SHACMAN 汽车电器知识培训

F2000-F3000

陕汽进出口公司服务部培训科

第十六课 主要车型启动电路

1. 起动机的作用：

起动机将贮存在蓄电池的**电能变成机械能**，再通过齿轮副带动发动机旋转，从而**实现发动机的起动**。

当今使用的起动机已采用超越离合器起动机机构取代了老式惯性啮合起动机构，主要有四种类型：

①直接起动式起动机；②齿轮减速式起动机；③强制啮合式起动机；④永磁式起动机。

其中**行星齿轮减速式起动机**为最常用的起动机，图中所示为陕汽重卡以及特种车辆装配过程中经常遇到的起动机以及接线端子接线要求，其中**50 起动端均接黑红黄色起动线，30 端接通过起动机线束与蓄电池正极接通，为提供更可靠的接地效果。**

有些起动机提供了31端可连接蓄电池负极，实际装配中图B 和图D 的31 端一般不使用。图A、C、E、F 中起动机上还集成了起动机保护继电器，可以减少整车相关电路，图B 中起动机端子在接起动机线束时，要根据接线端子颜色来确定正负极，红色端子接起动机线正极线束，黑色端子接起动机线负极线束，若装配时没有颜色区别时，可以通过起动机上的标识进行确认如D图所示，关于起动电路方面的内容后序介绍。

1.The Function of the Starter Motor: The starter motor converts the electrical energy stored in the battery into mechanical energy. It rotates the engine via a gear mechanism, enabling the engine to start. Today, the starters commonly used have replaced the old-style inertia engagement mechanisms with overrun clutch starter mechanisms, primarily in four types: Direct Drive Starter Motor; Gear Reduction Starter Motor; Bendix Drive Starter Motor; Permanent Magnet Starter Motor

Among these, the gear reduction starter motor is the most commonly used. The illustration depicts starter motors frequently encountered during the assembly process of SHACMAN and special vehicles, along with the wiring terminal connection requirements. In these, the 50 terminal is connected to the black-red-yellow starting wires, while the 30 terminal is connected to the positive terminal of the battery via the starter motor wiring harness to provide a more reliable grounding effect. Some starter motors provide a 31 terminal that can be connected to the negative terminal of the battery. In practical assembly, the 31 terminals in Figures B and D are generally not used. In Figures A, C, E, and F, starter protection relays are integrated into the starter motor, reducing related vehicle circuitry. When connecting the starter motor harness to the terminals in Figure B, the polarity should be determined based on the color of the wiring terminals. The red terminal connects to the positive lead of the starter motor harness, and the black terminal connects to the negative lead. If there is no color distinction during assembly, confirmation can be made through the markings on the starter motor, as shown in Figure D. Further details regarding the starter circuit will be discussed subsequently.

以上图中：图A，是常见的潍柴EGR发动机或潍柴LNG、CNG发动机的起动机，其50起动端是单线接线。图E，是常见的康明斯发动机的起动机，其50起动端是一个启动继电器接线。图I，是常见的潍柴国三、国四发动机的起动机，其50起动端是一个2孔插头接线。图中其余B，C，D，F，G，H，的起动机使用较少，不常见到。

In the above illustrations: Figure A depicts a common starter motor for Weichai EGR engines or Weichai LNG/CNG engines, with a single wire connection at the 50 starting terminal. Figure E shows a typical starter motor for Cummins engines, with a 50 starting terminal connected to a starter relay. Figure I displays a typical starter motor for Weichai Euro III and Euro IV engines, with a 50 starting terminal connected to a 2-pin connector. Other starter motors depicted in Figures B, C, D, F, G, and H are less commonly used and are not frequently encountered.

2. 潍柴起动机结构组成：

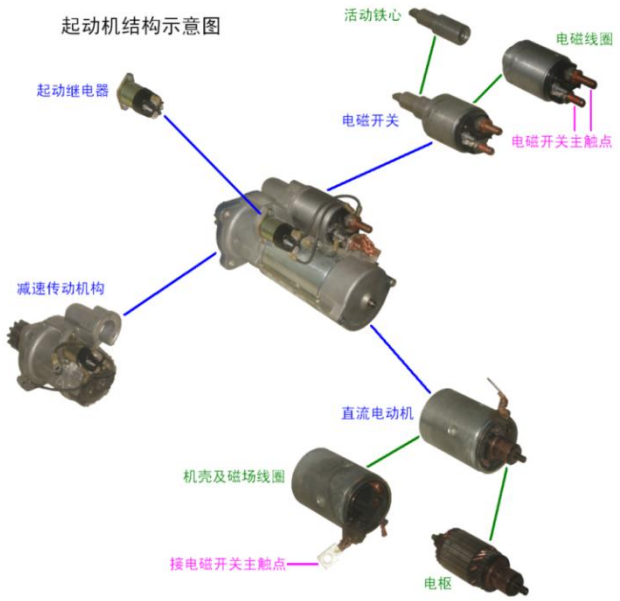
潍柴发动机采用的起动机如图所示，包括产生动力的串激式直流电动机，控制起动电机的电磁开关及起动继电器，减速传动装置。

注意：此起动机上没有负极电源接线柱，靠壳体搭铁（接负极）。

Structure of Weichai Starter Motor:

The starter motor used in Weichai engines, as shown in the diagram, consists of a series-excited DC motor that generates power, an electromagnetic switch and starter relay for controlling the starter motor, and a reduction transmission device.

Note: There is no negative power supply terminal on this starter motor; it relies on the casing for grounding (negative connection).



潍柴起动机结构示意图和起动机装配结构图

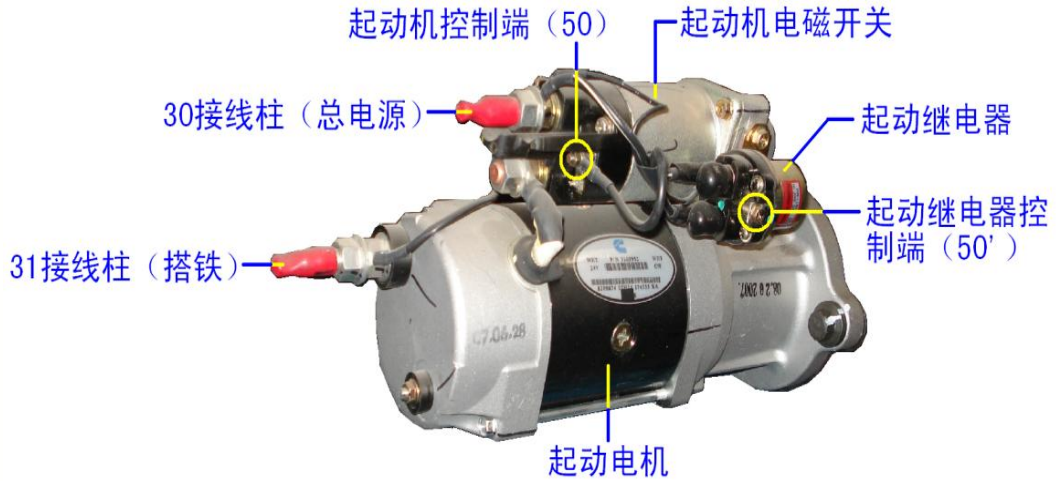
3. 起动机工作原理：

当钥匙开关输出起动信号后，电磁开关线圈通电，吸引活动铁心向线圈靠拢，同时带动拨叉运动，使驱动齿轮伸出，驱动齿轮转轴与减速器输出轴通过花键连接，且花键为螺旋形，所以在拨叉拨动驱动齿轮轴向运动时，驱动齿轮也在慢转，保证驱动齿轮啮合平顺。当驱动齿轮与发动机飞轮齿盘啮合后，电磁开关上的活动铁心推动电磁开关内的接触盘将两个主触点接通，此时直流电动机开始运转，通过减速器带动驱动齿轮。

Working Principle of the Starter Motor:

When the ignition switch outputs a starting signal, the electromagnetic switch coil is energized, attracting the armature towards the coil, simultaneously moving the shift fork, causing the driving gear to extend. The drive gear shaft is connected to the output shaft of the reducer through a spline, and the spline is spiral-shaped. Therefore, when the shift fork moves the drive gear shaft axially, the drive gear also rotates slowly, ensuring smooth engagement of the drive gear. After the drive gear engages with the engine's flywheel ring gear, the movable armature on the electromagnetic switch pushes the contact disc inside the electromagnetic switch to close the two main contacts. At this point, the DC motor starts running and drives the drive gear through the reducer.

4.康明斯起动机接线位置：



康明斯起动机接线位置说明图

康明斯起动机接线和潍柴起动机接线最大的不同就是配置了31接线柱（搭铁端子）此31接线柱必须正确连接棕色线和电瓶负极线。

其余接线柱30端连接电瓶总开关正极电源,50端连接启动信号，即起动继电器控制端。

The main difference between the wiring of Cummins starter and Weichai starter is the inclusion of a 31 terminal (grounding terminal) in the Cummins starter. This 31 terminal must be correctly connected to the brown wire and the battery negative wire.

The rest of the terminals are connected as follows: the 30 terminal is connected to the positive power supply of the battery master switch, and the 50 terminal is connected to the starting signal, which is the control terminal of the starter relay.

5. 德龙国二起动系统（F2000、F3000、EGR车型）

如下图，德龙起动机系统主要由空档开关S14、钥匙开关Q101和启动马达M100组成。启动马达M100共有三个接线端子，“30”端子由70-90mm²的黑(B)线直接接至电源总开关S149，为启动马达提供电源。

变速箱空档开关S14串接在起动机50端的控制回路上，当变速箱在空档位置时，空档开关S14闭合，此时钥匙开关Q101旋至启动“3”档位置时，Q101的8号端子输出的启动信号50300电源经电器装置板A100后面79-3进入80-2输出，然后通过水龙头X238-E端子，由BAD线经过空档开关S14接通起动机的50端，起动机马达磁力线圈工作，将电枢及启动齿轮推进飞轮齿圈带动发动机旋转启动。待发动机正式启动运转后马达齿轮自动退出飞轮。

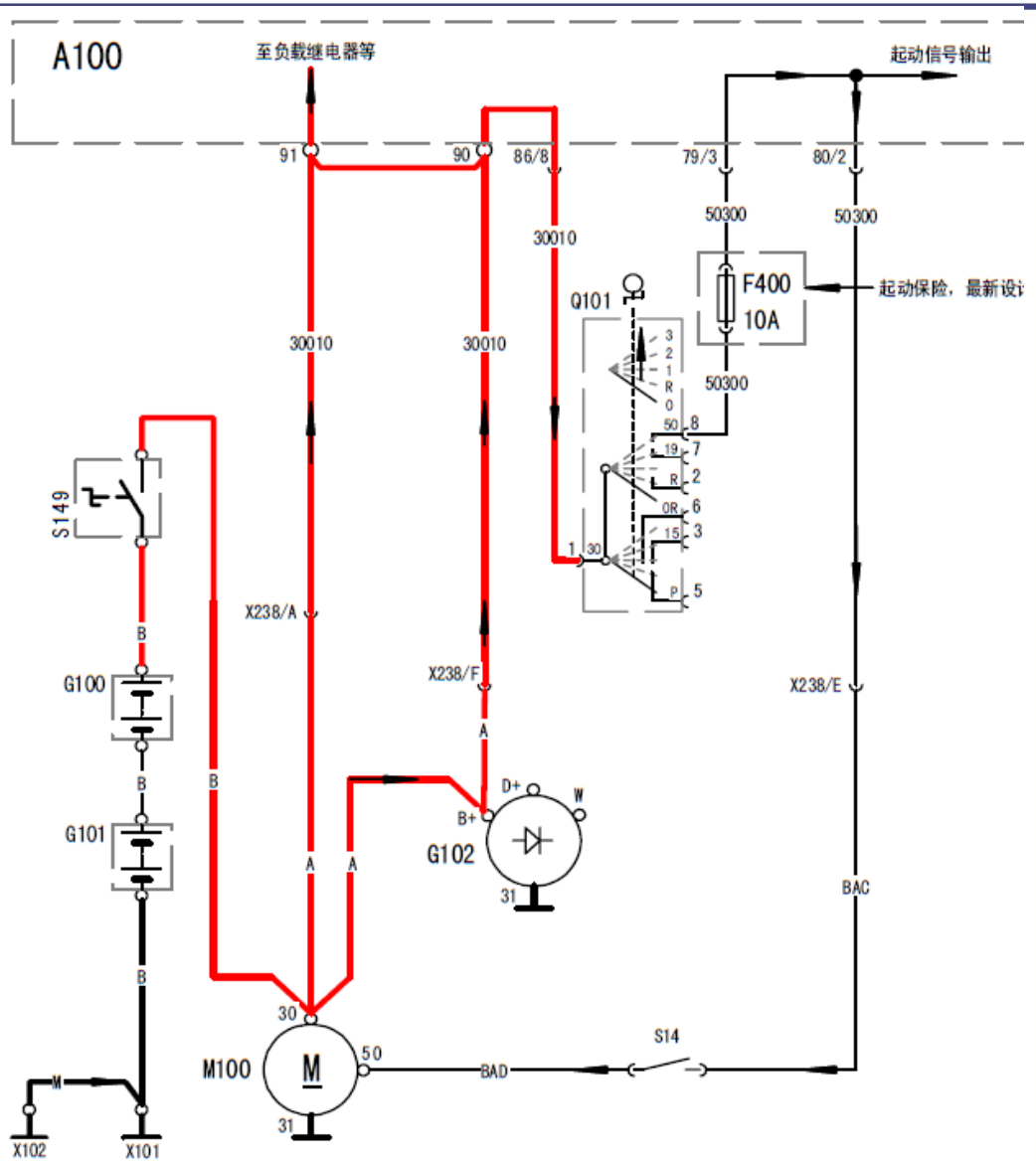
如果在启动操作时，变速箱挂合任何一个档位、空档开关S14均断开，启动电路均断路，启动马达都不能被接通，从而确保启动发动机的安全。

Delong Euro II Starting System (F2000, F3000, EGR Models)

The Delong starter system consists mainly of the neutral switch S14, ignition switch Q101, and starter motor M100. The starter motor M100 has three terminals. The "30" terminal is connected directly to the power supply master switch S149 with a 70-90mm² black (B) wire to provide power to the starter motor.

The gearbox neutral switch S14 is connected in series with the control circuit of the starter's 50 terminal. When the gearbox is in neutral position, the neutral switch S14 closes. At this time, when the ignition switch Q101 is turned to the "start" position, the starting signal 50300 from terminal 8 of Q101 is output, and it passes through the electrical device board A100, then enters terminal 79-3 and exits through terminal 80-2. Subsequently, it passes through connector X238-E and, via the BAD wire, passes through the neutral switch S14 to connect to the starter's 50 terminal. The starter motor coil works, pushing the armature and starting gear into engagement with the flywheel ring gear to start the engine. After the engine starts running, the starter gear automatically disengages from the flywheel.

If during the starting operation, the gearbox is engaged in any gear, the neutral switch S14 is open, and the starting circuit is interrupted. Consequently, the starter motor cannot be activated, ensuring the safety of starting the engine.



F2000起动电路原理图

F2000起动电路组成:

G100-G101蓄电瓶

S149电瓶总开关

A100电器装置板

Q101 钥匙开关

F400 保险丝(有的车型无此保险丝)

S14 空档开关

M100 起动机

G102发电机

Composition of F2000 Starting Circuit:

G100-G101 Battery

S149 Battery Master Switch

A100 Electrical Control Unit

Q101 Ignition Switch

F400 Fuse (Some models may not have this fuse)

S14 Neutral Switch

M100 Starter Motor

G102 Generator