

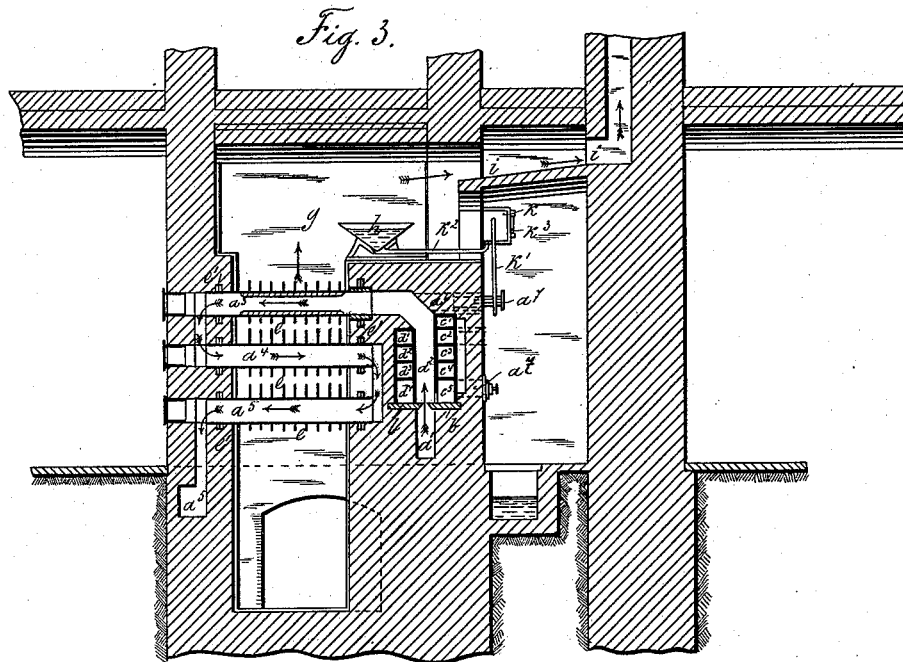
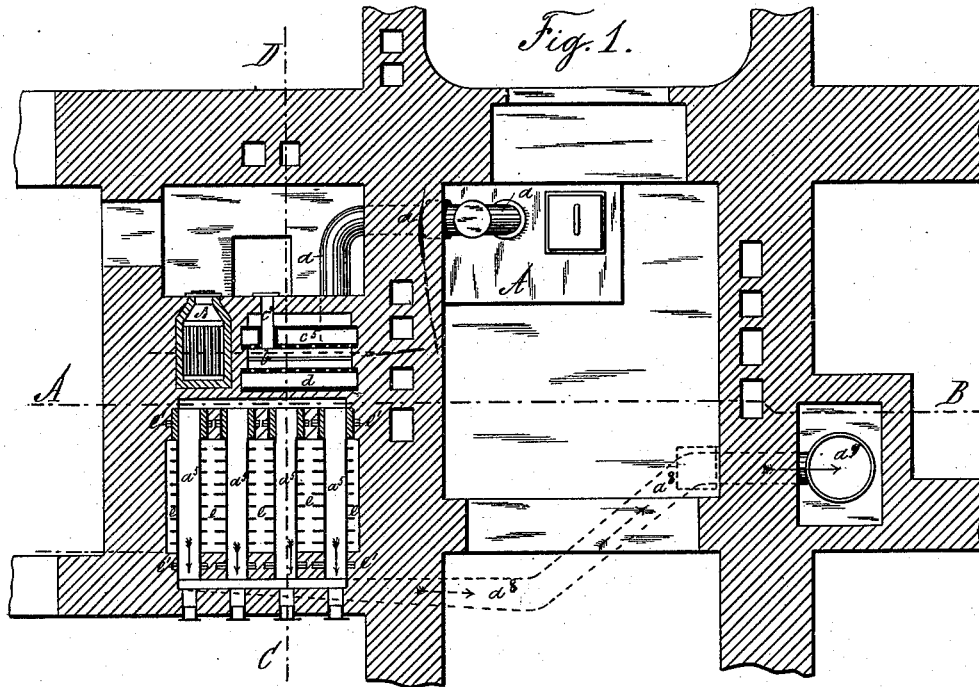
(No Model.)

3 Sheets—Sheet 1.

D. GROVE.  
AIR HEATER.

No. 384,203.

Patented June 5, 1888.



Witnesses.  
Anthony Steffen.  
Evan Lassert.

Inventor.  
David Grove.  
By his Attorneys.  
Edwin A. Bridges.

(No Model.)

3 Sheets—Sheet 2.

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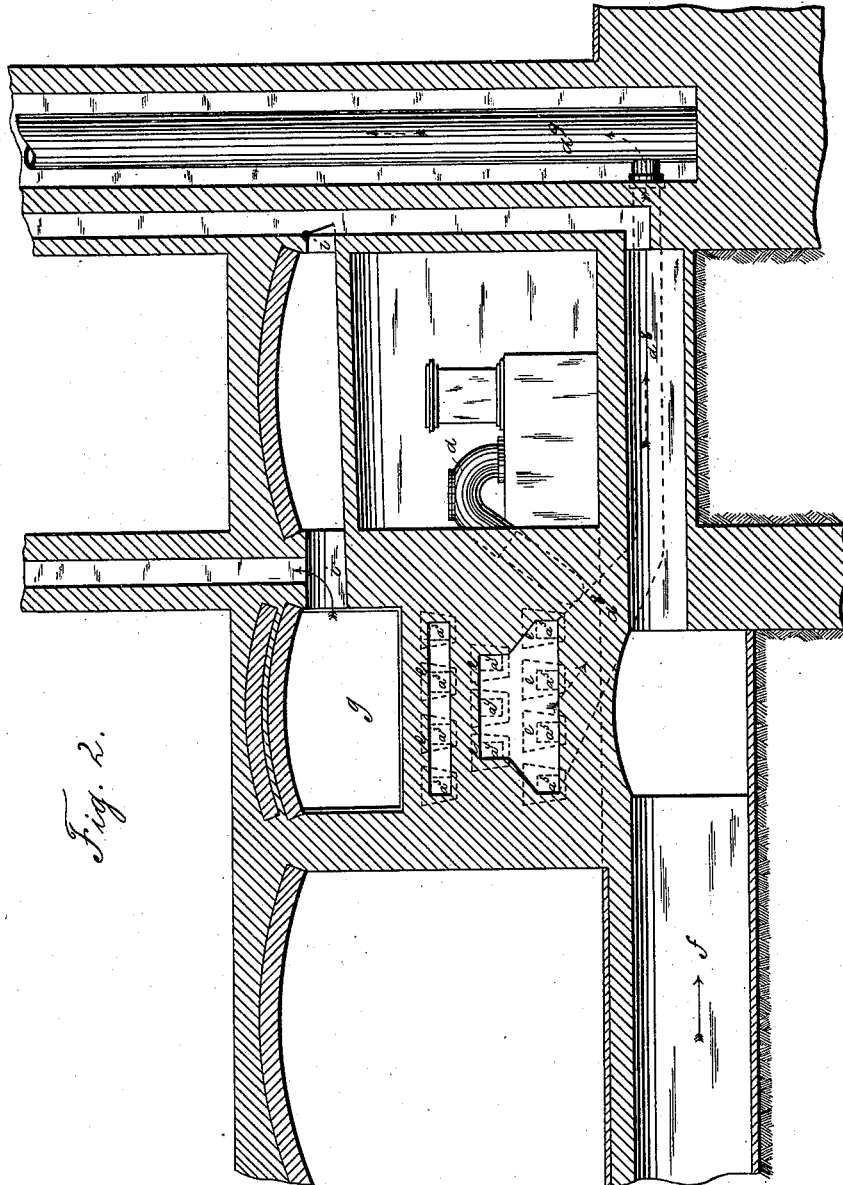


Fig. 2.

Witnesses,  
Anthony Steffen.  
Joan Lassert.

Inventor,  
David Grove.  
By his Attorney,  
Charles A. Bridges

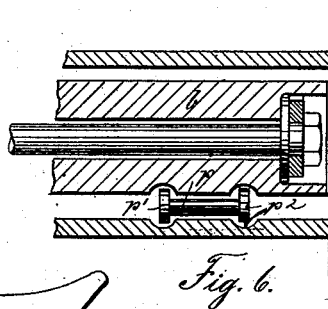
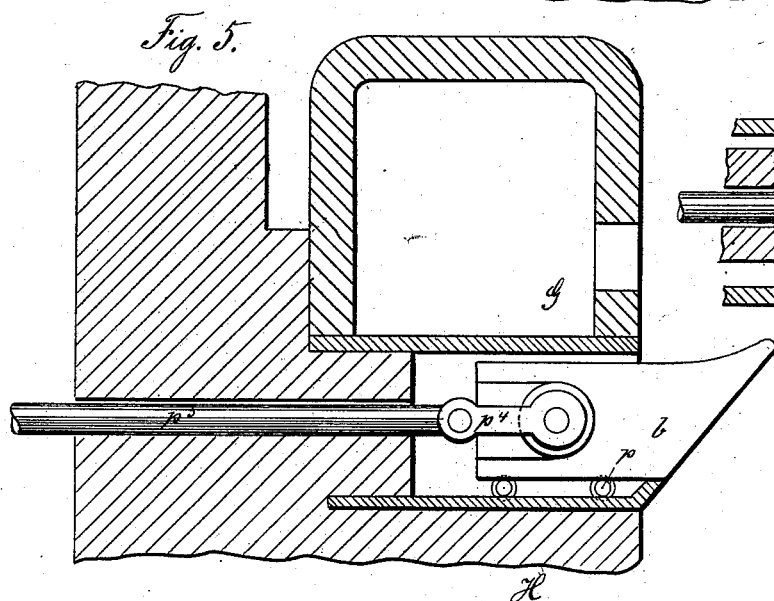
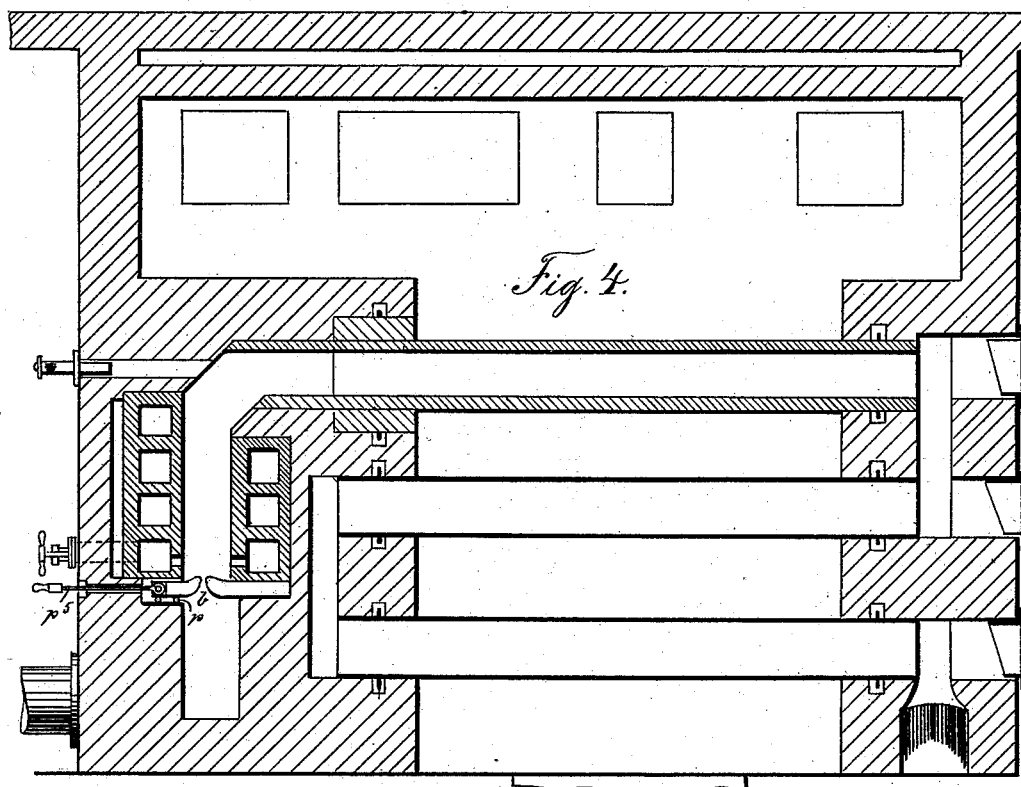
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3 Sheets—Sheet 3.

D. GROVE.  
AIR HEATER.

No. 384,203.

Patented June 5, 1888.



Witnesses.  
Anthony Spafford,  
John Lawton.

Inventor.  
David Grove,  
By his Attorney  
Edwin A. Bridges.

# UNITED STATES PATENT OFFICE.

DAVID GROVE, OF BERLIN, GERMANY.

## AIR-HEATER.

SPECIFICATION forming part of Letters Patent No. 384,203, dated June 5, 1888.

Application filed December 21, 1885. Serial No. 186,383. (No model.) Patented in Germany April 18, 1882, No. 20,730, and in England January 4, 1883, No. 61.

*To all whom it may concern:*

Be it known that I, DAVID GROVE, of the city of Berlin, Prussia, Germany, have invented certain new and useful Improvements in Air-Heaters, (which have been partly patented to me in Germany under No. 20,730, dated April 18, 1882, and in England under No. 61, dated January 4, 1883,) of which the following is a specification.

My invention relates to apparatus for heating dwellings, hotels, and the like by means of hot air, the heat being produced by the combustion of gas and air.

The present invention is to a certain extent an adaptation of the arrangement shown, described, and claimed by me in a pending application, Serial No. 182,969, (which is for an improvement in water-heaters,) to air-heaters.

To this end my invention consists in an arrangement of heating-tubes interposed between an inlet-pipe for the cold air and the flues leading to the rooms to be heated, the said heating-tubes being connected to each other, so as to form a continuous serpentine passage, the said tubes being arranged in series alongside of each other, and with one row above the other to any desired number. The lower flues of the series are in connection with the chimney, while the serpentine passage at the opposite end connects with a combustion-chamber, in which the combustion of the gas supplied from a suitable generator is caused by the introduction of heated air through a series of air-ducts, substantially as in the application above referred to, directly above the burner, the combustion taking place at this point, the heat and products of combustion passing from this point along the serpentine channel formed by the series of radiators and passing out through the chimney. In order to make the air moist and to prevent it from passing to the rooms to be heated in a hot dry state, I provide a water-receptacle within the chamber, which makes the air sufficiently moist. In order to allow the expansion and contraction of the radiator-tubes, I provide them with projections and support them loosely in sand.

Figure 1 is a top view or plan of an air-heating arrangement. Fig. 2 is a section of Fig. 1 on the line A B; Fig. 3, a section on the line C D in Fig. 1. Fig. 4 represents the heat-

ing-chamber of an air-heating arrangement with my improved adjustable burner. Fig. 5 is a view of the one cheek or jaw of the burner, and Fig. 6 a vertical section of Fig. 5 on the line G H.

The gases produced in the generator A, Fig. 1, pass through the pipe *a* into the flue or channel *a'*. From here they pass through the narrow orifices of the burner *b* into the combustion-chamber *a''*, where they come into contact with warmed atmospheric air. After the mixture of gas and air is ignited by means of a gas-jet or a rag impregnated with petroleum or any other suitable means, the burning gases stream through the cast-iron canals or flues *a'' a' a''* in a serpentine direction from one pipe into the other, and then enter into the chimney *a''* through a suitable flue, *a'''*.

The air for the combustion is heated in the interior of the canals or chambers *c' c'' c' c'' c'* and *d' d'' d' d'' d'*. This said atmospheric air passes through two openings, which can be closed, regulated, or altered in size, (and of which the one is in connection with the space *c'* and the other in connection with the canal or flue *d'*;) and continues in a serpentine direction through the air-heating canals or flues, which are lined with refractory material, until it passes out from the chambers *c' d'* through several small orifices, Fig. 1, provided for the purpose, and serves to promote the combustion of the regenerative gas. The draft for this current of air is caused by the chimney or shaft. *a''*, Fig. 3, is a spy-hole for the purpose of observing the flame, and by means of which air can be admitted above the burner or slot to the flame, which is done by suitably shifting the closing-piece *a''*.

The cast-iron canals or flues *a'' a' a''* are provided with a large number of ribs, *e*, in order to present the greatest possible heating-surface to the cold air passing through the flue *f* to the heating-chamber *g*. Besides this, the said cast-iron tubes or flues are provided at the ends with projections or shoulders *e'*, and, as shown in the drawings, these ends or projections are not fixed in brick-work, but are laid loosely in sand, in order to admit of expansion or contraction taking place consequent upon the changes of temperature.

In order to prevent the upper air canal or

pipe from becoming red-hot, which would render the air in the air-chamber deleterious to health, these upper canals or flues are lined with fire-proof clay or other suitable refractory material. A water-receptacle, *h*, is situated within the air-warming chamber *g*, the purpose of which is to supply the necessary amount of moisture to the warmed air before the same reaches the dwelling apartments through the conducting canals or flues *i i*. This said water-receptacle *h* is kept supplied with water by another similar receptacle, *K*, which is situated outside the air-warming chamber. This latter receptacle, *K*, is fed by a suitable water-pipe, *K'*, which is in connection with the water-main. By means of the connection pipe or tube *K<sup>2</sup>* the two vessels or receptacles act as communicating-pipes, so that the height of the water in the inner vessel, *h*, can be ascertained by means of the water glass or gage *K<sup>3</sup>*, arranged on the outer receptacle, *K*.

In order to avoid the necessity of putting the whole apparatus out of operation when repairs have to be carried out, a reserve furnace, *B*, Fig. 1, is arranged, and in this case the air-warming chamber *g* can be heated by direct firing.

The jaws *b*, Figs. 4, 5, and 6, consist of a fixed and a movable cheek or jaw, whereby the latter rests on small rollers *p*, which are provided with suitable collars, which run in appropriate grooves, *p<sup>2</sup>*, so that an accurate guiding of the burner jaw or cheek is attained when the same is moved backward or forward.

The movement of the burner jaw or cheek is effected by means of the rod *p<sup>3</sup>*.

Having now particularly described and ascertained the nature of my invention and in what manner the same is to be performed, I declare that what I claim is—

1. In a hot-air heater, a series of radiators having passages connected for the products of combustion to pass through, and in connection with a suitable chimney, said flues being ar-

ranged within a heating-chamber, a combustion-chamber in connection with one of said flues, a gas-supply for said combustion-chamber, and a burner therein, and air-ducts for supplying air thereto, suitable inlet-pipes to the heating-chamber for the cold air, and outlet-pipes therefrom to the apartments to be heated, combined with a water-receptacle contained in said chamber, substantially as described.

2. A hot-air heater having a combustion-chamber supplied with fuel from a suitable source, a contracted opening forming a burner for the combustion of the fuel, and a series of air-ducts arranged upon either side of the combustion-chamber for supplying air to promote combustion, the air-ducts of each series being in connection with each other, to form circuitous passages, and one of said ducts of each series being in connection with the outside air, substantially as described.

3. In combination, the combustion-chamber and the gas-duct leading into the same, said chamber having a contracted opening serving as a burner formed by two jaws, one of which is adjustable to increase or diminish the size of the opening, substantially as described.

4. An air-heater having a heating-chamber with radiating-tubes therein, a combustion-chamber and a gas-supply duct and an air-supply duct to furnish gas and air to create combustion, and a contracted opening acting as a burner between the gas-supply duct and the combustion-chamber, said opening being formed by two jaws, one of which is adapted to slide, and is provided with rollers and operating-rods, substantially as described.

In witness whereof I have hereunto signed my name in the presence of two subscribing witnesses.

DAVID GROVE.

Witnesses:

B. ROY,

M. W. MOORE.