

# RA890F PROTECTORELAY Burner Controller User's Manual



Azbil Corporation

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<http://www.azbil.com/products/bi/order.html>

### Precautions in Using

- (1) Since this protectorelay has the very important functions to operate a combustion equipment safely, it is necessary to use it correctly in accordance with this User's manual
- (2) The installation, wiring, maintenance, inspection and adjustment shall be made by trained, experienced flame safeguard control technicians.

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# 1.

# GENERAL

The RA890F is a solid state electronic burner controller to be used for the automatic operation and safety operation of gas, oil or combination gas-oil combustion equipment, up to 700 kW, in batch operation.

The flame detector of a flame rod or the C7012A\* Ultraviolet Flame Detector is used in combination with the RA890F.

If ignition failure should occur during starting, the safety switch is operated to stop the combustion safety device safely. In this case, restarting is prevented by safety design, unless the "RESET" pushbutton is operated.

The RA890F is a line voltage device, and operated after mounted directly onto the Q270A subbase.

\* Discontinuation date: March 2012.

- A safeguard circuit is incorporated to prevent the RA890F from being operated, when a false flame signal is detected by the flame detector.
- If the burner fails in ignition, the safety switch is operated to close the fuel valve automatically.
- A test jack is provided to permit the flame current to be read.
- Combustion control is also permitted by connecting together a line voltage controller or low voltage controller.
- Applicable to the interrupted pilot system or intermittent pilot system.
- The input circuit is protected against the high voltage of the ignition transformer, when a flame rod flame detector is used.
- Adaptable to combustion equipment in batch operation (started and stopped once or more per 24 hours). Not to be used for continuous operation.
- The RA890F performs recycle operation during flame failure. Therefore, when it is to be used together with a gas-fired combustion system, operate it in non-recycle sequence by using an on-delay timer. (Refer to Fig. 4.)

# 2.

# EXTERNAL DIMENSIONS

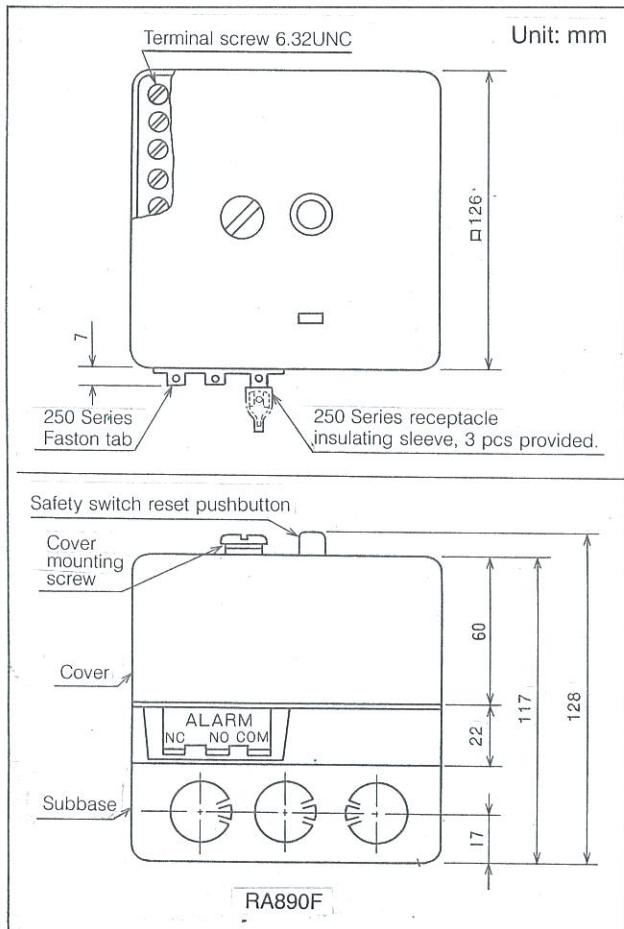


Fig. 1 External Dimensions

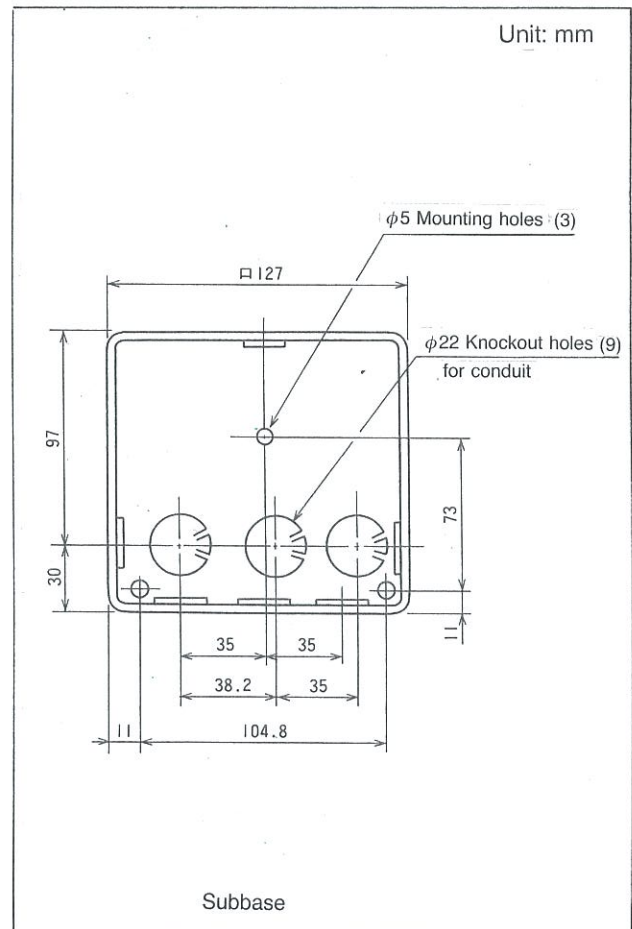


Fig. 2 Mounting Dimension Drawing

# 3.

# INSTALLATION AND WIRING

### 3.1 Cautions in Installation and Wiring

- (1) Absolutely avoid installing the RA890F at any of the following places:
  - ① There are special chemicals or corrosive gases (ammonia, sulfur, chlorine, ethylene compounds, acid, and the like).
  - ② There are water drops or excessive moisture.
  - ③ Exposed to high temperature.
  - ④ A large vibration exceeding the special vibration resistance continues for a long time.
- (2) Carry out installation and wiring in accordance with this instruction manual or that supplied by the other set manufacturer such as boiler manufacturer.
- (3) All the wiring shall comply with the specified standards.
- (4) Connect the power source finally to prevent possible electric shocks or damages. If the power line should touch any other terminal, a trouble or damage may be caused.
- (5) Never connect a load, which exceeds the rating given in the specifications, to the load terminals.
- (6) Supply the power source of the same voltage and frequency as indicated on the RA890F.
- (7) When using timers and/or auxiliary relays, addi-

- tionally as required, select high reliability ones having the sufficient load capacity, and configure a proper circuit with them.
- (8) Be sure to ground the casing of the boiler to an Earth of less than 100Ω.
- (9) Never clamp the flame detector cable together with the power cable or the high voltage cable of the ignition transformer, nor put them in the same conduit, but wire them separately from each other. Particularly, wire the high voltage cable independently of the others, and keep it 10 cm or more away from the RA890F.
- (10) Connect the high voltage cable of the ignition transformer tightly not to cause poor contact. Otherwise, high frequency electromagnetic waves may be generated, thus causing radio receivers to generate noise, or the RA890F to malfunction. Also install the ignition transformer directly onto the burner body or the metal part connected to the burner body electrically.
- (11) After the completion of wiring, be sure to check if the connections are made properly, as miswiring causes a damage or malfunction.
- (12) If a terminal screw is loose, faulty operation may occur. Be sure to check that the terminal screws are not loose.

### 3.2 How to Mount the Subbase

Mount the subbase so that the top is horizontal and the back is vertical as shown in Fig. 3. The subbase may lean backward as much as 45 degrees if necessary.

- (1) Open knockout holes for conduits as required, as shown in Fig. 3, and attach wiring conduits there.
- (2) Fix the subbase at the specified position with screws.

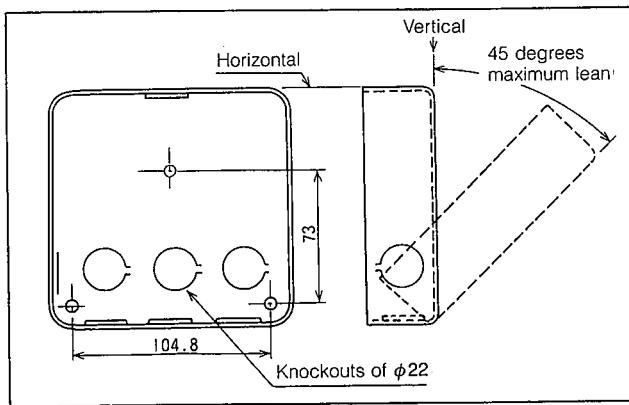


Fig. 3 Mounting the Subbase

### 3.3 Terminal Arrangement of Subbase

For the terminal arrangement of the subbase, refer to Figs. 4 and 5. The terminal Nos. required for wiring are stamped white on the terminal block of the subbase.

### 3.4 Terminal Arrangement of RA890F

The terminal arrangement of the RA890F corresponds to that of the subbase.

### 3.5 How to Mount the RA890F onto the Subbase

Mount the RA890F onto the subbase after the completion of external wiring.

- (1) Loosen the cover mounting screws and remove the cover from the RA890F.

- (2) Set the position of the RA890F mounting base to that of the subbase.
- (3) Tighten the terminal screws (10 pcs) of the RA890F mounting base securely in the individual terminal thread holes in the subbase. (Electrical connection with the subbase is completed when the RA890F is mounted.)
- (4) Replace the cover to the RA890F.

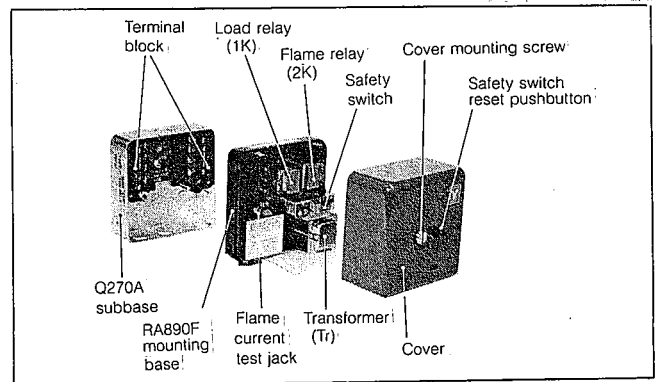


Photo 1 RA890F and Q270A Subbase

### Regular Pilot System (manual ignition system)

When the RA890F is to be used in the manual ignition system, cut off the pilot link shorting lead (refer to Photo 2) on the PCB of the RA890F. Avoid twisting off this lead. Otherwise, the PCB may be damaged.

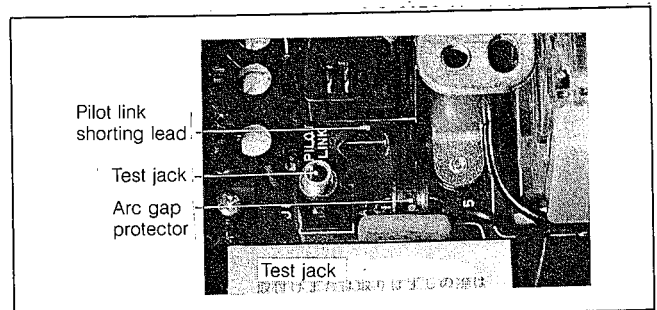
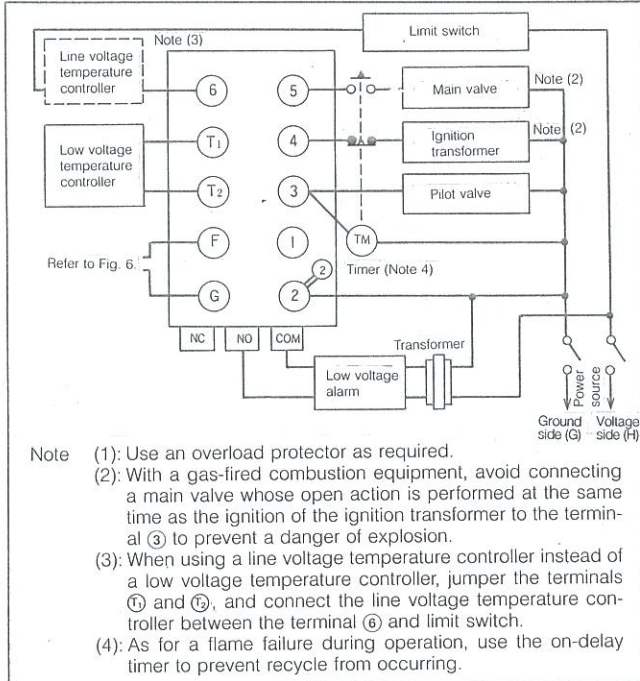


Photo 2

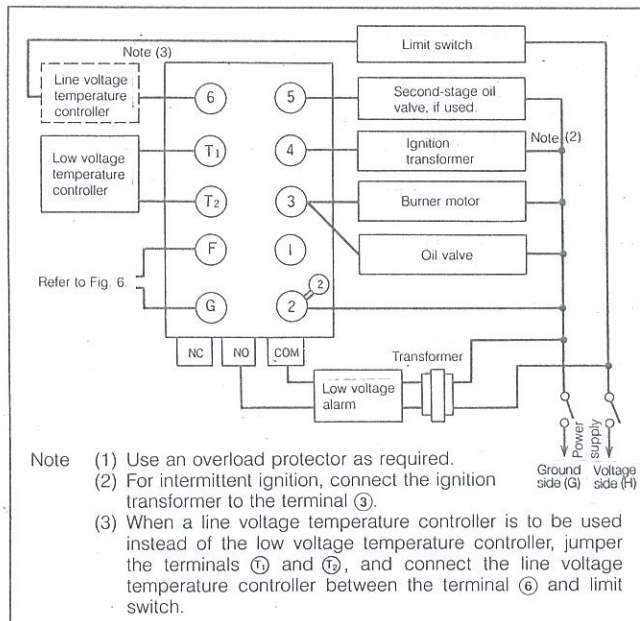
### 3.6 How to Wire the Subbase in Non-recycle or Recycle Mode

- (1) Fig. 4 shows the external wiring diagram when used with gas burner, while Fig. 5 shows the one when used with oil-fired combustion equipment.
- (2) When the power source is provided with ground potential, connect its voltage side (H) to the terminal ⑥, and its ground side (G) to the terminal ②.

For the connection between the power source and valve, refer to Fig. 7.



**Fig. 4 External Wiring Diagram when Used with Gas-Fired Combustion Equipment (non-recycle)**



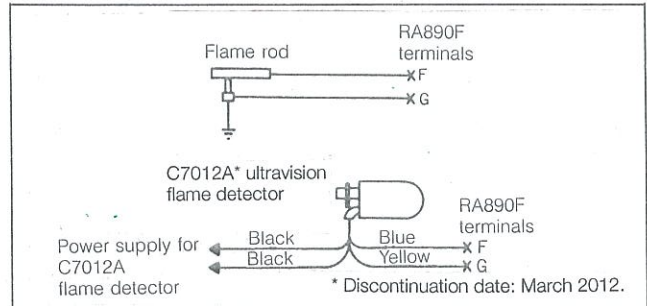
**Fig. 5 External Wiring Diagram when Used with Oil-fired Combustion Equipment (recycle)**

- (3) For wiring to each terminal, use the moisture-resisting type covered wire of 1.6G or more. For the wiring between the terminals ⑥ and ② of the Q270A subbase and the ignition detector, refer to Table 1.

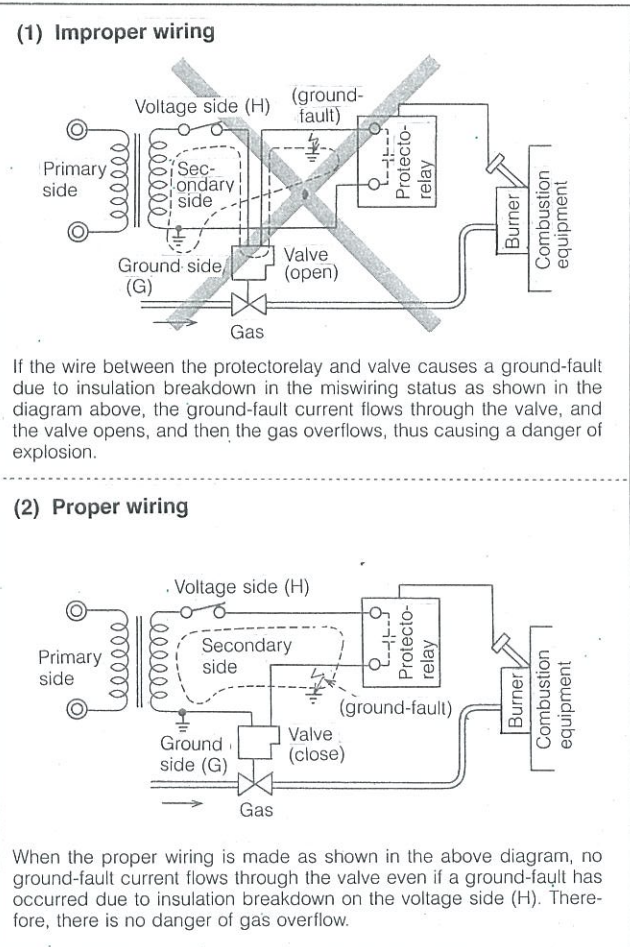
**Table 1.**

Type	Allowable Length	
	C7012A	Flame rod
JAN standard RG-11/U	Approx. 50 m	Approx. 30 m
JAN standard RG-114/U	Approx. 75 m	Approx. 50 m

Cable equivalent to RG-11/U...5C2 or 7C2 V



**Fig. 6 Wiring of Each Flame Detector**



**Fig. 7 Wiring between Power Source and Valve (with the power source provided with voltage and ground electrodes)**

### 3.7 Subbase Connection for Interrupted Pilot

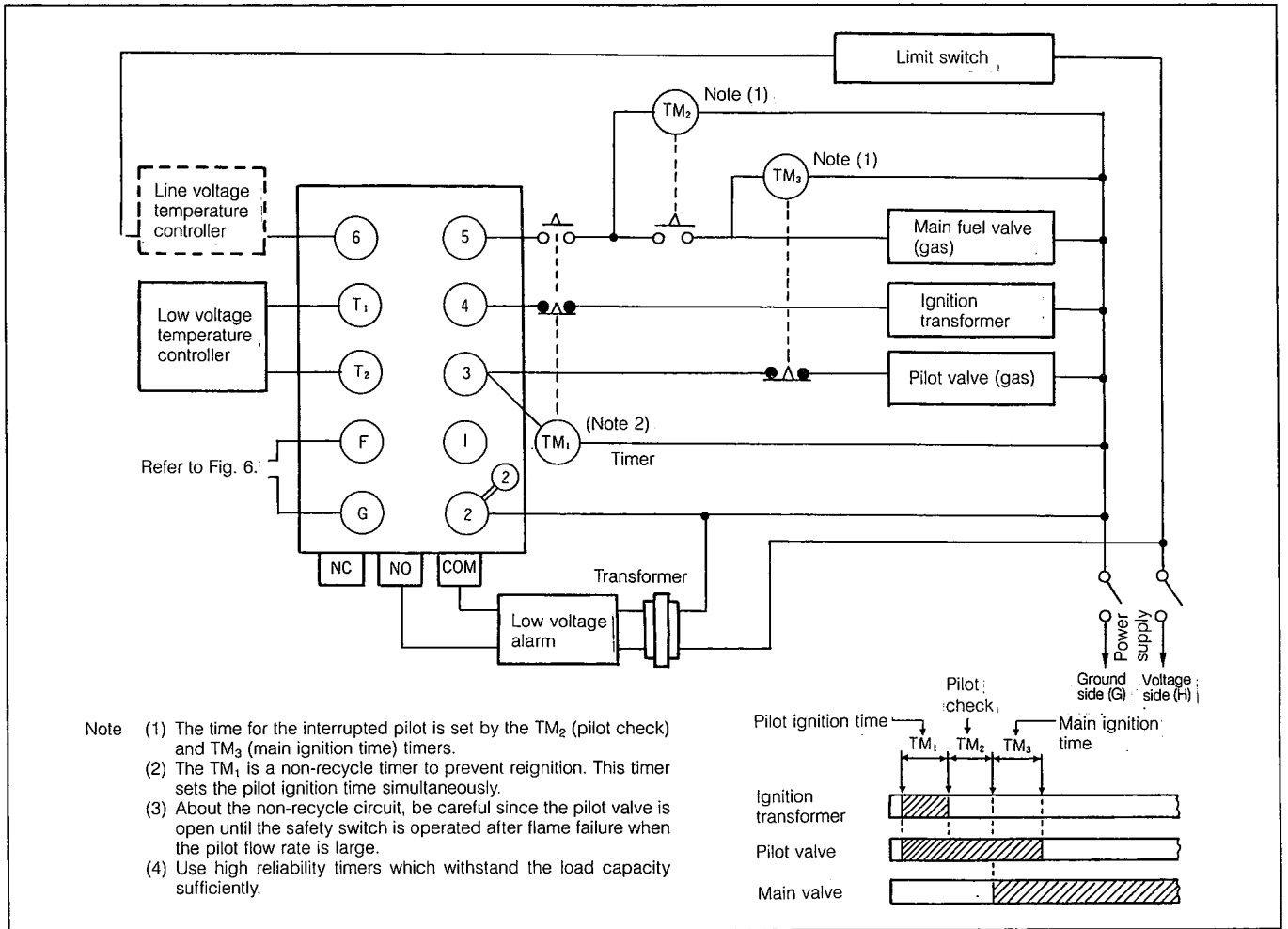


Fig. 8 External Timer Connection for Interrupted Pilot

### 3.8 Subbase Connection using Contacts whose Pre-purge has been Completed

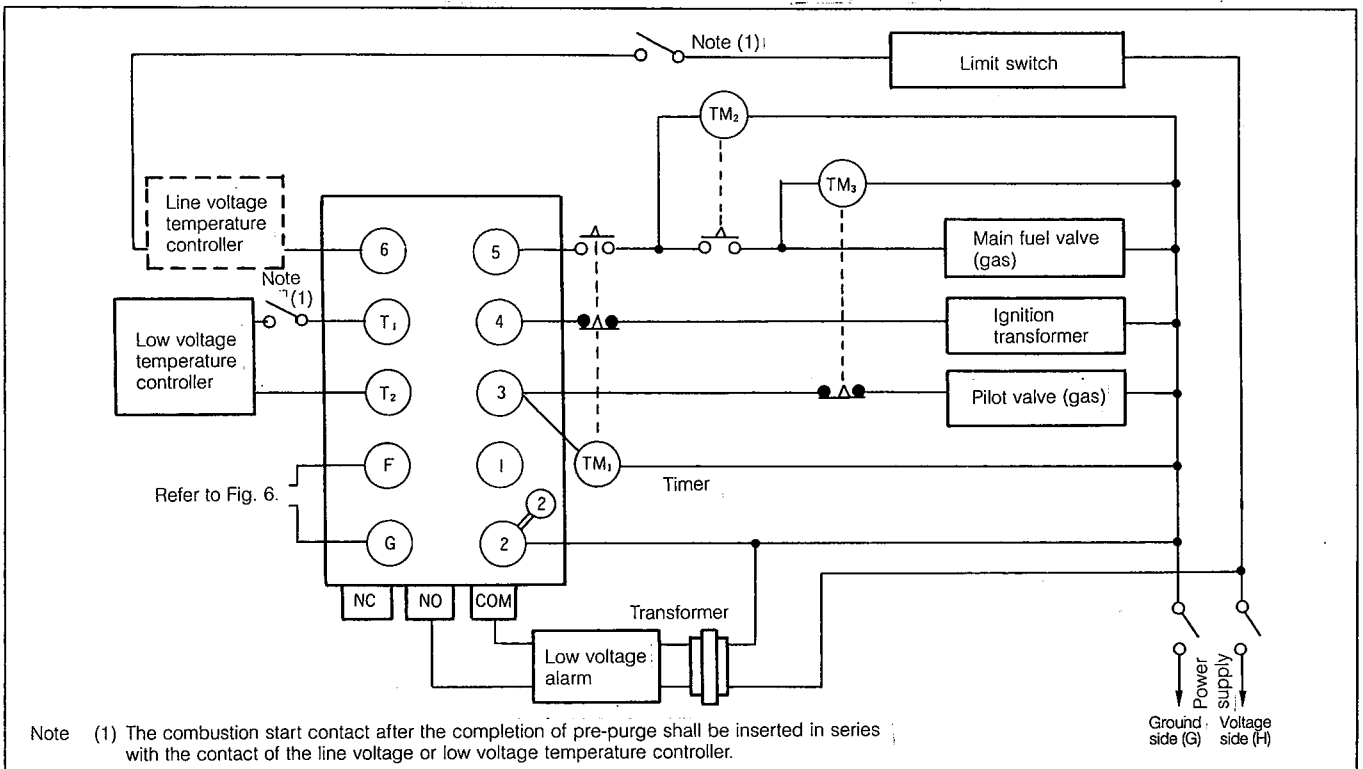
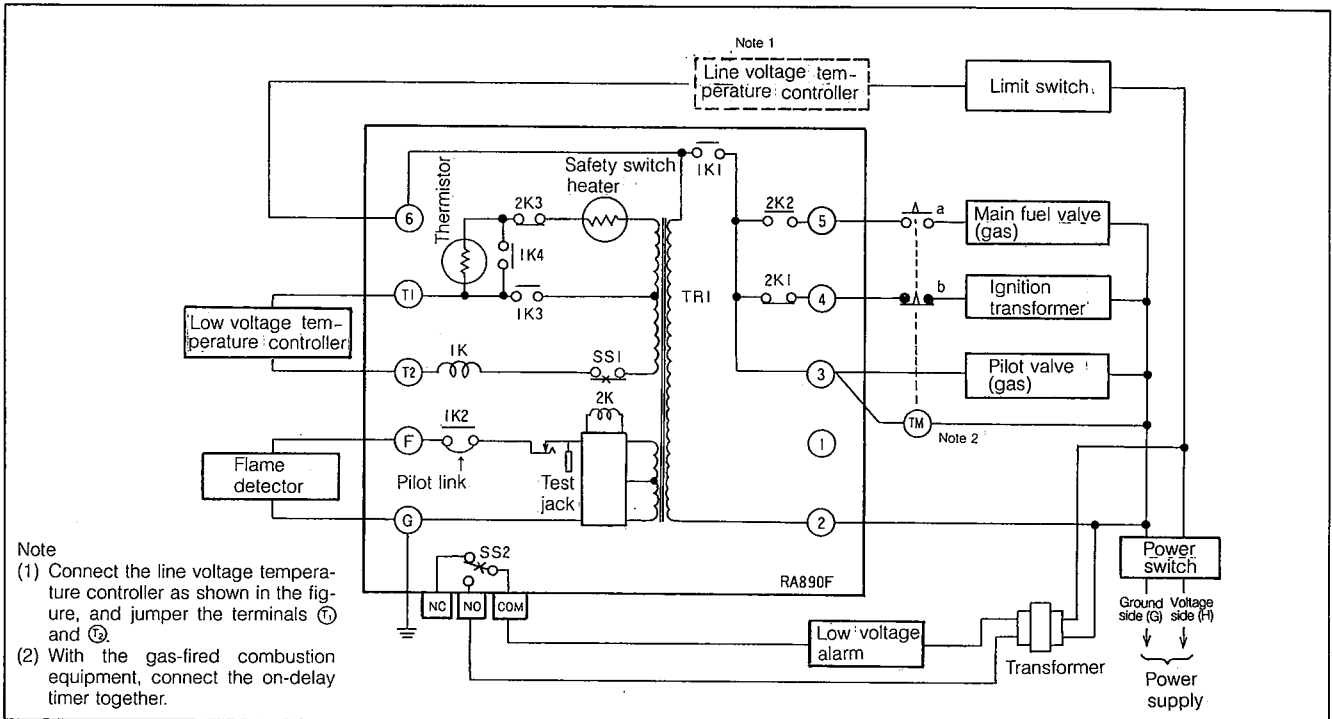


Fig. 9 External Contacts Connections using Pre-purge Timers

## 4-1. Gas-Fired Combustion Equipment



**Fig. 10 Example of Connection of Gas-Fired Combustion Equipment with External Devices and Internal Block Circuits of RA890F**

### (1) Normal Operation (Refer to Figs. 10 and 11)

Power Switch and Controller	Operation of RA890F	Equipment Status
Power switch ON Limit Controller ON	The power voltage is applied to the transformer of RA890F.	
Each Controller Combustion command (ON)	1. While the relay 2K is excited by a false flame signal in the flame detector circuit, the relay contact 2K3 is turned OFF. Therefore, the relay 1K is neither excited, nor the system is started.	Not started.
	2. If the relay 2K is not excited with no false flame signal, the relay contact 2K3 is turned ON and, after the delay time of approx. 3 sec for heating the thermistor, the relay 1K is excited and the relay contact 1K1 is turned ON. Then, the circuit between terminal ③, ④ and ⑥ is closed, and the relay contacts 1K3 and 1K4 are turned ON. Therefore, a self-hold circuit is configured for the relay 1K, and the safety switch heater starts to be heated.  * This is the start check time of approx. 3 sec at the rated voltage and the normal temperature. Especially, this time is affected by the ambient temperature. It changes by approx. 20 to 3 sec within the ambient temperature range of -20 to +40°C at the rated voltage.	Pilot valve "open" Ignition transformer starts operation.
Flame check by flame detector	The relay 2K is excited and the relay contact 2K1 is turned OFF. The circuit between the terminals ④ and ⑥ is opened and that between terminals ⑤ and ⑥ is closed. Further, the relay contact 2K3 is turned OFF, and the safety switch heater stops heating.	Ignition transformer stops operation. Main fuel valve "open".
Controller combustion stop command (OFF)	The relay 1K is not excited, and the relay contact 1K1 is turned OFF. The circuit between terminals ③ and ⑤ is opened, and at the same time, the relay contacts 1K3 and 1K4 are also turned OFF.	Main fuel valve and pilot valve "close".
Flame failure check by flame detector.	Relay 2K is not excited, and the controller is placed in wait status of combustion command from the controller.	All units stop.

### Caution

To reset the RA890F safety switch, after 3 minutes has elapsed from the time it has operated and then after the malfunction has been rectified, press the reset pushbutton to reset. Do not try 3 times or more.

#### (2) Ignition Failure (Refer to Fig. 12)

After the ignition transformer starts the ignition operation and the pilot valve is "opened", the voltage is applied to the (M).

If a flame is not detected within the on-delay set time of the (M), the contact of the timer is turned OFF, and the ignition operation is stopped.

After the safety switch timing of 15 sec, the safety switch is locked out, and the SS1 is turned OFF. The 1K relay is not excited, and the pilot valve is "closed".

If the set time of the (M) is more than 15 sec, the timer operation is cut off in 15 sec because the safety switch timing of 15 sec has priority. Generally, the set time of the (M) is 10 sec max.

For the time setting of the (M), refer to the guidance of the Japan or Local Gas Association.

(Safety technology guidance of industrial gas combustion facilities)

#### (3) Flame Failure during Combustion (Refer to Fig. 13)

If a flame failure is detected by the flame detector during operation, the flame relay 2K is released, and the relay contact 2K2 is turned OFF, and then no power is supplied to the terminal (5), but the main valve is "closed". The relay contact 2K3 is turned ON, and the voltage is applied to the safety switch heater.

In the gas-fired system, the on-delay timer is operated, and the contact is turned OFF. Therefore, re-ignition is prevented, but lockout occurs after timing of safety switch. The contact SS1 of the safety switch is turned OFF, and the control circuit is deenergized. The relay 1K is released, and the relay contact 1K1 is turned OFF, and then power is supplied between the terminals (3) and (4). At the same time the contact SS2 is turned ON, and an alarm is issued. For restarting, it is necessary to reset the safety switch manually.

### Caution

If there has been a power failure before lock-out after a flame failure while the device is operating but then power is recovered, ignition will start at the same time as the power is recovered. This is because the on-delay timer was reset when the power failure occurred.

If there has been a power failure after lock-out and then the power is recovered, 1K will not be turned ON because safety switch contact SS1 is open even when the power is recovered because lock-out has already occurred (1K OFF, 2K OFF). To restart, confirm that it is safe to do so and then manually reset the safety switch.

#### (4) In Case there is a False Flame at Start (Refer to Fig. 14)

If there is a false flame before the start of combustion, the relay 2K is excited after power ON, and the relay 1K is kept released.

Therefore, the relay 1K is not started, but kept released, even when the temperature controller is turned ON.

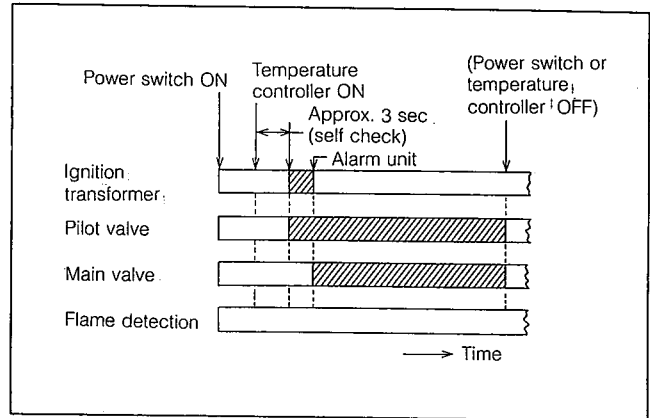


Fig. 11 Normal Operation

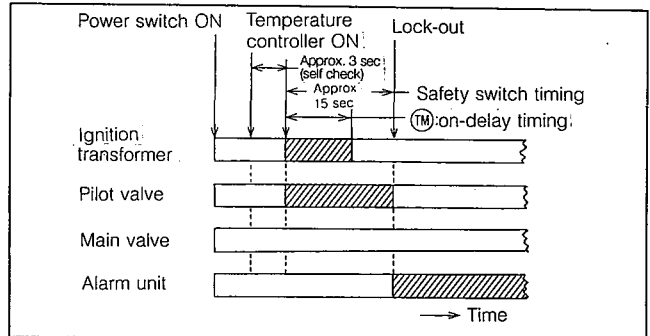


Fig. 12 Ignition Failure

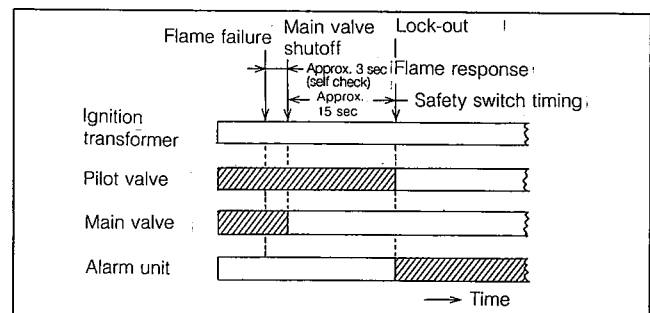


Fig. 13 Flame Failure (in gas-fired system)

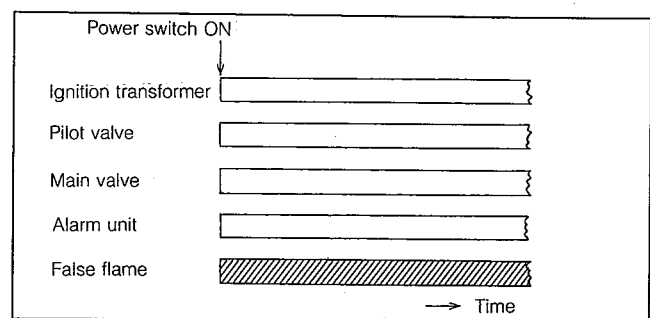
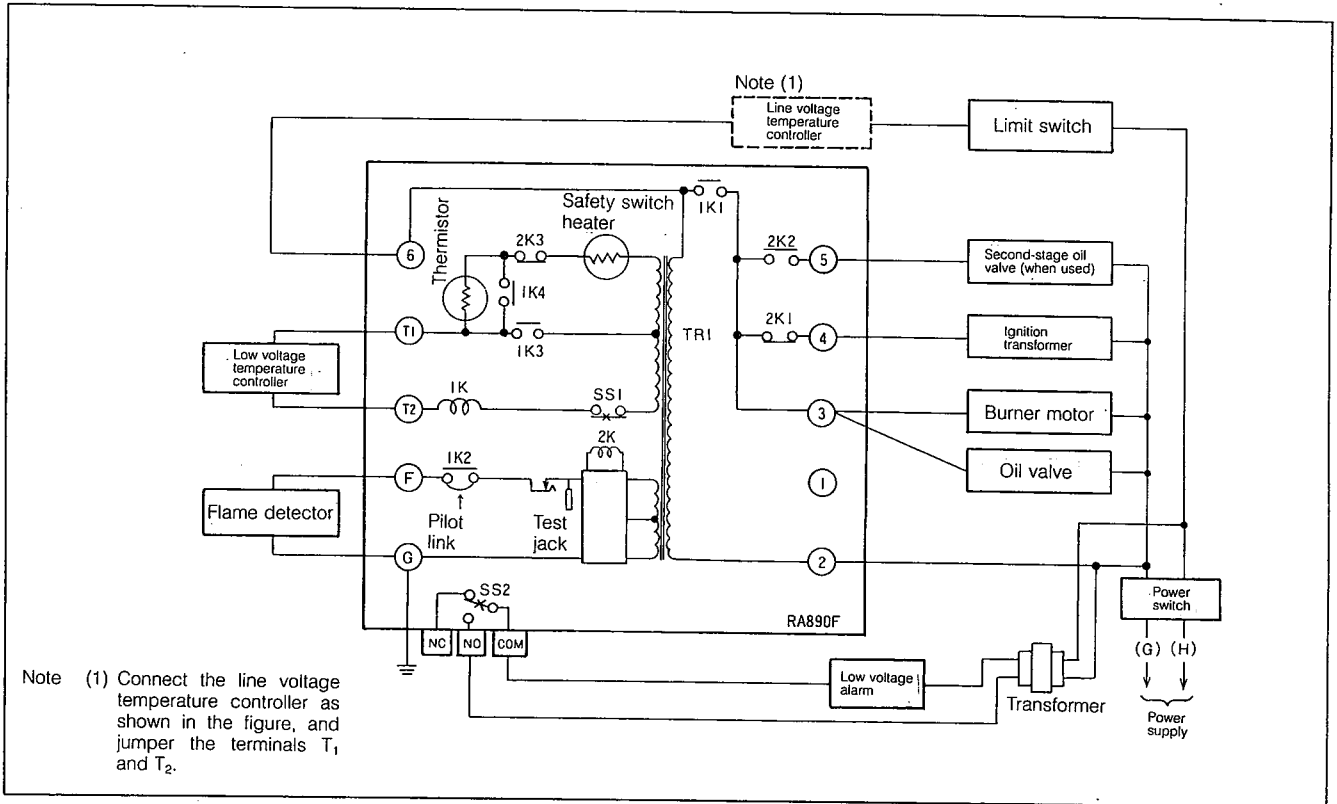


Fig. 14 With False Flame at Start



#### 4-2. Oil-Fired Combustion Equipment

(This is a recycle combustion equipment. When no-recycle is required, add a timer as in a gas-fired combustion equipment.)



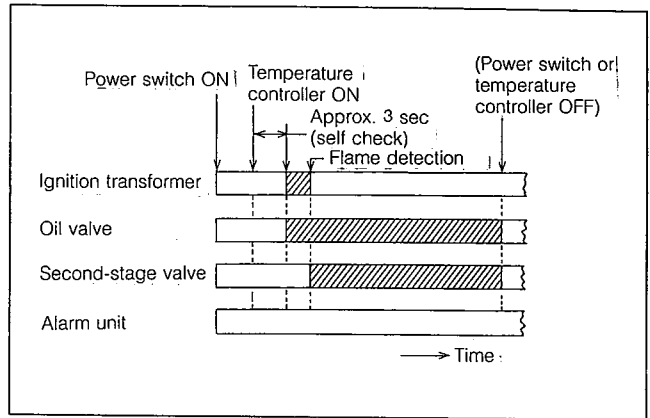
**Fig. 15 Example of Connection of Oil-Fired Combustion Equipment with External Units and Internal Block Circuits of RA890F**

#### (1) Normal Operations (Refer to Figs. 15 and 16)

Power Switch and Controller	Operation of RA890F	Equipment Status
Power switch ON Limit Controller ON	The power voltage is applied to the transformer of RA890F.	
Each Controller Combustion command (ON)	1. While the relay 2K is excited by a false flame signal in the flame detector circuit, the relay contact 2K3 is turned OFF. Therefore, the relay 1K is neither excited, nor the system is started.	Not started.
	2. When there is no false flame signal, the relay contact 2K3 is turned ON and, after the delay time of approx. 3 sec* for heating the thermistor, the relay 1K is excited, and the relay contact 1K1 is turned ON. Then, the circuit between terminals ③, ④ and ⑥ is closed, and the relay contacts 1K3 and 1K4 are turned ON. Therefore, a self hold circuit is configured through the relay 1K, and the safety switch heater starts to be heated. * This is the start check time of approx. 3 sec at the rated voltage and the normal temperature. Especially, this time is affected by the ambient temperature. It changes by approx. 20 to 3 sec within the ambient temperature range of -20 to +40°C at the rated voltage.	Ignition transformer starts operation. Burner motor starts. Oil combustion valve "open".
Flame check by flame detector	The relay 2K is excited and the relay contact 2K1 is turned OFF. The circuit between terminals ④ and ⑥ is opened and that between the terminals ⑤ and ⑥ is closed. Further, the relay contact 2K3 is turned OFF, and the safety switch heater stops heating.	Ignition transformer stops operation. Second-stage oil combustion valve "open".
Controller combustion stop command (OFF)	The relay 1K is released, and the relay contact 1K1 is turned OFF. The circuit between terminals ③ and ⑤ is opened and at the same time, the relay contacts 1K3 and 1K4 are turned OFF.	Second-stage oil valve and oil valve are "closed", and the burner motor is stopped.
Flame failure check by flame detector.	The relay 2K is released and the controller is placed in combustion waiting status.	All system stops.

**Caution**

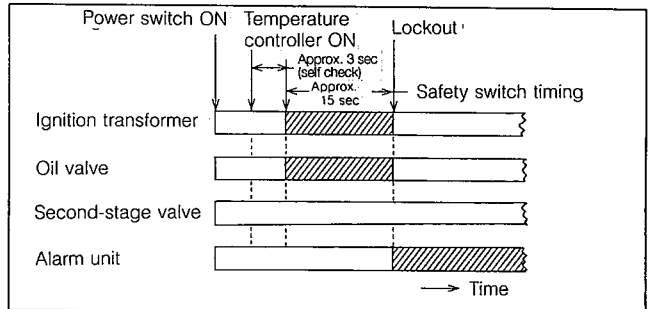
To reset the RA890F safety switch, after 3 minutes has elapsed from the time it has operated and then after the malfunction has been rectified, press the reset pushbutton to reset. Do not try 3 times or more.



**Fig. 16 Normal Operation**

**(2) Ignition Failure (non-fired) (Refer to Fig. 17)**

If the flame detector does not detect a flame within the lockout timing (approx. 15 sec) after the ignition transformer starts the operation and the oil valve is "opened" as shown in the normal operation of Fig. 14, the safety switch heater is heated, and the contact SS1 is turned OFF, and then the 1K relay is released. The contact 1K1 is turned OFF, and the ignition operation is stopped, and then the oil valve is "closed". At the same time, the contact SS2 is turned ON, and an alarm is issued.



**Fig. 17 Ignition Failure (not fired)**

**(3) Flame Failure during Combustion (Refer to Figs. 18 and 19)**

If the flame detector detects a flame failure during operation, the flame relay 2K is released, and the relay contact 2K2 is turned OFF, and then no power is supplied to the terminal ⑤, but the second-stage oil valve is "closed". The relay contact 2K3 is turned ON and the voltage is applied to the safety switch heater.

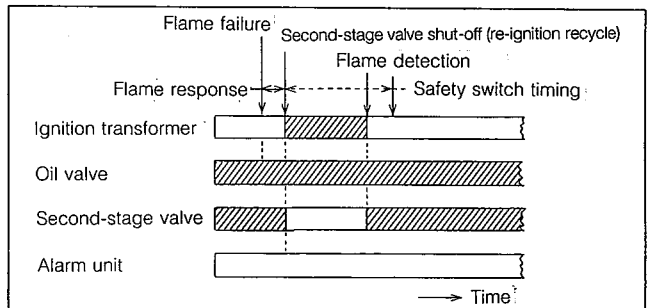
When the ignition transformer is connected to the terminal ④, the relay 2K is released and at the same time, the relay contact 2K1 is turned ON, and the ignition transformer is operated so as to re-ignite the burner, thus performing a recycle operation.

When a flame is detected again within the safety switch timing, the second-stage oil valve "opens", and the normal combustion starts. (Refer to Fig. 18.)

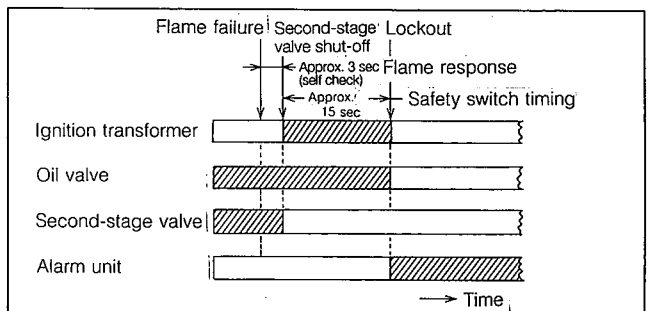
If a flame cannot be detected again, lockout occurs after the safety switch timing.

The safety switch contact SS1 is turned OFF, and relay 1K is released. The relay contact 1K1 is turned OFF, and no power is supplied to the terminals ③ and ④. At the same time, the contact SS2 is turned ON, and an alarm is issued.

For restarting, it is necessary to reset the safety switch manually. (Refer to Fig. 19.)



**Fig. 18 Recycle at Flame Failure (with re-ignition)**

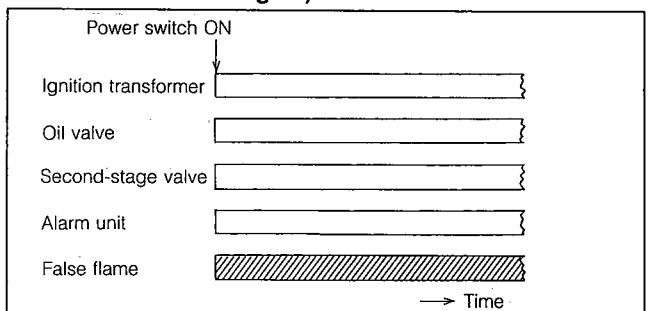


**Fig. 19 Flame Failure (in case a flame cannot be detected again)**

**(4) In Case there is a False Flame at Start (Refer to Fig. 20)**

If there is a false flame before the start of combustion, the relay 2K is excited after power ON, and the relay 1K is kept released.

Therefore, the relay 1K is not started, but kept released, even when the temperature controller is turned ON.



**Fig. 20 In Case There is a False Flame at Start**

**Caution**

Use utmost care while testing the RA890F, since the line voltage can be present on the most terminals when power is ON.

**1. Preliminary Checks**

- (1) Check through wiring.
- (2) Check if the RA890F is installed at a place within the allowable ambient temperature range.
- (3) Check if the flame detector is installed properly. (Refer to the instruction manual for the flame detector.)
- (4) Check if the burner has been adjusted properly.
- (5) Check the exhaust mechanism in the flue.
- (6) Press the green pushbutton at the front of the RA890F to reset the safety switch.

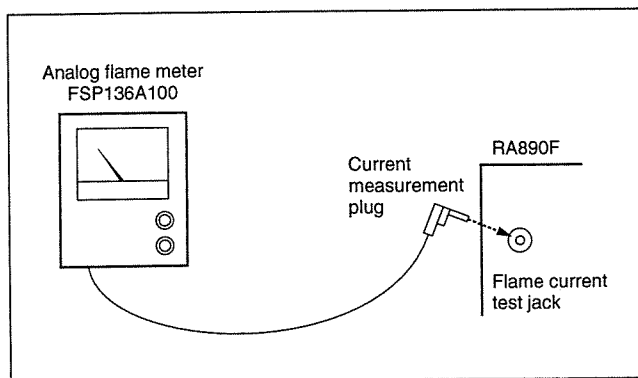
**2. Checkout Procedure**

To operate the system more safely, check for the following items satisfactorily.

- (1) Flame current check
- (2) Ignition spark test
- (3) Pilot turndown test
- (4) Safe shutdown checks
- (5) Check of hot refractory influence (only in the case of photocell)

**(1) Flame current check**

The flame current check is the best way to identify the proper flame detector installation. The check shall be done at the time of installation, every time service is done, and at least once a month, or more often. This will prevent shutdowns due to poor flame signal.



**Fig. 21 How to Measure the Flame Current**

When measuring the flame current, insert the current measurement plug of an Analog flame meter FSP136A100 into the flame current test jack of the RA890F protectorelay. Then, operate the burner and read the flame current from Analog flame meter (Fig. 21). When reading the flame current, ensure that the following two criteria are met.

- ① The flame current must be steady.
- ② The flame current must be at least 2 microamperes. The normal operating range will be 2 to 7 microamperes.

If the stable flame current is not obtained, one or more of the following items is considered.

- The power supply is not suitable.
- The connection of the flame detector is improper.
  - Open status
  - Short circuit status
  - Insulation breakdown of leads caused by moisture and contamination
- Unsuitable viewing position and viewing window
- Dirty light receiving face of ultra-vision
- Improper ultra-vision
- Improper application of a flame rod, including
  - insufficient flame contact area
  - poor location of flame rod in flame
  - excessive heat on flame rod insulator (greater than approx. 300°C)
  - ignition transformer influence
- Improper application of a photocell, including
  - temperature over 74°C (allowable temperature range)
  - dirty photocell envelope

**(2) Ignition spark response test**

Make arrangement so that the flame relay 2K may not be excited by the sparks generated during the operation of the ignition transformer.

Check the response of the flame detector to the ignition sparks in the following procedure, and check the mounting position.

- ① Close the manual fuel valves for the pilot burner and main burner to shut off the fuel.
- ② Close the power switch, and raise the set positions of the controller or close the start/stop switch to start the system.
- ③ The ignition transformer is operated and sparks are generated between the ignition electrode and flame ground.
- ④ Make sure that the flame relay is not excited at that time. The system is shut off after the safety switch timing of the protectorelay.
- ⑤ If the flame relay is excited, change the location of the flame detector or the ignition electrode.

**(3) Pilot Turndown Test****Caution**

The pilot turndown test shall be performed only by qualified personnel, and the instructions given below shall be followed carefully.

This test is intended to prove that the main burner can be lighted exactly so far as a pilot flame is detected by the flame detector, even when the gas pressure and air pressure are changed into the worst conditions.

Be sure to execute the pilot turndown test in service.

- ① Shut off the fuel supply to the pilot burner and main burner by closing their manual shutoff valves.
- ② Connect a manometer to the downstream side of the pilot solenoid valve.
- ③ Open the manual valve on the pilot gas line.
- ④ Start the system by raising the set point of the controller. The relay 1K is excited and the pilot valve opens, and then the ignition operation starts.

- ⑤ Gradually reduce the size of the pilot flame until no flame can be detected by the flame detector, by slowly closing the manual valve on the pilot gas line. The flame relay 2K and relay 1K are released and the pilot solenoid valve closes, and then the pressure of the manometer drops down suddenly. The safety switch heater starts heating and lock-out occurs 15 sec after. Record the pressure immediately before the pilot solenoid valve closes.
- ⑥ Reset the safety switch and restart the system.
- ⑦ Gradually open the manual valve again on the pilot gas line and set it to the pressure immediately before the shutoff measured in step ⑤.
- ⑧ Check if the main burner is lighted smoothly within 1 sec after the manual valve on the main gas line is opened.
- ⑨ While changing the gas pressure to minimum and maximum values and repeat ignition to the main burner 5 or 6 times. Then, check if ignition is performed smoothly within 1 sec every time.
- ⑩ If the main burner cannot be lighted, it is necessary to enlarge the size of the pilot flame. After enlarging the pilot flame, make the adjustment to keep the viewing line of the C7012A or photocell a little away from the axis of the pilot flame, or make correction with the flame size reduced.  
In the case of the flame rod, move it to a little outer side from the center of the pilot flame.
- ⑪ After the completion of adjustment, check if the main burner is lighted smoothly by repeating steps ⑤ to ⑨.
- ⑫ After the end of test, restore the manual valve on the main gas line to the fully open position and check if the flame current is proper.
- ⑬ Disconnect the manometer.

**Caution**

If this test needs to be repeated, stop the system completely once and perform the purge of unburned gases or oil in the firebox or flue before proceeding to the next step.  
Also allow at least 30 sec for the ON/OFF interval of the power supply to the RA890F.

**Caution**

Make sure that the C7012A Ultraviolet Flame Detector does not detect ignition sparks. If detected, change the location of the Ultra-vision or the ignition electrode.

**(4) Safe shutdown checks**

- ① Limit action check  
With the burner operating, lower the high limit setting to simulate an overheated boiler or furnace, and normal shutdown will occur. Restore the normal limit setting, and the burner will restart. It is recommended to use a manual resetting type high limit. When the manual reset type high limit is used, the system does not make recycle operation, but the cause can be located if the system stops.
- ② Flame failure check  
With the burner operating, close the manual fuel valves to simulate a flame failure, and the system will lock out in safety switch timing (approx. 15 sec). After the safety switch has cooled (in 3 min or more), open the manual fuel valves and reset the safety switch, and the burner will restart.

**Caution**

Be sure to check if the protectorelay is operated normally by shutting down the burner manually.

- ③ Power failure check  
With the burner operating, open and then immediately close the power switch to simulate a power failure. The burner will shut down, and after a short delay, will restart and operate normally.

**(5) Hot refractory influence check (only when a photocell is used as a flame detector in oil-fired system)**

If the flame relay is excited by the hot refractory influence at the end of the burner-on cycle, the system cannot restart until the system has been cooled, and the flame relay is released.

Therefore, operate the burner until the normal operating status is obtained, and then shut down the burner. Check if the flame relay is released immediately without being affected by the hot refractory. If the flame relay remains excited, the photocell may be heated or the flame relay is affected by the hot refractory. Reselect the viewing position or reduce the sensitivity of the photocell by inserting an orifice or filter in the viewing window. (For the reselecting method of the viewing position or the sensitivity reducing method for the photocell, refer to the instruction manual for the photocell.)

**Caution**

After the completion of individual adjustments, start the combustion with the beginning, and recheck if the system operates normally.

## 1. General Service

### Cautions

1. Only qualified personnel shall attempt to service the heating equipment or controls.
2. Do all checks under the check items on pages 11 and 12 when replacing the RA890F or restoring power to the system after shutdown in safety.
3. The captive mounting screws carry current. Be sure to disconnect power before loosening or tightening the mounting screws.
4. On each service call, check the controllers for approximately correct calibration and differential, and ensure that they are mounted securely.
5. Never use oil on any part of the RA890F.
6. When cleaning the burner, clean the flame detector as well.
7. Do not push the internal relays of the RA890F manually. This may damage the relays, and it is an unsafe practice because it overrides the protective features of the relay.

## 2. Periodic Maintenance

The specific maintenance schedule setup will depend on a number of factors, including types of equipment being controlled, operating conditions (dirt and heat especially), the cost of a nuisance shutdown, etc.

- (1) Perform a pilot turndown test whenever the burner is serviced, and at least annually.
- (2) Perform a burner shutdown check at least monthly.
- (3) Inspect and clean the flame detector and any viewing windows as often as required by soot accumulation and heat conditions at the detector.
- (4) Do a flame current check at least monthly and more often where a shutdown may be costly.

## 3. Troubleshooting

If trouble occurs in the heating system and its cause is not immediately apparent, the service technician can apply the following step-by-step checkout to locate the cause of most problems. Refer to Figs. 4 and 5 for terminal locations.

- (1) Set the controller not to call for heat.
- (2) Reset the safety switch for the protectorelay by pushing it.
- (3) Close the line switch.
- (4) Check for the line voltage between the terminals ② and ⑥. (The voltage will be zero if a line voltage controller is used. Check for the line voltage when the controller is set to call for heat.)
  - ① The voltage must be within +10 to -15% of the rated voltage.
  - ② If the voltage is zero (with the controller connected to the terminals ① and ②), check if the limit switch contacts are closed, and power is supplied. Check for blown fuses, open circuit or open disconnect switch.

### Caution

Use utmost care while troubleshooting the RA890F since the line voltage can be present on most terminals when power is on.

## 4. Flame Status Check

- (1) If the flame relay is not excited, proceed to step 5.
- (2) If the flame relay is excited, check for a flame simulation condition.
  - Disconnect the wiring to the flame detector.
    - ① If the flame relay is excited, replace the RA890F.
    - ② If the flame relay is not excited, the flame detector or external circuit is defective. Check them.

## 5. Set the Controller to Call for Heat.

If the controller is connected to the terminal ⑥ line, go back to steps ③ and ④.

## 6. Check if the Load Relay is Excited.

- (1) When the load relay is excited to light the pilot and start the burners, proceed to step 10.
- (2) If the load relay is not excited, proceed to step 7.
- (3) If the load relay is excited, but the pilot doesn't light, or the burner doesn't start, proceed to step 9.

7. Check the line voltage controller and limit switch for proper operation if the line voltage controller is connected to the terminal ⑥. If the load relay is not excited, turn ON the controller and check the voltage between the terminals ② and ⑥ again.

Replace the RA890F if the load relay is not excited still, although the rated voltage is obtained there. If a low voltage controller is used, proceed to step 8.

8. Check the low voltage controller, if used, for proper operation.

- (1) When the load relay is excited with the terminals ① and ② jumpered, check the low voltage controller and external connection circuit.
- (2) If the load relay is not excited with the terminals ① and ② jumpered, replace the RA890F.

9. If the load relay is excited, but the pilot won't light or the burner won't start, check the voltage at the terminals ②-③ or ②-④.

- (1) If no voltage is obtained at the terminals ②-③ or ②-④, replace the RA890F.
- (2) If the normal line voltage is obtained at the terminals ②-③ and ②-④, check the external circuits of the burner, ignition transformer and fuel valve. Check the wiring, burner adjustment, ignition system including the electrode spacing and location, oil quality, character and efficiency of oil atomization, fuel supply pressure, flame pattern, flame character and quality, pilot burner location with respect to main burner, flame detector, or other conditions that may delay ignition.

#### Flame Detecting Function

10. Observe the flame relay (right-hand relay) for excitation when the burner is lighted.

- (1) When the flame relay is excited, proceed to step 12.
- (2) When the flame relay is not excited, proceed to step 11.

11. Check the flame relay with a 123514A flame simulator, if available, or in the following procedure:

- (1) Check the flame current (refer to pages 9 and 10.)
- (2) If the flame current is satisfactory, replace the RA890F.
- (3) If the flame current is not satisfactory, check for all the items listed on pages 9 and 10.

#### Observation of Sequencing Operation

12. Observe the operation of the main fuel valve when the flame relay is excited. If the main fuel valve does not open, check the voltage at the terminals ②-⑤.

- (1) When the normal voltage is obtained, check the main fuel valve and valve circuit.
- (2) If the normal voltage is not obtained, replace the RA890F.

13. Check if sparks are cut off when the flame relay is excited, if the ignition transformer is connected to the terminal ④. Check if the wiring is proper. If sparks remain, replace the RA890F.

#### Miscellaneous Problems

##### 14. Relay Chattering

Load relay chattering may result from the extreme low power supply voltage (check the power supply voltage) or from a loose terminal connection (retighten).

Flame relay chattering may result from improper combustion (adjust the burner) or soot or carbon on the viewing part of the flame detector (clean).

##### 15. Repeated Lockout or Control Failure

The most common causes of repeated failures of the controller or flame detector, or repeated lockouts are:

- ① High ambient temperature (for the allowable range, refer to the specifications).
- ② Supply voltage variation greater than +10 to -15% of the rating.
- ③ Electrical overloading of the contacts
- ④ Marginal flame current value
- ⑤ Frequent start/stop operations at high ambient temperature

##### 16. Loose Terminal Screw

If faulty operation has occurred, check if there is a loose terminal screw.

# 7.

# SPECIFICATIONS

## Protectorelay:

Type No.	Rated Power Voltage	Frequency	Timing (at normal temperature, normal humidity, and rated voltage)			Operation against Flame Failure	Flame Detector used
			Selfcheck at start	Lockout	Flame response (at flame current of 2 $\mu$ A)		
RA890F1460x2	100 Vac	50–60 Hz	Approx. 3 s on reference condition. *1	Approx. 15 s	0.8 s	Recycle	Flame rod C 7007 A C 7008 A Ultra-vision C 7012 A *2
RA890F1411x2	100 Vac	50–60 Hz			3 $\pm$ 1 s		
RA890F1452x2	208 Vac	50–60 Hz			0.8 s		
RA890F1296x2	208 Vac	50–60 Hz			3 $\pm$ 1 s		

\*1 At rated voltage and ambient temperature of -20 to +40°C → approx. 20 to 3 s.

\*2 Discontinuation date: March 2012.

Adaptable equipment: Batch operation combustion equipment up to 700 kW in combustion rate  
 Object fuel: Combustion gas or oil (up to 700 kW in combustion rate)

### Contact ratings:

Terminal	Load	Contact rating
3*	Pilot valve	200 VA
4	Ignition transformer	300 VA
5	Main valve/Second-stage valve	200 VA
NC, NO, COM	Alarm	75 VA
T1, T2	Control circuit	0.17 A

\*: In case the burner motor and pilot valve are connected to the terminal ③.

Terminal	Load	Contact rating	
		100 Vac	200 Vac
3*	Burner motor	Normal	5.2 A
		Start	31.2 A
	Pilot valve	25 VA	25 VA

Flame current measuring test jack: Provided  
 Power consumption: 50 Hz–8.5 W (17.0 VA) max.  
 60 Hz–7.0 W (13.0 VA) max.

Allowable voltage: 85 to 110% of rated voltage  
 Allowable ambient temperature: -20 to +41°C (50 Hz), 45°C (60 Hz)  
 Allowable ambient humidity: 90% max. at 40°C  
 Dielectric strength: 1500 Vac for 1 min between terminals ②, ③, ④, ⑤ and case  
 Vibration resistance: 4.9 m/s<sup>2</sup> (2h in each direction of X, Y, and Z)  
 Mass: 1.24 kg  
 Cover coat color: Gray enamel  
 Mounting of main unit: Mounted on the Q270A subbase with terminal screws.  
 The Q270A is available at option.  
 External dimensions: Refer to Fig. 1.  
 Mounting dimensions: Refer to Fig. 2.  
 Accessories: Receptacle for alarm terminals } 3 pcs each  
 Insulating sleeves }  
 Auxiliary equipment: (Option)  
 Q270A1024 ..... Subbase  
 123514A..... Flame simulator  
 FSP136A100 ....Analog flame meter

**azbil**

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*Specifications are subject to change without notice.* (09)

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