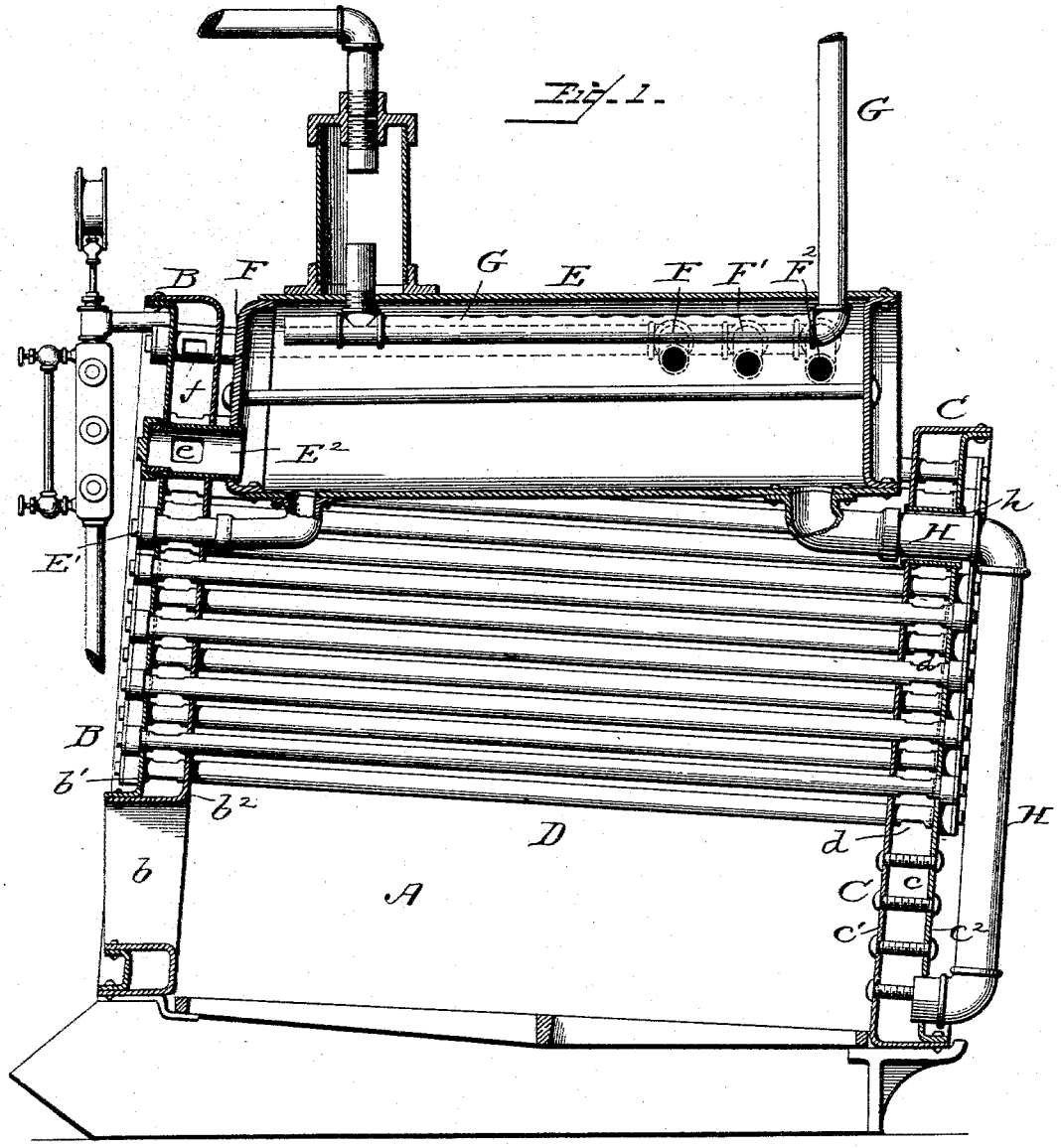
(No Model.) 2 Sheets—Sheet 1.

D. P. McQUEEN.

STEAM BOILER.

No. 490,303. Patented Jan. 24, 1893.



Witnesses
Wm. H. Sheiden.
Baltus De Long.

Inventor
Daniel P. McQueen.
By his Attorneys
Baldwin Davidson & Wright

(No Model.) 2 Sheets—Sheet 2.

D. P. McQUEEN.

STEAM BOILER.

No. 490,303. Patented Jan. 24, 1893.

Fig. 2.

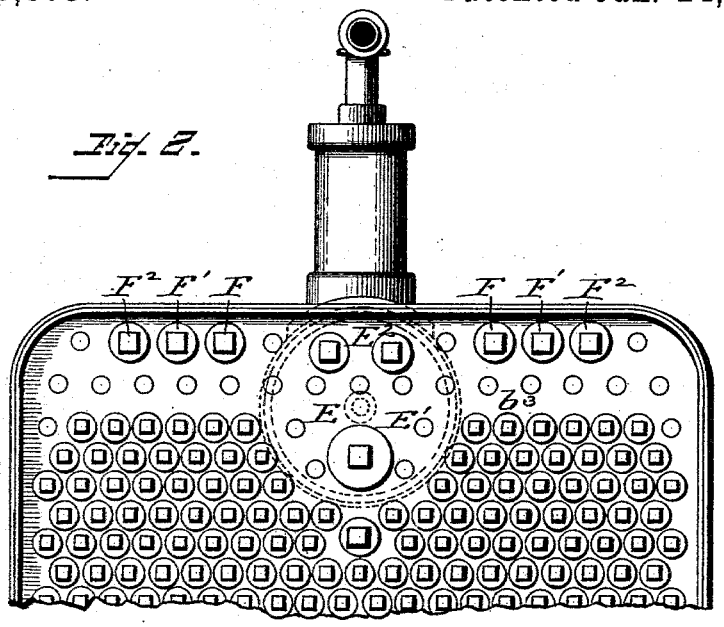


Fig. 3.

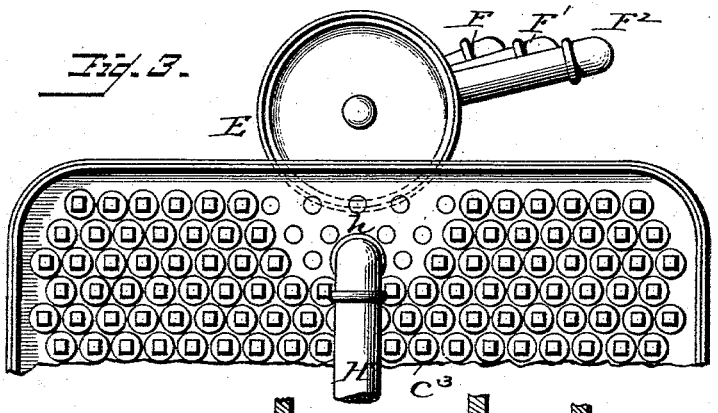
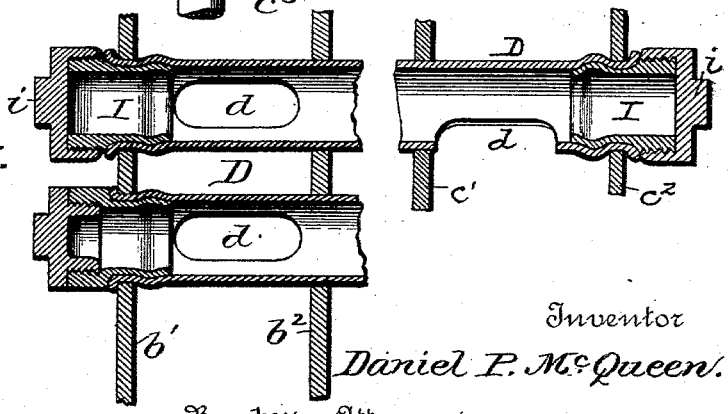


Fig. 4.



Witnesses
W. Dwight Sheldon
Baltus & Long.

Inventor
Daniel P. McQueen.
By his Attorneys
Baldwin Davidson & Wright

UNITED STATES PATENT OFFICE.

DANIEL P. McQUEEN, OF SCHENECTADY, NEW YORK.

STEAM-BOILER.

SPECIFICATION forming part of Letters Patent No. 490,303, dated January 24, 1893.

Application filed June 13, 1892. Serial No. 436,538. (No model.)

To all whom it may concern:

Be it known that I, DANIEL P. McQUEEN, a citizen of the United States, residing in the city and county of Schenectady, in the State of New York, have invented certain new and useful Improvements in Steam-Boilers, of which the following is a specification.

My invention more especially relates to locomotive boilers, so called, having horizontal or slightly inclined water-tubes in the fire-box, communicating with water-legs, in turn connected with the steam-drum by water-circulating pipes terminating at different levels to promote circulation.

The objects of my invention are to secure free entrance of the water from the boiler-shell, water-box or legs into the water-space of the steam-drum; and of the steam from the upper part of the boiler-shell or water-box to the steam-space of the drum; to prevent the expansion of the downflow pipe from racking or straining the water-legs or heads, and finally to obtain a secure and tight expansion joint between the water-tubes and the tube-sheets through which they pass. These ends I attain by certain novel constructions, combinations and organizations of instrumentalities hereinafter specified.

In order to carry out the objects of my invention in the best way now known to me, I connect the boiler-shell, water-legs or water-space of the front or firing end of a boiler with the lower part of a steam-drum or drums by laterally-perforated pipes passing tightly through the tube-sheets, so as to permit the water in the boiler-shell, legs or water-box to pass freely into the steam-drum. Similar pipes connect the upper part of the boiler-shell, water-box or legs with the steam-space of the drum, passing outside of the drum toward its back, and entering it at different points. These steam and water pipes are connected with the tube sheets and boiler by expanding the pipes into close contact with the edges of the boiler through which they pass, and expanding a capped ferrule inside each pipe. A downflow pipe or pipes passes from the lower rear end of the steam-drum through a sleeve in the rear boiler-shell, water-box or leg, and downwardly outside the fire-box, terminating in the water-leg at or near its bottom. This prevents the racking or straining of the tube-sheets of the water-leg, and insures quick circulation of the water.

The accompanying drawings show so much of my improved boiler as is necessary to illustrate the subject-matter herein claimed. Unless otherwise stated, the parts are of usual approved construction.

Figure 1 represents a vertical, central, longitudinal section through the apparatus; Fig. 2, an elevation of the upper part of the front tube-sheet; Fig. 3, an elevation of the corresponding back parts, and Fig. 4, a detail, longitudinal, sectional view, showing the expansion-joints between the tubes and sheets.

The fire-box A, is surrounded by the usual water-jacket. The front-head B, is provided with fire-doors *b*. This head and the back one C, are braced whenever expedient by through-bolts *c*, but are mainly strengthened by numerous water-tubes D, passing through and fitting holes in the tube-sheets b', b^2, c', c^2, of both heads, by means of expansion-joints, and closed by caps b^3, c^3. These tubes connect with the water-spaces of the front and rear heads or legs by lateral openings *d*. The water-tubes are shown as arranged longitudinally in the upper portion of the fire-box, and as inclined slightly upward from rear to front.

A steam-drum E, is shown as supported over the fire-box, inclining slightly upward and backward; so that while its front end is inside of the front water-box or head, and the upper surfaces of both box and drum lie at about the same level (see Figs. 1 and 2) its rear end is inside of, but projects partly above the top of the rear box or head C. The boxes and drums not being directly connected except by the pipes, are free to contract and expand without injury to each other. The front-head and lower front end of the steam-drum are connected by laterally-perforated water-pipes E', E^2, passing through expansion-joints in the tube-sheets and boiler to accommodate their contraction and expansion movements.

A series of steam-pipes F, F', F^2, are shown as passing through similar joints in the water-boxes or heads, and communicating therewith through lateral openings *f*. These pipes extend backward outside of the steam-drum, terminating in its steam-space near its rear end, but at different distances therefrom, and

thus conveying steam from the front-head to the drum.

A steam-exit pipe G, extends longitudinally through the steam-space of the boiler-shell or steam-drum E, and conducts the steam to the point desired, being perforated on top and bent upward at or near its ends, as shown in Fig. 1. The steam-inlet pipes, it will be seen, are inclined laterally downward at their rear ends, and enter the steam-space of the boiler-shell or steam-drum below the steam-exit pipe G. This organization thus tends not only to diminish the tendency of the boiler to prime, but also tends to produce extra or increased pressure at that end of the boiler, thus promoting the water-circulation as hereinafter explained. A downward-flow water-pipe H, passes from the bottom of the steam-drum through a sleeve *h*, in the upper part of the rear head C, and extends downward outside the fire-box, its end terminating in the lower end of the rear head. This organization compensates the differential rates of contraction and expansion of the pipe and back-head.

Fig. 3 shows my improved joint. The tubes D, themselves are shown as expanded into contact with the edges of the holes in the tube-sheets b', b^2, with their outer edges bent or flared outward to form flanges outside the outer tube-sheet, while the ferrules I, are expanded inside the tubes instead of outside, as has heretofore been done—as, for instance, in my patent No. 463,805, of November 24, 1891. The outer end of the ferrule is closed by the usual screw-cap *i*. This I find makes a very secure and lasting joint.

The operation of my improved boiler will readily be comprehended from the foregoing description. The feed-water flows through the water-spaces and tubes into the front end of the steam-drum, where the steam is collected while the unevaporated water descends through the pipe H, and re-enters the shell or water-space again through the tubes to the front end of the drum, and so on continuously. As the steam-inlet pipes F, F′, F², are at the rear end of the drum, their tendency is to exert a somewhat greater pressure on the water at that end than at the other, and thus force it rapidly through the downflow pipe. This operation is also facilitated by the fact that there is more steam room at the rear than the front end of the drum, owing to its upward and backward inclination hereinbefore mentioned.

I sometimes provide the tubes D, at their rear ends, with a single opening instead of two openings, as shown in Fig. 4, at the right-hand side. This opening *d*, is at the bottom of the tube, the top being closed. The opening is equal to or greater than the area of the tube, so that any unequal suction from tubes above cannot draw the water from the tube below, but the water will have to go through the tube it started in. The steam rushing up the firing end of the boiler may sometimes have a tendency to take more water through some tubes than others, but with the opening at the bottom of the tube in the front of the boiler, as shown, the water that enters must all pass through its own tube.

I claim as of my own invention—

1. The combination, substantially as hereinbefore set forth, in a steam-boiler, of a shell, head, water-box or water-leg; a steam-drum, and water-pipes passing through the tube-sheets into the steam drum through expanded joints, and having lateral connections with the water-space of the head.

2. The combination, substantially as hereinbefore set forth, of the front-head or water-leg of a steam-boiler; a steam-drum, and pipes directly connecting the water-spaces of the head and steam drum by means of expanded joints, and having lateral openings connecting the pipes and spaces.

3. The combination, substantially as hereinbefore set forth, in a steam-boiler, of a water-head or leg; a sleeve therein; a steam-drum, and a downflow pipe passing from the water-space of the drum through this sleeve, and terminating in the lower part of the water-space, whereby expansion and contraction of the parts is compensated and free circulation maintained.

4. The combination, substantially as hereinbefore set forth, in a steam-boiler of a fire-box; its water-heads or legs; laterally-perforated water-pipes connecting these heads; a steam-drum overlying the fire-box; water-pipes directly connecting the water-space of these heads with the drum by means of expanded joints, and a downflow pipe passing from the drum through a sleeve in the rear-head, and terminating in its water-space near the bottom, to maintain free water-circulation.

5. The combination, substantially as hereinbefore set forth, in a steam-boiler, of a water-head; a steam-drum, and a series of steam-pipes connecting the steam-spaces of the head and drum at different points near the rear end of the latter.

6. The combination, substantially as hereinbefore set forth, in a steam-boiler, of a fire-box; its heads; water-tubes connecting them; a drum overlying the water-tubes; water-pipes directly connecting the water-spaces of the head and drum at one end; a downflow pipe passing from the bottom of the opposite end of the drum through a sleeve in the adjacent head and terminating near its bottom, and steam-pipes extending from the upper end of the upward-flow water-head to the drum near the downflow pipe, to produce pressure therein.

7. The combination, substantially as hereinbefore set forth, in a steam-boiler, of the character described, of a head; an inclined shell or drum adjacent thereto; water-inlet and outlet pipes connecting the water-spaces of the head and drum at opposite ends of the latter, and steam-pipes extending from the

head to the opposite end of the drum and entering the latter at an angle to, and near the downflow pipe, to promote circulation therein.

8. The combination, substantially as hereinbefore set forth, in a steam-boiler, of a head; a drum; water-pipes connecting them at opposite ends; a longitudinal steam-exit pipe perforated on its upper side and having upwardly-bent ends; and steam-inlet pipes connecting the head with the opposite end of the drum, between the steam-exit and downflow pipes, to diminish priming and increase circulation.

9. The steam-boiler hereinbefore described, consisting of the combination of the fire-box; its shell or heads; the water-tubes connecting the heads inclining upward toward the firing-end of the fire-box; the drum overlying the tubes between the heads and inclined upward and backward from the firing-end; water-pipes directly connecting the firing end of the drum and its adjacent head; the downflow pipe passing through a sleeve in the opposite head, and terminating in the bottom of the water-space; steam-inlet pipes connecting the firing-end head with the rear end of the drum, and the longitudinal, perforated steam-exit pipe, for the purposes specified.

10. The joint hereinbefore described, consisting of a perforated tube-sheet; a pipe through one of these perforations, and having its outer end expanded to form a flange; a ferrule expanded inside the tube, and a cap closing the end of the ferrule.

11. A boiler shell having inner and outer sheets at front and rear, in combination with a water tube having an opening *d*, in its lower wall only, between the front and back sheets, substantially as and for the purpose specified.

In testimony whereof I have hereunto subscribed my name.

DANIEL P. McQUEEN.

Witnesses:
H. W. DENNINGTON,
FRANK L. SAUTER.