INSTRUCTIONS

MODEL GP301
(R4140L1089)
FLAME SAFEGUARD CONTROL

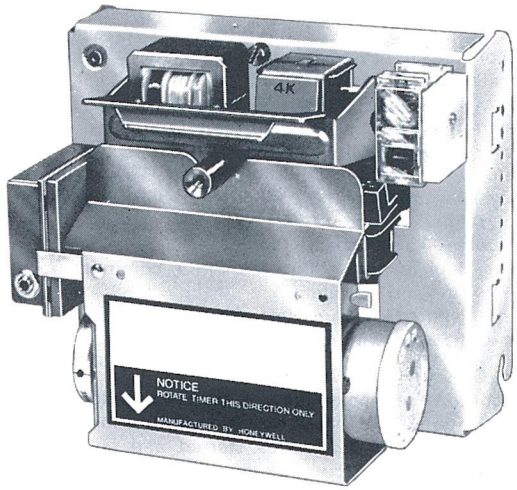
APPLICATION

The GP301 Flame Safeguard Control provides flameout protection plus automatic sequencing of the burner motor, firing rate motor, pilot valve, ignition spark, and main fuel valve for commercial and industrial gas, oil, or combination burners.

The GP301 Flame Safeguard Control is Underwriters Laboratories Inc. component recognized, Factory Mutual approved, and Canadian Standards Association certified for automatic-fired burners. With auxiliary equipment, it also complies with Industrial Risk Insurers (formerly F.I.A.) recommended good practices for single-burner boilers.

A motor driven timer in the GP301 provides control of the operating sequence. A selection of plug-in amplifiers allows the GP301 to be used with rectifying, infrared, or ultraviolet flame detectors.

The GP301 is cycled by a line voltage controller. Failure to establish flame or flame loss while the burner is running will result in safety shutdown (lockout). Safety shutdown will also occur if a flame (or a condition simulating a flame) is detected before or during prepurge, if a preignition interlock opens during prepurge, or on loss of airflow after 14 seconds. Firing rate motor switching is incorporated for both modulating and two-position motors.



FEATURES

GENERAL

PLUG-IN SEQUENCING CHASSIS: Mounts on subbase equipped with quick-connect contacts. Directly replaces the GP300 for most applications. Interchangeable with the GP201 without need of changing external field wiring.

PLUG-IN AMPLIFIERS: Solid state, color-coded, interchangeable—allow same programmer to use rectifying, infrared, or ultraviolet flame detectors. Amplifier capability includes three standard models, two Dynamic Self Check models and one Dynamic Ampli-Check model.

FLAME CURRENT JACK: Located on amplifier; provides convenient means of plugging in a microammeter to measure flame signal with system in operation.

ALARM TERMINAL: Operates an external line voltage alarm on safety shutdown (lockout).

TIMER SWITCH: Lets operator stop the timer motor prior to trial for main burner flame to facilitate checkout and troubleshooting.

FLAME SAFEGUARD

SAFE START: If flame relay pulls in before or during prepurge, ignition trials cannot be started; safety shutdown (lockout) will result.

SAFETY SHUTDOWN (LOCKOUT): Occurs on (1) detection of a flame (or a flame-simulating condition) before or during prepurge, (2) opening of a preignition interlock during prepurge, (3) opening of a lockout interlock (such as the Airflow Switch) after 14 seconds, (4) failure to ignite the pilot or main burner, or (5) loss of flame during the run period. System shuts down; timer completes its revolution and locks up at the start position; lockout switch must be manually reset to restart the system.

RAPID FLAME FAILURE RESPONSE: On loss of flame, fuel valve is de-energized in 2 to 4 seconds.

PREIGNITION INTERLOCK CIRCUIT: Prevents start if interlocks are open; causes safety shutdown (lockout) if interlocks open during prepurge.

LOCKOUT INTERLOCK CIRCUIT: Causes safety shutdown (lockout) if lockout interlock (Airflow Switch) does not remain continuously closed from 14 seconds after startup until the run period is over.

4-WIRE SWITCHING OF FIRING RATE MOTOR: Allows firing rate motor to be *driven* to both low and high fire positions.

PURGE RATE PROVING CIRCUIT: Stops sequencing timer near start of prepurge until purge rate switch closes.

LOW FIRE PROVING CIRCUIT: Stops sequencing timer before ignition trials until low fire switch closes.

SPECIFICATIONS

MODEL: GP301 Flame Safeguard Control—Flame safeguard protection and sequencing control for use on commercial and industrial gas, oil, or combination burners.

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

WIRING SUBBASE (order separately): Q520A1147 Wiring Subbase. Open bottom (3-sided); 20 terminals.

SEQUENCE PARTICULARS:

Timer Cycle—120 seconds.

Prepurge—Low-High-Low proven. 60 seconds. (Extended proven high fire prepurge capability per Industrial Risk Insurers (formerly F.I.A.) provided by auxiliary timer contact connected in series with and between the purge rate switch and terminal D.)

Early Spark Termination—4 second ignition available on terminal 18 for direct spark ignition systems.

Pilot Flame-Establishing Period—10 seconds.

Main Burner Flame-Establishing Period—10 seconds for pilot ignition systems; 4 seconds for direct spark ignition systems.

Postpurge—15 seconds.

Firing Rate Switching Circuit—4-wire; common, purge rate, low fire, and modulate.

Flame Failure Response Time—2 to 4 seconds.

Lockout Switch Timing—30 seconds (nominal).

INTERLOCK CIRCUITS:

Preignition Interlocks—Prevent start if interlocks are open. If interlocks open during prepurge (after 14 seconds), ignition trials cannot be started and safety shutdown (lockout) will occur. If a valve-closed indication circuit is used, the main fuel valve must remain closed during prepurge.

Lockout Interlocks—Must be closed (i.e., airflow must be proven) within 14 seconds after startup, and must remain closed through the run period, or safety shutdown (lockout) will occur.

Purge Rate Interlock—Timer stops at 8 seconds until purge rate proving switch closes, indicating damper is open for maximum purge rate during prepurge.

Low Fire Interlock—Timer stops at 52 seconds until low fire proving switch closes, indicating damper is closed prior to ignition.

ELECTRICAL RATINGS:

Voltage and Frequency—120V ac (102V minimum to 132V maximum), 50/60 Hz.

NOTE: Use of a 50 Hz power supply will lengthen the sequence timings by a factor of 1.2.

Power Consumption (with no loads connected to the output terminals)—18 watts maximum.

Maximum Total Connected Load—2000 VA.

Terminal Ratings—

TERMINAL	TYPICAL LOAD	MAXIMUM RATING AT 120V AC, 60 HZ
5	Ignition Transformer/ Pilot Valve	4.5 amp ignition and 50 VA pilot duty OR 2.5 amp ignition and 75 VA pilot duty
6	Oil Valve (Direct Spark Ignition)	
7	Main Fuel Valve (solenoid/ motorized)	250 VA pilot duty OR 65 VA pilot duty in parallel with motorized valve using a total of 1150 VA locked rotor (inrush), 460 VA to open, and 250 VA to hold OR motorized valve using a total of 1500 VA locked rotor (inrush), 600 VA to open, and 250 VA to hold
M	Burner Motor	9.8 amp full load, 58.8 amp locked rotor (inrush)
A	Alarm	75 VA pilot duty
10, 11, 12, and X	Firing Rate (damper) Motor Contacts	50 VA pilot duty
18	Ignition Transformer	4.5 amp

TABLE I—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 PHOTOCELLS[d]	C7003, C7010, C7013, C7014
					GAS OR OIL	ULTRAVIOLET (PURPLE PEEPER)	C7012A OR C.
		DYNAMIC SELF CHECK[a]	R7247B	2 TO 4 SEC	GAS	RECTIFYING FLAME RODS	HOLDERS[c]:C7004, C7007, C7011. COMPLETE ASSEMBLIES: C7005, C7008, C7009, Q179.
			R7247C	2 TO 4 SEC	GAS OR OIL	ULTRAVIOLET (PURPLE PEEPER)	C7012E OR F.
INFRARED	RED	NO	R7248A	2 TO 4 SEC	GAS OR OIL	INFRARED (LEAD SULFIDE)	C7015.
		DYNAMIC AMPLI-CHECK[b]	R7248B	2 TO 4 SEC			
ULTRAVIOLET	PURPLE	NO	R7249A	2 TO 4 SEC	GAS OR OIL	ULTRAVIOLET (MINIPEEPER)	C7027, C7035, C7044.

[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.

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NOTE: Allowable inrush can be up to 10 times the pilot duty rating.

EXAMPLE—Pilot Duty Rating = 50 VA.

At 120V, running current is

$$\frac{50}{120} = 0.42 \text{ amp.}$$

Maximum allowable inrush is 10 times 0.42 = 4.2 amp.

Interlock Ratings—

INTERLOCKS	REQUIREMENTS Must be able to carry and break current to:
Limits, Burner Controller, and Lockout Interlocks (including airflow switch)	Ignition transformer, pilot valve, and main fuel valve
Preignition Interlocks	Programmer relays 1K, 3K, and 4K (12 watts max)

AMBIENT OPERATING TEMPERATURE RATINGS:

Minimum—minus 40 F [minus 40 C].

Maximum (dependent on mounting position)—

PROGRAMMER MOUNTING POSITION	
STANDARD VERTICAL (WITH HANDLE AT TOP)	ANY OTHER
+130 F [+55 C]	+125 F [+52 C]

NOTE: If an R7248A Infrared Amplifier is used, the ambient operating temperature range will be 0 F to plus 125 F [minus 18 C to plus 52 C].

STORAGE TEMPERATURE RATINGS: Minus 60 F to plus 150 F [minus 51 C to plus 65 C].

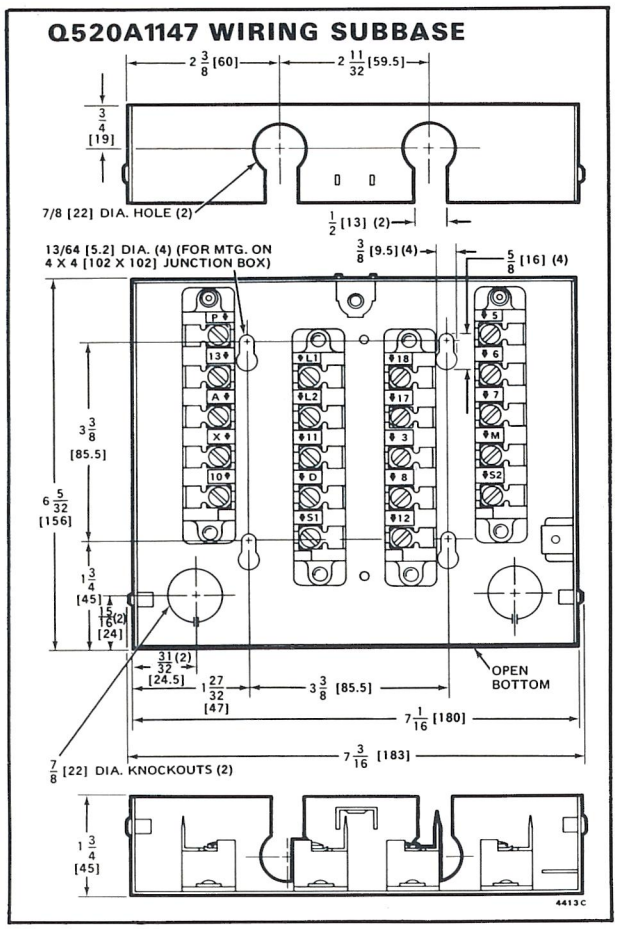


Fig. 1—Mounting dimensions of the Q520A1147 Wiring Subbase, in inches [millimetres shown in brackets].

MOUNTING: Q520A1147 Wiring Subbase with 20 contacts (order separately).

DIMENSIONS: See Figs. 1 and 2.

WEIGHT (without plug-in flame signal amplifier): 5 lb, 1 oz [2.3 kg].

APPROVALS:

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

CANADIAN STANDARDS ASSOCIATION CERTIFIED: File No. LR1620.

FACTORY MUTUAL APPROVED: Report No. 24181.04.

INDUSTRIAL RISK INSURERS (formerly F.I.A.): Approvable.

ACCESSORIES:

1. W136A Test Meter (includes 117053 Meter Connector Plug).
2. 117053 Meter Connector Plug (for older W136A models).
3. 123514A Flame Simulator (for use with R7247A Rectification Amplifiers).
4. 123514B Flame Simulator (for use with R7249A Ultraviolet Amplifiers).
5. 139695C Cover with reset button; heavy duty, metal cover for outside panel mounting.
6. 130716A Autotransformer—120V primary, 135V secondary. Provides extra power for operation of the shutter on a C7012E or F Purple Peeper Ultraviolet Flame Detector when the detector is mounted vertically, or within 45 degrees of vertical.

ORDERING INFORMATION:

Specify—Order number.

Order Separately—

1. Flame detection system (amplifier and matching flame detector). See Table I.
2. Q520A1147 Wiring Subbase.
3. Accessories, if desired.

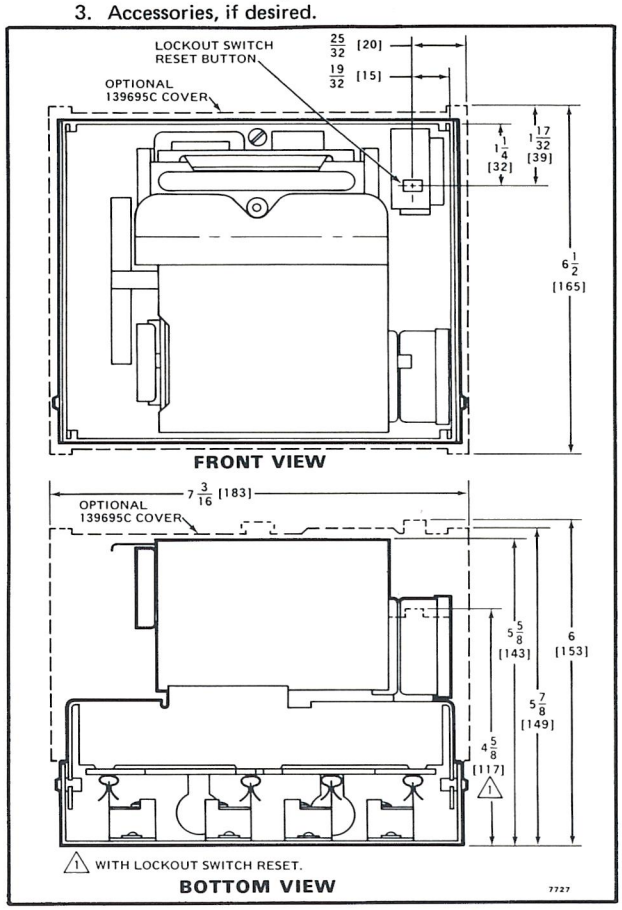


Fig. 2—Mounting dimensions of the GP301 Programmer on the Q520A1147 Wiring Subbase, in inches [millimetres shown in brackets].

OPERATION

The schematic below shows all contacts in the standby position (zero seconds). The opening and closing times are shown adjacent to each timer contact. Refer to the Timer Sequence chart and Step-By-Step Operation.

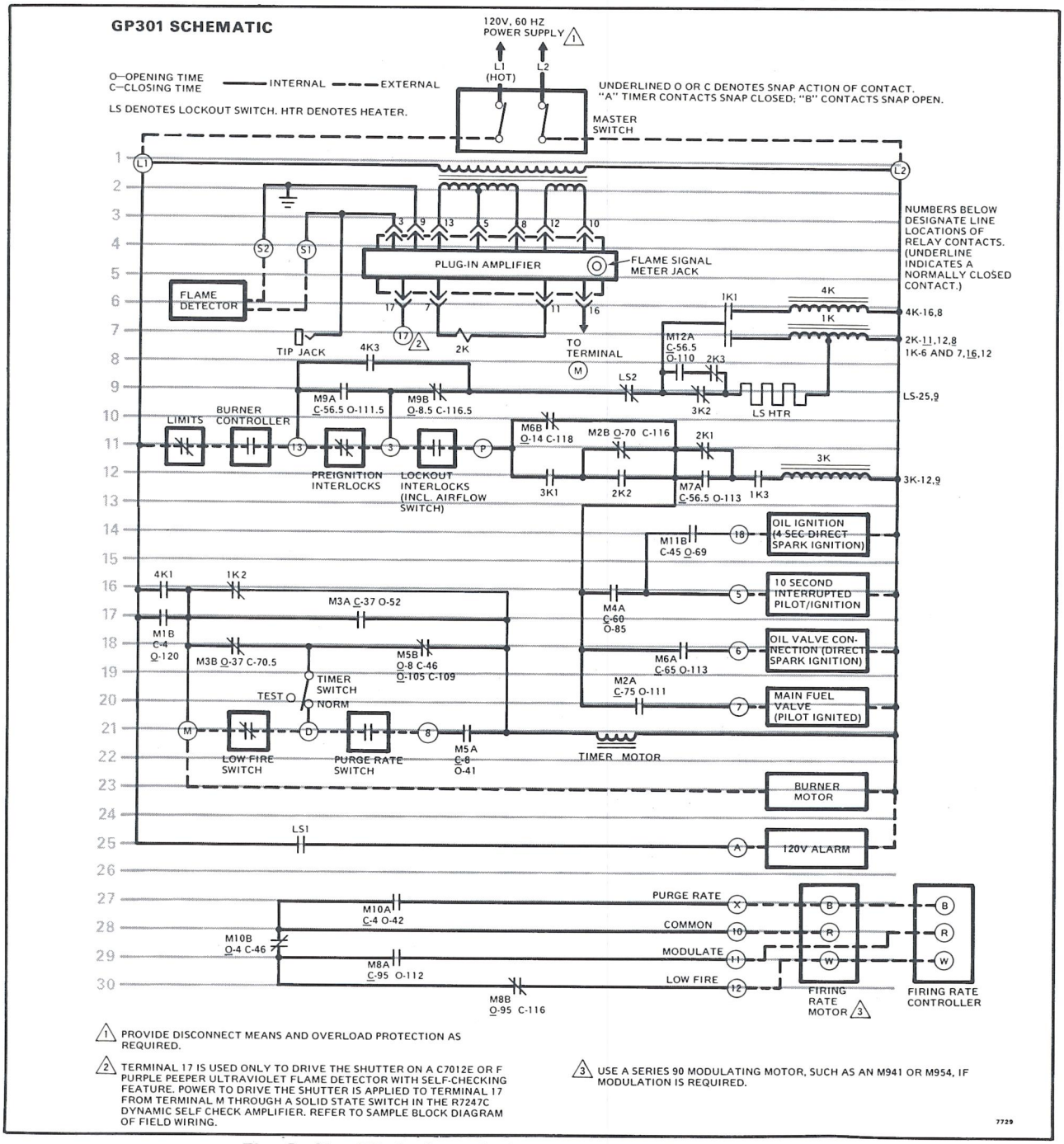


Fig. 3—Simplified schematic diagram of the GP301 Programmer.

STEP-BY-STEP OPERATION (GP301)

START AND PREPURGE

0 seconds—On a call for heat, the burner controller contacts close. If the limits and preignition interlocks are closed, relay 1K pulls in through M9B, LS2, 3K2, and the LS HTR (lockout switch heater—thus proving its continuity).

—1K1 closes; relay 4K pulls in and the LS HTR starts heating (through 1K1 and 3K2); 1K3 closes.

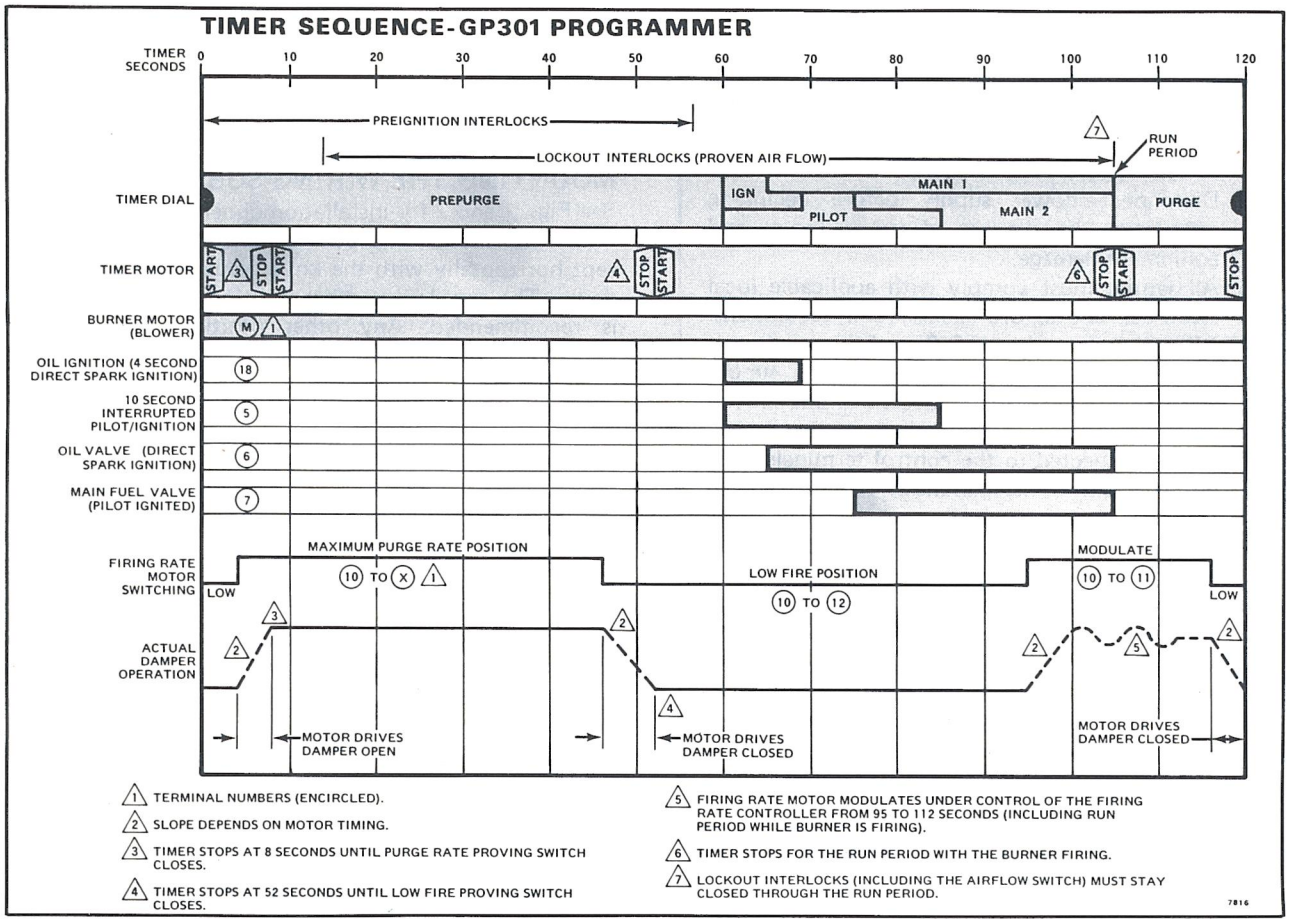
—4K1 closes and 1K2 opens; the timer starts (through M3B and M5B); power is applied to terminal M, starting the burner motor (blower).

—4K3 closes; 1K and 4K will stay pulled in through the run period unless safety shutdown occurs or a limit opens.

—Prepurge begins.

—When the lockout interlocks close (including the airflow switch and fuel pressure switches, if used), relay 3K pulls in (through M6B, 2K1, and 1K3).

- 3K1 closes, bypassing M6B.
- 3K2 opens; the LS HTR stops heating.
- If a flame (or a condition simulating a flame) is detected before or during prepurge (until 56.5 seconds), 2K pulls in, 2K1 opens, relay 3K drops out, 3K2 closes, the LS HTR heats, and safety shutdown occurs.



4 seconds—M10A closes and M10B opens; the firing rate motor drives toward maximum purge rate position (open).

—M1B closes, bypassing 4K1; the timer can complete its revolution if safety shutdown occurs or a limit opens.

8 seconds—M5A closes and M5B opens; timer stops until the purge rate proving switch closes; timer can be stopped by opening the timer switch (until 37 seconds when M3A closes).

8.5 seconds—M9B opens; 4K3 must be closed by this time or relays 1K and 4K will drop out and the system will be shut down; the timer will complete its revolution and recycle the programmer.

14 seconds—M6B opens; preignition interlocks must stay closed through prepurge and lockout interlocks must stay closed continuously (airflow must be proven) through the run period or relay 3K will drop out.

—If 3K drops out after 14 seconds:

- 3K1 opens; ignition trials cannot be started, or fuel valves are de-energized if burner is already firing; 3K cannot pull in again until the next cycle.
- 3K2 closes; lockout switch heater begins heating; safety shutdown occurs in approximately half a minute.

37 seconds—M3A closes, bypassing the purge rate switch and timer switch.

46 seconds—M10B closes; firing rate motor drives toward low fire position (closed).

52 seconds—M3A opens; timer stops until the low fire proving switch closes; timer can be stopped by opening the timer switch (until 70.5 seconds when M3B closes).

56.5 seconds—M7A closes, bypassing 2K1 in preparation for ignition trials; flame can now be detected without causing safety shutdown.

—M9A closes, bypassing the preignition interlocks.

—M12A closes; the LS HTR starts heating (through 1K1, M12A, and 2K3).

IGNITION TRIALS

60 seconds—M4A closes; power is applied to terminals 18 and 5, energizing the ignition transformer and pilot valve (if used).

—*If a pilot is used*: When the pilot flame is detected, relay 2K pulls in, 2K3 opens, and the LS HTR stops heating; 2K1 opens and 2K2 closes.

65 seconds—M6A closes, applying power to terminal 6; if direct spark ignition is used, the oil valve is energized and the oil burner is ignited.

—*If direct spark ignition is used*: When the oil burner flame is detected, relay 2K pulls in, 2K3 opens, and the LS HTR stops heating; 2K1 opens and 2K2 closes.

69 seconds—M11B opens, de-energizing terminal 18; if direct spark ignition is used, the 4 second ignition is cut off.

70 seconds—M2B opens; pilot or ignition trial ends; flame must be detected by this time (2K pulled in and 2K2 closed) or pilot/ignition will be de-energized, relay 3K will drop out, safety shutdown will occur, and the lockout switch will trip.

70.5 seconds—M3B closes, bypassing the low fire switch and timer switch.

75 seconds—M2A closes, applying power to terminal 7; if pilot ignition is used, the main fuel valve is energized and the main burner is ignited.

85 seconds—M4A opens; 10 second interrupted pilot/ignition (terminal 5) is de-energized.

95 seconds—M8A closes and M8B opens; firing rate motor is released to modulate under control of the firing rate controller.

105 seconds—M5B opens; timer stops with the system in the run condition.

RUN PERIOD (burner is firing)

POSTPURGE AND STOP

105 seconds—When the operating set point is reached, the burner controller contacts open; 1K, 3K, and 4K relays drop out; terminals 6 and 7 are de-energized; the oil valve (for direct spark ignition) or the main fuel valve closes.

—1K2 closes; timer motor starts; postpurge begins.

—When flame goes out, relay 2K drops out.

112 seconds—M8A opens; firing rate motor stops modulating under control of the firing rate controller.

116 seconds—M8B closes; firing rate motor drives toward low fire position (closed).

120 seconds—M1B opens; timer and burner motor stop; end of cycle.

CAUTION

1. Installer must be a trained, experienced, flame safeguard control serviceman.
2. Disconnect power supply before beginning installation to prevent electrical shock and equipment damage.
3. All wiring must comply with applicable local electrical codes, ordinances, and regulations.
4. All wiring must be NEC Class 1 (line voltage).
5. Voltage and frequency of the power supply and flame detector(s) connected to this control must agree with those marked on the device.
6. Loads connected to the control terminals must not exceed those listed in the SPECIFICATIONS section.
7. Limits and interlocks must be rated to carry and break current to the ignition transformer, pilot valve, and main fuel valve simultaneously.
8. All external timers must be listed or component recognized by authorities having jurisdiction, for the specific purpose for which they are used.
9. Perform all required checkout tests after installation is complete.

CAUTION

Limit and/or operating controls must be connected in series from the power source to Q520A1147 subbase terminal 13. Connection of limit and/or operating controls in series between the Q520A1147 subbase terminal 7 and the main fuel valves will void important safety features of the flame safeguard control. This does not include oil pressure limit controls or oil atomizing pressure limit control.

Use applicable installation instructions provided by other manufacturers which may apply in addition to the 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

LOCATION

TEMPERATURE

Install the GP301 where the surrounding temperatures will remain within the Ambient Operating Temperature Ratings in the SPECIFICATIONS section.

HUMIDITY

Install the GP301 where the relative humidity never reaches the saturation point. Condensation of moisture on the GP301 may cause enough leakage to short the flame signal to ground and thus prevent the burner from starting.

VIBRATION

Do not install the GP301 where it could be subject to extreme vibration. Vibration shortens the life of the electronic components.

WEATHER

The GP301 is not designed to be weathertight. If it is installed outdoors, it must be protected.

MOUNTING THE WIRING SUBBASE

See Figs. 1 and 2 for installation dimensions.

1. The subbase can be mounted in any position except horizontally with the knife-blade contacts pointing down. The standard vertical position (shown in Fig. 5) is recommended. Any other position decreases the maximum ambient temperature rating. (See Ambient Operating Temperature Ratings in the SPECIFICATIONS section.)

2. Select the location on a wall or instrument panel. (The Q520A1147 Subbase may be mounted directly in the customer's cabinet.) Be sure to allow clearances for servicing and for removal of the GP301.

IMPORTANT

Do not mount the wiring subbase horizontally with the knife-blade contacts pointing down.

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

4. Insert the mounting screws and tighten them securely.

WIRING TO SUBBASE (FIG. 4)

CAUTION

Make sure the wiring to terminal 6 or 7 does not touch any other terminal, especially terminal M.

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 (rated for 194 F [90 C] or higher required by Underwriters Laboratories Inc.).

3. *For high temperature installations*, use moisture-resistant No. 14 wire, selected for a temperature rating above the maximum operating temperature, for all but the ignition and flame detector "S1" leadwires.

   a. *For the ignition*, use Honeywell Spec. No. R1061012 Ignition Cable or equivalent. (This wire is rated at 350 F [175 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 "S1" leadwire*, use Honeywell Spec. No. R1298020 or equivalent. (This wire is rated up to 400 F [205 C] for continuous duty. It is tested for operation up to 600 volts and breakdown 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 350 F [175 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 Fig. 4 for typical field wiring connections. Follow wiring diagram if provided.

6. Make sure the loads do not exceed the terminal ratings. Refer to the label on the GP301 or to the Terminal Ratings in the SPECIFICATIONS section.

7. *Check the power supply circuit.* The voltage and frequency must match those of the GP301. Do not connect the GP301 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.

8. Check all wiring circuits before installing the GP301.

INSTALLING THE FLAME DETECTOR

Proper flame detector installation is the basis of a reliable flame safeguard installation. Refer to the instructions packed with the flame detector and amplifier, and to instructions. Follow the instructions carefully to make the best possible application of the flame detector.

Keep the flame signal leadwires from the flame detector to the 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 leadwire, conduit, and flame detector. *The ultimate limiting factor in flame signal leadwire length is the signal current.* Refer to Table II in the CHECKOUT section.

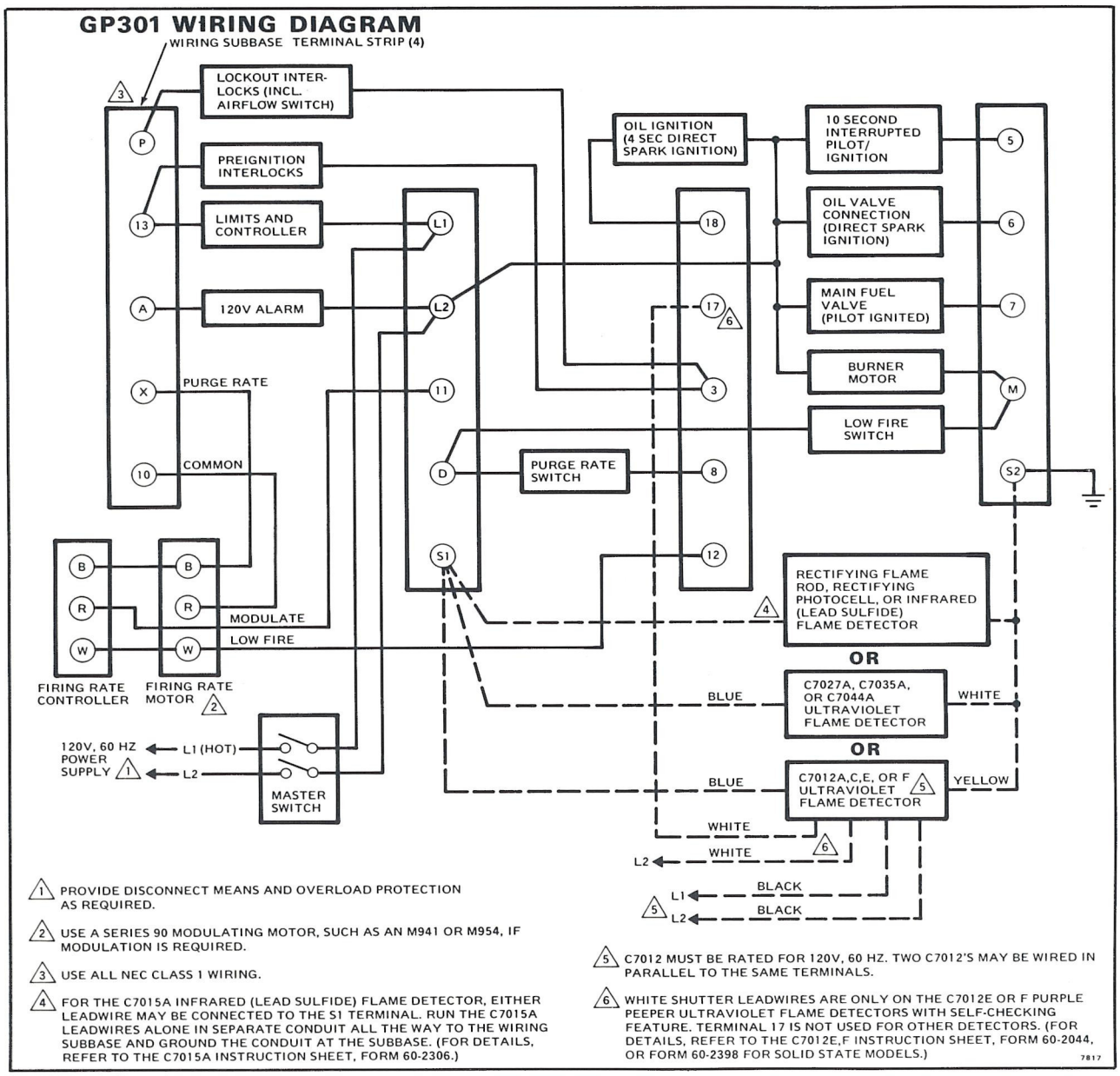


Fig. 4—Sample block diagram of field wiring for the GP301 Programmer.

INSTALLING THE PROGRAMMER (FIG. 5)

1. Open the master switch.
2. Make sure no subbase wiring is projecting out beyond the terminal blocks. Tuck wiring in against the back of the subbase so it does not interfere with the contacts.
3. Grasp the handle of the programmer chassis and engage the chassis hinge brackets with the pivot pins at the bottom of the subbase.
4. Swing the chassis inward until the spring connectors engage the knife-blade contacts. Push in until the contacts are fully engaged.
5. Tighten the chassis retaining screw securely.

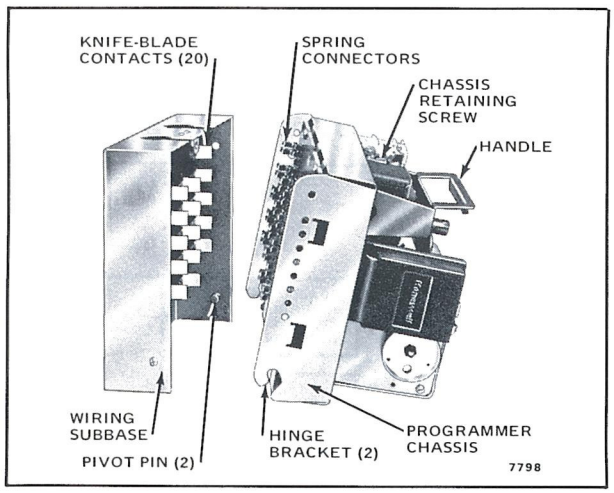


Fig. 5—Mounting the programmer on the subbase.

REMOVING THE PROGRAMMER

1. Open the master switch.
2. Loosen the chassis retaining screw.
3. Pull outward on the handle.
4. Disengage the chassis hinge brackets from the subbase pivot pins.

REMOVING AND REPLACING THE RELAY/TIMER COVER (FIG. 6)

CAUTION

If the programmer is mounted on the subbase, open the master switch before removing or replacing the relay/timer cover.

The relay/timer cover must be removed to install a plug-in flame signal amplifier, to observe relay and timer operation, or to inspect contacts.

REMOVING THE COVER

1. Grasp the relay/timer cover and squeeze until the V-notch on the cover slides free of the stud on the handle.
2. Rotate the cover down and out to disengage the 2 tabs from the slot in the bottom of the programmer chassis.
3. Pull the cover out.

REPLACING THE COVER

1. Insert the 2 tabs on the bottom of the cover between the timer and the programmer chassis and engage them with the slot in the bottom of the chassis. Make sure the tabs are not jammed in the slot.
2. Rotate the cover up and in so the V-notch slides along the stud on the handle. If the cover does not rotate easily, the tabs are jammed.
3. Make sure the spring clip on the cover fits over the plug-in amplifier.
4. Push in on the cover until the V-notch snaps into place on the stud.

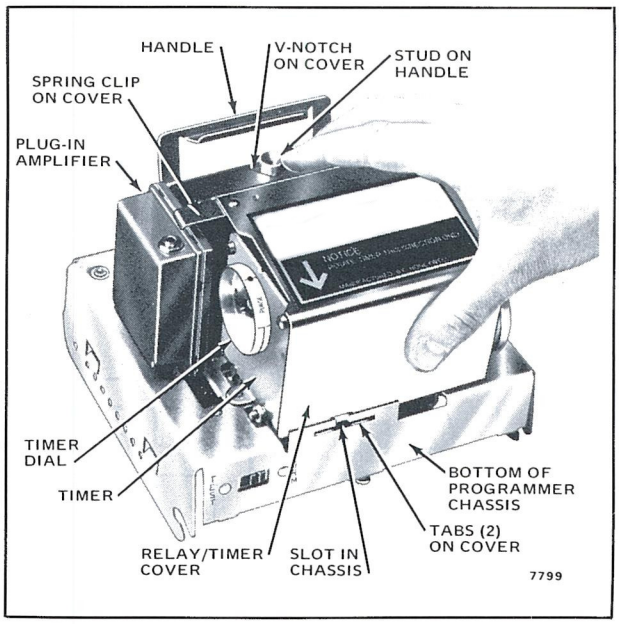


Fig. 6—Removing and replacing the relay/timer cover.

INSTALLING A PLUG-IN FLAME SIGNAL AMPLIFIER (FIG. 7)

1. Remove the relay/timer cover per previous instructions.
2. Make sure the amplifier nameplate is on the outside. Then align the circuit board with the keyed receptacle on the programmer.

NOTE: If you are installing a small amplifier, align its ends with the 2 scribe marks alongside the receptacle on the programmer.

3. Push in the amplifier until the circuit board is fully inserted into the receptacle.
4. Make sure the amplifier is firmly in place; then replace the relay/timer cover. Make sure the spring clip on the cover fits over the amplifier.

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.

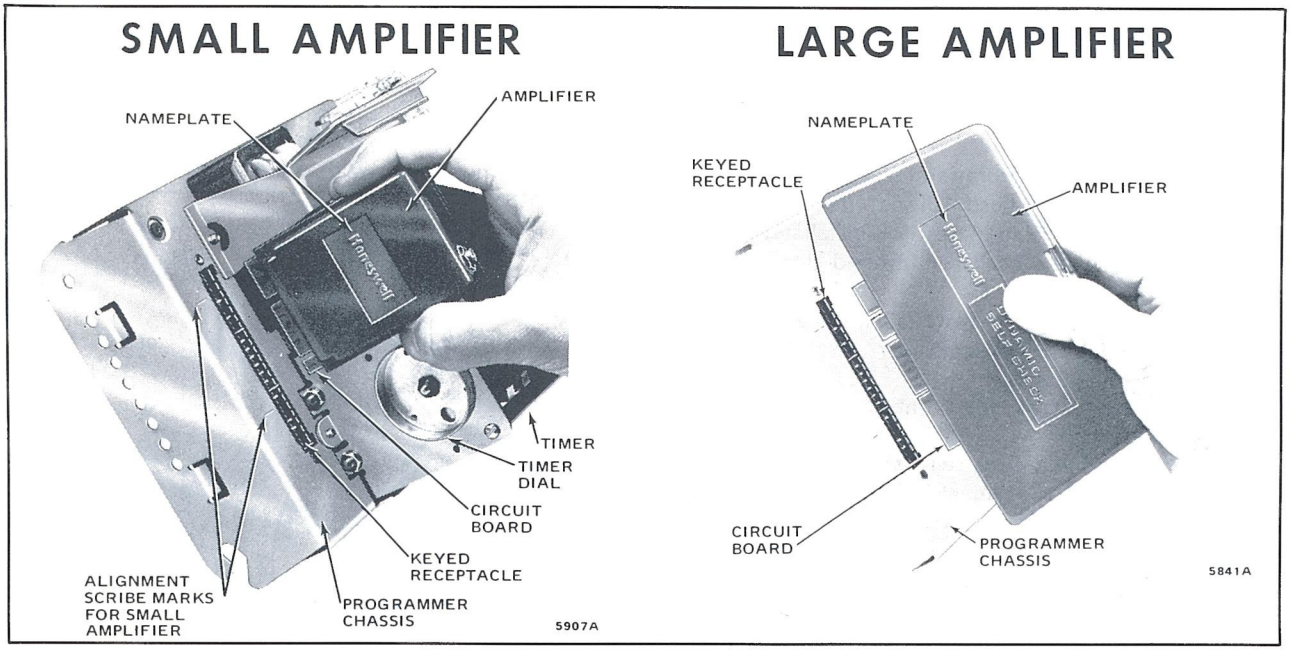


Fig. 7—Installing a plug-in flame signal amplifier.

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 4 seconds if direct spark ignited, or 10 seconds if pilot ignited. In any case, do not exceed the normal lightoff time specified 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 programmer; line voltage is present on most contacts when power is on.
2. Open the master switch before removing the programmer from the subbase, before reinstalling the programmer, 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

IMPORTANT

a. If the system fails to perform properly, note the point at which trouble occurs and refer to the TROUBLESHOOTING section.
b. Before you reset the lockout switch, wait at least 1 minute to allow the heater to cool.
c. 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.

EQUIPMENT REQUIRED

1. Voltmeter (Honeywell W136A or equivalent)—with 0 to 300V ac scale.
2. Microammeter (Honeywell W136A or equivalent)—with 0 to 25 microamp range and SPL scale with damping.
3. Meter connector plug—Part No. 117053 or equivalent.
4. Jumper wires (2)—No. 14 wire, insulated, 12 inches long, with alligator clips at both ends.
5. Watch or clock—with second hand.
6. Manometers (or pressure gauges)—to measure all fuel pressures.

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.

(continued on page 10)

- 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 Test–all installations using rectifying photocells or infrared (lead sulfide) 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 Fig. 4 for terminal locations, and to Fig. 8 for locations of component parts.

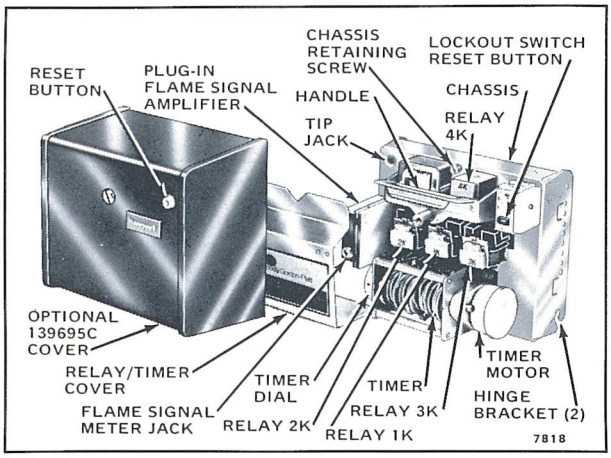


Fig. 8–Components of the GP301 Programmer.

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 I.
4. Burner is completely installed and ready to fire fuel lines are purged of air.
5. Combustion chamber and flues are clear of fuel and fuel vapor.
6. Power is connected to the system disconnect switch (master switch).
7. Lockout switch is reset (push in lockout switch reset button, Fig. 8).
8. Spring clip on relay/timer cover is holding the plug-in flame signal amplifier securely in the receptacle.
9. Timer switch is in NORM position (Fig. 9).
10. The large dot between PURGE and PREPURGE on the timer dial is at the index notch (Fig. 9). If it isn't, manually rotate the timer dial to the proper position. *Rotate the timer only in the direction shown by the arrow on the relay/timer cover.*
11. All limits and interlocks are reset.

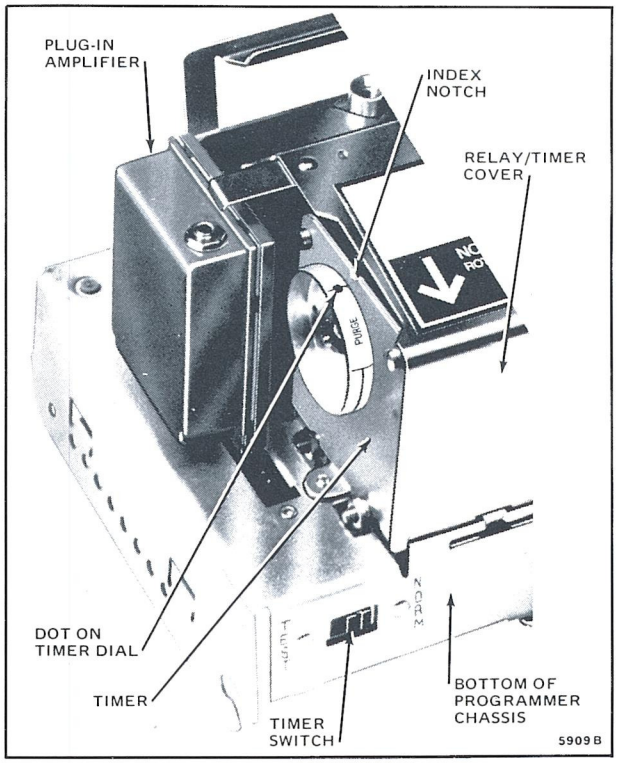


Fig. 9–Location of the timer switch and position of the timer dial at startup.

FLAME SIGNAL MEASUREMENT (FIG. 10)
(ALL INSTALLATIONS)

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

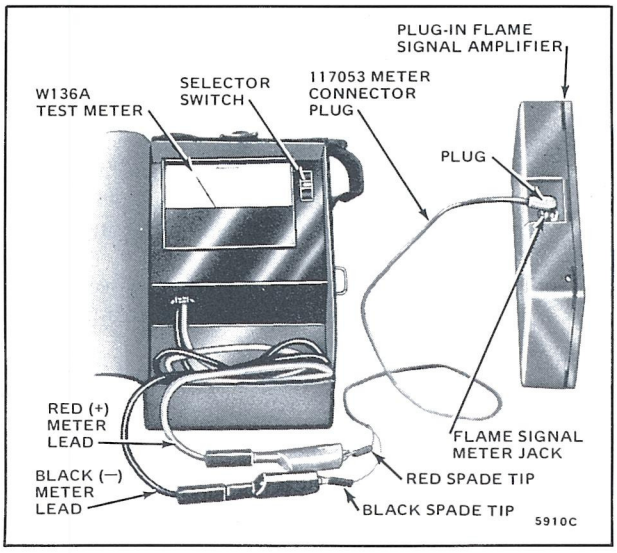


Fig. 10–Measuring the flame signal.

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 II after all tests have been completed and all adjustments have been made.

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 terminals L1-L2 on the wiring subbase.
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 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 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.

TABLE II—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)	3	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 4 RANGES OF SENSITIVITY: 104662A (RED), LOWEST; 104662B (YELLOW), MEDIUM; 104662C (GREEN), HIGH; 104662D (WHITE), HIGHEST 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.

5911C

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. (If the pilot takeoff is downstream from the manual main fuel shutoff valve, make sure the main fuel is shut off just upstream from the burner inlet, or disconnect power from the automatic main fuel valve.)

3. Close the master switch and start the system with a call for heat (raise the set point of the burner controller). The burner motor (blower) should run, the programmer timer should start, and prepurge should begin.

4. Let the timer dial advance through PREPURGE. When the PILOT part of the dial is opposite the index notch, spark should occur and the pilot should ignite. If it ignites, proceed to step 7.

5. If the pilot flame is not established in 10 seconds, safety shutdown will occur in approximately half a minute. Let the timer complete its revolution and stop.

6. Wait approximately 1 minute, reset the lockout switch, and let the system recycle once. If the pilot still does not ignite, make the following ignition/pilot adjustments:

   a. *Open the master switch* and remove the programmer from the subbase.
   b. On the subbase, jumper terminal L1 to the ignition, terminal 5. Disconnect the leadwire to the pilot valve.
   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.
   e. Make sure the ignition electrodes are clean. Then close the master switch and observe the spark.
   f. Once a continuous spark is obtained, *open the master switch* and reconnect the leadwire from the pilot valve.
   g. Close the master switch to energize both the ignition transformer and the pilot valve.
   h. If the pilot does not ignite and if the ignition spark is still continuous, adjust the pilot gas pressure regulator until a pilot is established.
   i. When the pilot ignites properly and stays ignited, *open the master switch and remove the jumper* from terminal L1-5 of the subbase.
   j. Check for adequate bleeding of the fuel line.
   k. Reinstall the programmer on the subbase, reset the lockout switch, and close the master switch.

7. When the pilot ignites, measure the flame signal. If necessary, adjust the flame or detector to give a proper flame signal.

8. Recycle the system to recheck lightoff and the pilot flame signal.

9. When the "MAIN 2" part of the timer dial is opposite the index notch, 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 15.

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

10. If the main burner flame is not established within 10 seconds, or within the normal lightoff time specified *close the manual main fuel shutoff valve(s) and open the master switch*.

11. Purge the combustion chamber to remove any unburned fuel. Check all burner adjustments.

12. Wait about 3 minutes. Reset the lockout switch, close the master switch, and let the programmer recycle to "MAIN 2." *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.

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

13. If the main burner flame is not ignited within the time specified in step 10 above, *close the manual main fuel shutoff valve(s) and open the master switch.* Check all burner adjustments.

14. Repeat steps 11 through 13 to establish the main burner flame.

15. When the main burner flame is established, the timer dial will advance to the end of "MAIN 2" and stop. Make burner adjustments for flame stability and input rating.

16. Shut down the system by lowering the set point of the burner controller. *Make sure the main burner flame goes out and all automatic fuel valves close. If used, remove the bypass jumpers from the low fuel pressure limits. Reset fuel pressure limits if required.*

17. Restart the system by raising the set point of the burner controller. Observe that the pilot is established during PILOT, and main burner flame during "MAIN 2," within the normal lightoff time specified by Peabody Gordon-Piatt.

18. Measure the flame signal. Continue to check for the proper signal (Table II) through the "MAIN 2" part of the timer dial, and into the run period after the timer stops. Check the signal at both maximum purge rate and low fire positions, and while modulating.

19. Run the burner through another sequence, observing the flame signal for—

—pilot alone,
—pilot and main burner flame together, and
—main burner flame alone.

Also observe the time to light the main burner.

20. 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. Refer to the sample block diagram of field wiring (Fig. 4) for hookup of ignition and oil valve.

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

1. Complete the normal "ready-to-fire" checkout of the oil supply and equipment as recommended

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

3. Close the master switch and start the system with a call for heat (raise the set point of the burner controller). The burner motor (blower) should run, the programmer timer should start, and prepurge should begin.

4. Let the timer dial advance through PREPURGE. When the IGN part of the dial is opposite the index notch, watch for ignition spark. When the "MAIN 1" part of the dial is opposite the index notch, listen for the click of the oil solenoid. (If spark does not occur or the oil valve does not open, refer to PROCEDURE H in the TROUBLESHOOTING section.)

5. Let the programmer complete its revolution and stop.

6. Open the manual fuel shutoff valve(s).

7. Reset the lockout switch and recycle the programmer through PREPURGE.

8. When the "MAIN 1" part of the timer dial is opposite the index notch, watch for the burner flame to be established. If it is, proceed to step 13.

9. If the burner flame is not established within 4 seconds, or within the normal lightoff time specified *close the manual shutoff valve(s) and open the master switch.*

10. Purge the combustion chamber to remove any unburned oil. Check all burner adjustments.

11. Wait about 3 minutes. Close the master switch, open the manual 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.

12. If necessary, repeat steps 7 through 11 to establish the burner flame.

13. When the burner flame is established, the timer dial will advance to the end of "MAIN 1" and stop. Make burner adjustments for flame stability and input rating.

14. Shut down the system by lowering the set point of the burner controller. *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. Reset fuel pressure limits if required.*

15. Restart the system by raising the set point of the burner controller. Observe that the burner flame is established during IGN, within the normal lightoff time specified

16. Measure the flame signal. Continue to check for the proper signal (Table II) through the "MAIN 1" part of the timer dial and into the run period after the timer stops. Check the signal at both maximum purge rate and low fire positions, and while modulating. Any pulsating or unsteady readings will require further adjustments.

17. 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 to measure pilot gas pressure during the turndown test.
4. Open the manual pilot shutoff valve.
5. Close the master switch and start the system with a call for heat (raise the set point of the burner controller). The burner motor (blower) should run, the programmer timer should start, and prepurge should begin.
6. When the IGN area of the timer dial is opposite the index notch, set the timer switch to TEST position to stop the timer. Relay 2K should pull in when the pilot ignites.

NOTE: If the timer does not stop, see Procedure T in the TROUBLESHOOTING section.

7. Turn the pilot pressure down very slowly, reading the manometer as it drops. Stop instantly when relay 2K drops out. Note the pressure at the dropout point. The pilot is at the turndown position. Turn up the pilot pressure immediately to pull in 2K.

NOTE: With the timer stopped in this position, the lockout switch will heat when 2K is not pulled in. If 2K is out for a total of about 30 seconds, safety shutdown will occur.

8. Repeat step 7 to verify the pilot gas pressure reading at the exact point of relay 2K dropout.

9. Increase the pilot pressure immediately to pull in 2K, and then turn it down slowly to obtain a pressure reading just above the dropout point.

10. Set the timer switch in the NORM position and let the timer proceed. When the "MAIN 2" area of the timer dial reaches the index notch, 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 17.

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

(continued on page 14)

11. If the main burner flame is not established within 10 seconds, or within the normal lightoff time specified *close the manual main fuel shutoff valve(s) and open the master switch.*

12. Purge the combustion chamber to remove any unburned fuel. Check all burner adjustments.

13. Wait about 3 minutes. Reset the lockout switch (if tripped), close the master switch, and let the programmer recycle to "MAIN 2." Repeat steps 10 and 11 (try lightoff once more).

14. If the second attempt is unsuccessful, 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.

15. Measure the pilot flame signal after adjusting the flame detector to make sure it is stable and above the minimum (see Table II).

16. Repeat steps 5 through 15 until the main burner positively lights with the pilot flame just holding in flame relay 2K.

17. Repeat the lightoff of the main burner several times (step 10) with the pilot at turndown.

18. When the main burner lights reliably with the pilot at turndown, disconnect the manometer and turn the pilot up to normal. *If used, remove the bypass jumpers from the low fuel pressure limits. Reset fuel pressure limits if required.*

19. 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 programmer will act as though the pilot, or oil burner if using direct spark ignition, 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 (or oil burner) on, and then with the pilot (or oil burner) only. 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 volt systems—1/16 to 3/32 inch [1.6 to 2.4 mm].

   10,000 volt systems—1/8 inch [3.2 mm].

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 though a flame failure has occurred.

If hot refractory saturation occurs, the condition must be corrected. Add an orifice 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 hot refractory is detected.

First check the plug-in flame signal amplifier by initiating a burner cycle. When the programmer stops in the run position, terminate the firing cycle while the refractory is at a low temperature. 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. (Lower the set point of the burner controller, or set the fuel selector switch to OFF. 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, fuel mist, atomizing air, or atomizing steam 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. (Lower the set point of the burner controller, or set the fuel selector switch to OFF. Do not open the master switch.)

NOTE: Some burners continue to purge their oil lines between the valve(s) and nozzle(s) even though the fuel valve(s) is closed. Termination of the firing cycle (instead of opening the master switch) will allow purging of the combustion chamber. 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 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). For details, refer to the C7015A instruction sheet, form 60-2306. 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 fuel shutoff valves.
2. Start the burner and run through the ignition period. 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.

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 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 main oil flame when using direct spark ignition). Check the signal at both maximum purge rate and low fire positions, and while modulating.

Also check the flame failure response time. Lower the set point of the burner controller 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.

IMPORTANT

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) detection of flame (or a condition simulating a flame) before or during prepurge, (2) opening of a preignition interlock during prepurge, (3) opening of a lockout interlock after 14 seconds, (4) failure to ignite the pilot, (5) failure to light the main burner, and (6) loss of flame during the run period.

On safety shutdown, the lockout switch should trip (pop out) and lock out the programmer. If used, the external alarm should turn on. The timer should complete its revolution and lock up at the start position. The lockout switch must be manually reset to restart the system.

(continued on page 16)

1. *Detection of Flame Before or During Prepurge*
   a. Reset the lockout switch if tripped.
   b. Close the master switch.
   c. Start the system with a call for heat (raise the set point of the burner controller).
   d. At about 30 seconds, momentarily simulate flame to pull in relay 2K. (Actuate the flame detector with a flame, or use a flame simulator—see step 3 under Procedure I in the TROUBLESHOOTING section.)
   e. Relay 3K should drop out, and there should be no ignition.
   f. Safety shutdown should occur approximately half a minute after 3K drops out.

2. *Opening of a Preignition Interlock During Prepurge*
   a. Make sure all interlocks are closed.
   b. Reset the lockout switch.
   c. Start the system.
   d. After about 30 seconds, open a preignition interlock.
   e. Relay 3K should drop out, and there should be no ignition.
   f. Safety shutdown should occur approximately half a minute after 3K drops out.

3. *Opening of a Lockout Interlock*
   a. Make sure all interlocks are closed.
   b. Reset the lockout switch.
   c. Start the system. Startup should be normal and the main burner should light normally.
   d. After the timer stops in the normal run position with the burner firing, open a lockout interlock (airflow switch or fuel pressure switch).
   e. Relay 3K should drop out, the automatic fuel valves should close, and the burner flame should go out.
   f. Safety shutdown should occur approximately half a minute after 3K drops out.

4. *Failure to Ignite Pilot* (or oil burner if using direct spark ignition of oil)
   a. Close the pilot and main fuel manual shutoff valves.
   b. Make sure all interlocks are closed, and reset the lockout switch.
   c. Start the system.
   d. The automatic pilot valve (or oil valve) should be energized, but the pilot (or oil burner) cannot ignite.
   e. Relay 3K should drop out about 10 seconds after the pilot valve (or oil valve) is energized.
   f. Safety shutdown should occur approximately half a minute after 3K drops out.

5. *Failure to Light Main Burner* (if using direct spark ignition, perform test 4)
   a. Open the manual pilot shutoff valve; leave the manual main fuel shutoff valve(s) closed.
   b. Reset the lockout switch.
   c. Start the system.
   d. The pilot should ignite and pull in relay 2K, but the main burner cannot light.
   e. Relay 2K should drop out within 4 seconds after the pilot goes out.
   f. Relay 3K should drop out immediately after relay 2K drops out.
   g. Safety shutdown should occur approximately half a minute after 3K drops out.

6. *Loss of Flame During the Run Period*
   a. Open the manual main fuel shutoff valve(s); the manual pilot shutoff valve must also be open.
   b. Reset the lockout switch.
   c. Start the system. Startup should be normal and the main burner should light normally.
   d. After the timer stops in the normal run position with the burner firing, close the manual main fuel shutoff valve(s) to extinguish the main burner flame.
   e. Relay 2K should drop out within 4 seconds after the main burner flame goes out.
   f. Relay 3K should drop out immediately after relay 2K drops out.
   g. Safety shutdown should occur approximately half a minute after 3K drops out.

IMPORTANT

1. If the lockout switch fails to trip and shut down the system on any of these tests, replace the programmer and rerun all Checkout tests from the beginning.
2. When all Checkout tests have been completed, reset all controller set points to the desired values.

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.

CAUTION

1. Close *all* manual fuel shutoff valves as soon as trouble occurs.
2. Use utmost care while troubleshooting the programmer; line voltage is present on most contacts when power is on.
3. Open the master switch before removing or replacing the relay/timer cover, before removing the programmer from the subbase, before reinstalling the programmer, before making any adjustments, and before replacing any devices.
4. Replace all external devices not operating properly. Do not bypass external devices.
5. Replace the relay/timer cover upon completion of troubleshooting.

Refer to the Step-By-Step Operation for the GP301 in the OPERATION section of this sheet. Observe the operation carefully to determine at what point the trouble occurs. Then refer to the Trouble Symptoms list and follow the troubleshooting procedure(s) outlined.

EQUIPMENT REQUIRED

1. Voltmeter (Honeywell W136A or equivalent)—with 0 to 300V ac scale.
2. Microammeter (Honeywell W136A or equivalent)—with 0 to 25 microamp range and SPL scale with damping.
3. Meter connector plug—Part No. 117053 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 long, with alligator clips at both ends.
7. Shorting wire—10 inches long, insulated, with 3/4 inch 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. Manometers (or pressure gauges)—to measure all fuel pressures.

PRELIMINARY CHECK (FIG. 11)

Open the master switch before performing this check. Eliminate the possibility of trouble being caused by poor contact of the spring connectors on the back of the programmer. Ensure that they are properly aligned and have the proper tension. They should be tight enough so that it is necessary to force a dime between the contacts. If a dime slips through, press the connector together gently with your finger tips—do not use pliers.

TROUBLE SYMPTOMS

Choose the applicable symptoms from the following list and proceed to the corresponding troubleshooting procedures.

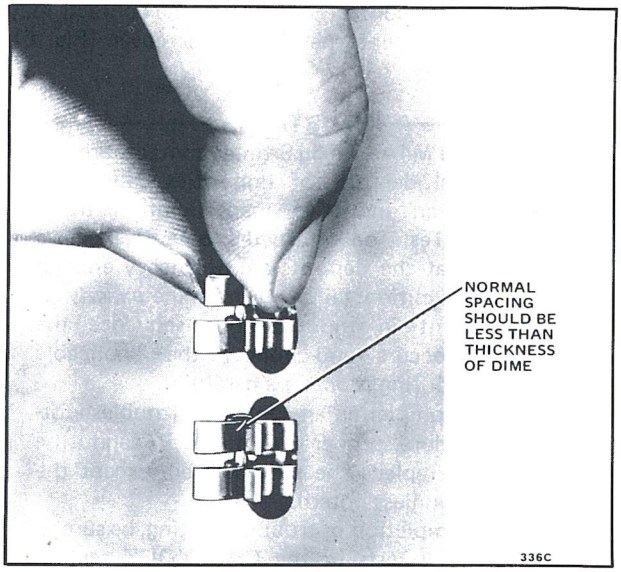


Fig. 11—Adjusting the spring connectors.

NOTE: If using direct spark ignition on an oil burner, substitute "oil burner" for "pilot" in Procedures H and I. Procedures J and K do not apply.

A. On a call for heat, programmer won't start (relay 1K does not pull in).
B. Relay 1K pulls in, but burner motor does not start.
C. Burner motor starts, but timer does not start.
D. Relay 1K pulls in initially, but drops out after a few seconds (pilot does not ignite and programmer recycles).
E. Timer stops at 8 seconds and will not continue sequence.
F. Timer stops at 52 seconds and will not continue sequence.
G. Safety shutdown occurs during prepurge.
H. Pilot does not ignite (safety shutdown occurs).
I. Pilot ignites, but relay 2K does not pull in (safety shutdown occurs).
J. Pilot ignites and relay 2K pulls in, but main burner does not light (safety shutdown occurs if using interrupted pilot).
K. Pilot does not go out at end of main burner flame-establishing period (interrupted pilot only).
L. Timer stops before the run period and will not continue sequence.
M. Burner cycles on and off continuously (timer does not stop for run period).
N. Burner stays at low fire during run period.
O. Shutdown occurs during run period.
P. Timer does not complete its revolution after operating set point is reached.
Q. Timer or burner motor keeps running at end of cycle.
R. Relay 2K stays in at end of cycle. (When new cycle starts, safety shutdown occurs during prepurge.)
S. External alarm (if used) does not function properly.
T. During testing, timer won't stop when timer switch is set to TEST position.

TROUBLESHOOTING PROCEDURES

Refer to Figs. 15 and 16 on the last page for location of relay and timer contacts. Access to the contacts may be gained by removing the relay/timer cover (Fig. 6).

IMPORTANT

a. Blackened M4A or M11B timer contacts are due to normal deposits of impurities caused by breaking an inductive load (ignition transformer). Tests on returned programmers have shown that the deposits are not heavy enough to cause ignition failure. Determine *exactly* at what point in the operating sequence the trouble occurs and follow the applicable troubleshooting procedure carefully.

b. If, after completing an applicable troubleshooting procedure, proper operation still cannot be obtained, replace the programmer (except the amplifier, unless noted).

c. At the completion of troubleshooting, be sure to perform *all* tests in the CHECKOUT section of this sheet.

A. ON A CALL FOR HEAT, PROGRAMMER WON'T START (RELAY 1K DOES NOT PULL IN).

1. Reset the lockout switch (if it is popped out).
2. Check that the programmer timer is at the start position. The large dot between PURGE and PREPURGE on the timer dial should be at the index notch (Fig. 9).
3. Open the master switch, remove the programmer from the wiring subbase, and close the master switch.
4. Check that there is line voltage between terminals L1-L2, 13-L2, and 3-L2 on the subbase.
5. If there is no voltage at terminal L1, make sure line voltage power is connected to the master switch, the master switch is closed, and overload protection (circuit breaker, fuse, or similar device) has not opened the power line.
6. If there is no voltage at terminal 13, check that the limits and burner controller contacts are closed. If a limit is open, determine the cause(s) and correct the condition(s) before proceeding.
7. If there is no voltage at terminal 3, check that the preignition interlocks are closed.
8. Replace all external devices not operating properly. *Do not bypass external devices.*
9. On the programmer, visually check that the M9B timer contacts and 3K2 relay contacts are closed.
10. Open the master switch and reinstall the programmer on the subbase; close the master switch.

B. RELAY 1K PULLS IN, BUT BURNER MOTOR DOES NOT START.

1. Check that relay 4K is pulled in. If it isn't, visually check that the 1K1 relay contacts are closed.
2. Visually check that the 4K1 relay contacts are closed.
3. Check that the external burner motor circuits are wired correctly.
4. Check that the manual switch of the burner motor is closed.
5. Check the motor power supply, motor overload protection, and motor starter.
6. Check the burner motor; replace if necessary.

C. BURNER MOTOR STARTS, BUT TIMER DOES NOT START.

Visually check that the M3B and M5B timer contacts are closed.

D. RELAY 1K PULLS IN INITIALLY, BUT DROPS OUT AFTER A FEW SECONDS (PILOT DOES NOT IGNITE AND PROGRAMMER RECYCLES).

Visually check that the 1K1 and 4K3 relay contacts are closed.

E. TIMER STOPS AT 8 SECONDS AND WILL NOT CONTINUE SEQUENCE.

1. Check that the timer switch is in the NORM position (Fig. 9).
2. Check that the external purge rate switch is closed. If the switch is not operating properly, replace it.
3. Visually check that the M3B, M5A, and M10A timer contacts are closed.
4. Visually check that the M10B timer contacts are open.
5. Check the firing rate motor and its transformer; replace if necessary.

F. TIMER STOPS AT 52 SECONDS AND WILL NOT CONTINUE SEQUENCE.

1. Check that the timer switch is in the NORM position (Fig. 9).
2. Check that the external low fire switch is closed. If the switch is not operating properly, replace it.
3. Visually check that the M5B, M8B, and M10B timer contacts are closed.
4. Visually check that the M8A and M10A timer contacts are open.
5. Check the firing rate motor and its transformer; replace if necessary.

G. SAFETY SHUTDOWN OCCURS DURING PREPURGE.

1. Check that relay 2K is not pulled in. (If it is, follow procedure R.)
2. Let the programmer timer complete its revolution, open the master switch, and remove the programmer from the subbase.
3. Jumper terminal M to terminal L1 on the subbase.
4. Close the master switch to start the burner motor (blower).
5. Check for line voltage between terminals P-L2 on the subbase. If voltage is present before 12 seconds, proceed to step 7.

6. If there is no voltage at terminal P, check that the Preignition Interlocks and the Lockout Interlocks (including the Airflow Switch) are closed. If voltage does not occur until after 12 seconds, check the operation of the Airflow Switch and the burner motor. Replace if they are not operating properly.

IMPORTANT

Relay 3K will not pull in unless proper airflow is established and the Airflow Switch closes before M6B opens. If the Airflow Switch opens after M6B opens, 3K will drop out and cannot pull in again until the next cycle. Safety shutdown occurs in either case.

7. On the programmer, visually check that the 2K1 relay contacts and M2B and M6B timer contacts are closed.
8. Open the master switch, remove the jumper from terminals M-L1 on the subbase, and reinstall the programmer on the subbase.
9. Reset the lockout switch, close the master switch, and recycle the programmer.
10. Visually check that—
    —1K3 closes when relay 1K pulls in.
    —relay 3K pulls in before M6B opens.
    —3K1 closes and 3K2 opens when 3K pulls in.

H. PILOT DOES NOT IGNITE (SAFETY SHUTDOWN OCCURS).

NOTE: If using direct spark ignition on an oil burner, substitute "oil burner" for "pilot."

1. *Close the manual main fuel shutoff valve(s) immediately.*
2. Let the programmer timer complete its revolution.
3. Make sure fuel is available, the manual pilot shutoff valve (or manual oil shutoff valve if using direct spark ignition) is open, and the fuel lines are not plugged. *Then close the manual pilot shutoff valve (or manual oil shutoff valve).*
4. Wait a minute and reset the lockout switch to start the programmer.
5. When the IGN area of the timer dial is opposite the index notch, set the timer switch to TEST position to stop the timer.

   NOTES:
   —If the timer does not stop, see Procedure T.
   —With the timer stopped in this position, the lockout switch will heat and safety shutdown will occur in about half a minute if a flame is not detected.

6. Check that the M2B and M4A timer contacts (also M6A and M11B if using direct spark ignition of oil) and the 3K1 relay contacts are closed.
7. Set the timer switch to NORM position and let the timer complete its revolution. Then *open* the manual pilot shutoff valve (or manual oil shutoff valve if using direct spark ignition).
8. Wait a minute and reset the lockout switch to start the programmer.
9. Let the programmer run through another cycle.
10. If the pilot (or oil burner) still does not ignite, open the master switch and remove the programmer from the subbase. *Close all manual fuel shutoff valves.*
11. Check that the ignition electrodes are clean and that the external pilot/ignition circuits are wired correctly. Replace deteriorated leadwires.
12. Check the operation of the ignition transformer and automatic pilot valve (or oil valve). Jumper terminals L1-5 (or L1-6 and L1-18 if using 4 second direct spark ignition of oil) and close the master switch to energize the ignition transformer and pilot valve (or oil valve).
    a. Ignition transformer—watch for spark or listen for buzz. 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. Then close the master switch and observe the spark. If a strong, continuous spark cannot be obtained, replace the ignition transformer.
    b. Pilot valve (or oil valve)—listen for click or feel head of valve for activation; replace if not operating properly.
13. Open the master switch, remove the test jumper(s) from the subbase, and reinstall the programmer on the subbase.
14. Open the manual pilot shutoff valve (or manual oil shutoff valve).
15. Reset the lockout switch, close the master switch, and let the programmer recycle.

I. PILOT IGNITES, BUT RELAY 2K DOES NOT PULL IN (SAFETY SHUTDOWN OCCURS).

NOTES:
—If using direct spark ignition on an oil burner, substitute "oil burner" for "pilot."
—The pilot will go out in about 10 seconds and safety shutdown will occur in approximately half a minute.

1. *Close the manual main fuel shutoff valve(s) immediately.*
2. Let the programmer timer complete its revolution and open the master switch.
   NOTE: 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.
   a. Plug a microammeter into the meter jack on the plug-in amplifier (Fig. 10).
   b. Wait a minute and reset the lockout switch.
   c. Close the master switch to start the programmer.
   d. When the IGN area of the timer dial is opposite the index notch, set the timer switch to TEST position to stop the timer. (*If using direct spark ignition, do not stop the timer.*)

(continued on page 20)

NOTES:

—If the timer does not stop, see Procedure T.

—With the timer stopped in this position, the lockout switch will heat and safety shutdown will occur in about half a minute if relay 2K does not pull in.

e. When the pilot (or oil burner) ignites, 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.

f. Set the timer switch to NORM position, let the timer complete its revolution, and open the master switch.

g. Repeat steps b through d and measure the flame signal again.

h. If the flame signal is unstable or less than the minimum acceptable value listed in Table II, proceed to step 3. Otherwise continue with step 2.i.

i. If the flame signal is stable and above the minimum acceptable value listed in Table II, either the amplifier or the programmer is faulty.

(1) Set the timer switch to NORM position, let the timer complete its revolution, and open the master switch.

(2) Replace the plug-in amplifier with a new one of the same part number.

(3) Repeat steps b through d and measure the flame signal again.

(4) If the flame signal is okay but relay 2K still does not pull in, replace the programmer. (Keep the plug-in amplifiers.)

3. 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) Set the timer switch to NORM position, let the timer complete its revolution, and open the master switch.

(2) Replace the plug-in amplifier with a new one of the same part number.

(3) Wait a minute and reset the lockout switch.

(4) Close the master switch to start the programmer.

(5) When the pilot (or oil burner) is ignited, relay 2K should pull in.

(6) If relay 2K pulls in, operation is normal. Omit step 4 and perform the Pilot Turndown Test in the CHECKOUT section, unless using direct spark ignition.

(7) If relay 2K does not pull in, either the flame detector or the programmer is faulty.

—Install the original amplifier.

—Check the flame detector and its circuit as described in step 4.b., on the next page.

—If the problem still exists, replace the programmer.

b. All standard models (R7247A, R7248A, and R7249A).

(1) Set the timer switch to NORM position and let the timer complete its revolution.

(2) Open the master switch and remove the programmer from the subbase.

(3) Remove the flame detector leadwire from terminal S1 on the subbase. *Be sure the leadwire does not touch anything after removal.*

(4) Reinstall the programmer on the subbase.

(5) Turn down the set point so the burner controller contacts will stay open.

(6) Proceed to the following instructions for the appropriate amplifier.

c. R7247A Rectification Amplifier (green)—used with rectifying flame rods, rectifying photocells, or C7012A or C Purple Peeper Ultraviolet Flame Detectors.

(1) Complete step 3.b., above.

(2) Close the master switch.

(3) Plug the probe of a 123514A Flame Simulator into the tip jack on the front of the programmer chassis (Fig. 12).

(4) Hold the plug (lead end) of the simulator against the programmer chassis. Relay 2K should pull in and stay in while the plug is in contact with the chassis.

(5) If relay 2K pulls in, the trouble is in the flame detector or its circuitry outside the programmer. Proceed to step 4 on the next page.

(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 and repeat (4).

(9) If relay 2K pulls in, restore the programmer to operating condition as instructed in step 4.a, on the next page.

(10) If relay 2K still does not pull in, replace the programmer.

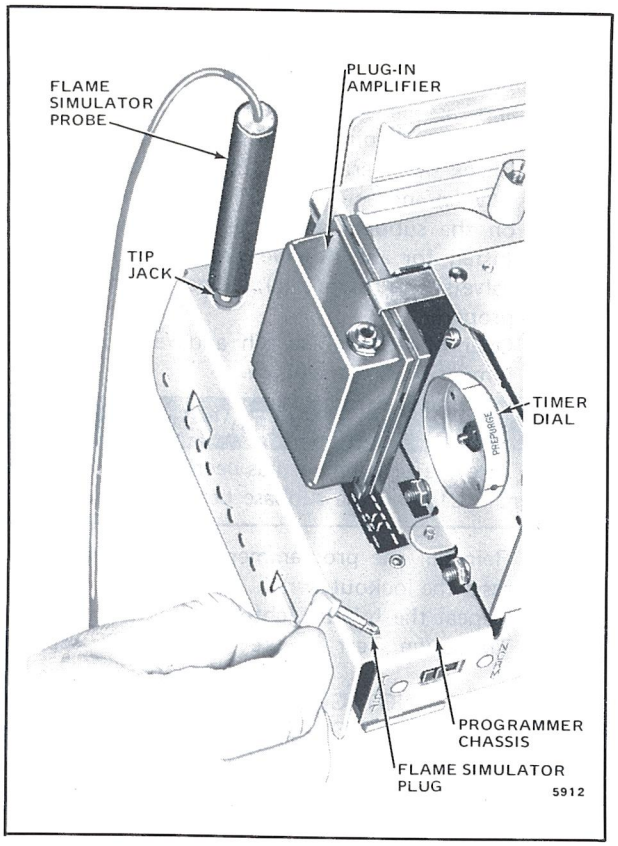


Fig. 12—Using a flame simulator.

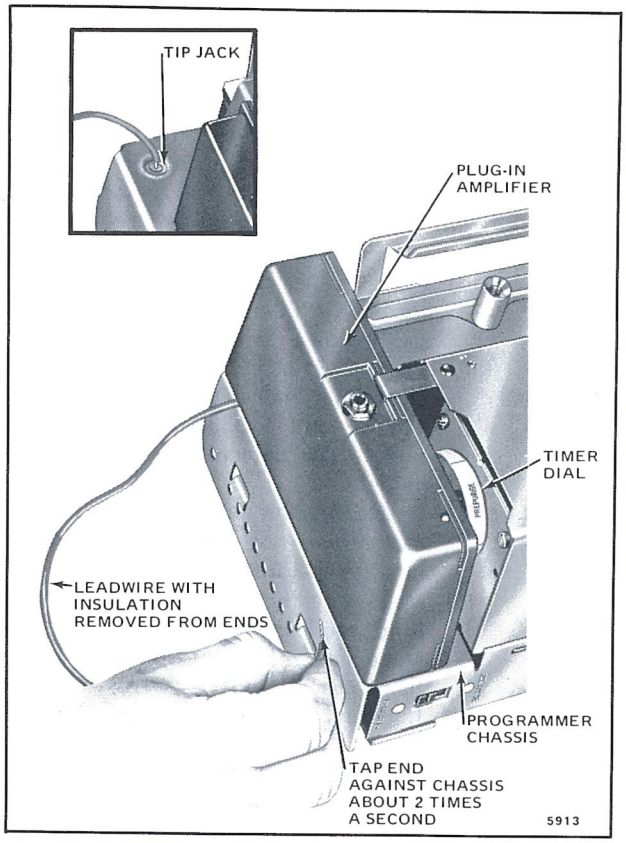


Fig. 13—Simulating flame for an infrared amplifier.

d. R7248A Infrared Amplifier (red)—used with C7015A Infrared (lead sulfide) Flame Detectors.
   (1) Complete step 3.b on page 20.
   (2) Remove the plug-in infrared amplifier.
   (3) Remove 3/4 inch of insulation from each end of a 10 inch length of insulated wire. Plug one end of this wire into the tip jack on the front of the programmer chassis (Fig. 13).
   (4) Reinstall the plug-in amplifier and close the master switch.
   (5) Tap the free end of the wire against the programmer 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.
   (6) If relay 2K pulls in, the trouble is in the flame detector or its circuitry outside the programmer. Proceed to step 4.
   (7) If relay 2K does not pull in, open the master switch.
   (8) Replace the plug-in amplifier with a new one of the same part number.
   (9) Close the master switch and repeat (5).
   (10) If relay 2K pulls in, restore the programmer to operating condition as instructed in step 4.a, below.
   (11) If relay 2K still does not pull in, replace the programmer.

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

4. Check the flame detector and its circuitry outside the programmer.
   a. Restore the programmer to operating condition as follows:
      (1) Open the master switch and remove the programmer from the subbase.
      (2) Reconnect the flame detector leadwire to terminal S1 on the subbase.
      (3) Reinstall the programmer on the subbase and reset the lockout switch.
      (4) Reset the burner controller set point to the desired value.
   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, soot, or accumulated dirt.

(continued on page 22)

(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 of this sheet.

J. PILOT IGNITES AND RELAY 2K PULLS IN, BUT MAIN BURNER DOES NOT LIGHT (SAFETY SHUTDOWN OCCURS IF USING INTERRUPTED PILOT).

NOTE: Not applicable for direct spark ignition on oil burners.

1. Check to see if the manual main fuel shutoff valve(s) is open. If it *is* open, proceed to step 2. If it is closed, open it and recycle the programmer to try lightoff again.
2. If the main burner does not light with the manual main fuel shutoff valve(s) open, *close it immediately*. Make sure fuel is available and that the fuel lines are not plugged; then proceed to step 3.
3. With the manual main fuel shutoff valve(s) closed, recycle the programmer.
4. When the "MAIN 2" area of the timer dial is opposite the index notch, visually check that the M2A, M7A, and M9A timer contacts and the 2K2 relay contacts are closed.
5. Recycle the programmer and this time *open* the manual main fuel shutoff valve(s). If the main burner still does not light, *close the manual main fuel shutoff valve(s) immediately*. Open the master switch and remove the programmer from the subbase.
6. Check that the air and fuel supplies are adjusted for the correct air-fuel ratio.
7. Check that the external main fuel valve circuits and associated interlock circuits are wired correctly. Replace deteriorated leadwires.
8. Check the operation of the automatic main fuel valve(s) and actuator(s). Jumper terminals L1-7 on the subbase and close the master switch. Listen for and observe operation of the main valve(s) and actuator(s); replace if not operating properly.
9. Open the master switch and remove the test jumper from the subbase.

CAUTION

Make sure the test jumper has been removed from terminals L1-7 on the subbase before proceeding.

10. Reinstall the programmer on the subbase and reset the lockout switch.
11. Repeat the Initial Lightoff Check and the Pilot Turndown Test in the CHECKOUT section.

K. PILOT DOES NOT GO OUT AT END OF MAIN BURNER FLAME-ESTABLISHING PERIOD (INTERRUPTED PILOT ONLY).

NOTE: Not applicable for direct spark ignition on oil burners.

1. Visually check that the M4A timer contacts are open.
2. Check that the external pilot circuits are wired correctly. Replace deteriorated leadwires.
3. Check that the automatic pilot valve closes properly; replace if necessary.

L. TIMER STOPS BEFORE THE RUN PERIOD AND WILL NOT CONTINUE SEQUENCE.

Visually check that the M3B timer contacts are closed.

M. BURNER CYCLES ON AND OFF CONTINUOUSLY (TIMER DOES NOT STOP FOR RUN PERIOD).

1. Check for proper operation and wiring of the burner controller, limits, and interlocks (including the Airflow Switch).
2. Replace all external devices not operating properly. *Do not bypass external devices.*
3. Visually check that the 1K2 relay contacts open when 1K pulls in.
4. When the PURGE area of the timer dial reaches the index notch, visually check that the M5B timer contacts open and that the M3A and M5A timer contacts are already open.

N. BURNER STAYS AT LOW FIRE DURING RUN PERIOD.

1. Visually check that the M8A and M10B timer contacts are closed and that the M8B and M10A contacts are open.
2. Check the firing rate motor, firing rate controller, and associated circuitry. Replace if necessary.

O. SHUTDOWN OCCURS DURING RUN PERIOD.

1. *Close the manual main fuel shutoff valve(s) immediately.*
2. Let the programmer timer complete its revolution and open the master switch.
3. If the lockout switch on the programmer has not tripped (if the reset button has not popped out), check the limits. If one or more has opened, determine the causes and correct the conditions before restarting the burner.
4. If the lockout switch has tripped:
   a. Check the burner motor and Lockout Interlocks (including the Airflow Switch).
   b. If using an infrared (lead sulfide) flame detector, perform the Hot Refractory Saturation Test in the CHECKOUT section.
   c. Check the flame detection system. Refer to Procedure I.
   d. Check the fuel lines and automatic main fuel valve(s). Refer to Procedure J.
5. Replace all external devices not operating properly. *Do not bypass external devices.*

P. TIMER DOES NOT COMPLETE ITS REVOLUTION AFTER OPERATING SET POINT IS REACHED.

1. Visually check that the M1B timer contacts and 1K2 relay contacts are closed.
2. Check that the burner controller contacts open; replace the controller if it is not operating properly.

Q. TIMER OR BURNER MOTOR KEEPS RUNNING AT END OF CYCLE.

1. Visually check that the 4K1 relay contacts and M1B timer contacts are open.
2. Check that the burner motor starter is not mechanically stuck.
3. Check that the external burner motor circuitry is wired correctly. Replace deteriorated leadwires.

R. RELAY 2K STAYS IN AT END OF CYCLE. (WHEN NEW CYCLE STARTS, SAFETY SHUTDOWN OCCURS DURING PREPURGE.)

1. Make sure the main burner flame is out. If the flame is still burning, check the external wiring and operation of the automatic valves and actuators. Replace if necessary.
2. If the flame detector is a rectifying photocell or infrared (lead sulfide) detector, perform the Hot Refractory Hold-in Test in the CHECKOUT section.
3. 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.
4. If the plug-in flame signal amplifier is an R7247A Rectification Amplifier (green) or an R7249A Ultraviolet Amplifier (purple), momentarily short the tip jack to the programmer chassis (Fig. 14). If this does not cause relay 2K to drop out, open the master switch and install a new amplifier.
5. Check the external wiring and operation of the flame detector (see step 4.b, of Procedure I). 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 of this sheet.

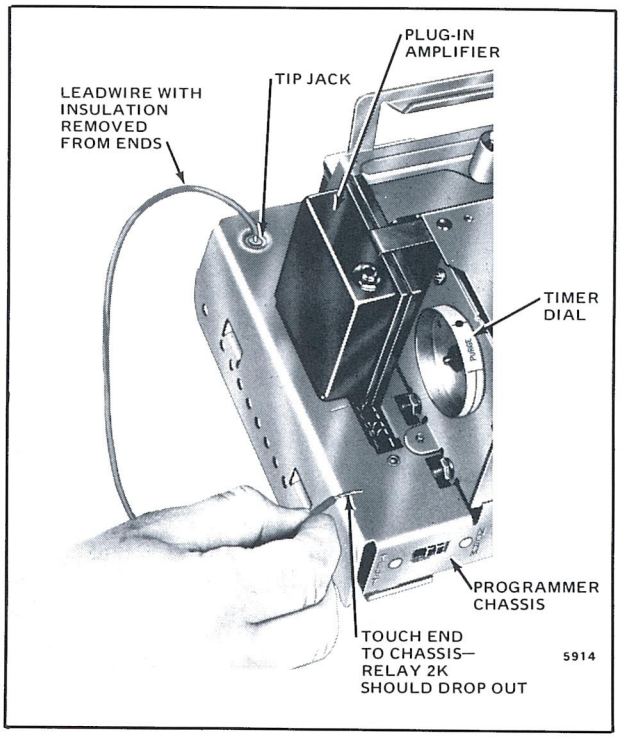


Fig. 14—Checking the plug-in flame signal amplifier for 2K hold-in (R7247A or R7249A only).

S. EXTERNAL ALARM (IF USED) DOES NOT FUNCTION PROPERLY.

1. If safety shutdown has occurred, make sure the lockout switch on the programmer has tripped (popped out).
2. Check the external wiring to the alarm. Replace deteriorated leadwires.
3. Check the alarm.
4. If trouble persists, replace the programmer.

T. DURING TESTING, TIMER WON'T STOP WHEN TIMER SWITCH IS SET TO "TEST" POSITION.

1. If performing the Pilot Turndown Test or Troubleshooting Procedure H or I, recycle the programmer and make sure you set the timer switch as soon as the beginning of the IGN area of the timer dial reaches the index notch.

IMPORTANT

You have about 10.5 seconds to stop the timer after the start of ignition.

2. Recycle the programmer. Visually check that the 1K2 relay contacts open when 1K pulls in, and that the M3A and M5A timer contacts open before the timer dial enters the IGN area.

CAUTION

1. Only qualified servicemen should attempt to service or repair flame safeguard controls and burner systems.
2. Open the master switch before removing the relay/timer cover or before cleaning contacts. Line voltage may be present on most contacts when power is on.

SCHEDULED INSPECTION AND MAINTENANCE

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

1. Always keep the burner and fuel mixture adjusted according to recommendations.
2. Clean the flame detector lens, filter, viewing window, and sighting pipe (as applicable).
3. Check the flame signal (Table II) using a Honeywell W136A Test Meter, or equivalent (and a 117053 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 THESE TUBES WITH COMMERCIAL SUBSTITUTES.

CONTACT CLEANING

Field cleaning of relay or timer 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.

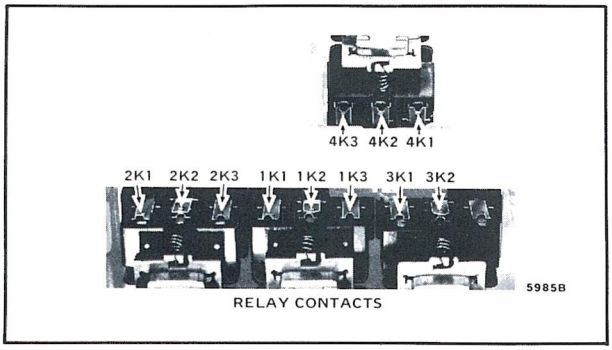


Fig. 15—Location of relay contacts (front view).

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 oily 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 (sand 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 loosens fine particles of the contact material which adhere to the surface of the contact, thus increasing its resistance.
4. Contact specifications (contact pressures, press-back, and gaps) are carefully controlled during manufacturing to ensure maximum contact life. Burnishing can easily change these specifications.

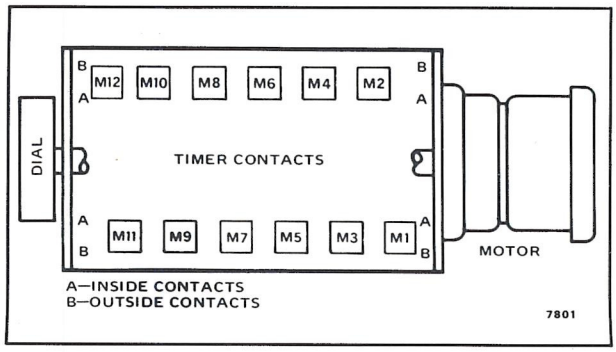


Fig. 16—Location of timer contacts (front view).