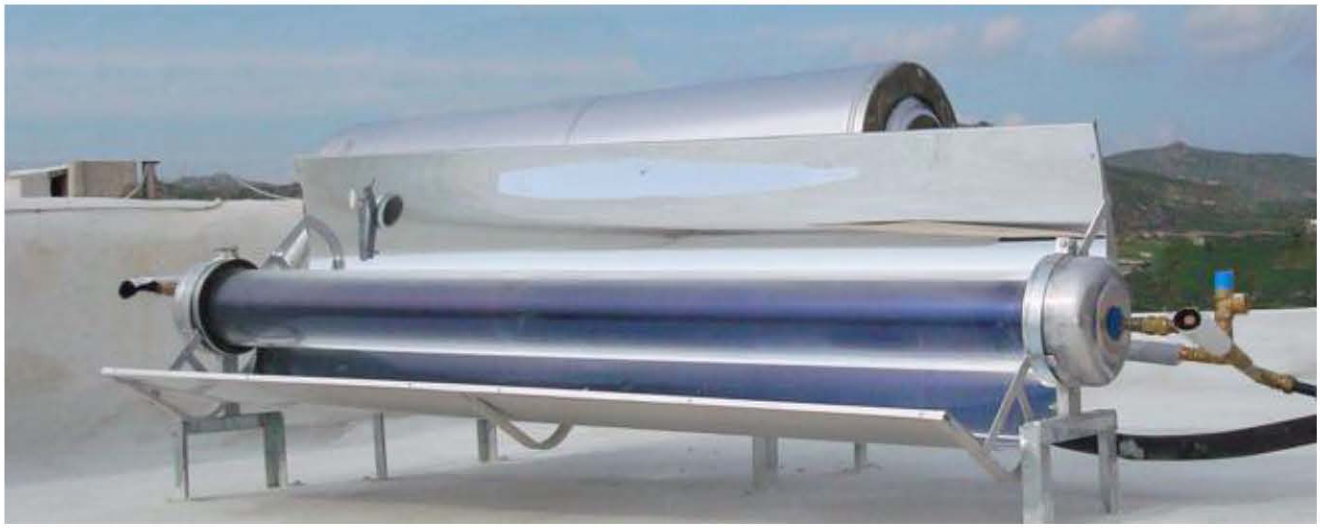
MAG VACUUM TUBE SOLAR COLLECTORS



Description of the technology

The MAG solar collector, which is used for the production of hot water for various uses, is the result of research for over a decade, with the aim of better exploitation of long sunshine in Greece as well as in other countries for solar heating in a much more energy-efficient way, without the simultaneous optical pollution present in the classical flat collectors.
During this decade the MAG solar collector was developed and with continuous improvements a very efficient final product was created.
The performance of the MAG solar collector is certified since 1997 after measurements conducted by the Centre for Renewable Energy Sources (CRES) using tele monitoring system for about 9 months ,according to the attached measuring arrangement for the system of a pair of MAG tubes which measurement gave the 16/6/97, 393lit/24h at the temperature of 39.34oC.
The above solar collector of space vacuum technology is characterized as a three walls vacuum tube (glass, copper and copper – the inside tube- in order from outside to inside) with high vacuum 10^{-4} Bar between the glass and the metallic wall, installed at the focus of an aluminium semi-cylindrical parabolic reflector.
The vacuum inside the tubes is of tester time resistance (test samples 1perate without problem since 1986).

MAG solar collectors are covered by 5 years guarantee.

MAG solar collector advantages

1. They collect solar energy when the rays fall obliquely, the hours before and after noon, as shown in sketch below.

2. MAG solar collectors have no induction losses due to the high vacuum between the glass (exterior) and bronze (interior) tract.

3. They reduce the heat loss due to radiation by 5% , using black titanium coating.

4. Due to the characteristics 1, 2 & 3 above, they have high efficiency in hot water production even under high operating temperatures (from 65oC up to 90oC), as shown in the chart below

5. MAG solar collector with an average annual performance of over 3.100kcal/day, usable surface of 0,87m^2 / MAG require a small amount of space (limited area) to be placed and that attribute makes them particularly attractive for Hotels, Industries, etc.

6. The following calculations show that MAG solar collectors exceed the requirements of the Operational Program for Energy (LTD) set by the Ministry of Development.
Thus: 1.063.000X0.90Kcal / MAG or 1.063.000X0.90Kcal / MAG / (0.87/m^2/1.063.000X0.90Kcal / MAG) = 1.100.000Kcal/m^2 / (860Kcal/Kwh) = 1.279Kwh/m^2 (much higher value than the one required by the O.P.f.E. (700Kcal/m^2) for new technology solar collectors and central systems and of course more than four times the value of 300Kwh/m^2 required for old technology collectors).

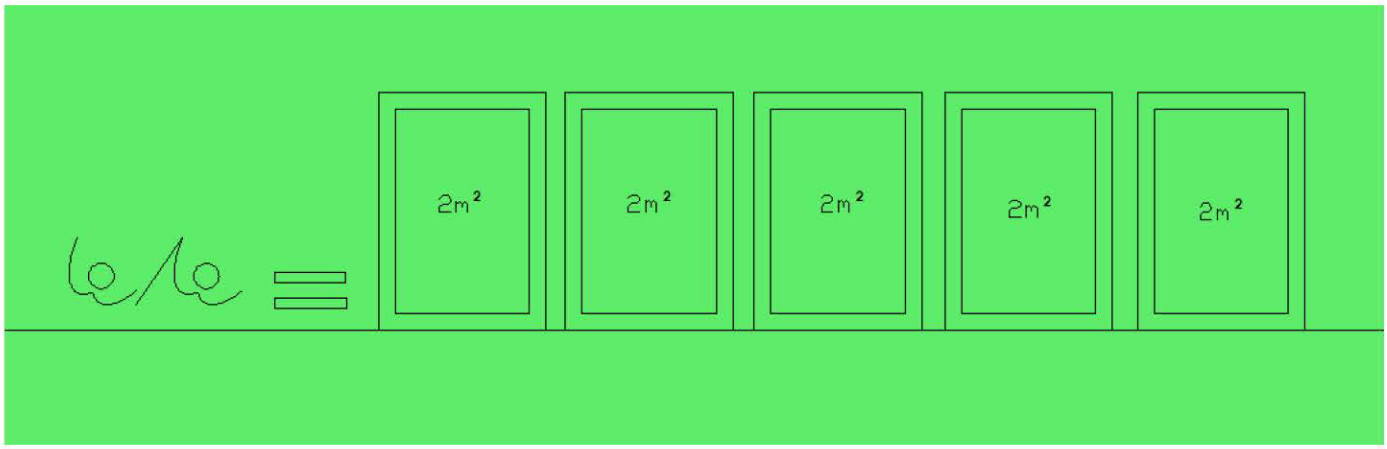
7. Finally, we must mention the very important advantage of non-visual pollution, which makes MAG solar collectors an unbeatable option for hotels and residences whose owners observe the rules of aesthetics and care for the environment.

Energy performance per m^2 of surface for each of the solar collector technologies

Old technology flat panel solar collectors.	300-350 Kwh/m^2
Flat solar collectors with vacuum tube technology.	600-700 Kwh/m^2
MAG solar collectors with parabolic mirrors.	**1279 Kwh/m^2**

MAG Hot Water Solar System

The drawing below represents a MAG system consisted of 2 MAG collectors with a flat enhancing mirror between them(50% energy performance increase for the collector on the left) and in the same scale on the right the equivalent flat panel technology solar collector system with the same energy performance of **10.750 kcal/ day** .Flat panel solar collectors are installed at 45° angle and their dimensions are 1m X 2m, as a result they interfere with the building aesthetics while our collectors with an active surface of 0,87m^2/collector are discreet and at the same time have much higher energy performance per m^2 .

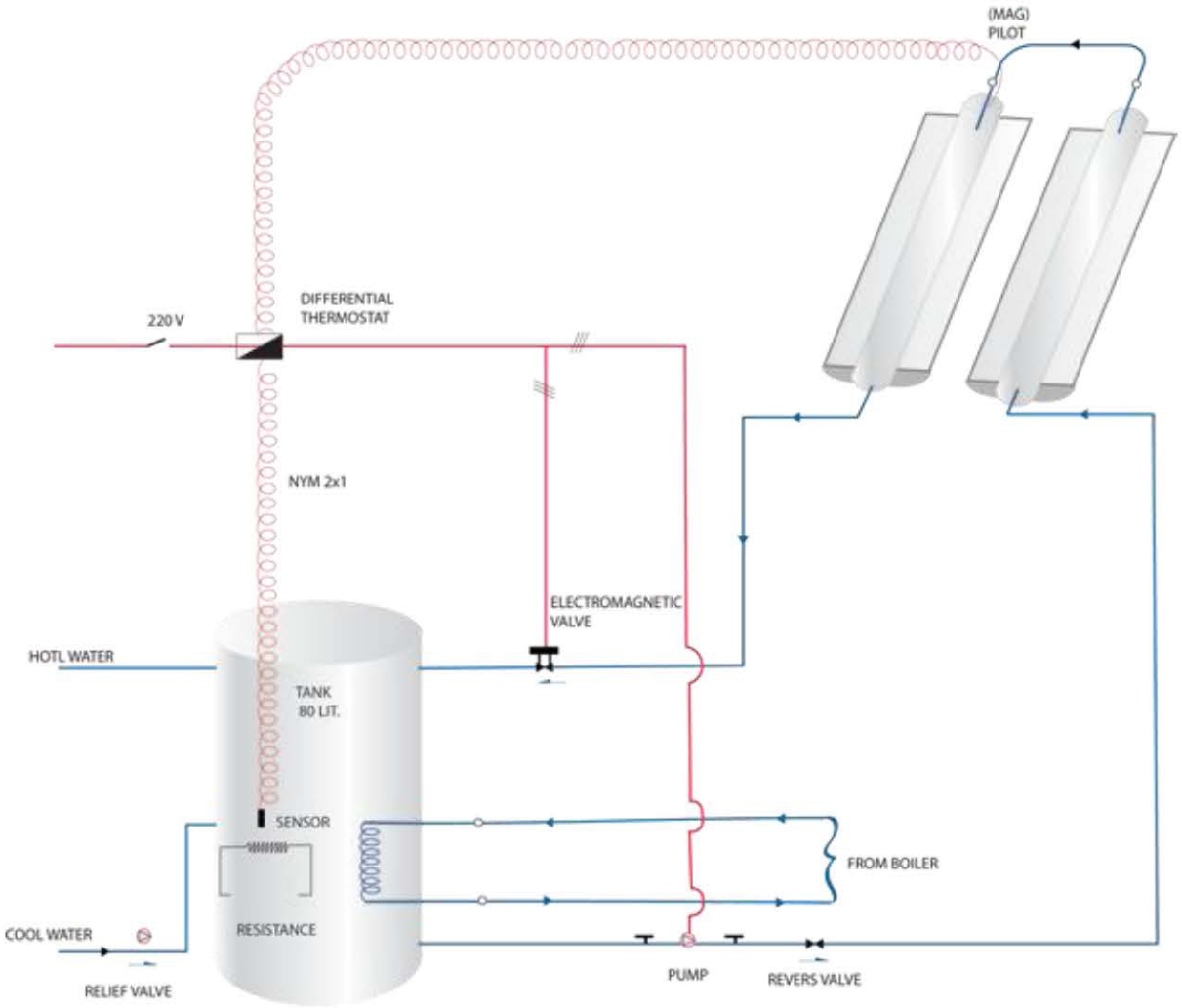


Detailed description of MAG vacuum tube solar collector

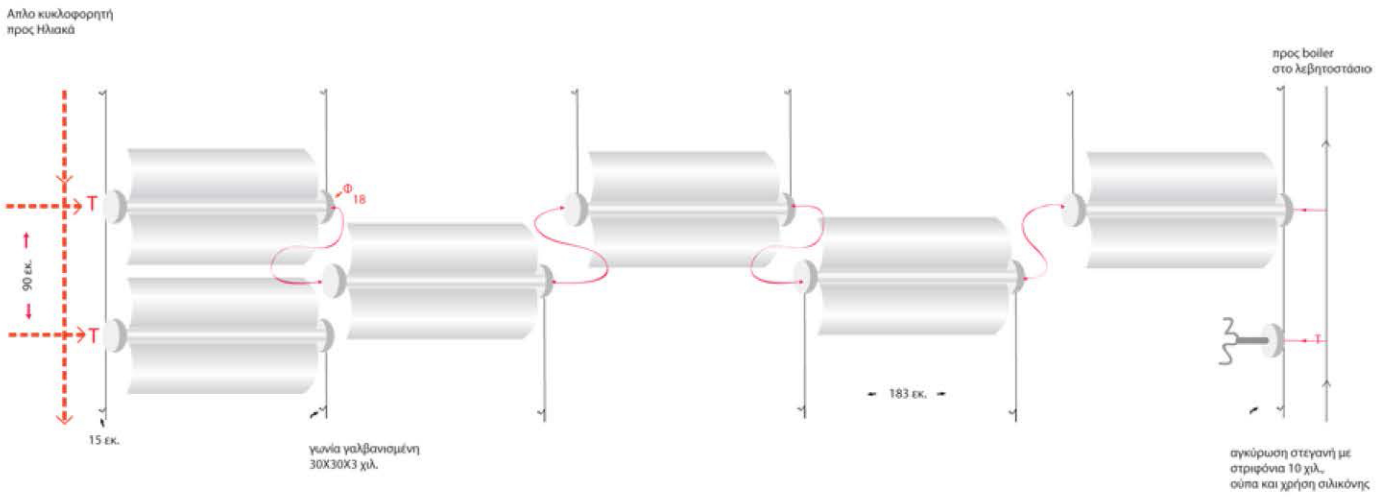
Consisting of three walls vacuum tube, in the focus of a high performance parabolic reflector with high efficiency at high operational temperatures that can also be a hot water storage device (for 40-60% of the total heating water volume) at open circuit systems. A glass tube 150mm in diameter and a thickness of 3mm, which surrounds the copper pipe (120mm and thickness 1mm), closed at both ends in order to form the heating water mass into a thin ring directly below the selective surface.

The bottoms of the glass tube are sealed with a special material that keeps its elasticity during the year and keeps the high vacuum (10^{-4} bar in operational temperatures) and withstands operating temperatures up to 150^{oC}.

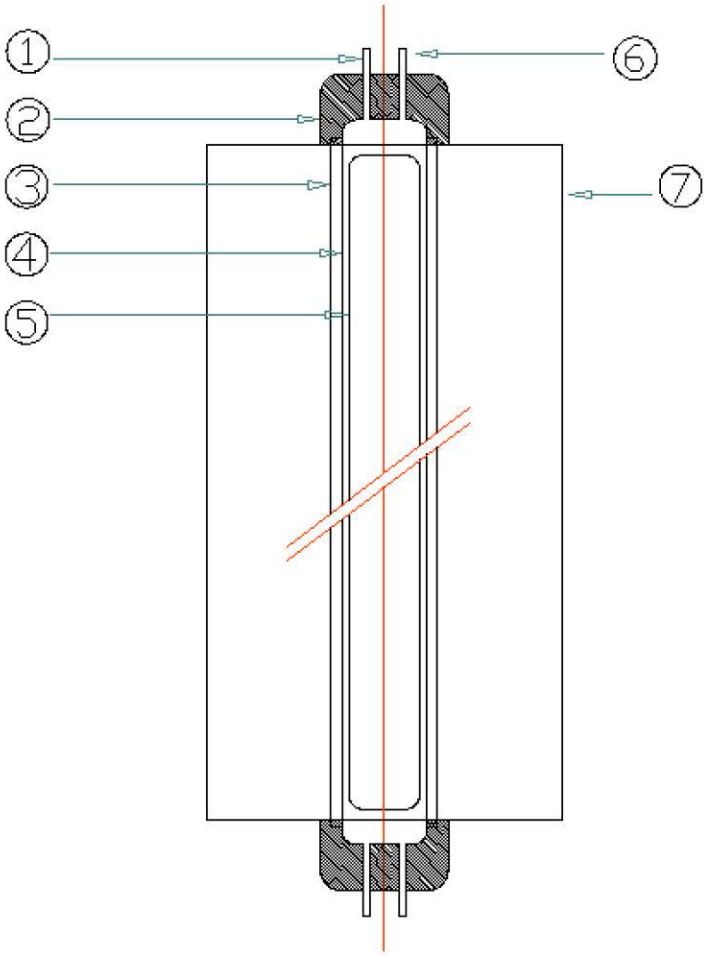
The bottoms of the sealed vacuum tube are covered with aluminium shells which are filled with polyurethane insulation and are firmly supported on the focus of a parabolic reflector $0{,}87m^2$/MAG width (useful surface) with reflectance factor 93%



Picture 1. MAG solar collectors connected to a solar water heater system



Picture 2. Multiple MAG collectors linked together



MAG solar collector applications

Steam and electric power production using a small steam turbine

Technical Characteristics

Three wall solar vacuum collector (closed circuit) located in the focus of a fixed semi-cylindrical reflector(7) .The silicon used for sealing (2) the edges of the glass-tube (3), that contains the iron-tube (4) as a third wall, and the vacuum can withstand high temperatures of 300^0C or even 400^0C, while the tubes (4,5) are made of iron-tubes or seamless tubes or stainless steel pipes, and both the inner tube (5) and the outer tube (4) are sealed and can bear pressure of 20 bar or even 60 bar. Furthermore, they have a big diameter so that the focal points of the sun rays are concentrated throughout the whole day on the selective surface off the outer tube (4) without moving the reflector (7). The ring of the outer tube (4) is half filled with water in order to facilitate the vaporization and the vacuum tubes are interconnected via pairs of small tubes over and under each bottom allowing the water circulate in the bottom (1) and allowing the steam at the top (6) to pass from tube to tube of each series of collectors.

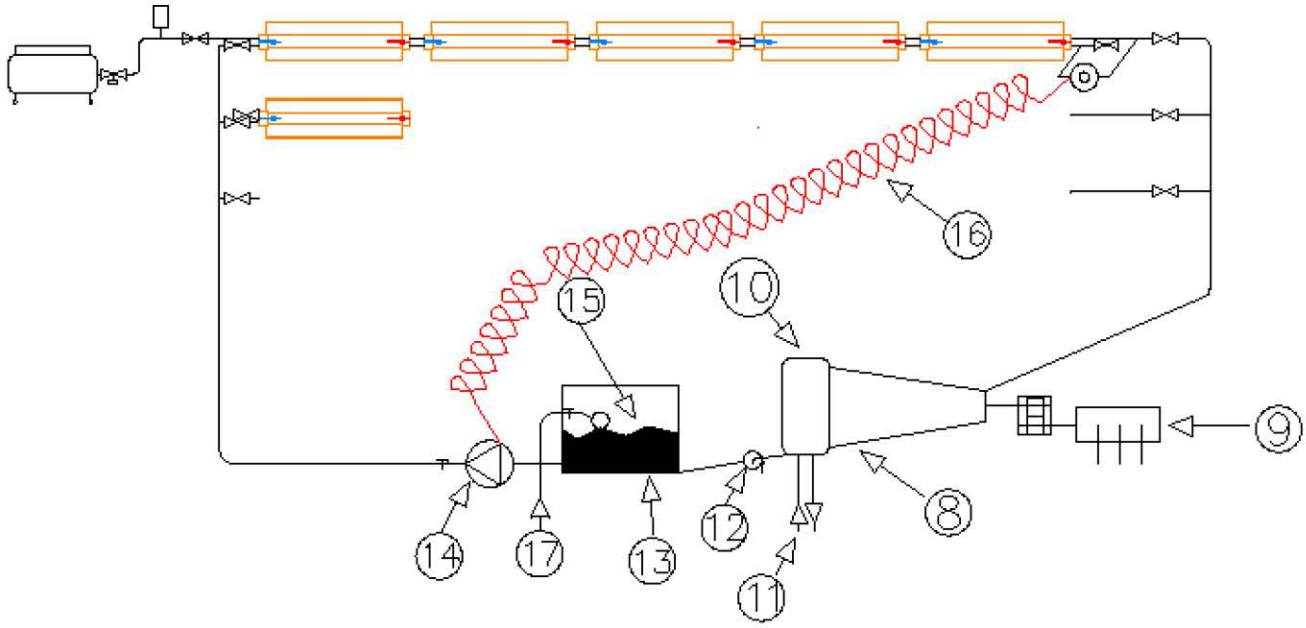


Fig 1. Electric power production using a small steam turbine

Depending on the use, we connect 5 or 6 or 7 solar collectors in series, the number of collectors connected in series is a function of the pressure and the temperature of the steam that is produced for the steam-turbine (8), that is employed in junction with a electric-generator(9) to produce electric energy, using the condenser(10) of the steam-turbine (8) the steam is liquidated by circulating cold water or special oil , in closed circuit(11) this way we also obtain thermal energy. The liquidized steam-water is driven via a steam-trap(12) in a tank for the liquidized steam-water(13) and from there using a high pressure pump (14) the liquidized steam-water (15) is inserted in the series of the solar collectors to be vaporized again. The filling level is retained employing an appropriate automation system (16) in the steam-boilers, while the water needed to replace the water (or steam) that could escape is done automatically in the steam-water tank (13) via a water-softener (17).

Desalination System

Distillation and desalination vacuum system of salt or semi-salt water using solar energy, heating the salt water in an insulated boiler (4) (Fig.2). With a recirculation hot water (10) closed circuit via MAG vacuum tube solar collectors with high efficiency ratio under high working pressures (7).

Hot salt water enters a special flat plate heat exchanger (1), in the entrance (A) through a circulator, in order to cool and liquefy the produced steam that entered in (C) the heat exchanger (1) with higher temperature and under greater pressure. Most of the incoming salt water vaporizes taking advantage of the latent heat from the condensing steam, while downwards in a big tank the high density salt water is collected and removed after it pre-heats incoming sea-water through a cross flow type heat exchanger, always with the help of a circulator. Gasification takes place in a low temperature vacuum environment (E), either with the help of an ejector pump (11) (Fig.2) or with a vacuum pump (8) (Fig.2). Liquefied fresh water leaves the system through a one-way valve at high temperature and through a simple cross flow type heat exchanger (5) is cooled, pre-heating at the same time incoming sea water. The out coming steam, pressure and temperature rise (crucial point of the invention) is achieved either with a special heat exchanger (2) and a hot water closed circuit using solar collectors (6) or with a special steam compression pump.

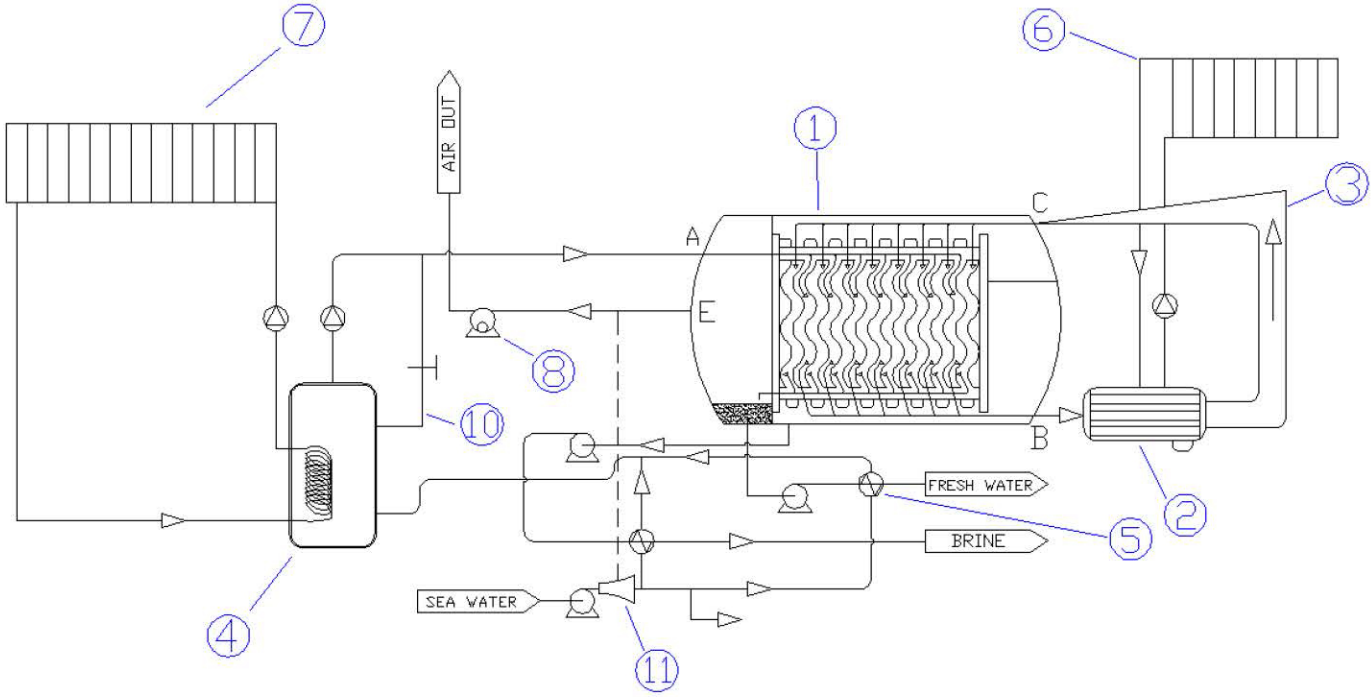
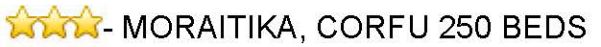


Fig 2. Desalination system

Already installed MAG solar collector systems

Our technology's functionality and reliability is proven by the already installed and effectively functioning systems in big hotel units with high energy costs and thermal demands and in houses.



- MORAITIKA, CORFU 250 BEDS

- CLOSED SIRCUIT MAG FOR STEAM PRODUCTION

AGLA HOTEL, RHODES - 200 BEDS

AIOLOS HOTEL, PERAMA, CORFU 1200 BEDS

HOUSE USE:HOT WATER AND POOL HEATING-10 MAG

KONTOKALI BAY, CORFU 600 BEDS

KRIOPIGI BEACH 82-MAG

MARABELLA HOTEL, MORAITIKA CORFU 100 BEDS

NASOS & DASY HOTEL MORAITIKA, CORFU 160 BEDS

PENINSOULA, AG. PELAGIA HERACLION CRETE 700 BEDS

ROYAL OLYMPIC, ATHENS 500 BEDS 241-MAG

SAINT GEORGE BAY HOTEL, ARACHAVI, CORFU 300 BEDS

ROOMS TO LET,RODA CORFU

BOILER ROOM KONTOKALI BAY
3X3000 lit Boilers

★★★★- ALIA CLUB, CRETA 44-MAG

★★★★- TINOS BEACH, TINOS 163-MAG

⭐⭐⭐- PALOMA BLANCA, CORFU
10-MAG

⭐⭐⭐- MARIS HOTEL, CORFU
94-MAG

⭐⭐- SIRENA, GOUVIA, CORFU
19-MAG

⭐⭐⭐- ATHINA HOTEL, KRETSENA
25-MAG

⭐⭐⭐- AKTI AEGEOU, TINOS 6-MAG

⭐⭐⭐- IRINI, AFIARTIS, KARPATHOS 25-MAG

CASTELLANO , ASTIPALEA 32-MAG

⭐⭐⭐⭐⭐- GRACE SANTORINI, SANTORINI 6-MAG

- DELFINIA , CORFU 124-MAG

- HABITAT HOTEL, KILKIS 39-MAG

ST. GEORGE BAY-COUNTRY CLUB, CORFU 120-MAG

APMATA HOTEL, SPETSES 10-MAG

KRIOPIGI BEACH, KRIOPIGI
CHALKIDIKI 82-MAG

OLYMPIC ROYAL⭐⭐⭐⭐⭐
ATHENS 241-MAG