No. 811,274. PATENTED JAN. 30, 1906.

A. CARTER.

SOLAR FURNACE.

APPLICATION FILED JAN. 6, 1904.

2 SHEETS—SHEET 1.

Fig. 1.

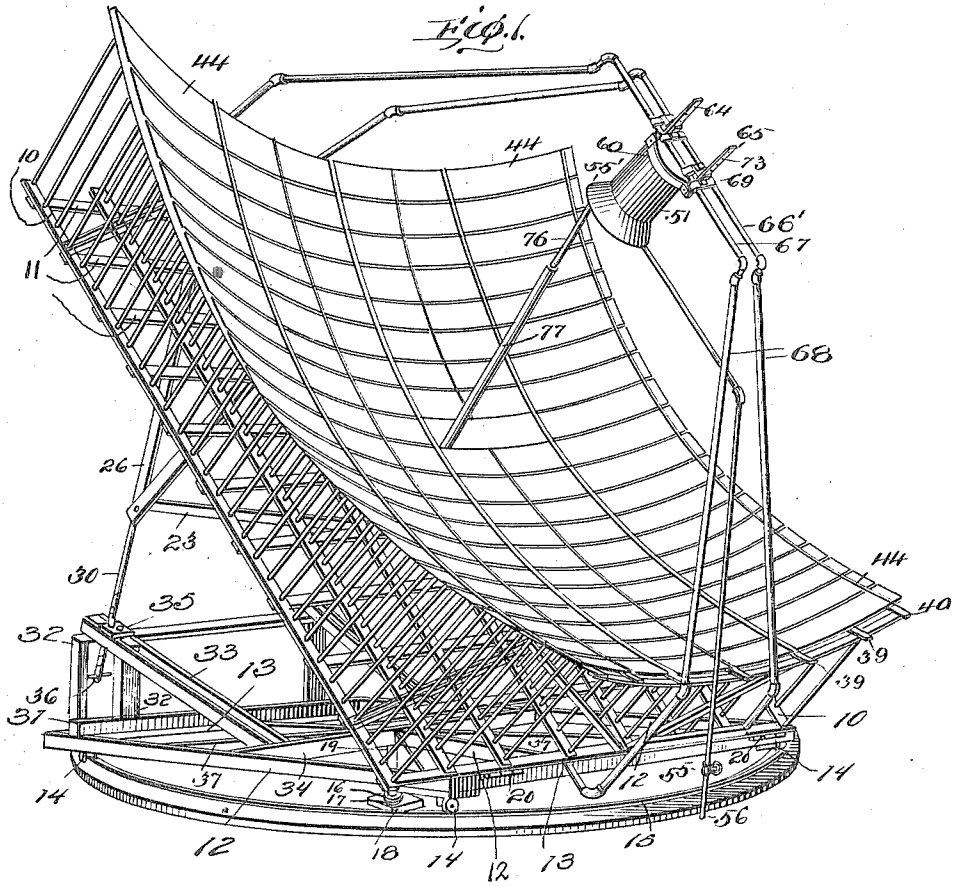


Fig. 4.

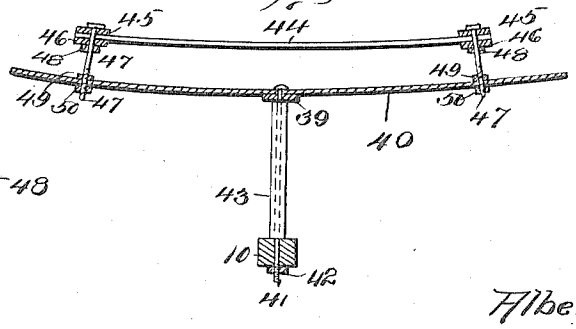
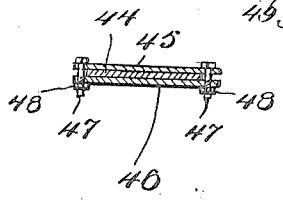


Fig. 6.



Witnesses

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2 SHEETS—SHEET 2.

Fig. 2.

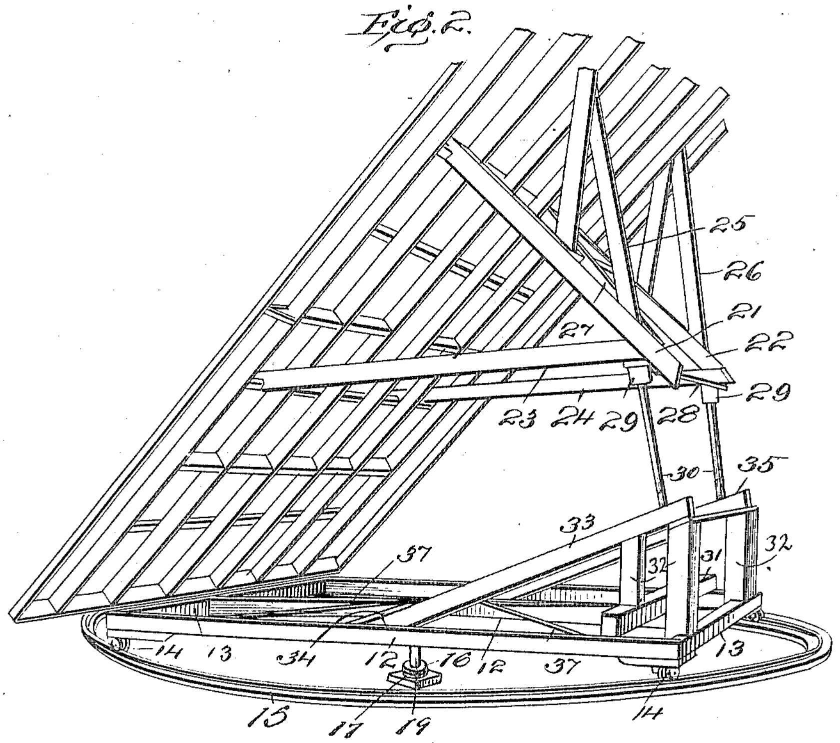


Fig. 5.

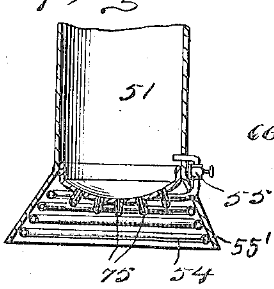
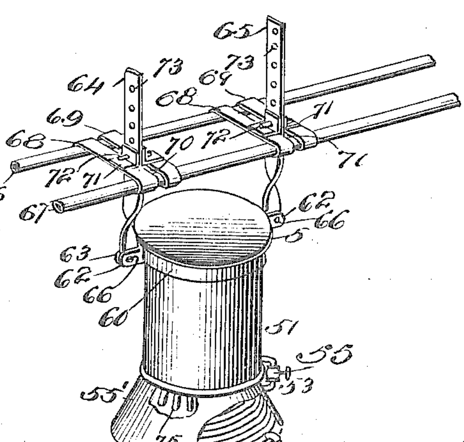


Fig. 3.



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SOLAR FURNACE.

No. 811,274. Specification of Letters Patent. Patented Jan. 30, 1906.

Application filed January 6, 1904. Serial No. 187,903.

To all whom it may concern:

Be it known that I, ALBERT CARTER, a citizen of the United States, residing at Los Angeles, in the county of Los Angeles, State of California, have invented certain new and useful Improvements in Solar Furnaces; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

This invention relates to solar furnaces wherein the sun's rays are reflected from a mirror against the boiler or other object to be heated, the object of the invention being to provide a construction wherein there will be employed a reflector comprising a number of individual sections so arranged and mounted to permit of concentration of the reflected rays from different sections against different portions of the object to be heated, and thus insure a comparatively even temperature of that portion of the body exposed to the rays and a consequent efficient heating of the contents of the body.

A further object of the invention is to provide such a mounting of the reflector as will permit it to remain close to the earth, and thus prevent it from blowing over, an additional object of the invention being to provide a novel manner of mounting the sections of the reflector and for mounting the boiler to permit of its adjustment.

Other objects and advantages of the invention will be understood from the following description.

In the drawings forming a portion of this specification, and in which like numerals of reference indicate similar parts in the several views, Figure 1 is a perspective view of the apparatus. Fig. 2 is a rear perspective view showing the turn-table and a portion of the supporting-frame for the reflectors with the adjusting mechanism. Fig. 3 is a perspective view showing the mounting of the boiler, a portion of the lower boiler-flange being broken away to illustrate the feed-water-heating coils. Fig. 4 is a detail view showing the manner of mounting each section of the mirror. Fig. 5 is a detail sectional view of the lower portion of the boiler. Fig. 6 is a section through one of the mirrors and its clamping-plates and supplemental frame, the clamping-bolts being in elevation.

Referring now to the drawings, the present apparatus comprises a supporting-frame including longitudinal sills 10 and transverse connecting beams or pieces 11. This portion of the frame is hinged at one end to a base-frame comprising sills 12 and cross-beams 13, the base-frame having wheels 14 at its corners, which run upon a track 15, which is circular in form. The wheels 14 rest lightly upon the track, the major weight of the base-frame being supported by the washers 16 and 17 upon the block 18, a pivot-bolt 19 being passed through the central sill 12 and through the washers and into the block 18.

The entire apparatus may be swung pivotally upon the bolt 19 for a purpose to be presently explained, while the frame including the members 10 and 11 is adapted to be swung in a vertical plane on its hinges 20. To thus swing the upper frame vertically, a truss is secured to the members 10 and comprises spaced members 21 and 22, which project downwardly at right angles to the members 10 and to the lower end portions of which are connected the braces 23 and 24, the braces of each of the members 21 diverging in the direction of the members 10. Additional braces 25 and 26 extend from the members 21 and 22 upwardly to the corresponding members 10, while diagonal braces 27 connect the members 21 and 22. Against the under sides of the members 23 is disposed a transverse member 28, against the under side of which are secured the socket-pieces 29, in which are received the rounded upper ends of screws 30. Upon the base-frame, which includes also a cross-beam 31, mounted upon the sills 12, are erected posts 32, upon which are secured the slanting beams 33, attached at their lower ends to the cross-beam 34, extending transversely of the sills 12. On the slanting beams 33 are plates 35, having threaded perforations therethrough, in which are engaged the screws 30, which latter have cross-bars or handles 36 at their lower ends for rotating the screws, it being understood that when the screws are rotated in one direction or the other they are fed upwardly or downwardly to raise or lower the upper frame upon its hinges. To insure against sagging of the ends of the base-frame under the weight of the upper frame, tie-rods 37 are engaged through the corner portions of the base-frame and are crossed over the center sill 12 adjacent to the pivot-bolt 19.

The upper frame of the apparatus carries a

supplemental frame comprising metal bands 39 and 40, which are bent into arc shape and which are arranged at right angles to each other and secured together by means of bolts 41, that are passed downwardly through them at their cross portions and through the longitudinal members 10 of the upper frame, nuts 42 being engaged with the lower ends of the bolts. The cross iron bars are held in spaced relation to the sills or members 10 by means of the sleeves 43, through which the bolts are passed and which sleeves bear with their ends against the lower faces of the bars 39 and the upper face of the members 10. The sleeves hold the supplemental frame against movement toward the upper frame, while the bolts hold them against separation.

The supplemental frame formed by the metal bars directly receives the mirror or reflector sections 44, the said mirror-sections when in place upon the supplemental frame forming a section of a sphere, as illustrated.

To hold each of the mirror-sections to the supplemental frame, each of said sections is clamped at each end and midway of its ends between upper and lower clamping-plates 45 and 46, through the end portions of which that project beyond the sides of the mirror-sections are passed clamping-bolts 47, having nuts 48 thereon, which are designed to impinge against the lower clamping-plate 46 to exert a clamping action between the clamping-plates. The clamping-bolts 47 are passed downwardly through the corresponding portions of the bars 40 of the supplemental frame, to which they are held by clamping-nuts 49 and 50, disposed, respectively, above and below the supplemental frame, so that they may be adjusted into contact therewith. By shifting these last-named nuts the several bolts may be adjusted to raise or lower the corresponding portion of the mirror-section 44, so that the entire number of mirror-sections may be adjusted to focus upon the same point or upon closely-related points. Furthermore, as each of the mirror-sections is curved, and while the curvatures of all of the sections are supposed to be the same, the individual sections may be adjusted to the proper positions corresponding to their specific curvatures.

The mirrors or reflectors in the present instance are employed to concentrate the sun's rays against a boiler comprising a shell 51. Secured to the lower end of the boiler is a frusto-conical pipe-coil 54, which is attached at one end to the boiler through a check-valve 55, this coil forming a feed-water heater for the boiler, the feed-water pipe 56 being connected to the lower end of the pipe-coil. The pipe-coil lies within the inclosure of an asbestos jacket 55′, secured to the lower flange of the boiler and which serves to retain the heat within its inclosure. The lower end of the boiler is convex, its center of curvature being very nearly the same as that of the composite mirror when the boiler is in position to receive the reflected sun's rays. Around the upper end portion of the boiler, at opposite sides thereof, are disposed the arc-shaped metal bands 60 and 61, having radial ears 62 and 63 at their ends, between which are passed the metal bars 64 and 65, respectively, which latter are held in place by bolts 66, passed through the bars and ears, the bars forming hangers for the boiler.

To support the boiler at the focus center of the reflector, a frame is provided comprising, in the present instance, the parallel pipe-sections 66′ and 67, which are connected at their ends with the downwardly-divergent supports 68, which are attached at their lower ends to the upper and lower ends, respectively, of the upper supporting-frame. Connecting the pipe-sections 66′ and 67 are pairs of transverse plates 68 and 69, having intervening slots 70, and adjacent to such slots the angle-irons 71. The bars 64 and 65 are each given a quarter-turn and passed upwardly through the slots, in which positions they are held by means of bolts 72, passed through the angle-irons and through perforations 73 in the bars. Each of the bars has a series of perforations 73, which permit of adjustment of the boiler toward and away from the reflector or mirror, the pipe-sections 66′ and 67 being arranged transversely of the mirror and the axis of the boiler coinciding with the radius of the reflector or mirror touching the center of the latter.

When the boiler has been properly positioned, the mirror-sections are adjusted so that they will focus either individually or in groups upon different points of the adjacent end of the boiler, so that the heat will be distributed over the end of the boiler substantially evenly.

The lower end of the boiler is convex and its face is parallel with the general curvature of the reflector or mirror, there being hollow projections 75 on the lower end of the boiler after the manner of an ordinary porcupine boiler, so that a greater surface will be exposed to the heat.

A steam-pipe 76 is connected adjacent to the upper corner of the boiler, which latter is in inclined position, as shown, and extends downwardly and through an opening at the center of the reflector or mirror, there being a flexible connection 77 between this pipe and an engine that is to be operated. The boiler may be provided with the usual steam-gage, water-glass, and safety-valve.

In the operation of the apparatus the mirror or reflector is maintained in position to receive the direct rays of the sun, for which purpose the pivotal mounting of the base-frame and the hinging of the upper frame thereto, together with the shifting mechan-

ism, is provided. In practice it has been found that the utilization of projections from a convex face of the boiler, which face is approximately parallel with the concave mirror, and by the further provision of a water-coil surrounding this zone and within the inclosure of which the rays are concentrated there is a resultant efficiency. It has been repeatedly demonstrated in steam-engineering practice that to generate steam in quantity the temperature surrounding the steam-generating apparatus must be in excess of 1,000° Fahrenheit, and even at this temperature the rate of evaporation per square foot of heating-surface per hour is very small, being not over one and one-half pounds. Hence it is evident that there must be an enormous condensation or concentration of the sun's rays in an open-air apparatus of this kind in order to meet the above requiremints. The projections from the convex end of the boiler are so short that they are subjected to practically the same intensity of heat-rays as the heat of the boiler itself. The provision of the water-coil forms an inclosure for the heated zone and prevents, furthermore, the displacement of the heated air from this zone due to outside air-currents. The pipe-coil becomes heated from the heated air in the inclosed zone, as do also the sides of the projections, being also heated by conductivity, and in actual practice it is found that a boiler having its structure in combination with the mirror described is much more efficient than when these features are omitted.

What is claimed is—

1. In an apparatus of the class described, the combination with a main frame including longitudinal and transverse members, of a concaved supplemental frame including longitudinal and transverse arc-shaped members corresponding to and lying respectively above the longitudinal and transverse members of the main frame, bolts passed through both members of the supplemental frame and through the main frame and provided with clamping-nuts, and sleeves of varying lengths inclosing the bolts and resting with their ends against the supplemental and main frames respectively.

2. In an apparatus of the class described, the combination with a main frame including longitudinal and transverse members, of a concaved supplemental frame including longitudinal and transverse arc-shaped members, concaved mirror-sections disposed between said transverse and longitudinal arc-shaped members, supporting means engaged through said arc-shaped members and with the first-named frame, parallel supporting members connected with the first-named frame and held in spaced relation to the concaved side of the mirror, a boiler, and arms extending from the boiler between said supporting members and adjustably connected therewith for movement of the boiler toward and away from the mirror.

3. In an apparatus of the class described, the combination with a concaved reflector, of a boiler disposed to receive the rays from the reflector, the surface of said boiler exposed to said rays being convex and substantially parallel with the reflector and having radiating projections.

4. In an apparatus of the class described, the combination with a reflector, of a boiler disposed to receive the rays from the reflector, the surface of said boiler exposed to said rays having projections in the direction of the reflector.

5. In an apparatus of the class described, the combination with a reflector, of a boiler disposed to receive rays from the reflector, said boiler having a pipe-coil within the inclosure of which said rays are received against the boiler, said coil being in communication with the boiler.

6. In an apparatus of the class described, the combination with a reflector, of a boiler disposed to receive rays from the reflector, a pipe-coil connected with the boiler and within the inclosure of which the reflected rays are received and a check-valve between the pipe-coil and the boiler.

7. In an apparatus of the class described, the combination with a concaved reflector, of a boiler having a convex surface disposed to receive the reflected rays from the reflector and having projections radiating from its convex face, and a pipe-coil connected to the boiler and surrounding said projections.

8. In an apparatus of the class described, the combination with a reflector, of a boiler disposed to receive the rays from the reflector, the surface of said boiler exposed to said rays having projections in the direction of the reflector, and means projecting from the boiler in the direction of the reflector and encircling said projections, for confining the heated zone.

In testimony whereof I affix my signature in presence of two witnesses.

ALBERT CARTER.

Witnesses:
JAS. H. BLACKWOOD,
GEO H. CHANDLEE.