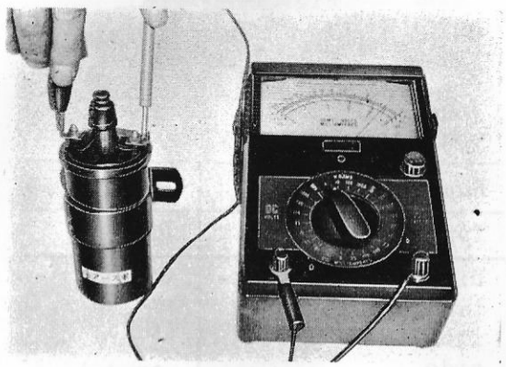


Fig. 10-67

(2) Sparking test

The secondary coil should be tested using a triple-pole needle gap tester. In this test, a nickle piece should be used as an electrode. With the ignition coil disposed in a constant-temperature oven, both internal and external temperatures should be elevated to 80°C and then, the oven is mounted on the testing bench, and high-tension power should be then applied to the ignition coil by operating the distributor at 1,800 - 2,000 r.p.m. to see if sparks exceed 6mm. If the constant temperature oven is not available, the distributor should be operated for about thirty minutes at 200 - 300 r.p.m. so that temperature of the ignition coil increases to 80°C. The ignition coil temperature should be by any means held as close as to 80°C for testing.

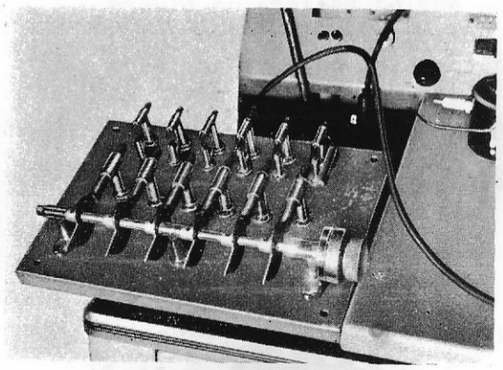


Fig. 10-68

(3) On-the-Spot trouble-shooting

The ignition coil mounted on the engine should be tested in the following manner. With the high-tension cord pulled out, the ignition switch should be turned on and the tip of the high-tension cord should be borne against the engine block keeping a distance of

about 6mm, and then, the engine should be rotated by the starter, or the contact breaker point should be operated with hand to see if sparks takes place. The test should be conducted with the ignition switch, battery wiring and contact points all held in their respective portion.

This method may sometimes fail to pick out defective point correctly and the ignition coil may fail to operate properly as the ambient temperature increases. (See Fig. 10-69)

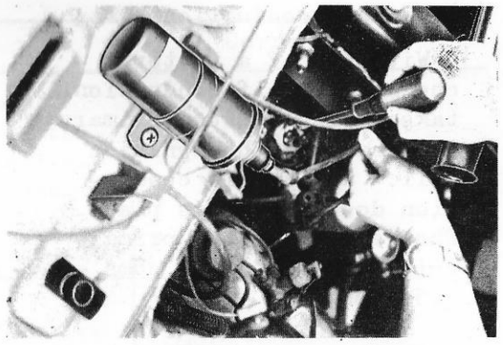


Fig. 10-69

10-5 DISTRIBUTOR (HITACHI)

10-5-1 Specifications

Distributor

Fig. 10-70

Engine type			PR20, G150
Type			D415-70
Direction of rotation as viewed from the drive side			Right
Weight (kg)			1.3
Drive			Male coupling
Angle advancing characteristic	Centrifugal type	Start operating speed rpm	400
		Medium °/rpm	8/1,000
		Maximum °/rpm	15/1,900
	Vacuum type	Start operating -mmHg	50
		Maximum °/-mmHg	8/250

10-5-2 Dismantling

(1) Remove the cap and take out the rotor. (Fig. 10-71)

Remove the Cap and Take Out the Rotor

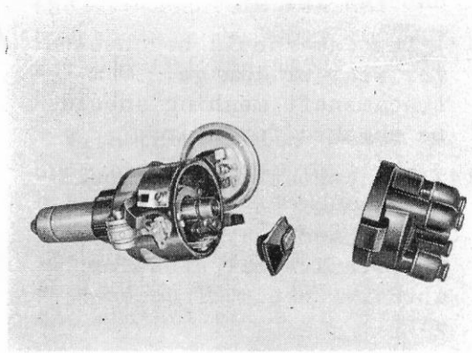


Fig. 10-71

(2) Remove the vacuum controller.

(3) Disconnect primary terminal and then, remove the contact breaker bracket.

(4) For disassembling the contact breaker, the moving plate should be held downward and then, the fixed plate is removed. As small steel ball is provided between the plates, they should be kept from being lost.

(5) The coupling should be removed and then, the edge of the kay groove in the main shaft should be smoothened by a file before removing the rotating parts. Before

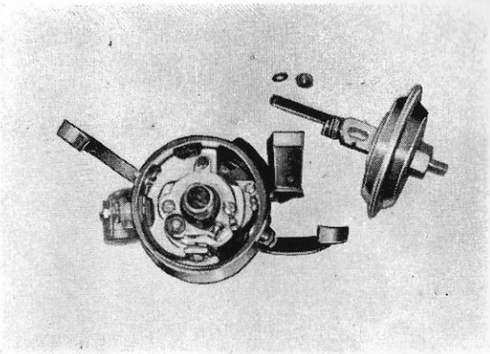


Fig. 10-72

the coupling is removed, the corresponding marks should be applied to the pertinent portions of the coupling and the main shaft or the pertinent positions of the rotor grooves in the camshaft, thus the direction of the coupling may be memorized.

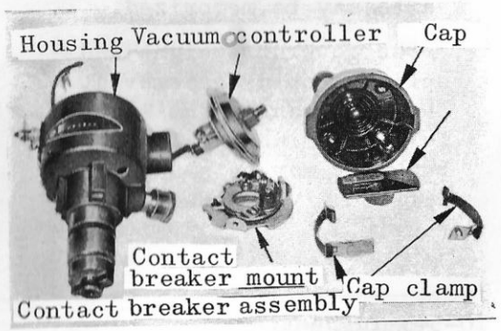


Fig. 10-73

(6) A screw should be removed before removing the cam. Similar marks should be applied to corresponding posi-

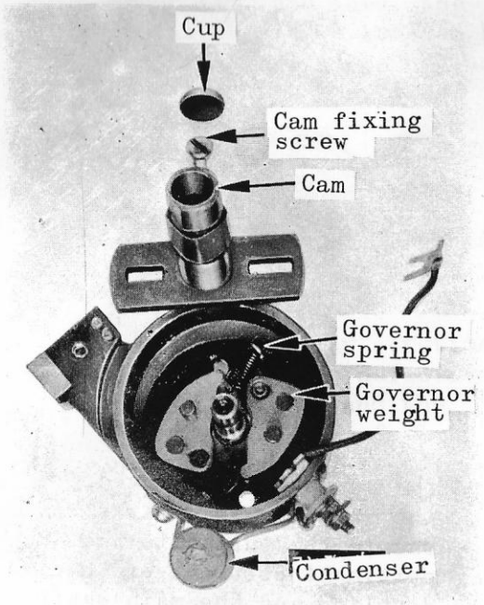


Fig. 10-74

tions of the flyweight mount plate and the camshaft so that the relations of the parts may be memorized.

(7) The governor weight and spring should be removed. The above shows the sequence for disassembling the parts but they may be changed at will to fit the necessary repair.

10-5-3 Inspecting

The parts should be cleaned for inspection and replaced if necessary. The vacuum timing control (diaphragm) and condenser should not be cleaned.

(1) The shaft and the housing should be checked for wear, and if bend of the shaft is in excess of 0.05mm, it should be replaced.

(2) The governor weight-to-pin contact and the governor spring mount should be checked for wear.

(3) The cam should be checked for wear or damage. Cam-to-camshaft meshing should be checked for wear.

(4) The contact point should be checked for wear or graze, and corrected with an abrasive oil stone or abrasive paper if necessary.

(5) The distributor cap and the rotor should be checked for crack, damage, rust or corrosion.

(6) If the distributor cap carbon is worn in excess of 2mm, the cap should be replaced.

(7) The ignition cord should be checked for tear or damage.

(8) The diaphragm in the vacuum timing control should be checked for wear.

10-5-4 Testing

(1) Contacting pressure of the breaker arm

The actuating pressure of the breaker arm should be tested with a spring tension tester. (The pressure of the spring acting on the breaker arm is 500gr - 650gr for HITACHI and 415gr ± 15% DENSO).

With the tension tester hung onto the tip of the breaker arm and pulled in a direction right-angle to the breaker arm, and the scale should be read when the contact point is opened.

Measuring the Contacting Pressure of the Breaker Arm

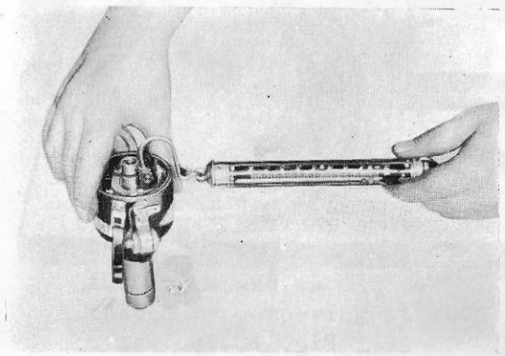


Fig. 10-75

(2) The cam angle should be tested with use of a distributor tester. Adjusting value is: 48° - 53° for HITACHI and 52° ± 3° for DENSO.

Cam angle

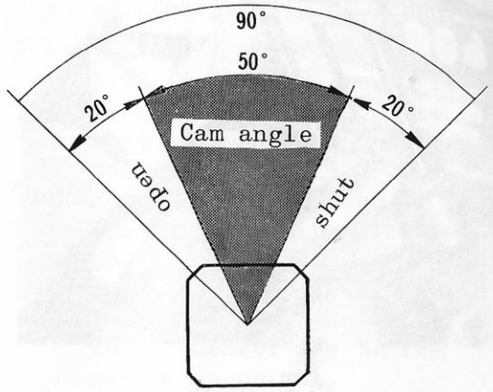


Fig. 10-76

(3) If the cam angle exceeds the rated value when the point gaps are properly adjusted, the trouble may be attributed to:

A Worn breaker arm heel
B Improperly mounted arm
C Worn cam
D Deformed cam

(4) Adjusting method

The cam angle should be adjusted after the point gap is corrected.

Cam angle	Point gap
Too large	Widen
Too small	Bring closer

Adjusting the Point Gap

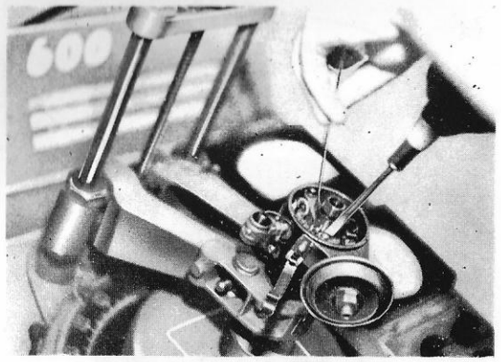


Fig. 10-77

(5) Point gap

The contact point is provided with the maximum gap at the breaker arm heel that comes in contact with the tip of the cam. With the breaker arm held in this position, the gap should be adjusted to 0.45mm.

(6) Angle advancing characteristic

The angle advancing characteristic of the governor and the vacuum control should be measured with use of a distributor tester in the manner illustrated in Figs. 10-78 and 10-79.

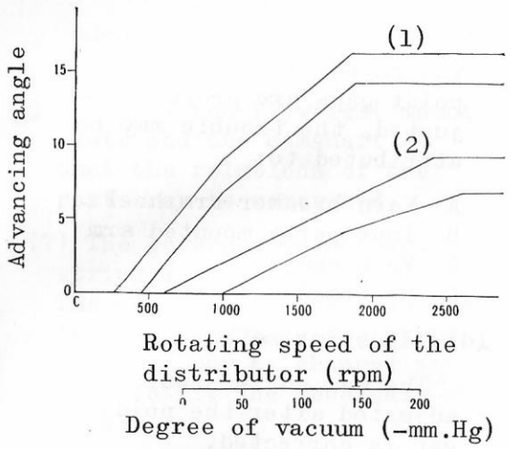


Fig. 10-78

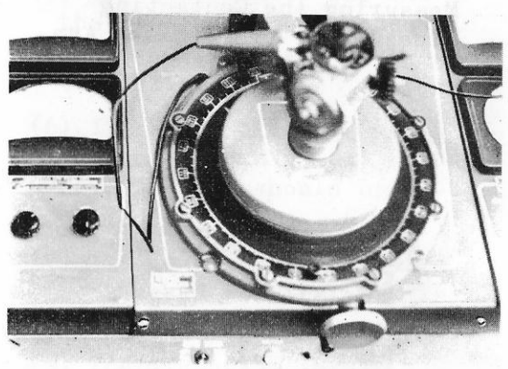


Fig. 10-79

(1) - Centrifugal angle advancing characteristic

(2) - Vacuum controlled angle advancing characteristic

10-6 CONDENSER

10-6-1 Specifications

Condenser capacity:
0.22 ± 0.02μF

Insulation resistance
(at normal temperature):
15MΩ

Condenser

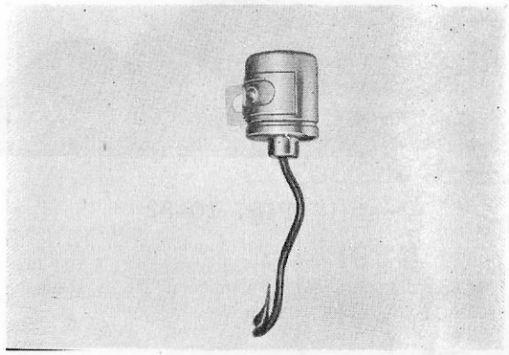


Fig. 10-80

(1) If insufficient sparking is due to condenser failure, the condenser should be tested by comparing it with a new one.

(2) One of the light-tester terminals should be connected to the condenser lead and the other terminal should be attached to the condenser body to see if the light-tester lights. The condenser should be regarded as short-circuitted if the light-tester lights on contact with the condenser body.

(3) DC or AC 200V should be instantly applied to the lead wire and the body of the condenser. 1 - 2 minutes later the edge of the lead should be held close to the body and if sparks occur when the lead is held 2mm apart from the body, the condenser may be regarded as normal.

(4) Capacity and insulation resistance of the condenser should be measured with use of a condenser tester or Megger.

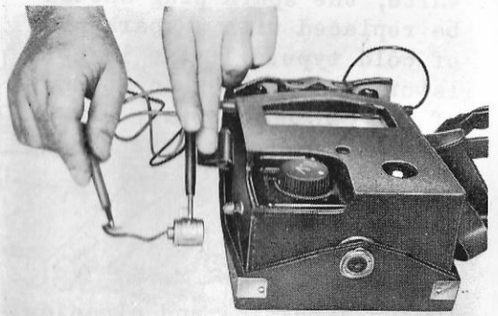


Fig. 10-81

10-7 SPARK PLUG (HITACHI)

10-7-1 Type HGK BGE

HITACHI L46J
Size 14mm P=1.25

Ignition plug

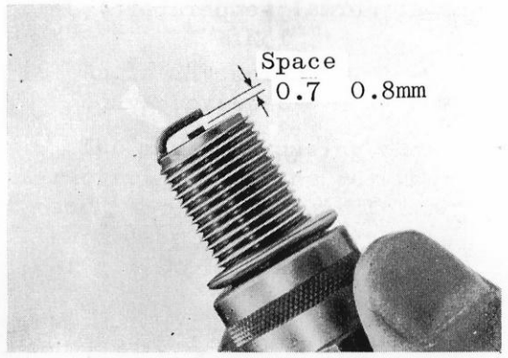


Fig. 10-82

10-7-2 Inspecting

(1) The insulator should be checked for crack.

(2) The electrodes should be checked for wear.

(3) The internal portion, threaded portion and electrode of the plug should be checked for wear or carbon deposit.

(4) The insulator should be checked for fouling

If the electrode turned white, the spark plug should be replaced with a spark plug of cold type. If the insulator turned black on account of the carbon deposit, a spark plug of hot type should be used.

10-7-3 Adjusting and cleaning

(1) The spark gap should be adjusted to 0.7 - 0.8mm.

(2) The spark plug should be regularly checked after every 3,000km of travel distance. For cleaning the spark plug, a spark plug cleaner or a wire brush should be used.

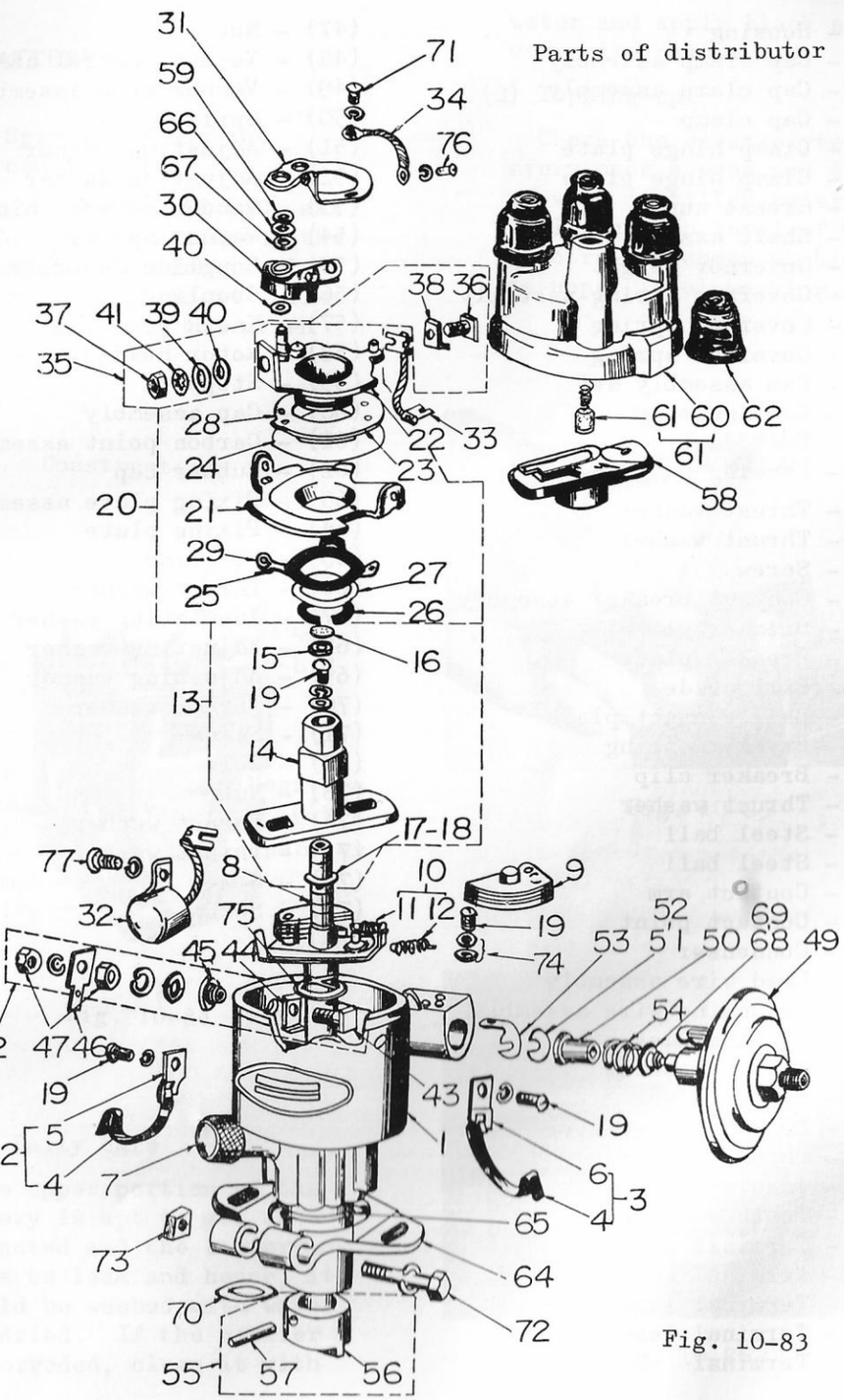


Fig. 10-83

(1) - Housing
(2) - Cap clamp assembly
(3) - Cap clamp assembly
(4) - Cap clamp
(5) - Clamp hinge plate
(6) - Clamp hinge plate
(7) - Grease cup
(8) - Shaft assembly
(9) - Governor weight
(10) - Governor spring assembly
(11) - Governor spring
(12) - Governor spring
(13) - Cam assembly set
(14) - Cam assembly
(15) - Felt disk
(16) - Packing ring
(17) - Thrust washer
(18) - Thrust washer
(19) - Screw
(20) - Contact breaker assembly
(21) - Breaker plate
(22) - Breaker plate
(23) - Ball guide
(24) - Ball contact plate
(25) - Breaker spring
(26) - Breaker clip
(27) - Thrust washer
(28) - Steel ball
(29) - Steel ball
(30) - Contact arm
(31) - Contact point
(32) - Condenser
(33) - Lead wire assembly
(34) - Grounding wire assembly
(35) - Terminal assembly
(36) - Terminal screw
(37) - Terminal nut
(38) - Terminal insulator
(39) - Thrust washer
(40) - Insulating washer
(41) - Teeth washer
(42) - Terminal assembly
(43) - Terminal screw
(44) - Terminal insulator
(45) - Terminal insulator
(46) - Terminal
(47) - Nut
(48) - Vacuum control assembly
(49) - Vacuum case assembly
(50) - Spring guide
(51) - Adjusting washer
(52) - Adjusting washer
(53) - Vacuum advance hinge
(54) - Vacuum spring
(55) - Coupling assembly
(56) - Coupling
(57) - Knock pin
(58) - Rotor head
(59) - Stopper
(60) - Cap assembly
(61) - Carbon point assembly
(62) - Rubber cap
(63) - Fixing plate assembly
(64) - Fixing plate
(65) - "O" ring
(66) - Thrust washer
(67) - Insulating washer
(68) - Adjusting washer
(69) - Adjusting washer
(70) - Thrust washer
(71) - Screw
(72) - Bolt
(73) - Nut
(74) - Thrust washer
(75) - Thrust washer
(76) - Screw
(77) - Screw

10-8 BATTERY

10-8-1 Specifications and construction

Models N30Z (for PR-D10) and NS40 (for PR-20) are used, the construction of which is illustrated in Fig. 10-84 while the specifications are given in Table 10-1.

Construction

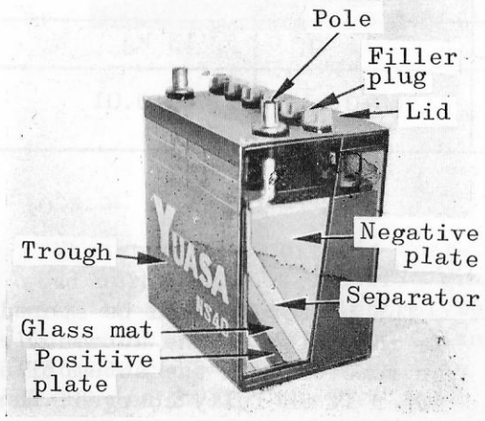


Fig. 10-84

10-8-2 Daily care

(1) The upper portion of the battery is apt to get contaminated and the battery tends to leak and hence, it should be washed with water and dried. If the carrier is corroded, clean it with water and apply black anti-corrosive paint.

(2) Topping-up

Check the electrolyte every once a week and top-up with distilled water until the top level of the electrolyte comes as high as upper level marking.

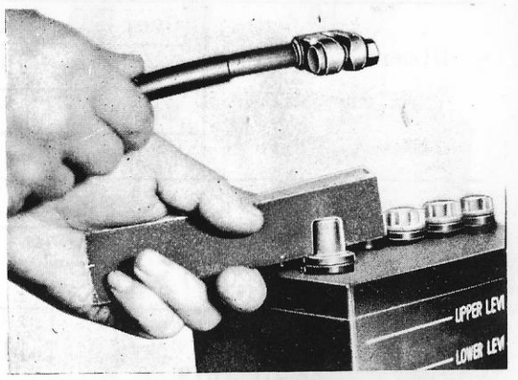


Fig. 10-85

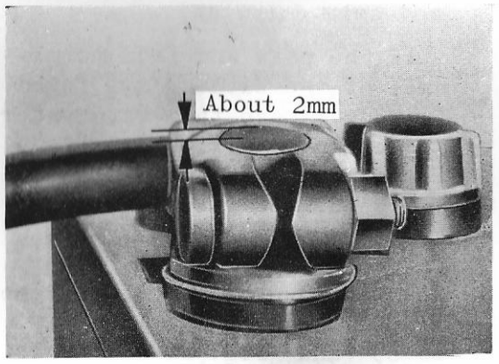


Fig. 10-86

(3)

Type		NS40	N30Z
Voltage (V)		12	12
Capacity per 20 hours		32	35
Number of positive plate per cell		4	4
-15°C 150A Discharge	Hours continued	Above 2.5 min.	Above 2.12 min.
	Voltage after 5 seconds	Above 8.4V	Above 7.3V
Dimensions (Maximum mm)	Over-all height	227	232
	Height of trough	203	207
	Width	128	135
	Length	196	204
Gross weight		11 kg	13 kg
Specific gravity of the electrolyte (20°C)		1.260±0.01	1.260±0.01

Table 10-1

* J.A.S.O. is the abbreviation of Japanese Automobile Standard Organization.

If the pole and lead terminals of the battery are found corroded, wash them with water and clean them with use of abrasive paper or wire brush and then, retighten the nuts and smear all external surfaces of the nuts and battery holding down bolts with grease or petroleum jelly. (See Fig. 10-85 and Fig. 10-86)

(4) Storing

The battery should be stored as installed in the automobile or removed from the automobile after it is fully charged. The battery tends to self-discharge as much as 1% of capacity per day in summer and at 0.5% per day in winter. Hence the battery should be re-charged once a month in summer and once in every three months in winter regardless of use. (See paragraph "charging")

Measuring the specific gravity

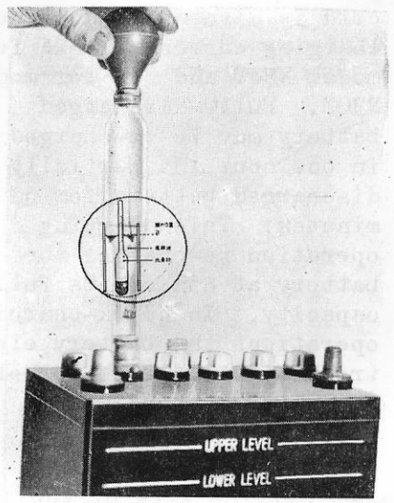


Fig. 10-87

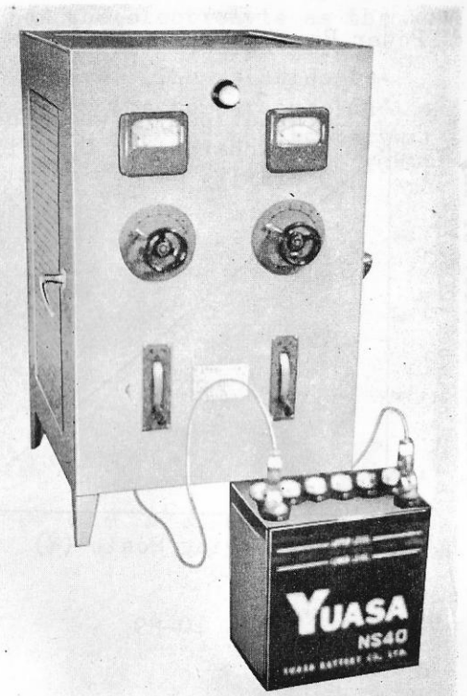


Fig. 10-88

10-8-3

When the automobile is operated normally, the specific gravity of the battery electrolyte is normal at 1.260 (at 20°C) and if measured value is less than 1.200 (at 20°C), the battery should be re-charged in the following manner.

(1) Normal charging

Connect the battery with the battery charger as illustrated in Fig. 10-88 and apply charging current rated at 1/10 of the battery capacity to the battery. The rated charging current for N-30Z is 3.2A and 3.2A for NS40. As the charging proceed, the voltage and specific gravity of the electrolyte increases and comes to a certain point where the voltage and specific gravity are held from further increase (At which time the voltage will be 15 - 16V and specific gravity at 1.260 at 20°C) and the charging may be regarded complete after the battery is held in this condition with the charging current supplied for continuous 2 hours. Fully discharged battery (specific gravity is less than 1.110) can be re-charged within 13 hours and partially discharged battery (50% dis-

Power Remains in the Battery

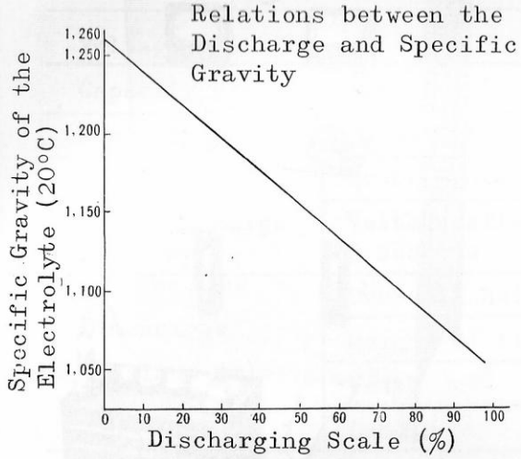


Fig. 10-89

charged, specific gravity is about 1.180) may be re-charged within 6 hours or so. The time required for re-charging the battery may be reduced or increased according to the charging current applied to the battery. The temperature of the electrolyte increases during charging operation, and if it exceeds 50°C, the current should be reduced to about half or the charging should be suspended until the temperature falls. During the charging operation, the battery should be kept away from flame.

(2) Quick-charging

When charging the battery while it is installed in automobile, the charging current should only be applied only after the ground cord is disconnected. The charging current is 32A for model NS40 and 32A for model N30Z. Fully-discharged battery may be re-charged in one hour and partially discharged battery for 30 minutes. This charging operation re-charges the battery at 85% of its full capacity. In quick-charging operation, the battery electrolyte should also be held on or lower than 50°C.

10-8-4 Service life of the battery and relations between the temperature and performance

(1) Service life of the battery

If the battery is used in a correct manner it should normally operate satisfactorily for about 2 years for personal automobile. Measure the specific gravity of each cell and if any or the cells fails to give specified value (less than 1.100) while others meet the rated value, or the specific gravity of the electrolyte or the voltage fails to increase as the normal charging current is applied, the battery may be regarded as out of the service life.

(2) Relations between the temperature and operating efficiency

The efficiency of the battery tends to decrease with

Relations between Electrolyte Temperature and Battery Capacity

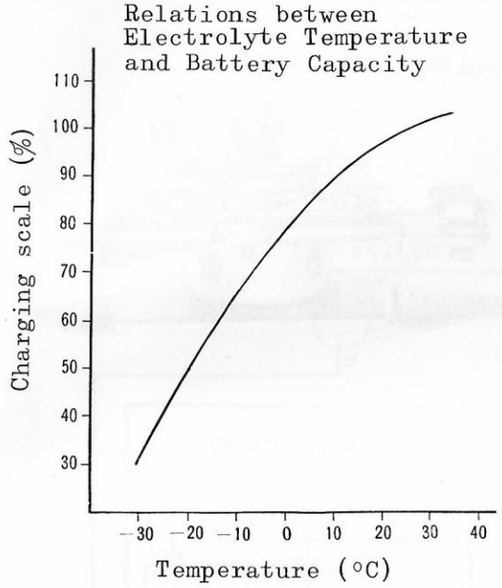


Fig. 10-90

reduction in the temperature of the electrolyte as the chemical reaction gets inactive. The relation between the temperature and efficiency of the battery is illustrated in Fig. 10-90.

10-9 STARTER, CHANGE-OVER SWITCH AND PREHEATING SYSTEM (HITACHI)

10-9-1 Construction

The Bellett diesel engine is equipped with 12-V electrical system except the starter is operated with 24V through the change-over switch.

Construction

(1) 24V starter (See Fig. 10-91)
(2) Change-over switch (See Fig. 10-92)
(3) Seized glow plug (See Fig. 10-93)
(4) Glow plug relay (See Fig. 10-92)

The above parts are connected as illustrated in Fig. 10-95.

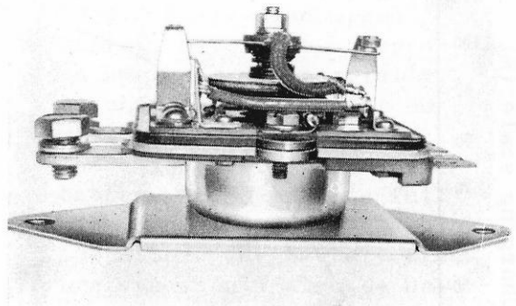


Fig. 10-92

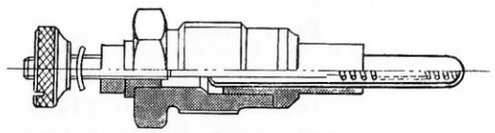


Fig. 10-93

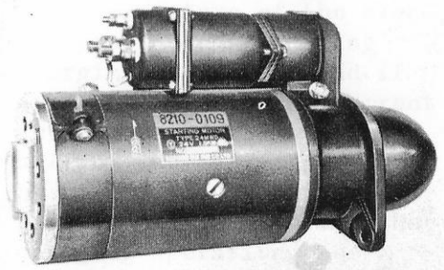


Fig. 10-91

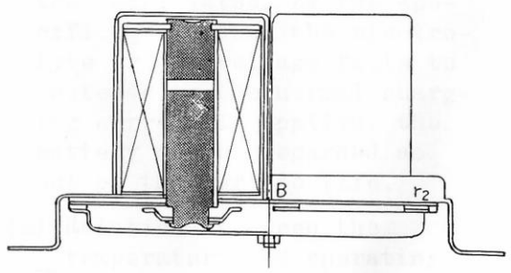


Fig. 10-94

Starter circuit

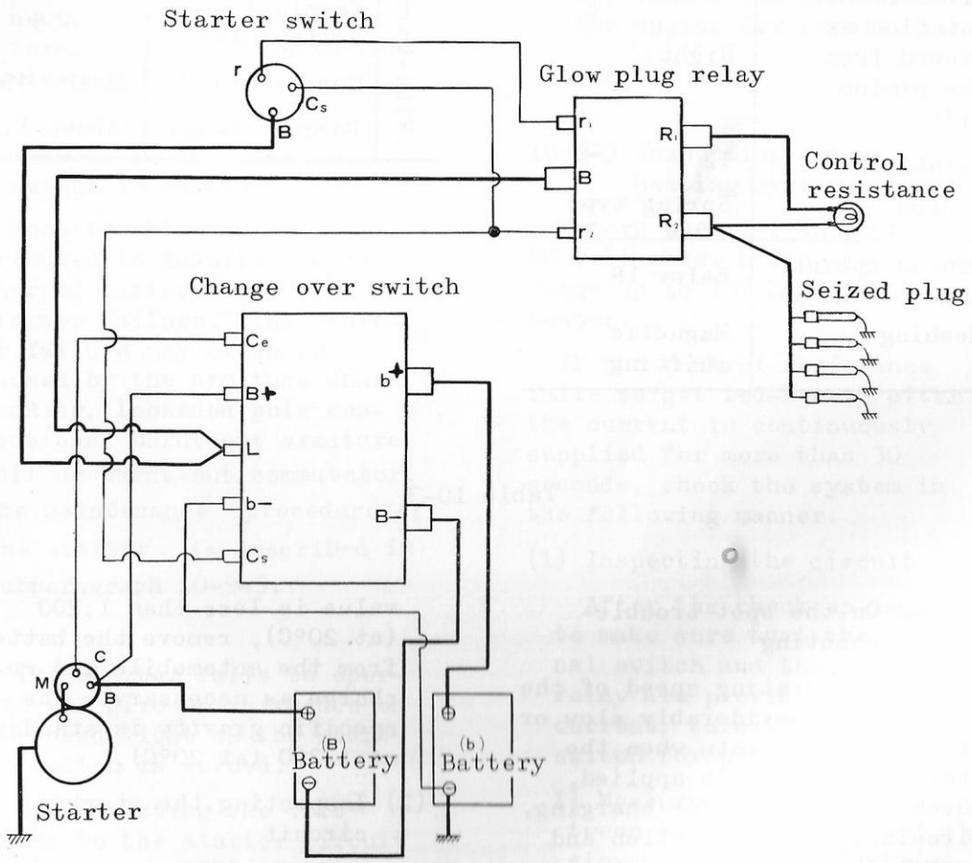


Fig. 10-95

10-9-2 Specifications of the starter

Type	24MW-A	Non-load	Terminal voltage (V) 21
Rated output (seconds)	30		Current (A) Below 60
Nominal power output (KW)	1.5		Speed of rotation Above 7500
Direction of rotation as viewed from the pinion side	Right	With-load	Terminal voltage (V) 4.5
Weight (kg)	12		Current (A) Below 450
Clutch	Spring type		Torque (m-kg) Above 1.8
Pinion operating voltage (V)	Below 18		
Meshing	Magnetic shifting		

Table 10-3

10-9-2 On the spot trouble-shooting

If the operating speed of the starter is considerably slow or if fails to operate when the starting current is applied, check the battery for charging, circuit for disconnection and poor contact of the terminal connections before dismantling the starter for repair.

(1) Inspecting the battery

Measure the specific gravity of the battery electrolyte and if the measured value is less than 1.200 (at 20°C), remove the battery from the automobile and recharge as necessary. The specific gravity is standard at 1.260 (at 20°C).

(2) Inspecting the starter circuit

Turn the head lights on and then turn the starter switch and check the following.

1) If the head lights goes out as the starter switch is turned: Check to make sure that the cables are properly connected to the battery terminals. Loosened terminal connections may be detected by touching the cable with finger. The terminal tends to get heated if it is provided with undue resistance for poor connection. In the event if the trouble is attributed to poorly connected cables, clean the terminal and retighten the clamping bolts.

2) If the head light power reduces as the starter switch is turned

Such trouble may be attributed to insufficiently charged battery or the starter failure. The starter failure may often be caused by the armature shaft bending, loosened pole connections, burnt-out armature coil or burnt-out commutator. The maintenance procedure of the starter is described in subparagraph 10-9-5.

3) The starter fails to operate and give no influence on the head light as the starter switch is turned.

By connecting the volt meter to the starter circuit in the manner illustrated in Fig. 10-12, check the voltage drop in the circuits. The volt meter required for this check-up is: DC volt meter having measurable range of 1-5V.

The voltage drop in the circuit when the starter switch is turned on should be less than 0.2V. If the voltage drop is in excess of 0.2V, check the connections and retighten the clamping bolts as necessary. If the starter failure is detected by the above check-up, remove the starter from the engine for repairing.

10-9-3 Inspecting the pre-heating system

Meters used for inspection: DC volt meter having measuring range up to 15V and circuit tester.

If the control resistance fails to get red-heated after the current is continuously supplied for more than 30 seconds, check the system in the following manner.

(1) Inspecting the circuit

After the check up is made to make sure that the terminal switch and the glow plug relay are provided with the current, turn the starter switch for pre-heating.

1) Measure the voltage between the terminal r_1 of the glow plug relay and the ground. If the volt meter fails to give response when it is connected to the circuit or the voltage differential between the glow plug relay and the terminal B is more than 0.2V, replace the

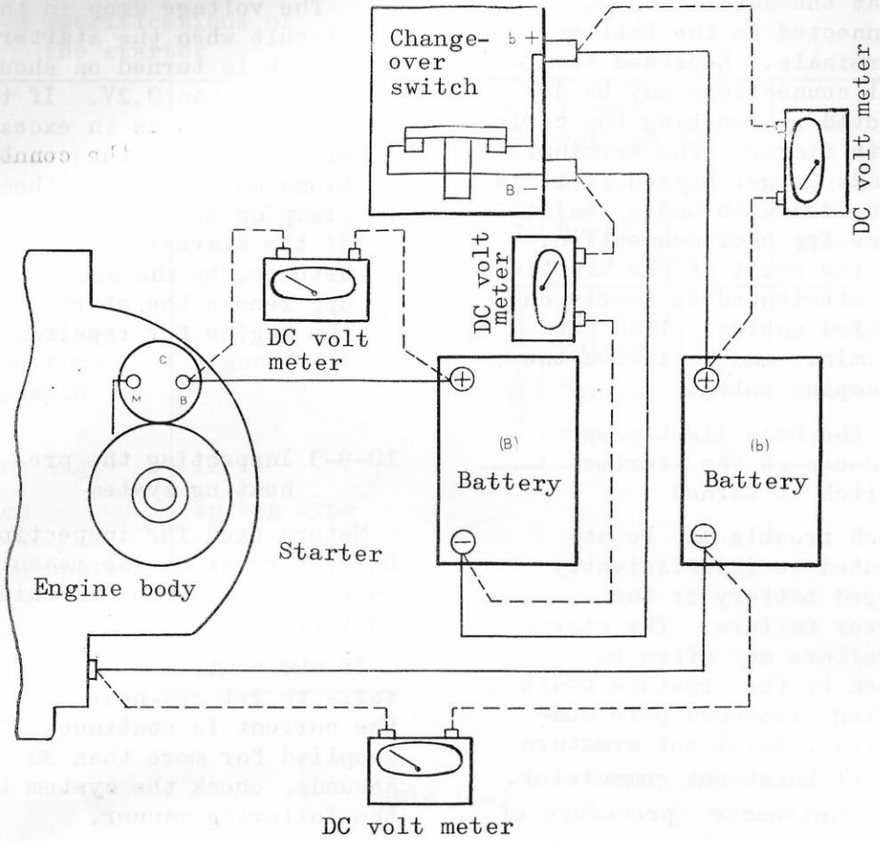


Fig. 10-96

glow plug. Then, insert lead of the terminal r_1 into the terminal r_1 and inspect the circuit for voltage drop in the same manner. (See Fig. 10-97)

2) Connect DC volt meter in the circuit between the terminals R_1 and R_2 of the glow plug relay for measuring the voltage thereof. If the measured value is 0 or above 0.8V, the trouble may be attributed to disconnected control resistance, disconnected circuit or loosened connections. (See Fig. 10-97)

(2) Inspecting the seized glow plug

Remove the connecting plate from the seized glow plug and then, connect the circuit

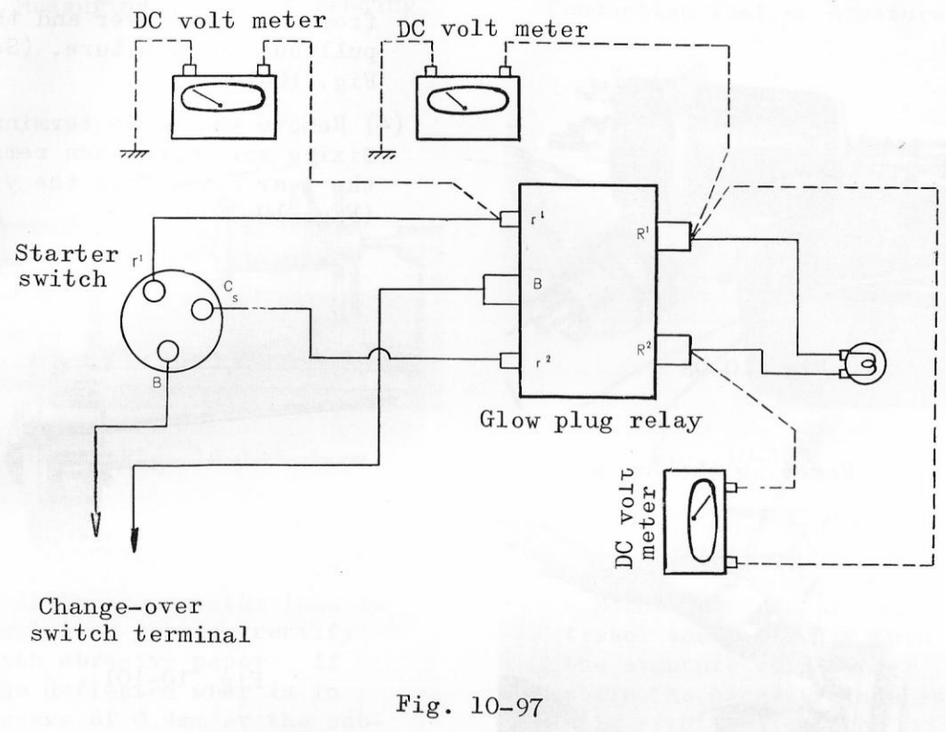


Fig. 10-97

ester in the circuit between he seized glow plug and the ngine body for checking the resistance thereof.

1) If the tester indication is 0, the trouble is attributed to internal short-circuit.

2) If the tester pointer indicate the maximum, the trouble is caused by disconnection.

3) If the tester pointer indicate 1.2 ohms. the glow plug may be regarded as normal.

10-9-4 Dismantling the starter

(1) Turn loose the terminal nut on the terminal M of the magnet switch and then, remove the connecting plate from the starter. Then slacken the two bolts fastening the magnetic switch to the gear case. (See Fig. 10-98)

(2) Remove the brush band and lift the brush spring and then remove the carbon brush from the brush box. (See Fig. 10-99)

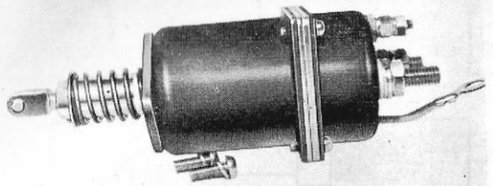


Fig. 10-98

Removing the Brush

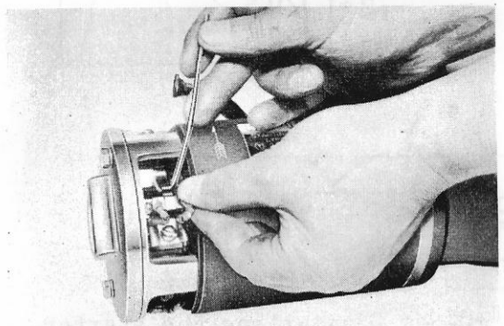


Fig. 10-99

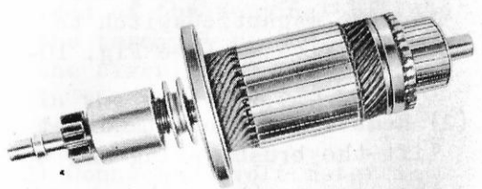


Fig. 10-100

(3) Remove the through bolts from the rear cover and then pull out the armature. (See Fig. 10-100)

(4) Remove the brush terminal fixing screw and then remove the rear cover from the yoke. (Fig. 10-101)

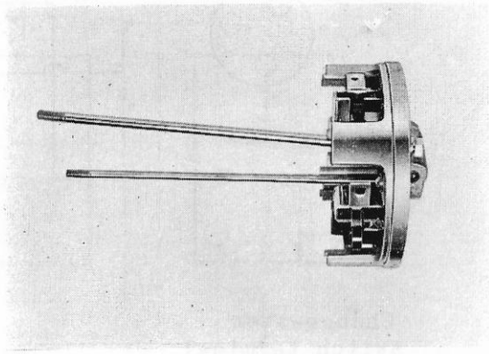


Fig. 10-101

(5) Remove the Stopper ring on the armature shaft end and then dismount the clutch assembly.

10-9-5 Maintenance and inspection

(1) Inspecting the armature

1) Armature shaft bending

Check the armature shaft bending with use of a dial gage. If the bending is in excess of 0.1mm, the shaft should be rectified. (See Fig. 10-102)

Measuring the Shaft Bending

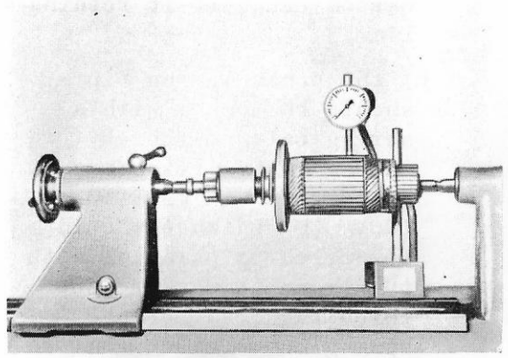


Fig. 10-102

2) Inspecting the commutator

If the commutator face is fouled or glazed, rectify with abrasive paper. If the deflected wear is in excess of 0.4mm or the subsidence of the mica insulator is below 0.2mm rectify the commutator in a lathe to hold the deflection within 0.05mm and to make the depth of mica insulator to 0.5 - 0.8mm. The limit for reduction in the commutator diameter is 2mm.

3) Conduction test between the commutator and shaft

Contact one of the tester nozzle to armature shaft and another to commutator as illustrated in Fig. 10-103. If conduction takes place therebetween, the armature is short-circuitted and hence, it should be regarded due for replacement.

Conduction Test on Armature

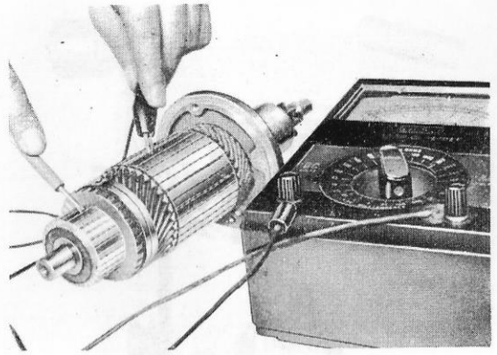


Fig. 10-103

4) Testing the armature

Mount the armature on the tester and carefully turn the armature with finger while the hacksaw blade is held right against the armature. If the armature is short-circuitted, the hacksaw blade is either magnetized or vibrates. The armature should then be replaced. (See Fig. 10-104) At which time check to make sure that the soldered portion on the commutator is normal.

5) Inspecting the yoke

Check the insulation between the field coil and yoke with use of a tester. If conduction takes place therebetween, check the terminal connections for insulating effect and if this part is free of trouble, the trouble may

Testing the Armature

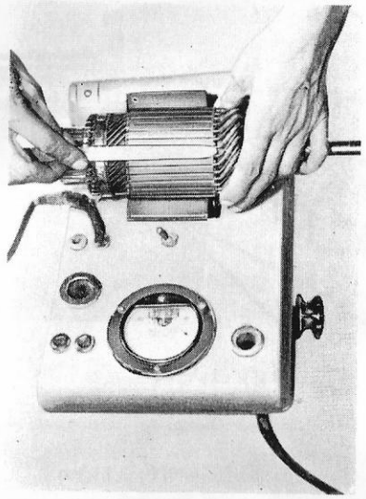


Fig. 10-104

be attributed to short-circuitted layer in the field coil. In the event of such trouble, turn loose the screw on the pole core and replace the field coil. (See Fig. 10-105)

Checking the Yoke

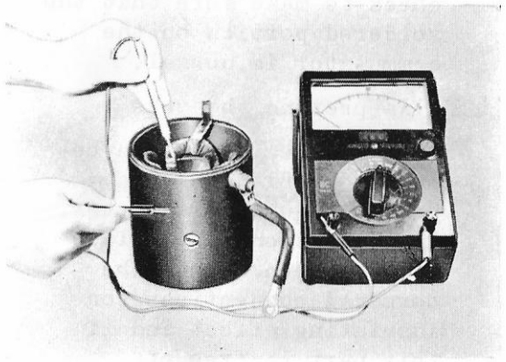


Fig. 10-105

6) Inspecting the rear cover

a) Check the height of the carbon brush if it retains 14mm.

b) The brush spring tip should be hooked with a spring balance thereby checking its pressure as illustrated in Fig. 10-106. The balance should be pulled in parallel with the brush to measure the force required for the spring to release from the brush. The brush strength is normally of the order of 0.9 - 1.1 kg.

(2) Inspecting the gear case

Put the gear case metal through the armature shaft. If the clearance is in excess of 0.2mm, the metal should be replaced. For inserting a new metal, the inside diameter of which should be finished to 14ϕ.

After the metal is finished, smear it with engine oil SAE 10-20#.

(3) Inspecting the over-running clutch

Clamping interference is provided between the driving spring and sleeve. This is normal at 0.25-0.5mm. If the clamping margin is reduced due to wear, bend the edge of the spring inner ward to adjust the inner diameter to 0.7mm in the manner illustrated in Fig. 10-107 and smear it with engine oil and then, as-

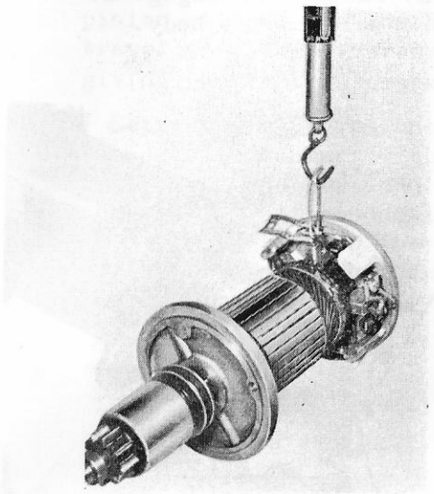


Fig. 10-106

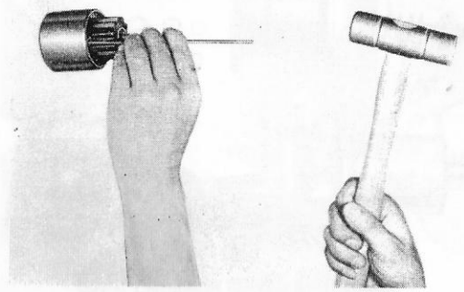


Fig. 10-108

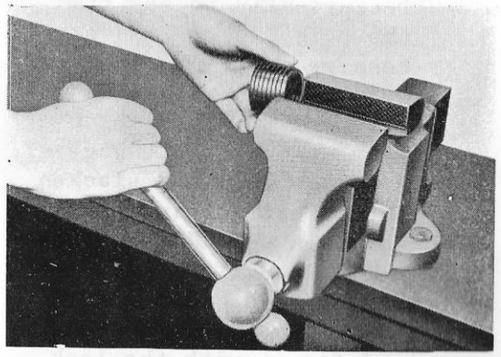


Fig. 10-107

semble it. The method for removing the drive spring is illustrated in Fig. 10-108. For inserting the drive spring back into place, see Fig. 10-109.

(4) Inspecting the engagement

Remove the solder from the terminal and remove the nut

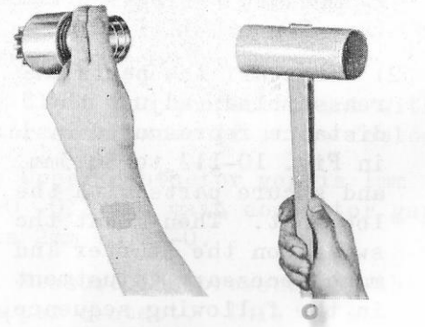


Fig. 10-109

and washer from the terminal C and then, dismount the switch cover. Slacken the lock nut on the adjust screw and then dismantle the adjust screw and return spring. Fig. 10-110 illustrates the magnet switch as dismantled. Fouled contactor face should be cleaned with use of abrasive paper.

1) Check to see if there is provided a clearance of 15± 0.1mm between the switch

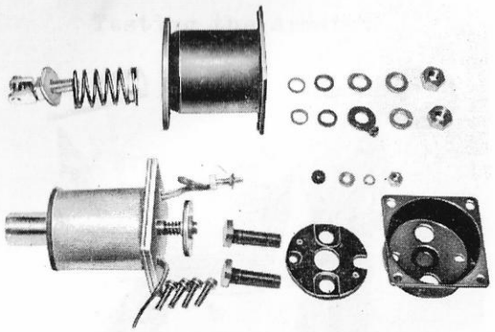


Fig. 10-110

cover and the terminal bolt when the terminal bolt is clamped to the switch cover. (See Fig. 10-111)

2) After all the parts are reassembled, adjust the distance represented by L in Fig. 10-112 to 56.5mm and secure parts with the lock nut. Then mount the switch on the starter and make necessary adjustment in the following sequence.

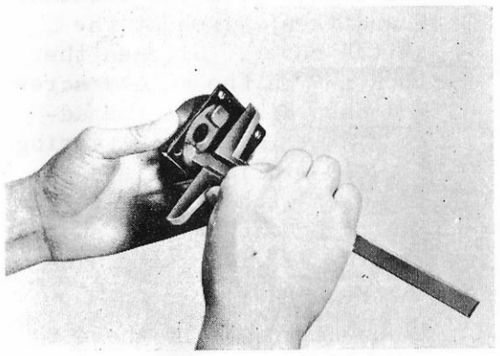


Fig. 10-111

a) Fasten the engage securely to the body.

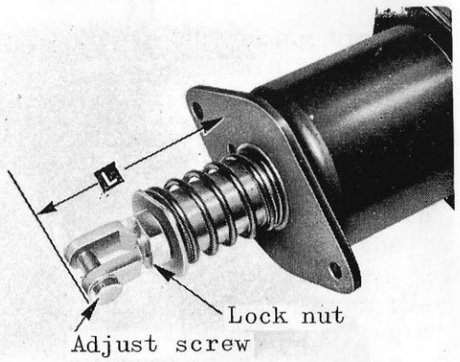


Fig. 10-112

b) Carefully move the pin reciprocally to see if there is provided an excessive play. Play of 0.3-0.5mm is rather desirable and if there is no play, remove the engage from the body and slacken the adjust nut and then, screw in the adjust screw a little. If the play is in excess of 0.5mm, turn loose the adjust screw and fix it with the lock nut.

c) Connect the tester in the circuit between the terminals B and M on the engage.

d) Remove the rubber cap on the upper part of the gear case and then insert a screwdriver through the hole and press the pinion. Check to see if the pinion comes in contact with the pinion stopper and further travel innerward thereby giving the tester response.

e) Retract the pinion until it comes in contact with the pinion stopper and check to see if conduction takes place between the terminals B and M on the engage. (See Fig. 10-114)

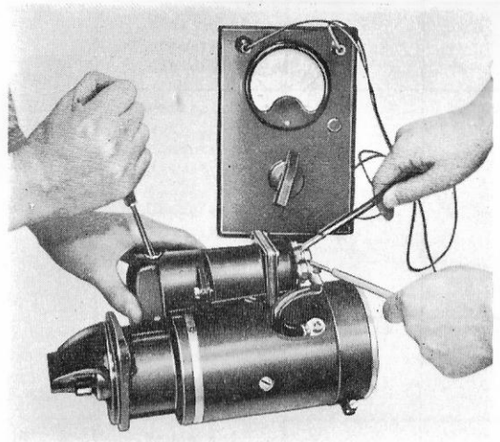


Fig. 10-113

Conduction should not take place if the engage is properly adjusted. If conduction takes place between the said terminals, the starter may often fail to stop when the starter switch is turned off after the engine is started.

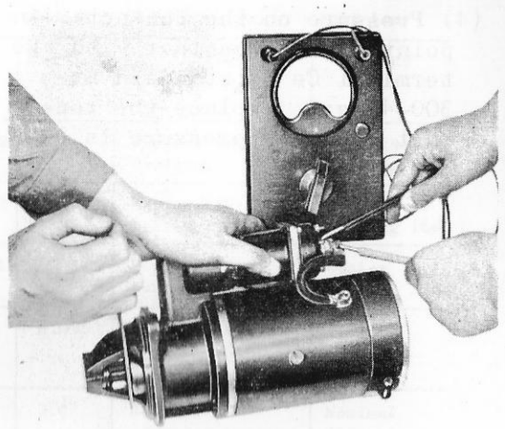


Fig. 10-114

10-9-6 Inspecting the change-over switch

(1) Clean the contact point with abrasive paper if it is fouled.

(2) Upper contactor gap is 1mm +0 -0.2 and main contactor gap is 2mm +0.2 -0.

(3) Measure the pressure of the upper contact. This is standard at 200-300gr.

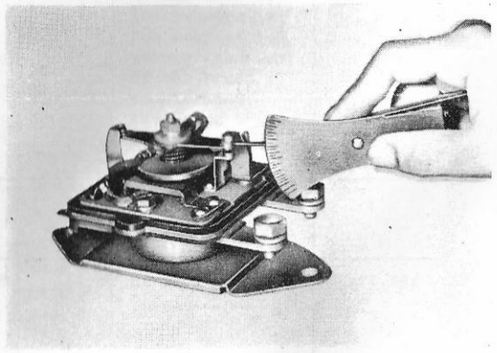


Fig. 10-115

(4) Pressure on the contact point held in contact with the terminal Ce is standard at 300-400gr. Replace the contact point is pressure is excessively low.

For measuring the point pressure, read the value on the pressure when the point opens.

Maintenance Standard Unit (mm)

		Check spot	Due for correction	Standard value for assembling	Service limit	Correction	Remarks
Armature shaft	Clearance between shaft and bearing	Gear case bearing	Above 0.2	0.016~0.052		Replace the bearing	Gear case bearing 14ϕ
		Rear cover bearing	Above 0.2	0.016~0.052		Replace the bearing	Rear cover bearing 16ϕ
		Center bearing	Above 0.25	0.070~0.141		Replace the bearing	Center bearing 25ϕ
		Wear and bending of the shaft	Above 0.1		0.05	Replace the shaft Rectify	
Commutator		Wear in the commutator diameter			3.0	Replace	Nominal dimension 49ϕ
		Deflected wear in the commutator diameter	Above 0.4	Below 0.05		Rectify	
		Depth of the mica insulator in the commutator	Below 0.2	0.5~0.8		Rectify	
		Commutator face				Rectify with abrasive paper if fouled or scuffed	
Carbon brush		Brush and brush spring			Length of the brush to 14mm	If the contacting face of the brush to commutator is not correct, or the tensile force of the brush spring is not even or the tension is too wear or too strong, the wear of the brush is accelerated. If the brush bracket is not normal, correct it.	Nominal length of the carbon brush 25. Tensile strength of the carbon brush as mounted in place is 0.9 1.1kg.
		Pinion				If the wear is serious, rectify or replace it.	
		Clearance between the pinion bearing and shaft	Above 0.2	0.032~0.068		Replace the bearing	Shaft 14ϕ

10-10 ALTERNATOR AND VOLTAGE REGULATOR (NIKKO)

10-10-1 Specifications

Alternator		Voltage regulator	
Type	12AGY	Type	12AR
Rated capacity	12V/400W	Adjusting method	
Power output	13V/31A (3000 rpm)	Non-load adjusting voltage	14±0.50V (2500 rpm)
Direction of rotation	Right (as viewed from pulley side)	Field relay operating speed	Below 1100 rpm
Pulley diameter	80ϕ	Ground polarity	⊖
Ground polarity	⊖	Weight	0.58 kg
Rectification	three phase all-wave rectification		
Brush	2 (Two) 7x7x14 (mm)		
Bearing	Front 6204VV Rear 6203VV		
Weight	6.5 kg		
Field coil resistance	4		

Table 10-4

10-10-2 On-the-spot trouble-shooting

On detection of charging failure, check the fan belt tension, circuit disconnection, short-circuitting, incorrect wiring, loosened terminal connection and contact point failure before dismantling the alternator and voltage regulator.

(1) Measuring the circuit resistance

Meters used for this test

Ammeter ... having maximum division of 15-30A

Volt meter ... having maximum division of 1-5V

1) PR20 series (with single battery)

a) Connect ammeter and volt meter into circuit illustrated in Fig. 10-116.

b) Start the engine and check to make sure that the charging current is generated and then, hold the engine at idling speed. Then connect the terminals B and F on the alternator in jumper and disconnect the terminal lead F from the voltage regulator.

c) Disconnect the leads from the meter.

d) Gradually increase the engine speed and adjust the engine speed to hold the charging current to 10A.

e) Then, connect the volt meter in circuit as illustrated in Fig. 10-117 and measure the voltage drop in the negative side. Check to make sure that the voltage difference is within 0.4V.

2) PR-D10 series (with two-battery)

Measure the voltage drop in the individual charging circuit as illustrated in Fig. 10-118. For diesel engine, turn the starter switch off instead of disconnecting the meter connections.

a) B side of the battery regarded as normal if the addition of volt meter reading (3) (4) and (2) comes lower than 0.4V when the ammeter (1) reading is at 10A. If the voltage drop is more than 0.4V, check the charging circuit and make necessary corrections.

(2) Inspecting the alternator output

Meters used:

Ammeter ..... having divisions of 50A

Volt meter .. having divisions of 20-30V

Tachometer .. Hone or hustler

Variable resistor ... Maximum load 50A

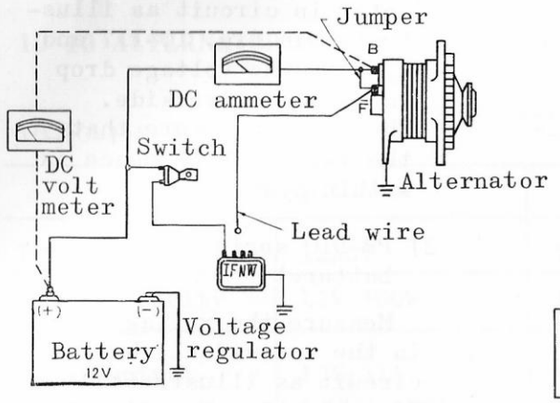


Fig. 10-116

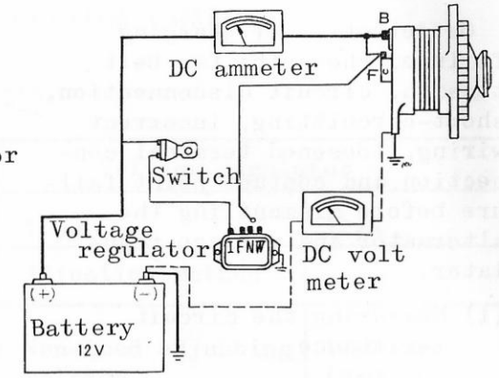


Fig. 10-117

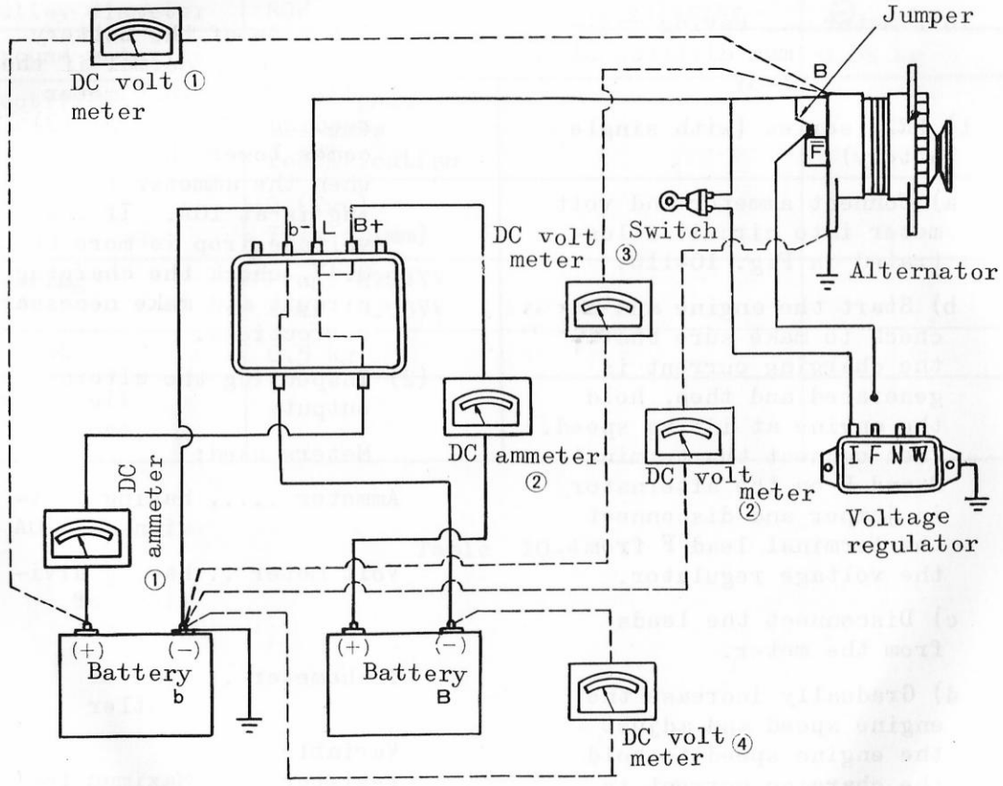


Fig. 10-118

1) Connect the volt meter, ammeter and variable resistor in the manner illustrated in Fig. 10-119.

2) Start the engine and check to make sure that the charging current is generated and then hold the engine at idling speed.

3) Connect the terminals B and F of the alternator in jumper and then, disconnect the voltage regulator terminal lead F.

4) Gradually increase the engine speed and when the volt meter indicate 13V, turn on the variable resistor switch and adjust the rotation of the alternator to 3,000 r.p.m. Hold the voltage from increasing beyond 15V and set the engine speed while adjusting the voltage with use of variable resistor.

5) Adjust the load with variable resistor to hold the volt meter reading to 13V, then read the ammeter indication and compare it with the output given in the Table 10-3. If the meter reading is excessively lower than the specified value, dismantle the alternator and make necessary correction.

6) For models PR-D10, connect the variable resistor into position as illustrated in Fig. 10-120 and test the charging circuit for failure.

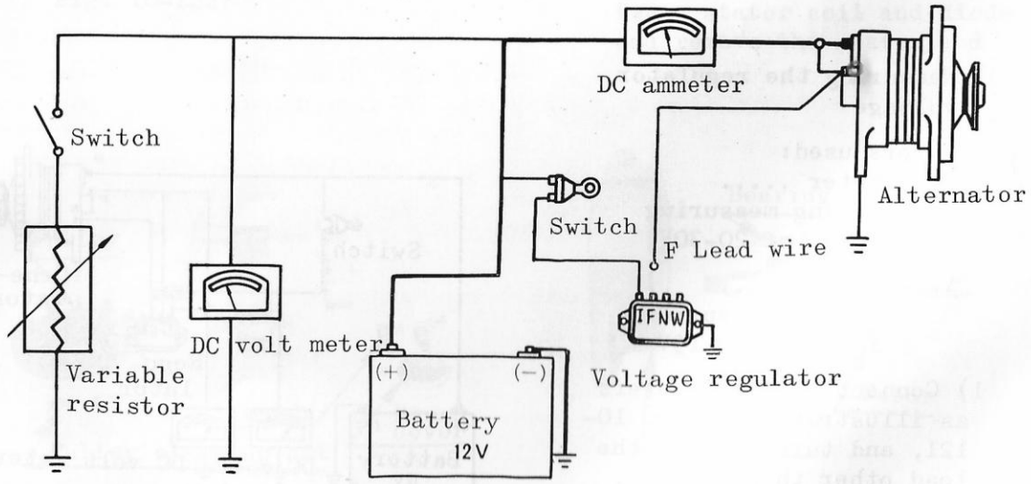


Fig. 10-119

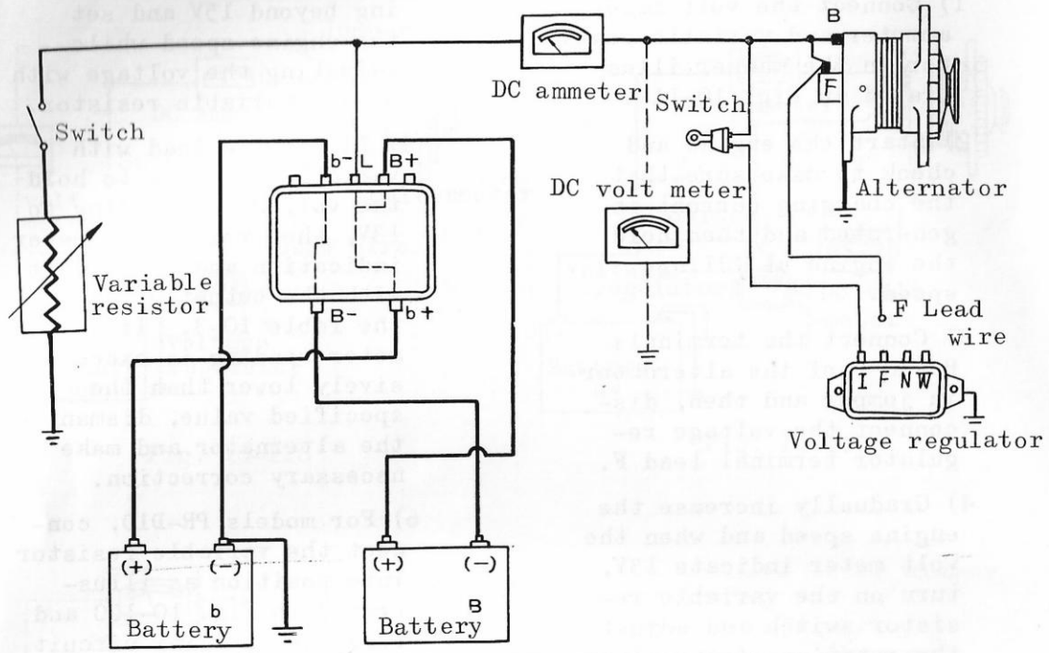


Fig. 10-120

(3) Measuring the regulator voltage

Meters used:
Volt meter .....
having measuring range of 20-30V

Volt meter .....
having measuring range of 10-15V

1) Connect the volt meters as illustrated in Fig. 10-121, and turn off all the load other than battery. Start the engine and keep charging the battery by operating the alternator

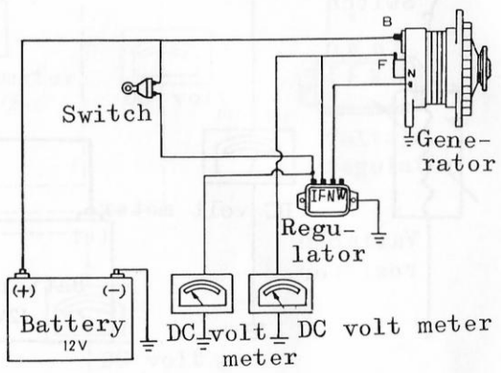


Fig. 10-121

at 3,000 r.p.m. until the voltage measured by connecting the volt meter between the terminal F of the alternator and ground indicates 4V or above.

2) Stop the engine and again start it to see if charging current measured at position between the terminal (1) of the voltage regulator and ground comes between 13.5 - 14.0V when the engine speed is increased from idling.

10-10-3 Dismantling the alternator for inspection

(1) Dismantling

1) Remove the pulley clamping nut and then dismount the pulley. Also remove the brush and brush cover from the rear cover. (See Fig. 10-122)

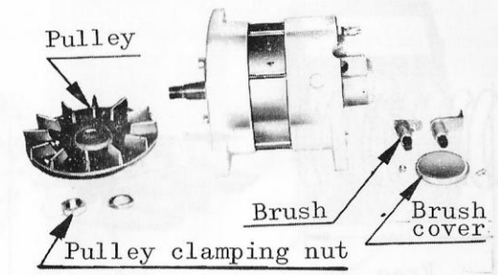


Fig. 10-122

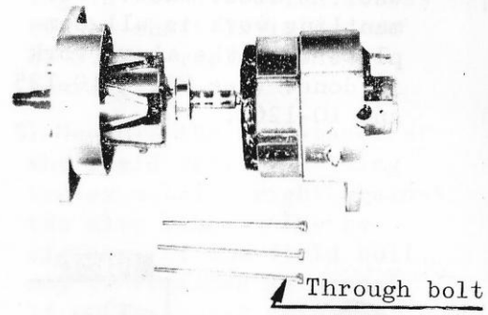


Fig. 10-123

2) Remove the through bolt and then, remove the front cover. (Fig. 10-123)

3) Remove the bearing retainer fixing bolt from the front cover and then, remove the rotor from the front cover. (Fig. 10-124)

4) Disconnect the joint between stator coil and diode and remove the stator and

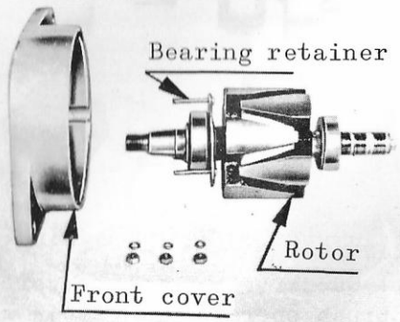


Fig. 10-124

rear cover. Then, remove the (+) diode base. Dismantling work is all complete when the above work is done. (See Figs. 10-125 and 10-126).

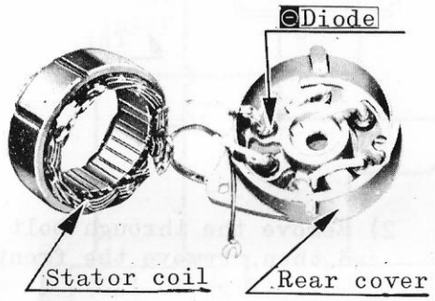


Fig. 10-125

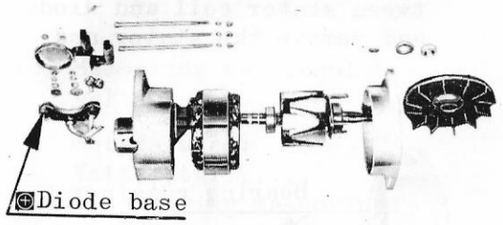


Fig. 10-126

(2) Inspecting and repairing

1) Check to see if the carbon brush operates freely in the brush holder. Replace the brush if it is worn and no longer gives 7mm. (See Fig. 10-127)

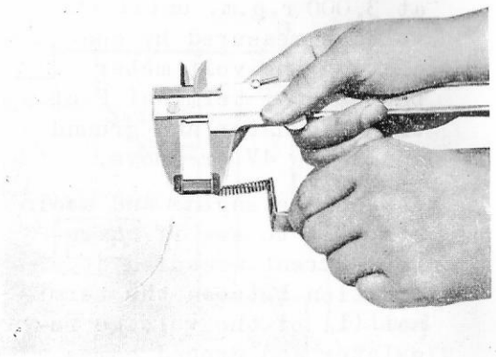


Fig. 10-127

2) The tensile strength of the brush spring is standard at 0.2 kg when it is compressed to 12mm. Weakened spring should be replaced.

3) Check the slip ring for roughened sliding face or deflected wear. Replace the slip ring if it fails to give 15mmø.

4) Check the bearing after every 24,000 km of travel distance and apply high temperature grease as necessary. If the bearing fails to rotate smooth or

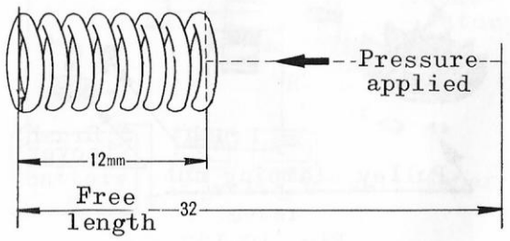


Fig. 10-128

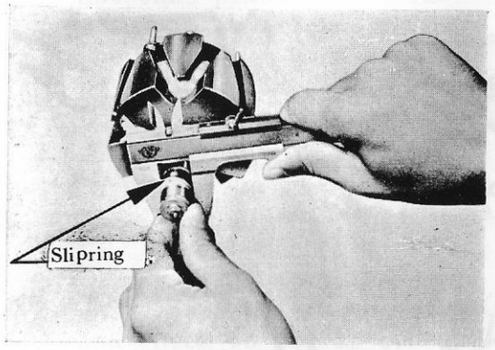


Fig. 10-129

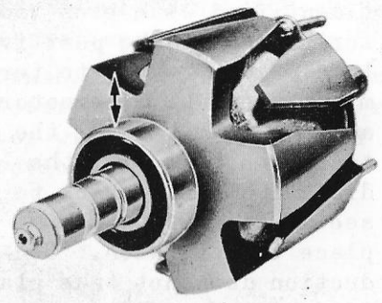


Fig. 10-130

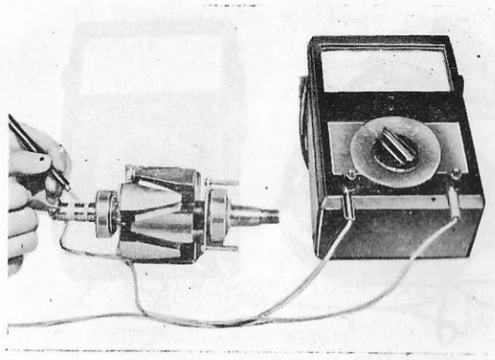


Fig. 10-131

the clearance of the bearing in the direction across to the shaft is in excess of 0.1mm, replace the bearing.

5) Measure the resistance of the field coil by holding tester nozzles right against the slip rings. The resistance of the field coil may be regarded as normal if the measured value is between 4-5 ohms. If the value is lower than 4 ohms, the trouble may be attributed to internal short-circuit. Greater resistance may be provided if the field coil is disconnected. (Fig. 10-131)

6) For checking the stator coil, disconnect the circuit between the stator coil and diode and then, connect the tester between the lead of the coil and the core, if conduction takes plate therebetween, the trouble may be attributed to short-circuit. (See Fig. 10-132)

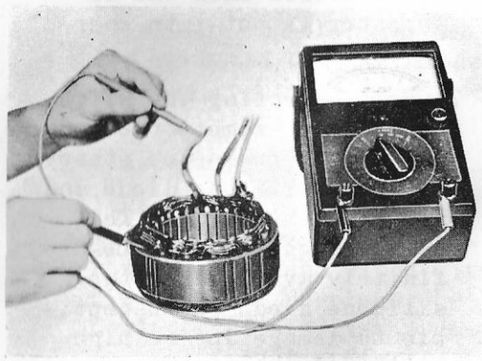


Fig. 10-132

The stator coil may be regarded as normal if the resistance measured between three of the lead wires is almost close to 0 and if conduction does not take plate between lead wires, the trouble may be attributed to disconnection. (Fig. 10-133)

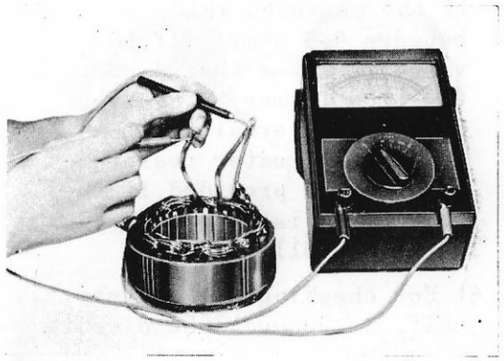


Fig. 10-133

Trouble with the stator coil can easily be detected in the manner similar to diode failure, as the fan belt vibrates and abnormal noise arises when the alternator is put into operation.

7) For inspecting the silicone diode, remove the connections between the stator coil and silicone diode and leads of the diode. The use of megger should be definitely avoided for the silicone diode is susceptible to damage due to high voltage developed by the tester. For checking the

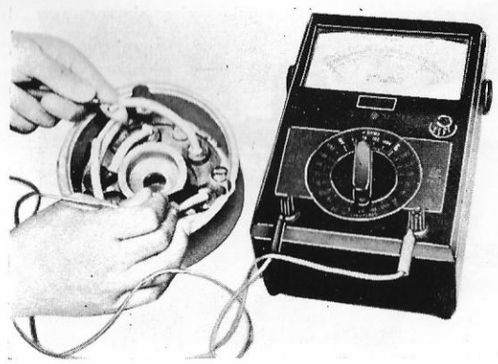


Fig. 10-134

positive side of the diode (identified with blue color), connect the positive lead of the tester to terminal B of the alternator and negative lead of the tester to outlet of the diode and then, check to see if conduction takes place therebetween. Conduction does not take place if wrong connections are made. (See Figs. 10-134 and 10-135) If conduction does

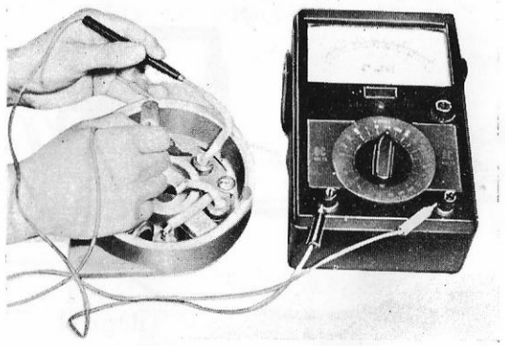


Fig. 10-135

not take place or the resistance is extremely low, the trouble may be caused by faulty diode.

For checking the negative side of the diode (identified with red color), connect the positive lead of the tester to outlet of the diode and negative lead of the tester to rear cover and check to see if conduction takes place.

(3) Reassembling

For reassembling the alternator, reverse the procedure for dismantling. Check the operation of the carbon brush, thrust bearing of the rotor and then, turn the rotor with finger to see if it rotate smoothly.

10-10-4 Dismantling and reassembling the voltage regulator

(1) Dismantling

1) Remove the voltage regulator cover.

2) Remove the resistors on the rear side of the voltage regulator. (See Fig. 10-136)

3) Remove the point retainer and armature plate from the yoke. (See Fig. 10-137)

4) Remove clamping nuts on the reverse side of the

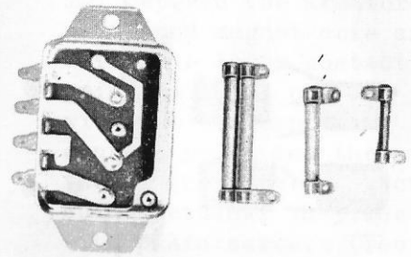


Fig. 10-136

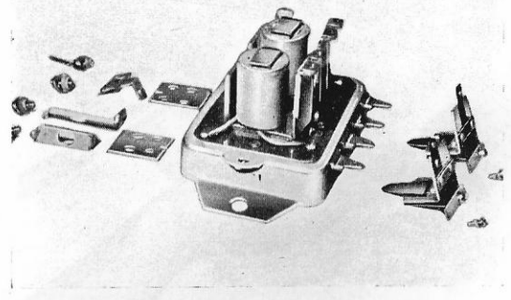


Fig. 10-137

regulator and then remove the yoke and coil from the voltage regulator base. (Fig. 10-138)

(2) Inspecting and repairing

1) Fouled contact points should be cleaned with abrasive paper and wiped with clean cloth. Replace the contacts points if the wear is significant. (Fig. 10-139)

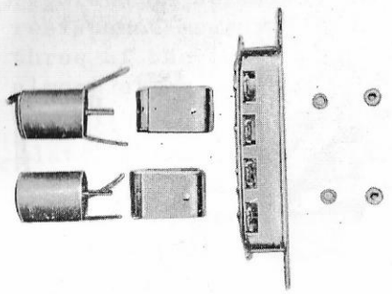


Fig. 10-138

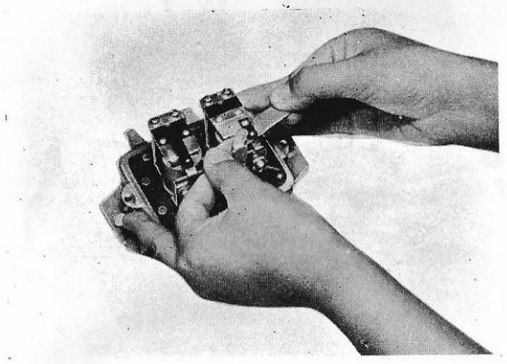


Fig. 10-139

2) For checking the pressure coil circuit in the voltage regulator, connect the tester between the terminal W and base. The coil may be regarded as normal if it is provided with 76 ohms of resistance. If conduction does not take place or the resistance is extremely low, the trouble may be attributed to disconnected or short-circuitted pressure coil or compensating resistor (55 ohms) and hence, the voltage regulator should be replaced. (See Fig. 10-140)

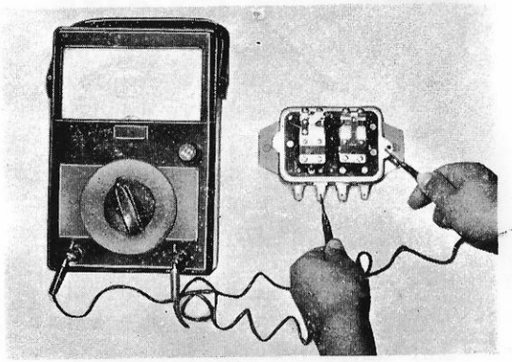


Fig. 10-140

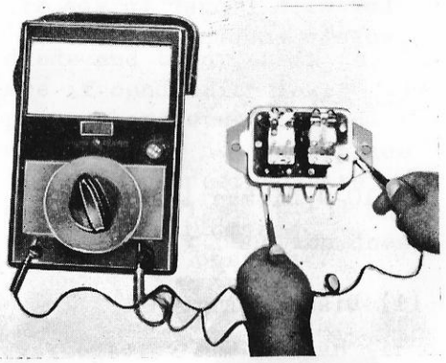


Fig. 10-141

3) For checking the pressure coil circuit in the field relay, connect the tester between the pressure coil terminal N and base. The coil may be regarded as normal if it is provided with resistance of 41 ohms. If conduction does not take

place or the resistance is extremely low, the trouble may be attributed to short-circuitted or disconnected pressure coil. The voltage regulator with faulty coil should be replaced. (Fig. 10-141)

(3) Reassembling

For reassembling the voltage regulator, reverse the procedure for dismantling.

1) Voltage regulator

(a) Mount the magnet yoke and coil on the voltage regulator base and then insert a gap gage (0.7mm) in the clearance between the yoke and armature plate. Then mount the armature plate on the yoke with plain screw. (The clearance between the yoke and armature plate is 0.7mm) (See Fig. 10-142)

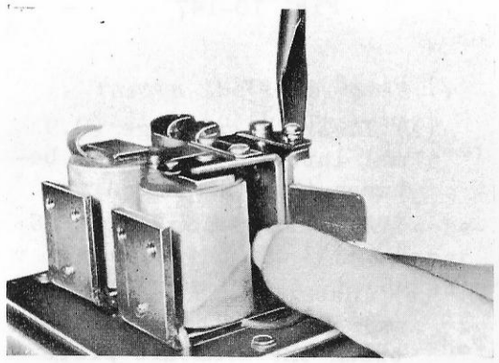


Fig. 10-142

(b) Insert a gap gage (1.1 mm) between the armature plate and magnet core and bring the lower contact point in light contact with the corresponding contact point and then, fasten the lower contact point retainer in place with plain screw. (The points gap is 1.1mm) (Fig. 10-143)

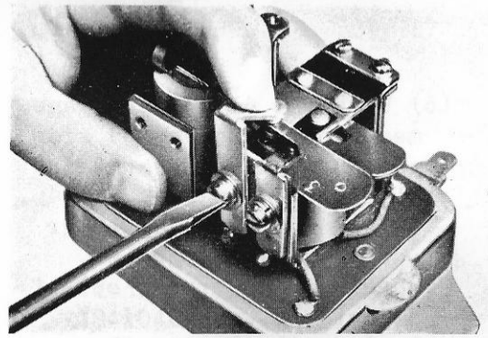


Fig. 10-143

(c) With the lower point held in contact with the corresponding point, insert a gap gage (0.3mm) into clearance between the upper points and fasten the upper point retainer to the body with plain screw. (Fig. 10-144)

(d) Adjust the clearance between the armature plate and adjust spring to 0.3-1.0mm by turning the adjust screw as necessary.

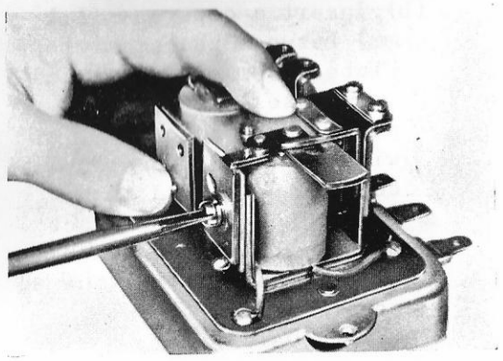


Fig. 10-144

(e) With use of tension gage, measure the low speed side point opening pressure as illustrated in Fig. 10-146. This is standard at 120gr - 130gr. If the point opening pressure is out of adjustment, adjust it by bending the lug on the yoke with use of an adjuster.

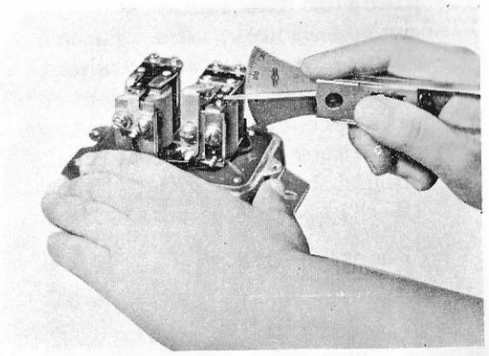


Fig. 10-146

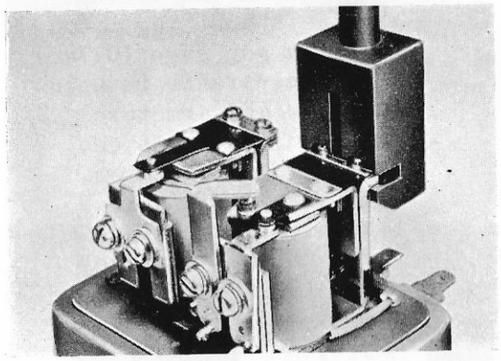


Fig. 10-147

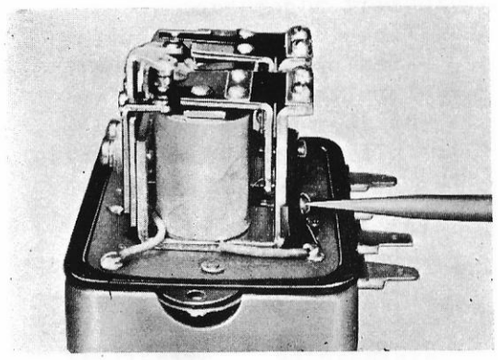


Fig. 10-145

2) Field relay

(a) Insert a gap gage (0.9 mm) into the clearance between the yoke and armature plate is 0.9mm) (Fig. 10-148)

(b) Insert a gap gage (0.9 mm) into the clearance between the armature plate and magnet core and bring the lower point into light contact with the corresponding point and then

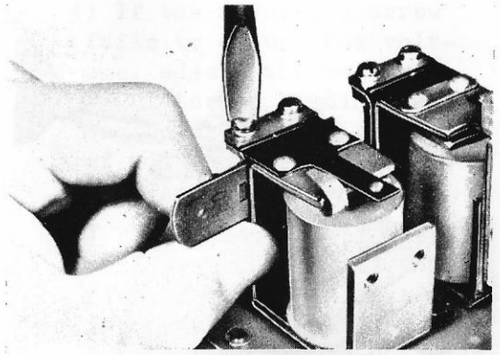


Fig. 10-148

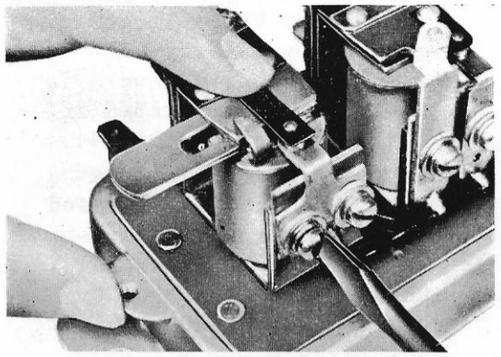


Fig. 10-149

fasten the lower point retainer to the base with plain screw. (Fig. 10-149)

(c) Insert a gap gage (0.5 mm) into the clearance between the lower and upper point and then, bend the stopper point to bring it in light contact with the armature plate. (The point gap is 0.5mm) (Fig. 10-150)

(d) Further turn the adjust screw in after it has reached the adjust plate.

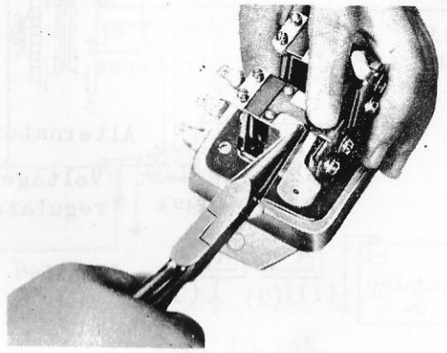


Fig. 10-150

(4) Adjusting

1) Voltage regulator

In the same manner as introduced in subparagraph 10-10-2 above, charge the battery until the voltage measured between terminals F and E becomes below 4V.

2) Stop the engine and again start it and accelerate the speed to vary the voltage between the terminals I and E. If the adjusting voltage comes between 13.5 - 14.0V (at normal operating temperature) within the range of low and high speed, the voltage regulator may be regarded as normal. If the voltage thereof is in excess of 13.5 - 14.0V turn the adjust screw counterclockwise to reduce the voltage and turn it clock-

wise to increase the voltage.

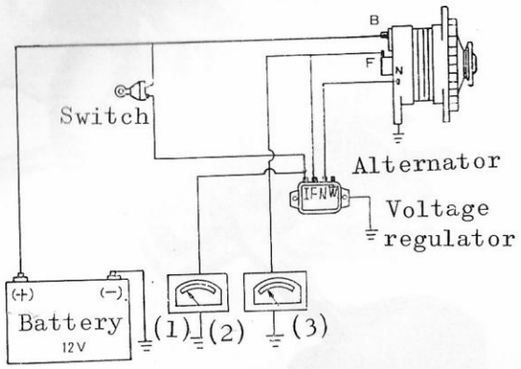


Fig. 10-151

(1) - DC voltmeter
(2) - DC voltmeter
(3) - DC voltmeter

3) Variation in the voltage in the circuit between the terminals I and E when the engine speed is increased is not detrimental to normal charging operation, but if the voltage thereof

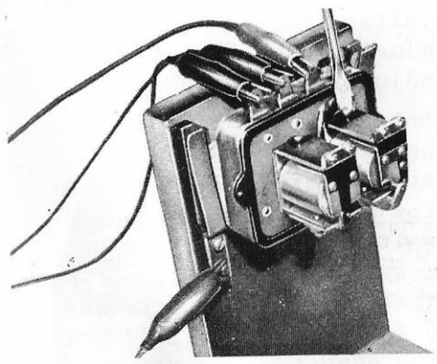


Fig. 10-152

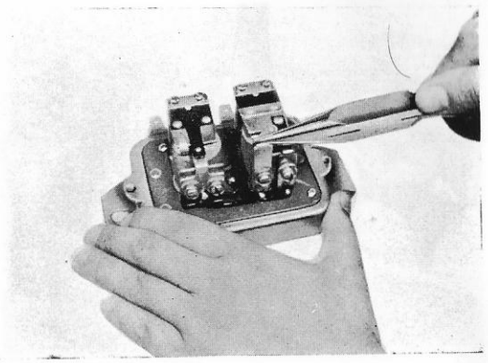


Fig. 10-153

tends to increase beyond 5V, adjust the voltage regulator by bending the point retainer downward in the manner illustrated in Figs. 10-153 and 10-154.

If the voltage tends to drop when the engine speed is increased, also adjust the voltage by adjusting the voltage regulator by bending the point retainer upward.

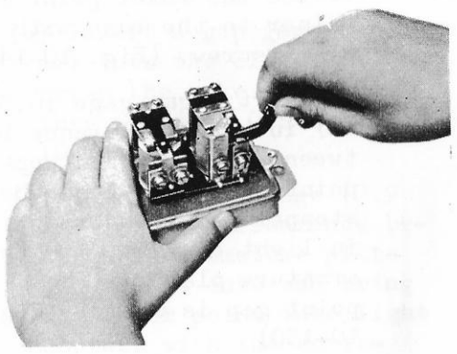


Fig. 10-154

4) If the adjusting screw fails to adjust the voltage, adjust the voltage regulator by bending the lug on the yoke with use of adjuster as illustrated in Fig. 10-147.

5) The adjustment of the voltage regulator is complete when the above adjustments are all done. But to make double-check, stop the engine and again start it and increase the speed to see if the charging voltage comes within 13.5 - 14.0V (at normal operating temperature).

(2) Field relay

Increase the operating speed of the alternator and check to see if the field relay point closes and the ammeter indication increases to 2.8A when the voltage in the circuit between the terminals N and E becomes 3.0 - 4.0V. If the points closes only when the voltage increases beyond 3.0 - 4.0V, adjust the voltage by turning the adjusting screw counter-clockwise. If the points closes with the voltage lower than 3.0 - 4.0V, turn the adjusting screw clockwise to adjust the voltage. (See Fig. 10-156)

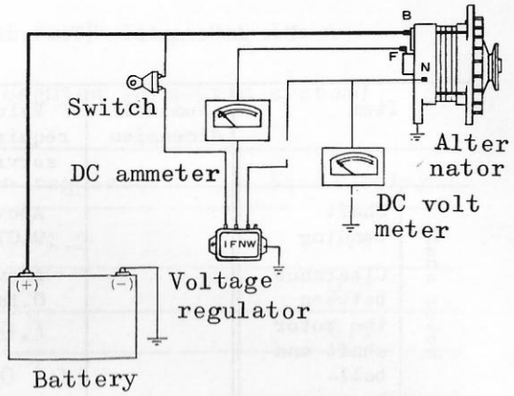


Fig. 10-155

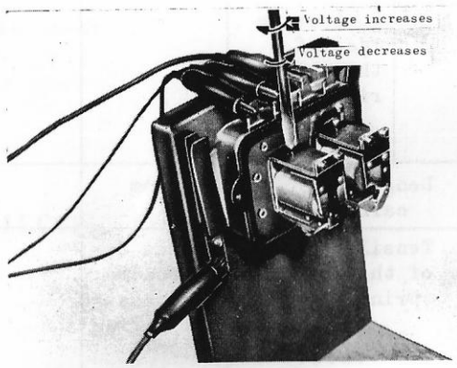


Fig. 10-156

10-10-5 Maintenance standard

The maintenance standards for alternator and voltage regulator are listed in Tables 10-5 and 10-6, respectively.

Maintenance Standard

For Alternator (The values are represented in metric system)

Item		Nominal dimension	Value requiring service	Standard value as assembled	Service limit	Correction
Rotor shaft	Shaft bending		Above 0.07mm			Rectify or replace
	Clearance between the rotor shaft and ball bearing		Above 0.1mm	Maximum 0.05mm		Replace the bearing
Slip ring	Diameter	17mm			15mm	15mm
	Deflected wear of the diameter		Above 0.4mm	Below 0.05mm		Replace
	Contacting face of the slip ring					Fouling or scuffing on the face may be cleaned with emery cloth
Length of carbon brush		14mm			7mm	
Tensile strength of the brush spring		Torque required to compress the spring to 20mm should be about 0.2kg				

Table 10-5

Maintenance Standard for Voltage Regulator

(The values are represented in metric system)

	Voltage regulator	Field relay
Operating clearance	1.1~1.2	0.9
Fixed clearance	0.7	0.9
Point clearance	0.3	0.5
Control resistor	10 (Ω)	—
Compensating resistor	55 (Ω)	—
Field resistor	—	17 (Ω)
Pressure coil	About 21 (Ω)	About 41 (Ω)

Table 10-6

10-11 RADIO RECEIVER (NATIONAL ELECTRIC COMPANY)

10-11-1 Specifications
(See Fig. 10-7)

Circuit: RF single stage
IF 2-stage amplification
6 transistors

Tuning: u-tuning, manual push button

Range of cycles:
535KC - 1605KC

Sensitivity:
20μV (20dB) or less (at output 0.5W)

Intermediate cycle:
455KC

Selectibility:
Above 18dB
(±10KC)

AGC characteristic:
Above 40dB

Maximum output:
Above 2.5W
(Maximum output without strain above 2W)

Output impedance: 8 ohms

Fidelity

	High tone	Low tone
100c/s	Within ±4dB	Within ±4dB
400c/s	0dB	0dB
2000c/s	—	Above -10dB
4000c/s	Within -15dB	—

Voltage of power source:
DC11~16V (Standard voltage 13.2V)
Power consumption:
About 9.9W (13.2V x 0.75A at maximum output)

Table 10-7

10-11-2 Construction

1. Radio receiver:
   Weight about 2 kg
   (Fig. 10-157)
2. Speaker:
   Weight about 500gr
   (Fig. 10-156)
3. Antenna:
   Weight about 400gr
   over-all length
   1060mm
   (Fig. 10-157)

10-11-3 Operating method

(1) Combination dial for power and volume (Fig. 10-157)

1) The power turns-on when the button is pushed and turns-off with another pushing.

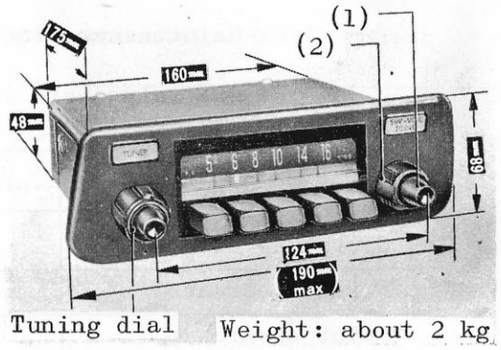


Fig. 10-157

(1) - Combination dial for power and volume
(2) - Tone control dial

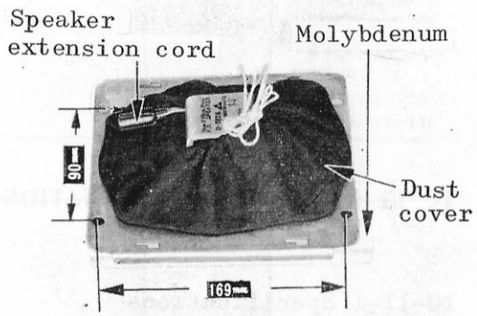


Fig. 10-158

2) The volume increases as the dial is turned clockwise.

(2) Tone control dial (Fig. 10-157)

1) Tone rises with the dial turned clockwise and lowers with it turned counter-clockwise.

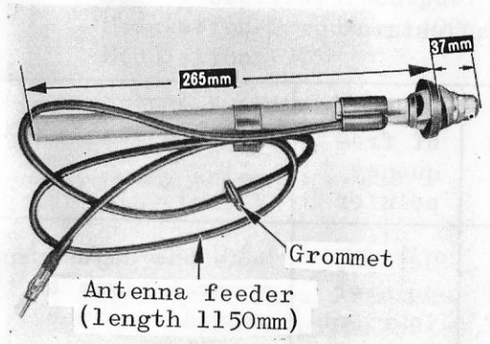


Fig. 10-159

(3) Tuning dial (Fig. 10-157)

This is for use in selecting the frequency without using the push botton control. This may also be used for setting the push botton.

(4) Method for adjusting the push botton

Pull the push botton all the way out and select the frequency with use of tuning dial and then, push the button all the way in.

10-11-4 Arrangement of the component parts

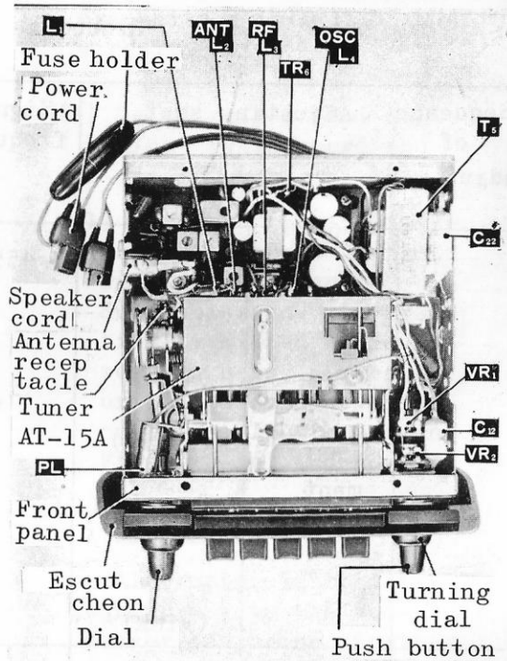


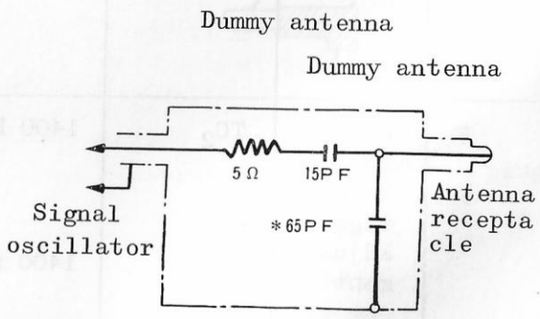
Fig. 10-160

10-11-5 Method for adjusting

(1) The following preparations should be made prior to adjustment.

1) Power source: DC 13.2V

2) Volume: Volume control turned to maximum and tone control also turned to maximum



*65PF include capacity of the feeder

Fig. 10-161

Procedure for adjustment

Sequence of adjustment	Adjusting spot		Signal frequency	Position of frequency pointer	Adjusting method
1	IFT adjustment	IFM_1 (Black)	455 KC	Set the pointer in right end	Make the adjustment several times to provide maximum output
2		T_3 (White)	"	"	
3		T_2 (Blue)	"	"	
4		T_1 (Pink)	"	"	
5	OSC adjustment	L_4 (Red)	525 KC	Point at which the frequency is lowest (left)	Calibrate to control so as to receive signal at any point within range of all frequency bound
6		TC_3	1650 KC	Point at which the frequency is highest (right)	
7	RF, ANT. Matching adjustment	TC_2	1400 KC	1400 KC point	Make the adjustment several times to provide maximum output
		TC_1	1400 KC	1400 KC point	

Table 10-8

3) Signal oscillator output: Modulation frequency 400c/s Modulation 30%

4) Signal supply: Antenna receptacle

5) Dummy antenna: Refer Fig. 10-161

(2) Sequence of adjustment

Adjustment should be made in the sequence given in Table 10-8 with reference to Fig. 10-162.

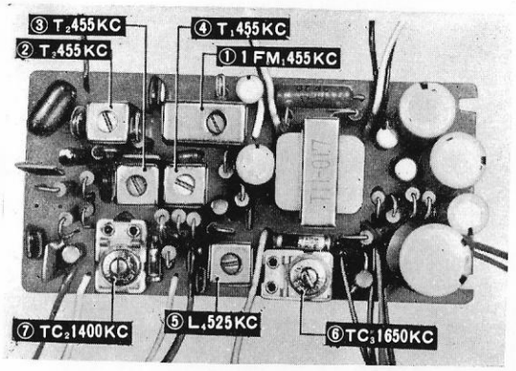


Fig. 10-162

(3) After the radio is installed in automobile, select the frequency for broadcast where the power is greatest and then, make readjustment on the antenna matching trimmer (TC_1) to make the output maximum.

10-11-6 Noise interference

Noise of the radio may be classified into: 1. Noise caught by the antenna and 2. transmitted from the power circuit.

(1) Noise arises from the high tension cord and distributor

1) Check to see if engine hood hinges are provided with jointing compound. Such noises may be practically killed by inserting noise supressor or condenser into circuits as illustrated in Figs. 10-163 and 10-164.

(2) Noise arises from the alternator

Alternator is readily equipped with the condenser and hence, further treatment is not required. For DC generator, insert a condenser in the circuit as illustrated in Fig. 10-165.

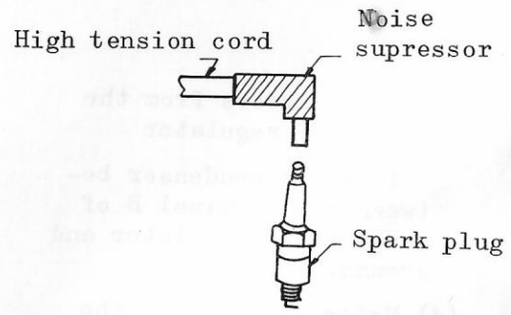
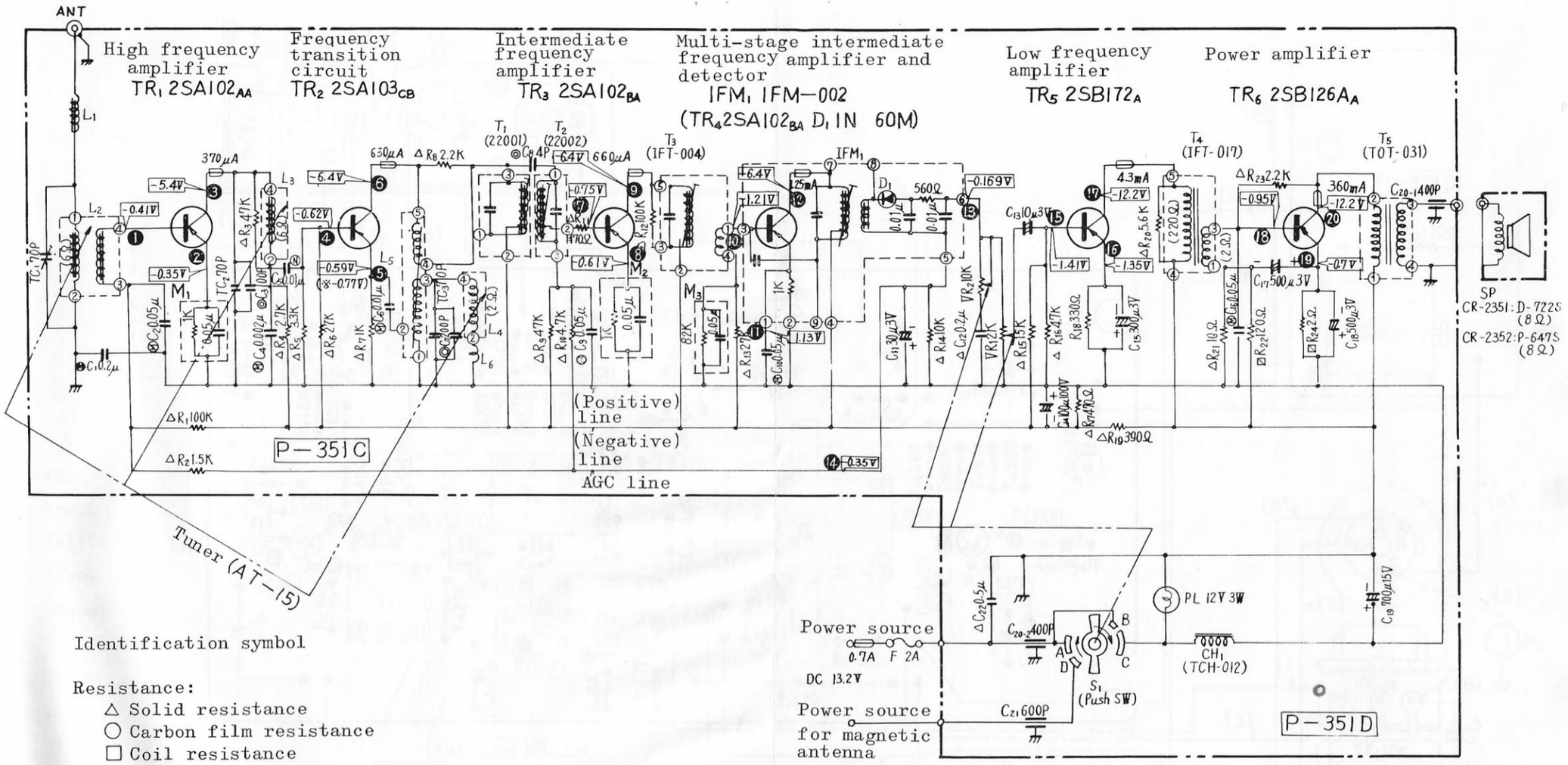


Fig. 10-163



Identification symbol

Resistance:

- △ Solid resistance
- ○ Carbon film resistance
- □ Coil resistance
- ⊠ Resin resistance
- ⊠ Laminated resistance

Condenser:

- ⊠ Paper condenser
- ⚠ MP condenser (MPBS)
- △ MP condenser (MPAR)(MPOR)
- ▲ Mica condenser
- ○ Titanium variable condenser
- ◎ Titanium condenser (parallel)
- ● Titanium condenser (For compensating the temperature)
- Ⓢ Styrol
- Ⓜ Miller
- Ⓣ Tantalum

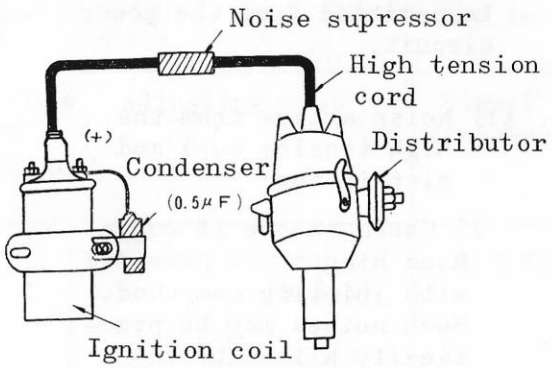


Fig. 10-164

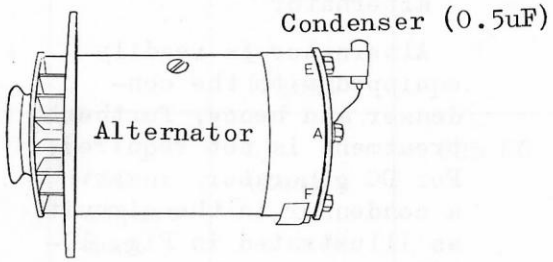


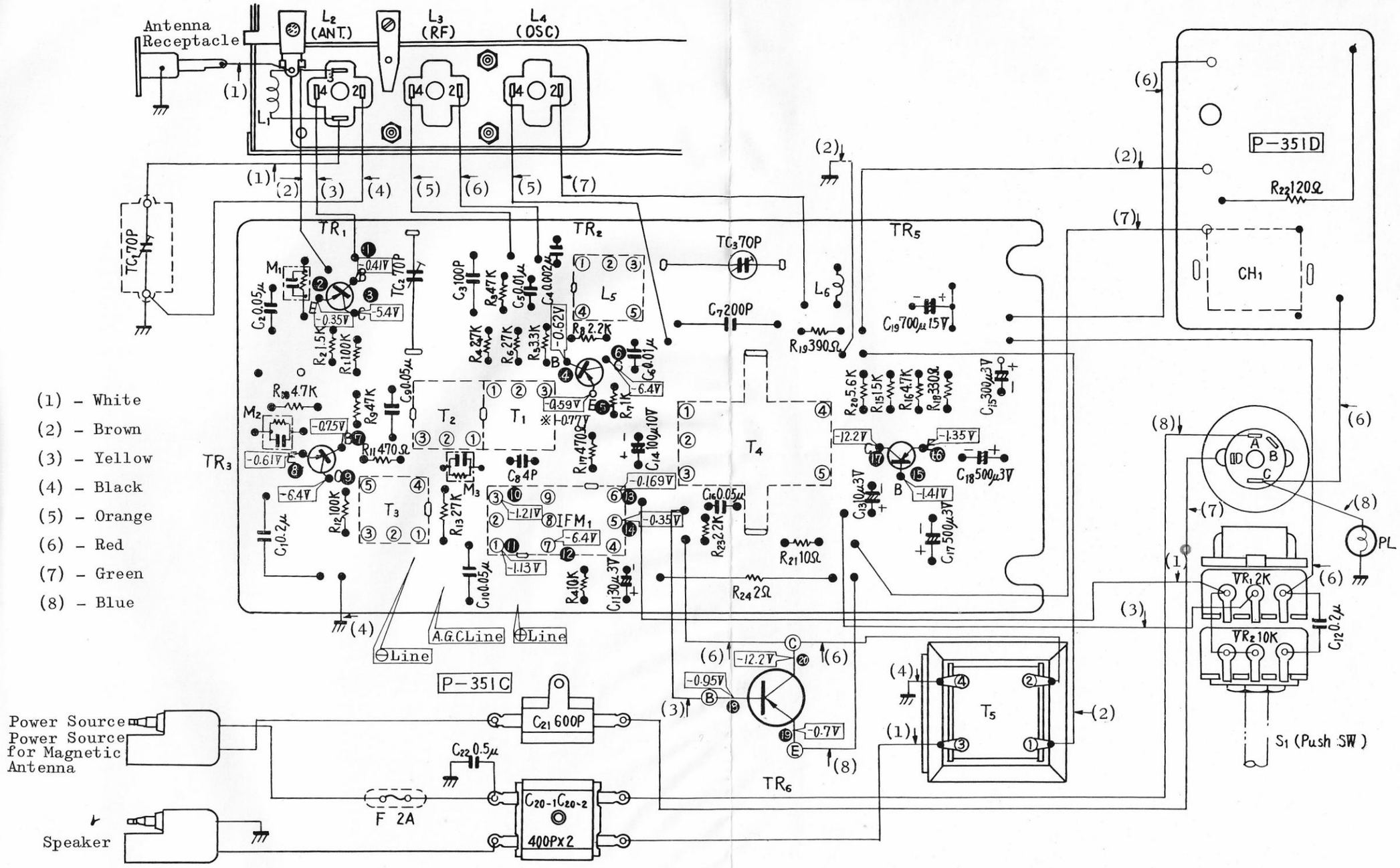
Fig. 10-165

(3) Noise arises from the voltage regulator

Insert a condenser between the terminal B of the voltage regulator and ground.

(4) Noise arises from the windshield wiper motor

Insert a condenser between wiper motor power cord (identified with blue color 0.5) and ground.


Antenna Receptacle
L2 (ANT.)
L3 (RF)
L4 (OSC)
(1) - White
(2) - Brown
(3) - Yellow
(4) - Black
(5) - Orange
(6) - Red
(7) - Green
(8) - Blue
TR1
TR2
TR3
TR4
TR5
TR6
T1
T2
T3
T4
T5
L5
L6
IFM1
P-351C
P-351D
CH1
PL
S1 (Push SW)
VR1 2K
VR2 10K
TC1 70P
TC2 70P
TC3 70P
C7 200P
C21 600P
C22 0.5μ
C20-1 C20-2 400PX2
F 2A
Power Source
Power Source for Magnetic Antenna
Speaker
A.G.C Line
⊖Line
⊕Line
R22 120Ω
R21 10Ω
R24 2Ω
-0.41V
-5.4V
-0.35V
-0.62V
-6.4V
-0.59V
※-0.77V
-0.61V
-0.75V
-6.4V
-1.21V
-6.4V
-1.13V
-0.169V
-0.35V
-12.2V
-0.95V
-0.7V
-12.2V
-1.35V
-1.41V