No. 705,167. Patented July 22, 1902.

F. WALKER.

COMBINED SOLAR AND ARTIFICIAL HEAT WATER HEATER.

(Application filed Apr. 19, 1898.)

(No Model.)

Fig. 1.

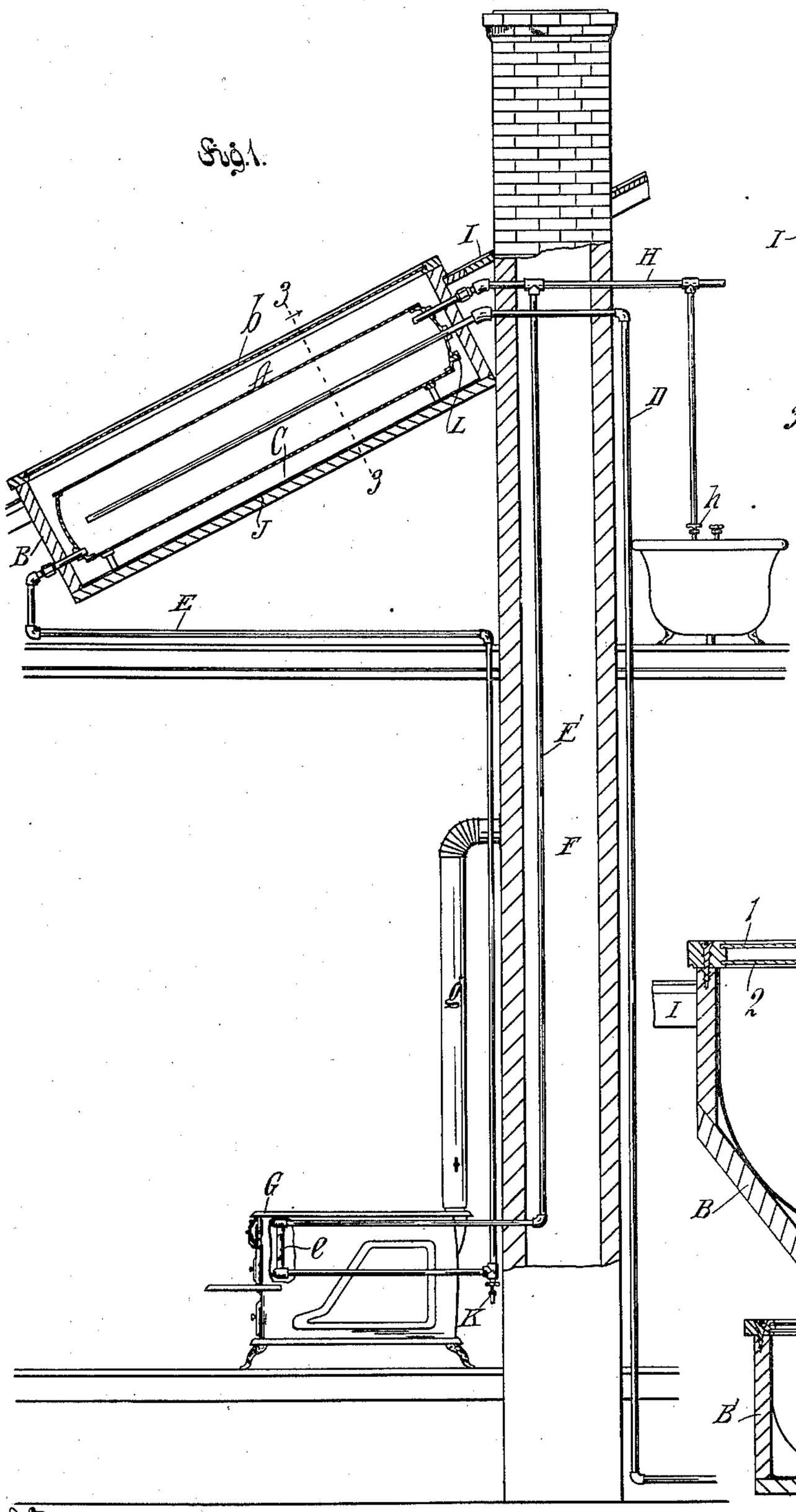


Fig. 2.

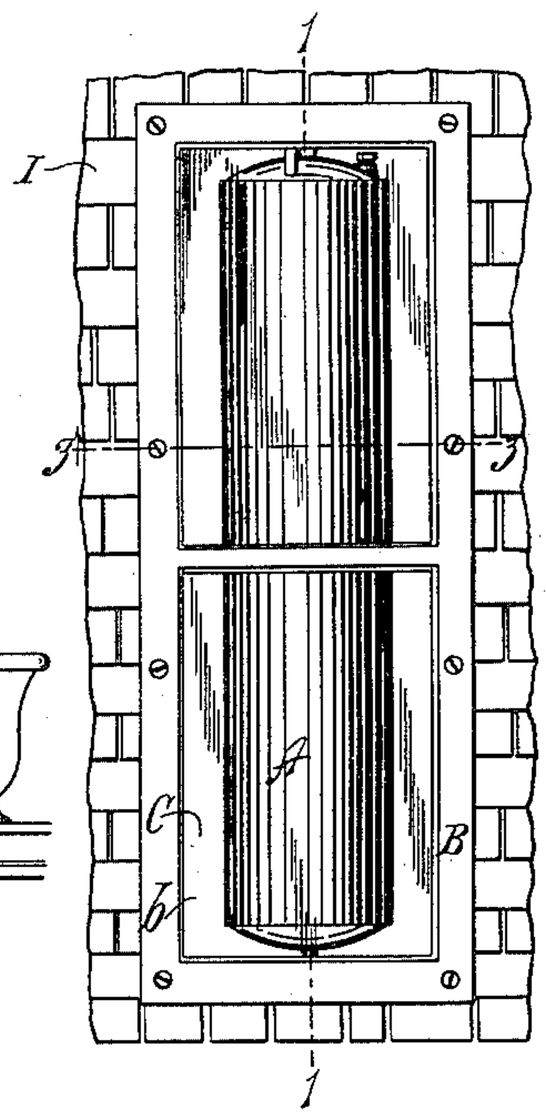


Fig. 3.

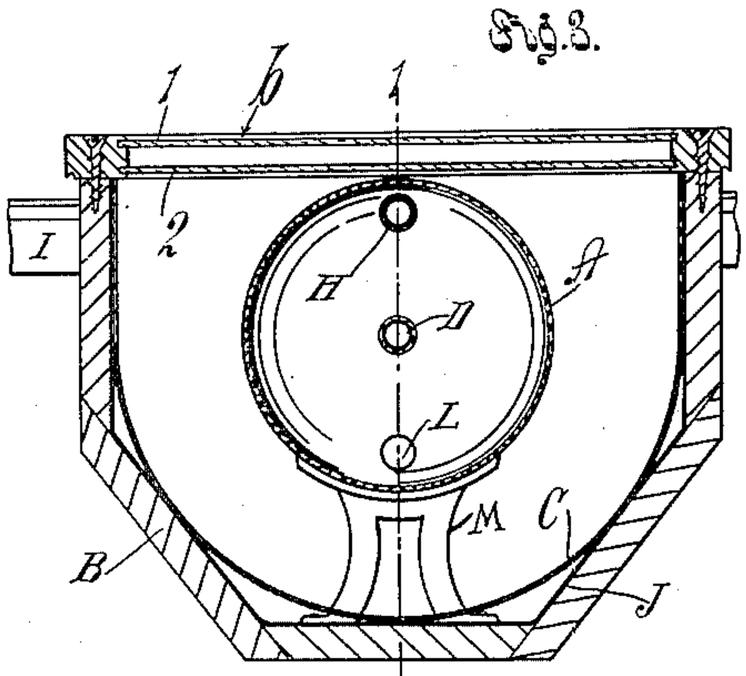
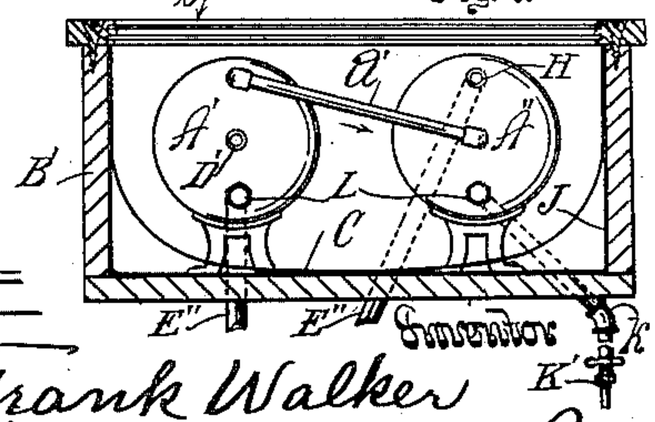


Fig. 4.



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UNITED STATES PATENT OFFICE.

FRANK WALKER, OF LOS ANGELES, CALIFORNIA.

COMBINED SOLAR AND ARTIFICIAL HEAT WATER-HEATER.

SPECIFICATION forming part of Letters Patent No. 705,167, dated July 22, 1902.

Application filed April 19, 1898. Serial No. 678,175. (No model.)

To all whom it may concern:

Be it known that I, FRANK WALKER, a citizen of the United States, residing at Los Angeles, in the county of Los Angeles and State of California, have invented a new and useful Water-Heating System for Buildings, of which the following is a specification.

The object of my invention is to provide superior and more economical means for supplying buildings with hot water.

At the present time solar water-heaters are being installed in buildings separately from range-boilers, and two separate hot-water systems are maintained where it is desired to employ both kinds of heaters. This is both expensive and inconvenient in that it requires two separate systems of hot-water-distributing pipes.

An object of my invention is to do away with this expense and inconvenience. I prefer to do this by using the ordinary hot-water boiler of a range-heater as the water-receptacle of the solar-heater and connecting it with the water back or coil in the range, stove, or furnace.

My invention comprises the combination of a water-receptacle, an insulating-case around such receptacle and having a transparent portion to admit the sun's rays to heat the receptacle, and also having a reflector arranged at the sides of said receptacle and opposite to the transparent portion to direct the heat-rays to the receptacle, a supply-pipe to discharge into the lower part of the receptacle, a circulating-pipe opening from the lower part of the receptacle and extending thence outside the case, then returned through the case and connected with and discharging into the upper part of the receptacle, and means for applying artificial heat to the circulating-pipe outside the case. The means for applying the artificial heat may be a lamp, a gas-burner, electric heater, stove, range, or artificial heater of any kind. For convenience of illustration I have shown in the accompanying drawings a stove or range for this purpose. Preferably the receptacle is an ordinary stand-boiler, such as is used with kitchen stoves and ranges for heating water under pressure from the main, and I prefer to arrange the boiler aslant, and the case is preferably let into a slanting portion of the roof of the building, the slant of the case and boiler being the same as that of the portion of the roof into which the case is let, and the upper side of the case is glazed with a single or double glazing, as may be preferred, the double glazing being preferred where the climate is cold. The boiler is also preferably blackened on the outside, so that it will more rapidly absorb the heat-rays, and I prefer that the means for applying the artificial heat to the circulating-pipe be in the lower part of the building; but I do not confine myself to such construction, nor do I confine myself to the inclined boiler. The receptacle may be horizontal or vertical, if desired. I also propose to carry the circulating-pipe from the artificial heater up through the smoke-flue, thus to utilize the waste heat and insure a better circulation of the water; but it may be carried up outside the flue with less perfect results.

It is an object of my invention to obtain superiority in various respects, some of which I will now enumerate.

First, in my newly-invented heater not only are the sun's rays utilized, but at the same time with a small amount of artificial heat large quantities of hot water can be readily heated with comparatively slight waste of heat. In my invention the hot-water boiler is thoroughly insulated by an insulating-case and by a surrounding medium of air, and the artificial heat is applied externally to a pipe which passes through the insulation and leads from and returns to the boiler. By this means large economy of heat results, for the reason that the hot water is carried from the artificial heater into a hot receptacle which is insulated to prevent escape of heat or radiation, but is arranged to receive heat by absorption of the sun's rays.

A second superiority which I desire to obtain is an increase of circulation. This is provided for by leading the circulating-pipe out of the lower end of the boiler, carrying it downward outside the chimney-flue to the stove or range where the artificial heat is to be applied, then conducting the pipe up through the chimney-flue through which the heated gases from the range or stove are discharged, thus both economizing the heat and increasing the circulation—that is to say, the

pipe which passes down outside the flue will always be of lower temperature than the pipe which passes up through the heated flue, and the gravity of the cooler water in the descending pipe will not be interfered with by the artificial heat, and at the same time the ascending pipe constantly increases the levity of the water, so that the circulation is made very rapid by this arrangement of the pipes. Furthermore, the sediment which settles at the bottom of the receptacle will be readily drawn off through the descending pipe. By preference the receptacle is arranged aslant, in order that a circulation will be induced by the solar heater when operating alone, and the circulating-pipe which leads to the artificial heater opens from the lower end of the slanting receptacle to take the coldest water out of the receptacle and pass it through the artificial heater, while the hot water in the receptacle rises to and remains at the top of the receptacle until drawn out or displaced by the water which becomes heated in the pipe and returns to the top of the receptacle and which water will there meet and mingle with the heated water which is heated by the direct and reflected sun's rays upon the receptacle. The water within the receptacle that is heated by the sun's rays rises to the top of the tank and meets the hot water from the artificial heater, while the colder water will fall to the bottom of the receptacle and be drawn through the pipes and then returned to the artificial heater. Thus the water within the receptacle circulates in two directions. The water after being heated does not continue to pass in a continuous circuit through the heaters and circulating-pipes, but accumulates at the top of the receptacle, except when hot water is being drawn from the system. When the water is heated by passing through the artificial heater, it meets the hot water which has been heated by the sun and is at the top of the receptacle, and from there the heated water goes into the service-pipes that lead out from the top of the receptacle. Under normal conditions no circulation takes place throughout the pipes of the system unless heat is applied at the artificial heater, and when there is no heat at the artificial heater the only circulation in the water-receptacle is that which arises from the hot water rising to the top and the cold water falling to the bottom of the receptacle.

The third point of superiority aimed at is to provide for extreme economy in mounting the apparatus and at the same time facilitate the most advantageous use of the sun's rays and provide for the most rapid cleansing. This object I attain by mounting the case for the receptacle aslant in the roof of the building to correspond with the slant of the roof. This arrangement dispenses with the necessity of supporting the tank with unsightly supports outside the roof, allowing me, on the contrary, to let the case into the roof, so that the apparatus does not disfigure the building, and at the same time the slant of the receptacle facilitates the discharge of the cold water from the receptacle and the disposition of impurities at the lower end of the receptacle, where they can be readily drawn out. By carrying the descending pipe down outside the chimney-flue and the other pipe up through the heated chimney-flue, thereby heating the ascending pipe, the column of water in such heated pipe is continually expanded and made lighter as it ascends, while the water in the descending pipe receives no additional heat until it reaches the fire. This increases the rapidity of the circulation of the water through the circulating-pipe over what would be obtained by placing both pipes inside or outside the flue. By means of the rapid circulation through the circulating-pipe the water is caused to more rapidly take up the heat from the pipe and a greater quantity of water can be heated by a given amount of fuel in a given time than can be heated with a slower circulation.

An object of my invention is to largely do away with the objection which obtains against water-backs in cooking stoves and ranges—that is to say, the ordinary water-back heater prevents the stove or range from being quickly heated for culinary purposes, because the water in the boiler is liable to be cold when the fire is started in the stove and is therefore liable to carry off the heat for a considerable time after the fire is started; but with my invention the water in the boiler is much more liable to be hot when the fire is started in the stove, and in such event the water-back does not carry off as large an amount of heat as with the former construction of water-heaters, thus allowing the heat to be applied more quickly to the oven.

My invention is also designed to be superior to any solar water-heater in the facility with which the water-receptacle can be kept free from sedimentary deposits. In former solar heaters the water is at rest at all times except when being drawn off; but, as above stated, a circulation of the water through the circulating-pipe and a rapid flow from the receptacle into the pipe which leads to the artificial heater will be induced at any time by means of the application of artificial heat to the circulating-pipe. By reason of the great height of the water-columns and the arrangement of the pipes the movement of the water can be made so great as in a measure to stir up and displace sediment which may deposit from impure water in the receptacle. I have, therefore, by combining an artificial heater and a solar heater provided against any stagnation of the water and against the accumulation of filth in the water-receptacle of the solar heater. The impurities which may settle to the bottom of the boiler may be drawn off through a cock provided for that purpose.

The accompanying drawings illustrate my invention.

Figure 1 is a view of my invention as applied in its preferred form in a building, a fragment of which is shown. Fig. 2 is a plan view of the insulating-case with reflector and boiler. A fragment of the roof is also shown. Fig. 3 is a section on line 3 3 of Fig. 1. Fig. 4 is a sectional view of a horizontal insulating-case with two horizontal water-receptacles therein which are shown in end elevation.

A indicates a water-heater boiler set aslant and blackened upon the outside.

B indicates an insulating-case inclosing the boiler and provided upon its upper side with a transparent portion *b* to admit the sun's rays to heat the boiler.

C indicates a reflector of tin or other suitable material inside the case at the sides and back thereof to reflect the heat-rays to the receptacle.

D indicates a supply-pipe to discharge into the lower end of the receptacle.

E indicates a circulating-pipe opening from the lower end of the boiler, extending thence through the case B and downward and bent at *e* at a lower level, where it is formed into a coil or connected with a hot-water back and thence led upward through the smoke-flue F and there led through the case and connected with the receptacle A to discharge into the upper part thereof.

G indicates a stove, range, furnace, or other means for applying artificial heat to the pipe at its bend, coil, or water-back *e*, and H indicates a hot-water pipe leading from the circulating-pipe, near the upper end thereof, and leading to the various fixtures where required, as indicated by the faucet *h*. The insulating-case B (shown in Figs. 1, 2, and 3) is set aslant in the roof I of the building. The stove or range G discharges smoke and surplus heat through the stovepipe *g* into the smoke-flue F.

J indicates insulating material, such as building-paper or any suitable non-conducting material, behind the reflector within the case B.

The circulating system, consisting of the pipes E, E′, and *e* and which system connects the solar heater A B *b* C and the artificial heater G, is connected with the source of liquid-supply D by means of the receptacle of the boiler A, so that the pressure from the source of supply is maintained throughout the system.

In practical operation the heat-rays which come through the transparent portion *b* will be absorbed by the blackened boiler A, those rays which at first pass the sides of the boiler being reflected back upon the blackened sides and back of the boiler A, which readily absorbs the heat-rays to heat the water. Artificial heat being applied to the coil *e*, circulation through the circulating-pipe E and the boiler A immediately sets up and the water is thus rapidly and with great economy of fuel brought to any degree of heat that may be required. The member E′ of the pipe E leads from coil *e* up through the smoke-flue F, so that the water becomes further heated as it rises through this member, and the circulation of water through the pipes and boiler is accelerated thereby.

K indicates a faucet for drawing off any sediment which may collect in the receptacle A.

L indicates a plug, which can be removed to allow access to the interior of the boiler for introducing a hose for washing it out in case of undue deposits resulting from long use of the solar heater alone or from any other cause.

1 2 indicate the upper and lower panes of glass for the transparent top.

In Fig. 4 the case B′ is horizontal and is wide enough to contain a plurality of horizontal receptacles A′ A″, connected by a pipe *a*′, which leads from the upper part of the first receptacle A′ to the middle of the second receptacle A″. The supply-pipe D′ enters the receptacle A′, and the circulating-pipe E″ leads from the receptacle A′ and returns to the receptacle A″.

k indicates a blow-off pipe with cock K′ to draw the sediment out of the receptacle A″. It is to be understood that the circulating-pipe E″ is provided with a cock K, the same as indicated in Fig. 1 for the pipe E.

M indicates brackets or supports which hold the receptacle above the reflector, so as to allow the heat-rays to be reflected to the under side of the receptacle to heat it.

In practical operation the receptacle will be charged through the inlet-pipe D, which will furnish a constant supply of water for the system. The heat from the sun's rays passing through the transparent top and reflected from the reflector will pass through the walls of the receptacle practically on all sides thereof and will heat the water which lies next to the walls of the receptacle. The colder water at the axis of the receptacle will fall to the lower part of the receptacle, and the heated water will rise to the top of the receptacle. When heat is applied to the circulating-pipe by the artificial heater, at first the water becomes hot in the return-pipe E′ and the pipe will become very hot sensibly to the touch. The heated water will then be displaced by the colder water in the descending pipe E and will enter the top of the solar-heated receptacle, where it meets and commingles with the hot water which has risen in the receptacle under the influence of the heat of the sun's rays. The colder water passes down through the member E of the circulating-pipe and becomes heated by the artificial heater and then rises through the return member E′ and a violent circulation of the water through the circulating-pipe takes place, and the heat of the return member E′ will then for a time diminish sensibly to the touch, for the reason that the circulation is so rapid through the circulating-pipe that the water passing through the artificial heater does not

become so highly heated as was the case before the circulation had started. The colder water, passing out from the lower part of the receptacle, flows so rapidly that there is produced an appreciable stirring up and displacement of sediment which may have settled in the receptacle while the artificial heater was not in operation, so that, if desired to discharge such sediment, this may be done by opening the cock K and drawing the water directly from the descending pipe E. The water being supplied to the receptacle from the cold-water pipe will flush the lower part of the receptacle and carry the sediment out through the cock K until the sediment is all drawn off. Then the cock K will be closed. By opening the cock K the cold water is allowed to fill the descending pipe E, so that when the cock K is closed the momentum of the cold column of water will operate to accentuate the circulation through the heater. I will incidentally state here that although the artificial heater is preferably applied to the ascending member E′ of the circulating-pipe the system would be in a measure operative if the heat were to be applied to the horizontal lowest portion of the pipe which leads from the cock K, for the reason that the circulation could be started through the pipe by opening and closing the cock K, thus, as above suggested, starting the water to flowing upward through the pipe E′ from the heater. The friction of the pipes modifies the operation of the apparatus, so that when water is being withdrawn from the system through the pipe H there will be a more ready flow into pipe H directly from the upper part of the receptacle than there will be from the bottom of the receptacle through the pipes E and E′. Subject to this influence of the friction of the pipes when the faucet *h* is open it will draw from the system the water which is the most highly heated—that is to say, if the amount of water drawn through the faucet *h* is so great as to cause the water to flow past the artificial heater so rapidly that it does not become so highly heated as is the water at the top of the receptacle the circulation through the artificial heater will diminish in volume and a greater or less amount of the supply for the faucet *h* will then be drawn from the top of the receptacle until the water in the artificial heater becomes of a temperature equal to that at the top of the receptacle. Then the water would be drawn practically in equal volumes from both heaters until the water is heated more by one of the heaters than it is by the other heater, the hottest water always being withdrawn from the system. When the faucet *h* is closed, the circulation continues rapidly until the water in the receptacle becomes thoroughly heated, and then the circulation will become slower and be sufficient only to supply the heat lost by radiation.

What I claim, and desire to secure by Letters Patent of the United States, is—

1. In a water-heating apparatus, the combination of a water-receptacle; an insulating-case around such receptacle and having a transparent portion to admit the sun's rays to heat the receptacle; a circulating-pipe opening from the receptacle and extending thence outside the case, then returned upward and opening into the receptacle; and means for applying artificial heat to the return member of the circulating-pipe at a point below the solar heater.

2. In a water-heating apparatus, the combination of a water-receptacle; an insulating-case around such receptacle and having a transparent portion to admit the sun's rays to heat the receptacle, and also having a reflector arranged at the sides of said receptacle and opposite to the transparent portion to direct the heat-rays to the receptacle; a supply-pipe to discharge into the receptacle; means for drawing hot water from the system; a circulating-pipe opening from the lower part of the receptacle and extending thence outside the case, then returned upward and connected with and discharging into the upper part of the receptacle; and means for applying artificial heat to the return member of the circulating-pipe at a point below the solar heater.

3. The combination of a water-heater boiler set at an inclination and blackened upon the outside; an insulating-case inclosing the boiler and provided upon one side with a transparent portion to admit the sun's rays to heat the boiler; a supply-pipe to discharge into the lower part of the boiler; a circulating-pipe opening from the lower part of the boiler, extending thence downward and bent at a lower level and led upward and discharging into the upper part of the boiler; means for supplying artificial heat to the return member of the pipe at a lower portion thereof; and a hot-water pipe leading from the return member of the circulating-pipe near the upper part of the boiler.

4. The combination with the roof of a house, of an insulated case set aslant into the roof and having its upper side transparent; a slanting water-boiler in the case; a supply-pipe to discharge into the lower part of the boiler; a circulating-pipe opening from the lower part of the boiler, extending thence downward and bent at a lower level and led upward and bent at its upper end and discharging into the upper part of the boiler; means for applying artificial heat to the return member of the circulating-pipe at a lower portion thereof; and a hot-water pipe leading from the upper part of the boiler.

5. The combination of the roof and chimney of a house, a slanting insulated case set in the roof of the house and having its upper side transparent; a water-boiler inside the case; a smoke-flue; a supply-pipe to discharge into the lower part of the boiler; a circulating-pipe opening from the lower part of the boiler, extending thence downward outside the smoke-flue and bent at a lower level and

led upward through the smoke-flue and bent at its upper end and discharging into the upper part of the boiler; a heating appliance for heating the return member of the circulating-pipe at a lower portion thereof and arranged to discharge its surplus heat into the smoke-flue; and a hot-water pipe leading from the upper part of the boiler.

6. A water-heating system comprising a liquid-receptacle; a solar heater therefor; a circulating system connected to said receptacle; and an artificial heater located below the solar heater to heat the liquid and produce a circulation thereof through said system and receptacle.

7. A water-heating system for buildings comprising a closed receptacle arranged to absorb heat from the sun's rays and insulated to prevent the escape of heat; a cold-water-supply pipe opening into the receptacle; a hot-water-discharge pipe opening from the receptacle; a circulating-pipe leading from a lower part of the receptacle and returned to an upper part of the receptacle; and an artificial heater for heating the water in the return member of the circulating-pipe at a point below the solar heater.

8. A water-heating system for buildings, comprising the water-receptacle; means for supplying cold water to the receptacle; means for drawing heated water from the receptacle; the insulating-case around the water-receptacle and provided with a transparent portion to admit the sun's rays; reflectors arranged in the case and adapted to direct the sun's rays against the receptacle; a pipe connecting the lower end of the receptacle with an artificial heater at a point below such receptacle; such artificial heater; and a pipe connecting such artificial heater with the upper end of the receptacle; all arranged substantially as described whereby a circulation of water is induced through the pipes and receptacles when heat is applied at the artificial heater.

9. A water-heating system for buildings, comprising the water-receptacle arranged to absorb heat from the sun's rays and arranged in an insulated heat-retaining case; means for furnishing a supply of cold water to the bottom of the receptacle; means for drawing off heated water from the top of the receptacle; a pipe connecting with such receptacle at its lower end and passing downward to an artificial heater; such artificial heater; a return-pipe connecting at its lower end to the artificial heater and at its upper end to the water-re ptacle; and means for heating the return-pipe above the artificial heater, whereby a rapid circulation and heating of the water in the receptacle and system are induced.

10. In a water-heating system for buildings, the combination with a receptacle, means for supplying cold water to the receptacle, and means for drawing the heated water from the receptacle; of a solar heater to heat the receptacle; an artificial heater located lower than the solar heater and receptacle; and a circulating-pipe, the ends of which connect with the receptacle and the lower portion of which pipe passes through the artificial heater.

11. In a water-heating system for buildings, the combination with an inclined receptacle, means for supplying the receptacle with cold water, and means for drawing the heated water from the receptacle; of a solar heater to heat the receptacle; a circulating-pipe, the ends of which communicate with the upper and lower ends of the receptacle respectively; and an artificial heater to heat the circulating-pipe at a point lower than the receptacle.

12. In a water-heating system for buildings, the combination of a house provided with a flue and the roof provided with an opening; of a heater communicating with the flue; an insulating-case in the roof, the top of which is open to the sun's rays, an inclined heat-absorbing receptacle provided with an inlet, and a reflector within the case, said receptacle being provided with a supply-pipe and with a circulating-pipe the ends of which communicate with the opposite ends of the receptacle respectively and the intermediate portion of which passes through the artificial heater, and a portion of the pipe between the artificial heater and the upper end of the receptacle lying within the flue; means for supplying water to the receptacle; and means for drawing the heated water from the receptacle.

13. A water-heating system for buildings comprising a hot-water receptacle arranged to absorb heat from the sun's rays; a heater arranged at a point below the hot-water receptacle and connected with the lower part of such receptacle; means connecting the heater with the top portion of the hot-water receptacle whereby the cold water of the receptacle is heated by the heater below the receptacle, and when thus heated, is mingled with the water that has been heated by the sun's rays.

14. The combination of a water-boiler in a solar heater and having one end higher than the other; a supply-pipe to discharge near the bottom of the boiler; a circulating-pipe opening from the bottom of the boiler, led downward therefrom and there bent and returned upward and ending in the boiler at the top portion thereof to form both an inlet and an outlet for hot water; a discharge-pipe leading from the upper part of said return-pipe and provided with a valve; and a heater at the lower portion of the return portion of the circulating-pipe to heat the same above the return-bend.

15. In a solar heater, the combination of an insulating-case provided with a curved reflector, and a top provided with two parallel transparent sheets with air-space between them; a cylindrical water-boiler in the case with air-space between it and the reflector; an inlet-pipe opening into the boiler at the lower portion thereof; a circulating-pipe leading from the lower portion of the boiler, extending thence downward and bent and then

returned and opening into the upper portion of the boiler; a heater at the lower portion of the return-pipe to heat the same; and a draw-off valve connected with the return-pipe.

16. In a water-heating apparatus, the combination of a water-circuit including a water-reservoir, said reservoir located in one side of the circuit and near the top thereof; a solar heater arranged to heat the reservoir, and an artificial heater arranged to heat the water-circuit at substantially the lowest part thereof.

17. In a water-heating apparatus, the combination of a water-circuit, a solar heater in one side of said circuit and near the top thereof, an artificial heater in the other side of the circuit and near the bottom thereof, means for introducing water to the circuit at substantially the lowest part of the solar heater, and means for withdrawing the heated water at substantially the top of the circuit.

18. A source of liquid-supply, a solar water-heater, an artificial heater located below the solar heater, and a circulating system connected with the source of liquid-supply and connecting the solar and artificial heaters, substantially as described.

19. A liquid-receptacle, a solar heater therefor, a circulating system connected to said receptacle, and an artificial heater located below the solar heater to heat the liquid and produce a circulation thereof through said system and receptacle.

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Witnesses:
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