APPARATUS FOR UTILIZING SOLAR HEAT

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By

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This invention relates to apparatus for absorbing the heat of solar radiation and for rendering it useful for various purposes, such as heating liquids for domestic, power, or warming purposes, or for purposes of evaporation.

While many attempts have been made to provide an apparatus of the character named they have been inefficient, due to the failure of the designers thereof to recognize certain conditions which are necessary to the satisfactory utilization of such radiation. The amount of heat per unit area contained in the solar radiation is, under the best conditions, relatively small, and to obtain a substantial rise in temperatures from it, necessitates the use of every refinement possible to reduce radiation and convection losses, while economic reasons demand the simplest and most inexpensive construction.

The apparatus herein described has been designed by me with the above points in view and my invention consists in the construction, arrangement and combination of the parts of which it is composed, as will be hereinafter more fully described and claimed.

Referring to the accompanying drawings in which corresponding parts are designated by corresponding marks of reference,—

Figure 1 is a vertical section through a device embodying my invention.

Figure 2 is a plan view of the device shown in Figure 1.

Figure 3 is a fragmental section through a boiler and connected parts shown in Figure 1.

Figure 4 is a detail through the tubular cover.

As shown in the drawings the device includes a ray-receiver, specifically shown as a boiler which is planar, i.e., is substantially flat, and consists of two parallel sheets 1 of suitable metal, which sheets at intervals are held together by bolts 2 and spaced apart by washers 3 surrounding the bolts at a distance relatively small in respect to the lateral dimensions of the boiler. The upper edges of the sheets are formed into flanges 4 as shown in Figure 3, to which is fastened a flattened side 6 of a cylindrical steam chest 6, a plate 5 being interposed between the flanges and the steam chest. The interior of the boiler is in communication with the interior of the steam chest by means of perforations (shown in dotted lines at 7 in Figure 3 in the plate). The lower edges of the sheets 1 are formed into a cylinder 8, into which passes the perforated intake pipe 9. A steam pipe 10 extends from the top of the steam chest to a suitable injector 11 attached to the water intake pipe 9 and to the water feed pipe 12.

A steam eduction pipe 13 is connected to the top of the steam chest.

The parts as above described are supported upon suitable frame work 14 by pillars 15 in such a manner that the plane of the boiler is approximately parallel to the earth's axis and at right angles to the plane of the meridian at the point where the device is installed, so the rays of the sun may be normal to the upper surface of the boiler at noon on the solstices, and such upper surface of the boiler is blackened to increase the amount of heat absorbed thereby.

The boiler and connected parts as above described are contained in a suitable casing 16 to reduce radiation and convection losses, and to further aid in this the boiler has placed below it and around it heat insulating packing 17.

With the construction as heretofore described, if the boiler is exposed to the sun's rays its contents will be heated, but as radiation and convection losses from the upper surface of the boiler rapidly increase as the temperature of the boiler and its contents are increased, the temperature which it is possible to obtain within the boiler will be limited. To prevent these heat losses from the upper surface of the boiler I provide a cover for the casing 16 and for the boiler container therein, which casing is diathermous to the rays of the sun, but which is opaque to the rays such as will be thrown back from the darkened surface of the boiler, and which will be non-conductive of heat. For this purpose the cover is made of a series of juxtaposed and preferably closely fitting evacuated vessels of suitable material. I have shown such vessels as glass tubes 18. These tubes are elliptical in cross section with their...
major axes parallel with the boiler, and each tube has at each end of its major axis a longitudinal channel 19 in its surface. In the channels 19 of adjacent tubes is placed a packing 20 which may be of tubing having a relatively thick wall. The material from which the tubes 18 are made is one highly transparent to rays of the wave lengths contained within the sun's beam, but highly nontransparent to rays emanating from a dark surface and as the temperature of the material of the screen will be raised by this lack of diathermancy to the last named rays, the tubes should be of a material having high thermal endurance and low thermal expansion. The material should have also low conductivity to prevent losses by conduction within the walls of the tube from the lower wall to the upper wall, the vacuum within the tubes reducing convection losses therein.

With a construction as hereinbefore described I have been enabled, in locations where the sun has considerable power, to raise the temperature of the contents of the boiler far above 100° C., and to trap enough heat for cooking and heating. The medium within the boiler is preferably water, but I may employ other fluids, such as ammonia, or sulphur dioxide, or for certain purposes, high test oils.

It will be noted that by making the tubes 18 elliptical with the major axes thereof parallel with the boiler, the screen is given a substantially flat upper surface, and that the several tubes present to the sun surfaces which are but slightly curved, and which therefore, when the boiler is oriented, as above described, will be disposed in a manner to result in the minimum of loss by reflection.

Having thus described my invention with which I claim and desire to secure by Letters Patent is:

1. In a device for utilizing the heat of the sun's rays the combination of a boiler having its upper and lower surfaces formed by plates spaced a short distance apart, and inclined to the horizontal, means for introducing fluid along the bottom edge of the boiler, a steam chest along the top edge of the boiler, insulation for the sides and bottom of the boiler and a tight screen transparent to the sun's rays and covering the top of the boiler consisting of a series of evacuated glass tubes.

2. In a device for utilizing the heat of the sun's rays the combination of a boiler having its upper and lower surfaces formed by plates spaced a short distance apart, and inclined to the horizontal, means for introducing fluid along the bottom edge of the boiler, a steam chest along the top edge of the boiler, insulation for the sides and bottom of the boiler and a tight screen covering the top of the boiler consisting of a series of evacuated glass tubes, and a packing between adjacent tubes.

3. In a device for utilizing solar energy, the combination of a stationary ray-receiver presenting an extended ray-absorbing surface, situated approximately parallel to the earth's axis and at right angles to the plane of the meridian; insulating material to reduce the loss of heat from other surfaces of said ray-receiver; and a planar screen transparent to sun rays, covering said ray-absorbing surface, comprising a plurality of hollow evacuated members elongated horizontally at right angles to the plane of the meridian, the screen being opaque to rays emitted from said ray-receiver to reduce loss of heat by radiation and air-convection from said ray-receiver.

In testimony whereof I hereunto affix my signature.

CHARLES GREELEY ABBOTT.