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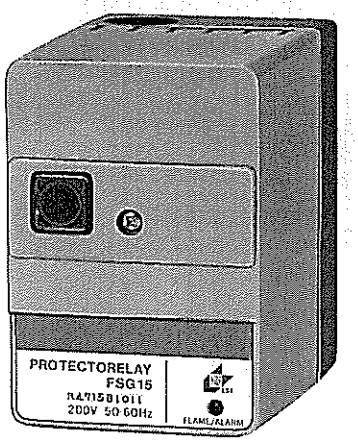
AI-1186E

The R4715B and C are Protectorelay designed for small and medium gas-fired combustion equipment with a maximum capacity of 175 kW. They are constructed of reliable components to ensure that the combustion equipment operates without fail in the correct sequence.

- Compact size and easy plug-in mounting.
- R4715B/C use custom LSI chip to improve performance.
- FLAME/ALARM indicator LED enables easy combustion equipment checks.
- Safe-start feature prevents start if a flame or flame simulating condition is present.
- On the R4715B safety switch lockout will occur on (1) failure to ignite pilot or main flame, (2) loss of flame while burner is running.
- R4715C will recycle once through prepurge if the flame goes out while the burner is running. If the pilot flame is not re-established, the safety switch will trip and lock out the system.
- If the safety switch is tripped, it must be manually reset to restore operation.

R4715B/C



PROTECTORELAY

RESTRICTIONS ON USE

This product has been designed, developed and manufactured for general-purpose application in machinery and equipment.
Accordingly, when used in applications outlined below, special care should be taken to implement a fail-safe and/or redundant design concept as well as a periodic maintenance program.

- Safety devices for plant worker protection
- Start/stop control devices for transportation and material handling machines
- Aeronautical/aerospace machines
- Control devices for nuclear reactors

Never use this product in applications where human safety may be put at risk.

SPECIFICATIONS

PROTECTORELAY:

Model No.	Voltage	Frequency	Sequence (under normal temperature, normal humidity, and rated voltage)				
			Prepurge	Trial for ignition	Post-ignition	Lockout	Flame response
R4715B1003-1	100 VAC	50 to 60 Hz	15 ± 4 s	4 ± 1 s	11 ± 4 s	Max. 23 s	1.5 ± 0.5 s (At 2 μA flame current)
R4715B1011-1	200 VAC						
R4715C1001	100 VAC			10 ± 3 s	1.2 ± 0.5 s		Max. 0.8 s (At 2 μA flame current)
R4715C1019	200 VAC						

Loss of flame while burner is running: R4715B locks out; R4715C recycles

CONTACT RATINGS:

Terminal	Load	Contact rating
10	Fan motor	120 VAC, 2A 240 VAC, 1A
9	Ignition transformer	250 VA
5	Pilot valve	100 VA
1	Main valve	100 VA
8	Alarm	75 VA

FLAME/ALARM INDICATOR LED:
Lit ..... Normal combustion
Flash ..... Ignition failure loss of flame while burner is running, or false flame signal at start-up

FLAME DETECTION SYSTEM:
Rectification type flame rod (C7007A/C7008A)

STANDARD FLAME CURRENT: 2 to 6 μA

RECOMMENDED FLAME ROD WIRE:
JAN standard (U.S. Joint Army-Navy Specifications) RG1IU

INDUCTIVE LIGHTNING SURGE RESISTANCE:
10 kV, 1.2/50 μs
(JEC-212, surge impedance: 75Ω minimum)
Install a surge absorber between one side of the power supply (terminal ⑦ side) and ground.

RECOMMENDED SURGE ABSORBER:
Type No. 83968019-001
(must be ordered separately)

POWER CONSUMPTION: 5W + 25% max.

ALLOWABLE VOLTAGE: 85 to 110% of rated voltage

ALLOWABLE AMBIENT TEMPERATURE:
-20 to +60°C

ALLOWABLE AMBIENT HUMIDITY:
90% RH (at 40°C)

COVER COLOR: Light gray

EXTERNAL DIMENSIONS: See Fig. 1

SUBBASE MOUNTING DIMENSIONS: See Fig. 2

MOUNTING:
Plug-in to subbase provided

MASS: Approx. 0.5 kg

Protectorelay

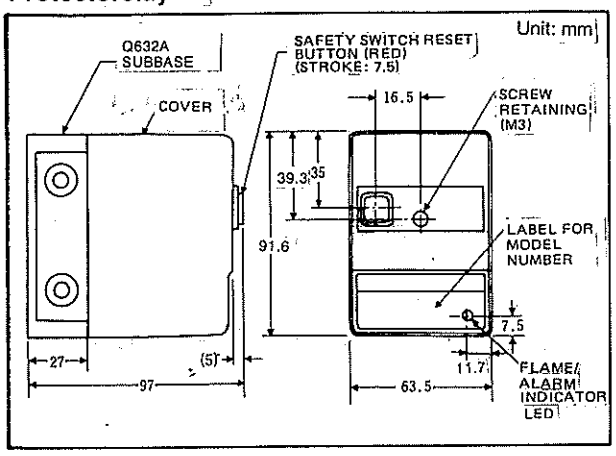


Fig. 1 External dimensions

Subbase: Q632A

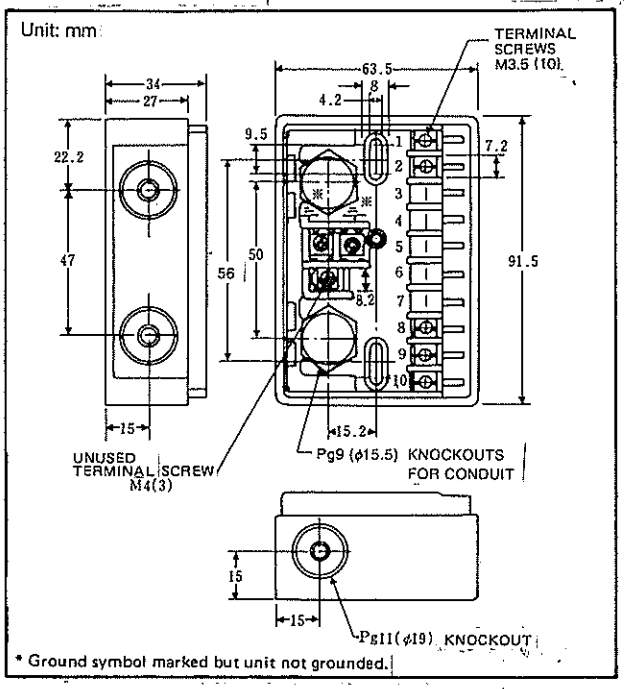


Fig. 2 Subbase mounting dimensions

Caution

(1) Because the Protectorelay is designed to ensure the safe operation of combustion equipment, it has an extremely important function and should be used correctly in accordance with this instruction manual.

(2) Installer must be a trained, experienced, flame safe guard control service technician.

INSTALLATION AND WIRING

Caution

(1) Absolutely avoid the following location:
① Places where there are special chemicals or corrosive gases (ammonia, sulfur, chlorine, ethylene compounds, acids, etc.).
② Places exposed to water droplets or excessive humidity.
③ Places exposed to high temperatures.
④ Places subjected to prolonged vibration.

(2) Perform installation and wiring in accordance with this manual or the instruction manual provided by the set maker (boiler maker, etc.).

(3) Perform all wiring in accordance with the specified standards.

(4) Connect the power wiring last in order to prevent electric shock or damage. If the power wiring accidentally touches another terminal, there is a risk of an accident or damage.

(5) Ensure that the loads connected to the respective terminals do not exceed the rated loads.

(6) Supply the same voltage and frequency as those indicated on the label of the Protectorelay.
(7) If necessary, select reliable timers, auxiliary relays, etc., to provide additional functions, and connect them correctly to the circuit.
(8) Be sure to ground the casing of the burner to an Earth of less than 100Ω.
(9) Do not run electrical power wiring and high voltage cables for the ignition transformer together with the flame rod wiring (do not bunch together or run in the same conduit). In particular, wire high voltage cables independently, and keep them al least 10 cm from the Protectorelay.
(10) Connect the high voltage cable to the ignition transformer properly, ensuring that there are no faulty contacts. If there is improper contact, radio frequency waves may be emitted, resulting in radio interference and possible misoperation. Also, directly mount the ignition transformer to the burner mount, or to a metal portion which is electrically connected to the burner.
(11) After wiring up the Protectorelay, be sure to check the wiring to see whether or not it is correct. Erroneous wiring may result in damage or misoperation.

1. Installation

The standard way to install the Protectorelay is vertically upright, as shown in the right hand portion of Fig. 1. However, as long as the reset button of the safety switch is not facing downwards, it is permissible to mount the Protectorelay in any direction.

2. Removing relay and subbase

(1) Slightly slacken the cover retaining screw shown in Fig. 1 until the screw head comes out about 2 mm high from the cover surface.
(2) Grasp the subbase and cover with the left and right hands, respectively, and separate them left and right, being careful not to apply unreasonable force.
(3) Perform installation in the reverse sequence to the above.

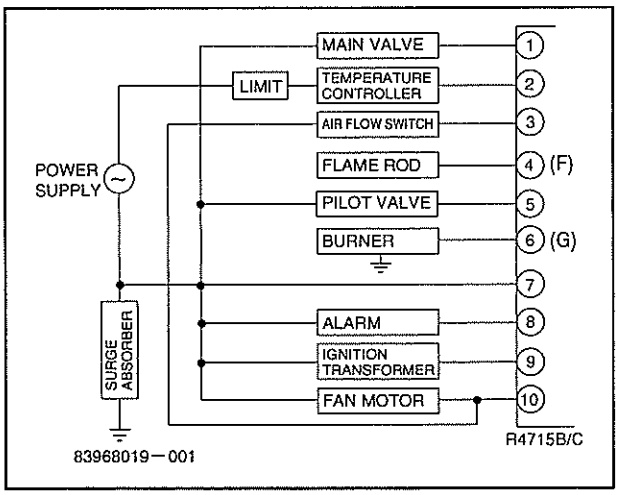


Fig. 3 Example of wiring to external equipment

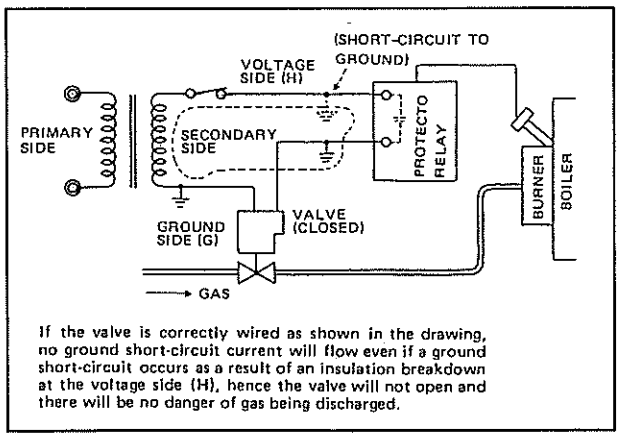


Fig. 4 Wiring between power supply and valve (when main supply has voltage and ground side)

3. Installing subbase

(1) As necessary, open the conduit knockout holes shown in Fig. 2, and install a wiring conduit.
(2) Fix the subbase at the specified position with mounting screws, taking care not to apply unreasonable force.

4. Wiring to subbase

(1) Fig. 2 shows the layout of the terminals of the subbase, and Fig. 3 shows an example of wiring between the subbase and external equipment.
(2) When the power source has a voltage side (H) and a ground side (G), connect the voltage side to terminal ② and the ground side to terminal ⑦. Wire the valve while referring to Fig. 4.
(3) Because the relay is installed using a plug-in method, be careful that the wiring does not interfere with the installation of the relay.
(4) Check to ensure that there is no incorrect wiring, then plug the relay into the subbase, and tighten the cover retaining screw.
(5) When using a surge absorber, connect a wire between terminal ⑦ and ground, as shown in Fig. 6 (1) and (2). Because the mounting bracket of the surge absorber is crimped with the ground side of surge absorber internally to provide electrical continuity, the surge absorber can be grounded by simply installing it on a grounded metal portion, such as the boiler, etc. Also, use wire of at least 0.75 mm^2 of JIS C 3306 (wire diameter 0.18 mm, number of strands 30) for connecting the surge absorber to the power supply. Fit a #187 faston receptacle at one end and keep the length of the wire as short as possible.

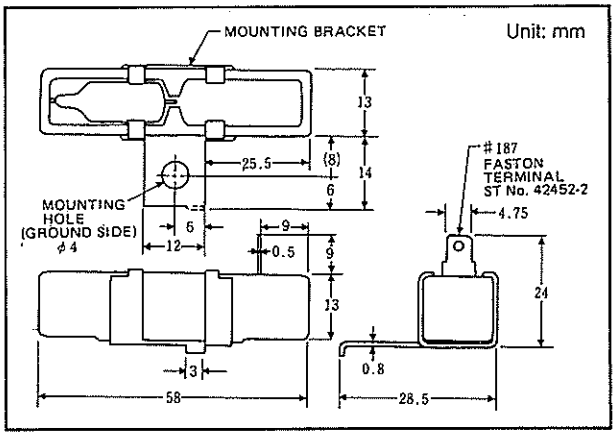


Fig. 5 External dimensions of surge absorber

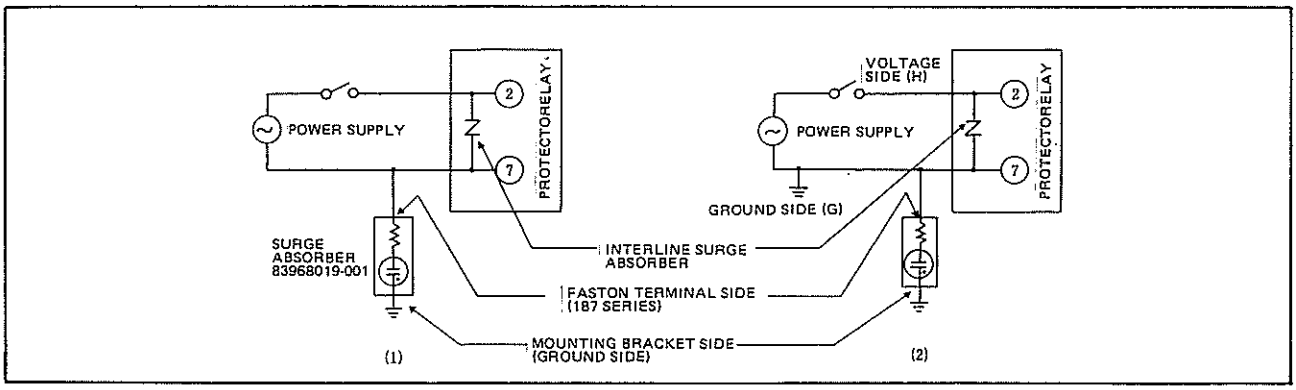


Fig. 6 Wiring of surge absorber

OPERATION

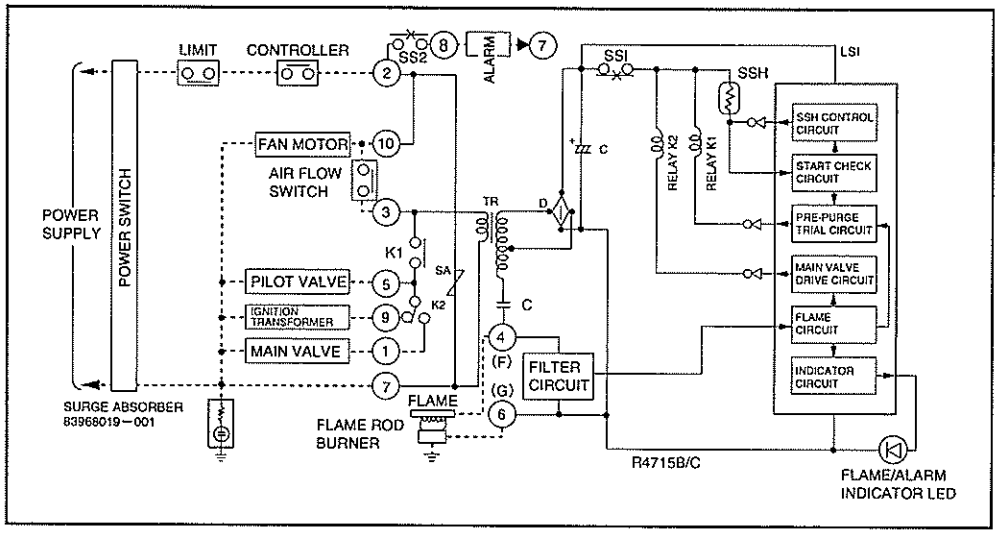


Fig. 7 Example of wiring to external equipment and internal block diagram

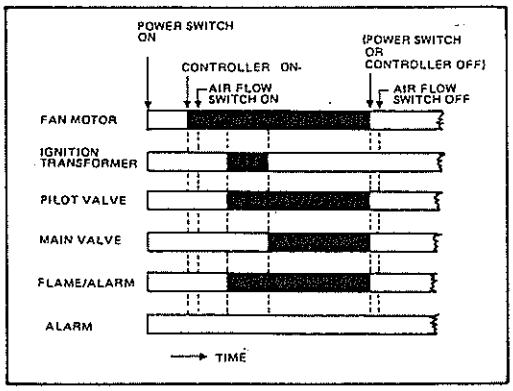


Fig. 8 Normal operation

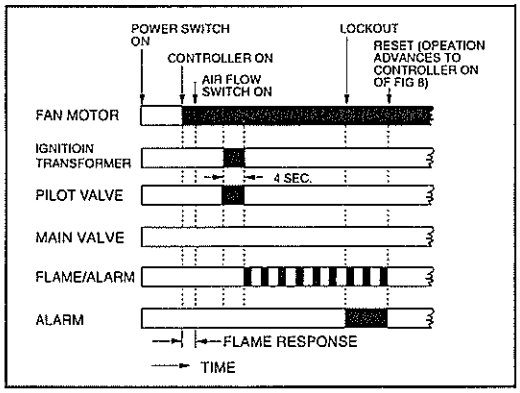


Fig. 9 Failure to ignite the pilot

1. Normal operation (see Figs. 7 and 8)

Power switch and controller	Operation of R4715B and C	Operation of device
Power switch ON, controller ON	Power voltage is supplied between terminals ② ⑩ ③ and ⑦. (Voltage is applied to terminal ③ after air flow switch goes ON.)	Fan motor starts. Air flow switch ON.
	The LSI start check circuit confirms that there is no false flame signal, then the prepurge trial circuit operates (prepurge timing).	
	Upon completion of prepurge timing, relay K1 is energized. Contacts K1 "close". Power supply voltage appears between terminals ⑤ ⑨ and ⑦.	Start of ignition operation Pilot valve open.
	When flame detector (flame rod) detects flame during ignition trial timing, the LSI flame circuit will operate.	FLAME/ALARM indicator LED lights.
	Upon completion of postignition timing, the main valve drive circuit of LSI will operate, causing relay K2 to be energized. Contact of K2 will switch over to terminal ① side.	Ignition operation stops. Main valve open.
Power switch OFF or controller OFF	Relays K1 and K2 will be de-energized, contacts K1 will "open", and contact of K2 will switch over to terminal ⑨ side.	Fan motor stops. Pilot valve close. Main valve close. FLAME/ALARM indicator LED will go out. Air flow switch OFF.
	All circuits return to initial condition in readiness for next ON signal.	

2. Failure to ignite the pilot (see Fig. 9)

If the flame detector does not detect a flame within the ignition trial timing (relay K1 will be de-energized, and contacts K1 will "open"). At the same time, the SSH control circuit of LSI will operate causing the FLAME/ALARM indicator LED to flash. After the lockout timing, the equipment will be locked out. However, the fan motor will rotate continuously, contacts SS2 "close" (contacts SS1 "open"), and an alarm will be emitted. In this case, the flashing of the indicator LED and the sounding of the alarm will continue until the system is reset. To restart the system, reset it by the reset button.

3. Flame failure during burner is running (see Fig. 10)

If flame failure occurs during normal combustion after ignition operation stops and the main valve goes "open" the pilot valve and the main valve will "close" after flame response time (relays K1 and K2 will become de-energized, contacts K1 will "open", and the contact of K2 will switch over to terminal 9 side). Also, in the case of the R4715B, the LSI SSH control circuit and indicator circuit will operate causing the FLAME/ALARM indicator LED to flash and the equipment to lock out after the lockout timing. Subsequent operation is the same as the description of ignition failure in the above item 2. In the case of the R4715C, operation will recycle once through prepurge.

4. Operation when false flame signal is generated

(1) When a flase flame signal is generated continuously from prepurge (see Fig. 11 (1)):
When the fan motor starts and the air flow switch goes ON, the LSI flame circuit, indicator circuit and SSH control circuit will operate, and the FLAME/ALARM indicator LED will flash. In addition, when the false flame signal continues to be emitted after the lockout timing, the R4715 will be locked out. Subsequently, operation is the same as described in "ignition failure" in the above Item 2.

(2) When a false flame signal is generated from the start of operation, and stops within prepurge timing (see Fig. 11 (2)):
The flash of the FLAME/ALARM indicator will stop and the system will move to the normal sequence (prepurge operation) from that point in time. (The pregurge timing is counted from the start of operation.

(3) When a false flame signal is generated during prepurging, and continues even after the prepurge timing (see Fig. 11 (3)):
When a false flame signal is emitted, the FLAME/ALARM indicator LED will flash, and after the lockout timing, R4715 will be locked out. Subsequent operation is the same as described in "ignition failure" in the above Item 2.

(4) When a false flame signal is generated during prepurging, and stops within the prepurge timing (see Fig. 11 (4)):
The FLAME/ALARM indicator LED will flash while the false flame signal is being generated. However, the system will continue to advance toward the normal sequence.

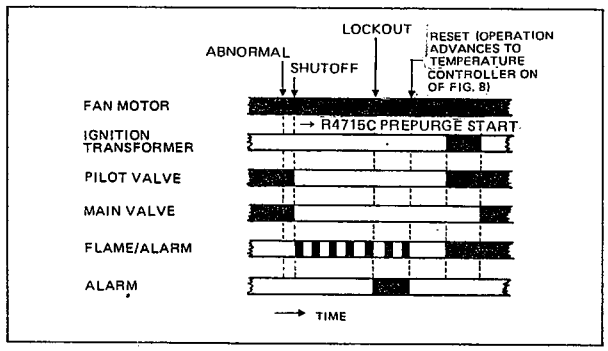


Fig. 10. Flame failure during burner is running

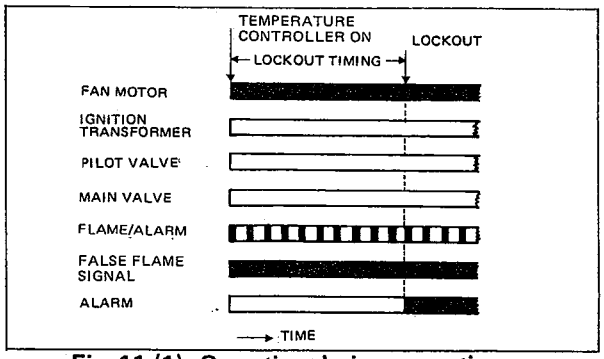


Fig. 11 (1) Operation during generation of false flame signal

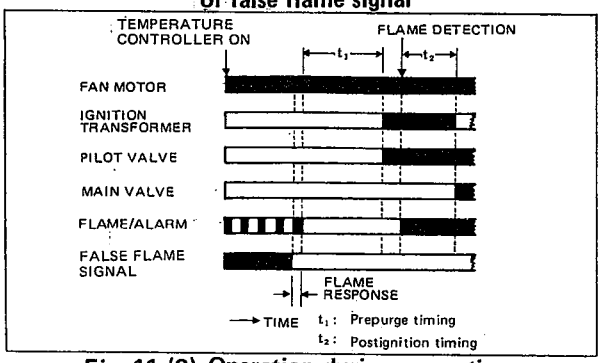


Fig. 11 (2) Operation during generation of false flame signal

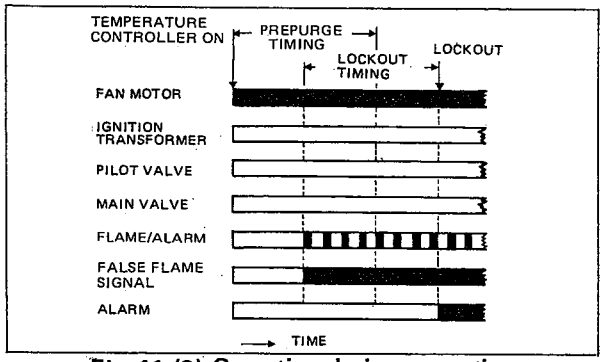


Fig. 11 (3) Operation during generation of false flame signal

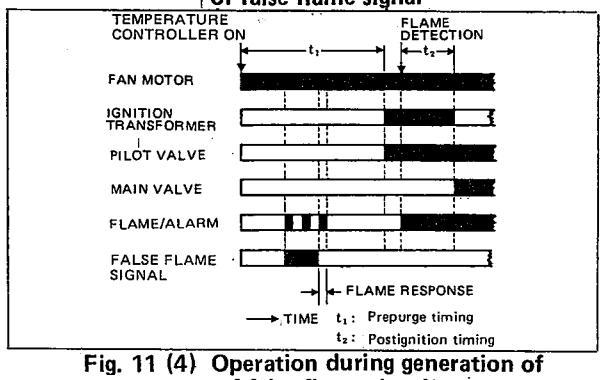


Fig. 11 (4) Operation during generation of of false flame signal

Caution If a lockout occurs, it means that there is a fault in some portion of the overall system containing the combustion equipment. It is therefore necessary to carefully inspect the system and remove the cause of the fault.

INSPECTION AND ADJUSTMENTS

Caution

Be very careful when performing inspection or adjustment because the supply voltage is applied to almost all terminals, creating a dangerous situation. In particular, switch off the power before disconnecting or connecting wiring. When checking the flame current, do not touch the flame rod because 220 VAC will appear across terminals ④ and ⑥.

1. Preliminary inspection

Perform the following checks:

(1) The ambient temperature and humidity should be within the allowable ranges.
(2) All wiring should be correct and there should be no loose terminals.
(3) The flame detector should be correctly installed. (Refer to the instruction manual of the flame detector regarding the mounting position, direction, etc.)
(4) The burner should be correctly adjusted.
(5) There should be no obstacle in front of the combustion air intake or exhaust outlet.
(6) The power supply voltage and frequency should correspond to the indication on the equipment.
(7) The safety switch of the Protectorelay should be reset. (Push the red reset button on the front of the Protectorelay.)

2. Inspection procedure

Carefully perform the following checks and adjustments to ensure that the combustion equipment operates safely:

(1) Checking flame current

Checking flame current is the best indicator of proper flame detector application. Check the flame current both when installing the flame detector and also during subsequent service. By performing this check at least once a month it is possible to prevent shutdowns due to poor flame signal.

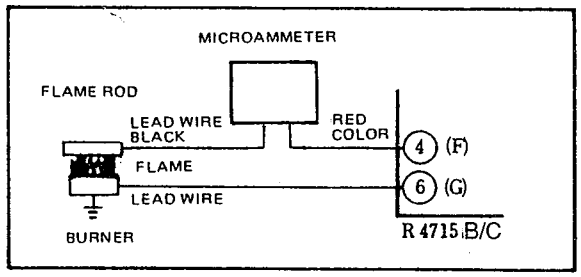


Fig. 12 Method of measuring flame current

Connect a microammeter (W136A, FSP136A or equivalent device) between terminal Ⓕ and the flame rod, as shown in Fig. 12, then operate the burner and read off the flame current. Normally, the flame current is 2 to 6 μA, a value of at least 2 μA being necessary. Also, the flame current must be stable. Confirm that the meter does not fluctuate unduly. If it is not possible to obtain a stable flame current, one or more of the following are conceivable causes, hence they must be carefully checked:

① Power supply voltage and/or frequency is not correct.
② Supply gas pressure and/or air-fuel ratio is not correct.
③ Connection to flame rod and burner is not correct.
- Open circuit condition
- Short-circuit condition
- High resistance short-circuit due to humidity or dirt on lead wires

④ Flame rod improperly installed
- Insufficient flame contact area
- Insertion position of flame rod in flame is incorrect
- Flame rod insulator is hot (315°C or higher)
- Effect of ignition transformer
  If the ignition transformer (8 to 10 KVAC and flame rod (F) (220 VAC) are in proximity to each other, the electrons in the flame will be drawn in the direction of the transformer, preventing an adequate flame current from being obtained.

(2) Pilot turn-down test
This test is used to determine the size of the smallest pilot flame which can positively ignite the main burner. Be sure to measure the flame current both before and after this test, and confirm that it is at least 2 μA.

① Turn off the power switch to stop all equipment.
② Set the main valve to "close" (either disconnect one of the wires going to the main valve or set the manual cock to "close"), to cut off the supply of gas to the main burner. Leave the pilot valve in the normal position.
③ Turn on the power switch. If the temperature controller is ON, the pilot valve will open and also ignition operation will start, after prepurging.
④ After the commencement of combustion by the pilot burner, throttle the pilot valve (manual cock) until the Protectorelay causes the flame failure shutoff action. When the flame is shut off, mark the position of the manual cock. Subsequently, push the reset button to reset the safety switch, and restart the system. Return the manual cock to a position slightly in front of (in the direction of higher gas flow) the previously marked position.
⑤ Turn off the power switch, return the main valve to its normal condition, and then once again turn the switch on . After prepurging, start combustion in the pilot burner, then start combustion in the main burner. If the main burner fails to ignite, immediately turn the power switch off . Such an ignition failure is due to the pilot flame being too small. It is thus necessary to enlarge it. To do this, correct the mounting position of the flame rod by moving it very slightly from the center axis of the pilot flame to the outside.
⑥ After correcting the installation position of the flame rod, once again perform steps ① to ⑤, and check to see whether or not the main burner ignites positively.

Caution:
If it is necessary to perform the above repeatedly, stop the entire system before each try and completely purge the inside of the combustion chamber and exhaust pipe of unburnt gas, in order to prevent an explosion.

(3) Checking safe shut down

① Checking limit operation
If, during operation of the burner, the limit switch on the boiler or burner is forcibly operated by lowering its setting, a safe shut down should occur. After confirming that a safe shut down, restore the initial setting. The burner will then restart.
② Flame failure check
During operation of the burner, close the manual gas cock. In the case of the R4715B, after the flame response time, the pilot valve and main valve should "close", and after the lockout timing, the system will be locked out. In the case of the R4715C, after it will recycle once through prepurge. However, because the manual cock is "closed", the system will be locked out. After confirming that these operation take place, set the manual cock to "open". After the safety switch cools down, push the reset button to reset the system. The burner can now be restarted.
③ Electrical power failure check
While the burner is operating, turn off the power switch to stop combustion, then after a certain period once again turn the power switch on. The burner will then restart.

MAINTENANCE AND INSPECTION

1. General maintenance and inspection

(1) When replacing the R4715B or C, carry out all inspections and adjustments, including the cautions on page 2.
(2) Do not lubricate any part of the R4715B or C under any circumstances.
(3) Remove burnt matter adhering to the flame rod or burner.

2. Frequency of maintenance and inspection

Determine the frequency of maintenance and inspection in view of the kind of equipment used, the conditions existing in the vicinity of the Protectorelay, and the frequency of use, etc. The following is a rough guide.:

(1) Clean the flame rod and burner at least once a year. After cleaning, be sure to perform a pilot turn-down test.

(2) Check the flame failure action of the burner at least once a month.
(3) Measure the flame current at least once a month.

3. Checking in event of breakdown

When checking the cause of a breakdown, it is recommended that the following procedure be adopted:

(1) Open the power switch.
(2) Push the reset button of the Protectorelay to reset the safety switch.
(3) Close the power switch. Check to see whether or not the specified voltage appears across terminals ②, ⑩ and ⑦ at temperature controller ON.
(4) If the voltage is zero, check the contacts of temperature controller, fuse, power switch, supply voltage, etc.
(5) Set so that the temperature controller goes ON. When the temperature controller goes ON, a voltage will appear between terminals ⑩ and ⑦, and the fan motor will start up. Next, proceed to step (7).
(6) If the fan motor does not start, check to see whether or not a voltage appears between terminals ⑩ and ⑦.
  ① If a voltage exists, check the fan motor itself and also the wiring connections to it.
  ② If there is no voltage, check the temperature controller.
(7) Confirm that the air flow switch operates normally.
  ① If the switch operates normally, K1 will operate.
  Then, after the prepurge timing, ignition trial will occur.
  ② If the switch does not operate, turn it ON by adjusting it. If it does not go ON, it is broken and must be replaced.
(8) If the pilot burner does not ignite, check to see whether or not there is a voltage between terminals ⑤ and ⑦ or between terminals ⑨ and ⑦.
  ① If there is a voltage, check the wiring between the pilot valve and terminals ⑤ and ⑦, and also between the ignition transformer and terminals ⑨ and ⑦.
  ② If there is no voltage, the R4750B is broken and must be replaced.
(9) Flame detector function tester
After the pilot ignites, confirm that the flame current is at least 2 μA.
(10) Confirmation of sequence operation
After the pilot burner ignites, confirm the operation of the main valve. If the main valve does not go "open", check to see whether or not there is a voltage between terminals ① and ⑦.
  ① If there is a voltage, check the wiring between the main valve and terminals ① and ⑦.
  ② If there is no voltage, the R4750B or C is broken and must be replaced.
(11) After the pilot burner ignites, confirm that the ignition operation of the ignition transformer stops. If it does not stop, check the wiring between the iginition transformer and terminals ⑨ and ⑦. If the wiring is correct, the R4715B or C is broken and must be replaced.
(12) When there is a false flame signal at start-up; after the temperature controller goes ON, the fan motor will start and the FLAME/ALARM indicator LED will flash. After about 20 seconds the system will be locked out and an alarm will be emitted. In such a case, fan motor will rotate continuously.
  ① Check the flame rod. If it is normal, the R4715B or C is broken and must be replaced.
  ② If the flame rod is defective, replace it with a new one.

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