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SOLAR HOUSE

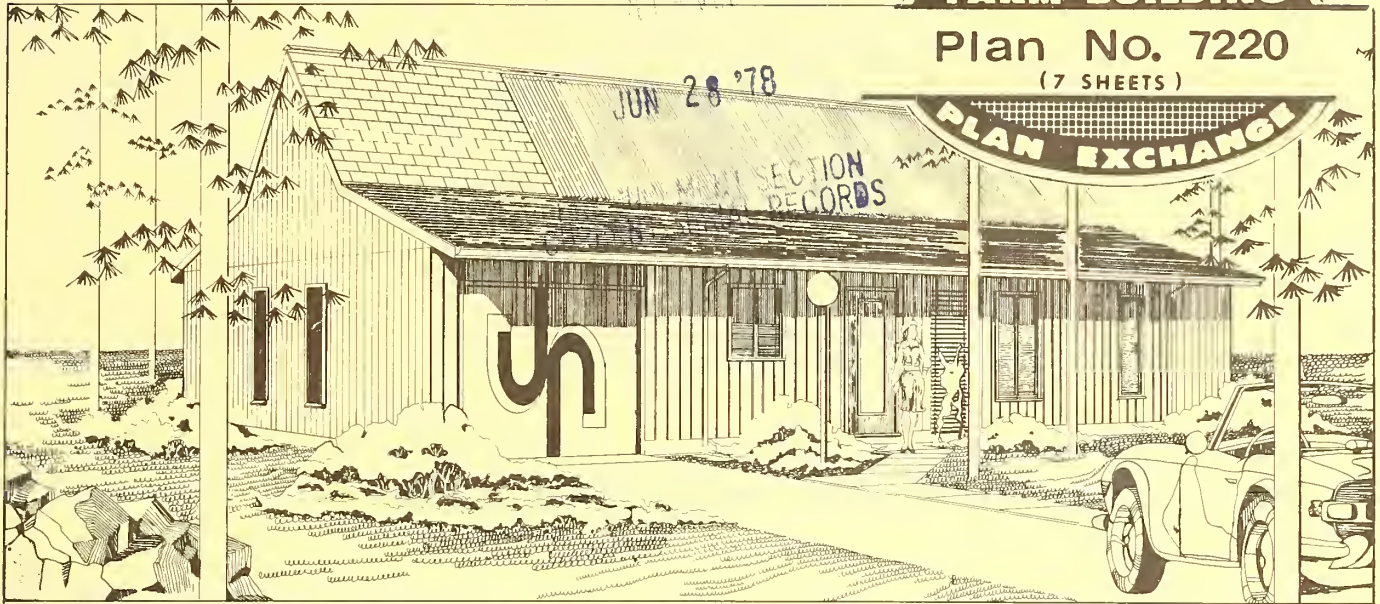
Experimental

U.S. DEPT. OF AGRICULTURE
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SERIALIZED

COOPERATIVE
FARM BUILDING

Plan No. 7220
(7 SHEETS)

PLAN EXCHANGE

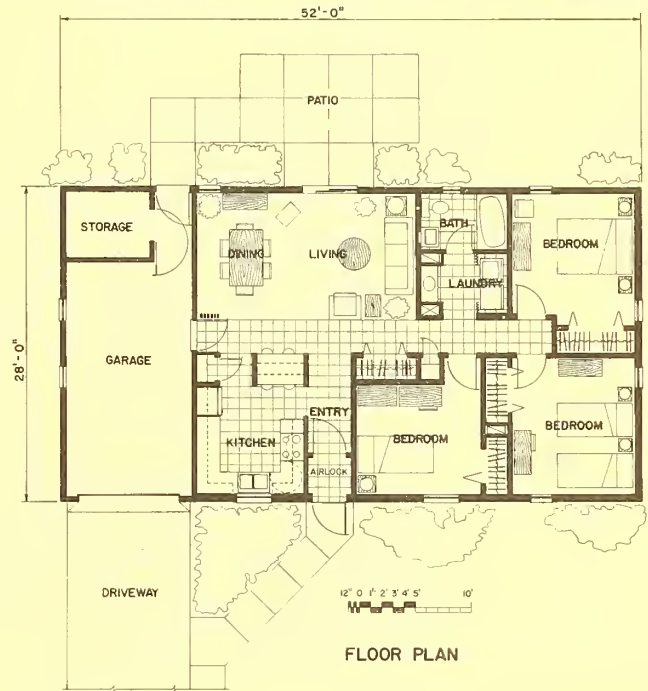


The attic of this USDA experimental house conserves energy and serves as a solar collector. Tests have demonstrated that the attic can collect as much as 59 percent of the solar energy available during January. Energy collection exceeding 50 percent is considered very efficient.

In addition to the heat-collection attic, a 12-inch layer of crushed rock beneath the house serves as a heat-storage bed. Otherwise, the house is conventional.

The solar-heating system is simple in design. Translucent fiberglass panels and polyester film replace conventional roofing on the south roof slope, transmitting sunshine into the attic where it is absorbed by a black plywood floor. The collected solar-heated air is then circulated to heat both the house and the rock-storage bed beneath the floor. Additionally, the rock bed will normally store a 3-day supply of heat output to warm the dwelling at night and during cloudy or rainy weather. The heating system is easily modified to meet the demands of other geographic and climatic areas. See "Exterior Elevation Variations" on back page for suggestions on proper zone location and architectural treatment.

The house is very livable. It contains three ample bedrooms with spacious closets and convenient bath and laundry facilities. (For a larger bathroom, the laundry could be moved into the garage storage room.) The living-dining area is secluded in the rear with an adjoining patio. The living area and kitchen snack bar are directly accessible from both the garage and main entry, allowing an excellent traffic pattern.



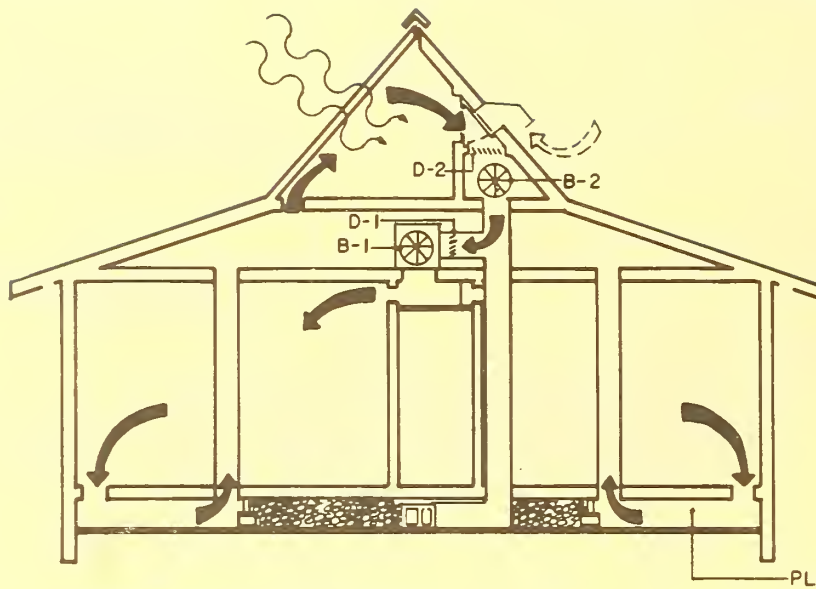
Complete working drawings may be obtained from the Extension agricultural engineer at your State land-grant university. There may be a small charge to cover cost of printing.

If you do not know the location of your State land-grant university, send your request to Agricultural Engineer, Extension Service, U.S. Department of Agriculture, Washington, D.C. 20250. Your request will be forwarded to the correct university.

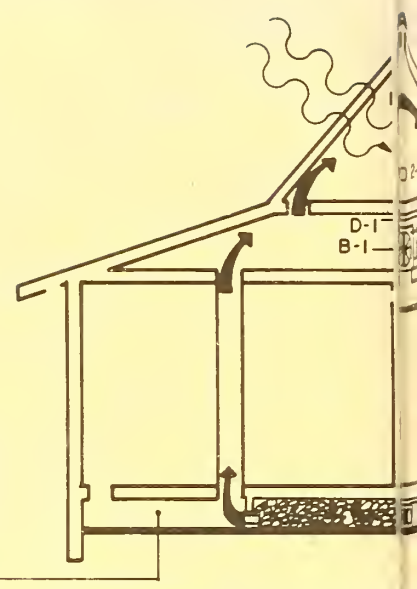
ORDER PLAN NO. 7220, SOLAR HOUSE, Experimental

Washington, D.C.

Issued March 1978



HEATING - ATTIC TO HOUSE
 COOLING - OUTSIDE AIR TO HOUSE (OPTIONAL)



HEATING - ATTIC TO STORAGE
 COOLING - OUTSIDE AIR TO STORAGE

AIR-FLOW DIAGRAMS FOR SIX OPERATING MODES



T₁ AND T₂ - 24V HEATING-COOLING THERMOSTATS, HEAT-OFF-COOL SELECTION.

HONEYWELL - T87F AND Q539A SUBBASE
 DAYTON - 2E096 AND 2E151 SUBBASE
 PENN CONTROLS - T-51ACG-1 AND Y 51CG-1 SUBBASE
 WHITE ROGERS - 1F 36-910 AND S20-1 SUBBASE

T₃ - TWO-SPEED BLOWER THERMOSTAT, SPDT LINE VOLTAGE, 1/2 HP RATED. SET FOR 100°F, 2° TO 7°F DIFFERENTIAL AMBIENT TEMPERATURE RANGE 0° TO 150°F.

PENN CONTROLS - A19BAC-1
 DAYTON - 2E206
 HONEYWELL - T631C1103A

T₄ - FAN AND LIMIT CONTROL SUPPLIED WITH FURNACE. USE FURNACE MANUFACTURERS SUGGESTED SETTINGS.

DM-1 AND DM-2 - SPRING RETURN DAMPER MOTOR. 2-POSITION (OPEN-CLOSE) POWER OPEN, SPRING RETURN. 115V CONTROL VOLTAGE.

BARBER COLMAN - MA - 405
 HONEYWELL - M436A1116
 PENN. CONTROLS - M811ACB-1 & 24V TRANSFORMER

D₁ AND D₂ DAMPERS - 12" x 20" SPECIFY END AND BLADE SEALS, FULL OPEN & FULL CLOSED USE.

JOHNSON SERVICE CO. - D-1300
 AMERICAN WARMING & VENTILATING - DAA-P-10
 LOUVERS & DAMPERS, INC. - CD-500
 SOLAR CONTROL CORP.

SDT-1 - DIFFERENTIAL THERMOSTAT AND SENSORS FOR WINTER SOLAR HEATING. SPECIFY 15±1°F TURN ON DIFFERENTIAL AND 5±1°F TURN OFF DIFFERENTIAL, RATED 1/2 HP 115V.

SOLAR CONTROL CORP.
 RHO SIGMA
 HELIO & ROPE GENERAL
 DEKO LABS
 SOLAR ENERGY RESEARCH CORP.

SDT-2 - DIFFERENTIAL THERMOSTAT AND SENSORS FOR SUMMER NOCTURNAL COOLING OF ROCK STORAGE. SPECIFY 5±1°F TURN ON DIFFERENTIAL AND 3±1°F TURN OFF DIFFERENTIAL, RATED 1/2 HP 115V. (OPTIONAL - PRIMARILY FOR DRY CLIMATE AREAS)

SOLAR ENERGY RESEARCH CORP.
 RHO SIGMA
 HELIO & ROPE GENERAL
 DEKO LABS
 SOLAR CONTROL CORP.

B-2 - COLLECTION BLOWER WITH PERMANENT SPLIT CAPACITOR MOTOR. MORE EFFICIENT THAN SHADED POLE MOTOR. AIR FLOW RATE PUT 2 TO 3 CFM/FT² OF COLLECTION WATER COLUMN. HIGH SPEED MOTOR. AIR FLOW RATE OF COLLECTOR SURFACE AT 100°F TO DAYTON 4C058.

B-1 - FURNACE BLOWER: AREA, 1/2" WATER COLUMN MOTOR.

TWO STANDARD HEAT-COOL SWITCHES CONTROL ELECTRIC FURNACE (B-1) IS SET AT 68°F WINTER AUX. HEAT OR COOL IS SET AT 68°F.

DAMPER MOTOR DM-1 IS ENERGIZED TO OPEN DAMPER (D-1). BLOWER MOTOR (DM-2) IS ENERGIZED TO START COLLECTION BLOWER HEATING.

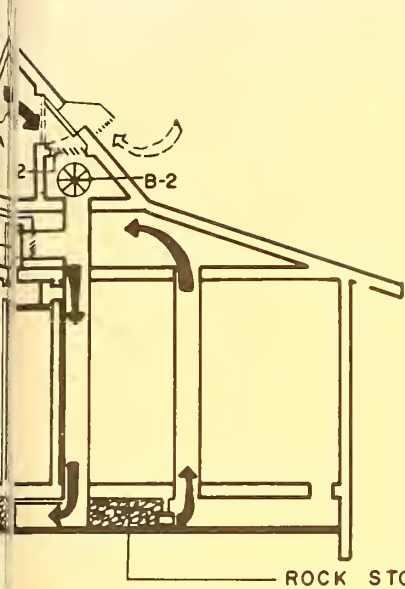
TWO DIFFERENTIAL THERMOSTATS SDT-1 CONTROLS BLOWER DAMPER MOTOR LOCATED IN ATTIC NEAR RIDGE VENT. IN ROCK ONE FOOT IN ON COLLECTOR. S₂ BLOWER STARTS AT LOW TEMPERATURE SET AT 100°F FOR HIGH SPEED BLOWER (B-2) DURING COOLING. S₃ IS 7°F COOLER THAN S₂ AIR THROUGH ROCK OR HOUSE. HEAT-COOL SWITCH ARE LOCATED NEAR BLOWER.

MANUAL CHANGE OVER

- (1) OPEN RIDGE VENT.
- (2) OPEN ROOF VENT TO OUTSIDE.
- (3) SWITCH TO COOLING TEMPERATURE.
- (4) CHANGE BOTH HOUSE AND STORAGE HEAT-COOL SWITCHES.
- (5) OPEN ALL SOFFIT VENTS.

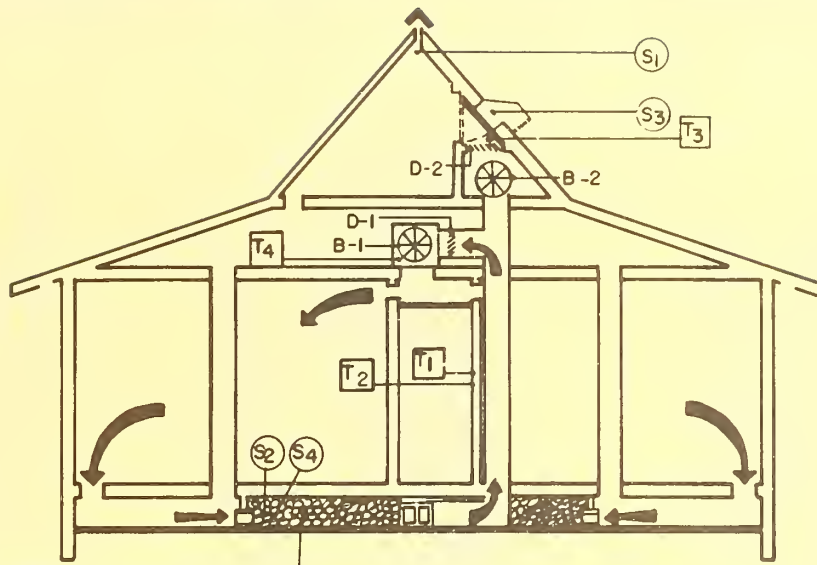
TO CHANGE FROM COOLING TO HEATING

NOTE: AUXILIARY FURNACE IS NOT USED.



ROCK STORAGE BEDS

CHANGE
STORAGE (OPTIONAL)



HEATING - STORAGE TO HOUSE / CONVENTIONAL FORCED-AIR HEATING
COOLING - STORAGE TO HOUSE / CONVENTIONAL FORCED-AIR COOLING

MODES & CONTROL LOCATIONS

15V 60 CYCLE MULTI OR TWO SPEED, TYPE, THESE ARE 40% TO 50% MORE MOTORS. LOW SPEED BLOWER OUTPUT SURFACE AT 3/8 INCHES OUTPUT SHOULD BE 4 TO 5 CFM/FT² INCHES WATER COLUMN. SIMILAR

V 60 CYCLE, ONE CFM/FT² OF FLOOR SUGGEST PERMANENT SPLIT CAPACITOR

RMOSTATS LOCATED IN HALLWAY HEATPUMP. T₁ - CONTROLLING BLOWER R & 75°F SUMMER. T₂ - CONTROLLING 65°F WINTER & 78°F SUMMER.

HIZED WHEN BLOWER (B-1) IS ON & R (B-1) IS TURNED OFF WHEN DAMPER WHEN BOTH DAMPERS ARE OPEN R COOLS HOUSE.

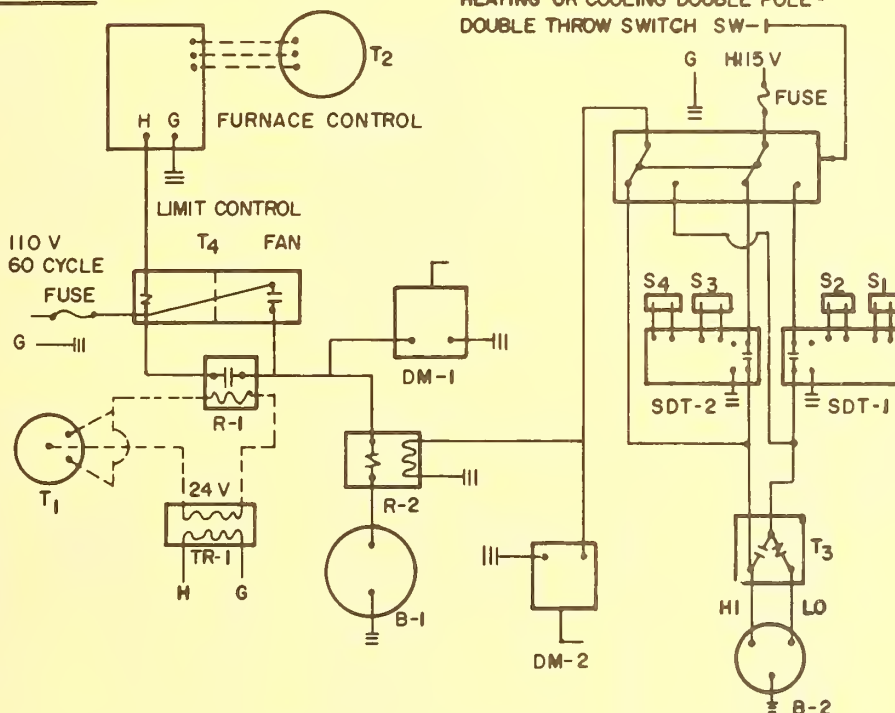
TS CONTROL COLLECTION BLOWER B-2. NG SOLAR HEAT CYCLE. SENSOR (S₁) IS E B SHADED. SENSOR (S₂) IS CENTERED L SIDE. WHEN S₁ IS 15°F HOTTER THAN EED. BLOWER 2-SPEED THERMOSTAT (T₃) BLOWER OPERATION. SDT-2 CONTROLS 3. SENSOR (S₃) IS LOCATED WITHIN S LOCATED NEAR (S₂) IN ROCK. WHEN COLLECTION BLOWER B-2 CIRCULATES COOL . BOTH DIFFERENTIAL THERMOSTATS AND D ON OR IN HOUSING FOR COLLECTION

VER FROM SOLAR HEAT TO COOLING.

WER B-2 & CLOSE OFF ATTIC TO BLOWER. RMOSTAT (SDT-2) WITH SWITCH SW-1. RMOSTATS TO COOL.

TO SOLAR HEAT REVERSE ABOVE CHANGE-OVER.

HEAT PUMP SHOULD BE SIZED BY LOCAL SUPPLIER.



SW-1 - ON-OFF SWITCH, DPDT, RATED 1/2 HP AT 115 V.

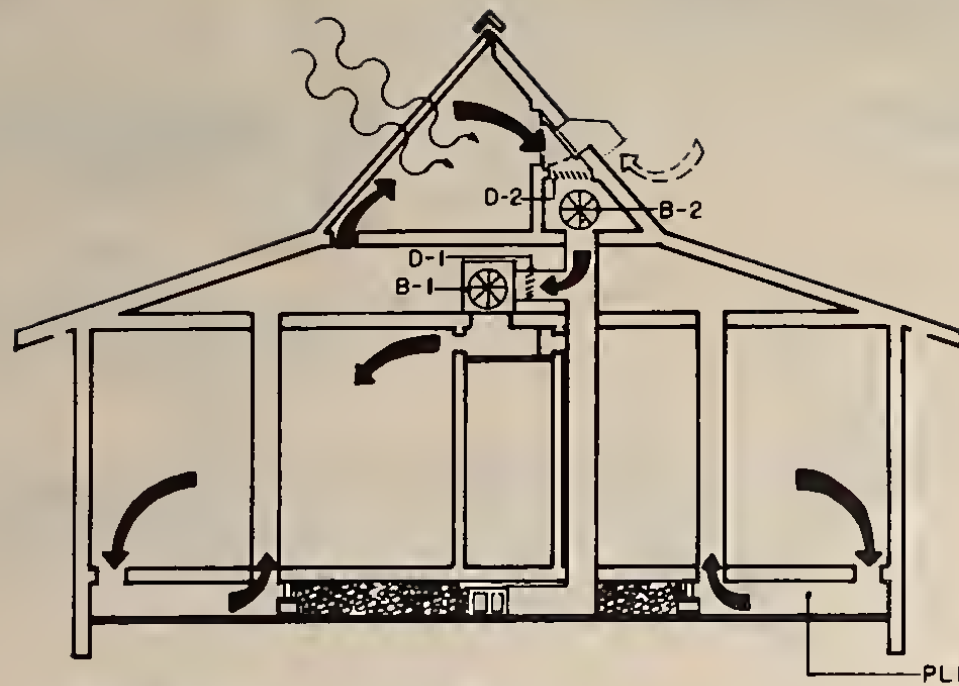
R-1 - SPDT RELAY, 24V COIL, RATED 1/2 HP AT 115 V.

R-2 - SPDT RELAY, 115 V COIL, RATED 1/2 HP AT 115 V.

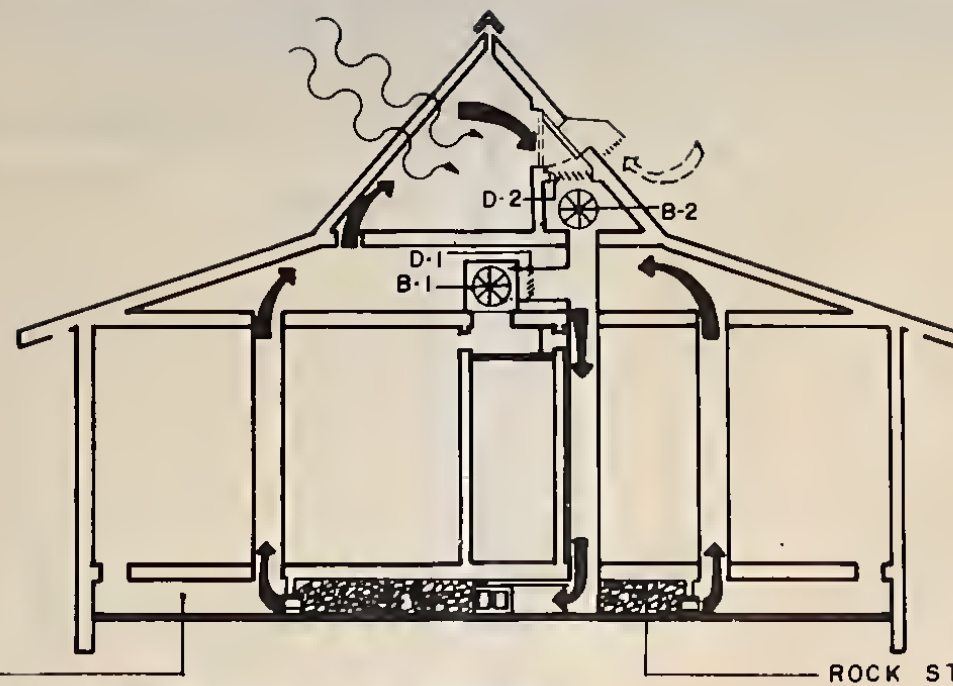
TR-1 - 24 V TRANSFORMER

NOTE

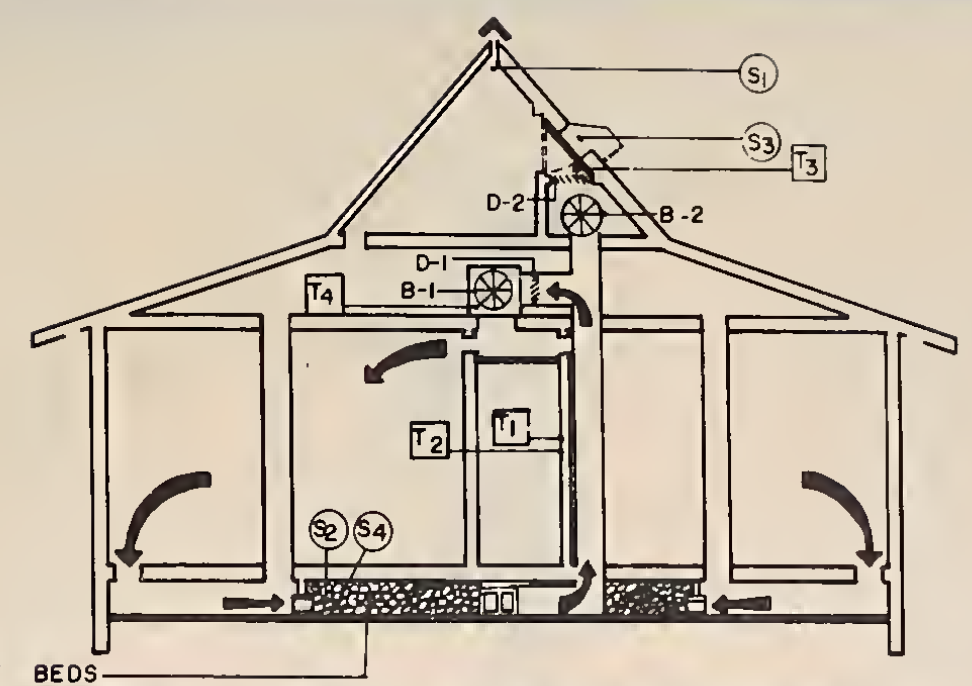
MENTION OF PROPRIETARY ITEMS DOES NOT IMPLY USDA GUARANTEE OR WARRANTY AND IS NOT INTENDED TO EXCLUDE OTHER SUITABLE PRODUCTS.



HEATING - ATTIC TO HOUSE
COOLING - OUTSIDE AIR TO HOUSE (OPTIONAL)



HEATING - ATTIC TO STORAGE
COOLING - OUTSIDE AIR TO STORAGE (OPTIONAL)



HEATING - STORAGE TO HOUSE / CONVENTIONAL FORCED-AIR HEATING
COOLING - STORAGE TO HOUSE / CONVENTIONAL FORCED-AIR COOLING

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SOLAR CONTROL CORP.

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RHO SIGMA
HELIO & ROPE GENERAL
DEKO LABS
SOLAR ENERGY RESEARCH CORP.

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B-2 - COLLECTION BLOWER: 115V 60 CYCLE MULTI DH TWO SPEED, PERMANENT SPLIT CAPACITOR TYPE, THESE ARE 40% TO 50% MORE EFFICIENT THAN SHADED POLE MOTORS. LOW SPEED BLOWER OUTPUT 2 TO 3 CFM/FT² OF COLLECTOR SURFACE AT 3/8 INCHES WATER COLUMN. HIGH SPEED OUTPUT SHOULD BE 4 TO 5 CFM/FT² OF COLLECTOR SURFACE AT 3/8 INCHES WATER COLUMN. SIMILAR TO DAYTON 4005B.

B-1 - FURNACE BLOWER: 115V 60 CYCLE, ONE CFM/FT² OF FLOOR AREA, 1/2" WATER COLUMN. SUGGEST PERMANENT SPLIT CAPACITOR MOTOR.

TWO STANDARD HEAT-COOL THERMOSTATS LOCATED IN HALLWAY CONTROL ELECTRIC FURNACE OR HEATPUMP. T₁ - CONTROLLING BLOWER (B-1) IS SET AT 68°F WINTER & 75°F SUMMER. T₂ - CONTROLLING AUX. HEAT OR COOL IS SET AT 65°F WINTER & 78°F SUMMER.

DAMPER MOTOR DM-1 IS ENERGIZED WHEN BLOWER (B-1) IS ON & OPENS DAMPER (D-1). BLOWER (B-1) IS TURNED OFF WHEN DAMPER MOTOR (DM-2) IS ENERGIZED. WHEN BOTH DAMPERS ARE OPEN COLLECTION BLOWER HEATS OR COOLS HOUSE.

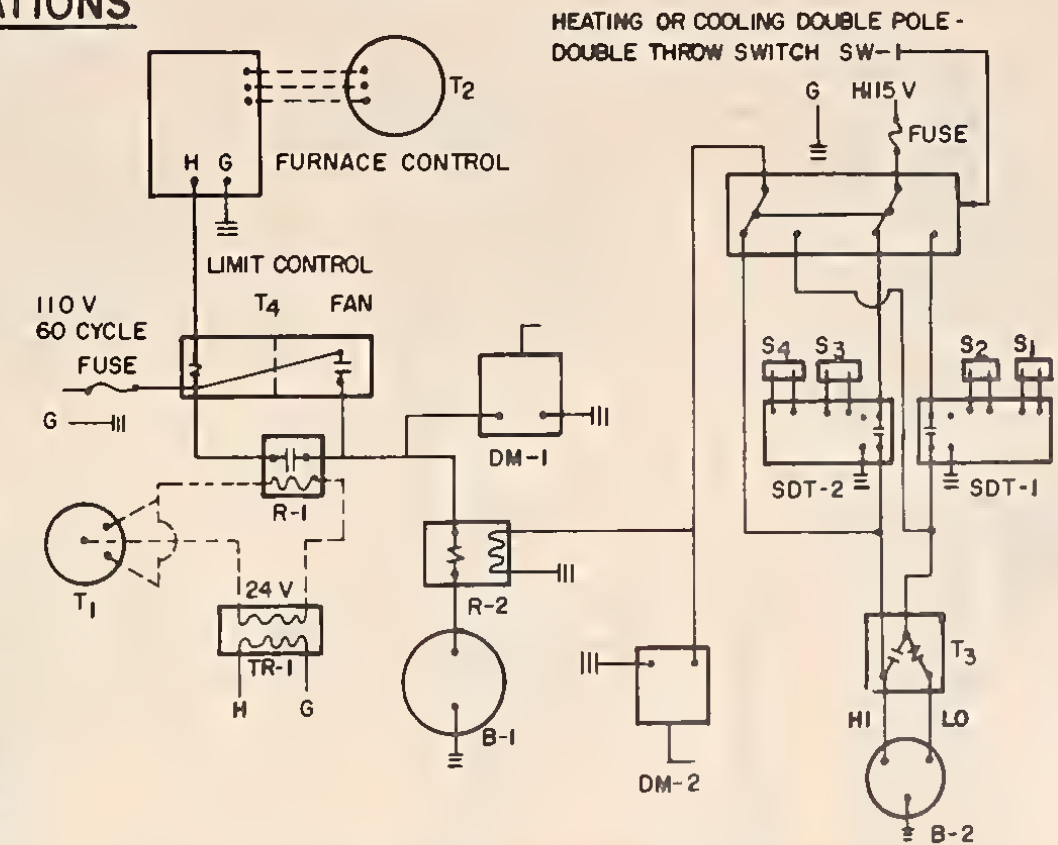
TWO DIFFERENTIAL THERMOSTATS CONTROL COLLECTION BLOWER B-2. SDT-1 CONTROLS BLOWER DURING SOLAR HEAT CYCLE. SENSOR (S₁) IS LOCATED IN ATTIC NEAR RIDGE & SHADED. SENSOR (S₂) IS CENTERED IN ROCK ONE FOOT IN ON COOL SIDE. WHEN S₁ IS 15°F HOTTER THAN S₂ BLOWER STARTS AT LOW SPEED. BLOWER 2-SPEED THERMOSTAT (T₃) SET AT 100°F FOR HI-SPEED BLOWER OPERATION. SDT-2 CONTROLS BLOWER (B-2) DURING COOLING. SENSOR (S₃) IS LOCATED WITHIN ATTIC INTAKE VENT & (S₄) IS LOCATED NEAR (S₂) IN ROCK. WHEN S₃ IS 7°F COOLER THAN S₄ COLLECTION BLOWER B-2 CIRCULATES COOL AIR THROUGH ROCK OR HOUSE. BOTH DIFFERENTIAL THERMOSTATS AND HEAT-COOL SWITCH ARE LOCATED ON OR IN HOUSING FOR COLLECTION BLOWER.

MANUAL CHANGE-OVER FROM SOLAR HEAT TO COOLING.

- (1) OPEN RIDGE VENT.
- (2) OPEN ROOF VENT TO BLOWER B-2 & CLOSE OFF ATTIC TO BLOWER.
- (3) SWITCH TO COOLING THERMOSTAT (SDT-2) WITH SWITCH SW-1.
- (4) CHANGE BOTH HOUSE THERMOSTATS TO COOL.
- (5) OPEN ALL SOFFIT VENTS.

TO CHANGE FROM COOLING TO SOLAR HEAT REVERSE ABOVE CHANGE-OVER.

NOTE: AUXILIARY FURNACE OR HEAT PUMP SHOULD BE SIZED BY LOCAL SUPPLIER.



SW-1 - ON-OFF SWITCH, DPDT, RATED 1/2 HP AT 115V.

R-1 - SPDT RELAY, 24V COIL, RATED 1/2 HP AT 115V.

R-2 - SPDT RELAY, 115V COIL, RATED 1/2 HP AT 115V.

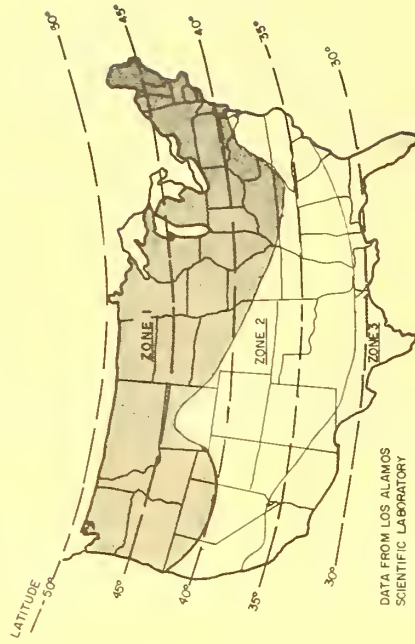
TR-1 - 24V TRANSFORMER

NOTE

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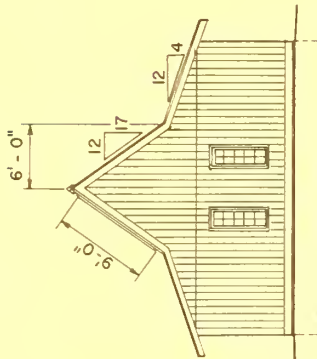
SITE PLANNING

ORIENTATE HOUSE WITH COLLECTOR FACING SOUTH FOR OPTIMUM SOLAR ENERGY ABSORPTION MAKING SURE NO OBSTRUCTIONS SUCH AS HIGH TREES OR BUILDINGS WILL BE BLOCKING THE SUN'S RAYS, MAKE MAXIMUM USE OF EXISTING ASSETS SUCH AS NATURAL SHADE, GOOD DRAINAGE AWAY FROM HOUSE, OPEN EXPOSURE TO SUMMER BREEZES, AND SHELTER FROM COLD WINTER WINDS.
IF HIGH WATER TABLE EXISTS, MAKE SURE ADEQUATE DRAINAGE IS PROVIDED TO PREVENT WATER SATURATION IN THE AIR PLenums AND ROCK STORAGE UNDER FLOOR; OTHERWISE HIGH DEGREE OF HUMIDITY DISCOMFORT WILL RESULT WITHIN THE DWELLING.

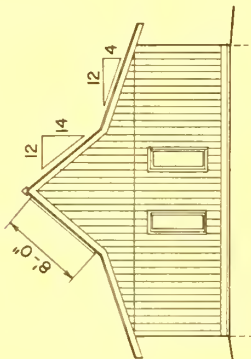


SOLAR COLLECTOR FOR SUPPLYING 75% OF HEATING

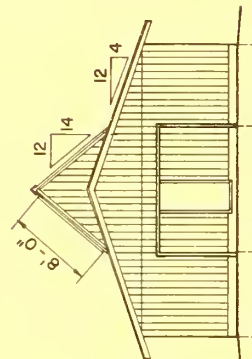
SOLAR HEAT PERCENTAGE FOR AVERAGE HEATING SEASON IS BASED ON 40% COLLECTION EFFICIENCY AND ALLOWS FOR CLOUD COVERAGE. IF SOLAR WATER HEATER IS INSTALLED IN ATTIC INCREASE PANEL AREA AMOUNT EQUAL TO THE WATER COLLECTOR OR ABSORBER.



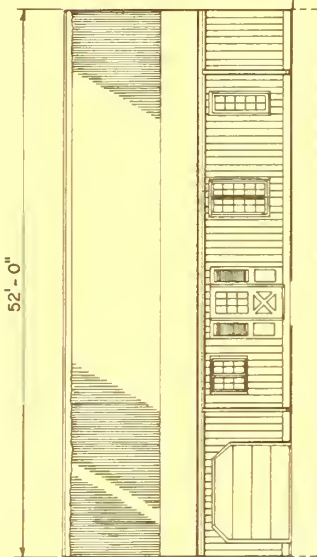
SIDE ELEVATION



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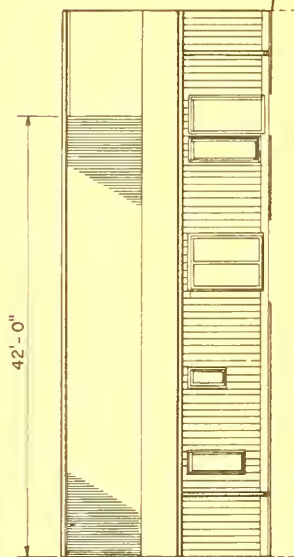


CARPORIT SIDE ELEVATION



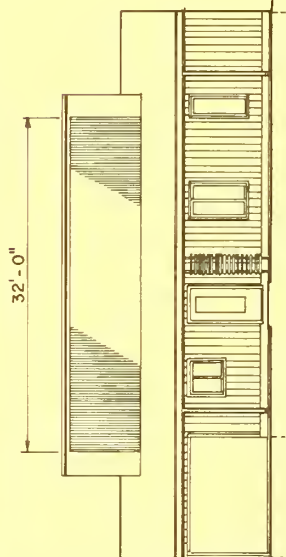
ZONE 1

FRONT ELEVATION W/ COLLECTOR FACING SOUTH



ZONE 2

REAR ELEVATION W/ COLLECTOR FACING SOUTH



ZONE 3

FRONT ELEVATION W/ COLLECTOR FACING SOUTH

EXTERIOR ELEVATION VARIATIONS