(No Model.) 2 Sheets—Sheet 1.

D. W. FLETCHER.

STEAM GENERATOR.

No. 418,117. Patented Dec. 24, 1889.

Fig. I.

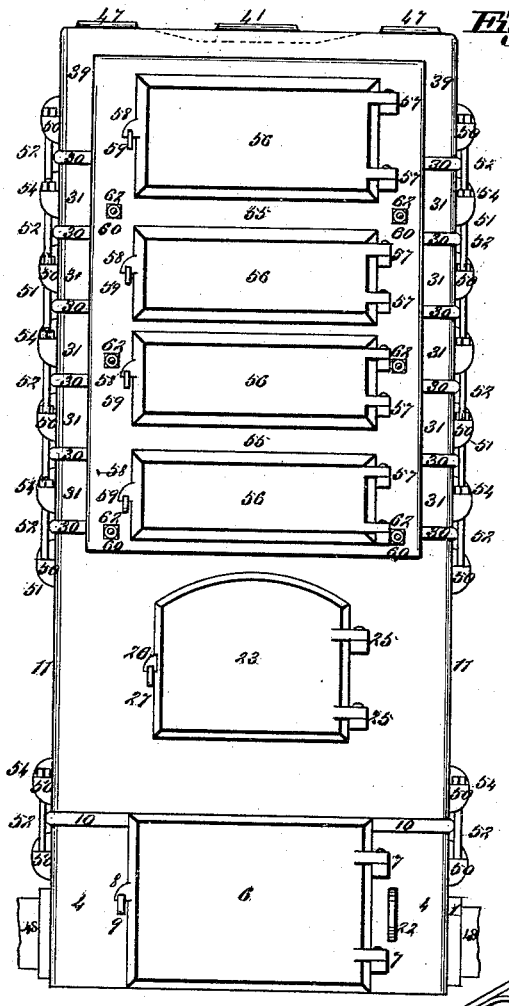


Fig. II.

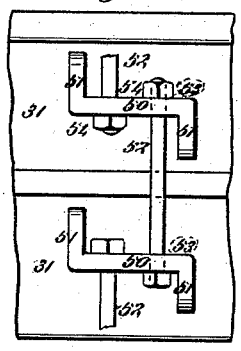


Fig. III.

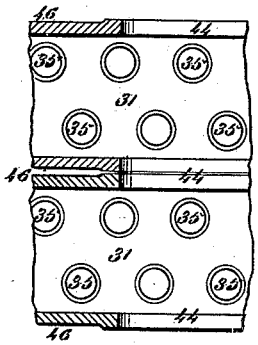
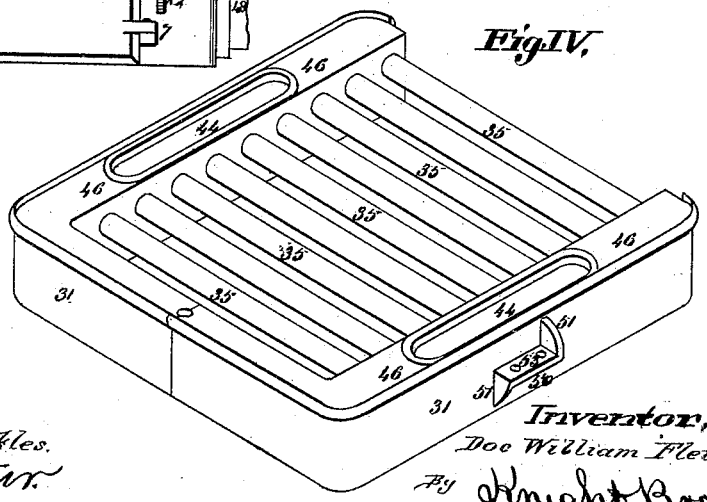


Fig. IV.



Attest;
Charles Pickles.
E. Arthur.

Inventor;
Doo William Fletcher.
By Knight Bros.
Attys.

(No Model.) 2 Sheets—Sheet 2.

D. W. FLETCHER.

STEAM GENERATOR.

No. 418,117. Patented Dec. 24, 1889.

Fig. V.

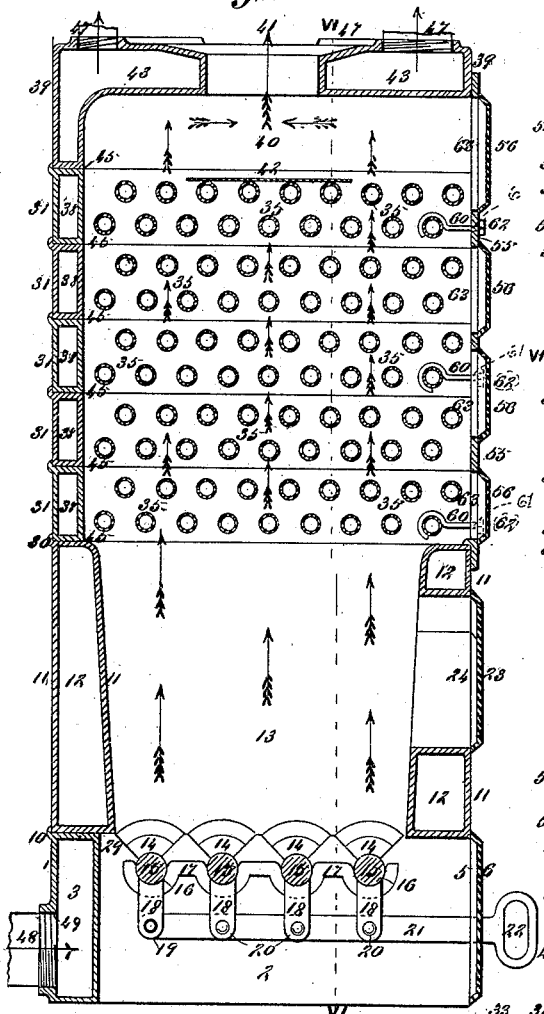


Fig. VI.

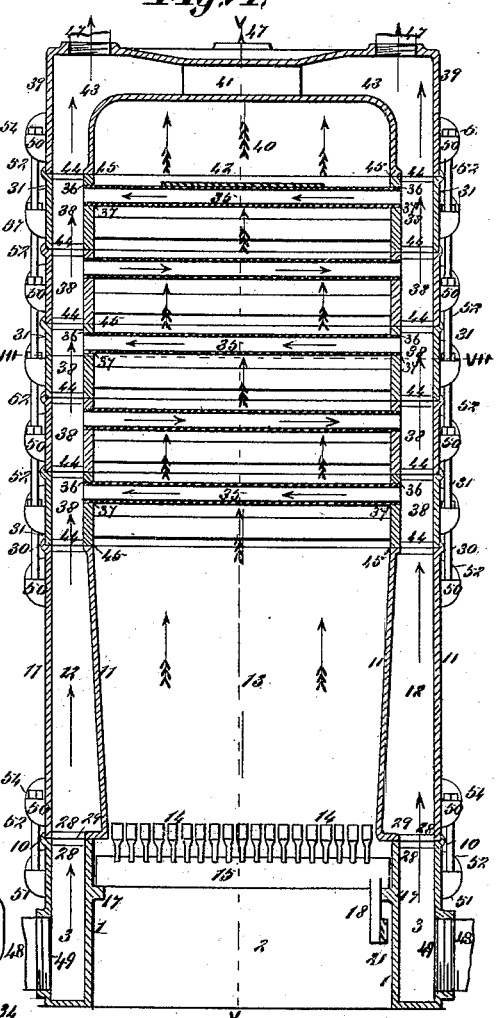


Fig. VII.

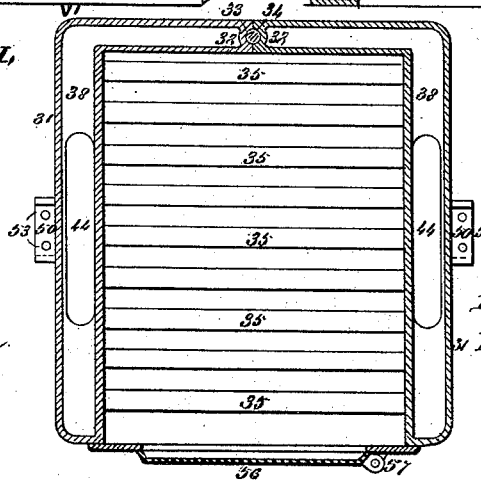
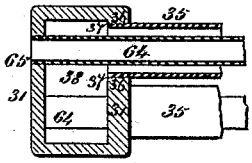


Fig. VIII.



Attest;
Charles Priffles.
E. Arthur.

Inventor;
Doc William Fletcher.
By Knight Bros.
Atty's.

UNITED STATES PATENT OFFICE.

DOC. WILLIAM FLETCHER, OF ST. LOUIS, MISSOURI, ASSIGNOR OF ONE-FOURTH TO WALTER RODGERS FLETCHER, OF SAME PLACE

STEAM-GENERATOR.

SPECIFICATION forming part of Letters Patent No. 418,117, dated December 24, 1889.

Application filed April 1, 1889. Serial No. 305,540. (No model.)

To all whom it may concern:

Be it known that I, DOC. WILLIAM FLETCHER, of the city of St. Louis, in the State of Missouri, have invented a certain new and useful Improvement in Steam-Generators or Water-Heaters, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings, forming part of this specification.

This invention relates to devices for the economic heating of water and generation of steam, so as advantageously to utilize the products of combustion from the furnace with a maximum of heating-surface in the tubes as compared with a minimum of space in which they are located; and the invention consists in features of novelty hereinafter fully described, and pointed out in the claims.

Figure I is an elevation of one of my steam-generators or water-heaters, and shows its outer sectional construction, the fire-box coupled to the basement-box that incloses the ash-pit, and the series of surmounting headers that carry the heating-tubes with their individual bolted attachments. Fig. II is an enlarged detail of two adjoining sections of the headers, and shows the means by which they are secured together. Fig. III is an enlarged detail vertical section of two adjoining headers, and shows the intercommunicating passage between the headers. Fig. IV is a perspective view of one section of the headers and its attached tubes, constituted of the duplicate right and left hand moieties of the header, secured together by the heating-tubes. Fig. V is a vertical section taken on line V V, Fig. VI, and shows the furnace surmounted by the tubes and the ascent of the products of combustion among the tubes, and shows the return-pipe which returns the supply of water for reheating. Fig. VI is a vertical section taken on line VI VI, Fig. V, and shows the water-jacket that cools the furnace-plates and utilizes the heat thereof and the course of the water and steam through the headers and tubes in the course of heating. Fig. VII is a horizontal section taken on line VII VII, Fig. VI, and shows the intercommunication of the headers and tubes; and Fig. VIII is a detail of a modification in which central flues are inserted within the hot-water or steam tubes for radiating purposes.

Referring to the drawings, 1 represents the double-wall cast boxing which incloses the two sides and back of the ash-pit 2. The inner and outer walls of said boxing are united at top and bottom by the same casting and stand sufficiently apart to inclose or constitute a water-jacket 3. The front plate 4, that connects said boxing on the remaining side of the ash-pit, is also cast integral therewith, and a doorway 5 in the center, which gives access to the ash-pit, is provided with a door 6, which is hung by the hinges 7 to said front plate, and is fastened to the same, when closed, by the latch 8, which engages with the catch 9, and said door is arranged to open to clean out the ashes, and may be opened or left ajar when it is desired to increase the draft through the combustion-chamber.

The above-described base is seated on any suitable foundation, and is furnished with a surmounting fender flange-rim 10, within which and resting on the top of the water-jacket boxing which incloses the ash-pit is a similar cast-iron boxing 11, which contains the water-jacket 12, that surrounds the combustion-chamber or fire-box 13. The said water-jacket boxing 11, which surrounds the combustion-chamber, except at the doorway, is of similar construction to that which incloses the ash-pit, except that it is located on all four sides of the combustion-chamber, and is preferably made more roomy, especially at bottom. It extends from about the level of the rocking grate-bars 14 to the top of the combustion-chamber.

The rocking grate-bars surmount the rock-bars 15, that have rocker-bearings 16 in the corrugated flange 17, which projects internally from the cast water-jacket boxing that incloses the ash-pit. Pendent arms 18, preferably cast integral with said rocker-bars, are attached at their lower ends, through perforations 19 therein, by pivot-bolts 20, to the operative shaker-bar 21, that is provided with a handle 22, that projects outwardly from the ash-pit through the front plate, which handle is conveniently located for the fireman to handle when he requires to shake the grate-bars and work down the ashes.

23 represents the feed-door of the fire-box or combustion-chamber for closing the feed-opening 24, through which fuel is introduced

into said combustion-chamber. 25 are the hinges on which said door is hung. 26 is the latch, and 27 the catch, which together form the fastening of said door.

28 represents open ports in the head of the cast water-jacket boxing that incloses the ash-pit and similar open ports in the bottom of the surmounting water-jacket that incloses the combustion-chamber. The said open ports register together and form intercommunicating channels, through which the rarefied heated water ascends. A layer of asbestus paper, stove-putty, or other fire-proof packing 29 is inserted between the contact parts of the castings around said open ports, so as to form a gasket to tighten the joint.

30 represents a flange fender-rim, that surmounts the cast boxing of the water-jacket 12, within which fender and resting on top of the casting that incloses the said water-jacket is the first or lowest lay-section of a series of cast box-headers 31, which inclose the hot-water and steam chambers 38, of which I show five in a vertical series, respectively surmounting and underlying each other; but the number may be increased or diminished, according to the exigencies of the case.

Each lay-section of the headers is made in double duplicate section, as shown in Figs. IV and VII, and when put together they form coadjutant right and left hand sections, that surmount the water-jacket that incloses the fire-box or combustion-chamber. Each moiety or semi-section of said lay-section that composes one of the series of surmounting sections has a junction water-tight partition 32, which individual partitions, when fitted together, are keyed in coincident registry by a packing column or core of asbestus 33 or other incombustible material, that is rammed down within the tubular opening 34, which is conjointly formed in both partitions.

35 represents intercommunicatory hot-water or steam tubes, which preferably are provided, respectively, with right-hand peripheral screws at one end and left-hand ones at the other end, both numbered 36. These screws are presented, respectively, to the correspondent perforate screws 37, opposite or facing each other in, respectively, the right and left hand semi-sections of the box-headers. The said perforate screw-seats in the box-headers and the screw-tapped tubes seated therein are preferably placed in two tiers in said headers, as shown in Figs. III, V, VI, and VIII, and are placed staggering, as shown in Figs. III and V; but, while I prefer such disposition of the tubes, for reasons that will be hereinafter specified, yet I do not confine myself to said disposition of the tubes, for they may, if desired, be placed in regular vertical line above each other, and the headers may also each only carry a single series of tubes, although, as stated, two series of tubes to each section of headers are preferred, as it reduces by one-half the number of headers and their attachments. Now it is evident one of the main reasons for casting the box-headers in semi-divisions is to enable the sufficient separation of said sections to screw the tubes into their respective seats therein. The tubes are screwed up in the headers until the right and left hand sections are brought into position and the joint behind at the junction partition 32 is brought tight home. Then, as stated, the tubular opening 34 is ram-packed with asbestus or other incombustible material, which keys the semi-sections of said headers together. In thus ram-packing the said tubular opening (except in the top one) I prefer to leave the upper part of said opening unfilled until packing the registering-opening of the next section of the headers, so as to provide a binding-core connecting the sections.

The insertion and ramming of the asbestus core may, if preferred, be deferred until the series of headers have all been placed and securely bolted in position, as hereinafter described.

I prefer, as stated, to screw-seat the hot-water or steam tubes in the box-headers, but do not confine myself to that means of attachment, for they may be expanded in their seats as flues are frequently expanded in boiler-heads.

Having described one section of the headers and their attached tubes and indicated the numbers by which the individual parts are defined, the said description and indication describe and indicate the parts of each surmounting section with its attachments.

39 represents a header-dome, whose hot-water and steam jacket 43 forms distributing-heads, as hereinafter described. The said dome surmounts the box-headers 31, whose sections carry the intercommunicatory tubes 35. This dome incloses the exhaust hot-air chamber 40 above the combustion-chamber and discharges said exhaust, when fully utilized, with the small remnant of unconsumed smoke, through the chimney-flue 41.

A buffer-plate 42, that rests on the central ones of the top tier of tubes, prevents the too rapid escape of the exhaust products of combustion, diverting their passage from the direct course toward the chimney-flue and guiding them against and under the hot-water and steam chambers 43, which, as a water-jacket, inclose and surmount the hot-air chamber 40.

44 represents open ports through the castings from the water-jackets 12, that surmount the combustion-chamber, into the hot-water and steam chamber 38 within the first section of the headers, and the same number 44 represents like succeeding open ports that connect said chambers of each underlying header with those of the one that surmounts it, and also alike connects said chambers of the topmost section with the hot-water and steam chambers 43 within the header-dome 39. Fender flange-rims, like that which rises from the fire-box and alike numbered 30, surmount

each header-section and bead in the section above of the headers 31 and at the top joint-bead in the header-dome 39.

Gaskets 45, of asbestus paper, stove-putty, or other suitable fire-proof material, provide water and steam tight joints around the open ports 44 between the castings and recessed surfaces 46 in the adjacent surfaces of the headers above and below, except immediately close to and around the open ports, and prevent the intrusion of said surfaces, that might otherwise interfere with the tightness of the joint around said open ports.

47 represents hot-water or steam pipes or flues that carry the heated water or steam (as the case may be) from the distributing-head 39, that distributes the heated products to any locations to which they are to be supplied—it may be to the kitchen, wash-room, laundry, scullery, bath-room, bed-chamber, or throughout a factory or any other location in which the hot water or steam products are required to be supplied—either for the direct use of the water for washing and other purposes or the steam for power in running motors, &c.; or the products may be for indirect use for the distribution of caloric by radiators.

The distributing pipes or flues may be made of different diameters, as shown, for instance, with two-flow, three-flow, or four-flow pipe, as the case may require, (the said pipes being then respectively of two, three, and four inch diameter,) the size of the pipes being increased or diminished according to the number of branch pipes that are tapped into them and the consequent product that they have to supply. The said distributing-pipes discharge their overplus or exhaust of water or condensed steam into the return-pipe 48, the forward lower end of which, being screw-tapped, engages in a water and steam tight joint in the screw-tapped open port 49 in the cast boxing 1 of the water-jacket 3, which partially incloses the ash-pit. It will thus be seen that the circuit is completed, the rarefied hot water constantly ascending and being conveyed by the various distributing-pipes throughout the building, and the cooled or partially-cooled water descending through the return-pipes, as also the condensed steam, from which return-pipes it is redelivered into the water-jacket 3, where it again commences the initial process of heating, that rapidly progresses as the water ascends through the water-jacket that incloses the combustion-chamber, from that through the series of headers, passing, as the plain shafted arrows indicate, through the tubes from one side of the headers to the other, and as it passes through said tubes the products of combustion rising from the fire-box or combustion-chamber lap around the tubes and quickly heat the water. As said products of combustion reach the tops of the uppermost tubes they are diverted from a direct central course toward the chimney-flue, toward which the flue-draft would otherwise rapidly draw them by the intervention of the buffer-plate 42, which lies or is secured on top of the pipes just beneath the chimney-flue. This buffer-plate causes the heated air, as it enters the header-dome, to curve around in close contact with the sides and overarching water-jacket that incloses the exhaust hot-air chamber within the dome, so as to utilize to the best advantage the remaining heat therein and to prevent its too rapid escape up the chimney-flue with its work not fully accomplished.

When it is desired to use the device as a steam-generator, the feed-water is reduced to the required quantity.

50 represents zigzag lugs that are cast on the ends and project externally from the ash-pit boxing, the fire-box, the sectional headers, and the header-dome on each side, respectively, of their joint-junctions. The attaching portions of the lugs run horizontally, respectively, above and below the coupling-joints of the castings that are to be connected. The lugs have a downwardly-projecting brace-arm 51 at one end and an upwardly-projecting brace-arm, also 51, at the other end, and the lugs are connected by two screw-tapped bolts 52 in each case, that pass through perforations 53 in the lugs, and when the screw-nuts 54 are turned home on the bolts the sections of the castings are held very firmly together, both by said bolts and by the fenders, which in each case rise from the underlying casting and bead in the surmounting casting.

55 represents a flat cast plate, which, with the doors 56, hung on hinges 57, and latches 58, that engage in catches 59, closes in the open space in front of the headers and dome, and said plate is held to its seat by hook-bolts 60, that pass through and are seated in perforations 61 in the plate, and the hooks engage around and are held by the nearest of the adjacent heating-tubes. The bolts are preferably screw-tapped on the outer ends, and screw-nuts 62 are turned into engagement thereon until the front plate is tightly secured in place. When it is desired to clean off the pipes or flues, also the headers and dome-chamber, the doors 56 are opened and a clear passage to said parts is thus obtained.

In Fig. VIII is shown a modification, in which the tubes 35 are constructed of somewhat larger diameter, and central flues 64 are run longitudinally through their centers and through perforations 65 in the header-castings for the purpose of heating air for radiator purposes. When these central flues are used, it is preferred that they, unlike the water and steam pipes, all receive on one side the header and all discharge on the other side, and on the discharge side a conveying-chamber may be constructed outside said header, leading into a distributing-dome, from which the hot air is taken by flues to one or more registers.

The water may be supplied by any suit-

able means. No novelty is claimed in the means of supplying the water or in the special form of the connecting-pipes that complete the circuit from the distributing to the return pipes.

The tubes 35 are inserted in the headers in a double row or tier in each section of the headers, the tubes in one row being placed in a staggering position, respectively, to those in the other, and said staggering location is respectively maintained throughout all the rows secured in the surmounting sections of the headers for a threefold reason, viz:

First. Economy of space is secured, for by staggering the location of the tubes more tubes can be accommodated within a given space without stifling the movement of the hot air, for it is evident that if the same number of tubes were located in the same space in vertical tiers, their maximum diameters being on that line, they would come nearer into conjunction than when staggered, and would form a lateral buffer (so to speak) that would exercise an adverse influence on the pulsating movement of the products of combustion.

Second. The hot air in its rapid ascent drives forcibly against and sweeps around the staggering-tubes, instead of, as when said tubes are placed in a vertical line with each other, merely or mostly sweeping past said tubes.

Third. While the movement of the hot air is not stifled, as it would in a measure be if the same number of tubes were placed in vertical line in the same space, yet the products of combustion have a much longer road to travel, for they have to stagger as do the tubes, and, as they wind around them, distribute their caloric both to the tubes and through them to the water or steam that is passing through them, as they embrace said tubes much more effectually for the transmission of heat than when they merely pass alongside the same.

It is evident that the interchangeable rarefaction by heat and condensation by cooling of the water and steam, as heretofore described, effectually produce the moving circuit of the products.

I have shown and described the headers 31 constructed in right and left hand sections, which sections are connected by the tubes 35, which is my preferred form of construction for various reasons, among which is the avoidance of warping and springing of the headers and the convenient handling in shipping and setting up; but I do not confine myself to that mode of construction, for said right and left hand sections and the intercommunicatory tubes 25 may be cast integral together. Also, although I have shown and described each of the individual series of surmounting headers carrying two tiers of tubes, yet they may be constructed with one tier each, and also the tubes, which I generally prefer to place vertically staggering, may be placed in straight vertical line, if it is so desired.

I have described the boxings of the ash-pit, combustion-chamber headers, and dome as cast, as they are preferably cast, of steel, iron, or brass; but I do not confine myself to cast material, as they may be made of sheet or wrought metal of any suitable description.

I claim as my invention—

1. In a steam generator or water-heater, the combination of the headers 31, that inclose hot-water and steam chambers 38, the said headers being coupled in right and left hand sections, the tubes 35, that connect said sections of the headers and connect said chambers 38 that they inclose, and the asbestus or fire-proof core 33, that keys the junction of the right and left hand sections of the headers, substantially as described, and for the purpose set forth.

2. In a steam-generator or water-heater, the combination of the headers 31, made in duplicate right and left hand sections that inclose the hot-water and steam chambers 38, the staggered tubes that connect said sections, the said connected right and left hand sections of the headers, and the staggered tubes they carry being placed and connected in a vertical sectional series underlying and surmounting each other, substantially as described, and for the purpose set forth.

3. In a steam-generator or water-heater, the combination of the boxing 1, that incloses the water-jacket 3, and within which is the ash-pit 2, the boxing 11 of the fire-box, that incloses the water-jacket 12 and the combustion-chamber 13, the flanged fender 10, that surmounts the ash-pit boxing and heads in the fire-box, the series of sectional headers 31, that inclose hot-water and steam chambers 38, the staggered tubes 35, that connect the sections of said headers and said chambers, the header-dome provided with the hot-water and steam distributing chamber 43, the fender-flanges 30, that surmount said fire-box and said headers and bead in the bases of the surmounting headers and dome, the zigzag lugs 50 above and below the joints of the surmounting sections, and the screw-tapped bolts 52, that couple said lugs and said adjoining box-sections together, all the boxings and headers that inclose said water-jackets and hot-water and steam chambers being provided with open ports through which the water and steam intercommunicate between the water jackets and chambers, and the gaskets that tighten the joints around said open ports, substantially as described, and for the purpose set forth.

DOC. WILLIAM FLETCHER.

In presence of—
BENJN. A. KNIGHT,
SAML. KNIGHT.