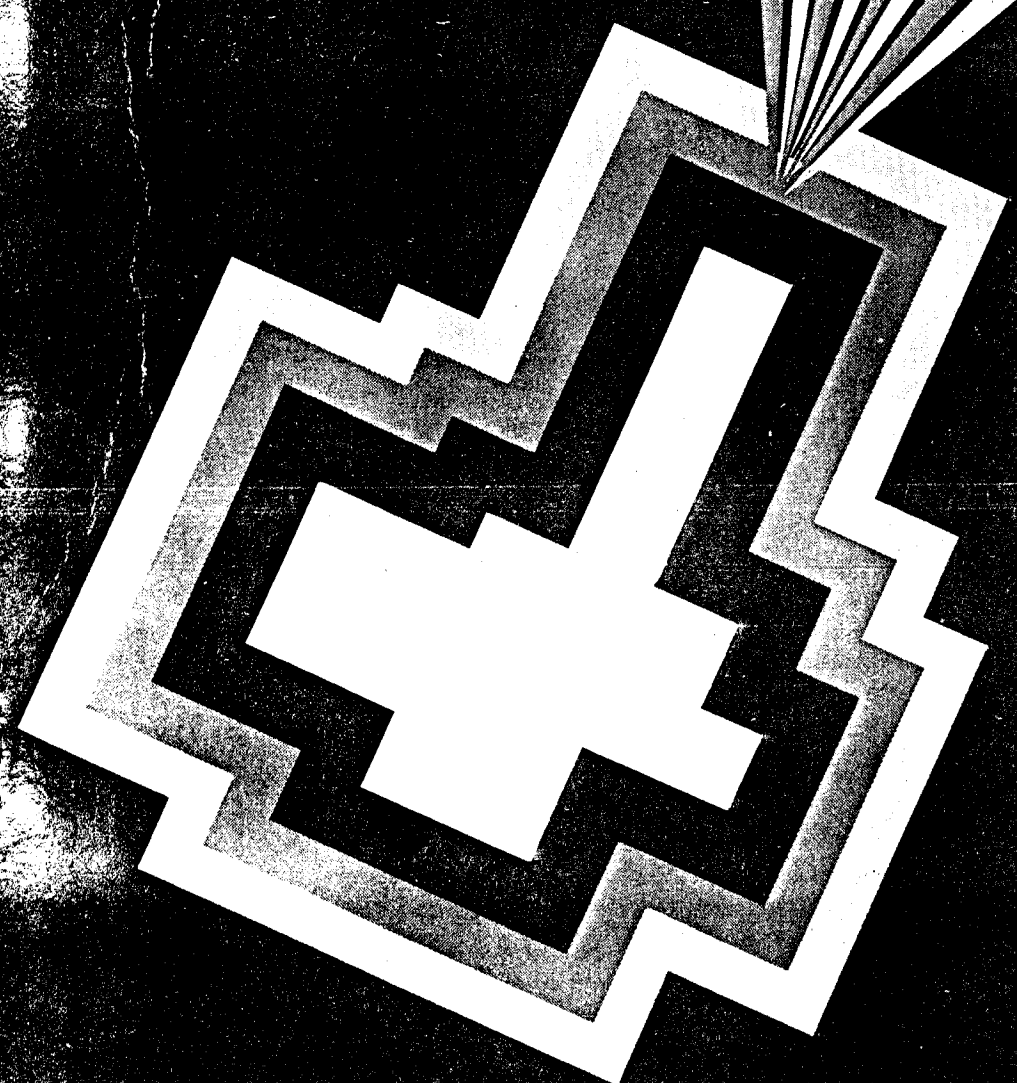


TRADELINE

OIL CONTROLS



SERVICE HANDBOOK

YOUR TRADELINE WHOLESALER IS READY TO SERVE YOU

Replacements for controls listed in this handbook are available from your full service wholesaler. He stocks the TRADELINE controls you need and provides you with technical and promotional literature. His trained men will help you in both new and replacement applications.

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TRADELINE controls are built by Honeywell to simplify selection and installation—they are developed especially for field application.

- Top quality
- Advanced design
- Easy installation
- Top performance
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TRADELINE makes it easy to select the control you need and assures you proven Honeywell dependability.

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Honeywell is cooperating with wholesalers and dealers to develop new markets and create new products. Salesmen located at the offices listed below offer assistance and special sales help on all controls and associated products in this handbook.

IMPORTANT: The following cities have sales branches only. Factory shipments should be made to Honeywell, 1885 Douglas Drive North, Minneapolis, Minnesota 55422.

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ARIZONA

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CALIFORNIA

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WISCONSIN

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THE OIL BURNER CONTROL HANDBOOK

This service handbook provides—

- information the serviceman needs to effectively troubleshoot the primary control in oil burner systems.**
- data on Honeywell oil primaries and auxiliary controls.**
- a cross reference from obsolete to active Honeywell oil burner controls.**
- guides to help the serviceman isolate troubles in residential burner systems.**

Every oil heat system can be divided into two basic parts—the oil burner system and the control system.

BURNER SYSTEM

Components of the burner system are shown on the diagram below. Major components are the—

Burner motor	Oil filter
Furnace	Oil tank
Stack	Oil supply line
Draft regulator	

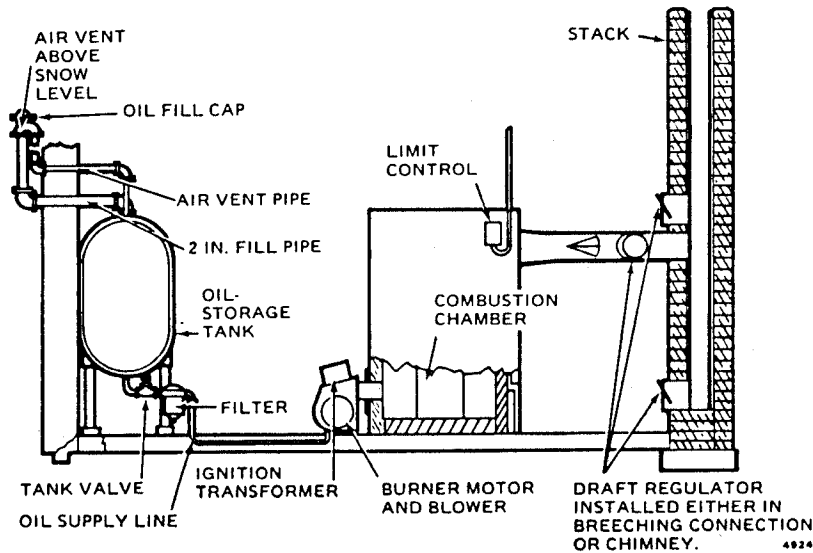


Fig. 1—Typical domestic oil burner system.

In general, fuel oil must be atomized, or broken into droplets, and mixed with air before it can be ignited. Burners are classified according to the method used to prepare the fuel for combustion. There are two basic types—vaporizing and atomizing.

VAPORIZING BURNERS

Vaporizing burners depend on natural evaporation, aided by heating the oil, to provide oil vapor for combustion. Typically, these burners have a gravity fuel feed and constantly burning pilot. They often are manually controlled and may have either natural or forced draft. The vaporizing burner is suitable for low firing rates and light (No. 1 or 2) oil only.

ATOMIZING BURNERS

Atomizing burners forcibly separate the fuel into tiny droplets and spray it into the combustion chamber. The resulting mixture of oil and air is ignited with a spark. Atomizing burners are suitable for either low or high pressure operation.

Rotary type atomizing burners consist essentially of a motor-driven blower, a spinning cup, an air nozzle, and an ignition transformer and ignition system. The oil flows through a hollow shaft to the spinning cup, where it is thrown off in droplets by centrifugal force. At this point, primary air supplied by the blower is directed into the oil spray by the air nozzle, thus creating a combustible mixture.

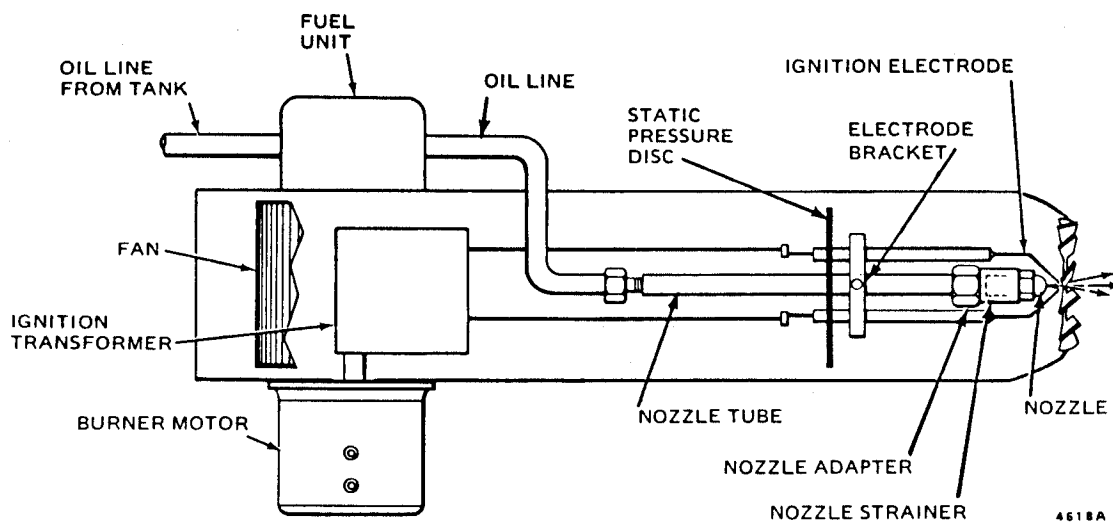


Fig. 2—Typical gun type oil burner (top view).

Gun type atomizing burners, by far the most common, use a fuel pump to deliver oil under pressure (up to 150 psi) to a precision-made nozzle. At the nozzle the oil is broken into a fine, cone-shaped mist. A blower driven by the burner motor directs a turbulent airstream into the oil mist as it leaves the nozzle. An electric spark provided by the ignition transformer and ignition electrode ignite the mixture.

CONTROL SYSTEM

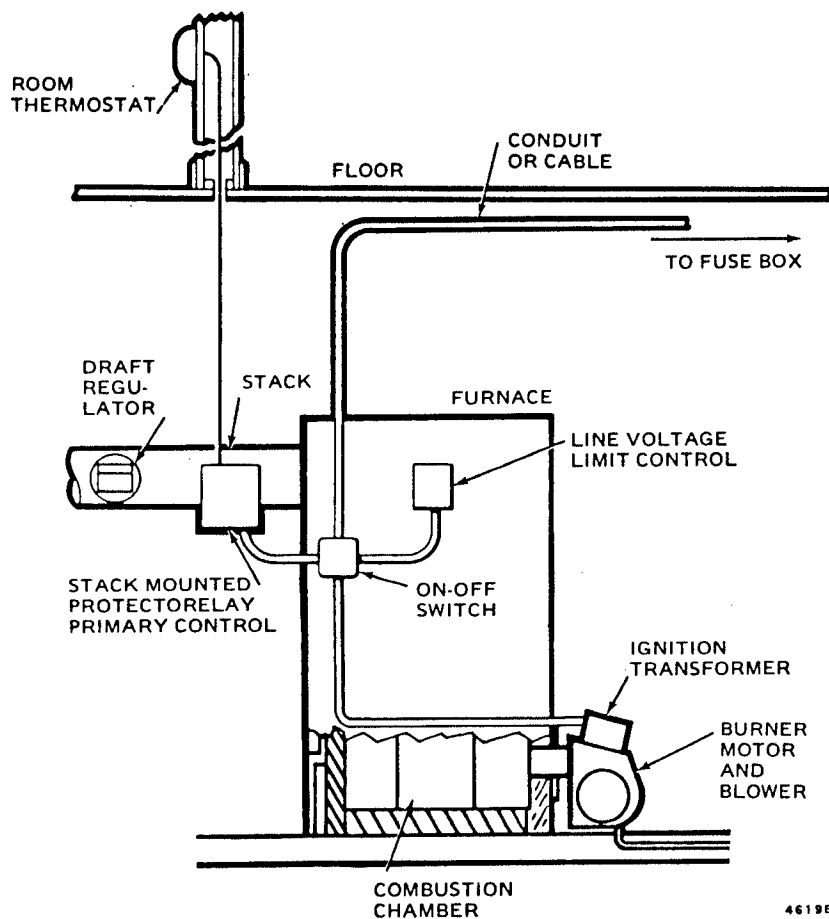


Fig. 3—Typical oil burner heating system, showing the control system.

The functions of the control system are to turn the heating system on and off in response to temperature changes in the space and to stop the system if an unsafe condition occurs. The controls needed to perform these functions are:

Thermostat—senses changes in controlled medium temperature and signals primary control to turn burner on or off.

High limit—opens circuit to burner if overheating condition occurs.

Primary control—turns burner on and off in response to thermostat action and monitors the burner flame.

Auxiliary controls—these may include such controls as circulator or fan controls, low limit, zone valves, air cleaner or humidifier controls, time delay controls, and additional relays.

PRIMARY CONTROL

The primary control is the heart of the oil burner control system. It controls the burner motor, ignition transformer, and oil valve in response to signals from the thermostat. The high limit is usually located in the power line to the primary control so that on limit action the burner is completely shut down. In addition, a sensor which is part of the primary control assembly “watches” the burner flame on startup and throughout the burner ON cycle. If flame fails for any reason, or if the power fails, the primary control shuts down the burner. The method used to sense the flame determines the type of primary controller used and its location in the heating system.

Three types of primary controls are covered in this handbook:

1. Burner-mounted with cad cell (light sensitive) flame detector.
2. Burner-mounted with stack mounted (thermal) sensor (two piece).
3. Stack-mounted with thermal sensor included (one piece).

Primary control action is defined by the following terms^a:

Constant ignition—ignition comes on when burner is energized and stays on as long as burner is firing.

Intermittent ignition—ignition comes on when burner is energized. It is cut off after main burner flame is established or after a preset ignition timing period.

Nonrecycling control—attempts to restart the burner immediately on loss of flame. Ignition attempt continues until control locks out on safety.

Recycling control—shuts down the burner immediately on loss of flame, then attempts to restart burner once before locking out on safety.

^aUnderwriters Laboratories Inc. refers to primary control action as follows:

Continuous ignition—igniter is on as long as the burner is in service, whether the main burner is firing or not.

Intermittent ignition—igniter comes on when burner is energized and stays on as long as the main burner is firing.

Interrupted ignition—igniter comes on when main burner is energized. It goes off automatically when flame is established or after a preset timing period.

CAD CELL PRIMARY CONTROLS

Cad cell primaries consist of a primary control and a light sensitive cad cell mounted so that it views the oil flame. The reduced resistance of the cad cell in the presence of light is used to complete the flame detection circuit, which in turn prevents the primary control from locking out on safety. The fast response of the cell to light eliminates the time lag found in bimetal sensors, making it especially advantageous in large oil burner installations.

These controls may include an integral Aquastat controller to combine burner supervision with water temperature or circulator control in hydronic heating systems.

CAD CELL FLAME DETECTORS

The cad cell detector consists of a photocell and a holder and cord assembly. The detector is installed inside the air tube of the burner where the cell can view the flame and is wired to the primary control.

The photocell is made from a ceramic disc coated with cadmium sulfide and overlaid with a conductive grid. Electrodes attached to the disc transmit an electrical signal to the primary control. The entire cell is sealed with a glass to metal hermetic seal to prevent cell deterioration.

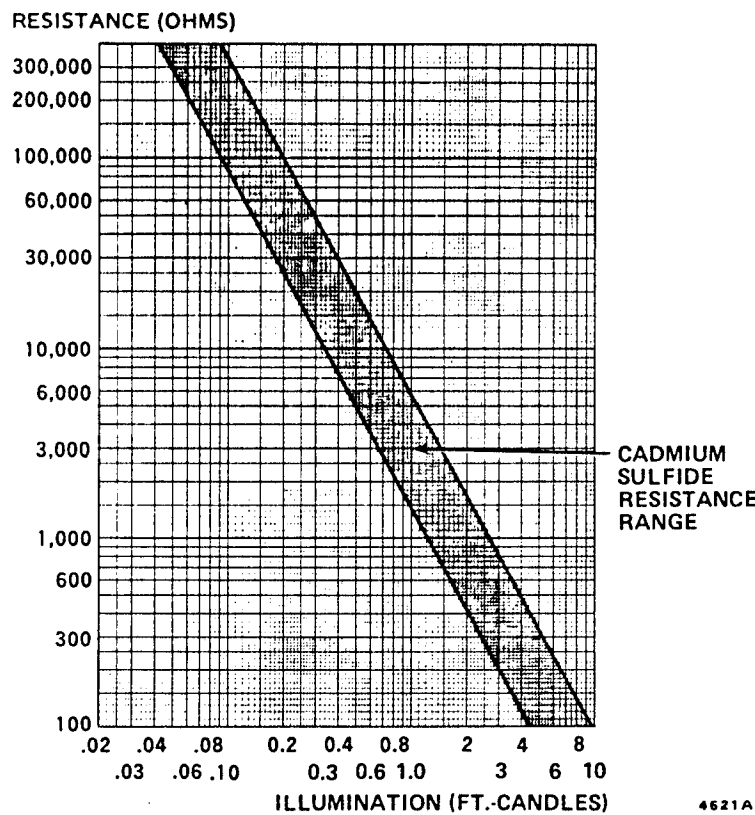


Fig. 4—Light response tolerance of a typical cad cell.

In darkness, cadmium sulfide has a very high resistance to the passage of electrical current. In the presence of visible light its resistance becomes very low and current is allowed to pass.

The small shaded curve in the graph below represents the area of sensitivity of the cad cell. The solid line represents an oil flame and the dotted line a typical gas flame. The light emission of an oil flame is in the cell response range, but the typical gas flame is above this range so the cell will not respond to it. (It is possible, though not typical, to apply the cad cell in specific gas burners to view a portion of the flame pattern which is fuel rich. This application is practical if the cell can be applied to always view the special flame condition.)

Hot refractories have a wave length of about 7000 angstroms and upward. Most of the cad cell response range is below 7000 angstroms.

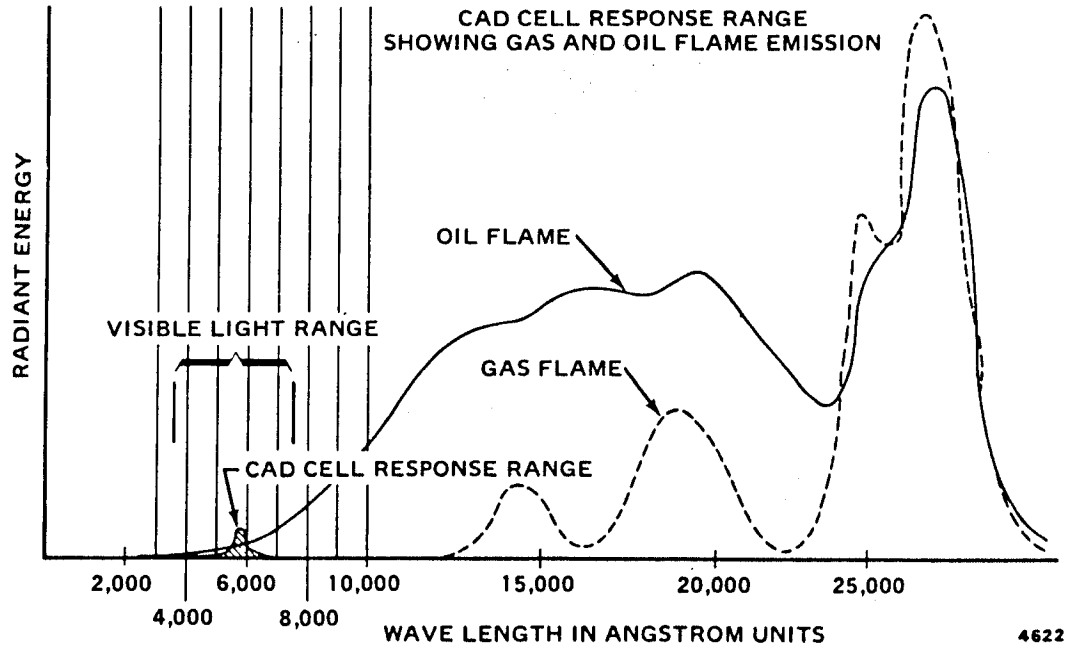
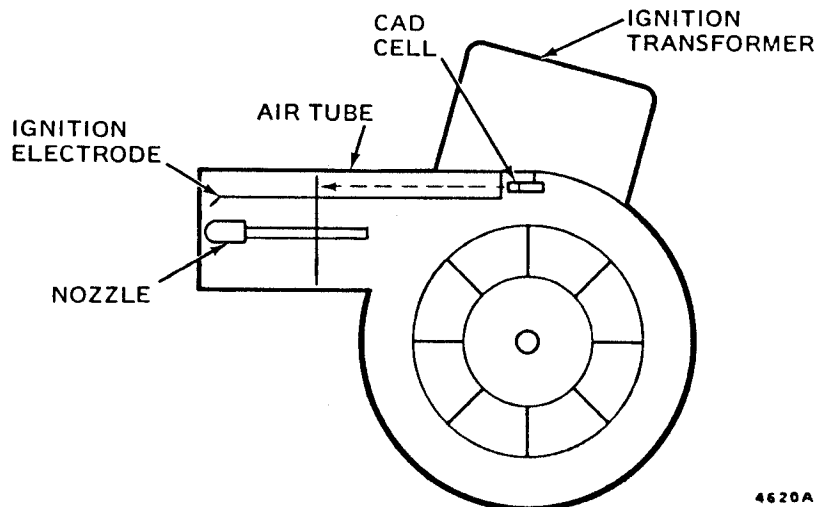


Fig. 5—Cad cell response range.

If the burner is properly adjusted, cad cell resistance will be in the range of 300 to 1000 ohms when the burner is operating. To ensure continued reliable burner operation, the resistance of the cell should never be above 1600 ohms during the burner run cycle. If cell resistance is greater than 1600 ohms, the cad cell may need cleaning or adjusting, or the burner flame may need to be adjusted. See troubleshooting section, "Burner Starts, Then Locks Out on Safety," page 41.

CAD CELL LOCATION



Cad cell location is carefully determined by the burner manufacturer to meet specific requirements:

1. Cell should view the flame directly.
2. Adequate light must reach the cell for sensing the flame. Even under adverse burner adjustment conditions, resistance of the lighted cell should be less than 1600 ohms. It should be under 1000 ohms with the burner properly adjusted.
3. Cell must be protected from external light (either direct or reflected). This is because the cad cell responds to any light in the visible range—not just the burner flame.
4. Ambient temperature should be below 140 F.
5. Cell must have adequate clearance so metal surfaces near the cell will not affect it by movement, shielding, or radiation.

The location should never be changed under normal circumstances. Service normally entails removing accumulated dirt and soot which may be blocking the view of the cell, or replacing the cell.

CAD CELL PRIMARY CONTROL

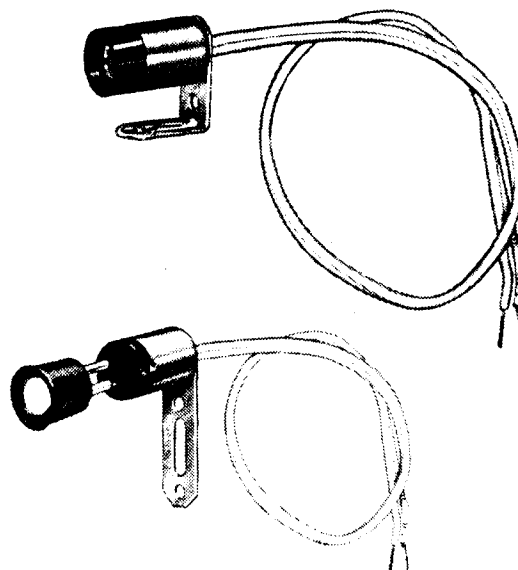
The cad cell detector is connected to the primary control by attaching the cad cell leadwires to the F-F (S-S in older controls) terminals in the primary.

When the burner is started, a bimetal operated safety switch in the primary starts to heat. This switch will break and shut down the burner unless flame is established. If flame is established, the cad cell resistance drops until current through the cad cell actuates a sensitive relay or electronic network in the primary. The circuit to the safety switch element is broken, the safety switch stop heating, and the burner runs. If flame goes out, the cad cell resistance goes up, the circuit containing the safety switch element remakes, and the safety switch starts to heat. The burner will then go out on safety unless the flame is re-established before the safety switch breaks. (Some intermittent ignition primaries recycle once before locking out on safety.)

C554A PHOTOCCELL FLAME DETECTOR

APPLICATION

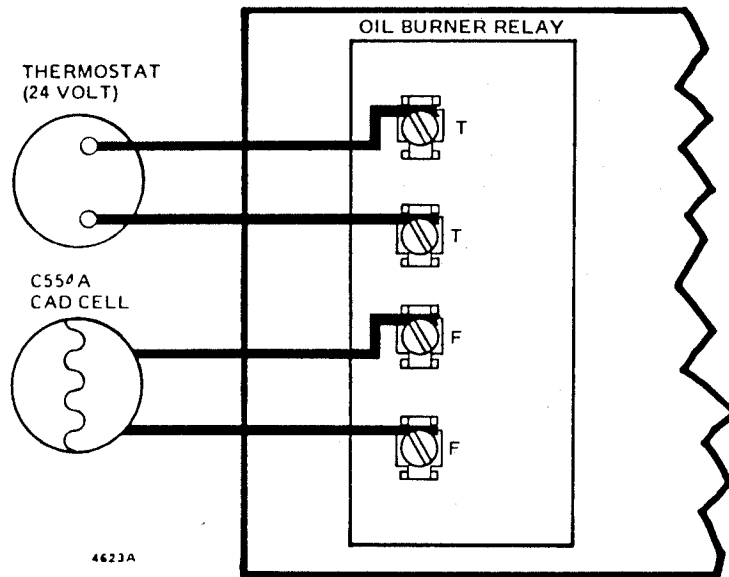
The C554A Photocell Flame Detector (cad cell) is a photoconductive, cadmium sulfide, flame detector used with Protectorelay controls such as R4166, R8182, R8184, and R8185 to prevent unsafe burner operation. Device includes a plug-in, light-sensitive cell, and a socket with mounting bracket and leadwire. A 1-piece model with permanently attached cell is also available.



SPECIFICATIONS

AMBIENT TEMPERATURE: 140 F at cell.
REPLACEMENT CELL: Part No. 130367.

TYPICAL HOOKUP

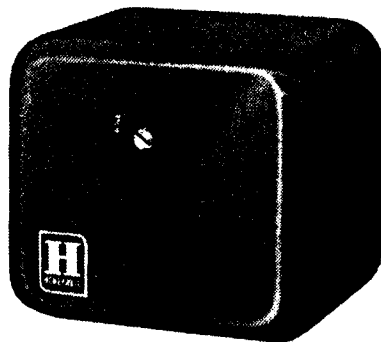


CLEANING AND REPLACING CELL

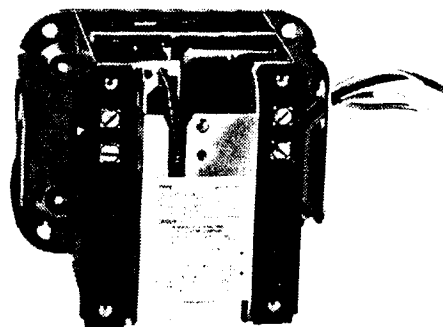
Under normal operating conditions the C554A does not require cleaning. Small accumulations on the surface of the cell will not affect its operation. However, if a badly adjusted burner has caused a heavy accumulation of soot, the surface of the C554A should be wiped carefully to remove all opaque substances and restore full view of the oil flame.

If the cell is ever damaged, it may be removed by simply unplugging it from the socket assembly. (On 1-piece C554, replace entire unit.) Avoid disturbing the positioning of the socket assembly. Replace the damaged cell with cad cell No. 130367. No. 130367 may be used to replace No. 120320 or No. 124607 in the C554 Flame Detector.

R4118, R8118, R8119 PROTECTORELAY PRIMARY CONTROLS



R4118A, R8118A, R8119A



R4118B, R8118B, R8119B

APPLICATION

These burner-mounted primary controls are used with the C554A Flame Detector. Line voltage connections may be either leadwires or screw terminals. "B" models are without base and cover for panel mounting.

TABLE I

MODEL ^a	CONTROLLER VOLTAGE	TYPE OF IGNITION	SAFETY SWITCH TIMING	IGNITION TIMING
R4118A,B	Line	Constant	80 sec.	—
R8118A,B	Low	Constant	80 sec.	—
R8119A,B	Low	Intermittent	80 sec.	70 sec.

^aAll models are now obsolete. See Table II.

TABLE II

MODEL ^a	LAST MANUFACTURED	REPLACEMENT
R4118A,B	8/69	R4184D
R8118A,B	A-12/65, B-8/69	R8184G
R8119A,B	8/72	R8185E

^aAll models are now obsolete.

ELECTRICAL RATINGS:

Line voltage burner motor load (amperes)—

	120V	240V
Full Load	7.4	3.7
Locked Rotor	44.4	22.2

IGNITION RATING (in addition to motor load rating):

R4118, R8118—250 VA.

R8119—500 VA.

MAXIMUM AMBIENT TEMPERATURE: 132 F at case.

RECYCLE TIMING (R8119): 3 min. maximum.

THERMOSTAT ANTICIPATOR SETTING: 0.4 amp.

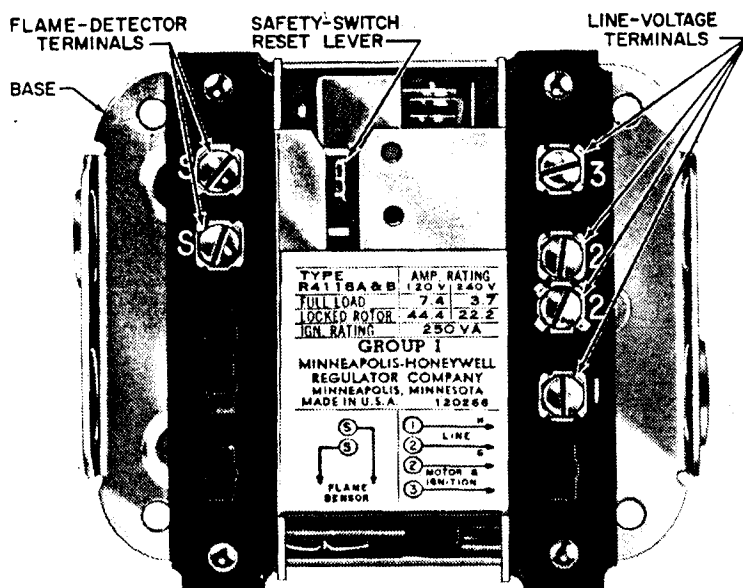
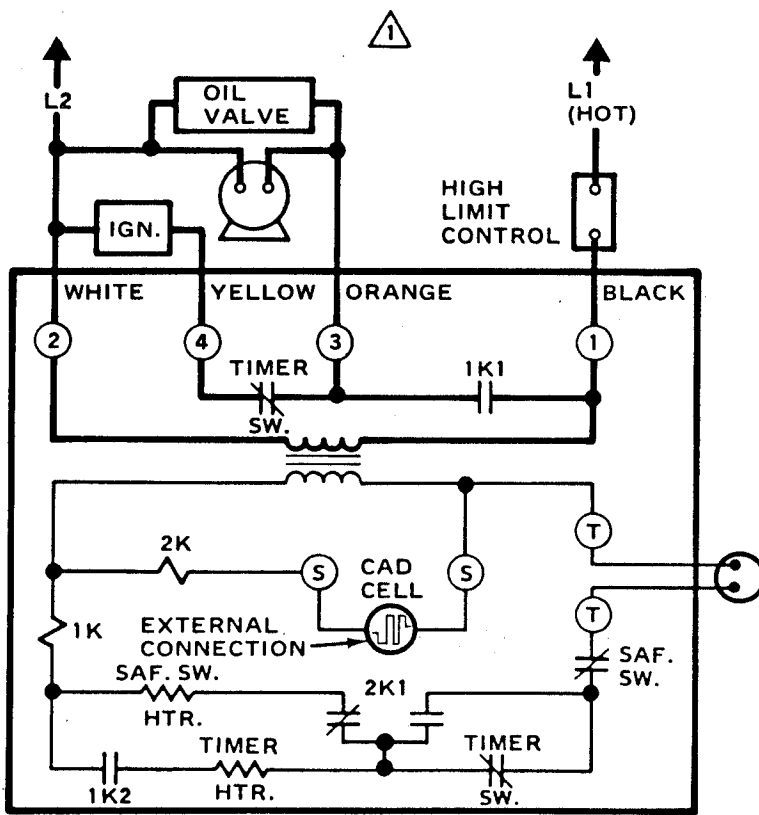


Fig. 6—R4118A with cover removed. R8118A, R8119A are similar except for terminals.

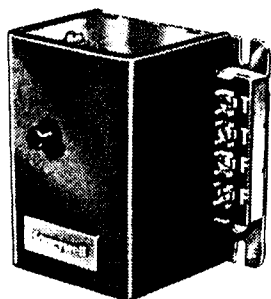


⚠ PROVIDE OVERLOAD PROTECTION AND DISCONNECT MEANS AS REQUIRED. 4626

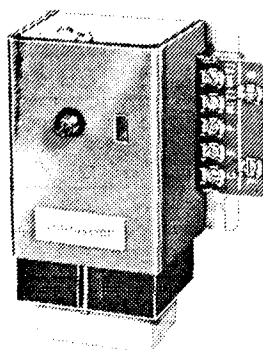
NORMAL OPERATION

EXTERNAL ACTION	R4118, R8118	R8119
On call for heat—	1K relay pulls in, energizing ignition, and burner motor.	Same, plus ignition timer starts heating.
When cad cell sees normal flame—	2K relay operates, shunting safety switch heater.	Same, plus timer switch shuts off ignition in approx. 70 sec.
When heat demand is satisfied—	1K relay drops out, shutting off ignition, oil valve, and burner. 2K relay returns to starting position as soon as C554 senses "no flame."	1K relay drops out, shutting off oil valve and burner. 2K relay returns to starting position as soon as C554 senses "no flame" and timer prevents restart for 2 - 3 minutes.

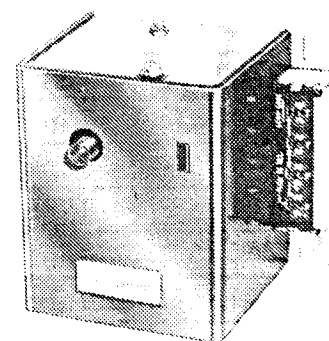
**R4184, R4185, R8184, R8185
PROTECTORELAY PRIMARY CONTROLS**



R8184G,K



R8184M



R8185E

APPLICATION

These primary controls are used with the C554A Flame Detector. Color-coded leadwires are provided for line voltage connections; exposed terminal strip with optional cover provided for low voltage connections. Newer models have solid state flame sensing circuit.

**SPECIFICATIONS
ACTIVE MODELS:**

MODEL	CONTROLLER VOLTAGE	IGNITION	SAFETY SWITCH TIMING
R4184D—junction box mtd.	Line	Constant	45 sec.
R8184G—junction box mtd.	Low	Constant	15, 30, or 45 sec.
R8184K—burner mtd.	Low	Constant	45 sec.
R8184L—separate terminals and switching for fan timer	Low	Constant	45 sec.
R8184M—40 va transformer, connections for cooling equipment	Low	Constant	45 sec.
R8185E—75 sec. ignition timing; 1 attempt to restart on flame failure	Low	Intermittent	15, 30, or 45 sec.

OBSOLETE MODELS:

MODEL	CONTROL- LER VOLTAGE	IGNITION	SAFETY SWITCH TIMING	LAST MFG.	REPLACE- MENT
R4184A	Line	Constant	60 or 70 sec.	8/69	R4184D
R4184B	Line	Constant	60 or 70 sec.	8/69	R4184D
R4185A	Line	Intermittent	60 or 70 sec.	8/69	R8185E ^a
R4185B	Line	Intermittent	60 or 70 sec.	2/66	R8185E ^a
R4185C	Line	Intermittent	60 or 70 sec.	5/66	R8185E ^a
R4185D	Line	Intermittent	60 or 70 sec.	1/69	R8185E ^a
R8184A	Low	Constant	60 or 70 sec.	8/72	R8184G
R8184B	Low	Constant	60 or 70 sec.	3/71	R8184G
R8184D	Low	Constant	60 or 70 sec.	3/71	R8184L
R8184E	Low	Constant	60 or 70 sec.	4/71	R8184G
R8184H	Low	Constant	15 or 30 sec.	7/72	R8184G
R8184J	Low	Constant	45 sec.	12/72	R8184L
R8185A	Low	Intermittent	60 or 70 sec.	8/69	R8185E
R8185B	Low	Intermittent	60 or 70 sec.	8/69	R8185E
R8185C	Low	Intermittent	60 or 70 sec.	11/65	R8185E
R8185D	Low	Intermittent	60 or 70 sec.	9/72	R8185E

^aJumper T-T terminals when replacing R4185.

RECYCLE TIMING (R8185E): 60 sec. minimum.

ELECTRICAL RATINGS:

R8184G (15, 30 sec. models); R8184H—obsolete.

R8185E.

BURNER MOTOR LOAD			IGNITION^a
	110/120V, 50/60 HZ	220/240V, 50/60 HZ	
Full Load	10 amp	5 amp	500 VA
Locked Rotor	60 amp	30 amp	

^aIgnition rating is in addition to motor load rating.

R4184A,B; R4185A-D; R8184A,B,D,E,J; R8185A-D—obsolete.

R8184G—45 sec. models.

R4184D; R8184K,L,M.

BURNER MOTOR LOAD			IGNITION^a
	110/120V, 50/60 HZ	220/240V, 50/60 HZ	
Full Load	7.4 amp	3.7 amp	360 VA
Locked Rotor	44.4 amp	22.2 amp	(250 VA—R4185)

^aIgnition rating is in addition to motor load rating.

THERMOSTAT HEAT ANTICIPATOR:

R8184A,B,D,E—0.38 amp.

R8184G,H,K,M—0.2 amp (0.4 amp available on R8184G,H,K).

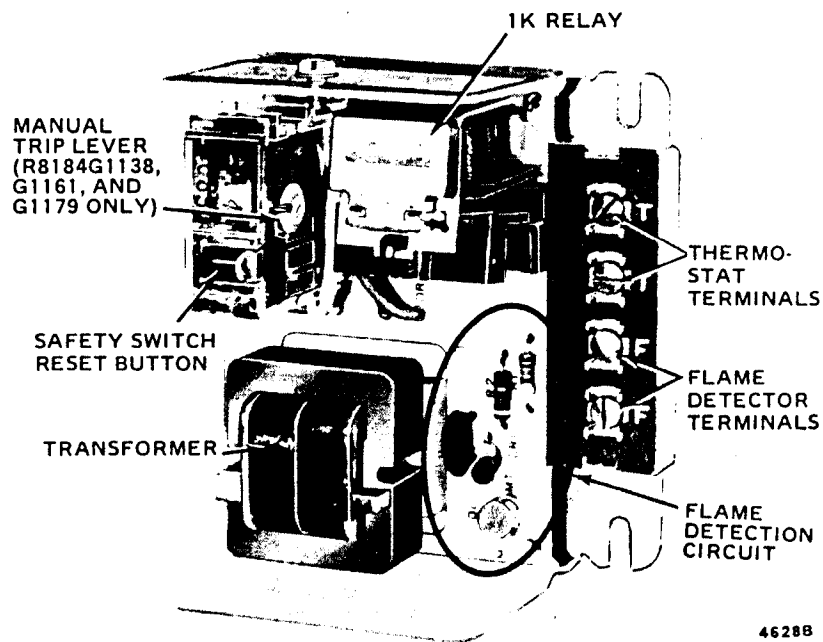
R8184J—0.32 amp.

R8184L—0.4 amp.

R8185A-D—0.3 amp.

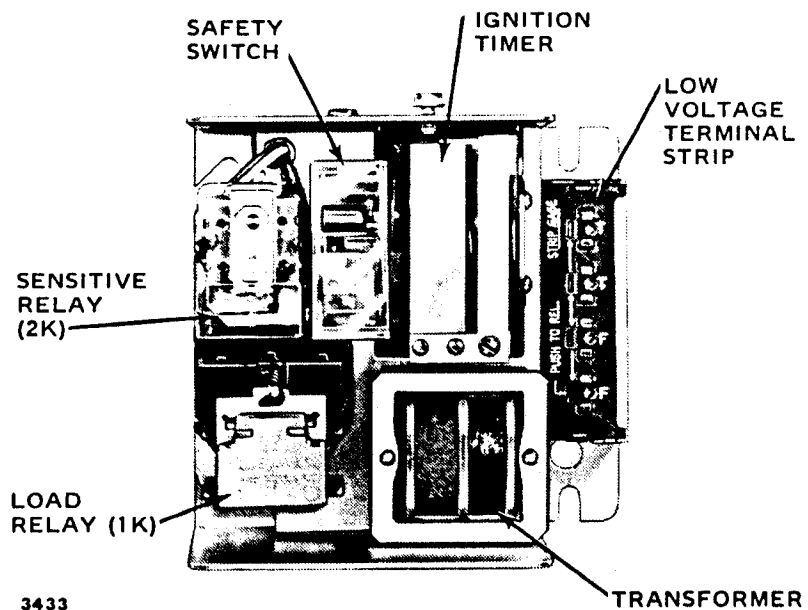
R8185E—0.2 amp.

MAXIMUM AMBIENT TEMPERATURE: 115 F.



46288

Fig. 7—R8184G with cover removed.

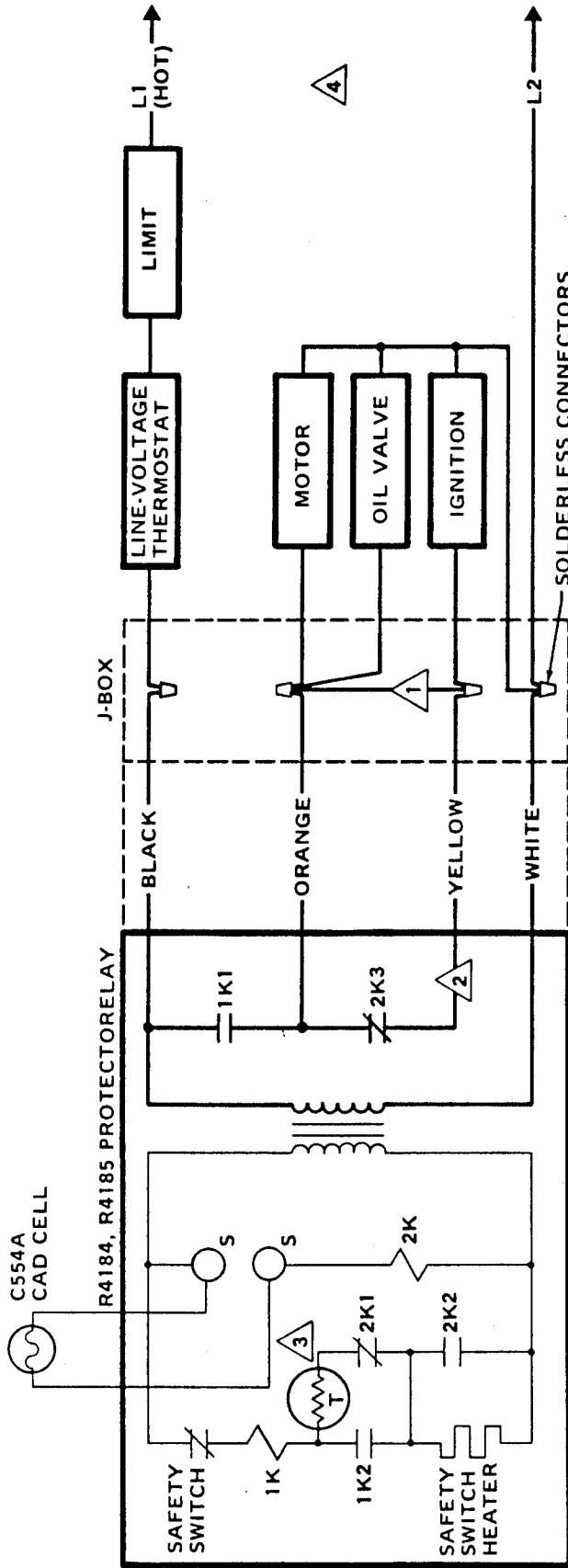


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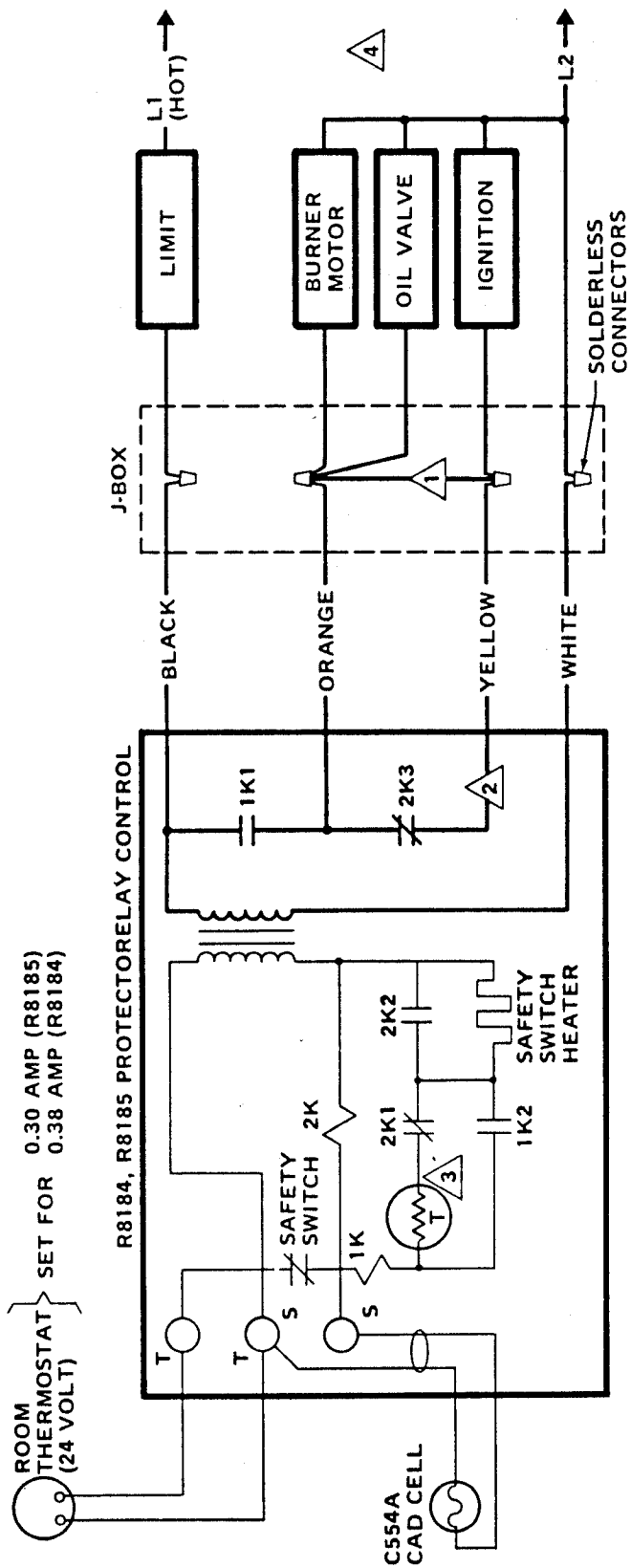
Fig. 8—R8185E with cover removed.

TYPICAL HOOKUPS

R4184A,B AND R4185A,B,C,D



R8184A,B,D,E AND R8185A,B,C,D



① CONNECTION FOR R8184 ONLY.

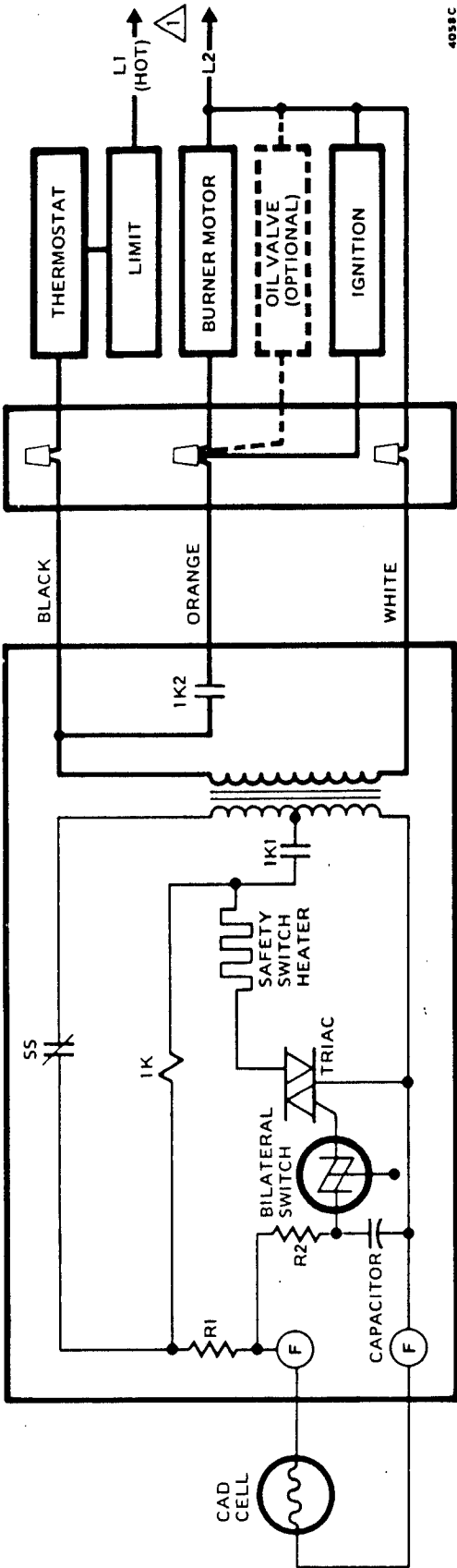
② CONNECTION FOR R8185 ONLY.

③ THERMISTOR IS IN R8184E AND R8185C,D CIRCUITS ONLY. (THERMISTOR CAUSES SLIGHT DELAY IN RELAY PULL-IN WHEN ENERGIZED).

④ ADD DISCONNECT MEANS AND OVERLOAD PROTECTION AS REQUIRED.

R4184D

R4184D PROTECTORELAY CONTROL

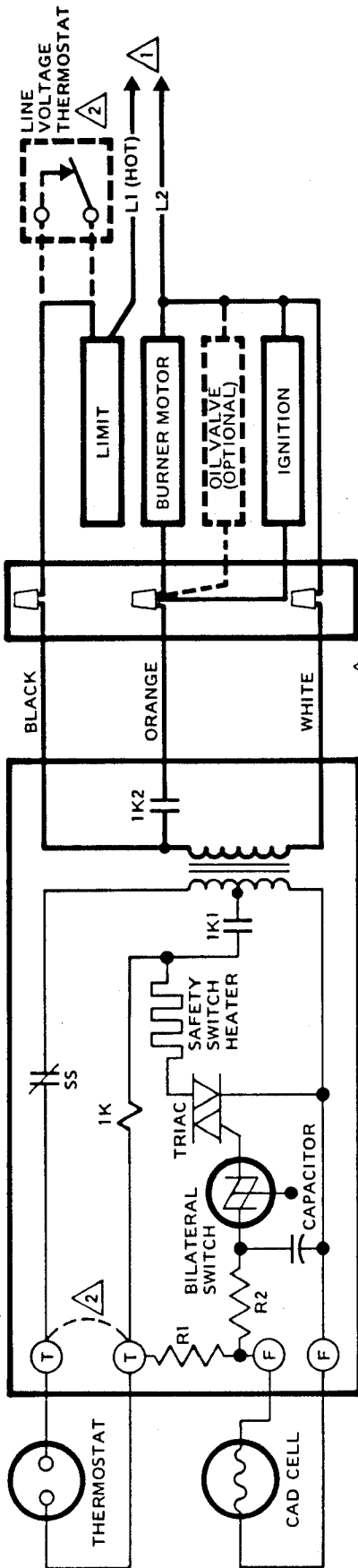


4058C

△ 1 POWER SUPPLY. PROVIDE DISCONNECT MEANS AND OVERLOAD PROTECTION AS REQUIRED.

R8184G,K

R8184G,K PROTECTORELAY CONTROL



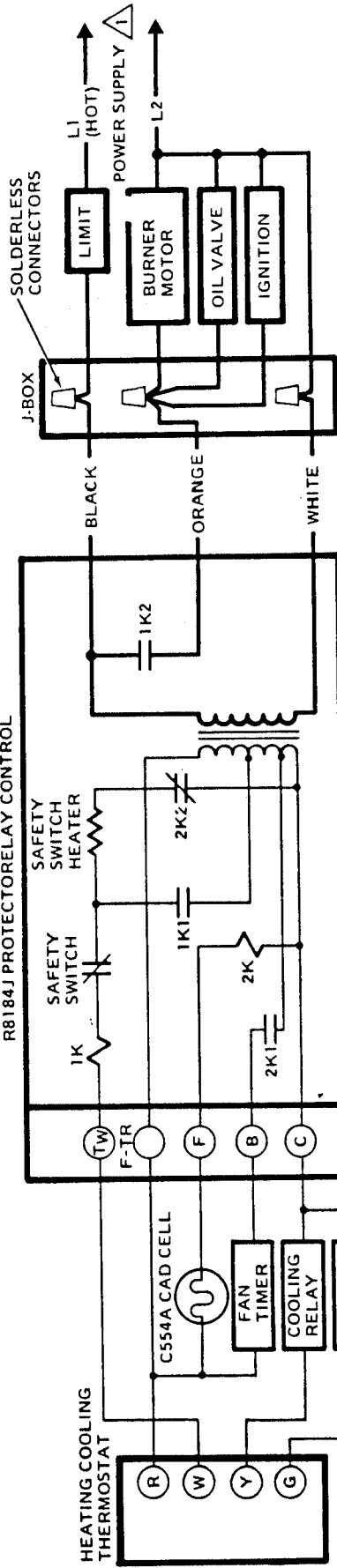
△ 1 POWER SUPPLY. PROVIDE DISCONNECT MEANS AND OVERLOAD PROTECTION AS REQUIRED.

△ 2 TO USE R8184 WITH LINE VOLTAGE CONTROLLER, JUMPER T-T TERMINALS AND CONNECT LINE VOLTAGE THERMOSTAT IN SERIES WITH LIMIT CONTROLLER.

4057E

R8184J

R8184J PROTECTORELAY CONTROL

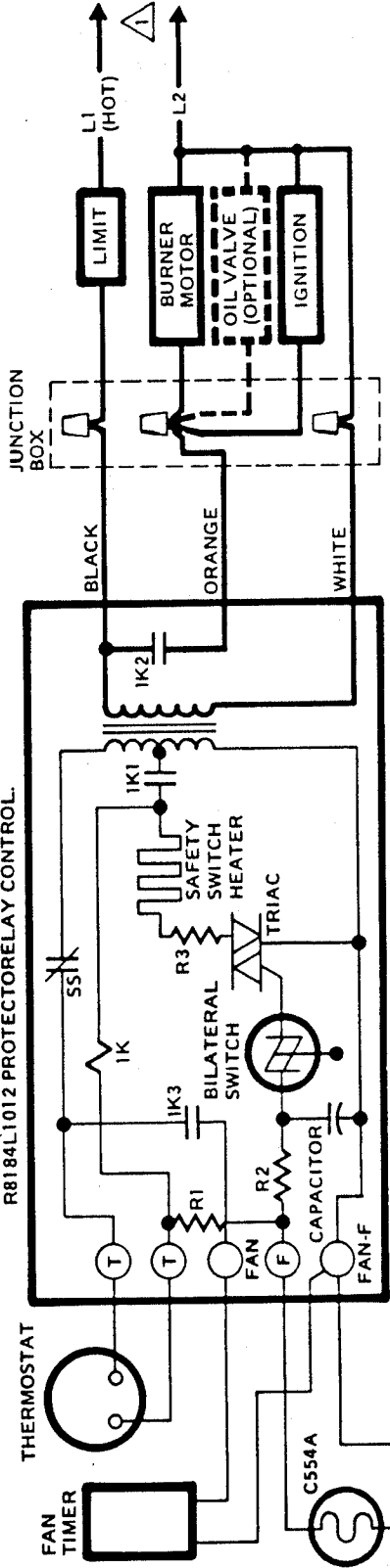


⚠ PROVIDE DISCONNECT MEANS AND OVERLOAD PROTECTION AS REQUIRED.

1456B

R8184L1012

R8184L1012 PROTECTORELAY CONTROL

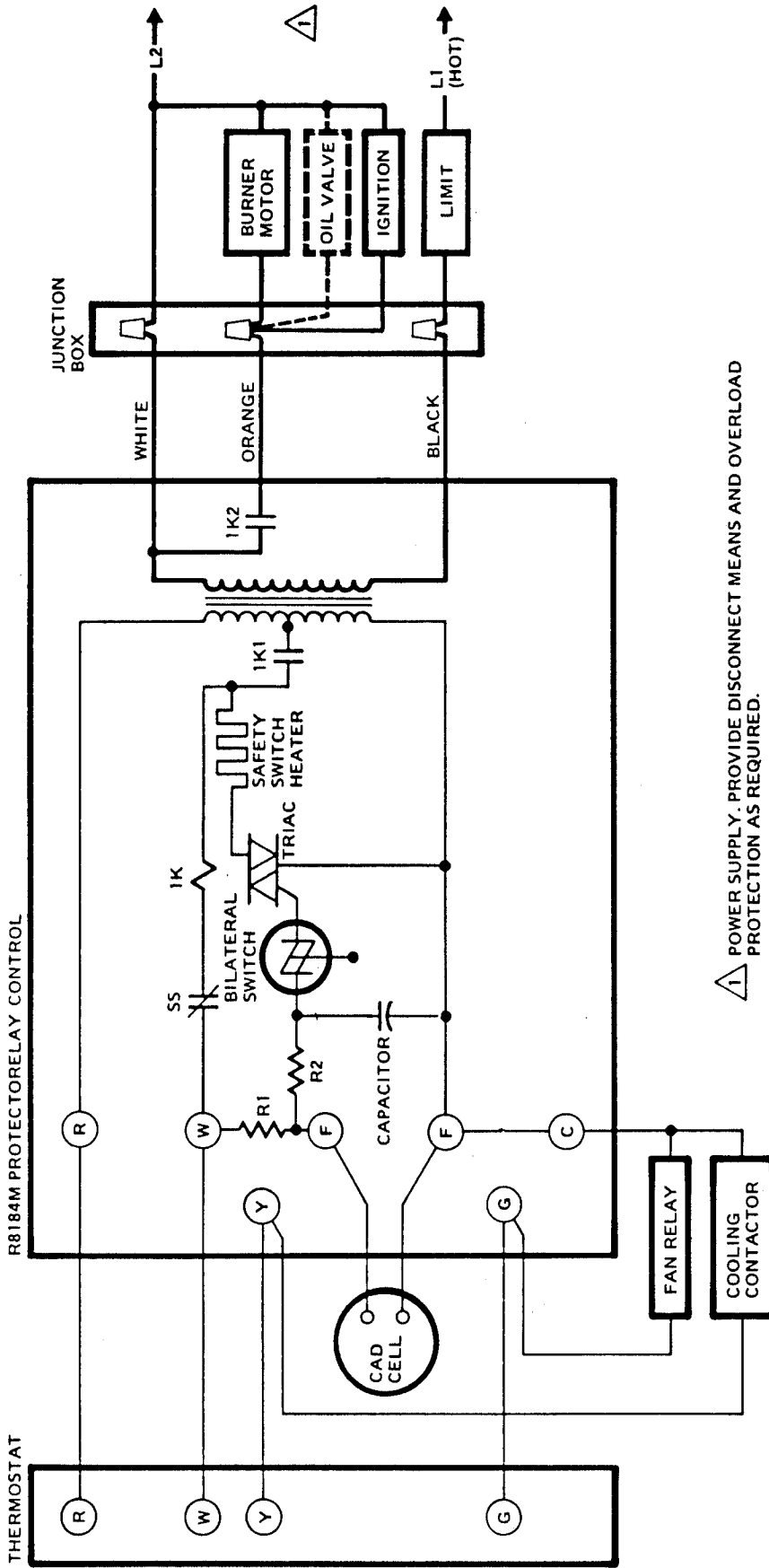


⚠ POWER SUPPLY PROVIDE DISCONNECT MEANS AND OVERLOAD PROTECTION AS REQUIRED.

NOTE: TERMINAL BOARD VARIES WITH EACH MODEL R8184L. CHECK BOARD BEFORE BEGINNING INSTALLATION.

4832B

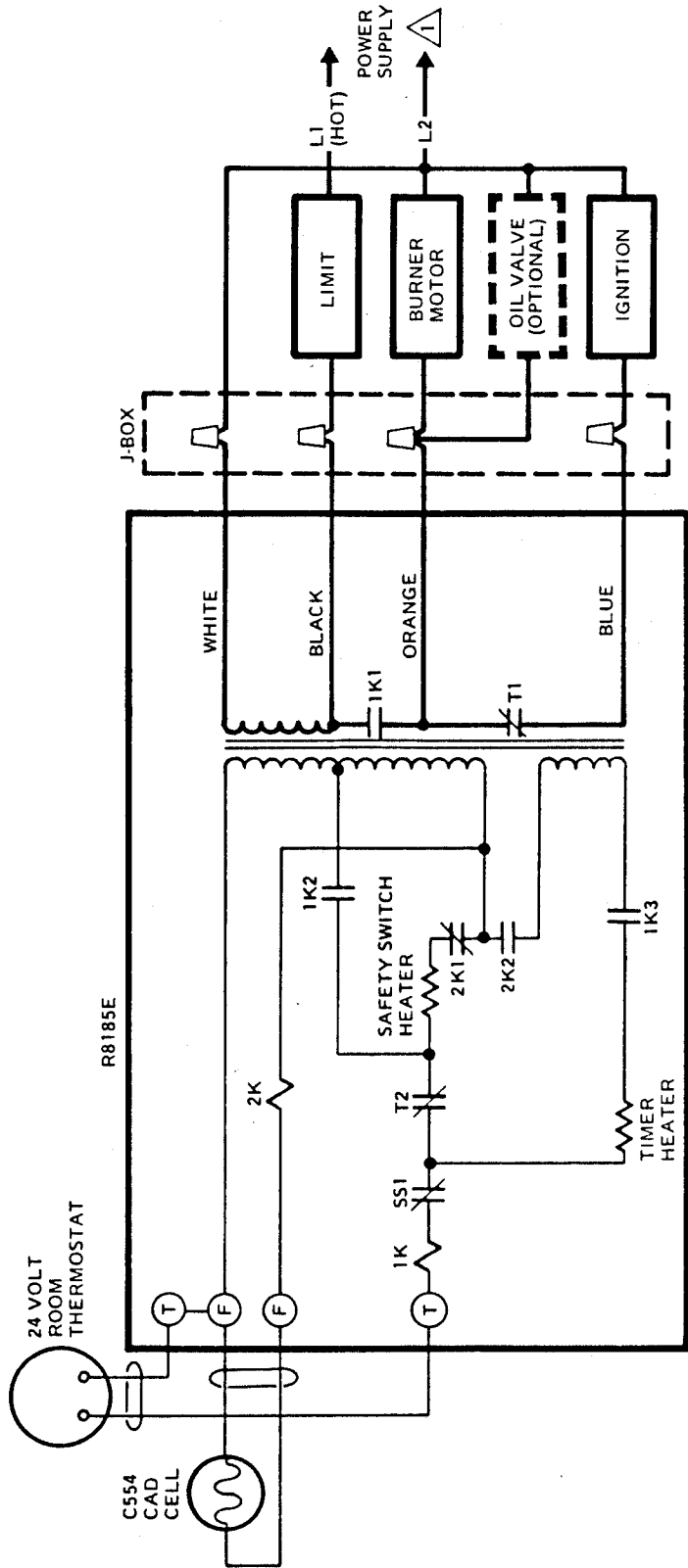
R8184M



⚠️ POWER SUPPLY. PROVIDE DISCONNECT MEANS AND OVERLOAD PROTECTION AS REQUIRED.

4370 B

R8185E



1 PROVIDE DISCONNECT MEANS AND OVERLOAD PROTECTION AS REQUIRED.

1460B

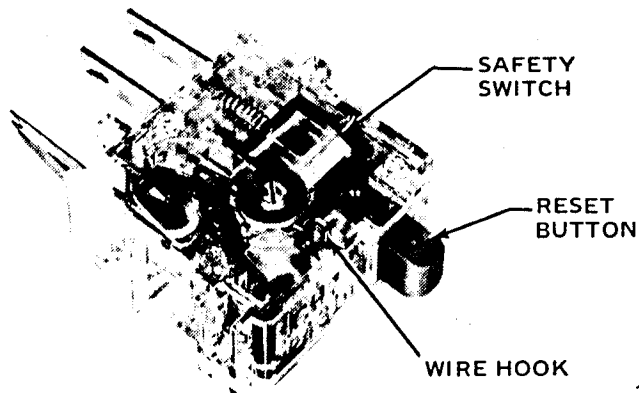
NORMAL OPERATION

EXTERNAL ACTION	PROTECTORELAY ACTION
Close line switch.	R4184—No action unless line voltage thermostat and limit contacts are closed. Then same as "Thermostat calls for heat." R8184—Transformer primary is energized if limit contacts are closed.
Thermostat calls for heat.	R4184—Transformer primary is energized. R4184, R8184—Relay 1K pulls in, closing contact 1K2, energizing the burner motor, oil valve, and ignition. Contact 1K1 also closes, but the safety switch heater continues to heat through the electronic network.
Cad cell senses flame within 15, 30, or 45 seconds depending on model.	Safety switch heater is de-energized. Burner operation continues under control of the thermostat and limit. R8184L—Contacts 1K3 close to energize fan timer.
Heat demand satisfied.	R4184—Transformer primary is de-energized, opening relay 1K and shutting off the burner motor, oil valve, and ignition. R8184—Relay 1K is de-energized, shutting off the burner motor, oil valve, and ignition.

SERVICE NOTE

TO MANUALLY TRIP SAFETY SWITCH ON R8184G1138, G1161, and G1179:

To assure burner shutdown while the system is being serviced, the safety switch may be manually tripped. Move the wire hook to the right until the safety switch reset button pops out. System is locked out. **REMEMBER: POWER SUPPLY HAS NOT BEEN DISCONNECTED.** Electric shock is still a possibility. To restart when service is complete, the safety switch must be manually reset (push in).



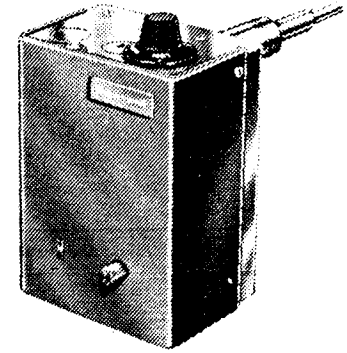
3770

R4166A,B COMBINATION AQUASTAT AND PROTECTORELAY CONTROL

APPLICATION

These immersion type water heater controls are used with the C554A flame detector. Both R4166A and R4166B provide oil burner supervision and control of water heater temperature. The R4166B also includes a fixed-setting high limit temperature control.

R4166



SPECIFICATIONS

ELECTRICAL RATINGS:

Voltage and Frequency—120V ac, 60 Hz.

Burner Motor Load—7.4 amp full load, 44.4 amp locked rotor.

Ignition rating (in addition to motor-load rating)—360 VA.

TEMPERATURE SETTING RANGE: 80-160 F, externally adjustable.

Scale marked COOL (80)—WARM (120)—NORMAL (140)—HOT (160). 100-180 F and 100-200 F ranges also available.

TEMPERATURE SET POINT DIFFERENTIAL: 5 F nonadjustable or 5-30 F adjustable.

HIGH LIMIT SETTING (R4166B only): 180 or 200 F, fixed.

SAFETY SWITCH TIMING: 45 sec.

TYPE OF IGNITION: Constant.

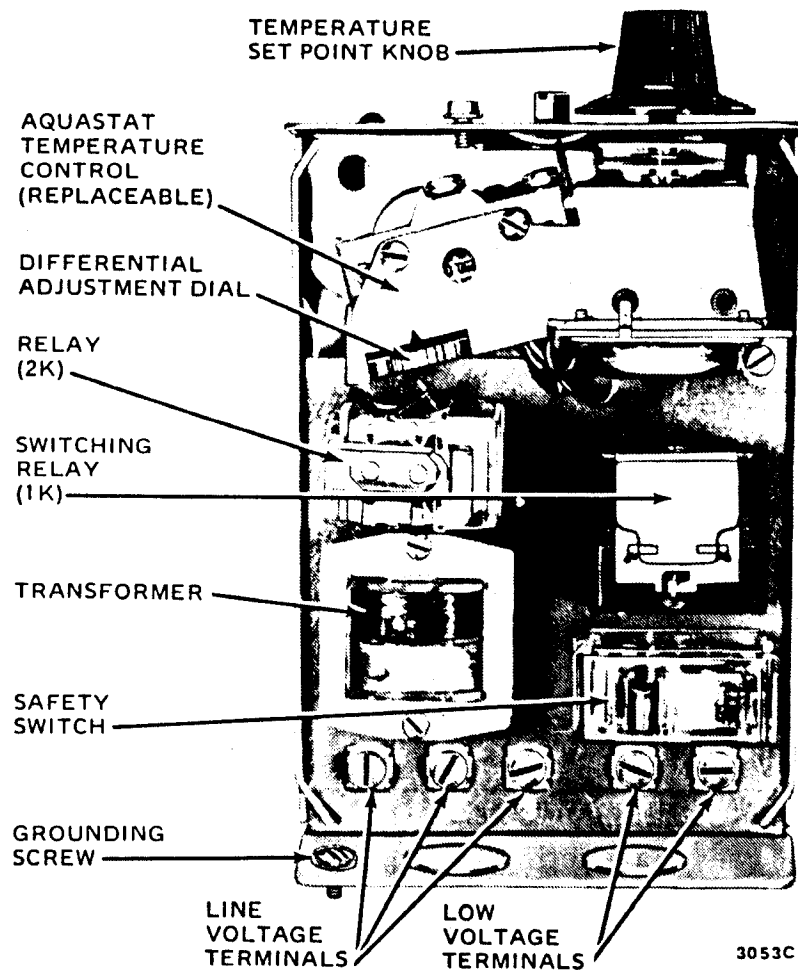


Fig. 9—Internal view of R4166B.

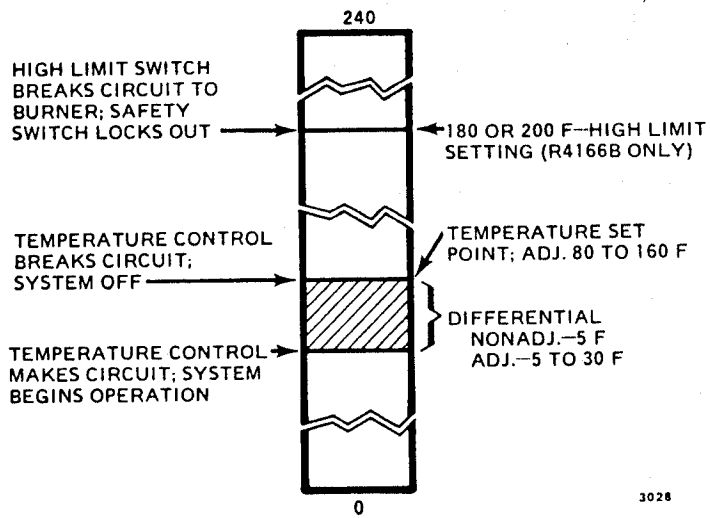
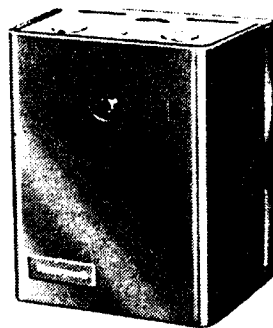
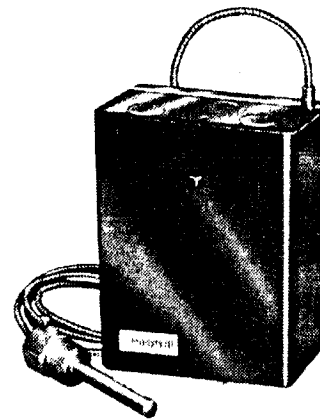


Fig. 10—Operation of the R4166, showing set points and differential on a temperature scale.

R8182A-C,D-F,H,J COMBINATION AQUASTAT AND PROTECTORELAY CONTROLS



R8182D,E,F



R8182H,J

APPLICATION

These immersion type controls supervise a constant ignition oil burner and, depending on model, provide combinations of high limit, low limit, and circulator control in a hydronic heating system. All models require a 24V thermostat and C554 flame detector. R8182H,J are designed for junction box mounting and have a remote sensor.

SPECIFICATIONS

MODEL	AQUASTAT SWITCHING ^a	CONTROL RANGE (ADJUSTABLE)	DIFFERENTIAL	REPLACEMENT
R8182A ^b Obsolete, last mfg. 11/69	High limit	120-240 F	10 F, fixed	R8182D
	Low limit-circulator	100-200 F	5-20 F, adj.	
R8182B Obsolete, last mfg. 3/70	High limit	180-240 F	15 F, fixed	R8182E
R8182C Obsolete, last mfg. 11/69	High limit	120-240 F	10 F, fixed	R8182F
	Circulator	100-200 F	10 F, fixed	
R8182D ^b	High limit	130-240 F	10 F, fixed	R8182D
	Low limit-circulator	110-220 F	10-25 F, adj.	
R8182E	High limit	180-240 F	15 F, fixed	R8182E
R8182F	High limit	130-240 F	10 F, fixed	R8182F
	Circulator	110-220 F	10 F, fixed	
R8182H ^b Remote bulb, leadwires	High limit	130-240 F	10 F, fixed	R8182H
	Low limit-circulator	110-220 F	10-25 F, adj.	
R8182J Remote bulb, leadwires	High limit	180-240 F	15 F, fixed	R8182J

^aSee Switch Functions on page 25.

^bAuxiliary Z_C and Z_R terminals may be used to provide zone control through an R845A Switching Relay.

ELECTRICAL RATINGS:

Voltage and Frequency—120V, 60 Hz.

Burner-circulator—4.4 amp full load, 26.4 amp locked rotor at 120V ac.

Ignition (in addition to motor load rating)—360 VA.

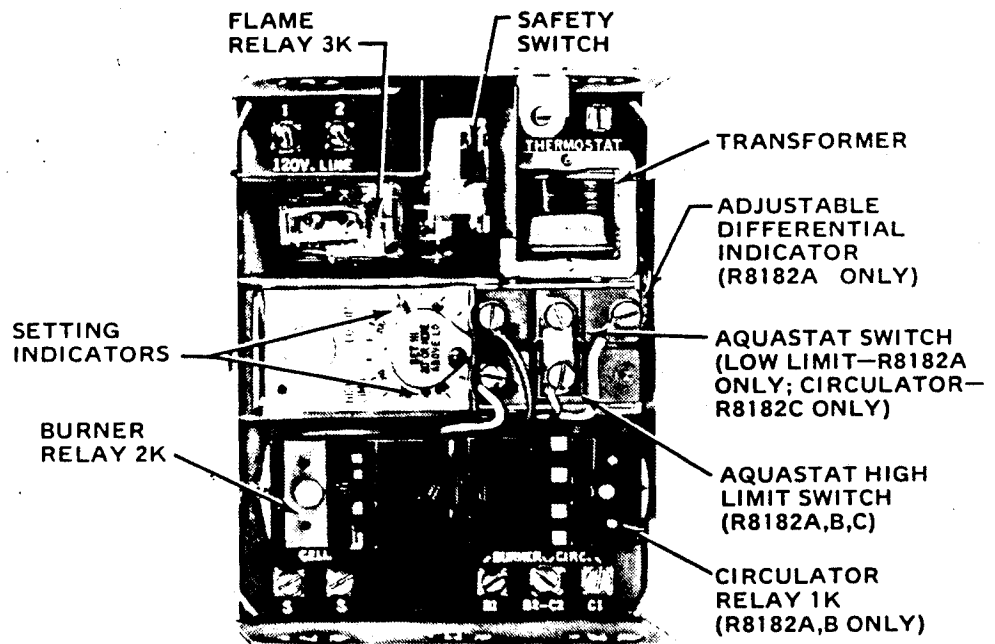
THERMOSTAT ANTICIPATOR: 0.2 amp for R8182, 0.4 amp for each R845A Switching Relay used.

SAFETY SWITCH TIMING: R8182A-C—70 sec.; R8182D-F,H,J—45 sec. nominal.

MAXIMUM AMBIENT TEMPERATURE: At element, 250 F; at control, 115 F.

MAXIMUM PRESSURE RATING: 200 psi on immersion well, 100 psi direct immersion.

MODEL	SWITCH FUNCTIONS
R8182A,D,H	High limit switch (spst) opens circuit to burner if temperature rises to set point.
	Low limit-circulator switch (spdt) maintains minimum water temperature for domestic hot water supply and prevents circulator operation if water temperature is low.
R8182B,E,J	High limit switch (spst) opens circuit to burner if temperature rises to set point. Circulator runs as long as thermostat is calling for heat.
R8182C,F	High limit switch (spst) opens circuit to burner if temperature rises to set point.
	Circulator switch (spst) prevents circulator operation if water temperature is below set point—operates independently of thermostat or high limit.



4668

Fig. 11—Cover-off view of R8182A. R8182B,C similar.

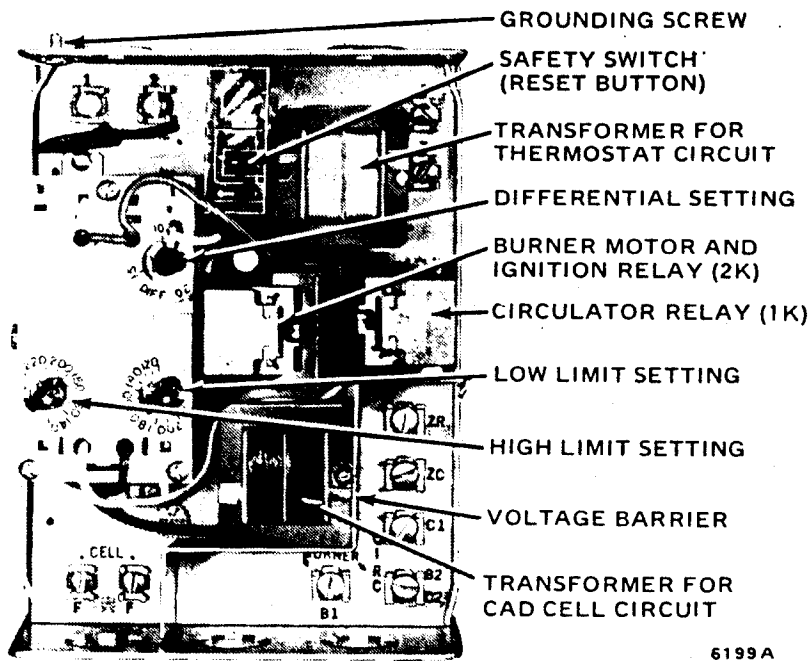


Fig. 12—Cover-off view of R8182D. R8182E,F similar.

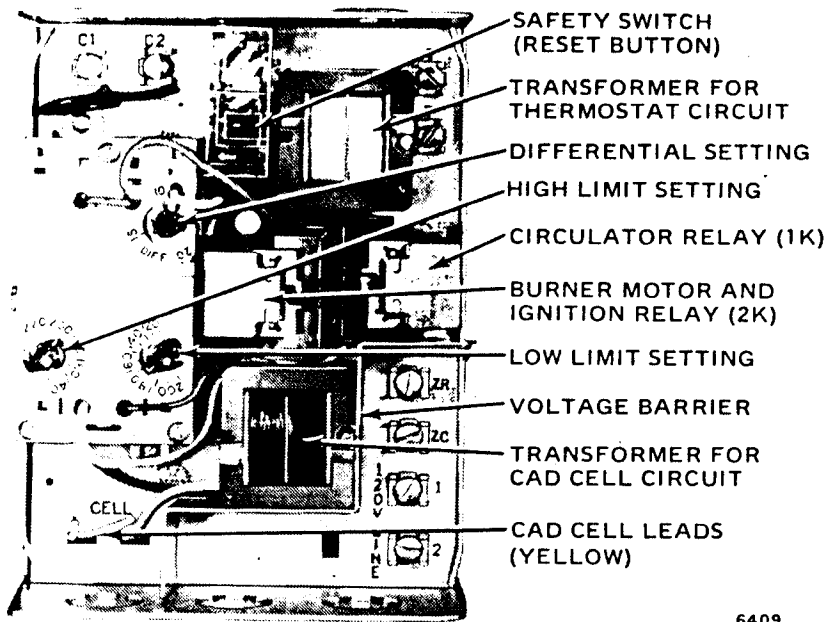
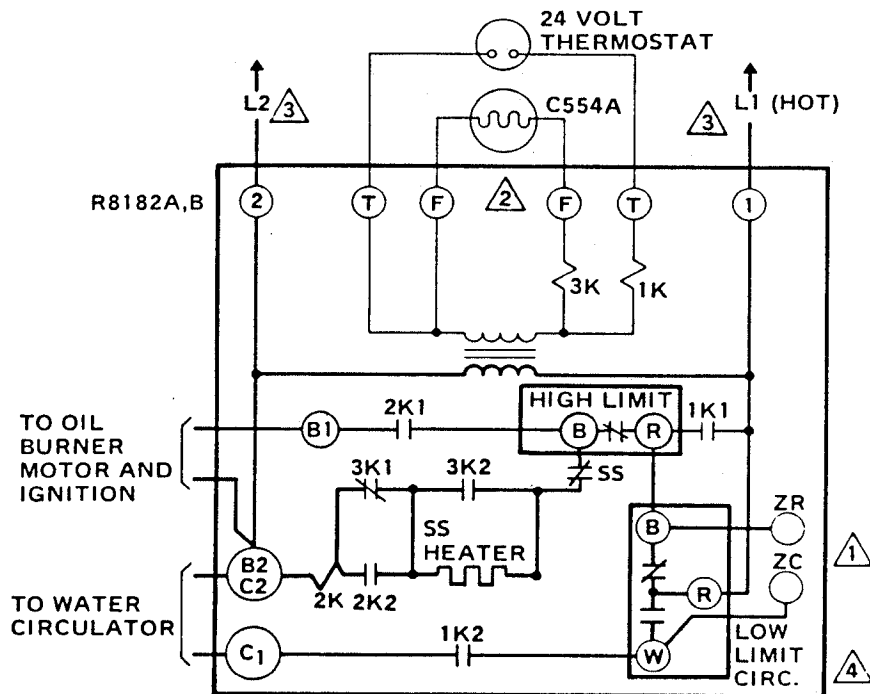


Fig. 13—Cover-off view of R8182H. R8182J similar.

TYPICAL HOOKUPS

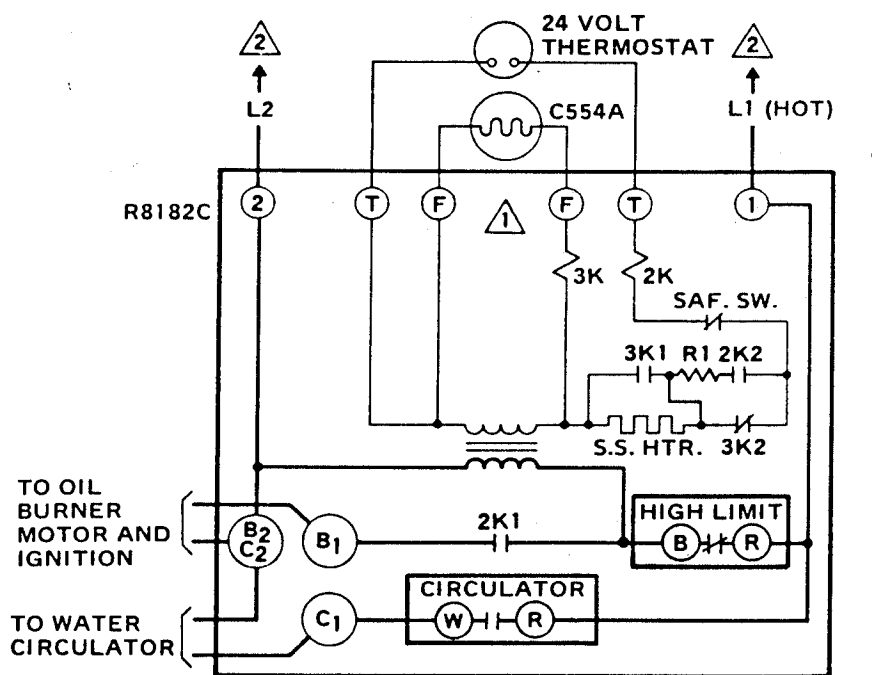
R8182A,B



- 1 R8182A ONLY. OLDER R8182A DOES NOT HAVE ZR-ZC TERMINALS.
- 2 F TERMINALS DESIGNATED S ON OLDER MODELS.
- 3 POWER SUPPLY. PROVIDE DISCONNECT MEANS AND OVERLOAD PROTECTION AS REQUIRED.
- 4 LOW LIMIT-CIRCULATOR ON R8182A ONLY.

4656A

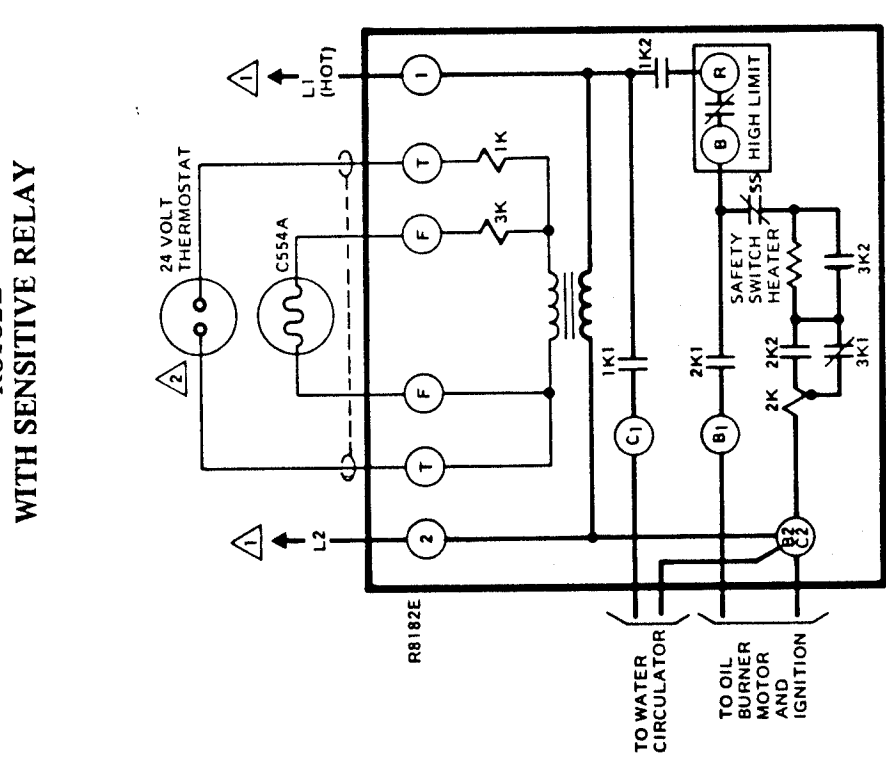
R8182C



- 1 F TERMINALS DESIGNATED S ON OLDER MODELS.
- 2 POWER SUPPLY. PROVIDE DISCONNECT MEANS AND OVERLOAD PROTECTION AS REQUIRED.

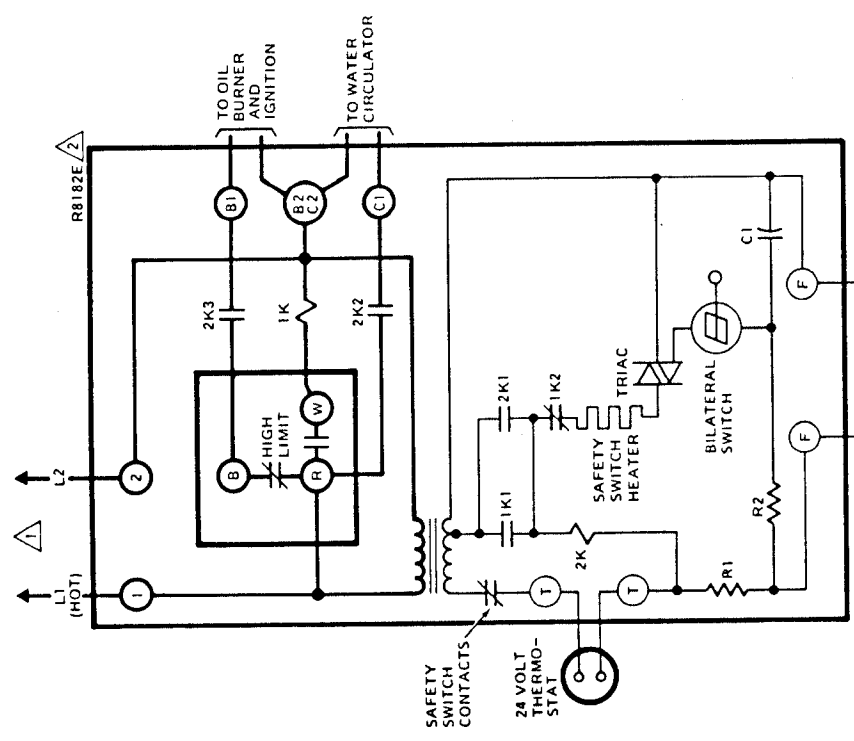
4657

R8182E WITH SENSITIVE RELAY



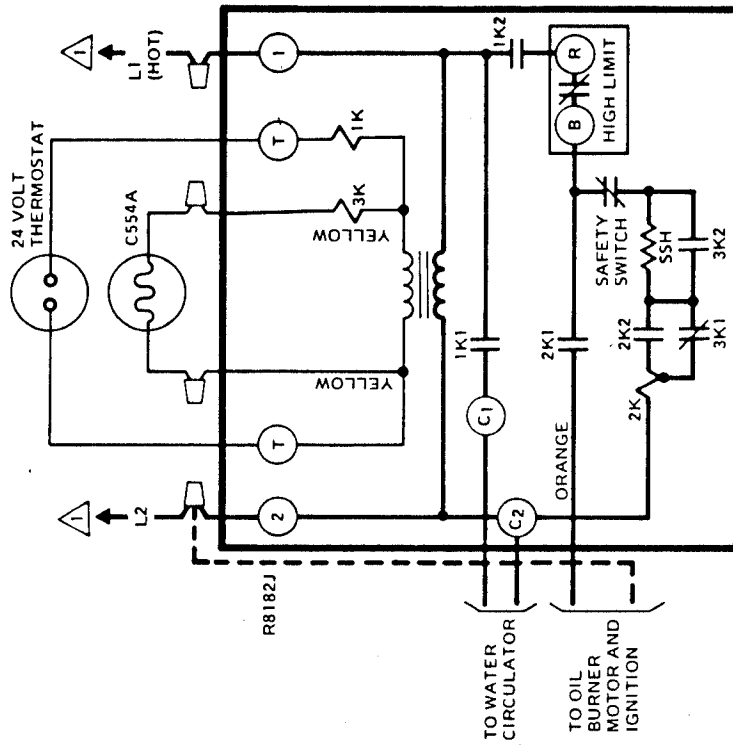
- LINE VOLTAGE
- - - LOW VOLTAGE
- 1 POWER SUPPLY, 120 VOLTS AC. PROVIDE DISCONNECT MEANS AND OVERLOAD PROTECTION AS REQUIRED.
- 2 CONTROL WIRES CAN BE RUN WITH LINE VOLTAGE WIRES IN CONDUIT BUT THEN MUST HAVE NEC CLASS 1 INSULATION.

R8182E WITH SOLID STATE FLAME SENSING



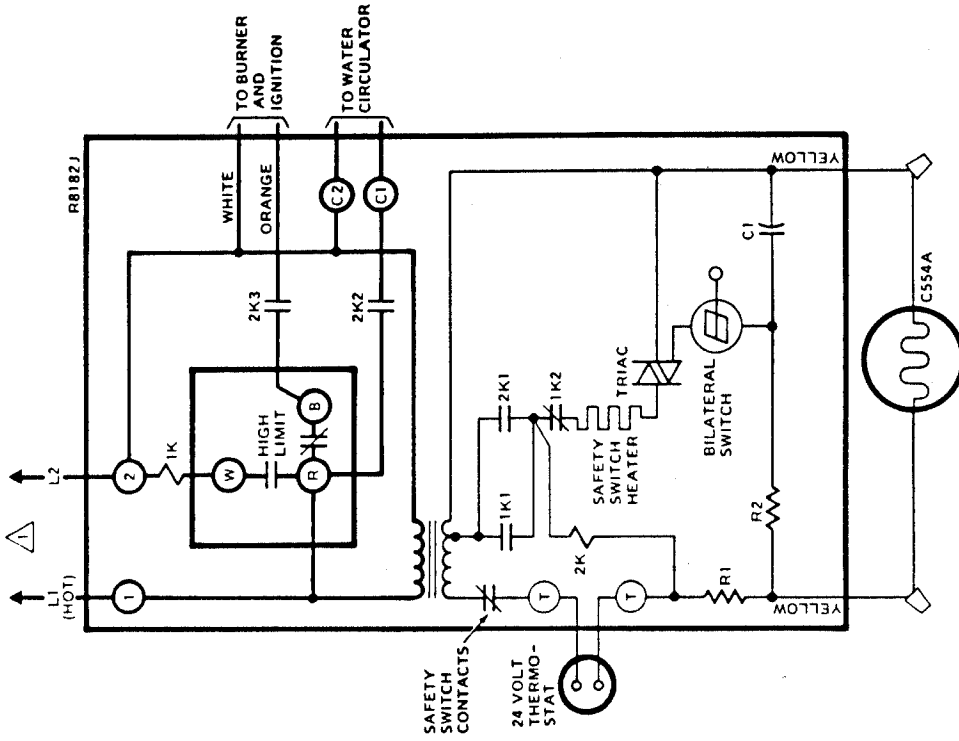
- LINE VOLTAGE
- - - LOW VOLTAGE
- 1 120V AC POWER SUPPLY. PROVIDE DISCONNECT MEANS AND OVERLOAD PROTECTION AS REQUIRED.
- 2 CONTROL CASE MUST BE CONNECTED TO EARTH GROUND USE GREEN GROUNDING SCREW PROVIDED

**R8182J
WITH SENSITIVE RELAY**



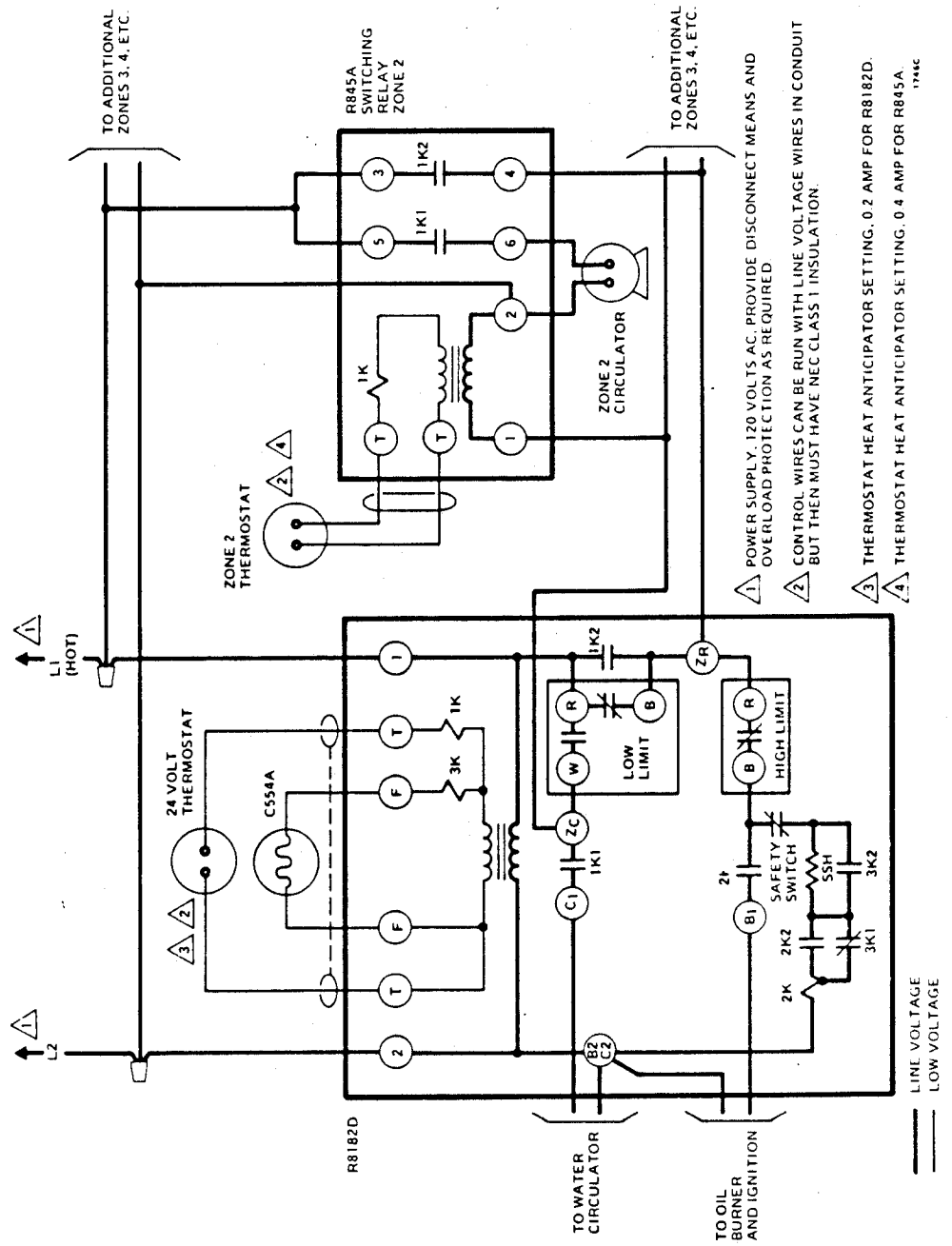
— LINE VOLTAGE
 — LOW VOLTAGE
 ⚠ POWER SUPPLY, 120 VOLTS AC. PROVIDE DISCONNECT MEANS AND OVERLOAD PROTECTION AS REQUIRED. 1-741A

R8182J WITH SOLID STATE FLAME SENSING

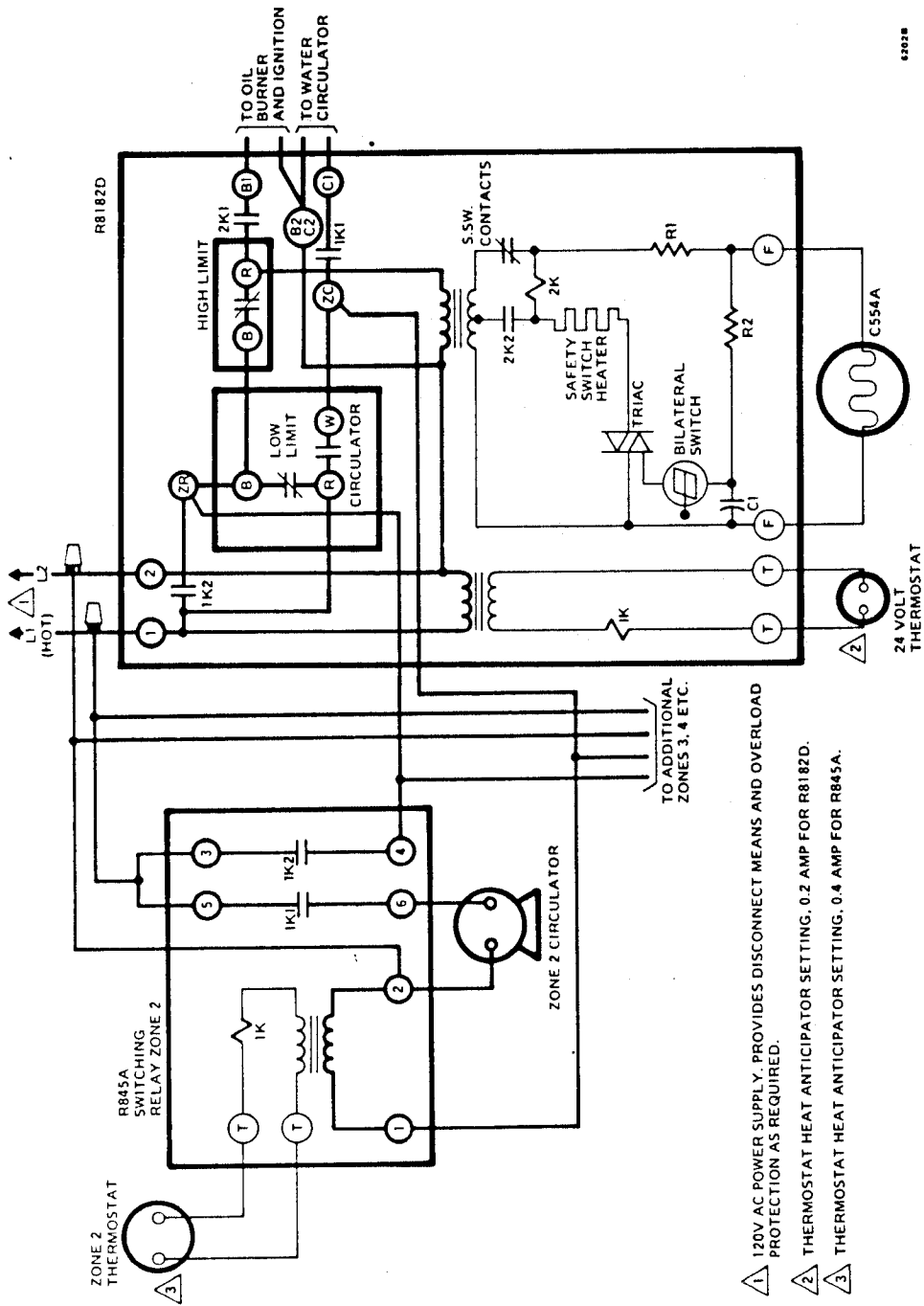


⚠ 120V AC POWER SUPPLY. PROVIDE DISCONNECT MEANS AND OVERLOAD PROTECTION AS REQUIRED. 4410A

R8182D WITH SENSITIVE RELAY AND R845A CONNECTIONS FOR MULTIPLE CIRCULATOR ZONING



NEW R8182D WITH SOLID STATE FLAME SENSING AND R845A CONNECTIONS FOR MULTIPLE CIRCULATOR ZONING



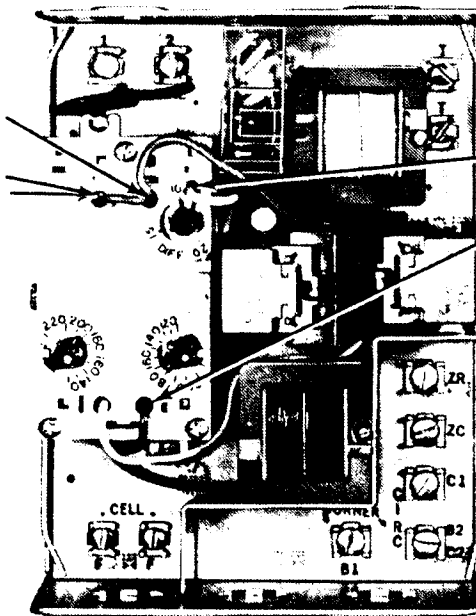
- 1 120V AC POWER SUPPLY. PROVIDES DISCONNECT MEANS AND OVERLOAD PROTECTION AS REQUIRED.
- 2 THERMOSTAT HEAT ANTICIPATOR SETTING. 0.2 AMP FOR R8182D.
- 3 THERMOSTAT HEAT ANTICIPATOR SETTING. 0.4 AMP FOR R845A.

82028

NOTE: The R8182D can be modified to replace the R8182B,C,E,F or the White Rodgers 6C92 as follows—

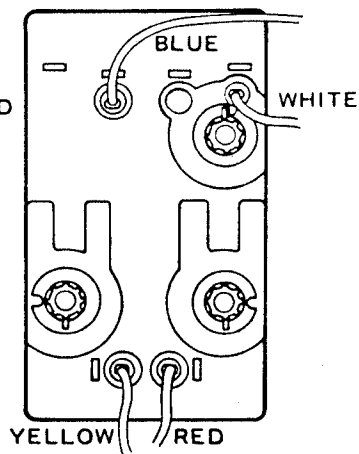
- To replace the R8182B,E or White Rodgers 6C92 remove the red and white leads from the push-in terminals and connect them with a wire nut.
- To replace the R8182C,F connect the circulator to ZC and C2 and remove and tape the lead indicated.

TO REPLACE R8182C,F REMOVE BLUE WIRE FROM THIS TERMINAL AND CUT IT AT POINT WHERE BARE WIRE IS DOUBLED OVER. THEN REMOVE REMAINING LENGTH OF BLUE WIRE FROM THIS TERMINAL. INSERT LONG BLUE WIRE AT TERMINAL WHERE SMALL BLUE WIRE WAS REMOVED. CONNECT CIRC. TO ZC AND C2.

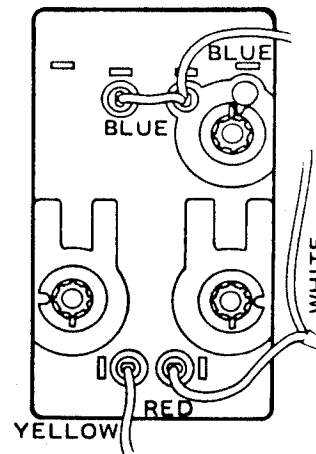


TO REPLACE R8182B,E AND WHITE RODGERS 6C92. REMOVE THESE LEADS (WHITE AND RED) FROM TERMINALS AND CONNECT WITH SOLDERLESS CONNECTOR

COMPLETED WIRING TO REPLACE R8182C,F



COMPLETED WIRING TO REPLACE R8182B,E, AND WHITE RODGERS 6C92



6200A

NORMAL OPERATION

R8182A,D,H

A call for heat by the thermostat pulls in relays 1K and 2K to turn on the burner. Safety switch heater starts to heat. If burner ignites within safety switch timing, cad cell sees flame and safety switch heater is bypassed (or relay 3K pulls in to de-energize safety switch heater on R8182A). Burner operates until call for heat is satisfied. Circulator operates when relay 1K pulls in ONLY if R to W in the Aquastat controller is made.

When low limit contacts (R to B) are made by a drop in water temperature 10 degrees below set point, it acts as a call for heat, pulling in relay 2K to turn on the burner. Circulator cannot operate.

The relay for each zone is connected to the Aquastat controller through terminals Z_C and Z_R . The R845A Relay and thermostat for each zone can energize the zone circulator ONLY if R to W in the Aquastat controller is made. If R to B is made, the zone thermostat energizes the burner.

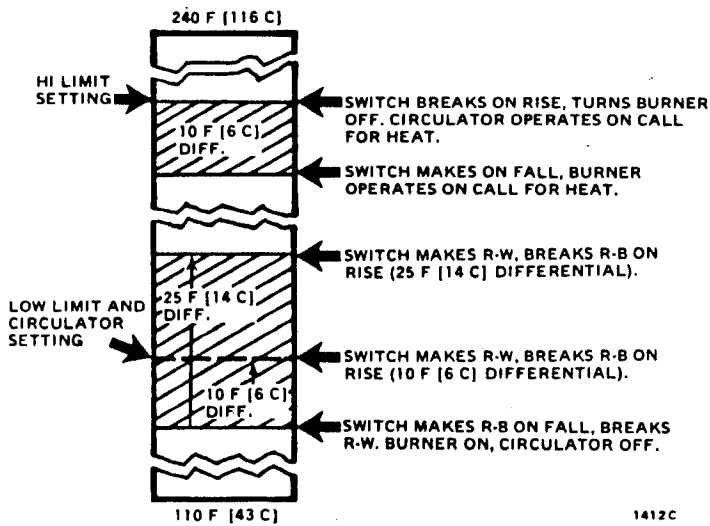


Fig. 14—Aquastat switching for R8182D,H. R8182A similar, but with different control range; see Specifications.

R8182B,E,J

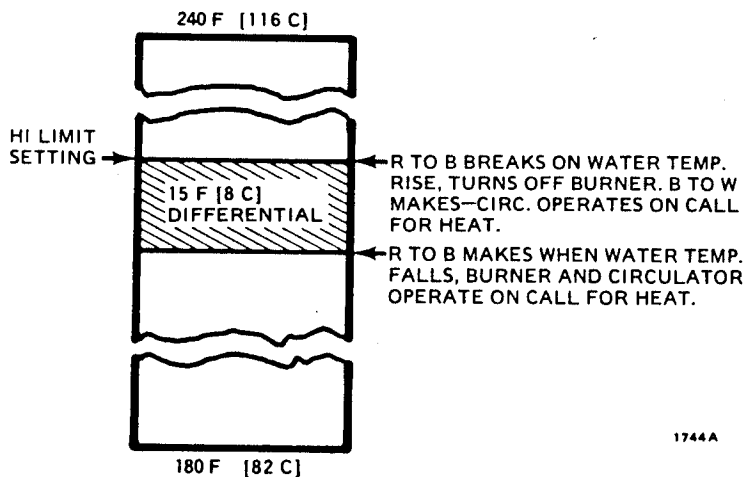


Fig. 15—Aquastat switching for R8182B,E,J.

On a call for heat by the thermostat, the 2K relay (1K and 2K relays on R8182B and on R8182E,J with sensitive relay) pulls in to turn on burner and circulator. When cad cell sees flame, safety switch heater is bypassed. If water temperature reaches high limit setting, burner shuts down; circulator continues to operate as long as thermostat is calling for heat.

R8182C,F

Thermostat call for heat pulls in relay 2K to turn on burner. When cad cell sees flame, safety switch heater is bypassed. The circulator, which is independent of thermostat circuit, is controlled only by Aquastat switch.

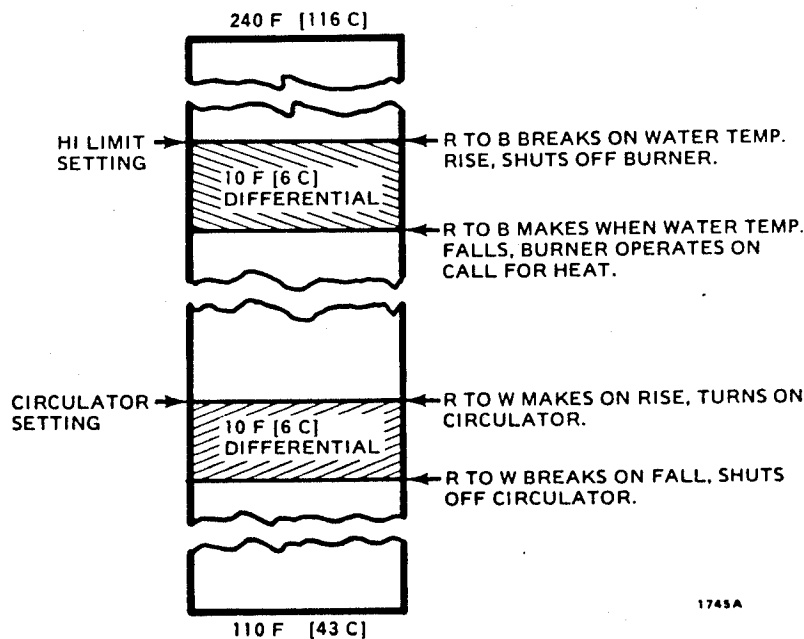


Fig. 16—Aquastat switching for R8182F. R8182C similar, but with different control range; see Specifications.

SERVICE NOTES

1. On the R8182A,D,H the high limit and low limit settings must be at least 20 degrees apart to assure proper operation.

2. *Aquastat replacement*—The R8182 controls provide for field replacement of the Aquastat switching assembly. When ordering a replacement Aquastat, specify the model number of the R8182. See R8182 specification sheet or TRADELINE Catalog for Aquastat assembly part numbers.

To remove a malfunctioning Aquastat assembly from an R8182 control:

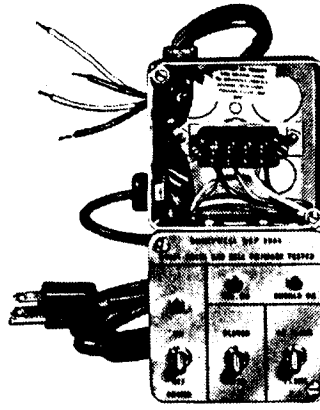
1. Disconnect power to R8182.
2. On models with a center mounted capillary, straighten the 4 hold-down tabs at the corners of the control and remove the control panel assembly. (This is necessary to have enough room to remove the sensing element.)
3. ON ALL MODELS, note the position of the connecting wires.
4. Remove the wires.
5. Remove the 2 Aquastat fastening screws.
6. Remove the Aquastat control and its capillary tube.
7. Install replacement control, inserting the capillary with care, before connecting to R8182 control panel and wiring.

DSP1544 CAD CELL PRIMARY TESTER

APPLICATION

This convenient, easy-to-use tester simplifies troubleshooting of R8184 and R8185 Primary Controls.

To use the tester, simply remove the primary from the burner system, connect it to the tester, and plug the tester into any convenient 120V outlet. Then operate the tester switches according to the instructions provided, to quickly determine whether the trouble is in the primary control.



DSP1544

SPECIFICATIONS

POWER SUPPLY: 120V ac, 60 Hz.

USE WITH: R8184, R8185 Primary Controls. Cannot be used to test primaries with solid state load switching.

Operating instructions for the DSP1544 are on page 42.

CHECKING OUT CAD CELL PRIMARIES

The following checks should be performed after installation and at the completion of all service and troubleshooting procedures.

STARTING PROCEDURE

CAUTION

Be sure combustion chamber is free of oil or vapor.

1. Push red reset button and release.
2. Open hand valve on oil supply line.
3. Set thermostat to call for heat.
4. Close line switch; burner will start.
5. Under normal conditions, burner operates until thermostat is satisfied or line switch is opened.

PROTECTORELAY CONTROL CHECKOUT

1. Flame failure—shut off oil supply hand valve while burner is on. Safety switch locks out in switch timing (varies from 15 to 70 sec. depending on model), ignition stops, motor stops, and oil valve closes. Some intermittent ignition models shut down immediately and attempt one restart before safety switch locks out. Safety switch must be reset.

2. Ignition and/or fuel failure—shut off oil supply while burner is off. Run through starting procedure, omitting step 2. Safety switch locks out and must be manually reset.

3. Power failure—turn off power supply while burner is on. When burner goes out, restore power and burner will restart.

NOTE: If you desire to trip the safety switch, run through the starting procedure, omitting step 2. The switch will trip out on safety in safety switch timing. R8184G1138, G1161, and G1179 have manual trip lever. See page 20.

R8182, R4166 AQUASTAT SWITCH CHECKOUT

HIGH LIMIT SWITCH

1. Close the line switch and set thermostat to call for heat.

2. Set high limit switch at lowest setting.

3. When water temperature reaches this setting, burner will stop.

NOTE: In a hydronic heating system, circulator will continue operation as long as thermostat is calling for heat if water temperature is above low limit switch setting.

LOW LIMIT AND CIRCULATOR SWITCH

1. Set low limit switch at the highest setting.

2. Burner, but not circulator, will start if water temperature is at least 10 F below set point.

3. Return low limit switch to lowest setting. Burner will stop.

4. Set thermostat to call for heat. Burner and circulator will come on.

5. With burner and circulator operating, raise low limit setting; circulator will stop. Lower setting; circulator will resume operation.

Return all switches to normal setting before leaving job.

TROUBLESHOOTING CAD CELL PRIMARIES

For complete troubleshooting of an oil burner installation both the burner and ignition systems, as well as the primary control, must be checked for proper operation and/or condition.

First check out the following parts of the burner and ignition systems:

1. Main power supply and burner motor fuse.

2. Ignition transformer.

3. Oil filter.

4. Electrode gap and position.

5. Contacts between ignition transformer and electrode.

6. Oil pump pressure.

7. Oil piping to tank.

8. Oil nozzle.

9. Oil supply.

If the trouble does not seem to be in the burner and/or ignition systems, check the cad cell and primary control as follows.

EQUIPMENT REQUIRED

1. Screwdriver
2. 0-150V ac Voltmeter
3. 1500 Ohm Resistor
4. Insulated Jumper Wires
5. Ohmmeter

CAUTION

Since checking must be done with live circuits, the troubleshooter must observe all the necessary precautions to avoid danger of electrical shock or equipment damage.

BURNER DOES NOT START WHEN THERMOSTAT CALLS FOR HEAT

PRELIMINARY CHECKS:

1. Make sure limit switches are closed and that contacts are clean.
2. Check for line voltage power at primary. With thermostat calling for heat, voltage between burner terminals 1 and 2 (or black and white leadwires) on primary should be 120V.

PROCEED AS FOLLOWS AFTER COMPLETING PRELIMINARY CHECKS:

NOTE: To troubleshoot R8184, R8185 using DSP1544, see page 42.

PROCEDURE	CORRECTIVE ACTION	
	BURNER STARTS	BURNER DOESN'T START
1. Jumper thermostat terminals— Low volt stat—at primary; Line volt stat—at thermostat.	1. Trouble is in thermostat circuit. Check stat and wiring connections.	1. Trouble is in cad cell or primary. Go to step 2.
2. Disconnect 1 cad cell lead.	2. Cad cell is seeing external light or is defective, or cad cell connections are shorted. Go to step 3.	2. Disconnect line switch; check all wiring connections. Tighten any loose connections and retest. If burner still doesn't start, replace primary.
3. Stop burner and reconnect cad cell. Make sure F-F is not shorted, shield cad cell from external light, and jumper T-T terminals to start burner.	3. Eliminate external light source or permanently shield cad cell.	3. Replace cad cell.

BURNER STARTS, THEN LOCKS OUT ON SAFETY

PROCEDURE	CORRECTIVE ACTION	
	BURNER LOCKS OUT	BURNER KEEPS RUNNING
1. Reset safety switch by pushing red safety switch button.	-	-
2. Disconnect cad cell leadwires at primary. If ohmmeter is available, connect cad cell leads to ohmmeter.	-	-
3. Jumper thermostat terminals to start burner— Low volt stat—at primary; Line volt stat—at thermostat.	-	-
4. After flame is established, but before safety switch locks out, jumper F-F terminals. Use 1500 ohm resistor or jumper wire if ohmmeter is not available.	4. Primary control is defective—replace. (If there is any doubt F-F terminals were jumpered within safety switch timing, wait 5 minutes, then repeat steps 1-4.)	4. Check cad cell using procedure A or B below.

A. PROCEDURE WHEN OHMMETER IS NOT USED

5a. Open line switch, remove 1500 ohm resistor and reconnect cad cell leads to F-F terminals.	-	-
6a. Unplug cell and clean face with soft cloth. Check sighting for clear view of flame. Replace cell in socket.	-	-
7a. Close line switch, reset safety switch, and jumper T-T terminals to start burner.	7a. Replace cad cell, go to step 8a.	7a. Cad cell is OK.
8a. Reset safety switch and restart burner.	8a. Check detector view of flame, flame shape, and oil nozzle. If flame is normal and detector has good view of flame, check for open circuits in socket assembly wiring. Replace assembly if necessary. With delayed oil valve, check delay timing (see page 70).	8a. Cad cell and socket assembly are OK.

B. PROCEDURE WHEN OHMMETER IS USED

5b. Take ohmmeter reading with burner running and locate reading in table below. Read across to determine cause and corrective action.

OHMMETER READING	CAUSE	ACTION
0 ohms.	Short circuit.	Check for pinched cad cell leadwires.
Less than 1600 ohms but not 0.	Cad cell and application are operating correctly.	None.
Over 1600 ohms but not infinite.	Dirty or defective cell, improper sighting, or improper air adjustment.	1. Clean cell face and recheck. 2. Check flame sighting. 3. Replace cell and recheck. 4. Adjust air band to get good reading.
Infinite resistance.	Open circuit.	Check for improper wiring, loose cell in holder, or defective cell.

TROUBLESHOOTING R8184, R8185 USING DSP1544 CAD CELL PRIMARY TESTER

NOTE: The DSP1544 cannot be used with units having solid state load switching.

CONNECT PRIMARY CONTROL TO TESTER

1. Connect primary leads color-to-color to tester line voltage terminals.

2. Slip mounting slots on primary base onto screws on top junction box on tester; tighten screws firmly.

3. Connect tester low voltage leads to low voltage primary terminals—black leads to T-T terminals and yellow leads to F-F terminals.

4. Make sure the tester switches are in the following positions: Power—OFF, T-T—OPEN, F-F—FLAME.

5. Plug the tester into 120V ac power.

TEST PRIMARY OPERATION

NOTE: Ignition light is used only when testing intermittent ignition controls.

PROCEDURE	BURNER AND/OR IGNITION LIGHTS	
	ON	OFF
1. Reset red safety switch button.	—	—
2. Place tester power switch in ON position (power light comes on).	—	—
3. Place T-T switch in CLOSED position.	3. Primary is defective; replace.	3. Go to step 4.
4. Place F-F switch in NO FLAME position.	4. Lights come on immediately—return F-F switch to FLAME within 5 sec. and go to step 5.	4. Primary is defective; replace.
5. With flame (F-F) switch in “FLAME” position wait 80 sec. to see if burner light stays on. <u>Intermittent Ignition Models</u> —ignition light off in about 75 sec. ^b	5. Burner light only stays on—go to step 6. <u>Intermittent Ignition Models</u> —If ignition light stays on, or burner light goes off, primary is defective; replace.	5. Burner light goes off—primary is defective; replace. <u>Intermittent Ignition Models</u> —ignition light only off, go to step 6.
6. Place T-T switch in OPEN position.	6. Primary is defective; replace.	6. Lights will go out almost immediately—go to step 7.
7. Place F-F switch in NO FLAME position. (On R8185E, wait 3 min. before going to step 8.)	—	—
8. Place T-T switch in CLOSED position; wait 60 sec.	8. Primary is defective; replace.	8. <u>Constant Ignition Models</u> —burner light goes off after safety switch timing ^a ; primary is OK. <u>Intermittent Ignition Models</u> —burner and ignition lights go off after safety switch timing ^a ; primary is OK.

^aSafety switch timing varies with model.

^bImmediately on R8185D.

STACK DETECTOR OIL PRIMARY CONTROLS

These are heat-actuated controls which use stack temperature to indicate presence or absence of flame. A bimetal element inserted into the stack actuates a pushrod on temperature rise to break the safety switch circuit. At the same time, an alternate circuit is established to allow continued burner operation. Some models provide ignition cutoff. The flame detector and primary control may be mounted separately (2-piece control), or they may be combined into one unit (combination control).

PYROSTAT FLAME DETECTORS

The components of a typical Pyrostat flame detector are shown in Fig. 17. All Pyrostat detectors are similar, although some models have only one set of contacts instead of the two sets illustrated.

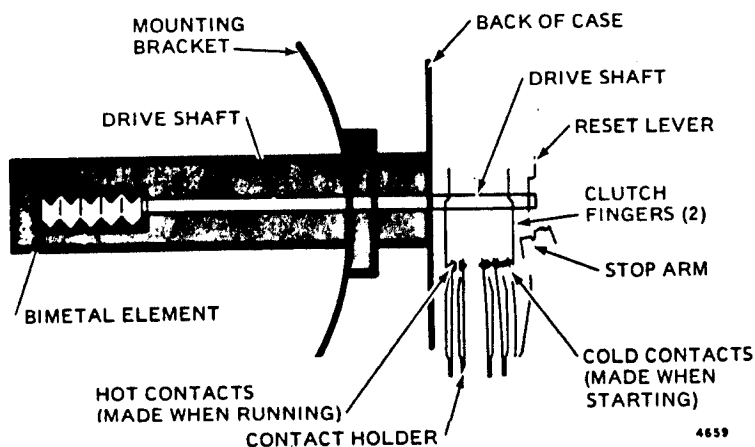


Fig. 17—Components of a typical Pyrostat flame detector.

Refer to Fig. 17 when reading the following operation summary.

PYROSTAT DETECTOR OPERATION

As stack temperature increases, a "W"-shaped or helical bimetal sensor in the detector straightens. As it straightens, it moves the drive shaft outward. The clutch fingers on the drive shaft first close the "hot" contacts and then open the "cold" contacts as the drive shaft continues to move. (On models with one set of contacts, the contacts open as the drive shaft moves outward.) When the outer clutch finger strikes the stop arm, clutch finger movement stops. The drive shaft moves a bit further to provide proper contact sequencing.

PYROSTAT DETECTOR LOCATION

The detector must be located where the element will be exposed to rapid temperature changes. Usually the detector is located on the stack (see Fig. 3) or on the front of the unit above the combustion chamber. Temperature at the selected location must be high enough to move the drive shaft slightly beyond the stop arm, but must be less than 1000 F. Other requirements are that the detector must be mounted ahead of any draft regulator and, if installed in an elbow, in the outside curve of the elbow.

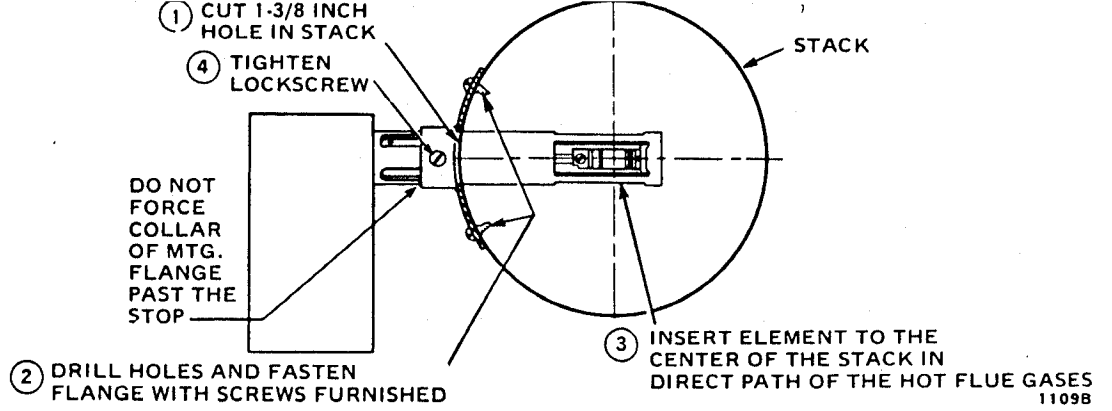


Fig. 18—Pyrostat detector location and mounting. NOTE: Ventilation slots in C550 element tube should not be covered.

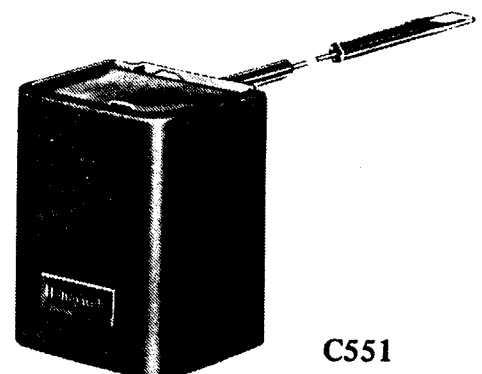
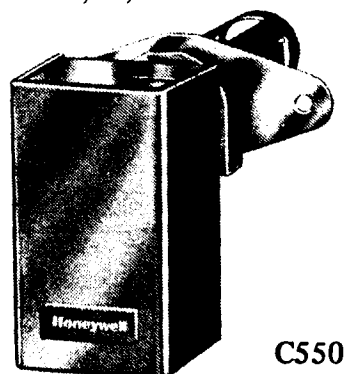
PYROSTAT PRIMARY CONTROL

The primary control sequences the burner and supervises burner operation. When the thermostat calls for heat, the burner motor and ignition are started and the oil valve is opened through relays in the primary control. The safety switch heater in the primary starts to heat. If burner is operating normally, stack temperature rises, straightening the bimetal in the detector until current through the safety switch heater is cut off. The burner runs until the call for heat ends. If flame is not established, the detector bimetal does not move, the safety switch heater continues to heat until its contacts break, and the burner locks out on safety.

If flame fails during the run cycle, the resultant cooling of the detector bimetal activates the safety circuits in the primary. Depending on model, the primary either shuts down immediately and then attempts one restart, or it attempts to restart immediately. With either type, if flame is not established within safety switch timing, the burner locks out on safety.

Regardless of the reason for lockout, a tripped safety switch must be manually reset before the primary control will attempt to start the burner again.

TWO-PIECE STACK DETECTOR PRIMARY CONTROLS C550A,D; C551A PYROSTAT FLAME DETECTORS



APPLICATION

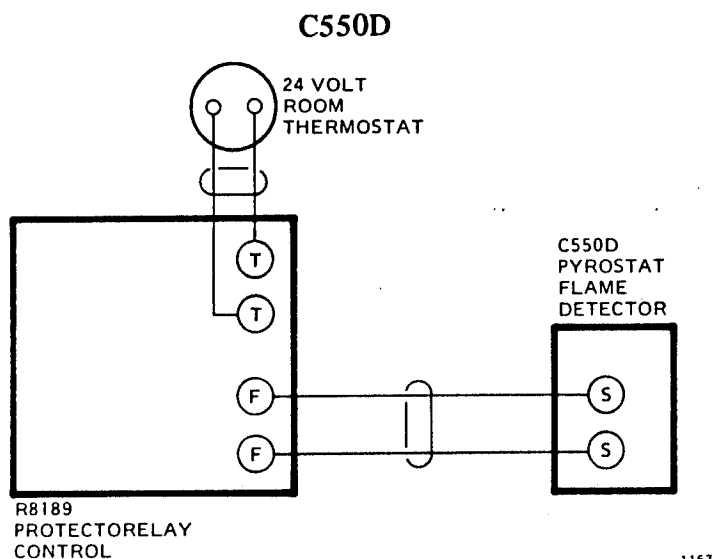
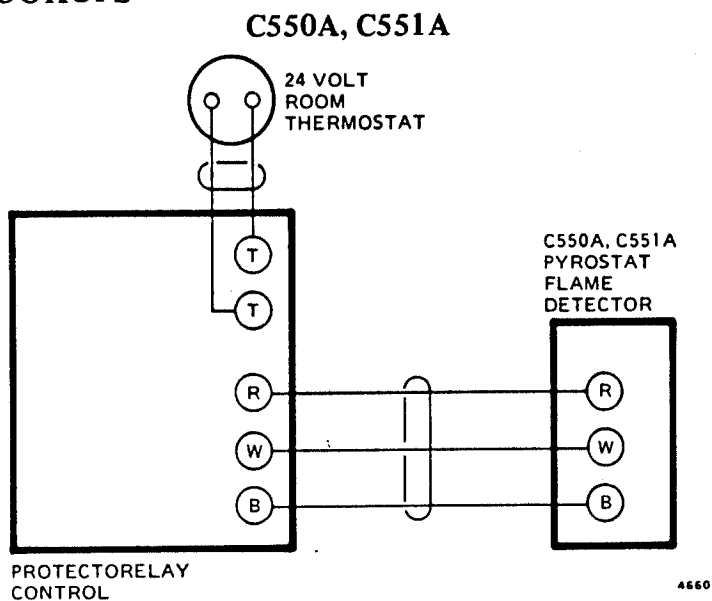
These 24V ac thermally operated flame detectors sense stack or combustion chamber temperature and signal the presence or absence of flame to the primary control.

SPECIFICATIONS

MODEL	USE WITH	SWITCHING	MAXIMUM OPERATING TEMPERATURE	REPLACEMENT
C550A stack mounted	R866, R867, R868, R869, R8142, R8143	3-wire, spdt, contacts may overlap	1000 F	C550A
C550D stack mounted	R8189	2-wire, spst	1000 F	C550D
C551A combustion chamber mounted	R866, R867, R868, R869, R8142, R8143	3-wire, spdt, nonoverlapping contacts	1200 F	C551A

ELECTRICAL RATING: 1.0 amp at 24V ac.

TYPICAL HOOKUPS

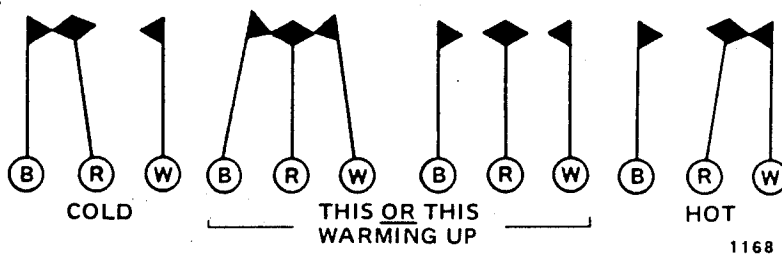


NORMAL OPERATION

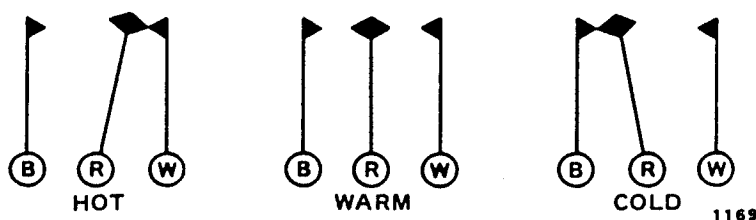
C550A

STARTING POSITION—R-B made.

TEMPERATURE RISE—hot contacts R-W may or may not make before cold contacts R-B open.



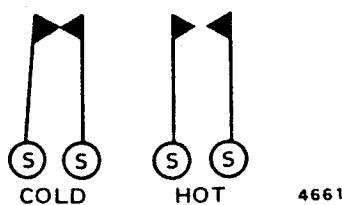
TEMPERATURE FALL—hot contacts R-W break. Cold contacts R-B should not make until the bimetal has cooled somewhat. When R-B remakes, the detector is ready to sequence the primary control on the next call for heat.



C550D

STARTING POSITION—the C550D has only two contacts, S-S, which are normally closed.

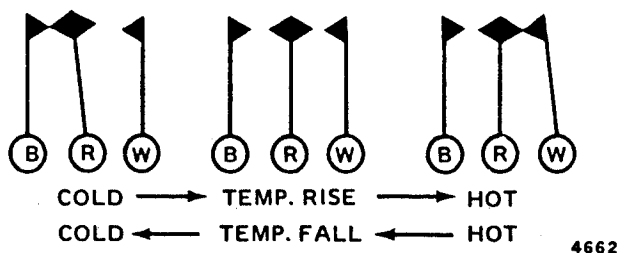
TEMPERATURE RISE—S-S open and remain open through the call for heat.



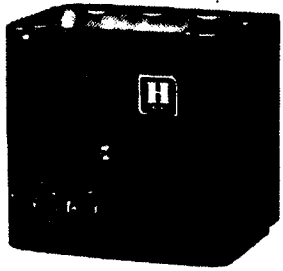
C551A

STARTING POSITION—cold contacts R-B made.

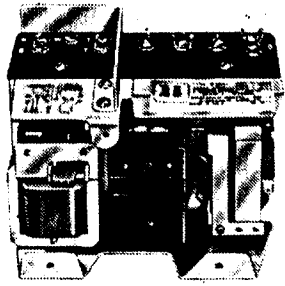
TEMPERATURE RISE OR FALL—contacts should not overlap.



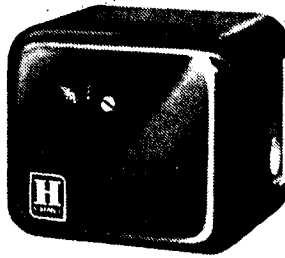
R866, R867, R868, R869, R8142, R8143 PROTECTORELAY PRIMARY CONTROL



R866, R867



R868, R869



R8142, R8143

APPLICATION

These controls provide automatic, recycling control of an oil burner. They are used with the C550A or C551A Flame Detectors.

SPECIFICATIONS

MODEL	IGNITION	SAFETY SWITCH TIMING	IGNITION TIMING	LAST MFG.	REPLACEMENT
R866A	Constant	80 sec.	—	3/64	R8189D and C550D ^c or RA116A ^d
R866B ^a	Constant	80 sec.	—	3/64	R8189D and C550D ^c or RA116A ^d
R867A	Intermittent	80 sec.	70 sec.	12/61	RA117A ^d
R867B ^a	Intermittent	80 sec.	70 sec.	12/61	RA117A ^d
R868A ^a	Constant	90 sec.	—	5/66	R8189D and C550D ^c or RA116A ^d
R868B ^{a,b}	Constant	90 sec.	—	3/64	R8189D and C550D ^c or RA116A ^d
R869A ^a	Intermittent	90 sec.	70 sec.	5/66	RA117A ^d
R8142A	Constant	80 sec.	—	1/68	R8189D and C550D ^c or RA116A ^d
R8142B ^a	Constant	80 sec.	—	7/66	R8189D and C550D ^c or RA116A ^d
R8143A	Intermittent	80 sec.	70 sec.	7/66	RA117A ^d
R8143B ^a	Intermittent	80 sec.	70 sec.	7/66	RA117A ^d

^aWithout base and cover for panel mounting.

^bProvides 2 to 2-1/2 min. postpurge after run cycle.

^cIf R8189D is used, C550A must be replaced by C550D.

^dRA116, RA117 include both primary and sensor.

ELECTRICAL RATINGS:

Burner Motor Load (amperes)–

	120V AC	240V AC
Full Load	7.4	3.7
Locked Rotor	44.4	22.2

Ignition (in addition to motor load rating)–

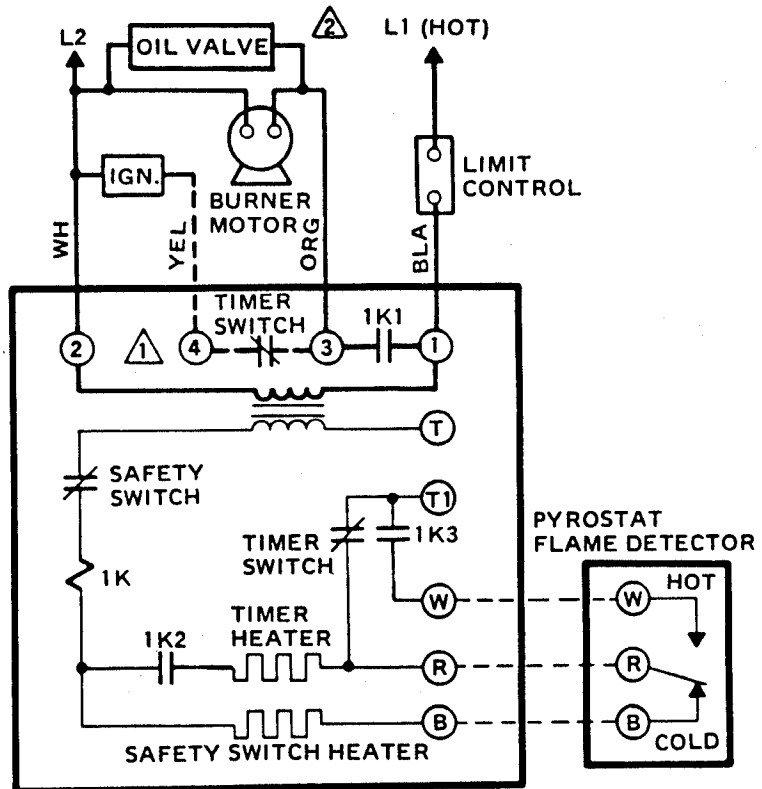
R866, R868, R8142–250 VA.

R867, R869, R8143–500 VA.

RECYCLE TIMING: 2-3 min.

TYPICAL HOOKUPS

R866, R867, R8142, R8143



⚠️ TERMINAL 4 ON R867, R8143 ONLY. ON R866, R8142 CONNECT IGNITION TRANSFORMER TO TERMINAL 3.

⚠️ POWER SUPPLY. PROVIDE DISCONNECT MEANS AND OVERLOAD PROTECTION AS REQUIRED.

4663

COVER-OFF VIEWS

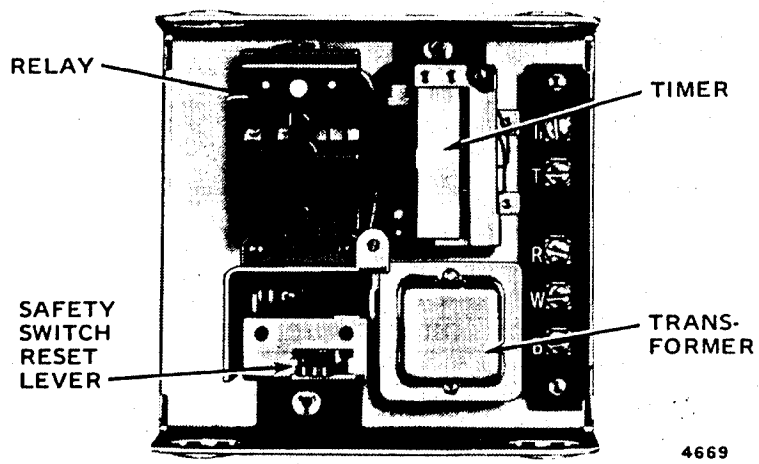


Fig. 19—R867A leadwire model with cover removed. R866A is similar without ignition lead.

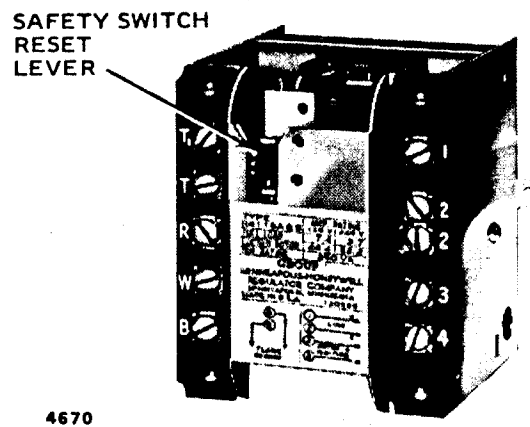


Fig. 20—R8143 with cover removed. R8142 is similar but has no terminal 4.

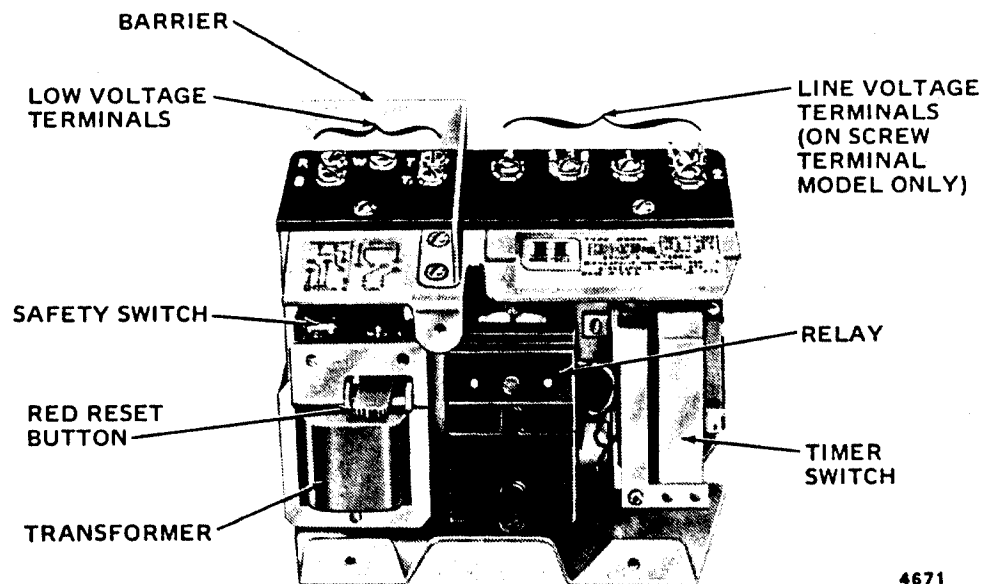


Fig. 21—R869 components. R868 is similar but has 3 line voltage terminals.

NORMAL OPERATION

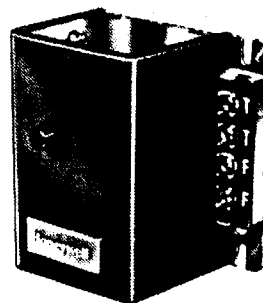
EXTERNAL ACTION	CONTROLLER ACTION
Call for heat	Relay 1K pulls in energizing burner motor, oil valve, and ignition. Safety switch starts to heat.
Detector senses flame	As stack temp. rises, detector makes R-W, then breaks R-B to de-energize the safety switch heater. Thermal timer heats, opening the timer switch (cutting off ignition on R867, R869, R8143).
Heat demand satisfied	Relay 1K drops out to de-energize the oil valve, burner motor, (and ignition on R866, R868, R8142). Flame detector contacts return to starting position, but a restart cannot be made until scavenging period ends with the cooling and closing of the timer contacts.

R8189D PROTECTORELAY PRIMARY CONTROL

APPLICATION

This burner-mounted control is used with the C550D to provide automatic, nonrecycling control of an oil burner system.

R8189



SPECIFICATIONS

ELECTRICAL RATINGS:

Burner Motor Load (amperes)–

	120V AC	240V AC
Full Load	7.4	3.7
Locked Rotor	44.4	22.2

Ignition (in addition to motor load rating)–360 VA.

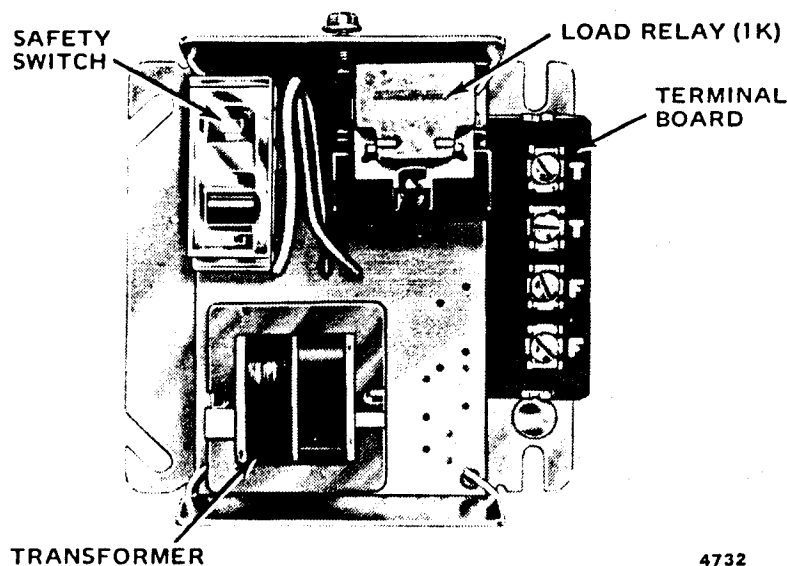


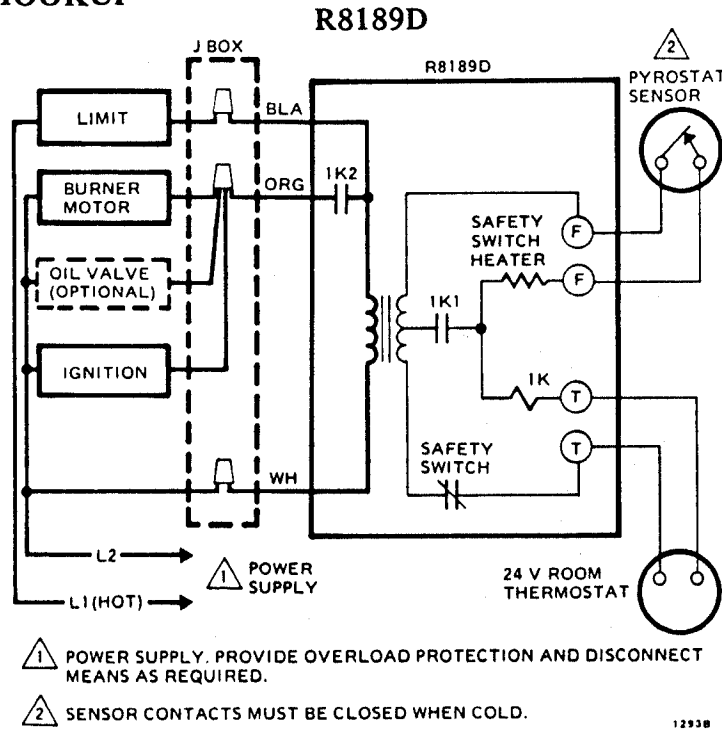
Fig. 22—Cover-off view of R8189D.

THERMOSTAT ANTICIPATOR: 0.2 amp.
 TYPE OF IGNITION: Constant.
 SAFETY SWITCH TIMING: 75 seconds (nominal).
 FLAME DETECTOR REQUIRED: C550D.

CAUTION

The R8189D requires the high contact pressure of the C550D to assure remaking the low voltage circuits if flame fails. DO NOT SUBSTITUTE ANY OTHER DETECTOR.

TYPICAL HOOKUP



NORMAL OPERATION

EXTERNAL ACTION	PROTECTORELAY RESPONSE
Line voltage applied to R8189	Transformer primary energized.
On a call for heat, thermostat contacts close circuit in the transformer secondary	Relay 1K is energized. Heater on safety switch begins warm-up. Contacts 1K1 and 1K2 close. Circuit made through 1K2 actuates burner motor, oil valve, and ignition.
The C550D senses flame within approximately 60 seconds and opens	Circuit through safety switch heater broken; heater begins to cool without having broken the switch contacts (closed when cool). Circuit through 1K is maintained through 1K1.
As heat demand is satisfied, thermostat contacts open	Relay 1K de-energized. Contacts 1K1 and 1K2 open, breaking circuit to heating equipment.

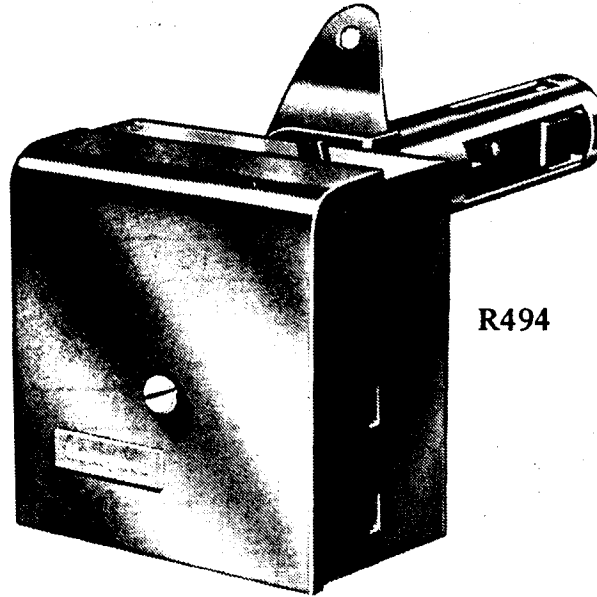
ONE-PIECE STACK DETECTOR PRIMARY CONTROLS

R494A PROTECTORELAY PRIMARY CONTROL

APPLICATION

This line voltage combination flame detector and primary control provides non-recycling, automatic control of an oil burner system.

The R494A is now obsolete. Replace with RA816A, jumpering T-T terminals. (If replacing with RA117A, connect ignition lead to terminal 3, leaving terminal 4 open.)



R494

SPECIFICATIONS

ELECTRICAL RATINGS:

Burner Motor Load (amperes)–

	120V AC	240V AC
Full Load	5.2	2.6
Locked Rotor	31.2	15.6

Ignition (in addition to motor load rating)–250 VA.

TYPE OF IGNITION: Constant.

SAFETY SWITCH TIMING: 80 seconds.

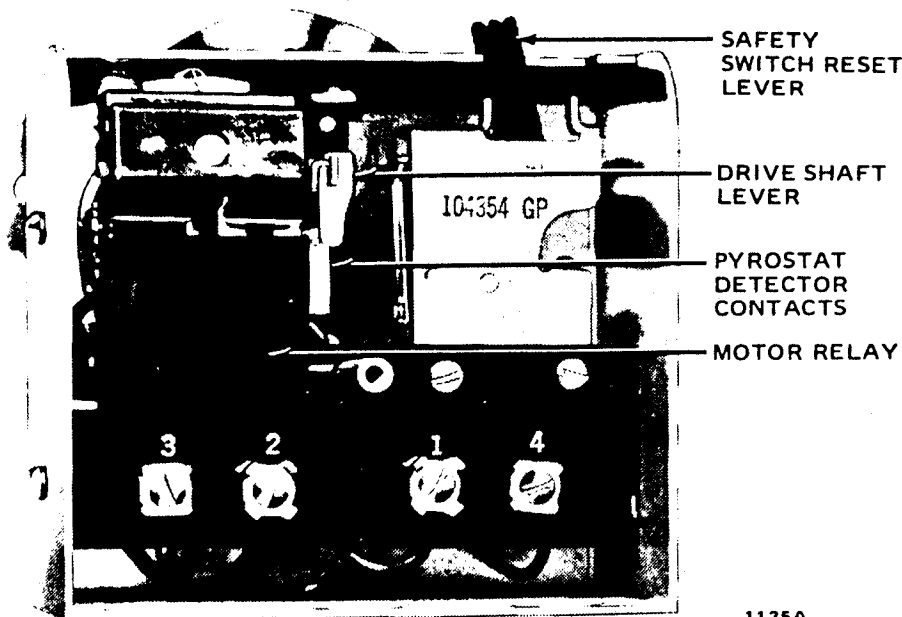
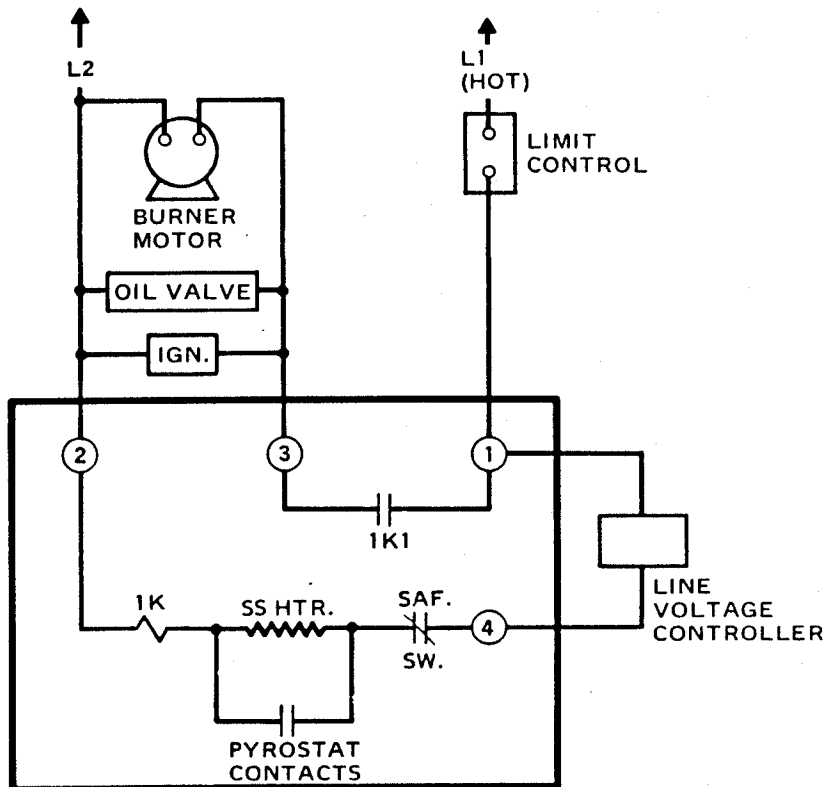


Fig. 23–Cover-off view of R494A.



⚠ POWER SUPPLY. PROVIDE DISCONNECT MEANS AND OVER-LOAD PROTECTION AS REQUIRED.

1134A

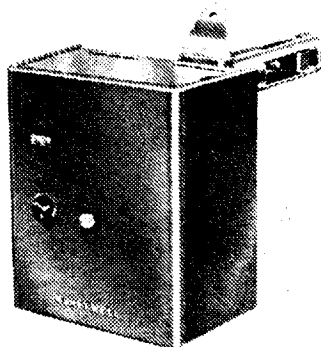
NORMAL OPERATION

EXTERNAL ACTION	CONTROLLER RESPONSE
Thermostat calls for heat	Relay 1K pulls in to energize burner motor, oil valve, and ignition. Safety switch heater starts heating.
Detector senses flame	Rising stack temp. closes detector contacts to bypass safety switch heater.
Call for heat satisfied	Circuit broken between terminal 1 and 4. Relay drops out to de-energize burner motor, oil valve, and ignition.

RA116, RA816, RA117, RA817 PROTECTORELAY PRIMARY CONTROLS

APPLICATION

These stack-mounted combination flame detector and primary controls provide automatic control of an oil burner system. RA117, RA817 are recycling controls. Safety switch may be manually tripped on all models except RA817C.



RA116, RA816
RA117, RA817

SPECIFICATIONS

MODEL	IGNITION	SAFETY SWITCH TIMING	IGNITION TIMING	TYPE OF CONTROLLER
RA116A	Constant	70 sec.	—	2- or 3-wire, 24V
RA816A	Constant	70 sec.	—	2-wire, 24V
RA117A	Intermittent	70 sec.	Ign. stops when cold contacts open	2- or 3-wire, 24V
RA817A	Intermittent	70 sec.		2-wire, 24V
RA817C	Intermittent	70 sec.	Timed, 35 ± 10, or 75 ± 15 sec.	2-wire, 24V

RECYCLE TIMING (RA117, RA817): 2-3 min.

ELECTRICAL RATINGS:

Burner Motor Load (amperes)—

	110V, 50 Hz; 120V, 60 Hz	220V, 50 Hz; 240V, 60 Hz
Full Load	7.4	3.7
Locked Rotor	44.4	22.2

Ignition (in addition to motor load rating)—

RA116A, RA816A: 360 VA.

RA117A, RA817A,C: 550 VA.

THERMOSTAT ANTICIPATOR (24V thermostats only): 0.4 amp.

MAXIMUM AMBIENT TEMPERATURE: 104 F.

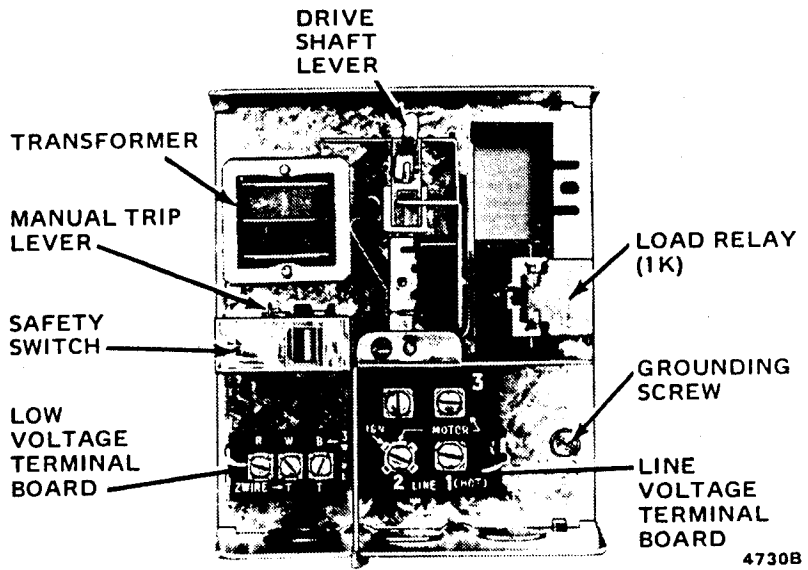


Fig. 24—RA116A with cover removed.

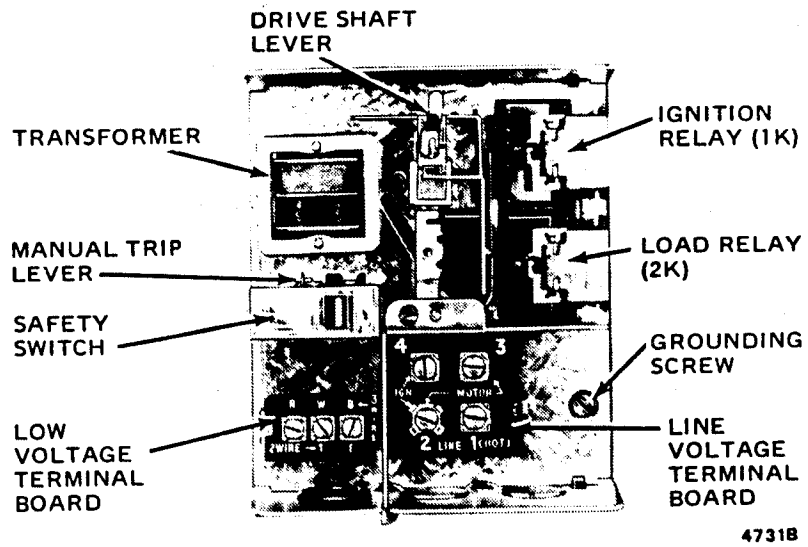
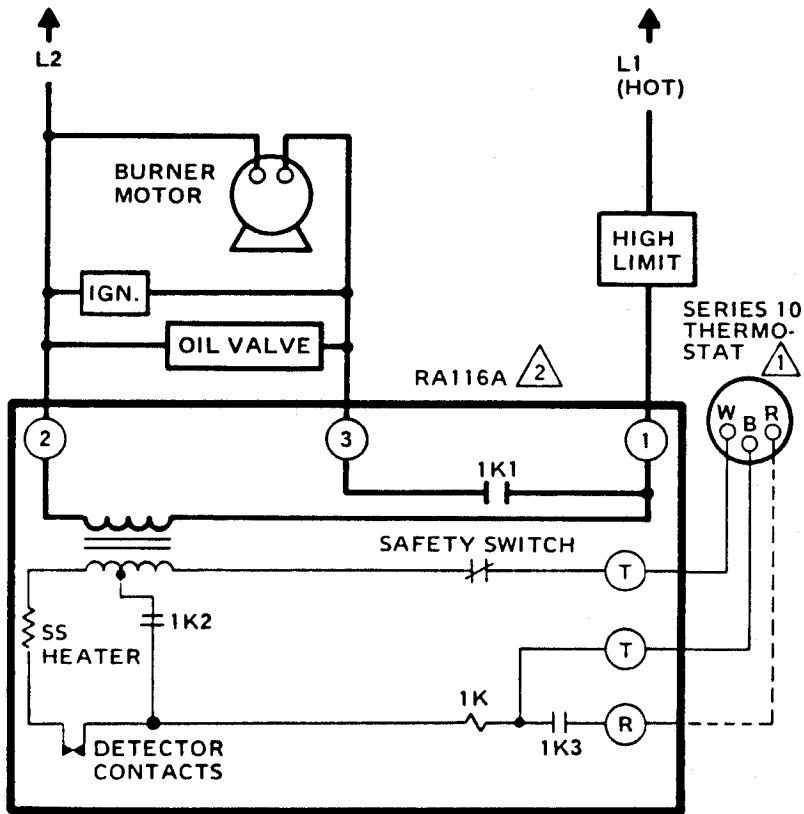


Fig. 25—RA117A with cover removed.

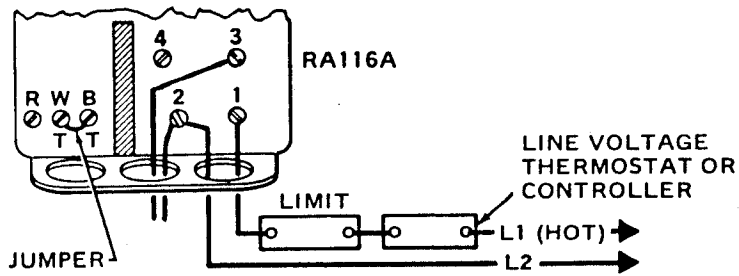
RA116A



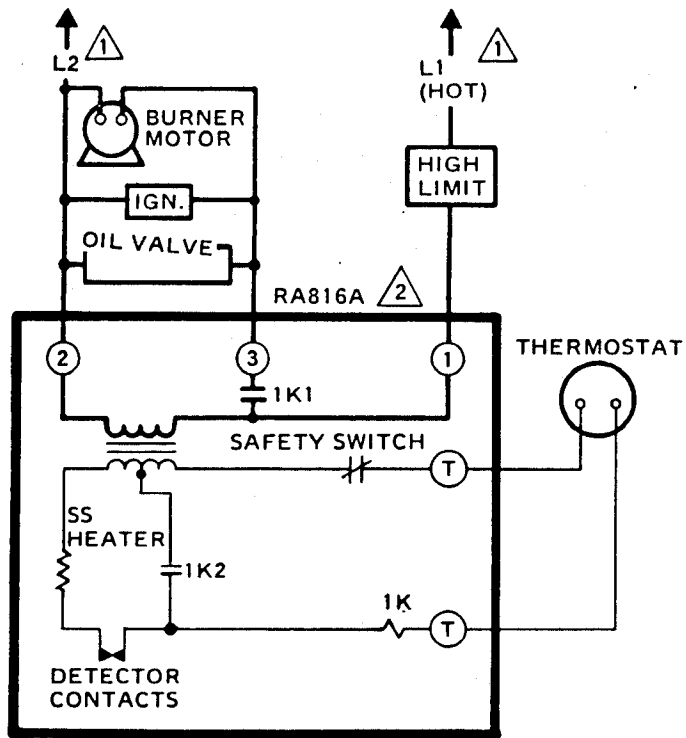
- 1 RA116A MAY BE CONTROLLED BY TWO-WIRE THERMOSTAT. CONNECT TO W AND B ONLY. TAPE LOOSE END OF RED WIRE, IF ANY.
- 2 CONTROL CASE MUST BE CONNECTED TO EARTH GROUND. USE GREEN GROUNDING SCREW PROVIDED.

1110E

RA116A HOOKUP
WHEN USING 120V CONTROLLER



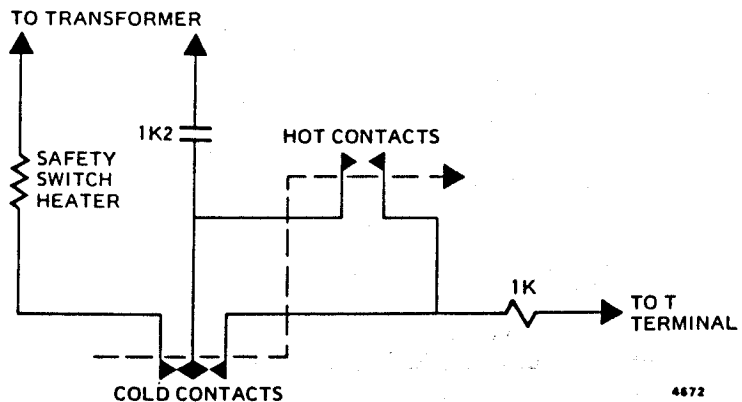
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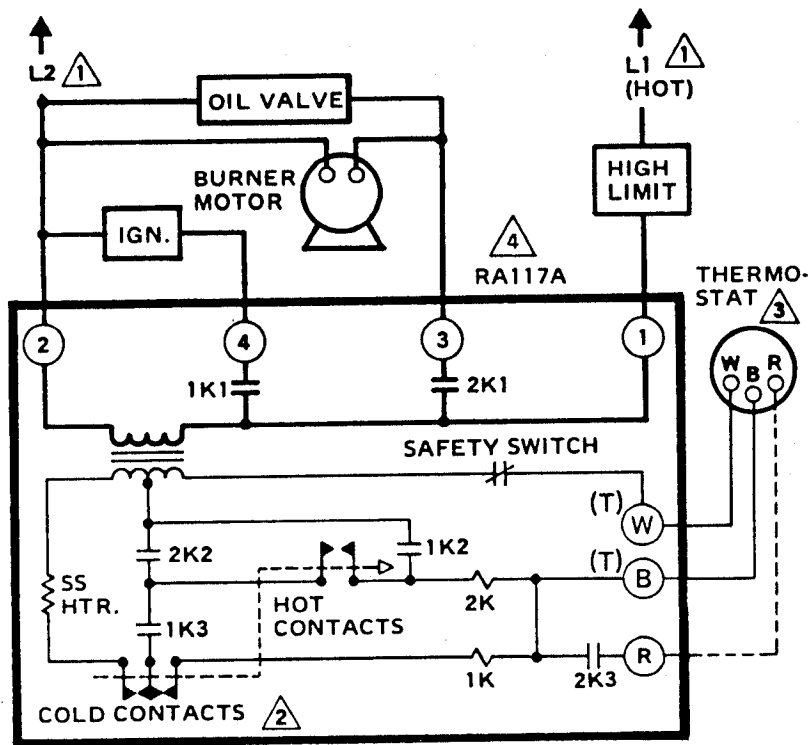
- ⚠ POWER SUPPLY. PROVIDE DISCONNECT MEANS AND OVER-LOAD PROTECTION AS REQUIRED.
- ⚠ CONTROL CASE MUST BE CONNECTED TO EARTH GROUND. USE GREEN GROUNDING SCREW PROVIDED.

1114B

**RA116A, RA816A
DETECTOR CONTACTS ON OLDER MODELS**



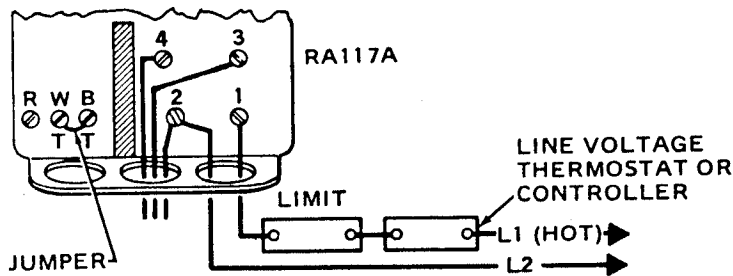
4672



- ① POWER SUPPLY. PROVIDE DISCONNECT MEANS AND OVER-LOAD PROTECTION AS REQUIRED.
- ② CONTACTS BREAK IN SEQUENCE ON RISE IN TEMP.
- ③ MAY BE CONTROLLED BY TWO-WIRE THERMOSTAT. CONNECT TO W AND B ONLY. TAPE LOOSE END OF RED WIRE, IF ANY.
- ④ CONTROL CASE MUST BE CONNECTED TO EARTH GROUND. USE GREEN GROUNDING SCREW PROVIDED.

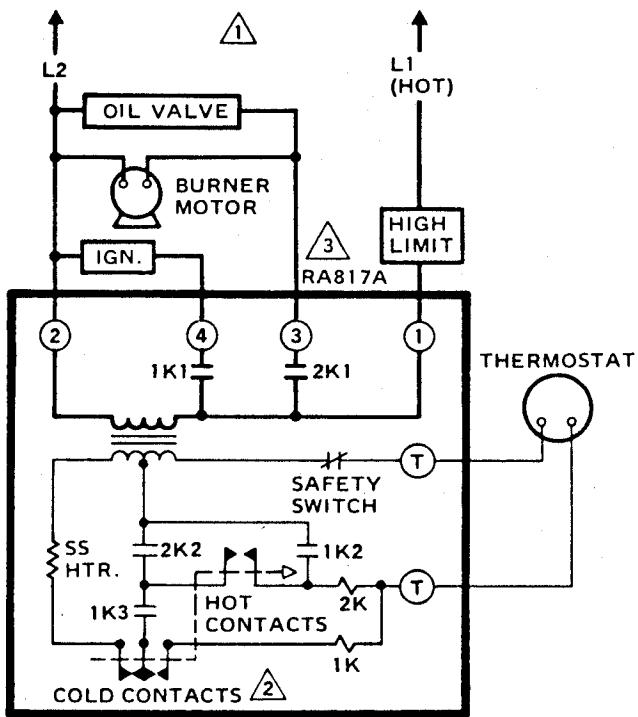
1112B

**RA117A HOOKUP
WHEN USING 120V CONTROLLER**



1113

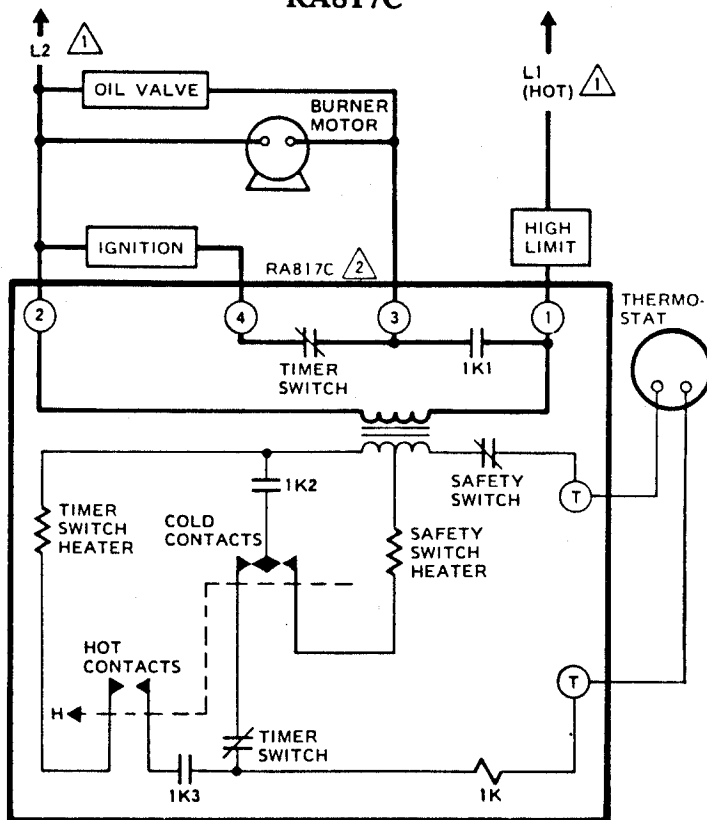
RA817A



- ⚠ 1 POWER SUPPLY. PROVIDE DISCONNECT MEANS AND OVERLOAD PROTECTION AS REQUIRED.
- ⚠ 2 CONTACTS BREAK IN SEQUENCE ON RISE IN TEMP.
- ⚠ 3 CONTROL CASE MUST BE CONNECTED TO EARTH GROUND. USE GREEN GROUNDING SCREW PROVIDED.

1115A

RA817C



- ⚠ 1 POWER SUPPLY. PROVIDE DISCONNECT MEANS AND OVERLOAD PROTECTION AS REQUIRED.
- ⚠ 2 CONTROL CASE MUST BE CONNECTED TO EARTH GROUND. USE GREEN GROUNDING SCREW PROVIDED.

1116A

NORMAL OPERATION

EXTERNAL ACTION	CONTROLLER ACTION
Thermostat calls for heat	Circuit is completed through relays to energize ignition, oil valve, and burner motor. Safety switch begins heating.
Detector senses flame	Rising stack temp. opens detector contacts on RA116, RA816 (closes hot and opens cold contacts on RA117, RA817 and older RA116, RA816) to de-energize safety switch, and stop ignition on RA117, RA817A. RA817C ignition timer heats to stop ignition in 35 or 75 seconds, depending on model.
Call for heat ends	Relays drop out, de-energizing oil valve, burner motor, and ignition (on RA116, RA816). Pyrostat contacts return to starting position. On RA117, RA817 and older RA116, RA816 models, burner won't restart until cold contacts make in about 1 minute.

SERVICE NOTE

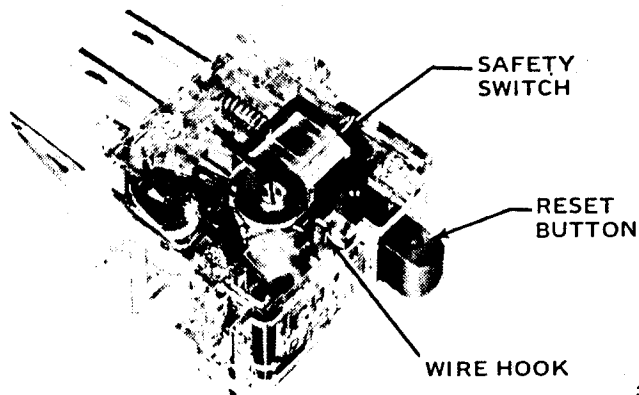
TO MANUALLY TRIP SAFETY SWITCH (all models^a except RA817C):

Move the wire hook to the right until the safety switch reset button pops out. System is locked out.

CAUTION

POWER SUPPLY HAS NOT BEEN DISCONNECTED. ELECTRIC SHOCK IS STILL A POSSIBILITY.

To restart when service is complete, the safety switch must be manually reset (push in).



3770

^aSome older models do not have manual trip feature.

CHECKING OUT STACK DETECTOR PRIMARY CONTROLS

STEPPING PYROSTAT DETECTOR CONTACTS

NOTE: Checkout procedure is the same whether 2-piece or combination control is used.

The detector contacts are actuated by a friction clutch that is mounted on a rod connected directly to the heat-actuated element. Occasionally this clutch gets "out of step" after a long period of idleness. To place the clutch and the contacts "in step," remove the cover, pull the lever outward about 1/4 inch, then slowly release the lever.

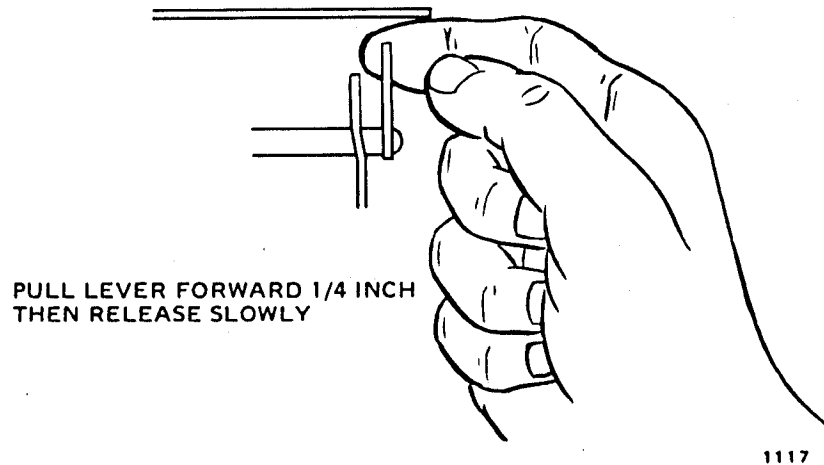
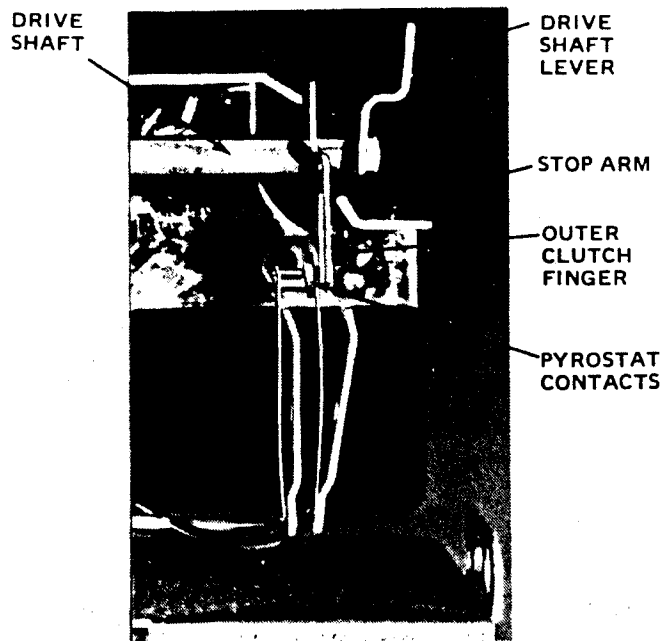


Fig. 26—Stepping Pyrostat detector contacts.

Be careful not to bend the contact arms or stops on the Pyrostat detector when stepping contacts or performing service operations. The figure below shows 2-blade Pyrostat detector contacts in the cold, or starting, position.



1399A

CLEANING PYROSTAT CONTACTS

Insert a piece of smooth, hard-surface cardboard, such as a business card, between each set of contacts. Apply slight finger pressure to movable contact arm to hold contacts against cardboard and slide cardboard back and forth a few times. Do not bend contact arms.

STARTING PROCEDURE

CAUTION

Be sure combustion chamber is free of oil or vapor before starting burner.

1. Put detector contacts in step. See Fig. 26.
2. Push in and release safety switch reset button.
3. Open hand valve in oil supply line.
4. Set limit control and thermostat to call for heat.
5. Close line switch, and burner starts.

CHECKOUT PROCEDURE

The following checks should be performed after installation and at the completion of all service and troubleshooting procedures.

1. Flame failure—simulate by shutting off the oil supply hand valve while burner is operating. Recycle models will shut down burner, then attempt one restart before locking out; other models maintain ignition until burner locks out on safety in safety switch timing. Safety switch must be manually reset.

2. Ignition or fuel failure—simulate by going through starting procedure, omitting step 3. Burner will lock out on safety in safety switch timing. Safety switch must be manually reset.

3. Power failure—simulate by shutting off power supply while burner is operating normally. System shuts down immediately. Wait a few minutes for stack to cool and restore power. System restarts automatically if thermostat is still calling for heat.

4. Scavenger timing (recycling models only)—with the burner operating normally, open and immediately close line switch. Burner should stop at once. After recycle timing (usually 1-3 min.) burner should restart automatically.

NOTE: If you wish to trip safety switch, run through starting procedure omitting step 3. The switch will trip out on safety in safety switch timing. Safety switch can be manually tripped on most RA116, RA816, RA117, RA817A. See page 62 for procedure.

TROUBLESHOOTING STACK DETECTOR PRIMARY CONTROLS

For complete troubleshooting of an oil burner installation, both the burner and ignition systems, as well as the primary control, must be checked for proper operation and/or condition.

First check out the following parts of the burner and ignition systems:

1. Main power supply and burner motor fuse.
2. Ignition transformer.
3. Oil filter.
4. Electrode gap and position.
5. Contacts between ignition transformer and electrode.
6. Oil pump pressure.
7. Oil piping to tank.
8. Oil nozzle.
9. Oil supply.

If the trouble does not seem to be in the burner and/or ignition systems, check the stack detector and primary control as follows.

EQUIPMENT REQUIRED

1. Screwdriver
2. 0-300V ac Voltmeter
3. Insulated Jumper Wires
4. Hard Surface Card (such as business card) for Cleaning Contacts

CAUTION

Since checking must be done with live circuits, the troubleshooter must observe all the necessary precautions to avoid danger of electrical shock or equipment damage.

BURNER DOES NOT START WHEN THERMOSTAT CALLS FOR HEAT

PRELIMINARY CHECKS

1. Make sure limit switches are closed.
2. Make sure safety switch is reset.
3. Check for line voltage power at primary. With the thermostat calling for heat, voltage between burner terminals 1 and 2 on primary should be 120V.

PROCEED AS FOLLOWS AFTER COMPLETING PRELIMINARY CHECKS

PROCEDURE	CORRECTIVE ACTION	
	BURNER STARTS	BURNER DOESN'T START
1. Jumper thermostat terminals. Low volt stat at primary; line volt stat at thermostat.	1. Trouble is in thermostat circuit—check stat and wiring connections.	1. Trouble is in detector or primary—go to step 2.
2. Put contacts in step by pulling drive shaft lever out 1/4 in. and releasing.	—	—

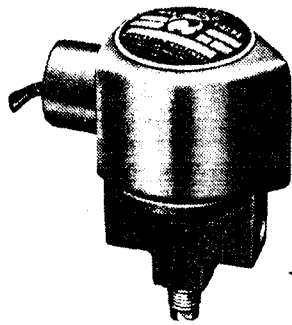
PROCEDURE	CORRECTIVE ACTION	
	BURNER STARTS	BURNER DOESN'T START
3. Jumper thermostat terminals to start burner.	3. Detector, primary OK.	3. Go to step 4.
4. Clean detector contacts and, on models with timer switch, timer contacts. Jumper thermostat terminals to start burner.	4. Detector, primary OK.	4. Go to step 5.
5. With thermostat terminals jumpered, touch a second jumper to normally closed contact blades (combination controls), or R-B terminals on detector (2-piece controls).	5. Reclean detector contacts and check again by jumpering thermostat terminals. If burner starts detector and primary are OK.	5. <u>Combination control</u> —replace control. <u>Two-piece control</u> —go to step 6.
6. With thermostat terminals jumpered, touch a second jumper to R-B terminals on primary control.	6. Check for broken wires, loose connections between detector and control. Repair and recheck by jumpering thermostat terminals. Replace detector if necessary.	5. Replace primary.

BURNER STARTS, THEN LOCKS OUT ON SAFETY

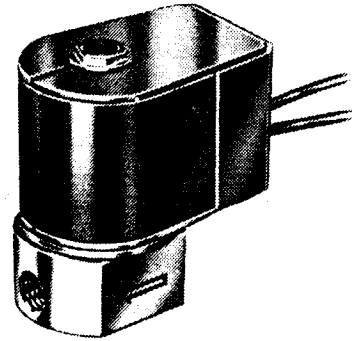
PROCEDURE	CORRECTIVE ACTION	
	BURNER KEEPS RUNNING	BURNER LOCKS OUT
1. Reset safety switch.	—	—
2. Clean detector contacts.	—	—
3. Jumper thermostat terminals to start burner.	3. Detector, primary OK.	3 Go to step 4.
4a. Clean drive shaft, remove detector and clean bimetal element. Replace detector.	—	—
b. Check detector location; if stack temperature is below 300 F, relocate detector.	—	—
5. Reset safety switch, and jumper thermostat terminals to start burner.	5. Detector, primary OK.	5. <u>Combination controls</u> —replace control. <u>Two-piece control</u> —replace detector and go to step 6.
6. Reset safety switch and start burner by jumpering thermostat terminals.	6. Detector, primary OK.	6. Replace primary. (With delayed oil valve, also check timing—see page 70.)

OIL VALVES AND ELECTRONIC TIME DELAY

V4001, V4046 MAGNETIC OIL VALVES



V4001



V4046

APPLICATION

These magnetic valves provide on-off control of oil flow to the burner, and close immediately on loss of power. Integral thermistor on some models delays opening until burner motor reaches full speed.

SPECIFICATIONS

MODEL	PRESSURE RATING	OIL FLOW CAPACITY	VALVE ACTION WHEN ENERGIZED	REPLACEMENT
V4001A Obsolete, last mfg. 3/60	125 psi 300 psi	5-35 gph	Opens after 3-8 sec. delay	V4046A
V4001B Obsolete, last mfg. 1/67	150 psi 300 psi	5-35 gph	Opens immediately	V4046B
V4046A	150 psi 300 psi	5-35 gph	Opens after 3-8 sec. delay	V4046A ^a
V4046B	150 psi 300 psi	5-35 gph	Opens immediately	V4046B ^a

^aAlso see replacement coil assembly table on page 68.

PRESSURE CORRECTIONS IN PSI:

To compensate for pressure drop through the valve, add the appropriate correction from table below to the desired nozzle pressure. For example, if the normal gauge setting for the pump is 100 pounds on a 25 gph oil burner, the V4046A (150 psi pressure rating) would require a 106 pound setting (100 + 6 = 106).

NOZZLE GAUGE GPH	5	10	15	20	25	30	35
150 psi model	1	2	3	4	6	9	12
300 psi model	4	13	28	48	73	103	140

ELECTRICAL RATINGS: 120, 208, 240V at 60 Hz; 120, 220, 240V at 50 Hz.

PIPE SIZE: 1/8-27 NPT.

VALVE PATTERN: Straight-through (bottom inlet optional on V4001).

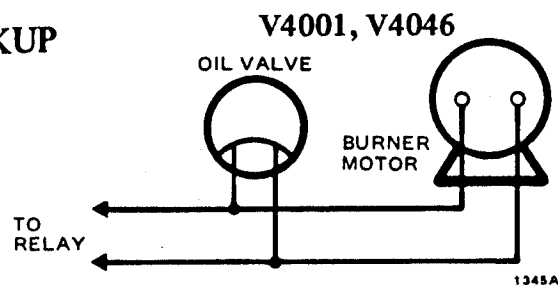
TYPE OF OIL: No heavier than No. 2 oil.

AMBIENT TEMPERATURE RATING: V4001-125 F maximum; V4046-32 to 115 F; 125 F maximum fluid.

REPLACEMENT COIL ASSEMBLIES (V4046 only): Assemblies include coil, leadwire, insulator, and bobbin. V4046A assemblies also include thermistor.

COIL ASSEMBLY FOR	PART NUMBER
V4046A-120V ac, 60 Hz	116649A
V4046A-240V ac, 60 Hz	116650A
V4046A-120V ac, 50 Hz	116651A
V4046A-220V ac, 50 Hz	116652A
V4046A-240V ac, 50 Hz	116653A
V4046B-120V ac, 60 Hz	116671A
V4046B-208V ac, 60 Hz	116782A
V4046B-240V ac, 60 Hz	116670A
V4046B-220V ac, 50 Hz	116669A

TYPICAL HOOKUP



NORMAL OPERATION

EXTERNAL ACTION	CONTROLLER ACTION
Thermostat calls for heat	Valve opens. V4001A, V4046A open after 3-8 sec. delay; V4001B, V4046B open immediately.
Call for heat ends	Valve closes immediately.

SERVICE NOTES

TO CHECK VALVE OPERATION:

Valve clicks audibly when it opens and when it closes. Listen for clicks to make sure valve is opening and closing properly.

IMPORTANT

Do not assume that valve must be replaced until all other sources of trouble have been eliminated.

IF THE VALVE DOES NOT OPEN WHEN THERMOSTAT CALLS FOR HEAT:

1. Make sure that normal fuel pressure is available at the valve.
2. Make sure that the bleed line is not obstructed.
3. Check power supply at the valve. If no voltage is indicated, check power source and circuit controls. If voltage is proper, but valve does not pull in, replace valve coil.

IF THE VALVE DOES NOT CLOSE WHEN DE-ENERGIZED:


1. Make sure that the oil flow is in the direction of the arrow on the valve body.
2. Check for short in the circuit.

REPLACING SOLENOID COIL

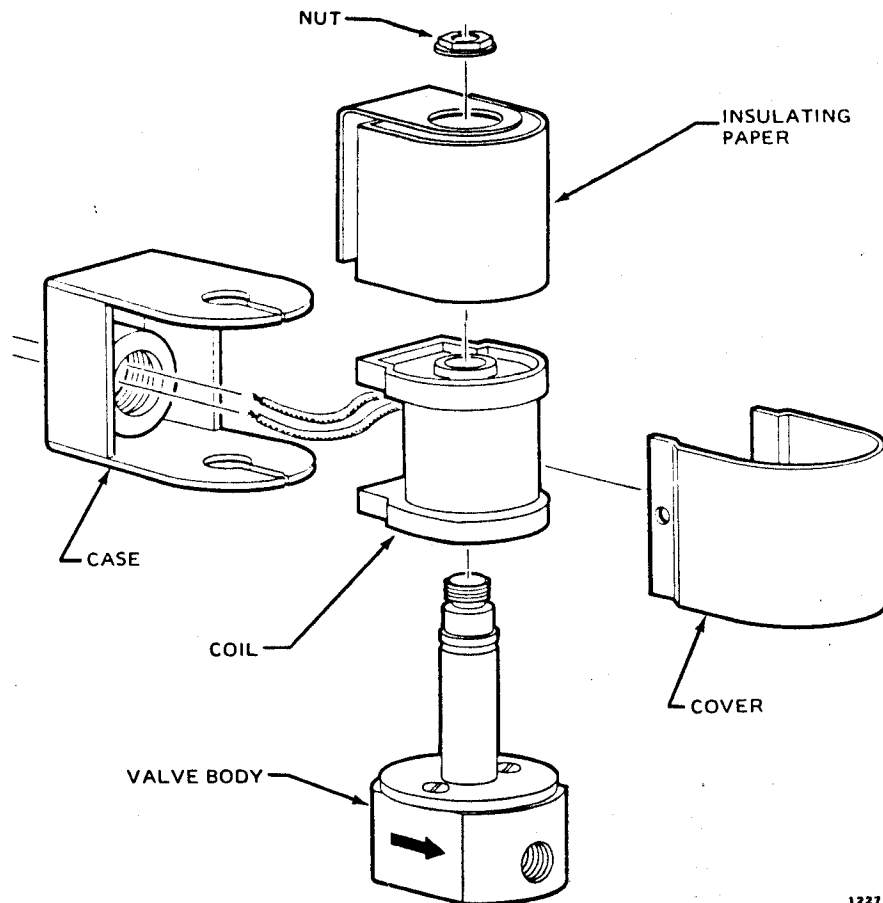
V4001A,B

1. Disconnect power supply and then disconnect wires at valve.
2. Remove cover screw and nameplate from top of valve.
3. Remove cover and solenoid coil, leaving bottom plate and insulating washer on valve body.
4. Remove insulating sheet (V4001A only) which shields delay element from cover.
5. Remove defective coil from cover, leaving spring, metal washer, and top insulating washer in place.
6. Place new coil in cover and, on V4001A, be sure that insulating sheet separates delay element from cover material.
7. Replace valve cover, tighten screw, and reconnect wiring.

V4046A,B (refer to Fig. 27)

1. Disconnect power supply.
2. Remove nut on top of valve (turn counterclockwise ).
3. Lift the powerhead assembly off the spindle.
4. Disconnect and remove the solenoid coil.
5. Connect the replacement coil and reassemble.

NOTE: The valve need not be removed from the pipe installation to change the solenoid coil.



1227

Fig. 27—Replacing solenoid coil on V4046.

CHECKING THERMISTOR OPERATION

The thermistor on an oil valve with delayed opening may be defective if the timing is significantly off. However, thermistor timing varies with ambient temperature, voltage level, and time lapse since last operation. See Figs. 28 and 29.

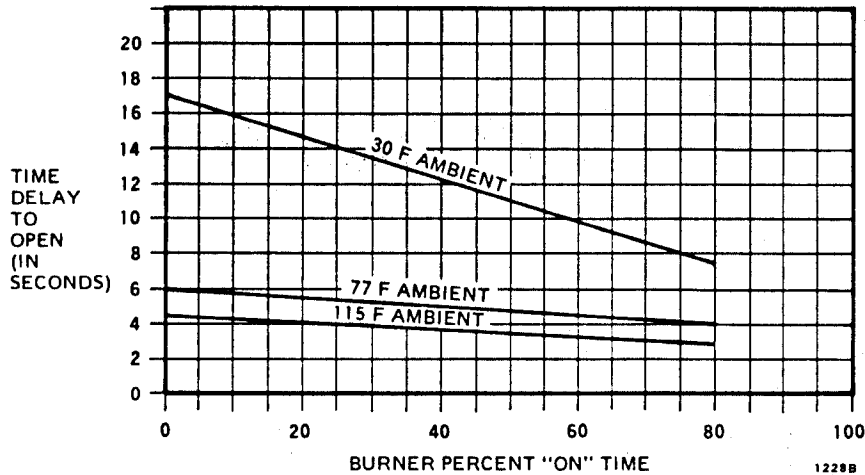


Fig. 28—Thermistor delay for V4046A valve opening as a function of burner percent "on" time and ambient temperature.

At constant supply voltage, the time delay decreases at the rate shown in Fig. 28 as burner ON time increases. Note that the rate of change, as well as the actual time delay, changes with ambient temperature. The higher the temperature at the valve, the shorter the time delay and the less change will be seen as burner ON time increases.

Fig. 29 shows the change in time delay which can be expected at different supply voltages, if burner ON time and ambient temperature remain constant.

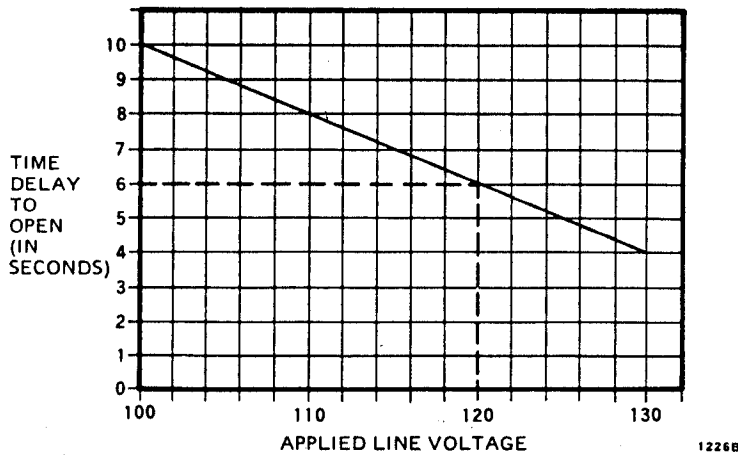


Fig. 29—Thermistor time delay for V4046A valve opening as a function of applied line voltage.

Before checking thermistor timing, make sure:

1. Thermistor is cool.
2. Voltage level is correct.
3. Ambient temperature is below maximum temperature rating of valve (see Specifications).

To check thermistor timing, energize valve and note time which elapses before opening click is heard.

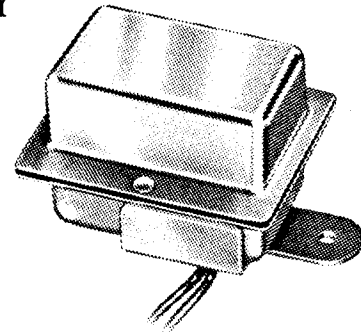
REPLACING THERMISTOR

The thermistor is attached to the solenoid coil and may be replaced by replacing the coil, or an ST70A Electronic Time Delay may be added in series with the valve to perform the delay function. If the ST70 is used, replace the coil with the appropriate V4046B Coil (less thermistor). The advantages of the ST70 are covered in the next section.

ST70A ELECTRONIC TIME DELAY

APPLICATION

Solid state delay timer provides delayed opening of V4001B, V4046B oil valves. Timing is not affected by ambient temperature (if within specified range).

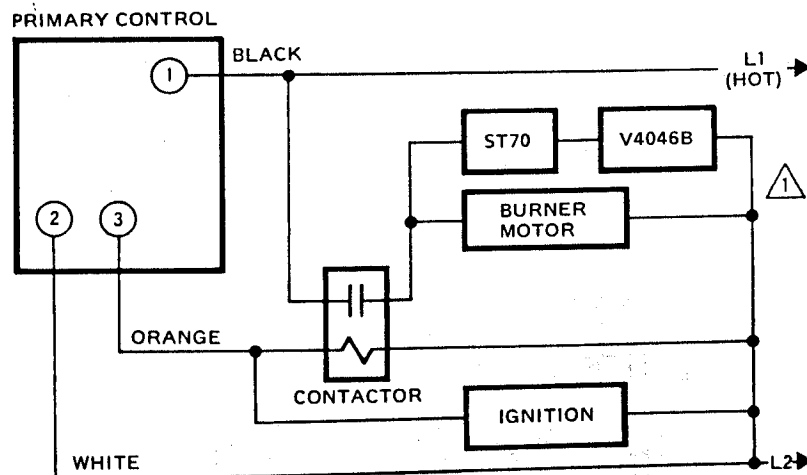


SPECIFICATIONS

ELECTRICAL RATING: 120V ac, 50/60 Hz. 0.25 amp maximum load.
TIME DELAY: 5 sec. nominal (3-7 sec.).
AMBIENT TEMPERATURE RANGE: 30-115 F. Must be protected from the weather.

TYPICAL HOOKUP

ST70A
CONNECTIONS WHEN USED WITH CONTACTOR AND 120V BURNER MOTOR



⚠ POWER SUPPLY. PROVIDE OVERLOAD PROTECTION AND DISCONNECT MEANS AS REQUIRED. 4925

NORMAL OPERATION

On a call for heat, the electronic circuit in the ST70A delays valve opening for approximately 5 seconds.

TROUBLESHOOTING SUMMARY

Most oil burner service calls fall into one of 4 basic categories:

1. No heat.
2. System overheats house.
3. System underheats house.
4. Miscellaneous complaints.

The following troubleshooting summary provides a guide to common possible causes of each of these complaints. Specific procedures for troubleshooting cad cell primaries are on page 39; stack relay troubleshooting procedures are on page 65.

NO HEAT COMPLAINTS

When troubleshooting a "no heat" complaint, always check the following basic points first.

1. Make sure power is on at the main switch.
2. Make sure burner motor fuse isn't blown.
3. Check burner on-off switch. If switch is off, make sure combustion chamber is free of oil or oil vapor, then turn switch to ON position.
4. Check oil supply.
5. Make sure manual oil valves are open.
6. Make sure limit switches are closed.
7. Reset safety switch and set thermostat to call for heat.

After completing these checks, run through starting procedure. If system still does not operate properly, note point at which sequence fails.

Check the appropriate table to determine which parts of the system are most likely to be the cause of the trouble.

BURNER MOTOR DOESN'T START

CAN INDICATE	POSSIBLE CAUSE	CORRECTIVE ACTION
Trouble in primary	See cad cell troubleshooting, page 39, or stack relay troubleshooting, page 65, as applicable.	
Trouble in thermostat	<ol style="list-style-type: none">1. Broken wires, loose connections.2. Dirty contacts.3. Defective thermostat.	<ol style="list-style-type: none">1. Replace broken wires, tighten connections.2. Clean contacts.3. Replace thermostat.
Faulty burner components	<ol style="list-style-type: none">1. Broken wires, loose connections.2. Motor start switch or thermal overload switch open.3. Defective motor.4. Defective pump.	See instructions supplied with heating equipment.

BURNER MOTOR STARTS—NO FLAME IS ESTABLISHED

CAN INDICATE	POSSIBLE CAUSE	CORRECTIVE ACTION
Trouble in primary	See cad cell troubleshooting, page 39, or stack relay troubleshooting, page 65, as applicable.	
Trouble in ignition system	<ol style="list-style-type: none"> 1. Loose connection, broken wires between ignition transformer and primary. 2. Defective transformer. 3. Ignition electrodes <ol style="list-style-type: none"> a. improperly positioned. b. spaced too far apart. c. loose. d. dirty. 4. Ceramic insulators dirty, shorted, damaged. 	<ol style="list-style-type: none"> 1. Replace broken wires, tighten connections. 2. Replace transformer. 3. Check manufacturer's instructions. 4. Replace electrode assembly.
Faulty burner components	<ol style="list-style-type: none"> 1. Dirty nozzle. 2. Nozzle loose, misaligned, worn. 3. Clogged oil pump strainer. 4. Clogged oil line. 5. Air leak in suction line. 6. Defective pressure regulator valve. 7. Defective pump. 8. Improper draft. 9. Water in oil. 10. Oil too heavy. 	See instructions supplied with heating equipment.

BURNER MOTOR STARTS, FLAME GOES ON AND OFF AFTER STARTUP

CAN INDICATE	POSSIBLE CAUSE	CORRECTIVE ACTION
Trouble in primary	<ol style="list-style-type: none"> 1. Dirty ignition or motor relay contacts. 2. Burned out contacts. 	<ol style="list-style-type: none"> 1. Clean appropriate contacts. 2. Replace primary.
Trouble in limit control(s)	<ol style="list-style-type: none"> 1. Dirty contacts. 2. High and low limit settings too close or differential set too wide. 	<ol style="list-style-type: none"> 1. Clean contacts. 2. Readjust setting(s) and/or differential.
Trouble in thermostat	<ol style="list-style-type: none"> 1. Broken wires, loose connections. 2. Differential set too close. 3. Anticipator defective. 4. Thermostat defective. 	<ol style="list-style-type: none"> 1. Replace broken wires, tighten connections. 2. Reset differential. 3. Replace thermostat. 4. Replace thermostat.
Faulty burner components	<ol style="list-style-type: none"> 1. Clogged or dirty oil lines. 2. Fluctuating water level (hydronic systems). 	See instructions supplied with heating equipment.

SYSTEM OVERHEATS HOUSE

CAN INDICATE	POSSIBLE CAUSE	CORRECTIVE ACTION
Trouble at primary	1. Defective primary.	1. With burner running, disconnect one low voltage thermostat lead from primary control terminal. If relay doesn't drop out, replace primary.
Trouble at thermostat	1. Wiring shorted. 2. Thermostat out of calibration. 3. Defective or incorrect heat anticipator in the circuit. Anticipator improperly set. 4. Thermostat stuck in ON position. 5. Thermostat improperly located in the area under control, or draft on stat through wall.	1. Repair or replace wiring. 2. Recalibrate with accurate thermometer. 3. Replace or readjust anticipator. Replace thermostat if necessary. 4. Repair or replace thermostat. 5. Relocate thermostat. It must be out of drafts, away from radiating surfaces, ducts, steam pipes, and sunny locations.
Trouble in distribution system	1. Ductwork closed to area where thermostat is located. 2. Flow control valve (hot water) stuck in ON position. 3. Circulator does not stop running.	1. Open ductwork. 2. Repair or replace valve. 3. Check circulator circuits and/or replace circulator switching device.
Trouble at limit control	1. Limit not operating (or set too high). 2. Aquastat limit in wrong location or set too high.	1. Replace (or reset). 2. Relocate or reset as necessary.
Faulty burner components	1. Extremely oversized system. 2. Oil leaking into chamber. 3. System control valves stuck in ON position. 4. Hot water circulator does not stop running.	See instructions supplied by manufacturer of heating equipment.

SYSTEM UNDERHEATS HOUSE

CAN INDICATE	POSSIBLE CAUSE	CORRECTIVE ACTION
Trouble at thermostat	<ol style="list-style-type: none"> 1. Open or loose wiring. 2. Contacts dirty. 3. Thermostat out of calibration. 4. Defective or incorrect heat anticipator in circuit. Anticipator improperly set. 5. Thermostat stuck in OFF position. 6. Thermostat improperly located. 7. Chronotherm clock thermostat 12 hours out-of-phase. 	<ol style="list-style-type: none"> 1. Repair or replace wiring. 2. Clean carefully. 3. Recalibrate thermostat with an accurate thermometer. 4. Replace or readjust anticipator. Replace thermostat if necessary. 5. Repair or replace thermostat. 6. Relocate to sense more accurately. 7. Advance setting 12 hours.
Trouble at the high or low limit controller	<ol style="list-style-type: none"> 1. Controller set too low. 2. Slow to return to ON position. 3. Controller defective. 	<ol style="list-style-type: none"> 1. Raise set point. 2. Adjust differential. 3. Replace.
Trouble at blower (for forced air system)	<ol style="list-style-type: none"> 1. Cutting out or recycling on overload. 2. Burned out blower motor. 3. Running too slow, or inadequate capacity. 4. Fan belt broken. 	See instructions supplied with heating equipment.
System defects	<ol style="list-style-type: none"> 1. Undersized furnace (possible if addition has been made to house) or boiler system. 2. Distribution system closed or inadequate. 3. Poor chimney draft. 4. Sooted heat exchanger. 5. Dirty warm air filters. 6. Dirty boiler water (steam system). 	See instructions supplied with heating equipment.
Faulty burner system components	<ol style="list-style-type: none"> 1. Fuel line clogged. 2. Impurities in oil, or strainer plugged. 3. Air in fuel line, or excess air in system. 4. Nozzle dirty, loose, or improperly sized. 5. Low oil pressure, or defective pump. 6. Motor does not come to proper speed. 7. Inoperative or inadequate circulator (hydronic system). 	See instructions supplied with heating equipment.

SYSTEM CYCLES TOO FREQUENTLY

Problem is outside the primary control. The most common problems are listed below.

CAN INDICATE	POSSIBLE CAUSE	CORRECTIVE ACTION
Trouble at thermostat	<ol style="list-style-type: none">1. Poor location.2. Loose, shorting, or poorly adjusted anticipator.3. Dirty contacts.4. Loose connections, defective wiring.	<ol style="list-style-type: none">1. Relocate thermostat.2. Tighten connections, readjust anticipator. If necessary, replace thermostat.3. Clean.4. Tighten connections, replace broken wires.
Trouble at high limit	<ol style="list-style-type: none">1. Limit set too low.2. Differential too narrow.3. Dirty contacts.	<ol style="list-style-type: none">1. Reset.2. Reset differential, replace control if necessary.3. Clean.
Faulty burner system components	<ol style="list-style-type: none">1. Dirty or clogged air filter.2. Loose connections.3. Fluctuating voltage.4. Intermittent shorts.	See instructions supplied with heating equipment.

RELAY CHATTERS AFTER PULLING IN

CAN INDICATE	POSSIBLE CAUSE	CORRECTIVE ACTION
Trouble at thermostat	<ol style="list-style-type: none">1. Burned out contacts.	<ol style="list-style-type: none">1. Replace thermostat.
Trouble at primary	<ol style="list-style-type: none">1. Supply voltage too low.2. Dirty contacts.3. Defective load relay.	<ol style="list-style-type: none">1. Call power company.2. Clean detector and timing switch contacts.3. Replace primary.

MISCELLANEOUS PROBLEMS

Other complaints, such as smoke, soot, odors, or combustion and equipment noise, are generally caused by defective burner operation. Check burner manufacturer's instructions for possible causes and corrective action.

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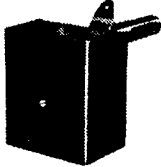

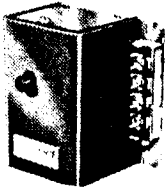
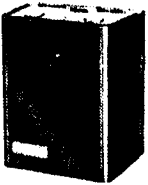
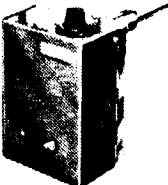
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CONTROL REPLACEMENT

ONE OF THESE FIVE CONTROLS
WILL REPLACE ALMOST ANY OLDER PRIMARY

CONTROL	REPLACES
 <p>RA117</p>	STACK-MOUNTED ONE-PIECE PRIMARY CONTROL AND PYROSTAT FLAME DETECTOR (INTERMITTENT IGNITION).
 <p>R8184G</p>	JUNCTION BOX MOUNTED PRIMARY CONTROL USED WITH A CAD CELL DETECTOR.
 <p>R8189D</p>	USE WITH A C550D PYROSTAT DETECTOR—REPLACES A BURNER-MOUNTED PRIMARY CONTROL AND SEPARATE STACK-MOUNTED FLAME DETECTOR.
 <p>R8182D</p>	COMBINATION AQUASTAT AND PRIMARY CONTROL, USED WITH A CAD CELL DETECTOR.
 <p>R4166B</p>	COMBINATION AQUASTAT AND PRIMARY CONTROL, USED WITH A CAD CELL DETECTOR FOR WATER HEATER CONTROL.

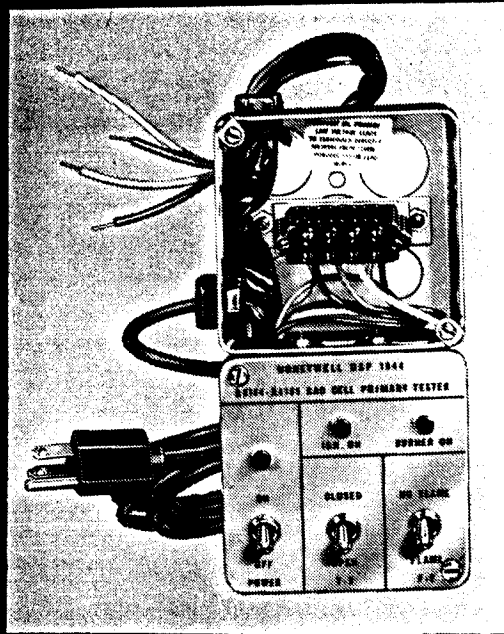
REPLACEMENT NOTES

1. WHEN REPLACING A CONSTANT IGNITION PRIMARY WITH AN RA117; CONNECT IGNITION LEAD TO TERMINAL 3. LEAVE TERMINAL 4 OPEN.
2. WHEN USING THE R8184G WITH A LINE VOLTAGE CONTROLLER, INSTALL A JUMPER WIRE ACROSS THE THERMOSTAT TERMINALS (T-T) ON THE R8184.
3. R8184G PROVIDES CONSTANT IGNITION; WHEN USED TO REPLACE AN INTERMITTENT IGNITION CONTROL, IGNITION WILL BE CONSTANT.

The tester that takes the guesswork out of R8184, R8185 checkouts!

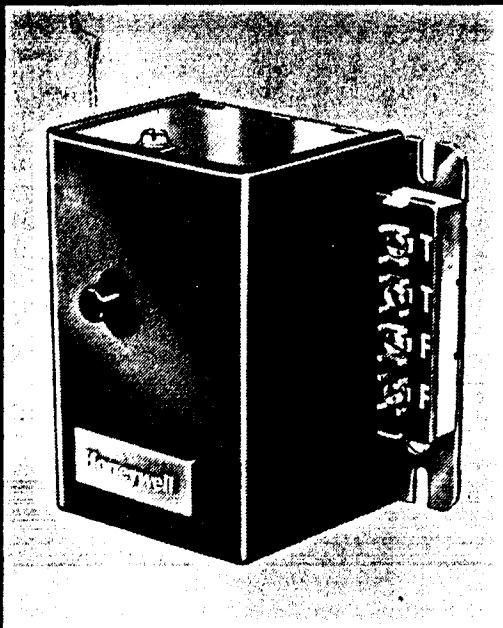
IT OFFERS . . .
COMPACT SIZE.
RUGGED DESIGN.
QUICK AND EASY CONNECTIONS.
SIMPLIFIED OPERATION.

A PERFECT ADDITION TO
EVERY SERVICEMAN'S
TOOL KIT



and

THE HONEYWELL R8184G



- * UNIQUE SCREW TERMINALS SPEED LOW VOLTAGE CONNECTIONS.
- * SPECIAL MANUAL-TRIP LEVER ON SAFETY SWITCH.
- * 7.4 AMP MOTOR RATING; 360 VA IGNITION RATING.
- * 24V THERMOSTAT CIRCUIT.
- * RELIABLE SOLID STATE FLAME DETECTION CIRCUIT.
- * RUGGED STEEL BASE AND COVER.
- * PLUS THE HIGH QUALITY YOU EXPECT FROM HONEYWELL.

**SPECIFY R8184G1138 — the universal replacement for
Honeywell and competitive cad cell primaries**

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