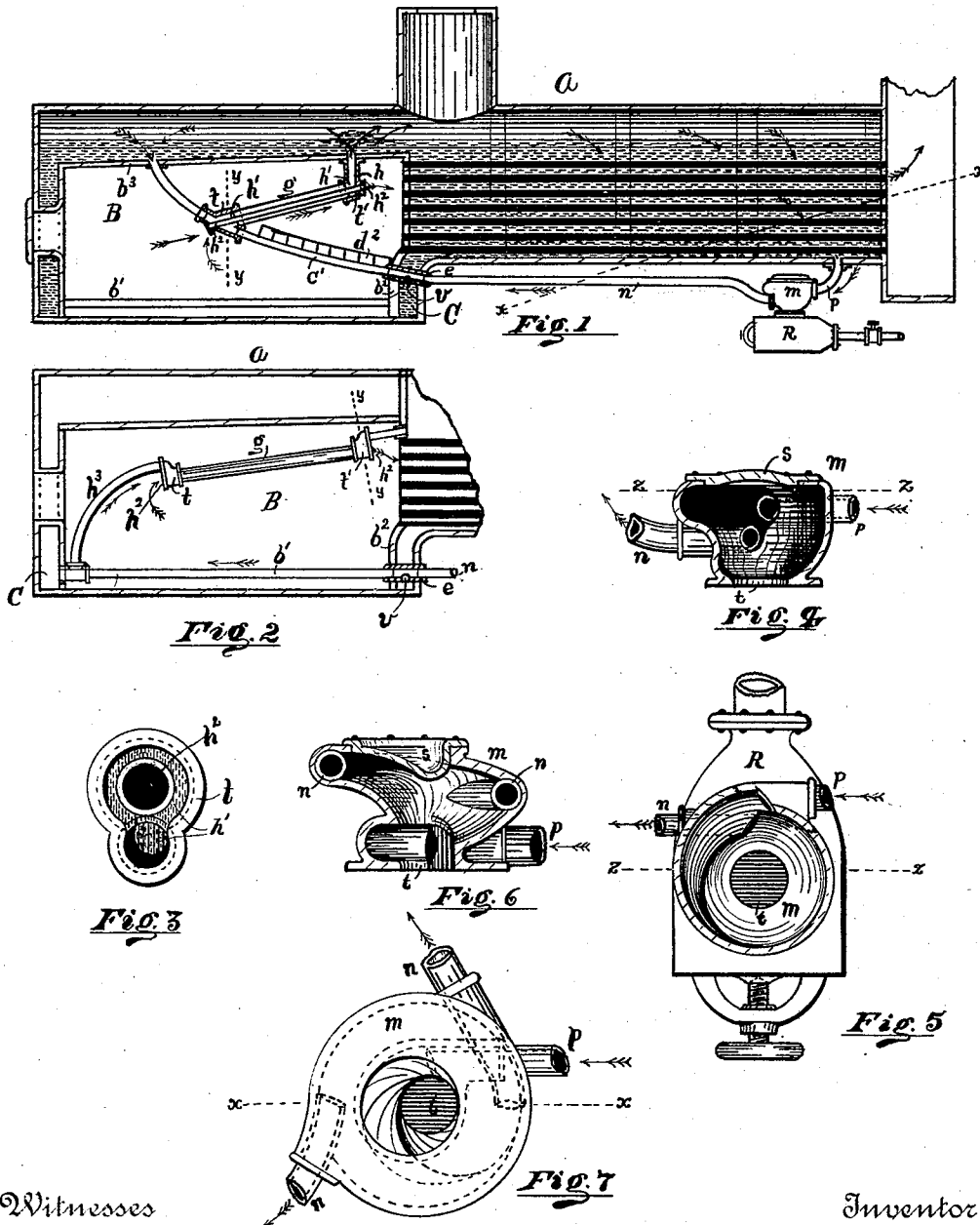


F. E. FITCH.

STEAM BOILER AND GENERATING APPLIANCE.

No. 459,520.

Patented Sept. 15, 1891.



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(No Model.)

2 Sheets—Sheet 2.

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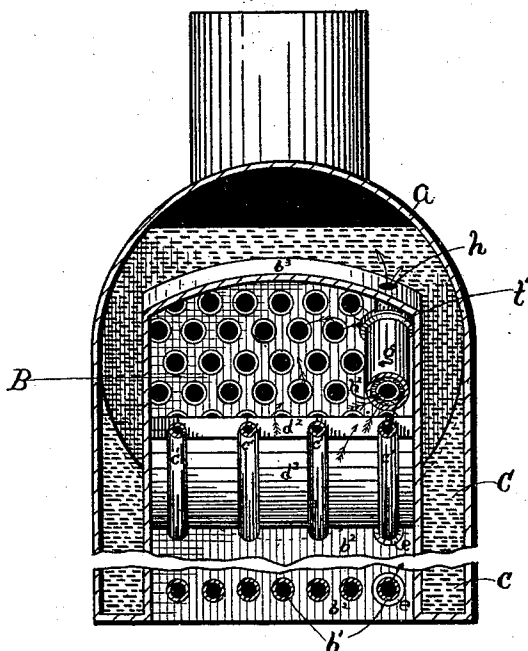


FIG. 8

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FRANCIS E. FITCH, OF ELMIRA, NEW YORK.

STEAM BOILER AND GENERATING APPLIANCE.

SPECIFICATION forming part of Letters Patent No. 459,520, dated September 15, 1891.

Application filed November 26, 1890. Serial No. 372,734. (No model.)

To all whom it may concern:

Be it known that I, FRANCIS E. FITCH, a citizen of the United States, residing at Elmira, in the county of Chemung and State of New York, have invented certain new and useful Improvements in Steam Boilers and Generating Appliances; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon, which form a part of this specification.

My invention relates to steam-generators and their relation with stationary or portable boilers, but more especially to that class of locomotive-boilers in which the water-chamber extends downward around the sides of the fire-box and have what is technically termed a "water-leg," and in which the fire-chamber from the boiler-throat plate to the crown-sheet is spanned with tubular arch-bars which support the arch within the chamber, or in which the fire-grate of the fire-chamber is composed of tubular pipes and is commonly called the "water-grate boiler."

In this special class of boilers which I prefer to illustrate and wherein important advantages by my improvements are attained the sediment formed by continued evaporation in generating the steam not only settles in the water-leg, but also in the opposite end or forward part of the "boiler," so termed, in connection with a locomotive, somewhat in the form as indicated by the dotted line *x x* in Fig. 1 of the drawings.

Devices heretofore arranged to relieve the above-described type of boilers of sediment by circulation fail of complete and substantial results, because the direction of circulation or current in the boiler has been transversely to that of the water-chamber, and made so by the generating ingress and egress pipes being both to one side of a transverse central line of the boiler, or because where the circulation has been longitudinally with the water-chamber no provision has been made to take water from the water-leg and front end of the boiler at the same time, and where the generating structure is arranged

to create only a single transverse current in the water-chamber of the boiler such current-walls necessarily have other current directions that in turn cause deposit elsewhere in the boiler, and where generators have been made designed for rapid circulation of water in their pipes no provision other than contrary structures to obtain gravitating action in settling to separate the sediment has been made under it, and as such settling in a rapid circulation is retarded imperfect results have only been obtained.

From this it may be adduced that the object of my invention is to further complete the system, to successfully remove all of the accumulation of sediment anywhere in the water-chambers of the boiler and thus remove its numerous deleterious effects, and to simplify the connection by utilizing one or more of the arch-bar tubes or one or more of the water-grate tubes, as the case may be, of an ordinary locomotive-boiler as connecting-pipes to the generator.

Further description may be had with reference to the accompanying drawings, in which similar letters of reference indicate corresponding parts.

Figure 1 is a longitudinal vertical section of a locomotive-boiler having the tubular arch-bars with my improvements in connection therewith. Fig. 2 is a like sectional view in part of the water-grate boiler, showing the manner of connecting my improvements thereto. Fig. 3 is a sectional view in detail of the annular generating-pipe on the line *y y*, Figs. 1 and 2. Fig. 4 is an enlarged sectional view of the sediment-separator on a central line indicated at *z*, Fig. 5. Fig. 5 is a plan view of the separator in its relation with the circulation-pipes and mud-drum, section-line at *z*, Fig. 4. Fig. 6 is a modified view of the separator with an additional discharge-pipe, section-line at *x*, Fig. 7. Fig. 7 is a plan view of the separator. Fig. 8 is a cross-section through the fire-chamber about midway between the ends of its hollow grate-bars.

In the drawings, Figs. 1 and 2, *a* represents a commonly-constructed locomotive-boiler, its water-compartments contractedly extending down to or on about a level with the fire-grate *b'* forms the water-leg *c*, and the tubular

arch-bars, one or more in the manner of c' , in boiler, Fig. 1, extending angularly across its fire-chamber B, uniting the throat-plate b^2 with the crown-sheet b^3 and consequently the water in the water-leg to that in the upper part of the boiler, having also the office of maintaining the arch or brick d^2 , that rests upon them.

In boiler, Fig. 2, the grate is composed of tubular water-pipes b' , which horizontally connect the water-chambers of the water-leg.

I have thus in the foregoing clause described the boilers as constructed previous to the addition of my improvements. This may begin with the cutting off of one or more of the arch-bar tubes near the upper end and reuniting it with an annular-chambered T union f , said union also rigidly receiving the annular pipe g , which inclines slightly upward in line, or nearly so, with the draft-line of flame from the furnace beneath, and has another similar-chambered union f' at its upper end, but lying in a higher plane and nearer the crown-sheet of the boiler, and from which the outlet-pipe h , passing upward through said crown-sheet or the flue-sheet, as may be desired, opens connection to the boiler-chamber. The annular chamber h' of the unions $f f'$ give water-passages through them to the connecting-pipes, and the opening h^2 of the flue-pipe g , which forms the fire-draft through it, supplies internal radiation and consequently double heating-surface to the water passing within said pipe, but in opposite direction to that previous to the connection of the more horizontally-laid generating-pipes, with the inclined generating arch-tubes below them. In this new connection circulation is instituted from the boiler through the one or more upper generating-pipes in the fire-chamber again to the boiler over the crown-sheet, such circulation being caused by expansion within the upper generating layer of tubes, and in this instance the circulation as attained within the boiler is partially over the crown-sheet backward to the upper end of the arch-tube, but now newly converted into a secondary stay or feed-pipe. As insertion of the chambered union in the arch-bar does not normally displace it, circulation is restored, as formerly, to the rear part of the boiler.

With reference to the water-grate boiler, in which the arch-bar tubes are not used and in which the annular pipe g cannot directly connect with the tubes of the water-grate, I connect them by means of the pipe h^3 and its proper unions, as may be seen illustrated in Fig. 2 of the drawings.

Having thus minutely described my generator as arranged within the fire-chamber of the boilers, I will proceed to the outer arrangement of pipes necessary to complete the circuit of circulation through the boiler and collect the sediment withdrawn thereby.

In employing the sediment-separator m , which is mounted upon the mud-drum R and

more fully described hereinafter, said drum is placed at that point in the circuit where the highest speed of water in the pipes may be attained. This position in my present arrangement is forward of the water-leg, as may be seen illustrated in the drawings. The separator intercepting the inlet-pipes of the generator as the pipe n thereof and the pipe p , leading thereto from the third barrel-sheet or forward part of the boiler, has by its internal construction the office of forcibly separating the sediment reaching it through said pipe and depositing it in the mud-drum beneath. Continuing the lower end of the arch-bar c' or the water-tube b' of the boilers heretofore described by the union e with the feed-pipe n , respectively, which passes through the water-leg and has circulation with said leg through the opening v in it, the pipe n then passing forward to the separator, the complete circuit of pipes is laid, referring to either boiler.

With reference to Figs. 4 and 5 of the drawings, it will be seen that the general shape or contour of the sediment-separator is somewhat semi-globular, or similar to that of an ordinary washboard, but provided with the opening t through its bottom direct to the mud-drum. This opening may properly be termed the "throat" of the separator. Entering said separator on a plane with the throat, or nearly so, but to one side of it in tangential direction, is the outlet-pipe n , also a like entrance of the inlet-pipe p , but in a plane one or more pitches higher than the said outlet-pipe.

Figs. 6 and 7 of the drawings show my separator in a somewhat modified form, it having two departure-pipes one or more pitches higher than its inlet-pipe. The bowl, having greater spiral configuration, allows tangential entrance of the pipes in the ways of the spirals therein. The relation of these pipes one with the other in their entrance to the separator-chamber is such, in conjunction with the structure of the bowl, as to institute and maintain a series of rapid circling currents of water and separation of sediment thereby, as follows: The water entering through the inlet-pipe is led by the circling walls of the separator, circling around its throat t and maintained by the one or more ingress and egress pipes that direct their discharge and withdrawal in a direct or tangent line with the current thus instituted. Now as the water rises higher the walls of the chamber, especially in the modified form of the separator, permit centrifugal action to take place in expansion of the current-circles, and a natural force is attained, driving the sediment arising in the separator from the outer or swifter currents to the inner ones, and finally to the central eddy of the whirling pool thus formed, and through the throat of the separator into the mud-drum. Said drum and separator having small area of connection only through the drum and sepa-

rator opening centrally to the separator, water connection in reaching the drum is stilled, and cohesion of the stilled and lesser currents of water circulating at this point tend to accelerate precipitation of sediment from the central eddy of the separator to the bottom of the mud-drum. A suitable cap or lid *s*, which may be removed at any time, closes the top of the separator by being fitted thereto in any removable manner that will effectually make its chamber water-tight. The annular generating-pipes *g* present a great area of heating-surface, which quickly imparts heat to the water coming in contact within them. It expands and becomes lighter than the strata over it. It therefore rises and water above in the boiler descends through the pipes *p n* and separator *m*, and this in its turn being expanded is made to rise. There is thus a continued current of the heated water upward into the rear part of the boiler and a counter-current of the colder water downward from the forward part.

It is evident that numerous slight changes might be resorted to in the construction of the separator and its departing-pipes; also the arrangement of the annular generator within the fire-chamber. Hence I do not wish to limit myself strictly to the form herein shown and described, but consider myself entitled to all such changes as fall within the spirit and scope of my invention, which I have thus fully described.

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

1. The improved steam-generator herein described, in which is combined a boiler having the water-leg *C* forming water-chambers at the side of the fire-box, annular heating-pipes connecting one or more of the arch-bar tubes and boiler and arranged within the said fire-box, a sediment-separator in connection with a mud-drum arranged at the side of said boiler, a pipe connecting the separator and water-leg with the arch-bar tube, and a pipe connecting said separator with the forward part of the boiler, substantially as shown and described.

2. The improved steam-generator combining therein a boiler having a water-leg, a centripetal separator and drum arranged at the side of said boiler, annular heating-pipes connecting the boiler within the fire-chamber, a pipe connecting one or more of said heating-pipes to the water-grate, and pipes connecting said separator and water-leg with the water-grate and forward part of the boiler, substantially as described.

3. In combination with a boiler having a water-leg, a centripetal separator and drum, and one or more annular heating-pipes disposed within its fire-chamber and connected to the boiler within said chamber and by a pipe through the water-bar to said separator and boiler, substantially as described.

4. In steam-generating appliances, a cen-

tripetal sediment-precipitator having peripheral increasing spiral inwalls to allow centrifugal current expansion within its chamber, substantially as described.

5. In generating appliances to steam-boilers, a centripetal sediment-separator having increasing circular inwalls rising from a central opening downward through its bottom, with inlet and outlet pipes disposed to discharge tangentially at its inner periphery in line of spiral or horizontal circulation instituted thereby, substantially as described.

6. In combination with the centripetal separator having peripheral inwalls of increasing spiral form rising from a central opening downward through its bottom, the inlet and outlet peripheral discharging-pipes disposed to tangentially discharge into and withdraw from the spiral ways in the inwall of the separator, substantially as set forth.

7. In generating appliances, the combination, substantially as herein set forth, of a centripetal sediment-separator having inner increasing spiral configuration, pipes disposed to tangentially discharge into and withdraw from the ways of the inwall of the separator and about a central opening downward through its bottom, and a still-water receptacle beneath the separator with like opening upward, wherein vertical action in precipitation of sediment from the separator is accelerated by cohesion of stilled and circulating water through the opening.

8. In a steam-generating appliance for boilers, the combination of a centripetal sediment-separator, a pipe leading from the under forward part of the boiler to said separator and connected to said separator to tangentially discharge therein, and a pipe or pipes leading from the separator to the generating-tubes and connected to said separator to tangentially withdraw therefrom, substantially as set forth.

9. In a steam-generating appliance for boilers, the combination of a centripetal separator having inner peripheral ways of increasing spiral configuration, and a pipe or pipes leading from the under forward part of the boiler to the separator and from the separator to the generating-tubes and connected to said separator to tangentially discharge into and withdraw therefrom in the peripheral ways of the inwall of the separator, substantially as set forth.

10. In a steam-generator for locomotive-boilers having a water-leg, the combined feed and discharge pipes adapted to support generating-tubes below the crown of the fire-box and constructed as connecting-pipes for circulation to and from the boiler and generating-tubes, substantially as described.

11. In a steam-generator for locomotive-boilers having a water-leg, the combination, with the boiler, of one or more generating arch-bar pipes, a secondary generating-pipe connecting said arch-bar pipe and the boiler, and

a pipe or pipes connecting the under part of the boiler with the generating arch-pipes, substantially as described.

12. In a steam-generator for locomotive-
5 boilers having a water-leg, the combination, with one or more generating arch-tubes connected to the water-leg of the boiler, of the one or more generating-tubes arranged angularly thereto and above them, both generating-pipes in a series of one or more being dis-
10 posed one above the other within the fire-box, and circulating feed and discharge pipes connecting the generating-pipes and boiler

and disposed to give current-circulation longitudinally within the boiler, substantially as 15 described.

13. The combination of a feed-pipe connected to the under part of the boiler, a separator connected to said feed-pipe, and a drum connected below the separator, substantially 20 as described.

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