Honeywell

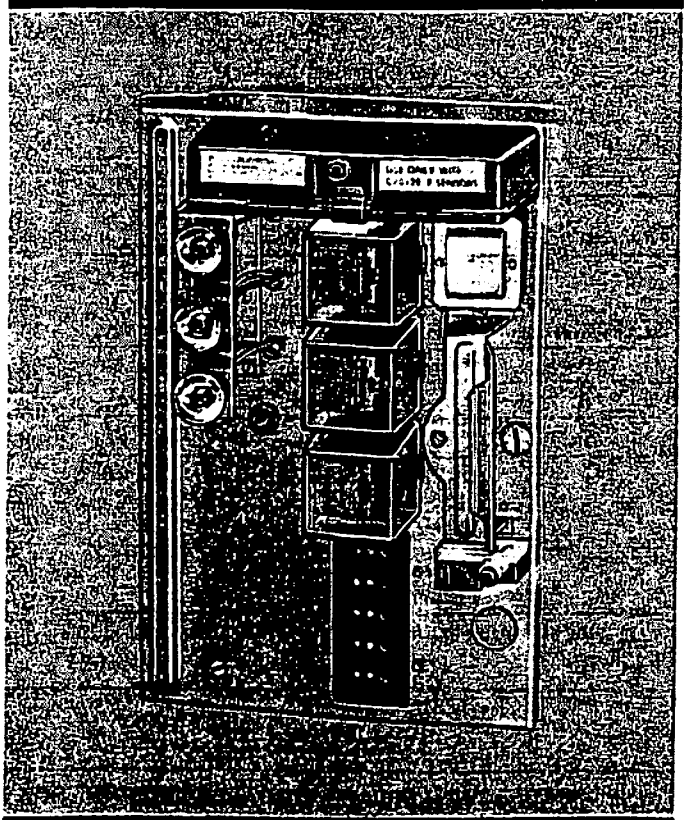
THE R4138C OR D INDUSTRIAL FLAME SAFEGUARD CONTROL IS A PRIMARY CONTROL FOR SUPERVISION OF A LARGE, SEMIAUTOMATIC, CONSTANT-FIRED, INDUSTRIAL BURNER USING GAS, OIL, COAL, OR A COMBINATION OF FUELS. ITS BASIC FUNCTION IS TO DELAY ADMISSION OF FUEL TO THE COMBUSTION CHAMBER UNTIL THE PILOT FLAME HAS BEEN PROVEN AND THEN TO MONITOR THE FLAME THROUGH THE RUN PERIOD.

- ☐ Approvals (120 V models only): Underwriters Laboratories Inc. component recognized, Canadian Standards Association certified, and Factory Mutual approved.
- ☐ Especially suitable where long periods of burner operation without shutdown are normal, such as in heat-treating ovens and kilns.
- ☐ With the plug-in S427D Purge Timer, the R4138 provides a timed purge period prior to the manual start.
- ☐ R4138D has override on momentary power interruptions (up to 1 second) to eliminate nuisance shutdowns during power line switchovers.
- ☐ Optional remote reset assembly allows resetting the lockout switch from a remote location.
- ☐ Solid state, color-coded, plug-in flame signal amplifier capability includes 3 standard models plus 3 Dynamic Self Check models and 1 Dynamic Ampli-Check™ model.
- ☐ Dynamic Self Check amplifier, when used with a rectifying flame rod or C7012E or F Purple Peeper Ultraviolet Flame Detector, tests all electronic components in the flame detection system (amplifier and detector) 60 to 240 times a minute during burner operation and shuts down the burner if the detection system fails.
- ☐ Dynamic Ampli-Check™ amplifier, when used with a C7015A Infrared (lead sulfide) Flame Detector, tests the flame signal amplifier during burner operation and shuts down the burner if the amplifier fails.
- ☐ If a pilot flame (or 1st stage oil flame) is not established, safety shutdown with lockout will occur. The lockout switch will trip, requiring manual reset to restore operation.
- ☐ Incandescent indicator lamps (FLAME OFF, PURGE COMPLETE, FLAME ON) provide a visual check of the system condition.
- ☐ Alarm terminal is available to operate an external, line voltage alarm when the system is shut down.
- ☐ Clear plastic relay covers help prevent contamination, damage, and tampering.
- ☐ R4138 plugs into a subbase or cabinet equipped with quick-connect contacts; easily removed without disconnecting any wiring.
- ☐ R4138C,D directly replaces most older model R4138A,Bs to meet the latest requirements; no change in terminal functions or numbering; no rewiring required for direct replacement.

L.Z.
Rev. 8-91

Form Number 60-2368—4

INDUSTRIAL FLAME SAFEGUARD CONTROLS



R4138C,D

SPECIFICATIONS

IMPORTANT

THE SPECIFICATIONS GIVEN IN THIS PUBLICATION DO NOT INCLUDE NORMAL MANUFACTURING TOLERANCES. THEREFORE, THIS UNIT MAY NOT MATCH THE LISTED SPECIFICATIONS EXACTLY. ALSO, THIS PRODUCT IS TESTED AND CALIBRATED UNDER CLOSELY CONTROLLED CONDITIONS, AND SOME MINOR DIFFERENCES IN PERFORMANCE CAN BE EXPECTED IF THOSE CONDITIONS ARE CHANGED.

MODELS:

R4138C Industrial Flame Safeguard Control. For supervision of large, semiautomatic, constant-fired burners.

R4138D Industrial Flame Safeguard Control. Same as R4138C but with power failure override to prevent shutdown during very short power outages (power line switching approximately 1 second or less).

NOTE: Pilot valve (or 1st stage oil valve) must stay open and flame must stay on for duration of the outage.

ELECTRICAL RATINGS:

Voltage and Frequency—120 V, 50/60 Hz.

Maximum Power Consumption (in watts)—

CONDITION	60 HZ	50 HZ
Standby	13 W	14 W
Running (1K pulled in)	19 W	21 W

Maximum Terminal Ratings—

TERMINAL	TYPICAL LOAD	VOLTAGE	PILOT DUTY RATING
16	Alarm	120 to 240 V	125 VA
16	Alarm	up to 30 V	50 VA[a]
6	Ignition	120 to 240 V	250 VA
19	Pilot Valve, or 1st Stage Oil Valve	120 to 240 V	125 VA
20	Main Fuel Valve(s)	120 to 240 V	250 VA

[a]Allowable inrush can only be 5 times the pilot duty rating.

NOTE: Allowable inrush can be up to 10 times the pilot duty rating (except for the Alarm up to 30 V).

EXAMPLE—Pilot Duty Rating – 125 VA.

At 120 V, running current is

$$\frac{120}{129} = 1.04 \text{ A}$$

Maximum allowable inrush is

10 times 1.04 = 10.4 A

Interlock Ratings—Fan interlock, limits, and miscellaneous interlocks must be able to carry and break current to ignition transformer, pilot valve (or 1st stage oil valve), and main fuel valve(s) simultaneously.

SAFETY FEATURES:

Safe Start Check—for presence of flame, or condition simulating a flame, provided at startup. If flame relay 2K is pulled in before START button is pressed, 2K2 is open, preventing load relay 1K from pulling in. System cannot be started until condition is corrected and 2K drops out.

NOTE: If using a C7012E or F Purple Peeper Ultraviolet Flame Detector (with a self-checking shutter), a Safe Start Check will not be provided with the jumper between terminals 13 and 7 (see Fig. 1, or Figs. 4-9). However, self-checking action will shut down the system if there is a flame-simulating component failure in the flame detection system.

Safety Shutdown with Lockout—occurs if START button is held in longer than lockout switch timing and (1) pilot flame (or 1st stage oil flame) is not established, or (2) a failure exists in the flame detection system (if using a self-checking system—see Table 1). Lockout switch trips and the load relay 1K drops out. Pilot

(continued on next page)

ORDERING INFORMATION

WHEN PURCHASING REPLACEMENT AND MODERNIZATION PRODUCTS FROM YOUR TRADELINE WHOLESALER OR YOUR DISTRIBUTOR, REFER TO THE TRADELINE CATALOG OR PRICE SHEETS FOR COMPLETE ORDERING NUMBER, OR SPECIFY—

1. **Order number.**

ORDER SEPARATELY—

1. **Flame detection system (amplifier and matching flame detector). See Table 1.**
2. **Mounting (1 of the following): Q477A Subbase or Q478A Cabinet (with or without start-stop station).**
3. **S427D Purge Timer. Specify—**
   a. **Desired timing range (8 to 60 seconds, 2 to 15 minutes).**
   b. **120 Volt, 50 or 60 Hz model.**
4. **Remote Reset Assembly, Part No. 118811B, if desired.**
5. **S445A Start-Stop Station, for remote operation.**
6. **Other accessories, if desired.**

IF YOU HAVE ADDITIONAL QUESTIONS, NEED FURTHER INFORMATION, OR WOULD LIKE TO COMMENT ON OUR PRODUCTS OR SERVICES, PLEASE WRITE OR PHONE:

1. **YOUR LOCAL HONEYWELL RESIDENTIAL AND BUILDING CONTROLS DIVISION SALES OFFICE (CHECK WHITE PAGES OF PHONE DIRECTORY).**
2. **RESIDENTIAL AND BUILDING CONTROLS DIVISION CUSTOMER SATISFACTION**
   HONEYWELL INC., 1885 DOUGLAS DRIVE NORTH
   MINNEAPOLIS, MINNESOTA 55422-3992 (612) 542-7500

   (IN CANADA—HONEYWELL CONTROLS LIMITED, 740 ELLESMERE ROAD, SCARBOROUGH, ONTARIO M1P 2V9)
   INTERNATIONAL SALES AND SERVICE OFFICES IN ALL PRINCIPAL CITIES OF THE WORLD.

valve (or 1st stage oil valve) is de-energized, and main fuel valve(s) cannot be energized. If used, external alarm is energized. Lockout switch must be manually reset to restart system.

Safety Shutdown—pilot (or 1st stage oil valve) and main fuel valve(s) are de-energized. If used, external alarm is energized. START button must be manually pressed to restart system.

Safety Shutdown occurs on—

1. failure to ignite pilot (or 1st stage oil burner if using direct spark ignition of oil). Lockout will occur if START button is held in longer than the lockout switch timing.
2. loss of flame during run period.
3. failure in the flame detection system (if a self-checking system is used—see Table 1). Lockout will occur at startup if the failure already exists and START button is held in longer than lockout switch timing.

Flame Failure Response Time—2 to 4 seconds.

Lockout Switch Timing—15 seconds (nominal).

AMBIENT OPERATING TEMPERATURE RATINGS:

Minimum—

— minus 20° F [plus 29° C].

— 0° F [minus 18° C] if using and S427D Purge Timer.

Maximum—

60 Hz: plus 130° F [plus 54° C].

50 Hz: plus 120° F [plus 49° C].

MOUNTING (order separately):

Q477A Subbase for mounting in customer's cabinet.

Q478A Dust-resistant Cabinet, for flush or surface mounting, with locking cover (with or without START-STOP push-button station).

MOUNTING DIMENSIONS: See Figs. 2 and 3 (pages 10 and 11).

WEIGHT (without plug-in flame signal amplifier): 6 lb. 2.7 kg].

FLAME DETECTION SYSTEM (order separately): Plug-in Flame Signal Amplifier and matching Flame Detector, see Table 1.

APPROVALS (120 V models only):

UNDERWRITERS LABORATORIES INC. COMPONENT RECOGNIZED: File No. MP268; Guide No. MCCZ2.

NOTE: All devices meeting UL component recognition bear the following symbol:

CANADIAN STANDARDS ASSOCIATION CERTIFIED: File No. LR95329-1; Guide No. 140-A-2, 300-1-0.2

FACTORY MUTUAL APPROVED: Report No. 24117.

REPLACEMENT PARTS:

Incandescent Indicator Lamp, 120 V—Part No. 118543A, or Sylvania type 120RB.

Door Mounted START-STOP Station—Part No. 122492A.

Locking Cabinet Latch Assembly (with 2 keys)—Part No. 122514.

Nonlocking Cabinet Latch Assembly—Part No. 122515.

Terminal Block Assembly (for a Q477A Subbase or Q478A Cabinet)—Part No. 101173N.

ACCESSORIES:

1. S427D Plug-in Purge Timer; models with adjustable timing—8 to 60 seconds, 2 to 15 seconds or 2 to 15 minutes. Must be mounted vertically; 120 V model required.
2. Remote Reset Assembly, Part No. 118811B, 120 V, 60 Hz; provides capability of resetting lockout switch from a remote location.
3. S445A START-STOP Station; for remote operation.
4. W136A Test Meter (includes 196146 Meter Connector Plug).
5. 196146 Meter Connector Plug (for older W136A models).
6. 123514A Flame Simulator (for use with R7247A Rectification Amplifiers).
7. 123514B Flame Simulator (for use with R7249A Ultraviolet Amplifiers).
8. R4155A Alarm Silencing Relay (available only in a 120 V, 60 Hz model).
9. Q624A Solid State Spark Generator; prevents detection of ignition spark when properly applied with flame detection systems using C7027, C7035, or C7044 Minipeeper Ultraviolet Flame Detectors. For use only with gas pilots.

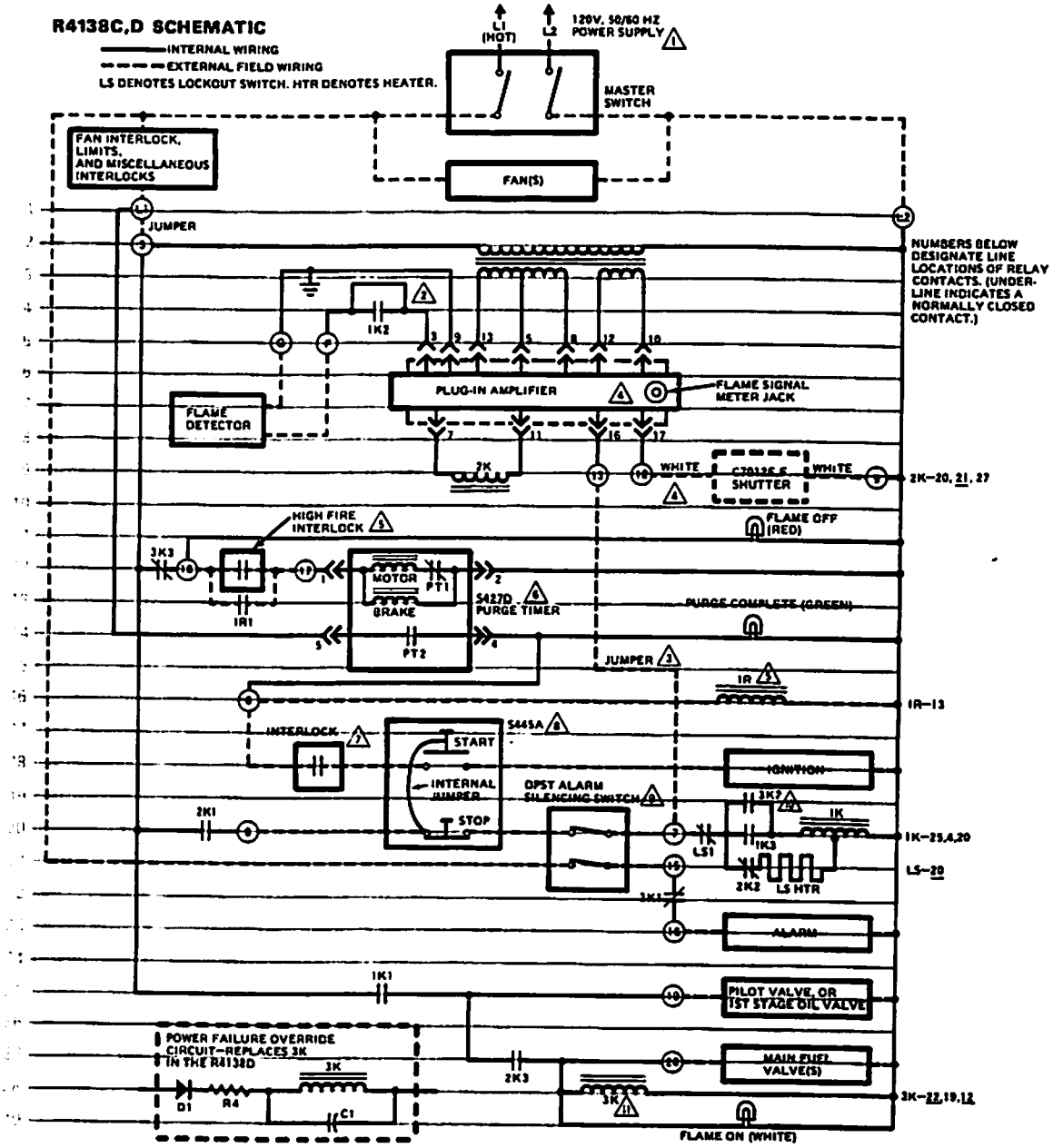
TABLE 1—FLAME DETECTION SYSTEMS.

PLUG-IN FLAME SIGNAL AMPLIFIERS					APPLICABLE FLAME DETECTORS		
TYPE	COLOR	SELF-CHECKING	MODEL	FLAME FAILURE RESPONSE TIME	FUEL	TYPE	MODELS
Rectification	Green	No	R7247A	2 to 4 sec.	Gas	Rectifying flame rods	Holders[c]: C7004, C7007, C7011). Complete Assemblies: C7005, C7008, C7009, Q179.
			R7247A, R7247B[b]	2 to 4 sec.	Oil	Rectifying Protocells[d]	C7003, C7010, C7013, C7014
					Gas, Oil, Coal	Ultraviolet (Purple Peeper)	C7012A or C.
		Dynamic Self Check[a]	R7247B	2 to 4 sec.	Gas	Rectifying Flame Rods	Holders: C7004, C7007, C7011. Complete assemblies: C7005, C7008, C7009, Q179.
			R7247C	2 to 4 sec.	Gas, Oil, Coal	Ultraviolet (Purple Peeper)	C7012E or F.
Infrared	Red	No	R7248A	2 to 4 sec.	Gas, Oil, Coal	Infrared (Lead Sulfide)	C7015.
		Dynamic Amplicheck™[b]	R7248B	2 to 4 sec.			
Ultraviolet	Purple	No	R7249A	2 to 4 sec.	Gas, Oil	Ultraviolet (Minipeeper)	C7027, C7035, C7044.
	Blue	Dynamic Self Check[a]	R7476A	2 to 4 sec.	Gas, Oil, Coal	Ultraviolet (Adjustable Sensitivity)	C7076.

[a]Dynamic self check circuitry tests all electronic components in the flame detection system (amplifier and detector) 60 to 240 times a minute during burner operation and shuts down the burner if the detection system fails.
[b]Circuitry tests only the flame signal amplifier during burner operation and shuts down the burner if the amplifier fails.
[c]Order flame rod separately; see instruction sheet for the holder.
[d]Use Honeywell photocell, part no. 38316, only.

OPERATION

The schematic below shows all relay contacts in the de-energized position. Refer to Sequence of Operation on next 4 pages.



1. PROVIDE DISCONNECT MEANS AND OVERLOAD PROTECTION AS REQUIRED.
2. PILOT LINK JUMPER WIRE; WILL BE CLIPPED FOR A CONTINUOUS (STANDING) PILOT APPLICATION. LINK MUST ALSO BE CLIPPED IN REDUNDANT PARALLEL SYSTEMS.
3. INSTALLED IF USING A C7012E OR F PURPLE PEEPER ULTRAVIOLET FLAME DETECTOR.
4. WHITE SHUTTER LEADWIRES ARE ONLY ON THE C7012E OR F PURPLE PEEPER ULTRAVIOLET FLAME DETECTOR WITH SELF-CHECKING FEATURE. POWER TO DRIVE THE SHUTTER IS APPLIED TO TERMINAL 12 FROM TERMINAL 13 THROUGH A SOLID STATE SWITCH IN THE R7247C DYNAMIC SELF CHECK AMPLIFIER. THE 2 BLACK LEADWIRES ON THE C7012 ARE CONNECTED TO L1 AND L2. REFER TO TYPICAL WIRING DIAGRAMS.
5. IF A HIGH FIRE INTERLOCK IS NOT USED, RELAY 1R AND CONTACT 1R1 ARE OMITTED, AND A JUMPER IS INSTALLED BETWEEN TERMINALS 17 AND 18.
6. IF A PURGE TIMER IS NOT USED, A JUMPER IS INSTALLED BETWEEN TERMINALS L1 AND 6, AND THE "PURGE COMPLETE" (GREEN) LAMP WILL LIGHT WHEN THE MASTER SWITCH IS CLOSED.
7. IF A LOW FIRE START INTERLOCK IS NOT USED, THE START SWITCH IS CONNECTED DIRECTLY TO TERMINAL 6.
8. AN S449A START-STOP STATION WITH AN INTERNAL JUMPER, OR EQUIVALENT, IS USED FOR REMOTE OPERATION.
9. IF AN ALARM SILENCING SWITCH IS NOT USED, THE STOP STATION WILL BE CONNECTED DIRECTLY TO TERMINAL 7, AND TERMINAL 15 WILL BE CONNECTED TO L1 BETWEEN THE MASTER SWITCH AND THE LIMITS AND INTERLOCKS.
10. CONTACT 2K2 IS IN THE R4138D ONLY. IT BYPASSES 1K3 TO ALLOW RELAY 1K TO PULL IN AGAIN AFTER A MOMENTARY POWER FAILURE.
11. IN THE R4138D, THE POWER FAILURE OVERRIDE CIRCUIT SHOWN IN THE INSET REPLACES RELAY 3K.

R4138C,D-6

FIG. 1—SIMPLIFIED SCHEMATIC DIAGRAM OF THE R4138C AND D, SHOWING TYPICAL FIELD WIRING FOR A GAS OR OIL CUTOFF SYSTEM.

SEQUENCE OF OPERATION FOR THE R4138C,D

NOTE: Italics denote special applications.

NORMAL OPERATION

OPERATOR ACTION	R4138 OPERATION	SYSTEM OPERATION
TO START: 1. Reset the lockout switch on the R4138. Reset all limits and interlocks. Close the master switch.	1. a. Power is applied to terminal L1 through the interlocks and limits, and to terminal 3 through the jumper from terminal L1; the plug-in amplifier is energized. b. Power is applied to terminal 15 (through the alarm silencing switch) and to terminal 16 (through 3K1). c. Power is applied to terminal 18 (through 3K3); the FLAME OFF (RED) lamp lights.	1. a. The fan(s) starts. b. The alarm is energized, but may be turned off by opening the alarm silencing switch (if used). c. None.
2. Open the damper to high fire position (if manually operated.)	2. a. None. b. Power is applied to terminal 17 (through the high fire interlock) and to the motor of the purge timer (through PT1), the purge timer starts. c. At the end of the preset time, PT1 opens and the purge timer stops. PT2 closes, applying power to terminal 6 (from terminal L1); the PURGE COMPLETE (GREEN) lamp lights	2. a. The high fire interlock closes when the damper is open. (The damper may open automatically.) b. The purge period begins, the fan(s) clears the combustion chamber of unburned fuel and fuel vapor. c. Relay 1R pulls in; 1R1 closes to bypass the high fire interlock and keep power applied to the purge timer. (If power is removed from the purge timer. It will reset, PT2 will open, and the system cannot be started.)
3. When the PURGE COMPLETE (GREEN) lamp lights, close the damper to low fire position (if manually operated).	3. None.	3. The high fire interlock opens, and the low fire start interlock closes when the damper is closed. (The damper may close automatically.)
4. Close the alarm silencing switch (if it was opened in step 1).	4. None.	4. The alarm is energized.
5. Push in the START button and hold it in. NOTE: To avoid nuisance shutdowns when not using a purge timer, wait at least 10 seconds after the fan interlock closes before pushing in the START button	5. a. Power is applied to the ignition transformer from terminal 6 (through the low fire start interlock and the START station). b. Power is applied to terminal 7 from terminal 6 through the low fire start interlock, START station, internal jumper, STOP station, and alarm silencing switch). c. Relay 1K pulls in through LS1, 2K2, and the LS HTR (lockout switch heater), thus proving the continuity of the heater. (1) 1K1 closes, applying power to terminal 19 from terminal 3. (2) 1K2 closes. (3) 1K3 closes; the LS HTR (lockout switch heater) begins heating (by auto-transformer action of 1K through 1K3 and 2K2). d. *If an R7247C Dynamic Self Check Amplifier is used, power is applied from terminal 7 through the jumper to terminal 13, through the solid state switch in the amplifier (between amplifier terminals 16 and 17), to terminal 12.*	5. a. The ignition transformer is energized. b. None. c. (1) The pilot valve (or 1st stage oil valve) is energized. The valve opens and the pilot or 1st stage oil burner) is ignited. (2) *If the pilot link jumper wire has been clipped for a continuous (standing) pilot application, the flame detection circuit to the amplifier is complete.* (3) None. d. *If a C7012E or F Purple Peeper Ultraviolet flame Detector (with self-checking feature) is used, the shutter is energized.*

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OPERATOR ACTION	R4138 OPERATION	SYSTEM OPERATION
	e. None.	e. The flame detector detects the pilot flame for 1st stage oil flame).
	f. When the flame is detected, relay 2K pulls in. (1) 2K1 closes, bypassing the purge timer contact PT2, low fire start interlock, START station, and internal jumper. Power will be applied to terminal 7 (from terminal 3, through 2K1 to terminal 8, and through the STOP station and alarm silencing switch) to hold in relay 1K (unless the limits open, the STOP button is pressed, or safety shutdown occurs).	f. (1) None.
	(2) 2K2 opens; the LS HTR stops heating.	(2) None.
	(3) 2K3 closes, applying power to terminal 20 (from terminal 3 through 1K1). Relay 3K pulls in and the FLAME ON (WHITE) lamp lights.	(3) The automatic main fuel valve(s) is energized. The valve(s) opens and the main burner is ignited. The system is in the run condition. *(If a manually opened valve is used, the main burner will not be ignited until step 7 is completed.)*
	g. When relay 3K pulls in— (1) 3K1 opens, removing power from terminal 16.	g. (1) The alarm is de-energized
	(2) <u>R4138D only</u>: 3K2 closes, bypassing 1K3. Relay 1K can pull back in after a momentary power failure if 3K is still pulled in.	(2) None.
	(3) 3K3 opens, removing power from terminal 18. The FLAME OFF (RED) lamp goes out. The purge timer resets and PT2 opens, removing power from terminal 6. The PURGE COMPLETE (GREEN) lamp goes out.	(3) Relay 1R drops out and 1R1 opens.
6. When the FLAME ON (WHITE) lamp lights, release the START button.	6. Normal operation, including self-checking of the flame detection system (if a self-checking system is used).	6. The ignition transformer is de-energized.
7. *Open manual main fuel valve(s) (if used).*	7. Normal operation.	7. *The main burner is ignited. The system is in the run condition.*
<u>TO STOP:</u> 8. Push in the STOP button and hold it in until the FLAME OFF (RED) lamp lights or until all relays drop out.	8. a. Power is removed from terminal 7. b. Relay 1K drops out. 1K1 opens, removing power from terminals 19 and 20. Relay 3K drops out and the FLAME ON (WHITE) lamp goes out.	8. a. *C7012E,F shutter is de-energized.* b. The pilot valve (or 1st stage oil valve) and the main fuel valve(s) are de-energized. The valves close and all flames go out.
	c. When relay 3K drops out— (1) 3K1 closes. (2) 3K3 closes; the FLAME OFF (RED) lamp lights.	c. (1) The alarm is energized. (2) None.
	d. When the flames go out, relay 2K drops out.	d. None.
	e. All relay contacts are reset for the next startup.	e. None.
9. Opens the alarm silencing switch (if used).	9. Power is removed from terminals 15 and 16.	9. The alarm is de-energized.
10. Open the master switch.	10. Power is removed from terminals L1 and 3. The plug-in amplifier is de-energized, and the FLAME OFF (RED) lamp goes out.	

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SAFETY OPERATION		
ABNORMAL CONDITION	**R4138 OPERATION**	**SYSTEM OPERATION**
Safe Start Check—A flame, or a condition simulating a flame, is present before the START button is pressed. *NOTE: This check does not apply if using a continuous (standing) pilot, or if using a C7012E or F Flame Detector with the jumper connected between terminals 13 and 7.*	Relay 2K pulls in when the flame (or flame-simulating condition) is detected. Contact 2K2 opens, preventing relay 1K from pulling in when the START button is pressed. • 1K1 stays open; no power can be applied to terminals 19 and 20. • Relay 3K cannot pull in; 3K1 and 3K3 remain closed. The FLAME OFF (RED) lamp remains on. The PURGE COMPLETE (GREEN) lamp may also come on.	The system cannot be started until the condition is corrected and 2K drops out. • The pilot valve (or 1st stage oil valve) and the automatic main fuel valve(s) cannot be energized. • The alarm remains energized.
The pilot (or 1st stage oil burner, is not ignited.	No flame is detected, so relay 2K does not pull in. 1. 2K2 stays closed; the LS HTR (lockout switch heater) heats until the lockout switch trips (if the START button is held in longer than the lockout switch timing). a. LS1 opens and relay 1K drops out, 1K1 opens, removing power from terminal 19. b. 2K3 stays open; power cannot be applied to terminal 20. c. Relay 3K cannot pull in; 3K1 and 3K3 remain closed. The FLAME OFF (RED) lamp remains on. 2. If the START button is released before the lockout switch trips— a. 2K1 stays open; the START station is not bypassed. When the START button is released, power is removed from terminal 7. b. Relay 1K drops out and 1K1 opens, removing power from terminal 19. c. 2K3 stays open; power cannot be applied to terminal 20. d. Relay 3K cannot pull in; 3K1 and 3K3 remain closed. The FLAME OFF (RED) lamp remains on.	The system cannot be started. The ignition transformer is de-energized when the START button is released. 1. Safety shutdown with lockout occurs. The lockout switch must be *manually* reset to try to restart the system. a. The pilot valve (or 1st stage oil valve) is de-energized, and the valve closes. b. The automatic main fuel valve(s) cannot be energized. c. The alarm remains energized. 2. Safety shutdown occurs. The START button must be *manually* pressed to try to restart the system. a. When the START button is released, the ignition transformer is de-energized. b. The pilot valve (or 1st stage oil valve) is de-energized, and the valve closes. c. The automatic main fuel valve(s) cannot be energized. d. The alarm remains energized.
The flame goes out during the run period. NOTE: Safety operation is the same if the main burner is not ignited in a system with an interrupted pilot (obtained only by the addition of external circuitry).	Relay 2K drops out. • 2K1 open, removing power from terminals 8 and 7. Relay 1K drops out and 1K1 opens, removing power from terminals 19 and 20. The FLAME ON (WHITE) lamp goes out. • Relay 3K drops out; 3K1 and 3K3 close. The FLAME OFF (RED) lamp lights.	Safety shutdown occurs. • The pilot valve (or 1st stage oil valve) and the automatic main fuel valve(s) are de-energized, and the valves close. • The alarm is energized.
A limit or interlock opens.	Power is removed from all terminals except 15. All indicator lamps go out and all relays drop out. 3K1 closes, applying power to terminal 16.	The system shuts down. All valves are de-energized, and the valves close. The alarm is energized.
Momentary power failure.	R4138C: Power is removed from all terminals, all indicator lamps go out, and all relays drop out.	The system shuts down. The alarm is energized when power is restored.

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ABNORMAL CONDITION	R4138 OPERATION	SYSTEM OPERATION
Momentary power failure.	R4138D: Power is removed from all terminals, all indicator lamps go out, and all relays except 3K drop out. The charge on capacitor C1 will hold in 3K for about 1 second.	
	• If power is restored before 3K drops out and before the pilot flame (or 1st stage oil flame) goes out— — 3K2 will stay closed, bypassing 1K3; 3K1 and 3K3 will stay open. — relay 2K will pull back in; 2K1 and 2K3 will close, and 2K2 will open. — the START station will be bypassed through 2K1, the STOP station, and the alarm silencing switch. — power will be reapplied to terminal 7. — relay 1K will pull back in through LS1 and 3K2. — operation will return to normal.	• If power is restored within 1 second and the pilot flame (or 1st stage oil flame) is still burning (the valve must be slow closing), normal operation will be resumed. The alarm will not be energized. If the main burner flame has gone out, it will be reignited by the pilot flame. (Power failure override circuits may have to be added to the pilot valve and main valve(s) to ensure that they do not close on a momentary power interruption.)
	• If 3K drops out before power is restored— — 3K2 will open, so 1K3 will not be bypassed; 3K1 and 3K3 will close. — relay 1K cannot pull back in since both 1K3 and 3K2 are open. — 1K1 stays open, so 3K cannot pull back in. — the FLAME OFF (RED) lamp will light when power is restored.	• The system shuts down. All valves are de-energized, and the valves close. The alarm is energized when power is restored.
	• If the pilot flame (or 1st stage oil flame) goes out before power is restored, — relay 2K cannot pull back in, so 2K1 stays open. — the START station cannot be bypassed. — power will *not* be reapplied to terminal 7. — relay 1K cannot pull back in. — relay 3K will drop out; 3K1 and 3K3 will close. — the FLAME OFF (RED) lamp will light when power is restored.	• The system shuts down. All valves are de-energized, and the valves close. The alarm is energized when power is restored.
IF USING A SELF-CHECKING FLAME DETECTION SYSTEM: The flame detection system fails while the system is turned off or during the purge period.	Relay 2K cannot pull in when the system is started-same operation as if the pilot (or 1st stage oil burner) is not ignited.	Safety shutdown occurs. Lockout will occur if the START button is held in longer than the lockout switch timing.
The flame detection system fails during the run period with the burner firing.	Relay 2K drops out—same operation as if the flame goes out.	Safety shutdown occurs.

INSTALLATION

WHEN INSTALLING THIS PRODUCT...

1. Read these instructions carefully. Failure to follow them could damage the product or cause a hazardous condition.

2. Check the ratings given in the instructions and on the product to make sure the product is suitable for your application.

3. Installer must be a trained, experienced, flame safeguard control technician.

4. After installation is complete, check out product operation as provided in these instructions.

CAUTION

1. Disconnect power supply before beginning installation to prevent electrical shock and equipment damage.
2. All wiring must comply with applicable local electrical codes, ordinances, and regulations.
3. All wiring must be NEC Class 1 (line voltage).
4. The fan interlock, limits, and miscellaneous interlocks must be rated to carry and break current to the ignition transformer(s), pilot valve(s) (or 1st stage oil valve), and main fuel valve(s) simultaneously.
5. If replacing an R4138 in an existing installation, remove all jumpers and capacitors from the terminal strip except those required for the new installation.
6. If the type of flame detector is changed, remove all jumpers and rewire for the new installation.
7. All external timers must be listed or component recognized by authorities having jurisdiction, for the specific purpose for which they are used.

IMPORTANT

1. For on-off gas-fired systems, some authorities having jurisdiction prohibit the wiring of any limit or operating contacts in series with the main fuel valve(s).
2. For continuous (standing) pilot applications, Factory Mutual requires that gas to the pilot burner be automatically shut off on pilot flame failure. A separate control must be used for this purpose. Recommendation 4 on page 9 in the Factory Mutual Engineering Corporation's Loss Prevention Data Sheet Section 6-4, 12-69 is interpreted to mean that this control can be a thermally actuated valve.
3. Do not connect more than two C7012E or F Purple Peeper Ultraviolet Flame Detectors (with self-checking shutter) in parallel to the same terminals.

Use applicable installation instructions provided by the burner manufacturer in addition to the corresponding instructions given here. Before putting the system into service, check out the installation using the procedures in the CHECKOUT section of this sheet, and any others stipulated by the burner manufacturer.

LOCATION

TEMPERATURE

Install the R4138 where the surrounding temperatures will remain within the Ambient Operating Temperature Ratings in the SPECIFICATIONS section.

HUMIDITY

Install the R4138 where the relative humidity never reaches the saturation point. Condensation of moisture on the R4138 may cause enough leakage to short the flame signal to ground and thus prevent the burner from starting.

VIBRATION

Do not install the R4138 where it could be subject to excessive vibration. Vibration shortens the life of the electronic components.

WEATHER

The R4138 is not designed to be weathertight. If it is installed outdoors, use weathertight enclosure.

MOUNTING THE CABINET OR SUBBASE

See Figs. 2 and 3 for installation dimensions.

1. Select the location on a *vertical* wall or instrument panel. (The Q477A Subbase may be mounted directly in the customer's cabinet.) Be sure to allow clearances for servicing and for removal of the R4138.

IMPORTANT

To ensure proper operation, the R4138 must be mounted vertically.

2. For surface mounting, use the back of the cabinet or subbase as a template to mark the 4 screw locations. Drill the pilot holes.

3. For flush mounting (Q478A Cabinet), make an opening in the vertical wall or instrument panel just slightly larger than the cabinet, not including the flange. Add the 2 detachable mounting brackets to the sides of the cabinet after it is in place.

4. Insert the 4 mounting screws and tighten them securely.

5. Install necessary conduit fittings.

WIRING TO TERMINAL STRIP (FIG. 4 THROUGH 8)

1. All wiring must comply with applicable electrical codes, ordinances, and regulations. Use NEC Class 1 (line voltage) wiring.

2. *For normal installations,* use moisture-resistant No. 14 wire suitable for at least 167° F [75° C].

3. *For high temperature installations,* use moisture-resistant No. 14 wire, selected for a temperature rating above the maximum operation temperature, for all but the ignition and flame detector "F" leadwires.

a. *For the ignition,* use Honeywell Spec. No. R1061012 Ignition Cable or equivalent (This wire is rated at 350° F [177° C] for continuous duty, and up to 500° F [260° C] for intermittent use. It has been tested to 25,000 volts.)

b. *For the flame detector "F" leadwire,* use Honeywell Spec. No. R1298020 or equivalent. (This wire is rated up to 400° F [204° C] for continuous duty. It is tested for operation up to 600 volts and breakdowns up to 7500 volts.)

4. *For ignition installations in a contaminating environment,* use Honeywell Spec. No. R1239001 High Tension Ignition Cable or equivalent. (This wire is very resistant to severe conditions of oil, heat, and corona, and is tested to withstand high voltages up to 25,000 volts RMS in a salt bath for 1 minute without breakdown. It is rated at 200° F [93° C] for continuous duty, and up to 250° F [177° C] for intermittent use.)

IMPORTANT

Do not run high voltage ignition transformer wires in the same conduit with the flame detector wiring.

5. Refer to Figs. 4 through 8 for typical field wiring connections. Follow the burner manufacturer's wiring diagram if provided.

IMPORTANT

Make sure the START-STOP station is wired as shown; rewire if necessary.

6. Do not remove the factory-installed jumpers from the terminal strip in the cabinet or on the subbase unless you are installing a High Fire Interlock or a C7012E or F Purple Peeper Ultraviolet Flame Detector (with self-checking shutter).

a. If you are installing a High Fire Interlock, remove the jumper between terminals 17 and 18 (if there is one). Add relay 1R (terminal 6) and connect contact 1R1 between terminals 17 and 18.

b. If you are installing a C7012E or F Purple Peeper Ultraviolet Flame Detector, remove the jumpers between terminals 14 and 13 and terminals 12 and F (if there are jumpers). Then add a jumper between terminals 13 and 7.

c. *Do not remove any other jumpers.*

7. Make sure the loads do not exceed the terminal ratings. Refer to the label on the R4138 or to the Terminal Ratings in the SPECIFICATIONS section.

8. *Check the power supply circuit.* The voltage and frequency must match those of the R4138. Do not connect the R4138 to a circuit which is subject to line voltage variations, such as would occur with on-off switching of heavy loads. A separate power supply circuit may be required for the flame safeguard control. Add required disconnect means and overload protection.

9. Check all wiring circuits and complete the STATIC CHECKOUT (page 18) before installing the R4138.

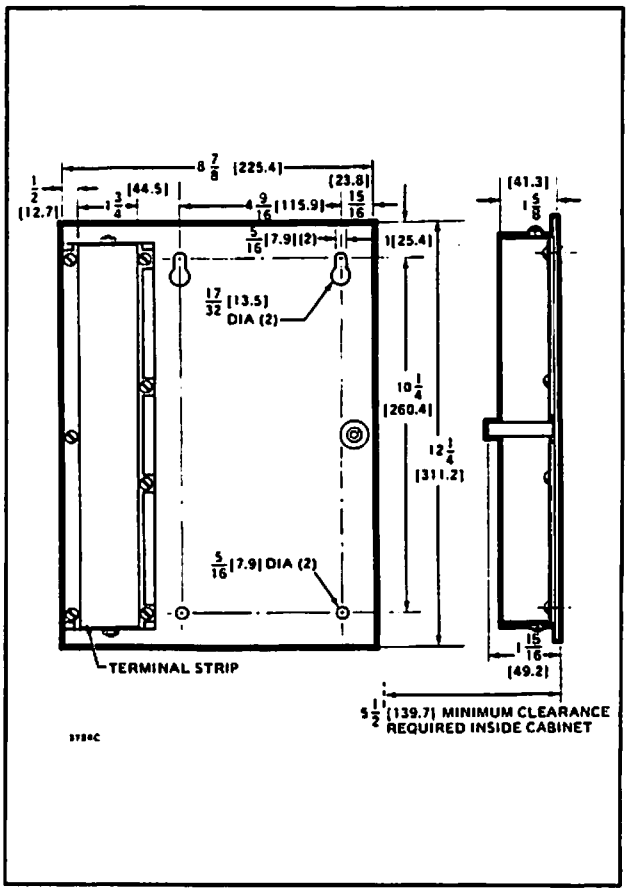
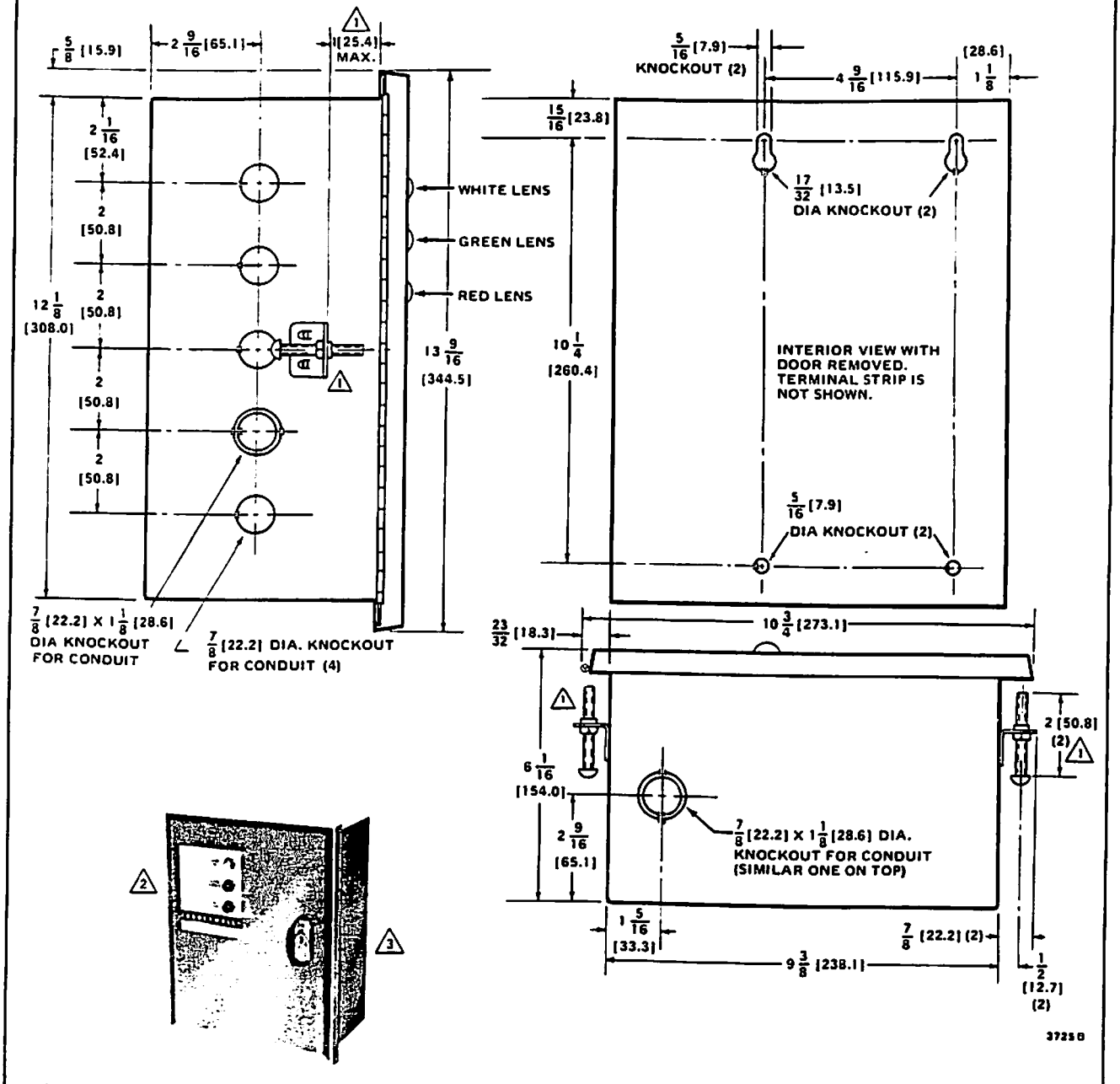
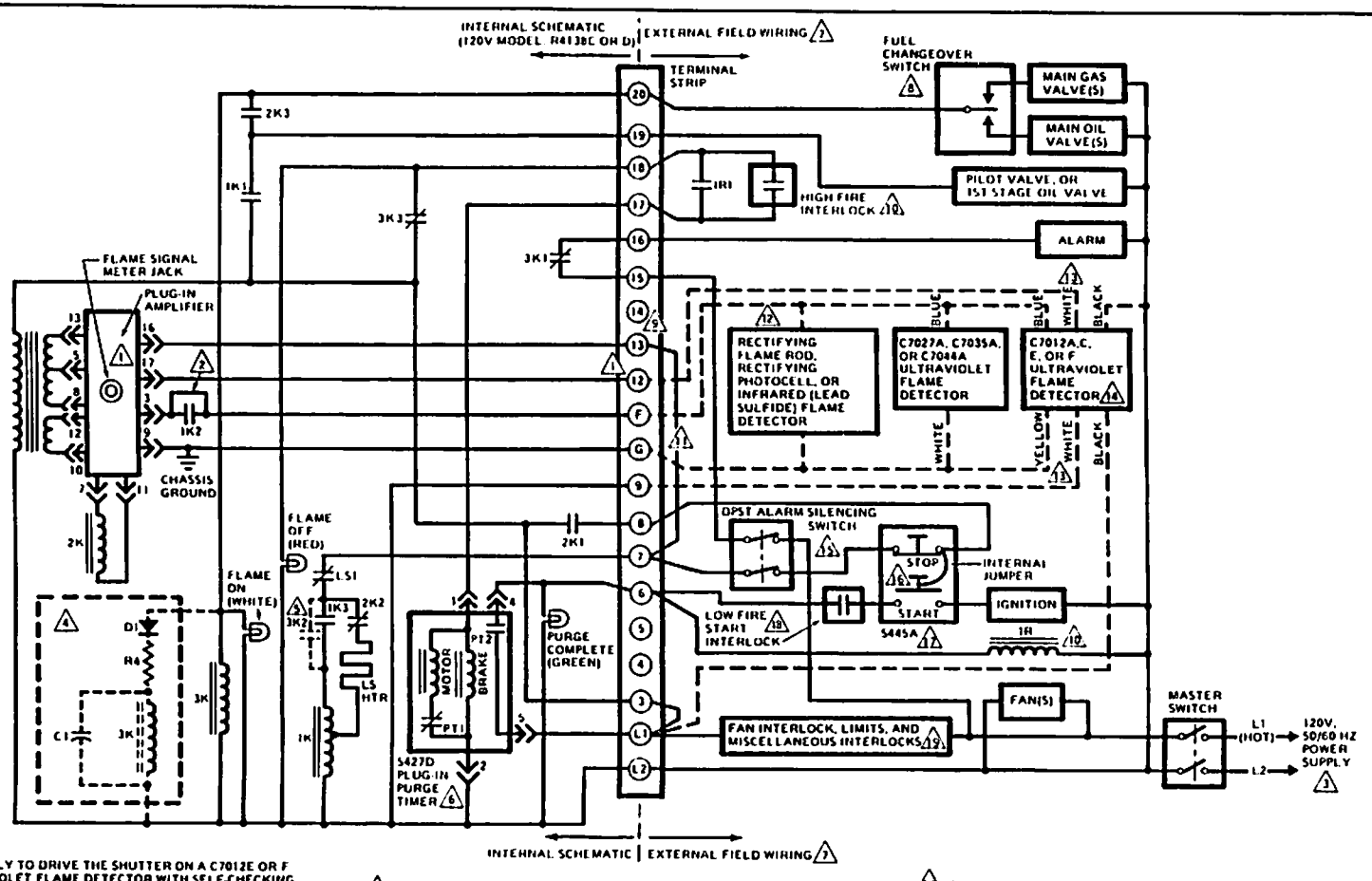


FIG. 2—MOUNTING DIMENSIONS OF THE Q477A SUBBASE, IN INCHES [MILLIMETRES IN BRACKETS].



1. FOR FLUSH MOUNTING. DETACHABLE SIDE BRACKETS (2) ARE PACKED WITH CABINET.
2. Q478A1015 HAS NO START-STOP STATION. Q478A1031 INCLUDES START-STOP STATION.
3. LOCKING COVER.

FIG. 3—MOUNTING DIMENSIONS OF THE Q478A CABINET, IN INCHES [MILLIMETRES IN BRACKETS].



1 TERMINAL 12 IS USED ONLY TO DRIVE THE SHUTTER ON A C7012E OR F PURPLE PEEPER ULTRAVIOLET FLAME DETECTOR WITH SELF-CHECKING FEATURE. POWER TO DRIVE THE SHUTTER IS APPLIED TO TERMINAL 12 FROM TERMINAL 13 THROUGH A SOLID STATE SWITCH IN THE R7247C DYNAMIC SELF CHECK AMPLIFIER

2 PILOT LINK JUMPER WIRE. CLIP FOR A CONTINUOUS (STANDING) PILOT APPLICATION.

3 PROVIDE DISCONNECT MEANS AND OVERLOAD PROTECTION AS REQUIRED.

4 IN THE R4138D, THE POWER FAILURE OVERRIDE CIRCUIT INSIDE THIS BOX (INDICATED BY DASHED LINES) REPLACES RELAY 3K.

5 CONTACT 3K2 IS IN THE R4138D ONLY. IT BYPASSES 1K3 TO ALLOW RELAY 1K TO PULL IN AGAIN AFTER A MOMENTARY POWER FAILURE.

6 IF THE S427D PURGE TIMER IS NOT USED, INSTALL A JUMPER BETWEEN TERMINALS L1 AND 6. THE "PURGE COMPLETE" (GREEN) LAMP WILL THEN LIGHT WHEN THE MASTER SWITCH IS CLOSED.

7 USE ALL NEC CLASS 1 WIRING.

8 FOR A SINGLE FUEL SYSTEM, OMIT THE CHANGEOVER SWITCH AND CONNECT THE FUEL VALVE(S) DIRECTLY TO TERMINAL 20.

9 REMOVE ALL CAPACITORS WHICH MAY HAVE BEEN PREVIOUSLY INSTALLED BETWEEN TERMINALS 12 AND 13, AND 13 AND G.

10 IF USING A HIGH FIRE INTERLOCK, REMOVE THE JUMPER BETWEEN TERMINALS 17 AND 18 (IF THERE IS ONE), AND ADD RELAY 1R (TERMINAL 6) AND CONTACT 1R1. THE DAMPER MUST BE OPENED (MANUALLY IF REQUIRED) TO CLOSE THE HIGH FIRE INTERLOCK AND START THE PURGE TIMER. WHEN THE PURGE IS COMPLETE (GREEN LAMP ON), 1R PULLS IN AND 1R1 CLOSES TO BYPASS THE HIGH FIRE INTERLOCK. THIS KEEPS POWER APPLIED TO THE PURGE TIMER WHEN THE DAMPER IS CLOSED AND THE SYSTEM IS IN THE LOW FIRE POSITION. IF NOT USING A HIGH FIRE INTERLOCK, OMIT RELAY 1R AND CONTACT 1R1, AND MAKE SURE THAT THERE IS A JUMPER BETWEEN TERMINALS 17 AND 18.

11 IF USING A C7012E OR F PURPLE PEEPER ULTRAVIOLET FLAME DETECTOR, REMOVE THE JUMPERS BETWEEN TERMINALS 14 AND 13 AND TERMINALS 12 AND F (IF THERE ARE JUMPERS), AND INSTALL A JUMPER BETWEEN TERMINALS 13 AND 7. (TO OBTAIN A SAFE START CHECK, MOVE THE JUMPER TO TERMINALS 13 AND 3. HOWEVER, THE SHUTTER WILL THEN BE ENERGIZED ALL THE TIME, UNLESS THE MASTER SWITCH IS OPENED.)

12 FOR THE C7015A INFRARED (LEAD SULFIDE) FLAME DETECTOR, EITHER LEADWIRE MAY BE CONNECTED TO THE F TERMINAL. RUN THE C7015A LEADWIRES ALONE IN CONDUIT ALL THE WAY TO THE CABINET OR SUBBASE, AND GROUND THE CONDUIT AT THE TERMINAL STRIP. (REFER TO PUBLICATION 60-2306 FOR DETAILED INSTRUCTIONS.)

13 WHITE SHUTTER LEADWIRES ARE ONLY ON THE C7012E OR F.

14 TWO C7012 PURPLE PEEPER ULTRAVIOLET FLAME DETECTORS MAY BE WIRED IN PARALLEL TO THE SAME TERMINALS AS SHOWN. THE C7012'S MUST BE 120V MODELS

15 THE ALARM SILENCING SWITCH IS OPTIONAL. IF IT IS NOT USED, CONNECT THE STOP STATION DIRECTLY TO TERMINAL 7, AND CONNECT TERMINAL 13 TO L1 BETWEEN THE MASTER SWITCH AND THE LIMITS AND INTERLOCKS. AN R4155A ALARM SILENCING RELAY MAY BE USED INSTEAD; CONNECT IT AS SHOWN IN THE INSTALLATION SECTION.

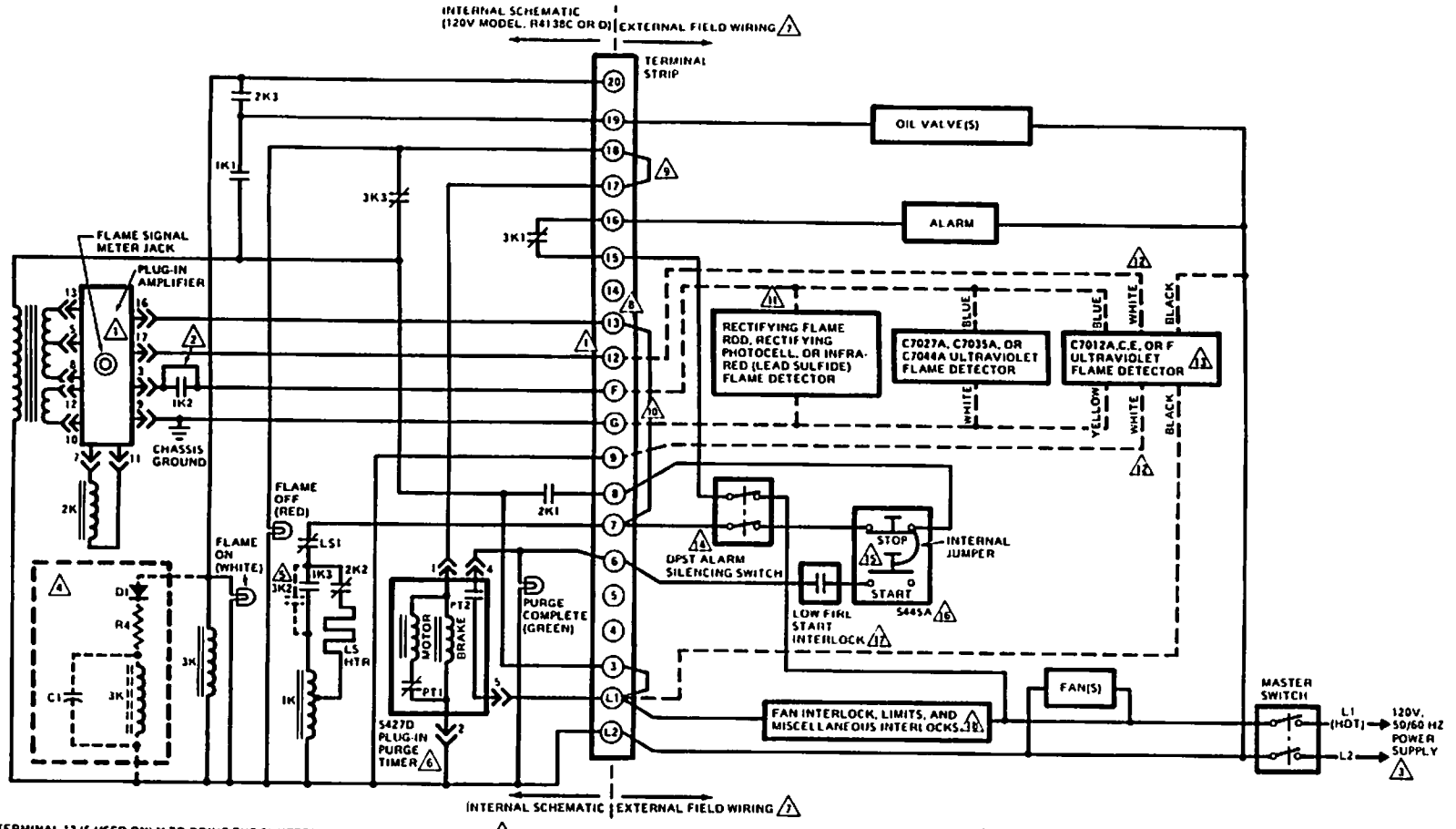
16 TO AVOID NUISANCE SHUTDOWNS WHEN NOT USING A PURGE TIMER, WAIT AT LEAST 10 SECONDS AFTER THE FAN INTERLOCK CLOSES BEFORE PRESSING THE "START" BUTTON.

17 FOR A Q478A1031 CABINET WITH A FACTORY INSTALLED START-STOP SWITCH, MAKE SURE THE SWITCH IS WIRED AS SHOWN. REWIRE IF NECESSARY. FOR REMOTE OPERATION, USE AN S445A START-STOP STATION, OR EQUIVALENT WITH AN INTERNAL JUMPER AS SHOWN.

18 THE LOW FIRE START INTERLOCK MUST BE CLOSED TO ENERGIZE THE IGNITION TRANSFORMER. IT CLOSES WHEN PURGE IS COMPLETE (GREEN LAMP ON) AND THE DAMPER IS CLOSED (MANUALLY IF REQUIRED). IF THIS INTERLOCK IS NOT USED, CONNECT THE START SWITCH DIRECTLY TO TERMINAL 6.

19 THESE INTERLOCKS AND LIMITS MUST BE RATED TO CARRY AND BREAK CURRENT TO THE IGNITION TRANSFORMER, PILOT VALVE (OR 1ST STAGE OIL VALVE), AND MAIN FUEL VALVE(S) SIMULTANEOUSLY

FIG. 4—TYPICAL WIRING DIAGRAM FOR THE 120 V MODEL OF THE R4138C OR D WHEN USED IN A GAS, OIL, OR DUAL FUEL CUTOFF SYSTEM.



1. TERMINAL 12 IS USED ONLY TO DRIVE THE SHUTTER ON A C7012E OR F PURPLE PEEPER ULTRAVIOLET FLAME DETECTOR WITH SELF-CHECKING FEATURE. POWER TO DRIVE THE SHUTTER IS APPLIED TO TERMINAL 12 FROM TERMINAL 13 THROUGH A SOLID STATE SWITCH IN THE R7247C DYNAMIC SELF CHECK AMPLIFIER.

2. PILOT LINK JUMPER WIRE; CLIP FOR A CONTINUOUS (STANDING) PILOT APPLICATION.

3. PROVIDE DISCONNECT MEANS AND OVERLOAD PROTECTION AS REQUIRED.

4. IN THE R4138D, THE POWER FAILURE OVERRIDE CIRCUIT INSIDE THIS BOX (INDICATED BY DASHED LINES) REPLACES RELAY 3K.

5. CONTACT 3K2 IS IN THE R4138D ONLY. IT BYPASSES 1K3 TO ALLOW RELAY 1K TO PULL IN AGAIN AFTER A MOMENTARY POWER FAILURE.

6. IF THE S427D PURGE TIMER IS NOT USED, INSTALL A JUMPER BETWEEN TERMINALS L1 AND 6. THE "PURGE COMPLETE" (GREEN) LAMP WILL THEN LIGHT WHEN THE MASTER SWITCH IS CLOSED.

7. ALL USE NEC CLASS 1 WIRING.

8. REMOVE ALL CAPACITORS WHICH MAY HAVE BEEN PREVIOUSLY INSTALLED BETWEEN TERMINALS 12 AND 13, AND 13 AND G.

9. IF USING A HIGH FIRE INTERLOCK, REFER TO THE WIRING DIAGRAM FOR A GAS, OIL, OR DUAL FUEL CUTOFF SYSTEM.

10. IF USING A C7012E OR F PURPLE PEEPER ULTRAVIOLET FLAME DETECTOR, REMOVE THE JUMPERS BETWEEN TERMINALS 14 AND 13 AND TERMINALS 12 AND F (IF THERE ARE JUMPERS), AND INSTALL A JUMPER BETWEEN TERMINALS 13 AND 7. (TO OBTAIN A SAFE START CHECK, MOVE THE JUMPER TO TERMINALS 13 AND 3. HOWEVER, THE SHUTTER WILL THEN BE ENERGIZED ALL THE TIME, UNLESS THE MASTER SWITCH IS OPENED.)

11. FOR THE C7015A INFRARED (LEAD SULFIDE) FLAME DETECTOR, EITHER LEADWIRE MAY BE CONNECTED TO THE F TERMINAL. RUN THE C7015A LEADWIRES ALONE IN CONDUIT ALL THE WAY TO THE CABINET OR SUBBASE, AND GROUND THE CONDUIT AT THE TERMINAL STRIP. (REFER TO PUBLICATION 60-2305 FOR DETAILED INSTRUCTIONS.)

12. WHITE SHUTTER LEADWIRES ARE ONLY ON THE C7012E OR F.

13. TWO C7012 PURPLE PEEPER ULTRAVIOLET FLAME DETECTORS MAY BE WIRED IN PARALLEL TO THE SAME TERMINALS AS SHOWN. THE C7012'S MUST BE 120V MODELS.

14. THE ALARM SILENCING SWITCH IS OPTIONAL. IF IT IS NOT USED, CONNECT THE STOP STATION DIRECTLY TO TERMINAL 7, AND CONNECT TERMINAL 15 TO L1 BETWEEN THE MASTER SWITCH AND THE LIMITS AND INTERLOCKS. AN R4155A ALARM SILENCING RELAY MAY BE USED INSTEAD. CONNECT IT AS SHOWN IN THE INSTALLATION SECTION.

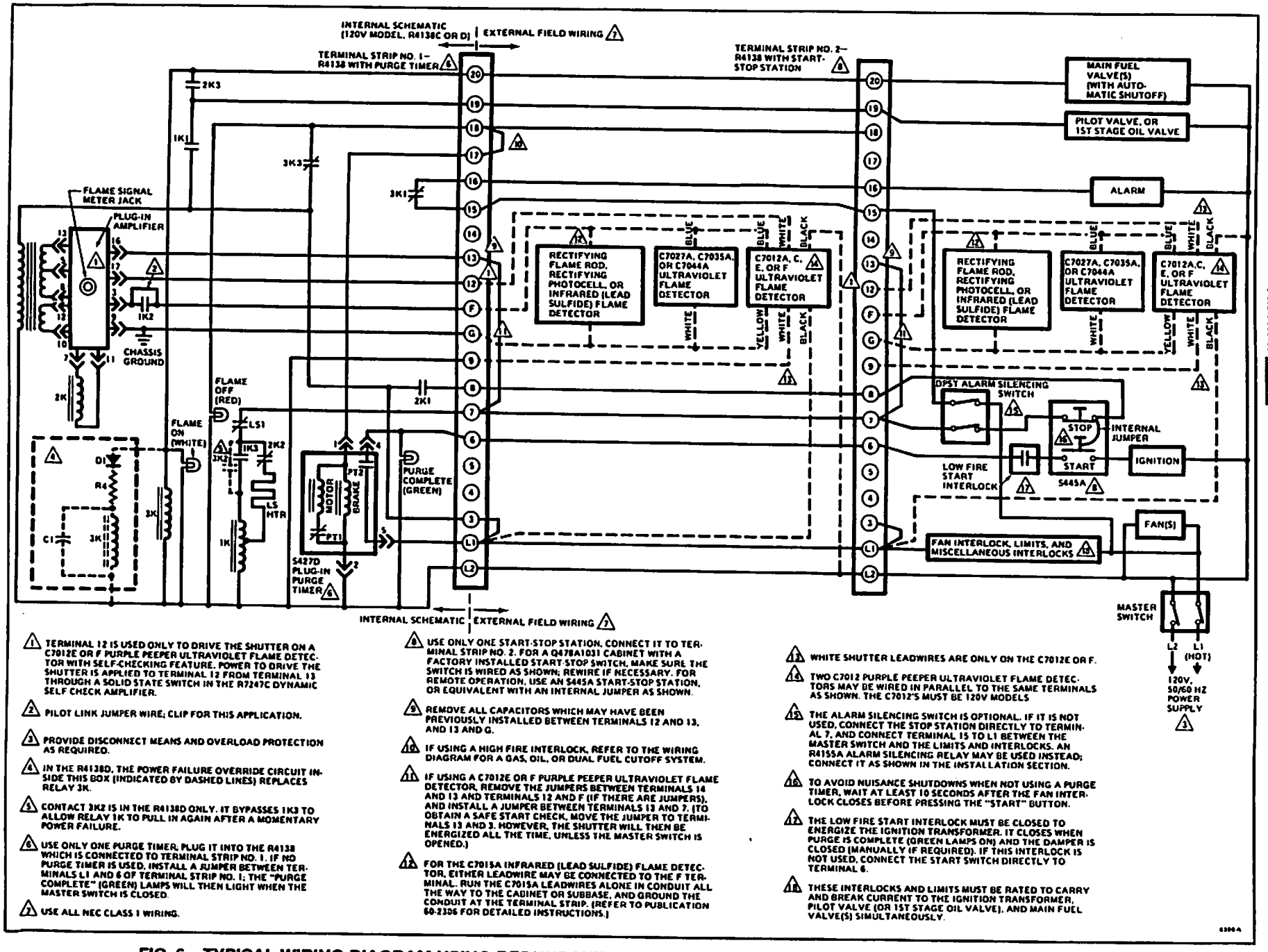
15. TO AVOID NUISANCE SHUTDOWNS WHEN NOT USING A PURGE TIMER, WAIT AT LEAST 10 SECONDS AFTER THE FAN INTERLOCK CLOSES BEFORE PRESSING THE "START" BUTTON.

16. FOR A Q478A1031 CABINET WITH A FACTORY INSTALLED START-STOP SWITCH, MAKE SURE THE SWITCH IS WIRED AS SHOWN. REWIRE IF NECESSARY. FOR REMOTE OPERATION, USE AN S445A START-STOP STATION, OR EQUIVALENT WITH AN INTERNAL JUMPER AS SHOWN.

17. THE LOW FIRE START INTERLOCK MUST BE CLOSED TO ENERGIZE RELAY 1K. IT CLOSES WHEN PURGE IS COMPLETE (GREEN LAMP ON) AND THE DAMPER IS CLOSED (MANUALLY IF REQUIRED). IF THIS INTERLOCK IS NOT USED, CONNECT THE START SWITCH DIRECTLY TO TERMINAL 6.

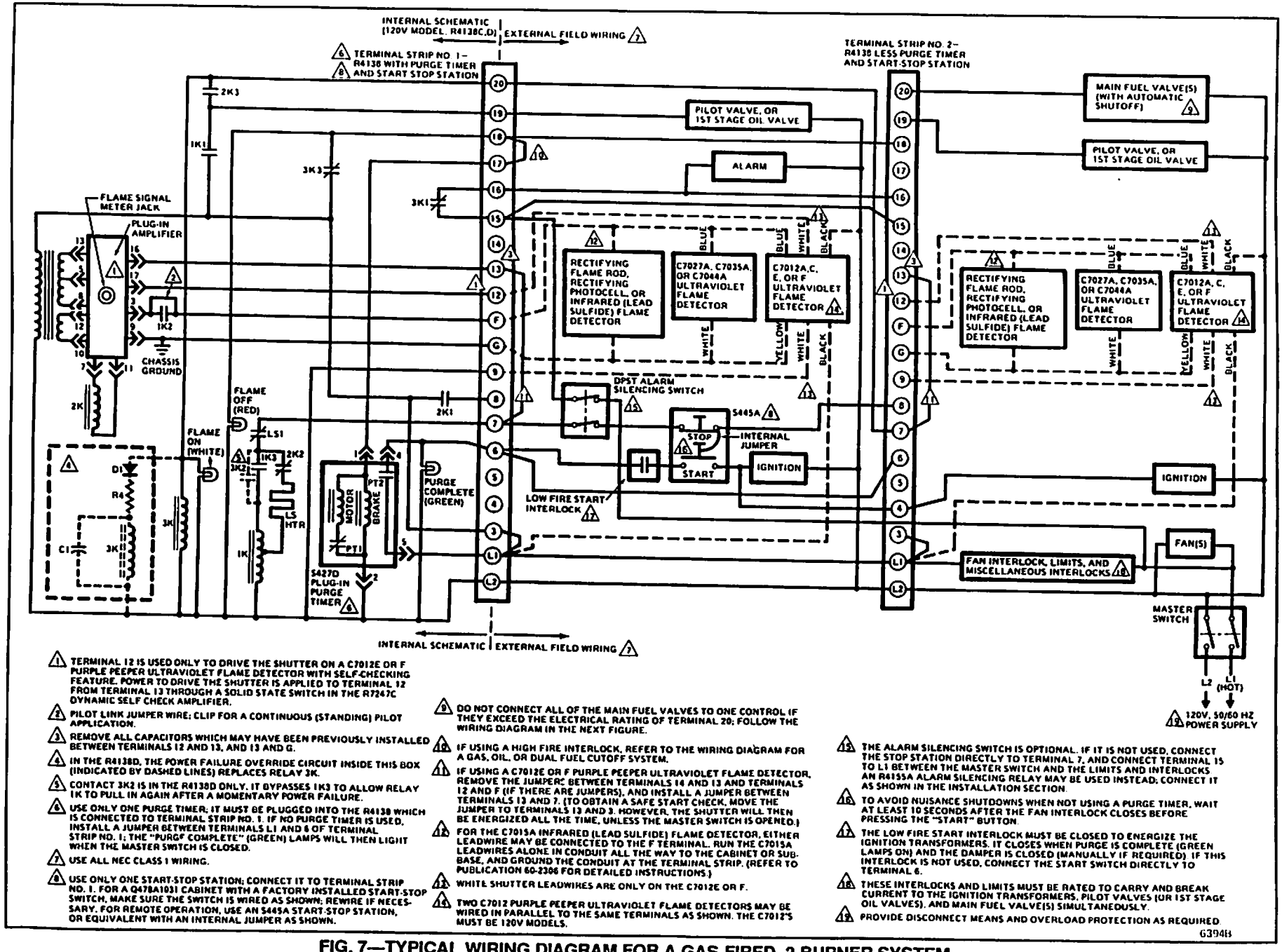
18. THESE INTERLOCKS AND LIMITS MUST BE RATED TO CARRY AND BREAK CURRENT TO THE OIL VALVE(S).

FIG. 5—TYPICAL WIRING DIAGRAM FOR A TORCH-IGNITED OIL-FIRED CUTOFF SYSTEM. REQUIRES 2 OPERATIONS: 1 TO PUSH IN THE "START" BUTTON AND



1. TERMINAL 12 IS USED ONLY TO DRIVE THE SHUTTER ON A C7012E OR F PURPLE PEEPER ULTRAVIOLET FLAME DETECTOR WITH SELF-CHECKING FEATURE. POWER TO DRIVE THE SHUTTER IS APPLIED TO TERMINAL 12 FROM TERMINAL 13 THROUGH A SOLID STATE SWITCH IN THE R7247C DYNAMIC SELF CHECK AMPLIFIER.
2. PILOT LINK JUMPER WIRE; CLIP FOR THIS APPLICATION.
3. PROVIDE DISCONNECT MEANS AND OVERLOAD PROTECTION AS REQUIRED.
4. IN THE R4138D, THE POWER FAILURE OVERRIDE CIRCUIT INSIDE THIS BOX (INDICATED BY DASHED LINES) REPLACES RELAY 3K.
5. CONTACT 3K2 IS IN THE R4138D ONLY. IT BYPASSES 1K3 TO ALLOW RELAY 1K TO PULL IN AGAIN AFTER A MOMENTARY POWER FAILURE.
6. USE ONLY ONE PURGE TIMER; PLUG IT INTO THE R4138 WHICH IS CONNECTED TO TERMINAL STRIP NO. 1. IF NO PURGE TIMER IS USED, INSTALL A JUMPER BETWEEN TERMINALS L1 AND 6 OF TERMINAL STRIP NO. 1; THE "PURGE COMPLETE" (GREEN) LAMPS WILL THEN LIGHT WHEN THE MASTER SWITCH IS CLOSED.
7. USE ALL NEC CLASS 1 WIRING.
8. USE ONLY ONE START-STOP STATION. CONNECT IT TO TERMINAL STRIP NO. 2. FOR A Q478A1031 CABINET WITH A FACTORY INSTALLED START-STOP SWITCH, MAKE SURE THE SWITCH IS WIRED AS SHOWN; REWIRE IF NECESSARY. FOR REMOTE OPERATION, USE AN S445A START-STOP STATION, OR EQUIVALENT WITH AN INTERNAL JUMPER AS SHOWN.
9. REMOVE ALL CAPACITORS WHICH MAY HAVE BEEN PREVIOUSLY INSTALLED BETWEEN TERMINALS 12 AND 13, AND 13 AND G.
10. IF USING A HIGH FIRE INTERLOCK, REFER TO THE WIRING DIAGRAM FOR A GAS, OIL, OR DUAL FUEL CUTOFF SYSTEM.
11. IF USING A C7012E OR F PURPLE PEEPER ULTRAVIOLET FLAME DETECTOR, REMOVE THE JUMPERS BETWEEN TERMINALS 14 AND 13 AND TERMINALS 12 AND F (IF THERE ARE JUMPERS), AND INSTALL A JUMPER BETWEEN TERMINALS 13 AND 7. (TO OBTAIN A SAFE START CHECK, MOVE THE JUMPER TO TERMINALS 13 AND 3. HOWEVER, THE SHUTTER WILL THEN BE ENERGIZED ALL THE TIME, UNLESS THE MASTER SWITCH IS OPENED.)
12. FOR THE C7015A INFRARED (LEAD SULFIDE) FLAME DETECTOR, EITHER LEADWIRE MAY BE CONNECTED TO THE F TERMINAL. RUN THE C7015A LEADWIRES ALONE IN CONDUIT ALL THE WAY TO THE CABINET OR SUBBASE, AND GROUND THE CONDUIT AT THE TERMINAL STRIP. (REFER TO PUBLICATION 60-2106 FOR DETAILED INSTRUCTIONS.)
13. WHITE SHUTTER LEADWIRES ARE ONLY ON THE C7012E OR F.
14. TWO C7012 PURPLE PEEPER ULTRAVIOLET FLAME DETECTORS MAY BE WIRED IN PARALLEL TO THE SAME TERMINALS AS SHOWN. THE C7012'S MUST BE 120V MODELS
15. THE ALARM SILENCING SWITCH IS OPTIONAL. IF IT IS NOT USED, CONNECT THE STOP STATION DIRECTLY TO TERMINAL 7, AND CONNECT TERMINAL 15 TO L1 BETWEEN THE MASTER SWITCH AND THE LIMITS AND INTERLOCKS. AN R4155A ALARM SILENCING RELAY MAY BE USED INSTEAD; CONNECT IT AS SHOWN IN THE INSTALLATION SECTION.
16. TO AVOID NUISANCE SHUTDOWNS WHEN NOT USING A PURGE TIMER, WAIT AT LEAST 10 SECONDS AFTER THE FAN INTERLOCK CLOSES BEFORE PRESSING THE "START" BUTTON.
17. THE LOW FIRE START INTERLOCK MUST BE CLOSED TO ENERGIZE THE IGNITION TRANSFORMER. IT CLOSES WHEN PURGE IS COMPLETE (GREEN LAMPS ON) AND THE DAMPER IS CLOSED (MANUALLY IF REQUIRED). IF THIS INTERLOCK IS NOT USED, CONNECT THE START SWITCH DIRECTLY TO TERMINAL 6.
18. THESE INTERLOCKS AND LIMITS MUST BE RATED TO CARRY AND BREAK CURRENT TO THE IGNITION TRANSFORMER, PILOT VALVE (OR 1ST STAGE OIL VALVE), AND MAIN FUEL VALVE(S) SIMULTANEOUSLY.

FIG. 6—TYPICAL WIRING DIAGRAM USING REDUNDANT PARALLEL R4138C,D FLAME SAFEGUARD CONTROLS ON 1 BURNER.



1 TERMINAL 12 IS USED ONLY TO DRIVE THE SHUTTER ON A C7012E OR F PURPLE PEEPER ULTRAVIOLET FLAME DETECTOR WITH SELF-CHECKING FEATURE. POWER TO DRIVE THE SHUTTER IS APPLIED TO TERMINAL 12 FROM TERMINAL 13 THROUGH A SOLID STATE SWITCH IN THE R7247C DYNAMIC SELF CHECK AMPLIFIER.

2 PILOT LINK JUMPER WIRE; CLIP FOR A CONTINUOUS (STANDING) PILOT APPLICATION.

3 REMOVE ALL CAPACITORS WHICH MAY HAVE BEEN PREVIOUSLY INSTALLED BETWEEN TERMINALS 12 AND 13, AND 13 AND G.

4 IN THE R4138D, THE POWER FAILURE OVERRIDE CIRCUIT INSIDE THIS BOX (INDICATED BY DASHED LINES) REPLACES RELAY 3K.

5 CONTACT 3K2 IS IN THE R4138D ONLY. IT BYPASSES 1K3 TO ALLOW RELAY 1K TO PULL IN AGAIN AFTER A MOMENTARY POWER FAILURE.

6 USE ONLY ONE PURGE TIMER; IT MUST BE PLUGGED INTO THE R4138 WHICH IS CONNECTED TO TERMINAL STRIP NO. 1. IF NO PURGE TIMER IS USED, INSTALL A JUMPER BETWEEN TERMINALS L1 AND 6 OF TERMINAL STRIP NO. 1; THE "PURGE COMPLETE" (GREEN) LAMPS WILL THEN LIGHT WHEN THE MASTER SWITCH IS CLOSED.

7 USE ALL NEC CLASS 1 WIRING.

8 USE ONLY ONE START-STOP STATION; CONNECT IT TO TERMINAL STRIP NO. 1. FOR A Q47BA1031 CABINET WITH A FACTORY INSTALLED START-STOP SWITCH, MAKE SURE THE SWITCH IS WIRED AS SHOWN; REWIRE IF NECESSARY. FOR REMOTE OPERATION, USE AN S445A START-STOP STATION, OR EQUIVALENT WITH AN INTERNAL JUMPER AS SHOWN.

9 DO NOT CONNECT ALL OF THE MAIN FUEL VALVES TO ONE CONTROL IF THEY EXCEED THE ELECTRICAL RATING OF TERMINAL 20; FOLLOW THE WIRING DIAGRAM IN THE NEXT FIGURE.

10 IF USING A HIGH FIRE INTERLOCK, REFER TO THE WIRING DIAGRAM FOR A GAS, OIL, OR DUAL FUEL CUTOFF SYSTEM.

11 IF USING A C7012E OR F PURPLE PEEPER ULTRAVIOLET FLAME DETECTOR, REMOVE THE JUMPERS BETWEEN TERMINALS 14 AND 13 AND TERMINALS 12 AND F (IF THERE ARE JUMPERS), AND INSTALL A JUMPER BETWEEN TERMINALS 13 AND 7. (TO OBTAIN A SAFE START CHECK, MOVE THE JUMPER TO TERMINALS 13 AND 3. HOWEVER, THE SHUTTER WILL THEN BE ENERGIZED ALL THE TIME, UNLESS THE MASTER SWITCH IS OPENED.)

12 FOR THE C7015A INFRARED (LEAD SULFIDE) FLAME DETECTOR, EITHER LEADWIRE MAY BE CONNECTED TO THE F TERMINAL. RUN THE C7015A LEADWIRES ALONE IN CONDUIT ALL THE WAY TO THE CABINET OR SUB-BASE, AND GROUND THE CONDUIT AT THE TERMINAL STRIP. (REFER TO PUBLICATION 60-2306 FOR DETAILED INSTRUCTIONS.)

13 WHITE SHUTTER LEADWIRES ARE ONLY ON THE C7012E OR F.

14 TWO C7012 PURPLE PEEPER ULTRAVIOLET FLAME DETECTORS MAY BE WIRED IN PARALLEL TO THE SAME TERMINALS AS SHOWN. THE C7012'S MUST BE 120V MODELS.

15 THE ALARM SILENCING SWITCH IS OPTIONAL. IF IT IS NOT USED, CONNECT THE STOP STATION DIRECTLY TO TERMINAL 7, AND CONNECT TERMINAL 15 TO L1 BETWEEN THE MASTER SWITCH AND THE LIMITS AND INTERLOCKS. AN R4155A ALARM SILENCING RELAY MAY BE USED INSTEAD; CONNECT IT AS SHOWN IN THE INSTALLATION SECTION.

16 TO AVOID NUISANCE SHUTDOWNS WHEN NOT USING A PURGE TIMER, WAIT AT LEAST 10 SECONDS AFTER THE FAN INTERLOCK CLOSES BEFORE PRESSING THE "START" BUTTON.

17 THE LOW FIRE START INTERLOCK MUST BE CLOSED TO ENERGIZE THE IGNITION TRANSFORMERS. IT CLOSES WHEN PURGE IS COMPLETE (GREEN LAMPS ON) AND THE DAMPER IS CLOSED (MANUALLY IF REQUIRED). IF THIS INTERLOCK IS NOT USED, CONNECT THE START SWITCH DIRECTLY TO TERMINAL 6.

18 THESE INTERLOCKS AND LIMITS MUST BE RATED TO CARRY AND BREAK CURRENT TO THE IGNITION TRANSFORMERS, PILOT VALVES (OR 1ST STAGE OIL VALVES), AND MAIN FUEL VALVE(S) SIMULTANEOUSLY.

19 PROVIDE DISCONNECT MEANS AND OVERLOAD PROTECTION AS REQUIRED.

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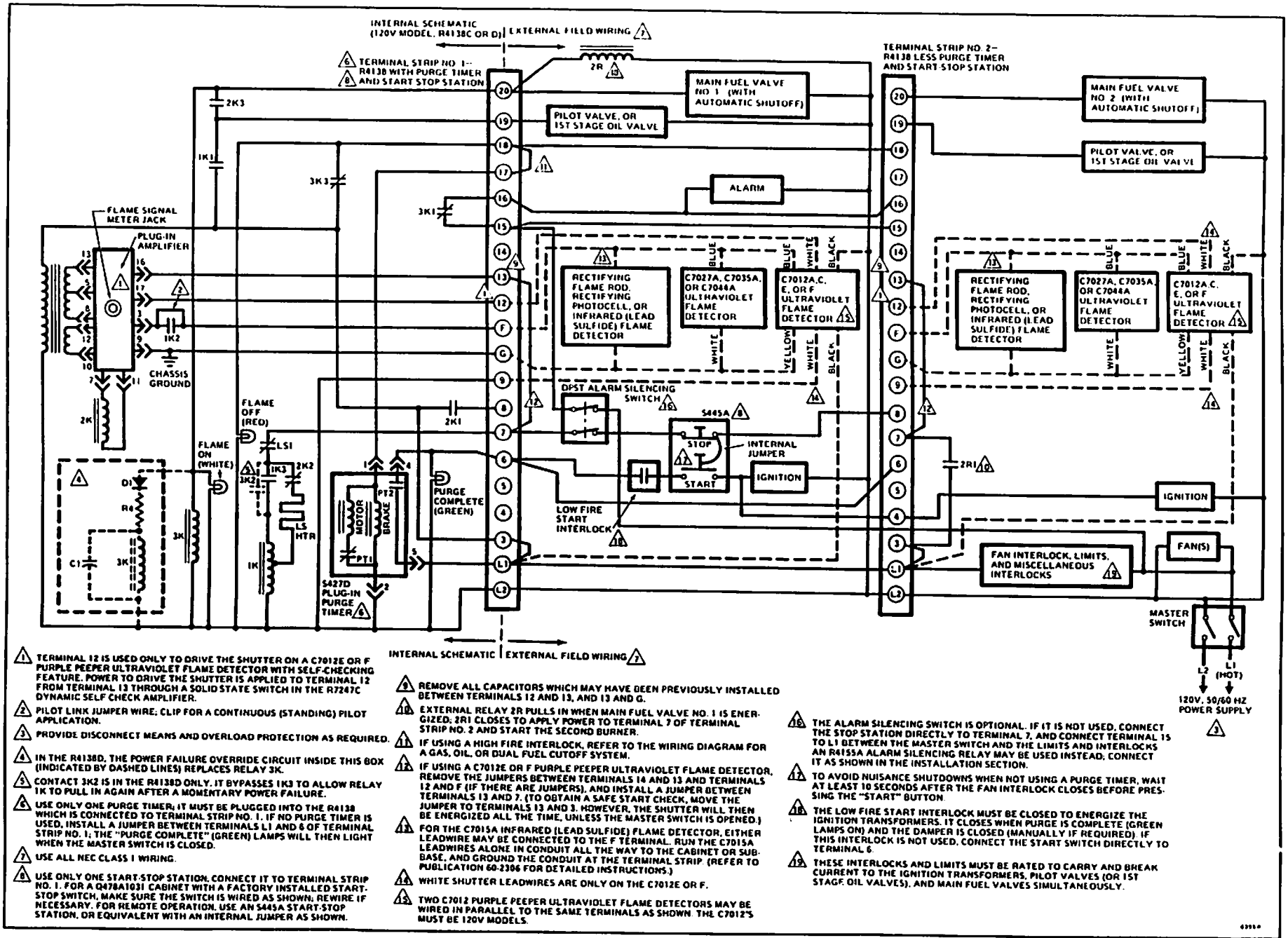
FIG. 7—TYPICAL WIRING DIAGRAM FOR A GAS-FIRED, 2 BURNER SYSTEM.

GAS-FIRED, 2 BURNER SYSTEM
Both burners shut down if either control indicates flame failure.

- Used if the main fuel valves cannot be connected to 1 control because together they exceed the electrical rating of terminal 20.
- Both burners shut down if either control indicates flame failure.



1. TERMINAL 12 IS USED ONLY TO DRIVE THE SHUTTER ON A C7012E OR F PURPLE PEEPER ULTRAVIOLET FLAME DETECTOR WITH SELF-CHECKING FEATURE. POWER TO DRIVE THE SHUTTER IS APPLIED TO TERMINAL 12 FROM TERMINAL 13 THROUGH A SOLID STATE SWITCH IN THE R7247C DYNAMIC SELF CHECK AMPLIFIER.
2. PILOT LINK JUMPER WIRE; CLIP FOR A CONTINUOUS (STANDING) PILOT APPLICATION.
3. PROVIDE DISCONNECT MEANS AND OVERLOAD PROTECTION AS REQUIRED.
4. IN THE R4138D, THE POWER FAILURE OVERRIDE CIRCUIT INSIDE THIS BOX (INDICATED BY DASHED LINES) REPLACES RELAY 3K.
5. CONTACT 3K2 IS IN THE R4138D ONLY. IT BYPASSES 1K3 TO ALLOW RELAY 1K TO PULL IN AGAIN AFTER A MOMENTARY POWER FAILURE.
6. USE ONLY ONE PURGE TIMER; IT MUST BE PLUGGED INTO THE R4138 WHICH IS CONNECTED TO TERMINAL STRIP NO. 1. IF NO PURGE TIMER IS USED, INSTALL A JUMPER BETWEEN TERMINALS L1 AND 6 OF TERMINAL STRIP NO. 1; THE "PURGE COMPLETE" (GREEN) LAMPS WILL THEN LIGHT WHEN THE MASTER SWITCH IS CLOSED.
7. USE ALL NEC CLASS 1 WIRING.
8. USE ONLY ONE START-STOP STATION. CONNECT IT TO TERMINAL STRIP NO. 1. FOR A Q478A1031 CABINET WITH A FACTORY INSTALLED START-STOP SWITCH, MAKE SURE THE SWITCH IS WIRED AS SHOWN; REWIRE IF NECESSARY. FOR REMOTE OPERATION, USE AN S445A START-STOP STATION, OR EQUIVALENT WITH AN INTERNAL JUMPER AS SHOWN.
9. REMOVE ALL CAPACITORS WHICH MAY HAVE BEEN PREVIOUSLY INSTALLED BETWEEN TERMINALS 12 AND 13, AND 13 AND G.
10. EXTERNAL RELAY 2R PULLS IN WHEN MAIN FUEL VALVE NO. 1 IS ENERGIZED; 2R1 CLOSES TO APPLY POWER TO TERMINAL 7 OF TERMINAL STRIP NO. 2 AND START THE SECOND BURNER.
11. IF USING A HIGH FIRE INTERLOCK, REFER TO THE WIRING DIAGRAM FOR A GAS, OIL, OR DUAL FUEL CUTOFF SYSTEM.
12. IF USING A C7012E OR F PURPLE PEEPER ULTRAVIOLET FLAME DETECTOR, REMOVE THE JUMPERS BETWEEN TERMINALS 14 AND 13 AND TERMINALS 12 AND F (IF THERE ARE JUMPERS), AND INSTALL A JUMPER BETWEEN TERMINALS 13 AND 7. (TO OBTAIN A SAFE START CHECK, MOVE THE JUMPER TO TERMINALS 13 AND 3. HOWEVER, THE SHUTTER WILL THEN BE ENERGIZED ALL THE TIME, UNLESS THE MASTER SWITCH IS OPENED.)
13. FOR THE C7015A INFRARED (LEAD SULFIDE) FLAME DETECTOR, EITHER LEADWIRE MAY BE CONNECTED TO THE F TERMINAL. RUN THE C7015A LEADWIRES ALONE IN CONDUIT ALL THE WAY TO THE CABINET OR SUB-BASE, AND GROUND THE CONDUIT AT THE TERMINAL STRIP. (REFER TO PUBLICATION 60-2306 FOR DETAILED INSTRUCTIONS.)
14. WHITE SHUTTER LEADWIRES ARE ONLY ON THE C7012E OR F.
15. TWO C7012 PURPLE PEEPER ULTRAVIOLET FLAME DETECTORS MAY BE WIRED IN PARALLEL TO THE SAME TERMINALS AS SHOWN. THE C7012'S MUST BE 120V MODELS.
16. THE ALARM SILENCING SWITCH IS OPTIONAL. IF IT IS NOT USED, CONNECT THE STOP STATION DIRECTLY TO TERMINAL 7, AND CONNECT TERMINAL 15 TO L1 BETWEEN THE MASTER SWITCH AND THE LIMITS AND INTERLOCKS. AN R4155A ALARM SILENCING RELAY MAY BE USED INSTEAD; CONNECT IT AS SHOWN IN THE INSTALLATION SECTION.
17. TO AVOID NUISANCE SHUTDOWNS WHEN NOT USING A PURGE TIMER, WAIT AT LEAST 10 SECONDS AFTER THE FAN INTERLOCK CLOSES BEFORE PRESSING THE "START" BUTTON.
18. THE LOW FIRE START INTERLOCK MUST BE CLOSED TO ENERGIZE THE IGNITION TRANSFORMERS. IT CLOSES WHEN PURGE IS COMPLETE (GREEN LAMPS ON) AND THE DAMPER IS CLOSED (MANUALLY IF REQUIRED). IF THIS INTERLOCK IS NOT USED, CONNECT THE START SWITCH DIRECTLY TO TERMINAL 6.
19. THESE INTERLOCKS AND LIMITS MUST BE RATED TO CARRY AND BREAK CURRENT TO THE IGNITION TRANSFORMERS, PILOT VALVES (OR 1ST STAGE OIL VALVES), AND MAIN FUEL VALVES SIMULTANEOUSLY.

FIG. 8—TYPICAL WIRING DIAGRAM FOR A GAS-FIRED, 2 BURNER SYSTEM TO PREVENT OVERLOADING OF CONTACTS WHEN 2 SAFETY SHUTOFF VALVES ARE REQUIRED.

INSTALLING THE FLAME DETECTOR

Proper flame detector installation is the basis of a safe and reliable flame safeguard installation. Refer to the instructions packed with the flame detector and to the burner manufacturer's instructions. Follow the instructions carefully to make the best possible application of flame detector.

Keep the flame signal leadwire from the flame detector to the terminal strip or wiring subbase as short as possible. Capacitance increases with leadwire length, reducing the signal strength. The maximum permissible leadwire length depends on the type of flame detector, leadwire, and conduit. *The ultimate limiting factor in flame signal leadwire length is the signal current. Refer to Table 3 in the CHECK-OUT section.*

WIRING THE FLAME DETECTOR

Wiring connections for the flame detectors are shown on Figs. 4-8 for most applications.

For normal installations, use moisture-resistant No. 14 wire suitable for at least 167° F [75° C].

For high temperature installations, use Honeywell Spec. No. R1298020 or equivalent for the "F" leadwire. (This wire is rated up to 400° F [204° C] for continuous duty. It is tested for operation up to 600 volts and breakdown up to 7500 volts.) For the other leadwires, use moisture-resistant No. 14 wire selected for a temperature rating above the maximum operating temperature.

All wiring must be NEC Class 1 and conform to local electrical codes, ordinances, and regulations. If the leadwires aren't long enough to reach the terminal strip, splices must be made in a junction box.

SPECIAL CONSIDERATIONS FOR THE C7012E OR F

Two sources of power must be provided for the C7012E or F Purple Peeper Ultraviolet Flame Detector (with self-checking shutter). The power to the *black* leadwires of the C7012E may be 120 V, 208 V, 220 V, or 240 Vac, depending on the model of the detector. The C7012F is available only in a 120 V model. This voltage must match the power supply of the flame safeguard control. The power to the *white* leadwires *must* be 120 Vac; this is the power supply for the operation of the self-checking shutter.

For 120 V models of the R4138; the line power supply feeds the white shutter leadwires directly through switching action within the plug-in R7247C Flame Signal Amplifier.

USING REDUNDANT PARALLEL C7012E OR F DETECTORS

For a flame that is difficult to sight, using 2 parallel C7012E or F Flame Detectors will reduce nuisance shutdowns. If only one of the parallel detectors loses the flame signal, the other will still indicate the presence of the flame and will keep the burner running. A *flame-simulating failure in either detector will cause the burner to shut down.* Two C7012E or F detectors may be wired in parallel to the same terminals on 120 Volt flame safeguard controls. To avoid

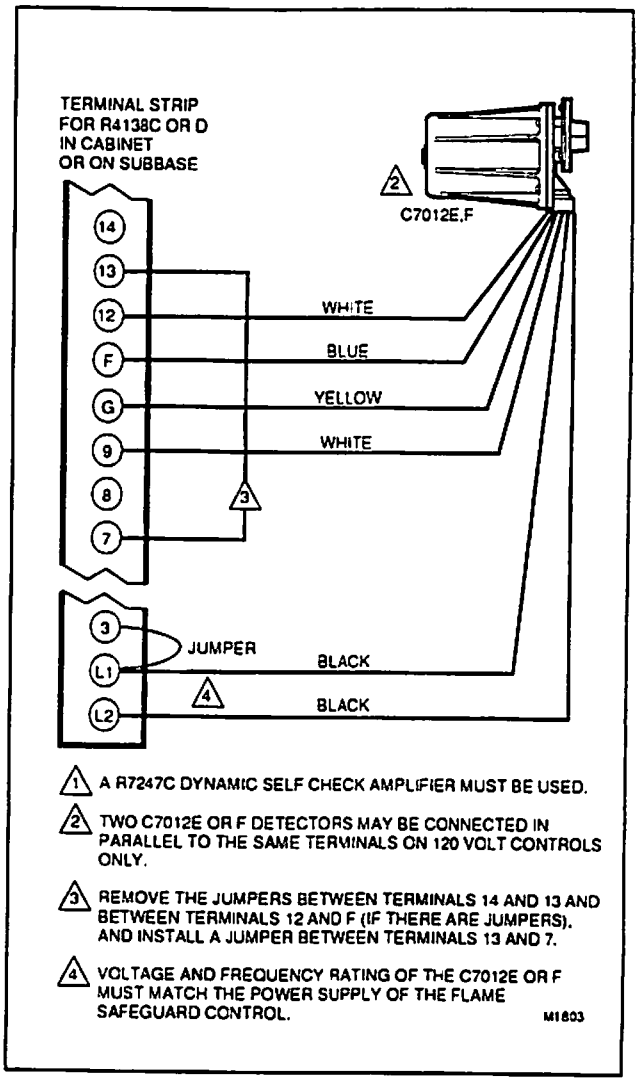


FIG. 9—WIRING DIAGRAM (120 VOLT R4138 MODELS ONLY) FOR MOUNTING A C7012E OR F FLAME DETECTOR.

exceeding the rating of the solid state shutter switch in the R7247C Flame Signal Amplifier, *do not connect more than two C7012E or F detectors in parallel.*

INSTALLING AN OPTIONAL R4155A ALARM SILENCING RELAY (FIG. 10)

For 120 Volt, 60 Hz models of the R4138, an R4155A Alarm Silencing Relay may be used instead of the dpst alarm silencing switch shown in Figs. 4 through 8. Wire the R4155A as shown in Fig. 10 on the next page. For mounting instructions, refer to the R4155A instruction sheet, form 60-2314.

The R4155A operates as follows:

1. When the master switch is closed, power is applied to terminal 16 through 3K1.

2. The alarm is energized through 3R2, and the RED indicating lamp lights.

3. Pressing the push button energizes the coil, 3R; 3R1 closes and 3R2 opens.

4. When 3R2 opens, the alarm is de-energized.

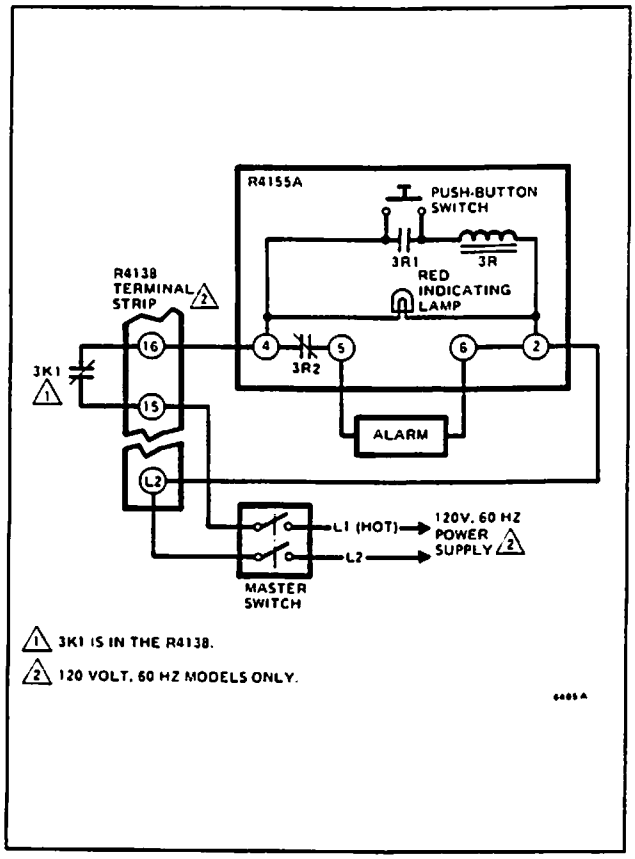


FIG. 10—WIRING DIAGRAM FOR AN R4155A ALARM SILENCING RELAY (120 V, 60 HZ MODELS ONLY.)

5. When the push button is released, 3R is held in through 3K1 and 3R1.

6. The alarm is now off, but the RED indicating lamp is still on.

7. When flame is detected, relay 3K in the R4138 pulls in and 3K1 opens and 3R2 closes; the R4155A is reset.

8. The RED indicating lamp goes out and 3R drops out; 3R1 opens and 3R2 closes; the R4155A is reset.

9. If the flame goes out, 3K in the R4138 drops out and 3K1 closes, applying power to terminal 16.

10. The alarm is energized and the RED indicating lamp lights.

STATIC CHECKOUT (TABLE 2)

After checking all wiring circuits, perform this checkout *before* installing the R4138 in the cabinet or on the subbase. These tests ensure that the terminal strip (in the cabinet or on the subbase) is wired correctly, and that the external switches; limits; actuators, valves, transformers, and other devices are operating properly.

CAUTION

1. Use utmost care while performing these tests; line voltage is present on many terminals when power is on.
2. Open the master switch before installing or removing a test jumper.
3. Be sure to remove the test jumper(s) after completing each test before continuing to the next test.
4. Replace all external devices not operating properly. Do not bypass external devices.
5. Close all manual fuel shutoff valves before starting these tests.

EQUIPMENT REQUIRED

1. Voltmeter (W136A or equivalent)—set on 0 to 300 Vac scale.

2. Jumper wires (2)—No. 14 wire, insulated, 12 inches [304.8 mm] long, with alligator clips at both ends.

GENERAL INSTRUCTIONS

1. Perform all tests in Table 2, on the next 2 pages, in the order listed. *Those in italics are for special applications.*

2. Make sure all manual fuel shutoff valves are closed.

3. Make sure the master switch is open before beginning.

4. Close the alarm silencing switch (if used).

5. For each test; open the master switch and install the jumper wire(s) between the terminals listed under TEST JUMPERS.

6. Close the master switch before observing operation.

7. Read the voltage between the terminals listed under VOLTMETER.

8. If there is no voltage or operation is abnormal, check the circuits and external devices as described in the last column.

9. Check all wiring in the circuits for correct connections, tight terminal screws, correct wire, and proper wiring techniques. Replace all worn or incorrectly sized wires.

10. Replace faulty switches, limits, actuators, valves, transformers, and other devices, as required.

11. Normal operation must be obtained for each required test before continuing the checkout.

12. Be sure to remove the test jumper(s) after completing each test before continuing to the next test.

TABLE 2—STATIC TESTS OF EXTERNAL DEVICES.

TEST NO.	MODELS	TEST JUMPERS	VOLT-METER	NORMAL OPERATION	IF OPERATION IS ABNORMAL, CHECK THE ITEMS LISTED BELOW
		CAUTION Make sure all manual fuel shutoff valves are closed.			1. Make sure that: a. the jumper is installed between terminals L1 and 3 on the terminal strip. b. the master switch is closed. c. power is connected to the master switch. d. overload protection (fuse, circuit breaker, etc.) has not opened the power line. e. the fan interlock, limits, and miscellaneous interlocks are closed. If open, determine the cause(s) and correct the condition(s). **IMPORTANT** Low Fuel pressure limits, if used, *could be open.* If so, bypass them with jumpers for the rest of the Static Tests.
1	All models	—	3-L2	1. Line voltage at terminal 3. 2. The fan(s) starts.	2. Make sure that: a. the manual switch for the fan is closed. b. the fan power supply, overload protection, and starter are functioning properly. c. the fan(s) is operating properly.
	120 V models only	3-7	13-L2	3. *If using a C7012E or F Purple Peeper Ultraviolet Flame Detector, move the voltmeter leadwire from terminal 3 to terminal 13. Line voltage should be measured.* **CAUTION** Line voltage is present.	3. *Make sure a jumper is installed between terminals 13 and 7 on the terminal strip.*
2	All models	15-16	—	Alarm (if used) is energized.	1. Make sure that: a. the alarm silencing switch (if used) is closed, or the R4155A Alarm Silencing Relay (if used) is reset. b. the alarm is functioning properly.
3	Only if using a high fire interlock	3-18	17-L2	1. With the system at *low fire*, no voltage at terminal 17. 2. With the system at *high fire*, line voltage at terminal 17.	1. Make sure that: a. the 1R1 contacts are open. b. relay 1R is not pulled in. c. the high fire interlock is open. d. the damper is closed. 2. Make sure that: a. the high fire interlock is closed. b. the damper is open.
		3-18 and L1-6	17-L2	3. With the system at *low fire*, line voltage at terminal 17.	3. Make sure that: a. the 1R1 contacts are closed. b. relay 1R is pulled in. c. relay 1R is installed properly.
	If *not* using a high fire interlock	3-18	17-L2	Line voltage at terminal 17.	1. Make sure that a jumper is installed between terminals 17 and 18.

(continued on page 20)

TABLE 2—STATIC TESTS OF EXTERNAL DEVICES *(continued)*.

TEST NO.	MODELS	TEST JUMPERS	VOLT-METER	NORMAL OPERATION	IF OPERATION IS ABNORMAL, CHECK THE ITEMS LISTED BELOW
4	All models	L1-6	7-L2	**WARNING** **Make sure all manual fuel shutoff valves are closed.** Push in the START button and hold it in. 1. Line voltage at terminal 7. 2. Ignition transformer is energized. Release the START button. 3. No voltage at terminal 7. 4. Ignition transformer is de-energized.	1. Make sure that: a. the low fire start interlock (if used) is closed. b. the damper is closed (low fire position). c. the internal jumper is installed in the S445A (or equivalent). d. the START switch is making contact. e. the STOP switch is making contact. f. the alarm silencing switch (if used) is closed. 2. Watch for spark or listen for buzz. Make sure that the ignition electrodes are clean. 3. Make sure that the START switch is open. 4. Observe that the spark goes out and/or the buzz stops. If not, make sure that the ignition transformer is wired correctly and is functioning properly.
5	All models	3-8	7-L2	1. Line voltage at terminal 7. Push in the STOP button and hold it in. 2. No voltage at terminal 7.	1. Make sure that: a. The STOP switch is making contact. b. The alarm silencing switch (if used) is closed. 2. Make sure that the STOP switch is open.
6	All models	3-19	—	Automatic pilot valve (or 1st stage oil valve if using direct spark ignition) opens.	1. Listen for click or feel head of valve for activation. 2. Make sure that the actuator (if used) ad the pilot valve (or 1st stage oil valve) are operating properly.
7	All models	3-20	—	**WARNING** **Make sure all manual fuel shutoff valves are closed.** Automatic main fuel valve(s) opens.	1. Listen for and observe operation of the main fuel valve(s) and actuator(s). Make sure that they are operating properly.
8	All models	None	—	Automatic pilot valve (or 1st stage oil valve) and main fuel valve(s) are closed. **CAUTION** Upon completing these tests, open the master switch, remove the test jumper between terminals 3 and 20 on the terminal strip, and remove bypass jumpers from the low fuel pressure limits (if used).	1. Make sure that the valve(s) and actuator(s) are operating properly.

INSTALLING THE R4138 (FIGS. 11, 12 AND 13)

1. If you are using the R4138 in a continuous (standing) pilot application, clip the pilot link jumper wire (Fig. 11). It must be clipped so that the system can start while the pilot flame is being detected.

2. If you are using the R4138 in a redundant parallel system, clip the pilot link jumper wire (Fig. 11). In a redundant parallel system, either of the R4138's may be removed while the system is running. If it is replaced while the burner is firing, the R4138 cannot start because the detector is sensing flame (safe start check). Clipping the pilot link jumper wire will allow the R4138 to start. If using a C7012E or F Purple Peeper Ultraviolet Flame Detector or a rectifying flame rod with an R7247 Dynamic Self Check Amplifier, all electronic components in the flame detection system will be tested in the first checking cycle.

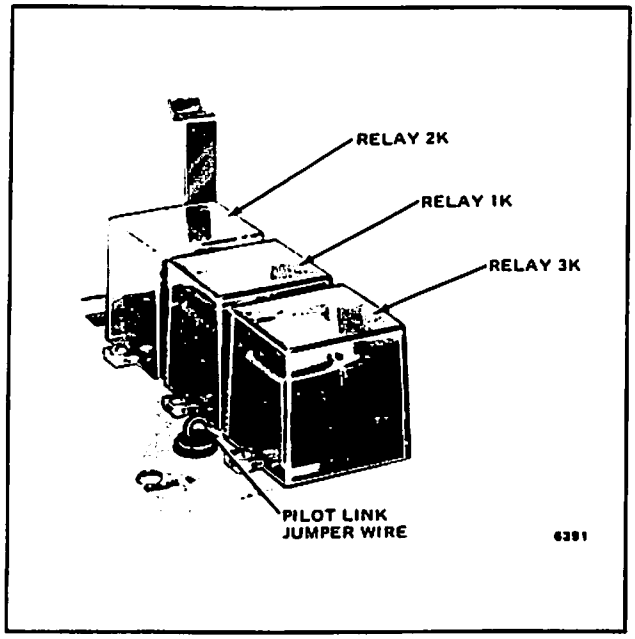


FIG. 11—PILOT LINK JUMPER WIRE.

3. Open the master switch.

4. Make sure no wiring is projecting outward from the terminal strip. Tuck wiring in against the back of the cabinet or subbase so it does not interfere with the contacts.

5. Grasp the handle of the R4138 chassis and insert the 2 ears (at the top and bottom along the left side) into the slots at the top and bottom of the terminal strip (Fig. 12).

6. Swing the chassis inward until the knife-blade contacts on the control engage the spring connectors alongside the terminal strip. Push in until the contacts are fully engaged.

7. Insert the chassis retaining screw (Fig. 13) into the threaded stud on the subbase or in the cabinet, and tighten it securely.

REMOVING THE R4138 (FIGS. 12 AND 13)

1. Open the master switch.

2. Disconnect the optional remote reset assembly (if used).

3. Loosen the chassis retaining screw completely from the threaded stud (Fig. 13).

4. Pull outward on the handle until the knife-blade contacts on the control disengage from the spring connectors alongside the terminal strip.

5. Disengage the 2 ears on the chassis from the slots at the top and bottom of the terminal strip (Fig. 12).

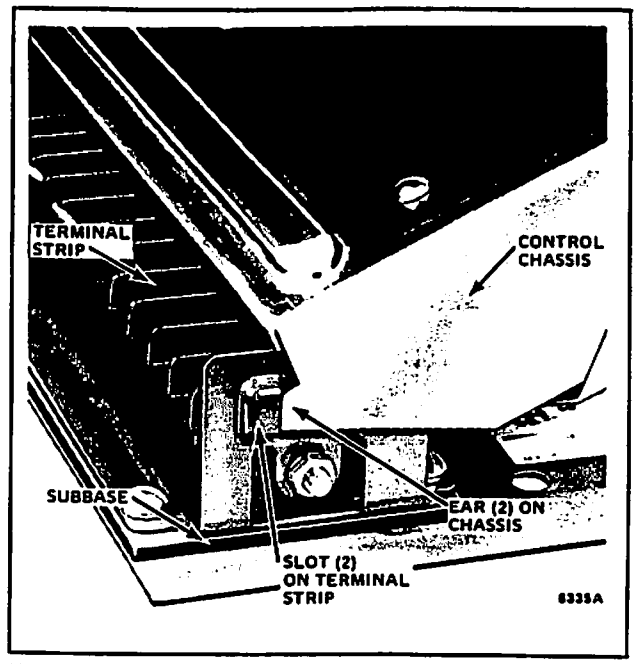


FIG. 12—INSERTING EARS (ON R4138) INTO SLOTS AT TOP AND BOTTOM OF TERMINAL STRIP.

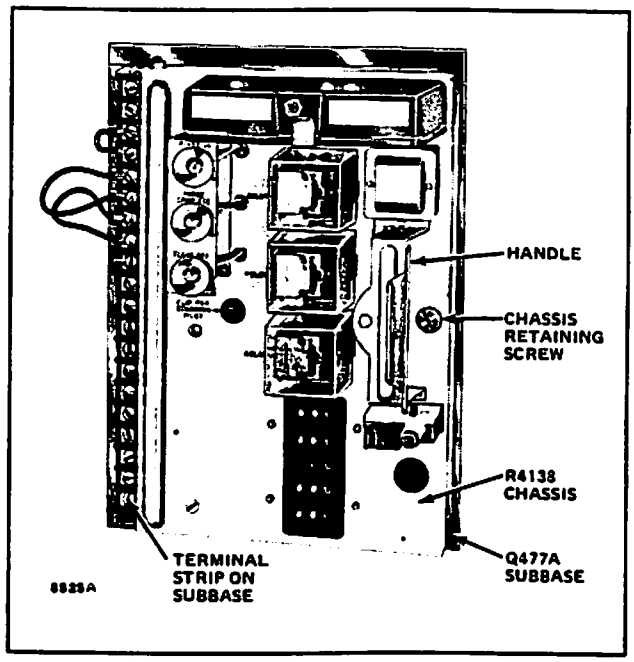


FIG. 13—R4138 INSTALLED ON A Q477A SUBBASE.

INSTALLING A PLUG-IN FLAME SIGNAL AMPLIFIER (FIG. 14)

1. Make sure the amplifier nameplate is on the outside. Then align the circuit board with the keyed receptacle at the top of the R4138 chassis.

2. Push in the amplifier until the circuit board is fully inserted into the receptacle.

3. Make sure the spring clip on the R4138 chassis fits over the amplifier and that the amplifier is firmly in place.

NOTE: For further information about self-checking amplifiers, refer to the R7247B,C instruction sheet, form 60-2358, or to the R7248B instruction sheet, form 60-2357, packed with the amplifier.

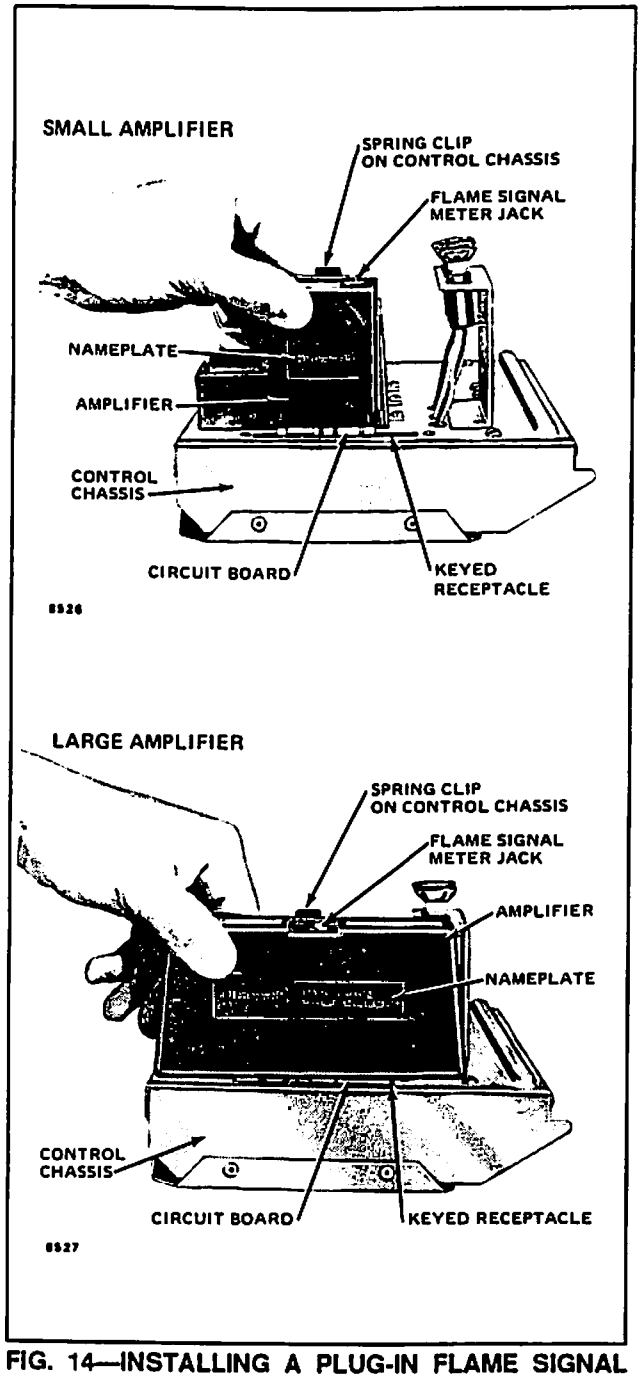


FIG. 14—INSTALLING A PLUG-IN FLAME SIGNAL AMPLIFIER.

INSTALLING AN S427D PURGE TIMER (FIGS. 15, 16, AND 17)

IMPORTANT

The purge timer must be mounted on a vertical surface or inaccurate timing will result.

1. Make sure the purge timer is rated for 120 V.

NOTE: If a 60 Hz timer is used on a 50 Hz power supply, the timings will be lengthened by factor of 1.2.

2. Open the master switch.
3. Align the 5 connector pins on the purge timer with the receptacle just below the 3K relay on the R4138 (Fig. 15).
4. Push in the purge timer until the connector pins are fully inserted into the receptacle.

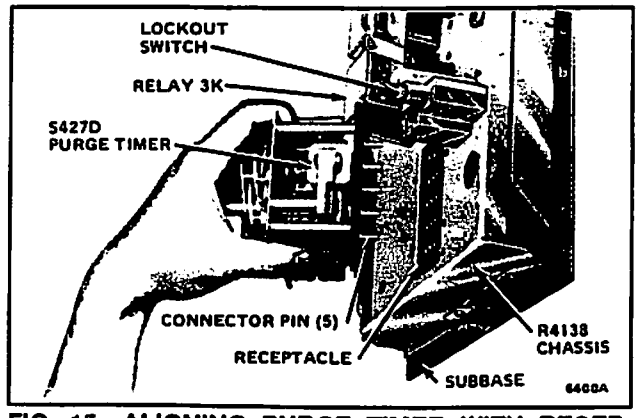


FIG. 15—ALIGNING PURGE TIMER WITH RECEPTACLE.

5. Insert the 2 mounting screws (Fig. 16) in the mounting holes (Fig. 17) and tighten them securely.

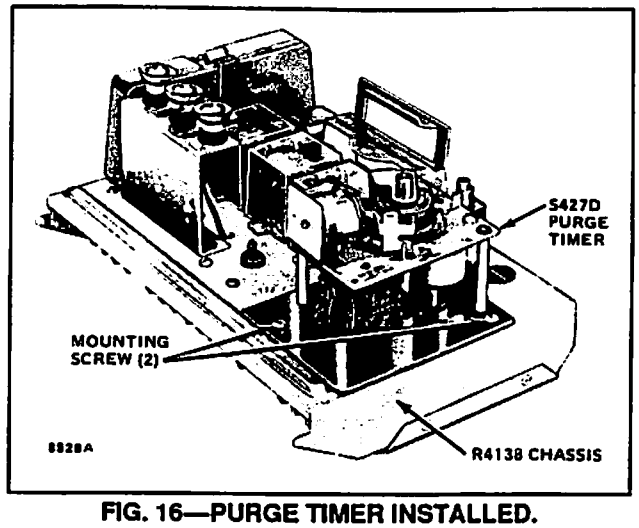


FIG. 16—PURGE TIMER INSTALLED.

6. Set the required timing period (Fig. 17).
   a. Loosen the locking screw located just under the scale.
   b. Slide the adjustment bar until the timing indicator is opposite the desired point on the scale.
   c. Tighten the locking screw.

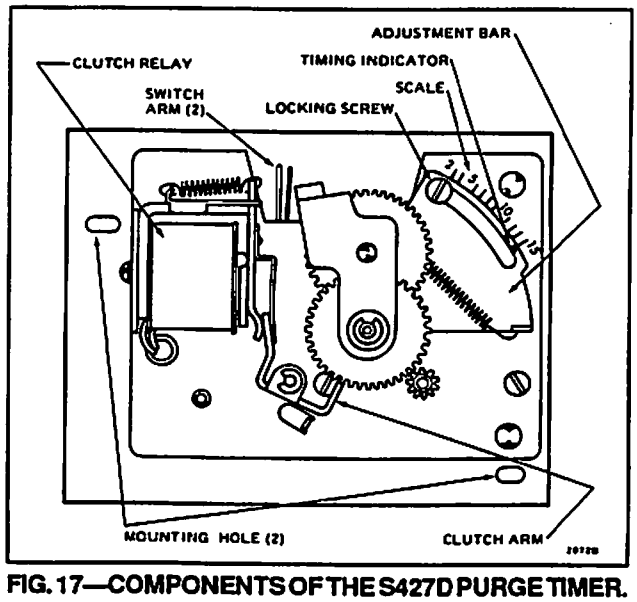


FIG. 17—COMPONENTS OF THE S427D PURGE TIMER.

INSTALLING AN OPTIONAL REMOTE RESET ASSEMBLY, PART NO. 118811B (FIGS. 18, 19, AND 20)

IMPORTANT

This reset assembly must be used only with a 120 volt, 60 Hz power supply.

1. Open the master switch.
2. Insert the nut and washer on the remote reset assembly into the hole in the chases just below the lockout switch on the R4138 (Fig. 18).

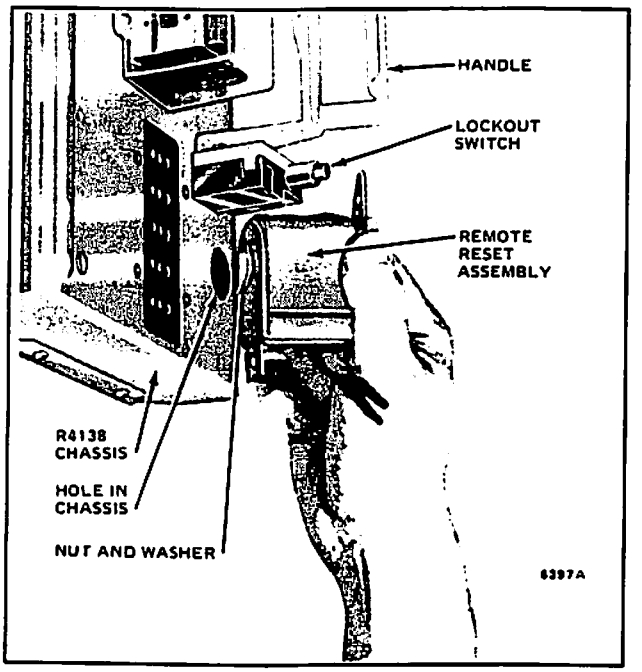


FIG. 18—INSTALLING A REMOTE RESET ASSEMBLY.

3. Make sure the washer engages the inside lip of the hole.
4. Slide the remote reset assembly upward (as shown by the arrow) as far as it will go.
5. Insert the mounting screw and tighten it securely (Fig. 19).

IMPORTANT

Make sure that there is a minimum of 1/4 inch [6.4 mm] clearance between the solenoid arm and the lockout switch reset button when the lockout switch is reset.

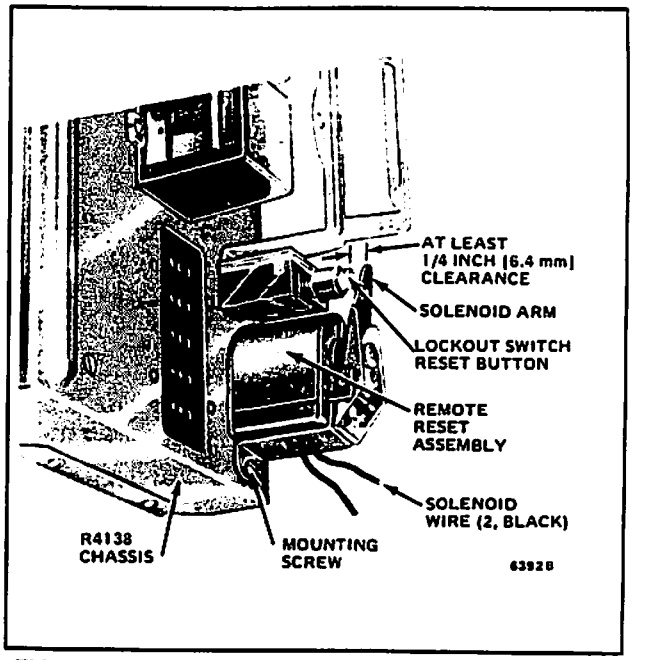


FIG. 19—REMOTE RESET ASSEMBLY INSTALLED.

6. Using wire nuts, connect the 2 black wires from the remote reset solenoid to a momentary push-button switch and a 120 V, 60 Hz power supply (Fig. 20).

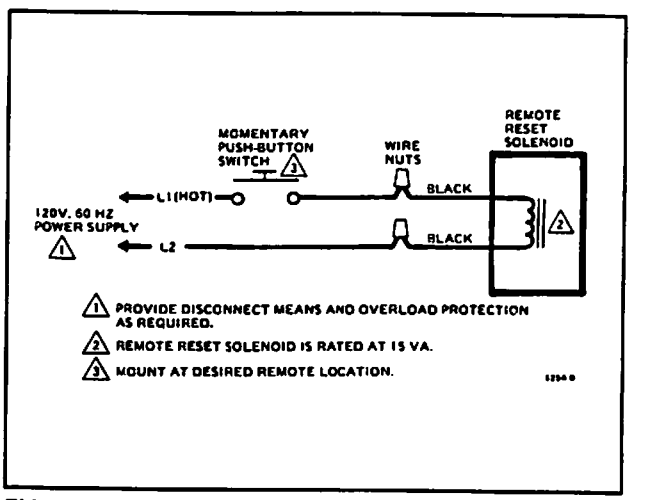


FIG. 20—WIRING DIAGRAM FOR A REMOTE RESET ASSEMBLY, PART NO. 118811B (120 V, 60 HZ ONLY).

CHECKOUT

WARNING

Do not allow fuel to accumulate in the combustion chamber. If fuel is allowed to enter the chamber for longer than a few seconds without igniting, an explosive mixture could result. It is recommended that you limit the trial for pilot to 10 seconds, and limit the attempt to light the main burner to 5 seconds. In any case, do not exceed the normal lightoff time specified by the burner manufacturer; close the manual fuel shutoff valves if the flame is not burning at the end of the specified time.

CAUTION

1. Use utmost care while testing the R4138; line voltage is present on most terminals when power is on.
2. Open the master switch before removing the R4138 from the cabinet or subbase, before reinstalling the R4138, before installing or removing any jumpers, and before making any adjustments.
3. Make sure all manual fuel shutoff valves are closed before starting the Initial Lightoff Check and the Pilot Turndown Test.
4. If low fuel pressure limits are bypassed for any of the tests, make sure you remove the jumpers from these limits before putting the system into service.
5. Do not put the system into service until you have satisfactorily completed all applicable tests described in this Checkout section and any others required by the burner manufacturer.

IMPORTANT

a. If the system fails to perform properly, note the point at which trouble occurs and refer to the TROUBLESHOOTING section.
b. Repeat ALL required Checkout tests after all adjustments have been made. ALL tests must be satisfied with the flame detector(s) in its FINAL position(s).

EQUIPMENT REQUIRED

1. Voltmeter (Honeywell W136A or equivalent)—with 0 to 300 Vac scale.
2. Microammeter (Honeywell W136A or equivalent)—with 0 to 25 microamp range and SPL scale with damping.
3. Meter connector plug—Part No. 196146 or equivalent.
4. Jumper wires (2)—No. 14 wire, insulated, 12 inches [304.8 mm] long, with alligator clips at both ends.
5. Watch or clock—with second hand.
6. Manometer (or pressure gauge)—to measure pilot gas pressure.
7. Thermometer or thermocouple—to measure temperature at the flame detector(s).
8. Orifice plates (aperture discs) or filters—as necessary to adjust sensitivity of flame detector(s).

CHECKOUT SUMMARY

The following list summarizes the checkout tests required for each type of installation. Instructions for each test are included in this section; also consult the burner installation instructions.

- Preliminary Inspection—all installations.
- Flame Signal Measurement—all installations.
- Initial Lightoff Check for Proved Pilot—all installations using a pilot.
- Initial Lightoff Check for Direct Spark Ignition of Oil—oil burners not using a pilot.
- Pilot Turndown Test—all installations using a pilot.
- Ignition Interference Test—all installations using flame rods.
- Hot Refractory Saturation Test—all installations using infrared (lead sulfide) flame detectors.
- Hot Refractory Hold-in Tests—all installations using ultraviolet (Purple Peeper or Minipeeper) flame detectors.
- Ultraviolet Response Tests—all installations using ultraviolet (Purple Peeper or Minipeeper) flame detectors.
- Flame Signal with Hot Combustion Chamber—all installations.
- Safety Shutdown Tests—all installations.

Refer to Figs. 4 through 8 for terminal locations, and to Fig. 21 for locations of component parts.

PRELIMINARY INSPECTION
(ALL INSTALLATIONS)

Perform this inspection to avoid common problems. Make certain that:

1. Wiring connections are correct and all terminal screws are tight.
2. Flame detector(s) is clean, and it is installed and positioned properly. Consult the appropriate instruction sheet.
3. Correct combination of amplifier and flame detector(s) is used. Refer to Table 1 in the SPECIFICATIONS section.
4. Voltage rating of the flame detector(s) matches the power supply of the R4138.
5. Spring clip on R4138 chassis is holding the plug-in flame signal amplifier securely in the receptacle.
6. Pilot link jumper wire is clipped if you are using a continuous (standing) pilot or a redundant parallel system.
7. Purge timer is rated for 120 V.
8. Purge timer is set for the desired timing period.
9. Lockout switch is reset (push in lockout switch reset button, Fig. 21).
10. Burner is completely installed and ready to fire (consult burner manufacturer's instructions); fuel lines are purged of air.
11. Combustion chamber and flues are clear of fuel and fuel vapor.
12. Power is connected to the system disconnect switch (master switch).
13. All limits and interlocks are reset.

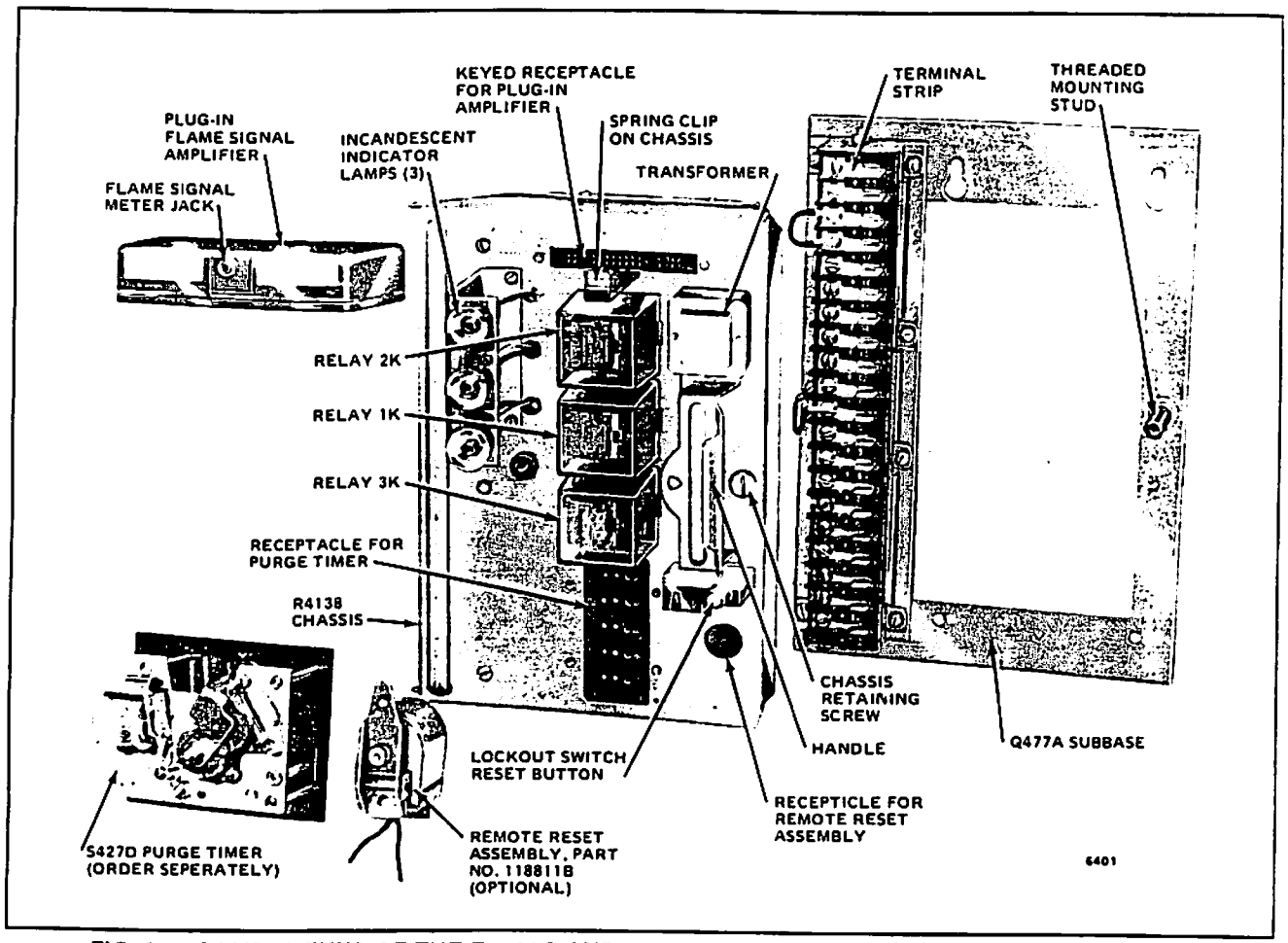


FIG. 21—COMPONENTS OF THE R4138C AND D INDUSTRIAL FLAME SAFEGUARD CONTROLS.

FLAME SIGNAL MEASUREMENT—FIG. 22 AND TABLE 3 (ALL INSTALLATIONS)

Measure the flame signal at the appropriate times defined in the following tests. Read the flame signal in microamps at the meter jack on the plug-in flame signal amplifier.

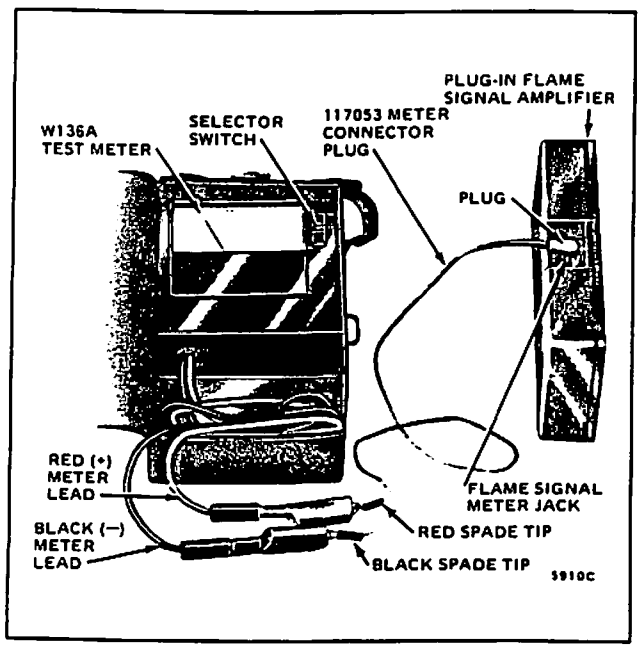


FIG. 22—MEASURING THE FLAME SIGNAL.

1. Use a Honeywell W136A Test Meter. (If a W136A is not available, a microammeter with a 0 to 25 microamp dc range may be used.)
2. Set the selector switch on the test meter to:
   25μA—for all standard amplifiers (R7247A, R7248A, and R7249A) or for an R7248B Dynamic Ampli-Check™ Infrared Amplifier.
   OR
   SPL—for an R7247B or C Dynamic Self Check Rectification Amplifier. (If the test meter is not a W136A, shunt the 0 to 25 microamp dc range with a 50 microfarad capacitor.)
3. Use a 117053 Meter Connector Plug. (It may be ordered separately.) Connect its RED spade tip to the RED (+) meter lead and its BLACK spade tip to the BLACK (–) meter lead.
4. Insert the plug into the flame signal meter jack and allow a few seconds for the meter reading to stabilize.
5. Read the average *stable* current. For an R7247B or C Dynamic Self Check Rectification Amplifier, disregard the peaks due to self-checking operation. The red flame indicating lamp on a self-checking amplifier should blink—
   — about 2-1/2 to 4 times a second on an R7247B.
   — about 1 to 2 times a second on an R7247C.
   — at the same rate that the flame is flickering (may be as high as 20 times a second) on an R7248B.

   If the lamp is ON or OFF continuously while reading the flame signal, replace the amplifier.
6. The meter reading must be as specified in Table 3 after all tests have been completed and all adjustments have been made.

TABLE 3—FLAME SIGNAL

FLAME DETECTOR	FLAME SIGNAL AMPLIFIER	MINIMUM ACCEPTABLE STEADY CURRENT[a] (MICROAMPERES)	MAXIMUM CURRENT EXPECTED (MICROAMPERES)
Rectifying Flame Rod	R7247A (Green)	2	5
	R7247B (Green; self check)	1-1/4	2-1/2
Rectifying Photocell	R7247A (Green)	2	5[b]
	R7247B (Green; Self check)[c]	1-1/4	2-1/2
C7012A,C Ultraviolet (Purple Peeper)	R7247A (Green)	2	6
	R7247B (Green; Self check)[c]	2	4
C7012E,F Ultraviolet (Purple Peeper)[d]	R7247C (Green; Self check)	2[d]	7
C7015A Infrared (Lead Sulfide Cell)	R7248A (Red)2-1/4[e]	5	
	R7248B (Red; Ampli-check)	3-1/2[e]	5
C7027A, C7035A, or C7044A Ultraviolet (Minipeeper)	R7249A (Purple)	3-1/2	7-1/2

[a]This minimum or stronger signal should easily be obtained if the detector is correctly installed and positioned to sense flame properly. This current must be obtained before completing checkout.

[b]Do not permit signal to exceed 5 microamperes as it would shorten photocell life, reduce signal by use of orifices (aperture discs) or filters as necessary.

[c]If using a rectifying photocell or a C7012A or C with an R7247B, the circuitry tests only the flame signal amplifier during burner operation and shuts down the burner if the amplifier fails.

[d]Shutter operation of the C7012E or F causes fluctuations in the current reading. Read the average stable current, disregarding the peaks.

[e]The lead sulfide cells are available in 2 ranges of sensitivity: 104662B (yellow), Low; 104662D (orange), high sensitivity. If a sufficiently strong signal cannot otherwise be obtained, try a different cell of the same range. If necessary, substitute a cell of higher sensitivity.

If the signal is unstable, or less than the minimum acceptable current, check the flame detector installation and circuitry.

1. Check the supply voltage at the master switch.
2. Check the detector wiring for defects, including—
   — wrong type or size of wire.
   — deteriorated wire.
   — open circuits.
   — short circuits.
   — leakage paths caused by moisture, soot, or accumulated dirt.
3. For a flame rod, make sure—
   — there is enough ground area.
   — the flame rod is located in the flame properly.
   — temperature at the flame rod insulator is no greater than 500° F [260° C].
   — ignition interference is not present (see Ignition Interference Test in this section).
4. For all other detectors, clean the detector lens, filter, viewing window, and sighting pipe (as applicable).
5. For a C7012A,C,E, or F Purple Peeper Ultraviolet Flame Detector, replace the 113236 and 115330/520 Electron Tubes (unless the detector is a solid state model).
6. Check that the temperature at the detector does not exceed its maximum rated temperature.
7. Make sure that the flame adjustment is not too lean.
8. Make sure that the detector is sighting the flame properly.
9. If necessary, resight or reposition the detector.

If you cannot obtain proper operation, replace the plug-in amplifier. If you still cannot obtain proper operation, replace the flame detector.

INITIAL LIGHTOFF CHECK FOR PROVED PILOT (ALL INSTALLATIONS USING A PILOT)

Perform this check on all installations using a pilot. It should immediately follow the preliminary inspection.

NOTE: Low fuel pressure limits, if used, *could be open.* If so, bypass them with jumpers during this check.

1. Open the master switch.
2. Make sure the manual main fuel shutoff valve(s) is closed. Open the manual pilot shutoff valve.
3. Reset the lockout switch and all limits and interlocks.
4. Close the master switch. The fan(s) should start and the alarm (if used) should be energized. (The alarm may be turned off by opening the alarm silencing switch, or by pressuring the push button on the R4155A Alarm Silencing Relay, if either is used.)
5. If a high fire interlock is used, open the damper to high fire position (if manually operated). The purge period should begin.
6. When the PURGE COMPLETE (GREEN) lamp lights, close the damper to low fire position (if manually operated). The low fire start interlock (if used) must be closed before the ignition can be energized.
7. Close the alarm silencing switch (if it was opened in step 4). The alarm should be energized. (If the push button on an R4155A alarm Silencing Relay was pressed in step 4, the alarm won't be energized until shutdown.)
8. Start the system by pushing in the START button and holding it in.
9. Spark should occur and the pilot should ignite. If it ignites, the FLAME ON (WHITE) lamp should light, and the alarm (if on) should be de-energized. If the FLAME ON lamp lights, release the START button and proceed to step 12.
10. If the pilot flame is not established and the FLAME ON (WHITE) lamp does not light in 10 seconds, release the START button.
11. Wait approximately 1 minute and push in the START button again. If the pilot still does not ignite within 10 seconds, release the START button. Make the following ignition/pilot adjustments.
    a. *Open the master switch.*
    b. Jumper terminal L1 on the terminal strip directly to the ignition terminal at the START switch.
    c. Close the master switch to energize the ignition transformer only.

ne ignition spark is not strong and continuous, *pen the master switch* and adjust the ignition electrode spark gap setting to the manufacturer's recommendation. Make sure the ignition electrodes are clean. Then close the master switch and observe the spark.

e. Once a continuous spark is obtained, run through the purge period (steps 4 through 7). Then push in the START button to energize both the ignition transformer and the pilot valve.
f. If the pilot does not ignite and if the ignition spark is still continuous, hold in the START button and adjust the pilot gas pressure regulator until a pilot is established.

NOTE: This step requires 2 people—one to hold in the START button and one to adjust the regulator.

IMPORTANT

If the START button is held in longer than the lockout switch timing (15 seconds nominal) without igniting the pilot, safety shutdown will occur. The lockout switch must be *manually* reset before you can restart the system.

g. When the pilot ignites properly and stays ignited, and the FLAME ON (WHITE) lamp lights, *open the master switch and remove the jumper* from terminal L1 to the ignition.
h. Repeat steps 4 through 9.

12. When the pilot ignites and the FLAME ON (WHITE) lamp lights, measure the flame signal. If necessary, adjust the flame or detector to give a proper flame signal.

13. Push the STOP button to shut off the pilot. Run through the purge period (steps 4 through 7). Then push the START button to restart the system. When the pilot ignites; release the START button and recheck the pilot flame signal.

14. Make sure the automatic main fuel valve(s) opens; then *smoothly* open the manual main fuel shutoff valve (and manually opened safety shutoff valve, if used) and watch for main burner flame ignition. When the main burner flame is established, proceed to step 20.

NOTE: This step requires 2 people—one to open the manual valve(s) and one to watch for ignition.

15. If the main burner flame is not established within 5 seconds, or within the normal lightoff time specified by the burner manufacturer, *close the manual main fuel shutoff valve(s) and open the master switch.*

16. Check all burner adjustments.

17. Run through the purge period (steps 4 through 7). Push in the START button, ignite the pilot, and release the START button when the FLAME ON (WHITE) lamp lights. *Smoothly* open the manual main fuel shutoff valve(s) and try lightoff again. The first attempt may have been required to purge the lines and bring sufficient fuel to the burner.

18. If the main burner flame is not ignited within 5 seconds, *close the manual main fuel shutoff valve(s) and open the master switch.*

19. Repeat steps 16 through 18 to establish the main burner flame.

20. When the main burner flame is established, make burner adjustments for flame stability and input rating.

21. Shut down the system by pushing in the STOP button. *Make sure the pilot and main burner flames go out and all automatic fuel valves close. If used, remove the bypass jumpers from the low fuel pressure limits.*

22. Run through the purge period (steps 4 through 7) and restart the system by pushing in the START button. Observe that the pilot and main burner flames are established within the normal lightoff time specified by the burner manufacturer. Then release the START button.

23. Measure the flame signal. Continue to check for the proper signal (Table 3) into the run period. Check the signal at both high and low firing rate positions and while modulating, if applicable.

24. Run the burner through another sequence, observing the flame signal for—
- — pilot alone (unless using direct spark ignition).
- — pilot and main burner flame together, and
- — main burner flame alone (unless monitoring intermittent or continuous pilot).

Also observe the time to light the main burner.

25. Make sure all readings are in the required ranges before proceeding.

INITIAL LIGHTOFF CHECK FOR DIRECT SPARK IGNITION OF OIL (OIL BURNERS NOT USING A PILOT)

This check applies for oil burners not using a pilot. It should immediately follow the preliminary inspection.

NOTE: Low fuel pressure limits, if used, *could be open.* If so, bypass them with jumpers during this check.

1. Open the master switch.

2. Complete the normal "ready-to-fire" checkout of the oil supply and equipment as recommended by the burner manufacturer.

3. Close all manual fuel shutoff valves. Check that the automatic fuel valves are closed. *Make sure oil is not entering the combustion chamber.*

4. Reset the lockout switch and all limits and interlocks.

5. Close the master switch. The fan(s) should start and the alarm (if used) should be energized. (The alarm may be turned off by opening the alarm silencing switch, or by pressing the push button on the R4155A Alarm Silencing Relay, if either is used.)

6. If a high fire interlock is used, open the damper to high fire position (if manually operated). The purge period should begin.

7. When the PURGE COMPLETE (GREEN) lamp lights, close the damper to low fire position (if manually operated). The low fire start interlock (if used) must be closed before the ignition can be energized.

8. Close the alarm silencing switch (if it was opened in step 5). The alarm should be energized. (If the push button on an R4155A Alarm Silencing Relay was pressed in step 5, the alarm won't be energized until shutdown.)

9. Start the system by pushing in the START button and holding it in.

IMPORTANT

If the START button is held in longer than the lockout switch timing (15 seconds nominal), safety shutdown will occur. The lockout switch must be manually reset before you can restart the system.

10. Watch for ignition spark and listen for the click of the 1st stage oil solenoid. If spark occurs, hold in the START button and proceed to step 12.

11. If ignition spark does not occur, release the START button. Adjust the ignition electrodes as follows:
- a. *Open the master switch.*
- b. Jumper terminal L1 on the terminal strip directly to the ignition terminal at the START switch.
- c. Close the master switch to energize the ignition transformer only.

d. If the ignition spark is not strong and continuous, *open the master switch* and adjust the ignition electrode spark gap setting to the manufacturer's recommendation. Make sure the ignition electrodes are clean. Then close the master switch and observe the spark.
e. Once a continuous spark is obtained, *open the master switch* and remove the jumper from terminal L1 to the ignition.
f. Repeat steps 5 through 9.

12. Hold in the START button to obtain ignition spark and then *smoothly* open the manual 1st stage shutoff valve(s).

NOTE: This step requires 2 people—one to hold in the START button and one to open the manual valve(s).

13. Watch for the burner flame to be established. If it is, the FLAME ON (WHITE) lamp should light, and the alarm (if on) should be de-energized. If the FLAME ON lamp lights, release the START button and proceed to step 19.

14. If the burner flame is not established within 5 seconds, or within the normal lightoff time specified by the burner manufacturer, release the START button, *close the manual shutoff valve(s), and open the master switch.*

15. Check all burner adjustments.

16. Run through the purge period (steps 5 through 8). Push in the START button to energize the ignition. Then *smoothly* open the manual 1st stage shutoff valve(s) and try lightoff again. The first attempt may have been required to purge the lines and bring sufficient oil to the burner.

NOTE: This step requires 2 people—one to hold in the START button and one to open the manual valve(s).

IMPORTANT

If the START button is held in longer than the lockout switch timing (15 seconds nominal), safety shutdown will occur. The lockout switch must be manually reset before you can restart the system.

10. Watch for ignition spark and listen for the click of the 1st stage oil solenoid. If spark occurs, hold in the START button and proceed to step 12.

11. If ignition spark does not occur, release the START button. Adjust the ignition electrodes as follows:

a. *Open the master switch.*
b. Jumper terminal L1 on the terminal strip directly to the ignition terminal at the START switch.
c. Close the master switch to energize the ignition transformer only.
d. If the ignition spark is not strong and continuous, *open the master switch* and adjust the ignition electrode spark gap setting to the manufacturer's recommendation. Make sure the ignition electrodes are clean. Then close the master switch and observe the spark.
e. Once a continuous spark is obtained, *open the master switch* and remove the jumper from terminal L1 to the ignition.
f. Repeat steps 5 through 9.

12. Hold in the START button to obtain ignition spark and then *smoothly* open the manual 1st stage shutoff valve(s).

NOTE: This step requires 2 people—one to hold in the START button and one to open the manual valve(s).

13. Watch for the burner flame to be established. If it is, the FLAME ON (WHITE) lamp should light, and the alarm (if on) should be de-energized. If the FLAME ON lamp lights, release the START button and proceed to step 19.

14. If the burner flame is not established within 5 seconds, or within the normal lightoff time specified by the burner manufacturer, release the START button, *close the manual shutoff valve(s), and open the master switch.*

15. Check all burner adjustments.

16. Run through the purge period (steps 5 through 8). Push in the START button to energize the ignition. Then *smoothly* open the manual 1st stage shutoff valve(s) and try lightoff again. The first attempt may have been required to purge the lines and bring sufficient oil to the burner.

NOTE: This step requires 2 people—one to hold in the START button and one to open the manual valve(s).

17. If the burner flame is not established within 5 seconds, release the START button, *close the manual shutoff valve(s),* and *open the master switch.*

18. Repeat steps 15 through 17 to establish the burner flame. When the FLAME ON (WHITE) lamp lights, release the START button.

19. When the 1st stage burner flame is established, make burner adjustments for flame stability and input rating. *If a 2nd stage is used, make sure the automatic 2nd stage oil valve has opened.*

20. Shut down the system by pushing in the STOP button. *Make sure the burner flame goes out and all automatic oil valves close. If used, remove the bypass jumpers from the low fuel pressure limits.*

21. *If a 2nd stage is used,* check the lightoff as follows. Otherwise proceed to step 22.

a. Open the manual 2nd stage oil valve.
b. Run through the purge period (steps 5 through 8) and restart the system by pushing in the START button.
c. When the 1st stage burner flame is established, watch for the automatic 2nd stage oil valve(s) to open. Observe that the 2nd stage lights off properly.

NOTE: This step requires 2 people—one to hold in the START button and one to watch for lightoff of the 2nd stage.

d. Release the START button.
e. Make burner adjustments for flame stability and input rating.
f. Shut down the system by pushing in the STOP button. *Make sure the burner flames go out and all automatic oil valves close.*
g. Proceed to step 22.

22. Run through the purge period (steps 5 through 8) and restart the system by pushing in the START button. Observe that the burner flame(s) is established within the normal lightoff time specified by the burner manufacturer. Then release the START button.

23. Measure the flame signal. Continue to check for the proper signal (Table 3) into the run period. Check the signal at both high and low firing rate positions and while modulating, if applicable. Any pulsating or unsteady readings will require further adjustments.

24. Make sure all readings are in the required ranges before proceeding.

PILOT TURNDOWN TEST (ALL INSTALLATIONS USING A PILOT)

Perform this check on all installations using a pilot. It should immediately follow the initial lightoff check. The

purpose of this test is to ensure that the main burner can be lighted by the smallest pilot flame that will hold in the 2K (flame) relay. Clean the flame detector(s) to ensure that it will detect the smallest acceptable pilot flame.

NOTE: Low fuel pressure limits, if used, *could be open.* If so, bypass them with jumpers during this test.

1. Open the master switch.
2. Close the manual main fuel shutoff valve(s).
3. Connect a manometer (or pressure gauge) to measure pilot gas pressure during the turndown test.
4. Open the manual pilot shutoff valve.
5. Reset the lockout switch and all limits and interlocks.
6. Close the master switch. The fan(s) should start and the alarm (if used) should be energized. (The alarm may be turned off by opening the alarm silencing switch, or by pressing the push button on the R4155A Alarm Silencing Relay, if either is used.)
7. If a high fire interlock is used, open the damper to high fire position (if manually operated). The purge period should begin.
8. When the PURGE COMPLETE (GREEN) lamp lights, close the damper to low fire position (if manually operated). The low fire start interlock (if used) must be closed before the ignition can be energized.
9. Close the alarm silencing switch (if it was opened in step 6). The alarm should be energized. (If the push button on an R4155A Alarm Silencing Relay was pressed in step 6, the alarm won't be energized until shutdown.)
10. Start the system by pushing in the START button and holding it in. When the pilot ignites, relay 2K should pull in, the FLAME ON (WHITE) lamp should light, and the alarm (if on) should be de-energized. Release the START button.
11. Turn the pilot pressure down very slowly, reading the manometer (or gauge) as it drops. Stop instantly when relay 2K drops out. Note the pressure at dropout point. The pilot is at the turndown position.
12. Open the master switch and reset the timing period on the S427D Purge Timer to its minimum value. (See Installing an S427D Purge Timer, in the INSTALLATION section.)
13. Run through the purge period (steps 6 through 9).
14. Push in the START button and hold it in. Turn up the pilot pressure until the pilot ignites and relay 2K pulls in. Then release the START button.

NOTE: This step requires 2 people—one to hold in the START button and one to adjust the pilot pressure.

15. Repeat step 11 to verify the pilot gas pressure reading at the exact point of relay 2K dropout.
16. Repeat steps 13 and 14 to pull in 2K, and then slowly turn down the pilot pressure to obtain a pressure reading just above the dropout point.
17. Open the master switch and reset the timing period on the S427D Purge Timer to the required value.

CAUTION!

Make sure the purge timer is set for the required purge period before trying to light the main burner.

18. Run through the purge period (steps 6 through 9).
19. Push in the START button. When the pilot ignites and the FLAME ON (WHITE) lamp lights, release the START button.
20. Make sure the automatic main fuel valve(s) opens; then *smoothly* open the manual main fuel shutoff valve (and manually opened safety shutoff valve, if used) and watch for main burner flame ignition. If the main burner flame is established, proceed to step 27.

NOTE: This step requires 2 people—one to open the manual valve(s) and one to watch for ignition.

21. If the main burner flame is not established within 5 seconds, or within the normal lightoff time specified by the burner manufacturer, *close the manual main fuel shutoff valve(s) and open the master switch.*
22. Check all burner adjustments.
23. Run through the purge period (steps 6 through 9). Push in the START button, ignite the pilot, and release the START button when the FLAME ON (WHITE) lamp lights. Repeat steps 20 and 21 (try lightoff once more).
24. If the second attempt is unsuccessfully, adjust the flame detector position so that a larger pilot is required to hold in flame relay 2K. This may require relocating the flame detector to sense further out on the pilot flame, or adding an orifice plate.
25. Measure the pilot flame signal after adjusting the flame detector to make sure it is stable and above the minimum (see Table 3).
26. Repeat steps 5 through 25 until the main burner positively lights with the pilot flame just holding in flame relay 2K.
27. Shut down the system by pushing in the STOP button. Repeat the lightoff of the main burner several times (steps 18 through 21) with the pilot at turndown.
28. When the main burner lights reliably with the pilot at turndown, disconnect the manometer (or gauge) and turn the pilot up to normal. *If used, remove the bypass jumpers from the low fuel pressure limits.*
29. Run the system through another cycle to check for normal operation.

IGNITION INTERFERENCE TEST (ALL FLAME RODS)

Test to make certain that a false signal from a spark ignition system is not superimposed on the flame signal.

Ignition interference can subtract from (decrease) or add to (increase) the flame signal. If it decreases the flame signal enough, it will cause safety shutdown (relay 2K will not pull in and the R4138 will act as though the pilot has not been ignited). If it increases the flame signal, it could cause relay 2K to pull in when the true flame signal is below the minimum acceptable value.

TEST

Start the burner and measure the flame signal with both ignition and pilot on (hold the START button), and then with the pilot only (release START button). Any significant difference (greater than 1/2 microamp) indicates ignition interference.

TO ELIMINATE IGNITION INTERFERENCE

1. Make sure there is enough ground area.
2. Be sure the ignition electrode and the flame rod are on opposite sides of the ground area.
3. Check for correct spacing on the ignition electrode:
   6,000 V systems—1/16 to 3/32 inch [1.6 to 2.4 millimetres].
   10,000 V systems—1/8 inch [3.2 millimetres].
4. Make sure the leadwires from the flame rod and ignition electrode are not too close together anywhere.
5. Replace any deteriorated leadwires.
6. If the problem cannot be eliminated, you may have to change to an ultraviolet flame detection system.

HOT REFRACTORY SATURATION TEST (ALL INFRARED DETECTORS)

Test to make certain that radiation from hot refractory does not mask the flickering radiation of the flame itself.

Start the burner and monitor the flame signal during the warmup period. A decrease in signal strength as the refractory heats up indicates hot refractory saturation. If saturation is extreme, the flame relay 2K will drop out and the system will shut down as through a flame failure has occurred.

If hot refractory saturation occurs, the condition must be corrected. Add an orifice plate ahead of the cell to restrict the viewing area. If this doesn't work, resight the detector at a cooler, more distant background. You can also try lengthening the sighting pipe or decreasing the pipe size (diameter). Continue adjustments until hot refractory saturation is eliminated.

HOT REFRACTORY HOLD-IN TEST (RECTIFYING PHOTOCELLS OR INFRARED DETECTORS)

Test to make certain that hot refractory will not cause flame relay 2K to stay pulled-in after the burner flame goes out. This condition would delay response to flame failure and also would prevent a system restart as long as a hot refractory is detected.

First check the plug-in flame signal amplifier by initiating a burner cycle. Terminate the firing cycle while the refractory is at a low temperature by pushing in the STOP button. Measure the time it takes for the flame relay 2K to drop out after the flame goes out. (Watch or listen to the flame relay to determine when it drops out.) If the flame relay fails to drop out within 4 seconds, open the master switch and replace the amplifier.

To check rectifying photocells for hot refractory hold-in, operate the burner until the refractory reaches its maximum temperature, then terminate the firing cycle by pushing in the STOP button. (Do not open the master switch.) Visually observe when the burner flame goes out. After the flame goes out, measure the time it takes for the flame relay 2K to drop out. (Watch or listen to the flame relay to determine when it drops out.) If the flame relay fails to drop out within 4 seconds, the photocell is sensing hot refractory. This condition must be corrected as described in the last paragraph of this test.

Infrared (lead sulfide) detectors can respond to infrared rays emitted by a hot refractory, even when the refractory has visibly ceased to glow. Infrared radiation from a hot refractory is steady, whereas radiation from a flame has a flickering characteristic. The infrared detection system responds only to a flickering infrared radiation; it can reject a steady signal from hot refractory. The refractory's steady signal can be made to fluctuate if it is reflected, bent, or blocked by smoke or fuel mist within the combustion chamber. Care must be taken when applying an infrared system to ensure its response to flame only.

To check infrared (lead sulfide) detectors for hot refractory hold-in, operate the burner until the refractory reaches its maximum temperature. If the installation has a multifuel burner, burn the fuel most likely to reflect, bend, or obscure the hot refractory's steady infrared radiation. (Burn solids instead of liquids, or liquids instead of gases.) When the maximum refractory temperature is reached, close *all* manual fuel shutoff valves, or open the electrical circuits of *all* automatic fuel valves. Visually observe when the burner flame goes out. After the flame goes out, measure the time it takes for the flame relay 2K to drop out. (Watch or listen to the flame relay to determine when it drops out.) If the flame relay fails to drop out within 4 seconds, the infrared detector is sensing hot refractory. Immediately terminate the firing cycle by pushing in the STOP button. (Do not open the master switch.)

NOTE: Some burners continue to purge their oil lines between the valve(s) and nozzle(s) even through the fuel valve(s) is closed. Termination of the firing cycle (instead of opening the master switch) will allow purging of the combustion chamber, if available. This will reduce a buildup of fuel vapors in the combustion chamber caused by oil line purging.

If the detector is sensing hot refractory, the condition must be corrected. Add an orifice plate ahead of the cell to restrict the viewing area of the detector. If this doesn't work, resight the detector at a cooler, more distant part of the combustion chamber. While resighting the detector, keep in mind that it must also sight the flame properly. For an infrared detector, you can also try lengthening the sighting pipe or decreasing the pipe size (diameter). Refer to the C7015A instruction sheet, form 60-2306, for detailed instructions. Continue adjustments until hot refractory hold-in is eliminated.

ULTRAVIOLET RESPONSE TESTS (ALL ULTRAVIOLET DETECTORS)

IGNITION SPARK RESPONSE TEST

Test to make certain that ignition spark is not actuating flame relay 2K.

1. Close the pilot and main burner manual shutoff valves.
2. Run through the purge period and push in the START button to energize the ignition transformer. Ignition spark should occur, but relay 2K must not pull in. The flame signal should not be more than 1/4 microamp.
3. If relay 2K does pull in, resight the detector farther out from the spark, or away from possible reflection. It may be necessary to construct a barrier to block the ignition spark from the detector's view. Continue adjustments until the flame signal due to ignition spark is less than 1/4 microamp.

NOTE: Honeywell's Q624A Solid State Spark Generator will prevent detection of ignition spark when properly applied with flame detection systems using C7027, C7035, or C7044 Minipeeper Ultraviolet Flame Detectors. The Q624A is for use only with gas pilots.

RESPONSE TO OTHER ULTRAVIOLET SOURCES

Some sources of artificial light produce small amounts of ultraviolet radiation. Under certain conditions, an ultraviolet detector will respond to them as if it is sensing a flame. DO NOT USE AN ARTIFICIAL LIGHT SOURCE TO CHECK THE RESPONSE OF AN ULTRAVIOLET DETECTOR. To check for proper detector operation, flame failure response tests should be conducted under all operating conditions.

FLAME SIGNAL WITH HOT COMBUSTION CHAMBER (ALL INSTALLATIONS)

With all initial startup tests and burner adjustments completed, operate the burner until the combustion chamber is at maximum expected temperature. (Observe the burner manufacturer's warmup instructions.) Recycle the burner under these hot conditions and measure the flame signal. Check the pilot alone, the main burner flame alone, and both together (unless monitoring only the pilot flame when using an intermittent or continuous pilot, or only the

1st stage oil flame when using direct spark ignition). Check the signal at both high and low firing rate positions and while modulating, if applicable.

Also check the flame failure response time. Push in the STOP button, and observe the time it takes flame relay 2K to drop out after the burner flame goes out. (2K should drop out within 4 seconds.)

If the flame signal is too low or unsteady, check the flame detector temperature. Relocate the detector if the temperature is too high. If necessary, realign the sighting to obtain the proper signal and response time. If the response time is still too slow, replace the plug-in flame signal amplifier. If the detector is relocated or resighted, or the amplifier is replaced, repeat all required checkout tests.

Repeat ALL required Checkout tests after all adjustments have been completed. ALL tests must be satisfied with the flame detector(s) in its FINAL position.

SAFETY SHUTDOWN TESTS (ALL INSTALLATIONS)

Perform these tests at the end of Checkout after all other tests have been completed.

Safety shutdown should occur upon (1) failure to ignite the pilot (or 1st stage oil burner if using direct spark ignition of oil), (2) failure to light the main burner *(only if external circuitry has been added to obtain an interrupted pilot)*, and (3) loss of flame during the run period.

On safety shutdown, the pilot and main fuel valve(s) are de-energized. If used, the external alarm is energized. The START button must be *manually* pressed to restart the system. Also, if the START button is held in longer than the lockout switch timing and the pilot flame (or 1st stage oil flame) is not established, lockout will occur. On lockout, the lockout switch trips and the load relay 1K drops out. The lockout switch must be *manually* reset to restart the system.

1. *Failure to Ignite Pilot* (or 1st stage oil burner if using direct spark ignition of oil)
   a. Close all manual shutoff valves (including the pilot valve or 1st stage oil valve, and the main burner shutoff valve).
   b. Reset the lockout switch and all limits and interlocks.
   c. Close the master switch and operate the system through the purge period.
   d. When the PURGE COMPLETE (GREEN) lamp lights and the low fire start interlock (if used) is closed, close the alarm silencing switch (if used); then push in the START button and hold it in.
   e. Relay 1K will pull in and the lockout switch heater will start to heat. The external alarm (if on) will stay on.
   f. Ignition spark should occur, and the automatic pilot valve (or 1st stage oil burner) cannot ignite. No flame is detected so relay 2K cannot pull in and the FLAME ON (WHITE) lamp cannot light. The FLAME OFF (RED) lamp should stay on.
   g. Continue holding in the START button. The lockout switch should trip approximately 15 seconds after the START button was pushed in.
   h. Relay 1K should drop out and the automatic pilot valve (or 1st stage oil valve) should be de-energized.
   i. Release the START button. The ignition spark should go out.
   j. The alarm (if on) should stay on until it is turned off manually.
2. *Failure to Light Main Burner* (unless flame detector is monitoring intermittent or continuous pilot, or 1st stage oil flame).

NOTE: *This test applies to a system with an interrupted pilot, which can be obtained only by the addition of external circuitry.*

   a. Open the manual pilot shutoff valve (or manual 1st stage oil valve); leave the manual main fuel shutoff valve(s) closed.
   b. Reset the lockout switch.
   c. Close the master switch and operate the system through the purge period.
   d. When the PURGE COMPLETE (GREEN) lamp lights and the low fire start interlock (if used) is closed, close the alarm silencing switch (if used); then push in the START button and hold it in.
   e. The pilot (or 1st stage oil burner) should ignite. Relay 2K should pull in, the FLAME ON (WHITE) lamp should light, and the FLAME OFF (RED) lamp should go out. The external alarm (if on) should be de-energized.
   f. The main burner cannot light.
   g. Release the START button. The ignition spark should go out.
   h. When the pilot (or 1st stage oil flame) goes out (interrupted by external circuitry), relay 2K should drop out within 4 seconds after the flame goes out, and the FLAME ON (WHITE) lamp should go out.
   i. The FLAME OFF (RED) lamp should light, and the external alarm should be energized.
3. *Loss of Flame During the Run Period*
   a. Open the manual main fuel shutoff valve(s); the manual pilot valve (or 1st stage oil valve) must also be open.
   b. Reset the lockout switch (if tripped).
   c. Close the master switch and operate the system through the purge period.
   d. When the PURGE COMPLETE (GREEN) lamp lights and the low fire start interlock (if used) is closed, close the alarm silencing switch (if used); then push in the START button and hold it in.
   e. The pilot (or 1st stage oil valve) and the main burner should ignite normally. The FLAME ON (WHITE) lamp should light and the FLAME OFF (RED) lamp should go out. The external alarm (if on) should be de-energized.
   f. Release the START button. The ignition spark should go out.
   g. Close all manual fuel shutoff valves to extinguish the pilot and burner flames.
   h. Relay 2K should drop out within 4 seconds after the flames go out, and the FLAME ON (WHITE) lamp should go out.
   i. The FLAME OFF (RED) lamp should light, and the external alarm should be energized.

IMPORTANT

If the system fails to shut down on any of these tests, replace the R4138 and rerun all Checkout tests from the beginning.

CAUTION

If low fuel pressure limits have been bypassed for any of the tests in this Checkout section, make sure you remove the jumpers from these limits before putting the system into service.

TROUBLESHOOTING

CAUTION

1. Close *all* manual fuel shutoff valves as soon as trouble occurs.
2. Use utmost care while troubleshooting the R4138; line voltage is present on most terminals when power is on.
3. Open the master switch before removing the R4138 from the cabinet or subbase, before reinstalling it, before making any adjustments, and before replacing any devices.
4. Replace all external devices not operating properly. Do not bypass external devices.

EQUIPMENT REQUIRED

1. Voltmeter (Honeywell W136A equivalent)—with 0 to 300 Vac scale.
2. Microammeter (Honeywell W136A or equivalent)—with 0 to 25 microamp range and SPL scale with damping.
3. Meter connector plug—Part No. 196146 or equivalent.
4. 123514A Flame Simulator—for use with R7247A Rectification Flame Signal Amplifiers (green).
5. 123514B Flame Simulator—for use with R7249A Ultraviolet Flame Signal Amplifiers (purple).
6. Jumper wires (2)—No. 14 wire, insulated, 12 inches [304.8 mm] long, with alligator clips at both ends.
7. Shorting wire—10 inches [254 mm] long, insulated, with 3/4 inch [19.1 mm] of insulation removed from each end; for simulating flame with an R7248A Infrared Flame Signal Amplifier (red).
8. Watch or clock—with second hand.
9. Manometer (or pressure gauge)—to measure pilot gas pressure.
10. Thermometer or thermocouple—to measure temperature at the flame detector.
11. Orifice plates (aperture discs) or filters—as necessary to adjust sensitivity of flame detector(s).

TROUBLESHOOTING PROCEDURES

Refer to the normal operation summary in the OPERATION section. Observe the operation carefully to determine at what point the trouble occurs. Then refer to Table 4 and follow the procedure outlined.

Refer to Figs. 4 through 8 for location of terminals, Fig. 21 for location of components, and Fig. 24 for location of relay contacts.

IMPORTANT

a. Before proceeding, perform the Static Checkout (Table 2, in the INSTALLATION section) to determine if any external devices are operating improperly. Replace defective devices and wiring as required.
b. If after completing an applicable troubleshooting procedure, proper operation still cannot be obtained, replace the R4138 (except the amplifier, unless noted).
c. At the completion of troubleshooting, be sure to perform *all* tests in the CHECKOUT section of this sheet.

TABLE 4—TROUBLESHOOTING CHART

	SYMPTOM	TEST	POSSIBLE CAUSE/CORRECTION
A.	1. ALARM (IF USED) DOES NOT GO ON WHEN MASTER SWITCH IS CLOSED.	1. Check for line voltage between terminals 16 and 12.	1. If none is detected, check contact 3K1. If 3K1 is closed, make sure the alarm silencing switch (if used) is closed. Check wiring, power supply, and alarm. Replace if defective.
	2. If 3K1 is open—	—	2. Replace the R4138.
B.	1. "FLAME OFF" (RED) LAMP DOES NOT LIGHT WHEN MASTER SWITCH IS CLOSED.	1. Check for line voltage between terminals 18 and L2.	1. If none is detected, check contact 3K3. If 3K3 is closed, check that the jumper is installed between terminals L1 and 3. Check that the fan interlock, limits, and miscellaneous interlocks are closed. Replace if defective.
	2. If voltage is present at terminal 18—	2. Install a new lamp.	2. If the new lamp doesn't light, replace the R4138.
C.	1. "FLAME OFF" (RED) LAMP LIGHTS, BUT PURGE TIMER DOES NOT START.	1. Check for line voltage between terminals 17 and L2.	1. If none is detected, make sure the high fire interlock (if used) is closed and the damper is at high fire position. Replace if defective. If a high fire interlock is not used, make sure there is a jumper between terminals 17 and 18.
	2. If voltage is present at terminal 17—	2. Pull out the purge timer and check for line voltage between pins 1 and 2 of the receptacle.	2. If voltage is present, install a new purge timer.
	3. If there is no voltage at the receptacle—	—	3. Replace the R4138.
D.	1. "PURGE COMPLETE" (GREEN) LAMP DOES NOT LIGHT AT END OF PURGE PERIOD.	1. Check for line voltage between terminals 6 and L2.	1. If none is detected, install a new purge timer and restart the system.
	2. If voltage is present at terminal 6—	2. Install a new lamp.	2. If the new lamp doesn't light; replace the R4138.

(continued on next page)

TABLE 4—TROUBLESHOOTING CHART *(continued)*

	SYMPTOM	TEST	POSSIBLE CAUSE/CORRECTION
E.	1. PILOT (OR 1ST STAGE OIL BURNER) DOES NOT IGNITE WHEN "START" BUTTON IS HELD IN.	1. Release the START button and check for line voltage between terminals 6 and L2.	1. If none is detected, check the external relay 1R (if used). If 1R1 is open, the purge timer will reset, removing power from terminal 6. Replace relay 1R if defective.
	2. If voltage is present at terminal 6—	2. Push in the START button and check for ignition spark.	2. If there is no ignition spark, make sure the low fire start interlock (if used) is closed and the damper is at low fire position. Make sure the START switch is closed. Replace if defective. Clean ignition electrodes. Replace ignition transformer if defective.
	3. If ignition spark is present—	3. Check for line voltage between terminals 19 and L2.	3. If none is detected, check relay 1K. If 1K has pulled in, replace the R4138.
	4. If voltage is present at terminal 19—	4. Make sure the manual pilot (or 1st stage) shutoff valve is open and the fuel lines are not plugged.	4. Make sure the automatic pilot valve (or 1st stage oil valve) opens. Replace if not operating properly.
	5. If there is no voltage at terminal 19 and relay 1K has not pulled in—	5. a. Check the lockout switch. b. Check for line voltage between terminals 7 and L2.	5. a. If the lockout switch has tripped, reset it. b. If none is detected, make sure the START switch, STOP switch, and alarm silencing switch (if used) are closed. Replace if defective.
	6. If voltage is present at terminal 7—	6. Check relay 2K.	6. If relay 2K has not pulled in but 2K2 is open, replace the R4138.
	7. If relay 2K has pulled in (safe start check)—	7. Perform the Flame Relay (2K) Hold-in Check immediately following this table.	7. Follow instructions in the Flame Relay (2K) Hold-in Check.
F.	1. PILOT (OR 1ST STAGE OIL BURNER) IGNITES, BUT "FLAME ON" (WHITE) LAMP DOES NOT LIGHT.	1. Check relay 2K.	1. If 2K has pulled in but 2K3 has not closed, replace the R4138.
	2. If relay 2K has not pulled in—	2. Perform the Flame Signal Check following this table. *For a continuous pilot application, first make sure that 1K2 is closed.*	2. Follow instructions in the Flame Signal Check.
	3. If relay 2K has pulled in and 2K3 is closed—	3. Install a new lamp.	3. If the new lamp doesn't light, replace the R4138.
G.	1. "FLAME ON" (WHITE) LAMP LIGHTS BUT MAIN BURNER DOES NOT LIGHT.	1. Check for line voltage between terminals 20 and L2.	1. If none is detected, replace the R4138.
	2. If voltage is present at terminal 20—	—	2. Make sure the automatic main fuel valve(s) opens. Replace if not operating properly. Clean out the fuel lines. Open the manual main fuel shutoff valve(s) before restarting the system.
H.	1. ALARM (IF USED), "FLAME OFF" (RED) LAMP, OR "PURGE COMPLETE" (GREEN) LAMP STAYS ON AFTER "FLAME ON" (WHITE) LAMP LIGHTS.	1. Check relay 3K.	1. If 3K1 or 3K3 is not open, replace the R4138.
	2. If 3K3 is open, but the PURGE COMPLETE (GREEN) lamp is still on—	2. Check for line voltage between terminals 6 and L2.	3. If voltage is present, install a new purge timer.
I.	1. IGNITION SPARK DOES NOT GO OUT WHEN "START" BUTTON IS RELEASED.	1. Check that the START button is not stuck.	1. If the START switch is open, check the wiring and operation of the ignition transformer.
J.	1. MAIN BURNER LIGHTS, BUT SHUTDOWN OCCURS AFTER THE "START" BUTTON IS RELEASED.	1. Check for line voltage between terminals 8 and L2.	1. If none is detected, replace the R4138.
	2. If voltage is present at terminal 8—	2. Check the lockout switch.	2. If the lockout switch has tripped, reset it and restart the system. Make sure contact 2K2 opens when flame is detected and relay 2K pulls in. If it doesn't, replace the R4138.

(continued on next page)

TABLE 4—TROUBLESHOOTING CHART *(continued)*

SYMPTOM	TEST	POSSIBLE CAUSE/CORRECTION
K. 1. SHUTDOWN OCCURS DURING THE RUN PERIOD.	1. Check the limits.	1. If 1 or more limit has opened, determine the causes and correct the conditions before restarting the system.
2. If limits are closed—	2. Perform the Flame Signal Check following this table. *If using an infrared flame detector, first perform the Hot Refractory Saturation Test in the CHECKOUT section.*	2. Follow instructions in the Flame Signal Check.
3. If flame signal is proper—	3. Check the fuel lines and automatic fuel valves.	3. Clean fuel lines. Replace valves and actuators if defective.
L. 1. "FLAME ON" (WHITE) LAMP STAYS ON WHEN "STOP" BUTTON IS HELD IN.	1. Check the STOP switch.	1. Make sure the STOP button is not stuck. Check wiring. Replace the STOP switch if detective.
2. If the STOP switch is open—	2. Check for line voltage between terminals 20 and L2.	2. If voltage is present, replace the R4138.
M. 1. "FLAME ON" (WHITE) LAMP GOES OUT, BUT BURNER KEEPS FIRING WHEN "STOP" BUTTON IS HELD IN.	1. Check the operation of the automatic fuel valves and actuators.	1. Check wiring. Replace defective valves and actuators.
N. 1. ALARM (IF USED) DOES NOT GO ON, OR "FLAME OFF" (RED) LAMP DOES NOT LIGHT WHEN "STOP" BUTTON IS HELD IN AND FLAME GOES OUT.	1. Check relay 3K.	1. If 3K1 or 3K3 is not closed, replace the R4138.
2. If 3K1 is closed but the alarm is off—	2. Make sure the alarm silencing switch is closed.	2. Check the alarm. Replace if defective.
3. If 3K3 is closed but the FLAME OFF (RED) lamp is off—	3. Install a new lamp.	3. If the new lamp doesn't light, replace the R4138.
O. 1. RELAY 2K STAYS PULLED IN AFTER FLAME GOES OUT.	1. Perform the Flame Relay (2K) Hold-In Check immediately following this table.	1. Follow instructions in the Flame Relay (2K) Hold-In Check.
P. 1. ALARM (IF USED) STAYS ON WHEN ALARM SILENCING SWITCH IS OPENED.	1. Check external wiring and the alarm silencing switch.	1. Replace deteriorated leadwires. Replace the alarm silencing switch if defective.

FLAME RELAY (2K) HOLD-IN CHECK

1. If the flame detector is a rectifying photocell or infrared (lead sulfide) detector, perform the Hot Refractory Hold-in Test in the CHECKOUT section.

2. If the plug-in flame signal amplifier is an R7247B or C Dynamic Self Check Amplifier (green) or an R7248A or B Infrared Amplifier (red), open the master switch and install a new amplifier.

3. If the plug-in flame signal amplifier is an R7247A Rectification Amplifier (green) or an R7249A Ultraviolet Amplifier (purple), momentarily short terminal F to terminal G on the terminal strip. If this does not cause relay 2K to drop out, open the master switch and install a new amplifier.

4. Check the external wiring and operation of the flame detector (see step 6.b. of the Flame Signal Check, below). Replace if faulty.

IMPORTANT

If you make any changes in the flame detection system (including the plug-in amplifier), repeat ALL required tests in the CHECKOUT section.

FLAME SIGNAL CHECK

IMPORTANT

If the flame relay 2K does not pull in when the pilot (or 1st stage oil burner) ignites, or if shutdown occurs during the run period, perform this check. The flame detector, plug-in flame signal amplifier, and flame relay 2K form a flame detection system which can be disabled by failure of any of the components.

1. Open the master switch and plug a microammeter into the meter jack on the plug-in amplifier (Fig. 22); then close the master switch. Make sure the alarm silencing switch (if used) is closed.
2. Run the system through the purge period. Then push in the START button and hold it in. When the pilot (or 1st stage oil burner) ignites, release the start button and measure the flame signal as described in Flame Signal Measurement in the CHECKOUT section. If the signal is unstable or weak, check the flame detector installation and circuitry as instructed.
3. If you check the flame detector, measure the flame signal again. IF it is still unstable or less than the minimum acceptable value listed in Table 3 proceed to step 5. Otherwise continue with step 4.
4. If the flame signal is stable and above the minimum acceptable value listed in Table 3, either the amplifier or the R4138 is faulty.
   a. Open the master switch.
   b. Replace the plug-in Amplifier with a new one of the same part number.
   c. Close the master switch. Make sure the alarm silencing switch (if used) is closed.
   d. Run through the purge period and push in the START button. When the pilot (or 1st stage oil burner) ignites, release the START button and measure the flame signal again.
   e. If the flame signal is okay but relay 2K still does not pull in, replace the R4138. (Keep the plug-in amplifiers.)
5. The procedure in this step depends on the model of the plug-in flame signal amplifier used.

a. All self-checking models:
R7247B Dynamic Self Check Rectification Amplifier (green)—used with rectifying flame rods, rectifying photocells, or C7012A or C Purple Peeper Ultraviolet Flame Detectors.
R7247C Dynamic Self Check Rectification Amplifier (green)—used with C7012E or F Purple Peeper Ultraviolet Flame Detectors (with self-checking shutter).
R7248B Dynamic Ampli-Check™ Infrared Amplifier (red)—used with C7015A Infrared (lead sulfide) Flame Detectors.
(1) Open the master switch.
(2) Replace the plug-in amplifier with a new one of the same part number.
(3) Close the master switch, run through the purge period, and hold in the START button.
(4) When the pilot (or 1st stage oil burner) is ignited, release the START button. Relay 2K should pull in.
(5) If relay 2K pulls in, operation is normal. Omit step 6 and perform the Pilot Turndown Test in the CHECKOUT section, unless using direct spark ignition.
(6) If relay 2K does not pull in, either the flame detector or the R4138 is faulty.
— Install the original amplifier.
— Check the flame detector and its circuit as described in step 6 on the next page.
— If the problem still exists, replace the R4138.

b. R7247A Rectification Amplifier (green)—used with rectifying flame rods, rectifying photocells, or C7012A or C Purple Peeper Ultraviolet Flame Detectors.
(1) Open the master switch and remove the flame detector leadwire from terminal F on the terminal strip. *Be sure the leadwire does not touch anything after removal.*
(2) Close the master switch.
(3) Touch the probe of a 123514A Flame Simulator to the F terminal on the terminal strip, and hold the plug (lead end) of the simulator against the R4138 chassis (Fig. 23). Relay 2K should pull in and stay in while the probe is on the F terminal and the plug is in contact with the chassis.
(4) If relay 2K pulls in, the trouble is in the flame detector or its circuitry outside the R4138. Proceed to step 6.
(5) If relay 2K does not pull in, open the master switch.
(6) Replace the plug-in amplifier with a new one of the same part number.
(7) Close the master switch.
(8) Repeat (3).
(9) If relay 2K pulls in, restore the R4138 to operating condition as instructed in step 6.a.
(10) If relay 2K still does not pull in, replace the R4138.

c. R7248A Infrared Amplifier (red)—used with C7015A Infrared (lead sulfide) Flame Detectors.
(1) Open the master switch and remove the flame detector leadwire from terminal F on the terminal strip. *Be sure the leadwire does not touch anything after removal.*
(2) Close the master switch.
(3) Remove 3/4 inch [19.1 mm] of insulation from each end of a 10 inch [254 mm] length of insulated wire.

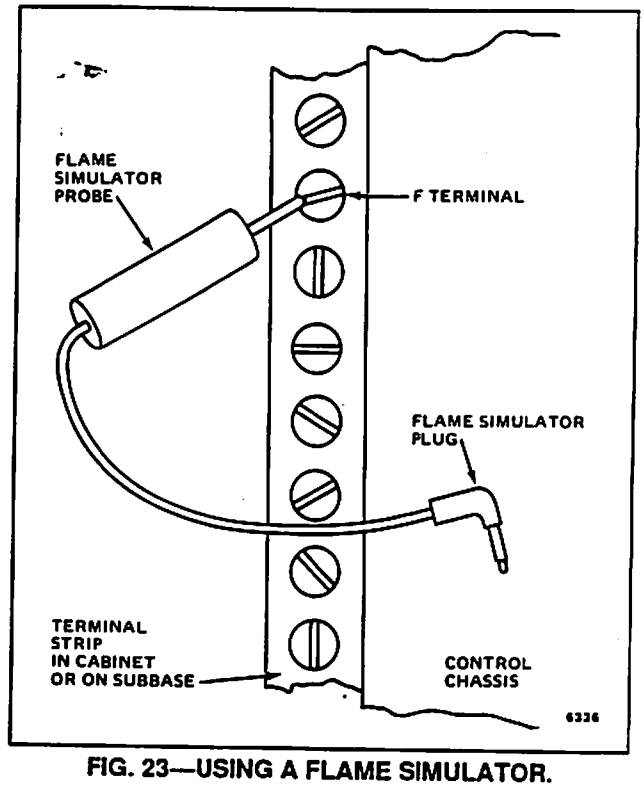


FIG. 23—USING A FLAME SIMULATOR.

(4) Touch one end of this wire to the F terminal on the terminal strip, and tap the other end of the wire against the R4138 chassis at a rapid frequency (about 2 times a second) to simulate flame. Relay 2K should pull in and stay in while flame is simulated.
(5) If relay 2K pulls in, the trouble is in the flame detector or its circuitry outside the R4138. Proceed to step 6 to check the flame detector.
(6) If relay 2K does not pull in, open the master switch.
(7) Replace the plug-in amplifier with a new one of the same part number.
(8) Close the master switch.
(9) Repeat (4).
(10) If relay 2K pulls in, restore the R4138 to operating condition as instructed in step 6.a. below.
(11) If relay 2K still does not pull in, replace the R4138.

d. R7249A ultraviolet Amplifier (purple)—used with C7027A, C7035A, or C7044A Minipeeper Ultraviolet Flame Detectors.
— Follow the same procedure as described in 5.b. on the previous page for an R7247A Rectification Amplifier, except substitute a 123514B Flame Simulator in (3).

6. Check the flame detector and its circuitry outside the R4138.
a. Restore the R4138 to operating condition as follows:
(1) Open the master switch.
(2) Reconnect the flame detector leadwires to terminal F on the terminal strip.
b. Check the detector and its circuitry as follows:
(1) Check the detector wiring for defects, including—
— wrong type or size of wire.
— deteriorated wire.

— open circuits.
— short circuits.
— leakage paths caused by moisture, dirt, or accumulated dirt.

(2) For a flame rod, make sure—
— there is enough ground area.
— the flame rod is located in the flame properly.
— temperature at the flame rod insulator is no greater than 500° F [260° C].
— ignition interference is not present (see Ignition Interference Test in the CHECKOUT section).

(3) For all other detectors, clean the detector lens, filter, viewing window, and sighting pipe (as applicable).

(4) For a C7012A,C,E, or F Purple Peeper Ultraviolet Flame Detector, replace the 113236 and 115330 Electron Tubes (unless the detector is a solid state model).

(5) Check that the temperature at the detector does not exceed its maximum rated temperature.

(6) Make sure that the flame adjustment is not too lean.

(7) Make sure the detector is sighting the flame properly.

(8) If necessary, resight or reposition the detector.

(9) If trouble persists, replace the detector. (Open the master switch before replacing the flame detector.)

IMPORTANT

If you make any changes in the flame detection system (including the plug-in amplifier), repeat ALL required tests in the CHECKOUT section.

SERVICE INFORMATION

CAUTION

1. Only qualified service technicians should attempt to service or repair flame safeguard controls and burner systems.
2. Open the master switch before removing or replacing a relay cover, or before cleaning contacts. Line voltage may be present on most contacts when power is on. If cleaning is necessary, be sure to replace the relay cover.

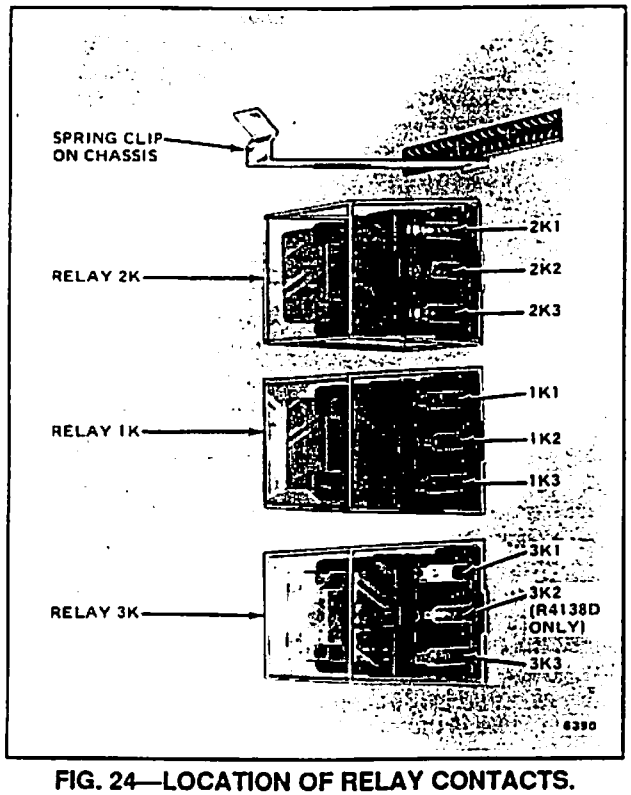


FIG. 24—LOCATION OF RELAY CONTACTS.

SCHEDULED INSPECTION AND MAINTENANCE

A schedule should be set up and follows for periodic inspection and maintenance, including the burner and all other controls as well as the R4138. Include the following in that schedule.

1. Always keep the burner and fuel mixture adjusted according to the burner manufacturer's recommendations.
2. Clean the flame detector lens, filter, viewing window, and sighting pipe (as applicable).
3. Check the flame signal (Table 3) using a Honeywell W136A Test Meter, or equivalent (and a 196146 Meter Connector Plug, if needed).
4. If using a C7012A,C,E or F Purple Peeper Ultraviolet Flame Detector, replace the 113236 and 115330 Electron Tubes annually (unless the detector is a solid state model). These tubes are tested by Honeywell to ensure reliability and safety. DO NOT REPLACE WITH COMMERCIAL SUBSTITUTES.

CONTACT CLEANING

Field cleaning of relay contacts is *not recommended.* If they must be cleaned, use *only* Honeywell pressurized contact cleaner, Part No. 132569. Honeywell's chemical analysis laboratory has found this cleaner to be acceptable for this task. Directions for using this cleaner are printed on the can.

IMPORTANT

1. Do not clean contacts unless absolutely necessary.
2. Use only Honeywell contact cleaner, Part No. 132569. Do not use any other type of contact cleaner.
3. Use utmost care to avoid bending the contacts or changing their specifications or configuration in any way.
4. Do not use an abrasive or a burnishing tool to clean contacts.
5. Do not use hard paper, such as a business card, to clean contacts.

Do not use other types of contact cleaners. Honeywell's chemical analysis laboratory tested other pressurized type contact cleaners but did not approve them for these reasons:

1. The solvents could deteriorate plastic parts and wire insulation.
2. The cleaners leave an oil residue which will collect dust and dirt. The residue will also break down to form

various carbonaceous products. Either result will cause early contact failure.

Do not use an abrasive (and paper stick, file, etc.) or a burnishing tool to clean contacts. Its use can cause early contact failure for these reasons:

1. Some relay and timer contacts are plated with gold for increased reliability. Burnishing can quickly remove the plating.
2. The radii or points of the contacts are designed with specific shapes to best serve the intended functions of the contacts. Burnishing can rapidly alter these contact configurations.
3. Use of an abrasive loosen fine particles of the contact material which adhere to the surface of the contact, thus increasing its resistance.
4. Contact specifications (contact pressures, pressback, and gaps) are carefully controlled during manufacturing to ensure maximum contact life. Burnishing can easily change these specifications.

REPLACEMENT

REPLACING A W124 OR IDO51 FLAME SAFEGUARD PANEL WITH A R4138C OR D

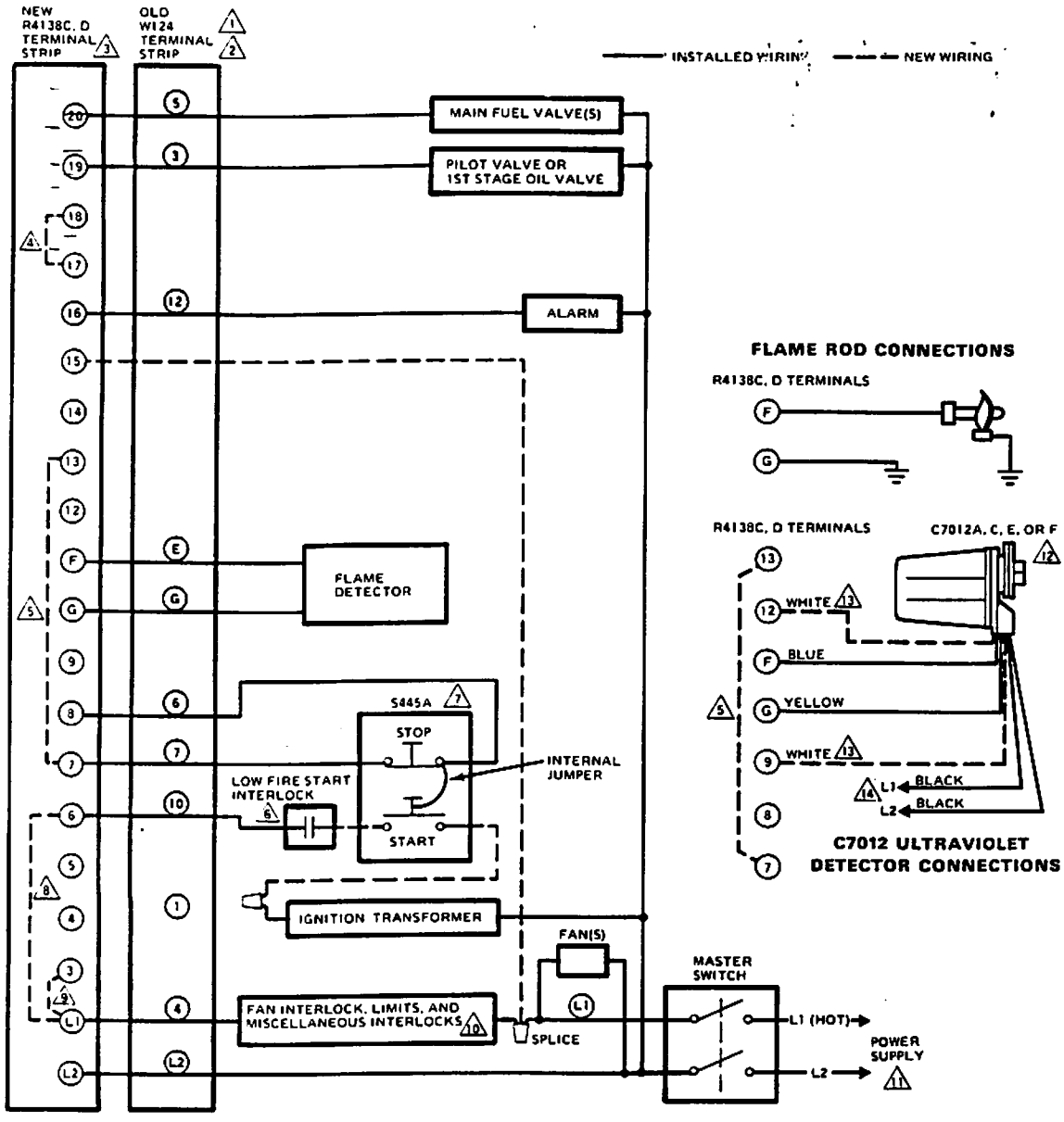
CAUTION

Disconnect power supply before making wiring connections to prevent electrical shock or equipment damage.

NOTE: An IDO51 is a W124 with an integral START-STOP station.

TO REPLACE A W124 OR IDO51 PANEL WITH AND R4138C OR D

1. Remove and carefully mark the old leadwires.
2. Remove the W124 or IDO51 chassis *and* case (if there is one).
3. Install a Q477A Subbase (for mounting in a customer's cabinet), a Q478A Cabinet (for flush *or* surface mounting). Refer to the appropriate section of this sheet for installation instructions.
4. Rewire the installation as shown in the typical wiring diagram on page 40, or refer to the installation instructions provided by the burner manufacturer. Before starting, carefully review the footnotes which accompany the wiring diagram.
5. Install the R4138 as instructed in this sheet.



1. OLD PANEL TERMINALS ARE SHOWN FOR REFERENCE ONLY. THE EXISTING WIRING TO BE REMOVED FROM THE PANEL TERMINALS IS SHOWN BY SOLID LINES (——) AND THE NEW WIRING IS SHOWN BY DASHED LINES (— —). USE ALL NEC CLASS 1 WIRING.
2. REMOVE AND DISCARD ALL JUMPERS USED ON THE W124 OR IDO51.
3. INSTALL A NEW Q477A SUBBASE, Q478A CABINET, OR FSP1225 (NEMA 4) ENCLOSURE. REMOVE AND DISCARD THE OLD CHASSIS AND CASE.
4. IF USING A HIGH FIRE INTERLOCK, REFER TO WIRING DIAGRAMS IN THE INSTRUCTION SHEET FOR THE R4138C,D (FORM 60-2368). OTHERWISE, INSTALL A JUMPER BETWEEN TERMINALS 17 AND 18.
5. IF USING A C7012E OR F PURPLE PEEPER ULTRAVIOLET FLAME DETECTOR (WITH SELF-CHECKING SHUTTER), INSTALL A JUMPER BETWEEN TERMINALS 13 AND 7.
6. IF A LOW FIRE START INTERLOCK IS NOT USED, CONNECT THE START SWITCH DIRECTLY TO TERMINAL 6.
7. FOR A Q478A1031 CABINET WITH A FACTORY INSTALLED START-STOP SWITCH, MAKE SURE THE SWITCH IS WIRED AS SHOWN; REWIRE IF NECESSARY. FOR REMOTE OPERATION, USE AN S445A START-START STATION, OR EQUIVALENT WITH AN INTERNAL JUMPER AS SHOWN
8. IF AN S427D PURGE TIMER IS NOT USED, INSTALL A JUMPER BETWEEN TERMINALS L1 AND 6.
9. INSTALL A JUMPER BETWEEN TERMINALS L1 AND 3.
10. THESE INTERLOCKS AND LIMITS MUST BE RATED TO CARRY AND BREAK CURRENT TO THE IGNITION TRANSFORMER, PILOT VALVE (OR 1ST STAGE OIL VALVE), AND MAIN FUEL VALVE(S) SIMULTANEOUSLY.
11. POWER SUPPLY MUST MATCH THE VOLTAGE AND FREQUENCY RATING OF THE R4138. PROVIDE DISCONNECT MEANS AND OVERLOAD PROTECTION AS REQUIRED.
12. TWO C7012 PURPLE PEEPER ULTRAVIOLET FLAME DETECTORS MAY BE WIRED IN PARALLEL TO THE SAME TERMINALS AS SHOWN, EXCEPT A C7012E NOT RATED FOR 120 VOLTS. ONLY ONE C7012E CAN BE CONNECTED AS SHOWN IF THE R4138 POWER SUPPLY IS NOT 120 VOLTS.
13. WHITE SHUTTER LEADWIRES ARE ONLY ON THE C7012E OR F (WITH SELF-CHECKING SHUTTER).
14. VOLTAGE AND FREQUENCY RATING OF THE C7012 MUST MATCH THE RATING OF THE R4138.

R4138C,D-6

FIG. 25—REPLACING A W124 OR IDO51 FLAME SAFEGUARD PANEL WITH AN R4138C OR D.

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