DOE/R2/05161-T1 FINAL REPORT

~~NV-80-013~~

WIND ENERGY GEOTHERMIC / SOLAR HEATING SYSTEM D.O.E. GRANT EG-42-80R20.5161

TABLE OF CONTENTS

Duplicate Copy

M86000473

DOE/R2/05161--T1

DE86 000473

FG42-80R205161
30/12/81

DISCLAIMER

OBJECTIVE PREFACE:

I've observed three distinct "camps" of renewable energy resources; WIND, Geothermic, & Solar. None of the three are completely adequate for the N.E. by themselves. I observe little effort to combine them to date.

My objective has been to demonstrate that the three can be combined in a practical system. To mitagate the high cost and poor payback for individual residences, I believe neighborhoods of 4 to 5 homes, apartment complexes or condominiums could form an Energy Association allotting a piece of ground (could be a greenbelt) which would contain the well or wells, Solar boosted underground water storage and the Solar banks. These are the high cost items which could be prorated and ammortized by the Association. Easements would permit each residence underground insulated water lines for individual heat pump conversions to existing forced air furnaces. Where regulations permit, an individual home could erect his own windmill to belt drive his freon compressor. With or without the optional windmill the water to freon heat pump with its solar boost on the well water, will enjoy C.O.P's. (coefficient of Performances or times better than electric resistance heat) beyond anything on the market today.

The reason water heat pumps are not more plentiful is pure economics. It requires several trades to make the installation. The well driller, trenching, plumbing, and refrigeration. In a neighborhood energy association, all trenching could be done together all plumbing could be one contract and they could qualify for quantity discounts on heat pump units, chillers and components and installation.

SUMMARY OF ALL WORK DONE

First Quarter - Report Dec. 31,1980

1) Restored a surplus 4000 gal. gasoline tank with manhole access, rust preventive coating inside & out

2) Excavated to bury tank midway between residences No. 1 & 2 six feet underground. Patented insulation system, Application 202.702

3) trenched and installed insulated water suction and discharge lines from tank to both residences. Also water supply line from well.

4) Reworked windmill drive line

5) To overcome complexity of controlled clutching & declutching of windmill and the A/C back-up motor, a second compressor dedicated to the A/C motor was added. Both compressors are in parelel and common freon circuits of residence no. 2.

6) Started procurement of heat pump components.

See photos of tank & insulation proceedures, windmill re-building with Dec. 31,1980 report.

Second Quarter - Report April 5,1981

1) Installed Renault transaxle at windmill base.

2) Enclosed drive line of windmill with remote greasing provision

3) procured ½" copper pipe for solar panels

4) erected windmill

See photos of erection with April 5,1981 report.

Third Quarter - Report of JUly 1,1981

1) Added flywheel to windmill drive.

2) reworked a Toyota manual clutch with motorized drive and limit switches to unload flywheel to compressor between adjustable high and low RPM settings.

3) ordered an Electro Tachometer for controlling 1) above

4) Hooked up water circulation system

5) Reworked "A" coil for furnace of Res. no. 2

6) Initial concept proposed for solar panel tracking orientor

7) gained insite on significant advantage of the old farm windmill over modern high speed wind generators. See page 2 of July 1,1981 report.

Third Quarter - Cont.

8) relocated windspeed indicator from windmill tower to remote mast.

See photos of flywheel, circulating pump vault & "A" coil rework with July 1,1981 report.

Fourth Quarter - Oct 9,1981 Final Report

1) Installed Electro Tachometer and wired motorized clutch on flywheel.

2) Total system automatic controls wiring 90% complete. Estimate not more than 200 hours remaining of loose ends. Scheduled completion by late November 1981.

3) Built seven Solar panels, one complete, six ready for final assembly. Ordered four panels from Universal Solar Development, Orlando Florida for comparative performance evaluation. (shipment promised wk of 10/12)

4) Refined concept of tracking orientor. Patent Application mailed 10/8/81 to U.S. Patent Office.

5) Priority present effort is to complete the prototype for above. Visited Greer Hydraulics in Commerce City California Oct.2. They have provided 2 Greeolators, the pressure vessel with bladder separators. It is interesting to note they have not seen this application using freon/ oil fluids before. Completion goal is to be operational by Open House Oct. 30th.

6) Fabricated Solar panel trunion and mount in concrete pedistal.

7) Added controlls for maintaining storage tank water level from well.
Added temperature water probe to tank.
Added agitator drive to tank water.

8) On October 8th we had a "cold front" move in with 60 MPH gale winds for four hours. The tower and driveline had onehell of a test. Flywheel attained speed in excess of 1000 RPM. No problem.

9) Negotiating with Rochester Gas & Electric for loan of watt hour meters and recorders to monitor system for a period of time. Final diagrams and performance data will be forwarded in due course.

October 9,1981

A.T. Program Mgr.
D.O.E.
26 Federal Plaza, Rm. 3200
New York, N.Y. 10278

Final Report July - September 1981 ; D.O.E. Grant EG-42-80 R 20.5161

Man hours spent:

a) Braught forward from July 1st report	713.5
b) This reporting period July - Sept	446.6
Total	1160.1

Original budget estimated 1410 man-hours. At this point of virtual completion, man-hours are 18% under budget. There remains perhaps 200 man-hours control wiring and final documentation. This should be complete late November.

Financial Summary:

From ledger sheet No. 1

Category No. 3	Equipment/ Supplies	$ 364.16	
Category No. 4	Materials	5,721.11	
			$6,085.27

From ledger sheet No. 2

Category No. 3	Equipment/ Supplies	$ 34.95	
Category No. 4	Materials	1,123.17	
Category No. 7	Sub-Contract	1,000.00	
			$2,158.12

From ledger sheet No. 3

Category No. 3	Equipment/ Supplies	$ 844.27	
Category No. 4	Materials	2,794.49	
			$3,638.76

From ledger sheet No. 4

Category No. 3	Equipment/ Supplies	$ 351.07	
Category No. 4	Materials	134.96	
Category No. 7	Sub- Contract	1,000.00	
			$1,486.03

Financial Summary, con't.

Totals from ledger sheets 1,2,3, &4 by Category:

Category No. 3 Equipment/ Supplies	$1,594.45	
Category No. 4 Materials	9773.73	
Category No. 7 Sub- Contract	2,000.00	
		$13,368.18

Breakdown by Budget, Original scope, Solar supplement:

	Budget	Original Scope	Solar Supplement	Total
Category No. 3	$ 800.00	$ 809.08	$ 785.37	$ 1,594.45
Category No. 4	9,410.00	8,394.95	1,378.78	9,773.73
Category No. 7	2,500.00	2,000.00	-- --	2,000.00
Misc.	290.00			
Totals	$13,000.00	$11,204.03	$2,164.15	$13,368.18

A total of 57 checks were issued on A/C 050206-1919-06 starting No. 1 - 7 and continuing No. 101 - 151. Total dollar amount of checks including a $4.98 Check Charge is $13,040.89. Two deposits were made for refund of material returned for credit and canceled, $94.46 & $51.80, which gives a net total of checks written of $12,894.63

Attached are copies of the Check book and ledger sheets 1,2,3,&4. The check book closing balance has been Bank verified verbally as check No. 150 to Newark Electronics has yet to clear. ($45.06). The balance $258.60 balances against deposits and accrued interest as follows:

Deposits of Grant Draws (3)	$13,000.00
Accrued Interest	153.23
Total deposits	$13,153.23
Less net Total checks issued	-12,894.63
Balance	$ 258.60

I have written two final checks 10/5/81 to close the account. No.152 payable to Roger H. Cross Jr. for $105.37. See note on ledger sheet No.4, partial re-imbursement of cash spent in this last quarter, balance absorbed by R.H.C. The second No 153 is enclosed and payable to A.T. Program Mgr. D.O.E. for $153.23. (accrued interest)

Project over-run was 1.7% of budget. $227.92 absorbed by RHC

$$\frac{\$368.18 - 146.26}{\$13,000.00} = 1.7\%$$

It is interesting to note the major expense category of heat pump related material and sub-contract was within 3% of budgeted $7250.00 ($4750.00 plus $2,500.00 The total for this portion was$7466.46 and comprised checks No.103,107,119,124, 125,130,134,146,151,117,118,120,126,136, &140 (less credit return $94.46)

Financial summary, con't.

Acknowledgement must be given to Suppliers who donated free or at cost goods and services because of their faith in the projects future potential. This saved well over $3,000. Considerable salvage material has been used at no charge to the project. All of this has made possible the $2,164.15 allocation to the Solar Supplement package.

Project Status:

1) Wind Mill driven heat pump.

The Electro Tackometer ordered from Ossman Instruments was very late in coming. (early Sept) This controls clutching and de-clutching of flywheel stored low energy winds to the compressor. Do not as yet have operational experience as installation has just been completed.

2) Back-up motor driven heat pump.

This shares in parallel the same freon network of the wind mill driven compressor. It is operational in cooling and heating modes.

3) Monitoring of performance:

We are negotiating with Rochester Gas & Electric for loan of watt-hour meters and recorders for use over a sustained period. No data available at this time.

4) Automatic controls:

All material is available and wiring is 90% complete. Estimate it may be late November 81 for completion with documentation.

5) Water suction leak reported in July report:

This was located, excavated and repaired. Pump now holds prime.

6) Solar Supplement:

I have opted to build my own panels from a cost saving veiwpoint. The initial bank has 7 panels 41"wide X93"high for a total of 183 square feet. The first one is completed, the other six require final assembly. Construction consists of 16 gage fabricated steel frame, double glazed with window glass. Two inch Thermex insulation backed with salvage above ground aluminum pool perimiter. I made the absorber plates from 14 gage alum. sheet 41" wide and 16" high. I built a hydraulic press to form nine ⌐¬ shapes every 4" in the 16" direction. Thus 5½ of these 16" formed stips painted flat black make up one absorber plate. Seven and one half foot copper pipe (totol of 9 per absorber plate) is locked into the ⌐¬ shape with Thermex Thermal conductive cement. I have independently of the grant purchased 4 panels from Universal Solar Development which will provide a basis of performance comparison to those I have made.

Solar Supplement - Cont.

These seven solar panels are hinge mounted on a rotatable trussed trunion. The rotational bearing support was salvaged using one half of a Rockwell dump truck full floating rear axle mounted vertically in a concrete pedistal. The hot water return from the upper panel discharge manifold returns to the tank thru the center of the axle in insulated pipe (inplace of the original axle shaft) . The horizontal hinged support mounting allows seasonal adjustment of the tilt to match the sun's ever changing path summer to winter. The would be a manual adjustment 2 or 3 times per year. Cold water supply to the bottom feed manifold comes from a motorized valve on an underground insulated line from the main circulating pump which supplies tank water to the chillers in each heat pump locations in residences 1 & 2. An adgitator was been added to the 4000 gal tank to prevent temperture stratification. A Delta T temperature differential monitor controls the feed water valve whenever panel temperature exceeds tank temperature by more than 10 degrees. Another motorized valve has been reworked to "normally open" operation. When panel temerature approaches freezing the valve de-energizes allowing draindown protection. The reworked mode also assures anti-freeze protection in event of power failure.

A Patent Application, copy attached, has been filed for a Solar tracking Orientor device. This is a triangular package mounted on top of the center Solar panel. It operates on differential pressure applied to CW & CCW hydraulic cylinders. Cylinders are mounted on the concrete pedistal at the base. Pressure differential exists when the triangular sensing panel doesn't directly face the sun. A Freon charged loop feeds the bladder of a pressure vessel (Greerolator) in both the E & W insulated and glazed chambers of the sensing collector. Freon pressure differential as a result of temerature differences in the two chambers works against hydraulic oil on the other side of the bladders in the pressure vessels. This oil feeds the opposing hydraulic cylinders thru hoses. The cylinders rotate the trunion mounting the solar bank, until pressure equalizes, that is when temperatures are equal in the E &W chambers and the whole trunion directly faces the sun. The whole unit can be made for under $500. It would have application for concentrating collectors as well as photovoltaic collectors. This market is now dependent on electronic sensors and power devices which are far more complex and costly.

I have the material to build the prototype and expect to be testing and debugging by late November.

Conclusion:

While this is the "final" report to satisfy Oct. 15th filing, final performance will not be available until system has undergone a years heating and cooling cycle.

Mr. Garvin and I have considerable pride and confidence in the system. We plan an open house October 30 & 31, 2 to 5 PM and are inviting the many suppliers, individuals and public officials who's cooperation has made this possible. High on the list is the D.O.E. and we hope conditions permit your attendence.

By copy attached, I've informed D.O.E. Patent Council of the patent application on the Solar orientor and requested clearance.

Also enclosed is a copy of Eugene Stephans letter of Sept 21 advising allowance of Patent Application 202.702, - Thermal Insulation System.

Sincerely

Roger H. Cross Jr.
October 9,1981

Enclosures:

copies of
1) ledger sheets 1,2,3, &4
2) check book entries for 59 checks on A/C 050206-1919-06
3) check No. 153 for accrued interest ($153.23)
4) Photos of 4th qtr. work
5) open house invitation
6) Patent Appl. for Solar Tracking Orientor
7) Letter to D.O.E. Patent Council with 6
8) Letter Sept 21. Stephans Thermal Insulation System

D.O.E. GRANT No FG-42-80R 20.5161 OCT 80

EQUIPMENT Cost Cat 3 → BALANCE
MATERIALS Cost Cat 4 →
LABOR HOURS 5 →

DATE		ck		ck		
1980 10/27	Debbie Supply U.G.P. PIPE	•	43 76			
10/27	Frank E. Laffan 7/16 Nuts + Washers	•	7 16			
10/26-27	TANK REFURBISHING					
10/26	10 GAL TANK ASPHALT 84 LUMBER	•	18 92			
10/31	Perlite Freight EXC 11-1/3	•	173 00			
10/31	Perlite INSULATION Cochrane	•	615 45			
11/7	tank - 4,000 Gal O Bashman			3	300 00	SOLAR
10/28	Devcon - G. works	•	8 03			
11/4	Durant Rental - Pumps			2	25 21	
10/29	Howe & Bassett - Plug - tank	•	6 14			
11/7	John P Halpin - Filter - (Maint)	•	4 53			
11/4	Haverstick - Pipe	1	207 06			
	• Total Paid by RHC 876.49 PRIOR to RECEIPT of FUNDS (Reimbursed Check No [illegible])					
11/9	Pipe fittings 84 Lumber	Cash	3 22			
11/8	" " Weiders	Cash	1 69			
11/8	Face Masks Morans	Cash	4 49			
11/10	Haverstick Pipe 1"	5	73 21			
11/10	Dygert & Stone - tubing P.E.	6+7	~~48 44~~			
12/31/80	John M Forster Co. Pillow Blocks	101	201 14			
1981 1/3/81	84 Lumber 4" PVC Drive Shaft Cover	102	31 84			
1/5/81	Daniel Garvin Heat Pump Comps	103	2050 00			
1/10/81	Regional Supply - Grease Tubing	104	26 18			
1/10/81	Sava's Auto Supply Flaring Tool	Cash			13 95	
	grease Fittings	Cash	11 98			
1/8/81	Color Methods Film Devel.	Cash	10 51			
	• Total Paid by RHC 11/9/80 - 1/8/81 CASH 445.84 (Reimbursed by Ck No 10[illegible])					
1/9/81	Brooks Grandy - Grease	Cash	2 68			
11/18/80	Howe & Bassett - PVC Pipe	Cash	11 55			
1/12/81	Rochester Welding (oxy-acyt)	106	25 15			
1/29/81	Daniel Garvin Heat Pump Comps	107	1381 06			RHC Reimb
4/14/81	Haverstick & Co Inc. RHC	Cash •	513 89		SOLAR 1/2 Ck 7/21/81 Ck 131	
1/26/81	Frank Laffan Nuts	Cash	5 11			
1/23/81	S B Roby Co. Cable	Cash	42 27			
11/16/80	Weiders Hardware	Cash	6 74			
~~3/31/81~~	~~Scrantoms (Book~~					
4/3/81	Paint - Morans	108	24 01			
2/28/81	Scrantoms - Energy Book	Cash •	6 92			
	• Total Paid by RHC 1/9 - 4/[illegible] CASH [illegible] (Reimbursed by Ck No 109)					
4/14/80	James Slocum - blower Rental	Cash •			25 00	
1/26	Checks		498			
			Total	6085.27 ✓		

RHP

Sub Contract Cost Cat 7 →
Equipment Cost Cat 3 →
Materials Cost Cat 4 →
Labor hours 5 →

Date			ck.		Balance
4/29	81	H.M. Cross Belts & Pulley	112	1565	
4/27	81	H.M. Cross Belt	Cash	1228	
5/2	81	Morans (1 gal Al Rust)	111	2271	
4/20	81	Frank Lalifan - Hex nuts	Cash	511	
4/15	81	John Halsey - nuts	Cash	139	
4/22	81	Parts Plus - Hose Clamps	Cash	256	
4/29	81	Weiders Hardware - PVC Pipe	Cash	229	
5/2	81	Weiders Hardware PVC Pipe	Cash	319	
5/3	81	Regna Elect - Cable for Pump	113	4708	
5/11	81	Regna Elect - Circ Break	114	1850	
4/20	81	White wire - suction screen	Cash	315	
5/7	81	Rochester Welding	Cash	4102	
		• TOTAL PD. BY RHC 4/-5/7 CASH $96.19 (Reimbursed by ck. No 115)			
5/12	81	Edmunds Scient. Wind Speed	Cash	3495	
5/13	81	Haverstick Co elec Pipe Fitting	116	5299	
6/1	81	Noble Refrig - Heat Pump Comp	115	7124	
5/15	81	Ontario Metal Supply - Cable	117	8102	
6/2	81	Dan Garvin - Heat Pump Parts	119	16480	
6/3	81	Noble Refrig - Insulation	120	3383	
6/4	81	Ontario Metal Supply	Cash	1362	
5/15	81	Honeoye Falls Auto Parts - Lubricant	Cash	214	
6/2	81	Ontario Metal Supply	Cash	510	
4/9	81	Color Methods - Film Dev	Cash	1938	
4/9	81	K.C. Livermore - Grass Seed	Cash	5591	
4/13	81	K.C. Livermore - Grass Seed	Cash	556	
4/7	81	Monroe Tractor - Backhoe Rental	110	6150	
4/8	81	Cole Sand & Gravel - Gravel	Cash	1663	
		• TOTAL PD. BY RHC 5/7 - 6/7 CASH $153.28 (Reimbursed by ck. No 121)			
4/10	81	Gleason Works - bearings	Cash	1984	
6/9	81	Fotomat - film Dev	Cash	765	
6/10	81	Steel Service (bearing cost)	122	5180	← TO BE CREDITED ORDER CANCELED RHC 7/2/81
6/19	81	Avon Lumber (Portland Cem)	123	2247	
6/29	81	Daniel Garvin Heat Pump Comp	124	14810	
6/29	81	Daniel Garvin (Consult subcont)	125		10000
6/30	81	Haverstick & Co. (Cat 4 Pumps)	129	2244	
6/19	81	Rochester Welding Supply	Cash	2593	
6/30	81	Noble Refrig	126	3943	
7/2	81	Photomate (Report Photo)	Cash	716	
5/2	81	Ontario Metal Supply fittings	Cash	382	
7/13	81	Ontario Metal Supply Portland C	128	1501	
6/30	81	Haverstick & Co Pumps	129	2244	Duplicate entry
					Total 215812

Sub Cont. Cat 7
Equip Cat 3
Material Cat 4
Labor Hours

Date		Description	Labor Hours	Ck.	Material		Equip	Sub Cont
7/15	81	Howe & Bassett PVC Fit		129	4 97			
7/16	81	Daniel Garvin - Nochl R12 Ref		130	48 15			
7/16	81	Weiders Hardware PVC Fit		Cash	84			
7/18	81	Bride Hardware - Pipe Thread		Cash	5 33			
		Total Paid by RHC 6/7 - 7/21/81 CASH - INCLUDES 7/14/81 Haverstick $513.89						
		Solar Pipe authorized 7/13/81 Phone - TOTAL $584.46						
7/21	81	Roger H Cross Jr. - Reimbursement		Ck 131	584.46			
7/21	81	Requa Elect (J BOX Conduit)		132	33.61			
8/4	81	Credit (Elect Service Ck 122)		(122)	(51.80)	X		
8/6	81	Radio Shack (term strips)		Cash	15 98			
8/6	81	Requa Elect (Connectors) Elect		Cash	4 12			
8/8	81	Daniel Garvin (Valves Relamp)		ck 134	946 40			
8/7	81	Requa Elect - Wire Nos. labels		Cash	6 31			
8/12	81	Roch Welding - Oxygen		Cash	6 19			
8/12	81	Maynards - Wire, Gas Fittings, couplings		Cash	32 04			
8/14	81	Avon Lumber - Slag Portland R.R.		Cash	42 91			Solar
8/14	81	Elam Bros. - Concrete Mix		Cash	25 02			Solar
8/15	81	Weiders Hardware - Fittings		Cash	2 18			
8/15	81	Morans - Fittings, Solder		Cash	32 30			
8/17	81	Ossman Instruments Tachometer		Ck 133			655 22	
8/17	81	Requa Elect (Elect J BOX)		ck 135	42 90			
8/17	81	Noble Refrig (Pipe insul)		ck 136	19 74			
8/24	81	Haverstick & Co Pipe Fittings		ck 137	41 62			
8/23	81	Weiders Hardware (Fittings)		Cash	4 16			
8/25	81	Total paid by RHC 7/21 - 8/25 Cash		ck 138	171.19			
8/25	81	Noble Refrig. Solder, Fittings		ck 140	36 80			
8/24	81	Peterson's (Panel insulation)		ck 139	270 18			Solar
8/19	81	Solar Component Corp, order 05-1321		~~Cash~~	~~134 30~~	Cash	134 30	Solar
8/27	81	Ossman Inst (tax)		ck 141			45 72	
8/26	81	Simcona Electronic (Connector)		Cash			9 03	
8/26	81	Howe & Bassett (3/4" elbow)		Cash	1 61			
8/27	81	H.M. Cross & Sons (Pulley)		Ck 142	15 12			
8/17	81	T.&T. Bearing (agitator)		Cash	16 73		Solar	
9/1	81	Haverstick - Pipe fitting		ck 144	42 61			
8/31	81	Thermon Mfg Co. Adhesive		ck 143	148 73		Solar	
9/3	81	Haverstick (fitting)		ck 145	92 65			
9/11	81	Daniel Garvin (H.P. Parts)		ck 146	540 35			
9/11	81	Bartholomew's Mfg (Solar Pan Steel)		ck 147	265 00		Solar	
9/12	81	Haverstick (solder fitting) 33371		ck 148	24 96			
9/17	81	Credit Garvin Parts Returned (6246)			([illegible])	X		
			X (Not checked)				Total 3,638.76	

Sub-Cont Cat 7
Equip Cat 3
Material Cat 4
Labor hours

Date						
9/19 81	Sears - Hacksaw Bl.			Cash	1703	Solar
9/17 81	Rock Telephone	Cash	816			
9/14 81	Longashy Corr Elect Spec	Cash	1241			
9/10 81	Hadlock House (Plot Block)	Cash	3259			Solar
9/12 81	Sears - Pop Rivets	Cash	562			
9/19 81	Regua Elect Connect	Cash	212			
9/2 81	Davis Haviland Corporation	~~Cash 267~~		Cash	2675	Solar
9/7 81	Cook Akron Weld Supply	~~Cash 942~~		Cash	9425	Solar
9/8 81	T & T. Bearing (Band Saw)	~~Cash 311~~		Cash	311	Solar
9/8 81	John M Forster (Band Saw Belt)	~~Cash 653~~		Cash	653	Solar
9/9 81	Jackson Saw (Band Saw Blade)	~~Cash 1288~~		Cash	1288	Solar
9/9/81	Portables (Panel Frame Brace)	Cash	2101			Solar
9/14/81	Regua Elect Conn.	Cash	1018			
9/15/81	Regua Elect Flex Conn	Cash	151			
9/19 81	Rochester Hyd (2 4"x16" Cyl)	~~Ck 149 25.35~~		Ck 149	27535	Solar
9/19/81	Newark Electronics	Ck 150	46.06			
9/24/81	Daniel Corrin (Sub-Cont)	Ck 157	~~1000.00~~			1000.00

10/5 81 Cash Paid by RHC 9/25 - 9/15/81 $327.29 - Partially Re-imbursed by Check No 153 in amount of $105.37 for balance closing of bank Acct - Total expenditure $13,000.00
Balance of $221.92 (327.29 - 105.37) overrun absorbed by R.H.C.

Roger H. Crouch Jr
10/5/81

Total 1,486.03

DATE	CHECK NUMBER	CHECKS ISSUED TO OR DEPOSIT RECEIVED FROM	AMOUNT OF DEPOSIT	V	FEE	AMOUNT OF CHECK	BALANCE
11/2		Dep.					6500 —
11/4	1	Haverstick - Pipe		✓		207 06	6292 94
11/5	2	Durant Rentall		✓		25 21	6267 73
11/7	3	B Baskinan		✓		300 00	5967 73
11/7	4	Roger H Crouch		✓		876 99	5090 74
11/10	5	Haverstick - Pipe		✓		73 21	5017 53
11/10	6	Dygert + Stonecliff		✓		133 60	4883 93
11/13	7	Dygert + Stonecliff		✓		14 84	4869 09
11/19		Interest	13 46	✓			4882 55

SUGGESTIONS FOR USE OF THIS REGISTER ARE PRINTED ON REVERSE

PLEASE BE SURE TO DEDUCT ANY PER CHECK CHARGES OR SERVICE CHARGES THAT MAY APPLY TO YOUR ACCOUNT

CHECK NO.	DATE	CHECKS ISSUED TO OR DESCRIPTION OF DEPOSIT	(−) AMOUNT OF CHECK	✓ T	(−) CHECK FEE (IF ANY)	(+) AMOUNT OF DEPOSIT	BALANCE
							4882 55
	11/26	TO/FOR Check Charge	4 98	✓			4 98
							B 4877 57
	12/15	TO/FOR Interest		✓		17 66	17 66
			CK 12/15/80				B 4895 23
101	12/31	TO/FOR John M Forster Co. Pillow blocks	201 14	✓		~~201 14~~	201 14
							B 4694 09
102	1/3/81	TO/FOR 84 Lumber PVC Pipe 4" Cpl.	31 84	✓			31 84
							B 4662 25
103	1/5/81	TO/FOR Daniel J. Gazin Invoice 5748	2050 00	✓			2050 00
							2612 25

REMEMBER TO RECORD AUTOMATIC PAYMENTS / DEPOSITS ON DATE AUTHORIZED.

3,918.87

PLEASE BE SURE TO DEDUCT ANY PER CHECK CHARGES OR SERVICE CHARGES THAT MAY APPLY TO YOUR ACCOUNT

CHECK NO.	DATE	CHECKS ISSUED TO OR DESCRIPTION OF DEPOSIT	(−) AMOUNT OF CHECK	✓ T	(−) CHECK FEE (IF ANY)	(+) AMOUNT OF DEPOSIT	BALANCE
							2612 25
104	1/10/81	TO/FOR Regional Parts Inc Grease fire & Fittings	76 48	✓			2536 07
105	1/4/81	TO/FOR Roger H Cron Jr. Cash Reimburse 4/9/80-1/4/81	45 84	✓	OK-1/2	9/81	2490 23
106	1/12/81	TO/FOR Rochester Welding Oxygen - acetelene	25 15	✓			2465 08
107	1/24/81	TO/FOR Daniel Garvin	1381 06	✓			1084 02
	1/16/81	TO/FOR interest 12/16 to 1/16/81		✓		10 31	
	1/16/81	TO/FOR interest 12/16 - 12/31		✓		10 90	1094 33
							1105 23
	2/18	TO/FOR interest 1/17 to 2/18	OK 2/18/81	✓		7 57	1112 80
	3/16	TO/FOR interest 2/19 to 3/16	OK 3/16/81	✓		4 23	1117 03
108	4/12	TO/FOR Morans	2401 ✓		OK 5/2		1093 02
109	4/15	TO/FOR Roger H Cron Jr. 1/9-4/1 Cash Reimbursement	75 27 ✓				75 27
							1017 75
110	4/17	TO/FOR Monroe Tractor backhoe Rental	61 50 ✓				61 50
							956 25
111	5/2	TO/FOR Morans Paint tower	22 71 ✓				22 71
							933 54
112	4/21	TO/FOR H. M. Cron Co Inc Belt & Pulley	15 65 ✓				15 65
							917 89

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5,646.24

PLEASE BE SURE TO DEDUCT ANY PER CHECK CHARGES OR SERVICE CHARGES THAT MAY APPLY TO YOUR ACCOUNT

CHECK NO.	DATE	CHECKS ISSUED TO OR DESCRIPTION OF DEPOSIT	(−) AMOUNT OF CHECK	✓ T	(−) CHECK FEE (IF ANY)	(+) AMOUNT OF DEPOSIT	BALANCE
							917 87
	5/2	TO/FOR Interest 3-17/4-15			✓	4 87	4 87 B/AL 922 76
113	5/3	TO/FOR Regua Elect Cable	47 08		✓		47 08 B/AL 875 68
114	5/11	TO/FOR Regua Elect 2P-210V 20A CB	18 50		✓		18 50 B/AL 857 18
	5/12	TO/FOR Deposit			✓	5200 00	5200 00 B/AL 6057 18
115	5/12	TO/FOR Roger H Crow 4/1-5/7 Cash Reimbursement	96 79		✓		96 79 B/AL 5960 39
116	5/13	TO/FOR Heverstick & Cinelli fittings - water system	52 99		✓ OK 5/15/81		52 99 B/AL 5907 40
118	6/1	TO/FOR Hoehle Kefry	71 24	✓			71 24 B/AL 5836 16
117	5/15	TO/FOR Ontario Metal Supply	81 02	✓			81 02 B/AL 5755 14
119	6/2	TO/FOR Daniel Garvin	164 80	✓			164 80 B/AL 5590 34
120	6/3	TO/FOR Noehle Refrig [illegible] & fitting	33 83	✓			33 83 B/AL 5556 51
	5/15	TO/FOR interest 4-15/5/15			✓	7 90	7 90 B/AL 5564 41
121	6/8	TO/FOR Roger H Crow 5/7-6/7 Cash re-imbursement	153 28	✓			153 28 B/AL 5411 13
122	6/10	TO/FOR Service Steel Flywheel Bearing Cast	51 80	✓			51 80 B/AL 5359 [illegible]

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6[illegible]7,57 6/30/81

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		TO/FOR					2828 53
	8/4	Refund Van Pelt Corp check No 122 Service Ltd			✓	51 80	51 80
							BAL 2880 33
134	8/16	TO/FOR Daniel Garvey Valves + Relays	946 40	✓			946 40
							BAL 1933 93
135	8/17	TO/FOR Pegasus Elect Electrics	42 90	✓			42 90
							BAL 1891 03
136	8/17	TO/FOR Noehle & Ehrig	19 74	✓			19 74
							BAL 1871 29
137	8/24	TO/FOR Bayerstick & Co Fittings	41 62	✓			41 62
							BAL 1829 67
138	8/24	TO/FOR Roger D. Crow & Co Cash Disc 7/21-8/25	171 19	✓			171 19
							BAL 1658 48
	8/25	TO/FOR Interest 2/16-8/17			✓	17 47	17 47
							BAL 1675 95
139	8/29	TO/FOR Pedersons Solar Panel Insul	270 18	✓			270 18
							BAL 1405 77
140	8/25	TO/FOR Noehle Ehrig Fittings + Silver Solder	36 80	✓			36 80
							BAL 1368 97
141	8/27	TO/FOR Assurance Agent Inc Tax + Check 133	45 72	✓			45 72
							BAL 1323 25
142	8/27	TO/FOR AM Cross 26" motor pulley	15 12	✓			15 12
							BAL 1308 13
143	8/31	TO/FOR Thermon Mfg Co.	148 73	✓			148 73
							BAL 1159 40
	8/31	TO/FOR Deposit - 3rd draw			✓	1300 00	1300 00
							BAL 2459 40

REMEMBER TO RECORD AUTOMATIC PAYMENTS / DEPOSITS ON DATE AUTHORIZED.

10,734.11

PLEASE BE SURE TO DEDUCT ANY PER CHECK CHARGES OR SERVICE CHARGES THAT MAY APPLY TO YOUR ACCOUNT

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							2459 40
144	9/1	TO/FOR Haverstick. Invoice 30780	42 61	✓			42 61
							BAL 2416 79
145	9/3	TO/FOR Haverstick fitting	92 65	✓			92 65
							BAL 2324 14
146	9/11	TO/FOR Daniel Garvin Heat Pump Parts	540 35	✓			540 35
							BAL 1783 79
147	9/11	TO/FOR Barthelmes Mfg Solar Panel Stuff	285 00				285 00
							BAL 1498 79
148	9/12	TO/FOR Haverstick Invoice 33371	24 96	✓			24 96
							BAL 1473 83
	9/17	TO/FOR Credit returning part Garvin Credit Inv 6246				94 46	94 46
							BAL 1568 29
149	9/19	TO/FOR Rochester Hydraulics 2 - Cylinders	275 35	✓			275 35
							BAL 1292 94
150	9/19	TO/FOR Newark Electronics 500 MA Meter	45 06				45 06
							BAL 1247 88
151	9/12	TO/FOR Daniel Garvin Sub-Contract	1000 00	✓			1000 00
							BAL 247 88
	10/5	TO/FOR Interest 8/18 - 9/16		✓		10 72	10 72
							BAL 258 60
152	10/5	TO/FOR Roger H Crear Cash Rient 9/25 - 10/5	105 37				105 37
							BAL 153 23
153	10/5	TO/FOR AT Prog Mag - DOE acc interest	153 23				153 23
							BAL 00 00
		TO/FOR					

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13,040.89 ✓

ROGER H. CROSS, JR.
D. O. E. GRANT NO. F64280R205161
927 ERIE STATION
RUSH, NY 14543

153

Oct 5 1981

50-936
223

PAY TO THE ORDER OF A.T. Program Mgr. D.O.E. $ 153 23/100

One Hundred Fifty three & 23/100 DOLLARS

VSP MANUFACTURERS HANOVER TRUST COMPANY CENTRAL NEW YORK
Henrietta Office
3333 West Henrietta Rd., Rochester, N.Y. 14623

FOR Accumulated Interest Roger H Cross Jr.

⑆022309365⑆ 050206 1919⑈06

Original with
No 1 Copy

October 7,1981

Dept. of Energy
Brookhaven Area Office
Upton, New York 11973

Attention Leonard Belkin, Chief
Office of Patent Counsel

Dear Mr. Belkin: D.O.E. Grant No. FG-42-80R205161

Reference is made to your letter of Jan 6,1981 enclosing Confirmatory License (Format A) which you asked I file out and return for your Ref. Docket No. S-53,393 - S.N. 202,702 - Roger H. Cross Jr. - Thermal Insulation System. I believe I have carelessly neglected to return the signed copy as I just came across the material. Enclosed please find same.

Secondly, I take this opportunity to inform you of a second Patent App. copy attached, which has just been filed for a Solar powered sensing and tracking devise. I request clearance on this also.

Sincerely,

Roger H. Cross Jr.

927 Erie Station Rd.
Rush, New York 14543

EUGENE S. STEPHENS
STONEBRAKER, SHEPARD & STEPHENS
PATENT, COPYRIGHT & TRADEMARK LAW

716-244-7910

75 COLLEGE AVENUE
ROCHESTER, N.Y. 14607

Cable ESSPAT

September 21, 1981

Mr. Roger H. Cross, Jr.
927 Erie Station Road
Rush, New York 14543

Dear Roger:

Re: Patent Application Sn. No. 202,702
THERMAL INSULATION SYSTEM

We are pleased to report that the Examiner has allowed the above application, and it will proceed toward issuance.

Issuance of the patent will bar any foreign filing, so if you have changed your plans and desire any foreign applications, please let me know soon.

The enclosed invoice covers the response that was filed and the issuance fee.

Please call if you have any questions.

Cordially,

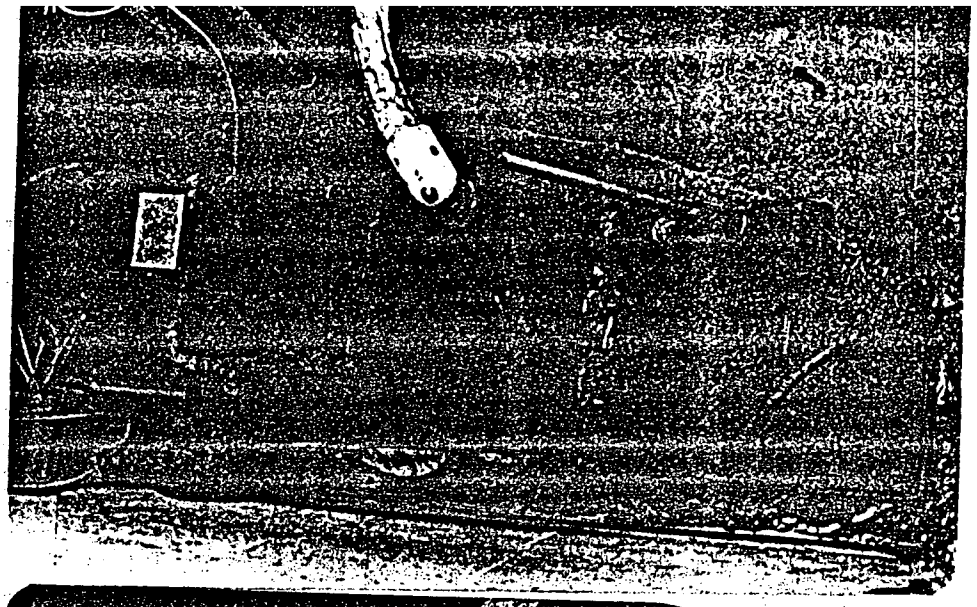
STONEBRAKER, SHEPARD & STEPHENS

Gene

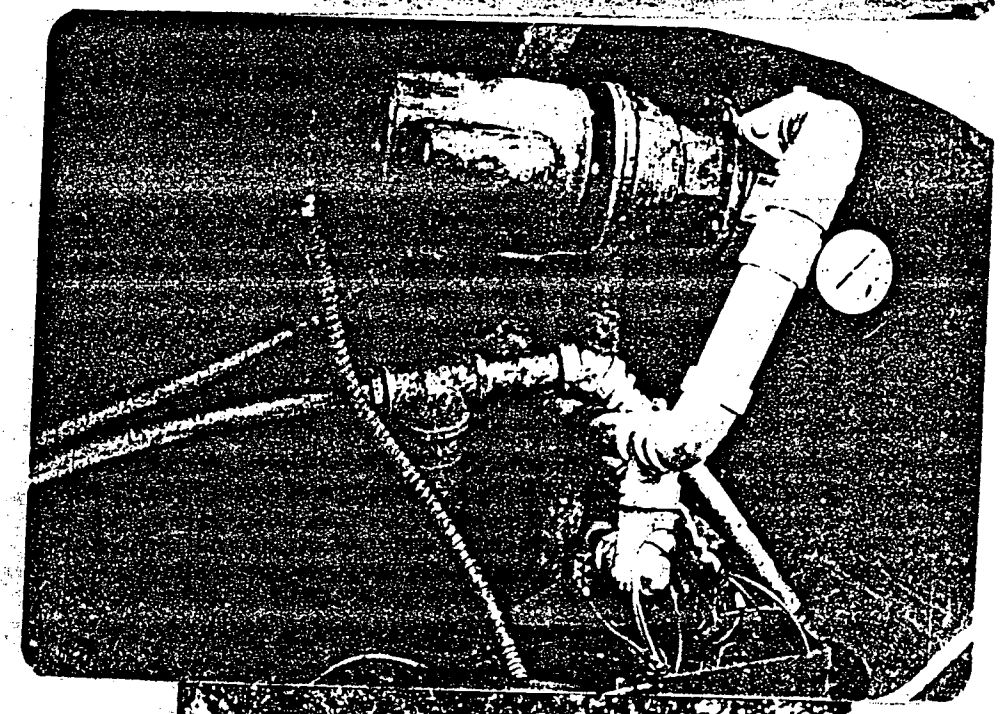
Eugene S. Stephens

ESS:cba

Enclosure



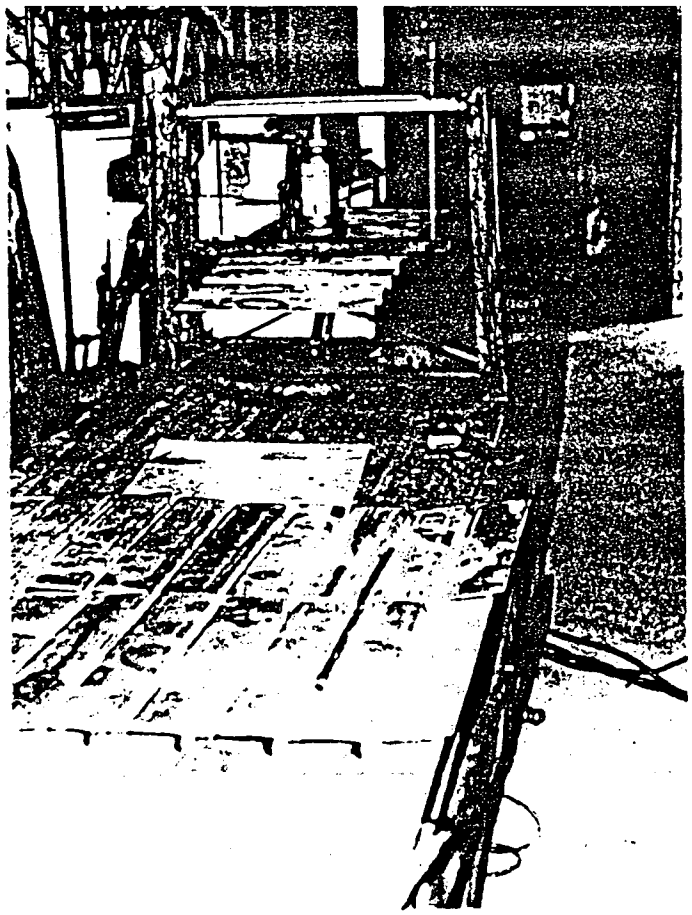
SUCTION LINE / PUM
SOLAR FEED & DUMP
SOLAR RETURN
AGITATOR PROP. SHA



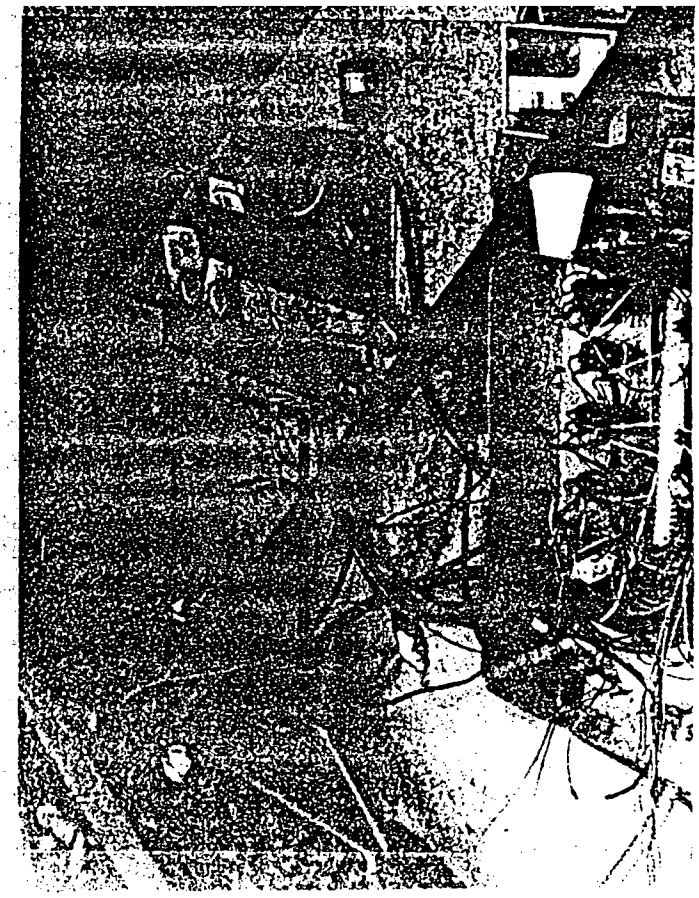
CIRCULATING PUMP
MANHOLE & WATER
DISTRIBUTION
CENTER

POURING TRUNION
PEDESTEL

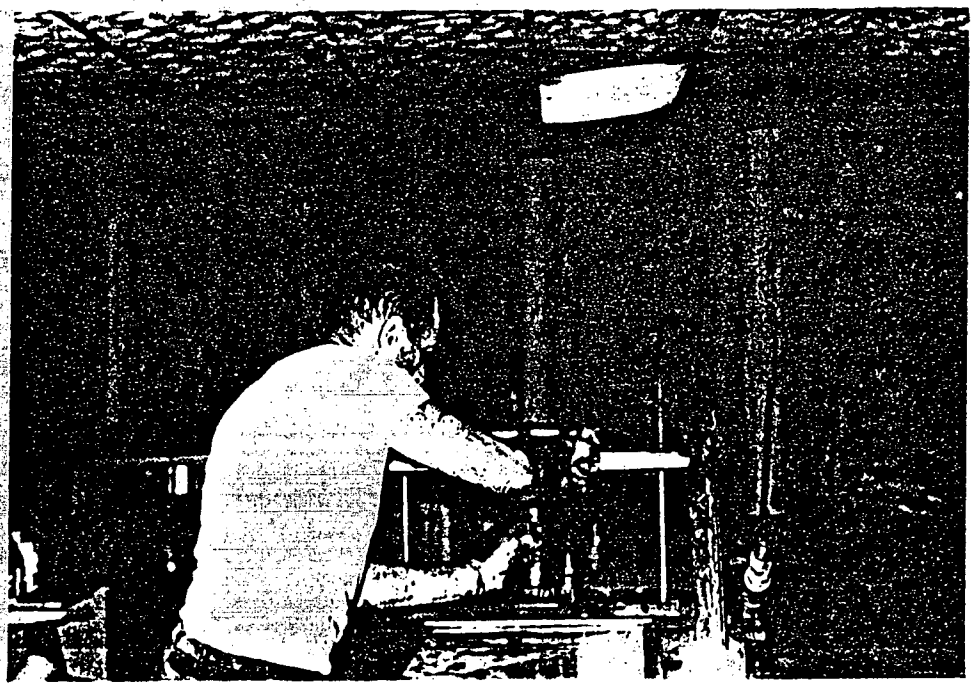
Enclosure 4-1

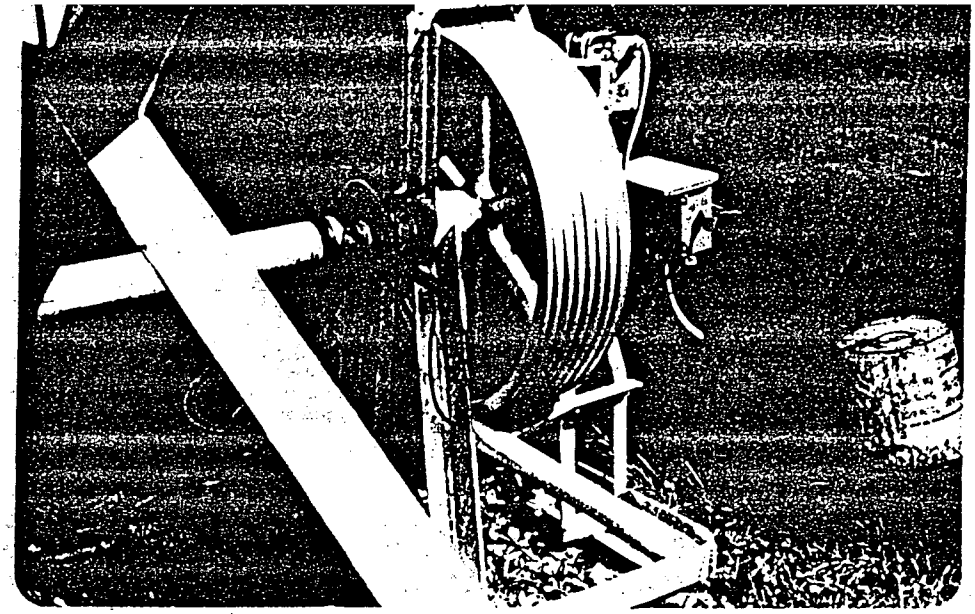


FORMING ABSORBER PLATES

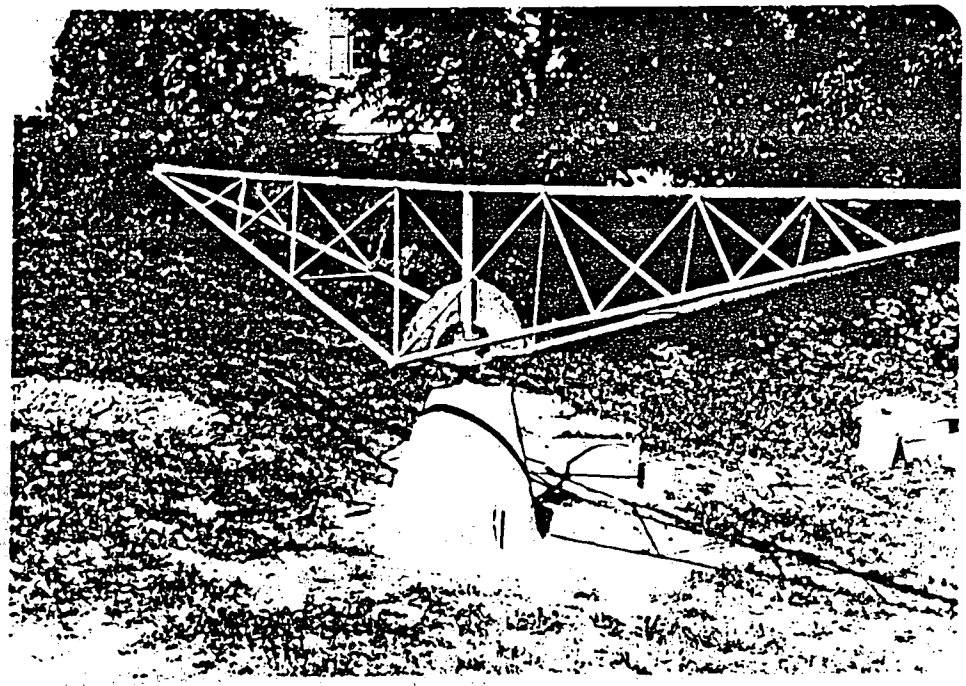


MAIN CONTROL CENTER, RESIDENCE 2

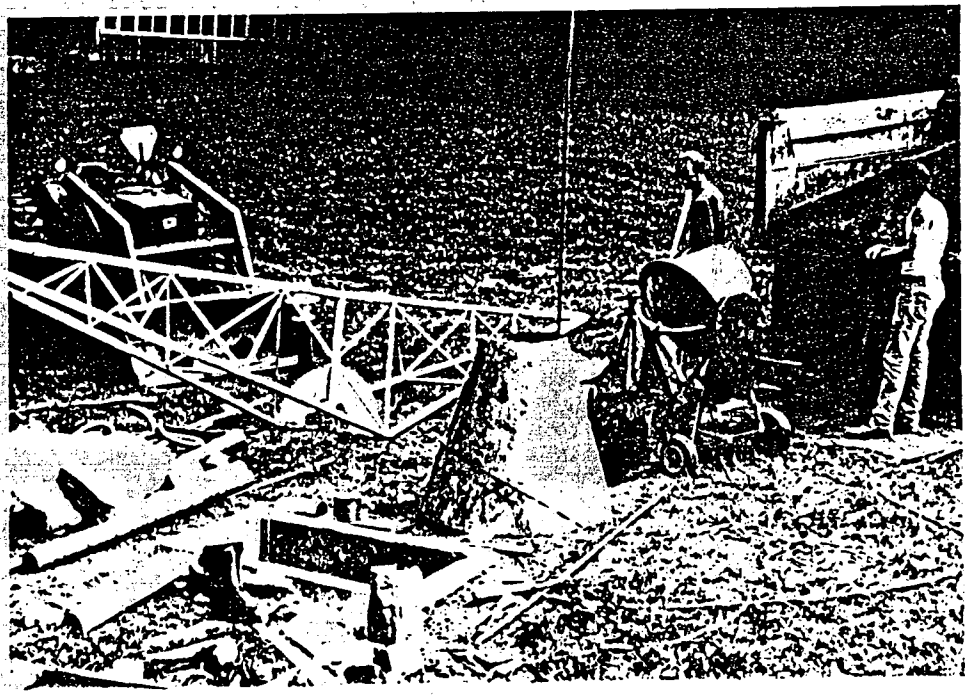




MOTORIZED LOW
WIND STORAGE
FLYWHEEL, CLU
& ELECTRO TACH



PANEL ROTATABL
TRUNION MOUNT



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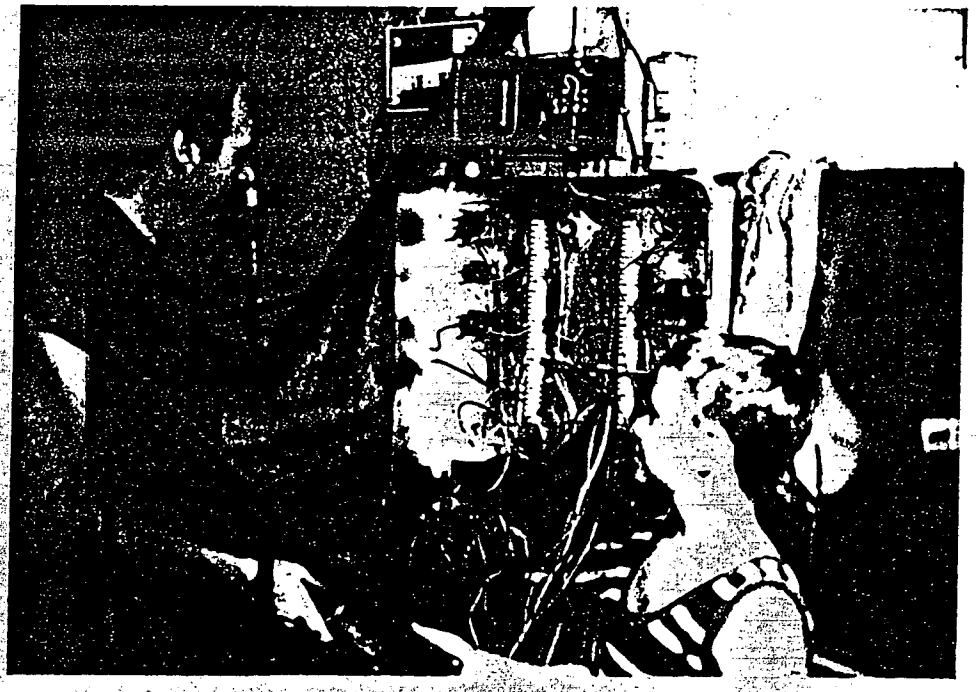

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

APPLICANT: Roger H. Cross, Jr.✓

SERIAL NO: Not Yet Assigned

FILED: Concurrently Herewith

TITLE: SOLAR POWERED, SOLAR AIMING DEVICE

DISCLOSURE STATEMENT

Commissioner of Patents
and Trademarks
Washington, D. C. 20231

Sir:

Although no preliminary search was made before filing this application, applicant has disclosed this invention to several workers well experienced in hydraulics, refrigerants, and solar collector arts without discovering any previous suggestion for a solar powered, solar aiming device.

For any question on the art or the application, the Examiner is respectfully invited to call applicant's attorney.

Respectfully submitted,

STONEBRAKER, SHEPARD & STEPHENS

Eugene S. Stephens, Reg. No. 20,649
75 College Avenue
Rochester, New York 14607
(716) 244-7910

ESS:cba

Dated:

TITLE

SOLAR POWERED, SOLAR AIMING DEVICE

BACKGROUND

Solar energy collectors are known to be much more efficient if aimed to track the sun. Accomplishing this has been cumbersome and expensive, though. It requires a mechanical mounting that allows solar energy collectors to pivot, a power supply for moving the collectors, and a control system for insuring that the movement tracks the sun reasonably accurately. The cost and difficulty of meeting these requirements have practically limited most solar collectors to stationary positions that are less efficient.

My invention suggests a solar powered aiming device that draws both the necessary power and the aiming control from the sun itself and uses this in a simple, low cost, and effective way for aiming continuously at the sun. My device attains automatic and reliable operation without human intervention and without a separate source of power so that the sun itself supplies all that is needed for a solar aiming device.

SUMMARY OF THE INVENTION

My solar powered, solar aiming device is pivotally mounted on a base and uses a pair of separate solar sensor tubes that are insulated from each other and oriented at an angle to each other. It includes hydraulic means for angularly pivoting the sensor tubes relative to the base in response to pressure produced by sunlight shining on the sensor tubes. These contain refrigerant material communicating with a pair of bladder separators that separate the refrigerant from hydraulic material operating the hydraulic pivoter, so that solar energy respectively incident on the sensor tubes pressurizes the separators and the hydraulic material.

These components are arranged so that when an aiming plane bisecting the angle between the sensor tubes is aimed at an angle from the sun, causing the sensor tubes to receive different incident sunlight and reach different temperatures, the refrigerant material applies different pressures to the respective separators which then power the hydraulics to pivot the sensor tubes to correct the solar aim of the bisector plane. Conversely, when the bisector plane is aimed at the sun, causing the sensor tubes to reach approximately equal temperatures, the refrigerant material applies approximately equal pressures to the respective separators, which then hold the hydraulics stationary.

DRAWINGS

Figure 1 is a partially schematic, fragmentary plan view of a preferred embodiment of my solar powered, solar aiming device;

Figure 2 is a partially schematic, fragmentary elevational view of the sunny side of the device of FIG. 1; and

Figure 3 is a partially schematic, fragmentary elevational view of the shady side of the device of FIG. 1.

DETAILED DESCRIPTION

The drawings show a preferred arrangement of components that work together to form a solar powered, solar aiming device according to my invention. These components include a pair of sensor panels 11 and 12, a pair of hydraulic bladder separators 21 and 22, and a pair of hydraulic cylinders 31 and 32, all arranged to respond to sunlight for powering and aiming the device. Many variations in these components are possible according to the invention as explained below.

First, the solar sensor panels 11 and 12 are separate and insulated from each other and oriented at an angle to each other as illustrated. Panels 11 and 12 include respective sensor tubes 13 and 14 preferably

formed of copper that is blackened to collect solar energy. Tubes 13 and 14 are arranged in patterns that are angled to each other and are suitably disposed for receiving incident radiation from the sun; and in the preferred arrangement illustrated, tubes 13 and 14 are bent into a zigzag path that forms a large surface area. The zigzag portions of tubes 13 and 14 are also formed in a concave configuration as best shown in FIG. 1, and the main reason for this is to widen the solar angle of view of each tube for receiving solar radiation. This helps the morning sun be effectively incident on the eastern sensor tube 13 when the device is pointed westward from following the previous day's sun, for example. Tubes 13 and 14 can also be arranged in flat planes and convex shapes; they can be spiraled instead of zigzagged and can be laid out in other ways for effectively receiving incident sunlight.

Glazing 15 and 16, preferably formed of glass, encloses sensor tubes 13 and 14 to make them more effective at receiving solar energy and to reduce wind chill effects. Just as the sensor tubes 13 and 14 can be arranged in many different configurations, glazing 15 and 16 can also have different shapes and be formed of different materials. One possibility is a blister-shaped glazing that collects a wider angle of sunlight, and another possibility is an optical glazing that directs small incidence angle sunlight inward against tubes 13 and 14.

Sensor panels 11 and 12 can be spaced widely apart or close together as illustrated; but they are thermally insulated from each other, either by distance or by a thermal insulation material 17 arranged between them.

The general orientation of sensor panels 11 and 12 is at an angle to each other, and the angle is preferably acute as shown in FIG. 1. This angular orientation refers to the angle of view from which sensor panels 11 and 12 can receive incident sunlight, and the respective

solar angles of view of panels 11 and 12 are angled from each other and preferably overlap in the direction of aim toward the sun. Another way of expressing this is that sensor panels 11 and 12 are oriented along opposite sides of an arrowhead that aims at the sun and is preferably pointed or acute angled, rather than blunt. A plane 18 that bisects the angle between sensor panels 11 and 12 serves as an aiming plane that is directed toward the sun, and panels 11 and 12 are acutely angled to plane 18 and disposed on opposite sides of plane 18 as illustrated.

Bladder separators 21 and 22 correspond with each of the panels 11 and 12, and one end of each of the sensor tubes 13 and 14 is coupled to respective bladder separators 21 and 22. The opposite ends 19 of tubes 13 and 14 are sealed closed. Separators 21 and 22 have internal bladders 23 and 24 that resemble the bladders in hydraulic accumulators. Separators 21 and 22 are simpler, however, and do not require check valves and other accessories found in accumulators.

Refrigerant material trapped within sensor tubes 13 and 14 communicates with bladders 23 and 24 in separators 21 and 22 to provide solar powered hydraulic pressure. The refrigerant material can be any of the refrigerant materials presently in use, and a suitable quantity of refrigerant is charged within tubes 13 and 14 and separators 21 and 22 so that the refrigerant does not entirely vaporize at the highest expected operating temperature of the device. The refrigerant vapor pressure is then a known function of the temperature attained by sensor tubes 13 and 14 on exposure to incident sunlight.

Flexible hydraulic lines 25 and 26 lead respectively from separators 21 and 22 to hydraulic cylinders 31 and 32. The available space in separators 21 and 22, lines 25 and 26, and cylinders 31 and 32 is filled with a conventional hydraulic material such as hydraulic oil. Passive overflow lines 33 and 34 lead from cylinders 31

and 32 to a reservoir 35 of hydraulic material to fill the hydraulic system with oil and eliminate air and moisture.

As increased pressure from refrigerant vapor expands bladders 23 or 24 in separators 21 and 22, this forces hydraulic material out of separators 21 or 22 and into hydraulic cylinders 31 or 32 to accomplish hydraulically powered movement. Bladders 23 and 24 thus separate refrigerant and hydraulic material at a pressure interface that moves as sunlight varies the temperatures of sensor tubes 13 and 14.

Lines 25 and 26 are long enough and flexible enough so that they can accommodate the full scope of rotation of the device. They also preferably include small orifices 27 and 28 arranged to restrict the flow of hydraulic material between separators 21 and 22 and cylinders 31 and 32 so that pivotal movement of the device is necessarily slow. This keeps the hydraulic system from over responding to temporary discontinuities in received solar energy, such as short-lived shadows; and it also helps the hydraulic system hold the device steady against wind force. A rotation of only 15° per hour is adequate to track the sun, but orifices 27 and 28 allow substantially faster pivoting than that so the device can rotate from west to east in response to the morning sun.

Cylinders 31 and 32 are each single-acting hydraulic cylinders that are preferred for simplicity, but a double-acting cylinder or a hydraulically powered rotor can be substituted. Cylinders 31 and 32 are mounted on arms 37 and 38 of base 40. Clevises 39 couple opposite ends of a cable 41 to cylinders 31 and 32, which operate in a push-pull fashion to move cable 41 back and forth. This motion of cable 41 is converted to pivotal motion by wrapping cable 41 around a drum or pulley 42 concentric with a vertical pivot shaft 43. Shaft 43 is vertically supported on base 40 by a bearing 44 and carries both a

solar collector 45 and sensor panels 11 and 12 for pivoting together relative to base 40. This brings the pivotal effect back to sensor panels 11 and 12 as explained below.

Base 40 can be formed in many different ways and is sturdy enough to support all the components. Bearing 44 is selected to pivot freely while bearing the full load of a solar collector 45 or other device to be aimed at the sun, together with the solar aiming device. Pivot shaft 43 is preferably vertical for balance and simplicity, and solar collector or device 45 can be supported on shaft 43 in a wide variety of ways. A truss framework (not shown) is one strong and simple way of mounting collector 45 on shaft 43, but other arrangements are possible. Solar device 45 is oriented perpendicular to the bisector plane 18 between sensor panels 11 and 12 so that when plane 18 aims at the sun as intended, device 45 also aims at the sun for maximum efficiency. Other rotors, pulleys, and levers can be substituted for drum 42; and there are many ways that a hydraulic system can cooperate with a mechanical system to produce the desired pivoting.

Panel system 45 is preferably mounted for pivoting a few degrees around a horizontal axis for manual azimuth adjustment to aim the device at the elevation of the sun at different times of the year. Sensor panels 11 and 12 are ordinarily far smaller than an energy collector 45 and are conveniently mounted atop collector 45 directly above base 40. They can also be mounted elsewhere, of course.

A pair of stops 47 and 48 are arranged on base 40 to engage a bottom edge of collector 45 or its supporting framework to limit the extremes of pivotal motion of the device. The angular range of movement of the device can be made to vary with circumstances; but for most applications, 120° should be adequate. Radiation from the early morning and late evening sun is relatively small,

and mid-day is the most important time for tracking the sun accurately. So the device usually need not track the sun accurately all the way to sunset and swing all the way back to aim at the rising sun, although this is possible.

Especially when the device aims short of the setting sun at its western limit of motion against stop 48, a shade 50 can be fixed to base 40 to extend up to a position suitable for casting a shadow on western sensor tube 14 to prevent overheating as tube 14 faces the evening sun. The device also preferably has safety plugs (not shown) arranged to open for any excessive pressure. Otherwise, the device is intended to operate automatically without human intervention or any power source other than sunlight for indefinitely long periods of time.

In operation, as radiation from the rising sun intensifies and falls on eastern sensor tube 13, refrigerant pressure increases against bladder 23 in separator 21, pressurizing the oil in line 25 leading to cylinder 31. Meanwhile, the absence of sunlight on sensor tube 14 causes a lower pressure on bladder 24 and hydraulic line 26 leading to cylinder 32. When the pressure difference between sensor tubes 13 and 14 becomes large enough, hydraulic material moves through line 25 and orifice 27 to move cylinder 31 and pull cable 41 to turn drum 42 and shaft 43. This pivots both the sensor panels 11 and 12 and collector 45 eastward toward the sun, which may require several minutes because of the restriction of orifice 27.

As the bisector 18 between the orientation angles of sensor panels 11 and 12 approaches the sun, sunlight becomes incident on sensor tube 14 as well as sensor tube 13; and the pressures in both tubes approach equality. This equally pressurizes bladders 23 and 24 in the separators and the hydraulic material thrusting against cylinders

31 and 32 so that by the time aiming plane 18 reaches the sun, the hydraulic system is in equilibrium and stops pivotal motion, leaving the device aimed at the sun for the most efficient reception of energy.

As the sun proceeds westward, it illuminates western tube 14 more than eastern tube 13 and creates an opposite pressure difference increasing the pressure in separator 22 and cylinder 32 to pivot the device westward. Sensor panels 11 and 12 seek equilibrium, because any temperature difference between them causes a hydraulic pressure imbalance that pivots the device in a direction to equalize temperature and thus keeps bisector plane 18 between sensor panels 11 and 12 approximately aimed at the sun during the day. If clouds obscure the sun so that it cannot produce any temperature difference in sensor tubes 13 and 14, the device remains stationary until the sun reappears and falls on one of the sensor tubes. Since solar collector 45 is perpendicular to the aiming plane 18, collector 45 is accurately aimed at the sun to receive maximum incident sunlight.

I claim:

1. A solar powered, solar aiming device pivotally mounted on a base and comprising:

a. a pair of separate solar sensor tubes insulated from each other and oriented at an angle to each other;

b. hydraulic means for angularly pivoting said sensor tubes relative to said base;

c. a pair of hydraulic bladder separators;

d. hydraulic material communicating with said bladder separators and said hydraulic means;

e. refrigerant material in each of said sensor tubes communicating respectively with said bladder separators for pressurizing said separators and said hydraulic material as a function of solar energy respectively incident on said sensor tubes; and

f. said sensor tubes, bladder separators, and hydraulic means being arranged so that when an aiming plane bisecting said angle between said sensor tubes is aimed at an angle from the sun causing said sensor tubes to receive different incident sunlight and reach different temperatures, said refrigerant material applies different pressures to said respective separators which then power said hydraulic means to pivot said sensor tubes to correct the solar aim of said bisector plane; and when said plane is aimed at the sun causing said sensor tubes to reach approximately equal temperatures, said refrigerant material applies approximately equal pressures to said respective separators which then hold said hydraulic means stationary.

2. The device of claim 1 wherein said angle between said sensor tubes is an acute angle.

3. The device of claim 1 including glazing material arranged over said sensor tubes.

4. The device of claim 1 including small orifices restricting movement of said hydraulic material between said separators and said hydraulic means to prevent rapid movement of said hydraulic means.

5. The device of claim 1 including stops for limiting said pivoting of said sensor tubes.

6. The device of claim 1 wherein said hydraulic means includes a pair of cylinders mounted on said base, a cable connected between said cylinders, a rotor mounted to pivot with said sensor tubes, and said cable being wrapped around said rotor so said cylinders operate to turn said rotor and pivot said sensor tubes.

7. The device of claim 1 including a solar energy collector mounted on said base for rotation with said sensor tubes, said solar energy collector being oriented perpendicular to said bisector plane.

8. The device of claim 7 including stops for limiting said pivoting of said sensor tubes and said solar collector.

9. The device of claim 8 including glazing material arranged over said sensor tubes.

10. The device of claim 9 wherein said angle between said sensor tubes is an acute angle.

11. The device of claim 10 including small orifices restricting movement of said hydraulic material between said separators and said hydraulic means to prevent rapid movement of said hydraulic means.

TITLE

SOLAR POWERED, SOLAR AIMING DEVICE

ABSTRACT

A solar powered, solar aiming device pivotally mounted on a base 40 uses a pair of separate solar sensor panels 11 and 12 that are insulated from each other and oriented at an angle to each other. Hydraulics angularly pivot the sensor panels relative to the base in response to pressure produced by sunlight shining on sensor tubes 13 and 14 arranged within the sensor panels to contain refrigerant material. The refrigerant communicates with and pressurizes a pair of bladder separators 21 and 22 that separate the refrigerant from hydraulic material operating the hydraulic pivoter. Sensor tubes 11 and 12, separators 21 and 22, and the hydraulics are arranged so that when an aiming plane 18 bisecting the angle between the sensor panels is aimed at an angle from the sun thus causing the sensor tubes to receive different incident sunlight and reach different temperatures, the refrigerant material applies different pressures to the respective separators which in turn power the hydraulic means to pivot the sensor panels and correct the solar aim of bisector plane 18. The device can be used to aim a solar energy collector or other solar device oriented perpendicular to the aiming plane between the sensor panels.

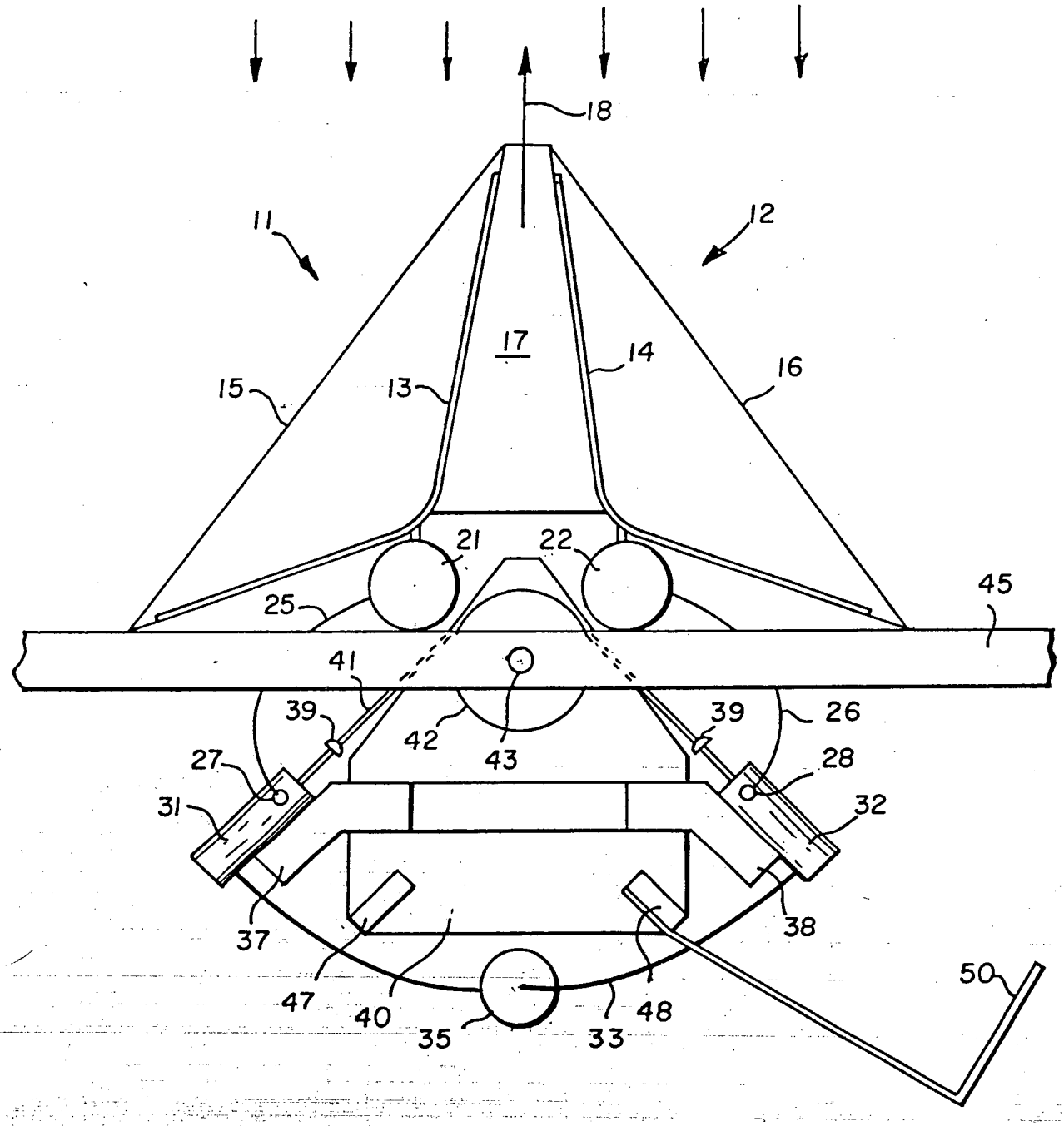
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FIG. 1

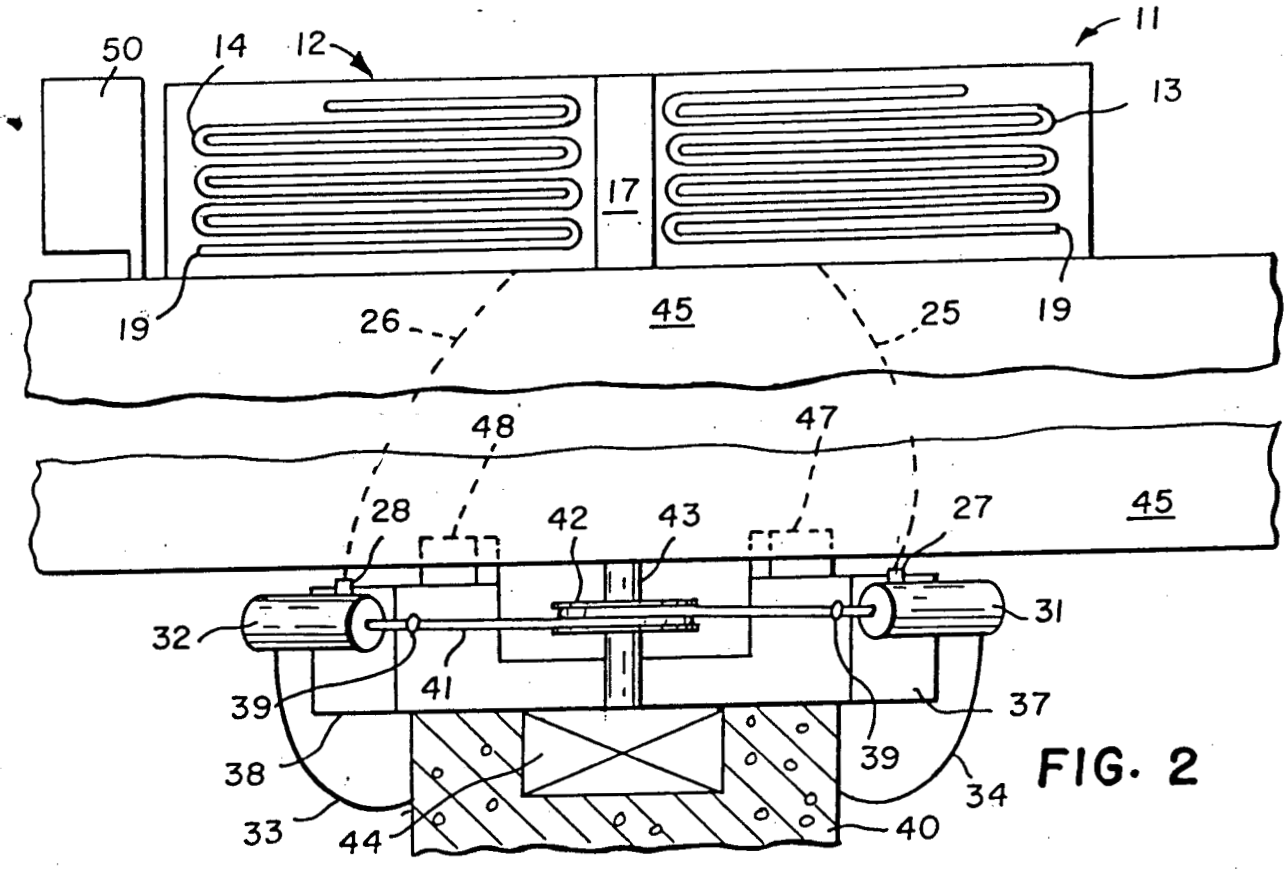
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FIG. 2

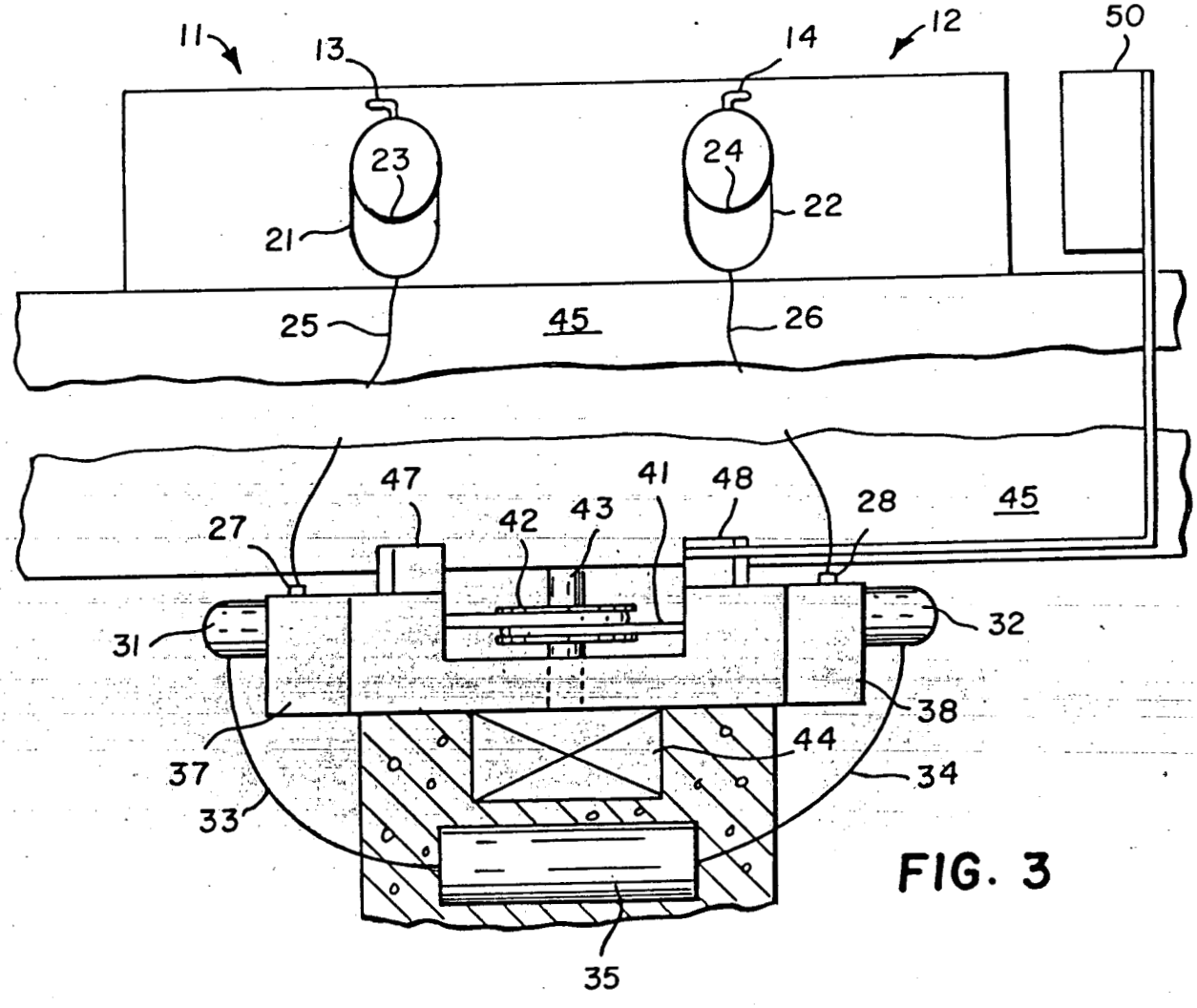
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FIG. 3