(No Model.) 2 Sheets—Sheet 1.

J. HOUSTON.

RADIATOR.

No. 431,975. Patented July 8, 1890.

Fig: 1.

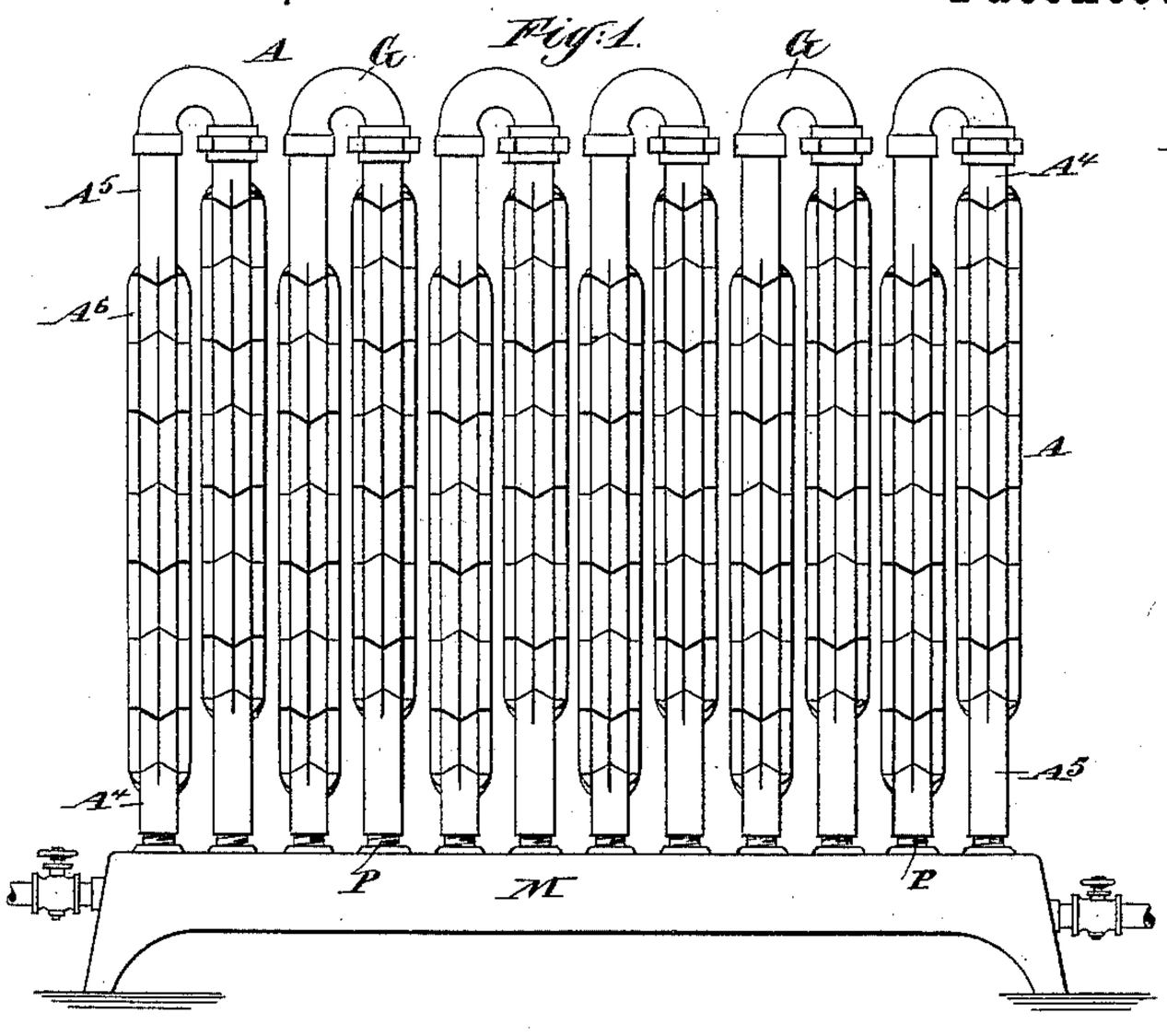


Fig: 2.

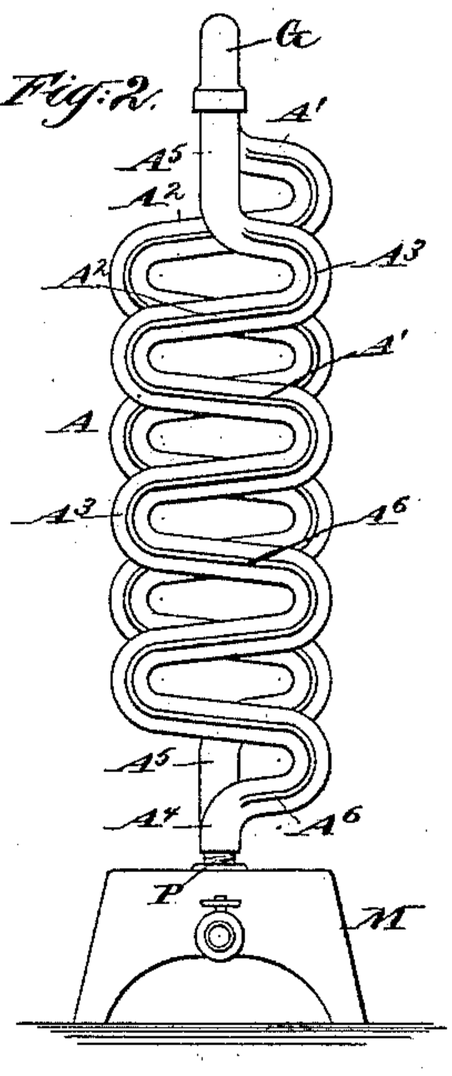
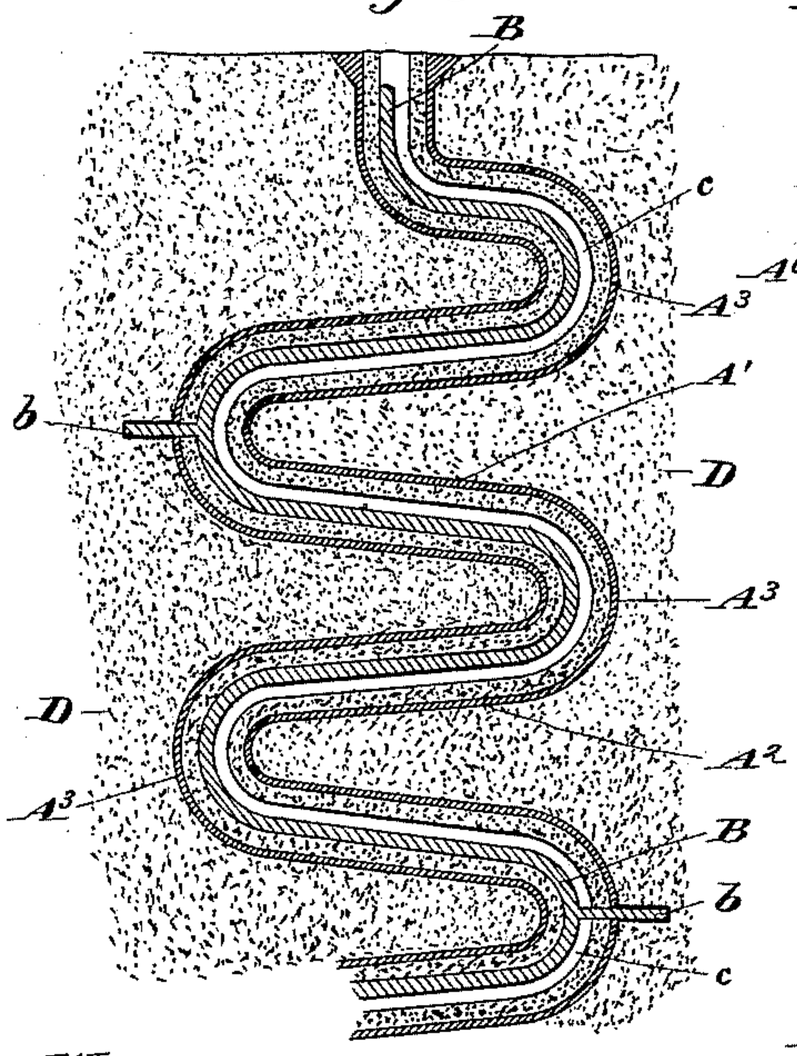


Fig: 3.



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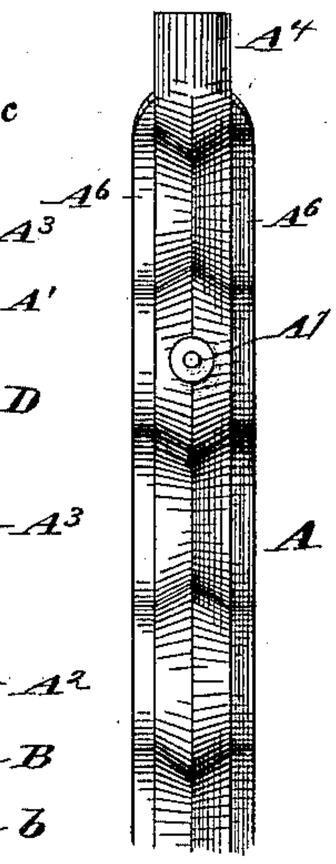

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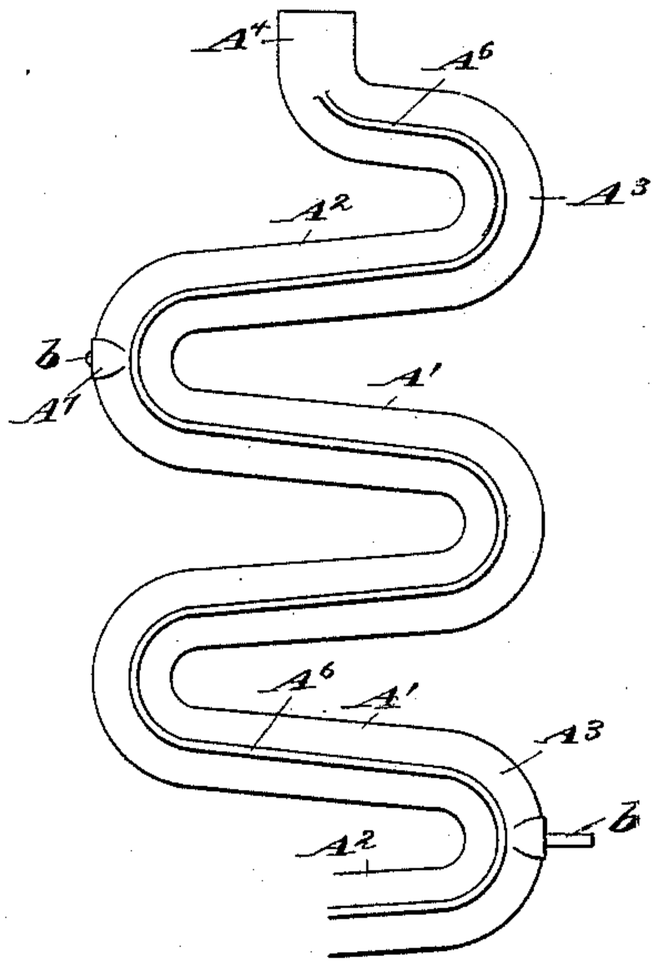

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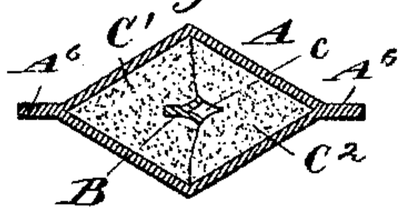


Witnesses:
Charles R. Searle,
Chas. F. Barter.

Inventor:
John Houston
by his Attorney
Thomas Drew Stetson

(No Model.) 2 Sheets—Sheet 2.

J. HOUSTON.

RADIATOR.

No. 431,975. Patented July 8, 1890.

Fig. 7.

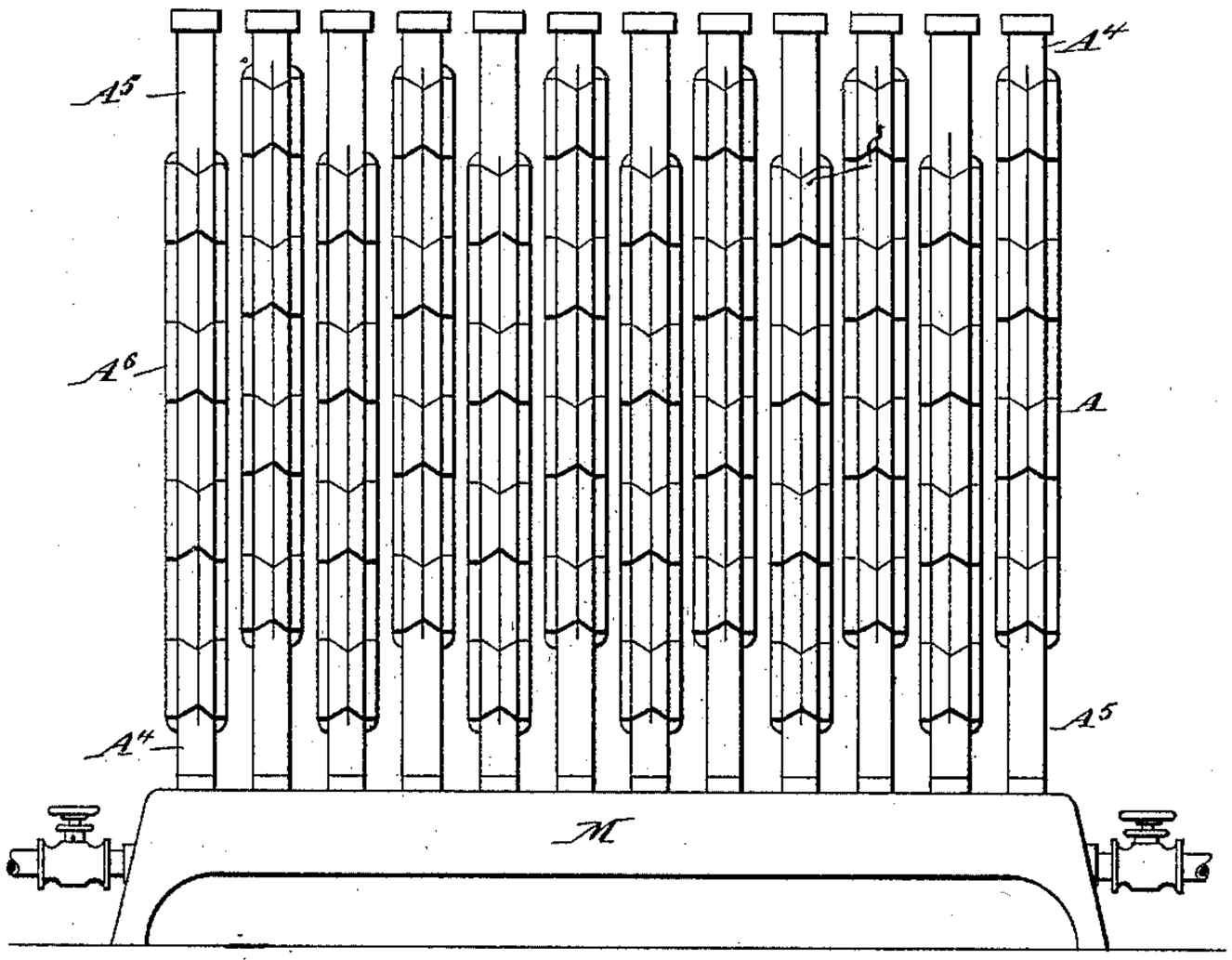
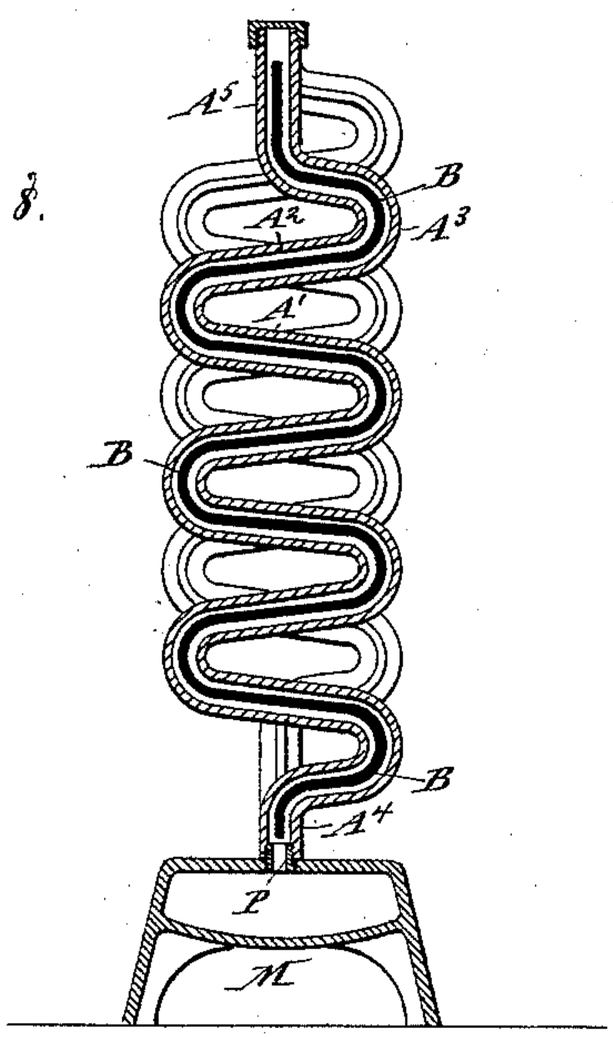


Fig. 8.



Witnesses
Charles R. Searle.
Chas. S. Barber.

Inventor
John Houston
By his Attorney
Thomas Drew Stetson

UNITED STATES PATENT OFFICE.

JOHN HOUSTON, OF BROOKLYN, NEW YORK, ASSIGNOR TO THE BURR & HOUSTON COMPANY, OF SAME PLACE.

RADIATOR.

SPECIFICATION forming part of Letters Patent No. 431,975, dated July 8, 1890.

Application filed March 29, 1889. Serial No. 305,262. (No model.)

To all whom it may concern:

Be it known that I, JOHN HOUSTON, a citizen of the United States, residing in Brooklyn, in the county of Kings and State of New York, have invented a certain new and useful Improvement in Radiators, of which the following is a specification.

Wrought-iron tubes have long been used for radiators connected so as to be inclined first in one direction and then in the other. The water of condensation descends to the bottom of each inclined tube and runs along to the bend, where it descends into the length below and runs in the opposite direction. There are marked advantages in this arrangement of pipes.

With suitable precautions pipes may be cast in one piece of moderate thickness suitable to be connected together or to stand each independent on a hollow base, and each containing several alternate inclined portions extending to the right and left like the several inclined pipes in a wrought pipe-radiator; but instead of the expense and risk of leakage involved by having a great number of returns and joints such radiators are each in a single piece of cast-iron. In my improvement each contains a smaller correspondingly-crooked bar of iron which has served as a core-bar. It tends in a slight degree to facilitate the circulation when my radiators are used each standing independent. In such case the core-bar is a partial division, allowing the steam and air to pass up one side and down the other side of the interior of the radiator with less mingling and in more nearly independent channels by reason of the core-bar.

I esteem it important to hold the core very effectually against becoming displaced by a twisting or tilting motion. To prevent such I extend a spur from the core-bar out through the space to be filled with hot metal to constitute the radiator at several points near the mid-length of the radiator. These points, being received in suitable joints, hold the core very truly in position. There are simply naked spurs extending out from and being cast with and forming part of the core-bar. When the casting is cold, the outer end of each such spur is filed off or otherwise removed, and the earthy portion of the core being loosened and removed by tumbling the lot of radiators in a sufficiently large barrel or by other sufficient agitation, and the loose earth shaken out or blown out, or both, the radiator, with its core-bar and spurs united to the shell-radiator, and all constituting one piece, is ready to be screw-threaded and united to a base or to another radiator, or otherwise used, like ordinary radiators. The presence of a core-bar in the interior does not involve objection by obstructing the passages, because there is never any occasion for any strong flow of steam or of any fluid through the radiator.

My radiators allow of the presence of webs on the exterior, or on both the exterior and interior, to give greater surface for receiving the heat from the steam into the metal and for delivering the heat from the metal into the air of the apartment to be warmed. In my experiments I have used a continuous web extending up and down on the right and left of each radiator on the outside.

The accompanying drawings form a part of this specification.

Figure 1 is a general side elevation. Fig. 2 is a corresponding end view. Fig. 3 is a vertical section through the tube and mold. Fig. 4 is an elevation, and Fig. 5 is an edge view. Figs. 3, 4, and 5 are on a larger scale than the preceding figures. Fig. 6 is a transverse section on a still larger scale. Fig. 7 is a side view, and Fig. 8 is a vertical cross-section, showing my radiator mounted independently. When thus set each has a screw-cap.

Similar letters of reference indicate like parts in all the figures where they occur.

A designates the entire radiator, certain portions being marked, when necessary, by supernumerals, as A′. The portions inclined in one direction are marked A′. Those inclined in the opposite direction are marked A^2, and the curved portions by which they are united are marked A^3. A short straight portion at one end is marked A^4, and a longer straight portion at the other end is marked A^5. By mounting a series of these radiators side by side with the ends alternately reversed the several inclined portions A′ A^2 are brought sufficiently out of the plane of the corresponding inclines in the adjacent radia-

tors to allow a free flow of the heated air upward through the series.

A^6 A^6 are webs extending up and down, as shown, and which serve to increase the surface to give off the heat.

B is a core-bar of an approximate T or more nearly a Y section. One such bar having the proper serpentine form is employed in the manufacture of the core for each radiator and is allowed to remain in the radiator. Each core-bar is formed with spurs *b*, which extend out, as shown, from the outer edge of alternate return-curves A^3; but they may be located at other points. A less number may suffice. Whatever the number and location there must be corresponding or larger "prints" formed in the green-sand or other mold D, in which the radiator is cast. The spurs lying in these prints support the core-bar B and hold it exactly in place. When the core is properly applied on the core-bar and baked, the spurs extend out through it and across the thickness of the space which is to mold the radiator and engage strongly in the prints in the sand-mold. When the casting is cold, it is taken out of the sand and the ends of the spurs *b* are chipped off or otherwise removed.

Special provision is made for ventilating (technically "venting") the core. Each core is roughly shaped in two halves C' C^2, one of which may be shaped on the core-bar B and caused to adhere by a coating of clay-wash. The other is molded separately in a separate core-box or other device, and is applied in position against the core-bar and the other part of the core and made to adhere thereto while plastic. The baking unites the two parts into one, with a diamond-section channel *c* running along the whole length. This channel serves as a perfect vent, and I have, when all is correctly performed, obtained perfect castings.

I use a very fusible mixture of metal and raise it to as high a heat as practicable. The mold is gated at several places; but these precautions may not be necessary to produce thick radiators. I have succeeded in making thin castings. I have experimented in iron; but other metals may be used.

The presence of the core-bar in the completed radiator is of advantage in promoting circulation of the steam, as set forth at the commencement. The core-bar aids to form two channels, in one of which a vigorous current of steam may be ascending, while in another, partially separated by the core-bar, the water and air may be descending. There is another advantage in the retention of the core-bar. Its great capacity for heat makes the action of the radiator more uniform than it would be without it. The thin external shell holds little heat. If it is thickened it holds more heat; but the flow of heat outward is retarded by the increased thickness. I keep the shell thin and supply a liberal stock of iron in the inclosed core-bar, which absorbs heat from the steam when the heat is great and gives it off again when the heat is less, and thus contributes to uniformity.

In coupling my radiators to the base M, I use threaded thimbles P. In coupling them to a return G at the top I can set the return on one before applying it, using a thimble P to unite the other.

By forming the radiator with the stout projections A^7, as shown, I insure sufficient heat at those points to effect a permanent union, a fusion of the surface of the inclosed spurs *b*, so that the metal will combine and stand thenceforward as if made in one single casting, the core-bar and the radiator. This end will be facilitated by cleaning and turning this portion of each spur *b* before putting the cores in the sand; but I do not esteem such precaution generally necessary.

The inversion of alternate radiators causes the inclines A' A' to stand, not each in the same plane as the next, but in a different plane—zigzag, technically "staggered." This is of much advantage in mixing and warming the air.

The serpentine form of my radiators not only exposes greater surface and under conditions which cause the current of ascending air to be thoroughly warmed, but also offers great elasticity. Two of my radiators held rigidly together by the returns A^8 may be heated unequally by a movement of steam up one driving the previously-contained air down the other with any degree of slowness, so that one is heated and expanded in advance of the other without inducing any severe strain on either, because the bends allow the several inclined parts of the heated one to be compressed slightly together and the inclined parts of the cooler one to be extended or stretched apart easily.

I do not in this patent claim the mold to produce the construction. Such is made the subject of a separate application for Letters Patent filed September 4, 1889, Serial No. 322,891.

I claim as my invention—

1. A cast-metal radiator in serpentine form A' A^2 A^3, in combination with a corresponding but smaller serpentine bar B, rigidly attached by spurs *b* in its interior, as herein specified.

2. A heater composed of a series of serpentine pipes or sections A' A^2 A^3, each having a corresponding serpentine core-bar B, with spurs *b* held in a fixed position therein, as herein specified.

3. The sections A, having inclines A' and A^2 in opposite directions, with curved junctions A^3 and long and short ends A^4 A^5 alternately inverted, in combination with a serpentine bar B and spurs *b* and with a base M, all arranged to serve as herein specified.

4. The sections A, having inclines A' and

A^2 in opposite directions, with curved junctions A^3 and long and short ends A^4 A^5 and webs A^6, combined with a base M and with returns G, connecting the tops of adjacent sections, all arranged to serve as herein specified.

In testimony whereof I have hereunto set my hand, at New York city, N. Y., this 25th day of March, 1889, in the presence of two subscribing witnesses.

JOHN HOUSTON.

Witnesses:

THOMAS DREW STETSON,

CHAS. F. BARTER.