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DOE/NASA CONTRACTOR REPORT

DOE/NASA CR-150697

MASTER

DESIGN DATA BROCHURE: SOLAR HOT AIR HEATER

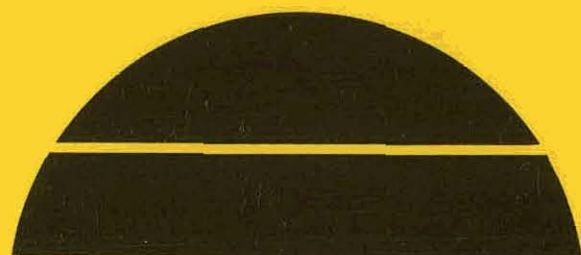
Prepared by

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Under Contract NAS8-32247 with

National Aeronautics and Space Administration
George C. Marshall Space Flight Center, Alabama 35812

For the U. S. Department of Energy



U.S. Department of Energy



Solar Energy

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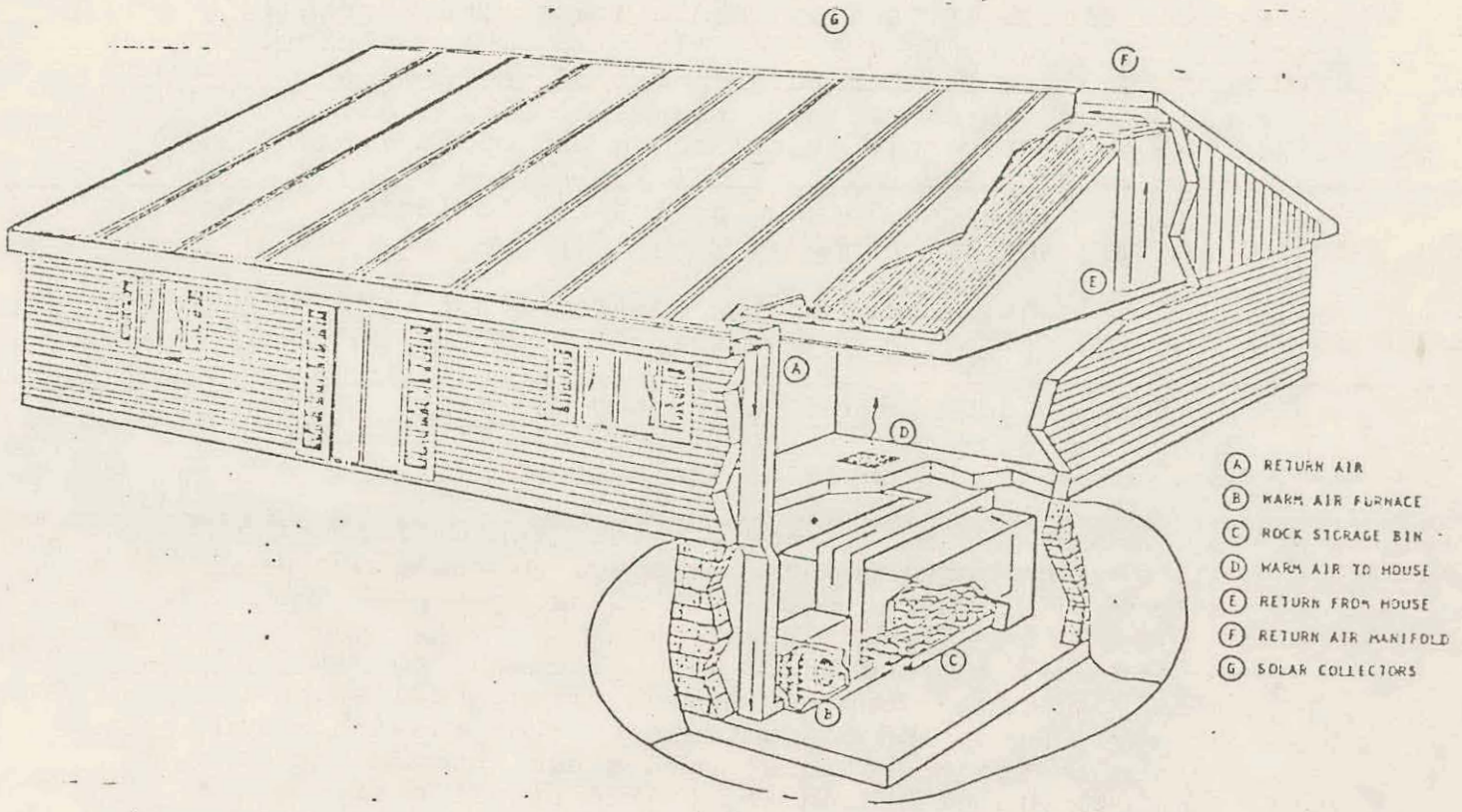
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1. REPORT NO. DOE/NASA CR-150697		2. GOVERNMENT ACCESSION NO.		3. RECIPIENT'S CATALOG NO.	
4. TITLE AND SUBTITLE Design Data Brochure: Solar Hot Air Heater				5. REPORT DATE May 1978	
				6. PERFORMING ORGANIZATION CODE	
7. AUTHOR(S)				8. PERFORMING ORGANIZATION REPORT #	
9. PERFORMING ORGANIZATION NAME AND ADDRESS Solar Engineering and Equipment Company 3305 Metairie Metairie (New Orleans), LA 70001				10. WORK UNIT NO.	
				11. CONTRACT OR GRANT NO. NAS8-32247	
12. SPONSORING AGENCY NAME AND ADDRESS National Aeronautics and Space Administration Washington, D. C. 20546				13. TYPE OF REPORT & PERIOD COVERED Contractor Report	
				14. SPONSORING AGENCY CODE	
15. SUPPLEMENTARY NOTES This work was done under the technical management of Mr. Valmore Fogle, George C. Marshall Space Flight Center, Alabama.					
16. ABSTRACT This Design Data Brochure provides information on the design, installation, performance, and application of SEECO Mod-1 Solar Hot Air Heater for residential, commercial and industrial use. The system has been installed at the Concho Indian School in El Reno, Oklahoma.					
17. KEY WORDS			18. DISTRIBUTION STATEMENT UC-59c Unclassified-Unlimited <i>William A. Brooksbank, Jr.</i> WILLIAM A. BROOKSBANK, JR. Mgr, Solar Heating and Cooling Project Office		
19. SECURITY CLASSIF. (of this report) Unclassified		20. SECURITY CLASSIF. (of this page) Unclassified		21. NO. OF PAGES 25	22. PRICE NTIS

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- (A) RETURN AIR
- (B) WARM AIR FURNACE
- (C) ROCK STORAGE BIN
- (D) WARM AIR TO HOUSE
- (E) RETURN FROM HOUSE
- (F) RETURN AIR MANIFOLD
- (G) SOLAR COLLECTORS

TYPICAL INSTALLATION

SOLAR HEATING SYSTEM SINGLE FAMILY RESIDENCE

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Key

INTRODUCTION

This system was designed by Solar Engineering & Equipment Co. Inc. in collaboration with The Binkley Company, Inc.

This design was further developed under a contract with the National Aeronautics & Space Administration, Marshall Space Flight Center, Huntsville, Alabama. The contract with NASA required further development of the design wherein two prototype systems would be developed and fabricated and ultimately installed in two operational test sites selected by NASA, the first system being a single family residence located at the Concho Indian School in El Reno, Oklahoma.

Basically the requirements of the NASA contract were to accomplish the following objectives:

1. To further develop and refine two prototype solar hot air systems utilizing the concept of the SEECO collector as the basis of the system.
2. To design and install the complete system including all storage requirements for specific buildings as selected for operational test sites.
3. To test all components of the system and to ultimately test the complete system through all stages of development and to continue testing the installed system at the operational test sites through one complete winter season and to report all test findings to NASA for further evaluation.

The specific goals of the program were:

- a) To develop a solar heating collector and system that would be economical yet durable and efficient.
- b) To prove that the air-to-air system would function as well as a liquid system and thereby eliminate the problems of freezing of the transfer fluids and inherent problems in liquid collectors.
- c) To design a collector in which the basic materials used in its manufacture are standard products readily available off the shelf that can be mass produced in large quantities.
- d) The collector can be manufactured in any length up to 40 feet to accommodate design of any roof

span to the 40 foot limitation, thereby eliminating the need for multiple manifold connections required in a series of small collector modules.

- e) To prove that the collector can efficiently serve as the actual roof of a building through its structural integrity and waterproofness and thereby eliminating the cost of the roof, therefore reducing the solar system collector cost.

As this development program progressed it became apparent that the SEECO collector could provide other advantages when used in industrial and agricultural systems for proper produce drying and for industrial and institutional hot water. Several systems have been designed for lumber drying, cotton and industrial hot water for hospitals and nursing homes.

Solar Engineering & Equipment Co. Inc. extends its services to architects and engineers as well as to private individuals and companies who have an interest in solar systems utilizing the concept outlined in this brochure of employing any of the other methods wherein solar energy can provide useful and economical alternative energy sources.

S E E C O M O D - I

SOLAR HOT AIR HEATER FOR

RESIDENTIAL, COMMERCIAL and INDUSTRIAL USE

Technical Manual for Architects and Engineers

I N D E X

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FIG. 1 - CROSS SECTION - SEECO Mod I COLLECTOR

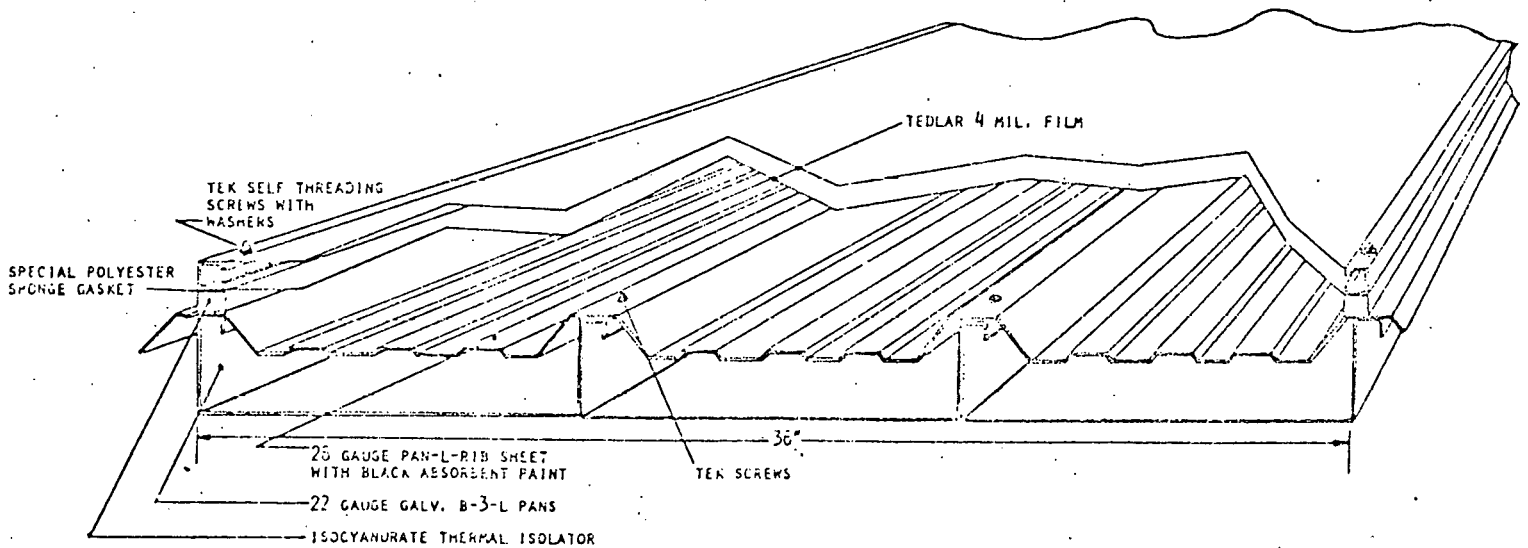


FIGURE 1

SOLAR COLLECTOR

1. System Description

The SEECO solar air heater, Mod I, is made in modules 3' wide and any length not exceeding forty feet. These modules are joined to form a collector of any chosen width in multiples of three feet. The collectors are fabricated by utilizing standard steel building wall components, as shown by the drawing (Fig. 1). Three bottom pans, each 12" wide made of galvanized steel, 22 gauge, are joined to form the three foot width. A standard 26 gauge steel sheet, painted with best grade flat black paint of a special heat resistant type, forms the absorber plate. Over this is installed the top thermal window consisting of two layers of Dupont Tedlar 4 mil thick plastic film mounted on a 3/4" x 3/4" steel frame. This window is separated from the absorber plate by a special urethane-isocyanurate thermal isolator. Forced air is passed over and under the absorber plate through air plenums at the top and bottom of the collector system, as shown on the drawing. Each module channel may be individually balanced by the use of hand dampers installed as shown. This adjustment is made after installation, at the job site, prior to closing in the hot air plenum at the roof ridge. This system of air ducts or plenums connects into the existing warm air system. This interconnection detail will vary in accordance with the conventional hot air system which will interface with the solar system. A typical installation is shown.

(Fig. 3)

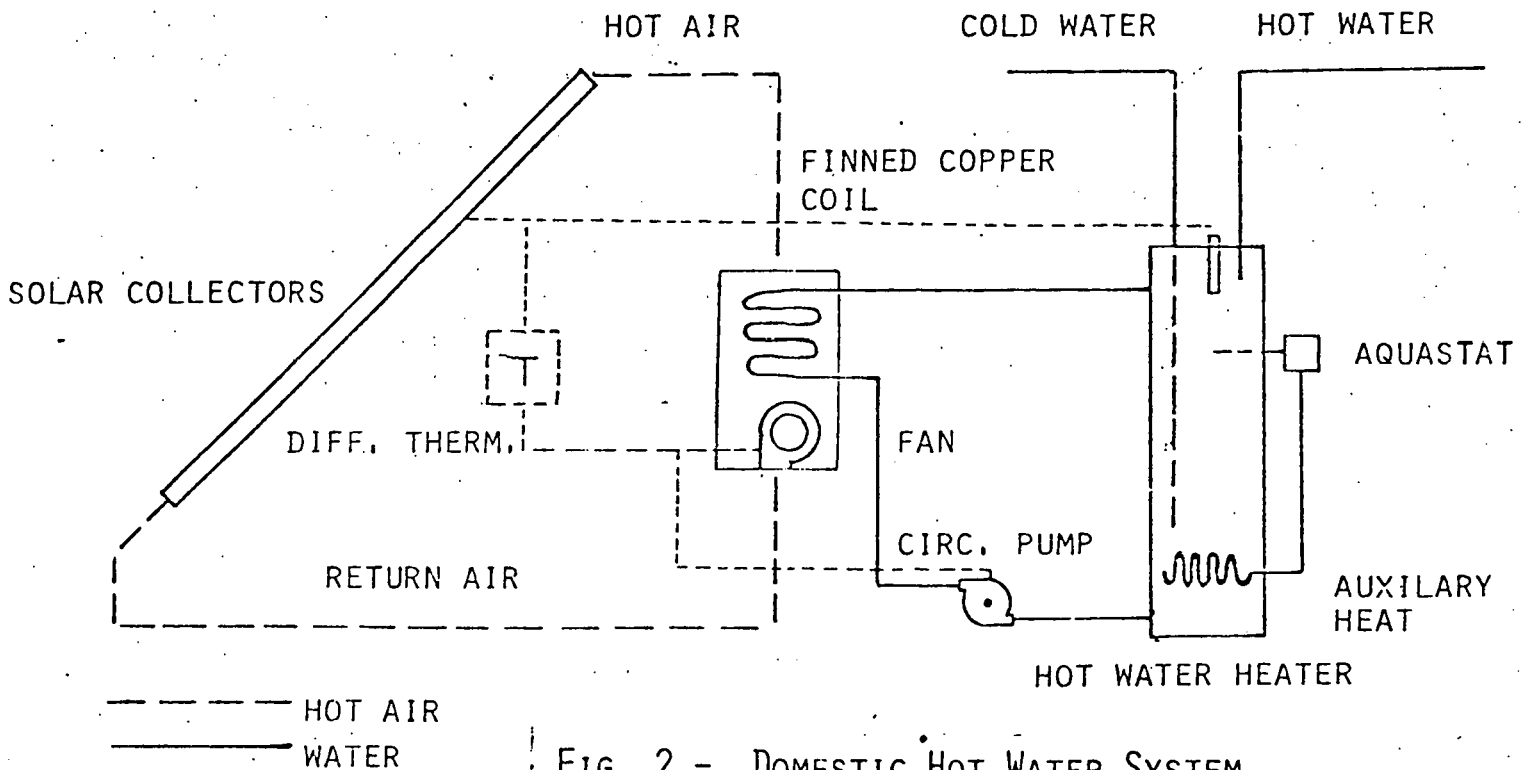


FIG. 2 - DOMESTIC HOT WATER SYSTEM

2. Accessories

This system may be equipped with an air to water heat exchanger to heat domestic hot water. (Fig. 2) This is an economical and efficient way to produce hot water for domestic use because there is no danger of cross pollution between antifreeze admixtures because no antifreeze is necessary and our high efficiency heat transfer coils actually are lower in price than double tube liquid heat exchangers of the same capacity. A drawing of a typical domestic hot water system shows the simplicity of the system.

3. Typical Installation Arrangements

The SEECO solar collector may be used as a structural part of the roof. It can be self supporting in spans up to twenty feet and may eliminate a part of the roof in new construction. In order to minimize on field installation work, the collectors are shipped from the factory in maximum sized modules. Because of overhead clearance and road regulations, maximum widths of four modules or 12 ft. are shipped factory joined. Any length up to forty feet can be custom made to fit job requirements. These collector modules may be installed with their long axes

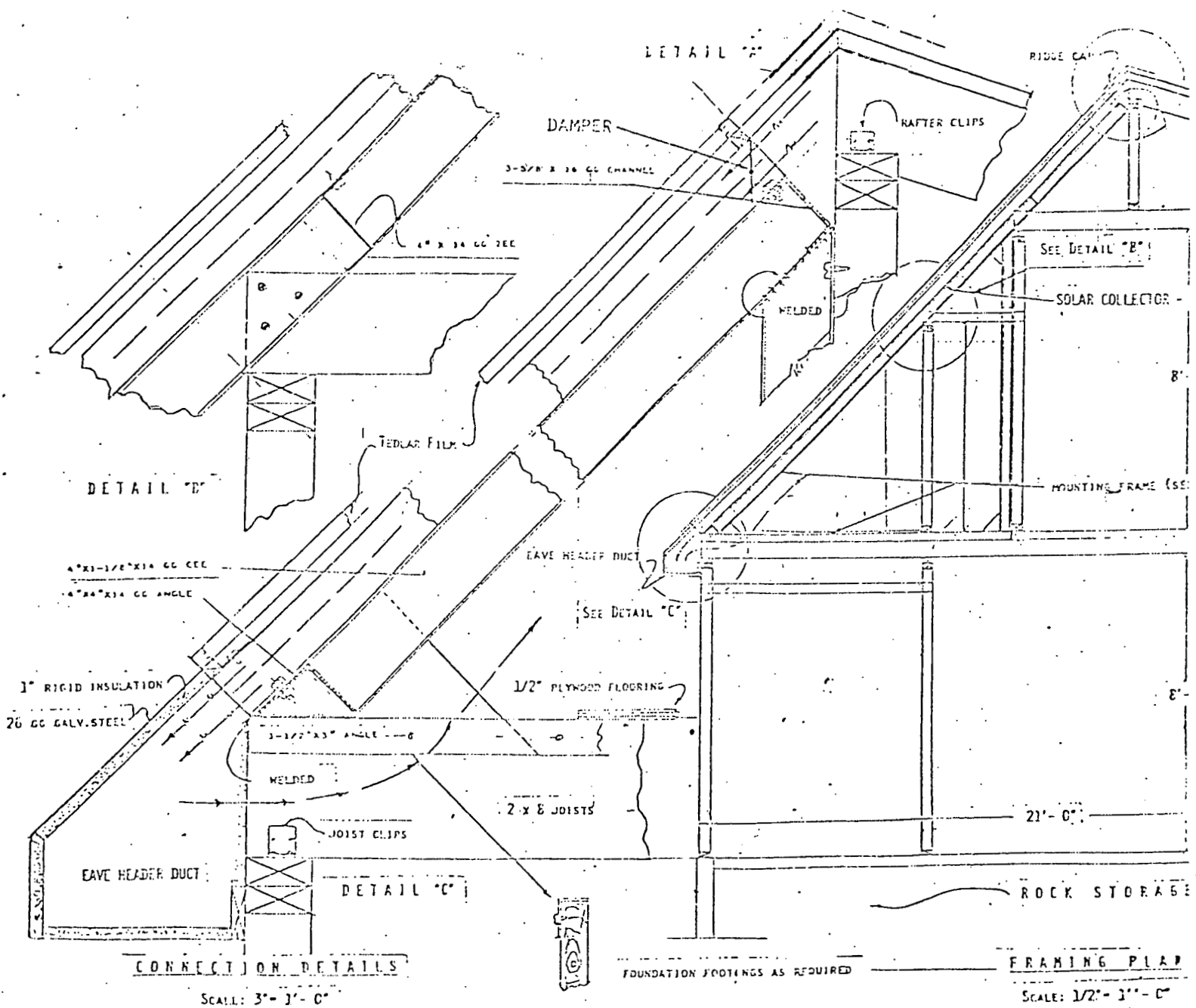


FIG. 3 - INSTALLATION DETAILS

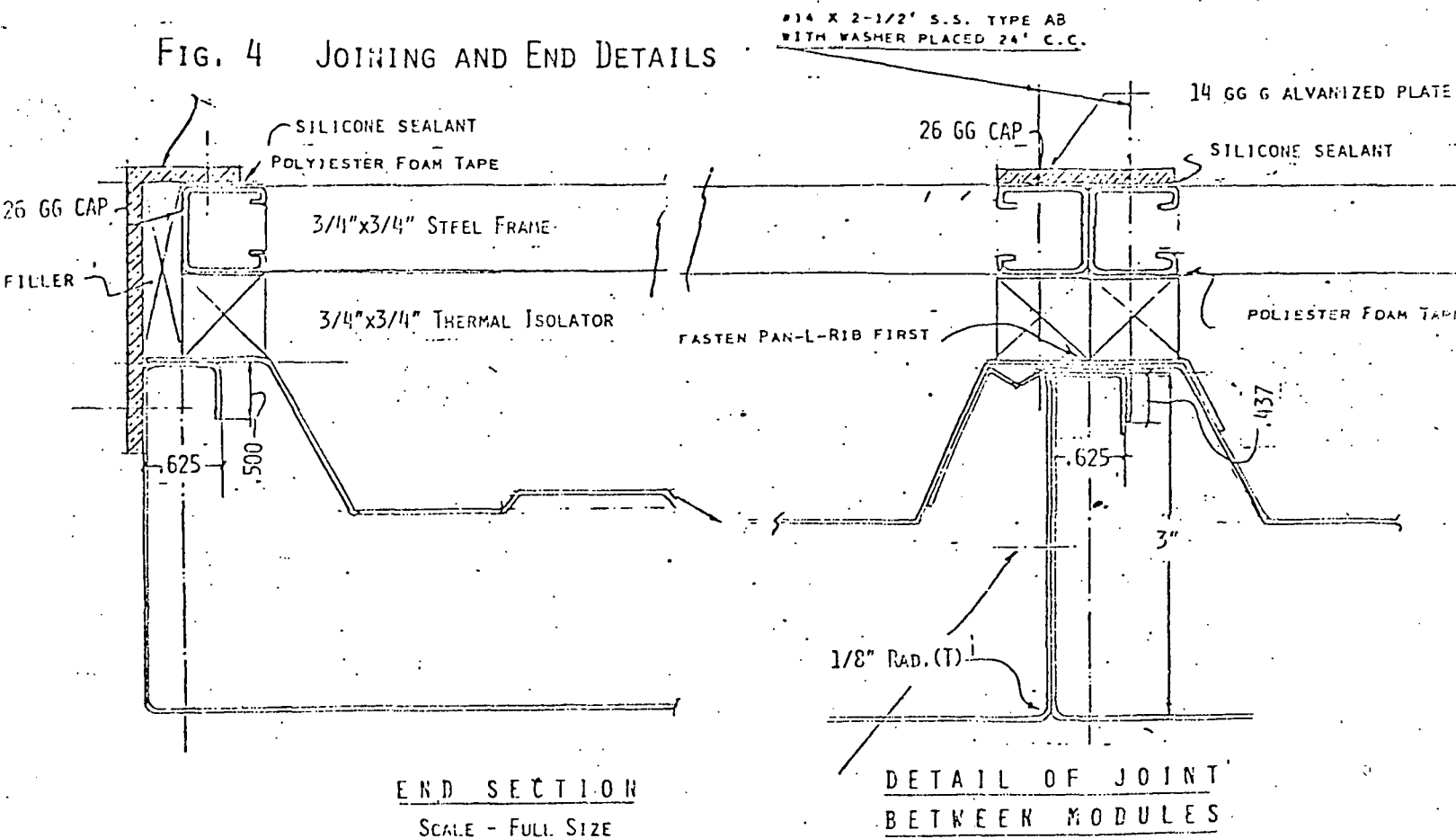
either horizontal or vertical. The vertical axis with inlet at the eave and outlet at the ridge is usually preferable because of inlet and outlet air plenum design, but the system is flexible and may be used either way.

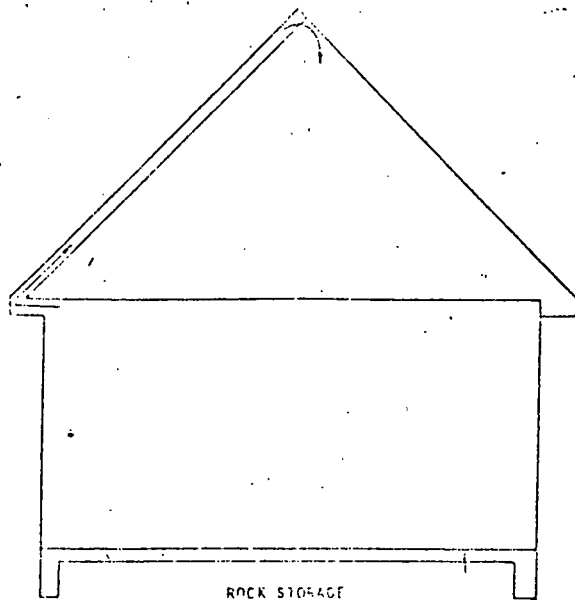
The twelve foot wide collector sections can be lifted by special lifting slings with a crane and installed on the roof where they are joined by factory furnished sealing strips and gaskets. The method of fastening the collectors must meet the existing roof conditions, but usually it is made by using special hold down clips or brackets at each end of the collector, so as to avoid having to break down the collector to place screws through the bottom of the pan into the roof. The installer should begin at one end of the roof and proceed to the other, utilizing the special sliding ladder to make the top surface joints.

The supply and return manifolds are then connected into the conventional system. This will vary in accordance with the type of system that will be used, but interfacing ducts and control dampers are usually similar to the example shown, although exact duct locations may vary. If possible, interfacing duct work should be designed by a professional who understands the principals of air distribution and ductwork design. SEECO is always ready to assist the client in this sort of work.

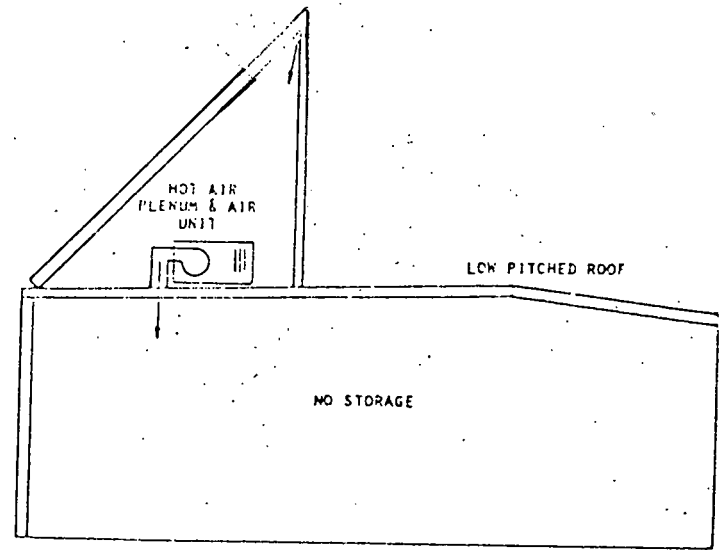
When the fan(s) have been installed and are operable, full capacity air should be circulated through the system, prior to installing the bottom of the hot air supply plenum or any other obstacle to access to the adjustable dampers. It is essential that these dampers be individually adjusted for each air channel to equalize air flow across the roof. This flow velocity can be checked with a hand held velometer with a flexible tube connected nozzle. When the air circulation has been balanced the duct system should be closed and sealed and the entire system checked for air leaks, inspecting each joint where air might possibly escape. Air leaks should be sealed with the special silicone sealant furnished with the installation. The contractor should then adjust the various control damper combinations for proper operation and sequencing in accordance with the various modes. As may be seen from the typical drawings, the SEECO collector can be tailor-made to fit a required length but the width must be maintained in multiples of three feet.

FIG. 4 JOINING AND END DETAILS

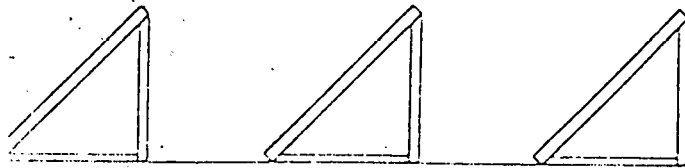




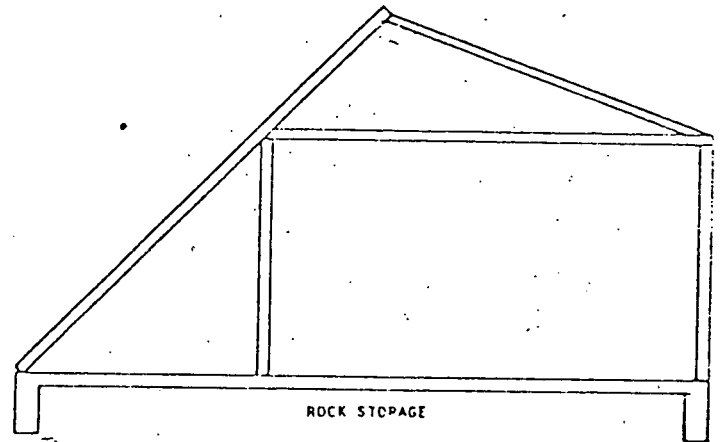
A) AS INTEGRAL PART OF A HIGH PITCHED ROOF



B) AS A UNIT WITH ENCLOSED AIR PLENUM FOR LOW PITCHED ROOF



C) IN MULTIPLE ROWS ON FLAT ROOFS



D) AS ROOF-WALL ON SOUTHERN EXPOSURE

FIG. 5 - VARIOUS MOUNTING SYSTEMS

4. Unit Dimensions and Mounting Instructions

The SEECO Mod I collector can be mounted in various ways. Typical arrangements are shown on the drawing (Fig. 5). As a general rule, especially designed mounting flashings or straps are furnished by the factory and shipped with the unit. Typical strapping and hold-down flashings may be seen on the hot air plenum drawings, both ridge and eave. (Fig. 3).

The collectors may also be free standing for mounting on a flatter roof, either with especially designed mounting arrays or in factory fabricated housings which are also air plenums as shown on the typical drawings. (Fig. 5).

5. Physical Data

The basic collector weighs five pounds per square foot. The additional weight of the plenums must be calculated from the special plans. When the collectors are installed on structural mounts or factory built air plenums, the weight will depend on the design. The performance of the collector will depend upon the area, average temperatures, volumes of air, building heating load, etc. but in general it may be expected that the collector will operate at an average forty percent efficiency when using three cubic feet of air per minute per square foot of collector area.

6. Selection Procedure

We suggest that the design of a solar system be handled through a professional engineer who has data on local weather conditions, HVAC tables, ASHRAE heat loss and solar tables and other pertinent information. The first step is the calculation of the average maximum heat load during the coldest month that is to be considered. (In some cases in the coldest northern states it may not be economically feasible to attempt to furnish collector areas sufficient to meet peak loads during December and January when the sun also is at its lowest point.) The heat loads for the space should be based on the maximum use of energy conserving materials such as adequate insulation, double paned storm windows, good weather-stripping, minimum outside air introduction, etc. If possible all energy conservation methods suggested by the new ASHRAE codes should be adopted, because it is not feasible to install expensive solar collectors to heat spaces that are not maximized for heat conservation. Daily average and minimum temperatures are given for each month of the year for hundreds of cities in the USA by tables furnished by the NOAA which may be obtained through your local weather bureau. These tables also include data on solar insolation for each hour of the day, (Fig. 11) and percentages of sunlight that may be expected for each month of the year. This information is readily available and any engineer who will work in solar energy should have it all in his files.

Once we have determined the maximum amount of sunshine and solar energy which we may expect to obtain on the design day chosen, we refer to our collector efficiency chart to determine how much usable energy we may expect to receive per day from our system. A simple formula is one in which the total maximum daily heat required, including stored heat, will be

Page 4

divided by the BTU per square foot which we may expect to obtain from our collector, will give us the total amount of collector area required.

$$Q = \frac{\text{Total BTU}}{\text{Coll. BTU/SQFT}} = \text{Collector Sq. Ft. Area}$$

Whether we use the required amount of collector area and the calculated amount of storage volume, will depend on the highly variable trade-off against total cost that we can obtain and there is no fixed rule of thumb to determine this, as the two main variables are the amount of solar heat available and the range of outside temperature which we choose as our base. For this reason we suggest that this selection work be done by an experienced HVAC solar engineer, and his methods and choices can be studied and employed on other projects at a later date.

150 CFM

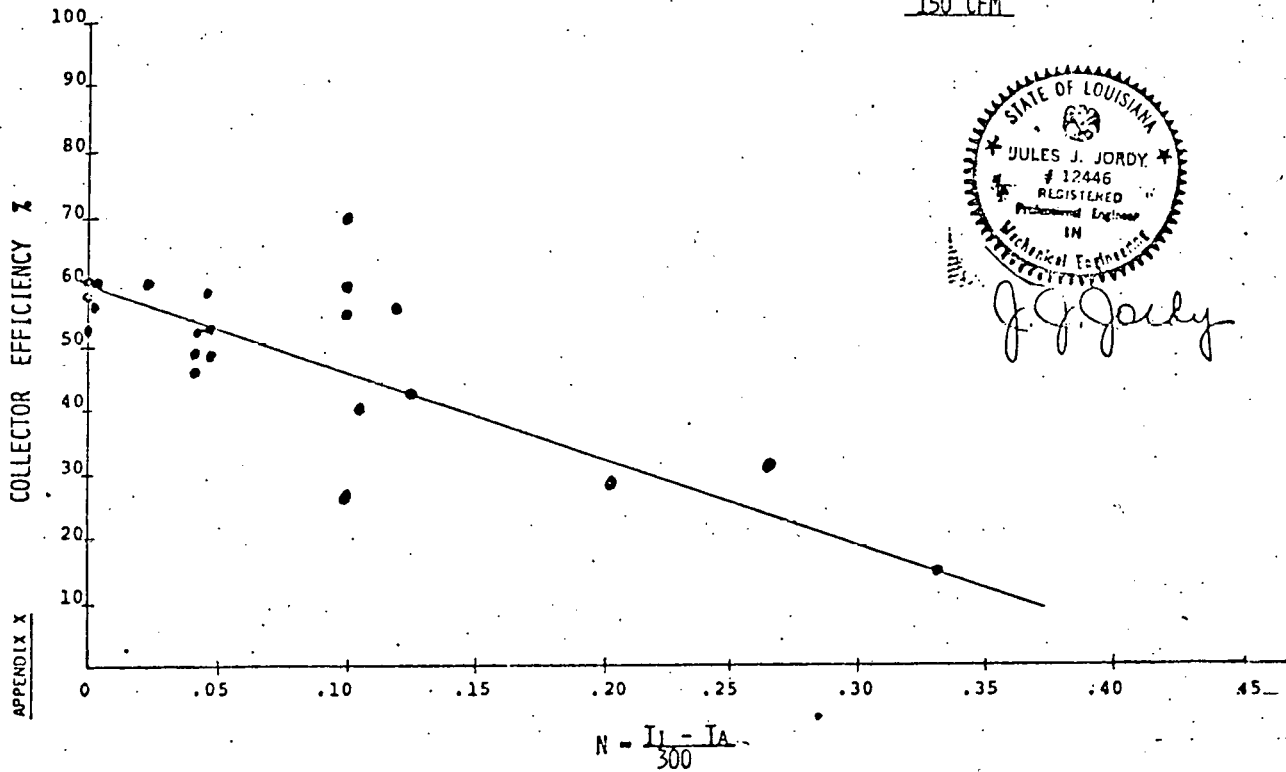


FIG. 6 - SEECO MOD I - PERFORMANCE CURVE

Collector Performance

The SEECO Mod I collector has been fully tested in accordance with approved Bureau of Standards and ASHRAE testing procedures and the curves (Fig. 6) should be an excellent guide for collector efficiency and selection under certain conditions. The efficiency chart will show how you should expect your SEECO collector to perform. Since this collector operates at peak efficiency at low operating temperatures, the thermal design is based on a twenty degree F. rise over the collector which means that the normal operating air temperature will be between 90° and 100° F. Air volume has been calculated on this basis also. On retrofit jobs the collector can be operated on other air volumes, if necessary to work in conjunction with existing hot air heating systems.

Selection Procedure

1. Calculate 24 hour heat load for building. This heat load should be based on the average daily temperature for the site, taken from NOAA climatological data, for the coldest month of the year. This will determine the temperature differential to be used in the heat load calculations. It will be important for the client to indicate the amount of heating that he will require, with particular reference to number of hours per day and specific temperatures required during the day and at night. (In our example calculation we have chosen a daytime temperature of 70 degrees for eight daylight hours at 70 degrees and 55 degrees for 16 hours - when solar heat is not available. The architect or the client should also specify the percentage of the total heat requirement that should be furnished by solar energy. For example, some system designers base their calculations on furnishing only 75% of the theoretical heat requirement and on the use of auxiliary heat at other times. It should also be noted that the sun does not shine 100% of the time and the days of effective sunlight are listed in the NOAA climatological data and the client should be made aware of this percentage, which should be taken into consideration when deciding on the amount of solar energy which will be required.

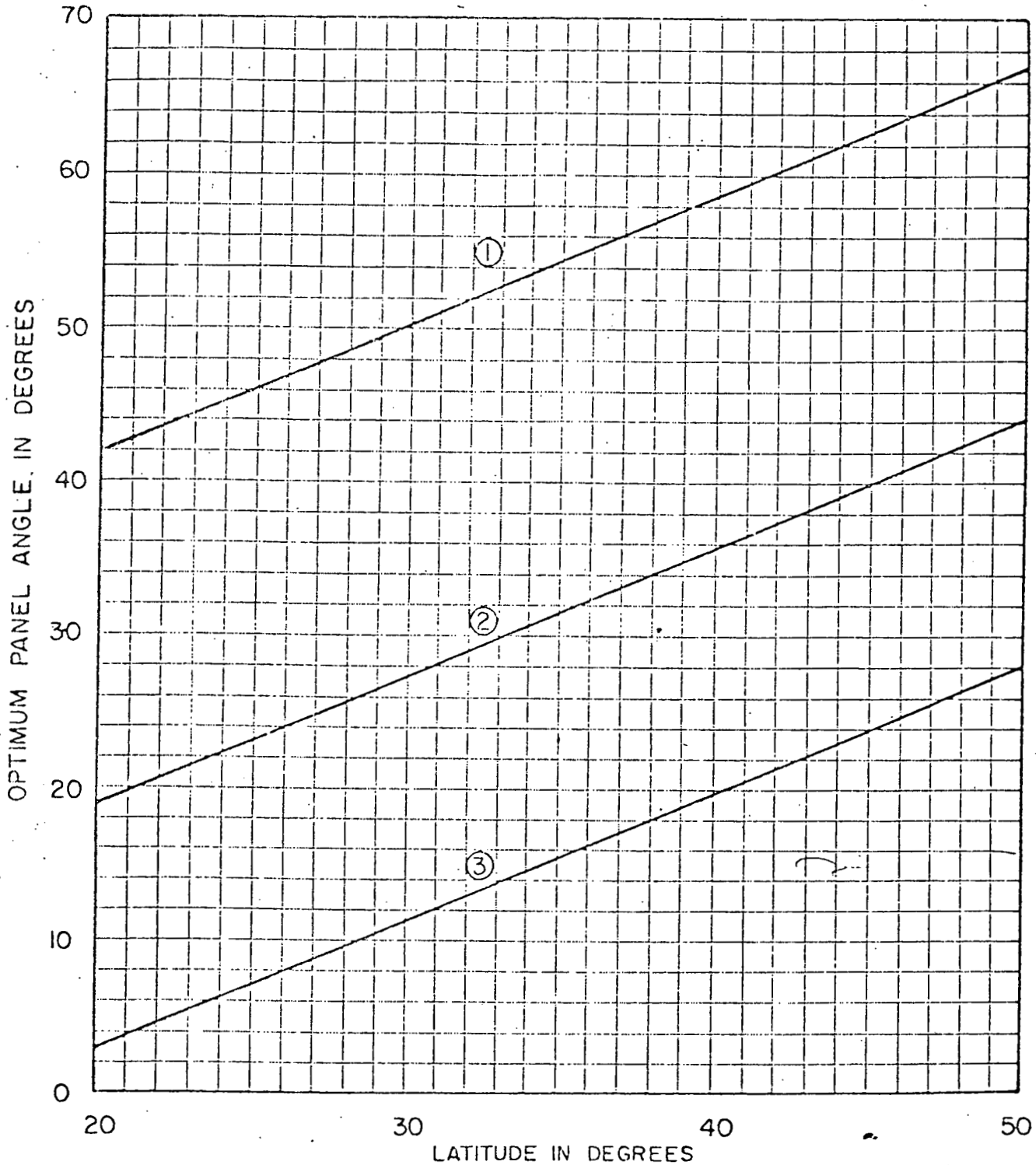
2. Collector Area Selection

Refer to insolation data for the chosen month and to the collector efficiency curve at the average inlet temperature (usually 70 deg. F.) minus the average outside temperature divided by the insolation figure. This will give the collector efficiency for those conditions. By multiplying the insolation for the day by the collector efficiency we arrive at the amount of usable heat we may expect to collect per square foot of collector. By dividing the daily heat load (which should include a total 24 hour supply of heat for the various temperatures chosen, including storage) we can arrive at the number of square feet of collector that will be required. There are additional transmission losses in ductwork, etc. which should theoretically be subtracted, but normally these losses are ignored.

Storage

A certain percentage of the heat collected will be stored in a rock storage bin. It is usually not economically feasible to store more than the heat required for the night hours. Many designers use only 75% of the night requirement. There are several ways to calculate the volume of the storage varying from rules of thumb such as one half cubic foot of rock per square foot of collector area while others base their volumes on ASHRAE data and the actual specific heat of the

RECOMMENDED PANEL INSTALLATION ANGLE FOR
SOUTH FACING PANELS



To use chart, draw line from latitude to desired time of year solar energy is to be collected.
Read panel angle directly left on chart.

- ① - For maximum winter insolation.
- ② - For maximum year round insolation.
- ③ - For maximum summer insolation.

FIG. 7 COLLECTOR INCLINATION

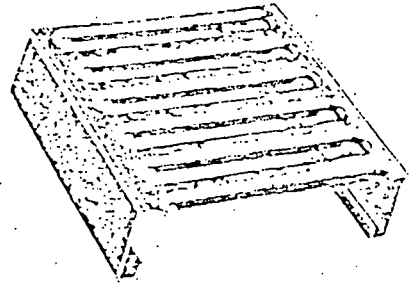
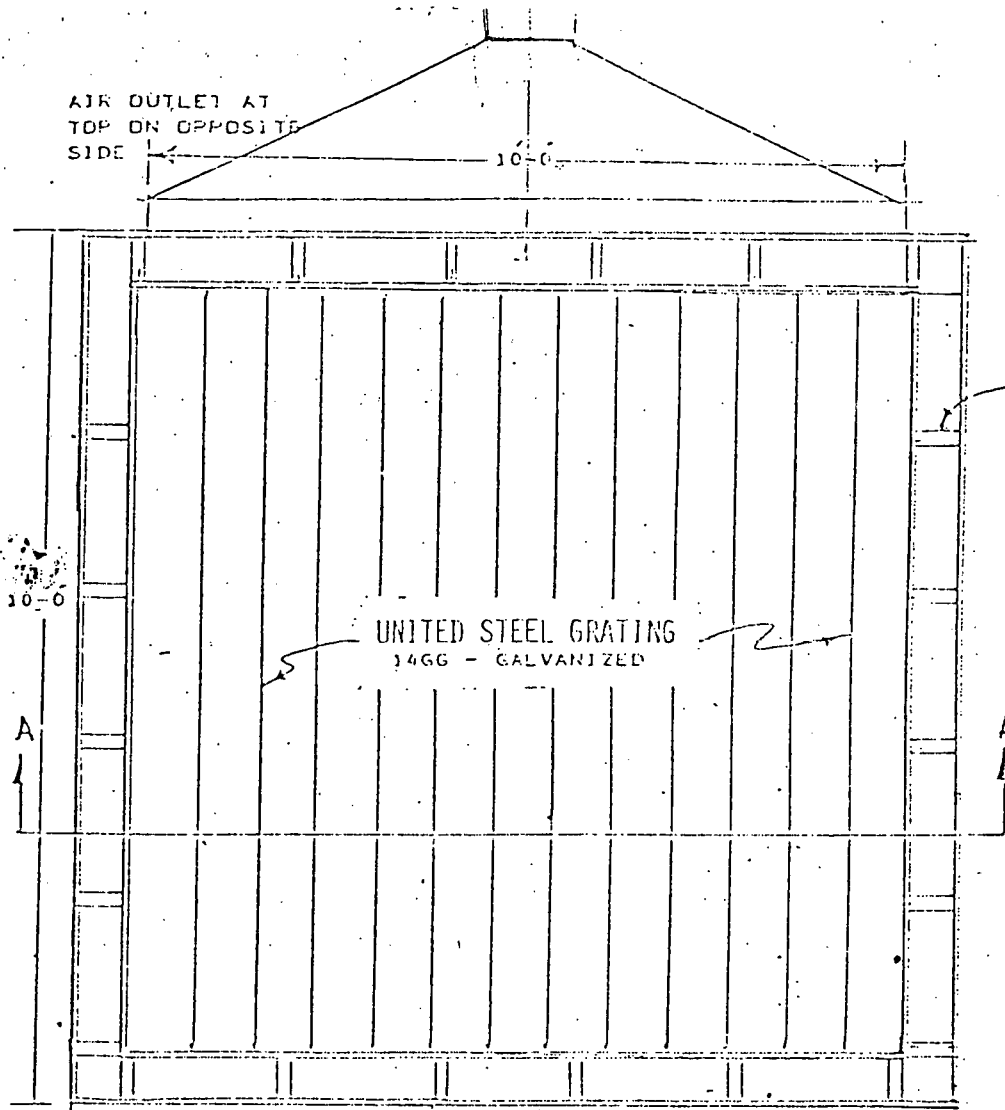
rock which arrives at one cubic foot of rock per square foot of collector, but in most cases the actual amount of storage installed will depend on the space and the money available. Our example is based on ASHRAE data.

Storage

Solar air heating systems normally use a rock storage bin for storing heat collected during the day to heat the space at night. The heat collected requirement is usually the same as the daytime requirement depending upon the thermostat settings. Under normal conditions we would recommend a setting of 70 degrees F from 0700 to 0900 at night and a setting of 55 degrees from 1900 to 0700 or 50% - 50% division of heating requirement. Solar collector collecting ability should only be based on approximately 0900 to 1700 hours or a maximum of eight hours in the winter. We therefore must consider that we can use direct solar heat for only 8 hours and must store sufficient heat for 16 hours in our storage calculations. Useful storage temperatures may vary between 100 degrees F to 75 degrees F (when the thermostat is set at 55 degrees).

The calculation of actual storage volume will depend on several variables discussed under Selection Procedure. Usually, the amount of storage installed will depend on space available and costs.

There are several methods to store rocks. The storage tank may be placed outside of the house and underground, or it may be placed under the floor slab when this is on the ground and without basement. Plywood bins may be used, as shown in our typical design. (Fig. 8) These latter may be prefabricated and installed on the site. It is generally unfeasible to provide storage for more than one night, and some say that only 75% of this storage is effective. This has yet to be proved, as no exhaustive studies of rock storage have yet been made.



PLAN

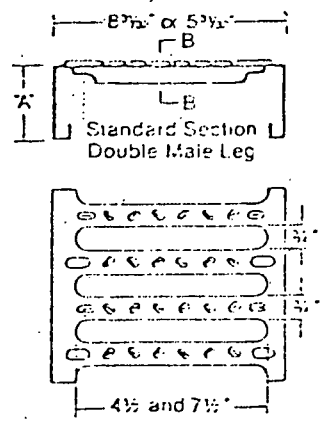
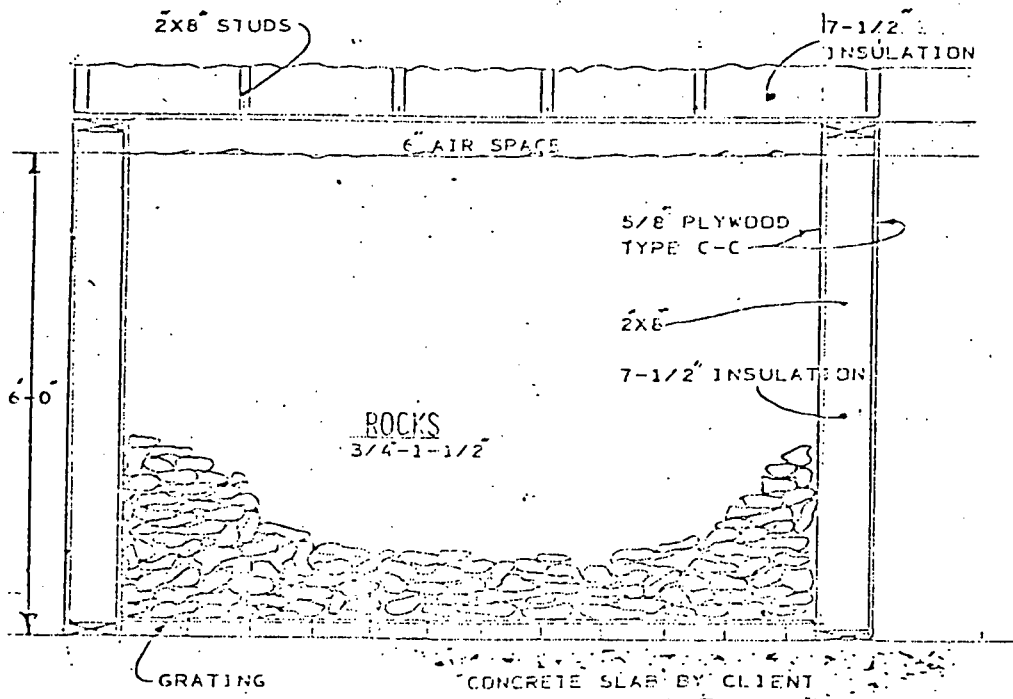
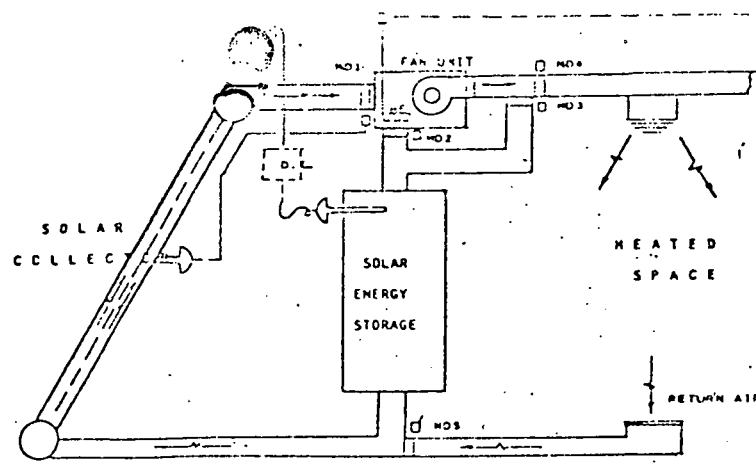
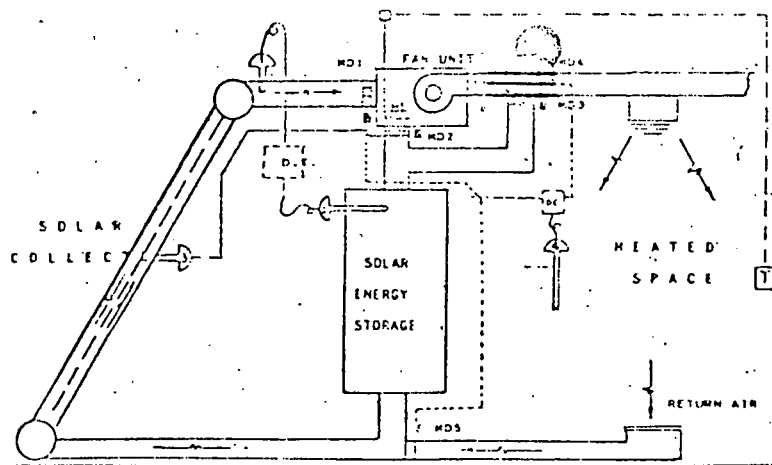
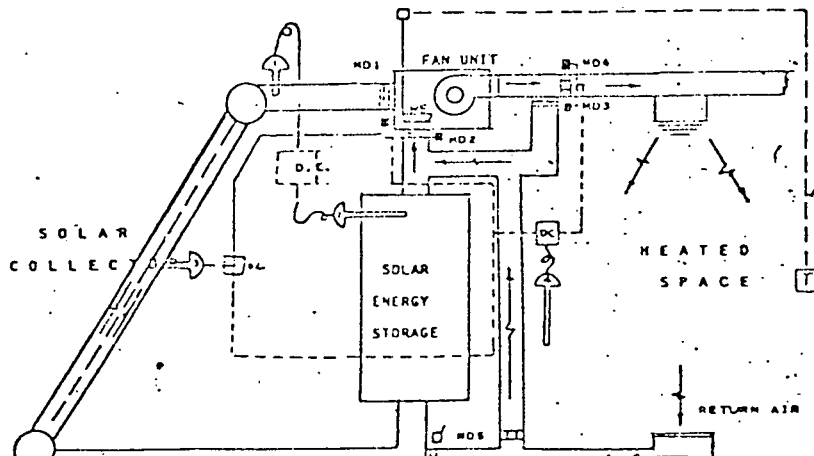
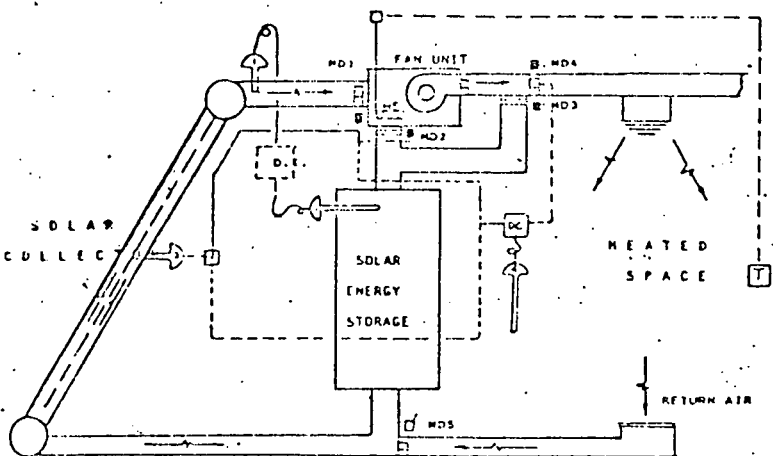


FIG. 8 TYPICAL ROCK STORAGE BIN



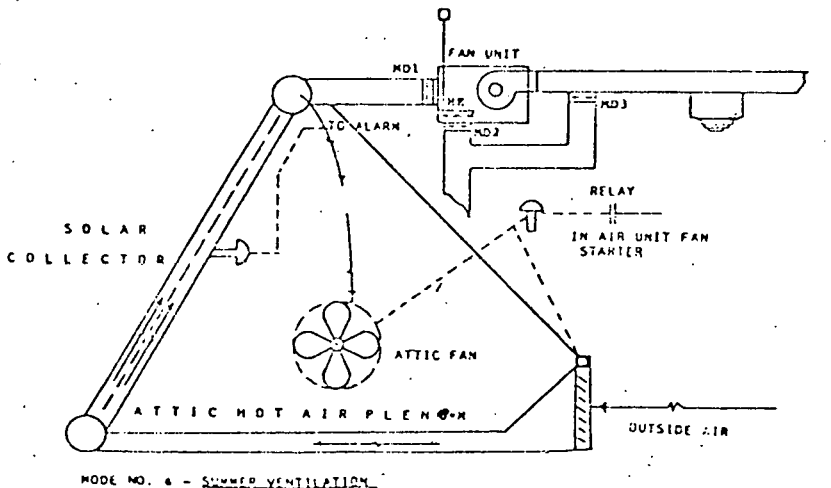
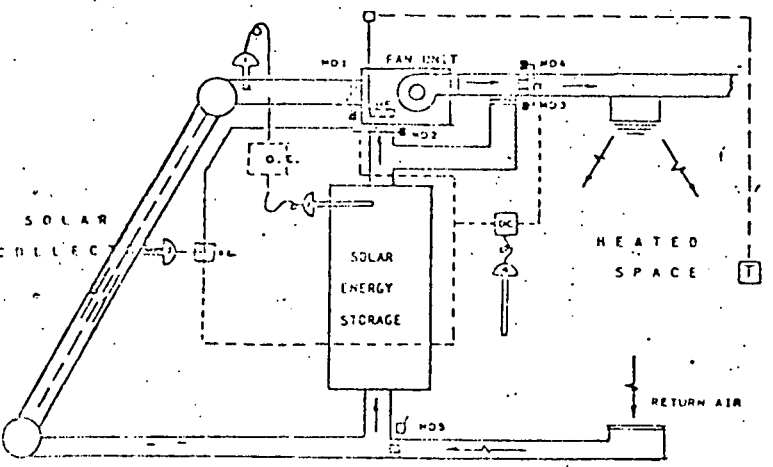
MODE NO. 1 - STORAGE CYCLE
 WHEN BUILDING TEMPERATURE IS SATISFIED SENSOR A ACTUATES RELAYS OPEN MD-1 AND CLOSE MD-2 AND MULTIPLEX TO CLOSE MD-3, CLOSE MD-4 AND OPEN MD-5. ALL DAMPER SETS, EXCEPT MD-5, ARE INTERLIMED AND SPRING LOADED TO A NORMAL POSITION WHICH IS CHANGED BY MOTORIZED ACTION. NOTE THAT STORAGE CYCLES MAY BE INTERMITTENT WITH HEATING CYCLES.

MODE NO. 4 - AUXILIARY HEAT
 IN ALL OTHER MODES, WHEN SPACE THERMOSTAT T CALLS FOR ADDITIONAL HEAT IT ACTUATES AUXILIARY HEAT SOURCE HE TO FURNISH ADDITIONAL HEAT TO THE BUILDING. OTHER CONTROLS CONTINUE TO OPERATE IN ACCORDANCE WITH THE MODE IN EFFECT.



MODE NO. 2 - SOLAR HEATING CYCLE
 WHEN SENSOR 3 INDICATES THAT SOLAR HEAT IS AVAILABLE IT ACTIVATES CIRCUIT TO SENSOR 4 WHICH WILL ACTIVATE DAMPER CIRCUIT AND OPEN MD-1, CLOSE MD-2, CLOSE MD-3, OPEN MD-4 AND OPEN MD-5, WHICH WILL ALLOW CIRCULATION OF SOLAR HEATED AIR THROUGH HEATED SPACE. THIS OPERATION MAY BE INTERMITTENT AS CONTROLLED BY SENSOR 4. THERMOSTAT T WILL ACTIVATE AUXILIARY HEATING SOURCE WHEN SOLAR HEAT IS NOT SUFFICIENT.

MODE NO. 3 - CONVENTIONAL SYSTEM
 DAMPER MD-1 CLOSES INLET FROM SOLAR COLLECTOR. DAMPER MD-5 CLOSES RETURN TO COLLECTOR AND OPENS BYPASS DAMPER. MD-2 IS OPEN TO PERMIT RETURN TO CONVENTIONAL AIR UNIT. CONVENTIONAL SYSTEM IS THEN CONTROLLED BY ITS OWN SYSTEM.



MODE NO. 5 - HEATING FROM STORAGE
 WHEN SENSOR 3 INDICATES THAT SOLAR HEAT IS NOT AVAILABLE IT CLOSES MD-1 AND OPENS MD-2. IF SENSOR 4 INDICATES THAT SPACE HEAT IS REQUIRED IT OPENS MD-3 AND CLOSES MD-4 AND MD-5. HEAT FROM STORAGE IS THEN CIRCULATED THROUGH HEATED SPACE. WHEN MD-4 IS CLOSED AND FAN IS STOPPED.

MODE NO. 6 - SUMMER VENTILATION
 TO PREVENT STAGNATION AND OVERHEATING OF COLLECTOR IN SUMMER, A RELAY IN STARTER AIR UNIT WILL CLOSE WHEN FAN IS STOPPED. IF AMBIENT AIR SENSOR INDICATES A TEMPERATURE ABOVE A HIGH LIMIT, IT CLOSSES CIRCUIT AND STARTS ATTIC FAN AFTER OPENING INLET AIR SHUTTER. AN ALARM CIRCUIT SOUNDING AN AUDIBLE SIGNAL MAY BE INCORPORATED INTO THIS CIRCUIT IF DESIRED.

LEGEND	
	TEMPERATURE SENSOR
	CONTROL MOTOR
	MOTORIZED DAMPER
	HEATING ELEMENT
	DIFFERENTIAL CONTROLLER

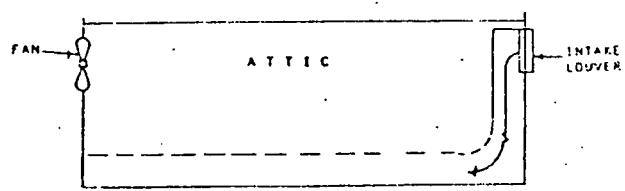


FIG. 9 - CONTROL SYSTEM Page 13

PLAN SCHEMATIC

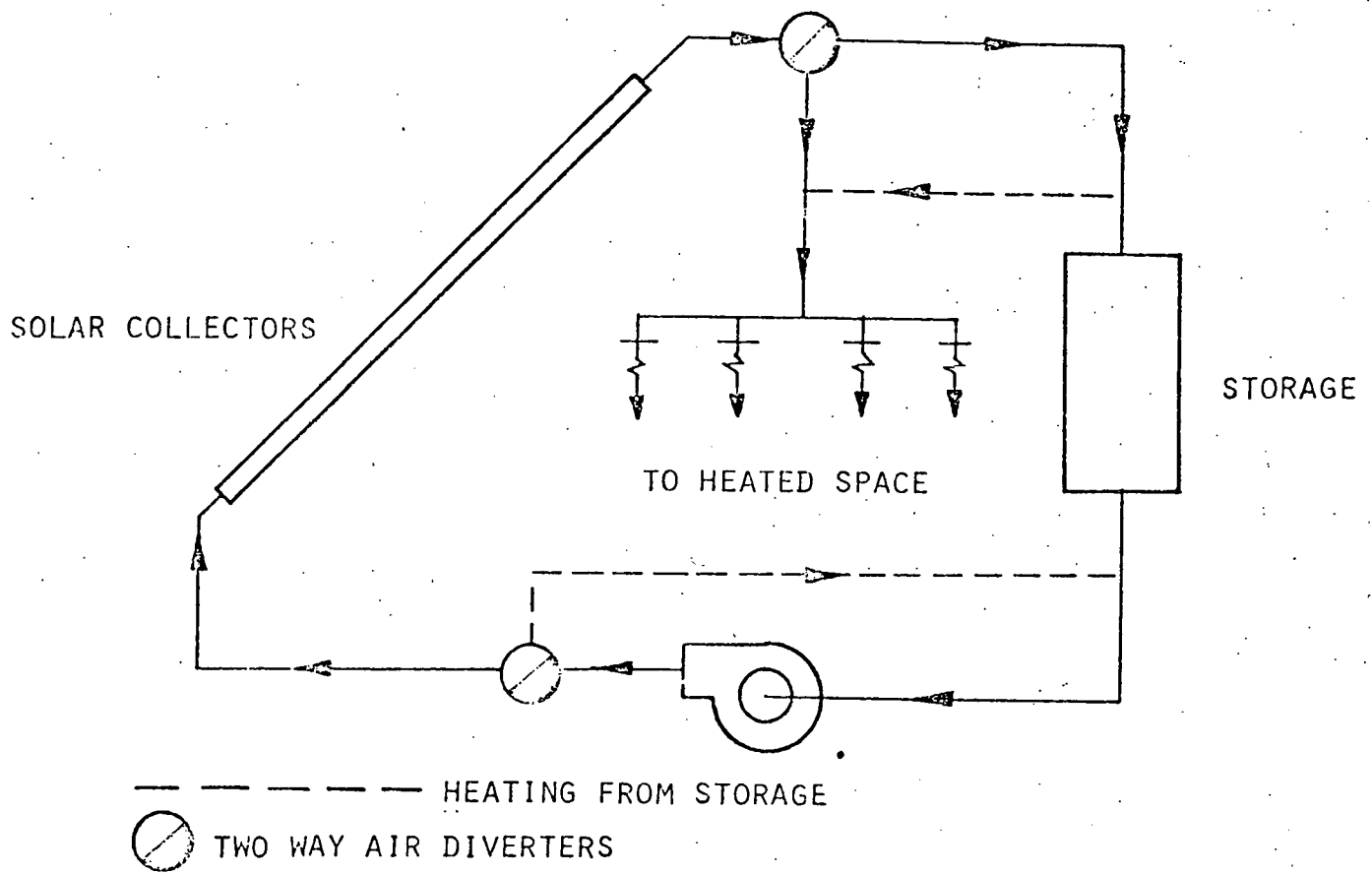


FIG. 10 - TYPICAL AIRFLOW DIAGRAM

9. Guide Specification

The solar collector system shall be of the air heater type. The system shall be designed to produce not less than _____ BTU per day when operating at a median temp. of _____ °F during the month of _____ with a total daily solar insolation of _____ BTU/HR/Sq.Ft. of net collector area, as determined from the ASHRAE or NOAA climatological data. Latitude is _____.

Collector absorption plates shall be made of 26 gauge steel with a black surface which shall have an absorption capability of not less than 90% with equal emissivity.

Collector case shall be 22 gauge galvanized steel. Cover window shall be two sheets of TEDLAR 4 mil thick special solar plastic film glued to steel frame with Monsanto GELVA or equal special adhesive. After glueing TEDLAR shall be shrunk on frame to drum tightness. Cover window shall be fastened to collector frame with self threading chromium plated ICK screws over a special polyester sponge type sealing gasket.

Collecting system shall include capacity to warm _____ gals. per day of domestic hot water from _____ degrees F to _____ degrees F through a copper tube air to water heat exchanger with aluminum fins. Solar contractor shall furnish heat exchanger, separate fan, and circulating pump, with a differential control thermostat in a separate self contained package which will attach to the existing conventional hot water system.

Heat load of space and interface design should be done by a registered professional engineer with experience in both HVAC and Solar design.

EXAMPLE

Three bedroom house at Ashland, MA. Lat. = 45° N

Floor area = 1300 sq. ft. Roof slope = 35°

Refer to NOAA Climatological Data

Insolation, 21 Jan. - 1632 BTU/DAY/SqFt. (interpolated)

Average Min. Temp. = 30°F

24 Hr. Heat Loss = 352,660 BTU

Night Loss (storage load) = 193,640 BTU

Average collector efficiency = 40% (See Fig.)

Collector Area Required

$$\frac{352,600 \text{ BTU/DAY}}{40\% \text{ Eff} \times 1632 \text{ BTU/sq ft}} = 540 \text{ sq. ft.}$$

Storage (night load only)

Temp. Diff. (night) = 75 - 55 = 20°F

Rock Temp. range = 90° - 70° = 20°

Weight of crushed rock = 100 lbs./cu ft.

Specific Heat = .02 BTU/°F/LB = 20 BTU/CU FT.
= 20 BTU x 20°F = 400 BTU/CU FT.

Volume = $\frac{193,600}{400}$ = 484 cu. ft.

Domestic Hot Water

4 Occupants at 15 gal. = 60 gal./day

60 x 8.33 = 500 lbs/day

Water in = 50°F Out = 140°F T.D. 90°

500 lbs. x 90 T.D. = 45,000 BTU/day

$$\frac{45,000}{40\% \times 1632} = 69 \text{ sq. ft. of collector}$$

TABLE A3 ... SOLAR POSITION AND INSOLATION VALUES FOR 40 DEGREES NORTH LATITUDE

DATE	SOLAR TIME		SOLAR POSITION		BTUH/SQ. FT. TOTAL INSOLATION ON SURFACES																		
	AM	PM	ALT	AZM	NORMAL		HORIZ.		SOUTH-FACING SURFACE ANGLE WITH HORIZ.														
					30°	45°	60°	75°	90°	30°	45°	60°	75°	90°									
JAN 21	8	3	2.1	55.3	232	28	65	74	81	85	88	90	91	92	93	94	95	96	97	98	99	100	
	9	3	15.8	64.9	239	83	155	171	182	187	191	194	197	199	201	203	205	207	209	211	213	215	
	10	2	23.3	70.9	244	127	218	227	249	259	263	267	270	273	275	277	279	281	283	285	287	289	
	11	1	25.4	75.0	249	154	257	277	299	309	313	317	320	323	325	327	329	331	333	335	337	339	
	12		30.0	80.0	250	190	270	291	313	326	330	333	335	337	339	341	343	345	347	349	351	353	
	SURFACE DAILY TOTALS				2152	648	1800	1830	1947	1980	2000	2015	2025	2035	2045	2055	2065	2075	2085	2095	2105	2115	2125
FEB 21	7	5	4.8	72.7	252	70	119	121	125	127	128	129	130	131	132	133	134	135	136	137	138	139	
	8	4	15.4	82.2	224	73	124	127	128	127	127	127	127	127	127	127	127	127	127	127	127	127	
	9	3	25.0	87.2	234	132	155	155	155	155	155	155	155	155	155	155	155	155	155	155	155	155	
	10	2	32.8	91.9	235	173	174	174	174	174	174	174	174	174	174	174	174	174	174	174	174	174	
	11	1	38.1	95.9	235	206	206	206	206	206	206	206	206	206	206	206	206	206	206	206	206	206	
	12		40.0	100.0	235	216	216	216	216	216	216	216	216	216	216	216	216	216	216	216	216	216	
	SURFACE DAILY TOTALS				2540	1410	2000	2152	2202	2225	2240	2250	2255	2260	2265	2270	2275	2280	2285	2290	2295	2300	2305
MAR 21	7	5	11.4	80.2	274	65	55	54	51	48	45	42	39	36	33	30	27	24	21	18	15	12	
	8	4	22.5	89.6	250	114	140	141	135	131	127	123	119	115	111	107	103	99	95	91	87	83	
	9	3	32.8	97.3	232	173	215	217	213	202	192	182	172	162	152	142	132	122	112	102	92	82	
	10	2	41.6	101.9	237	218	273	274	271	255	240	225	210	195	180	165	150	135	120	105	90	75	
	11	1	47.7	105.6	235	247	310	313	307	293	279	265	251	237	223	209	195	181	167	153	139	125	
	12		50.0	110.0	232	257	322	326	320	305	290	275	260	245	230	215	200	185	170	155	140	125	
	SURFACE DAILY TOTALS				2915	1352	2308	2330	2284	2174	2074	1974	1874	1774	1674	1574	1474	1374	1274	1174	1074	974	874
APR 21	6	6	7.4	88.9	289	70	11	8	7	6	5	4	3	2	1	0	0	0	0	0	0	0	
	7	5	18.9	92.5	266	67	77	70	61	50	37	24	11	0	0	0	0	0	0	0	0	0	
	8	4	30.3	94.3	252	152	153	145	133	117	93	69	45	21	0	0	0	0	0	0	0	0	
	9	3	41.3	97.2	234	207	221	213	199	179	153	127	101	75	49	23	0	0	0	0	0	0	
	10	2	51.2	101.4	235	250	275	257	232	209	186	163	140	117	94	71	48	25	0	0	0	0	
	11	1	58.7	105.2	232	277	308	301	295	280	265	250	235	220	205	190	175	160	145	130	115	100	
	12		61.6	110.0	232	297	322	313	305	290	275	260	245	230	215	200	185	170	155	140	125	110	
	SURFACE DAILY TOTALS				3222	2272	2932	2922	2862	2762	2662	2562	2462	2362	2262	2162	2062	1962	1862	1762	1662	1562	1462
MAY 21	5	7	1.9	114.7	300	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	6	6	12.7	105.6	280	49	75	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	
	7	5	28.0	96.6	246	214	89	76	50	44	33	22	11	0	0	0	0	0	0	0	0	0	
	8	4	35.4	87.2	250	175	158	140	125	104	79	54	29	4	0	0	0	0	0	0	0	0	
	9	3	46.8	75.0	257	227	221	206	186	160	135	110	85	60	35	10	0	0	0	0	0	0	
	10	2	57.5	60.9	277	257	270	255	233	205	177	150	123	96	69	42	15	0	0	0	0	0	
	11	1	66.2	57.1	283	275	301	287	264	234	204	174	144	114	84	54	24	0	0	0	0	0	
	12		70.0	50.0	272	301	312	297	274	243	213	183	153	123	93	63	33	0	0	0	0	0	
	SURFACE DAILY TOTALS				3222	2272	2932	2922	2862	2762	2662	2562	2462	2362	2262	2162	2062	1962	1862	1762	1662	1562	1462
JUN 21	5	7	0.2	117.1	310	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	6	6	14.8	108.4	285	60	30	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	
	7	5	25.0	99.7	246	123	92	77	59	41	23	5	0	0	0	0	0	0	0	0	0	0	
	8	4	37.4	90.7	246	182	159	142	121	97	73	49	25	0	0	0	0	0	0	0	0	0	
	9	3	48.8	80.2	263	233	219	202	179	151	123	95	67	39	11	0	0	0	0	0	0	0	
	10	2	59.8	65.8	272	272	266	248	224	194	164	134	104	74	44	14	0	0	0	0	0	0	
	11	1	69.2	41.9	277	276	276	278	253	221	189	157	125	93	61	29	0	0	0	0	0	0	
	12		73.5	0.0	279	304	306	289	253	220	187	154	121	88	55	22	0	0	0	0	0	0	
	SURFACE DAILY TOTALS				3180	2548	2834	2724	2574	2374	2174	1974	1774	1574	1374	1174	974	774	574	374	174	0	0
JUL 21	5	7	2.3	115.2	313	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	6	6	13.1	106.1	288	50	25	17	15	14	13	12	11	10	9	8	7	6	5	4	3	2	
	7	5	24.3	97.2	248	114	89	75	50	44	33	22	11	0	0	0	0	0	0	0	0	0	
	8	4	35.8	87.5	241	174	157	142	124	102	74	46	18	0	0	0	0	0	0	0	0	0	
	9	3	47.2	74.7	259	225	218	203	182	157	132	107	82	57	32	7	0	0	0	0	0	0	
	10	2	57.9	61.7	269	265	260	251	229	200	171	142	113	84	55	26	0	0	0	0	0	0	
	11	1	67.0	57.3	275	290	295	284	258	228	198	168	138	108	78	48	18	0	0	0	0	0	
	12		72.0	0.0	276	315	307	292	265	235	205	175	145	115	85	55	25	0	0	0	0	0	
	SURFACE DAILY TOTALS				3072	2630	2680	2530	2330	2130	1930	1730	1530	1330	1130	930	730	530	330	130	0	0	0
AUG 21	5	6	7.0	93.5	311	21	12	9	8	7	6	5	4	3	2	1	0	0	0	0	0	0	
	6	5	19.3	80.0	281	57	76	59	60	49	38	27	16	5	0	0	0	0	0	0	0	0	
	7	4	30.7	73.5	237	150	150	141	129	113	97	81	65	49	33	17	0	0	0	0	0	0	
	8	3	41.8	67.9	250	205	215	207	193	173	153	133	113	93	73	53	33	13	0	0	0	0	
	9	2	51.7	52.1	272	245	267	250	240	221	201	181	161	141	121	101	81	61	41	21	0	0	
	10	1	59.3	29.7	274	271	300	292	274	257	240	223	206	189	172	155	138	121	104	87	70	53	

TABLE A4 ... SOLAR POSITION AND INSOLATION VALUES FOR 48 DEGREES NORTH LATITUDE

DATE	SOLAR TIME		SOLAR POSITION		BTUW/SQ. FT.	TOTAL INSOLATION ON SURFACES					
	AM	PM	ALT	AZM		SOUTH FACING SURFACE ANGLE WITH MORTIZ.					
						NORMAL	HORIZ.	0°	30°	60°	90°
JAN 21	8	4	3.5	54.6	37	4	17	19	21	22	22
	9	3	11.0	42.5	135	46	172	172	142	195	132
	10	2	16.9	23.4	239	83	190	256	216	220	206
	11	1	20.7	15.1	281	107	231	249	260	263	243
	12		22.0	0.0	267	115	245	254	275	278	255
SURFACE DAILY TOTALS					1713	595	1362	1478	1650	1573	1472
FEB 21	7	5	7.0	72.2	12	1	4	4	4	4	4
	8	4	11.6	60.5	158	49	95	102	105	105	96
	9	3	19.7	47.7	251	100	178	187	191	190	167
	10	2	26.2	33.3	275	139	240	251	255	251	217
	11	1	30.5	17.2	293	165	275	290	294	288	247
SURFACE DAILY TOTALS					2373	1057	1855	1972	2024	1978	1720
MAR 21	7	5	10.0	78.7	153	37	43	42	47	45	35
	8	4	19.5	66.8	236	96	131	132	129	122	96
	9	3	25.2	53.4	270	147	205	207	203	193	152
	10	2	35.4	37.8	287	187	263	264	251	249	195
	11	1	40.3	13.5	285	212	323	303	297	283	223
SURFACE DAILY TOTALS					2780	1578	2268	2222	2182	2074	1632
APR 21	6	6	8.6	87.8	102	27	13	9	8	7	5
	7	5	18.5	75.7	205	85	75	59	59	48	21
	8	4	28.5	74.5	247	142	140	141	122	113	62
	9	3	37.3	61.2	265	191	215	208	194	174	115
	10	2	45.8	44.6	282	225	265	257	245	225	152
SURFACE DAILY TOTALS					3076	2106	2358	2265	2114	1902	1262
MAY 21	5	7	5.2	114.3	41	3	4	4	4	3	2
	6	5	14.7	103.7	162	61	27	16	15	13	10
	7	5	24.6	93.0	213	118	33	75	50	43	13
	8	4	34.7	81.6	248	171	155	142	123	101	45
	9	3	44.3	69.3	264	217	217	202	182	156	86
SURFACE DAILY TOTALS					3254	2452	2418	2234	2019	1728	982
JUN 21	5	7	7.3	116.5	77	21	9	8	7	5	5
	6	6	17.2	106.2	172	74	33	19	18	16	12
	7	5	27.0	95.8	220	129	33	77	53	39	15
	8	4	37.1	84.6	246	181	157	140	113	95	35
	9	3	46.9	71.6	251	225	216	195	175	147	74
SURFACE DAILY TOTALS					3254	2452	2418	2234	2019	1728	982
JUL 21	5	7	5.7	110.7	43	10	5	5	4	4	3
	6	6	15.2	104.1	155	62	28	18	16	15	11
	7	5	25.1	93.5	211	118	69	75	59	42	14
	8	4	35.1	82.1	240	171	154	140	121	99	43
	9	3	44.8	68.8	256	215	218	199	178	153	83
SURFACE DAILY TOTALS					3158	2474	2335	2240	1974	1694	956
AUG 21	5	6	3.1	93.3	31	28	14	10	9	8	6
	6	5	12.1	87.2	100	85	75	67	56	47	20
	7	4	22.0	75.4	232	141	145	137	125	109	65
	8	3	32.4	61.8	254	189	210	201	187	168	110
	9	2	46.4	45.1	266	225	260	252	237	214	146
SURFACE DAILY TOTALS					2838	2086	2401	2246	2046	1854	1228
SEP 21	7	5	10.0	78.7	131	35	44	46	43	40	31
	8	4	19.5	66.8	215	92	124	124	121	115	90
	9	3	28.2	53.4	251	142	195	197	193	183	143
	10	2	35.4	37.8	269	181	251	254	248	236	185
	11	1	40.3	13.5	278	205	287	289	284	269	217
SURFACE DAILY TOTALS					2568	1572	2167	2118	2070	1966	1506
OCT 21	7	5	7.0	71.9	4	0	1	1	1	1	1
	8	4	11.2	60.2	165	44	85	91	95	95	87
	9	3	19.3	47.4	233	94	167	176	180	178	157
	10	2	25.7	33.1	262	133	228	239	242	239	207
	11	1	30.0	17.1	274	157	265	277	281	275	237
SURFACE DAILY TOTALS					2154	1022	1774	1814	1830	1855	1526
NOV 21	8	4	3.5	54.7	36	5	17	19	21	22	22
	9	3	11.2	42.7	172	46	117	129	137	141	135
	10	2	17.1	29.5	233	83	185	202	212	215	201
	11	1	20.9	15.1	255	107	227	245	255	258	238
	12		22.2	0.0	251	115	241	253	270	272	250
SURFACE DAILY TOTALS					1622	536	1336	1408	1518	1566	1462
DEC 21	5	7	8.0	40.9	140	27	87	98	105	110	103
	6	6	13.6	28.2	214	63	164	180	192	197	170
	7	5	17.3	16.4	242	86	207	226	239	244	231
	8	4	18.6	0.0	250	94	222	241	254	260	244
	SURFACE DAILY TOTALS					1444	406	1136	1250	1326	1354

- NOTE: 1) BASED ON DATA IN TABLE 1, pp 387 in 1972 ASHRAE HANDBOOK OF FUNDAMENTALS, 0% GROUND REFLECTANCE; 1.0 CLEARNESS FACTOR.
 2) SEE FIG. 4, pp 394 in 1972 ASHRAE HANDBOOK OF FUNDAMENTALS FOR TYPICAL REGIONAL CLEARNESS FACTORS.
 3) GROUND REFLECTION NOT INCLUDED ON NORMAL OR HORIZONTAL SURFACES.

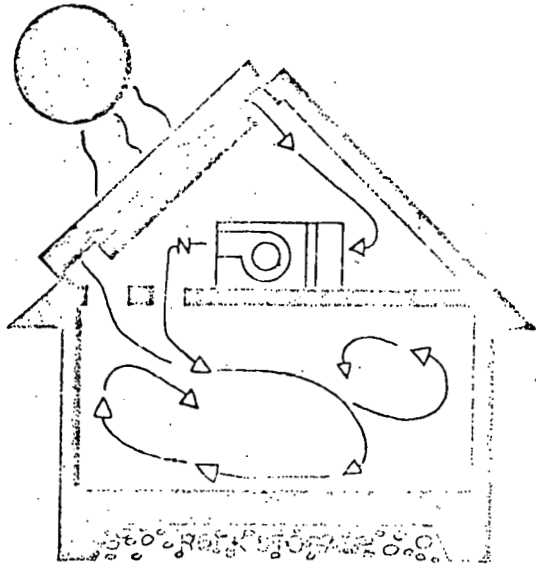
MEAN PERCENTAGE OF USABLE SUNSHINE FOR SELECTED LOCATIONS

State and Station	YRS	J	F	M	A	M	J	J	A	S	O	N	D	ANN
Ala., Birmingham	56	43	49	56	63	66	67	62	65	65	67	58	44	59
Montgomery	49	51	53	61	69	73	72	66	69	69	71	64	48	64
Alaska, Anchorage	19	39	46	56	58	50	51	45	29	35	32	33	29	45
Fairbanks	20	34	50	61	68	55	53	45	35	31	28	38	29	44
Juneau	14	30	32	39	37	34	35	28	30	25	18	21	19	30
Nome	29	44	45	48	53	51	48	32	26	34	35	36	30	41
Ariz., Phoenix	64	76	79	83	88	93	94	84	84	89	88	84	77	85
Yuma	57	83	87	91	94	97	99	92	91	93	93	90	83	91
Ark., Little Rock	66	44	53	57	62	67	72	71	73	71	74	58	47	62
Calif., Eureka	49	40	44	50	53	54	56	52	46	52	48	42	39	49
Fresno	55	46	63	72	83	89	94	97	97	93	87	73	47	78
Los Angeles	63	70	69	70	67	68	69	80	81	80	76	79	72	73
Red Bluff	39	50	60	65	75	79	86	95	94	89	77	64	50	75
Sacramento	48	44	57	67	76	82	90	96	95	92	82	65	44	77
San Diego	68	68	67	68	66	60	60	67	70	70	70	75	71	68
San Francisco	64	53	57	63	69	70	75	68	63	70	70	62	54	66
Colo., Denver	64	67	67	65	63	61	69	69	66	71	71	67	65	67
Grand Junction	57	58	62	64	67	71	79	76	72	77	74	67	58	69
Conn., Hartford	48	46	55	56	54	57	60	62	60	57	55	48	46	56
D.C., Washington	65	46	53	56	57	61	64	64	62	62	61	54	47	58
Fla., Apalachicola	26	59	62	62	71	77	70	64	63	62	74	66	53	65
Jacksonville	60	58	59	66	71	71	63	62	63	58	58	61	53	62
Key West	45	68	75	78	78	76	70	69	71	65	65	69	66	71
Miami Beach	48	66	72	73	73	68	62	65	67	62	67	65	65	67
Tampa	63	63	67	71	74	75	66	61	64	64	67	67	61	68
Ga., Atlanta	65	48	53	57	65	68	68	62	63	65	67	60	47	60
Hawaii, Hilo	9	48	42	41	34	31	41	44	38	42	41	34	36	39
Honolulu	53	62	64	60	62	64	66	67	70	70	68	63	60	65
Lihue	9	48	48	48	46	51	60	58	59	67	58	51	49	54
Idaho, Boise	20	40	48	59	67	68	75	89*	86	81	65	46	37	66
Pocatello	21	37	47	58	64	66	72	82	81	78	66	48	36	64
Ill., Cairo	30	46	53	59	65	71	77	82	79	75	73	56	46	65
Chicago	66	44	49	53	56	63	69	73	70	64	61	47	41	59
Springfield	59	47	51	54	58	64	69	76	72	73	64	53	45	60
Ind., Evansville	48	42	49	55	61	67	73	78	76	73	67	52	42	64
Fort Wayne	48	38	44	51	55	62	69	74	69	64	58	41	38	57
Indianapolis	63	41	47	49	55	62	68	74	70	68	64	48	39	59
Iowa, Des Moines	66	56	56	56	59	62	66	75	70	64	64	53	48	62
Dubuque	54	48	52	52	58	60	63	73	67	61	55	44	40	57
Sioux City	57	55	58	58	59	63	67	75	72	67	65	53	50	63
Kans., Concordia	52	60	60	62	63	65	73	79	76	72	70	64	56	67
Dodge City	70	67	66	68	68	68	74	78	78	76	75	70	67	71
Wichita	46	61	63	64	64	66	73	80	77	73	69	67	59	69
Ky., Louisville	59	41	47	52	57	64	68	72	69	68	64	51	39	59
La., New Orleans	69	49	50	57	63	66	64	58	60	64	70	60	46	59
Shreveport	18	48	54	58	60	69	78	79	80	79	77	65	60	69
Maine, Eastport	58	45	51	52	52	51	53	55	57	53	50	37	40	50
Mass., Boston	67	47	56	57	56	59	62	64	63	61	58	48	48	57
Mich., Alpena	45	29	43	52	56	59	64	70	64	52	44	24	22	51
Detroit	69	34	42	48	52	58	65	69	66	61	54	35	29	53
Grand Rapids	56	26	37	48	54	60	66	72	67	58	50	31	22	49
Marquette	55	31	49	47	52	53	56	63	57	47	38	24	24	47
Sau. St. Marie	60	28	44	50	54	54	59	63	58	45	36	21	22	47
Minn., Duluth	49	47	55	60	58	58	60	68	63	53	47	25	40	55
Minneapolis	45	49	54	55	57	60	64	72	69	60	54	40	40	56
Miss., Vicksburg	66	46	50	57	64	60	73	69	72	74	71	60	45	64
Mo., Kansas City	69	55	57	59	60	64	70	76	73	70	67	59	52	65
St. Louis	68	48	49	56	59	64	68	72	68	67	65	54	44	61
Springfield	45	48	54	57	60	63	69	77	72	71	65	58	48	63
Mont., Havre	55	49	58	61	63	63	65	78	75	64	57	46	46	62
Helena	65	46	55	58	60	59	63	77	74	63	57	48	43	60
Kalispell	50	28	40	49	57	58	60	77	73	61	50	28	20	53
Nebr., Lincoln	55	57	59	60	60	63	69	76	71	67	66	58	55	64
North Platte	53	63	63	64	62	64	72	78	74	72	70	62	58	68

MEAN PERCENTAGE OF POSSIBLE SUNSHINE FOR SELECTED LOCATIONS

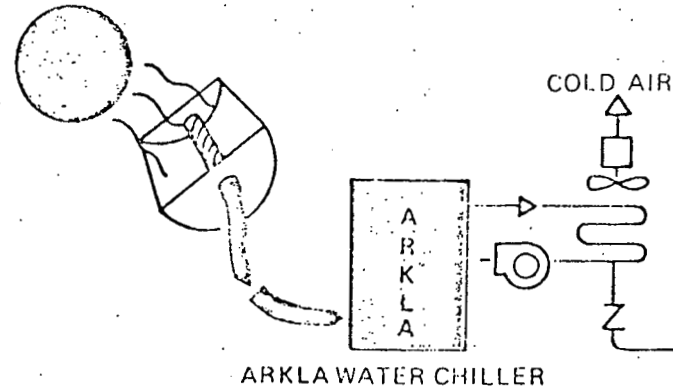
State and Station	YRS	J	F	M	A	M	J	J	A	S	O	N	D	ANN
Nevada, Ely	21	61	64	68	65	67	79	79	81	81	73	67	62	72
Las Vegas	19	74	77	78	82	85	91	84	85	92	84	83	75	82
Reno	51	59	64	69	75	77	82	90	89	86	76	68	96	76
Winnemucca	53	52	60	64	70	76	83	90	90	86	75	62	53	74
N.H., Concord	44	48	53	55	53	51	56	57	58	55	50	43	43	52
N.J., Atlantic City	62	51	57	58	59	62	65	67	66	64	54	58	52	60
N.M., Albuquerque	28	70	72	72	76	79	84	76	75	81	80	79	70	76
Roswell	47	69	72	75	77	76	80	76	75	74	74	74	69	74
N.Y., Albany	63	43	51	53	53	57	62	63	61	58	54	39	38	53
Binghamton	63	31	39	41	44	50	56	54	52	47	43	29	26	44
Buffalo	49	32	41	49	51	59	67	70	67	60	51	31	28	53
Canton	43	37	47	50	48	54	61	63	61	54	45	30	31	49
New York City	83	49	56	57	59	62	65	66	64	64	61	53	50	59
Syracuse	49	31	38	45	50	58	64	67	63	56	47	29	26	50
N.C., Asheville	57	48	53	56	61	64	63	59	59	62	64	59	48	58
Raleigh	61	50	56	59	64	67	65	62	62	63	64	62	52	61
N. Dak., Bismark	65	52	58	56	57	58	61	73	69	62	59	49	48	59
Devils Lake	55	54	60	59	60	59	62	71	67	59	56	44	45	58
Fargo	39	47	55	56	58	62	63	73	69	60	57	39	46	59
Williston	43	51	59	60	63	66	66	78	75	65	60	48	48	63
Ohio, Cincinnati	44	41	46	52	56	62	69	72	68	68	60	46	39	57
Cleveland	65	29	36	45	52	61	67	71	68	62	54	32	25	50
Columbus	65	36	44	49	54	63	68	71	68	66	60	44	35	55
Ok., Oklahoma City	62	57	69	63	64	65	74	78	78	74	68	64	57	68
Oregon, Baker	46	41	49	56	61	63	67	83	81	74	62	46	37	60
Portland	69	27	34	41	49	52	55	70	65	55	42	28	23	48
Roseburg	29	24	32	40	51	57	59	79	77	68	42	28	18	51
Pa., Harrisburg	60	43	52	55	57	61	65	68	63	62	58	47	43	57
Philadelphia	66	45	56	57	59	61	62	64	61	62	61	53	49	57
Pittsburgh	63	32	39	45	50	57	62	64	61	62	54	39	30	51
R.I., Block Island	48	45	54	47	56	58	60	62	62	60	59	50	44	56
S.C., Charleston	61	58	60	65	72	73	70	66	66	67	68	68	57	66
Columbia	55	53	57	62	68	69	68	63	65	64	68	64	51	63
S. Dak., Huron	62	55	62	60	62	65	68	76	72	66	61	52	49	63
Rapid City	53	58	62	63	62	61	66	73	73	69	66	58	54	64
Tenn., Knoxville	62	42	49	53	59	64	66	64	59	54	64	53	41	57
Memphis	55	44	51	57	64	68	74	73	74	70	69	58	45	64
Nashville	63	42	47	54	60	65	69	69	68	69	65	55	42	59
Tx., Abilene	14	64	68	73	66	73	86	83	85	73	71	72	66	73
Amarillo	54	71	71	75	75	75	82	81	81	79	76	76	70	76
Austin	33	46	50	57	60	62	72	76	79	70	70	57	49	63
Brownsville	37	44	49	51	57	65	73	78	78	67	70	54	44	61
Del Rio	36	53	55	61	63	60	66	75	80	69	66	58	52	63
El Paso	53	74	77	81	85	87	87	78	78	80	82	80	73	80
Fort Worth	33	56	57	65	66	67	73	78	78	74	70	63	58	68
Galveston	66	50	50	55	61	69	78	72	71	70	74	62	49	63
San Antonio	57	48	51	56	58	60	69	74	75	69	67	55	49	62
Utah, Salt Lake City	22	48	53	61	68	73	78	82	82	84	73	56	49	69
Vt., Burlington	54	34	43	48	47	53	59	62	59	51	43	25	24	46
Va., Norfolk	60	50	57	60	62	67	66	66	66	63	64	60	51	62
Richmond	56	49	55	59	63	67	66	65	62	63	64	58	50	61
Wash., North Head	44	28	37	42	48	48	48	50	46	48	41	31	27	41
Seattle	26	27	34	42	48	53	48	62	56	53	36	28	24	45
Spokane	62	26	41	53	63	64	68	82	79	68	53	28	22	58
Tatoosh Island	49	26	36	39	45	47	46	48	44	47	38	26	23	40
Walla Walla	44	24	35	52	63	67	72	86	84	72	59	33	20	60
Yakima	18	34	49	62	70	62	74	86	86	74	61	38	29	65
W. Va., Elkins	55	33	37	42	47	55	55	56	53	55	51	41	33	48
Parkersburg	62	30	36	42	49	56	69	63	60	60	53	37	29	48
Wis., Green Bay	57	44	51	55	56	58	64	70	65	58	52	40	40	55
Madison	59	44	49	52	53	58	64	70	66	60	56	41	38	56
Milwaukee	59	44	48	53	56	60	65	63	67	62	56	44	39	57
Wyo., Cheyenne	63	65	66	64	61	59	68	70	68	69	69	65	63	66
Lander	57	66	70	72	66	65	74	76	75	72	67	61	62	69
Sheridan	52	56	61	62	61	61	67	76	74	67	60	53	52	64
Yellowstone Park	35	39	51	55	57	56	63	73	71	65	57	45	38	56
P. Rico, San Juan	57	64	69	71	66	59	61	65	67	61	63	63	65	65

INDUSTRIAL AGRICULTURAL



HEATING

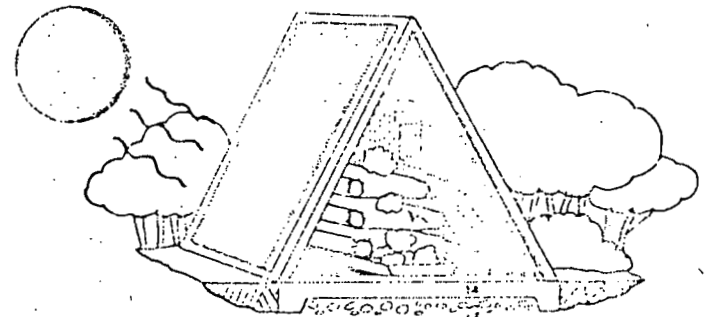
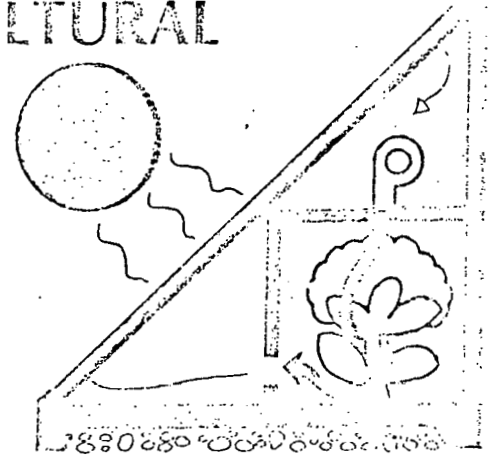
HOT AIR CAN BE INTRODUCED INTO ANY CONVENTIONAL FORCED HOT AIR HEATING SYSTEM



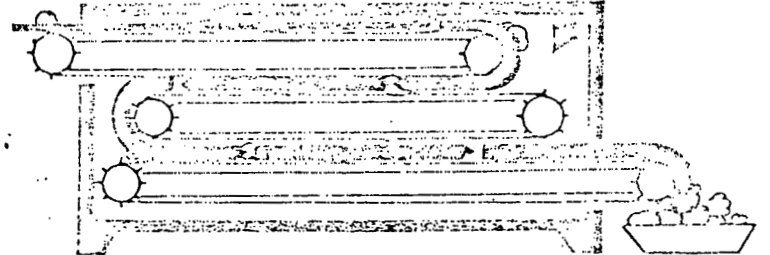
ARKLA WATER CHILLER

COOLING

SEECO IS A DISTRIBUTOR FOR THE FAMOUS ARKLA ABSORPTION CHILLER. EFFICIENT LOW COST CONCENTRATING COLLECTORS FURNISH HI-TEMP WATER TO THE UNIT WHICH PRODUCES LOW-TEMP WATER FOR COOLING AIR IN THE CONVENTIONAL FORCED AIR CONDITIONING SYSTEM



VARYING LENGTH CONVEYORS



HEAVILY INSULATED SEECO STEEL SOLAR DRYING BUILDINGS DIVIDE THE COST OF COLLECTOR AND BUILDING TO GIVE THE VERY LOWEST TOTAL COST OF EFFECTIVE UTILIZATION OF SOLAR ENERGY.



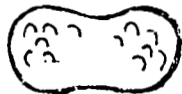
COTTON

MAY BE EFFECTIVELY DRIED IN SEVERAL WAYS, INCLUDING A COMBINATION OF SOLAR AND LINT BURNING INCENERATORS



LUMBER

SOLAR ENERGY IN A SEECO KILN CAN EFFECTIVELY DRY ALL TYPES OF LUMBER



PEANUTS

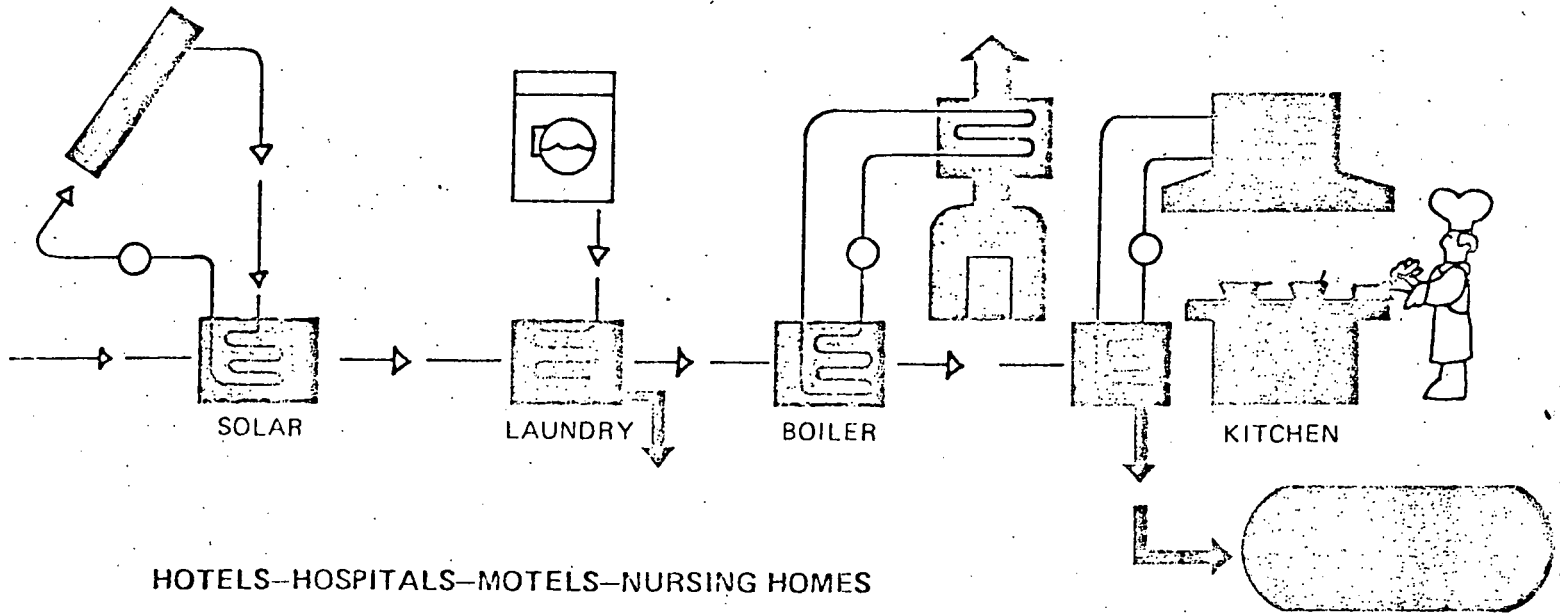
ARE IDEALLY ADAPTED TO SOLAR DRYING SINCE THEY REQUIRE ONLY LOW TEMPERATURE AIR

**CORN
GRAINS
BEANS
RICE**

SEECO HAS DEVELOPED EFFECTIVE SYSTEMS TO DRY THEM ALL

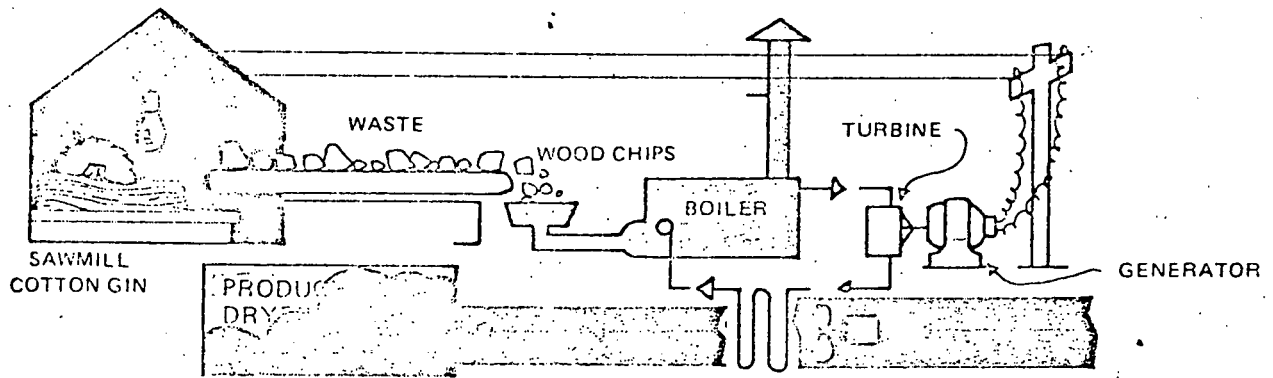
ALFALFA

ENERGY CONSERVATION



Vast quantities of energy may be reclaimed from the wasted heat from laundry washers, boiler stacks, kitchen range hoods, hot exhaust air, through a series of heat exchanging devices, starting with solar heated inlet air, to be utilized for comfort heating, process water heating, etc. in hotels and motels, fast food shops, hospitals, nursing homes, laundries, canning and packing plants and in a variety of industries. SEECO can offer professional engineering and contracting service in the form of a turn-key installation contract.

TOTAL ENERGY



Complete utilization of waste products from cotton gins, sawmills, planing mills, peanut shells, corn husks, etc. will furnish energy to fire special boilers to produce steam which will drive a turbine to turn a generator which will furnish electricity. The exhaust heat from the turbine will be used to produce heat to dry the product and the electricity will power the fans, pumps, saws, etc. in the mill. SEECO has done considerable research in this field and has designed small prototype plants which show clearly that there are many industries which can be 100% self-sustaining.

Industrial & Domestic Heating & Cooling

HEATING

FOR ANY USE - RESIDENTIAL, COMMERCIAL OR INDUSTRIAL CAN BE GENERATED BY THE SEECO HOT AIR COLLECTOR WITHOUT THE USE OF ANTI-FREEZE SOLUTIONS, AT HIGHER EFFICIENCY AND LOWER COST THAN LIQUID COLLECTORS

HOT WATER

