(No Model.)

S. SMITH.

STEAM GENERATING APPARATUS.

No. 364,868. Patented June 14, 1887.

Fig. 1.

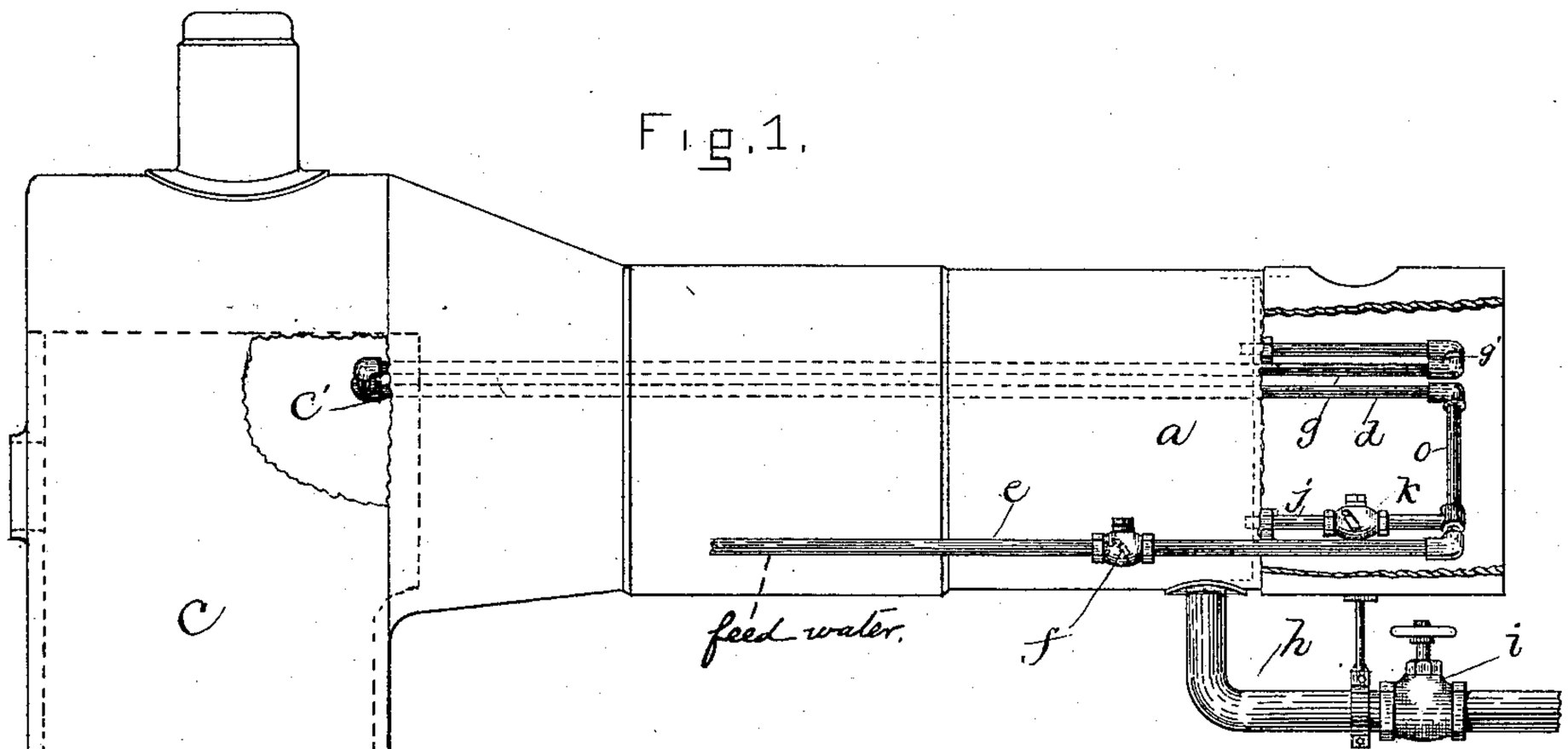


Fig. 2.

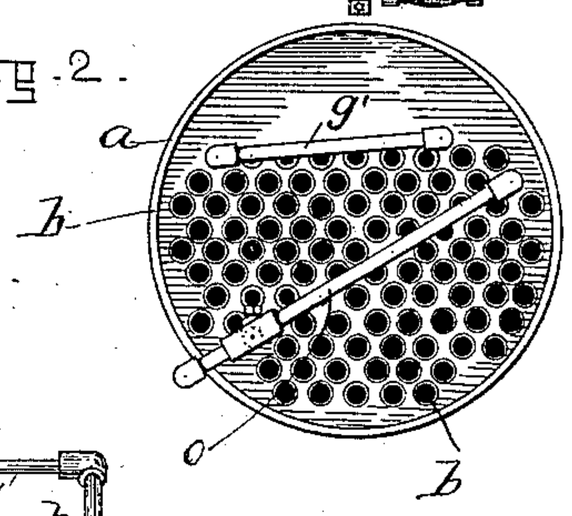


Fig. 3.

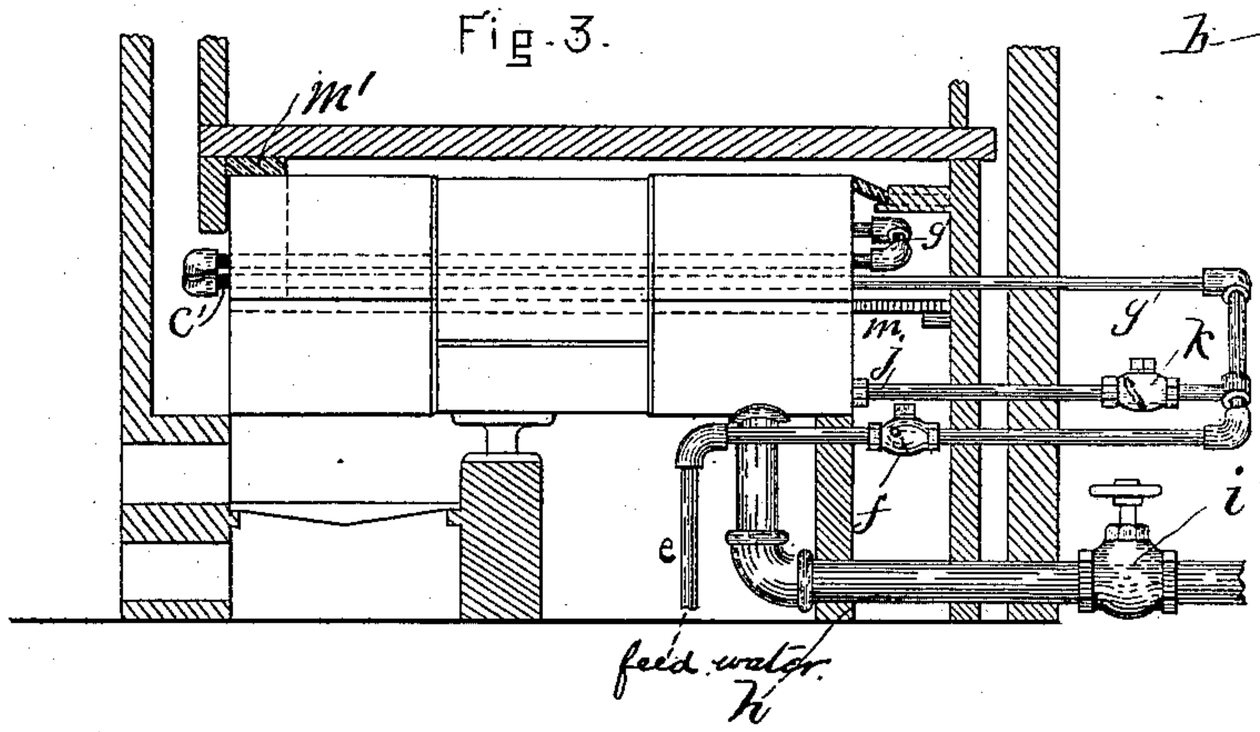
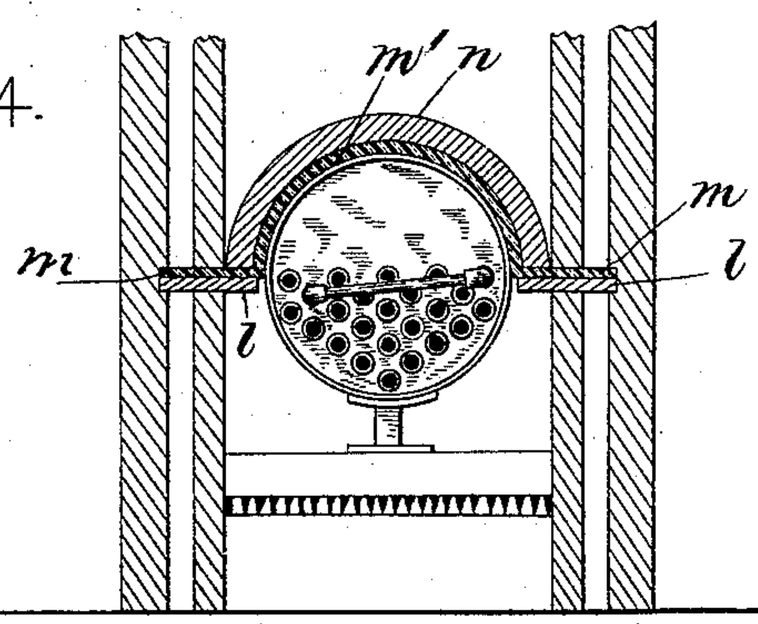


Fig. 4.



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UNITED STATES PATENT OFFICE.

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STEAM-GENERATING APPARATUS.

SPECIFICATION forming part of Letters Patent No. 364,868, dated June 14, 1887.

Application filed April 7, 1887. Serial No. 233,989. (No model.)

To all whom it may concern:

Be it known that I, SIDNEY SMITH, of Cambridge, in the county of Middlesex and State of Massachusetts, have invented certain new and useful Improvements in Steam-Generating Apparatus, of which the following is a specification.

My invention relates to boilers for generating steam, and particularly to such boilers employing a locomotive fire-box in connection therewith, or to "hog-nose" boilers and common tubular or flue boilers.

My invention has for its object to so improve the feed-water-heating contrivances as to raise the temperature of the water supplied to the boiler to as near that of the steam generated therein as possible before admitting the water to the boiler proper, so as to obviate the wear and tear of the boiler consequent upon unequal expansion and contraction, and at the same time avoid danger of explosion, &c., by keeping all of the parts of the shell of the boiler at a uniform temperature, preventing, also, disintegration, rupture, and breakage of both shell and stay-rods.

My invention also has for its object to so improve the construction in stationary boilers of the heating chambers or contrivances in their relation to the boiler as to avoid unduly heating the same from the fire chamber or box, or from the walls or casing of the same or the boiler, above the low-water line of the latter, thus, in connection with the particular provisions by which circulation of the water in the boiler is secured, and sediment or solid or glutinous matter calculated to form scale is frequently removed or "blown off," effectually preventing any and all incrustation of the boiler, and removing scale from boilers in which it has already formed from any cause.

My invention also has for its object improvements incidental to the foregoing, having the attainment of substantially the same results in view.

To the ends mentioned my invention consists in the improvements which I will now proceed to describe, so that others skilled in the art may be able to make and use the same, the invention being particularly set forth in the claims hereto appended.

Of the accompanying drawings, forming a part of this specification, Figure 1 represents a side elevation of a locomotive-boiler and some of those parts immediately connected therewith (parts being shown as broken away) embodying my invention. Fig. 2 represents a diagram of the front end of the boiler represented in Fig. 1, showing my improvements as applied thereto. Fig. 3 represents a side view of the invention as embodied in a stationary boiler, the casing or framing being shown as in section. Fig. 4 represents a vertical sectional view through the casing or framing on the line 1 1 of Fig. 3.

Similar letters of reference indicate corresponding parts in all of the figures.

In the drawings, reference being had to Figs. 1 and 2, *a* represents a tubular locomotive-boiler of common construction; *c*, the casing or wall of the fire-box; *c'*, the interior of the fire-box, and *d* the smoke-box.

The parts thus far described, as also the parts necessarily connected therewith for forming a steam-generating boiler, (not shown herein or particularly illustrated or explained,) may be of common and well-known character, or such as are illustrated in the frontispiece plates of the "Catechism of the Locomotive," by M. N. Forney, New York, the Railroad Gazette, publishers, 1875, and as shown and described in the patent granted to me November 27, 1883, No. 289,317, to which reference may be had.

e represents the feed-water-supply pipe provided with a check-valve, *f*, which feed-water-supply pipe extends out into and diagonally upward in the smoke-box *d*, where it connects with the feed-water-heating pipe *g*, which latter passes through one of the flues or tubes near one side of the boiler to the fire-box, into which it issues, passing across to the opposite side of the boiler, where it enters a tube or flue higher up, returning to the smoke-box, into which it extends, and by a connecting-pipe, *g'*, (see Fig. 2,) crosses to near the opposite side of the boiler or near the side at which it first entered a flue, where it enters the boiler proper just at or above the upper row of tubes or low-water line. By this means the water fed through the pipe *e* to the boiler attains a temperature substantially as high as the steam generated in the boiler before it enters therein.

Extending downward from the bottom of the

boiler and outward at any convenient point is a large pipe, *h*, forming a substantial receptacle or pocket for matter and a purpose to be presently explained. Said pipe *h* is provided with a suitable blow-off cock, *i*. A pipe, *j*, extends out into the smoke-box from the boiler near the bottom thereof to and connects with the feed-water-supply pipe *c*, said first-mentioned pipe being provided with a suitable check-valve, *k*, to prevent water forced into the boiler through the feed-water-supply pipe *c* from entering said boiler by the way of said pipe *j*, by which construction, when no water is being fed to the boiler, a constant circulation of the water in the boiler will be kept up through the pipe *j* and *g* and the boiler.

In Figs. 3 and 4 I have represented a stationary boiler with my invention applied thereto. In these latter views the parts similar to those above described are indicated by similar letters of reference, and all of said similar parts are constructed and arranged to operate in a similar manner. In carrying out the objects of my invention in its application to this form of boiler, I make certain modifications in the structure of its appurtenances, which I will now proceed to set forth.

l l represent sheets or plates of soapstone, tile, or other suitable material built into the walls or casing, substantially as shown in my patent hereinbefore referred to, which sheets project inwardly from the wall to near the sides of the boiler, the walls being at a little distance from the sides of the shell of the boiler.

m m represent sheets of asbestus, or sheets composed of similar material, filled with amianthus, which sheets extend from the side walls to the boiler a little below the water-level and form a cut-off to prevent the direct contact of the flame with the boiler above the water-line. This material does not become greatly heated, and consequently does not overheat the boiler-plates, as would hot masonry. An arched plate, *m'*, of similar material, which is a poor conductor of heat and is incombustible, serves as a cut-off to the flames at the end of the boiler.

If desired, pipes or receptacles similar to pipe *h* may be provided at or near the end opposite that at which said pipes are shown as attached to the boiler, or at other points, which pipes may also be provided with blow-off cocks similar to blow-off cock *i*, said receptacles and pipes being comparatively large size, so as to effect by their operation a practical washing out of the boiler.

Before proceeding with a description of the operation of my invention it may be well to still further explain the general principles upon which it is based, as well as the difficulties heretofore experienced in the use of contrivances to which it relates.

Steam, which is one of the most powerful mechanical agents known, is at the same time in most respects one of the most manageable. Chief among the dangers attending its use are explosions, which it sometimes causes, and these results are in most instances unquestionably due to the incrustation of the boilers. Another objectionable effect of incrustation is the fact that it necessitates an increased amount of heat to generate steam, it being admitted that a boiler with a crust one-fourth of an inch thick requires sixty per cent. more fuel to generate steam than would the same boiler if it were clean or free from crust. If, therefore, incrustation can be avoided it will result in a great saving of fuel, as well as a diminution of dangers from explosion.

Incrustation is produced by the accumulation upon the sides of the boiler of carbonates of lime, magnesia, oxide of iron, vegetable matter, and other substances in the water which are not convertible into steam, and cannot be held in suspension and carried off by the steam, which accumulations on the sides of the boiler are burned thereon time after time in thin layers by the heat in the furnace until the interior of the boiler becomes heavily incrusted. The substances in water which produce incrustation are precipitated at or near a temperature of 290° or less; and it has been demonstrated by tests that the residuum or substances mentioned which produce incrustation will flow into eddies outside of the currents of circulating water in a boiler.

In carrying out my invention, I take advantage of the foregoing facts. First, by leading the feed-water-heating pipes through the flues of the boiler in the manner described, I am enabled to introduce water to the boiler at or nearly at the same temperature as the steam generated, which in the boiler of a high-pressure locomotive running from one hundred and twenty-five to one hundred and fifty pounds pressure is from 330° to 350°, and in a low-pressure boiler from 220° to 300°. This high temperature of the water introduced to the boiler not only prevents the contraction of the plates which cooler currents would produce, but admits of the immediate precipitation of residuum and other crust-forming substances, in the manner hereinbefore stated.

I have also ascertained that the pockets or receptacles formed by the pipes leading down from the bottom of the boiler near the point where the feed-water heaters are connected with the boiler and from the leg of locomotive-boilers form favorable receptacles for these precipitated substances, which receptacles I provide with blow-off cocks, which are frequently operated and so constructed as to effect a complete washing out of the receptacles and of the boiler as well.

To further facilitate precipitation of the substances mentioned, which are superinduced by currents of water in the boiler, I connect the pipe *j*, extending from the bottom of the boiler, with the feed-water-heating pipe *g*, as stated, whereby, when the pump or injector by which the water is forced from the tank to

the boiler is stopped or thrown out of operation, a circulation is induced through the boiler and from it through said pipes. Practice demonstrates the fact that circulation, under the conditions mentioned, is constant through the boiler and pipes so long as there is any fire under the boiler, and this constant current of water sends all crust-forming substances in their plastic or formative state into the receptacles mentioned, and which may be provided in the bottom of the boiler.

The blow-off cocks connected with the residuum-receiving receptacles or pockets are designed to be frequently operated, as often as three times a day, if necessary, in order to discharge the precipitated residuum and in effect wash out the boiler.

There being no heat of consequence from the fire applied to the boiler above the low-water line, there is no means or agency for burning or drying the crust substances on the interior of the boiler; and the residuum-receiving pockets or receptacles being below the heating-point, such crust-forming substances as are precipitated therein are free from all liability of being burned onto the interior of the boiler, as they must be in order to form a crust.

It is well known that a line or ridge of scale or coating is frequently found on the inside of boilers at or near the water-level. In the common setting the casing or walls come in contact with the shell at this point, and this ridge is caused by the heat from the walls or casings burning the scum floating on the surface of the water onto the shell. In my method the incasing-walls are kept away from the shell and the burning on of scum from the radiated heat entirely avoided; and, furthermore, as practical tests have demonstrated, by my described improvements, incrustation may be removed from boilers in which it has already formed and become fixed to the internal surfaces.

The use of my improvements may produce chemical or physical changes as well as electric currents not herein enumerated in the attainment of the results specified; but further knowledge of matters of this nature is not necessary to an understanding of my invention.

I am well aware that "hand-holes" in the head of the boiler are in common use, and that "blow-offs" are now employed in the heads of boilers as well as in the sides of the "water-legs," which blow-offs are designed to be used at the close of each week, or at longer intervals, in blowing off the boiler, in order to permit the free residuum to be scraped out through the hand-holes, the covers of which are removed. I therefore do not claim the use of these devices as constituting my invention, but confine the same to the construction and relationship of parts set forth in the claims, whereby the residuum or crust-forming substances are precipitated into the receptacles or pockets provided in the bottom of the boiler, and are blown off while in their plastic or formative state.

What I claim is—

1. A steam-boiler, a fire-box wall a little removed from the side of said boiler, and a plate extending from the wall to the side of the boiler just below the water-level, said plate being of non-conducting material, substantially as described, all in combination, substantially as and for the purpose stated.

2. The combination, with a boiler, of a feed-water-heating pipe connected with the boiler at the lower portion of the head by a connection having a check-valve which closes toward the boiler, said feed-pipe running through the tubes or flues of the boiler and entering the same at or below the water-line, for the purposes set forth.

3. The combination, with a boiler, of a feed-water-heating pipe connected with the boiler at the lower portion of the head by a pipe having a check-valve which closes toward the boiler, the feed-pipe entering and running through a flue rising and crossing at the opposite end of the boiler and entering a flue at the side opposite to that through which it first passed, returning to the first-mentioned end through the last-mentioned flue and entering the boiler at or below the water-line, as set forth.

4. The combination, with a boiler, of a feed-water-heating pipe provided with the check-valve *f*, which opens toward the boiler, said pipe connected with the boiler at the lower portion of the head and running through the tubes or flues of the boiler and entering the same at or below the water-line, and the connecting-pipe *j*, provided with a check-valve closing toward the boiler, as set forth.

5. The combination, with a boiler, of a feed-water-heating pipe provided with the check-valve *f*, opening toward the boiler, said pipe connected with the boiler at the lower portion of the head and running through the tubes or flues of the boiler and entering the same at or below the water-line, the connecting-pipe *j*, provided with a check-valve closing toward the boiler, with a pocket or pipe at the bottom of the boiler provided with a blow-off cock, as set forth.

In testimony whereof I have signed my name to this specification, in the presence of two subscribing witnesses, this 30th day of July, 1886.

SIDNEY SMITH.

Witnesses:
A. D. HARRISON,
H. BROWN.