No. 652,110. Patented June 19, 1900.

F. J. HUGHES & G. M. BISHOP.

FURNACE.

(Application filed Dec. 27, 1899.)

(No Model.)

Fig. 1.

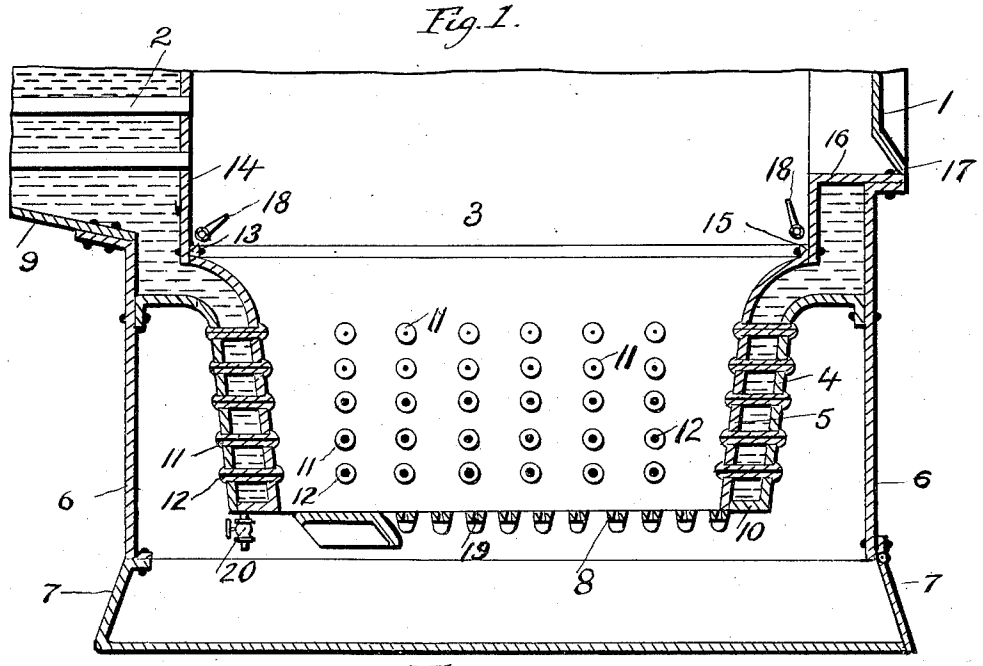
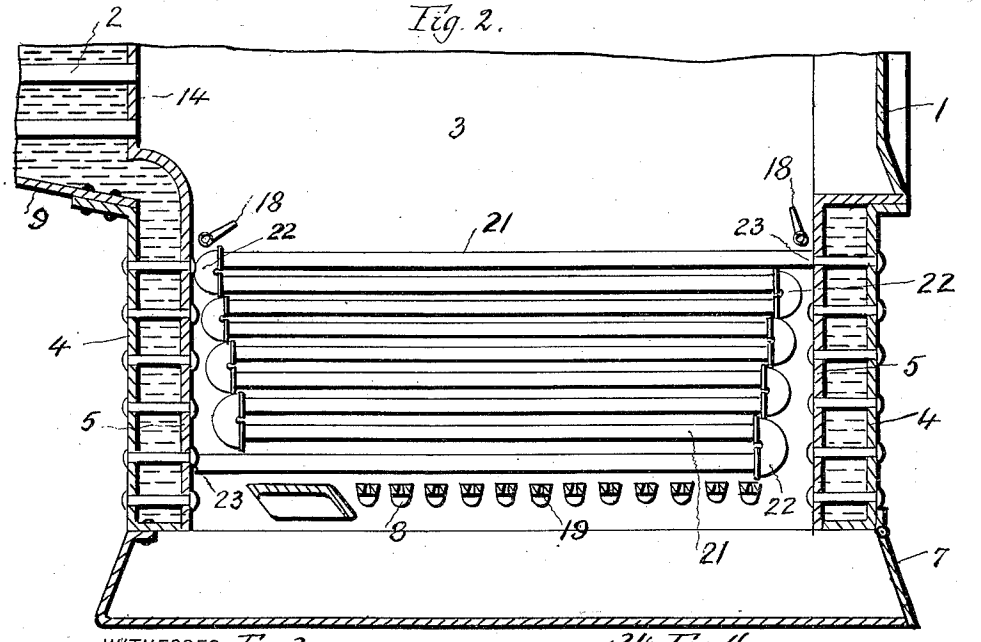


Fig. 2.



WITNESSES: Fig. 3.

N. L. Bogan

Arthur Haymaker

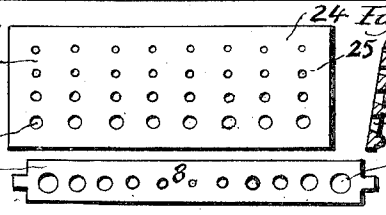


Fig. 5.

Fig. 4.

INVENTORS

Frank J. Hughes and

George M. Bishop

BY

N. C. Evarts & Co

ATTORNEYS

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

FRANK J. HUGHES AND GEORGE M. BISHOP, OF PITTSBURG, PENNSYLVANIA.

FURNACE.

SPECIFICATION forming part of Letters Patent No. 652,110, dated June 19, 1900.

Application filed December 27, 1899. Serial No. 741,765. (No model.)

To all whom it may concern:

Be it known that we, FRANK J. HUGHES and GEORGE M. BISHOP, citizens of the United States of America, residing at Pittsburg, in the county of Allegheny and State of Pennsylvania, have invented certain new and useful Improvements in Furnaces, of which the following is a specification, reference being had therein to the accompanying drawings.

Our invention relates to certain new and useful improvements in steam-boiler furnaces, and a furnace constructed in accordance with our invention is particularly adapted to consume all the combustibles contained in the fuel, thereby increasing the temperature of the heat and obtaining a considerable saving in the consumption of fuel.

One object of our invention is to construct a furnace of this class with means to supply air to the fire-box in a graduating manner, causing the fire to burn more evenly and increasing the temperature of the same without an additional charge of fuel for attaining this purpose, or, in other words, thoroughly utilizes all the combustibles contained in the fuel, thereby obtaining this increased temperature for generating steam more rapidly at a considerable saving in the consumption of fuel.

A further object of our invention is to construct a furnace in which the natural tendency of the smoke and combustibles to be drawn outward through the flues before they can be consumed will be restrained and these combustibles held within the furnace until such time as they may be consumed without in any manner interfering with the natural draft of the furnace.

A further object of our invention is to construct our furnace with improved grate-bars which are provided with a series of openings graduating in size from the center of the bar toward each end, dispensing thereby with the use of the usual slot and obtaining by this construction a stronger and more durable bar.

Briefly described, our invention consists of forming the fire-box of the furnace with a water-jacket the walls thereof connected together by a series of stay-bolts provided with openings graduating in size from the bottom of the fire-box upwardly, forming the grate-bars with a series of graduating openings, and arranging a series of steam-jets for the injection of steam into the furnace above the fire to arrest the smoke and combustibles as they pass toward the flues and force the same backward into the fire-box to be consumed.

Our invention finally consists in the novel construction, combination, and arrangement of parts to be hereinafter more fully described, and specifically pointed out in the claims.

In describing the invention in detail reference is had to the accompanying drawings, forming a part of this specification, and wherein like numerals of reference indicate corresponding parts throughout the several views, and in which—

Figure 1 is a longitudinal sectional view of a boiler, partly broken away, showing our improved arrangement of fire-box and graduated openings for the passage of air to the fire-box. Fig. 2 is a similar view of a modified form of construction. Fig. 3 is a front plan view of a modified form of plate which is used instead of stay-bolts, the plate being provided with a series of graduated openings. Fig. 4 is a vertical sectional view thereof. Fig. 5 is a top plan view of one of the grate-bars.

Referring to the drawings by reference-numerals, 1 indicates the door of the furnace; 2, the flues thereof; 3, the fire-box, formed by the outer 4 and inner walls 5; 6, a sheet surrounding the fire-box, provided with a converging end 7; 8, the grate-bars; and 9 a surrounding shell for the flues. The upper portion of the boiler-furnace is broken away, as shown.

The inner and outer walls of the fire-box are suitably spaced apart, forming a water-jacket which extends entirely around the fire-box. These inner and outer walls are closed at their lower end by means of a plate 10 and securely held apart and connected together by means of the stay-bolt 11, suitably connected thereto, and which are each provided with an opening extending entirely therethrough, as at 12. These openings graduate in size from the lower bolt upwardly, as shown. The upper end of one of the inner walls of the furnace is suitably connected, as at 13, to a flue-sheet 14, the opposite inner

wall being connected, as at 15, to an angle-iron 16, having one end thereof connected to the frame of the door, as at 17.

18 indicates a series of steam-jets, which are suitably connected to the dome of the boiler for injecting steam into the fire-box. These steam-jets may be arranged as desired within the fire-box; but one must positively be arranged near the flue-sheet 14, so when the steam is projected therefrom it will arrest and force backward into the fire-box the smoke and combustibles which are passing toward the flues, and one of these steam-jets must be arranged below the door of the furnace to inject steam inwardly to arrest any outward movement of the smoke and combustibles toward the furnace-door when the same is opened.

The grate-bars 8 are formed with a series of openings 19, graduated in size from the center toward each end, and the bars are suitably arranged at the bottom of the fire-box in any desirable manner.

20 indicates an exhaust-cock arranged at the bottom of the water-jacket surrounding the fire-box.

In the modified form of construction shown in Fig. 2 we dispense with the hollow stay-bolts, but arrange therein a series of pipe-sections 21 in a horizontal manner, coupled together at each end by the unions 22, with the exception of the upper and lower pipe-sections. One end of these sections is connected to the water-jacket, as shown at 23. Attention is called to the fact that these pipe-sections are arranged with an intervening space between them, graduating in size upwardly, and we obtain by this arrangement a circulation of air through and an even burning of the fire, owing to the fact that the passage of air through the fire graduates from the bottom upwardly. Otherwise than the arrangement of pipe-sections and dispensing with the hollow stay-bolt the construction of this modified form is identical with that set forth in Fig. 1.

In Fig. 3 is shown an inclined plate 24, provided with a series of openings 25, graduating in size from the bottom, and a series of which are adapted to be arranged within the fire-box, if desired, and rest upon the grate-bars. The inner face of the walls of the fire-box is provided with a suitable ridge or hook to receive the hooked end 26 of the plate for securing the same in position. When using these plates for forming the wall of the fire-box, the hollow stay-bolts are dispensed with, although the water-jacket surrounding the fire-box is shown. This form of plate we use in the construction of boilers with vertical sides set forth in Fig. 2.

We provide the fire-box with hollow stay-bolts graduating in size upwardly for the purpose of admitting a greater amount of air at the bottom of the fire, thereby causing it to pass through the entire body thereof and greatly increasing the temperature of the same than if the holes were all of the same size, these graduating holes obtaining a more even burning of the fire over the entire thereof, and dispenses with the use of the ordinary diaphragm-sheet in the front end of the boiler, and, furthermore, as the fire-box is entirely surrounded by the water-jacket it will be seen that the same will stand the increased temperature as well as the other parts of the furnace. The air admitted to the fire-box is not taken directly from the outside, but is drawn into the fire from the ash pan or pit, owing to the arrangement of the sheet 6 around the fire-box, and by placing this sheet in the position shown the air-space between the inner face thereof and the walls of the fire-box is made very much smaller, which enables the steam-jets flowing in the direction as heretofore stated to create a vacuum and draw the air up through the fire.

The grate-bars are provided with a series of holes graduating from the center toward each end, which will admit the air to the bottom of the fire-box in the same manner as the ordinary grate-bars, and by this arrangement in a locomotive we are able to use a very much larger nozzle, which is a great saving of machinery and increases the speed of the engine, as well as decreasing the consumption of fuel. Furthermore, the grate-bars will be much stronger and more durable and also not permit so much fire to drop through the same to the ash-pan.

By arranging the sections of pipe with a different-sized air-space between them, as well as the hollow stay-bolts graduating in size, as heretofore stated, the air is regulated in its passage through the fire—that is to say, owing to the fact that a greater amount of fire is at the lower portion of the fire-box a greater charge of air is necessary to increase the draft properly—and owing to the fact that the fire at the top of the fire-box is of a smaller quantity it will not be necessary to have a greater amount of air passing therethrough as the air necessary for the lower part of the fire. Furthermore, this arrangement of graduated air-openings will overcome the objection as to having the openings all of one size. For example, on a locomotive the strong draft caused by the exhaust pushes the fire away from the top holes, and then the air all passes through the top openings without engaging the fire, the graduated openings overcoming this, for the reason that the small openings at the top permit only a small passage of air, and the air desiring an outlet will pass through the larger holes at the bottom, increasing combustion and causing an even burning. This could not be accomplished if the graduating openings were dispensed with.

The arrangement of the steam-jets within the fire-box prevents the smoke and combustibles from passing through the flues and out of the door and forces the same back upon

the fire, where the heat is so intense that they are readily consumed.

It will be evident that in connecting the pipes to the water-jacket a circulation of water is obtained, and, as heretofore stated, by gradually increasing the spaces between the pipe-sections the passage of air will cause an even burning of the fire.

Having thus fully described our invention, what we claim as new, and desire to secure by Letters Patent, is—

1. In a steam-boiler furnace, a water-jacketed fire-box, and means extending through said water-jacket for feeding air to the fire-box in a graduating manner.

2. In a steam-boiler furnace, a fire-box suitably arranged therein and provided with means to permit of the feeding of air therethrough in a graduating manner, and means arranged in said fire-box for injecting steam therein to arrest the passage of smoke and combustibles through the boiler-flues.

3. In a steam-boiler furnace, a fire-box, grate-bars therefor provided with a series of graduating openings, means connected to said fire-box and adapted to permit of the feeding of air thereto in a graduating manner, and means for injecting steam in said fire-box to arrest the passage of smoke and combustibles through the flues of the furnace.

4. In a steam-boiler furnace, a fire-box, grate-bars therefor provided with a series of graduating openings, means connected to said fire-box and adapted to permit of the feeding of air thereto in a graduating manner, and means for injecting steam in said fire-box to arrest the passage of smoke and combustibles through the flues of the furnace, and separate means for injecting steam into the fire-box to assist in creating combustion.

5. In a steam-boiler furnace, a fire-box, means suitably connected thereto and adapted to permit of feeding air therethrough in a graduating manner, means arranged in said fire-box to inject steam therein to arrest the passage of smoke and combustibles through the flues of the furnace and force the same onto the fire for consumption, and separate means arranged in the fire-box for injecting steam therein to increase the combustion of the fuel.

6. In a steam-boiler furnace, a fire-box, means suitably connected thereto and adapted to permit of the feeding of air therethrough in a graduating manner, a series of grate-bars arranged at the bottom of said fire-box and provided with a series of graduating openings, means arranged in said fire-box to inject steam therein to arrest the passage of smoke and combustibles through the flues of the furnace forcing the same onto the fire for consumption, and separate means arranged in the fire-box for injecting steam therein to increase the combustion of fuel.

7. In a steam-boiler furnace, a water-jacketed fire-box, a suitable inclosure for the same, a series of stay-bolts arranged in said jacket and each provided with an opening so arranged that they will graduate upwardly, suitably-supported grate-bars arranged at the bottom of the fire-box and provided with graduating openings, means arranged in said fire-box for injecting steam therein at the front of the boiler-flues to prevent the passage of the smoke and combustibles therethrough and to force the same back onto the fire for consumption, and separate means arranged in the fire-box for injecting steam in the furnace to increase combustion.

In testimony whereof we affix our signatures in the presence of two witnesses.

FRANK J. HUGHES.
GEORGE M. BISHOP.

Witnesses:
JOHN NOLAND,
ALBERT J. WALKER.