هلیوسار آبگرمکن خورشیدی ساراول

HELIOSAR®

COLLECTOR PANEL

APPLICATION:

* Domestic Hot Water
* Residential & Industrial Heating
* Swimming Pool

SARAVEL SOLAR

CAT. NO. 220-80B1

®- Heliosar Registered Trade Mark

DESIGN FEATURES OF HELIOSAR COLLECTOR

* High performance
* Long life
* Rugged construction
* Free of Service
* Light weight
* Low cost

SARAVEL SOLAR SYSTEMS

Saravel Experience

Saravel Manufacturing Co. experience with solar energy products dates back to 1960. Saravel has pioneered solar system design and installation in several locations.

Saravel Manufacturing Co. is a leading manufacturer of air conditioning equipments, covering an extensive product array. The expertise is used in design and manufacturing of the most efficient and practical flat plate solar - collector.

Saravel has the capability to design and manufacture the complete solar heat source packages for heating, cooling and domestic hot water.

With its design and manufacturing capability, Saravel offers single source system capability for solar energy systems.

Saravel HELIOSAR Collector Panel is unique in design, rugged in construction and offers maximum wetted surface for performance with high efficiency.

Two major production lines are manufactured:

MODEL HELIOSAR "A"

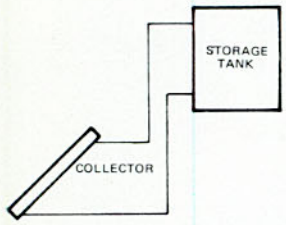
Has a net area of $1.7m^2$ (18.3 Sq. ft) with parallel flow passages for moderate temperatures and high flow rates.

MODEL HELIOSAR "B"

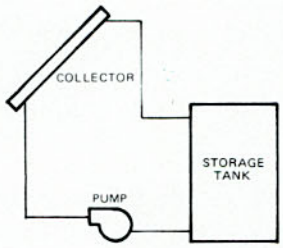
Has a net area of $1.7m^2$ (18.3 sq.ft) with series flow passages for high temperatures and low flow rates.

SYSTEMS

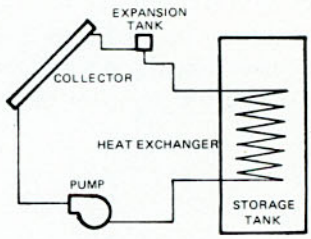
Saravel HELIOSAR collector is the heart of every system packaged by Saravel. Saravel can offer HELIOSAR collector alone or any of the following systems, packaged complete with controls:



THERMO SIPHON SYSTEM



DIRECT PUMP SYSTEM



TANK HEAT EXCHANGER (ANTIFREEZE)

COVER ASSEMBLY

- Galvanized sheet metal frame
- Non-glass transparent material
- Superior impact and shatter resistance
- Minimum restriction for insolation entry
- Serviceable in the field
- Cover gasket provides seal

STEEL ABSORBER PLATE

- Maximum possible wetted surface
- Minimum flow resistance
- Rugged steel construction
- Pressure tested
- High temperature insulating strip insulates abosrber from frame

SUPPORT BOX

One piece support bracket welded to the bottom plate.

HIGH TEMPERATURE INSULATION

Maximum insulation with minimum volume

PIPING CONNECTIONS

½" female pipe thread

Integrated with collector manifold

Inlet and outlet connections from panel bottom.

SELECTION METHOD

For those who are interested in special designs and investigations, Fig. 1 gives the HELIOSAR collector efficiency as a function of water in and out temperatures, ambient temperature, and the hourly insolation. A comprehensive insolation data for 24,32, and 40 degrees N.latitude with variation in the collector tilt angle are given in Table I. The hourly insolation multiplied by the efficiency results in an hourly heat output. An integration of the hourly heat output during the day gives the total daily collector heat output.

Table II can be used for a quick collector selection for domestic hot water applications. In this table the daily insolation values are shown for all months of the year. The associated collector efficiences are also presented for the two selected systems of "Tank Heat Exchanger" operating in a freezing climate and "Direct pump system" operating in a warm climate. The actual energy output of the collector is the product of the daily insolation and collector efficiency.

The actual selection of a solar collector is based on a system economic evaluation and environmental conditions to design the optimum system with or without back up. The following example demonstrates only the use of charts for the selection and sizing of the Saravel HELIOSAR Collector.

GIVEN

1. A 100 unit hotel located in a freezing region at 32 degrees N. latitude requires domestic hot water at $120^{o}F$
2. The system has to be self sufficient during the summer months (June to September) considering one cloudy day. A back up system will be available for the other months of the year.
3. Collector angle with horizontal 32^{o}.

FIND

Select the number of collector panels and storage tank capacity.

SOLUTION

1. Tank Capacity

From table III the daily demand for a hotel is 10 gallons per day per unit. Therefore, for the 100 unit hotel the daily requirement is 1000 gallons per day. Assuming a tank useful factor of 70 percent, and one cloudy day,

$$\text{Tank Capacity} = \frac{\text{daily water demand}}{\text{useful factor}} (1 + \text{cloudy day})$$

$$\text{Tank Capacity} = \frac{1000}{0.7} (1+1) = 2876 \text{ gal.}$$

Select a 3000 gal. tank.

2. Numbering of collector panels

a) Total heat, Q

Q = (daily water demand) (1+ cloudy day) (hot water temperature – tap water temperature) (8.34) Btu/day.

Q = 1000 (1+1) (120 -65) (8.34) = 917400 btu/day

b) Collector performance

Using Table II, from the summer months, the month of June has the lowest performance and efficiency. Therefore it will be used for design. Collector output= daily insolation X efficiency = 2234 x 0.56 = 1251 btu/day sq.ft. HELIOSAR collector panel area = 18.3 sq. ft.

Heat output per collector = 1251 x 18.3 = 22893 btu/day.

c) Number of Collectors

Number of collectors = total heat ÷ heat outputut per collector = 917400 ÷ 22893 ≈ 40

Therefore 40 HELIOSAR panels and 3000 gallons tank are needed.

TABLE I – SOLAR INSOLATION OF SURFACES Btu/ft^2 – Hr

Date	Solar time AM	Solar time PM	24° N. LAT.					32° N. LAT.					40° N. LAT.				
			SOUTH FACING SURFACE ANGLE WITH HORIZ.														
			Horiz.	14	24	34	Vert.	Horiz.	22	32	42	Vert.	Horiz.	30	40	50	Vert.
Jan 21	7	5	10	17	21	25	31	0	0	0	0	1					
	8	4	83	110	126	137	127	56	93	106	116	115	28	65	74	81	84
	9	3	151	188	207	221	176	118	175	193	206	181	83	155	171	182	171
اول بهمن	10	2	204	246	268	282	207	167	235	256	269	221	127	218	237	249	223
	11	1	237	283	306	319	226	198	273	295	308	245	154	257	277	290	253
	12		249	296	319	332	232	209	285	308	321	253	164	270	291	303	263
Surface daily totals			1622	1984	2174	2300	1766	1288	1839	2008	2118	1779	948	1660	1810	1906	1726
Fab 21	7	5	35	44	49	53	46	22	34	37	40	38	10	19	21	23	22
	8	4	116	135	145	150	102	95	127	136	140	108	73	114	122	126	107
	9	3	187	213	225	230	141	161	206	217	222	158	132	195	205	209	167
اول اسفند	10	2	241	273	286	291	168	212	266	278	283	193	178	256	267	271	210
	11	1	276	310	324	328	185	244	304	317	321	214	206	293	306	310	236
	12		288	323	337	341	191	255	316	330	334	222	216	306	319	323	245
Surface daily totals			1998	2276	2396	2436	1476	1724	2188	2300	2345	1644	1414	2060	2162	2202	1730
Mar 21	7	5	60	63	64	62	27	54	60	60	59	32	46	55	55	54	35
	8	4	141	150	152	149	64	129	146	147	144	78	114	140	141	138	89
	9	3	212	226	229	225	95	194	222	224	220	119	173	215	217	213	138
اول فروردین	10	2	266	285	288	283	120	245	280	283	278	150	218	273	276	271	176
	11	1	300	322	326	320	135	277	317	321	315	170	247	310	313	307	200
	12		312	334	339	333	140	287	329	333	327	177	257	322	326	320	208
Surface daily totals			2270	2428	2456	2412	1022	2084	2378	2403	2358	1276	1852	2308	2330	2284	1484
Apr 21	6	6	7	5	4	4	2	14	9	6	6	3	20	11	8	7	4
	7	5	83	77	70	62	10	86	78	71	62	10	87	77	70	61	12
	8	4	160	157	149	137	16	158	156	148	136	35	152	153	145	133	53
اول اردیبهشت	9	3	227	227	220	206	46	220	225	217	203	68	207	221	213	199	93
	10	2	278	282	275	259	61	267	279	272	256	95	250	275	267	252	126
	11	1	310	316	309	293	74	297	313	306	290	112	277	308	301	285	147
	12		321	328	321	305	79	307	325	318	301	118	287	320	313	296	154
Surface daily totals			2454	2458	2374	2228	488	2390	2444	2356	2206	764	2274	2412	2320	2168	1022
May 21	6	6	22	15	10	9	5	36	21	13	13	7	49	25	15	14	9
	7	5	98	85	73	59	12	107	88	75	60	13	214	89	76	60	13
	8	4	171	159	145	127	15	175	159	145	127	15	175	158	144	125	25
اول خرداد	9	3	233	224	210	190	16	233	223	209	188	33	227	221	206	186	60
	10	2	281	275	261	239	22	277	273	259	237	56	267	270	255	233	89
	11	1	311	307	293	270	34	305	305	290	268	72	293	301	287	264	108
	12		322	317	304	281	37	315	315	301	278	77	301	312	297	274	114
Surface daily totals			2556	2447	2286	2072	246	2582	2454	2284	2064	469	2552	2442	2264	2040	724
Jun 21	5	7											4	3	3	2	1
	6	6	29	20	12	12	7	45	26	16	15	9	60	30	18	17	10
	7	5	103	87	73	58	13	115	91	76	59	14	123	92	77	59	14
	8	4	173	158	142	122	16	180	159	143	122	16	182	159	142	121	16
اول تیر	9	3	234	221	204	182	18	236	221	204	181	19	233	219	202	179	47
	10	2	280	269	253	229	18	279	268	251	227	41	272	266	248	224	74
	11	1	309	300	283	259	19	306	299	282	257	56	296	296	278	253	92
	12		319	310	294	269	22	315	309	292	267	60	304	306	289	263	98
Surface daily totals			2574	2422	2230	1992	204	2634	2436	2234	1990	370	2648	2434	2224	1974	610
Jul 21	6	6	23	16	11	10	6	37	22	14	13	8	50	26	17	15	9
	7	5	98	85	73	59	13	107	87	75	60	14	114	89	75	60	14
	8	4	169	157	143	125	16	174	158	143	125	16	174	157	142	124	24
اول مرداد	9	3	231	221	207	187	18	231	220	205	185	31	225	218	203	182	58
	10	2	278	270	256	235	21	274	269	254	232	54	265	266	251	229	86
	11	1	307	302	287	265	32	302	300	285	262	69	290	296	281	258	104
	12		317	312	298	275	36	311	310	296	273	74	298	307	292	269	111
Surface daily totals			2526	2412	2250	2036	246	2558	2422	2250	2030	458	2534	2409	2230	2006	702
Aug 21	6	6	7	5	4	4	2	14	9	7	6	4	21	12	9	8	5
	7	5	82	76	69	60	11	85	77	69	60	12	87	76	69	60	12
	8	4	158	154	146	134	16	156	152	144	132	33	150	150	141	129	50
	9	3	223	222	214	200	39	216	220	212	197	65	205	216	207	193	89
اول شهریور	10	2	273	275	268	252	58	262	272	264	249	91	246	267	259	244	120
	11	1	304	309	301	285	71	292	305	298	281	107	273	300	292	276	140
	12		315	320	313	296	75	302	317	309	292	113	282	311	303	287	147
Surface daily totals			2408	2402	2316	2168	470	2352	2388	2296	2144	736	2244	2354	2258	2104	978
Sep 21	7	5	57	60	60	59	26	51	56	56	55	30	43	51	51	49	32
	8	4	136	144	146	143	62	124	140	141	138	75	109	133	134	131	84
	9	3	205	218	221	217	93	188	213	215	211	114	167	206	208	203	132
اول مهر	10	2	258	275	278	273	116	237	270	273	268	145	211	262	265	260	168
	11	1	291	311	315	309	131	268	306	309	303	164	239	298	301	295	192
	12		302	323	327	321	136	278	318	321	315	171	249	310	313	307	200
Surface daily totals			2194	2342	2366	2322	992	2014	2288	2308	2264	1226	1788	2210	2228	2182	1416
Oct 21	7	5	32	40	45	48	42	19	29	32	34	32	7	14	15	17	16
	8	4	111	129	139	144	99	90	120	128	133	104	68	106	113	117	100
	9	3	180	206	217	223	138	155	198	208	213	153	126	185	195	200	160
اول آبان	10	2	234	265	277	282	165	204	257	269	273	188	170	245	257	261	203
	11	1	268	301	315	319	182	236	294	307	311	209	199	283	295	299	229
	12		279	314	328	332	188	247	306	320	324	217	208	295	308	312	238
Surface daily totals			1928	2198	2314	2364	1442	1654	2100	2208	2252	1588	1348	1962	2060	2098	1654
Nov 21	7	5	10	16	20	24	29	0	0	0	1	1					
	8	4	82	108	123	135	124	55	91	104	113	111	28	63	72	78	81
	9	3	150	186	205	217	172	118	173	190	202	176	82	152	167	178	167
اول آذر	10	2	203	244	265	278	204	166	233	252	265	217	126	215	233	245	219
	11	1	236	280	302	316	222	197	270	291	303	241	153	254	273	286	248
	12		247	293	315	328	228	207	282	304	316	249	163	267	287	298	258
Surface daily totals			1610	1962	2146	2268	1730	1280	1816	1980	2084	1742	942	1636	1778	1870	1686
Dec 21	7	5	3	7	9	11	14										
	8	4	71	99	116	129	130	41	77	90	101	107	14	39	45	50	56
	9	3	137	176	198	214	184	102	161	180	195	183	65	135	152	164	163
اول دی	10	2	189	234	258	275	217	150	221	244	259	226	107	200	221	235	221
	11	1	221	270	295	312	236	180	258	282	298	251	134	239	262	276	252
	12		232	282	308	325	243	190	271	295	311	259	143	253	275	290	263
Surface daily totals			1474	1852	2058	2204	1808	1136	1704	1888	2016	1794	782	1480	1634	1740	1646

TABLE II – ESTIMATED COLLECTOR PERFORMANCE

TOTAL DAILY INSOLATION, Btu/day-ft^2													DAILY EFFICIENCY PERCENT	
N.LATITIUDE	25			30			35			40			FREEZING** REGIONS	WARM*** REGIONS
PLATE ANGLE*	15	25	35	20	30	40	25	35	45	30	40	50		
Jan.21 اول بهمن	1964	2160	2280	1880	2060	2166	1774	1940	2050	1660	1810	1906	32	60
Feb.21 اول اسفند	2260	2380	2420	2210	2320	2360	2140	2250	2300	2060	2162	2202	37	61
Mar.21 اول فروردین	2420	2450	2400	2390	2420	2370	2360	2380	2350	2308	2380	2284	48	63
Apr.21 اول اردیبهشت	2450	2370	2230	2448	2360	2220	2440	2340	2200	2412	2320	2168	47	65
May.21 اول خرداد	2450	2280	2070	2460	2280	2060	2450	2280	2060	2442	2264	2040	48	66
Jun.21 اول تیر	2420	2230	2000	2440	2240	2000	2440	2230	1980	2434	2224	1974	56	68
Jul.21 اول مرداد	2420	2250	2040	2420	2250	2020	2415	2240	2020	2409	2230	2006	61	69
Aug.21 اول شهریور	2400	2320	2160	2400	2300	2150	2380	2280	2130	2354	2258	2104	60	70
Sep.21 اول مهر	2340	2360	2320	2300	2320	2280	2260	2280	2240	2210	2228	2182	57	70
Oct.21 اول آبان	2180	2300	2350	2126	2240	2280	2060	2160	2200	1962	2060	2098	45	66
Nov.21 اول آذر	1940	2120	2240	1860	2020	2130	1760	1910	2010	1636	1778	1876	34	59
Dec.21 اول دی	1840	2040	2180	1750	1940	2060	1640	1810	1920	1480	1634	1740	27	60

* South facing surface angle with horizontal.

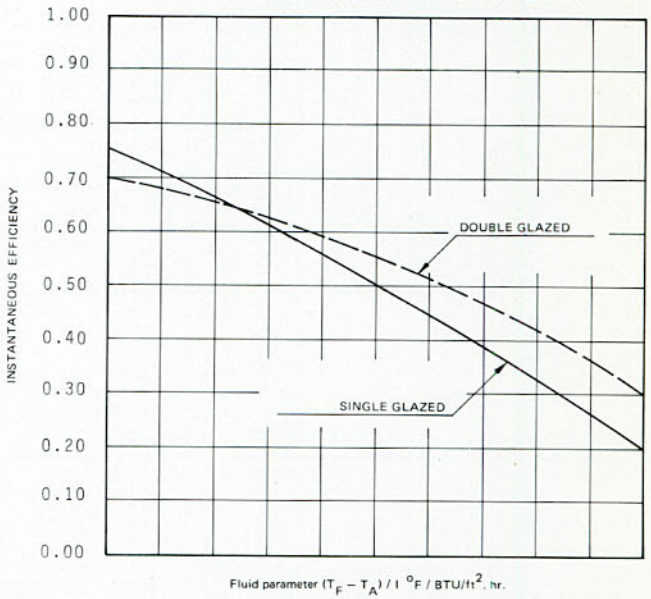
** "Tank heat exchanger system" for four seasons.
Collector water: in at 120°F, out at 140°F.
Ambient temp. variation 25°F to 90°F.

*** Direct pump system for warm non-freezing area. Collector water: in at 10°F to 90°F, out at 140°F,
Ambient temp. variation 70°F to 110°F.

TABLE III,

AVERAGE DAILY DOMESTIC HOT WATER DEMANDS	
Building Type	Hot Water Demand ave/day
Motels & Hotels	
20 units or less	20 gal/unit
60 "	14 "
100 "	10 "
Office Building	1 gal/person
Apt & Houses	
20 units or less	42 gal/apt.
50 "	40 "
75 "	38 "
100 "	37 "
200 or more	35 "
Elementary School	0.6 gal/student
High School	1.8 "

FIGI – HELIOSAR COLLECTOR PANEL EFFICIENCY



T_F = (WATER TEMPERATURE IN + WATER TEMPERATURE OUT) / 2, °F

T_A = AMBIENT TEMPERATURE, °F

I = TOTAL HOURLY INSOLATION ON SURFACE, Btu/FT^2. HR.

ENGINEERING SPECIFICATIONS

Furnish and install standard Saravel HELIOSAR Collector Panels based on the following specifications and as shown on the plan drawings.

The standard unit shall consist of cover, absorber plate, and piping connections.

Cover

The cover shall be transparent material that features solar properties equivalent to glass, superior impact and shatter resistance, light weight, and low thermal expansion. The cover assembly shall be of rigid galvanized sheet metal construction.

Absorber Plate

The absorber plate shall be seam welded and die formed steel metal with maximum wetted surface and minimum flow resistance. The absorber plates shall be tested hydraulically at 60 psi. A proper manifold design shall ensure even flow distribution in the passages and also allow complete drainage of the absorber to prevent freezing. Proper surface coating shall be used on absorber plate. The depth of the black coating shall be controlled, resulting in a high solar absorptivity of 87 to 92 percent and low thermal emissivity of 0.07 to 0.35 percent.

The absorber plate shall be insulated from the plate frame by means of a high temperature insulation strip. The absorber box shall be filled with high temperature insulation.

The absorber shall be supported by rigid one piece support bracket, spot welded to the bottom plate and side walls.

Piping Connections

The Piping connections shall be ½" FPT, flush mounted standard pipe fitting, integrated with the collector manifolds.

Optional Features

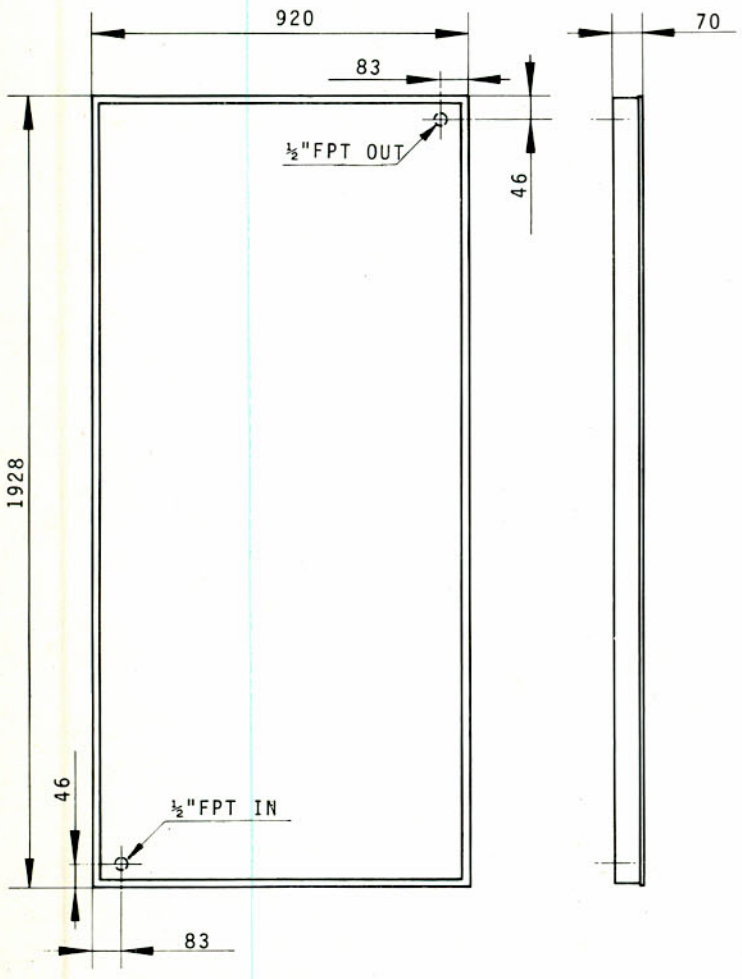
1: Double glazed cover
2. Stainless steel absorber panel
3. Aluminium enclosure

Optional Systems

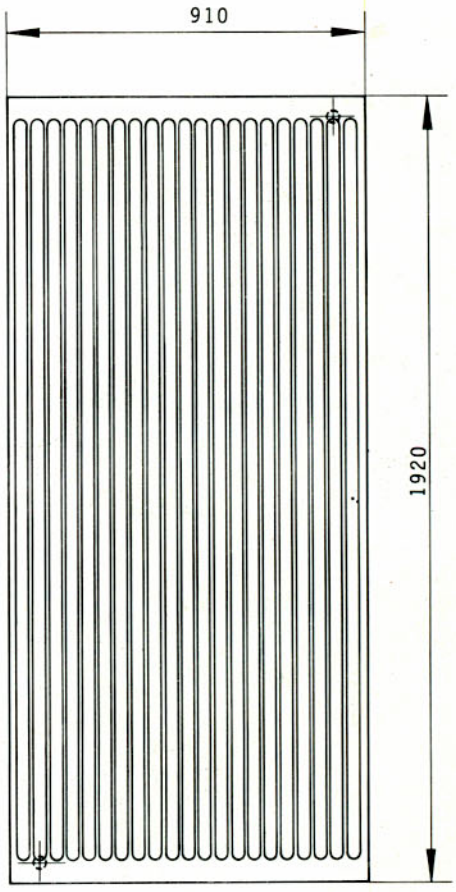
Saravel offers the following systems as total package based on the customer requirements:

1. Thermo siphon system
2. Direct pump system
3. Tank heat exchanger (antifreeze) system

The package shall be supplied complete with HELIOSAR collector panels, storage tank, pump, controls, electrical wiring and interconnecting piping.



COLLECTOR ASSEMBLY



ABSORBER PLATE

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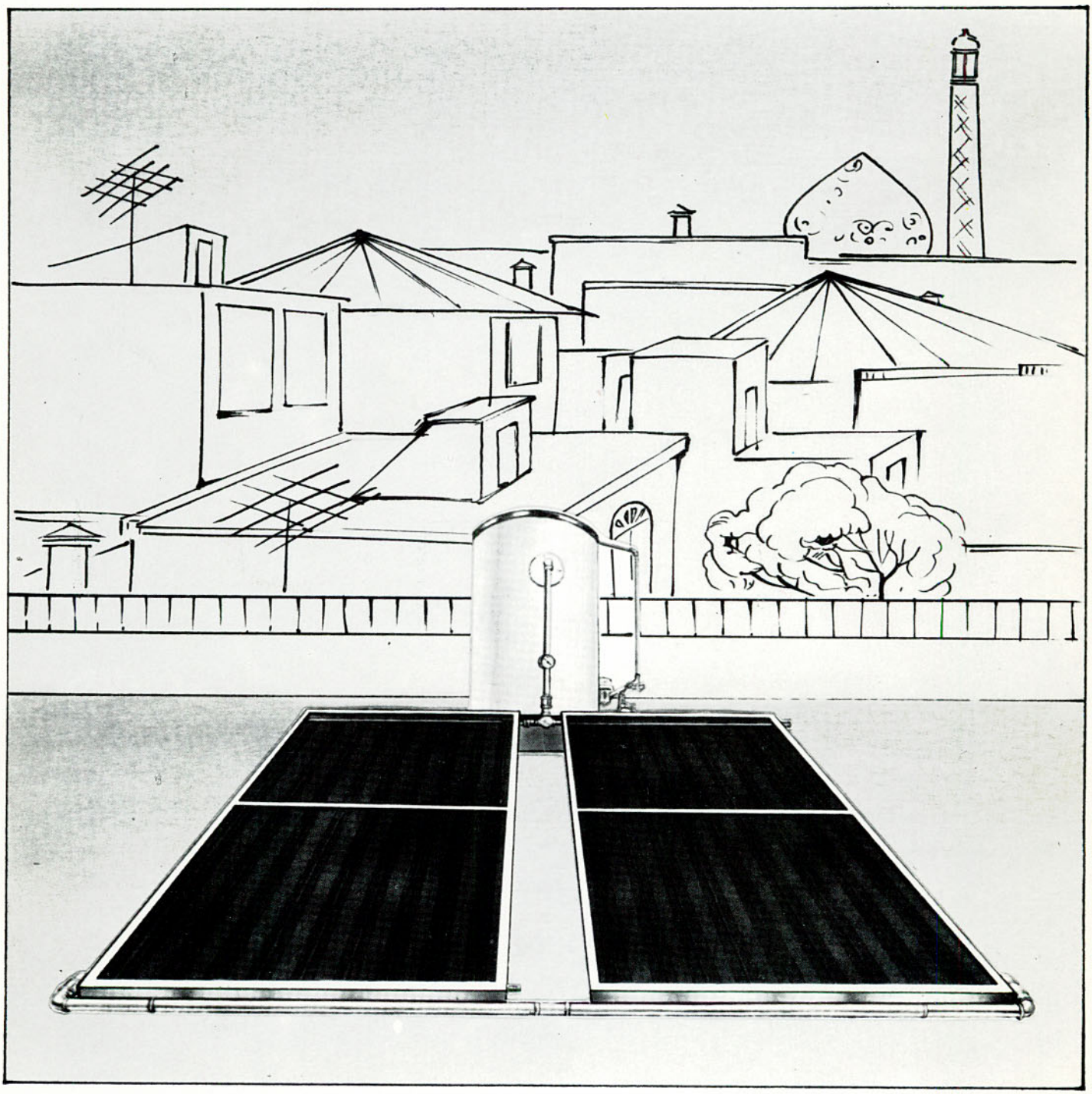

شرکت صنعتی ساراول (عام)

میدان ونک خیابان ملاصدرا ـ خیابان پردیس پلاك ۷۵ طبقه سوم

تلفن: دفتر فروش ۶۸۶۲۵۵ - ۶۸۵۶۹۴
کارخانه ۵-۶۸۰۵۸۳

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