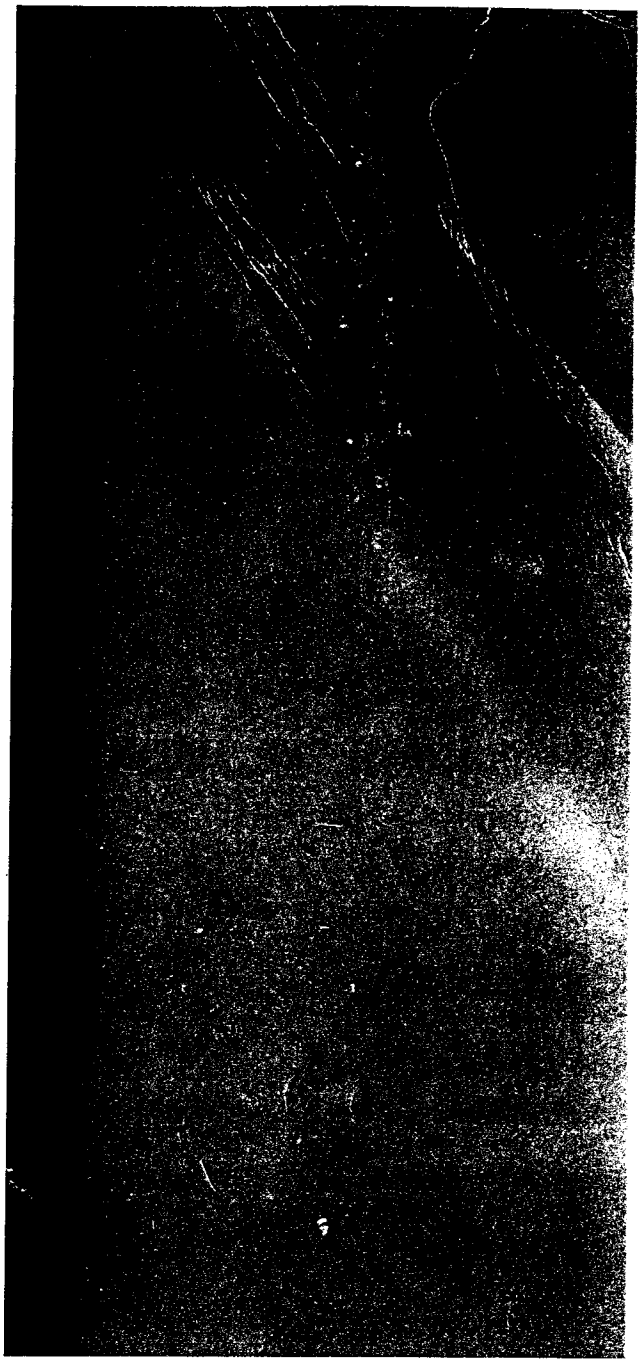
DET TRONICS



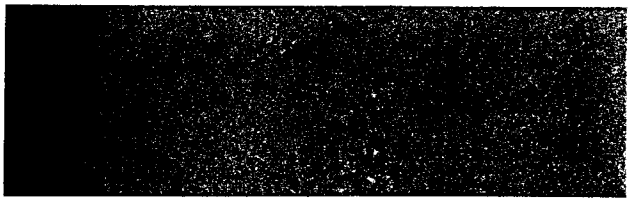
INSTRUCTIONS

Flame Safeguard System

9001 Flame Safeguard Controller

9501 Ultraviolet Flame Scanners

9502 Luminescent Flame Scanners



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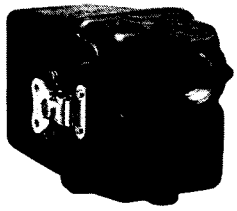
SYSTEM APPLICATION

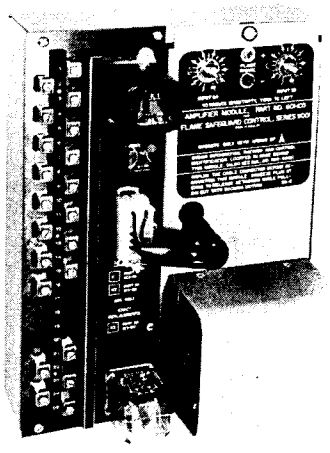
The Det-Tronics Flame Safeguard System provides recognition and continuous monitoring of fossil fuel flames in semiautomatically controlled boilers and furnaces. The 9001 Flame Safeguard Controller monitors signals from either one or two flame scanners and de-energizes fuel shutoff valves within four seconds upon loss of flame detection. In conjunction with the appropriate interlock and limit sensing devices, it prevents burner startup unless required conditions have been verified, and initiates immediate shutdown if limit conditions are exceeded during burner operation.

Two flame scanner models are available. The 9501 Ultraviolet Flame Scanner responds to ultraviolet (UV) radiation in the range of 1900 to 2900 Angstroms, which is emitted by gaseous and liquid fuel flames. The 9502 Luminescent Flame Scanner responds to longer wavelengths of visible light (7700 to 9400 Angstroms) enabling the reliable detection of coal, oil and other residual fuel flames under conditions that make UV detection difficult. The 9001 Flame Safeguard Controller can monitor either two UV scanners, two luminescent scanners or one of each, without requiring modification.

FEATURES

- Four second maximum response to loss of flame.
- Ultraviolet and luminescent sensitive scanners provide a choice of application techniques.
- Scanner/control system integrity checked every 10 seconds. If response to simulated flame loss is improper, fuel shutoff valves will be de-energized.
- Plug-in relays provide flame loss response and, in conjunction with system interlock and limit sensors, control burner startup and shutdown.
- All solid state, plug-in control unit.
- Independent inputs for two flame scanners - selection of UV or luminescent scanner does not require controller modification.





- Full range sensitivity control for each flame scanner input provides adjustment for discrimination in multiburner furnaces.
- Low impedance signal transmission from scanner to controller for maximum transient immunity.
- Plug-in weatherproof flame scanner can be removed and replaced in seconds without disturbing the wiring.
- Scanner incorporates a light chopper mechanism, which is designed for exceptionally long life.
- Front panel output jacks for connecting a flame intensity meter.

SYSTEM DESCRIPTION

9001 Flame Safeguard Controller

The 9001 Controller (Figure 1) consists of an amplifier module and a terminal board assembly mounted together on a metal chassis.

The amplifier module contains the circuitry for processing signals from two flame scanners and for energizing the flame relay in response to flame verification. It also contains the circuitry to energize a light chopper in the scanner head at regular (10 second) intervals in order to verify scanner operation. The faceplate of the amplifier module includes two input sensitivity controls and FLAME SIGNAL test jacks for connecting an external flame meter.

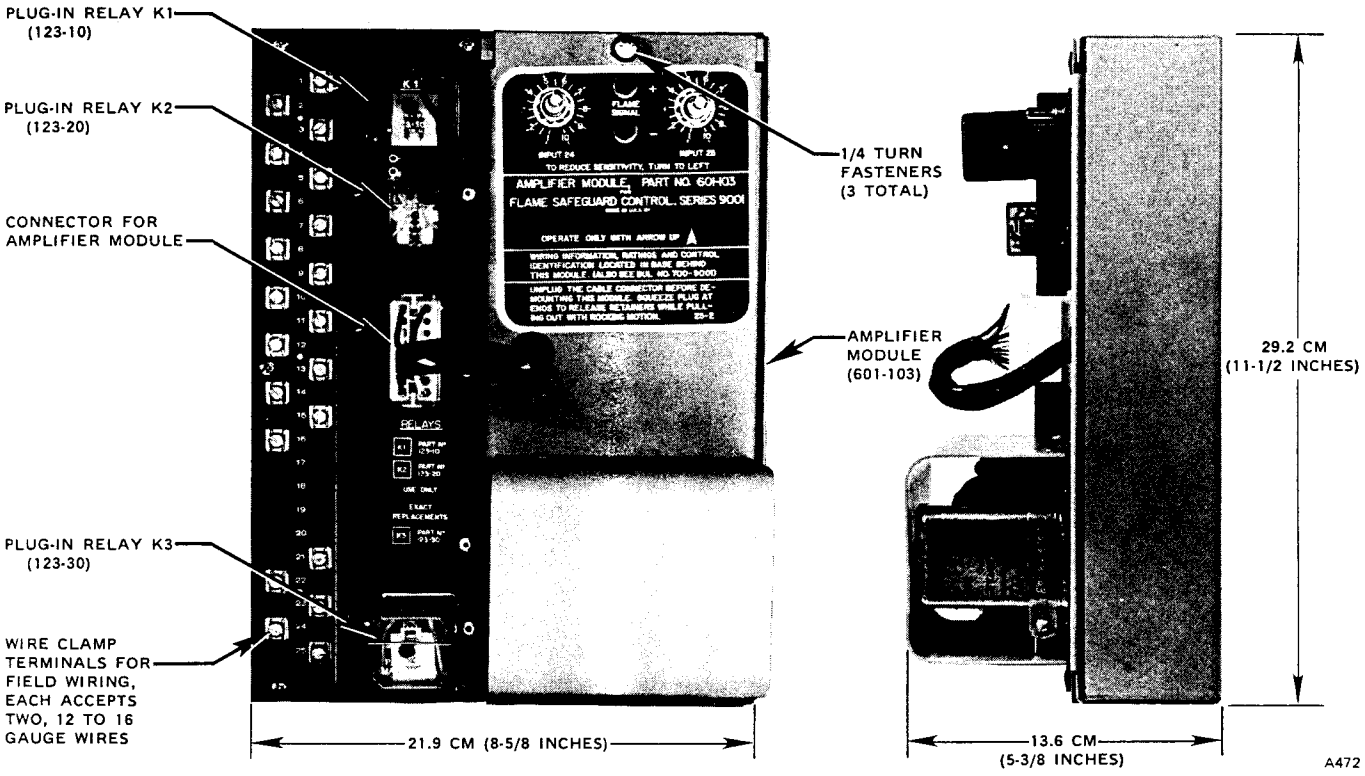


Figure 1—9001 Flame Safeguard Controller

The terminal board assembly includes a receptacle for connecting the amplifier module, wire clamp terminals for field wiring, and mounting sockets for three plug-in relays. Power relay K1 supplies power to the main burner load. Contacts of control relay K2 and flame relay K3 in conjunction with interlock and limit sensing devices, supply energizing power to relay K1.

9501 UV Flame Scanner

The 9501 Flame Scanner (Figure 2) incorporates an ultraviolet sensitive (Geiger-Müller type) detector tube, electronic circuitry to generate and transmit an output signal, a quartz viewing window and a mechanical, light-blocking chopper, which is used to test detector tube response to absence of flame.

The scanner chassis is mounted in a weatherproof, cast metal enclosure. A base casting and a cover casting mate to each other and are secured with spring-loaded, half-turn fasteners. The base casting has a 1 inch NPT (American National Standard taper pipe thread) tapping for mounting onto a threaded, 1 inch API (American Petroleum Industry) standard 5L sight pipe. The base also includes a 1/2 inch NPSM (American National Standard straight pipe thread for free-fitting mechanical joints) tapping for an electrical connector and a 3/8 inch NPT tapping for connection of a purge air line.

9502 Luminescent Flame Scanner

The 9502 Flame Scanner is physically similar to the 9501 Flame Scanner. Only the sensor element and the circuitry required to generate an output signal are different. In place of a UV sensitive tube, the 9502 uses a solid state sensor that is sensitive to the lower frequencies of visible light.

THEORY OF OPERATION

General

The operation of the 9001 Controller centers on the three plug-in relays. Power relay K1 supplies power to the main burner load, and is controlled by contacts of flame relay K3 and several sensing elements of the external operating control circuitry. Controller relay K2 is both powered by and latches K1; they are mutually dependent.

The external control circuitry (Figure 3) includes limit, start and run circuits. The limit circuit is a series of sensors that monitor conditions such as temperature, pressure and boiler drum water level, and can independently de-energize power relay K1, thereby preventing startup or initiating shutdown. **The limit circuit is always in series with both the start and run circuits.** The start circuit typically includes a pushbutton start station together with sensing

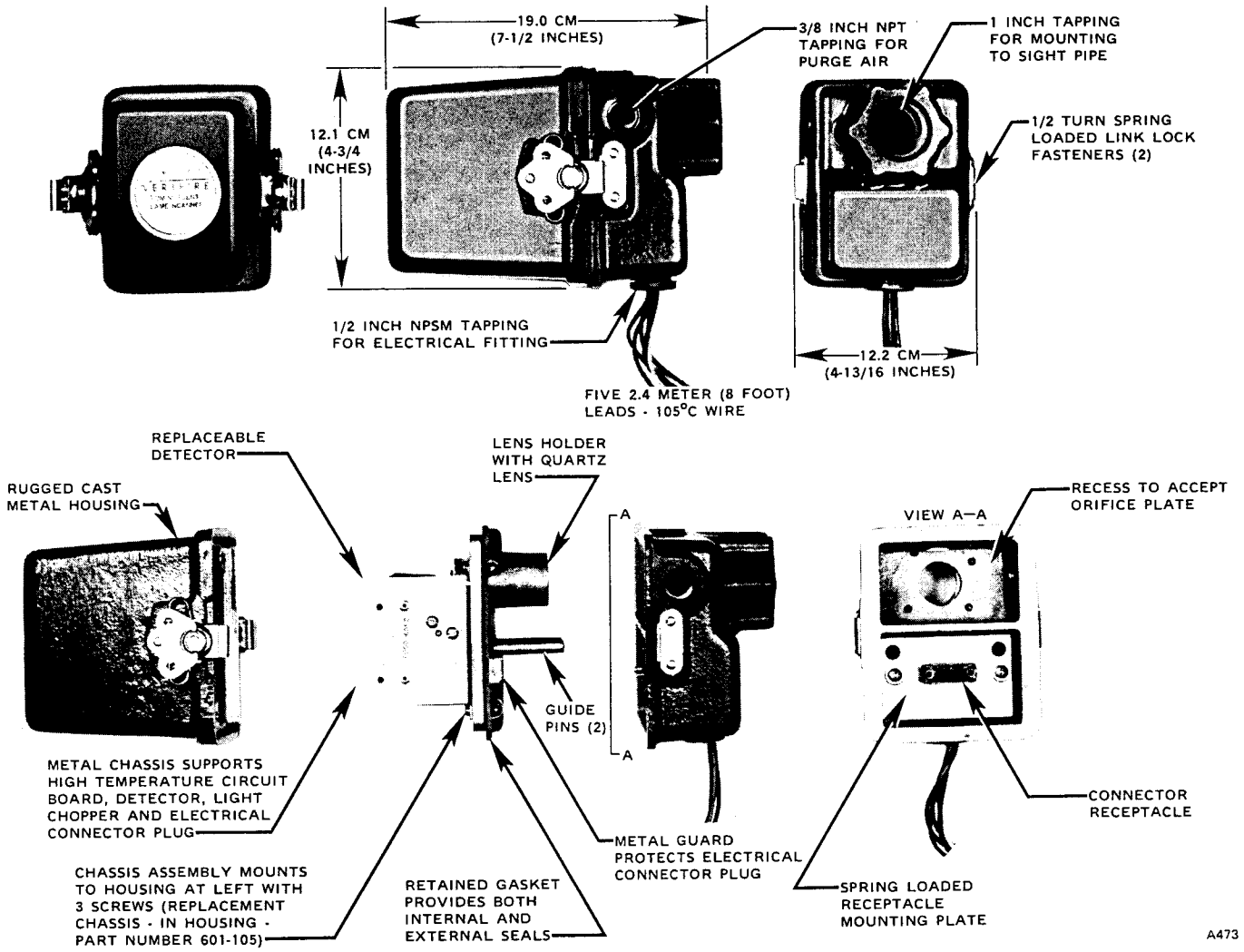


Figure 2—9501-01/9502-01 Flame Scanners

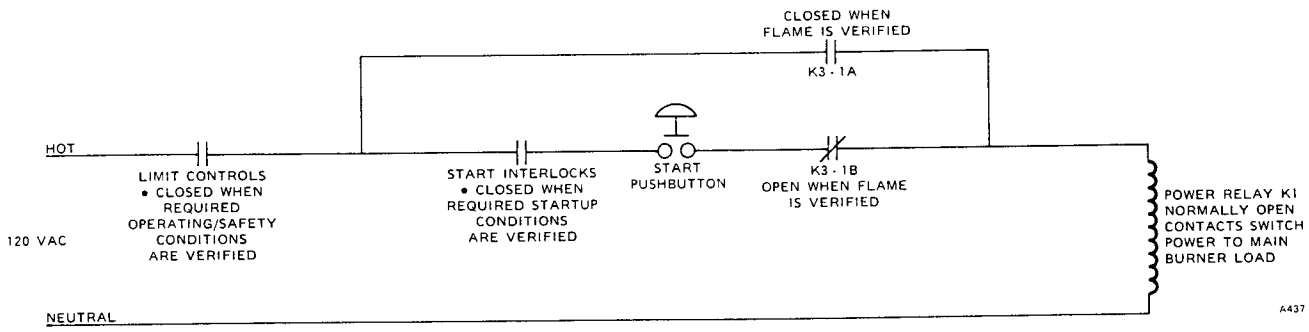


Figure 3—Simplified Diagram of Operating Control Circuitry

devices that monitor conditions pertinent to starting, but not to continual operation. The run circuit bypasses the start circuit and includes a "flame detected" contact of flame relay K3 in addition to the limit circuit. Refer to the "Example of Burner Control Operation" in the next section for additional information.

Flame Verification

The primary function of the flame safeguard system is the verification of burner flame. The 9501 and 9502 Flame Scanners must be precisely mounted to monitor the flame of interest. Precision is particularly important when mount-

ing scanners in multiburner furnaces. The 9501 UV Flame Scanner is most effective in the detection and control of natural gas and hydrogen fueled flames. The 9502 Luminescent Flame Scanner allows reliable detection and control of coal, oil and other residual fuel flames that make UV detection difficult due to shrouds of unburned fuel between the flame and the UV scanner, which absorb UV radiation. The output signals of the two types of scanners are similar and can be monitored by the 9001 Controller without special modification.

The flame response circuitry (Figure 4) monitors the signals from the flame scanners and energizes Flame relay K3 when the integrated signal exceeds the factory set flame-on threshold. At ten second intervals, a mechanical light chopper in the scanner is actuated and the signal pulses are interrupted while the scanner's vision is blocked.

Referring to Figure 4:

- If the signal pulses are interrupted for a period greater than 3.4 seconds (due to a loss of flame), the flame failure timer will "timeout" and de-energize relay K3.
- If the signal pulses are **not** interrupted (in response to the chopper test) at 10 second intervals, the 18.5 second chopper test timer will "timeout" and de-energize relay K4, which causes K3 to "timeout".

A relative measure of flame signal strength, as represented by integrated signal pulses, can be read with a 0 to 10 Vdc voltmeter connected to the Flame Signal jacks on the faceplate. If two scanners are in use, the signal voltage measurement reflects their combined signals.

The 9001 Controller includes a safe-start interlock that prevents burner starting if K3 is energized (due to a valid or invalid flame signal) when the start circuit is activated.

EXAMPLE OF BURNER OPERATION WITH THE TYPICAL CIRCUIT OF FIGURE 5

Assume: Combustion air fan is started and stopped with external manual control, not shown. Firing rate settings are governed either manually or automatically (as selected) by control, not shown. Boiler limit and fuel interlock switches are closed. Main fuel valve and supervisory cock are closed. There is no flame signal and relay K3 is not energized. Burner startup is accomplished as follows:

1. Start combustion air fan(s). Fan interlocks and combustion airflow switch will close.
2. Set burner control switch to ON. TL is energized and TL-1 immediately closes.
3. Set combustion control selector to MANUAL and adjust for maximum firing rate position. Purge interlocks will close.
4. Depress and release Purge Start pushbutton. TP will be energized (to start timing) and will be latched via TP-4. The "Purging" indicator is energized via TP-1.
5. As TP times out, the purge permissive interlocks are bypassed by TP-3 closing. The "Purging" indicator is de-energized by TP-1 opening and the "Purge Complete" indicator is energized by TP-2 closing.
6. Manually adjust combustion control to lightoff position. Starting interlock circuit will now be completed.
7. Depress and hold Burner Start pushbutton. TL is de-energized and starts timing. Relay K1 is energized, powering terminals 7 and 10. The ignition transformer and TM are energized (via the pushbutton switch). The pilot fuel valve is immediately energized by TM-1 closing.

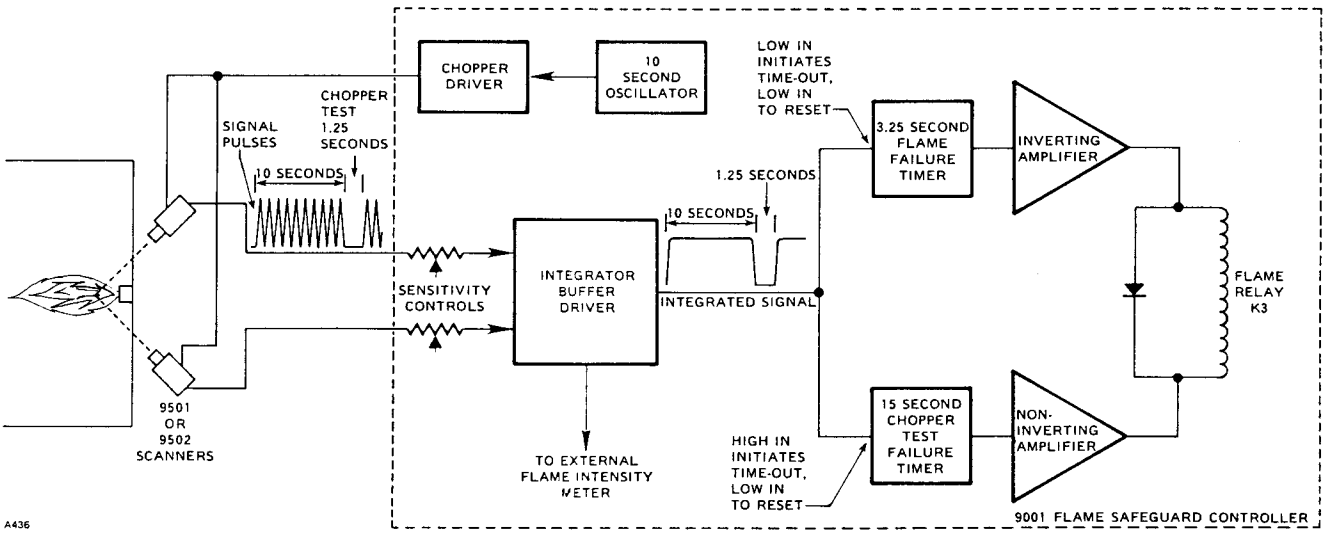


Figure 4—Block Diagram - Flame Response Circuitry

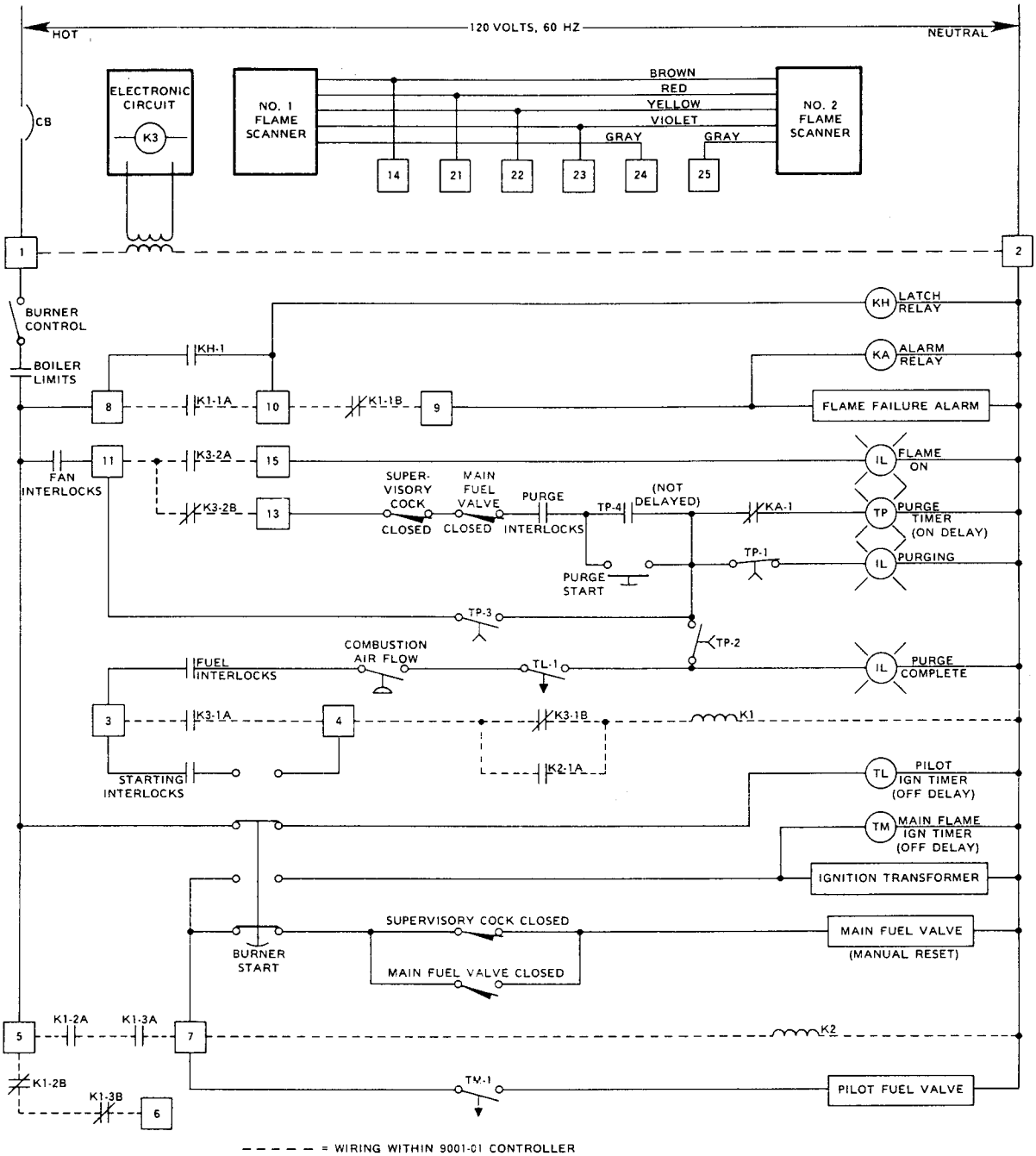


Figure 5—Semiautomatic Oil or Gas Burner System with Interrupted Pilot Ignition

KH is energized via K1-1A and latched by KH-1. K2 is energized via K1-2A and K1-3A.

8. With spark and fuel present, pilot flame will be established and will be detected by a flame scanner, causing relay K3 to be energized.

9. As soon as "Flame On" indicator is energized (via K3-2A), release the Burner Start pushbutton. TL is re-energized and its timing aborted; the ignition transformer is de-energized; TM is de-energized and starts timing; and the main fuel valve is energized via the "Cock Closed" interlock. Although the starting circuit was opened by Burner Start button release, K1 remains energized via K3-1A and K2-1A.

10. Manually reset the main fuel valve. Its normally open interlock switch shunts the "Cock Closed" interlock. Slowly open the supervisory cock. As main fuel is admitted, it is ignited by the pilot flame and should be detected by one or both flame scanners.

11. As TM times out, the pilot fuel valve is de-energized by TM-1 opening. The scanner(s) must now detect the main flame in order for operation to continue.

12. If the Burner Start button was held depressed too long (allowing TL to time out), if there is inadequate or lost flame signal, or if the Combustion Airflow, Fuel Interlock, or Fan Interlock switches open, K1 will be de-energized. Any loads concurrently energized from terminal 7 will thus be de-energized. KA and the alarm will be energized via KH-1 and K1-1B. KA-1 opening ensures de-energizing TP. The alarm is silenced and KH is reset by setting the Burner Control switch to OFF.

13. There will be shutdown but no alarm if a Boiler Limit switch opens. If alarm is desired, terminal 8 should be connected immediately before, instead of after, the Boiler Limit switches.

NOTE

Timers shown in Figure 6 are electro-pneumatic type. Typical timer settings are: TP - 3 minutes, TL - 10 seconds, TM - 15 seconds.

SPECIFICATIONS

9001-01 Flame Safeguard Controllers

INPUTS–
Independent inputs for simultaneous operation of 2 flame scanners: 2 ultraviolet, 2 luminescent, or 1 ultraviolet and 1 luminescent.

OUTPUTS–
Flame signal monitor jacks, field wiring terminals (wire clamp type).

Relay Contact Ratings: (pilot duty rating assumes an inrush current 10 times greater than the normal rated current.)
K3, terminals 13 and 15, each - 63 VA pilot duty
K1, terminals 6, 8 and 9, each - 125 VA pilot duty
K1, terminal 7 - 1/3 hp or 250 VA pilot duty

Alternate Option No. 1 for Terminal 7: Simultaneous combination load consisting of a 300 VA ignition transformer and up to 3 solenoid valves with total maximum inrush and 350 VA normal.

Alternate Option No. 2 for Terminal 7: Simultaneous combination load consisting of up to 3 motorized valves with maximum 1150 VA locked rotor, 550 VA opening and 125 VA holding, plus carry and break (but not make) of solenoid valves as defined in alternate option No. 1.

OPERATING VOLTAGE–
120 volts ac, 60 Hz (106 volts to 132 volts)

POWER CONSUMPTION–
20 VA at 120 volts ac.

TEMPERATURE–
-20 to +57°C (-4 to +135°F).

DIMENSIONS–
Refer to Figure 1.

SHIPPING WEIGHT–
Approximately 6.4 kilograms (14 pounds).

9500 Series Flame Scanners

ELECTRICAL–
8 foot non-shielded conductors (5), insulation rated at 600 volts ac, 105°C (220°F) dry.

MECHANICAL–
1 inch NPT to sight pipe
3/8 inch NPT purge air
1/2 inch NPSM tap for electrical fitting

TEMPERATURE–
-20 to +93°C (-4 to +200°F), measured at mounting hub, inside housing ambient air not exceeding 71°C (160°F).

DIMENSIONS–
Refer to Figure 2.

SHIPPING WEIGHT–
Approximately 3.2 kilograms (7 pounds).

OPTIONS–
9501-01 Ultraviolet Flame Scanner
9502-02 Luminescent Flame Scanner

INSTALLATION

Controller Mounting

1. Select a vertical mounting surface that is relatively free of vibration and where operating temperatures will be within specified tolerance (see "Specifications" section for temperature limits).

2. Prepare mounting holes as shown in Figure 6. Detach the amplifier module and secure the base (with long axis vertical and terminal board to left) with two No. 10 screws and lockwashers.

Controller Wiring

1. The electrical connections of the 9001 Flame Safeguard Controller are shown in Figure 7.

2. Wire in accordance with National Electrical Code and local code requirements.

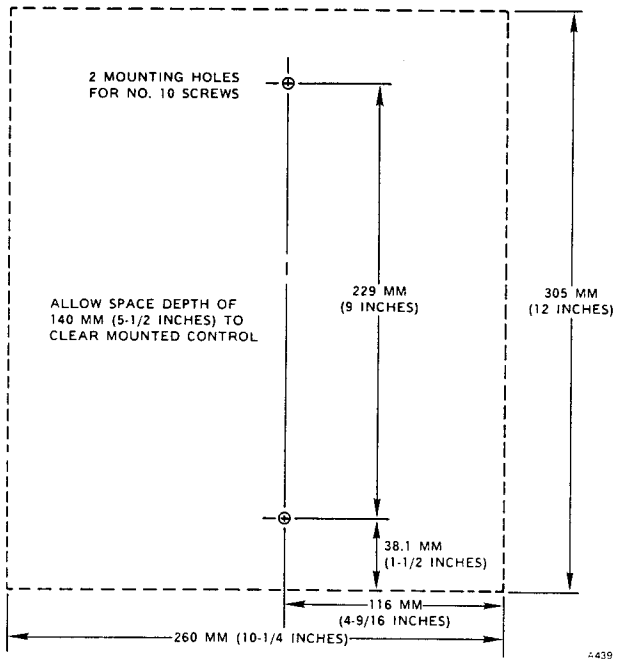


Figure 6—Space and Mounting Layout for 9001-01 Controller (Provides Approximately 1/4 inch Clearance, 3 sides, and 1-3/8 inch Wiring Clearance, Left Side)

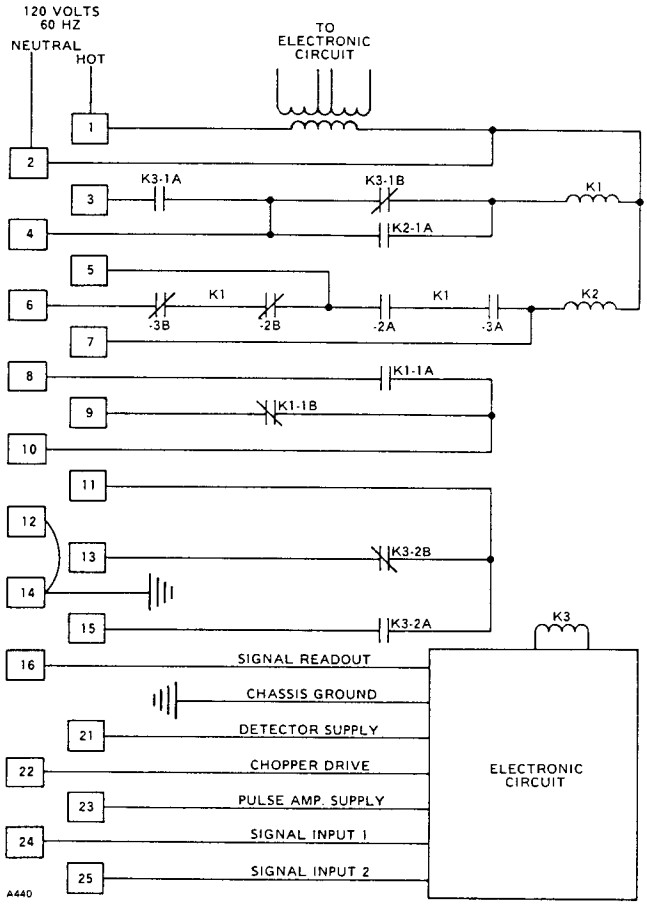


Figure 7—Internal Connections, 9001-01 Controller

3. Wires connecting to the controller should have ends stripped to 3/8 inch maximum and the stripped ends inserted under the pressure plate on the wiring terminal. Tighten terminal screws to obtain a secure connection.

   Caution: Excessive turning or pushing force could fracture the terminal board.

4. Each terminal is designed for a maximum of two wires. Rather than connect a greater number, make splices in a suitable junction box. Do not make splices in conduit or fittings. Splices should be made with approved insulated crimp connectors, at insulated terminal posts or by soldering the connection and insulating with electrical tape.

5. For any wiring runs on or near hot surfaces, use wire rated for 105°C or higher.

Flame Scanner Mounting

1. Choose a sighting location where the scanner will have an unobstructed view of the flame under all firing conditions. Greatest UV radiation is produced in the area immediately ahead of the burner. Greatest luminescent radiation is produced in the later (cooler) stages of combustion.

   A scanner monitoring a pilot flame must sight at a point where pilot and main flames intersect to ensure that a detectable pilot flame will reliably ignite the main flame.

   In the multiple burner furnaces, choose a sighting angle with the best possible view of the flame of interest and the poorest view of other flames in the furnace. The sight pipe should be inclined at least slightly downward toward the furnace, so that unburned particles or condensed moisture will not fall or drain into the scanner.

2. Prepare a hole in the burner front or windbox wall to clear the sight pipe at the angle of approach selected. Select a length of 1 inch standard pipe (with NPT thread on one end) no longer than is necessary to place the scanner housing in an unobstructed and accessible area. If a sight pipe longer than 12 to 18 inches is required, the sight pipe should be of larger diameter (2 inch pipe, for example) with the reduction to 1 inch occurring as close to the scanner as practical.

3. Thread the scanner base assembly onto the sight pipe until tight, making certain that, in the final position, the wiring entrance faces downward.

4. Tack weld the unthreaded end of the sight pipe at the selected location and angle. Do not project the pipe through the hole in the mounting surface.

5. In many instances it will be convenient to attach the sight pipe to a swivel mount (part number 506-2) that, in turn, is attached to the sight pipe mounting surface. This mount allows angular adjustment within a cone of approximately 20 degrees. If the mount is to be used with sight pipes larger than 1 inch IPS, an adapter must be used.

6. Install an electrical fitting in the housing base tapping and encase the extension leadwires in 1/2 inch flexible metal conduit or other flexible conductors meeting local standards. Terminate the assembly at a junction box and splice the leadwires to conductors extending to the 9001 Controller. The scanner to controller wiring scheme is shown in Figure 5. For a watertight connection, use an appropriate fitting and liquid tight conduit arranged to pitch downward from the scanner. Select wire according to paragraph 5 under "Controller Wiring."

7. The introduction of cooling and/or purging air will be required if operating temperatures are likely to exceed ratings (see "Specifications" section) and is highly desirable even if temperature will not be excessive. A positive flow of air down the sight pipe can eliminate the necessity for frequent lens cleaning and prevent transmission losses caused by products of combustion in the sight path. The purge air source must be oil free and dry and it should be of low pressure (0.5 to 1.0 psig) or should be restricted to prevent pressure within the scanner base from exceeding 5 psi. Unless the purge line includes a flexible connecting portion, it cannot be attached until the permanent scanner position has been determined.

EXAMPLE OF INITIAL STARTUP AND CHECKOUT PROCEDURES

1. Observe electrical precautions:

   A. Electrical ratings for the various terminals are listed under "Specifications." Be sure to analyze connected loads carefully to assure that the rating will not be exceeded. Where total load on any terminal would exceed its rating, it will be necessary to use a contactor to carry the load current. A pilot duty rating allows the connection of inductive devices (**relays, contactors, solenoids**) under conditions where the normal current does not exceed the rating and inrush current does not exceed ten times the rating. Small incandescent indicator lights, although not inductive, do have inrush currents that may approach ten times the normal operating current. Control transformers and purely resistive devices are evaluated solely on the basis of normal VA rating. Because ignition transformers and motorized fuel valves have characteristics differing from both pilot duty and resistive loads, ratings specific to combinations of these devices are explained in the "Specifications" section - alternate ratings for terminal 7.

   B. Contacts are rated on the basis of normal currents plus limited magnitude inrush currents occurring at infrequent intervals. An overload or short circuit condition that causes fuses to blow or breakers to trip may weld or otherwise damage contacts within the conductive path. Any condition that could cause chattering of electrical switching devices could have similar results. The following procedures must be observed prior to establishing any flame at initial startup, after any work has been done on the electrical system (wiring change, device replacement, etc.), after opening of a fuse or circuit breaker, or after any known instance of sustained contact chattering:

      a) Close all manual fuel shutoff valves.

      b) Check that all safety limits function as intended.

      c) Initiate normal purge and lightoff procedures, checking that the main fuel safety shutoff valves do **not** become energized and that the pilot fuel valves are de-energized at the end of the pilot trial-for-ignition period.

2. Make preliminary settings of all controls and position interlocking switches. Make sure pilot and main burners are in the intended operating position.

3. Make sure that manual fuel shutoff valves for the main burner are closed and manual fuel shutoff valves for the pilot burner are open.

4. Set dampers and registers for maximum air flow.

5. Check that all limit conditions are satisfied.

6. Initiate purge.

7. When purge is complete, set air and fuel controls to lightoff position.

8. Remove flame scanner housing assembly from its base. Depress burner start button to bring on pilot flame, hold button depressed. Verify that pilot flame is established, then look down scanner sight pipe to check the scanner's viewing field. If the sighted area is not completely filled with flame, determine in which direction and by what amount the sight pipe angle should be changed. Release start button and make sighting change if necessary. Repeat steps 5 through 8 until proper sighting is achieved.

9. Install and secure the scanner housing assembly to its base. Repeat steps 5 through 7. Ignite pilot and check for proper flame signal (see "Checking and Adjusting for Proper Flame Signal" section). After verifying proper pilot flame signal, shut burner down (unless it shut off automatically as the main flame trial-for-ignition period expired).

10. Open main burner manual fuel shutoff valves. Initiate purge. When purge is complete, ignite pilot. With pilot flame established and detected, release start button to energize main fuel valve(s). Manually open main fuel valve (if required), then slowly open supervisory cock (if used) and watch for main flame to ignite. If main flame is not established within 5 seconds, shut burner off and repeat the purge and lighting procedures.

CAUTION

A full main flame trial-for-ignition period of 10 to 15 seconds should not be allowed to run its course until it has been verified that the pilot size and position are such as to reliably ignite main burner fuel.

11. After main flame has been established and the pilot has shut off, check for adequate main flame signal. If signal is inadequate, proceed as instructed in the following section "Checking and Adjusting for Proper Flame Signal").

12. After proper ignition and firing performance has been determined, check each control limit action by purposely creating the **over limit condition** (if possible) or by manual actuation. Flame failure response should be checked by closing manual fuel shutoff valves during burner operation. Shutdown and alarm should occur in not more than 4 seconds after flame is observed to go out.

CHECKING AND ADJUSTING FOR PROPER FLAME SIGNAL

1. Connect a 1 to 10 volt dc voltmeter (minimum resistance 10,000 ohms per volt) at the FLAME SIGNAL test jacks or at terminals 16 (+) and 14 (-).

2. Observe the meter after flame is established. During (automatic) chopper actuation, the meter will drop by 2 or more volts and then move up again. This provides a positive indication of chopper test operation. With sensitivity controls set at maximum and any but a very strong signal, there will be minor fluctuation of the reading. For reliable operation, a signal reading should **not drop below 4 volts**. For best performance and early indication of any condition causing signal deterioration, the maximum signal reading should be limited (by attenuating sensitivity if necessary) to approximately 9 volts.

3. An inadequate signal will usually be the result of improper sighting. If the sight pipe was only tack welded, as instructed, or if it is on a swivel mount, vary the angle to achieve the highest signal voltage reading.

4. If a single scanner is used to monitor both pilot and main flames, adequate flame signal from each should be verified with the other flame shut off. If a good signal can be acquired from both flames only at two different sighting angles, either the sight pipe should be relocated to a more appropriate sighting area or the use of two scanners should be considered.

5. Another consideration is that if two scanners are used with one controller, it is often possible to choose sighting angles that allow a maintaining signal to be produced by either scanner alone. This has the advantage that each scanner, in turn, can be removed for lens cleaning, or other service, without shutting down the monitored burner.

6. In multiple burner furnaces where individual flame discrimination is required, it is possible that a strong signal may be received from an interfering flame as well as from the flame of interest. The best way to correct this condition is to restrict the size of the viewing orifice of the scanner so that the signal intensity from both flames is reduced. Assuming that the monitored flame, for which the sighting angle is optimized, will provide more signal than an adjacent flame, a reduction of signal strength (by restricting the viewing orifice) will permit the difference in signal level from the two flames to be recognized. The unwanted signal can then be "tuned out" by adjusting the sensitivity control(s). The meter reading with a strong attenuated signal is virtually free of fluctuations (except for the chopper test dip). Satisfactory operation can be obtained with an attenuated signal reading as low as 4 volts.

   If a sensitivity control setting less than maximum is used, record both the voltmeter reading and the approximate point on the sensitivity control scale that is in line with the potentiometer shaft slot. (The scale surrounding the potentiometer shaft is for position reference only and does not have any numerical significance relating to percentage of attenuation.)

7. *IMPORTANT.* The electric spark used to ignite a pilot flame is an emitter of UV and luminescent radiation. To ensure that the sighting arrangement does not permit the detection of direct or reflected spark energy, it should be determined that a reading of no more than 1 volt on the signal voltmeter is obtained with fuel sources shut off and spark energized. Re-align the

scanner or optically shield the igniter if necessary to avoid spark detection. As an additional precaution, it is a common and recommended practice to de-energize the ignition transformer and energize the main fuel valves simultaneously.

8. *IMPORTANT.* A scanner responsive to a pilot flame is not properly applied if it detects a flame that is too small to reliably ignite the main burner. This can be checked by reducing the pilot flame size to the smallest that can be detected (sensitivity set to maximum) and then determining that such reduced flame will readily ignite the main burner fuel.

CAUTION

If ignition of main flame does not occur at once, or is slower than usual, shut off fuel immediately, re-aim the scanner to sight further out, and repeat the test.

If the pilot flame signal is relatively strong, the viewing orifice should be restricted to inhibit detection of the pilot flame. Attenuation of the signal with the sensitivity control in this instance is not recommended unless some means is contrived to guard against the setting being changed.

9. *IMPORTANT.* When satisfactory sighting has been achieved, the sight pipe should be permanently welded in place to maintain the selected position. If a swivel mount is used, tack weld it to prevent further movement.

10. With the sight pipe in a fixed position, a permanent purge air line connection can be made to the scanner base.

TROUBLESHOOTING

The following suggestions presuppose that line voltage within the range of ± 12 percent of nominal is present at controller terminals 1 and 2 and that all limit and interlock circuits are completed to provide line voltage at terminals 3 and 5.

Troubleshooting procedures outlined below assume that spares are available for relays K1, K2 and K3, the amplifier module and the scanner; and that a good multimeter (20,000 ohms/volt dc, 5000 ohms/volt ac) is available for voltage and resistance tests. When a symptom is identified, try suggested corrective measures in sequence until the fault is identified.

1. Symptom: K1 does not pull in when burner start button is depressed
   Possible Reason: Defective K1 (substitute spare)
   Possible Reason: K3 in energized position (circuit closed between terminals 11 and 15) due to -
   a) Flame being seen (investigate cause and correct)
   b) Defective K3 (substitute spare)
   c) Defective scanner (substitute spare)
   d) Defective amplifier (substitute spare)

2. Symptom: K1 pulls in, but pilot fuel valve is not energized
   Possible Reason: Defective K1 (evidenced by no 60 Hz line voltage between terminals 2 and 7). (Confirm by substituting spare.)

3. Symptom: K1 drops out coincidentally with flame being detected (start button still depressed).
   Possible Reason: Defective K2 (substitute spare).

4. Symptom: K1 drops out when start button is released even though flame signal reading up to that point was adequate
   Possible Reason: Pilot became unstable or went out when spark was cut off (Check and remedy)
   Possible Reason: K3 did not pull in (circuit remained open between terminals 11 to 15) due to -
   a) Defective K3 (substitute spare)
   b) Defective amplifier (substitute spare)

5. Symptom: Flame established normally, flame signal reading adequate, but burner shuts down in less than 1/2 minute after flame is detected
   Possible Reason: Checking action and/or response not proper, due to -
   a) Wiring short or open circuit to chopper. Disconnect wire(s) from terminal 22 and measure resistance from disconnected lead to ground (should be within 10 percent of 2600 ohms). If circuit measures open or shorted and wiring is good, substitute spare scanner module and recheck for proper resistance before reconnecting leadwire(s).
   b) Defective chopper timer. Voltage of 27 to 31 volts dc should appear for about 1 second at 8 to 9 second intervals between terminals 22 (+) and 14 (-). If voltage is low or absent, substitute spare amplifier module.
   c) Assuming checks a) and b) did not disclose fault - defective scanner (signal voltmeter will not show pronounced dip at 8 to 9 second intervals). Substitute spare scanner.
   d) Fault in amplifier (substitute spare amplifier module).

6. Symptom: Flame established normally, but flame signal is inadequate to keep burner operating
   Possible Reason: Scanner not receiving adequate UV radiation due to -
   a) Dirty lens (check and clean with soft cloth, either dry or dampened with Det-Tronics lens cleaning solution. (If there are sooty accumulations in the base chamber, use a dry paint brush to clean.)

b) Abnormal flame pattern due to dirty, misadjusted or defective burner (check and remedy)
c) Poor sighting (sight pipe must be aligned so that entire viewing field is filled with flame).
d) (Oil burner only), sight path too close to atomizer and UV is "screened" by oil spray (change sighting)

Possible Reason: Detector has lost sensitivity or pulse modifier has become faulty (substitute spare scanner)

The above procedures cover fairly obvious malfunctions, but by no means all that could occur. A thorough, understanding of the burner apparatus and control system is essential for effective troubleshooting.

ORDERING INFORMATION

When ordering specify:

9001 Flame Safeguard Controller
9501 Ultraviolet Flame Scanner
9502 Luminescent Flame Scanner
9503 Fiber Optic Scanner

For assistance in ordering a system to fit your application, please contact:

Corporate Headquarters
6901 West 110th Street
Minneapolis, Minnesota 55438 U.S.A.
Telephone (612) 941-5665
Telex 29-0562
Cable Detronics

Burner Management Systems Group Office
Crosby Road
Dover, New Hampshire 03820 U.S.A.
Telephone (603) 749-3450
Twx 510-297-4452

Branch Offices

Detector Electronics Corporation
14614 Falling Creek
Suite 124
Houston, Texas 77068 U.S.A.
Telephone (713) 440-0906

Detector Electronics International
Vossepad 24
7822 BB Emmen Holland
Telephone 001 31 5910 14913
Telex 844-30112

Detector Electronics UK Ltd.
51/53 The Pantiles
Royal Tunbridge Wells
Kent TN2 5TH
ENGLAND
Telephone 0892-42919
Telex 957532 (DETRON G)

Detector Electronics do Brazil
Av. Geremario Dantas 493
22700 Jacarepagua
BRAZIL
Telephone 011-55-21-221-6600
Telex 391-2123477

Detector Electronics Canada, Ltd.
Bay 107
1915 - 27th Avenue Northeast
Calgary, Alberta T2E 7E4
CANADA
Telephone (403) 276-5359

REPLACEMENT PARTS

UV Scanner Assembly (plug-in module, without base: part number 601-105
UV Detector Tube (separately replaceable in scanner): part number 601-107
Luminescent Scanner Assembly (plug-in module, without base): part number 601-108
Amplifier Module: Part number 601-103
Relay K1: Part number 123-10
Relay K2: Part number 123-20
Relay K3: Part number 123-30

DEVICE REPAIR

For components in need of repair, contact your local source or return to:

Detector Electronics Corporation
Return Goods Department
6901 West 110th Street
Minneapolis, Minnesota 55438 U.S.A.