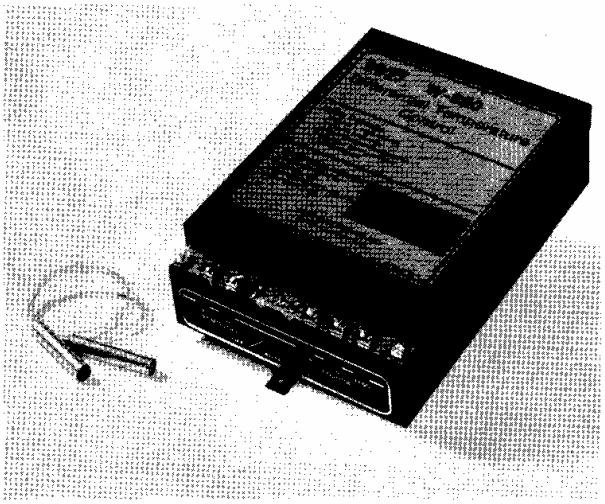
WEI W-900 SERIES DIFFERENTIAL TEMPERATURE CONTROLS



DEVELOPED SPECIFICALLY FOR SOLAR ENERGY SYSTEMS

THE W-900 IS A DIFFERENTIAL TEMPERATURE CONTROL FOR THE AUTOMATIC CONTROL OF CIRCULATING PUMPS, VALVES, BLOWERS, DAMPERS, MOTORS AND OTHER ACCESSORIES USED IN SOLAR ENERGY SYSTEMS

All models contain a solid state differential temperature control with the following features:

- Adjustable Delta Temp. on
- Adjustable Delta Temp. off
- Adjustable freeze protection
- Adjustable over temp. protection
- Separate sensors are not required for freeze or over temperature protection
- R and W terminals for use with remote low voltage thermostat
- LED visual indication of relays activated
- Override switch for relay output K1 (off/auto/on)

W-990-A has a single relay output (K1) with normally open dry contacts rated 3/4 HP at 120 VAC. The relay closes with differential temperature rise or freeze protection and opens on over temperature protection. Two jumpers are provided, J4 and J2, which may be cut to disable pickup of K1 for recirculation type freeze protection and disable dropout of K1 on reaching over temperature protection limits respectively.

W-990-B adds a second LED visual indicator and relay output (K2) with normally open dry contacts rated 3/4 HP at 120 VAC. This relay is normally closed with power applied to the unit and opens on reaching freeze or over temperature protection limits or loss of AC power. Two jumpers are provided, J3 and J1, which may be cut to disable opening of K2 for freeze protection or over temperature respectively.

W-990-C adds a third LED visual indicator and relay output (K3) with normally open dry contacts rated at 3/4 HP at 120 VAC. This relay is normally open and closes on reaching over temperature limit.

The W-900 series of Differential Temperature Controls offer more flexibility than is available with any other differential temperature control and the highest horse power rated relays in the industry are standard. All this at prices competitive with lesser controls.

HISTORY

Webb Electronics is over fifteen years old and has been active in the solar voltaic and solar thermal control field for over four years. WEI has, up to now, sold all solar products only on a private label basis. The W-990 series is a proven controller. It has been sold with slight modification in a different package under private label for over three years. During this time, only two controllers have been returned as field failures and one was due to installer error.

WEI

WEBB ELECTRONICS INC.
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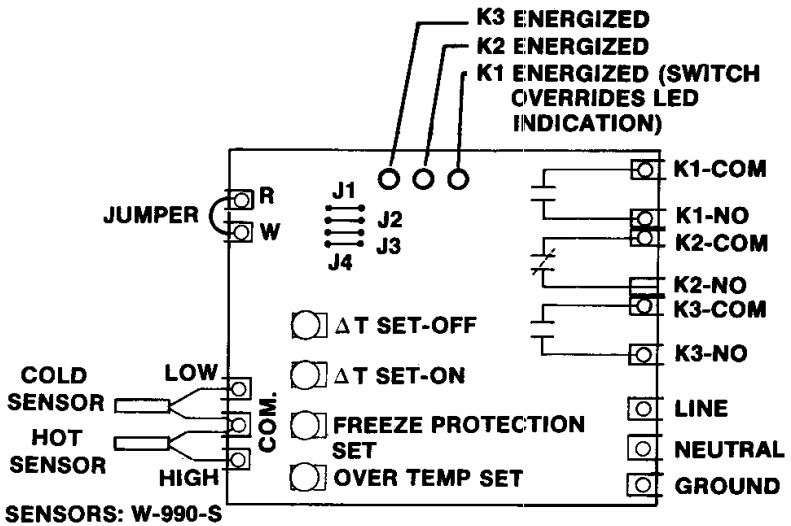
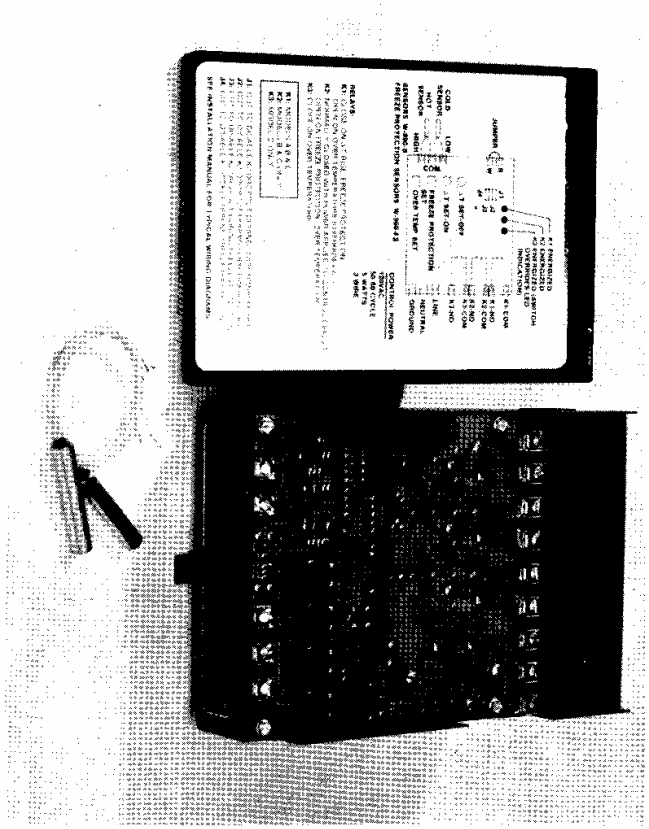


SENSORS: W-990-S
FREEZE PROTECTION SENSORS: W-990-FS

CONTROL POWER
120VAC
50/60 CYCLE
5 WATTS
3 WIRE



RELAYS:
K1: CLOSE ON ΔT RISE, FREEZE PROTECTION
OPEN ON OVER TEMPERATURE (OVERRIDES ΔT)
K2: NORMALLY CLOSED WITH POWER APPLIED TO CONTROL CIRCUIT
OPEN ON FREEZE PROTECTION, OVER TEMPERATURE
K3: CLOSE ON OVER TEMPERATURE

K1: MODELS A,B,& C
K2: MODELS B & C ONLY
K3: MODEL C ONLY

J1: CUT TO DISABLE K2 DROPOUT DURING OVER TEMPERATURE
J2: CUT TO DISABLE K1 DROPOUT DURING OVER TEMPERATURE
J3: CUT TO DISABLE K2 DROPOUT DURING FREEZE PROTECTION
J4: CUT TO DISABLE K1 PICKUP DURING FREEZE PROTECTION

SPECIFICATIONS

TEMPERATURE SETTING RANGES:
Differential temperature controls—Adjustable ON and OFF differentials from 0° to 50°F (0° to 28°C). Factory set at 10°F (5.6°C) temperature difference ON and 3°F (1.7°C) temperature difference OFF. Calibrated potentiometers may be adjusted without tools or test equipment.

Freeze Protection
Freeze Protection ON—Adjustable from 39°F (3.9°C) to 50°F (10°C). Factory set at 39°F. Calibrated potentiometer may be readjusted without tools or test equipment.
Freeze protection differential—6°F (3.3°C)

Overtemperature Protection
Overtemperature protection ON—Adjustable from 70°F (21.1°C) to 180°F (82.2°C).
Factory set at 180°F. Calibrated potentiometers may be readjusted without tools or test equipment.
Overtemperature differential 4°F (2.2°C)

ELECTRICAL RATINGS

Input Voltage—120 VAC, 50/60 Hz.
Power Consumption—5 Watts maximum.
Load Relay Contacts:
30 Amps at 120/240 VAC
3/4 Hp. at 120 VAC
Continuous current limited to 13.8 Amps full load by printed circuit wiring.

AMBIENT TEMPERATURE RANGE

Controller—0° to 122°F (-17.7° to 50°C)
Temperature Sensor—Minus 50° plus 400°F (-46° to 204°C)

MOUNTING

Controller—Two screw holes in back of housing just above printed circuit board. Two secondary mounting holes are accessible by removing the printed circuit board, Fig. 2. Electronic temperature sensors—the sensors may be mounted by a clip to flat plates, with a hose clamp to pipes or in an immersion well for tank sensing, Figs. 1 and 3.

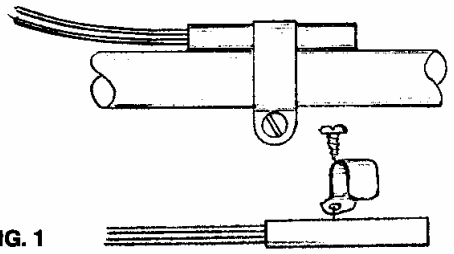


FIG. 1

WIRING CONNECTIONS

Low voltage connections on outside of box.
1 Hot sensor
2 Sensor common
3 Cold sensor
4 W
5 R

HIGH VOLTAGE CONNECTIONS inside box
1 K1 common
2 K1 No
3 K2 common - Available
4 K2 No B & C models only
5 K3 common - Available
6 K3 No C model only
7 Line
8 Neutral
9 Earth Ground

DIMENSIONS: See Fig. 2

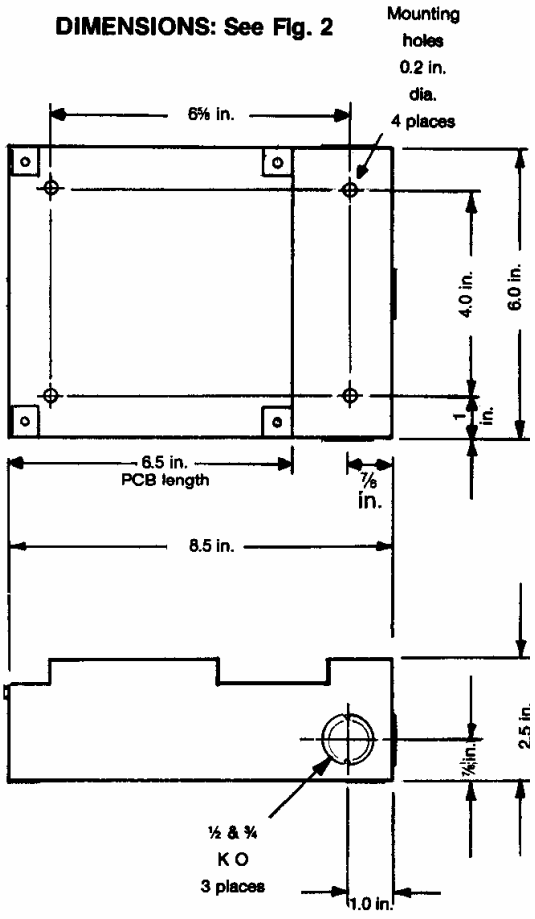


FIG. 2

INDICATOR LIGHTS:

1 K1 Energized
2 K2 Energized - Available on B & C models only
3 K3 Energized - Available on C model only

OFF-AUTO-ON SWITCH

Manual override switch which permits automatic operation of the controller or allows the controller to be switched directly ON and OFF. Switch does not affect the operation of the auxillary relay (K2 and K3 available on the B and C models) or affect any of the LED function indicators.

INSTALLATION

Installation must be performed by trained service personnel, and in accordance with the national electrical code and local codes.

LOCATION

Locate the control in any convenient, protected location near the controlled equipment to minimize wiring runs. Ensure sufficient side to side clearance to allow screwdriver access to cover screws and front access to the mode switch. Locate the control where the ambient temperature does not exceed 122°F (50°C) or go below 0°F (-18°C).

MOUNTING

Remove the cover screws and remove the cover. Locate the controller case on any convenient, flat surface near the circulator pump or blower. Mount the controller with two screws through the two holes in the back of the case just above the printed circuit board. Two secondary mounting holes are accessable by removing the printed circuit board.

WIRING

CAUTION

RISK OF ELECTRICAL SHOCK. DISCONNECT ALL POWER DURING INSTALLATION OR SERVICING TO PREVENT ELECTRICAL SHOCK OR POSSIBLE DAMAGE TO THE EQUIPMENT. MORE THAN ONE DISCONNECT SWITCH MAY BE REQUIRED TO DE-ENERGIZE THIS DEVICE.

The W-990 series of Differential Temperature Controls can be used for numerous applications in solar energy systems. Refer to Fig. 8 through Fig. 11 for typical examples of W-990 hookups for hydronic, air and pool systems. The W-990 series may be used with only one sensor for fixed temperature applications.

The low voltage class II connections, sensors and thermostats are made at the front edge of the printed circuit board outside the controller case. The high voltage connections are made at the back edge of the printed circuit board inside the case. Check rating of circulating pump or blower and other loads to be sure they do not exceed the relay contact rating of the W-990 controller. If rating of motor or loads exceeds the W-990 controller rating, install an adequately rated relay or contactor to operate motor.

Make wiring connections to identified screw terminals or PCB edge. The sensor leads should be at least No. 22 wire for lengths up to 100 ft. No. 18 wire should be used for runs up to 500 ft. Sensor wire connections and splices, except to control screw terminals, should be soldered and then covered with a wire nut filled with RTV. Tie the wires in a knot just below the connection so the soldered connection will not take any strain.

All relay contacts are dry, i.e., you must supply power to one terminal in order to get power out of the other terminal when the relay contact closes. This allows greater flexibility in application. Low voltage and high voltage switched circuits may both be contained within the same wiring space, provided all wiring is insulated for the highest voltage.

CAUTION: MAKE ALL WIRING CONNECTIONS AND CHECK FOR CORRECTNESS *BEFORE* APPLYING POWER. IMPROPER WIRING MAY CAUSE PERMANENT DAMAGE.

GROUNDING

All large metal pieces of any collector array system *must* be grounded. Ungrounded collector plates can generate dangerous and destructive voltages during nearby lightning strikes.

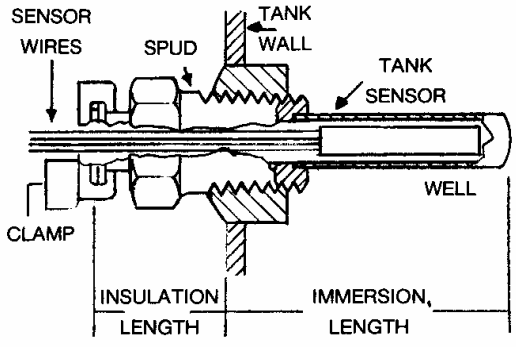


FIG. 3 TANK SENSOR INSERTED IN IMMERSION WELL.

SENSOR INSTALLATION

COLLECTOR SENSOR (HOT SENSOR)

The collector sensor in an air system will normally be mounted directly to the collector plate with a bracket as shown in Fig. 5. Great care must be exercised in hydronic systems so that installation of the sensor does not cause penetration of the liquid passages and leaks. We recommend that the sensor be strapped to the collector exit pipe or mounted in an immersion well in the collector exit pipe. Figs. 1 and 3. Bring high temperature leads outside of installation and make connection to thermostat cable outside insulation next to pipe. Do not clamp on wires or run over any sharp edges.

ADJUSTMENTS AND PROGRAMMING

ADJUSTMENTS

The four potentiometer adjustments should be adjusted as required for each job. The control comes adjusted for 10° F ΔT on, 3° F ΔT off. 39° F freeze protection and 180° F overtemperature protection. These settings are probably acceptable for a domestic hot water heating system. We would suggest a 40° to 45° F ΔT on with a 20° to 30° F ΔT off setting for hot air space heating with overtemperature limit set at 90° F and freeze protection disabled.

PROGRAMMING

There are four (4) jumpers provided for programming the functioning of relays K1 and K2. The function of each jumper is as follows:

J1 cut to disable drop out (opening) of K2 for overtemperature protection.

J2 cut to disable drop out (opening) of K1 for overtemperature protection.

J3 cut to disable drop out (opening) of K2 for freeze protection.

J4 cut to disable pickup (closing) of K1 for freeze protection (recirculation inhibit)

CAUTION: ONE OR MORE JUMPERS MAY HAVE TO BE CUT TO ALLOW PROPER OPERATION OF THE SYSTEM BEING CONTROLLED.

CHECKOUT PROCEDURE

When components are installed and wiring is completed, recheck the wiring and apply power. Check control for proper operation as follows:

1. Disconnect both sensors. With the R and W terminals jumpered together, the output relays should be checked for the proper "freeze protection" operation.
2. With jumpers, short both sensor inputs to sensor common. With R and W terminals jumpered together, the output relays should be checked for the proper "overtemperature protection" operation.
3. Remove the jumpers from both sensor inputs to common and connect the sensor leads to the control. If a remote low voltage thermostat is used, connect its R and W terminals to the R and W terminals on the control, after removing the jumper between these terminals.
4. Before leaving the installation, a complete operating cycle should be observed to see that all components are functioning properly.

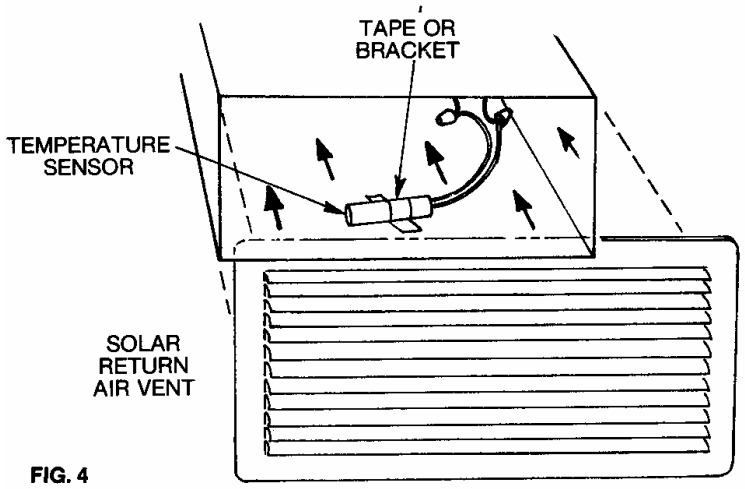


FIG. 4

INSTALLATION: ROOM AIR SENSOR

1. Install A. sensor just behind the solar return air grill.
2. Use double sided foam tape, 3/8" copper pipe clamp, or other method to attach sensor to convenient attachment point.
3. Make thermostat wire connections to sensor inside duct or at other convenient location and **solder** the connection for better reliability.
4. Use rubber grommet or similar padding where wire goes through duct metal to prevent damage to wires.
5. **DO NOT** clamp on wires or run over any sharp edges.
6. Connect other end of thermostat of cable to proper terminals at control terminal strip.

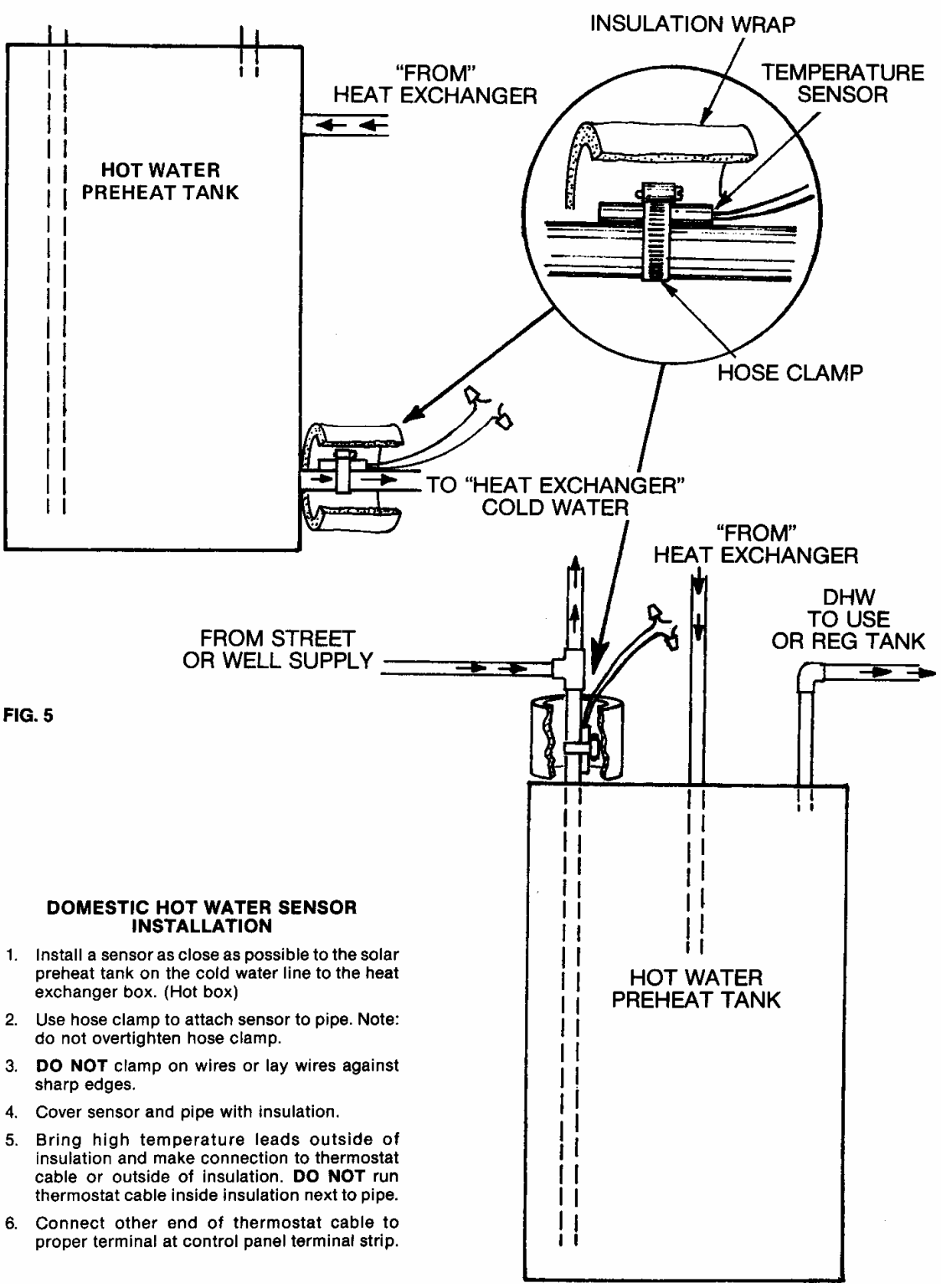


FIG. 5

DOMESTIC HOT WATER SENSOR INSTALLATION

1. Install a sensor as close as possible to the solar preheat tank on the cold water line to the heat exchanger box. (Hot box)
2. Use hose clamp to attach sensor to pipe. Note: do not overtighten hose clamp.
3. **DO NOT** clamp on wires or lay wires against sharp edges.
4. Cover sensor and pipe with insulation.
5. Bring high temperature leads outside of insulation and make connection to thermostat cable or outside of insulation. **DO NOT** run thermostat cable inside insulation next to pipe.
6. Connect other end of thermostat cable to proper terminal at control panel terminal strip.

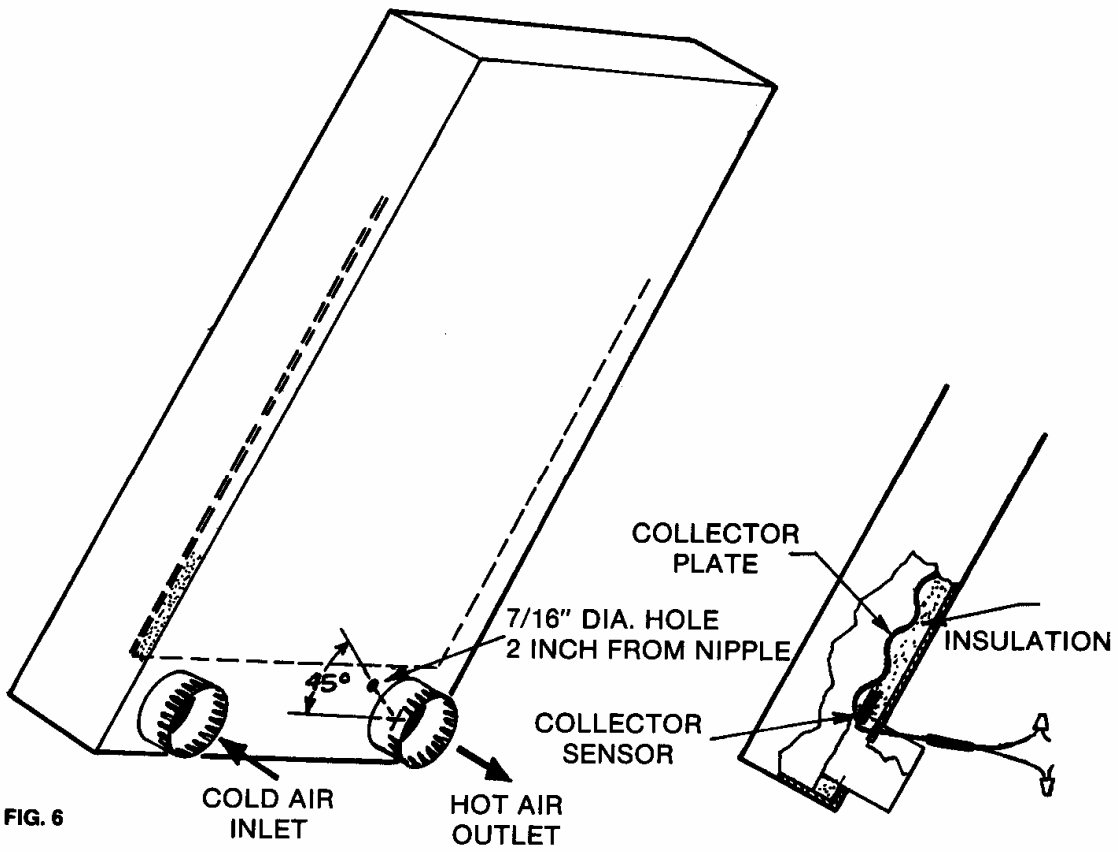


FIG. 6

EXAMPLE OF AIR COLLECTOR INSTALLATION

COLLECTOR SENSOR INSTALLATION

WARNINGS

1. Do not run thermostat cable inside or in contact with bare hot air ducts.

   Temperature rating of thermostat cable is as low as 60°C (140°F) and insulation can be damaged by hot air from the collector.

2. The collector plate must be grounded or dangerous and destructive voltages will be induced by nearby lightning strikes.

INSTALLATION

1. Sensor goes in hottest (last) collector in series connected string.
2. Drill hole through back of collector approximately 2 inches outside of **hot air outlet** nipple on a 45° angle from the centerline of nipple. Use a 7/16 inch drill.
3. Push sensor through hole into collector and attach to collector plate or wedge under edge of collector plate.
4. Fill 7/16 inch hole in back of collector with silicone rubber (RTV) caulking compound or equivalent.
5. Tape wire from collector sensor to **outside** of duct insulation.
6. Make connections to cable going to control panel and **solder connections** for best reliability. Use electronic grade (rosin core) solder only.
7. Tape or wire nut over soldered connections and tape to outside of duct insulation for support.
8. Run cable going to control panel outside of duct insulation.

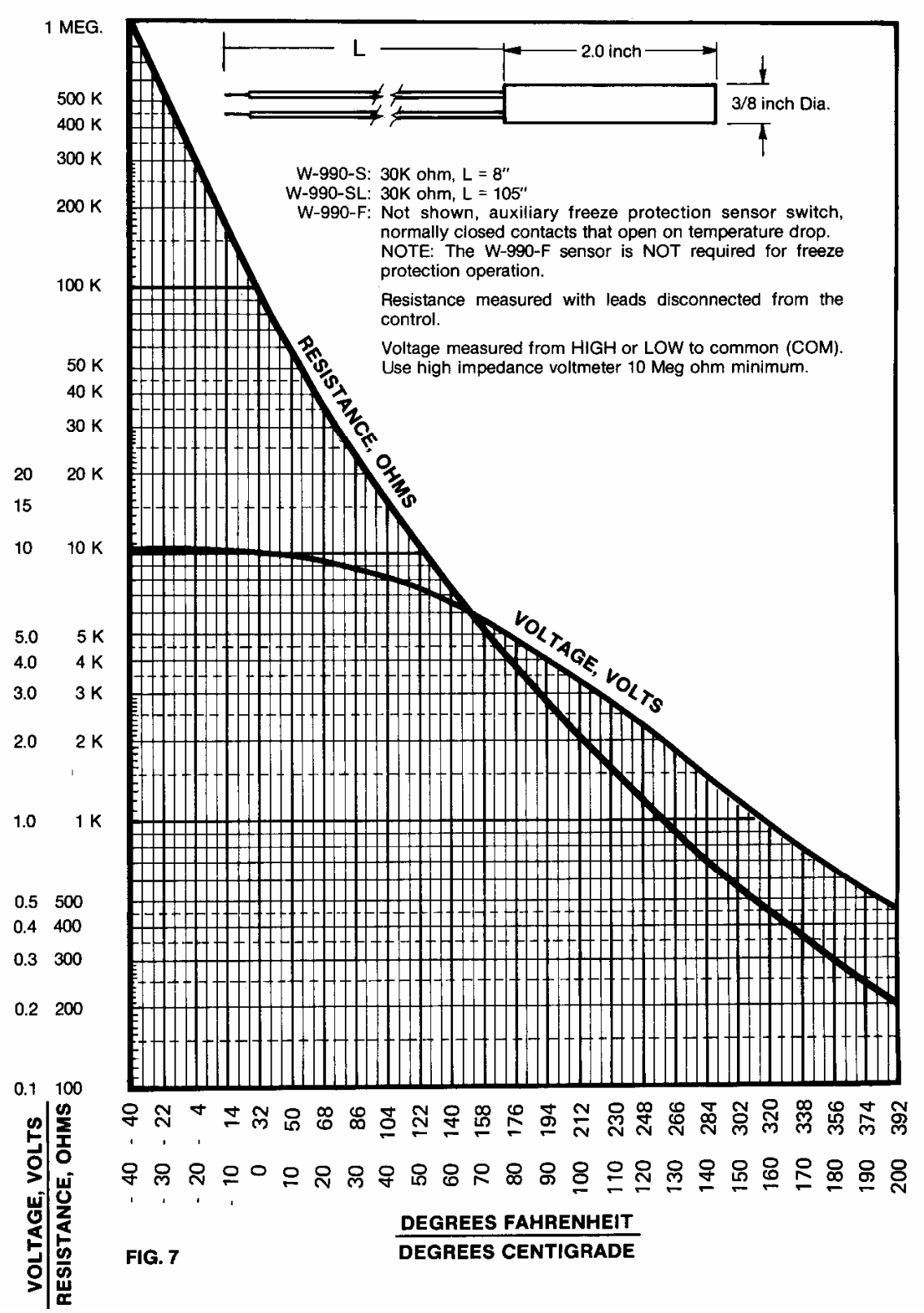

L
2.0 inch
3/8 inch Dia.
W-990-S: 30K ohm, L = 8"
W-990-SL: 30K ohm, L = 105"
W-990-F: Not shown, auxiliary freeze protection sensor switch, normally closed contacts that open on temperature drop. NOTE: The W-990-F sensor is NOT required for freeze protection operation.
Resistance measured with leads disconnected from the control.
Voltage measured from HIGH or LOW to common (COM). Use high impedance voltmeter 10 Meg ohm minimum.
RESISTANCE, OHMS
VOLTAGE, VOLTS
1 MEG.
500 K
400 K
300 K
200 K
100 K
50 K
40 K
30 K
20 K
10 K
5 K
4 K
3 K
2 K
1 K
500
400
300
200
100
20
15
10
5.0
4.0
3.0
2.0
1.0
0.5
0.4
0.3
0.2
0.1
- 40 - 22 - 4 14 32 50 68 86 104 122 140 158 176 194 212 230 248 266 284 302 320 338 356 374 392
- 40 - 30 - 20 - 10 0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200
DEGREES FAHRENHEIT
DEGREES CENTIGRADE
VOLTAGE, VOLTS
RESISTANCE, OHMS

FIG. 7

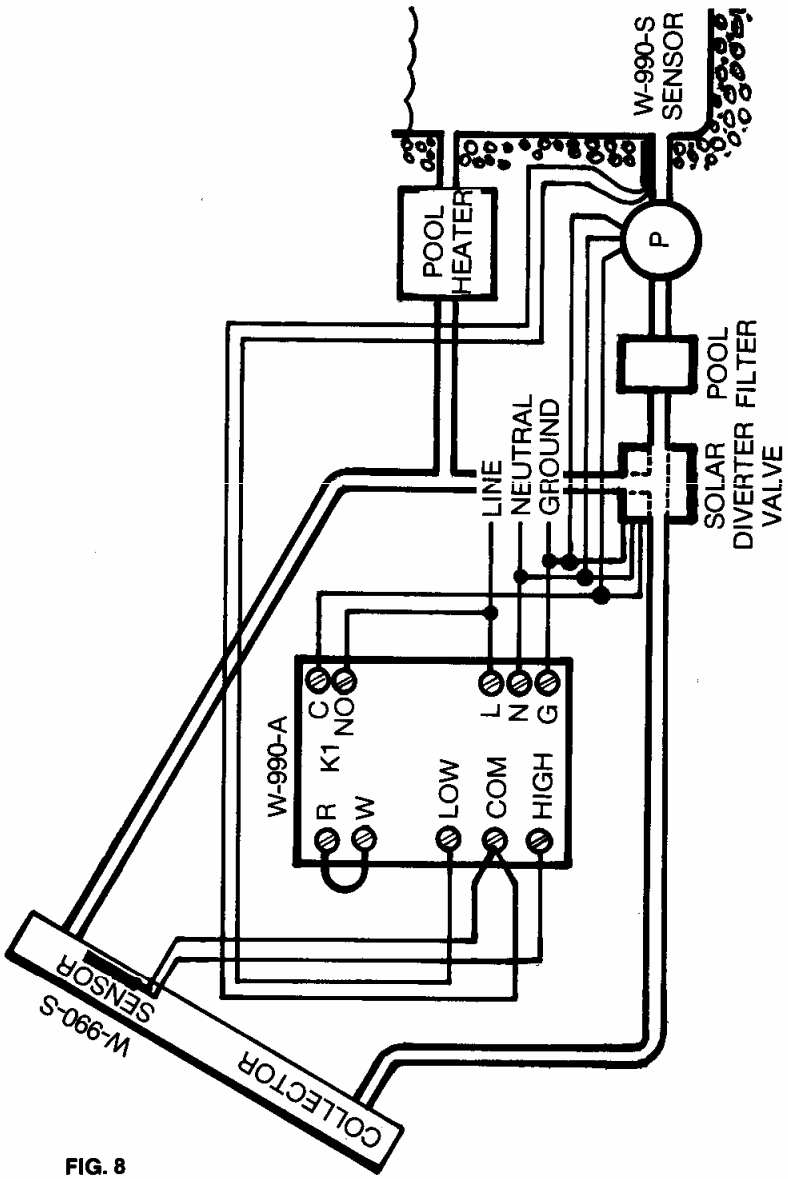


FIG. 8

BASIC SOLAR POOL HEATING SYSTEM

The basic solar pool heating system shown above is a representation of the many pool heating systems available. This representation does not take into account the pool filtering and pool sweep time clocks or the backup heater controls. The three power lines going from the W-990-A control would normally go to the existing pool controls to indicate to those controls that solar was available and that the pool needed to be heated. The existing pool controls would then control the backup heater and pump.

Please feel free to contact our engineering department to discuss specific applications of our W-990 series of controls for solar heating of spas and pools.

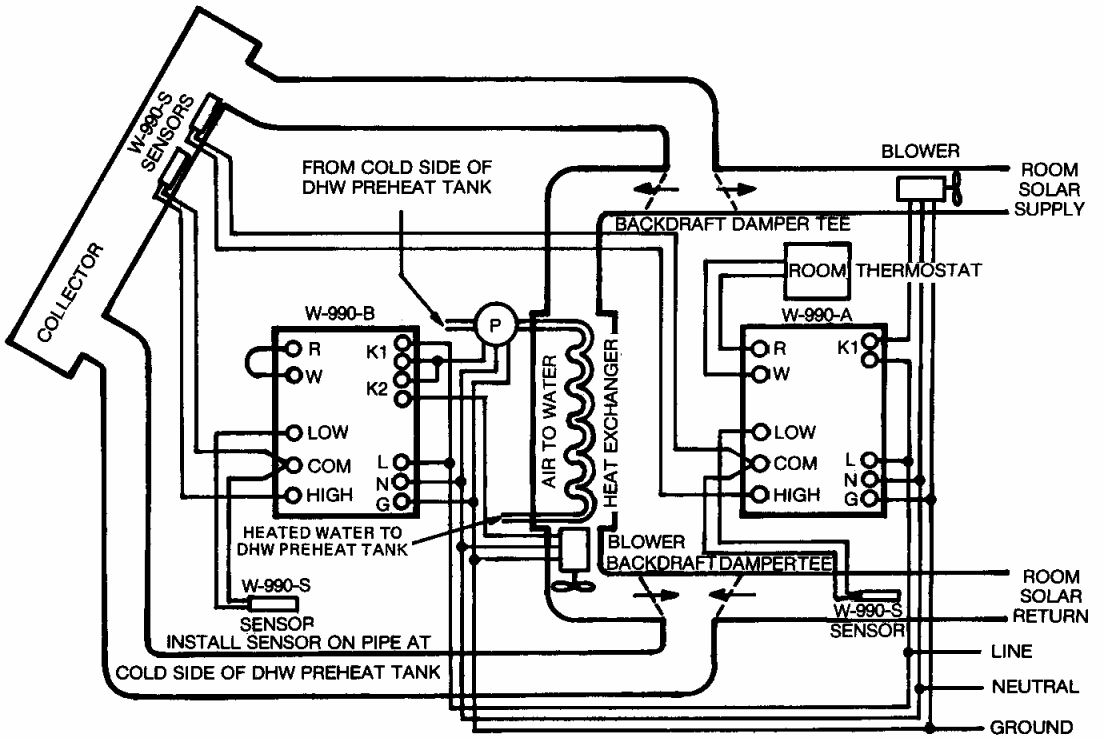


FIG. 9

SYSTEMIZER II
COMBINATION DHW AND SPACE HEATING SYSTEM

The SYSTEMIZER II combination DHW and space heating system uses two differential temperature controls, greatly increasing system efficiency and safety. The increase in efficiency is due to these factors:

- Lower differential temperatures may be set on the DHW control than would be comfortable for the space heating.
- The system allows use of the low energy early morning sun to preheat water even before the collector is hot enough to heat space. This will increase energy collected as much as 9%.
- When the collector is collecting enough energy the system will allow both blowers to operate, thus decreasing collector temperature and increasing efficiency.

The system has the following safety features:

- When the collector sensor of the W-990-B senses that temperatures are approaching freezing the pump will be turned on without the blower being turned on, thus preventing freezing of the water coils in the air to water heat exchanger due to thermosiphoning of cold air from the collector.
- The W-990-A over temperature control can be set at 80° or 85°F and this will limit space heating to these temperatures even if the room thermostat fails.

To prevent the space heating blower from turning on during the freeze protection mode, it is necessary to cut J4 on the W-990-A control. It is not necessary to cut any jumpers on the W-990-B control for proper operation of the system.

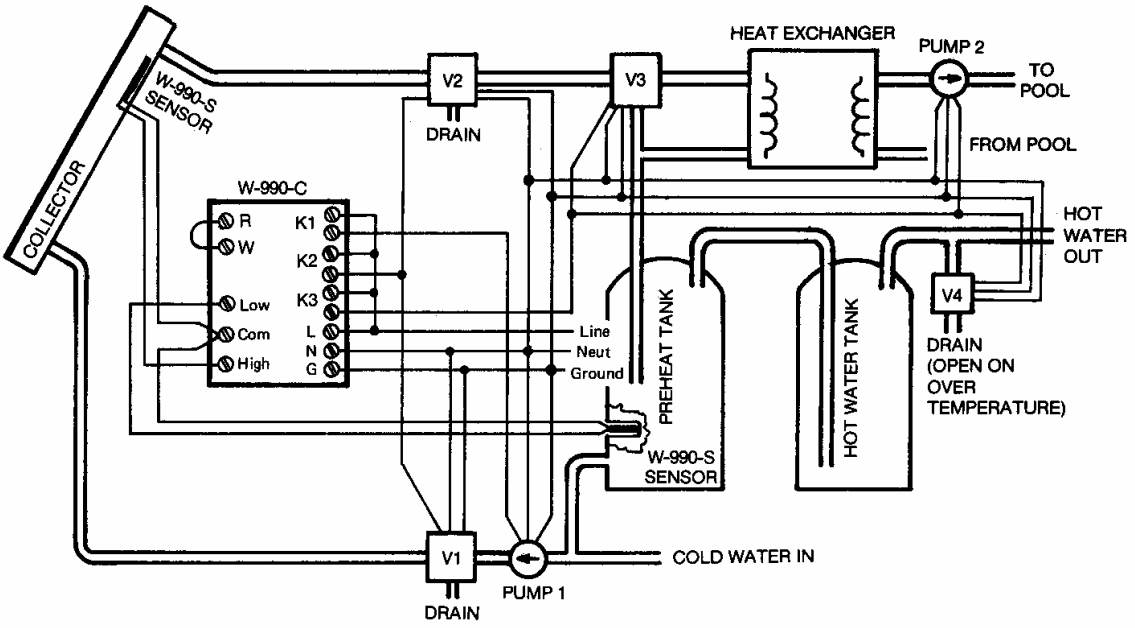


FIG. 10

HYDRONIC DRAIN DOWN SYSTEM WITH SECONDARY LOAD OR ENERGY DUMP

The above system can operate in four ways:

1. Without V1, V2, V3, V4, P1 and the heat exchanger and with the W-990-C replaced with a W-990-A, we have a simple domestic hot water preheat that will recirculate for freeze protection and the pump will stop when the stored water reaches overtemperature setting. The problem with this system is that the water in the collectors can boil.

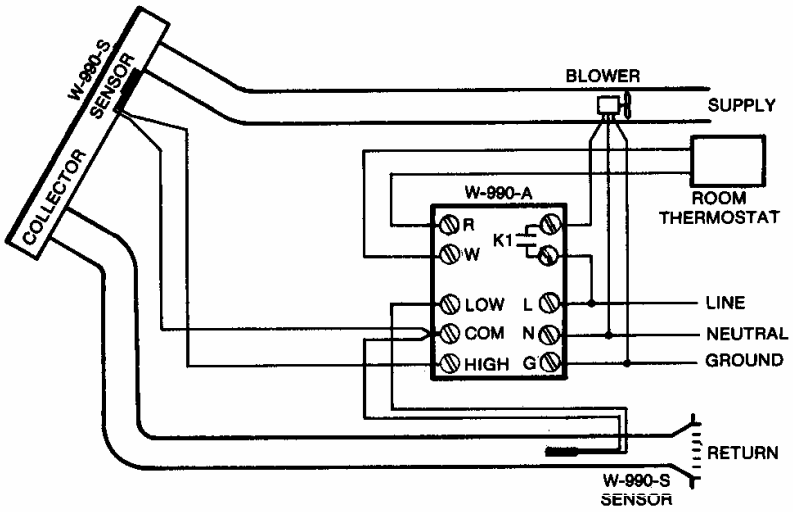
   To disable the pump shutdown during overtemperature protection mode cut jumper J2. This may allow the water in an open storage tank to boil but the collectors will not see stagnant conditions.

2. Without V3, V4, P2 or the heat exchanger and with the W-990-C replaced with a W-990-B, we have a domestic hot water preheat that will drain down for freeze protection and for overtemperature protection. The draindown on overtemperature will prevent steam from forming in the stagnant collector. To prevent the pump P1 from turning on with the system drained down during the freeze protection mode, it is necessary to cut jumper J4. The pump P1 will be shutdown by the controller automatically during the overtemperature protection mode.

3. Without V4 installed, the system will divert energy to a secondary load. When the preheat tank has reached its temperature set point V3 will be energized, diverting the hot water from the collector through the heat exchanger and pump P2 will be energized. A slightly less efficient system would eliminate V3 and the water from the collector loop would always flow through the heat exchanger. To prevent the pump P1 from turning on with the system drained down during the freeze protection mode, it is necessary to cut jumper J4. To disable pump P1 shutdown during the overtemperature protection mode, it is necessary to cut jumper J2. To prevent the system from draining down during overtemperature protection mode, it is necessary to cut jumper J1.

4. Without V3, P2 and the heat exchanger installed the system will dump the excess energy collected, thus preventing collector stagnation. By draining the hot water from the preheat tank through the hot water tank you prevent the hot water tank from cooling off and its heater from turning on. To prevent the pump P1 from turning on with the system drained down during the freeze protection mode, it is necessary to cut jumper J4. To disable the pump shutdown during the overtemperature protection mode, it is necessary to cut jumper J2. To prevent the system from draining down during overtemperature protection mode, it is necessary to cut jumper J1.

FREEZE PROTECTION: When the collector sensor senses that it is approaching freeze conditions the system will drain down through three way valves V1 and V2.



This system will turn on the blower when the collector is hot and the room thermostat is calling for heat. To prevent the blower from turning ON during freeze protection mode cut jumper J4. To disable the internal over temperature protection cut jumper J2. Jumpers J1 and J3 are not used in a W-990-A.

The above system may be used for processes or room heating without an external thermostat by jumpering the R and W contacts and not cutting jumper J2. The maximum temperature is then controlled by the overtemperature potentiometer setting inside the control.

FIG. 11

STANDARD SIMPLE ROOM AIR HEATING SYSTEM.

REPAIRS AND REPLACEMENT

Field repairs must not be made. Replacement units may be obtained from your distributor or directly from WEI. When ordering a replacement controller, specify product #"W-990" and series type "A", "B" or "C" and serial # if available.

LIMITED 1 YEAR WARRANTY ON SOLAR CONTROLLER ONLY

We warrant the solar controller to be free from defects in material and workmanship under normal use and we will, within 1 year from the date of purchase, repair, or at our option, provide a replacement (new or rebuilt, at our option) if the solar controller proves to be defective.

This warranty applies only to the solar controller itself, and does not apply to components connected therewith.

Written notice of any defect of the solar controller should be given, within 10 days after such defect becomes apparent, to the warrantor hereunder, which is Webb Electronics, Inc., 272A South Monaco Parkway, Denver Colorado, 80224. In the event that this solar controller requires replacement or repair, the purchaser shall be responsible for causing the solar controller to be delivered to Webb Electronics, Inc. at the above address. The replacement shall be returned to the purchaser F.O.B., Denver, Colorado.

These warranties shall NOT apply if the solar controller (a) has been subjected to accident, fire, alteration, abuse or misuse or customer negligence; (b) is moved from one location to another; or (c) has been damaged by hurricane, tornado, wind, freezing, flood or other Acts of God.

WEBB ELECTRONICS, INC.'S SOLE LIABILITY WITH RESPECT TO ANY DEFECT IS SET FORTH IN THIS WARRANTY AND ANY CLAIMS FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES ARE EXCLUDED.

Some states do not allow the exclusion of limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you. This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

November 1, 1977.