(No Model.) 2 Sheets—Sheet 1.

R. H. LAIRD.

HEATER.

No. 523,477. Patented July 24, 1894.

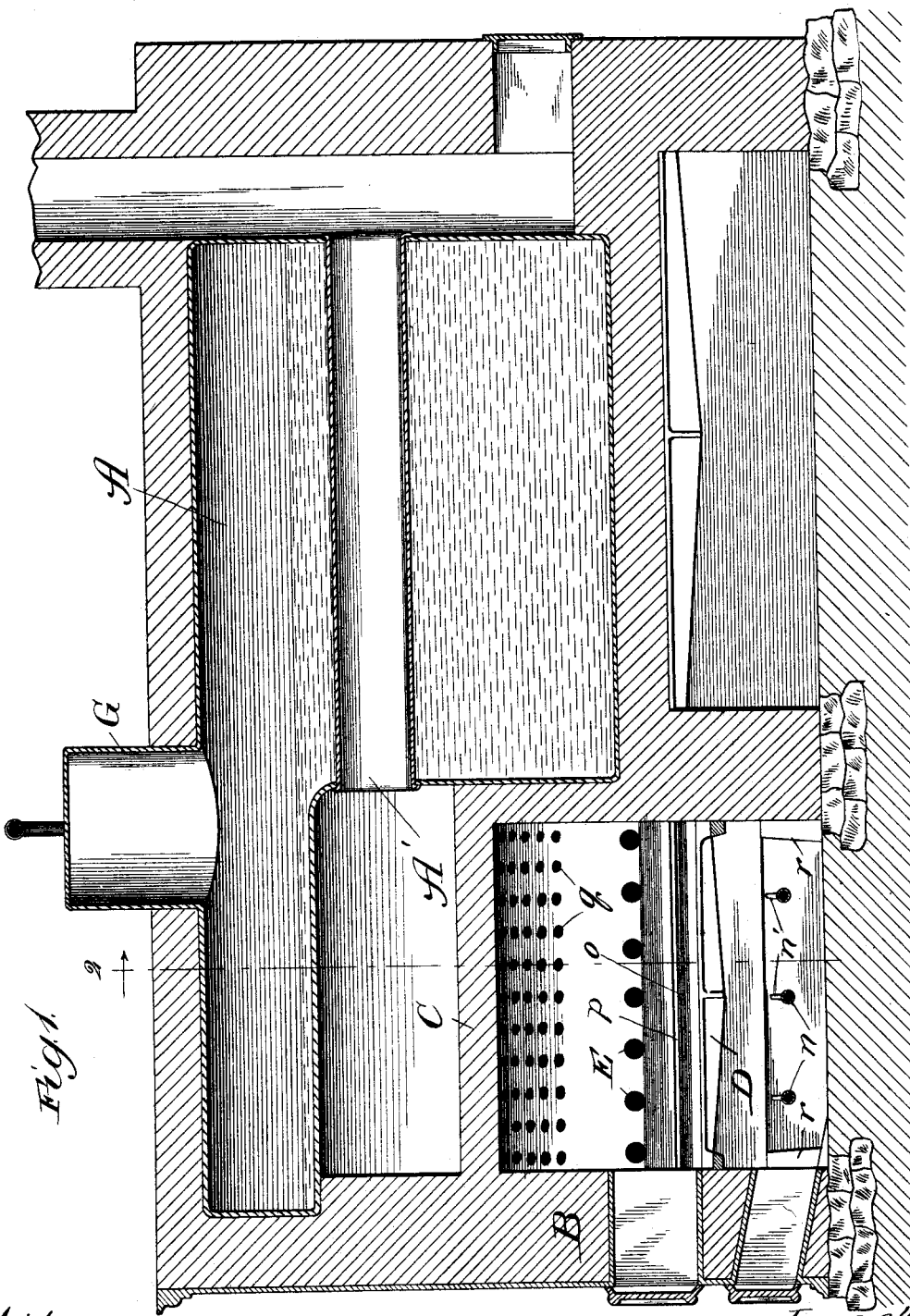

Fig. 1.

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(No Model.) 2 Sheets—Sheet 2.

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HEATER.

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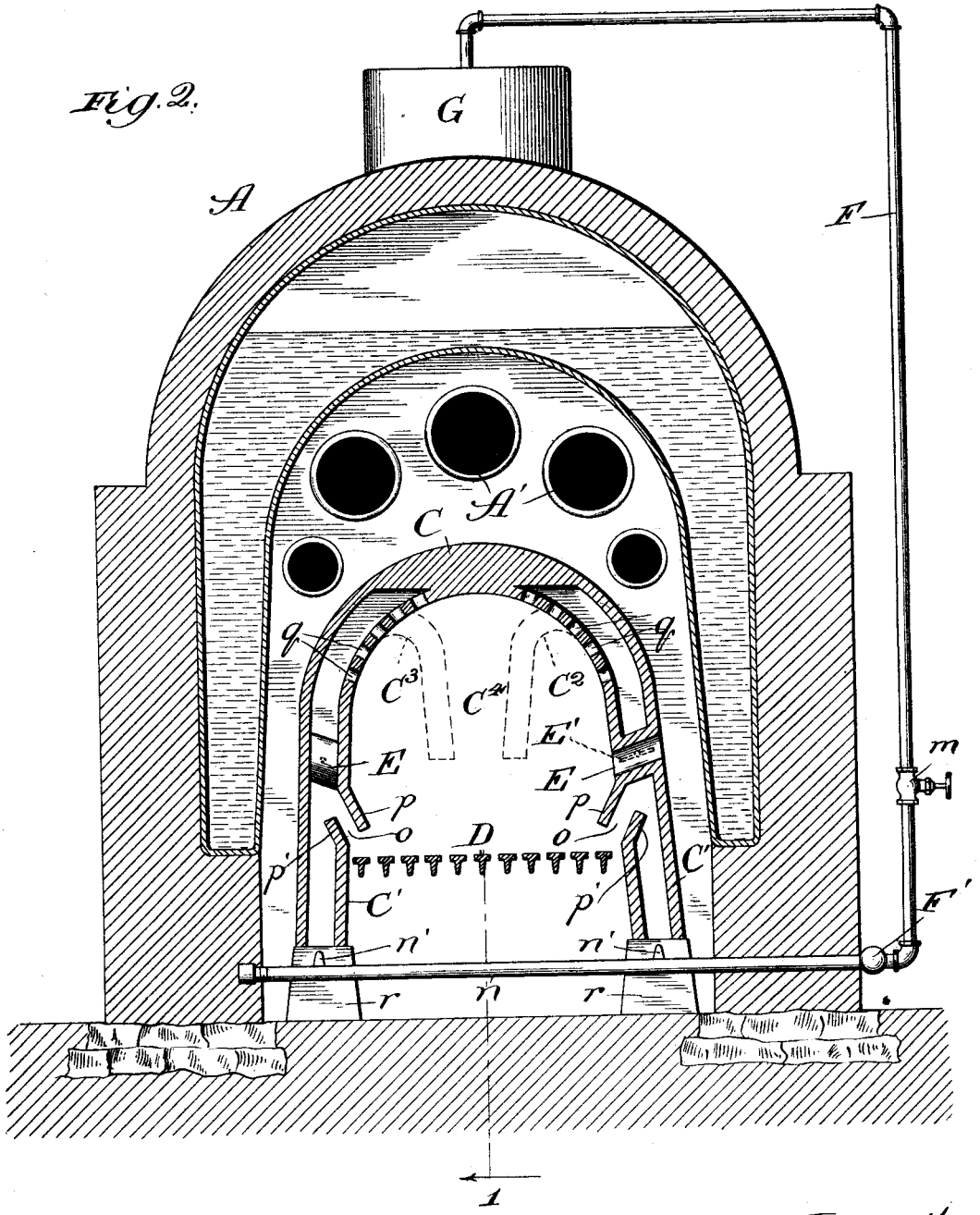
Fig. 2.



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Chas. E. Gaylord,
Luth. L. Alter.

Inventor.
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UNITED STATES PATENT OFFICE.

ROBERT H. LAIRD, OF CHICAGO, ILLINOIS, ASSIGNOR TO WILLIAM HENRY LAIRD, OF NEW YORK, N. Y.

HEATER.

SPECIFICATION forming part of Letters Patent No. 523,477, dated July 24, 1894.

Application filed November 2, 1893. Serial No. 489,822. (No model.)

To all whom it may concern:

Be it known that I, ROBERT H. LAIRD, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented a new and useful Improvement in Heaters, of which the following is a specification.

My invention relates, more particularly stated, to an improvement in means for promoting the combustion of fuel in the class of heating apparatus generally wherein solid fuel, (coal) is burned, more usually, on a grate, thus including heaters (stoves and furnaces) for domestic purposes as well as power-plant and other furnaces.

My object is to provide a construction of the fuel-chamber whereby the products of combustion from the burning fuel-bed, preparatory to their escape to exert their heat upon the object to be heated, shall be mixed with air by passing them through a chamber for the purpose, and thence directed against the flames rising from the fuel-bed, the chamber forming a species of hood over the fire and tending to confine the products of combustion the longer in the fuel-chamber and thus increase to the utmost their degree of combustion before they are allowed to escape.

To illustrate my invention I show it as embodied in a furnace applied to a steam-generating boiler in the accompanying drawings, in which—

Figure 1 is a view in longitudinal sectional elevation, the section being taken at the line 1 on Fig. 2 and viewed in the direction of the arrow; and Fig. 2 is a section taken at the line 2 on Fig. 1 and viewed in the direction of the arrow.

A is a variety of steam-boiler well-known in the art and requiring no detailed explanation as it forms no part of my invention, the latter not being limited to any particular construction of boiler or other medium through which to transmit the heat of the products of combustion generated by my improved furnace B.

The furnace B is shown as built into the forward end-portion of the boiler in position to direct the products of combustion generated in it through the longitudinal boiler-flues A′ to the stack A^2.

I provide the furnace B with a hollow-arch structure C, which should extend the full length of the furnace-chamber and rest at the bases of its legs C′ on piers *r*, placed at proper intervals; the structure C being formed with suitable incombustible material, preferably fire-brick. The arch-structure thus affords a species of hood over the grate D, or fuel-chamber, and is provided in its inner wall with numerous outlet-openings *q*. Near the top of the grate, in the opposite inner walls of the leg-portions of the arch-structure, are openings *o*, in any desired number, leading from the fuel-chamber into the interior of the arch near its base and each being formed with parallel oblique shelves or diaphragms *p* and *p′*; and above the plane of the openings *o*, are flues E extending through the walls of the arch to direct the products of combustion from the fuel-chamber into the space surrounding the arch or hood, whence the boiler-flues A′ lead. A steam-conduit F leads from the dome G to a manifold F′, whence extend, at intervals below the grate, across the ash-pit, steam-pipes *n* having jets *n′* at points where they serve to inject steam into the open bases of the arch-legs C′; and the conduit F contains a valve *m* for controlling the steam supply.

The operation is as follows: The products of combustion rising from the bed of burning fuel on the grate (and which bed should not extend above the base of the flues E) are drawn by the air-suction through the open bases of the arch-structure into the mixing-chamber afforded by the hollow arch. This air-suction may, when desired, be increased by steam forced into the base of the mixing chamber from the nozzles *n′*, with the further advantage of the effect of the steam on the products of combustion, particularly if it be superheated. Combustion is thus further promoted in the arch-structure by the addition of the oxygen of the air-supply, which moreover adapts the products of combustion to take up more carbon. This they do by passing from the openings *q* through the flames rising from the bed of fuel, wherein the confinement, afforded by the hood which the arch-structure provides over the fuel-chamber, holds them the longer in the lat-

ter. By the time the products of combustion pass through the flues E, they have been enriched by the additional carbon they take up from the flames in passing through them from the mixing-chamber in the hood. To suggest the change that takes place in the combination of the products of combustion between their first leaving the fuel-chamber by the openings *o* and finally by the flues E, it may be described as a conversion of CO_2 to CO, as though in passing from the mixing-chamber through the flames in the fuel-chamber to the outlet-flues, they take up an additional atom of carbon.

As will thus be seen, the effect of my improved structure is to produce, in a single furnace-chamber, a return to the fuel-chamber of the products of incomplete combustion taken from it; and, by prolonging their confinement in the fuel-chamber under subjection therein to the flames rising from the fuel-bed, thoroughly mixing the two and reducing them to a condition of complete, or much more complete, combustion before allowing their escape to the object to be heated, as the boiler A.

I indicate, by dotted representation in Fig. 2, a modification of my improved construction, which will, in a desirable measure, at least, produce the same result as that described. This modification, which I intend to be included as within my invention, consists in forming the hollow arch C in two sections C^2 and C^3, the outer legs of which, as in the form described, rest at their open bases on the piers *r*, the inner ends however being disunited and open at their extremities and bent to extend downward over the fire, whereby a passage is formed between them for the escape of the products of combustion into the space surrounding the arch-structure, whence they enter the boiler-flues A′. With this form of the construction the flues E, if provided, though they may be dispensed with, contain dampers E′ (indicated by dotted lines in Fig. 2) to adapt them to be closed and thus render the passage C^4 the only ultimate outlet for the products of combustion.

The effect of the modified construction is also, obviously, to take the products of combustion from the fuel-bed through the mixing-chambers afforded by the arch sections C^2 and C^3, therein mix them with air or air and steam, and return the mixture to the fuel-chamber into the rising flame, the bent inner ends of the arches being provided with numerous perforations, if desired, in their inner walls, in addition to the openings in their ends; and the hoods afforded by the arch-sections tend to confine the products of combustion in the fuel-chamber preparatory to their escape by way of the outlet C^4.

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

1. In a heater, the combination with the fuel-chamber and oxygen supply thereto of a hollow arch-structure in said chamber extending over the plane of the fuel-bed and having an outlet-flue through both of its walls and opening through the upper part of its inner-wall portion into the fuel-chamber and communicating near its base with the fuel-chamber and with the oxygen-supply, said arch-structure affording a mixing chamber operating to take the products of combustion upward through the arch, mix them therein with oxygen, and return them into and confine them in the fuel-chamber preparatory to their escape at said outlet-flue, substantially as and for the purpose set forth.

2. In a heater, the combination with the fuel-chamber of a hollow arch-structure supported therein and having an open base for the admission into it of oxygen, an outlet-flue for the products of combustion, extending through both of its walls, openings in its inner-wall portion leading into it from the fuel-chamber below the plane of the top of the fuel-bed, and return-openings to the fuel-chamber, in the upper part of its inner-wall portion, for the products of combustion from the arch-structure, substantially as and for the purpose set forth.

3. In a heater, the combination with the fuel-chamber of a hollow arch-structure supported at its open base therein and affording a mixing-chamber, said arch-structure having openings *o* extending into it from below the plane of the top of the fuel-bed and formed with oblique diaphragms *p* and *p′*, and openings in the inner wall of its upper hood-like portion for returning the products of combustion downward into the fuel-chamber and an outlet-flue for the escape of the products of combustion from the fuel-chamber, substantially as and for the purpose set forth.

4. In a heater, the combination with the fuel-chamber, of a hollow arch-structure C supported at its open base therein and forming a continuous hood over the fuel-chamber, and provided with openings *q* in the inner wall of its upper portion, oblique openings *o* entending into it near its base from below the plane of the top of the fuel-bed, and outlet-flues E above the plane of the openings *o*, substantially as and for the purpose set forth.

5. In a heater, the combination with the fuel-chamber of a hollow arch-structure C supported at its open base therein and forming a continuous hood over the fuel-chamber, and provided with openings *q* in the inner wall of its upper portion, oblique openings *o* extending into it near its base from below the plane of the top of the fuel-bed and outlet-flues E above the plane of the openings *o*, and steam-pipes *n* extending across the base of the arch-structure and provided with jets *n′* leading upward into the same, substantially as and for the purpose set forth.

ROBERT H. LAIRD.

In presence of—
M. J. FROST,
W. N. WILLIAMS.