Sheet 1-3 Sheets.

A. M. Perkins.

Steam Boiler.

No. 1,768. Patented Sep. 4, 1840.

Fig. 1.

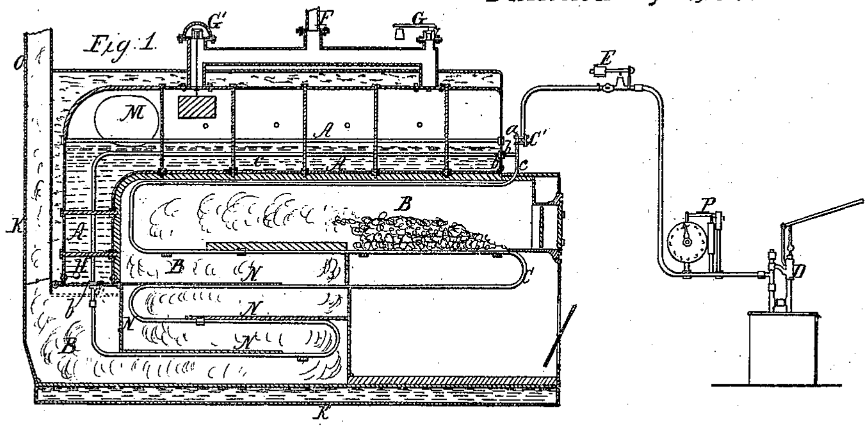


Fig. 3

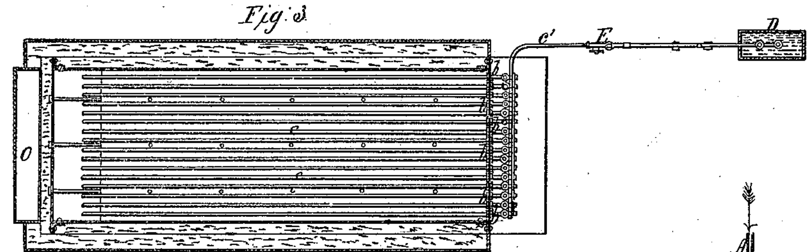


Fig. 6.

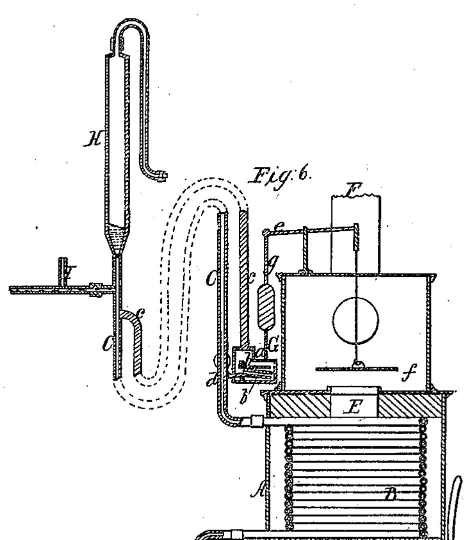


Fig. 5.

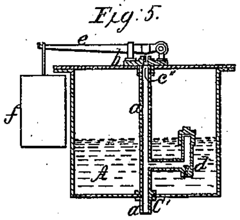


Fig. 14.

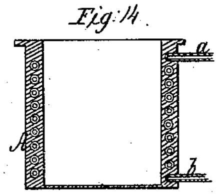
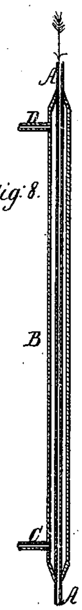


Fig. 8.



Inventor;

Angier March Perkins

N. PETERS, PHOTO-LITHOGRAPHER, WASHINGTON, D. C.

A. M. Perkins.
Steam Boiler.

No. 1,768. Patented Sep. 4, 1840.

Fig: 4.

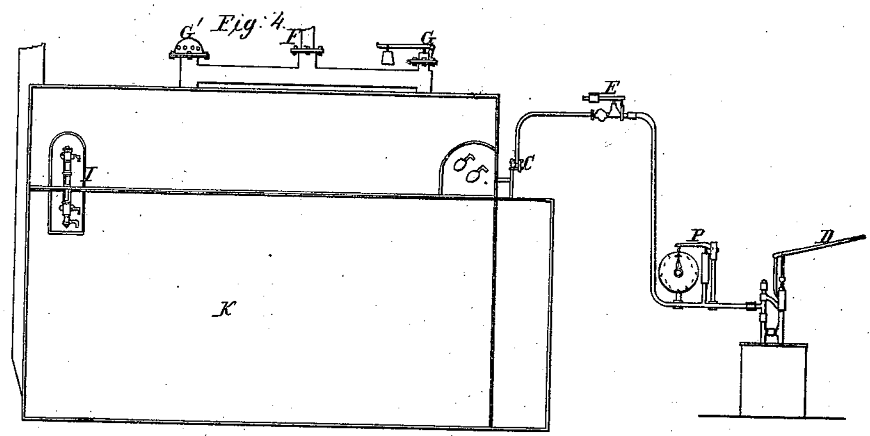


Fig: 2.

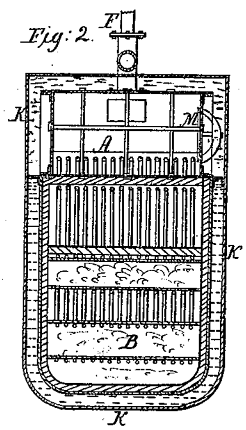


Fig: 9.

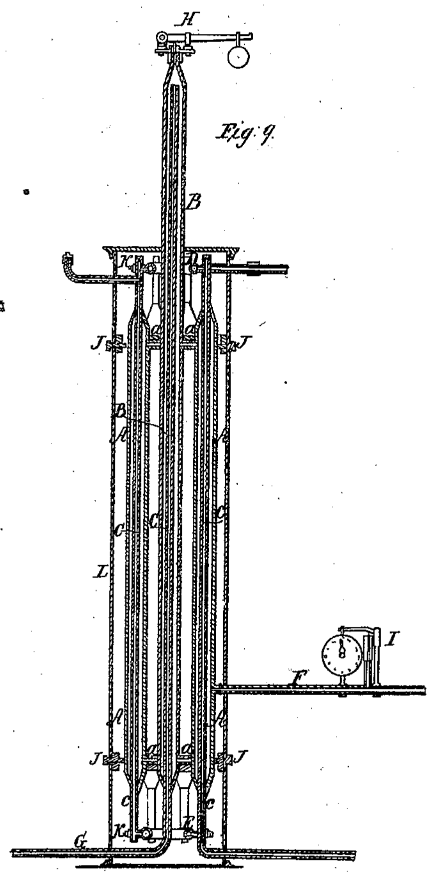
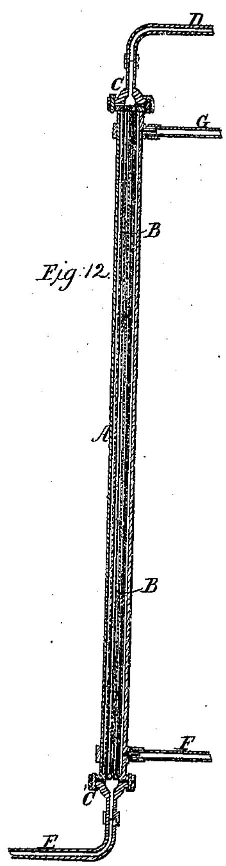


Fig. 12.



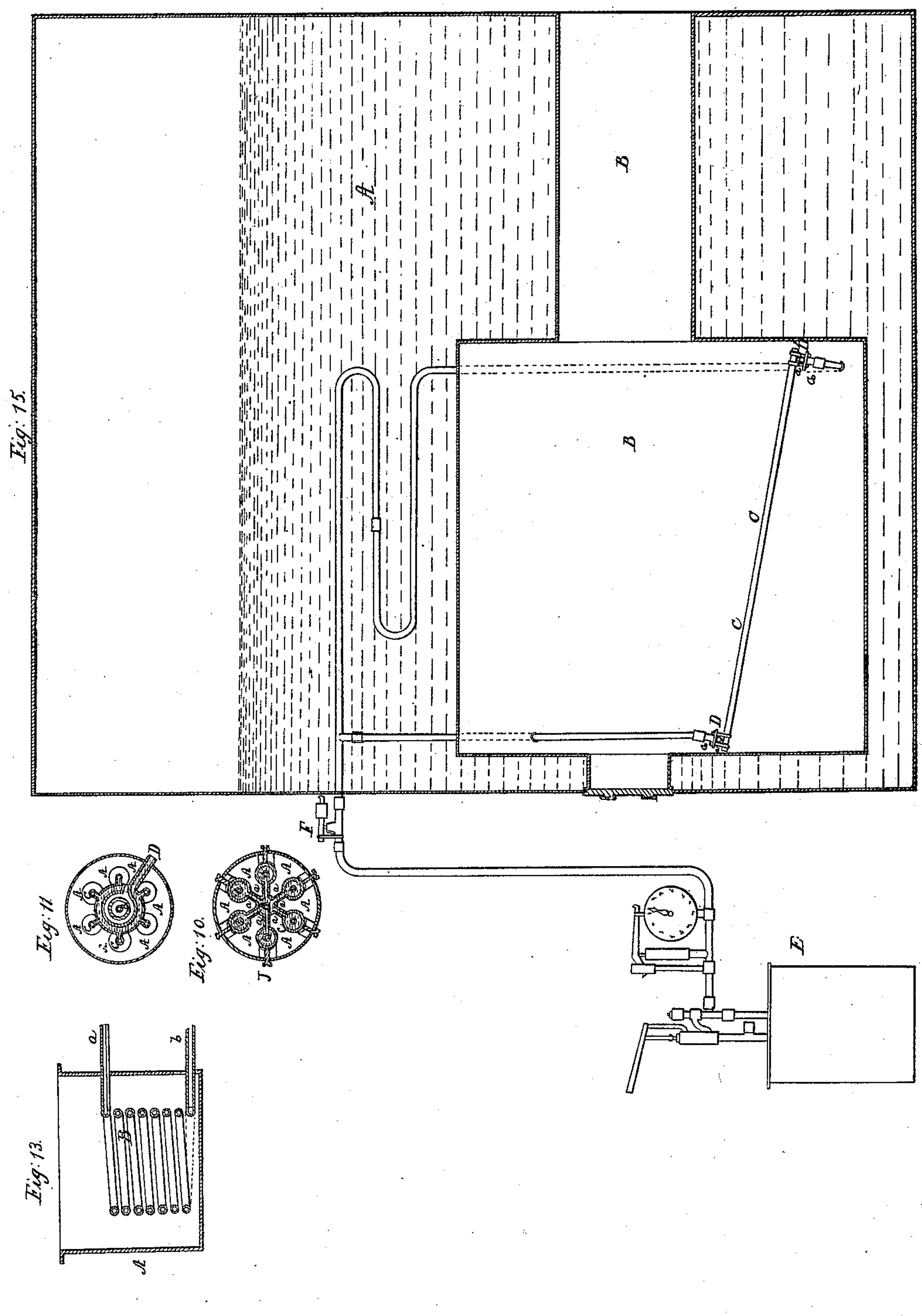
Inventor;
Angier March Perkins

Sheet 3-3 Sheets.

A. M. Perkins.

Steam Boiler.

No. 1,768. Patented Sep. 4, 1840.



Inventor;
Angier March Perkins

UNITED STATES PATENT OFFICE.

ANGIER MARCH PERKINS, OF LONDON, ENGLAND.

APPARATUS FOR GENERATING STEAM AND FOR HEATING WATER AND OTHER FLUIDS.

Specification of Letters Patent No. 1,768, dated September 4, 1840.

To all whom it may concern:

Be it known that I, Angier March Perkins, formerly of Newburg Port, in the State of Massachusetts, in the United States of America, but now residing in Great Coram street, London, in the county of Middlesex, in the Kingdom of Great Britain, engineer, have invented certain Improvements in Apparatus for Generating Steam and for Heating Water and other Fluids, the object of which invention is to render the boilers, vessels, or other receptacles containing such water or other fluids free from all deterioration, wear, and danger of explosion, as well as to abstract the heat more effectually and economically from the fire and to impart it to the aforesaid water or other fluids in such manner as to obviate the necessity of exposing the boiler, vessel, or other receptacles containing the aforesaid water or other fluids to the action of the fire; and I do hereby declare that my improvements are fully described and set forth in the following specification, reference being had to the accompanying drawings and to the letters and figures marked thereon—that is to say—

My invention consists in transmitting or transferring the heat from the fire to the aforesaid water or other fluids by means of the circulation of water in tubes closed in all parts and as Letters Patent under the seal of the United States have here-to-fore been granted to me for warming the air in buildings and also for heating water and other fluids by means of the circulation of water in tubes closed in all parts and moreover as the circulating hot water tubes which I now propose to employ are in many respects similar to those for which the aforesaid Letters Patent were granted. Now I declare that my present improvements are intended to make such addition to the aforesaid circulating hot water tubes and such alteration thereof as shall render them more fully applicable to the several purposes before mentioned.

Having thus made known the nature and objects of my invention I shall proceed to describe in detail those methods of carrying the same into effect which I have hitherto found to be most advantageous and to which I give the preference—I wish it to be distinctly understood however that it is not my intention to confine myself exclusively to the modification of my improvements herein described but I intend to make such variation in the general arrangement as circumstances may from time to time require retaining always those principles which constitute the basis of my claim as herein fully set forth.

Drawing A: Figures 1, 2, 3 and 4 exhibit the application of my improvements to a marine steam boiler of sufficient capacity to evaporate fifteen cubic feet of water per hour. The several parts are denoted by the same letters of reference in each of the several drawings. Fig. 1 is a longitudinal section through the center of the apparatus. Fig. 2 is a latitudinal or cross section. Fig. 3 is a horizontal plan at the water line. Fig. 4 is a side elevation of the whole.

A A, the boiler containing the water to be evaporated. It is placed horizontally over the furnace B and the sides of the bolier and furnace are surrounded by a double casing of iron containing water or some slow conductor of heat. Those parts of the boiler and casing which are in close proximity with the furnace and flue are protected from the action of the fire by a lining of fire clay or bricks. The boiler consists of a vessel in the form of a parallelogram having a perpendicular elongation of one fourth the length of the boiler which I shall call the water box. The boiler is strongly braced by ties in every part and thus rendered secure against internal pressure; it is furnished with safety valves, water gages and the other usual appendages of steam boilers being in these respects similar to the boilers ordinarily employed. My improvements are not limited to any peculiar shape of boiler but may be applied with more or less advantage to all boilers.

B, the furnace and flue; C C C, a series of wrought iron tubes one inch in external and one half of an inch in internal diameter which I denominate the "circulating" or "transmitting" tubes the use of which is to convey or transmit the heat from the fire in the furnace to the water in the boiler by means of the circulation of the water contained within them which water is entirely separated from and independent of that to be evaporated in the boiler. To effect this object a certain portion of the tubes is employed to abstract the heat from the fire and is disposed in and about the furnace and flue in such manner as most fully to accomplish the desired end, while another portion of the tubes is placed within the vessel containing the fluid to be heated and imparts to the fluid the heat previously acquired in the furnace. The tubes are 16 in number and are arranged horizontally and parallel to each other at the distance of one inch apart. Near the bottom of the water box they enter that part of the flue which is most distant from the fire and after rising in serpentine direction they pass under the fire and returning from the fire bars of the grate upon which the fire rests; then again returning they pass over the fire at the hottest point and emerging from the furnace enter the boiler a few inches below the water line then passing through the horizontal portion of the boiler they bend and descend through the water box and join their other respective ends in the flue.

At *a*, *a*, Fig. 1, they are joined to a cross-pipe C′ called the feed pipe, the use of which is to distribute the water equally in all the tubes thus avoiding the trouble and delay of filling each tube separately. Except at their junction with the feed pipe the several tubes have no connection or communication with each other but each maintain a circulation throughout its entire length independently of the rest. The length of each tube is fifty feet and the total length of all the tubes is eight-hundred feet being equal to a superficial surface of two hundred square feet of which one fourth part is within the boiler and the other three fourths in the furnace and flue. These proportions admit of considerable variation but they are those which I have found productive of the best effect. The ends of the tubes are joined to each other by lockets with right and left hand screws and the joints thus made are capable of resisting any pressure which the tubes will bear. The passage of the tubes through the boiler-plate is rendered tight and secure by means of the flange nuts *b*, *b*, screwed upon the tubes and closely embracing each side of the boiler-plate. D, a small force pump for supplying any deficiency of water that may occur within the tubes from leakage that being the only manner in which loss can ever take place in consequence of the tubes being completely closed in all parts. E, the expansion or safety valve. The water in the tubes when heated undergoes considerable expansion or increase in bulk. To prevent any undue pressure which such expansion would occasion within the tubes the valve E is provided. It is loaded at a pressure somewhat above that which is consequent upon the temperature at which the tubes are worked but far below that which the tubes are previously proved to be capable of sustaining; no water therefore is ever permitted to escape from this valve but that which is ejected by the increased pressure arising from the expansion before mentioned. Instead of the expansion valve E a loaded piston moving in a cylinder may be employed to open a valve and allow the water to escape; the common safety valve however from its simplicity is to be preferred. F, the steam pipe. G G′, the safety valves. H, the feed pipe for supplying the boiler with water. I, Fig. 4, the water gage. J, the gage cock. K, the double iron casing surrounding the boiler and furnace. L, the damper. M, the man hole. N, N, iron plates interposed in the flue causing the heated air and smoke to pass in the direction of the hot water tubes. O, the chimney. P, the indicator for showing the pressure.

The stationary boilers where increased size and weight are not objectionable, I intend sometimes to substitute a wall of brick work for the double iron casing, and in those cases where the boiler is allowed to cool periodically, I also intend to remove the force pump and supply the tubes with water by a self acting apparatus represented in Fig. 5. A, is a cistern the capacity of which is proportioned to the size of the apparatus; one of sufficient size to contain a gallon of water will be quite aaequate for the supply of an apparatus like that before described. *a*, *a*, *a*, continuation of the feed pipe C′ extending upward into and through the cistern A upon the top of which is screwed the valve box *b*, the feed pipe *a*, *a*, containing two valves C″ and *d*. The valve C″ is the expansion or safety valve and opens outward against the pressure of the lever *e*, caused by the weight *f*. The valve *d* is the supply valve and opens inward toward the feed pipe C′.

The apparatus having been filled with water when the action of the fire will expand the water within the tubes and create a pressure sufficient to open the valve C″ and allow the excess of water to flow out. When the tubes have arrived at their maximum temperature the water will undergo no further expansion and the valve C″ will close, no more water will then escape unless the tubes are sufficiently over heated to open the valve C″ by the pressure of steam resulting from the increased temperature of the water. When the apparatus is allowed to cool the water will contract to its original bulk and a vacancy or vacuum will be created equal in extent to the amount of water previously ejected by expansion added to that which may have escaped by leakage at the joints which vacancy will be immediately filled by water from the cistern A through the passage of the valve *d*, and the feed pipe C′. The return of the water to the cistern A when under pressure is prevented by the closing of the valve *d*.

Fig. 6 is a sectional view of a furnace for heating the hot water tubes to a high temperature for the several purposes hereinafter mentioned. A, the iron casing or covering of the furnace. B, a continuous coil of hot water pipe within which the fire is made. C, the flow pipe or pipe containing the ascending current. D, the return pipe containing the descending current. E, the stoke hole. F, the flue. G, the heat governor or regulator by means of which the temperature of the apparatus is maintained at any required degree. *a*, an iron box containing a series of multiplying levers *b*, *b*, *b*. *c*, an iron rod welded to the flow pipe and extending downward into the box *a*—*d*, a nut screwed upon the flow pipe C and in contact with the short arm of the lowest of the levers *b*, *b*, *b*. *e*, a lever from one end of which is suspended the damper *f* in the flue; from the other end the rod *g* extends downward and rests upon the long arm of the highest of the levers *b*, *b*, *b*.

When the apparatus has arrived at the required temperature the nut *d*, is screwed down until it bears upon the lever, any further increase of temperature will expand or lengthen the flow pipe C and the nut *d* by acting upon the short arm of the lever and thence through the multiplied action of the levers, *b*, *b*, *b*, will raise the rod *g* and close the damper within the flue. The check thus given to the draft will prevent any further increase of temperature. When the intensity of the fire is too low the apparatus cools and the contraction of the flow pipe C will reverse the action of the levers and open the damper. H, the expansion pipe. It is quite empty when the apparatus is cool but the water when heated undergoes considerable expansion or increase in bulk and to guard against a rupture of the tubes which would take place if the water were closely confined the expansion pipe is made more than sufficiently large to contain all the water that may be ejected by expansion. I, the pipe by which the hot water tubes are filled with water. The elevation of this tube determines the level of the water within the apparatus.

Figs. 8, 9, 10 and 11, exhibit several modifications of my apparatus as applied to generate steam of extraordinary pressure for steam guns and other purposes.

Fig. 8 represents a generator in its most simple form. A, the hot water tube being a continuation of the furnace coil. B, a large tube containing the water to be evaporated. The hot water tube is welded to the large tube of each of its ends; the hot water flows downward as indicated by the arrow and imparts its heat to the water by which it is surrounded. C, the pipe leading from the force pump by which the generator is supplied with water. D, the steam pipe.

Fig. 9 shows a combination of several such generators working together. A A, the large or exterior tubes placed perpendicularly around a center tube B of the same diameter and communicating with it both at the top and bottom by the small pipes *a*, *a*. The center tube extends several feet above the generating tubes, the part so elongated serving as a steam chamber or reservoir, while the lower part acts as a reservoir of water for the surrounding tubes. C C, the circulating hot water tubes; their upper ends are connected to the circular distributing tube D, and their lower ends to a similar tube E. The tubes D and E are severally joined to the top and bottom of the heating or furnace coil. The hot water ascends from the furnace coil to the distributing tube D and flows downward through the tubes C C into the tube E and returns to the bottom of the furnace coil. The heat of the circulating water is transmitted to the water in the generating tubes by which the tubes C C are surrounded. F, the pipe by which the generator is supplied with water. G, the steam pipe terminating near the top of the steam chamber. It is extended downward through the center tube to avoid radiation. H, the safety valve for relieving the pressure within the generator should it be accidentally filled with water the expansion of which would in such case burst the tubes. But for this contingency the safety valve would be superfluous because the temperature of the water in the generator can never exceed that of the circulating hot water but is always considerably below it. I, the indicator showing the pressure within the generator. J J, iron frame plates by which the large tubes are kept in their proper position and securely joined to the small pipes *a*, *a*. K K, similar frame plates by which the hot water tubes C C are joined to the circular distributing tubes D and E. L, the iron casing or covering of the generator.

Fig. 10 a horizontal sectional plan of the iron frame plates J, J, showing the large tubes A A, the center tube B, the hot water tubes C C and the connecting pipes *a*, *a*.

Fig. 11, a horizontal sectional plan of the frame plates showing the hot water tubes C C, the center tube B, and one of the distributing tubes D E.

Fig. 12 is a sectional view of another modification in which several small hot water tubes are inclosed in a large tube or generator. A, the exterior tube. B B, small wrought iron tubes the ends of which are welded to the ends of the exterior tube. C C′, caps screwed upon the ends of the generator forming a connection between the small tubes and the two pipes D and E which are continuations of the furnace coil. The hot water ascends through the pipe D into the cap or chamber C and flows downward through the small tubes B B into the lower cap C′ from whence it is conveyed by the pipe E to the bottom of the furnace coil.

The water to be evaporated is contained in the large tube and is heated by its contact with the small or hot water tubes. F, the pipe which supplies the generator with water. G, the steam pipe.

Figs. 13 and 14 are sectional views of my apparatus as applied to heat, tar, pitch, turpentine, &c.

Fig. 13 is a modification in which the substance to be heated is in immediate contact with the hot water tubes. A, the vessel or receptacle containing the substance to be heated. B, a coil of hot water tubes immersed in the liquid; the end *a* is continued to the top and the end *b* to the bottom of the furnace coil.

Fig. 14 is another arrangement for heating substances which do not admit of contact with iron. A, the vessels or kettle of brass, copper, tin or other metal. B, a hot water coil cast or embedded in the sides or circumference of the kettle. The two ends *a* and *b* are continued to the furnace coil. The heat of the water is imparted to the metal by which the tubes are surrounded and thence to the fluid which is in contact with the sides of the kettle.

In certain cases I intend to use the circulating hot water tubes as fire bars without extending them farther than may be necessary to abstract the heat which they have acquired by contact with the fire; and I intend to apply such fire bars to steam boilers of any construction which are already erected, and also to all other furnaces which are used for heating fluids or are in connection with facilities which admit of the abstraction of the heat from the tubes.

Drawing B: Fig. 15 shows the application of the hot water tubes as fire bars to a marine steam boiler. A, the boiler. B, the furnace and flue. C C, a series of hot water tubes arranged parallel to each other with the usual air space between them the width of which is determined by the nature of the fuel to be consumed. D D′, cross tubes to which the fire tubes C C are connected by the small cones *a*, *a*. The ends of the cross tube D are bent upward and continued into the boiler, then descending circuitously they leave it near its lowest part and joint the ends of the cross tube D′. E, the force pump by which the water is supplied to the cross tube D. F, the expansion or safety valve. G G″, iron straps by which the tubes C C are kept in their proper position, and securely joined to the cones *a*, *a*. The hot water tubes or fire bars C C are constantly kept at a low temperature by the circulation of the water which when heated ascends by the cross tube D into the boiler and having imparted its heat to the surrounding water descends to the cross pipe D′.

The circulation of the hot water which takes place in each of the foregoing applications of hot water tubes arises from a well known principle and is similar to that which takes place in the apparatus for warming buildings before alluded to and which has been made the subject of a previous patent. That portion of the water contained in the tubes which are exposed to the action of the fire acquires an increase of temperature and its specific gravity being thereby lessened it ascends by its superior levity while that portion which is employed to transmit the heat thus acquired to the water or other fluid acquires increased density as it parts with its heat and descends by its superior gravity to take the place of the lighter or ascending current.

It is desirable in all cases so to arrange the tubes within the boiler, generator or other vessel as to cause the hot water current to flow downward through the surrounding fluid and impart its excess of heat as far as practicable to the upper surface of the fluid. In vessels of great height and small lateral capacity like the water box of the boiler Fig. 1, and the generators Figs. 8, 9, and 12, the hot water current by descending through water of a constantly decreasing temperature will part with the whole of its heat and leave the bottom of such vessel at a temperature no greater than that of the water by which the vessel is supplied. This entire transmission or transference of heat however cannot take place except in those cases where the lower extremity of the vessel is constantly supplied with cold water to make good the deficiency occasioned by evaporation at the surface and consequently when the water or other fluid is intended to remain for a long time stationary or unchanged so that the whole mass will become equally heated little benefit can result from the downward current. Another advantage attending such an arrangement is that in steam generators of small capacity no priming or over flow of water will ever occur however hot the tubes may be. It is also desirable to reduce as low as possible the temperature of the smoke and heated air before allowing it to enter the chimney by causing it to pass in an opposite direction to that of the hot water current so that after leaving the fire it may at first come in contact with the highly heated tubes and lastly with the colder tubes near the bottom of the apparatus. It is by due attention to this facility which my apparatus affords of reducing the temperature both of the descending hot water current and the smoke and heated air to a point much below that of the steam or of the upper part of the water or fluid that one of its advantages is realized.

I claim as new, the following parts of the apparatus described in the foregoing specification, viz.

1. The combining of a force pump with the circulating tubes arranged and combined as set forth closed in all parts, as herein described, excepting in that for the admission of water from said pump.

2. The supplying the tubes with water by means of a valve opening inward, within a cistern constructed and operating substantially in the manner of that represented in Fig. 5, and herein described; the water being thereby allowed to enter said tubes by its own gravity or by atmospheric pressure, whenever a deficiency arises from either of the causes within enumerated.

3. The combining with said apparatus, what I have denominated the expansion, or safety valve, for allowing a portion of water to flow out of the tubes when expanded by heat.

4. The employment of a portion of the circulating tubes of my system of closed tubes, to constitute fire bars as set forth; not intending to claim as my invention, the using of hollow fire bars, communicating with a steam boiler, this having been before done.

5. The manner of using the expansion and contraction of one of the hot water tubes, in combination with my system of circulating tubes, as a heat governor, or regulator, whereby the fire is kept at any required degree of intensity, and the tubes at any required temperature.

ANGIER MARCH PERKINS.

Witnesses:
WILLIAM HEATH,
JOSEPH NASON.