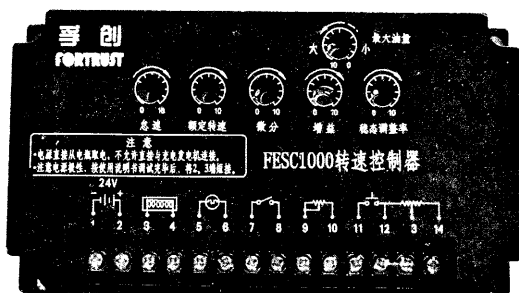


ESG1000 SERIES
ELECTRONIC GOVERNOR
INSTRUCTION



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PREFACE

ESG1000 series electronic governor , with its simple structure ,high reliability, convenient operation, easy function extension and high cost performance, applied to varies kinds of diesel generating sets, vehicles and marine diesel engines. Its normal type is all-electronic single pulse speed and double close loop position structure and is provided with functions of non-corresponding or corresponding control, speed and rated speed during running. Maximum fuel supply control, emergency stop, etc.. It is also capable to add other control functions According to the custom's particular requirements.

FORTRUST'S CAUTION

- An independent over-speed protecting device must be fitted for the engine.
- The independent speed pickup fitted for this electronic governor must isolate from other systems.
- Before starting engine, check governor and high-pressure fuel pump by using the “test” button.
- Before starting engine, the “idle/run” switch must be confirmed to be at “idle”.

1 MAIN STRUCTURE AND PRINCIPLE

- *Main Structure*
- *Principles*
- *Parameters Adjusting*
- *Protecting function*

1.1 Main Structure

ESG1000 series electronic governor consisted of main parts (including a magnetic pickup, a governor controller, and electromagnetic actuator) and accessories (including a remote potential device, a control switch and some patching cords).

Main system structure is shown **Figure 1**.

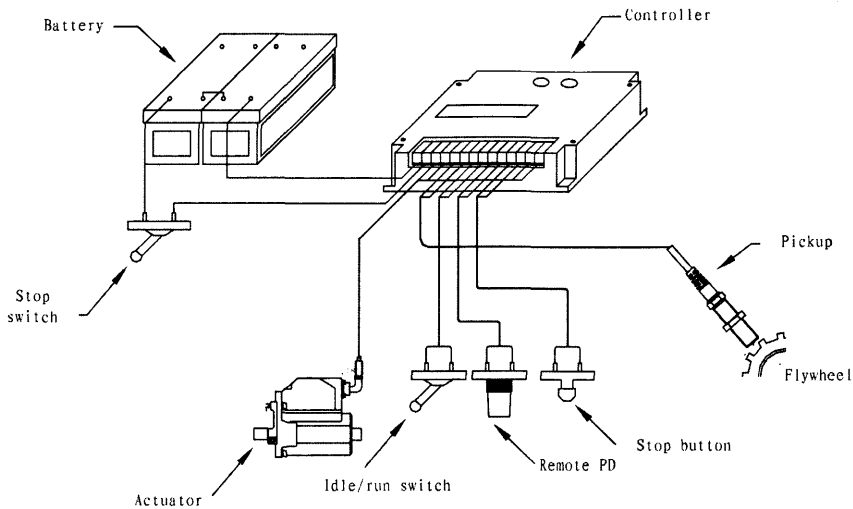


Figure 1. Basic structure of ESG1000A1-D electronic governor

1.2 Principles

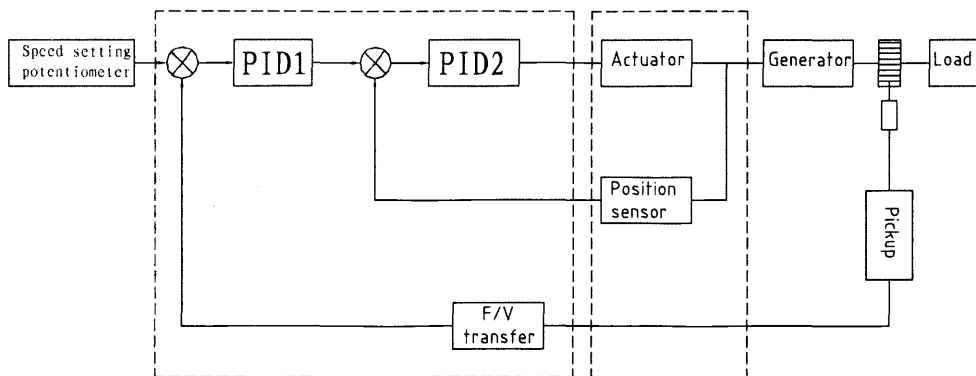


Figure 2. Principle of ESG1000A1-D electronic governor

In the governor of system, the ideal speed is set by adjusting the speed potentiometer in the controller and the external remote control meter. The actual speed will be received by a pickup which transmit an AC signal with a frequency proportional to the speed of the engine to a special circuit where the AC signal will be converted into a DC voltage. A differential speed will be made out and then calibrated and magnified by PID1 and transformed into the adjusting value of the position of the rack, a control current is sent out through PID2 and the power amplifier, then change the output position of the electromagnetic actuator and drive the rack in the fuel pump to move in the direction of decreasing the differential speed so that the engine can be running stably at the rated speed.

The electromagnetic actuator is an armored DC proportional electromagnetic iron. Its driving forces to increase fuel is proportional to the control current in the coil, and its reset force to decrease fuel is given by the reset spring. When these two forces are equal, The output axis of the actuator will be in a respective balance position. In case of increasing control current, the output axis will move in the direction of increasing fuel, on the contrary, the output axis will move in the direction of decreasing fuel. The actual position of the output axis will be fed back to the controller by the position sensor.

1.3 Parameter Adjusting

Figure 3 is the parameter adjusting panel of the governor controller.

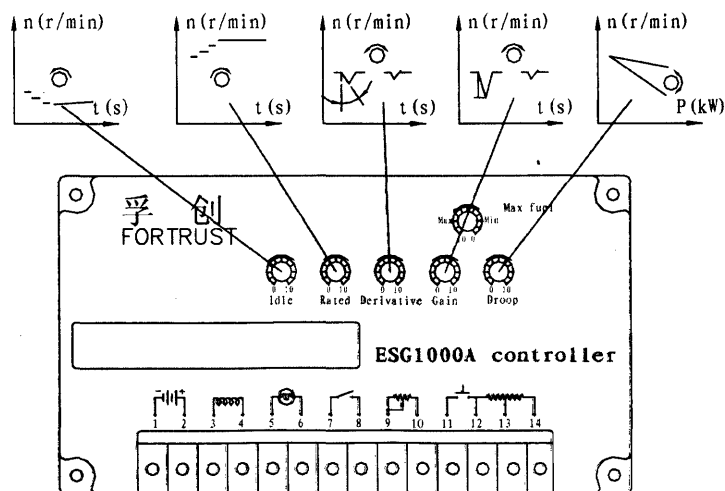


Figure 3. ESG1000A Governor controller

CAUTION:

- *Don't connect the power terminal to the terminal of the battery charging motor directly.*
- *Pay attention to the power polarity. After checking according to the instruction manual, short 2 and 3 terminal.*

The speed range in the governing system will be adjusted by the “idle” potentiometer and the “rated” potentiometer on the governor controller and the external remote control potentiometer. The droop and the dynamic corresponding feature can be adjusted by the “droop”, “gain” and “derivative ” potentiometers on the governor controller to ensure the satisfactory static and dynamic state of the governing system.

1.4 Protecting Function

In the ESG1000 series electronic governor, a security protecting circuit is designed to ensure that in case of unexpected events such as interruption of speed feedback and setting signal or power shut off of the governor due to programs like cable damage, the rack will be pulled to the zero-position automatically.

CAUTION:

- *considering the above circuit can not act totally instead of the general engine over-speed protecting device, a separate emergency stoop or over-speed protecting device should be provided on the engine to ensure the safety of whole system.*

2 MAIN TECHNICAL PARAMETER

- Governor Controller
- Electromagnetic Actuator
- Magnetic Pickup

2.1 Governor controller

TYPE:	C1000A
SUPPLY VOLTAGE:	DC24V (Range:16-32V)
SUPPLY CONSUMPTION:	<0.1A (Excluding Actuator)
CONTROL FREQUENCY:	300~13,000Hz, Classified into Four Classes C1: $\leq 1,700\text{Hz}$ C2: $\leq 3,400\text{Hz}$ C3: $\leq 7,800\text{Hz}$ C4: $\leq 13,000\text{Hz}$
SPEED FLUCTUATION RATIO:	$\pm 0.25\%$
STATIC SPEED REGULATION:	0~5%
AMBIENT TEMP.:	-10~+50°C -30~+70°C(For Military Product only)
RELATIVE HUMIDIT:	<95%
WEIGHT:	0.68kg

2.2 Electromagnetic Actuator

TYPE:	A1
WORKING ABILITY:	1Nm
CONTROL CURRENT:	<10A(Transient Maximum Value) <2.5A(Average Value at 24V DC)
AMBIENT TEMP.:	-40~+100°C
RELATIVE HUMIDIT:	<95%

2.3 Magnetic Pickup

TYPE:	M18×1.5
COIL RESISTANCE:	About 360 Ω
OUTPUT VOLTAGE:	1~18V (Active Value)
OUTLINE DIMENSION:	See Figure 4.
AMBIENT TEMP.:	-40~+100°C
RELATIVE HUMIDIT:	<95%

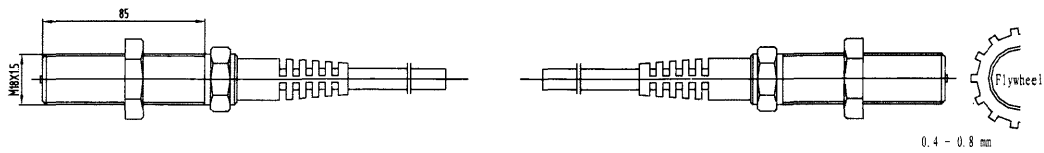


Figure 4. Outline dimension of pickup and its installation

3 SYSTEM INSTALLATION

- **Magnetic Pickup**
- **Electronic Actuator**
- **Governor Controller**
- **Power Supply**
- **System Circuit**

3.1 Magnetic Pickup

It is recommended to install magnetic pickup at the localization of the flywheel gear ring, the clearance between the pickup and the tip of the tooth should be within 0.4~0.8mm. For installation, screw in the pickup firstly until it touches the tip of the tooth, then screw it out for about half loop then secure with securing nut. If the flywheel has no teeth, other sensing gear can be also instead of it whose material must be magnetic conductive and it must be ensured that engine working speed be in range, the output frequency of the pickup which means the teeth amount passing through the pickup per second is not less than 300Hz . The commensurate formula of engine speed and pickup feedback frequency is:

$$f = nz / 60 \quad (\text{Hz})$$

In which , f (Hz) means output frequency of the pickup, n (RPM) means engine speed, and z means teeth amount of sensing gear. Installation method of the magnetic pickup is shown in **Figure 4**.

CAUTION: *This magnetic pickup is for electronic governor only, don' t be used in other speed checking system.*

3.2 Electromagnetic Actuator installation

A1-D electronic actuator

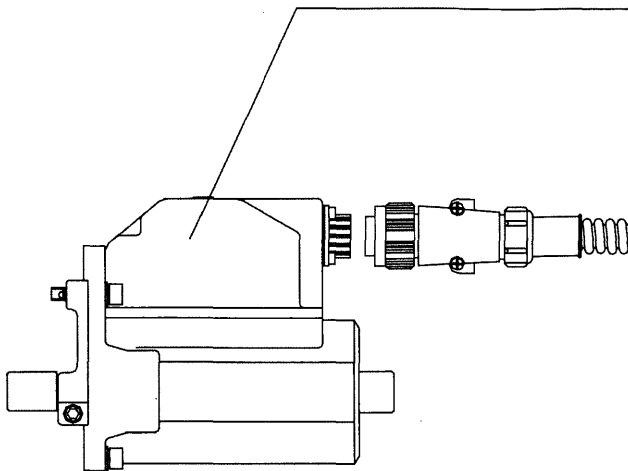


Figure 5. Electromagnetic actuator

3.3 Governor Controller

The governor controller should be installed in a safe cabinet so that it can free from strong impulsive vibration and electromagnetic interference. sufficient space must be left over for installation and maintenance and heat abstraction. The out shell of the cabinet must be grounded properly. The installation dimension of the governor controller is shown in **Figure 6**

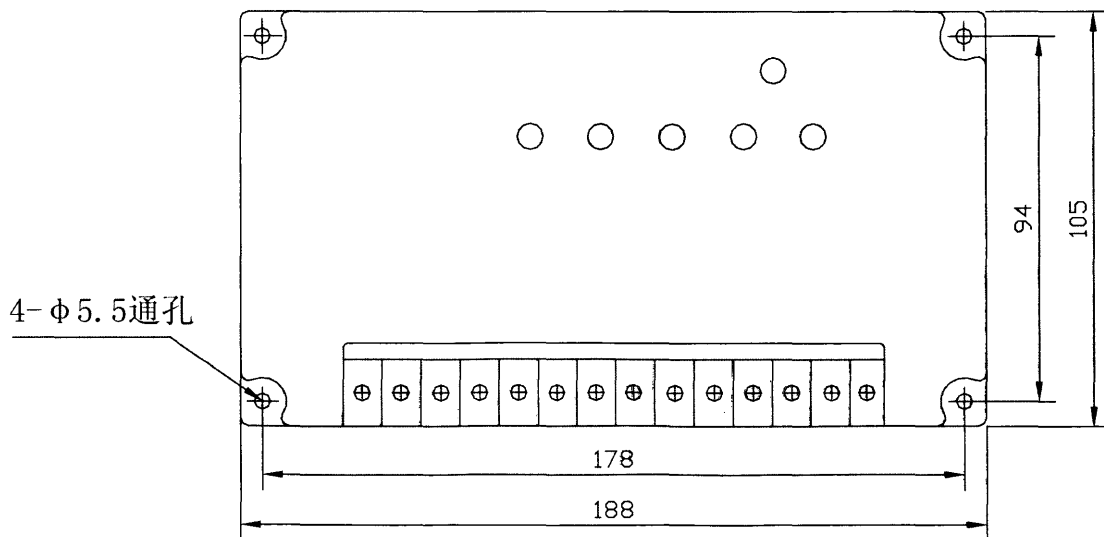


Figure 6. Outline dimension of controller

Considering the different operation speed range and teeth amount of the flywheel gear from various engines, it is necessary to check the correct correspond position of the running state choosing terminals on the right side of the controller circuit board in accordance with the operation frequency range of the engine and the requirement of

governor's performance before installation. Following **Figure 7** and the right stable show the relationship between the connecting position of each terminal and the control frequency and the governor's performance. While using ,make sure that the up limit of the speed feedback is 70~90% of the up limit of the governor control frequency. When it is required that the droop of the system is not zero, then connect C5 .Normally, FORTRUST engineers will complete connecting for C1-C6 before the governor leaves the factory according to the customer's situation.

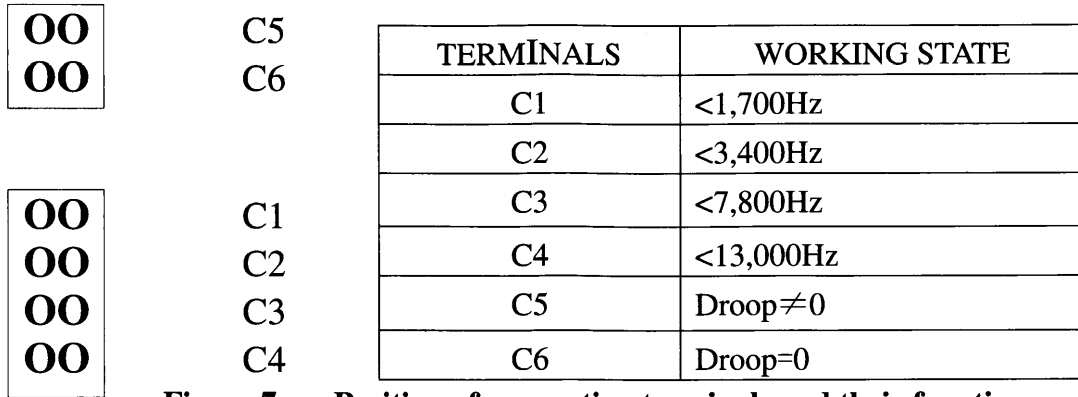


Figure 7. Position of connecting terminals and their function

Controller connecting sees **Figure 8**. in which, the cables used to connect the magnetic pickup and speed remote control potentiometer to the controller should be shielded and the shielding layer should be grounded at the end of the controller. Please pay attention to the wire number or the color of the cable from the electromagnetic actuator to the controller and do connection properly according to **Figure 8**.

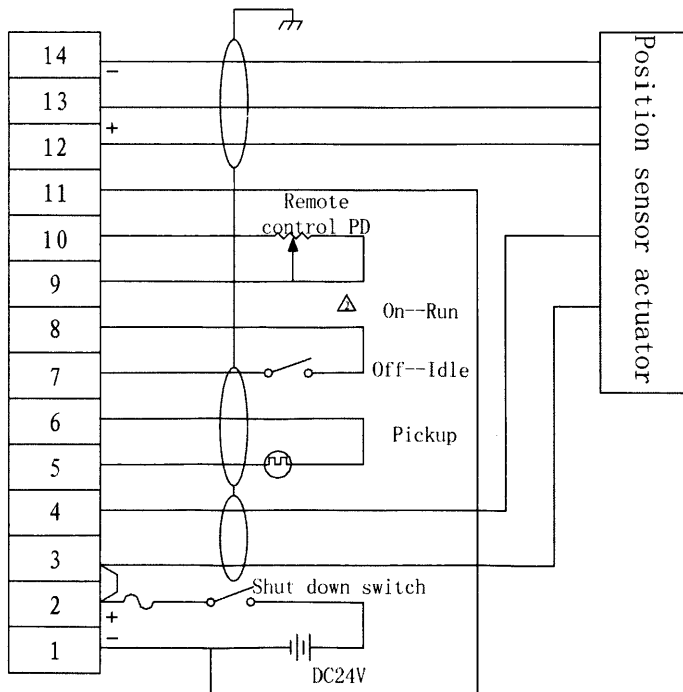


Figure 8. Connection diagram of controller

CAUTION:

- 1) *When power on, voltage between 12 and 14 should be 9V. Voltage at 13 should be 0V when it is at the stop position, it will increase while the position of rack increases. Please do not connect wrong.*
- 2) *The shielding cover can be connected with the fitting screw of the ESG1500C1 controller and then grounded properly by this connection point.*
- 3) *Only when the correct connection of power polarities and normal value of power voltage are confirmed, then short 2 and terminals through a piece of wire.*

To avoid the damage on the controller circuit due to wrong electrode connecting, one Protecting diode is provided in the controller. But considering that the diode will produce lots of heat after long time working, it is recommended to connect No.2 and No.3 terminals of the controller by the short wire supplied together with the unit after completion of system installation and commissioning to reduce controller heat and thus increase the system stability.

3.4 Power Supply

The working voltage of this governor is DC24V that can be provided by the starting batteries of engine or other stable voltage or non-stable voltage power source that can ensure the system peak output and the voltage vibration range. In case of using the starting batteries, some charging device should be provided to give sufficient power to the batteries. When starting engine, the short-time droop of the voltage output of the batteries will not affect the normal working of the engine .

CAUTION: *24V control battery is recommended by FORTRUST*

4 FIRST START PROTOCOL

- *Installing, checking , and Presetting*
- *First Start Operation*
- *Droop Adjusting*

4.1 Installing, Checking, and Presetting

After installing the governor on the engine , following checking and presetting items must be done before first start:

4.11 According to the relative mechanic and electric installation drawing, confirm that all electric connections are correct, there is no any seizing in mechanic driving, the magnetic pickup is installed and secured properly. Check and confirm that the output axis of the actuator is located at zero fuel supply position of the engine .

- 4.12 Switch off the “idle/run” switch (i.e. at idle position) .
- 4.13 Switch on the power and check if the output axis of actuator stays at the fuel supply zero position, then check if the voltage between 12(+) and 14(-) terminals is 9 (± 0.5) V.
- 4.14 Press “test” button or connect terminal 11 with 12 ,now the output axis will be at the fuel supply maximum position, Adjust the “maximum fuel limit” potentiometer on the controller to make the current in the governor at about 2.5A~3A , then switch off the “test ” button and the output axis should return to the fuel supply zero position. This procedure can be judged by observing the current changing of the governor.

CAUTION: Before carrying out above operation , the 2nd and 3rd terminal on the controller should not be connected until 4.1.3 and 4.1.4 items are checked O.K..

4.2 First Start Operation

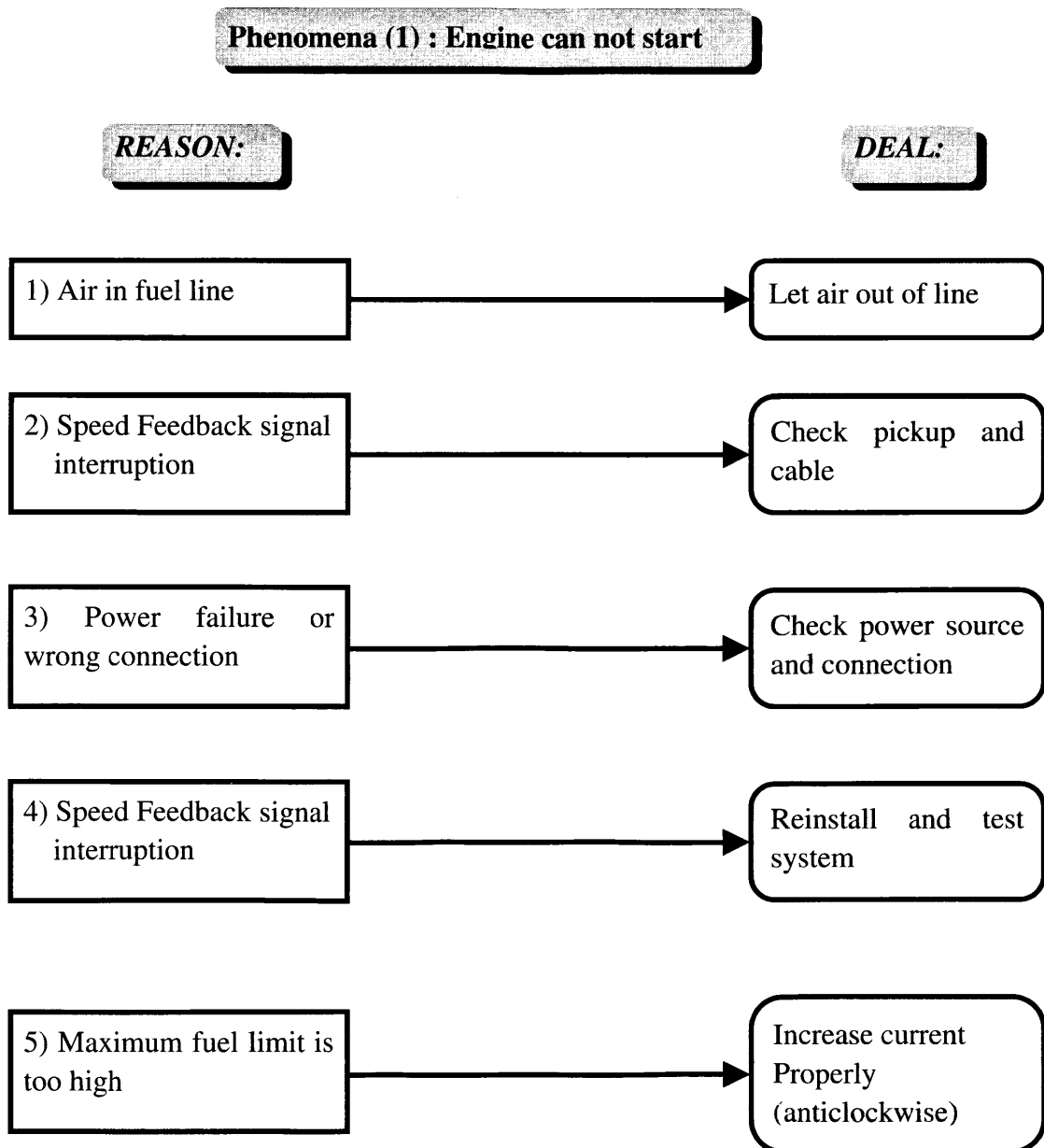
After all checking items and presetting in 4.1 are completed and confirmed correctly, the engine can be started. Following operation procedure is recommended:

- 4.21 Switch on the governor power, check by using “test” button. When the button is pressed , the current should be 2.5A (or 3A) around, and when it is released, the current will be about 0A.
- 4.22 Start engine; adjust “gain” and “derivative” potentiometers to the engine Run stably under the idle speed state. After heating up the engine for some minutes. Switch on “idle/run” switch, increase the speed to the rated value gradually. Adjust “gain” potentiometer and “derivative ” potentiometer to ensure stable running of engine when necessary.
- 4.23 Increase or decrease load step by step. Observe the correspondence of governing system, adjust “gain” and “derivative” potentiometer to achieve the best static and dynamic performance of the system.
- 4.24 Load down and change the engine speed, observe engine running within the full speed range .Do above operation repeatedly when necessary until the system can keep steadily with satisfactory dynamic performance within the full speed range.
- 4.25 Set the “idle/run” switch at “idle” position., engine running speed will decrease to the idle speed ; shut off the power switch of the governor (i.e. stop switch), the engine will stop very quickly.

5. TROUBLE SHOOTING

- *Engine can not start*
- *Over-speed when start engine*
- *Unsteady engine speed*
- *Halt unexpectedly*
- *Engine can not stop*
- *Drop can not be adjusted*

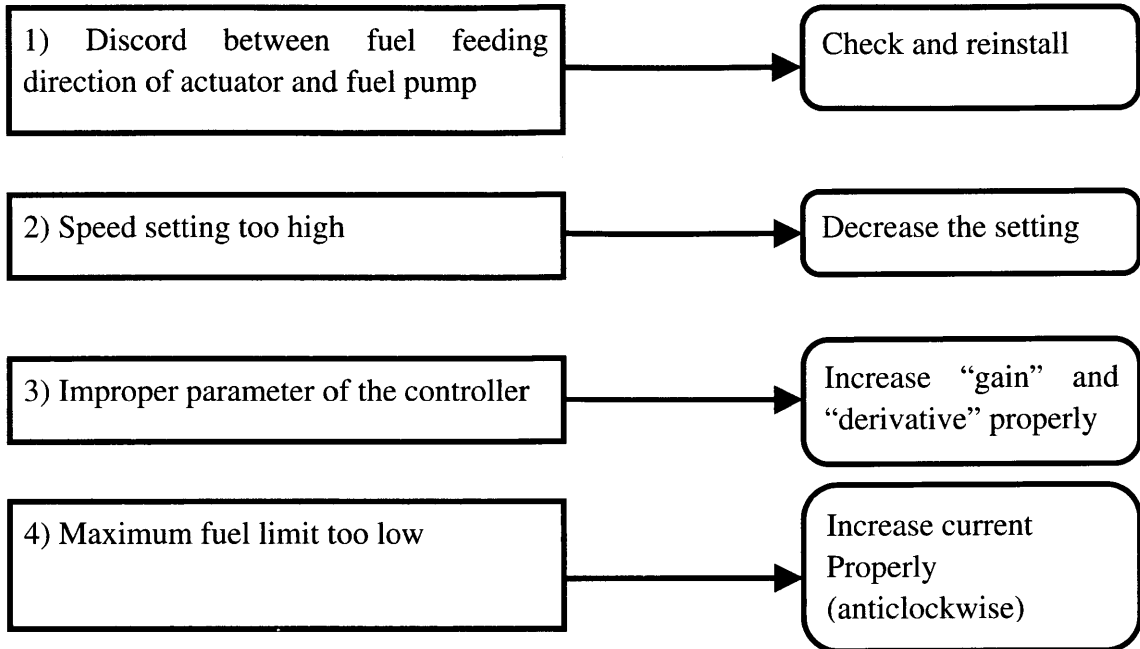
When any incorrect matter happens during installation testing or using , please clear the problem refer to following diagrams.



Phenomena (2) : Over-speed when start engine

REASON:

DEAL:



Phenomena (3) :Unsteady engine speed

REASON:

DEAL:

1) Seizing or excessive clearance between actuator and drive rod

Check and reinstall

2) Overload of engine

Reduce engine load

3) Sensor loose or worn

Rescuer or change

4) Installation clearance of magnetic pickup too big

Check and reinstall

5) Improper controller parameter

1) Decrease "gain" and "derivative" if surge circle speed > 10Hz;
2) Increase "gain" and "derivative" if surge circle speed < 1Hz.

Phenomena (4) : Halt unexpectedly

REASON:

DEAL:

1) Governor power failure



Check power and cable connection

2) Speed feedback signal interruption



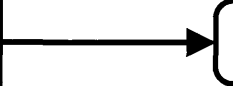
Check sensor and cable

3) Speed setting signal interruption



Check remote control potentiometer and cable

4) Actuator cable break or short



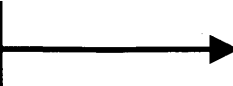
Check actuator and cable

Phenomena (5) : Engine can not stop

REASON:

DEAL:

1)Discord between zero position of actuator and fuel pump



Check and reinstall

2)Fuel pump seized

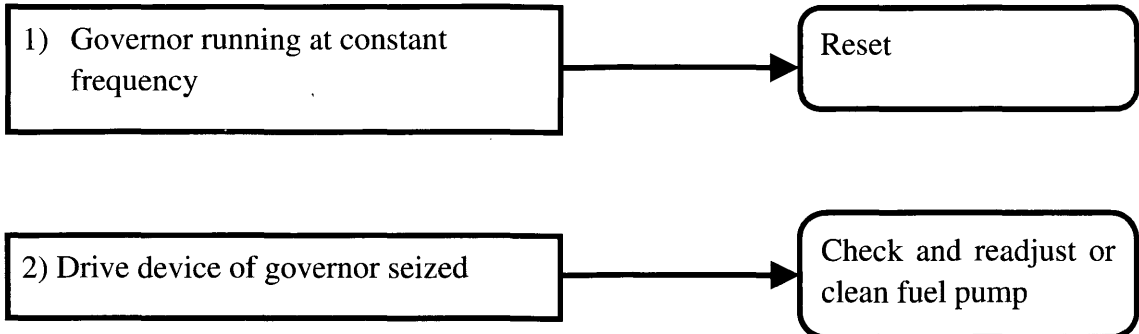


Same as above

Phenomena (6) :Drop can not be adjusted

REASON:

DEAL:



CAUTION: The maximum fuel limit potentiometer should be adjusted when engine stops. If the defect still remains after checked and dealt according to above diagrams, and the engine system is confirmed correct, then it may be the defect of the governor itself. In this case, please send the governor to the maintenance department for repair. Don't overhaul the governor if you is not capable to do so, otherwise, you may cause a bigger defect.

6.CAUTION

- Every time before starting engine, make sure the "idle/run" switch be at "idle"
- All potentiometers on the controller have been tested by the manufacture. Any non-professional staff are forbidden to do any adjustment or remove
- When starting engine after it has been stopped for a long time, make sure the governor is still under good condition by using "test" button.
- After 2000 running HRS, the actuator should be checked. If there is no any seizing, just leave it, otherwise drop some L.O. on the actuator bearing, then operate the actuator manually for a few times, if it is smooth without any seizing, then it can be used normally.

THE END

