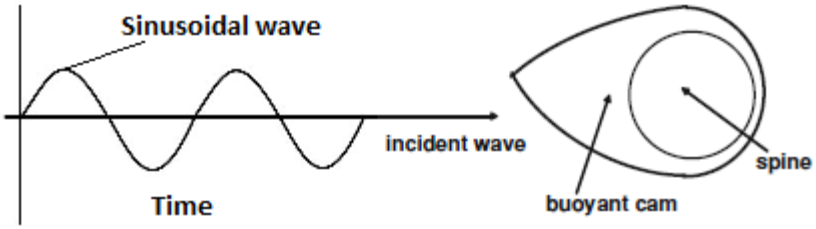
Wave Energy

Ocean wave energy is another type of ocean based renewable energy source that uses the power of the waves to generate electricity. Wave power system converts the periodic up and down movement of the oceans waves into electricity by placing equipment on the surface of the oceans that captures the energy produced by the wave movement and converts this mechanical energy into electrical power. Oceans cover more than 70% of the earth's surface so wave power is abundant and, if appropriately harnessed, it has the potential to provide a great deal of electric power.

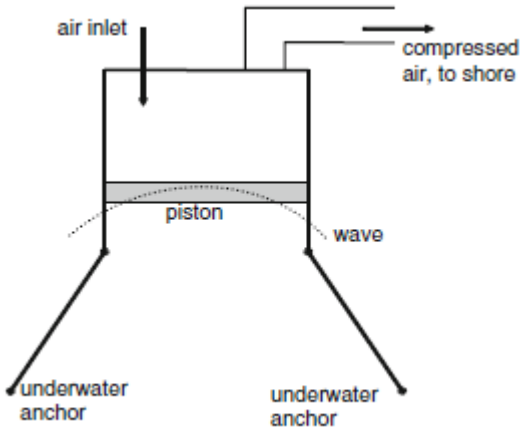
The ocean waves are directly caused by the wind and indirectly from the solar energy. How? As the sun's rays strike the earth's atmosphere, they warm it up. So, different regions of the earth will have different temperature depending upon its position on the earth. This difference of temperature between different regions of the earth results in winds. Air will always move from hotter region to cooler region. As the wind passes over the surface of the oceans, a portion of the winds kinetic energy is transferred to the water below and generates the waves. The kinetic energy of the wave can turn a turbine attached to a generator, which produces electricity. In short, an ocean wave is the up and down vertical movement of the sea water and let assumed, which varies sinusoidally with time.

Systems for Wave Power Utilization

The **Salter Duck** was developed in the 1960's and took its name because it's up and down motion resembles that of a duck in the water. It consists of a central cylindrical spine, around which is positioned a buoyant cam with a conical prismatic shape, as shown in Fig. below. The cam is positioned so that its leading edge is in the principal direction of the incident waves. The shape of the cam is such that it responds to the motion of the incident waves, but it does not disturb the flow behind. The cam absorbs the energy of the incoming waves without creating any other waves and converts the wave motion to its own motion, which in turn is transmitted to the prime mover of an electric generator.



Another, simple mechanism to harness (bring it in our control) the up and down motion of the waves is to use the **inverted cylinder and piston assembly**, which is depicted in Fig. on right side. The wave action moves the buoyant piston in a vertical motion. When the piston moves downwards, a valve opens at the top and allows air to flow into the cylinder. When the motion of the piston is reversed, the inlet valve closes and the confined air is compressed until a predefined pressure is reached. At this moment the outlet valve opens and the compressed air is directed to a duct, which carries the compressed air to a power producing turbine, usually located onshore (situated or occurring on land).



Environmental Effects of Wave Power and Other Considerations

Ocean wave power is clean, renewable, almost continuous, and does not pollute the atmosphere. Because the wave systems are built in the open seas, they do not affect the environment and the ecology of the coastal areas as much as tidal systems. The following are the most important environmental effects of the conversion of wave power to electricity:

1. Because the wave power density is relatively low, the wave conversion systems are massive and require large quantities of materials for their construction.
2. Most wave power systems are lengthy. Therefore, the navigation of ships will be obstructed.
3. All wave power systems include moving parts, which would kill fish and other sea animals if they are trapped in the systems.

Mechanical systems for wave power conversion must operate in adverse conditions: First, the systems must operate and maintain their structural integrity under heavy and low seas, under storms, and calm weather. This imposes a large constraint on the size, the strength of the materials and the design of the systems, which must withstand a very high range of forces. Because of the very high density of water, the forces that sea-wave systems must endure are by far higher than those of the wind-power systems. Secondly, the salt in the sea water is corrosive to most materials, and any wave energy system must be designed around this constraint.

Thirdly, the failure of the anchoring systems. Often, the anchors fail or drift and this may cause the failure or damage of the power system on the water surface. Fourthly, some systems, such as the Dam-Atoll systems (some kind of electric energy generation system from waves), must be located far from the shore (land along the sea). This makes the transmission of the electric power produced problematic. Such systems are also more susceptible to damage from the strong storms and high waves that occur in the high seas. These are some of the reasons why wave power systems are expensive and there are not many systems in operation, other than experimental or pilot systems.

In the future, wind turbines can also be installed along the wave power systems. The construction of both types of electric production units at the same location would bring advantages from economies of scale as, for example, common generators, transmission lines, and maintenance crews. (Economies of scale occur whenever a firm's marginal costs of production decrease)