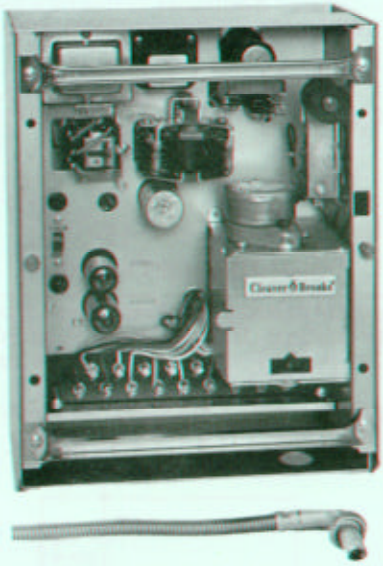
B3475
Supersedes B3870

Bulletin CB-3

System FP-2
using
Type 26RJ8 — Model CB-3



FLAME SAFEGUARD AND PROGRAMMING CONTROL

—for automatic burners

FEATURES:

System FP-2 FLAME SAFEGUARD CONTROL provides ignition and flame failure protection for Industrial sizes of automatically Ignited Oil and Gas Burners. In conjunction with limit and operating controls and interlock devices, they automatically program the operation of Burner/Blower Motor, Ignition, Main Fuel Valves and Modulator.

The control cycles automatically when the operating control circuit closes and following a power interruption, but must be manually reset following a safety shutdown.

Featured are — enforced maximum air flow prepurge, pilot proving prior to energizing the main fuel valve, selectable 10-15-30 second trial for ignition of main flame and a postpurge following fuel shutoff.

A safe start interlock is incorporated which is effective on every start. Any condition which causes the flame relay to be in its energized position during the checking period will cause safety lockout. An interlock circuit is provided for a valve position interlock which proves the main fuel valve closed prior to a start-up. The modulator switching circuit drives the air dampers closed during the off period; open during the purge; to the starting position prior to lightoff; and to automatic control after the main flame is established. Interlock circuits require proof that the dampers are open during the purge and at the starting position during lightoff. An interlock circuit is provided for air flow switches, fuel pressure switches, etc., which must be closed during the prepurge and firing cycle. A safety lockout will occur if this interlock circuit opens during an operating cycle. The control system is designed to de-energize all fuel valves within 1 to 2 seconds following flame failure. An alarm circuit actuates audible or visual alarms following a safety lockout. The control incorporates plug-in design for ease of installation.

Specifications

System FP-2, consisting of Control Type 26RJ8, Model CB-3, and Scanner Type 48PT1.

SUPPLY VOLTAGE:

120 volts (Min. 102v, Max. 132v),
50/60 hz, 1 phase

VOLT-AMPERE RATINGS:

Power consumption: Operating 30va;
Standby 10va
Max. simultaneous connected load: 2000va

MAXIMUM OPERATING TEMPERATURE:

Scanner Type 48PT1 . . . . . 125°F
Control Type 26RJ8 . . . . . ambient, . 125°F

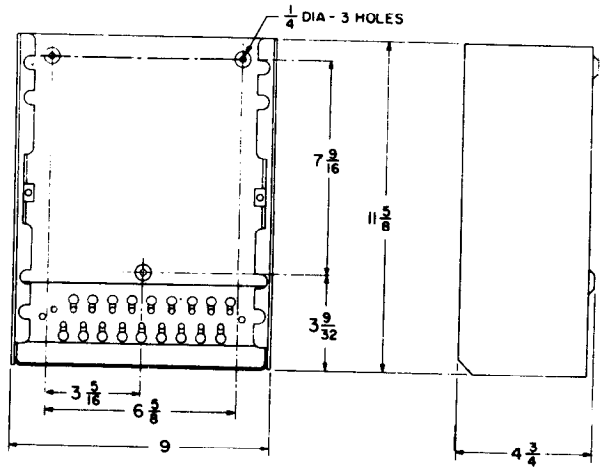
SHIPPING WEIGHT: 22 lbs.

Terminal Ratings (Maximum) for
Type 26RJ8 Control

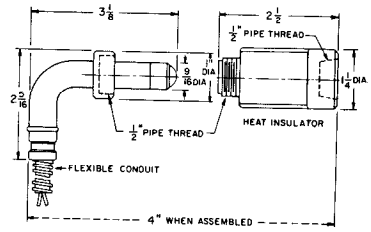
Terminal	Typical Load	Maximum Ratings at 120V 60 Cycles
5-6 Combined	Ignition Transformer	500 Va
	Pilot Valve	125 Va (Pilot Duty)
7	Main Fuel Valve	130 Va (Pilot Duty) (Solenoid) or 460 Va Opening (Motorized)
8	Burner or Blower Motor or Starter	Amperes @ 120 Volts 60 Cycles Full Load 5.8 Locked Rotor 34.8 Alternate: 250 va Pilot Duty
9	Alarm	50 Va (Pilot Duty)
10-11-12-13	Modulator	125 Va (Pilot Duty) or 2 Amps at 30 Volts Max.

Total connected load not to exceed 2000 va.

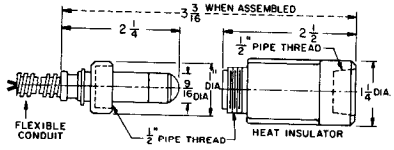
MOUNTING AND OUTLINE DIMENSIONS



MOUNTING FRAME



SCANNER 48PT1-9000



SCANNER 48PT1-1000

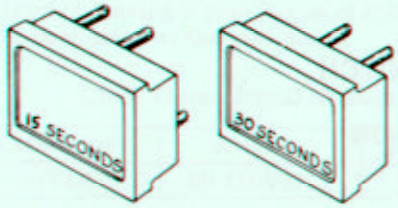
TIMING SEQUENCE: 26RJ8—CB-3

Gas or Oil Proven Pilot
(No connection between terminals 6 and 7)

Timer Rotation (Seconds)	Dial Indications	BURNER STARTUP ACTION
0	0	Operating control closes. Fuel valve interlock closed. Non-recycling relay (RL3) and master relay (RL1) relay energized. Burner motor (terminal 8) energized. Modulator control switches go to high fire position (10-12 opens, 10-13 closes.)
0	0	Purge airflow interlock must be satisfied before timer motor will start.
8	—	Non-recycling interlock circuit (FV-R) must be satisfied for cycle to continue. See Note 1 below.
30	—	Modulator control switches go to low fire position (10-13 opens, 10-12 closes).
35	—	If low fire ignition interlock (W to B) is not satisfied, timer motor stops until interlock is satisfied.
45	1	Ignition and 10 second trial for ignition (terminal 5) on. Selectable 15 second or 30 second trial for ignition (terminal 6) on. See Note 2.
55	2	Fuel valve (terminal 7) on (provided pilot is proven).
65	3	10 second trial for ignition (terminal 5) off.
70	4	Selectable 15 second trial for ignition (terminal 6) off. Modulator control switches go to automatic position. (10-12 open, 10-11 closed).
85	Dot (Index)	Selectable 30 second trial for ignition (terminal 6) off. End of initiating cycle; timer motor stops. Burner operates until heat demand is satisfied.
85	Dot (Index)	Burner Shutdown Action Operating control opens; RL1, RL3, and fuel valve (terminal 7) de-energized. Timer motor energized. Modulator control switches go to low fire position (10-11 open, 10-12 closed).
105	0	Burner motor (terminal 8) circuit and cycle timer motor de-energized.
		System is ready for startup whenever operating control closes again.

NOTES:

1. Non-Recycling relay (RL3) must be energized continuously after 8 seconds in the cycle. If RL3 drops out, lockout and safety shutdown will occur.
2. Selectable trial for ignition plug data:

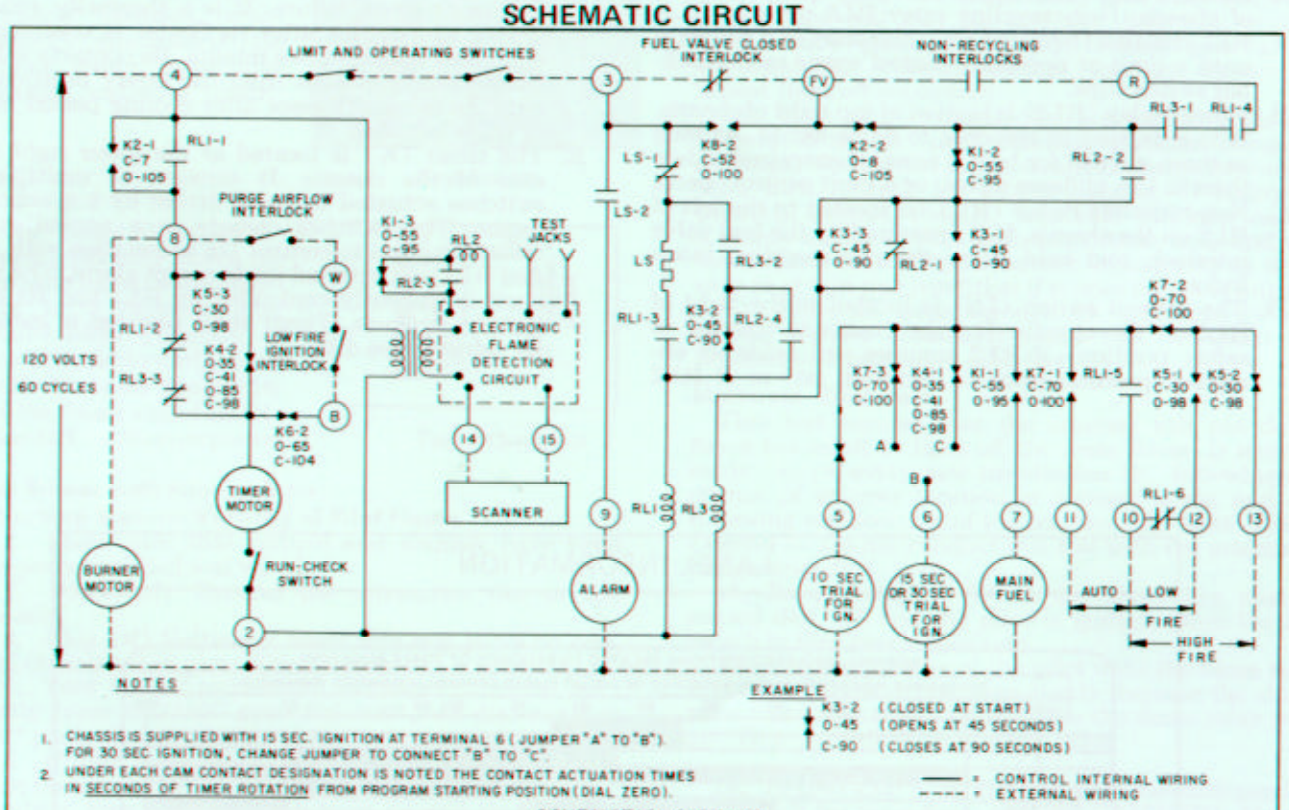


Part No. 61-3045. (15 second T.F.I.) standard on all units.

Part No. 61-3046. (30 second T.F.I.) special — must be ordered separately. Note: not to be used on F.M. applications.

3. The safe start check component feature is part of the non-recycling relay (RL3) circuit. If the flame relay (RL2) should be in an energized position at any time preceding the trial for ignition, RL3 will be de-energized and lockout will occur.

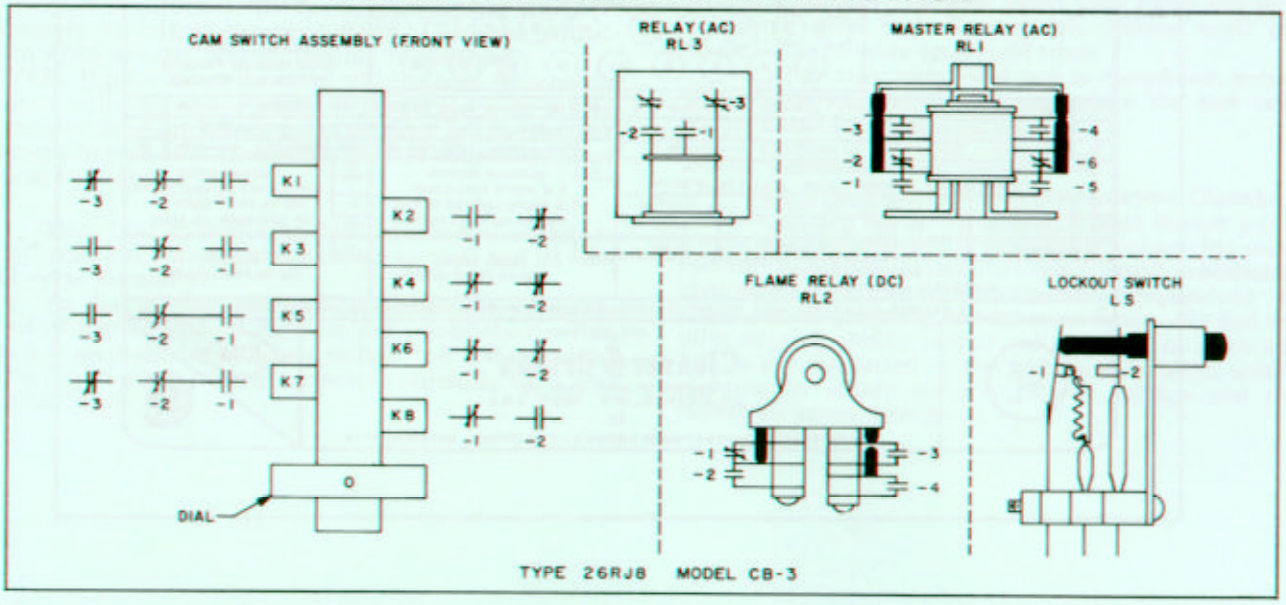
SCHEMATIC CIRCUIT



SCHEMATIC CIRCUIT

TYPE 26RJ8 MODEL CB-3 CODE 35 SCANNER TYPE 48PTI

CAM and RELAY CONTACT IDENTIFICATION



TYPE 26RJ8 MODEL CB-3

RELAY, LOCKOUT SWITCH AND TIMER OPERATION

A. Master Relay (RL1) is located slightly above center of chassis. Non-recycling relay RL3 pulls in RL1. RL1 remains energized from the start of a program until a limit or operating control opens or the lockout switch trips.

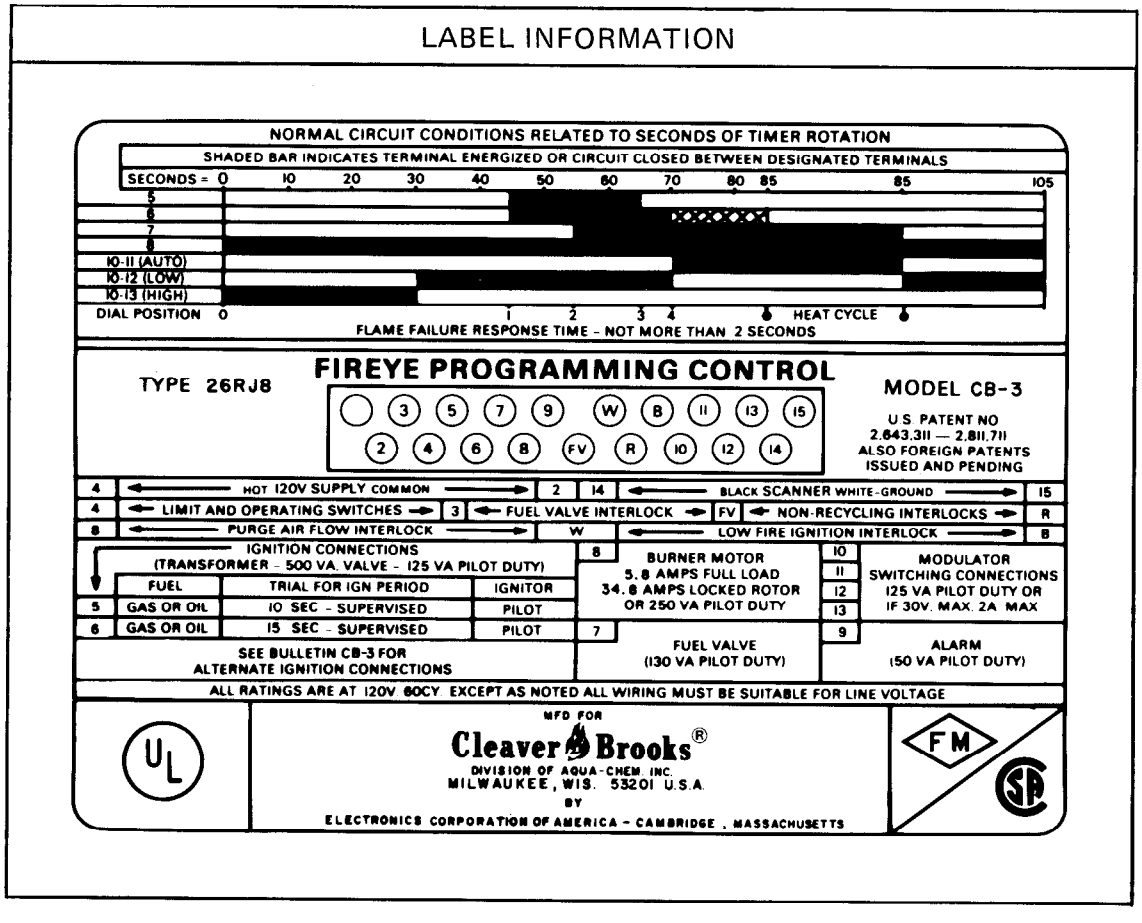
B. Flame Relay (RL2) is located at top right of chassis. It is energized in response to flame signal. As long as there is a call for heat it remains energized unless there is loss of flame signal, or a limit control opens.

C. Non-recycling Relay (RL3) is located to the left of RL2 on the chassis. It is energized by the fuel valve interlock, and held in by the non-recycling interlocks.

D. The lockout switch (LS) is located to the right of RL2 on the chassis. It trips (contacts transfer to safety position) if RL2 assumes and holds its energized position prior to "ignition on" or if RL2 assumes its de-energized position due to ignition failure or flame failure. It is a thermally actuated device which trips after its heater is continuously energized for about one minute. Its contacts will not automatically release from the safety position and must be manually reset after cooling period of two or more minutes.

E. The timer (K) is located at the lower right hand side of the chassis. It consists of multiple-leaf switches actuated by cams driven by a synchonous motor. The switches operate in a non-adjustable timed program to control (in association with RL1, and RL2) all external loads except alarm. The timer itself is variously controlled by RL1 and RL2 and its own contacts. Timer shaft position is indicated by a drum-type dial.

LABEL INFORMATION



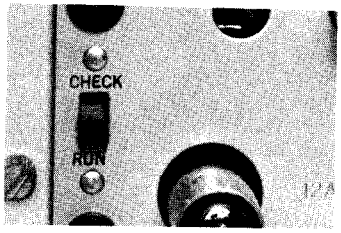
1. Flame Signal Measurement

Flame signal voltage may be measured with a suitable DC voltmeter (having a resistance of at least 1000 ohms per volt) connected at the test jacks.

CB-3 Flame Signal Voltages

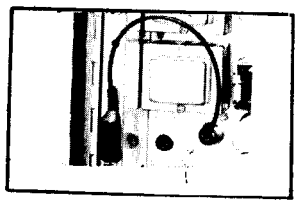
Minimum	Average	Saturation
80VDC	90-110VDC	115

2. Test Switch when in "check" position, electrically disconnects the timer motor, permitting manual control of timer.



Test Switch

3. Flame Signal Attenuator. Directly above the vacuum tubes on the chassis is a recessed pin, which when grounded to the chassis by a clip cord will reduce the sensitivity of the flame signal amplifier 40% for test purposes.



Test Attenuator

For Burner with Pilot Ignition

Checking Scanner Viewing of Pilot Flame

1. Make sure that control and scanner have been properly installed and wired.
2. (Optional) Ground the attenuator pin to the chassis.
3. Plug DC Voltmeter leads into test jacks on control chassis (Red-plus; Black-minus).
4. Turn burner switch on. Let timer progress normally from dial "O" past dial "X". At dial position "1" place the test switch in the "check" position.
5. If pilot flame is not established within 15 seconds turn burner switch off, place the test switch in the "run" position, turn burner switch back on and repeat from step 4. Repeat as necessary until pilot flame is established.
6. Observe reading on voltmeter. Reading should be steady; see chart. If the reading fluctuates, it will be necessary to adjust the pilot flame. Continue adjustment until steady, correct reading is obtained.

NOTE: If pilot is not detected within about 60 seconds, control will lock out, making it inoperative. It will be necessary to allow two or three minutes for the thermal element to cool and to reset the control manually. Then repeat from step 4.

7. Turn burner switch to "off", place test switch in "run" position, return burner switch to "on" and let control cycle normally.
8. As dial reaches position "2" watch for establishment of main flame. If flame is not established within about 5 seconds, turn burner switch "off", then return to "on" and allow control to recycle normally for a new lighting trial.

NOTE: On an initial starting attempt, portions of fuel lines may be empty and require "bleeding" time. It is better to accomplish this with repeated short lighting-trial periods with intervening purge periods than to risk prolonged fuel introduction at a time when burner adjustments have not been completed and the minimum pilot test has not been conducted. Do not repeat unsuccessful lighting attempts without rechecking burner and pilot adjustments if lighting does not occur within 5 seconds after fuel introduction is verified or can be reasonably assumed.

9. When main flame is established, leave burner on and let timer progress until ignition shuts off (dial position 3 or "dot"). If scanner main flame sighting is reasonably good, the flame relay will stay energized, main flame will stay lit, and the timer will progress to dial "dot" position and stop. If flame goes out due to instability without ignition, readjust burner and repeat light-off procedure.
10. With step 9 completed and burner remaining lit with timer at "dot" position, readjust burner as necessary for correct flame size and optimum combustion, then recheck for proper lighting. If scanner is properly sighted, the DC voltmeter will now register a steady signal voltage with pilot flame only and with main flame only. Repeat burner adjustment as necessary to obtain this condition if it does not exist initially.
11. With all steps through 10 satisfactorily completed, remove attenuator connection (if used) and proceed with minimum pilot test.

Minimum Pilot Test

This test assures that the scanner will not detect flame too small to light off the main flame. It must be made (a) on every new installation (b) following any change of scanner location or viewing angle, and (c) following replacement of the scanner cell. Note: 26RJ8 Control — Do not conduct this test with the attenuator pin grounded!

12. Repeat step 4. When the timer has slightly passed dial "1" and the pilot is ignited, place the test switch in the "check" position.
13. Reduce the size of the pilot until the flame relay is observed to drop out, then slowly increase the size of pilot flame just to the point where the flame relay pulls in. This is called minimum pilot.
14. Repeat step 8. When timer reaches dial position "2", watch for main flame to light. CAUTION: If main flame does not ignite in approximately the same time as it did with normal full pilot flame, immediately turn the burner switch off. Realign the scanner sighting tube so that detection requires a larger pilot flame and repeat minimum pilot test. Repeat this process until main flame lights reliably on several trials.
15. After minimum pilot test is completed, increase pilot flame to normal size, and place the test switch in the "run" position.

26RJ8 Control

Checking Detection with Hot Combustion Chamber

With all the foregoing tests and final burner adjustments completed, operate the burner (observing manufacturer's warm-up instructions) until combustion chamber is at maximum expected temperature. Recheck for adequate signal with main flame only and with pilot only. If steady output voltage of 90 or more volts DC is not measured at the test jacks, realign scanner sighting to obtain suitable output voltage and then repeat all steps through 15.

INSTALLATION TESTING (Cont.)

For Burner with Spark Ignition (No Pilot) Checking Scanner Viewing of Main Flame

1. Proceed according to steps 1, 2, and 3 as outlined previously.
2. Turn burner switch on. Master relay will pull in and timer will start.
3. As timer reaches dial position 1, watch for main flame to be established. If flame is not established by the time dial position "2" is reached, turn burner switch off and then on again and allow control to recycle normally.

CAUTION: If fuel is observed to enter combustion chamber and ignition does not occur at once, shut burner switch off and check electrode settings. Do not repeat ignition attempts unless a good spark can be observed in a position where the fuel will be readily ignited.

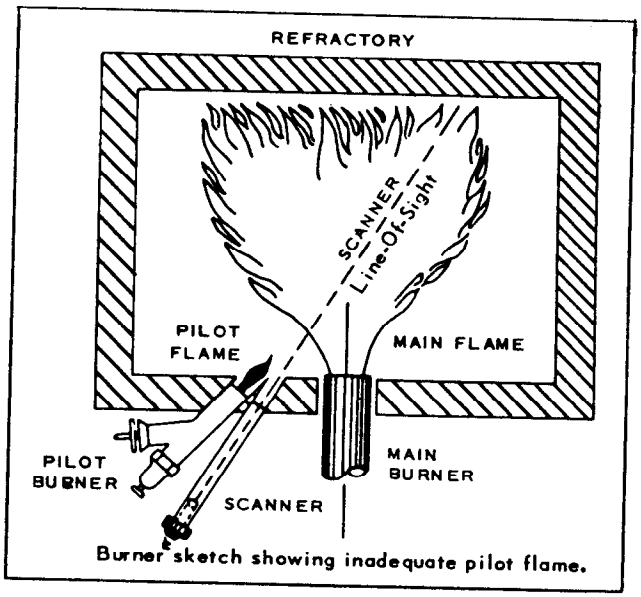
4. If burner ignites and burns properly, DC voltmeter will register a steady signal voltage. If voltmeter registers satisfactorily until ignition shuts off at dial position 3 and then becomes unsteady, readjust burner to obtain stable flame both with and without ignition on.
5. Remove attenuator connection (if used).

Checking Pilot Flame Failure Protection

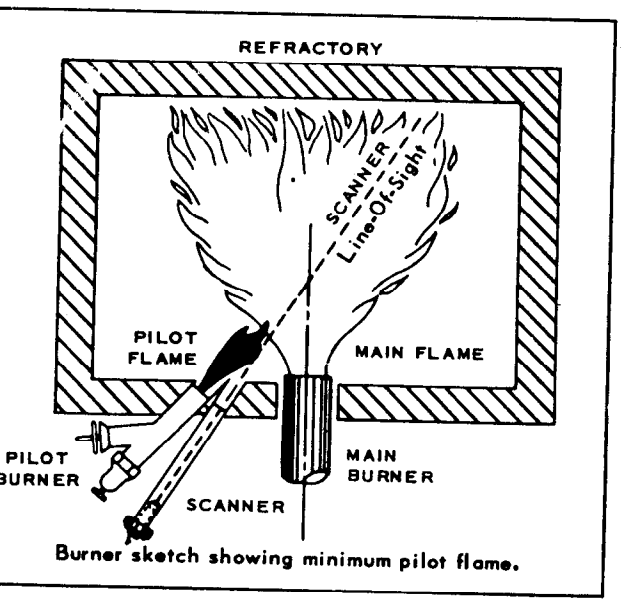
1. Shut off the fuel to the pilot burner.
2. Start the control cycle.
3. After the purge period, the pilot assembly will be energized.
4. Because no pilot flame is detected, the pilot assembly will shut off after 10 seconds. The main fuel valve will not be energized.
5. The programming timer will complete its cycle during which time the lockout switch will trip, effecting a safety lockout and actuating the alarm (if used).

Checking Main Flame Failure Protection

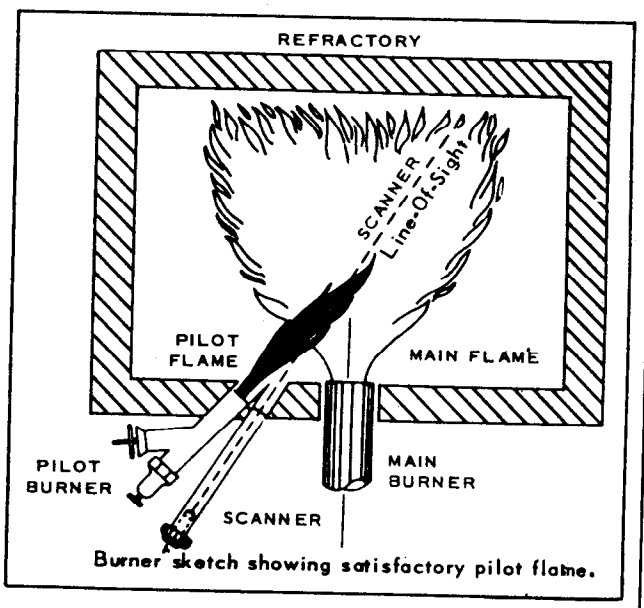
1. Start the burner in the normal manner.
2. After the startup programming has been completed, shut off the main fuel supply.
3. Within 2 seconds after the flame fails, the main fuel valve will close and after approximately 60 seconds, the lockout switch will trip.
4. Following a 15-second post purge or spin-down period, the blower motor will stop, and the alarm circuit will be energized.
5. The lockout switch may be reset after allowing the thermal element to cool (approximately 2 minutes).



Burner sketch showing inadequate pilot flame.



Burner sketch showing minimum pilot flame.



Burner sketch showing satisfactory pilot flame.

Troubles in FP-2 System installations can be readily isolated by following the approved procedure in the sequence given below. Before beginning any troubleshooting, however, make sure that:

1. Installation and wiring have been made in accordance with instructions.
2. Chassis is securely plugged in and thumbscrews tightened; lockout switch is reset.
3. Make sure that voltage source to the control (whether supplied directly from the line or from a control circuit transformer) complies with the voltage and frequency ratings shown on page 1. NOTE: 60 cycle programming controls can be operated from 50 cycle supply if the voltage is within the range specified for 60 cycles, but all program timings will be increased by 20 percent.

TROUBLESHOOTING

In the following tabulation, troubles appear within boxes and possible causes are listed below the boxes.

CONDITION: Zero voltage between terminals 2 and 4.

1. Disconnect Switch Off.
2. Blown fuse.
3. Broken wire.
4. Incorrect wiring.

CONDITION: Zero voltage between terminals 3 and 2.

1. Open limit switch circuit (Pressure, LWCO etc.)
2. Broken wire.
3. Incorrect wiring.

CONDITION: Non-recycling relay (RL3) does not pull in.

1. Fuel valve interlock circuit (3-FV) not closed.
2. Contacts K2-2, K1-2, RL2-1 dirty or open.
3. Supply voltage is too low (see page 1 for rated minimum).
4. RL3 armature may be mechanically stuck open.
5. Timer not at dial O position.
6. Defective programming control or detector.

CONDITION: Master relay (RL-1) does not pull in.

1. Contacts RL3-2, K3-2 dirty or open.
2. Lockout switch tripped.
3. RL1 armature may be mechanically stuck open.
4. Supply voltage is too low.
5. Defective programming control.

CONDITION: Master relay pulls in but burner motor does not start.

1. Insufficient voltage between terminals 2 and 8.
2. Blown motor fuse or motor starter overloads tripped.
3. Burner motor incorrectly wired.
4. Defective motor or starter.
5. Contact RL1-1 dirty or open.

CONDITION: RL1 pulls in but modulator motor does not drive toward open-damper position.

1. Modulator motor not powered.
2. Linkage jammed.
3. Incorrect wiring.
4. Contacts RL1-5, K7-2, K5-2 dirty or open.
5. Contact RL1-6 does not open.
6. Defective modulator equipment.

CONDITION: Timer motor does not start when modulator motor reaches high fire position.

1. Purge airflow interlock circuit (8-W) open.
2. Contact K4-2 dirty or open.

CONDITION: RL3 drops out after 8 seconds.

1. Non-recycling interlock circuit (FV-R) open.
2. Contact RL3-1, RL1-4 dirty or open.

CONDITION: Modulator motor does not drive toward closed-damper position at 30 seconds.

1. Modulator motor not powered.
2. Linkage jammed.
3. Incorrect or faulty wiring.
4. Contacts RL1-5, K7-2, K5-1 dirty or open.

CONDITION: Timer motor stops when modulator motor returns to low fire position.

1. Low fire ignition interlock (W-B) open.
2. Contact K6-2 dirty or open.

CONDITION: RL3 drops out at dial position "1".

1. Momentary or sustained opening of limit circuit (4-3), or interlock circuit (FV-R).
2. Contact K3-3 dirty or open.

CONDITION: Timer dial reaches position "1". Pilot flame is not established.

1. Insufficient voltage between Terminals 2 and 5 or 6.
2. Contacts K3-1, K7-3, K6-1, K4-1 dirty or open.
3. Defective gas valve.
4. Defective ignition transformer or electrode.
5. Improper electrode setting.
6. Plugged pilot burner.
7. Insufficient gas pressure.
8. Improper pilot burner adjustment.
9. Ignition assembly incorrectly wired.
10. Selector plug loose (15 or 30 sec. plug).

CONDITION: Timer dial at position 1. RL1 drops out.

1. LS heater coil open.
2. RL1-3 contact dirty or open.

CONDITION: Flame relay (RL2) does not pull in when pilot flame lights.

1. Pilot flame too small. Make sure gas pressure is not less than that specified for the pilot burner.
2. Scanner sight tube obstructed or scanner lens dirty.
3. Scanner sighting is incorrect.
4. Scanner is incorrectly wired — correct connection is to terminals 14 and 15.
5. Flame relay is mechanically bound or K1-3 dirty or open.
6. Defective Scanner, or cell
7. Defective control.
8. Scanner is too hot or sees hot refractory. Tubes reversed or inoperative.

CONDITION: Timer dial reaches position "2". Main fuel valve stays shut.

1. Insufficient voltage between Terminals 2 and 7.
2. Contacts RL2-2 or K1-1 dirty or open.
3. Defective valve.
4. Incorrect wiring.
5. Pilot flame not detected.

CONDITION: Fuel valve is energized. Main flame does not light.

1. Inadequate pilot.
2. Incorrect burner adjustment.
3. No main fuel.

CONDITION: Main flame lights and then goes out.

1. Lockout switch has tripped. Allow to cool for two minutes and reset.
2. Limit and operating control circuit or non-recycling interlock circuit open.
3. RL2-3 dirty or open.

CONDITION: Safety shutdown initiated at or after dial position "2".

1. Ignition failure.
2. Flame failure.
3. Inadequate flame signal.
4. Non-recycling interlock circuit (FV-R) open.

CONDITION: Timer dial reaches position "3" or "dot" (10 sec. TFI). Pilot flame does not go out.

1. Gas pilot valve is stuck open.
2. Contact K6-1 does not open.
3. Valve incorrectly wired.

CONDITION: Timer dial reaches position "4" (15 second TFI). Pilot flame does not go out.

1. Contact K7-3 does not open.
2. See 10 second TFI above for additional data.

CONDITION: Timer dial reaches position "4" Modulator motor does not respond to modulation controller.

1. Modulator motor not powered.
2. Setting of modulation controller incorrect.
3. Linkage jammed.
4. Incorrect wiring.
5. Contacts K7-1, RL1-5 dirty or open.
6. Defective modulator equipment.
7. Contact RL1-6 does not open.

CONDITION: Main flame goes out when pilot shuts off.

1. Scanner does not "see" main flame.
2. Incorrect burner adjustment.
3. Incorrect wiring to main fuel valve.

CONDITION: Timer does not stop at "dot".

1. Contacts K4-2 or RL1-2 stuck closed.

CONDITION: Timer dial reaches "dot" position (30 second TFI). Pilot flame does not go out.

1. Contact K4-1 does not open.
2. See 10 second TFI above for additional data.

CONDITION: Timer does not rotate to "O" when operating or limit control opens.

1. Contacts RL1-2, RL3-3 or K2-1 dirty or open.
2. Limit switches incorrectly wired.

CONDITION: During post purge period modulator motor does not drive toward damper-closed position.

1. Modulator motor not powered.
2. Linkage jammed.
3. Incorrect wiring.
4. Contacts RL1-6 dirty or open.
5. Defective modulator equipment.

CONDITION: Timer does not stop at "O".

1. Contacts RL1-1 or K2-1 stuck closed.
2. Limit and operating switch circuit closed.

CONDITION: Burner motor does not stop when timer dial reaches "O".

1. Contacts RL1-1 or K2-1 stuck closed.
2. Limit and operating switch circuit closed.
3. Motor starter is mechanically stuck.
4. Motor starter is incorrectly wired.

MAINTENANCE

48PT1 Scanner

Scanner Cell: Estimated life 20,000 hours, when operated within ambient temperature limits. The scanner lens should be cleaned as often as operating conditions demand.

26RJ8 Control

Tubes: Types 12AX7; 12BH7A; have an estimated life of 10,000 hours. Annual replacement recommended.

Humidity Effects: To protect against high resistance leakage in the electronic circuit resulting from high humidity, it is recommended that the 26RJ8 Control be left powered continually even when not in operation. It it is necessary to shut down completely for an extended period, power should be turned on for 48 hours before putting the control back in operation.

Rotation: It is recommended that units purchased as spares be rotated periodically, so that each unit will be placed in operation at least every 90 days.

Contacts: All relay contacts are designed with adequate wiping action for self cleaning under normal conditions. In atmospheres carrying excessive dust or oily vapors, contacts may require occasional cleaning. Use only a burnishing tool or a fine grade of crocus cloth for cleaning. Do not file.

Periodic Safety Check: It is recommended that a procedure be established to test, at least once a month, the complete flame safeguard system. This test should verify flame failure safety shutdown and fuel valve tightness.

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