



INSTRUCTIONS

R4181A PROTECTOGLO FLAME SAFEGUARD CONTROL

APPLICATION

The R4181A is an electronic, self-checking, flame safeguard and programming control for controlling large industrial oil, gas, and combination oil-gas burners. Its maximum safety circuit checks all system components each second during burner operation, not just at burner start.

A synchronous-motor-driven timer provides for a 60-second prepurge, a 10-second trial for ignition, 15-second postpurge, and either a 15- or 30-second, or 10- or 15-second (field selectable) trial for main flame ignition.

Either a manual start-stop switch or an automatic controller may be used. The R4181A recycles on power failure but shuts down and locks out on flame failure of more than 2 to 4 seconds. It may be used with either a rectifying flame rod flame detector (for gas) or a C7012E, F Ultraviolet Flame Detector (for gas or oil).

FEATURES

MAXIMUM SAFETY: A special checking circuit checks the flame detector and the components of the R4181A once every second during burner operation; shuts down the system safely if a component or the flame detector fails.

MOTOR-DRIVEN SEQUENCE TIMER: Synchronous-motor driven to provide precise program timing. Timer completes revolution even if control circuit is opened earlier.

SAFE START: System cannot be started if, during a burner-off period, the flame detector senses an actual flame, or a flame-stimulating component failure exists in the electronic network.

COMPLETE FLAME SUPERVISION: Supervises pilot and/or main flame.

RAPID RESPONSE TO FLAME OR COMPONENT FAILURE DURING OPERATION: Cuts off power to fuel valve in three seconds (nominal).

SPECIFICATIONS

MODEL: R4181A self-checking primary control; basic sequencer less cabinet or base.

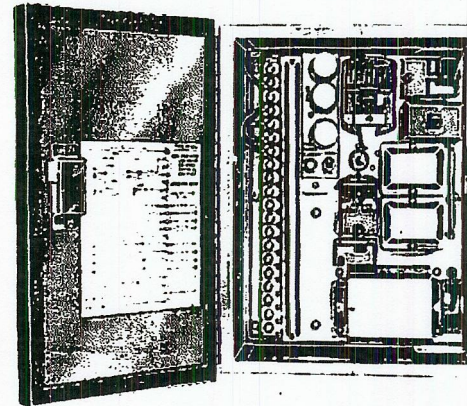
FLAME DETECTOR REQUIRED: Flame rod type detector (for gas) or C7012E, F Ultraviolet Flame Detector (for gas or oil).

MOUNTING MEANS: Must be mounted in Q514A1017 cabinet or Q477B1016 panel. Order separately.

FLAME RESPONSE TIME: 3 seconds (nominal).

PREPURGE TIME: 60 seconds, minimum.

Rev. 8-69
J.S.



FLAME CURRENT TEST JACK ON PANEL: Permits direct measurement of flame signal.

SAFETY SWITCH LOCKOUT: On failure to ignite, loss of flame, R4181A component failure, or flame detector failure.

MULTI-VOLTAGE: Suitable for use on 120-, 208, or 240-volt, 60-cycle power supply.

PROVISION FOR SAFE START AND RUNNING INTERLOCKS

ALARM TERMINAL AND CONTACTS Line-voltage external alarm sounds upon flame failure or malfunction of any component of the R4181A or the flame detector.

PLUG-IN COMPONENTS: The vacuum tube and pulsing relay are easily removable for checking or replacement.

QUICK-DISCONNECT MOUNTING: Can be removed from cabinet or panel without disconnecting any wiring.

POSTPURGE TIME: 15 seconds, fixed.

TIMED TRIAL FOR PILOT IGNITION: 10 seconds, fixed.

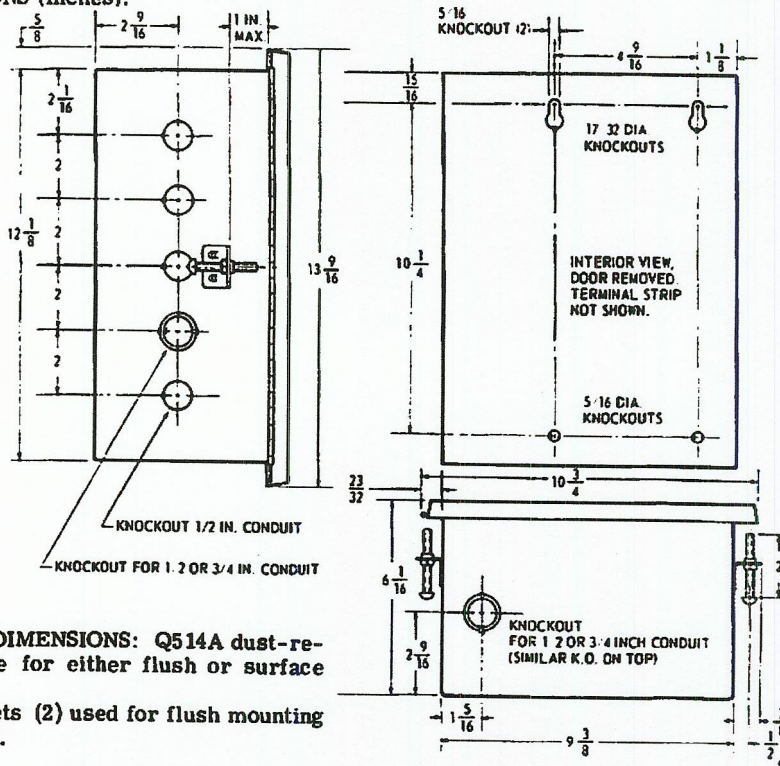
TIMED TRIAL FOR MAIN FLAME: 15 or 30 seconds (selectable) standard; 10 or 15 seconds (selectable) available to meet F.M. requirements for power burners under 12.5 million BTUH.

SAFETY-SWITCH TIMING: 30 seconds.

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Matlack Industrial Center
207 Carter Dr Unit C
West Chester, PA 19382
800 356-3774

Form Number **95-6363-1**
Residential Div.

MOUNTING DIMENSIONS (inches):



Q514A1017

CABINET MOUNTING DIMENSIONS: Q514A dust-resistant cabinet, suitable for either flush or surface mounting. Detachable side brackets (2) used for flush mounting are packed with cabinet.

Fig. 1. Cabinet and panel mounting dimensions.

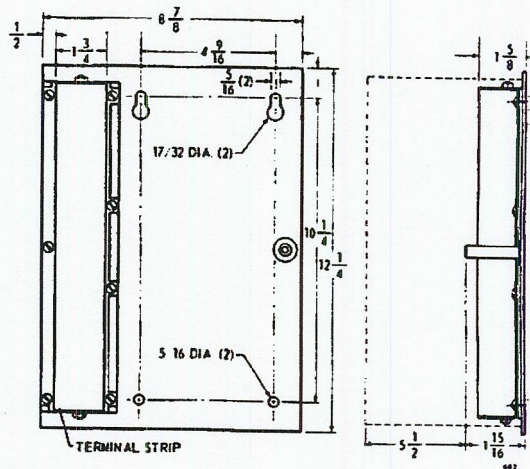
ELECTRICAL RATINGS OF LOAD TERMINAL:

	120V	208V	240V
Ignition Transformer (Terminal 5 or 6)	3.0a	1.7a	1.5a
Burner Motor (Terminal 8)			
Full Load	9.8a	5.6a	4.9a
Locked Rotor	58.8a	33.6a	29.4a
Pilot Valve (Terminal 5 or 6)	50 va pilot duty		
Main Valve (Terminal 7)	250 va pilot duty or 1000 va opening 400 va holding		
Alarm (Terminal 9)	75 va pilot duty		
Modulator (Terminals 10, 11, 12, and 13)	100 va 100 percent pf, 100 va inrush		
Maximum Connected Load	1970 va		
Maximum Power Consumption	15 watts		

AMBIENT TEMPERATURE LIMITATIONS: Measured outside cabinet, -20 F to 120 F. If not installed in cabinet or other small enclosure, -20 F to 130 F.

VOLTAGE SELECTOR: Permits use on any 120-, 208 240-volt, 60-cycle power supply.

LISTING BODIES: F.I.A. Approvable, Underwriters' Laboratories, Inc. listed, file number MP268, guide number 167E10. 10 second trial for main flame model meets Factory Mutual requirements for power burners under 12.5 million BTUH.



Q477B1016

PANEL MOUNTING DIMENSIONS: Q477B panel, suitable for mounting in customer's cabinet.

ORDERING INFORMATION:

1. SPECIFY -
 - a. Model Number.
 - b. Timed Trial for Main Flame - (10/15 or 15/30)
 - c. Mounting panel or cabinet.
2. ORDER FROM -
 - a. Your usual source or,
 - b. Honeywell
1885 Douglas Drive, North
Minneapolis, Minnesota 55422
(In Canada—Honeywell Controls Limited
740 Ellesmere Road
Scarborough, Ontario)

INSTALLATION

Applicable installation instructions provided by the burner manufacturer should be used in addition to the corresponding instructions given here. The checkout procedures on pages 4 to 6 of this sheet, and any others recommended by the burner manufacturer, should be used to perform a thorough operational check of the installation before putting the system into service.

TEMPERATURE

The R4181 should be installed where the ambient temperature will remain within the limits stated under Specifications. Higher ambient temperatures lower the electrical ratings and may shorten the life of the R4181. If possible, locate the R4181 in a clean control room where it will be protected from the more severe temperatures likely to occur near the burner.

HUMIDITY

The R4181A should be installed where the relative humidity will not exceed 90 percent. Condensation of moisture on the R4181A may cause sufficient electrical leakage to "ground out" the flame signal and thus prevent the burner from starting.

WEATHER

The Q514A cabinet for the R4181A is not designed to be weather tight. If installed outdoors, it must be protected from the elements.

VIBRATION

The R4181A should be mounted where vibration will not exceed 1/2 G at 3600 RPM. Excessive vibration shortens life of electronic components.

DISTANCE

The maximum permissible distance between the R4181A and the burner depends on the type of flame detector, type of flame-signal wire, and the method of flame-signal wiring. See Wiring. The limiting factor in every case is the signal current. Refer to FLAME DETECTOR CHECKOUT instructions.

FLAME DETECTOR

Proper flame detector installation is the basis of a good flame safeguard installation. Use only a rectifying flame-rod flame detector or a C7012E Ultraviolet Flame Detector with the R4181A. Refer to the instructions packed with the flame detector and to the burner manufacturer's instructions. Follow the instructions carefully and make the best possible application of the flame detector.

PANEL OR CABINET

1. Select a good location for the cabinet or panel with due consideration of the limiting factors mentioned in the preceding paragraphs. The location selected should be on a vertical wall or instrument panel. Be sure that there will be enough clearance in front of the cabinet or panel for servicing and for removal of the R4181A.

2. Refer to Fig. 1 for mounting dimensions or take dimensions directly from cabinet or panel. The Q514A cabinet is designed for either flush or surface mounting. Flush mounting will require an opening in wall or panel just large enough to accommodate the body of the cabinet; access from the rear of the wall or panel will be necessary for installing the mounting securely.

WIRING

1. All wiring must comply with applicable electrical codes, including use of NEC Class 1 wiring.

2. Refer to Fig. 3 for typical wiring diagram; follow the burner manufacturer's wiring diagrams, if provided.

3. Add required disconnecting means and overload protection to the power supply circuit.

4. Moisture and high temperatures frequently are encountered where flame safeguards are installed; therefore it is recommended that No. 14 TW (moisture resistant) single conductor wire be used. If very high temperatures are likely to be encountered, Honeywell No. 1298 cable (rated 400 F, continuous duty) is recommended for all but the ignition lead. Honeywell No. 1061 ignition cable (rated 350 F, continuous duty) is recommended for the ignition lead.

5. The flame-signal lead wire from flame detector to the R4181A should be as short as practicable because the capacitance of that circuit increases with lead length and reduces the strength of the flame signal. For a C7012E, this is the lead that must be connected to terminal F of the Protectoglo primary control; for a flame rod, to terminal 16. The maximum permissible length of this lead depends on the type of lead wiring and the type of flame detector used. Maximum lengths for ten different types of lead wiring when used with each of the two types of flame detectors are given in the following table.

Type of Flame-Signal Lead Wiring	Maximum Lead Length in feet from detector to R4181A	
	For C7012E	For Flame Rod
2 No. 14 Wires in 1/2 in. Thin-Wall Conduit	400	325
4 No. 14 Wires in 1/2 in. Thin-Wall Conduit	350	275
2 No. 14 Wires in 3/4 in. Thin-Wall Conduit	425	350
4 No. 14 Wires in 3/4 in. Thin-Wall Conduit	400	325
2 No. 14 Wires in 1/2 in. Greenfield	500	375
4 No. 14 Wires in 1/2 in. Greenfield	450	350
2 No. 14 Wires in 3/4 in. Greenfield	550	475
4 No. 14 Wires in 3/4 in. Greenfield	500	400
2 No. 14 Wires in B. X. Cable	240	175
RG58U Coaxial Cable	350	300

6. Wiring circuits should be checked with a meter before the R4181A chassis is installed.

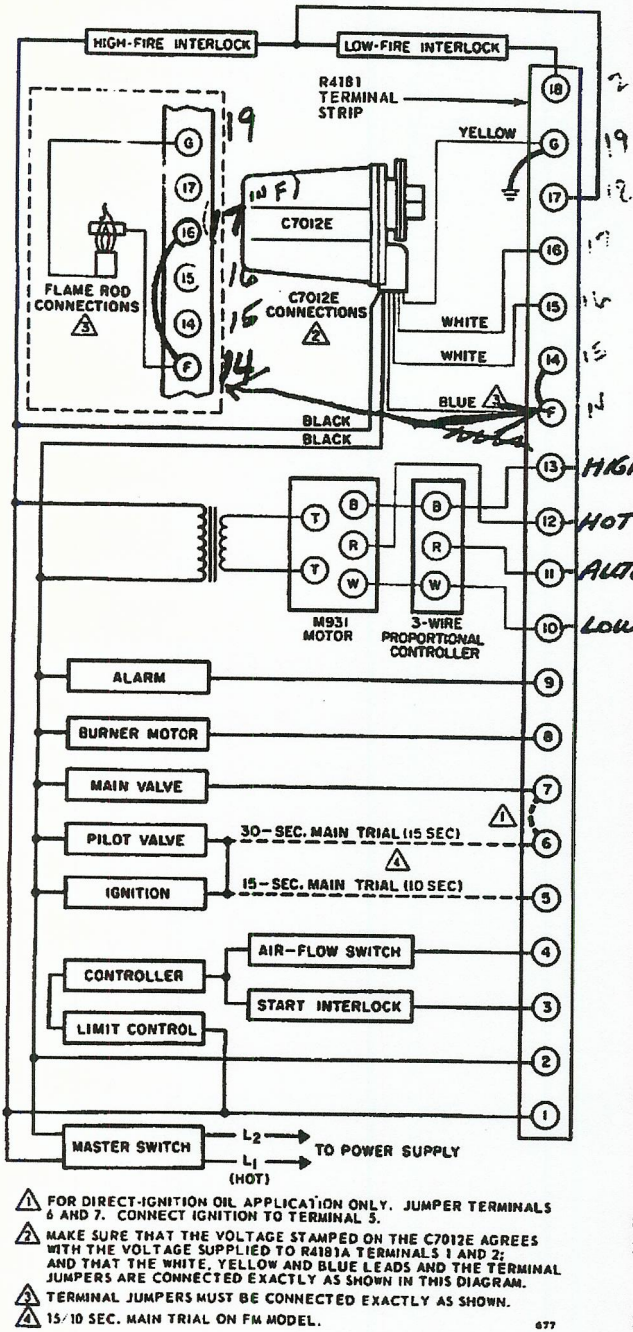


Fig. 2—Typical external connections to the R4181.

CHASSIS

VOLTAGE SETTING:

The R4181A can be set for anyone of the three common ac power-supply voltages — 120, 208, or 240. Set the adjustable link of the voltage selector, on back of chassis, to match the supply voltage.

1. Loosen the center screw. See Fig. 3.

2. Remove the end screws from the link, rotate the link to the proper voltage position, then insert the end screws.
3. Tighten all three screws.

SETTING FLAME-DETECTOR SELECTOR LINK:

These links are located on the back of the chassis, see Fig. 3. The links should be connected between the upper two of the three screws if a C7012E Ultraviolet Flame Detector is to be used; or between the lower two screws for a rectifying flame-rod detector.

1. To change the position of the links, loosen all three screws but do not remove them.
2. Move link to the proper position.
3. Tighten all three screws.

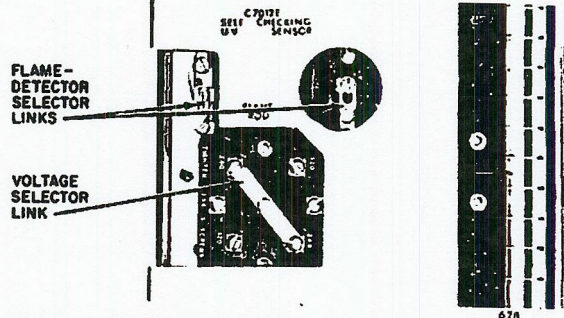


Fig. 3—Voltage-selector and flame-detector links.

INSTALLING CHASSIS: See Fig. 4.

1. Open the system disconnect switch.
2. Insert the chassis ears into the sockets located above and below the terminal strip of the panel or cabinet. Press the chassis inward firmly into place.
3. Tighten the large slotted head retaining screw near the chassis handle.

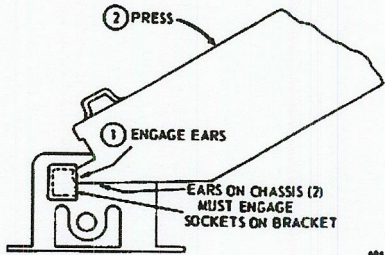


Fig. 4—Installing chassis (bottom view with cabinet cut away).

CHECKOUT

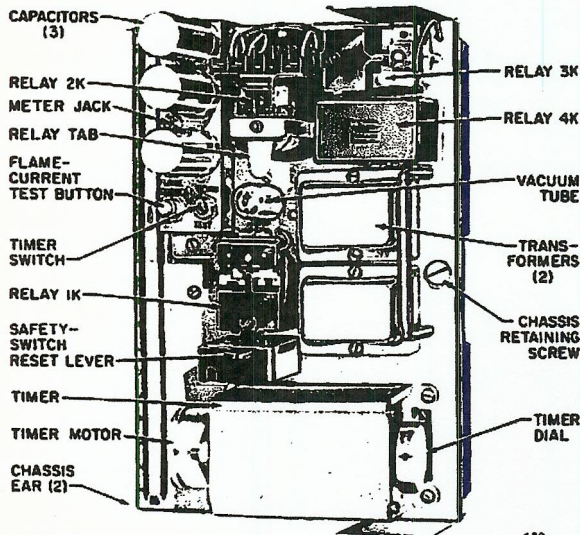


Fig. 5—Identification of components.

546 15-30 SEC - 1018
10-15 SEC - 1034

TO CONTROL SEQUENCE MANUALLY

TO KEEP R4181A ON CONTINUOUS PREPURGE WHILE CLEARING FUEL LINES OF AIR, SET TIMER SWITCH TO "TEST" POSITION. TIMER WILL STOP BEFORE END OF NORMAL PREPURGE PERIOD.

TO KEEP PILOT ON CONTINUOUSLY DURING PILOT CHECKOUT. SET TIMER SWITCH TO "TEST" POSITION AS SOON AS 2K RELAY PULLS IN.

PRELIMINARY INSPECTION

Make certain that:

1. Voltage selector is set for proper supply voltage.
2. Detector selector links are correctly connected for the type of flame detector used.
3. Wiring connections are correct and all terminal screws tight.
4. Flame detector is properly installed and connected.
5. Burner is completely installed and ready to fire; fuel lines are purged of air.
6. Combustion chamber and flues are clear of fuel and fuel vapor.
7. Power is on at system disconnect switch.
8. Safety switch is properly set.

FLAME DETECTOR CHECKOUT

Use only a rectifying flame rod or a C7012E Ultra-violet Flame Detector with the R4181A. Check carefully the instructions packed with the flame detector.

Start the system in the normal manner. As soon as flame is established, the 4K relay should begin to click at normal rate, between 60 and 120 clicks per minute. The clicking should be positive, not hesitant; and the rate should be regular, not erratic. Become familiar with the sound of normal clicking, it is the best indicator of normal operation and should be checked audibly every day. If between 60 and 120 clicks per minute, the actual clicking rate is relatively unimportant but stable regularity of clicking is very important.

The flame signal current should be checked with an accurate dc microammeter, preferably a Honeywell W136A, which has a plug for insertion into the meter jack on the R4181A.

During normal operation, the flame signal is interrupted momentarily each time the 4K relay clicks and cannot be measured properly with a microammeter connected in the external flame-signal circuit. For that reason, the R4181A is equipped with a meter jack through which the meter may be properly connected into the electronic circuit; and with a test button which, when pressed, changes the interrupted signal to a continuous signal that may be measured accurately. Microammeter leads must terminate in a plug suitable for connecting to the jack on the R4181A. (A Honeywell 117053 Meter Connecting Plug Assembly may be ordered separately for an older W136A or other microammeter not having a suitable plug.)

To check the flame signal, proceed as follows.

1. Plug microammeter into meter jack on R4181A.
2. Start system in normal manner.
3. As soon as pilot flame is established move timer switch to TEST position to stop timer, then -
 - a. Hold in relay 2K by pressing on the relay tab.
 - b. Press the flame-current test button on the R4181A and hold it in.
4. Note the microammeter reading. For dependable operation it should be at least 8-10 microamperes for a rectifying flame rod; at least 9-14 microamperes for a C7012E. It is very important that the reading be steady. If the signal is either weak or unsteady, steps must be taken to improve it as described in following paragraphs.
5. Release the test button.
6. A few seconds later, release the 2K relay tab.

With either a rectifying flame rod or a C7012E Flame Detector it is VERY IMPORTANT that the measured flame signal be steady. If it fluctuates, the condition must be corrected. The cause may be a wavering flame or poor sighting of the C7012E. After a steady signal has been assured, take a new meter reading.

If the flame detector is a rectifying flame rod, a reading lower than 8 microamperes indicates a marginal flame detector installation which must be corrected before proceeding further with the overall checkout. Check the power-supply voltage at terminals 1 and 2. Check position, size, and burning characteristics of the flame. Also try changing the position of the flame rod in the flame and increasing the flame ground area. Check to make sure that the length of the flame-signal lead between detector and R4181A is not too great for the type of lead wiring used, see table under WIRING.

If a C7012E flame detector is used and the meter reading is STEADY but less than 9 microamperes, the C7012E power-supply voltage may be too low or the length of the flame-signal lead between detector and R4181A may be too great for the type of lead wiring used, see table under WIRING. If the C7012E has been in service, its quartz window may need cleaning, or the C7012E may need new vacuum tubes or a new ultraviolet sensing tube; try a new C7012E. Whatever the trouble, it must be corrected before proceeding further with the overall checkout.

PILOT TURNDOWN TEST

If the flame detector is used to prove the pilot flame, make the following turndown test to be certain that the main burner can be lighted by the smallest pilot flame that will prevent relay 2K from dropping out.

1. With manual fuel valves open, turn on the power and start the system normally.
2. As soon as the pilot flame is established and relay 2K has pulled in, set the timer switch to TEST position to stop the timer and hold the system on PILOT TRIAL.
3. Turn the pilot flame down VERY SLOWLY, stopping instantly when relay 2K drops out.
4. Jumper terminals 6 and 7 momentarily. The main burner should light immediately when the jumper is applied. Remove the jumper as soon as it has been determined whether or not the burner lights immediately.
5. If the main burner lighted immediately, repeat step 4 several times to make sure that the burner ALWAYS can be lighted with the pilot flame turned down that low. If the main burner always lights immediately, the turndown test is completed. Then turn the pilot up to normal and set the timer switch at NORM position.

If the main burner does not always light immediately when repeating step 4. proceed to step 6.

6. Make needed adjustment in flame detector to reduce the signal current so that a larger pilot flame will be required to hold in relay 2K. This usually requires resighting the C7012E, or relocating the flame rod farther out along the axis to the pilot flame. Measure the flame detector current again after every readjustment of the detector. See FLAME DETECTOR CHECKOUT.

7. With a satisfactory flame signal assured after the readjustment of the detector, repeat the pilot turndown test.

8. If the system still does not pass the pilot turndown test, repeat the program of adjusting the flame detector, measuring the flame signal, and making turndown tests until it has been determined that the main burner positively will be lighted with the pilot flame too small to hold in relay 2K. Then turn the pilot flame back up to normal and set the timer switch at NORM position.

SAFETY LOCKOUT

Safety lockout should occur upon failure to ignite the pilot, upon failure to light the main flame, and upon loss of flame. Check each of these conditions as follows.

Failure to Ignite Pilot:

1. Shut off the fuel supply to both pilot and main burner manually or by disconnecting pilot and main fuel supply leads at R4181A panel.
2. Turn on the power.
3. Reset the safety switch if tripped.
4. Start the system.
5. Pilot will not light. Safety switch should trip and lock out, and the external alarm should sound, about 70 seconds after starting the system.

Failure to Light Main Flame:

1. Turn on the fuel supply to the pilot burner only; leave main-burner fuel valve shut off.
2. Reset the safety switch.
3. Start the system.
4. Pilot should light but main burner will not light. Relay 2K should drop out within 2 to 4 seconds after main-burner IGNITION TRIAL ends; the safety switch should trip and lock out, and the external alarm should sound, about 30 seconds after 2K drops out.

Loss of Flame:

1. Turn on the fuel supply to the main burner; pilot gas supply also must be on.
2. Reset the safety switch.
3. Start the system. Start-up should be normal and the main burner should light normally.
4. After timer stops with main flame normal, shut off the main-burner fuel supply to extinguish the main flame.
5. Relay 2K should drop out within 2 to 4 seconds later.

NOTE: If the safety switch fails to trip and shut down the system on any of these three tests, replace the R4181A with a new one; then rerun all CHECKOUT tests from the beginning.

OPERATION

OPERATION OF SELF-CHECKING FLAME-DETECTION CIRCUIT

When flame detector senses flame, it passes a pulsating dc signal current to capacitor C5. Through succeeding pulses, a charge is built up quickly on C5 until its leakage rate through associated resistors equals the charging rate. Through interconnections of the network, the charge on capacitor C5 causes capacitor C6 to be charged in the direction that biases tube section 2 to cutoff. Section 2 stops conducting, removing negative bias from tube section 1, allowing section 1 to conduct and pull in relay 4K.

But when relay 4K pulls in, contacts 4K3 open and allow C7012E detector shutter to interrupt flame signal. This allows capacitor C6 to discharge through a parallel resistor. Tube section 2 again conducts and cuts off section 1. Relay 4K drops out, contacts 4K3 close, and the flame signal is re-established. This recycling of relay 4K continues at the rate of approximately 1.5 times per second as long as the detector

senses a satisfactory flame. (With a flame-rod detector, contacts 4K3 interrupt the flame signal to terminal 16 to accomplish the same purpose.)

Each time relay 4K is pulled in, contacts 4K2 open to disconnect capacitor C2 from C1; contacts 4K1 close to transfer charge from C2 to C3. By the alternating operation of contacts 4K2 and 4K1 as relay 4K pulses (cycles in and out), the charge on capacitor C3 quickly builds up until its voltage is sufficient to pull in relay 2K. When relay 2K pulls in, contacts 2K11 open to de-energize safety-switch heater. Contacts 2K9 and 2K10 close with no immediate effect.

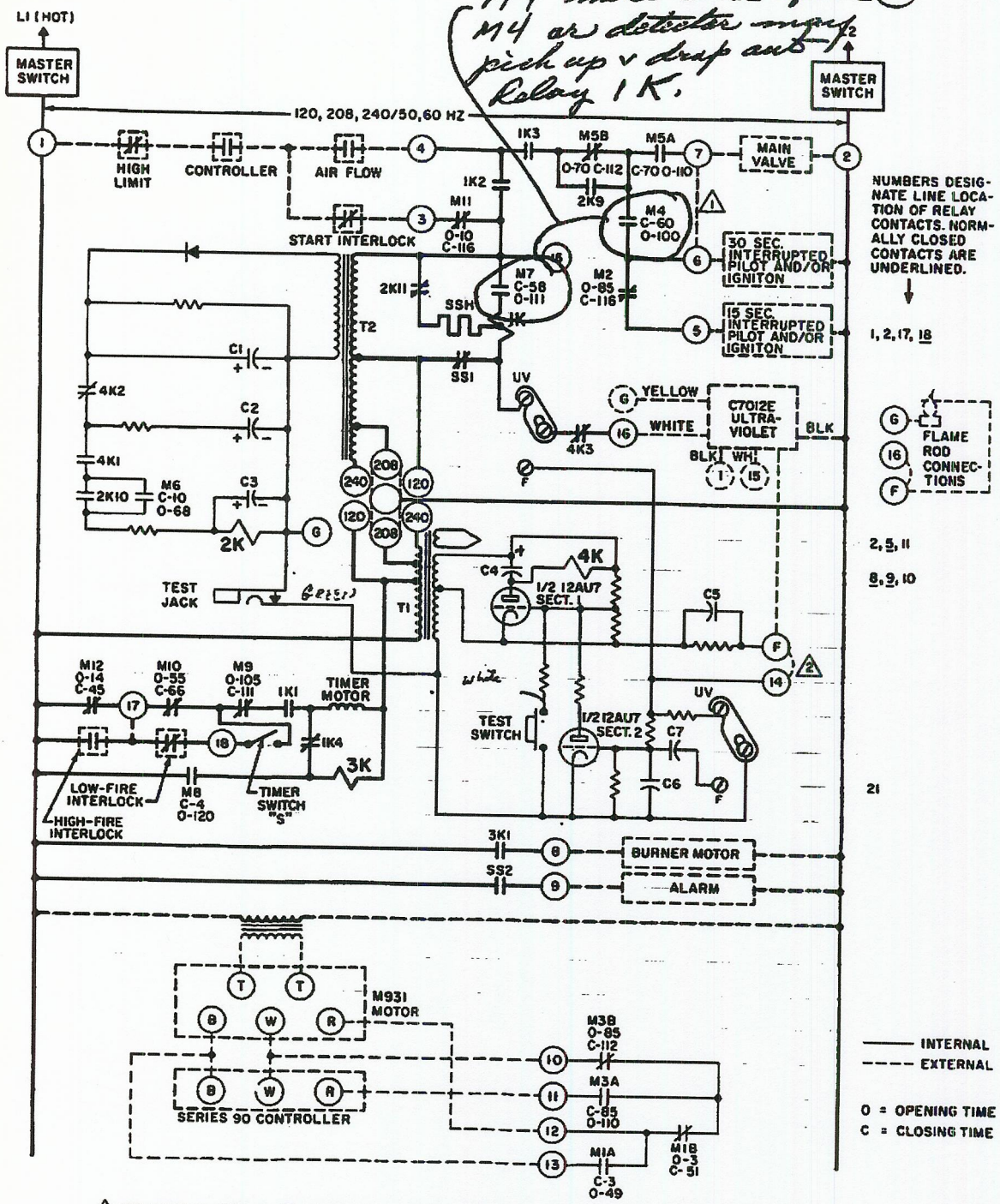
(If the flame or any electronic component fails, no further charge can be transferred to C3; its charge will leak off through winding of relay 2K and that relay will drop out within 2 to 4 seconds. Contacts 2K9 will open and de-energize terminals 5, 6, and 7 to shut down the system safely. Contacts 2K11 will close to energize safety-switch heater; safety switch will trip and lock out about 30 seconds later. Safety-switch contacts SS2 will close to sound external alarm).

INTERNAL SCHEMATIC

The wiring diagram below shows all contacts in the standby position. The opening and closing times of the timer contacts are shown next to each contact. A step by step description of the operation of the standard model is given on the opposite page.

NOTE: Operation of model designed to meet F.M. requirements is the same as standard model except for 10 or 15 second trial for main flame.

M7 must close before M4 or detector may pick up & drop out Relay 1K.

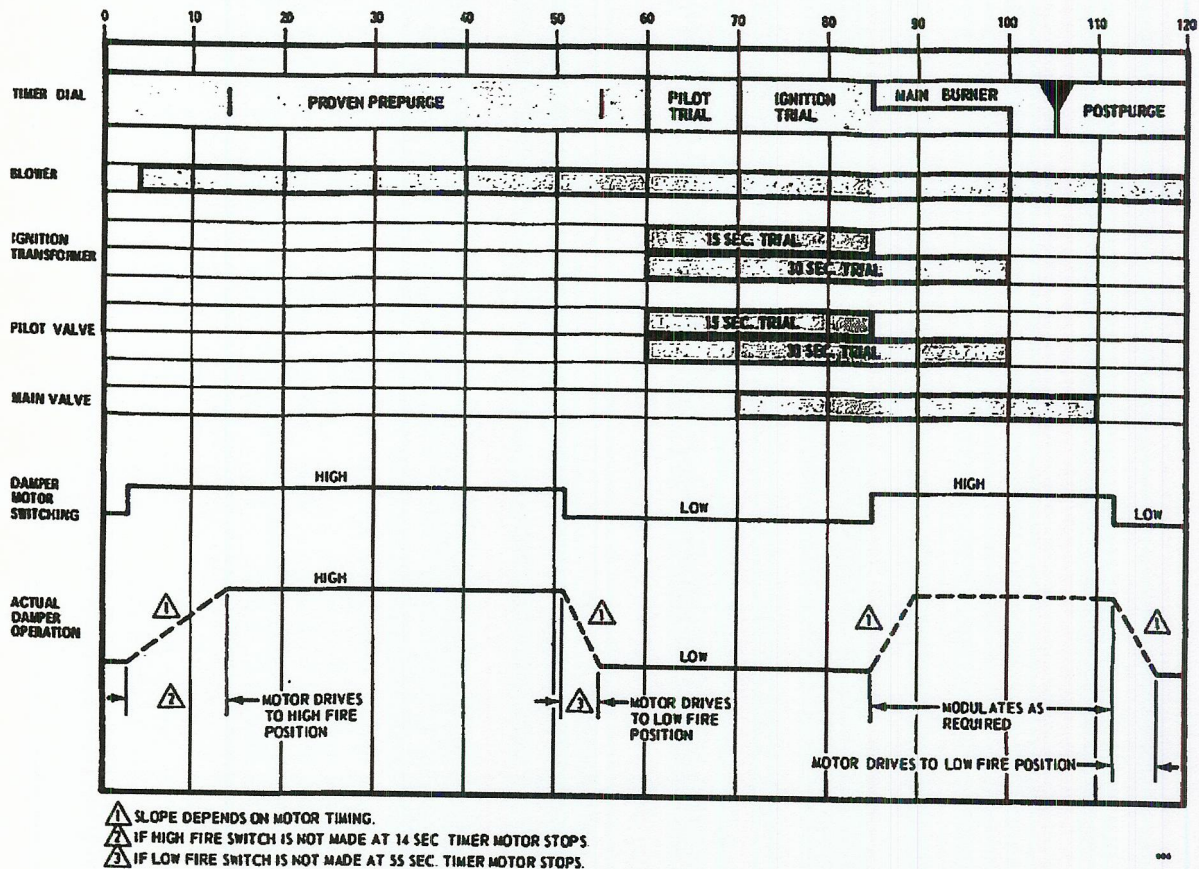


⚠ FOR DIRECT-IGNITION OIL APPLICATION ONLY. JUMPER TERMINALS 6 AND 7. CONNECT IGNITION TO TERMINAL 5.
 ⚠ JUMPER REQUIRED WHEN USING C7012E. MAKE SURE VOLTAGE STAMPED ON C7012E AGREES WITH VOLTAGE SUPPLIED TO RA181A TERMINALS 1 AND 2; AND THAT THE WHITE, YELLOW, AND BLUE LEADS ARE CONNECTED EXACTLY AS SHOWN.

Fig. 6—Wiring diagram of the R4181A; typical external connections included.

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OPERATING SEQUENCE



STEP-BY-STEP OPERATION

START

1. Controller contacts make; if limits and starting interlocks are made, relay 1K pulls in. (Safety switch heater is energized on start but not enough power is dissipated to cause safety lockout.) Timer starts.

2. Damper motor starts driving to the high fire position at 3 seconds. Relay 3K pulls in at 4 seconds to power terminal 8, burner motor. The air flow switch must close before 10 seconds (air flow proved) or the system will shut down.

3. Contacts M12 open at 14 seconds; if the high fire interlock is not made, timer stops until it is. This proves high fire purge (60 percent air flow) assuring at least four air changes before the pilot trial.

4. Damper motor starts driving to the low fire position at 51 seconds; if the low fire interlock is not made at 55 seconds, the timer stops until it does make. This proves low fire start. Note that the timer can be stopped with the timer switch any time between 55 and 66 seconds.

5. The safety switch heater is energized at 58 seconds. (a segment of relay 1K acts as the low voltage, high current winding of an autotransformer.)

6. The ignition transformer and the pilot valve are energized at 60 seconds. Pilot flame must be sensed (relay 2K pulls in) before 70 seconds. If the pilot is proved, the main valve opens at 70 seconds.

7. 15 second trial for main flame ends at 85 seconds when ignition and pilot are cut off if connected to terminal 5. The firing rate motor is now free to modulate under control of a separate Series 90 controller.

8. 30 second trial for main flame ends at 100 seconds when ignition and pilot are cut off if connected to terminal 6.

9. Timer stops at 105 seconds in the run position.

STOP

10. Controller contacts open; 1K drops out and the main fuel valve closes. Relay 2K drops out about 3 seconds after the flame goes out.

11. Firing rate motor drives to the low fire position at 112 seconds.

12. Relay 3K drops out and the timer stops at 120 seconds. Control is set for the next cycle.

MAINTENANCE AND TROUBLESHOOTING

To assure the maximum in safe operation, a schedule should be set up, and followed, for periodic inspection and maintenance of burner and all other controls as well as the R4181A

To minimize nuisance shutdowns, the operation of the 4K pulsing relay should be checked audibly every day. Become familiar with the normal clicking sound of this relay. The clicking should be positive, not hesitant; and regular, not erratic. The rate of clicking should be between 60 and 120 clicks per minute; if outside these limits, the 2K relay may dropout and cause nuisance shutdown. The clicking rate depends on the applied line voltage and the strength of the flame signal supplied by the flame detector. If within the limits stated, the actual clicking rate is relatively unimportant, stable regularity is more important. When using a flame-rod flame detector, an excessively high clicking rate may indicate a too weak flame signal. A too weak flame signal from a C7012E detector may cause weak clicking at varying rate.

Keep burner(s) and fuel mixture always adjusted to the burner manufacturer's recommendations.

To avoid nuisance shutdowns caused by weak flame signal, check flame signal at least weekly so as to detect any appreciable deterioration in signal strength and make early correction. See page 5.

Install a new Honeywell No. 102988 Vacuum Tube annually. Order by Honeywell Number. These tubes are selected by special tests to assure reliability and safety; DO NOT replace with a commercial type tube.

Install a New 106615A Plug-In Relay annually.

If a C7012E Flame Detector is used, install new vacuum tubes in it annually. Order by Honeywell Nos. 113236 and 115330. These tubes are selected by special tests to assure reliability and safety; DO NOT replace with commercial tubes. The No. 113228 UV tube need not be replaced unless found defective. Clean the quartz window of the C7012E whenever flame signal test indicates a weakening of the signal; for access to the window, remove three screws that hold the C7012E to its mounting flange, then remove the C7012E from the mounting flange.

NOTE: Keep the R4181A powered the year around except while servicing, to prevent condensation within the cabinet.

The importance of the types of jobs on which R4181A's are used justifies keeping a new R4181A and new plug-in components on hand for prompt substitution in case trouble develops. The plug-in components are No. 102988 Vacuum Tube and No. 106615A Plug-In Relay. A No. 123514A Flame Simulator also should be kept on hand for testing purposes. A Honeywell W136A1029 Test Meter is recommended for measuring line voltage and flame-signal current.

WHEN TROUBLE OCCURS

If trouble occurs, do not assume that the R4181A is at fault. Follow an orderly procedure in locating the real cause of trouble. Review the normal operating sequence as described under OPERATING SEQUENCE. Then check the actual performance against the normal operating sequence to determine just how far through the sequence the performance is normal. Knowing the stage at which performance deviates from normal will help in locating the trouble.

Checking Line Voltage

Since the pulsing rate of the 4K relay, and the resulting voltage applied to the 2K relay, are affected by the line voltage, make sure that the line voltage is correct before checking any further. Check voltage between terminals 1 and 2. This voltage should be within 85 percent and 110 percent of the rated voltage for which the voltage selector on the back of the R4181A is set. (See that the voltage selector is set for the correct nominal line voltage). Remember that line voltage can vary considerably within any 24-hour period. If line voltage is too low, notify power company. If voltmeter shows no voltage, check for open master switch, blown fuse, open circuit breaker, or open circuit in line.

If a C7012E flame detector is used, check the voltage of its power source also. The strength of the flame signal is greatly affected by that voltage, which should be within 85 percent and 110 percent of the rated voltage.

TROUBLE-SHOOTING PROCEDURE

1. See that timer-motor switch is set at NORM.
2. See that safety switch has been reset.
3. See that master switch is closed.
4. Check to make sure that line voltage at terminals 1 and 2 is correct. See Checking Line Voltage.
5. If a C7012E flame detector is used, check to make sure that its power-supply voltage is correct.
6. Close the starting circuit manually or by raising the controller setting high enough to call for heat.

Start-up and operation should be normal. If it is not, note at what stage the operation deviates from normal. Then locate the symptom in the following trouble-shooting outline, which is arranged in the order of normal operation, and follow the instructions given there. Timings indicated for certain symptoms in the outline are nominal timings and serve only to relate the symptoms to respective timer positions.

A. RELAY 1K DOES NOT PULL IN

1. See that timer is at stand-by position.

a. If it is, proceed to step 2.

b. If it is not, check and clean contacts M8 and 1K4 as instructed under **CLEANING CONTACTS**, page 13. If timer does not then run to stand-by position after master switch is closed, install a new R4181A.

2. Jumper terminals 1 and 3 momentarily.

a. If that causes relay 1K to pull in, the trouble is not in the R4181A but is due to an external open circuit between terminals 1 and 3.

(1) Jumper the controller or control switch, limit control, and starting interlocks, one at a time, to find the one that is open.

(2) If that did not locate the fault, check the external wiring between terminals 1 and 3 for open circuit.

b. If jumpering terminals 1 and 3 does not cause relay 1K to pull in.

(1) Inspect and clean contacts M11 and 2K11 as instructed, page 13.

(2) If relay 1K still will not pull in, install a new R4181A.

B. TIMER MOTOR DOES NOT START FROM STAND-BY POSITION.

1. Inspect and clean contacts M10, M12 as instructed, page 13.

2. If that does not correct the trouble, install a new R4181A.

**C. MODULATING MOTOR DOES NOT RUN TO HIGH FIRE POSITION (at 3 sec)
Jumper terminals 12 and 13.**

1. If that does not run the motor to high-fire position, the trouble is not in the R4181A.

a. Check power at modulating motor.

b. Check modulating motor control wiring.

c. Check Series 90 controller, if used.

d. Check modulating motor.

2. If jumpering terminals 12 and 13 runs the motor to high-fire position, inspect and clean contacts M1A as instructed, page 13. If that does not correct the condition, install a new R4181A.

D. RELAY 3K DOES NOT PULL IN (at 4 sec)

1. Inspect and clean contacts M8 as instructed under **CLEANING CONTACTS**, page 13.

2. If that does not correct the trouble, install a new R4181A.

**E. BURNER MOTOR DOES NOT START (at 4 sec)
Jumper terminals 1 and 8.**

1. If that does not start motor, the trouble is not in the R4181A.

a. See that manual motor-switch is closed.

b. Check motor fuses or circuit-breaker.

c. Check motor starter.

d. Check motor external wiring.

e. Check motor according to manufacturer's instructions.

2. If jumpering terminals 1 and 8 starts the motor, inspect and clean contacts 3K1 as instructed under **CLEANING CONTACTS**, page 13.

3. If motor still does not start, install a new R4181A.

F. RELAYS 1K AND 3K DROP OUT AND PREVENT START-UP (at 10 sec)

The trouble is that the air-flow switch is not sensing air flow.

1. Check the draft-fan operation.

2. Check the air-flow switch and its wiring between terminal 4 and the controller or control switch.

**G. MODULATING MOTOR DOES NOT RETURN TO LOW-FIRE POSITION AND PARTIALLY CLOSE THE DRAFT DAMPERS (at 51 sec)
Jumper terminals 10 and 12.**

1. If that does not run motor to low-fire position, the trouble is not in the R4181A.

a. Check power at modulating motor.

b. Check modulating motor control wiring.

c. Check Series 90 controller if used.

d. Check modulating motor.

e. Check damper linkage.

2. If jumpering terminals 10 and 12 runs motor to low-fire position, inspect and clean contacts M1B and M3B as instructed on page 13.

3. If that does not correct the trouble, install a new R4181A.

H. TIMER MOTOR STOPS (at 55 sec)

1. Make sure that timer-motor switch is at **NORM** position.

2. Jumper terminals 1 and 18.

a. If that starts timer motor, check for open low-fire interlock contacts or open low-fire interlock circuit.

b. If jumpering terminals 1 and 18 does not start timer motor, install a new R4181A.

I. PILOT OR DIRECT-IGNITED OIL BURNER DOES NOT LIGHT (at 60 sec)

Jumper terminals 4 and 5 or 4 and 6 (5 or 6, the terminal to which pilot and ignition are connected).

1. If that does not light burner, the trouble is in the R4181A.
 - a. See that manual fuel valves are open.
 - b. See that there is ample oil in the fuel tank.
 - c. Check pilot valve or oil valve and valve external circuit.
 - d. Check ignition transformer, ignition electrodes, and ignition circuits.
2. If jumpering terminals 4 and 5 (or 6) causes burner to light, inspect and clean contacts 1K3, M5B, M4, and M2 as instructed on page 13.
3. If that does not correct the trouble, install a new R4181A.

J. RELAY 4K DOES NOT START PULSING WHEN FLAME IS ESTABLISHED (60 sec) OR PULSES WEAKLY AND IRREGULARLY

1. After making sure that supply voltage(s) are correct, install a new 102988 vacuum tube.
2. If that does not correct the trouble, install a new 106615A Plug-In Relay (4K).
3. If trouble still exists,
 - a. Close the manual valves in pilot and main burner fuel-supply lines.
 - b. Disconnect the C7012E blue lead from terminal F, or the flame-rod lead from terminal F.
 - c. With R4181A powered, insert the plug of a No. 123514A Flame Simulator into the meter jack on the R4181A. Then hold the simulator probe on terminal F.
 - (1) If that pulls in relay 4K, the trouble is not in the R4181A. Reconnect the flame-detector lead to its proper terminal and open the manual fuel valves. Then check the flame detector as instructed under **FLAME DETECTOR CHECKOUT**.
 - (2) But if use of flame simulator did not pull in relay 4K, install a new R4181A.

K. RELAY 2K DOES NOT PULL IN AFTER FLAME IS ESTABLISHED (60 sec), OR PULLS IN BUT DROPS OUT BEFORE FLAME IS EXTINGUISHED.

The pulling in and holding in of relay 2K requires strong and regular pulsing of relay 4K; weakening and increasing irregularity of clicking warns of eventual failure of relay 2K to pull in or its eventual dropping out and causing nuisance shutdown.

1. Whenever the sound of relay 4K indicates approaching trouble, follow instructions given under "J" to locate and correct the condition.
2. If relay 4K is clicking strongly and regularly inspect and clean contacts 2K10 as instructed under **CLEANING CONTACTS**.
3. If trouble continues, install a new No. 106615A Plug-In Relay (4K). (The trouble may be in contacts K1 or 4K2 but the 4K relay is sealed, preventing inspection and cleaning of those contacts.)
4. If trouble still exists, install a new R4181A.

L. MOVING TIMER MOTOR SWITCH TO "TEST" POSITION AFTER 66 SECONDS STOPS TIMER MOTOR.

1. Inspect and clean contacts M10 as instructed under **CLEANING CONTACTS**.
2. If this does not correct the trouble, install a new R4181A.

M. MAIN GAS BURNER DOES NOT LIGHT (70 sec) Jumper terminals 6 and 7 momentarily.

1. If that does not cause main burner to light,
 - a. See that manual main-fuel valve is open.
 - b. Check automatic main-fuel valve and its external control circuit.
 - c. If main fuel valve opens and supplies gas to main burner, run a pilot turn-down test and make any adjustments needed; see instructions under **PILOT TURNDOWN TEST**.
2. If jumpering terminals 6 and 7 causes main burner to light, inspect and clean contacts 2K9 and M5A as instructed under **CLEANING CONTACTS**.
3. If trouble still exists, install a new R4181A.

N. MODULATING MOTOR DOES NOT RUN TO HIGH-FIRE POSITION (85 sec)

Modulating motor should run to high-fire position at this time only if the Series 90 controller is calling for high fire.

Jumper terminals 11 and 12.

1. If that does not start modulating motor to run toward high-fire position, the Series 90 controller may not be calling for high fire.
 - a. Check Series 90 controller.
 - b. If Series 90 controller is calling for high fire, check modulating-motor power supply, modulating-motor control wiring, and modulating motor.
2. If jumpering terminals 11 and 12 starts modulating motor to run toward high-fire position, inspect and clean contacts M3A as instructed below.
3. If motor still will not run to high-fire position, install a new R4181A.

O. MODULATING MOTOR DOES NOT RUN TO LOW-FIRE POSITION (at 112 sec) Jumper terminals 10 and 12.

1. If that does not run motor to low-fire position, check motor power supply, motor control wiring, motor, and Series 90 controller.
2. If jumpering terminals 10 and 12 runs motor to low-fire position, inspect and clean contacts M1B and M3B as instructed below.
3. If that does not correct the trouble, install a new R4181A.

TRANSIENT TROUBLE

In any electrical or electronic device, trouble of a transitory nature may sometime occur. Such trouble may be caused by a short circuit or an open circuit in a coil, capacitor, or resistor; and last only while the faulty component is passing through a certain temperature range or occur only when it reaches a certain temperature. Because of its fleeting nature, the cause of such trouble may be difficult to determine. Substituting a new vacuum tube or a new 4K relay will help to determine whether either of those components is at fault. But if such fault develops in any other R4181A component, it is recommended that R4181A be returned to the factory for repair.

CLEANING CONTACTS

Relay and timer contacts need be cleaned only when the possibility of dirty contacts is indicated. Contacts should be cleaned only with Honeywell Contact Cleaner, part number 132569. The cleaner comes in a pressurized spray can; instructions for its use are printed on the can.

DO NOT use other commercial contact cleaners - these may leave deposits on the contacts or damage chassis parts.

DO NOT use any abrasive object to clean contacts.

DO NOT push in relays - except where specifically instructed to do so. This may damage the relay and is an unsafe practice because it overrides the safety function of the device. Locations of the relay and timer contact positions are shown in the figures opposite.

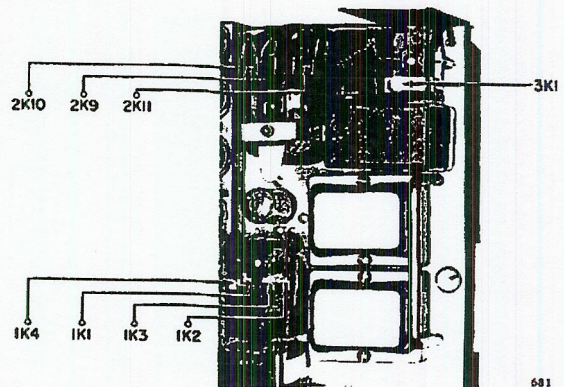


Fig. 7—Identification of relay contacts.

SUFFIX "A" INDICATES INSIDE CONTACTS
SUFFIX "B" INDICATES OUTSIDE CONTACTS

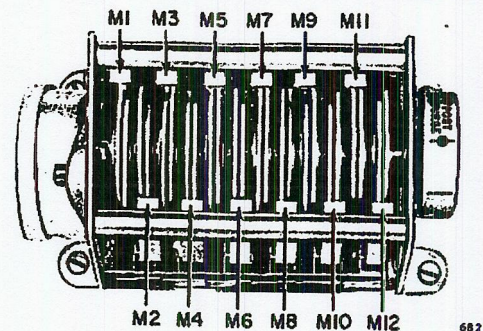


Fig. 8—Identification of timer contacts.