Chapter XII Electrical system

Section Ⅰ System principle

The electrical system on the Lifan sedan includes: power starting system, electrical injection system, ABS system, power rear view system, wiper-washer system, audio system, illumination signal system, combination meter system, air conditioner system, air bag system, remote control door lock system and window lifter system.

1. Power starting system schematic diagram (12-1)

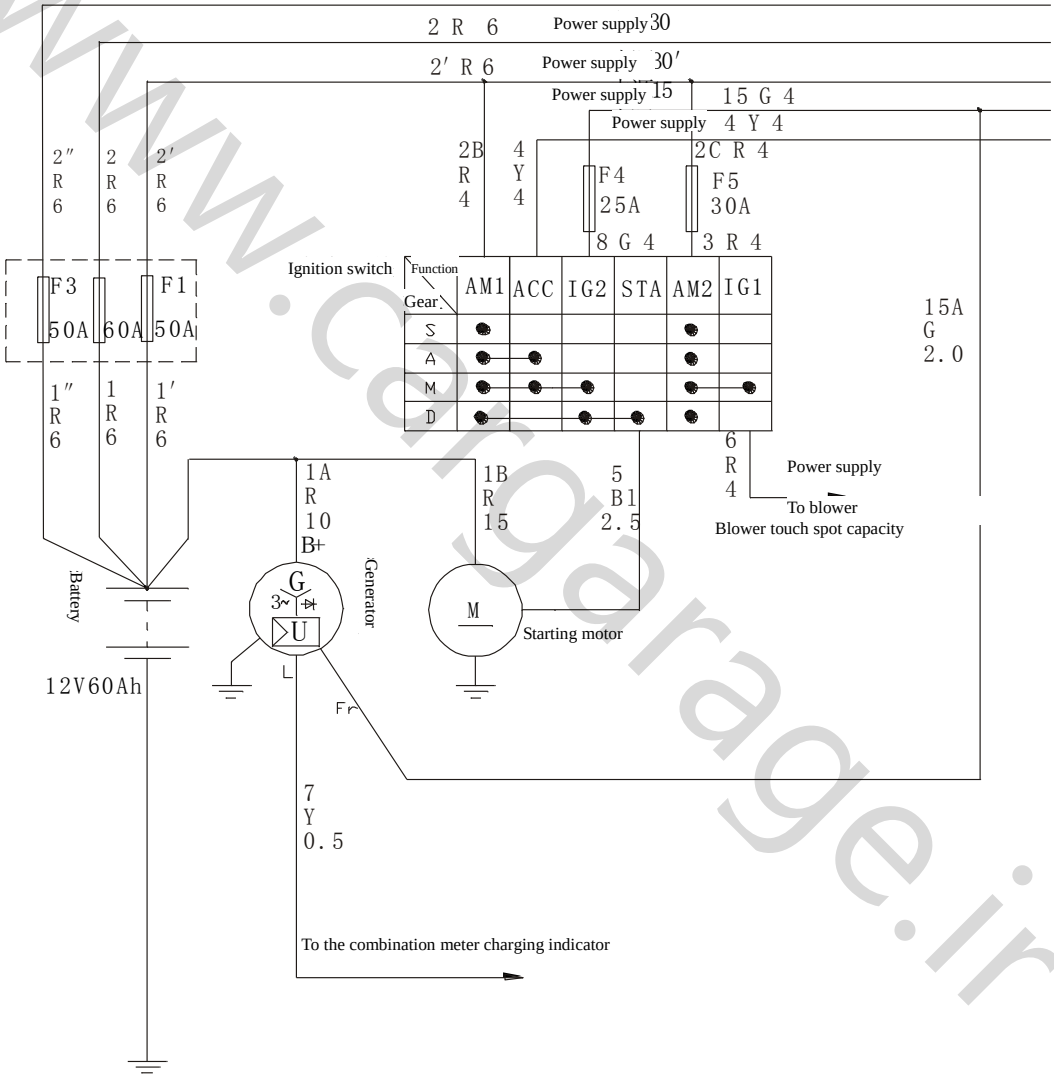

Figure 12-1 Power starting system schematic diagram

2. Schematic diagram of electrical injection system (12-2, 12-3)

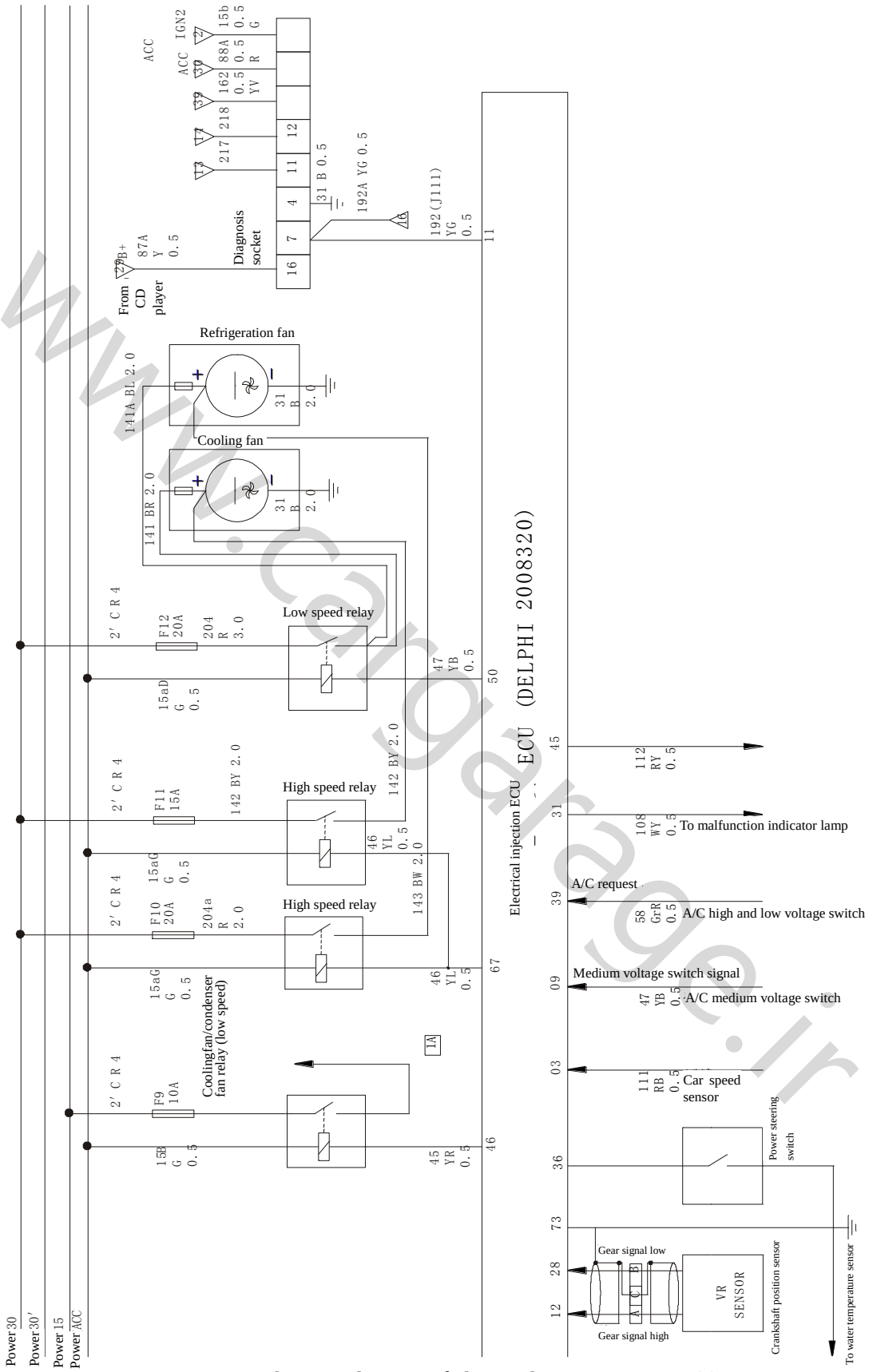

Figure 12-2 Schematic diagram of electrical injection system (a)

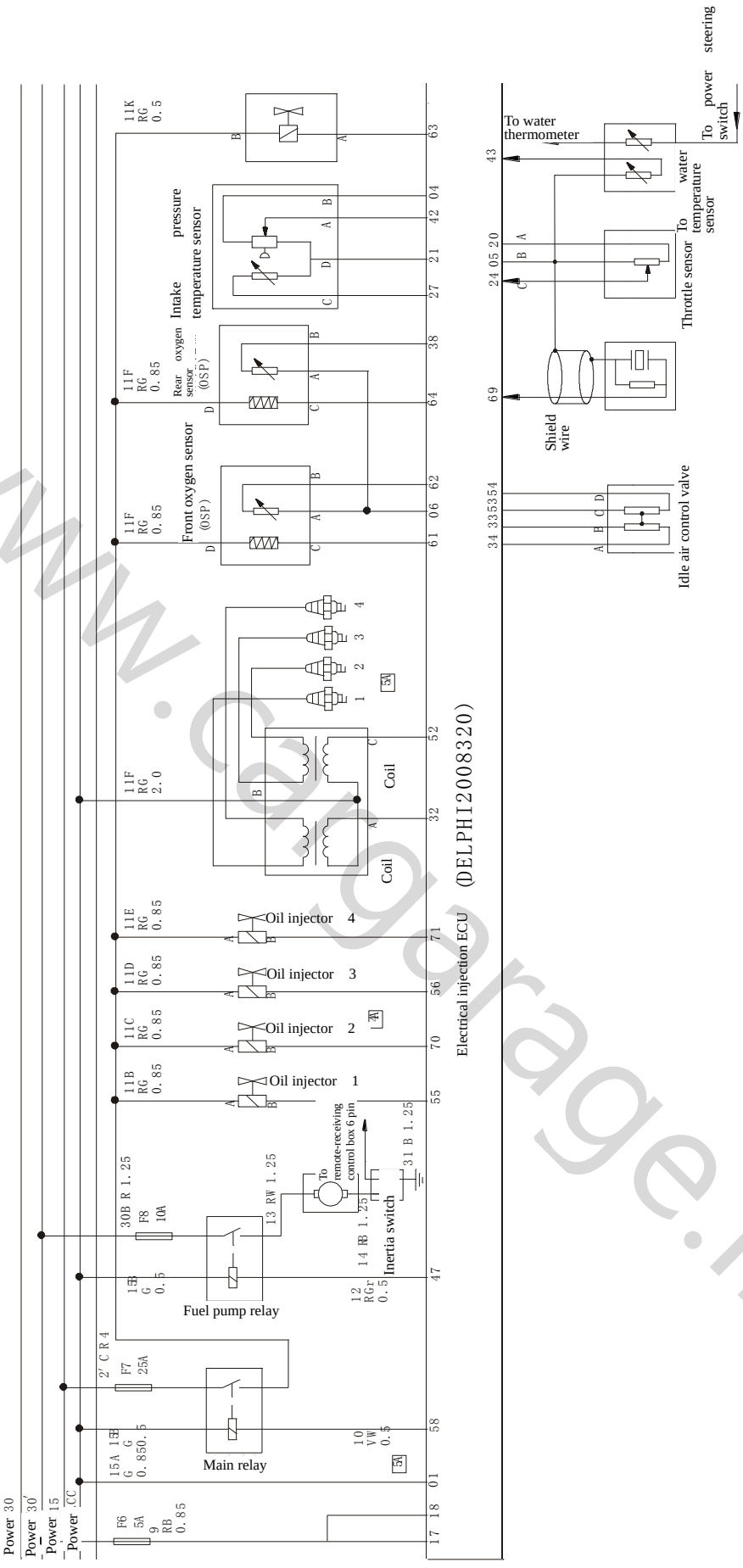

Figure 12-3 Electrical injection system schematic diagram (b)

3. ABS system schematic diagram (12-4)

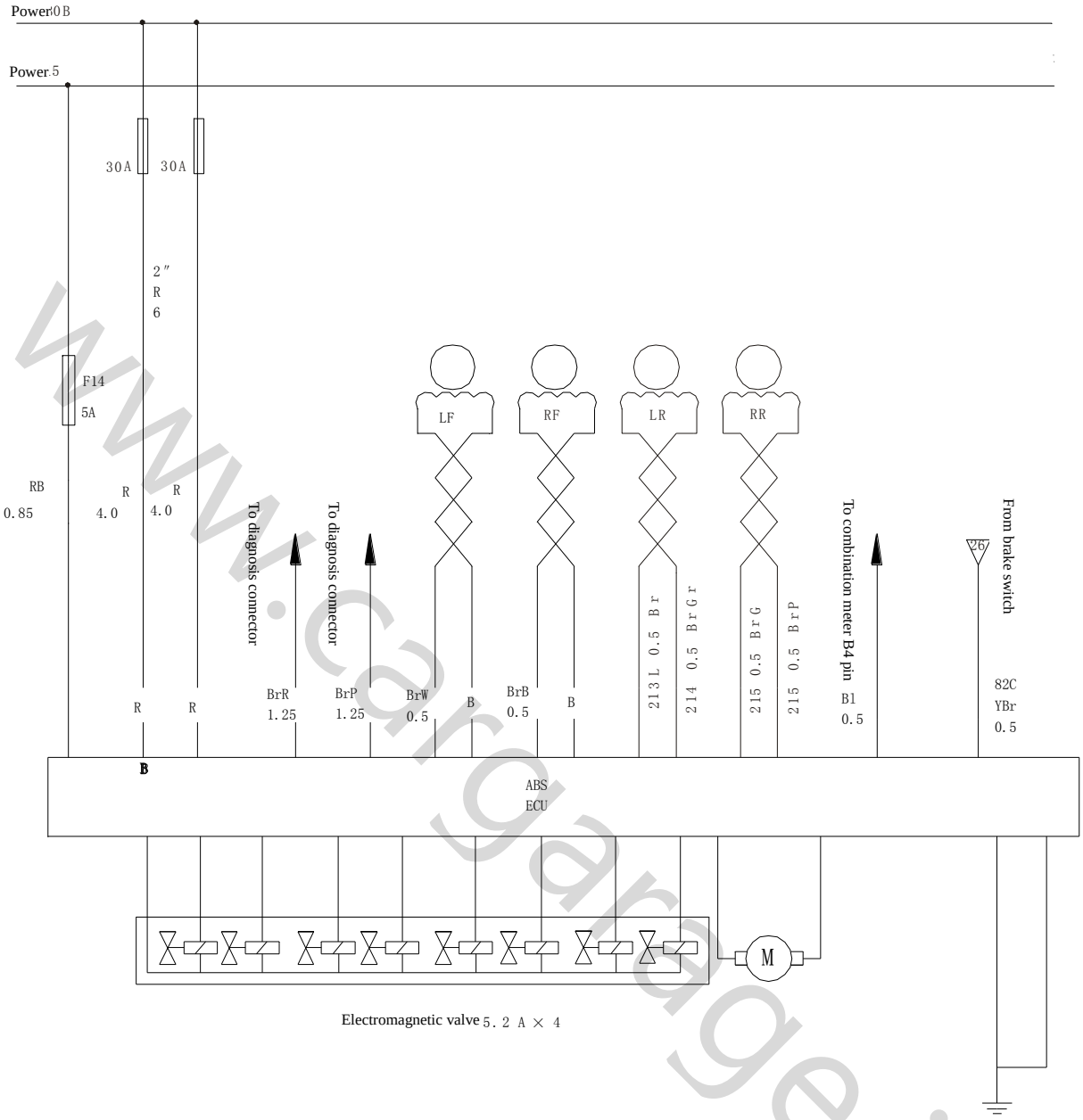

Figure 12-4 ABS system schematic diagram

4. Power rear view mirror system schematic diagram (12-5)

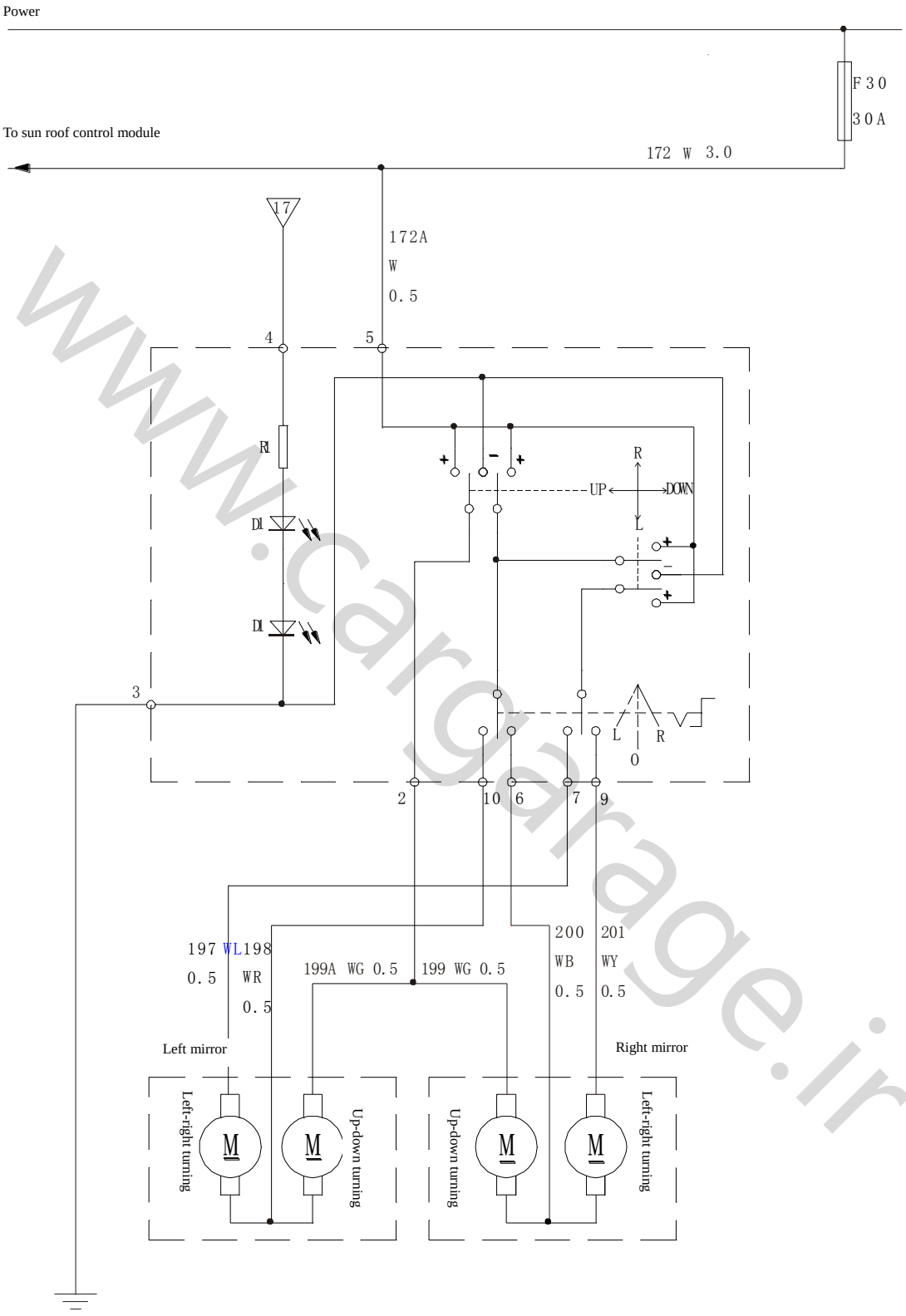

Figure 12-5 Power rear view mirror system schematic diagram

5. Wiper-washer system schematic diagram (12-6)

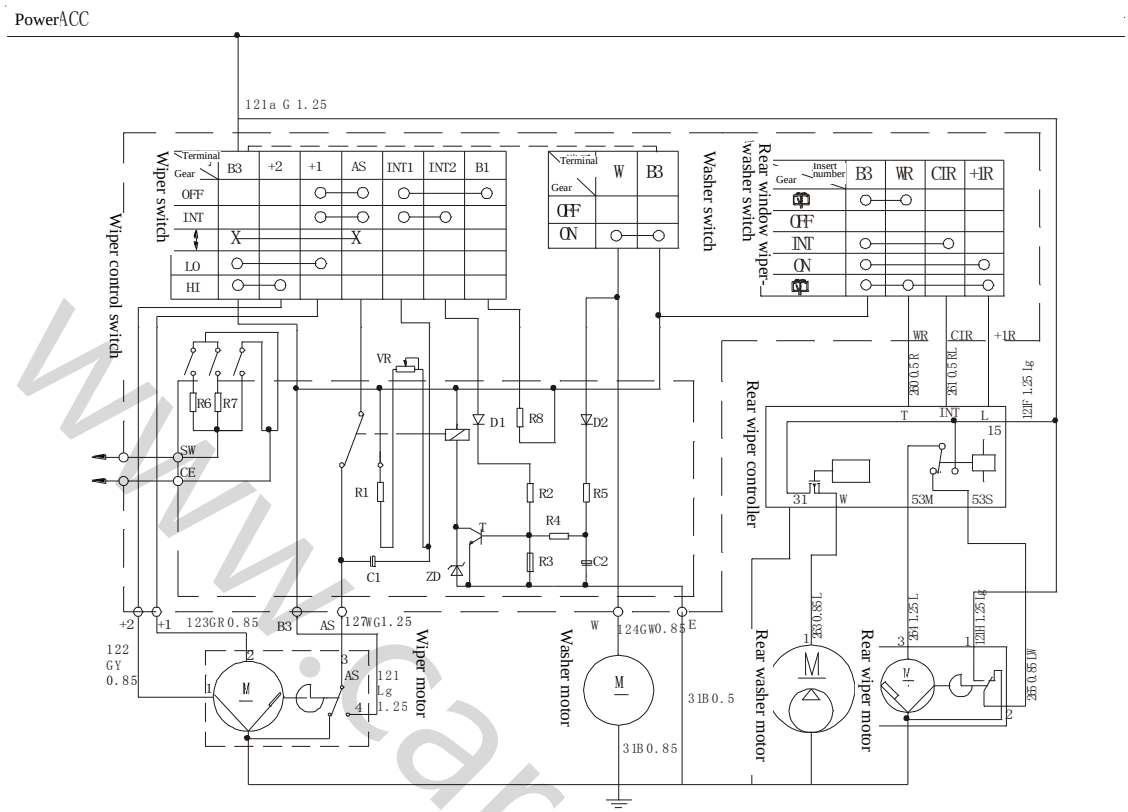

Figure 12-6 Wiper-washer system schematic diagram

6. Audio system schematic diagram (12-7)

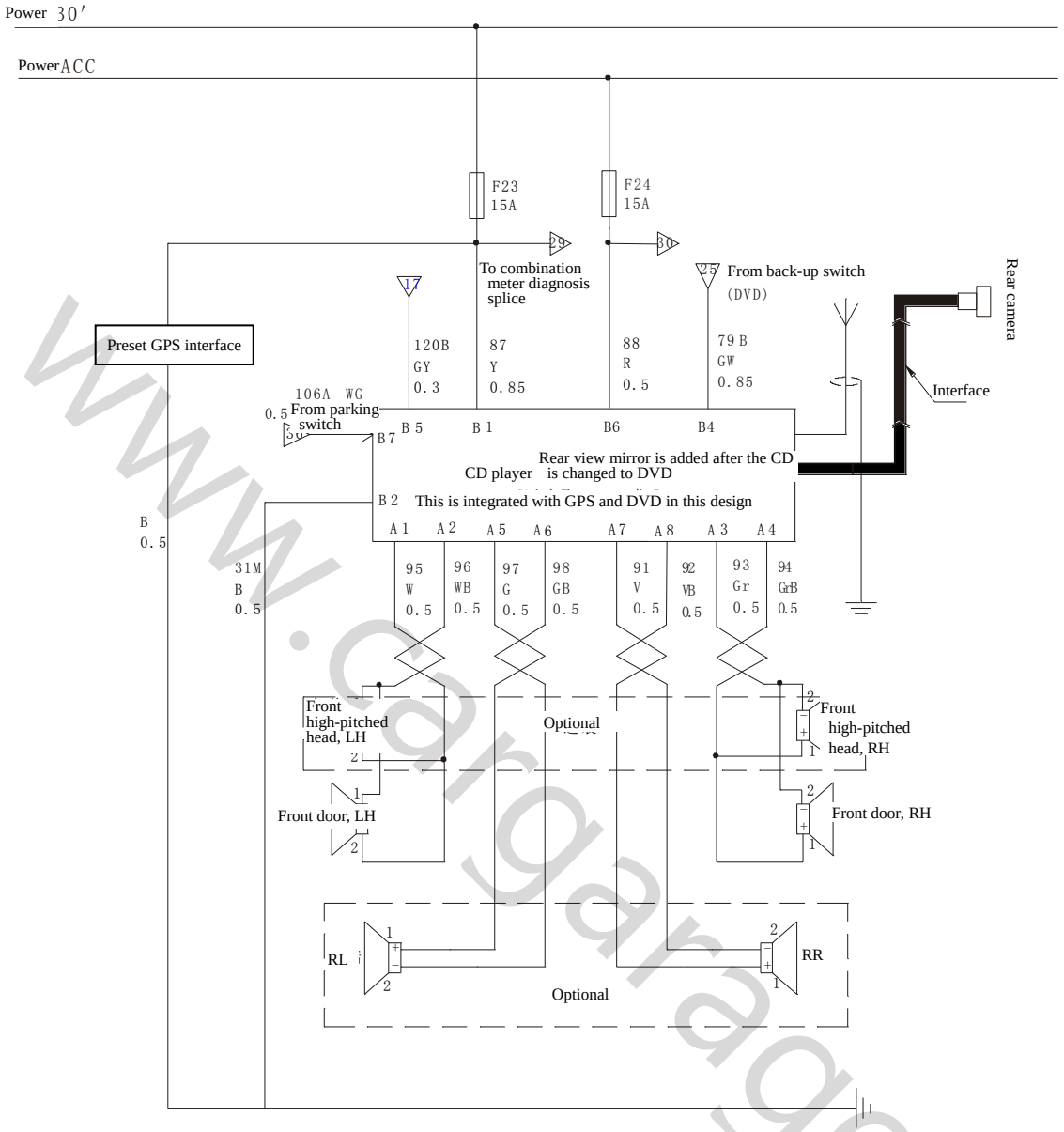

Figure 12-7 Audio system schematic diagram

7. Illumination signal system schematic diagram (12-8)

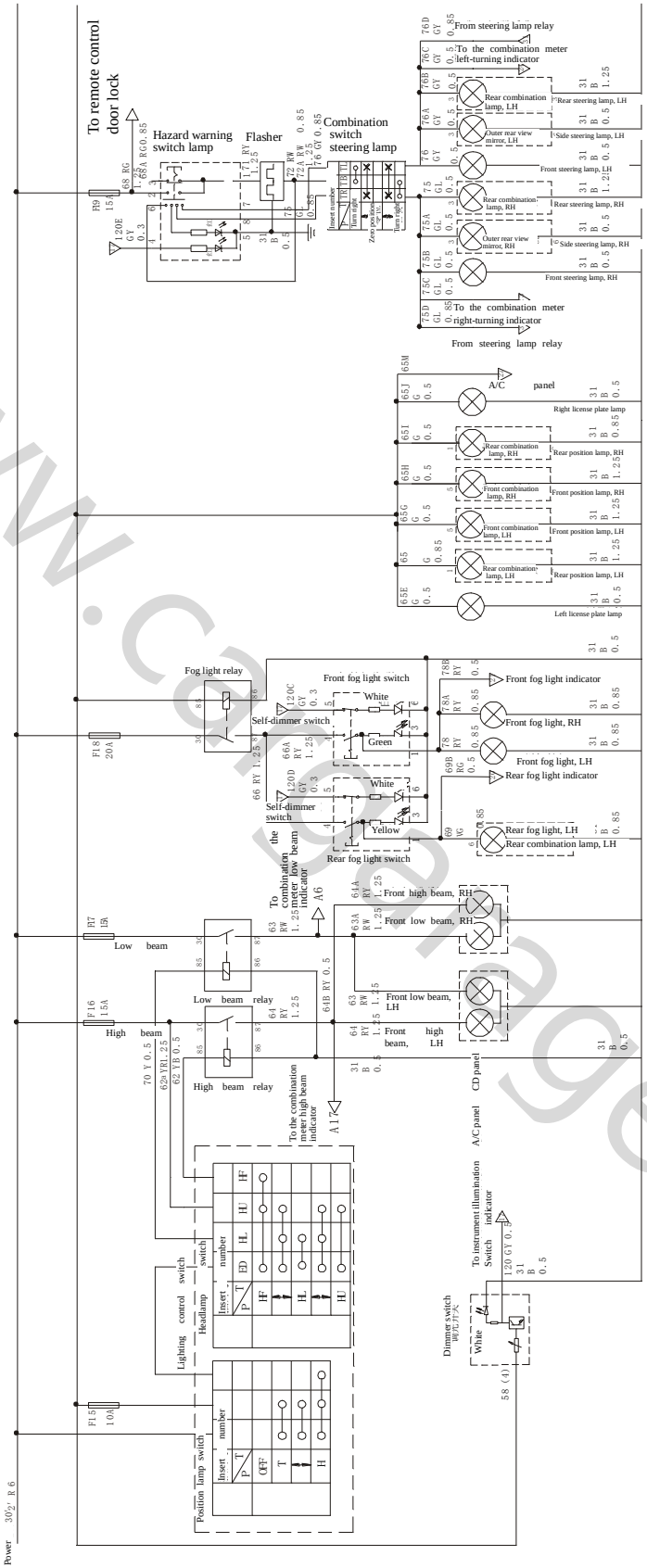

Figure 12-8 Illumination signal system schematic diagram (a)

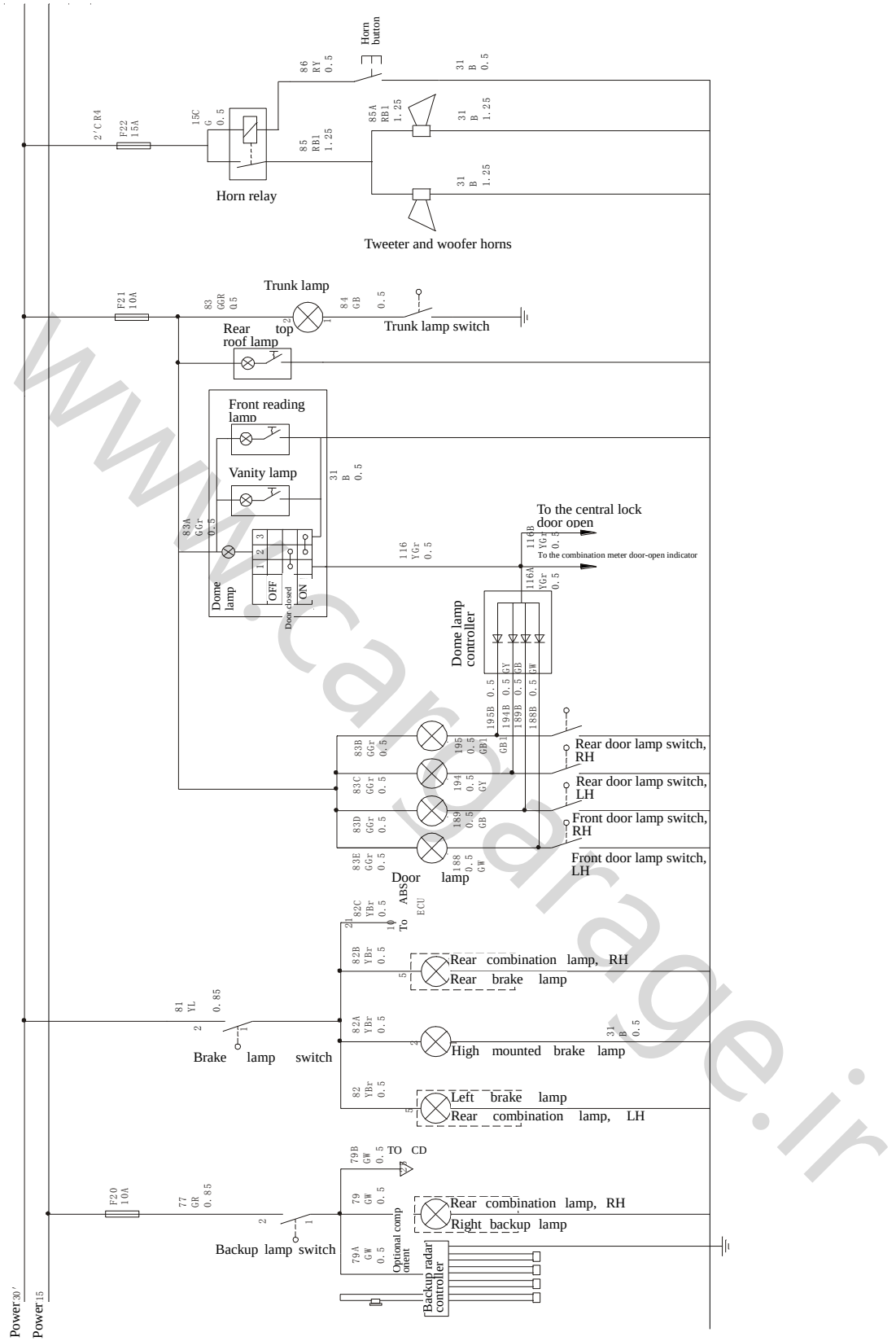

Figure 12-9 Illumination signal system schematic diagram (a)

8. Air conditioner system schematic diagram (12-10)

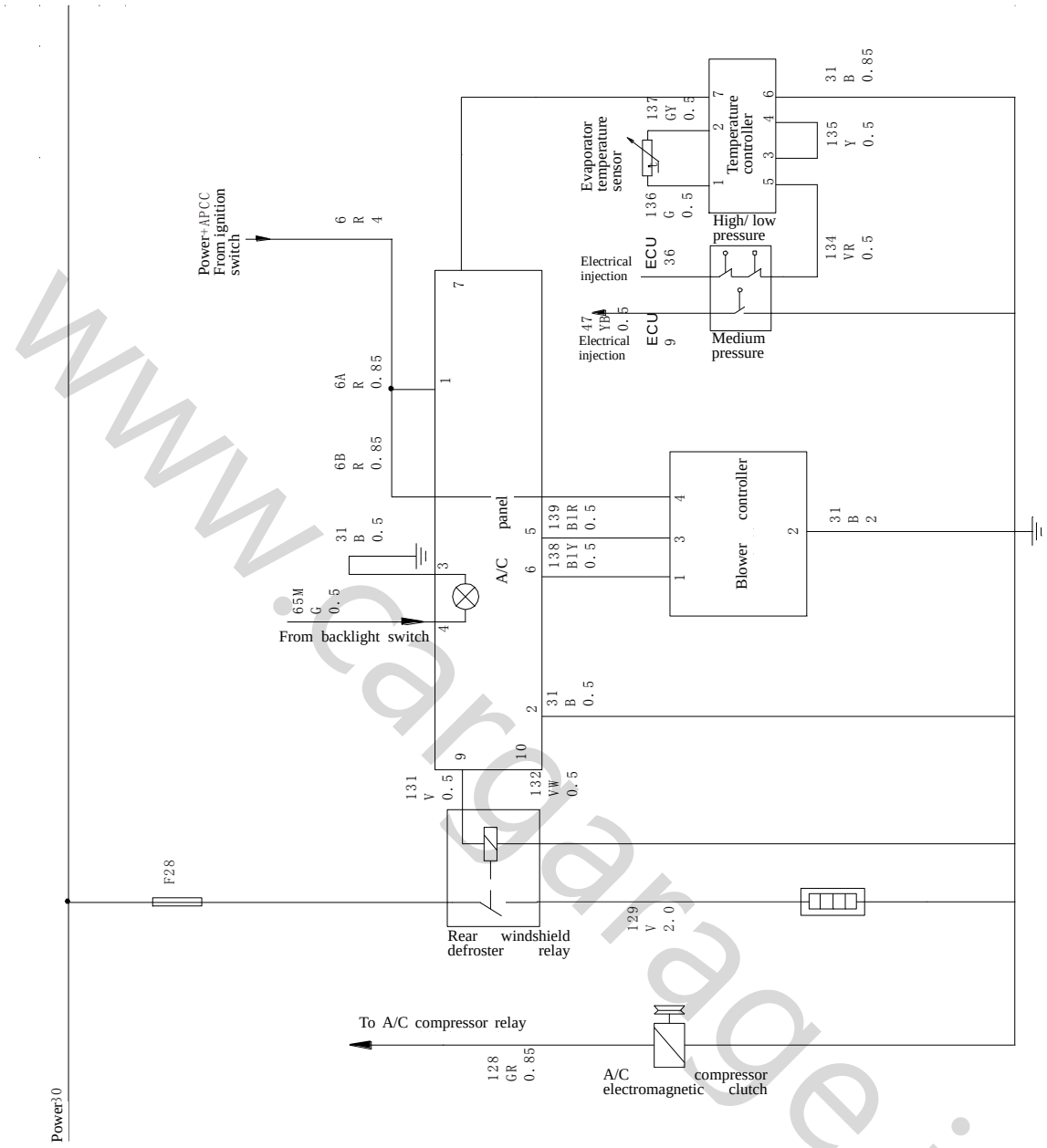

Figure 12-10 Air conditioner system schematic diagram

9. Combination meter system schematic diagram (12-11)

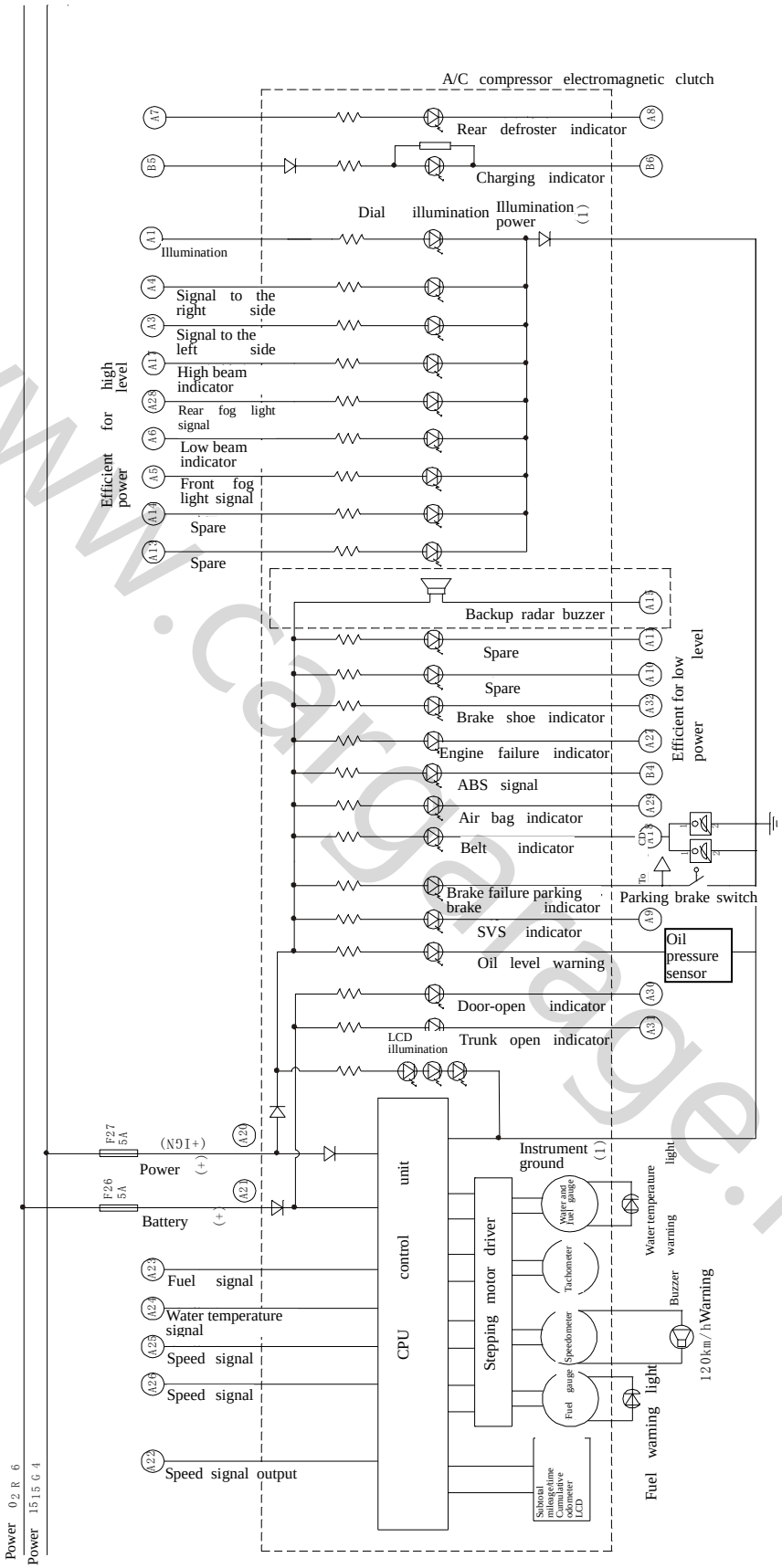

Figure-11 Combination meter system schematic diagram

10. Remote control door lock system schematic diagram (12-12)

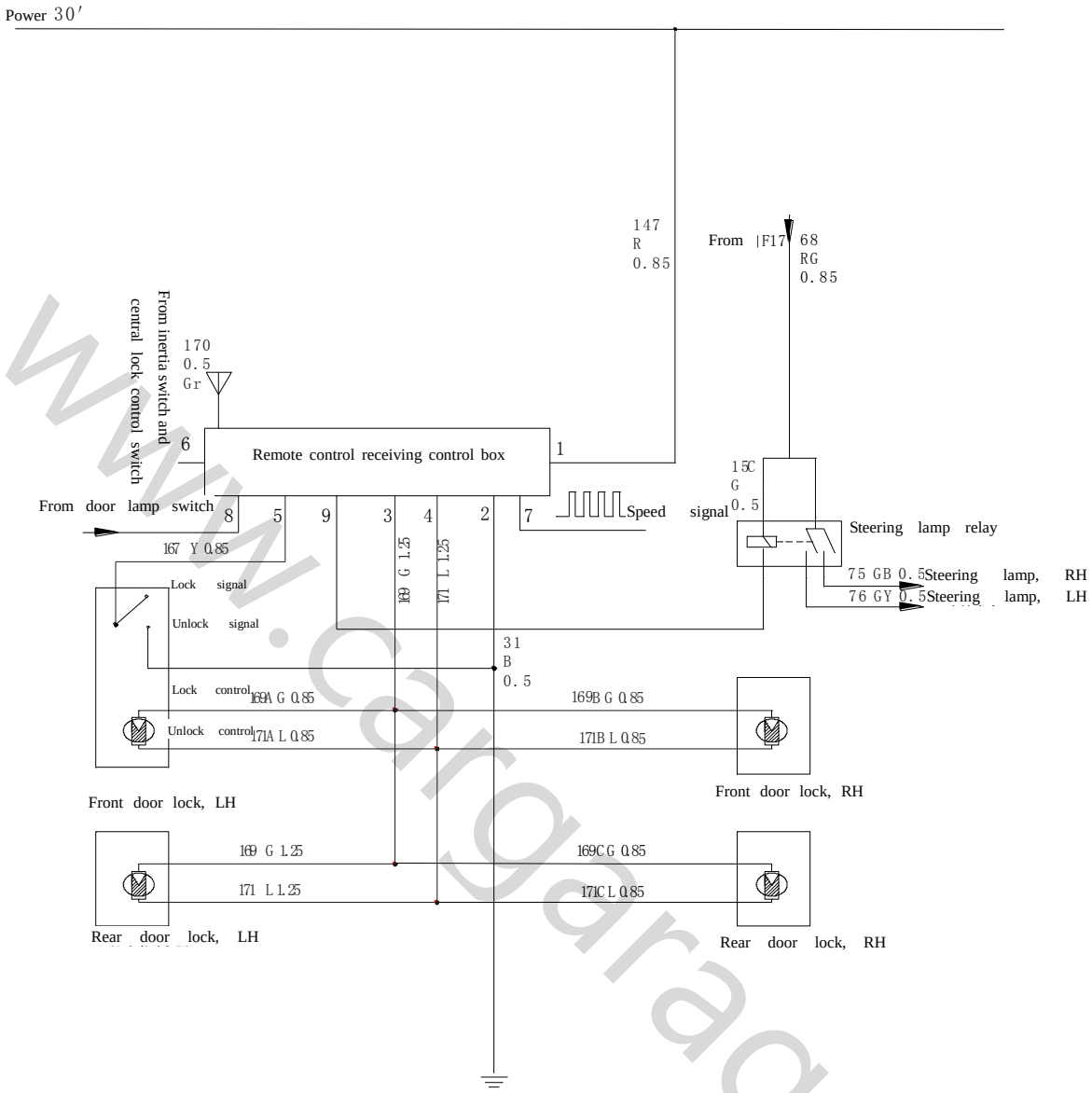

Figure 12-12 Remote control door lock system schematic diagram

11. Sun roof system schematic diagram (12-13)

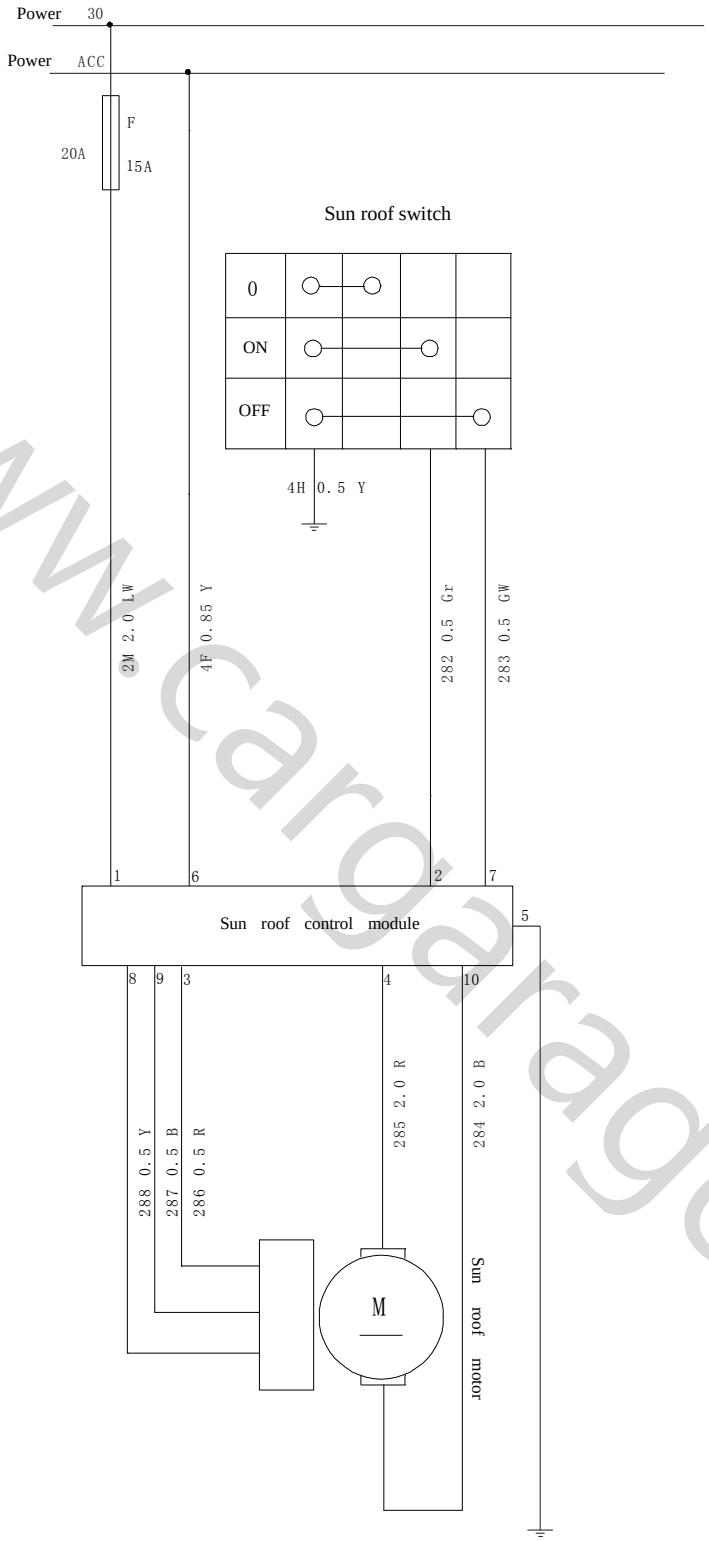

Figure 12-13 Sun roof system schematic diagram

12. Window lifter schematic diagram (12-14)

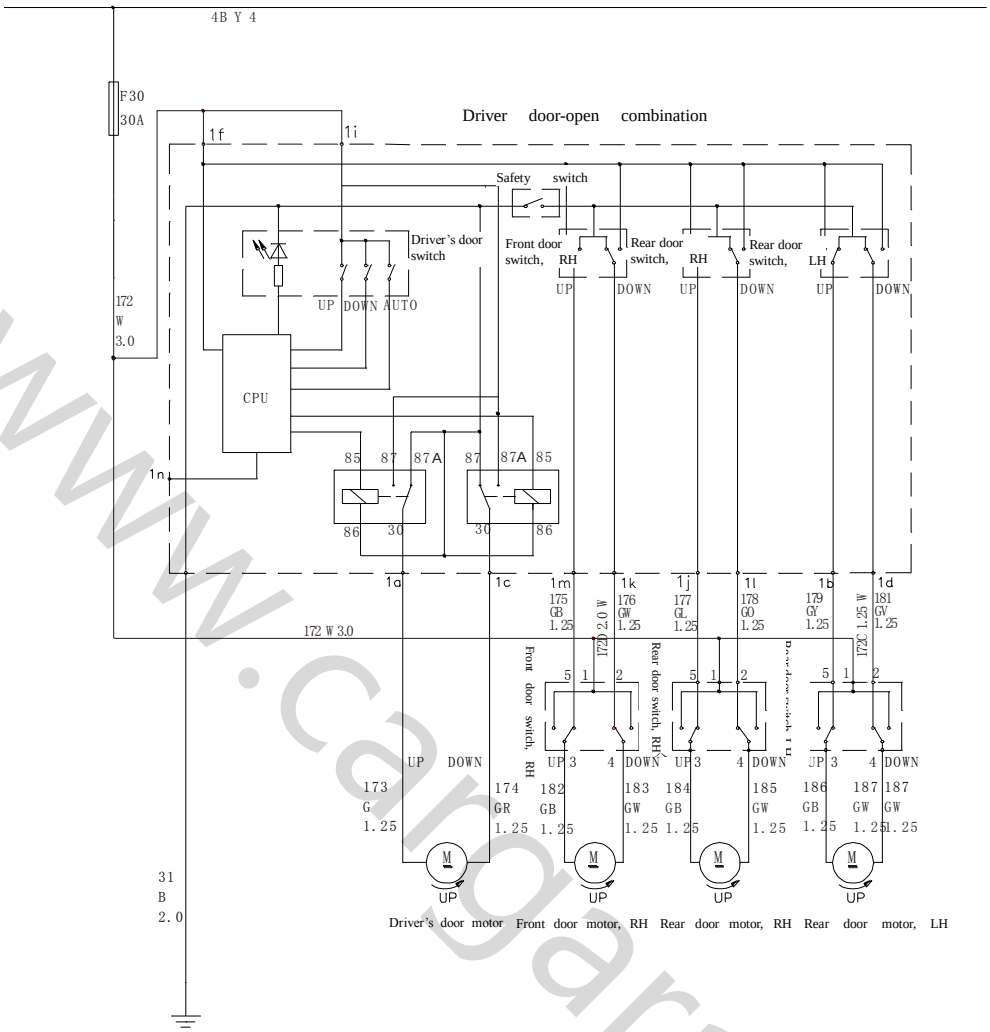

Figure 12-14 Window lifter schematic diagram

Code table of the wire colors (12-1)

Color	Black	White	Red	Green	Yellow	Brown	Blue	Grey	Purple	Orange
Code	B	W	R	G	Y	Br	B1	Gr	V	O

Fuse specification table (12-2)

F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12	F13	F14	F15
50 A	50 A	60 A	25 A	30 A	5 A	25 A	10 A	10 A	20 A	15 A	20 A	20 A	30 A	10 A

F16	F17	F18	F19	F20	F21	F22	F23	F24	F25	F26	F27	F28	F28	F30
15A	15A	20A	15A	10A	10A	15A	15A	15A	30A	5A	5A	15A	10A	30A

Section II Battery

I. Composition and principle of battery

1. Application

The battery is one of car power supplies, which is connected to the generator in parallel and applied in the following aspects:

(1)Starting power: supply the starting current for the starter and ignition system when the car engine is started.

(2)Auxiliary power supply: supply the electric energy to the electric equipment alone or assist the generator in supplying the electric energy to such equipment, when the generator is out of work or its voltage is low.

(3) Storing the electric energy of generator: in case of insufficient electric energy stored in a battery, the generator can charge the battery, and convert the redundant electric energy into chemical energy to be stored for the next starting in future.

(4) Stabilizing the voltage of electric network: the battery is equivalent to a large-capacity capacitor, which can absorb the transient overvoltage of car's electric system to protect the electric elements. A few electronic devices are installed on Lifan 520 car, so it's very important to ensure the perfect connection of battery, which can prevent the transient high voltage pulse produced by electric system from damaging the on-board electronic equipment.

2. Basic composition of battery

Lifan 520 car also adopts a lead acid battery, whose core consists of pole plate and electrolyte, as shown in Fig.12-13. The storing, discharging or charging of battery energy are realized by electric chemical reactions of active substance on the pole plate and electrolyte. The active substance on a positive plate of battery is dark brown lead dioxide (PbO_2). The active substance on negative plate is pure lead (Pb). The electrolyte of battery is prepared in a certain proportion by pure sulphuric acid and distilled water.

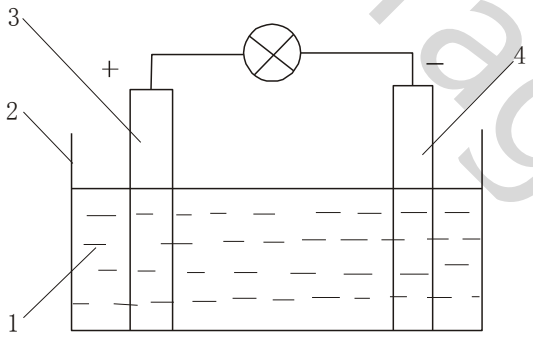

Fig. 12-13 Cells of lead-acid battery

1-Electrolyte 2-Vessel 3-Positive plate 4-Negative plate

In order to expand the capacity, any actual battery consists of several positive and negative plates in parallel. The sets of positive and negative plates are set-in, in which a layer of insulated bulkhead is inserted to avoid the shorts of positive and negative plates. A set of positive and negative plates forms a single-cell battery, whose nominal voltage is 2V, therefore, a battery of rated voltage 12V consists of six single-cell batteries connected in series. The structure of common battery is shown in Fig.12-14.

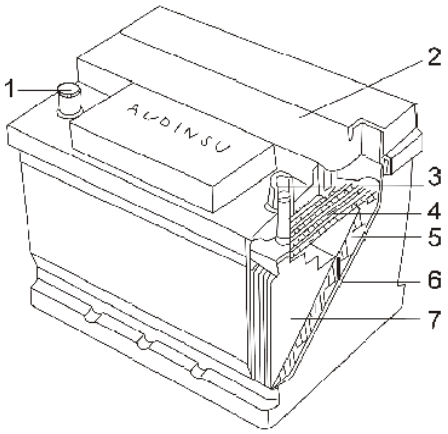

Fig. 12-14 Structure of lead-acid battery

1-Negative pile 2-Filling cover 3-Positive pile 4. 6-Division plate 5-Negative plate 7-Positive plate

3. Basic principle of lead-acid battery

(1)Establishing the electromotive force of battery

After the positive and negative plates are inserted in the electrolyte, a part of active substances on the pole plate can be dissolved and ionized. The lead dioxide (PbO_2) on positive plate is changed to quadrivalent lead ion (Pb^{4+}) due to dissolving and ionizing to make the potential of positive plate increased, the pure lead on positive plate is changed into the electron (e) with negative potential to make the potential of negative plate reduced. Then, a potential difference is produced between the positive and negative poles. This potential difference is called as an electromotive force, which can make the battery capable of supplying the power to external circuit. The intensity of battery's electromotive force is related to the density of Pb^{4+} and e on the pole plate. When the battery is completely charged, the electromotive force between the positive and negative poles is 2.1V or so.

(2) Discharging process of battery

When any external circuit is connected between the positive and negative poles of battery, the electrons on negative plate will flow to the positive plate due to the electromotive force to form the discharge current. After receiving an electron, Pb^{4+} on positive plate is changed into a bivalent lead ion (Pb^{2+}), which is dissolved in the electrolyte. PbO_2 on positive plate continues to be dissolved and ionized to supplement the reduced Pb^{4+}. Pb on negative plate can provide the electrons through its continual dissolution and ionizing. During the discharge, the bivalent lead ion Pb^{2+} in electrolyte is combined with sulfate ion (SO_4^{2-}) of electrolyte to create lead sulfate ($PbSO_4$) respectively deposited on the surfaces of positive and negative poles. During the discharge, the active substances PbO_2 and Pb on positive and negative poles are changed into $PbSO_4$, the amount of sulphuric acid (H_2SO_4) in electrolyte is reduced, that of water (H_2O) is increased, and the density of electrolyte is reduced.

(3) Charging process of battery

After the discharge is stopped, a small amount of $PbSO_4$ on positive and negative plates will be dissolved and ionized. After the charging power is connected to, the electric field force of charging power will seize an electron from Pb^{2+} on the surface of positive plate and send it to the

negative plate to form the charging current. After Pb^{2+} becomes Pb^{4+} after losing its electron, it reacts with the water in electrolyte, then is reduced into PbO_2, and deposited on positive plate. After Pb^{2+} on the surface of negative plate receives the electron, it is reduced into Pb and deposited on negative plate. During the charging, $PbSO_4$ on positive and negative plates are gradually reuced into active substances called as PbO_2 and Pb, the amount of water (H_2O) in electrolyte is reduced, that of sulphuric acid (H_2SO_4) is increased, therefore the density of electrolyte is increased.

4. Model and capacity of battery used by Lifan car

In order to adopt to the increase of electricity consumption of car's electric appliances and electronic devices, the capacity of battery used by Lifan car is also increased, and the model and specifications of battery: 12V60Ah 640CCA, sealing-type, with a built-in density meter, and capable of checking its state through its inspection hole.

II. Common faults of battery and their remedy

1. Sulfurization of polar plate

The vulcanizing of battery polar plate is one of the commonest faults, i.e. the said vulcanizing means that the hard and insoluble coarse-grain lead sulfate is created on the polar plate, and difficult to reduce during the normal charging. After the polar plate of battery is vulcanized, the internal resistance of battery is increased, its capacity and starting performance are reduced, showing in case of charging and discharging: its terminal voltage is rapidly reduced in case of discharging, but its voltage and temperature are rapidly raised and prematurely "boiled" in case of charging, and the density of electrolyte is slowly raised and can't reach the specified value.

(1)Cause of polar plate vulcanizing Causes that the polar plate of battery is easy to vulcanize:

1) When the battery is at the state of power lack for a long time, $PbSO_4$ on the polar plate can't be reduced to active substance in time. When its temperature is changed from high to low, $PbSO_4$ in electrolyte will be oversaturated and precipitated out, and insoluble coarse grains will be formed in such recrystallization, which is called as vulcanizing of polar plate.

2) Too low level of electrolyte, exposure and oxidation of polar plate. When the car has a bumpy ride, and the recrystallization and vulcanizing will be produced because the electrolyte contacts with the oxidized section of upper part of polar plate sometimes.

3) Deep discharge. The said deep discharge is a long-time excessive discharge of little current, which makes the active substance deeply in the polar plate changed into $PbSO_4$, and relies on the car's generator to supply the electricity to battery, with which $PbSO_4$ of this part can't be reduced, and will become the coarse-grain lead sulfate.

In addition, overhigh density, impurity or external temperature's fierce fluctuation of electrolyte, etc will make the polar plate vulcanized.

(2)Treatment of vulcanized polar plate: any seriously vulcanized polar plate (the capacity of battery is very low, and it can't be normally used) can only be scraped; any slight vulcanizing of polar plate can be removed by adopting the following devulcanization charging method:

1) Dump out the battery electrolyte, flush it twice with distilled water, and then add in enough distilled water.

2) Connect the power supply, and charge the battery by rated current 1/30A. When its density is raised up to $1.15g/cm^3$, dump out the electrolyte, add in distilled water, and then charge the

battery again. Repeat this operation again and again until the density of electrolyte can't be raised.

3) Discharge the battery by rated current 1/10A. When the voltage of any single-cell battery is reduced to 1.7V, stop the discharge, then charge the battery by rated current 1/10A, discharge again or charge again until the capacity of battery reaches 80% of its rated capacity.

4) Adjust the density of electrolyte to its specified value.

2. Self-discharge

In case of disconnecting the external circuit, the electric energy of battery consumes independently, which is called as self-discharge. Under normal conditions, the self-discharge of battery is unavoidable, however, if its self-discharge every day and night exceeds 2%, it belongs to the fault of self-discharge. The expression of its self-discharge: the insufficiency of electricity occurs to the battery that is completely charged after it is out of work for several days or hours.

(1)Causes of battery's self-discharge The causes leading to its self-discharge include:

1) The current leakage is caused by oil dirt, dust or electrolyte, etc on the surface of battery cover.

2) The short between the positive and negative plates is caused by excessive amount of sediments on the shell bottom.

3) The short between the positive and negative plates is caused by division plate.

4) The electrolyte is impure and contains excessive metal impurities.

(2) Removal of self-discharge

The self-discharges caused by different reasons shall be removed by different methods:

1) Check the surface of battery cover. If any dirt, please clean it.

2) Observe whether the color of electrolyte is brown or not during the charging of battery. If yes, the self-discharge will be caused by excessive amount of sediments on the shell bottom, and it's necessary to dump out the entire electrolyte, flush off inside the shell with distilled water, then refill the electrolyte, and charge the battery completely.

3) If its self-discharge fault is still obvious after ensuring the battery's normal or receiving all the other causes resulting in self-discharge, it may be caused by impure electrolyte, which can be removed by the following method: firstly, discharge the battery completely or overdischarge it to make all the impurities into the electrolyte, dump out all the electrolyte, flush off inside the shell with distilled water, then refill the electrolyte, and charge the battery completely.

Note: In case of connecting the switch of any electric equipment, short or current leakage of any circuit, and the same fault as the self-discharge of battery will occur. After checking and removing such self-discharge of battery, check whether the battery is connected to an external circuit first.

Provided that digital quartz clock, electronically tuned (radio memory) transceiver or electric jet computer's memory, etc is powered on after disconnecting any of their ignition switches, therefore, it's normal that the output current of battery is found to be not 0 or the resistance of electric equipment's circuit is not open (resistance$\neq\infty$) if all the ignition switches and other switches of electric equipment are disconnected, but any of their currents shall not exceed 1A, its resistance shall not be less than 100Ω, otherwise it means that the short or current leakage shall occur to its circuit or switch.

3. Premature flaking of active substances

The electrolyte can become a turbid brown solution during the charging of battery, and the charging voltage is too fast raised, the electrolyte is prematurely "boiled", but the density of

electrolyte can't reach its specified maximum density; if the voltage is too fast reduced, resulting in obvious insufficiency during the discharge, it means that more active substances on battery polar plate are flaked off.

(1)Causes of active substances' flaking The amount of active substances flaking on battery plate during its normal use is limited, and the causes resulting in premature flaking of active substances on polar plate include:

1) Overhigh charging current or long-time charging can make a great amount of water electrolyzed, and the produced steam creates a pressure in the hole of polar plate, resulting in flaking of active substances. High current charging is easy to make the temperature of electrolyte overhigh, which will make the polar plate deformed and active substances flaked off, and any excessive charging can make the grid holder excessively oxidized, resulting in loosening or flaking of active substances and grid holder.

2) $PbSO_4$ produced by long-time high-current charging of battery, especially the long-time high-current discharge at low temperature, is easy to form a compact layer. In case of charging, PbO_2 will be produced in the form of tree crystal easy to flake off.

3) Excessive discharge, too much $PbSO_4$ on polar plate and expansion of volume lead to the extrusion, which may make the active substances flaked off.

4)Poor and loose installation of battery plate sets, or insecure installation of battery on the car makes the plate sets more vigorous bumped or vibrated, resulting in flaking of active substances.

5)Any failure to charge the battery in time after discharging it in Winter makes the density of electrolyte overlow or makes it frozen, resulting in flaking of active substances.

(2)Treatment of faults If less active substances are flaked off, dump out all the electrolyte, refill the electrolyte after flushing it in distilled water, and continue to use it after charging it. If excessive amount of active substances are flaked off, it's necessary to replace the plate sets or battery.

III. Operation and maintenance of battery

1. Daily check and maintenance of battery

(1)Check the appearance of battery as per the following items:

1) Check whether the battery is firmly installed, whether the connection of wire clamps and polar piles

is firm, and remove the oxides on them. Paint Vaseline or grease on their surfaces to prevent them from oxidizing.

2) Check whether the surface of battery cover is clean. All the dusts, oil dirt or electrolyte, etc shall be removed in time.

3) Check whether the vent hole of filling cover is unblocked, so as to avoid the compression fissures or explosion of shell caused by overhigh pressure due to gathering of air inside the battery.

(2)Check the level of electrolyte The level of electrolyte shall be 10mm to 15mm above any polar plate. If the level is too low, refill the distilled water other than electrolyte in time, so as to avoid overhigh density of electrolyte. Under the normal operating conditions, the reduction of its level is caused by natural evaporation and electrolyzation of water during the charging. If the insufficiency of electrolyte is caused by its dumping or leakage, the electrolyte with the equivalent density can be added in.

(3)Check the discharge of battery Check the discharge of battery by measuring the electrolyte density or voltage drop of single-cell battery (Fig.12-15). Commonly, its density reduced by 0.01g/cm^3 is equal to 6% discharge of battery. If the level of its discharge exceeds 25% in Winter and exceeds 50% in Summer, reuse the battery after recharging it.

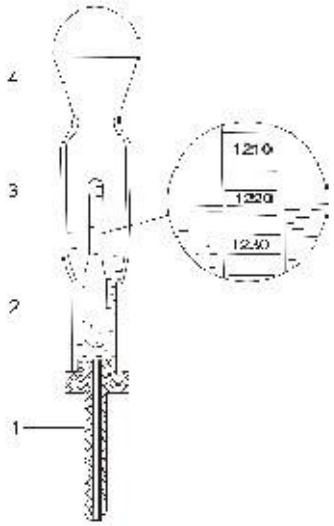

Fig. 12-15 Measuring the Density of Battery Electrolyte

1-Suction nozzle 2-Densimeter 3-Glass tube 4-Rubber ball

Note: after the battery is just discharged by high current or filled with the distilled water, don't measure the density of electrolyte at once; measure the density and temperature of electrolyte at the same time, and convert the measured actual density into the one at 25℃ based on the following formula:

$$r_{25℃}=r_t+0.00075(T-25)$$

Where: $r_{25℃}$--the density of electrolyte at 25℃(g/cm^3);

r_t—measured actual density of electrolyte (g/cm^3); T--measured actual temperature of electrolyte (℃).

Section III Charging system

I. Structure and principles of generator

The generator is a major power of car, and the belt pulley is used to drive the generator to generate the electricity during the operation of engine. During the normal operation of generator, supply the electricity to the battery in addition to electric equipment, so as to ensure the enough electric energy of battery for next startup of engine.

1. Composition of generator

Lifan car generator is a built-in silicon rectification generator of regulator, which mainly consists of rotor (magnetic pole), stator (armature), rectifier, regulator, electric brush and brush holder, etc. The composition of generator is shown in Fig.12-16.

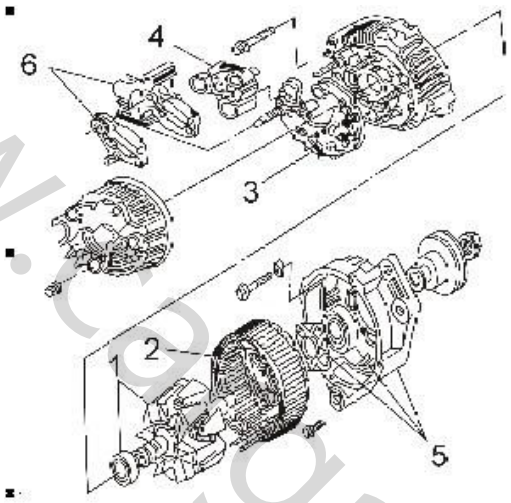

Fig.12-16 Composition of Generator

1-Rotor 2-Stator 3-Silicone rectifier 4-Regulator 5-Bearing and end cover 6-Electric brush and brush holder(connected to field winding) 7-High-power switch triode of regulator

(1)Rotor The rotor is a magnetic pole of generator, which is used to lead in the current through the electric brush and sliding ring, and create a rotary magnetic field. The rotor consists of claw iron core and field winding, both sliding rings on the rotor shaft are respectively connected to both ends of this winding.

(2)Stator The stator is an armature of generator, which is used to create an induction electromotive force in the rotary magnetic field. The stator consists of iron core and winding, three sets of stator windings are symmetrically arranged, and form a delta connection.

(3)Silicone rectifier The silicone rectifier is used to rectify three-phase alternating current produced by the winding of generator armature into output direct current. The silicone rectifier of Lifan car generator has nine diodes, of which six higher-power diodes form a three-phase bridge rectifier circuit used to rectify the output current of generator, three lower-power diodes form a bridge rectifier circuit used to provide the exciting current for field winding.

(4)Regulator The regulator is applied to stabilize the voltage of generator by adjusting its exciting current in case of changing the rotating speed of engine, and ensure the normal operation of electric equipment. The regulator consists of integrated circuit and a high-power triode.

(5)Electric brush and brush holder The electric brush and brush holder are used to lead the direct current into a rotating field winding. The electric brush relies on the springs inside the brush holder to keep in good contact with the sliding ring on the rotor.

2. Operating principles of generator

The principles of Lifan car generator circuit are shown in Fig.12-17.

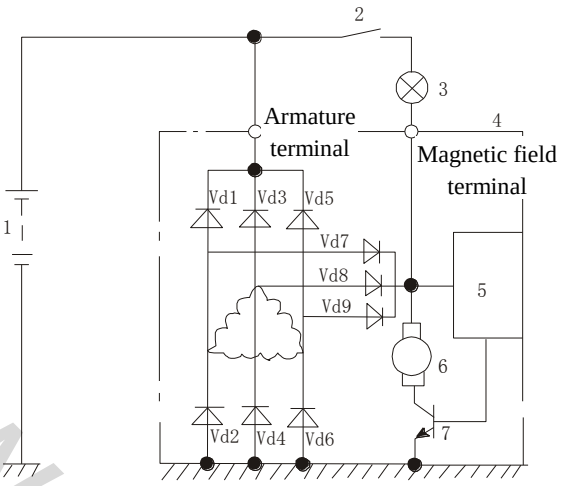

Fig.12-17 Principles of Generator Circuit

1-Battery 2-Ignition switch 3-Charging indicator 4-Generator assembly 5-Regulator 6-Electric brush and brush holder

(1)Generating principles of generator The field winding of generator leads in direct current through the electric brush and sliding ring. After the generator is driven, a rotary magnetic field is produced inside the generator, and the stator windings symmetrically arranged disconnect the magnetic lines to create an an induction electromotive force, as shown in Fig.4-55a.

(2)Rectifying principles of rectifier Three-phase bridge rectifier circuit formed by VD_1, VD_3, VD_5 and VD_2, VD_4, VD_6 rectifies three-phase AC electromotive force into an output direct current to the electric equipment and battery (Fig. 12-18), the three-phase bridge rectifier circuit composed of VD_7, VD_8, VD_9 and VD_2, VD_4, VD_6 is mainly used to provide the exciting current for field winding of generator.

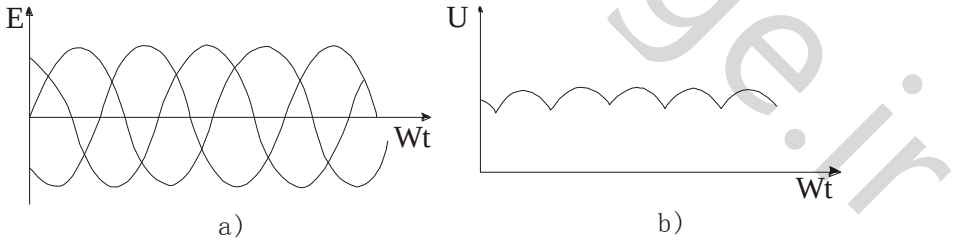

Fig.12-18 Voltage Waveform of Generator

a)Electromotive force of armature winding b)Rectified voltage waveform of generator

(3)Exciting mode of generator Before creating the voltage, the generator provides the exciting current (separate excitation) for the field winding from the battery via ignition switch, electric brush, sliding ring and regulator (switch triode); when the engine reaches a certain rotating speed, DC voltage rectified by the generator is higher than the voltage of battery. Three-phase bridge rectifier circuit composed of VD_7, VD_8, VD_9 and VD_2, VD_4, VD_6 provides the exciting current (self-excitation).

3. Operating principles of regulator

(1)Purposes of regulator The induction electromotive force of generator is proportional to the rotating speed and magnetic field intensity of generator, therefore, the rectified end voltage of generator is also proportional to its rotating speed and magnetic field intensity. The rotating speed of engine can vary within a larger range during its actual operation, which makes its voltage variable and unable to satisfy its use requirements. The regulator is used to stabilize the voltage of generator by adjusting the field intensity of generator if the rotating speed of engine varies.

(2)Voltage-stabilizing principles of regulator The input of regulator is induced by the voltage of generator, and the high-power switch triode of regulator is connected to the exciting circuit of generator in series (refer to Fig.12-17). Only if this triode is connected, the exciting circuit of generator can be connected. The voltage-adjusting process of regulator is as follows:

1) In case of engine's low rotating speed, the voltage of generator is lower than the set voltage, the electronic circuit of regulator makes the high-power triode saturated and connected, the field winding of generator is connected, and the rectifier circuit of battery or generator provides a stable exciting circuit.

2) When the engine reaches a certain rotating speed and the voltage of generator reaches the operating voltage of regulator, the electronic circuit of regulator disconnects the high-power triode, which leads to repeated alternate conversions, makes the voltage of generator fluctuated within a certain upper and lower limit (refer to Fig.12-19), and keeps its mean voltage stabilized to the set value.

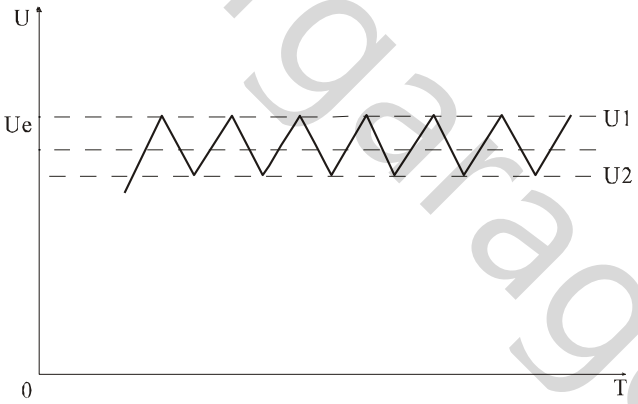

Fig.12-19 Generator's Voltage Waveform Adjusted by the Regulator under a Certain Rotating Speed

U_1-Upper limit voltage making the regulator switch triode connected

U_2-Lower limit voltage making the regulator switch triode disconnected

3) When the rotating speed of engine is lifted, the rise of generator's voltage quickens but its reduction

slows down, which makes the connection time of regulator's high-power triode reduced, and makes its disconnection time relatively increased. This makes the mean exciting current of generator reduced and its field intensity weakened, resulting in constant voltage of generator. The changes of generator's voltage, exciting current and rotating speed is shown in Fig. 12-20.

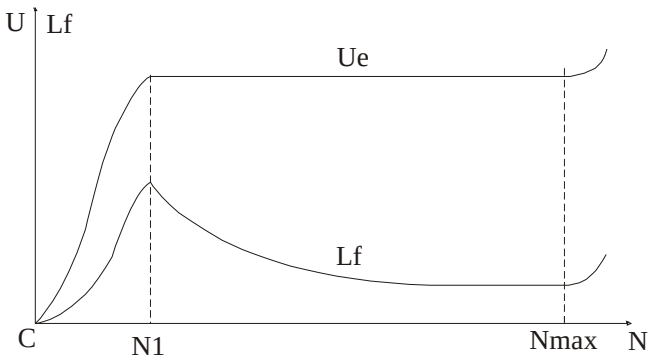

Fig.12-20 Operating Characteristics of Generator with a Voltage Regulator

n_1-Rotating speed when the regulator starts its adjustment

n_{max}-Rotating speed when the regulator starts to fail

4. Operating principles of charging indicator

Before turning on the ignition switch, the input terminal of regulator is the voltage of battery, this voltage is lower than the adjusted voltage of regulator, and the regulator power triode is connected. Then, a circuit is formed from the positive pole of battery, via ignition switch, charging indicator, generator field winding, high-power triode of regulator to the earth, and the charging indicator goes on. When the voltage of generator reaches or exceeds that of battery after starting the engine, both ends of charging indicator are end voltages of generator, i.e. the charging indicator goes out due to voltage loss, meaning that the generator has been kept in normal generation.

When the generator stops due to any fault, the charging indicator goes on again due to the voltage between both its ends, showing the fault occurs to the charging system.

5. Model and performance parameters of Lifan car generator

Lifan car generator has JSZ197D and its configuration adopts the corresponding international standards.

Performance parameters related to Lifan car generator:

Nominal voltage of generator: 14V

Adjusted voltage: 13.5V to 14.5V

II. Common faults of charging system and their diagnosis

1. Brightening of charging indicator

After starting the engine, the charging indicator on instrument panel brightens, or during the normal operation of engine, the charging indicator goes on, which means that a charging failure occurs to the generator.

(1)Cause of fault Possible causes of charging indicator's brightening fault include:

1) Fault of generator, e.g. short, break or earthing of armature winding, or short or earthing of generator field winding.

2) Fault of generator, high-power triode can't be saturated or connected due to the damages of electronic elements in regulator.

3) Loosening of generator driving belt The generator stops due to slipping of driving belt, non-rotation or overlow rotating speed of generator.

(2)Fault diagnosis Firstly , check the driving belt of generator for slipping. If normal, disassemble the generator and regulator for check.

2. Extinguishing of charging indicator

Turn on the ignition switch until the generator runs normally, but the charging indicator always extinguishes, showing the poor charging or uncharging fault occurs to the charging system.

(1)Fault causes Possible causes of charging indicator's extinguishing include:

1) Poor contact of electric brush and sliding ring of generator.

2) Disconnection or break of high-power triode caused by the damages of electronic elements in the regulator.

3) Short of rectifier diode in the generator.

4) Break of charging indicator circuit, e.g. wiring failure of fuse, charging indicator, generator field terminal and ignition switch, etc.

(2)Fault diagnosis Diagnosis methods of charging indicator extinguishing fault:

1) When the ignition switch is disconnected, check the grounding voltage of generator field terminal. Normally, the voltage shall be 0. If any battery voltage, it shows the short of rectifier diode in the generator, so the generator shall be disassembled for repair; if the voltage is 0, carry out the next step for diagnosis.

2) After connecting the ignition switch, check the grounding voltage of generator field terminal. Normally, the voltage shall be battery voltage. If the voltage is still 0, check the circuit of charging indicator; if the voltage is normal, carry out the next step for diagnosis.

3)Disassemble and check whether the contact of generator's electric brush and sliding ring is good, and check the field winding for breaks. If no, overhaul or replace the regulator.

3. The charging indicator is normal, but the generator stops generating, or poor charging fault occurs to it.

In case of connecting the ignition switch, the charging indicator can go on, and go out after starting the engine and during its operation, but the deficiency of electricity will occur to the battery soon.

(1)Fault causes Possible causes of such fault include:

1) Poor generation of generator.

2) Overlow voltage of regulator or fault of the circuit in it.

3) Poor contact of charging circuit from generator to battery.

4) Serious vulcanizing of battery plate.

5) Self-discharge of battery, current leakage of electric appliances and circuits of car.

(2)Fault diagnosis Carry out the fault diagnosis as per the following steps:

1) Check the grounding voltage of generator armature terminal by adopting DC voltage range of multimeter. Normally, the voltage shall be battery voltage. If the voltage is still 0, it shows that the wiring connection between the generator armature terminal and battery is broken, check and repair it; if the voltage is normal, carry out the next step for check.

2) Starting the generator makes the engine running at intermediate speed. When the charging indicator goes out, check the grounding voltage of generator armature terminal. If the voltage is still the battery voltage, check and repair the generator and regulator; if the voltage is a little increased, carry out the next step for check.

3) When the engine runs at intermediate speed, check the output current and end voltage of generator, as shown in Fig.12-21. If the voltage can reach 13.8V to 14.5V after increasing the rotating speed of engine, and the ammeter indicates a higher charging current, it shows that the generator and regulator is normal. If the rapid current deficiency of battery may be caused by the fault of battery itself or current leakage of car's electric equipment and circuit, check it; if the voltage can reach 13.8V to 14.5V quickly, but no charging current exists or it's very little, check whether the wiring connection between the generator armature terminal and battery is poor. If no, it may be caused by serious vulcanizing of battery plate.

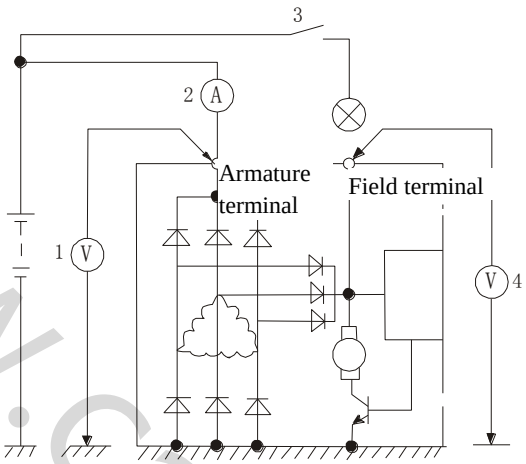

Fig.12-21 Fault Check of Generator and Charging Circuit

1-Check the grounding voltage of generator armature terminal 2-Check the charging current of generator 3-Ignition switch 4-Check the grounding voltage of generator field terminal

4. Overhigh charging current of generator

If the car's bulb is easy to burn, the temperature of battery is too high, and the consumption of its electrolyte is too fast, it shows that the charging current of generator is too high.

(1)Fault causes: Overhigh charging current of generator is usually caused by overhigh adjusting voltage or failure of regulator.

(2)Fault diagnosis: in case of determining that easy burning of bulb, high temperature of battery and too quick consumption of electrolyte are normal, disassemble the generator and replace the regulator.

5. Unstable charging current

During the stable operation of engine, the charging indicator goes on or out from time to time, or the illuminance of headlight varies at intervals after activating the lamp at nights, it shows that charging current of charging system is unstable.

(1)Fault causes Causes for unstable charging current include:

1) Poor contact of generator's electric brush and sliding ring.

2) Poor voltage regulator of generator.

3) Poor contact of circuits outside or inside the generator caused by their loose connection.

(2)Fault diagnosis Connect a headlight bulb directly between the generator armature terminal and earth (Fig.12-22), and make the generator stably running at intermediate speed. If the bulb still goes on or out, it shows that the circuits in the generator, contact of electric brush and sliding ring or the voltage regulator is poor, so it's required to disassemble and check the generator; if the illuminance of bulb is stable, it may be caused by loose connection of generator output circuits or rusting on contact surface, so the bulb shall be checked and repaired.

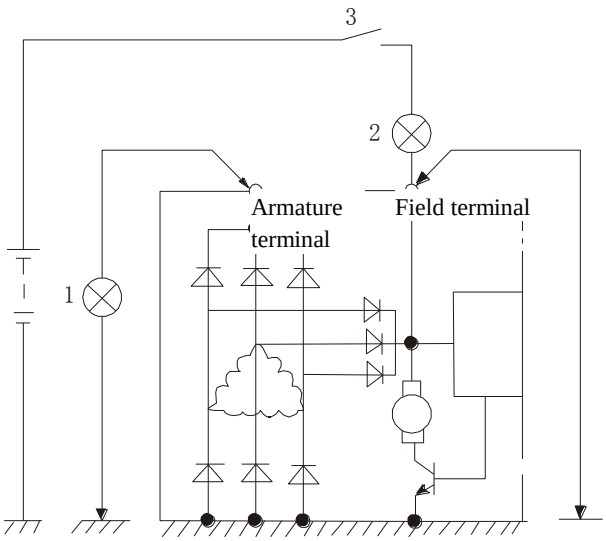

Fig.12-22 Check of Generator Generating Stability

1-Inspection bulb 2-Charging indicator of generator 3-Ignition switch

III. Check and repair of generator

1. Removal and disassembly of generator

(1)Removal of generator: after loosening the fastening bolts on front and rear supports and fastening bracket of generator, remove the generator (Fig.12-23).

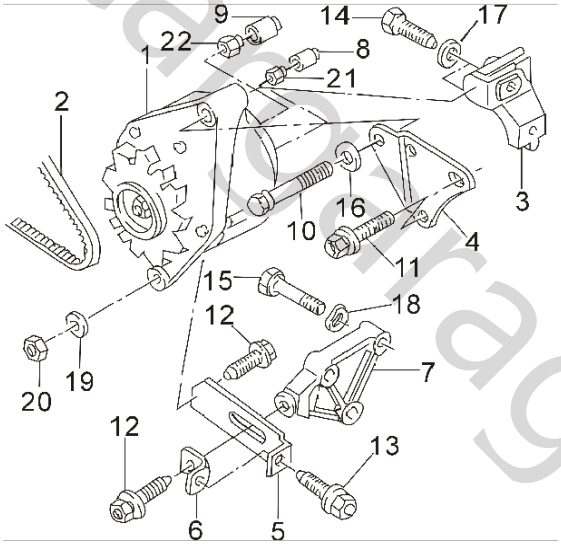

Fig. 12-23 Generator and Components Related to its Installation

1-Generator 2-Generator driving belt 3-Rear support of generator 4-Front support of generator 5-Fastening bracket of generator 6-Components of fastening bracket 7-Generator support 8, 9-Sheath 10, 11, 12, 15-Bolt 13, 14-Screw 16, 17, 19-Washer 18-Wave spring washer 20, 21, 22-Nut

(2)Disassembly of generator: the exploded view of generator is shown in Fig.12-16, and the generator shall be disassembled as per the following method:

1) Remove the connection bolts of its front and rear end cover, and separate front and rear end covers from their connection part.

2) Remove the terminals of stator winding connectors, and take out the stator winding from rear end cover.

3) Remove the fixing nuts and screws of brush holder, and take down the components of regulator and electric brush.

2. Check and repair of generator rotor

(1)Common faults of generator rotor: main faults of generator rotor include:

1) If dirt and ablation of sliding ring surface make the contact of electric brush and sliding ring poor, break or reduction of generator's exciting current makes the generator stop generating or kept in poor generation.

2)Short, break or earthing of generator field winding makes any rotor unable to produce an electromagnetic field or makes this field weakened, resulting in stopping generating or poor generation of generator.

(2)Check and repair the generator rotor according to the following methods:

1) Check whether the surface of rotor sliding ring is smooth and clean. If any oil dirt, clean the surface with a cloth soaked in some gasoline; if any burning or scratch, grind the surface with "00" sandcloth.

2) Check the rotor winding for breaks or shorts. Check the resistance between both rotor sliding rings through the ohms range of multimeter, as shown in Fig.12-24. Its normal resistance shall be 3Ω or so. If the resistance is too low, it shows that the rotor winding is shorted. If the resistance is ∞, the rotor winding is broken.

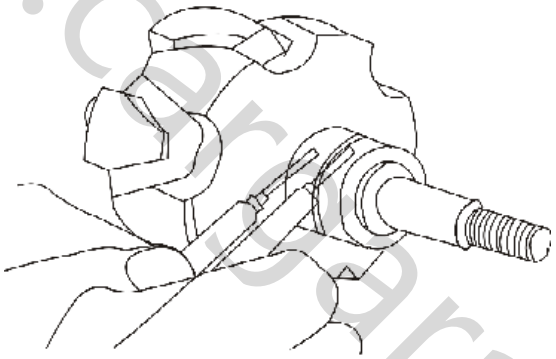

Fig.12-24 Short of Generator Rotor Winding

3) Check the rotor winding for earthing, and check the resistance between the sliding ring and shaft of rotor, as shown in Fig.12-26. Normally, the resistance shall be disconnected. If connected, it shows that the winding or sliding ring shall be shorted.

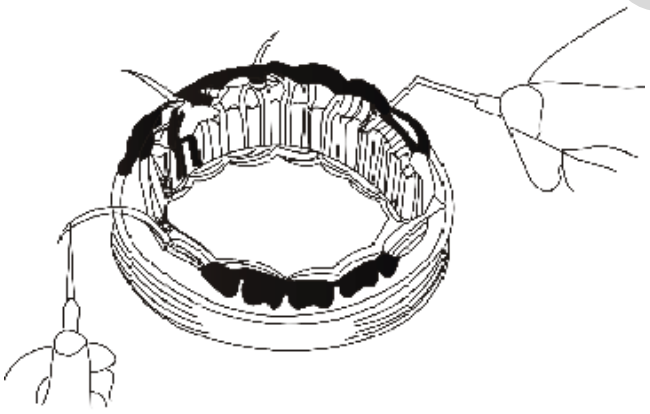

Fig.12-26 Break Check of Generator Stator Winding

If finding out the faults of rotor winding, it's required to replace the rotor assembly.

3. Check and repair of generator stator

(1)Common faults of generator stator: the stop or poor generation of generator is mainly caused by short, break or earthing of generator armature winding.

(2) Check and repair the generator stator as per the following methods:

1) Measure the resistance between the stator winding terminals through the ohms range of multimeter, to check the stator winding for breaks (Fig. 12-25). It shall be connected, otherwise it shows that the winding is broken, and it's required to replace the stator.

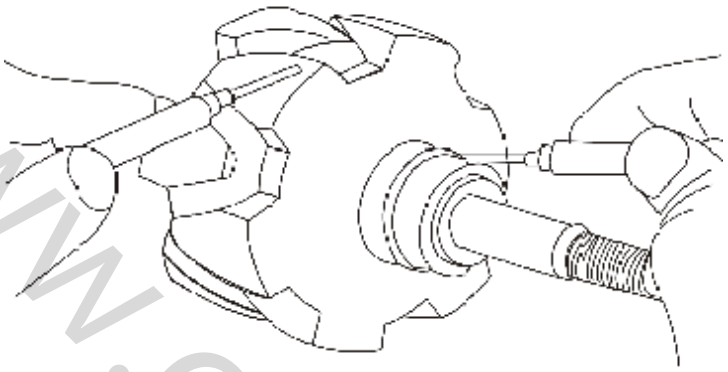

Fig.12-25 Earthing of Generator Rotor Winding

2) Measure the resistance between the stator winding terminal and iron core through the ohms range of multimeter, to check the stator winding for earthing (Fig.12-27). Normally, it shall be disconnected. If connected or its resistance below 50MΩ, it shows that the earthing or poor insulation occurs to the stator winding, so it's required to replace the stator.

Fig.12-27 Earthing Check of Generator Stator Winding

4.Check and repair of generator's electric brush and brush holder

(1)Common faults of electric brush and brush holder include:

1) Excessive wear of electric brush makes the contact pressure of electric brush and sliding ring reduced, resulting in poor contact. The reduction or stop of generator's exciting current leads to the poor or stopped generation of generator.

2) The failure of spring in the electric brush makes the contact pressure of electric brush and sliding ring reduced, resulting in poor contact. The reduction or stop of generator's exciting current leads to the poor generation or stop generating of generator.

(2)Check and repair of rectifier: check the positive and negative resistances of each rectifier diode through the resistance range of multimeter. Normally, the difference between the positive and negative resistances is very large. If the positive and negative resistances of a diode are measured as ∞, it shows that the diode is broken; if the positive and negative resistances is evened to 0, it shows that the diode is shorted. In case of short or break of diode, replace the rectifier. 2) Check whether the electric brush is freely slipped in the brush holder, and whether the electric brush has a certain spring pressure. If poor, replace it.

5. Check and repair of generator rectifier

(1)Common faults of rectifier: main faults of rectifier include short and break of rectifier diode, which can lead to poor or stopped generation of generator.

3) The deformation or dirt in brush holder channel makes the electric brush seized or makes it incapable of good contact with the sliding ring, which will lead to stopped or poor generation of generator.

(2)Check and repair the electric brush and brush holder as per the following methods:

1) Check the length of electric brush. If the section of electric brush exposed above the brush holder is less than 5mm, it shows that the electric brush has been excessively worn, so it's required to replace.

6. Recovered installation of generator

The assembling and installation of generator is carried out in reverse sequence of disassembly and removal. In case of installing the bearing, paint the lubricant.

7. Performance check of generator and regulator

(1) Check the output current of generator as per the following methods:

1) Check whether the battery is charged. In case of insufficient charging, recharge the battery. This check shall be carried out while the battery is completely charged.

2) After turning on the ignition switch, the charging indicator goes on. After staring the engine, the charging indicator goes out, and carry out the next step for check of generator performance, otherwise it shows that a fault occurs to the charging system. The fault shall be removed.

3) Connect the voltmeter, ammeter and varistor to the output circuit of generator, as shown in Fig. 12-28.

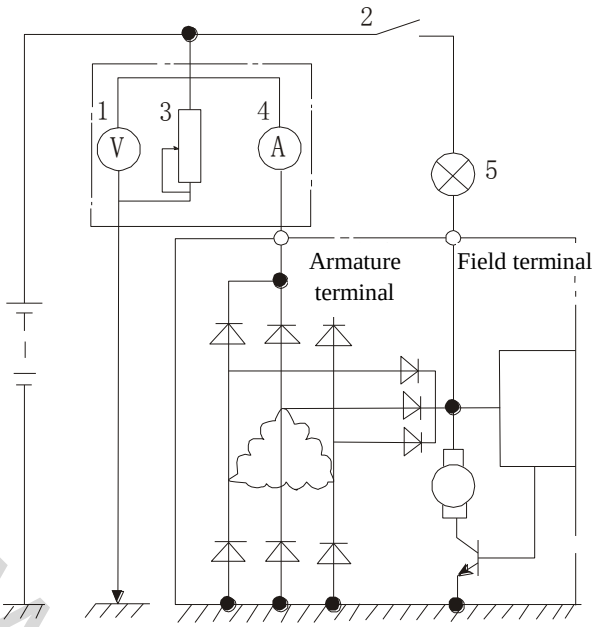

Fig.12-28 Performance Check of Generator and Regulator

1-Voltmeter 2-Ignition switch 3-Varistor 4-Ammeter 5-Charging indicator

(2)Check the performance of regulator as per the following methods:

4) In the event that the engine stays at the normal operating temperature, the rotating speeds of engine shall be stabilized to 2,000r/min, 3,000r/min and 4,000r/min. At the stable rotating speed of each engine, adjust the resistor, make the end voltage of generator 13.5V, and check the output current. At the stable rotating speed of engine, the output current of generator is shown in Table 12-3.

If the value specified in Table 12-3 can't be reached, check and repair the generator.

Table 12-3 Output Current when the End Voltage of Generator is 13.5V

Rotating speed of engine (r/min)		2000	3000	4000
End voltage of generator (V)		13.5	13.5	13.5
Output current of generator (A)	8 grade	49	62	68
	9 grade	62	76	83

1) Connect the voltmeter and varistor as shown in Fig.12-3

2) Adjust the varistor to zero (R=∞), and disconnect all the electric equipment.

3) In the event that the battery is completely charged and the engine reaches its normal operating temperature, the rotating speed of engine shall be stabilized to 5000r/min. See the voltage shown in the voltmeter.

If the voltage exceeds 14.7V, it shows that the performance of regulator is poor or it's completely damaged, so the regulator shall be replaced.

8. Keypoints for check and repair of generator

(1)During the operation of engine, don't disconnect the battery cables to avoid the overvoltage, burning of rectifier diode in the generator or damages to other electronic elements in the car.

(2)During the operation of generator, don’t check the generator for generation by adopting the flame gouging method, which is also easy to burn the rectifier diode.

(3)In case of checking the insulation capability of armature winding with a 220V AC test lamp or a megohmmeter, disconnect the rectifier diode and armature winding at first, otherwise the rectifier diode will be burnt.

(4)During the shutdown of engine, don’t connect the ignition switch for a long time, because the battery will continue discharging the electricity to the generator field winding after connecting the ignition switch, which not only wastes the electric energy of battery but also burns the generator field winding for a time.