(No Model.) 2 Sheets—Sheet 1.

W. HARMAN.

COMBUSTION DEVICE FOR STEAM BOILER FURNACES.

No. 287,670. Patented Oct. 30, 1883.

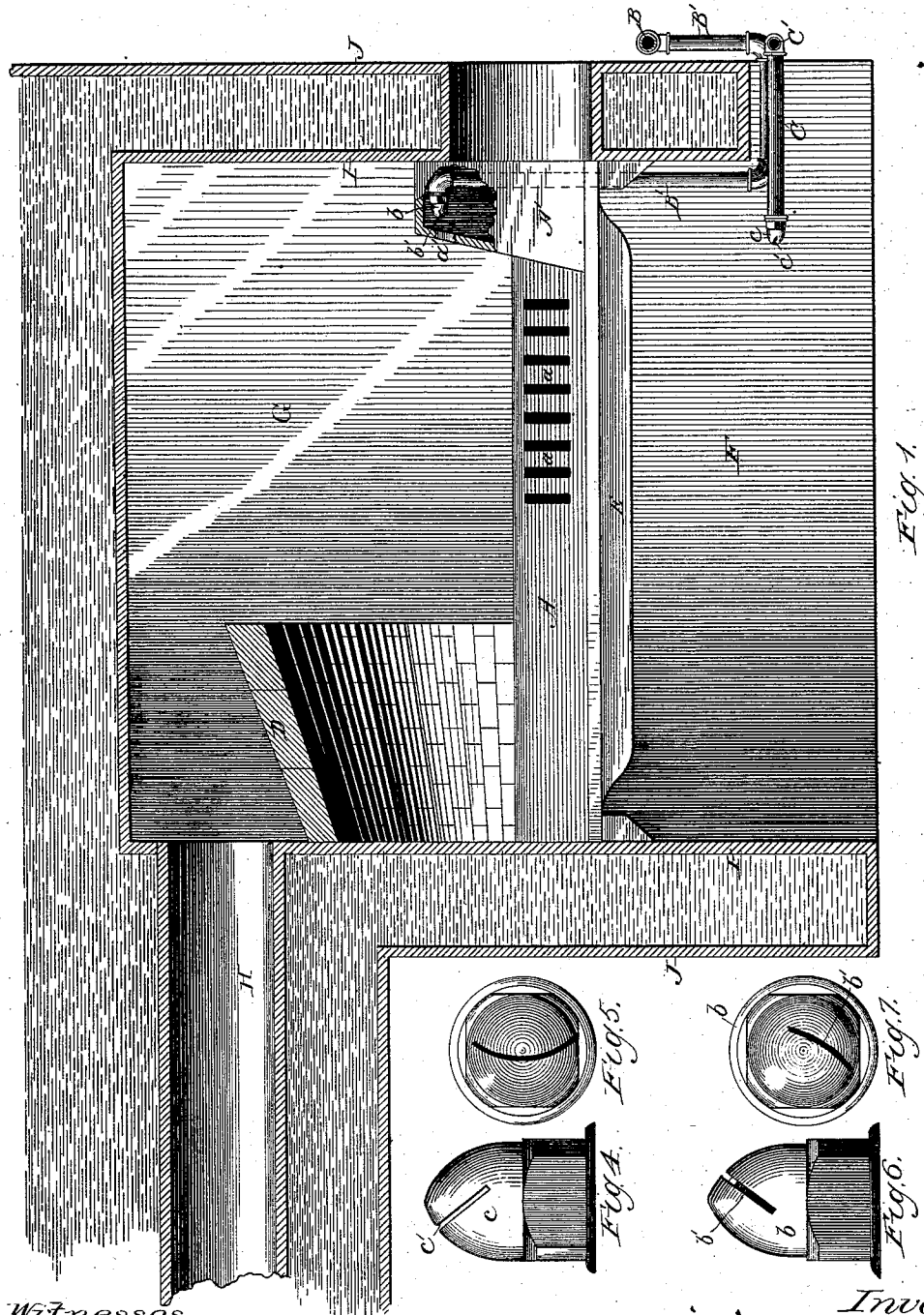


Fig. 1.

Fig. 5.

Fig. 7.

Fig. 4.

Fig. 6.

Witnesses.
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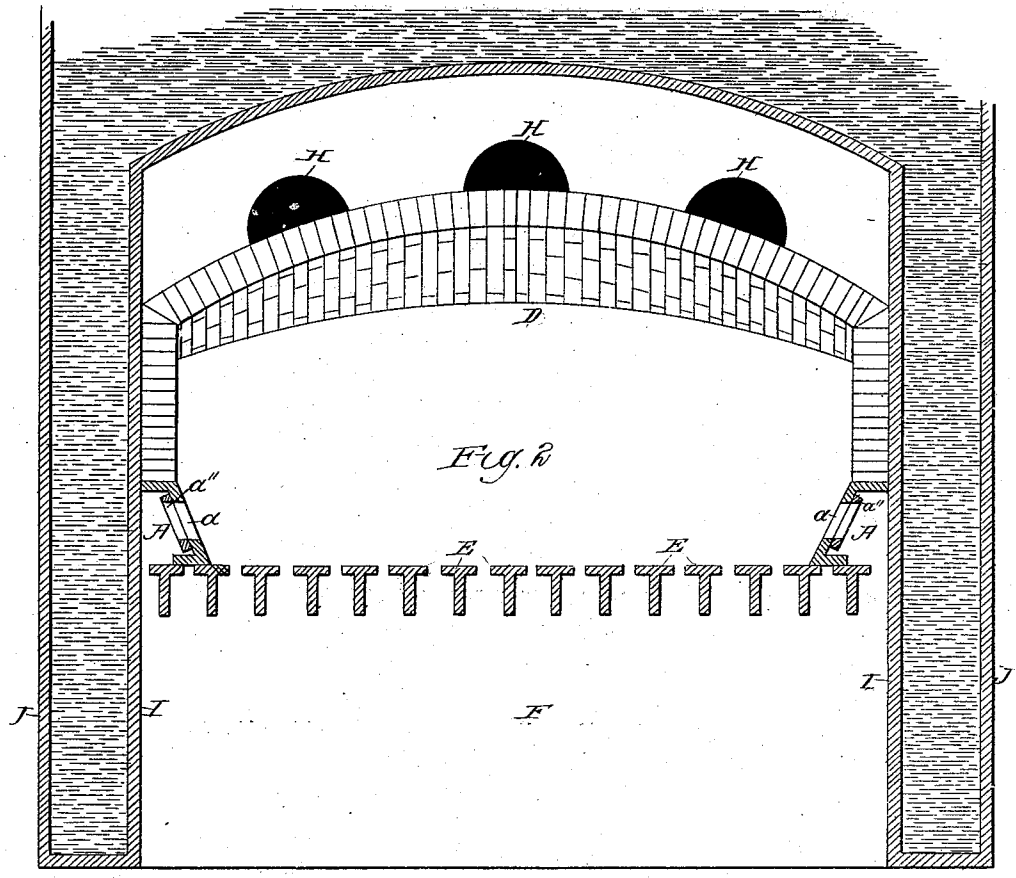


Fig. 2.

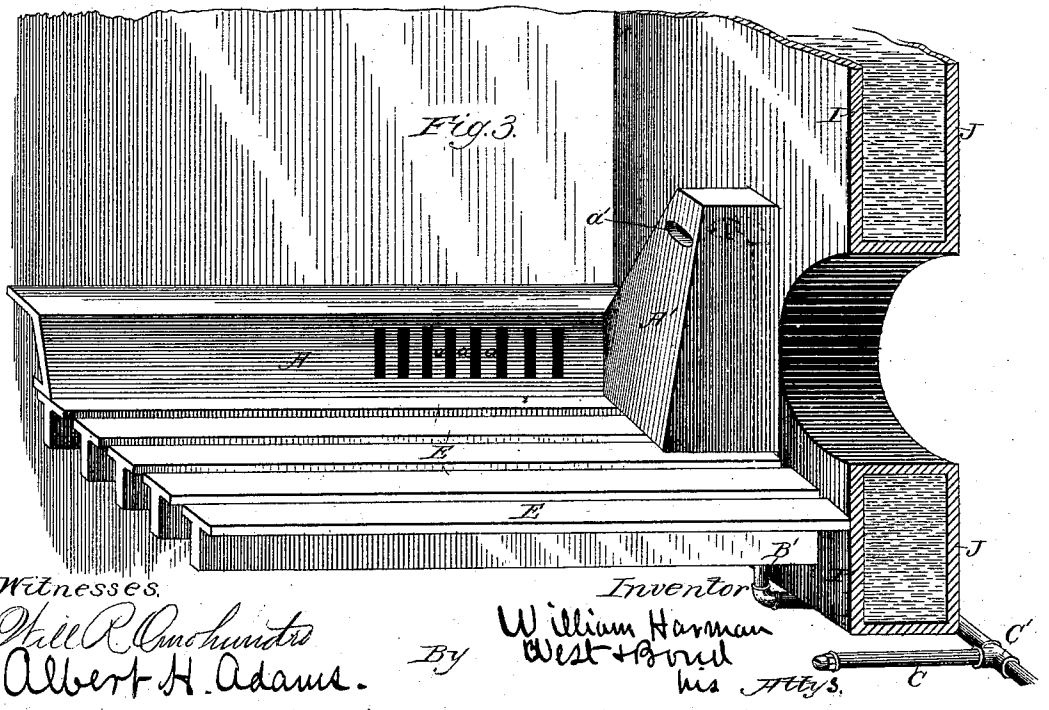


Fig. 3.

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UNITED STATES PATENT OFFICE.

WILLIAM HARMAN, OF CHICAGO, ILLINOIS.

COMBUSTION DEVICE FOR STEAM-BOILER FURNACES.

SPECIFICATION forming part of Letters Patent No. 287,670, dated October 30, 1883.

Application filed August 11, 1883. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM HARMAN, residing at Chicago, in the county of Cook and State of Illinois, and a citizen of the United States, have invented new and useful Improvements in Combustion Devices for Steam-Boiler Furnaces, of which the following is a full description, reference being had to the accompanying drawings, in which—

Figure 1 is a longitudinal section, showing the fire-box end of a "marine boiler," so called, with the combustion devices applied thereto; Fig. 2, a cross-section of the same; Fig. 3, a detail in perspective and partly in section, showing one side of the fire-chamber; Figs. 4 and 5, details showing the form of jet-nozzles used beneath the grate-bars; and Figs. 6 and 7, details showing the form of jet-nozzles used above the grate.

This invention relates to devices to be applied to marine and other steam-boilers for the purpose of producing a perfect combustion of the fuel used, and thereby prevent the eruption of smoke from the stack or chimney, and has for its object to accomplish the desired result in an efficient and reliable manner; and its nature consists in providing on each side of the fire-pot a hot-air flue, from which the air is projected in a forcible manner, by the use of a steam-jet nozzle, over the surface of the fuel and beneath an arch located at the rear end of the fire-box, carrying the unconsumed products of combustion therewith, to be returned over the live fire or coals and subjected to an intense heat before escaping through the flues; and, also, in providing a steam-jet nozzle located beneath the grate-bars in the ash-pit, for projecting a spray of steam upward toward the arch at the rear end of the fire-pot, as hereinafter more specifically described, and pointed out in the claims.

In the drawings, A represents the hot-air flues, one located on each side of the fire-box above the grate-bars, as shown in Fig. 2, the lower face of the flue resting, as shown, on the grate-bars; but the flues may be supported in any other suitable manner. The side of the flue which is adjacent to the fuel is provided with a series of openings or slots, *a*, for the admission of hot air from above the grate-bars in the fire-chamber, and, as shown, the bottom of the flue does not extend to the side of the fire-box, and a space is left, forming an opening for the admission of hot air from beneath the grate-bars. The rear end of each flue is closed, and at the front end is provided a well, A′, formed as shown in Figs. 1 and 3, or in any other suitable manner, to have its interior in free communication with the interior of the hot-air flue A, to which it is connected or attached, and at the upper end of which well A′ is a slot or opening, *a′*, as shown in Figs. 1 and 3. As shown, the openings *a* in the hot-air flue are provided with a sliding plate, *a″*, which forms a damper, by which the supply of air through the opening *a* to the flue can be regulated, the plate or damper *a″* being operated in any suitable manner from the front end of the furnace.

B is a steam-pipe taking its supply of steam from the boiler or other suitable source of supply, the pipe being located, as shown, in front of the furnace, and having suitable connections with the boiler or other source of supply, which connections may be of any of the usual and well-known forms. From the pipe B a supply-pipe, B′, for each hot-air flue A is led, each pipe B′ being suitably connected with the pipe B, and, as shown, passing down, and thence in through the opening for the ash-pit, and thence up into the interior of the well A′, and terminating at its upper end in line with the slot or opening *a′* in the upper end of the well; and the terminal end of each pipe is provided with a jet-nozzle, *b*, having a slot, *b′*, the nozzle *b* for the right-hand pipe B′, which enters the right-hand well A′, having its slot *b′* cut to project the jet of steam downward and toward the left side of the fire-chamber, while the nozzle for the left-hand pipe has its slot *b′* cut to project the jet of steam down and toward the right side of the chamber, the result being that the jets of steam from the respective nozzles are projected down in opposite directions and toward or across each other in the direction of the rear end of the fire-chamber, the jets of steam passing out through the openings *a′* in the respective wells A′. This projecting of the jets of steam through the openings *a′* in the respective wells A′ produces a vacuum in such wells, into which the hot air from the respective flues A rushes, to

be projected out through the opening *a'* by the action of the steam from the nozzles *b*.

C is a steam-pipe receiving its supply from the boiler or other source of supply, the same as the steam-pipe B, which steam-pipe C, as shown, is located below the steam-pipe B in front of the furnace and the opening to the ash-pit, and from this pipe C a second pipe, C', leads to the ash-pit, on the end of which pipe C' is a jet-nozzle, *c*, having a slot, *c'*, which slot is cut equally on both sides of the center of the nozzle with an upward inclination, to project a jet of steam upward through the grate-bars toward the rear end of the fire-chamber, as shown in Figs. 1 and 3. The form of nozzle *c* and the manner of cutting the slot *c'* therein are shown in Figs. 4 and 5, and the form of nozzle *b* for the left-hand air-flue A and the manner of cutting the slot therein are shown in Figs. 6 and 7. For the right-hand air-flue the nozzle *b* will have its slot *b'* cut in the opposite direction from that shown in Fig. 7—that is, the main portion of the slot will be on the left side of the nozzle, instead of the right side, as shown in Fig. 7.

D is an arch, of fire-brick or other suitable material that will stand the heat, built at the rear end of the fire-chamber above the grate-bars, and having at its top an upward inclination to bring its forward end above the flues, as shown in Fig. 1. As shown, the side walls of this arch are built directly on the top of the hot-air flues A.

E represents the grate-bars, F the ash-pit, G the fire-chamber, H the escape-flue, I the interior walls of the boiler and furnace, and J the exterior walls, with the water-space between them, of one form of marine boilers, such as are used on tugs. The parts represented by the letters E F G H I J are of the ordinary form of construction and arrangement, and need not be specifically described, and it is to be understood that the combustion-producing devices are to be applied and used with other forms of marine boilers, and also with boilers of other descriptions, to do which all that is necessary is to locate the air-flue A on each side of the fire-chamber above the grate-bars, with a free communication to their interior for the hot air from the fire-chamber and the ash-pit, and provide the wells A' at the front end of the fire-chamber, to communicate with the interior of the flue A, and locate steam-pipes to enter the walls and project the steam from a jet-nozzle through the openings *a'* diagonally across the fire-chamber in opposite directions toward the rear end of the chamber, and arrange the steam-pipe to project the steam from a jet-nozzle upward through the grate-bars centrally of the fire-chamber and toward the rear thereof, and provide an arch, D, at the rear end of the fire-chamber, for the projected steam-jets from respective nozzles to enter and impinge against.

The operation is as follows: Fire is built upon the grate-bars in the fire-chamber, as usual, and the fresh fuel, as it is supplied, is placed at the front of the chamber on the bars, the ignited and partly-consumed fuel being pushed back. The hot air from the fire-chamber passes into the flues A on each side through the openings *a*, while hot air is also supplied to these flues from the ash-pit through the opening in the bottom of the flues, and this hot air, by reason of the vacuum created in the wells A', rushes into such wells, and is projected out through the openings *a'* with the steam from the nozzles *b*, intermingling with the steam, and by reason of the downward direction given to the jets of steam by the inclined slits *b'* this blast of mingled hot air and steam cuts the products of combustion arising from the fresh fuel, and prevents such products from rising, and carries them over the hot coals or partially-consumed fuel toward the rear end of the fire-chamber, subjecting them to the intense heat of the partially-consumed fuel, by which the unconsumed products will be burned, and such products as are not burned will be carried into the space beneath the arch, to be again returned over the hot coals or partly-consumed fuel before they can escape, when the combustion of such unconsumed products will be effectually completed.

It will be noticed that the mingled air and steam over each side of the furnace is projected downward and diagonally toward the opposite side, while the mingled air and steam from the ash-pit is projected upward, the result being that the three streams thus projected produce beneath the arch a whirling of the mingled air and steam with the unconsumed products of combustion, by which such unconsumed products will become thoroughly mixed with the steam and air, so as to be readily consumed as they pass from beneath the arch over the live coals or partially-consumed fuel to enter the exit-flue; and this whirling motion given to the air, steam, and unconsumed products of combustion tends largely to separate the unconsumed products, thereby producing a thorough mixing or intermingling of the air, the steam, and unconsumed products, by which the combustion of such products will be insured.

Instead of the common supply-pipe, B, for the pipes B', leading to the hot-air flues, these pipes B' might both be led, independently, directly to the source of supply, and they could be made to enter the wells A' in some other manner than passing up from the ash-pit; but in any case they are to terminate so as to bring their nozzles in line with the opening *a'* of the respective wells, to project the mingled stream of hot air and steam downward and in opposite directions over the fire.

The arch D is to be located and arranged at the rear end of the fire-chamber to suit the form of chamber, and could be supported otherwise than from the air-flues.

What I claim as new, and desire to secure by Letters Patent, is as follows:

1. The combination of a hot-air flue on each

side of a fire-chamber, communicating with wells at the front of the fire-chamber, with steam-pipes leading into the wells, and projecting steam downward, rearward, and diagonally, and an arch at the rear end of the fire-chamber, substantially as and for the purpose specified.

2. The hot-air tubes A, one on each side of a fire-chamber, wells A′, communicating with the flues and having openings *a′* at their upper ends, steam-pipes B′, one entering each well, and having a nozzle, *b*, as described, in combination with an arch, D, for projecting commingled currents of hot air and steam directly over the fuel to carry the unconsumed products of combustion beneath the arch, substantially as and for the purpose specified.

3. The hot-air flues A, one on each side of the fire-chamber, wells A′, communicating with the hot-air flues, steam-pipes B′, entering the wells, and a steam-pipe, C, entering beneath the grate-bars, the steam-pipes B′ and C having nozzles *b c*, respectively, constructed as described, in combination with an arch, D, substantially as and for the purposes specified.

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Witnesses:
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ALBERT H. ADAMS.