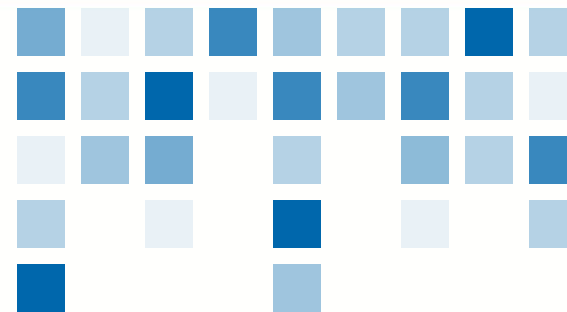
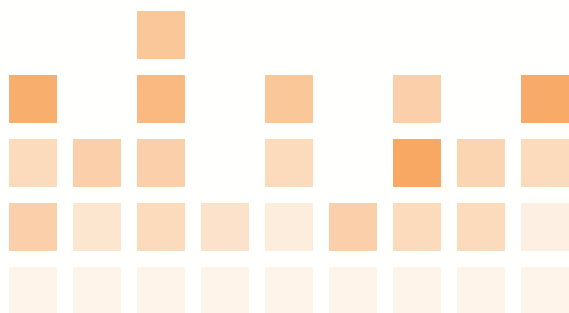




SHACMAN 汽车电器知识培训

F2000-F3000

陕汽进出口公司服务部培训科



第十五课 发电机

1. 概述：发电机由发动机带动，用来给整车电器设备供电（除起动机）及向蓄电池充电。我公司生产车型安装的是硅整流发电机，额定输出电压为28V，略高于蓄电池电压（24V），电瓶接线柱实际上测量的电压是25—27V之间。

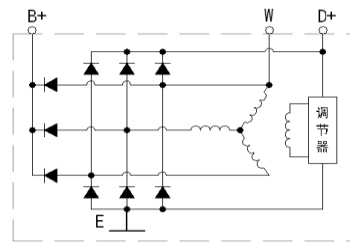
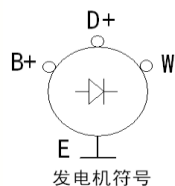
2. 发电机的符号及内部接线图

如图所示，B+端为发电机的电源输出，直接与整车主电源电路并联。D+端为充电指示灯接口，同时也是发电机的外接励磁电源接口。W为用于转速表转速信号的交流信号输出。E端为搭铁端。

Overview: The alternator is driven by the engine and is used to supply power to the entire vehicle's electrical equipment (excluding the starter) and to charge the battery. The models installed by our company are equipped with a silicon rectifier alternator, with a rated output voltage of 28V, slightly higher than the battery voltage (24V). The actual voltage measured at the battery terminal is between 25V to 27V.

Symbol and Internal Wiring Diagram of the Alternator

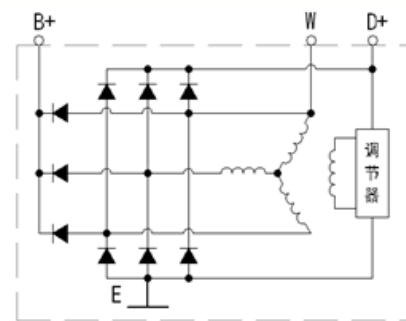
As shown in the diagram, the B+ terminal is the power output of the alternator, directly connected in parallel with the main power circuit of the vehicle. The D+ terminal is used for the connection of the charging indicator lamp and serves as the external excitation power supply interface of the alternator. The W terminal is used for the AC signal output for the speedometer. The E terminal is the grounding terminal.



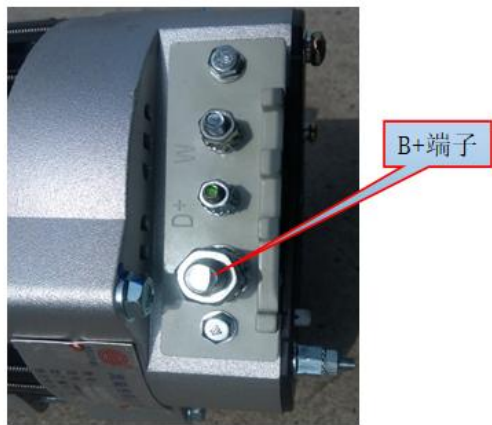
3.发电机接线端子的测量

从图可以看出，从搭铁（发电机的外壳或E接线柱）到B+、D+、W接线柱均有二极管连接，可以通过对二极管的测量判断发电机是否有故障。以常用的数字式万用表为例，首先关闭电源总开关，将发电机上B+、D+、W接线柱上的接线断开。将万用表的旋钮旋至“ ”档，将红表笔搭铁（搭到发电机外壳或E接线柱上），将黑表笔接到B+、D+或W接线柱上，将此时的读数记下（例如700），再将红、黑表笔交换位置后读数（例如1500）。如果第二次的读数大于第一次，则表明发电机内的二极管无故障，否则表明发电机内部电路故障。

From the diagram, it can be observed that there are diode connections from the grounding (alternator casing or E terminal) to the B+, D+, and W terminals of the alternator. This allows diagnosing the alternator for faults by measuring the diodes. Using a common digital multimeter as an example, first, switch off the main power switch and disconnect the wires from the B+, D+, and W terminals of the alternator. Set the multimeter dial to the "Diode Test" mode. Place the red probe on the grounding (touching the alternator casing or E terminal) and the black probe on either the B+, D+, or W terminal, and note the reading (for example, 700). Then, reverse the positions of the red and black probes and note the reading again (for example, 1500). If the second reading is higher than the first, it indicates that there are no faults in the diodes inside the alternator. Otherwise, it suggests an internal circuit fault within the alternator.

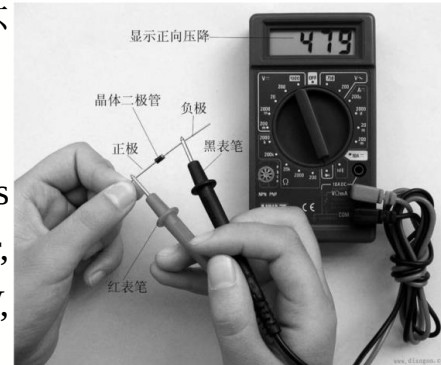


发电机线路图



关于数字式万用表二极管档测量的说明：二极管测量档标记为“”，主要功能是测二极管的正向压降，根据表的型号不同，其显示的单位也不同，有的表显示的电压单位为V，所以读数正向导通时显示数值会小于1，例如0.735，有些表显示的电压单位为mV，所以测量相同二极管可能会显示735。

Instructions for measuring diodes using the diode test function on a digital multimeter: The diode test function on a digital multimeter is typically labeled as "". Its main purpose is to measure the forward voltage drop across a diode. Depending on the model of the multimeter, the displayed unit may vary. Some multimeters display the voltage unit as V, so the reading for forward conduction will be less than 1.0V, for example, 0.735V. Other multimeters may display the voltage unit as mV, so the same diode measurement might display as 735mV.



另外当万用表显示为“1”（注意，不带任何小数点）则表明超越量程，一般表明开路，也就是说如果某一个二极管测得正向导通时测得的数值为735，反向测得的数值为1，则表明此二极管功能正常。如果对二极管正、反向测得的数值相同，则表明二极管已损坏，失去单向导电能力（同为0表明二极管内部短路、同为1表明二极管内部开路，同为一相同的数值表明失去单向导电能力，相当于一个电阻）。

导致发电机二极管损坏的可能原因：

1. 电源被接反。当电源接反后相当于将蓄电池电源正负极短路，此时将瞬间烧坏发电机二极管。
2. 接线柱搭铁，此时是将发电机的输出短路从而烧坏二极管。

Additionally, when the multimeter displays "1" (note: without any decimal point), it indicates exceeding the range, typically meaning an open circuit. So, if a diode shows a forward voltage drop of 735 and a reverse reading of 1, it suggests the diode is functioning correctly. If the forward and reverse readings are the same, it indicates the diode is damaged, losing its ability to conduct in one direction (if both are 0, it suggests an internal short circuit; if both are 1, it suggests an internal open circuit; if both are the same non-zero value, it suggests loss of unidirectional conduction ability, akin to a resistor).

Possible reasons for damage to the generator diodes: Reverse polarity connection: When the power source is connected incorrectly, it essentially short circuits the positive and negative terminals of the battery, leading to instantaneous burning of the generator diodes. Short circuit between terminals: When the terminal is short-circuited, it shorts the output of the generator, thus burning out the diodes.

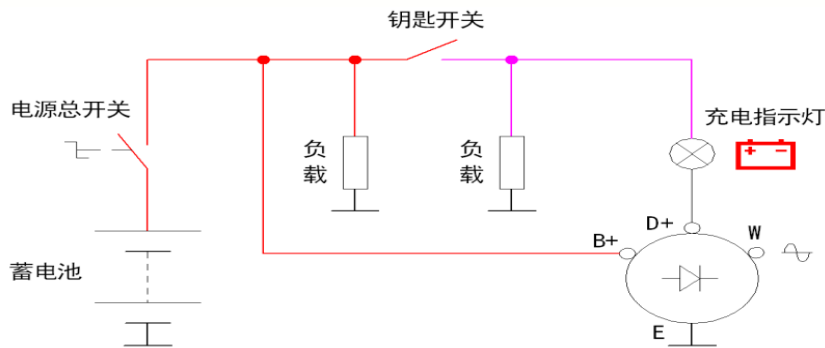


4. 发电机的励磁电路

图所示为发电机外部接线示意图，值得注意的是充电指示灯必须用灯泡而不能用常规的发光二极管指示灯代替，因为在发动机未运转前需由充电指示灯为发电机提供励磁电流，如果用发光二极管代替，则无法满足发电机有足够的励磁电流（发光二极管工作电流一般不大于10mA），会导致发电机不发电故障。

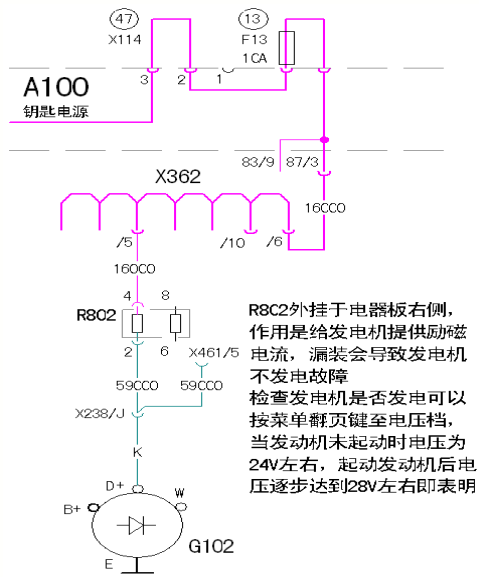
Excitation Circuit of the Generator

The diagram illustrates the external wiring of the generator. It's worth noting that the charging indicator must be a bulb and cannot be replaced with a conventional LED indicator. This is because before the engine starts running, the charging indicator needs to provide excitation current to the generator. If an LED is used instead, it cannot provide sufficient excitation current to the generator (the working current of an LED is generally not greater than 10mA), which can lead to generator failure to generate electricity.



对于安装CBCU/CUFU的车型，其仪表通过CAN总线传递各信号灯状态，不再依靠充电指示灯提供发电机的励磁电流，而是改为通过外挂于电器板右侧的模拟电阻R802来提供励磁电流（见图1-5）。另外CBCU/CUFU内部有电压测量模块，当其测得电路电压低于27V（发电机额定输出电压为28V）时就点亮充电指示灯，对于某些性能较低的发电机，可能会出现怠速时充电指示灯点亮的情形。

For vehicle models equipped with CBCU/CUFU, the instrument panel transmits various signal lamp statuses through the CAN bus, no longer relying on the charging indicator to provide excitation current to the generator. Instead, it is replaced by an analog resistor R802, which is externally mounted on the right side of the electrical board (refer to Figure 1-5). Additionally, the CBCU/CUFU internally includes a voltage measurement module. When it detects that the circuit voltage is below 27V (the rated output voltage of the generator is 28V), the charging indicator light illuminates. For some lower-performance generators, the charging indicator light may illuminate at idle.



用于CBCU/CUFU的发电机励磁电路

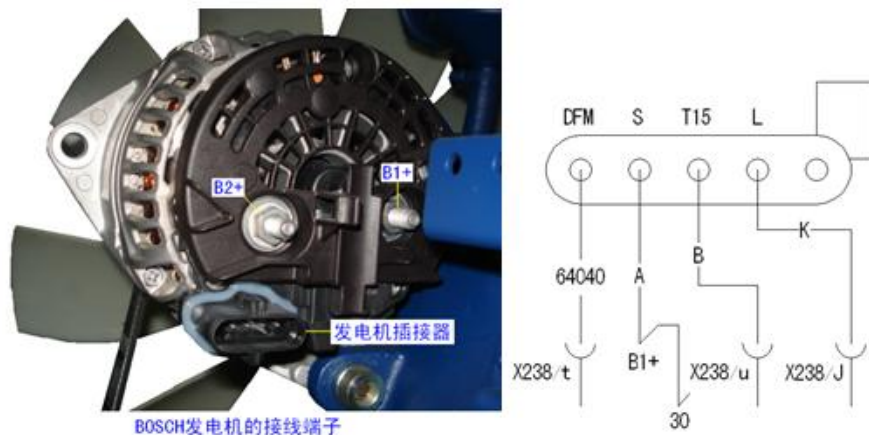


5. WP12发动机发电机端子说明:

WP12发动机的发电机比较特殊，其上有两个B+接线柱，接主电源，另有一个5孔插接器，插接器上的接线端子如图1-6所示。

Terminal description of the generator for the WP12 engine:

The generator for the WP12 engine is unique in that it has two B+ terminals for connecting to the main power supply. Additionally, there is a 5-pin connector, with terminal descriptions illustrated in Figure 1-6



WP12 发动机上的发电机及其接线端子

DFM —— 发电机负载状况信号输出（目前未使用）。用于电源管理系统侦测发电机的负载状况，输出信号为占空比变化的方波信号，电源管理系统通过检测信号占空比可以测出发电机的负荷情况。

DFM - Generator Load Status Signal Output (Currently Unused). Used for the power management system to detect the load status of the generator. The output signal is a square wave signal with a variable duty cycle. The power management system can measure the load condition of the generator by detecting the duty cycle of the signal.



S —— 电源电压信号（接蓄电池“+”极）。发电机控制器测定蓄电池的电压并控制充电电流。即常电电源。

T15 —— 发电机工作激励信号（连接钥匙电源，15为钥匙电源的通用表示）。当此端未连接电源时发电机将不工作。右图所示为装配WP12发动机的德龙车型的发电机励磁电路。

注意：WP12发电机的接线端S端和T15端必须正确接入24V电压才可以发电。

L —— 连接充电指示灯（ ），灯亮表示发电机未发电。

BOSCH发电机接线特点，发电机工作需要的励磁电源由T15端提供，不再由充电指示灯提供。所以当BOSCH发电机不发电时应检查T15端电源是否正常。

B1+、B2+ —— 连接主电源电路，通过此端向驾驶室供电，也对蓄电池充电。

S - Power supply voltage signal (connected to the "+" pole of the battery). The generator controller measures the battery voltage and controls the charging current. It is a constant power supply.

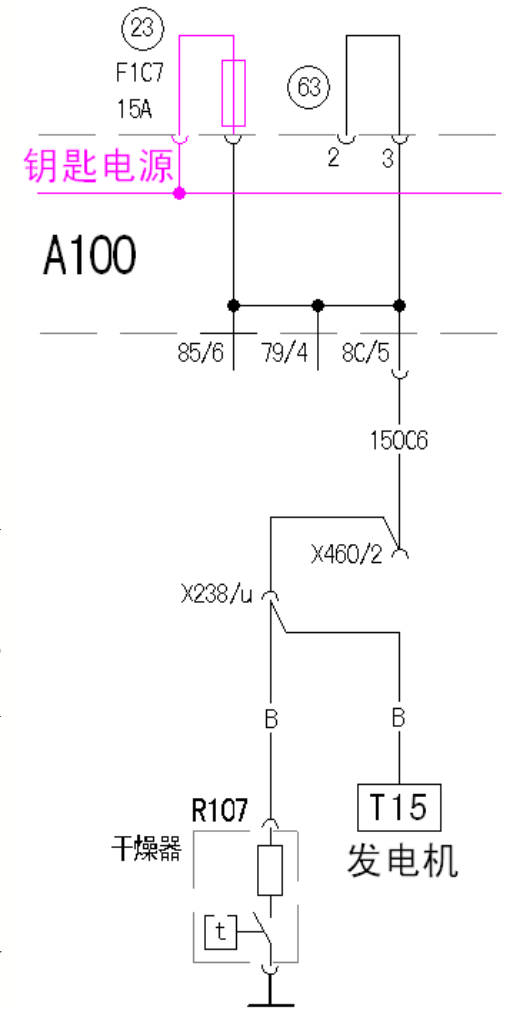
T15 - Generator working excitation signal (connected to the ignition power, "15" is a universal representation of ignition power). When this terminal is not connected to power, the generator will not work. The right diagram shows the excitation circuit of the generator installed in the DeLong model equipped with the WP12 engine.

Note: The S terminal and T15 terminal of the WP12 generator must be correctly connected to a 24V voltage for the generator to work.

L - Connected to the charging indicator light (), the light illuminates when the generator is not generating power.

BOSCH generator wiring characteristics: The excitation power required for the generator to work is provided by the T15 terminal, not by the charging indicator light. Therefore, when the BOSCH generator is not generating power, it is necessary to check if the power supply to the T15 terminal is normal.

B1+, B2+ - Connected to the main power circuit, supplying power to the cabin through this terminal and also charging the battery.



WP12发动机发电机励磁电路



6. 发电机故障判断:

①**充电灯常亮:** 表现启动发动机后充电灯常亮不灭。此时需要判断电瓶端电压, 是否在发电机由静止到发动机运转时, 电压是否有升高的表现。如果电压升高表明发电机可以发电, 然后排查充电灯常亮故障 (通常是59000线搭铁或空调继电器K486故障)。如果电压没有升高, 还要踩油门让发动机高速运转, 再查看电压是否升高。如果确认电压没有升高, 就要排查发电机不发电的故障。(对比法)

②**发电机不发电:** 需要检查发电机的D+端子接线是否正确。还有可以断开X238插接器J孔位的蓝色线, 测量驾驶室一端是否有24V电压, 如果没有24V, 故障部位在驾驶室的充电灯的线路。如果有24V, 就要观察把驾驶室一端的J端子搭铁时, 充电灯要点亮, 驾驶室一端的J端子不搭铁时, 充电灯不亮。如果发电机D+端接线正确, 而且充电灯的搭铁实验点亮熄灭正确, 可能是发电机损坏。(断开法)

Generator Fault Diagnosis:

① **Charging Light Constantly On:** This is indicated when the charging light remains illuminated after starting the engine. In this case, it is necessary to check the voltage at the battery terminal and observe if there is an increase in voltage from when the generator is at rest to when the engine is running. If the voltage increases, it indicates that the generator is capable of generating power. Then, investigate the cause of the constantly illuminated charging light (usually caused by a fault in the 59000 line grounding or the air conditioning relay K486). If the voltage does not increase, accelerate the engine to high speed and observe if the voltage increases. If it is confirmed that the voltage does not increase, then diagnose the fault of the generator not generating power (by comparative method).

② **Generator Not Generating Power:** Check if the D+ terminal of the generator is connected correctly. Also, disconnect the blue wire from terminal J of connector X238 and measure if there is a 24V voltage at one end of the cabin. If there is no 24V, the fault lies in the circuit of the cabin's charging light. If there is 24V, observe that when terminal J of the cabin is grounded, the charging light should illuminate, and when terminal J of the cabin is not grounded, the charging light should not illuminate. If the generator's D+ terminal connection is correct and the grounding experiment of the charging light is correct, it may be a fault with the generator itself (by disconnecting method).



③**充电灯不亮**：需要检查发电机的D+端子接线是否断路。还有检查驾驶室一端的J端子是否断路。还要检查组合仪表的绿色插头22孔位的59000线束是否正确，以及在仪表处断开59000线，检查仪表是否有24V电压输出，如果没有24V就要更换组合仪表。如果仪表有24V电压输出，就要检查从仪表蓝色插头22孔位到X238插接器J孔位再到发电机D+端子的线束断路故障，如果发电机的D+端子接线处有24V电压，而且把此处的D+端子搭铁时充电灯会点亮，就是发电机D+端子内部电磁线圈开路，需要更换发电机。

③ **Charging Light Not Illuminated**: Check if there is a circuit break in the D+ terminal connection of the generator. Also, check if terminal J at one end of the cabin is circuit broken. Additionally, inspect the 59000 harness at the green plug position 22 of the combination instrument to ensure correctness. Disconnect the 59000 wire at the instrument panel and check if there is a 24V voltage output. If there is no 24V, the combination instrument needs to be replaced. If there is a 24V voltage output from the instrument panel, inspect the harness for circuit breakage from the blue plug position 22 of the instrument panel to terminal J of connector X238 and then to the D+ terminal of the generator. If there is a 24V voltage at the generator's D+ terminal connection point, and grounding the D+ terminal here illuminates the charging light, it indicates an open circuit in the internal electromagnetic coil of the generator's D+ terminal, necessitating replacement of the generator.

