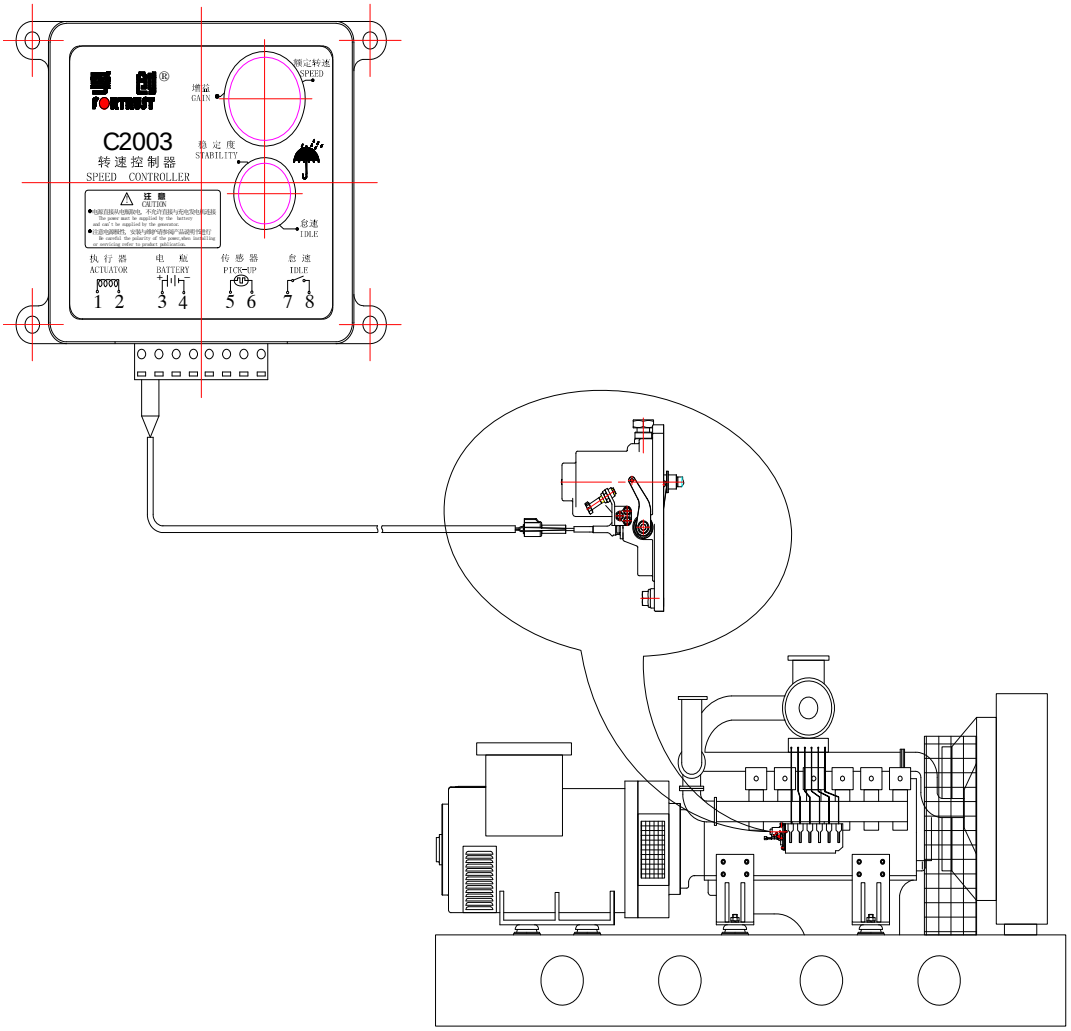
ESG2003 系列

ESG2003 Series

电子调速器使用说明书

Electronic Governor Instruction



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前 言

本使用说明书主要介绍了电子调速系统的工作原理、组成、调节、操作、维护及简易故障的排除方法等，适用于对发动机及电子调速器有一定了解、日常进行安装、接线、使用及维修的工作人员。建议将本说明书置于产品的工作场所，并严格遵循这里所提供的方法去操作。

警 告

- 本电子调速系统中所使用到的转速传感器不得与其他系统共用，否则将有可能造成严重后果。
- 您不能完全依靠本电子调速系统来防止发动机超速，而应在发动机系统上安装独立、有效的超速保护装置。
- 发动机起动之前应确认喷油泵供油杆处于断油的位置，推拉供油齿杆应灵活无卡涩。

1 电子调速器工作原理

发动机调速器是将发动机稳定控制在设定工作转速下运行的精密控制装置。电子调速器因其性能可靠、功能齐全、安装维护方便以及调速性能优异等有别于其它类型调速器的独特优势，正越来越广泛地应用于发动机调速系统、发电机组监控系统之中，成为行业应用的一种发展趋势。

电子调速器具有转速设定、测速、比较、运算、驱动输出、执行元件、调节系数设定、保护或限制等机构或部件，各机构或部件经过有效组合形成一个闭环控制系统(如图 1.1 所示)：

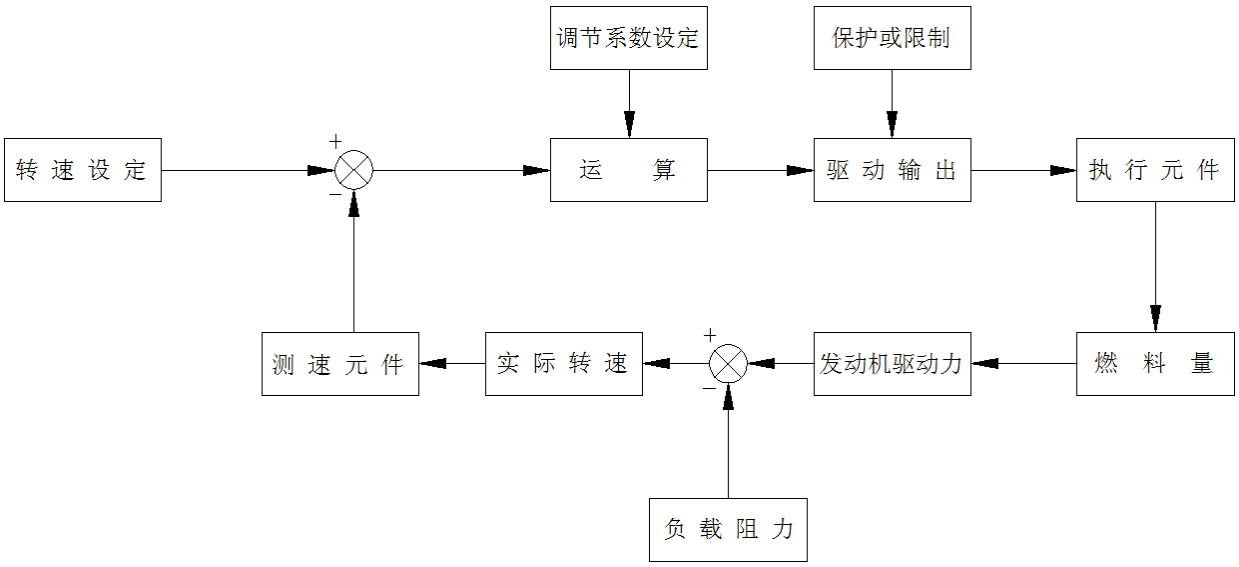


图 1.1 调速器原理示意图

2 电子调速系统的组成

2.1 C2003 转速控制器

2.1.1 基本电气特性

☑ 电源电压： DC24V（范围 18V～32V）或 DC12V（范围 9V～16V）

☑ 电源消耗： ＜ 0.1A（不包括执行器）

☑ 转速波动率：≤ ±0.25 %

☑ 高速设定范围：1KHz～7.5KHz

☑ 环境温度： -40℃～ +85℃

☑ 环境湿度： ＜ 95%

2.1.2 C2003 型转速控制器的基本功能

● 转速控制：采用单闭环方式控制转速；

● 高低速转换：可在怠速工况与额定工况之间进行切换；

● 自动停车保护：当转速信号消失、控制器掉电时，使发动机自动停机；

以上基本功能的实现可参考后续章节参数设置中的详细说明。

2.1.3 C2003 转速控制器接线图

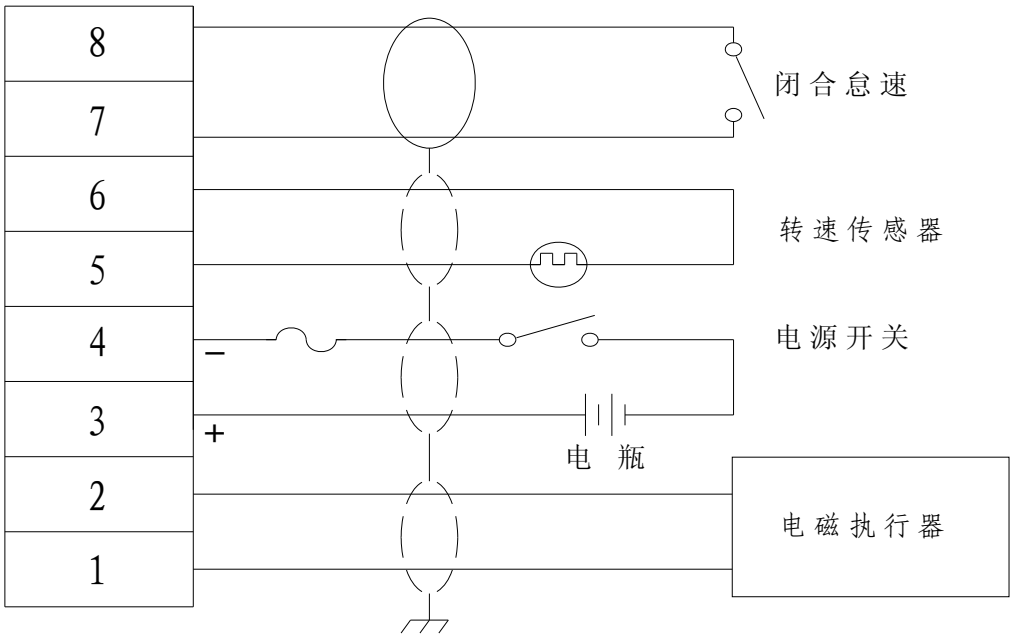


图 2.1 C2003 转速控制器接线图

2.1.4 C2003 转速控制器外形及安装尺寸

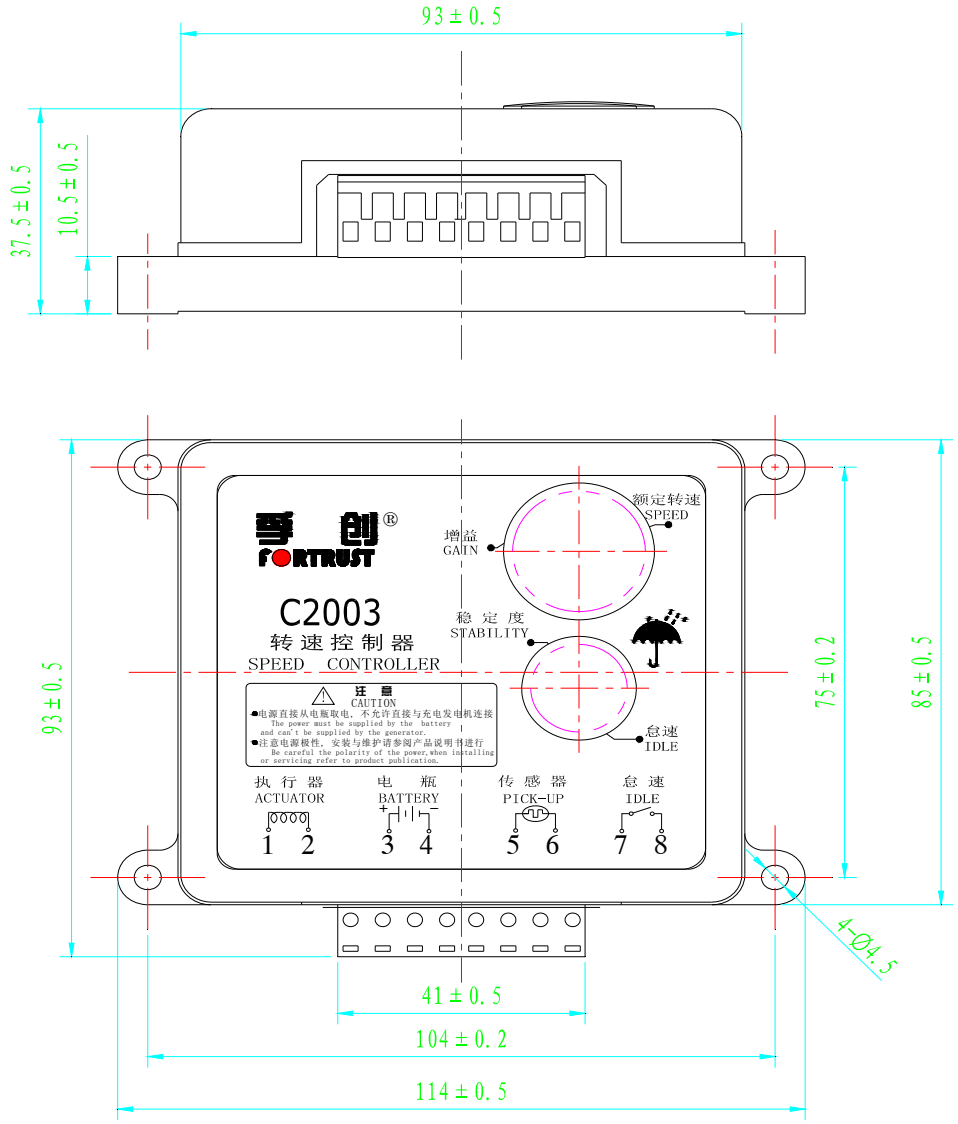
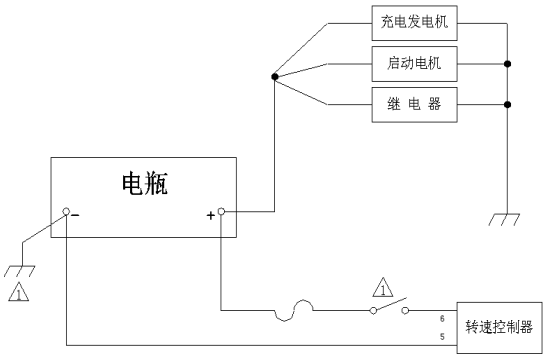
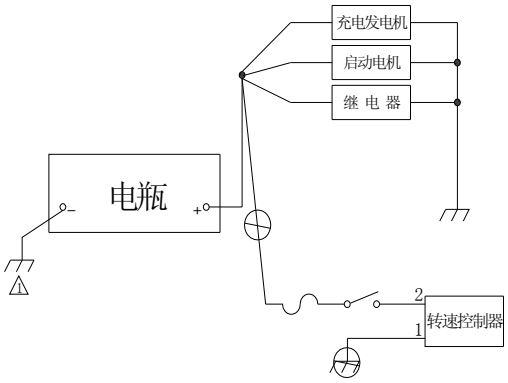


图 2.2 C2003 转速控制器外形及安装尺寸

2.1.5 接线端口的定义及要求：

◆ 1、2 端子接执行器(ACTUATOR)，3、4 端子接电瓶(BATTERY)，要求两组线截面 1.3 mm² 或更粗，线缆越长要求线径越粗，以减小电压降。为防止意外发生，电池组正极到转速控制器电源正极(即端子 3)之间的线缆上串接 15A 的保险丝(FUSE)是十分必要的；控制器的电源线应单独、直接从电瓶的正负极取出，而不得绕道其他接口，正确接线如下：





☑正确的电源接线图　　错误的电源接线图

- 5、6 端子接速度传感器(PICK-UP)，速度传感器必须全程使用编织屏蔽网线缆连接，线缆的屏蔽网部分应如图 3.1 的方式 360 度环接到支点上，不可与发动机的其他任何地连接，否则干扰信号可能进入转速控制器，造成难以预测的后果；
- 7、8 端子接高/低速切换开关（IDLE），闭合时为怠速运行状态，断开后按已经设定的加速时间（SPEED RAMPING）上升至额定转速运行；

2.2 电磁执行器

本说明书所述转速控制器可与孚创公司生产的所有单闭环电磁执行器配套使用，用户可根据油泵的型号灵活地选用孚创公司生产的电磁执行器及配套的中间体等，或由孚创公司的专业配试人员进行现场配试，为您的产品提供最佳的配机方案；本说明书所列电磁执行器是根据您产品的配机要求罗列的，若需查询孚创生产的电磁执行器的种类及详细资料可登录孚创公司网站 www.fortrust.cn 或 Email：sales@fortrust.cn、销售热线 021-51961611/12/13 转总机进行查询或与我们联系；配置不同的电磁执行器时，转速控制器的稳态调速率的调节范围会略有不同，这是正常现象，若配置不同的电磁执行器后导致不能满足您的调速率要求，请与我们联系，我们将会为您提供专业的解决方案。

2.2.1 A07A 电磁执行器基本特性

☑ 电源电压：　DC24V（范围 16V～32V）

☑ 工作能力：　0.8N M

☑ 工作行程：　15mm

☑ 环境温度：　-40℃～ +95℃

☑ 环境湿度：　< 95%

☑ 位置配置：　依据供油泵在发动机上的位置可选配左右

2.2.2 A07A 电磁执行器外形及安装尺寸(如图 2.3)

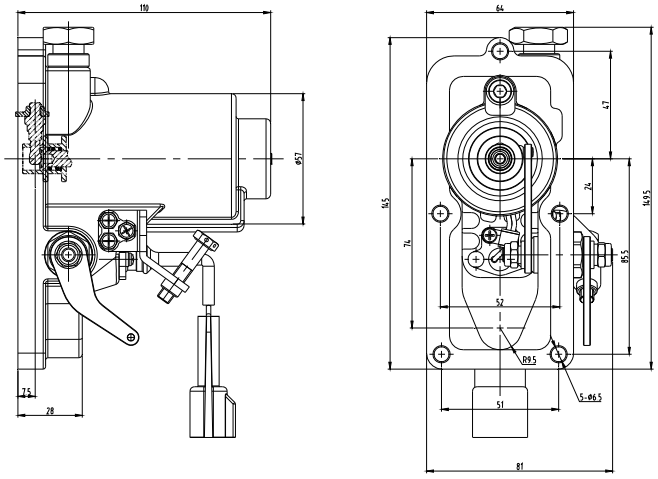


图 2.3　A07A 电磁执行器外形及安装尺寸图

2.3 转速传感器

本电子调速系统所采用的转速传感器采用无源磁电式转速传感器，它根据测速齿轮旋转所引起的磁隙变化，在转速传感器的磁头线圈中产生出感应电动势，形成转速信号输出。安装时应将转速传感器固定在发动机齿轮盘上，通过感应飞轮齿数来判断发动机的转速；传感器的安装应在接触到齿轮的齿顶后退出 1／2 － 3／4 圈（约 0.45mm），这是一个较为理想的间隙。转速输出信号的频率与转速的对应关系为：f=nz/60，其中 f 为频率（Hz），n 为转速（转/分），z 为飞轮齿数（个）。用户可根据不同发动机的飞轮齿数按上式进行换算来初步设定转速控制器的速度设定值，在发动机起动后再精确调整，来达到所要求的转速值。

孚创公司生产的转速传感器可提供多种安装尺寸，用户可根据实际需要进行选择。

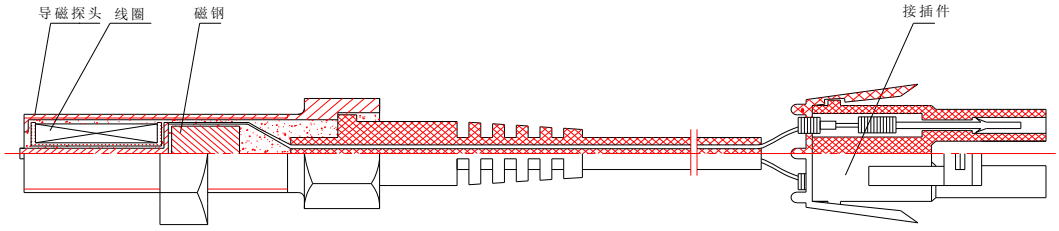


图 2.4 转速传感器结构图

注意：本电子调速器系统中所使用到的转速传感器不得与其他测速系统共用，否则可能造成非常严重的后果！

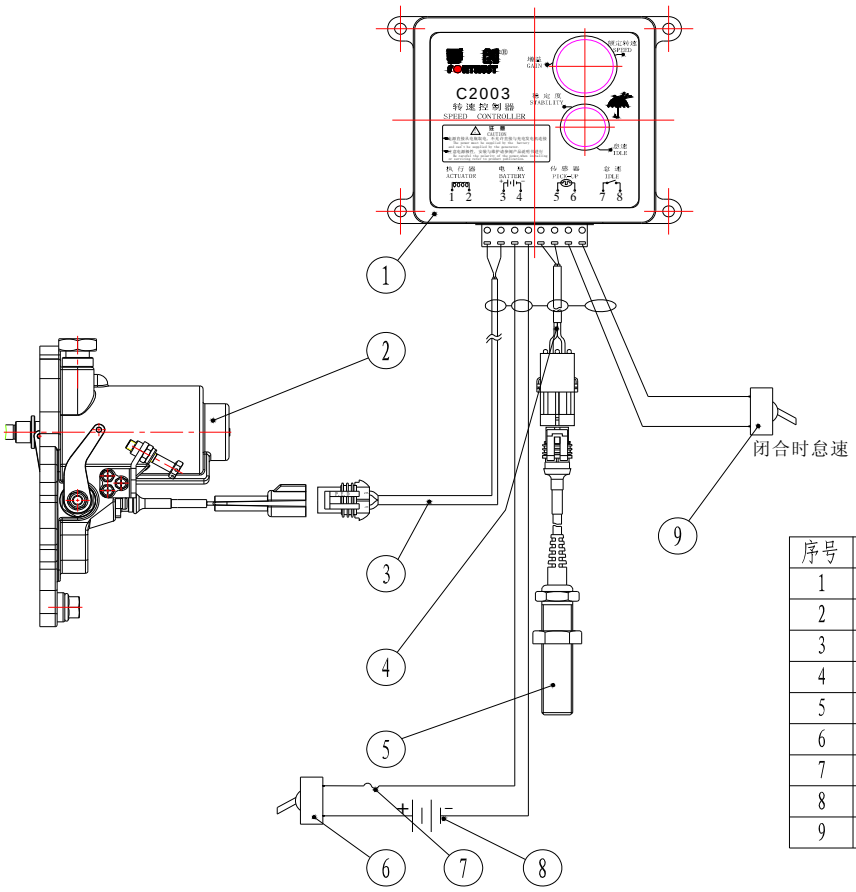
3 安装与调试

3.1 电子调速器的安装

C2003 转速控制器通常安装于控制柜之中或固定在发动机其它外围设备上，安装时应尽量选择空气干燥、温度适宜的地方安装；转速控制器有防潮处理，但仍须防止水、雾或者凝结物等与控制器接触；安装时应远离高温及热辐射，以防止控制器高温损坏，如果在水和湿气比重较大的地方使用应将控制器垂直安装。

注意：1. 发动机应有独立的超速保护装置，不能依赖调速控制系统来阻止超速.

3.2 ESG2003 电子调速系统接线图



序号	名　　称
1	转速控制器
2	电磁执行器
3	执行器电缆
4	传感器电缆
5	转速传感器
6	电源开关
7	10A保险丝
8	控制电瓶
9	怠速/额定转换开关

图 3.2 ESG2002 电子调速系统接线图

3.3 发动机起动前调速系统的调整

若是初次起动发动机，安装时应严格检查如下几点：

▲ 检查供油杆的灵活性

要求油泵的整个供油行程无卡滞，供油杆推拉灵活。此项检查非常重要，若供油杆不灵活，意味着可能出现控制系统失灵，造成发动机转速不稳、超速、甚至飞车等严重故障。

▲ 检查执行器的动作是否灵活

要求执行器的连杆与供油杆之间的连接无间隙，执行器的动作灵活，执行器在自然状态下的最小位置应能断油（气），在最大限位位置应能达到最大供油（气）；

▲ 检查相关电气连接

按图 3.1 或配套电子调速系统图的要求，检查电气连接是否正确，电瓶电压应符合使用要求（电瓶空载时略大于 24V，起动瞬间不低于 18V）；

▲ 检查出厂参数设置

孚创公司生产的电调在出厂时一般都已经根据配机单及供货状态协议进行过参数设置，只需按要求核对一下即可，若在特殊情况下您无法了解到这些信息，那么按以下几点进行检查和设置时必要的：

（1） 检查增益(GAIN)和稳定度（STABILITY）电位器的位置，在不确定情况下请将它们设置在 12 点位置（即中间位置）；

（2） 拨码开关位置若非特别注明，请按如下要求设置：拨码开关 SW1 置于 1 下 2 上 3 下的状态（详细设置可参考状态开关调整）；

（3） 将高/低速切换开关置于低速的一端（ON），；

（4） 控制器的转速设定在出厂时已经根据用户数据进行了预设，在起动柴油机前一般无需对控制器的转速设定电位器进行调整，用户只需在起动发动机后进行更为精准的调整；若不能确定转速设置值，请将额定转速设定电位器逆时针旋转几圈，同时观察一下怠速电位器的位置，在不确定的情况下可将怠速电位器设定在 12 点钟的位置。

3.4 发动机起动后转速控制器的参数调整

注意：在开始进行参数设定之前，以下事项是您需要关注的。

控制器上的所有电位器除额定转速（SPEED）电位器（可转动 25 圈）外（如图 3.2），其余电位器如稳定度（STABILITY）、增益（GAIN）、怠速（IDLE）等电位器都是旋转不到一圈的电位器，最大有效调整角度为 270 度，从时钟方向看约为从 7 点顺时针到 4 点的范围，**在进行参数调整时，切记不得超过此范围强行转动，否则将导致电位器损坏，引起发动机停机、不稳定、甚至超速等严重故障。以上电位器均为精密电子器件，调整时应使用专用工具缓慢调节，以防造成人为破坏。**

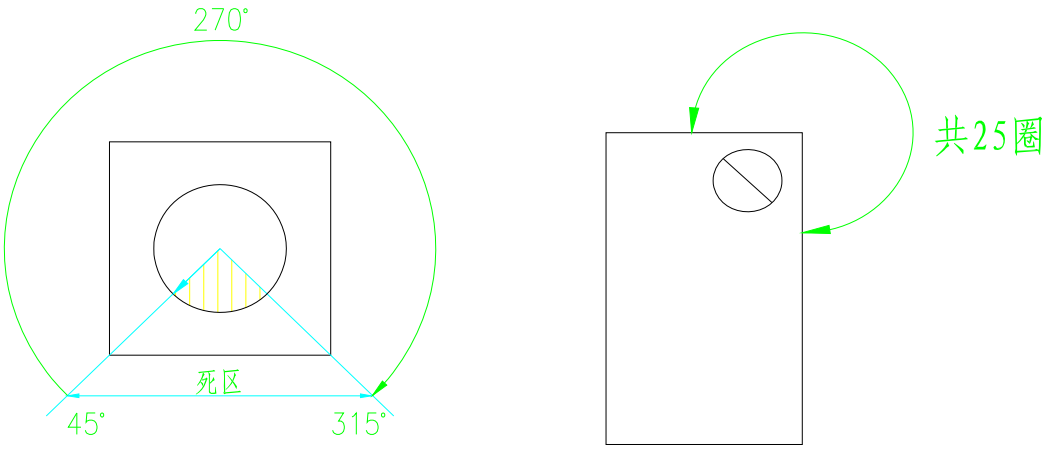


图 3.2 电位器的调节位置

3.4.1 高低速调整

发动机起动后控制器应控制在怠速位，怠速电位器（IDLE）用于设定发动机在怠速工况下的转速值，顺时针方向为转速增加的方向，逆时针方向为转速降低的方向；根据开机状态下所显示的转速值，缓慢旋转怠速电位器，直到达到所要求的怠速值为止；

切换高低速开关至高速端(OFF 端),发动机开始由怠速值根据一定的升速斜率逐渐升速到额定转速值；额定转速电位器（SPEED）用于对发动机的额定转速值进行调整，顺时针方向为转速增加的方向，逆时针方向为转速降低的方向，调整额定转速电位器直到达到所要求的额定转速值为止；

需要注意的是，当调整额定转速电位器或外接微调电位器来调整发动机的额定转速值时，会同时影响到怠速值的设定，所以在设定好额定转速值之后，应当对怠速值进行校正。

3.4.2 稳定性调整

如果发动机起动后转速不稳定，则可阅读以下内容按步骤进行调整；稳定性的调整顺序一般为先怠速、后高速、再满载，使发动机在三种状态下都达到稳定。

> **注意：发动机在怠速、高速及带载情况下的稳定性是相互关联的，调整时要三者兼顾，使系统在三种工况下的稳定性都达到最佳。在满足以上的稳定性后，增益（GAIN）电位器应尽量调节在偏大的方向，以保证发动机具有最佳的动态指标。**

发动机的不稳定性可分为周期性及非周期性的不稳定。

周期性的不稳定性又可分为快速不稳定性及慢速不稳定性。快速不稳定性一般是指频率在 3Hz 或更高频的不稳定，而频率小于 3Hz 的不稳定则称为慢速不稳定；慢速不稳定有可能是**非常强烈的不稳定，要特别小心；若出现特别强烈的慢速不稳定，应尽快调节参数将其转变为较为快速的不稳定，再**

进行精细的调节，以防损坏机器甚至发生事故。

发动机的稳定性调整主要是通过对增益(GAIN)和稳定度(STABILITY)电位器并配合状态拨码开关 SW1 的调整来完成。增益电位器是用来调节调速系统的灵敏度，顺时针调节是增大灵敏度，反之是减少；稳定度电位器是用来调节调速系统的响应时间，顺时针调节是增大响应时间的速率，反之为减少；通过对增益和稳定度的相互配合调节，一般可使发动机达到最佳的状态。当发动机起动后，在出现不稳定状态时，可按下面方案逐步进行调整：

方案一：

1. **调节增益（GAIN）电位器：**顺时针旋转增益电位器，若不稳定性有增大的趋势，则逆时针旋转增益电位器直至出现稳定；若没有稳定点，则应旋转增益电位器至相对最稳定处；调节完成后应在此基础上再逆时针回调一点以确保其稳定性能；
2. **调节稳定度（STABILITY）电位器：**顺时针旋转稳定度电位器，若不稳定性有增大的趋势，则逆时针旋转稳定度电位器直至出现稳定；若没有稳定点，则应旋转稳定度电位器至相对最稳定处；调节完成后应在此基础上再逆时针回调一点以确保其稳定性能。

反复方案一所述的两个步骤，一般可使发动机达到所要求的稳定性；若仍不稳定，则可继续下面的方案。

方案二：调节状态开关：

由前述可知，本转速控制器上的拨码开关 SW1（三位），即为状态开关，是用来更改控制器对信号的处理方式以适应不同发动机的固有特性的，该拨码开关每一位所表达的意思及所适合的机型可参考如下表格

图表 1.SW1 状态调整（表中所说的“上”与“下”分别对应于 ON 与 OFF）

项目	拨码开关状态	适用
SW1(三位)	1 上 2 上	适用于阻尼力较大的机型，对大中型柴油机或燃气机可选用此状态
SW1(三位)	1 下 2 上	适用于 100KW 以下的小型柴油机，有较好的动态指标及稳定指标

需要注意的是，以上设置及分类是根据大量的配机试验及日常使用经验而得出的结论，对于一些由于在发动机设计、制造或系统集成等方面所形成的系统的固有特性可能并不是明确地按以上分类的，甚至出现状态交叉的现象，因而说以上分类并**不具有明确的对应关系**。

SW1 状态拨码开关 1 号位置，是基于转速控制器对调速系统的响应时间而设计的；

SW1 状态薄码开关 3 号位置，是添加的一个补偿电容；

由以上分析可知，当发动机出现快速不稳定，且发动机速度越高其不稳定的频率也越高，反之亦然，这时，可尝试将 SW1 的 1 号拨码开关置于 OFF 端（下面），来减少转速控制器对高频信号的敏感度；调节好状态后，再重复方案一的方法进行调整，若仍不稳定，可根据图表 2 找出对应此时 SW1 拨码开关 2 号与 3 号的状态，并按图表 2 来调校，拨码开关设置完后应再次重复方案一的方法进行调整，直到发动机稳定。

当出现慢速不稳定，可尝试将 SW1 的 1 号拨码开关置于 ON 端（上面），或根据图表 2 来进行调校，每调校一次都应重复方案一的方法进行调整，直至达到稳定；

当出现非周期性不稳定时，亦可根据图表 1 及图表 2 的方式来进行调整；若通过以上方案仍不能成功解决，则可能是发动机本身的问题，应检查燃油系统、进气系统、负载的稳定性，并评估发动机的性能，还应检查电源的稳定性、转速信号的幅度是否符合要求（怠速时大于 1.5Vpp，正常转速时大于 4Vpp）、转速信号线和外部调速信号线的屏蔽效果是否良好等。

图表 2. SW1 补偿电容调整

如果是**快速不稳定**，请根据 SW1 的状态在图表中找到对应的位置，并**沿图表往下调整**		
如果是**慢速不稳定**，请根据 SW1 的状态在图表中找到对应的位置，并**沿图表往上调整**		
1	2	3
ON	ON	ON
	ON	OFF
OFF	OFF	ON
	OFF	OFF

4 故障判断与处理

4.1 电子调速器故障判断

电子调速器故障将引起发动机性能下降，以至于发动机不能运行，如果能明确判断为电子调速器故障，更换电子调速器即可；如果是发动机及其辅助系统故障，有可能通过发动机转速达不到使用要求表现出来，更换电子调速器也不能解决问题，因此，故障原因应通过对系统的综合分析,逐项验证排查来判断.

故障现象	检测部位	检测方法
发动机不能起动	电瓶电压	测量 3、4 端电瓶电压应为 DC24V 或 DC12V。
	传感器	1、 转速传感器安装不良，间隙过大。
		2、 转速传感器电缆断线，测量其直流电阻应为 830～970 欧姆。
	执行器	1. 执行器与油泵齿条联动部分有卡阻现象。
		2. 执行器电缆断线，测量执行器线圈内阻是否符合要求。
执行器不能将油阀完全打开	电瓶电压	起动时测量电瓶电压，如果电压低于额定工作电压的 75%，则电瓶欠压，需要对电瓶进行充电。
	执行器	执行器与油泵齿条联动部分有卡阻现象。 There is the jamming phenomenon in the linkage section between the actuator and pump gear.
发动机转速不稳	控制器	调节控制器上的稳定度和增益电位器，具体方法详见章节 3.4.5。
	执行器	检查执行器与油泵齿条联动部分是否有间隙及松动现象。
发动机超速	控制器	1. 发动机齿数确认有误，额定转速设置过高。
		2、增益设置过低，灵敏度差，导致突卸负载时转 2. 速瞬间过高。
		3. 转速控制器故障，应更换。
	执行器	执行器与油泵齿条联动部分有卡阻现象或连接松脱。
		执行器与油泵供油零位不匹配，执行器断电后仍不能关断油泵供油。
	转速传感器	转速传感器信号出错，接线损坏。

4.2 磁性不充足的速度传感器信号

当转速传感器信号较强，则能抵抗外部脉冲干扰，转速控制器能够测量到转速传感器输出 3V 以上的有效值信号. 当电压低于 3V 时，应减小速度传感器和发动机的齿间隙，可以提高信号的振幅. 间隙要小于 0.45mm. 如此时电压仍低于 3V，应检查转速传感器的磁性是否太弱.

4.3 电磁干扰

调速系统会被大的干扰信号通过电缆的传导或直接辐射进入到控制回路，对控制回路产生不利的偏差，给调速系统带来不良影响。为了防止中等的干扰，所有孚创生产的转速控制器都包括过滤装置和屏蔽设置，来保护敏感回路不受外部干扰源的影响。

对干扰值的预测是复杂和困难的，对于空间场的无线电通信、无线对讲机、无线电发报机以及包括使用磁电机、固态点火系统、电压调节器或电池充电机等都应该考虑在可能的干扰源范围内。当您怀疑到空间场或其他系统在使用过程中通过传导或直接辐射的方式影响到了本调速系统的工作时，我们建议您将本控制器的所有外接线缆都使用双屏蔽线缆，并应确保屏蔽线的一端包括速度传感器的屏蔽线 360 度环接到转速控制器外壳的一个支点上，并且将速度控制器的金属板接地或安装在内封密的金属箱内，来防止电子辐射的干扰；用金属罩或金属容器效果更好；采用屏蔽线是最普通的抗干扰措施。若配用有刷的发电机，则其产生的电火花干扰是不能忽略的，所以大的干扰环境应采用特殊的屏蔽措施；若您不能解决此类问题，请与我们的工程师联系，他们将会给您提供更多的建议。

CATALOGUE

Foreword

This manual mainly introduced the working principle of the electronic speed control system,system composition,Regulation,operation, maintenance and simple troubleshooting method, suitable for a certain understanding, to the engine and the electronic governor routine installation, use and repair personnel. Recommend the product specification in the workplace, and strictly follow the method given here to operate.

Caution

- **Speed sensor to the electronic control system shall not be shared with other systems, or they may cause serious consequences.**
- **You can't rely on the electronic speed control system to prevent engine overspeed, and overspeed protection device installed independently, effectively in the engine system.**
- **Before starting the engine should confirm the fuel injection pump rod in oil cut-off position, push and pull the fuel rack should be flexible and no jam.**

1 The Principle Of The Electronic Governor System

Electronic governor, with its simple structure, high reliability, convenient operation, easy function extension and high cost performance, applies to all kinds of diesel generating sets, vehicles and marine diesel engines.

Its normal type is all-electronic single pulse speed and close loop position structure, provided with functions of non-corresponding or corresponding control, speed and rated speed during running maximum fuel supply control, emergency stop and etc.

It is also capable of adding other control functions according to the customer's particular requirements.

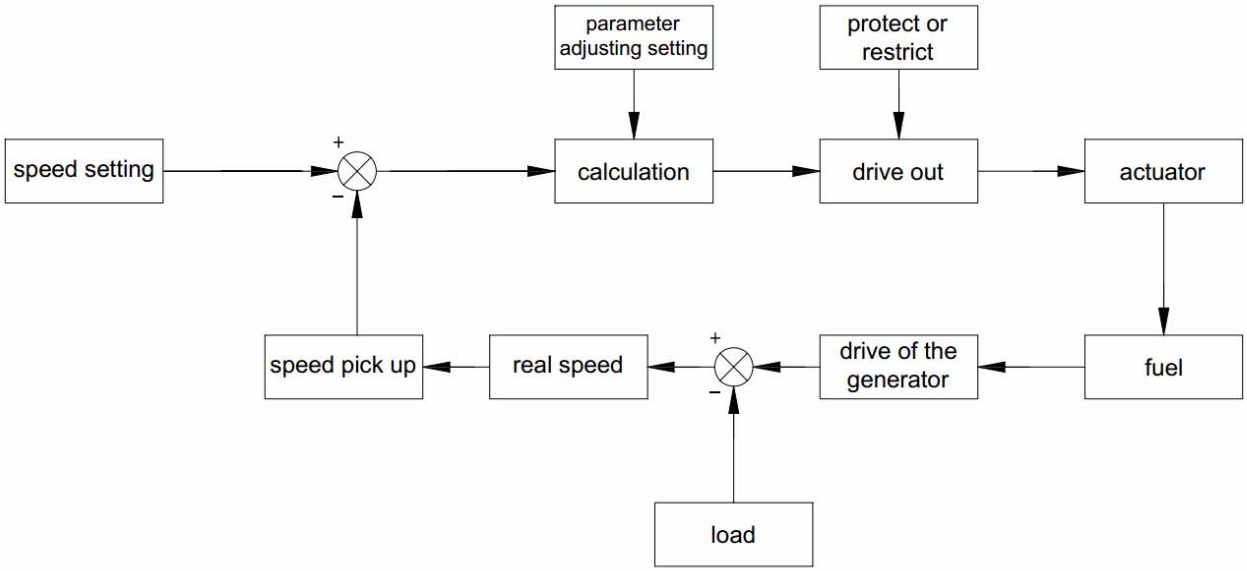


Figure 1.1 Electronic governor system

2 The Structure Of The Electronic Governor System

2.1 Speed Control Unit

2.1.1 The basic electronic characteristics

- SUPPLY VOLTAGE : DC 24V（Scope 18V～32V）or DC12V（Scope9V～16V）
- SUPPLLY CONSUMPTION : < 0.1A (static state)
- SPEED FLUCTUATION RATIO : ≤±0.25%
- HIGH SPEED SCOPE: 1KHz～7.5KHz
- AMBIENT TEMP. : -40°C ~ +85°C
- RELATIVE HUMIDITY : <95%

2.1.2 Basic Performance Of C2003 controller

Speed Control: Control Speed by the single close loop.

● High & Low Speed Switch: Switch between the idle and rated.

● Automatic stopping protection: The engine will stop automatically when there is no signal and no power.

For more information about the basic performance, please see the following chapter about the parameter setting instruction.

2.1.3 The wiring diagram of speed controller C2003

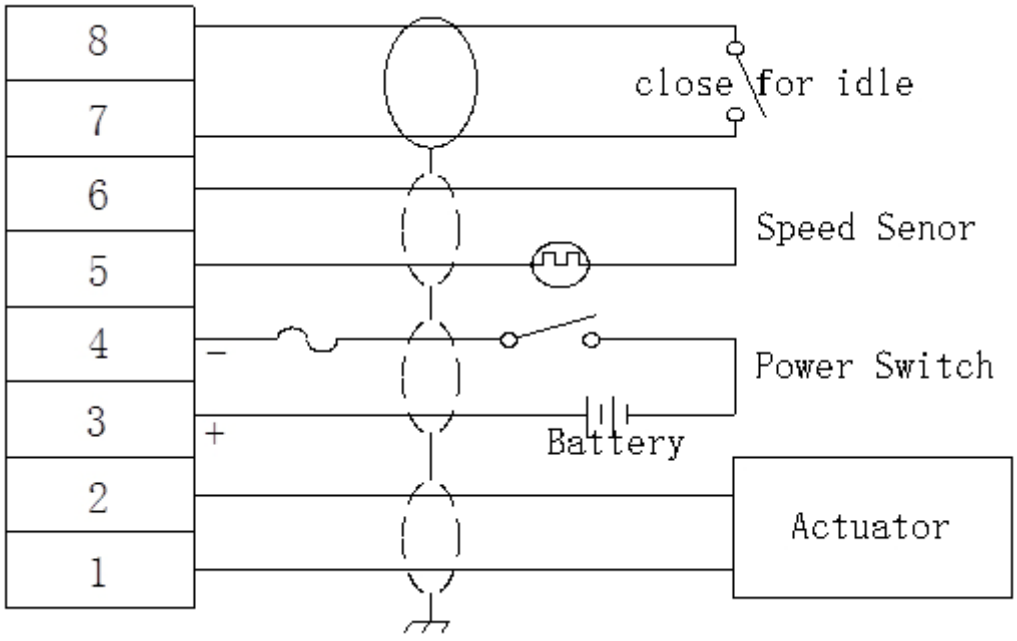


Figure 2.1

2.1.4 C2003 speed controller appearance and installation dimensions

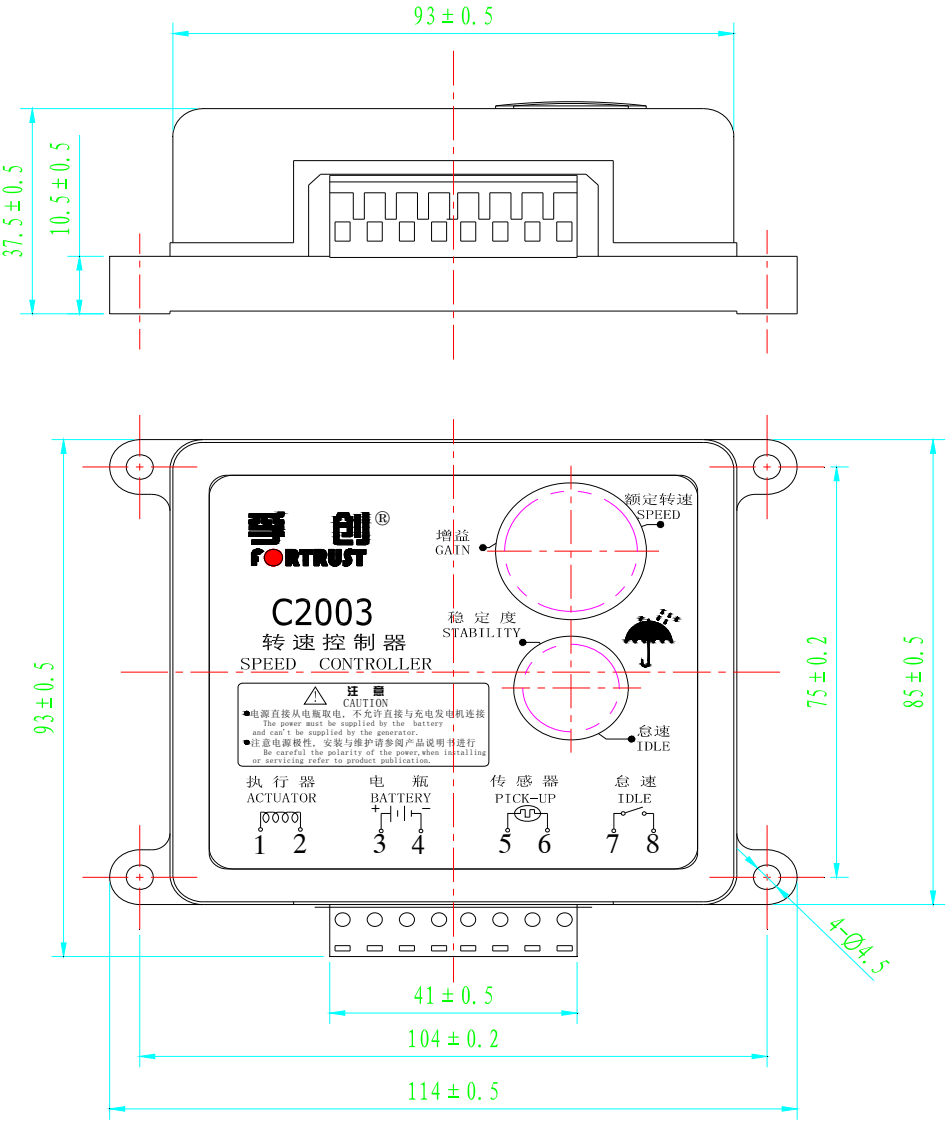
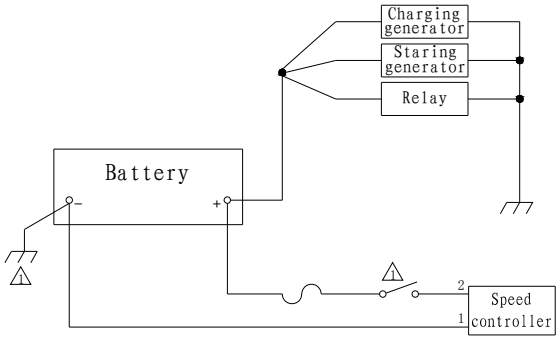


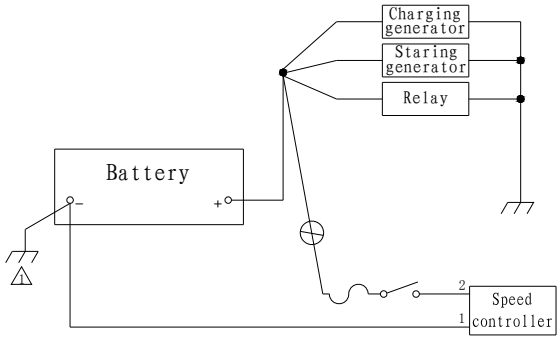
Figure 2.2

2.1.5 The definition and requirement of Connection Terminal

● Terminal 1 and 2 is use for connecting the actuator, terminal 3 and 4 is use for connecting the battery, the cable section should be 1.3 mm² or more to decrease the voltage drop, so more long more bigger. For avoiding the accident, a 15 A fuse is necessary on the cable that is from the battery positive to the power positive of the speed controller (terminal 3);The cable of the speed controller should be connected directly and separately from the battery positive and negative, please don't connect to other terminal, for the correct way see below.



☑ The correct wiring diagram



■ The wrong wiring diagram

● Terminal 5 and 6 is use for connecting the speed sensor, the cable should be the braided shielded net cable and connect to the point by 360°as figure 3.1 indicated, but it can't be connected to others of the engine ,otherwise it may have the interference signal input to the speed controller and result in the unpredictable consequence.

● Terminal 7 and 8 is use for connecting high & low speed switch, it is idle condition when closed, the speed ramping of preset will rise to rated speed after shut off.

2.2 The Electromagnetic Actuator

The speed controller as this manual mentioned can used with all of the single close-loop actuator that produced by Fortrust, customer choose the actuator and middle plate flexibly according to the model number of the pump, and you also can ask for Fortrust People provide a best solution to you after testing in the site. The actuators as this manual listed according to the requirement of your products, if you need more information of the actuators please log in Fortrust company website as www.fortrust.cn or send mail to sales@fortrust.cn or call us 021-51961611/12/13;

Different actuator with different stability, if you find the problem about that please contact us, we will provide the professional solution to you.

2.2.1 The Basic Character of Actuator A07A

☑ Supply Voltage: DC24V (16V～32V)

☑ Working Torque: 0.8N M

☑ Working Stroke: 15mm

☑ Ambient Temperature: -40℃～ +95℃

☑ Ambient Humidity: < 95%

☑ Installation: according to the pump section in the engine.

2.2.2 The Outline Overall and Installing dimensions of A07A Electromagnetic actuator (See Figure 2.3)

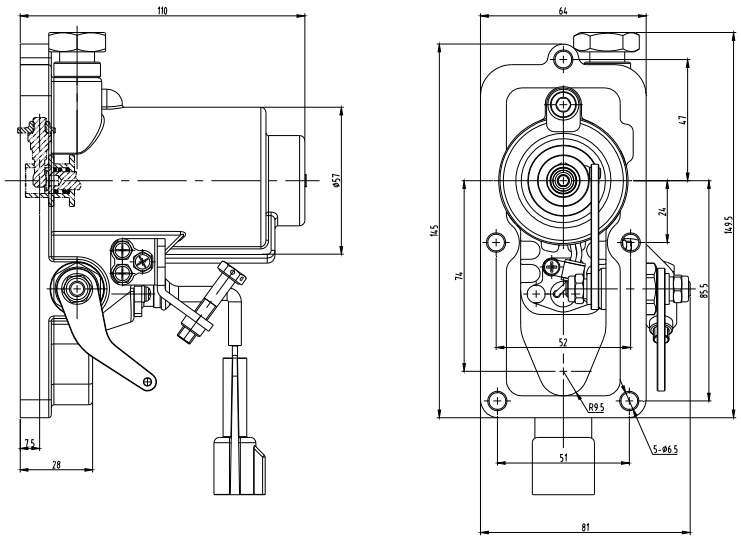


Figure 2.3

2.3 Speed Pick-up

The speed sensor of this electronic governor system we used is the passive

magnetoelectric speed sensor, it output the speed signal through the magnet gap change that caused by the rotation of the speed measuring gear, and the change will generate the induced electromotive force in the coil of the speed sensor. The speed sensor should be fixed on the engine gear plate when install it, the engine speed will be got through the reaction of flywheel gear numbers; The best gap of installation of the speed sensor is return 1 / 2 — 3 / 4 circle(about 0.45mm）after touching the gear teeth. f=nz/60, f is frequency（Hz）, n is speed (speed/minute),z is flywheel gear numbers. Customer could use this formula to calculate and get the initial speed value of speed controller, and adjust the value to the required value after starting the engine.

Speed sensor produced by Fortrust have different model with different installing dimension, people choose according to your demand.

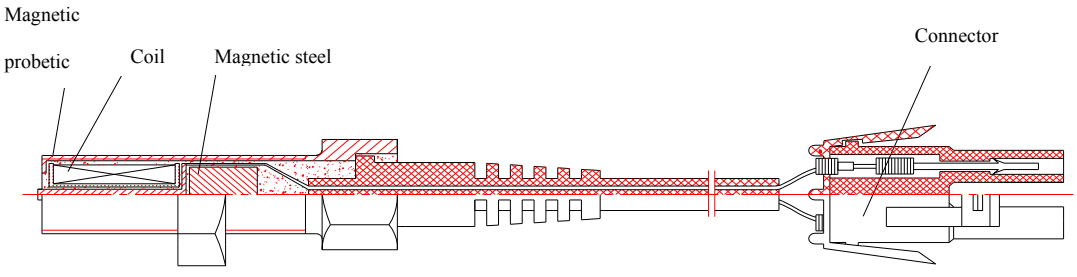


Figure 2.4 The Structure Chart of Speed Senor

Cautions: The speed sensor is only use for this electronic governor, it cannot be used with other speed measuring system, otherwise it may result in very serious consequence.

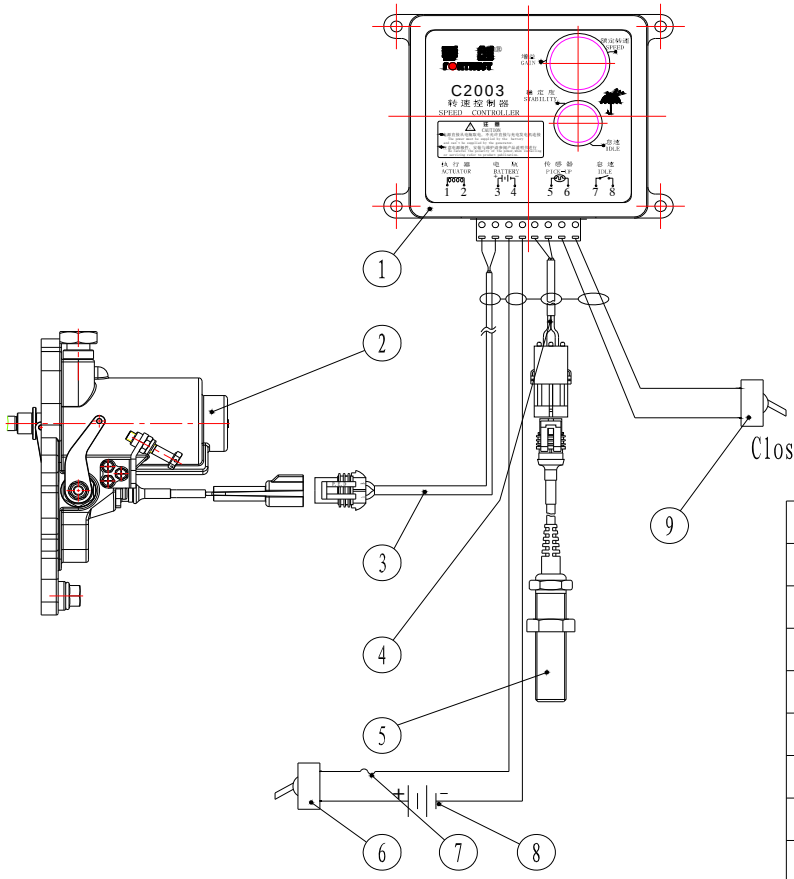
3 Installing and Debugging

3.1 Installing Of The Electronic Governor

The C2003 speed controller is usually installed in a control cabinet or fixed on other external device of the engine, and please choose the place with dry air and appropriate temperature. The the speed controller should be far away from the water, the mist or the freezing object, even if it has the dampproof surface; the speed controller also should be far away from the high temperature and the thermal radiation to avoid it was damaged. If the place is near the water or with the heavy moisture, please install the controller by vertical direction.

Cautions: The engine should have its own over speed protection device, it cannot only rely on the control system of electronic governor to stop over speed

3.2 Connection Diagram Of The ESG2003 Series Electronic Governor System



No.	Commponent Name
1	Speed control unit
2	Electromagnetic actuator
3	Actuator cable
4	Sensor cable
5	Magnetic pick-up
6	Switch of the power
7	Fuse
8	Battery
9	Idle/Speed switch

Figure 3.1 the wiring diagram of electronic governor

3.3 Debugging before starting engine

If start the engine in the first time, please strictly check as below.

▲ Check the flexibility of the oil rod

The whole oil supply of the pump should work without jamming and the oil rod works flexibly. If the oil rod worked inflexibly, it means the control system is not work properly and it may cause the major failure of the engine such as speed unsteady, over speed and run away.

▲ Check the flexibility of the actuator

There should have no gap between the shaft of the actuator and oil rod, the actuator is working flexibly, the minimum section is reach to stop oil and the maximum section is reach to supply oil at largest.

▲ Check the relative electrical connection

According to figure 3.1 wiring diagram or the requirement of mating electronic governor system, please check if the electrical connection is correct and battery voltage is accord with the requirement (No-load is slightly larger than 24V,starting moment is not less than 18V).

▲ Check the factory parameter setting

The electronic governor produced by Fortrust have been finished the parameter setting usually according to customer's supply agreement, so you just need to check it, if you cannot get the information under the special situation, please check and set as below.

(1) heck the potentiometer section of GAIN and STABILITY, please set them to 12' clock position if you cannot be sure.

(2) If there is no special indication, please set the dial switch as following, SW1 turn to 1 down 2 up 3 down. (For the details, please refer to the status switch adjustment)

(3) Turn the high speed / low speed switch to low speed.

(4) The speed of controller have been preset according to user data, you don' t need to adjust the the speed setting potentiometer of the controller before starting the diesel engine, you just need to adjust it accurately after starting the engine. If you cannot sure the speed setting value, please turn the rated speed setting potentiometer by anticlockwise several circles, meanwhile observe the positon of the idle potentiometer, then set it to 12' clock position.

3.4 Parameter adjustment of speed controller after starting engine

Cautions：Before setting the parameter, please pay more attention to the following. Except the rated speed potentiometer (can turn 25 circles, see figure 3.2),other potentiometer of the controller such as Stability, Gain, Idle cannot be turn more than one circle, their largest adjustable angle is 270°， it is about from 7'clock to 4'clock by clock direction. When you are setting the parameter, please don't turn it over this range, otherwise the potentiometer will be damaged and result in the major failure such as the engine stop, instability and over speed. All of the above potentiometers are the precision electron device, please adjust slowly by the special tools to avoid the man-made

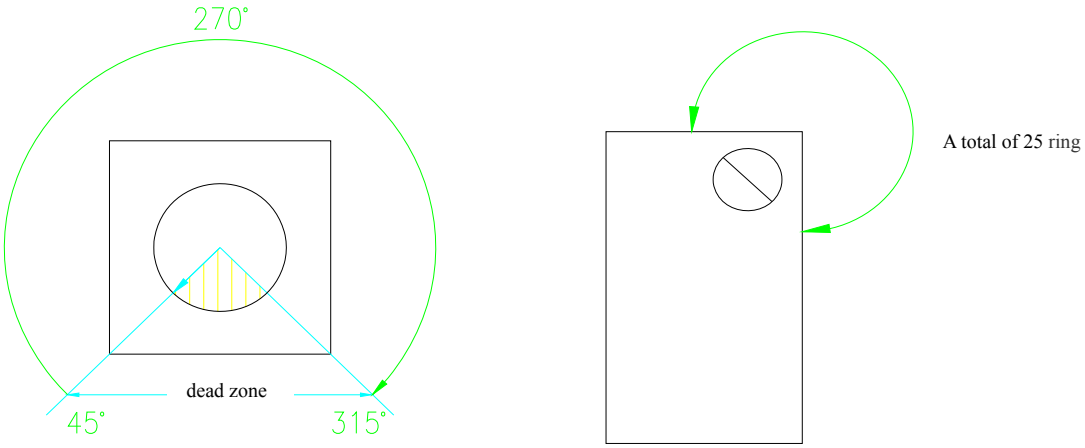


图 3.2 电位器的调节位置

3.4.1 High/Low Speed Adjustment

The controller should control on the idle position after starting the engine, the idle potentiometer is used for setting speed value under the idling condition, turn clockwise is for increasing speed, turn anticlockwise is for decreasing speed; turn the idle potentiometer slowly until to the required value according to the speed value under the condition of starting up.

When turn the switch to OFF terminal, the engine will increase speed from idle value to rated speed gradually according to the raising speed slope. The speed potentiometer is used for adjusting the rated speed of the engine, turn clockwise is for increasing speed and turn anticlockwise is for decreasing speed until to the required value.

Need to pay attention to is, when adjust the rated speed potentiometer or external Trimming Potentiometer to adjust the rated engine speed value。At the same time, will affect the idle speed setting value, so after setting the rated speed value, it should be on the idle value correction.

3.4.2 Stability Adjustment

If the engine is starting with instable speed, you can adjust it as the below information. The stability adjustment has three steps and there are idle, high speed and full loading.

Cautions: The engine works under the stability of the idle, high speed and full loading is syntrophic, so adjust the system refer to three steps to the best stability. After reaching to the stability, adjust Gain potentiometer to the larger value to be sure the engine get the best dynamic indicator.

The engine instability has the periodicity and the aperiodicity.

Periodicity instability has the speediness and the low speed. The speediness is usually means the frequency is 3HZ or more, but the frequency is less than 3HZ is low speed instability. Low speed may cause the strong instability and pay more attention to that; If happened, please adjust the parameter to the speediness firstly, then adjust slowly to avoid to damage the machine or the accident happen.

The stability adjustment of engine finished mainly through the adjustment of GAIN, STABILITY potentiometer and SWI switch. Gain Potentiometer is used for adjusting the sensitivity of the governor system, turn clockwise is for increasing, on the contrary is for decreasing. The stability potentiometer is used for adjusting the respond time of the governor system, turn clockwise is for increasing, on the contrary is for decreasing. The adjustment between Gain and Stability will let the engine works under the best condition. When start the engine with instable status, please adjust as following.

Solution Ⅰ:

1. **Adjust Gain potentiometer:** Turn clockwise Gain potentiometer, if instability is tend to increase, please turn anticlockwise until to stable; If the stable point cannot be found, please turn Gain to relative stable position; then turn anticlockwise to a little back to be sure the stability.

2. **Stability Potentiometer:** Turn clockwise the Stability potentiometer, if the instability is tend to increase, please turn anticlockwise until to stable; If the stable point cannot be found, please turn Stability to relative stable position; then turn anticlockwise to a little back to be sure the stability.

Repeat 2 steps of the solution, usually the engine will reach to the stability, if failed, please see the below solution.

Solution Ⅱ: Adjust SW1:

We know from the above, the dial switch of the controller SW1 is the status switch, it is used for changing

the controller signal way to adapt the different engine, for the meaning of each dial please see the below

Chart 1. SW1 adjustment (Up means ON, Down means OFF)

Item	Status	Apply to
SW1(three numbers)	1 up 2 down	Apply to the machine with major damping force, such as medium and large diesel engine or gas egine/
SW1(three numbers)	1 up 2 down	Apply to small diesel engine, with well dynamic indicator and stability.

To be attention, all of the above solution we got from the plenty of matching test and daily service experience, for the problem caused by the engine design, manufacturing or system integration may not be classified as the above, even the phenomenon of state cross, that is why we see the above classify is not specific correspondence.

No.1 positon of SW1 is designed for the respond time of the controller to governor.

No.3 position of SW1 is designed for increasing a compensation capacitor.

We know from the above, when the engine works unstably with speediness, the faster the engine run, the higher the unstable frequency is, on the contrary is same If happened like this, you can try to turn No.1 switch of SW1 to OFF terminal(underside), it will decrease the sensitivity of controller from the high frequency signal. Please repeat solution Ⅰafter that, if it is still unstable, please find out NO.2 and No.3 switch of SW1 dial switch refer to chart 2 an adjust, after finished, repeat solution Ⅰuntil the engine reach to the stability.

When the engine works with low speed is unstable, you can try to turn NO.1 switch to ON terminal (upside), or adjust according to chart 2,and repeat solution Ⅰfor each time until reach to the stability.

If the periodic instability is happened, you also can adjust refer to Chart 1 and Chart2.If the problem still can't be solved, it may caused by the engine own problem, please check the stability of fuel system, the air intake system and the loading. You also need to evaluate the engine performance and check the power stability, the speed signal range, speed signal cable and the shielding effect of external signal cable for speed governing. About the speed signal range, the normal idle should be more than 1.5Vpp and the normal speed is more than 4Vpp.

Chart 2 Compensation Capacitor Adjustment Of SW1

If the engine works unstably with speediness, please find out the right position according to SW1 status and adjust as this chart by the underside.		
If the engine works unstably with low speed, please find out the right position according to SW1 status and adjust as this chart by the upside.		
1	2	3
ON	ON	ON
	ON	OFF
OFF	OFF	ON
	OFF	OFF

4 Failure Predication And Treatment

4.1 Check-up the Fault

The failure of the electronic governor will decrease the performance of the engine ,it will result in the engine works in failure. If the electronic governor is fail to work, you need to change a new one; If the failure is from the engine or its auxiliary system, it may show the problem as the engine speed can't reach to the requirement, the problem is hard to solve even you change a new governor, therefore, the failure reason should be estimated through the comprehensive analysis and test each item.

Failure Phenomenon	Parts Test	Testing Method
The engine is fail to start.	Battery Voltage	Measure Terminal 3 and Terminal 4 should be DC24V or DC12V.
	Speed Sensor	1.The installation is unqualified with big gap.
		2.The cable of speed sensor is broken, please measure its DC resistance and it should be 830～970 Ω.
	Actuator	1.There is the jamming phenomenon in the linkage section between the actuator and pump gear.
		2.The cable of the actuator is broken, please measure the internal resistance of the coil.
The actuator is fail to open fuel valve.	Battery Voltage	Measure the battery voltage when starting, if the voltage is less than 75% of rated voltage, it means undervoltage and the battery need to be charged.
	Actuator	2.There is the jamming phenomenon in the linkage section between the actuator and pump gear.
The engine works with unstable speed.	Speed Controller	Adjust the stability and gain potentiometer, for the details please see chapter 3.4.5.
	Actuator	Please check the linkage section between the actuator and pump gear if there has the gap or moveable phenomenon.
The engine works with over speed.	Speed Controller	1.Incorrect RPM.
		2.Low Gain with bad sensitivity, it result in the transient speed is too high when load discharge suddenly.
		3.You should change a new speed controller.
	Actuator	1.Please check the linkage section between the actuator and pump gear if there has the jamming or moveable phenomenon.
		2.The actuator is not match with fuel supply parts of the pump, even shut off the power but can't shut off the fuel supply.
	Speed Sensor	.Wrong signal because the connection is broken.

4.2 Sensor Signal because of inadequate magnetism

When the sensor works with strong signal, it can resist the external impulse interference. The speed controller can measure more than 3V effective signal from sensor. When the voltage of the sensor signal is under 3V, please decrease the gear gap between sensor and engine, it will improve the amplitude of sensor signal. If the gap has been adjusted to less than 0.45mm, the voltage still is under 3V, please check the magnetism of the sensor and it may too small.

4.3 Electromagnetic interference

The big interference signal will enter into the control loop of the governing system through the cable conduction or direct radiation, it will generate the badly difference to the control loop and effect the governing system. For preventing the medium interference, all of speed controller produced by Fortrust have the filter unit and shield setting, it will protect the sensitive loop from the external interference effect.

The interference value is hard and complex to forecast, so all of these should be considered into the possible interference range such as the wireless communication in the space, wireless walkie-talkie, radio transmitter, magneto, solid state ignition system, voltage regulator or battery charger. When you think the space field or other system have affected the governing system through conduction or direct radiation during using, we suggest you change all of the cables for this governing system to double-shielded cables, and it to be sure one of shielded terminal of the cable and also included the sensor shielded cable should be connected 360° to a supporting point of the controller housing, and you also need to install the metal plate of the controller inside of sealed metal box or connect to ground, it will resist the interference from the electron radiation, the metal covering or metal container will be better, the shielded cables is a common anti-interference measure. If the engine with the brush, its electric spark interference can't be omitted, so the big interference environment should have a special shielded measurement, if you can't solve the problems like these, please contact our engineers, they will give you more suggestion.

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