(No Model.) 2 Sheets—Sheet 1.

F. F. LANDIS.

STEAM BOILER.

No. 456,149. Patented July 21, 1891.

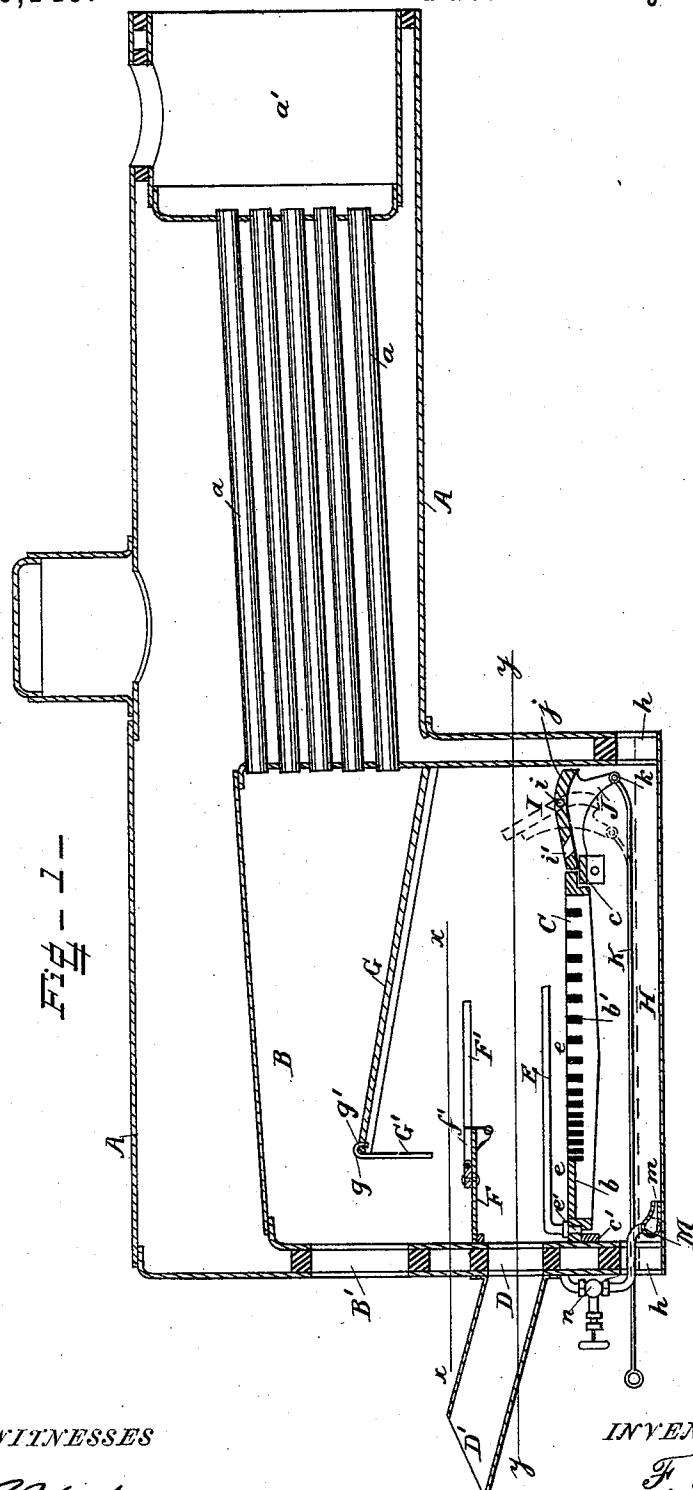

Fig. 1.

WITNESSES

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Fig. 2.

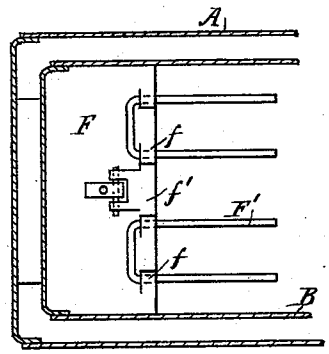


Fig. 3.

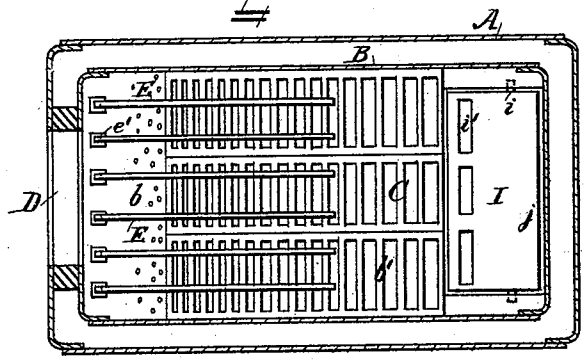
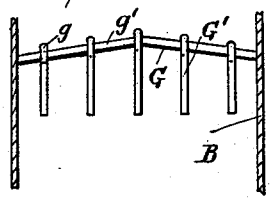


Fig. 4.



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UNITED STATES PATENT OFFICE.

FRANK F. LANDIS, OF WAYNESBOROUGH, PENNSYLVANIA.

STEAM-BOILER.

SPECIFICATION forming part of Letters Patent No. 456,149, dated July 21, 1891.

Application filed September 15, 1890. Serial No. 365,073. (No model.)

To all whom it may concern:

Be it known that I, FRANK F. LANDIS, a citizen of the United States, residing at Waynesborough, in the county of Franklin and State of Pennsylvania, have invented certain new and useful Improvements in Steam-Boilers; 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.

This invention relates to steam-boilers; and it consists in the novel construction and combination of the parts, hereinafter fully described and claimed, whereby the boiler is adapted to be heated by the combustion of straw, coal, or other light or heavy fuel, as found most convenient.

In the drawings, Figure 1 is a longitudinal section through the boiler. Fig. 2 is a sectional plan view taken on line *x x* in Fig. 1. Fig. 3 is a sectional plan view taken on the line *y y* in Fig. 1. Fig. 4 is a detail view of the front end of the baffle-plate.

A is the shell of the boiler.

B is the fire-box, and *a* are the fire-tubes extending between the fire-box and the smoke-box *a'*, in the usual manner.

B' is the charging-opening for coal, which may be provided with a door of any approved construction.

C is the grate, which is supported upon the cross-bars *c* and *c'* in the lower part of the fire-box. The grate is provided with a dead-plate *b* at the front end of the fire-box, and a series of grate-bars *b'*. Coal or other hard and compact fuel may be burned upon the grate C in the usual manner; but in order that the boiler may be heated by burning straw, grass, shavings, or other similar light fuel, when coal is not obtainable, the grate-bars *b'* are arranged crosswise of the grate instead of longitudinally in the usual manner, and the air-spaces between the said grate-bars are made to increase in width from the front to the back of the grate, the bars being arranged very close together at the dead-plate end.

D is the charging-opening for straw at the front of the fire-box between the grate and the charging-opening B' for coal.

D' is an inclined spout, secured outside the boiler in front of the opening D, which is preferably of the full width of the fire-box. The straw or other light fuel is packed into the spout D', and is pushed forward into the fire-box with as much regularity as possible, and in quantities proportional to the amount and pressure of the steam required.

E are bars, removably secured to the front end of the grate and extending longitudinally over the grate-bars for about two-thirds the length of the grate, leaving a space *e* between the bars E and the grate. The bars E are preferably constructed with downwardly-bent ends *e'*, which are dropped into holes in the end of the grate; but the said bars may be secured in any other convenient manner, so as to be easily removable.

F is a removable dead-plate, supported in the fire-box above the charging-opening D for light fuel.

F' are longitudinal bars projecting rearwardly from the end of the plate F over the bars E, and removably connected to the said plate by the lugs *f* and the pivoted catch *f'*.

The baffle-plate G is of any approved construction, and may be permanently secured inside the fire-box.

G' are removable bars, which project downwardly from the front end of the baffle-plate. These bars may be attached to the baffle-plate in any convenient manner, so as to be easily removable, but are preferably provided with hooked ends *g*. These hooked ends are dropped over the bar *g'* at the front end of the baffle-plate, and the bars G' hang in a vertical row, as shown in Fig. 4.

When coal or other hard fuel is to be used to heat the boiler the dead-plate F and the bars G', F', and E are all removed, and the charging-opening D is closed by any convenient door or plate. The coal, which is charged through the opening B', falls upon the grate without obstruction and is burned in the usual manner, the flame and smoke passing around the baffle-plates, through the tubes, and into the smoke-box in the usual way.

When the boiler is to heated by light fuel, the dead-plate F and the bars G', F', and E are secured in position, as shown in the drawings, and the firing-opening B' for coal is closed up. The straw is ignited upon the bars E, and the small particles fall through

the bars E upon the dead-plate and the grate-bars under the said bars E. As the grate-bars near the dead-plate are very close together and only permit just enough air to pass through them to support the combustion of the small particles of straw which rest upon the front end of the grate, a layer of small particles of burning material is soon formed upon the surface of the front end of the grate, which burning layer serves to ignite the body of the straw which rests upon the bars E above it. The fire at the front of the grate is not pushed backward by the entering straw, which is supported by the bars E. The straw is very quickly ignited and burns fiercely as it is pushed backwardly over the bars E and under the bars F′. The dead-plate F above the straw prevents the top layer of it from taking fire too rapidly, and prevents the draft of air from passing direct from the opening D past the end of the baffle-plate to the fire-tubes. The burning straw falls over the ends of the bars E upon the grate-bars at the rear of the fire-box, which are spaced wide apart so as to permit a free and full supply of air to support the combustion of the straw. The bars F′, which project rearwardly from the dead-plate F, keep the straw down upon the bars beneath them, and permit the flames to pass upwardly around the baffle-plate.

The bars G′ at the front of the baffle-plate prevent light burning masses of straw from being drawn over by the strong current of air against the tube-plate.

H is the ash-box below the grate, and *h* are the air-inlet openings at the ends of the ash-box.

I is a crushing and dumping plate pivoted upon the pins *i*, between the rear end of the grate and the end of the fire-box. The front end of this plate is preferably inclined downwardly and forwardly, and rests by its own weight upon the bar *c*, being provided with air-openings *i′*, so that the straw above it may burn freely. The rear end *j* of the plate I is curved downwardly and rearwardly beyond the pivot-pins, and J is an arm projecting from the under side of the said plate.

The front end of plate I is heavier than the rear end, so that the plate has no tendency to open of itself when there is no fuel on the grate, and the rear end is curved, so that a grinding action may be applied to the clinkers between it and the end plate of the fire-box. The clinkers formed by burning straw and rubbish are very brittle and glass-like, and can be broken up and pulverized by vibrating the plate I and grinding them against the end plate of the fire-box.

K is a rod which passes through the ash-box and is pivoted to the arm J by the pin *k*.

The burning straw upon the grate has considerable dirt mixed up with it, and also much vegetable rubbish, and forms clinkers, which are pushed to the rear of the fire-box and accumulate above the plate I. These clinkers are got rid of by repeatedly pulling the rod K and turning the plate I upon its pivots, as shown by the dotted lines in Fig. 1. The small clinkers are dropped into the ash-box and the larger clinkers are crushed and broken up between the front end of the said plate and the end of the fire-box, so that they also fall into the ash-box. The small clinkers at the rear of the ash-box and the fine ashes upon the ash-box bottom are got rid of by means of a jet of hot water from the boiler.

M is a pipe provided with a very narrow slot *m* and extending across the front end of the ash-box close to the bottom of it. The pipe M is preferably of the cross-section shown in the drawings, and has a flat lower side which rests upon the bottom of the ash-box. The upper part of the pipe M is flattened and curved outwardly toward the rear, so that the narrow slot *m* comes close to the bottom of the ash-box. When the valve *n* is opened, the pressure of the steam forces the water in a very thin sheet through the slot *m* and drives all the ashes and clinkers out of the ash-box through the air-opening at the rear of it. The water quenches the red-hot ashes and wets them thoroughly, so that they are driven out in a mass, which falls upon the ground and does not fly about in the form of fine dust, as would be the case if the ashes were expelled by steam or air.

What I claim is—

1. In a boiler, the combination, with a fire-box provided with a grate and two separate openings for charging the grate with heavy or with light fuel, of removable bars adapted to be secured within the said fire-box when light fuel is to be burned, for supporting and guiding the said light fuel, the said bars being taken out when heavy fuel is to be burned, substantially as set forth.

2. In a boiler, the combination, with a fire-box provided with a grate and separate openings for charging the grate with heavy or with light fuel, of removable longitudinal bars for supporting the entering light fuel a short distance above the grate, and removable longitudinal bars above the said entering light fuel and below the said charging-opening for heavy fuel, substantially as and for the purpose set forth.

3. In a boiler, the combination, with a fire-box provided with a grate, a tube-plate at its rear end, and two separate openings at its front end for charging the grate with heavy or with light fuel, of a baffle-plate extending forwardly and upwardly from the tube-plate below the tubes, removable longitudinal bars for supporting and guiding the entering light fuel, and removable bars depending from the front end of the said baffle-plate, whereby the furnace may be changed to adapt it to light or heavy fuel, substantially as and for the purpose set forth.

4. In a boiler, the combination, with a fire-box provided with an opening for light fuel, of a grate provided with a dead-plate at its

front end and with air-openings increasing in area from the dead-plate toward the rear of the grate, and removable longitudinal bars secured at their front ends below the said charging-opening and adapted to support the entering light fuel a short distance above the front and middle portions of the grate, whereby the light fuel may be rapidly ignited, substantially as set forth.

5. In a boiler, the combination, with a fire-box provided with an opening for light fuel, of a grate provided with a dead-plate at its front end and with air-openings increasing in area from the dead-plate toward the rear of the grate, and removable longitudinal bars provided with downwardly-bent ends adapted to be dropped into holes in the dead-plate for supporting the entering light fuel, substantially as set forth.

6. In a boiler, the combination, with a fire-box provided with an opening for light fuel, of a removable dead-plate supported above the said opening for preventing the too rapid ignition of the fuel, and longitudinal bars projecting from the rear of the said dead-plate for guiding the fuel and permitting it to burn freely in the middle and rear portions of the fire-box, substantially as set forth.

7. In a boiler, the combination, with a fire-box provided with an opening for light fuel at its front and a tube-plate at its rear, of a baffle-plate projecting from the said tube-plate and provided with a bar at its front end extending across the fire-box, a series of removable bars depending vertically from the said bar and adapted to retain the burning light fuel below the said baffle-plate, substantially as set forth.

8. In a boiler, the combination, with a fire-box and a grate supported therein, of a plate pivoted between the grate and the end plate of the fire-box, said plate being heavier upon that side of its pivot next the grate and curved downwardly beyond the said pivot, and an arm projecting downwardly from the said plate, whereby the plate may be oscillated to crush and grind the clinkers against the end plate of the fire-box, substantially as set forth.

9. In a boiler, the combination, with a fire-box and a grate supported therein, of an oscillatory curved plate journaled at the rear of the said grate and adapted to be raised to crush and grind the cinders against the end plate of the fire-box, substantially as set forth.

In testimony whereof I affix my signature in presence of two witnesses.

FRANK F. LANDIS.

Witnesses:

HERBERT W. T. JENNER,

E. R. R. HOYT.