(No Model.)

2 Sheets—Sheet 1.

M. L. SEVERY.

APPARATUS FOR UTILIZATION OF SOLAR HEAT.

No. 567,618. Patented Sept. 15, 1896.

FIG. 2.

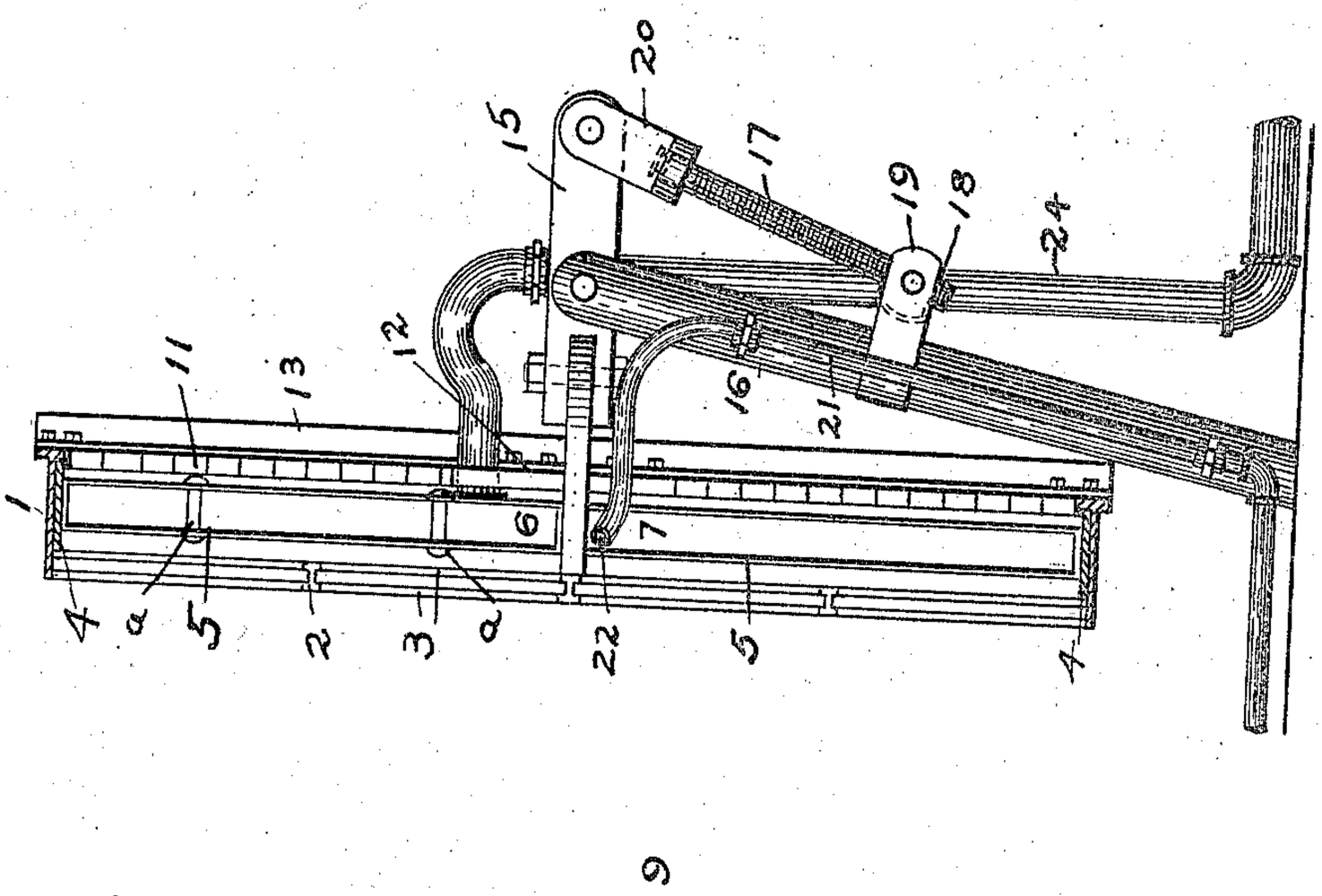

FIG. 1.

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(No Model.)

2 Sheets—Sheet 2.

M. L. SEVERY.

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Fig. 3.

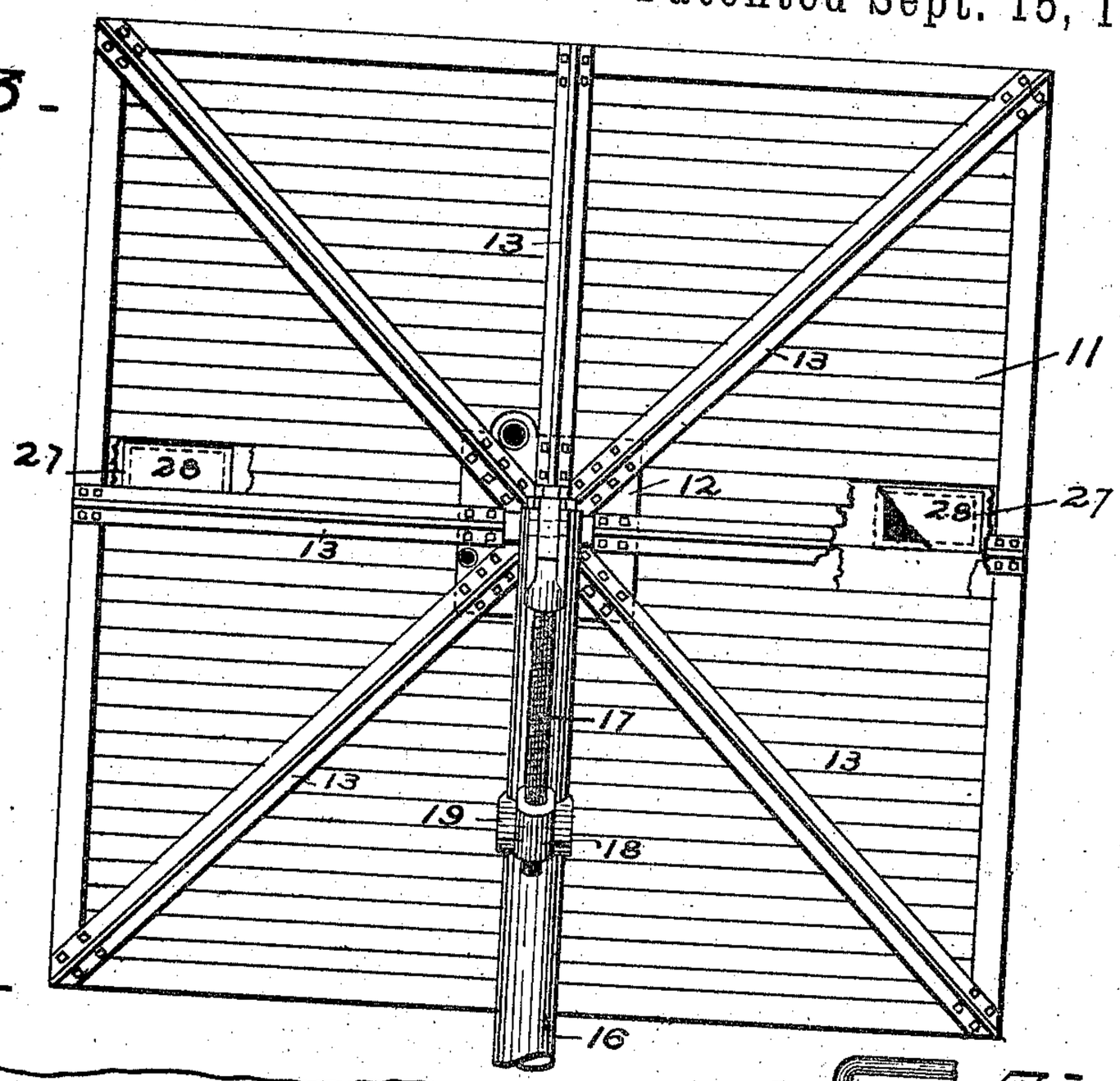


Fig. 7.

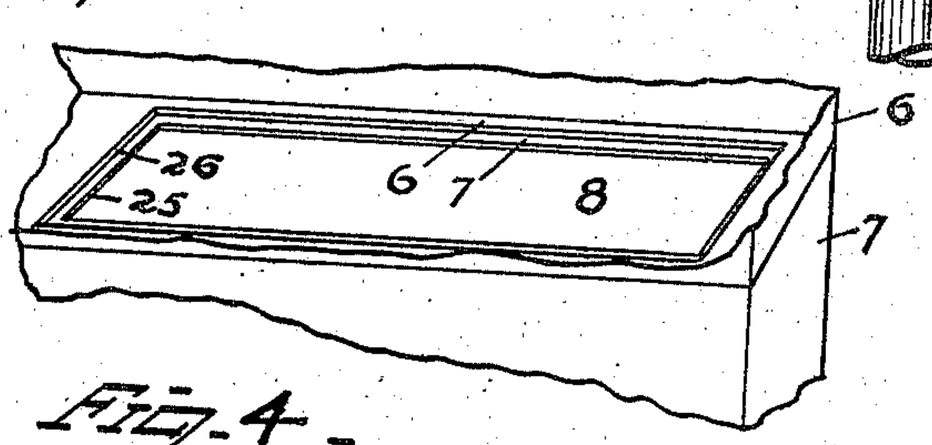
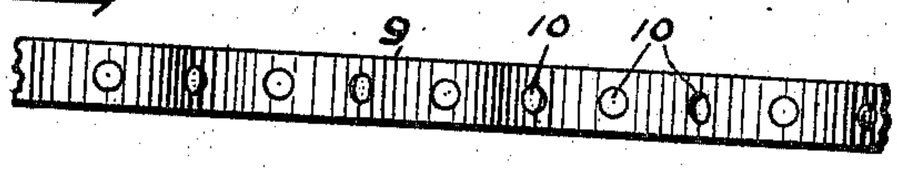


Fig. 4.

Fig. 5.



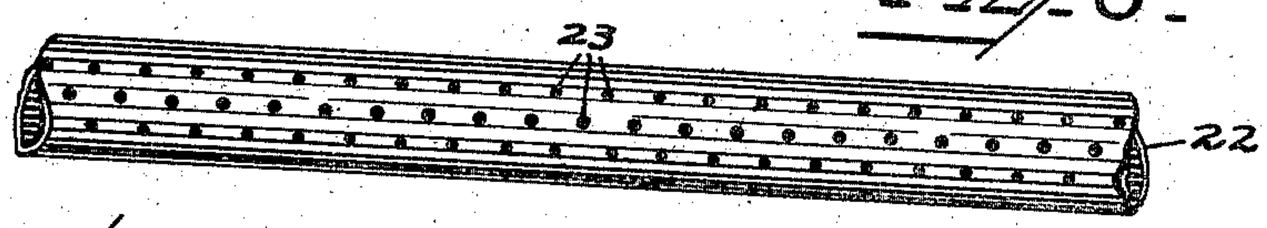


Fig. 6.

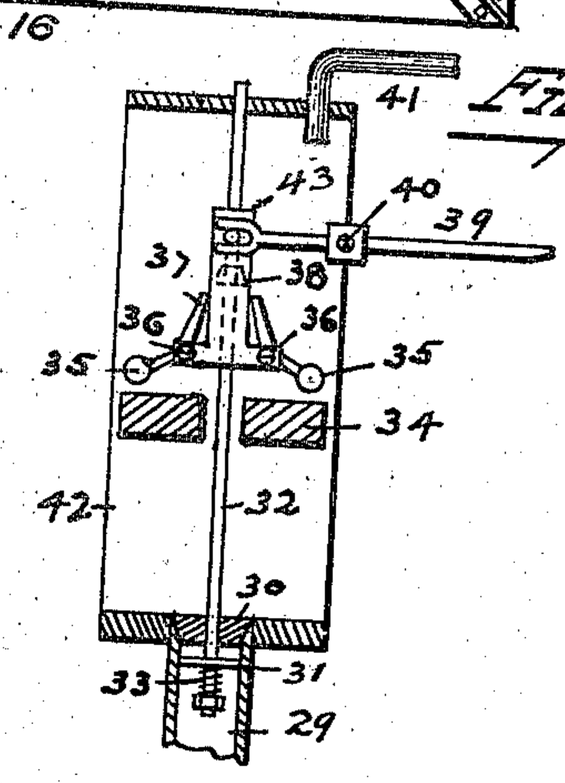


Fig. 8.

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UNITED STATES PATENT OFFICE.

MELVIN L. SEVERY, OF BOSTON, MASSACHUSETTS.

APPARATUS FOR UTILIZATION OF SOLAR HEAT.

SPECIFICATION forming part of Letters Patent No. 567,618, dated September 15, 1896.

Application filed February 6, 1896. Serial No. 578,274. (No model.)

To all whom it may concern:

Be it known that I, MELVIN L. SEVERY, a citizen of the United States, residing in Boston, in the county of Suffolk and State of Massachusetts, have invented certain new and useful Improvements in Apparatus for the Utilization of Solar Heat, of which the following, taken in connection with the accompanying drawings, is a specification.

This invention relates to apparatus for generating steam or vapor by solar heat, and to boilers or heat-receivers to be used with such apparatus, which boilers or heat-receivers are capable of being used with other sources of heat; and the invention consists, first, in dividing the boiler into compartments by a series of partitions, substantially as hereinafter more fully set forth, and combined so that communication is afforded between the several compartments and the proper circulation of vapor and liquid secured, whereby it is rendered possible to construct the boiler of thin sheet metal without rendering it liable to rupture or collapse, thus obtaining a boiler or heat-receiver in which steam or vapor at more than atmospheric pressure can be generated, and which will at the same time have the lightness desirable for a boiler used in apparatus for generating steam or vapor by solar heat, though where unconcentrated solar heat is used I prefer to use the steam or vapor somewhat below 212° Fahrenheit; second, in attaching to the feed-water pipe another pipe substantially parallel to the plane of the boiler or heat-receiver, and extended nearly across it from side to side, and provided with perforations, as hereinafter more fully set forth; third, for the sake of convenience in construction, in dividing the boiler into two sections, opening the one into the other, and in providing one side of one section with openings to admit of securing the sections together, substantially as hereinafter more fully set forth; fourth, in combination with the hot-well, of mechanism for automatically regulating the supply of water or other vapor-generating liquid to the boiler in small quantities at a time, thus securing rapidity of action and superheating of steam or vapor, and obviating the great weight incident to a boiler nearly full of liquid; fifth, in combination with the boiler or heat-receiver, of means for converting the luminous solar rays into dark heat rays and preventing the escape of the heat thus generated by radiation, convection, or conduction, and, sixth, in combination with a boiler or heat-receiver, means for presenting the front surface of such boiler at right angles to the direction of the solar rays through the various apparent changes of the sun's position relative to the earth.

I accomplish these results by means of the apparatus illustrated in the accompanying drawings, in which—

Figure 1 is a view in elevation of the front of a boiler constructed in accordance with the principles of my invention. Fig. 2 is a sectional view of the same. Fig. 3 is an elevation of the back of the apparatus. Fig. 4 is a plan view of one of the partitions. Fig. 5 is a front view of the same. Fig. 6 is a view of the perforated tube through which water is supplied to the boiler. Fig. 7 is an isometrical view showing the connection between the two parts of the boiler; and Fig. 8 is a sectional view of the hot-well placed between the condenser and the boiler, and of mechanism for regulating the supply of liquid from the hot-well to the boiler or heat-receiver.

In these several figures like numerals refer to like parts.

Referring to the drawings, 1 is a shallow rectangular frame, of wood, metal, or other suitable material. It is shown as equilateral, but it may be oblong or of any other suitable form. The sides of this frame are shown as T-shaped in section in order to avoid thickness of material and for securing suitable braces of angle-iron to the back of the frame, as it is desirable that the frame should be as light as it is possible to make it consistent with strength.

On the front of the frame is a series of bars 2 at right angles to one another, and in the spaces inclosed by these intersecting bars are suitably secured sheets of glass 3, or other material transparent to the direct heat-rays of the sun, but opaque to radiated dark heat. Within this frame and concentric with it is another frame 4 of a less depth than the first frame, and which also has a front of glass or other transparent material similar to that in the first frame. Owing to the difference in the depth of the frames an air-space is formed between the glass fronts, the object being to prevent the escape of heat radiated from the surface of the boiler. I do not confine myself

to the use of two thicknesses of glass, as my invention can be operated with but one, but I have found the best results were obtained where I have used two thicknesses.

The boiler or heat-receiver 5 is situated behind the inner transparent front and is separated from the same by a space for the purpose of preventing the escape of heat radiated from the boiler. It is preferably made in two sections 6 and 7, placed one upon the other edge to edge, but communicating with one another through openings 8 in the lower side of the upper section and the upper side of the lower section.

The boiler may be constructed of sheet metal, preferably of copper, on account of the slight tendency of this metal to corrosion and its high conductivity for heat, but as this sheet metal when used in the construction of a flat boiler or heat-receiver is not sufficiently strong to resist outward flexure when the internal pressure much exceeds that of the external atmosphere I insert bolts or soldered rivets *a*, running from side to side of the boiler and firmly binding them together.

In order to prevent a collapse of the boiler and for other reasons, I place a series of partitions 9 of sheet metal between the back and front of the boiler at right angles thereto, and so constructed as to secure the necessary communication and circulation of vapor and liquid between the compartments formed by the partitions and to present a large heating-surface to the contents of the heat-receiver. These partitions may be placed either vertically or horizontally, and are preferably parallel. The necessary communication may be obtained by making the length of the partitions a little less than the distance between the top and bottom of the boiler if the partitions are placed vertically, or a little less than the length of the boiler if they are placed horizontally; also by perforating the partitions, as at 10, and I consider this the preferable method. In order to increase the strength of these partitions, they are preferably corrugated, as shown. A boiler is thus obtained which is of sufficient strength to be used for the generation of steam or vapor, and at the same time it is of but little weight. This lightness is of great importance in an apparatus which must be supported on pivots and capable of being easily turned in two directions in order that its front may be always exposed to the rays of the sun. This front surface of boiler is preferably blackened with lampblack or other suitable material to favor the absorption of the heat and to convert the luminous solar rays into dark heat.

I have described the boiler as used with apparatus for generating steam or other vapor by solar heat, but it may be used with any other source of heat and may be of any form, and it need not necessarily be made in sections, as described.

Behind the boiler, and preferably separated from it by a space, is a backing 11, of a material which is a non-conductor of heat, as, for example, strips of wood, as shown. In the center of this backing is a plate 12, of wood or metal, and diagonal, vertical, and horizontal braces 13, preferably of angle-iron, are secured to this plate and to the frame for the purpose of strengthening the structure.

The structure can be moved by hand or by suitable mechanism. A convenient device for effecting this movement in a vertical plane is shown, whereby the structure can be set at the proper angle to bring its front opposite to the sun, according to the declination of the latter at different seasons in the year. This device consists of a screw 17, one end of which passes through a nut 18, pivoted to an arm 19, fixed on the standard 16, and through the lower member of an L-shaped arm 20, pivoted by its upper member to the outer end of the horizontal bar 15. A worm-wheel and worm device provided with a crank working around the pivotal point of the arm 15 in the post 16 can be used for moving the structure on the vertical pivot, or both movements may be automatically performed by the machinery actuated by the device.

In other forms of the apparatus for utilizing solar heat patented by me, as, for example, that described in Letters Patent No. 495,163, I have supported the apparatus so that it is capable of movement in a vertical and horizontal plane, and therefore in this application I do not claim this general manner of supporting such apparatus. Various devices for accomplishing this result have been shown and described in this and other patents, and any one of those devices can be applied to the structure herein described, or any other device which will accomplish the desired result can be used.

21 is the feed-water pipe. This is preferably carried into the middle of the upper part of the lower section of the boiler, and has attached to it at right angles thereto another pipe 22, which may extend nearly across the chamber from side to side. The partitions under the pipe are shorter than the other partitions in order to afford space for this pipe. The pipe 22 is perforated, as shown at 23, through which the feed-water or other liquid is discharged into the boiler in the form of a spray, and thus is more quickly converted into steam than if discharged in a stream.

24 is the pipe for the steam or vapor, and this pipe is connected to the upper section of the boiler.

For the purpose of establishing communication between the two sections of the boiler two openings 25, preferably rectangular, are formed in the top of the lower section or opening near the opposite ends of the section, and 26 are two rectangular openings in the bottom of the upper section, above the openings 25, which openings 26 are a little wider and longer than the openings 25, to facilitate soldering or brazing.

When the sections are placed in position in the construction of the apparatus, the edges of the two opposite openings are soldered together. For the purpose of reaching these openings, in order to conveniently apply the solder, an opening 27 is provided in the back of the upper section opposite the opening 25, which opening 27 is covered by a plate 28 when the soldering has been completed.

The hot-well, (shown in section in Fig. 8,) is composed of the cylindrical shell 42, closed at the top and bottom, though preferably not air-tight at the top. To the lower end of this shell is connected the pipe 29, which is connected to the feed-pipe 21, the end of the pipe 29 being closed by the spring-actuated valve 30, as well as by the sucking effect of the boiler when the pressure is below that of the atmosphere. This valve is fast on the rod 32, which passes through a bridge 31 within the pipe, and surrounding the rod below the bridge is a spring 33, which acts to keep the valve closed.

Mounted on the rod 32, and normally sliding freely thereon, is a collar 43, to the lower end of which are pivoted, at 36, the trip-levers 37, the lower ends of which are weighted, as at 35. The upper ends of these levers pass through slots in the sides of the collar 43.

Fixed on the rod 32, within the collar 43, is a lug 38, adapted to be engaged by the ends of the levers 37 when they are pressed inwardly by the raising of their ends 35. Under the levers and surrounding the rod 32 is a float 34, which moves freely within the hot-well.

The collar 43 is connected to and moved by the lever 39, pivoted at 40.

The operation of this mechanism is as follows: The liquid from the condenser enters the hot-well by the pipe 41 and raises the float 34. The outer end of the lever 39 is struck by a projection on the condenser-pump, (not shown in the drawings,) so that at every downward stroke of the pump the collar 43 is raised on the rod 32. As the float 34 is raised by the condensed liquid entering by the pipe 41 it will strike the lower end 35 of the levers 37 and force the upper ends inward and under the lug 38, thus connecting the collar 43 and the rod 32 together, so that at the next stroke of the pump the rod 32 will be raised, thus opening the valve 30, which will afford free communication between the hot-well and the boiler through the pipes 29, 21, and 22. The boiler being connected to a condenser through the pipe 24 and the engine or pump operated, there is a constant suction on the boiler, and the result is that a small portion of the liquid in the hot-well is drawn therefrom into the boiler, provided its internal pressure is less than that of the external atmosphere, and by means of the perforated pipe 22 is sprayed into the boiler and instantly converted into steam or vapor and superheated.

I do not confine myself to the use of my apparatus for the generation of steam merely, as it may be used to vaporize many other liquids besides water, and is further applicable to the heating of air for use in hot-air engines. It is obvious that if a higher temperature is desired than that afforded by unconcentrated solar heat it may be secured by the addition of superimposing refracting or reflecting devices converging the concentrated rays upon my heat-receiver, and such would be within the province of my invention. In a patent issued to me and numbered 527,379 I have shown such subsidiary reflecting device in an "apparatus for generating electricity by solar heat," for which reason I do not again show it here.

I do not confine myself to the particular shape of the boiler or heat-receiver shown, as, although I prefer that the surface presented to the solar beams shall be flat and square, as shown, it might be made oblong, circular, polygonal, or of many other figures without in any way altering its principle of action. It is very desirable, however, that this box-like heat-receiver should be relatively thin; that is, of small dimension along the direction of the beam to which it is exposed, so that its exposed surface may be large relative to its cubical contents.

My invention may be carried into effect by having a considerable volume of liquid constantly in the heat-receiver or boiler and generating saturated steam or vapor therefrom in the usual manner; but I much prefer to supply the boiler or heat-receiver with only such liquid as it can vaporize at once and superheat, reinjecting the condensed vapor as fast as used by the engine. The advantages attained by this method are very considerable.

Having thus described my invention, what I claim, and desire to secure by Letters Patent of the United States, is—

1. A boiler or heat-receiver for the generation of steam or vapor by unconcentrated solar rays, consisting of a thin box-like heat-receiver of relatively small dimension along the direction of the solar beam to which it is exposed provided with means for intermittently supplying the liquid to be vaporized and an outlet-pipe for the vapor communicating with the device to be operated, substantially as described.

2. A boiler or heat-receiver for the generation of steam or vapor by unconcentrated solar rays, consisting of a thin box-like chamber adapted to interrupt a solar beam of any desirable shape of cross-section, but of large cross-section relative to the cubical contents of said chamber, a pipe for supplying the liquid to be vaporized to the chamber, a pipe for the vapor communicating with the device to be operated and means for keeping the boiler or heat-receiver directed toward the sun.

3. A boiler or heat-receiver for the genera-

tion of steam or vapor, or the expansion of air by solar heat, consisting of a thin box-like receiver of small cubical contents relative to the area of the cross-section of the beam it interrupts, the receiver being provided with an inlet-pipe for the fluid to be expanded, an outlet-pipe for the expanded fluid communicating with the device to be operated, and means for jacketing the boiler or heat-receiver in a manner to permit its free absorption of the solar rays, their conversion into dark heat and to prevent the escape of such heat from the receiver.

4. A solar boiler or heat-receiver consisting of a thin box-like chamber of small cubical contents relative to the area of the cross-section of the solar beam it intercepts, one or more thicknesses of glass or similar material transparent to the sun's rays but opaque to dark heat-rays, placed over the front surface of the heat-receiver and separated therefrom and from each other by an air-space, means for holding said heat-receiver and glass jackets in place relative to each other and for insulating the rear and sides of the receiver, a feed-pipe and a supply-pipe communicating with the receiver and means for keeping said receiver turned toward the sun.

5. A solar boiler or heat-receiver capable of furnishing superheated steam or vapor, in combination with means for intermittently injecting the liquid to be vaporized into said boiler, and means for regulating the amount of liquid to be injected by the amount of steam or vapor used and a supply-pipe leading from boiler to device using the steam or vapor, substantially as described.

6. In a boiler or heat-receiver adapted to be worked by unconcentrated solar rays means for supplying the boiler with the liquid to be vaporized, means for vaporizing and superheating same and means for conducting the superheated vapor from the boiler to the device operated by it, substantially as described.

7. In a boiler or heat-receiver adapted to be worked by solar rays, a jacket of glass or other material transparent to solar rays but opaque to dark heat, placed over but not touching the face of the receiver presented to the sun, means for preventing loss of heat from the other surfaces of heat-receiver, means for supplying the boiler with the liquid to be vaporized, means for vaporizing and superheating same and means for conducting the superheated vapor from the boiler to the device operated by it and means for keeping the front face of the heat-receiver toward the sun, substantially as described.

8. A solar boiler or heat-receiver composed of a chamber having two large flat opposed parallel surfaces separated by a relatively small space, provided, on its front side, with a jacket or glass or similarly-acting material, parallel to said front surface and separated therefrom by an air-space, means for holding the jacket and boiler in place relative to each other and for preventing loss of heat from rear and sides of boiler, means for injecting liquid into the boiler, means for conducting the steam or vapor from boiler to device to be operated and means for moving heat-receiver or boiler to face the sun in its various apparent changes.

9. In combination with a boiler, an injecting device and means for automatically governing the supply of fluid injected by the amount of vapor drawn from the boiler, substantially as described.

10. The combination substantially as and for the purpose set forth, with a boiler or heat-receiver for generating steam or vapor or expanding air, a series of partitions dividing the boiler into compartments, said partitions being constructed as described whereby communication is permitted between the compartments for the circulation of vapor and liquid or air.

11. The combination, substantially as and for the purpose set forth, with a boiler or heat-receiver for the generation of steam or vapor or the expansion of air, of a series of perforated partitions extended between the walls of the boiler.

12. The combination, substantially as and for the purpose set forth, of a boiler or heat-receiver for the generation of steam or vapor, having the distance between the side which is exposed to heat and the opposite side considerably less than the dimensions in the other directions and a series of partitions extended between these sides and constructed as described, whereby communication is afforded for the circulation of air, steam, or vapor and liquid between the compartments formed by the partitions.

13. The combination, substantially as and for the purpose set forth with a boiler or heat-receiver for the generation of steam or vapor, and constructed of sheet metal, of a series of partitions extended between two opposite sides of the boiler and dividing the same into compartments and constructed as described, whereby communication is afforded for the circulation of vapor and liquid between said compartments.

14. In apparatus for the generation of steam or vapor by solar heat, the combination of a frame of a dimension considerably less in one direction than in other directions, the front of said frame, on one of the two sides of greatest area, composed of glass or other material transparent to the direct rays of the sun, but opaque to dark radiated heat, and a back of some non-conducting material; a boiler or heat-receiver preferably constructed of sheet metal and a little less in size than the frame and placed between the front and back of the frame but separated respectively from the front and back by a space and having its heat-receiving surface preferably blackened; a series of partitions between the front and back of the boiler and constructed as described, whereby communication is afforded for the circulation of vapor

and liquid between the compartments formed by the partitions; a feed-pipe for the liquid and steam or vapor pipe connected with the boiler or heat-receiver, and means for supporting the structure whereby it is capable of movement in a horizontal and in a vertical plane.

15. In an apparatus for the generation of steam or vapor by solar heat, the combination, substantially as and for the purpose set forth, of a boiler or heat-receiver composed of two chambers having their dimensions in one direction considerably less than their dimensions in other directions and placed edge to edge; openings in the top of the lower chamber near each side and openings in the bottom of the upper chamber just above the openings in the lower chamber, and said last-mentioned openings being a little larger than the first-mentioned openings, and means for joining the edges of the same together.

16. The combination, substantially as and for the purpose set forth, of a boiler or heat-receiver for the generation of steam or vapor composed of two chambers of sheet metal, having their thickness considerably less than their other dimensions and placed edge to edge; openings in the top of the lower chamber near each side; openings in the bottom of the upper chamber just above the openings in the lower chamber and removable plates in the back of the upper chamber just above the openings in said chamber.

17. In an apparatus for the generation of steam or vapor by solar heat, the combination, substantially as and for the purpose set forth, of two quadrilateral rectangular concentric frames of a thickness or depth which is considerably less than their dimensions in the other directions and the inner frame being less in depth than the outer frame; fronts for each frame composed of glass or other material transparent to direct solar-heat rays but opaque to dark radiated heat; a space between these two fronts and back of non-conducting material; a boiler of sheet metal inclosed by the frame and separated from the inner front and the back respectively by a space and made in communicating sections; a series of vertical parallel partitions of sheet metal in each section, constructed as described, whereby communication is afforded for the circulation of vapor and liquid between the compartments formed by the partitions and collapse of the boiler prevented; a feed-pipe for liquid and steam or vapor pipe communicating with the boiler or heat-receiver; a plate secured on the center of the backing; vertical, horizontal, and diagonal braces, preferably of angle-iron, secured at their extremities to the plate and frames, as described, for supporting the structure so that it is capable of movement on a horizontal plane and in a vertical plane.

18. The combination, substantially as and for the purpose set forth, with a boiler or heat-receiver, of a feed-pipe communicating with a pipe provided with a series of perforations in its sides, and means for opening this pipe to the hot-well at suitable intervals.

19. The combination, substantially as and for the purpose set forth, with a boiler or heat-receiver for the generation of steam or vapor, and of a form such that the distance between the face which is exposed to heat and the opposite surface is considerably less than the distance between the sides at right angles to the exposed surface and set upon this narrower side; of a feed-pipe entering near the top of the boiler or heat-receiver; a pipe communicating with the feed-pipe and extending nearly across the boiler between the upright sides and a series of perforations in the sides of the pipe.

20. The combination, substantially as and for the purpose set forth, of a boiler or heat-receiver for the generation of steam or vapor, having the distance between the surface which is exposed to heat and the opposite surface considerably less than the dimensions of the boiler in other directions, and set upon this narrower side; a feed-pipe entering the top of the lower section of the boiler; another pipe connected to the feed-pipe and extending nearly across the boiler near the top, between the upright sides which are at right angles to the side exposed to heat, and provided with a series of perforations arranged along its side; vertical partitions extending between the side of the boiler exposed to heat and the opposite side and shorter under the perforated horizontal feed-pipe than in other parts of the boiler.

21. The combination, substantially as and for the purpose set forth, with the hot-well of a steam or vapor boiler, of mechanism operated by the condensing-pump and acting when the liquid reaches a certain height in the hot-well to open a valve connecting the hot-well with the feed-pipe.

22. The combination, substantially as and for the purpose set forth, of the hot-well; the pipe connected with the condenser and entering this well; a pipe connected to the bottom of the well and communicating with the feed-pipe of the boiler; a valve closing the pipe; a vertical rod attached to this valve; the sleeve connected by the pin and joint lever to the condenser-pipe; the bent levers pivoted on said sleeve with the upper arm embracing the rod and lower arms on said levers and the front under the said arms.

In testimony whereof I have hereunto subscribed my name this 7th day of January, A. D. 1896.

MELVIN L. SEVERY.

Witnesses:
CHAS. A. KELLOGG,
WM. W. MONTGOMERY.