(No Model.) 3 Sheets—Sheet 1.

J. F. BENNETT.

HOT BLAST STOVE.

No. 303,203. Patented Aug. 5, 1884.

Fig. 1.

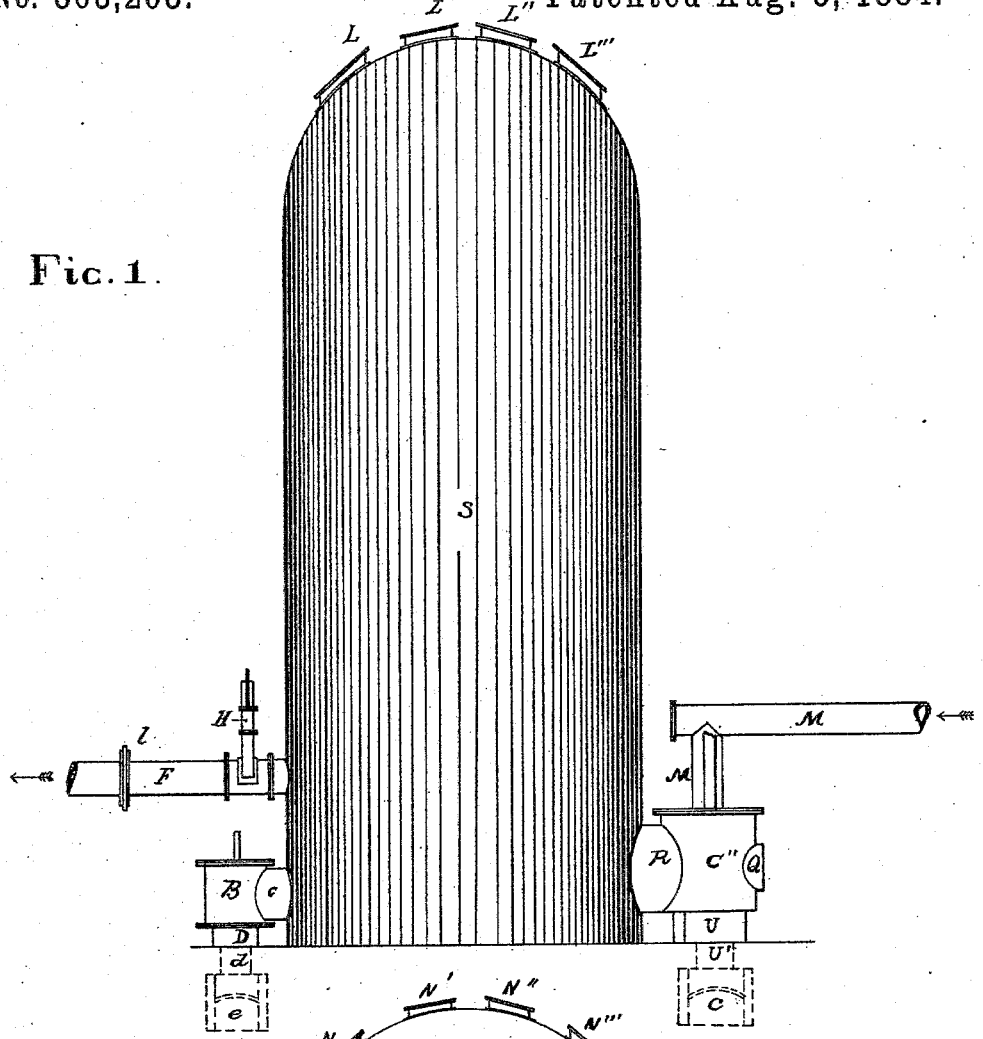
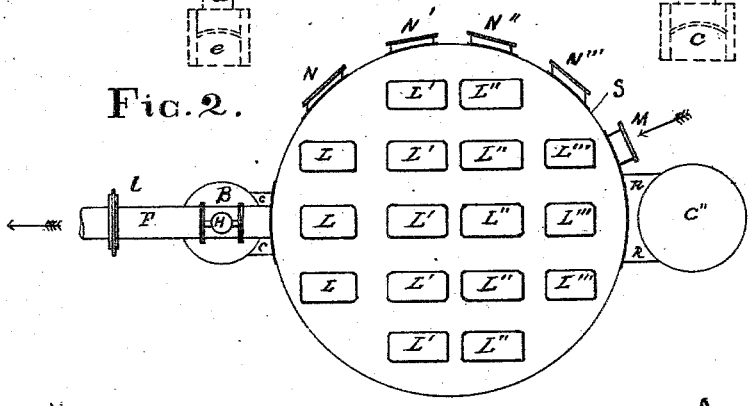


Fig. 2.



Witnesses.
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A. M. Strickler

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(No Model.) 3 Sheets—Sheet 2.

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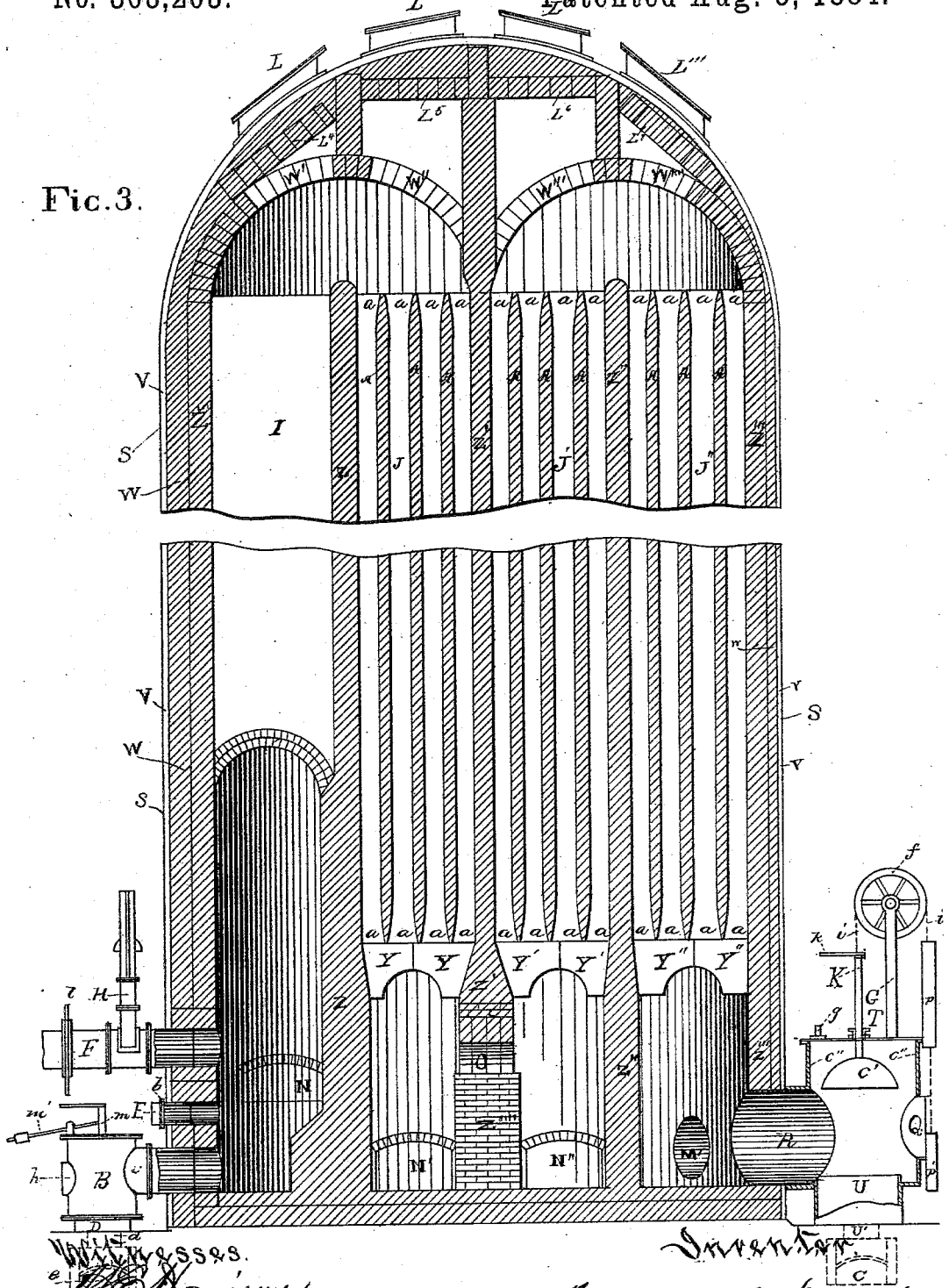
Fig. 3.



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(No Model.) 3 Sheets—Sheet 3.

J. F. BENNETT.

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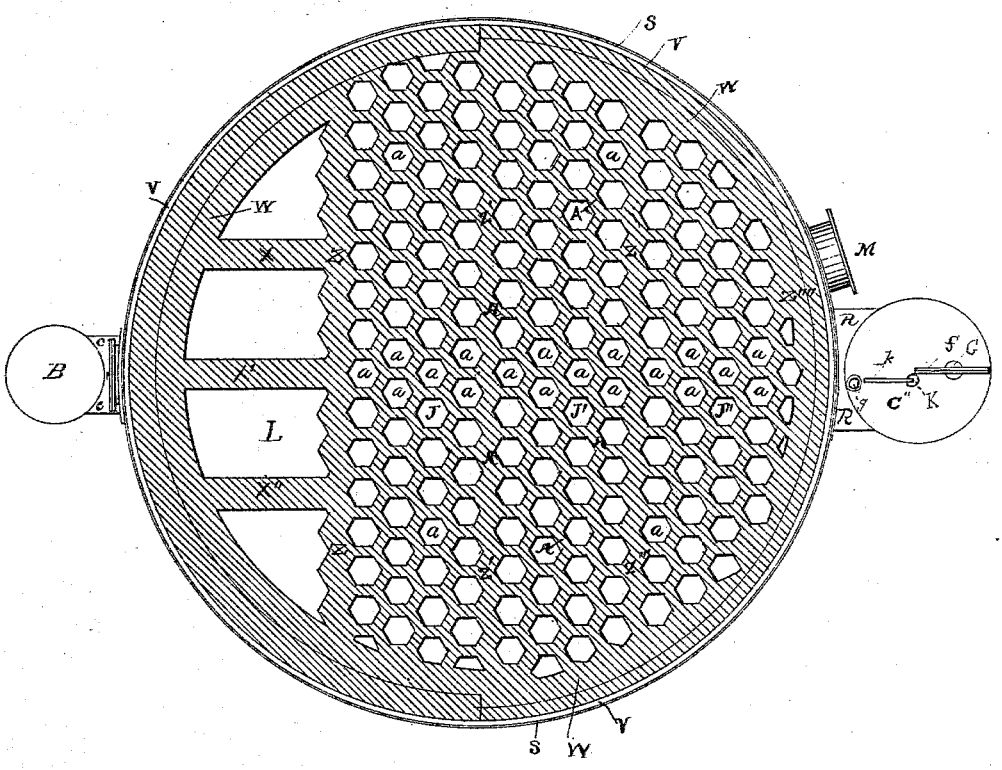
Fig. 4.



Witnesses.
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UNITED STATES PATENT OFFICE.

JOHN F. BENNETT, OF PITTSBURG, PENNSYLVANIA.

HOT-BLAST STOVE.

SPECIFICATION forming part of Letters Patent No. 303,203, dated August 5, 1884.

Application filed September 24, 1883. (No model.)

To all whom it may concern:

Be it known that I, JOHN FRANCIS BENNETT, of Pittsburg, in the county of Allegheny and State of Pennsylvania, have invented certain new and useful Improvements in Hot-Blast Stoves; and I do hereby declare that the following is a full, clear, and exact description thereof, reference being had to the accompanying drawings, and to the letters of reference marked thereon, which form part of this specification.

My invention relates to improvements in stoves for heating air-blasts for blast-furnaces, in which atmospheric air, on its passage through the stove, takes up the heat previously deposited by the hot waste gases from the blast-furnace; and the objects of my improvements are, first, to facilitate the passage of the cold air through the stove; second, to present a large heated surface to the air forced through; and, third, to attain these ends with simplicity of construction. I attain these objects by the means illustrated in the accompanying drawings, in which—

Figure 1 represents an elevation of my stove, showing the relative location of the parts. Fig. 2 is a plan view of the same. Fig. 3 is a sectional elevation, and Fig. 4 a horizontal section, thereof.

Similar letters refer to corresponding parts throughout the views.

A represents the tubes which form the flues *a a a*, by which the hot air is conducted from the blast-furnace flue *e* to the chimney-flue C, and the cold air from the cold-air inlet M to the heated-air main F, which leads to the furnace. The tubes are so shaped that the cross-section of the flues forms a hexagon, whereby a large surface for the storage of heat is presented to the waste gases and a greater increment of temperature imparted to the atmospheric air than heretofore possible. The ends of each tube are rounded or tapered to avoid frictional resistance to the passage of the air or gas.

B is the valve-casing, in which a valve similar to C′ moves. The valve-stem *m* has a weighted lever, *m′*, attached thereto, so that the hot gases can only enter the stove when their pressure exceeds that of the weighted lever, the weight being horizontally adjustable to obtain different degrees of pressure. The hot gases are admitted to the casing B from the blast-furnace by the main underground flue *e* and pipes *d* D, and thence conducted to the stove by pipe *c*. A flanged cover, *h*, capable of vertical movement on the box, affords access to its interior for cleaning or inspection.

C is the main underground flue conducting the waste gases, after having traversed the stove and been largely, if not entirely, relieved of heat by contact with the tubes and the walls of the stove and pipes, either to the shaft or to a point of further utilization.

C′ is a valve regulating access of the waste gases to the flue C. Its vertical position determines the velocity of the hot gases and the amount of heat abstracted. To a handle, *k*, affixed to the valve-stem K, is attached a chain, *i*, passing over the wheel *f*, supported by a suitable standard, G, on the valve-casing C″. Weights P P′ are attached to the other end of the chain *i*, to counterbalance the tendency of the valve to approach its seat, caused by gravity and the suction of the chimney. As the weights approach each other the strain on C′ is increased.

U U′ are pipes connecting the valve-box C″ with the chimney-flue C. An eye-piece, *g*, affords means for observing the interior of the valve-box, and a man-hole, Q, affords access thereto.

D is a pipe connecting the valve-box B with the pipe *d*.

E is a duct having a valve, *b*, therein, by which the cold air requisite to secure perfect combustion of the hot gases is admitted to the stove.

F is the pipe leading the heated atmospheric air from the stove to the furnace. A valve, H, regulates the amount fed. A joint, *l*, is provided to allow of ready access to the pipe.

G is a standard supporting the wheel *f*.

I J J′ J″ represent the four chambers through which the hot gas or heated air is conducted, either to the chimney-flue C or to the heated-air main F, according as the respective source is the underground flue *e* or the cold-air pipe M.

K is the stem of the valve C′.

L L′ L″ L‴ are a series of doors at the top of the stove, permitting access to its interior for cleaning or inspection purposes.

M is a cold-air pipe having a valve, M′.

N N′ N″ N‴ are doors at the bottom of the furnace for cleaning or observation.

O is a passage, formed by arching the partition Z′ over the pier Z⁗, by which the gases can go from the chamber J to J′, and the heated air from J′ to J, the gases and air pursuing opposing directions.

P and P′ are counter-weights for the valve C′.

Q is a man-hole to admit access for cleaning the valve C′, valve-box C″, and pipes R and U.

R is a pipe connecting the chamber J″ with the valve-box C″.

S represents the iron casing of the stove. The stove is preferably made of an altitude of seventy feet and a diameter of twenty-one feet.

T represents a nut affording a bearing for the valve-stem K and guiding its vertical reciprocation.

U U′ are pipes connecting the valve-box C″ with the underground flue C.

V is the air-space between the casing S and the brick-work W, to obviate conduction.

W′ W″ W‴ W⁗ are large stones, which can be removed to afford access, respectively, to the chambers I J′ J″ J‴ by first opening the series of doors L L′ L″ L‴ and removing the stones L^4 L^5 L^6 L′.

X X′ X″ are cross-walls sustaining the wall Z in position.

Y Y Y′ Y′ Y″ Y″ are large stones supporting the tubes A A A in position. The stones are so cut as to form a quadrant in one corner, thereby forming an arch when two stones, counterpart each of the other, are placed in the position illustrated on the drawings, whereby maximum strength is secured.

Z Z′ Z″ Z‴ are the brick partitions forming the chambers I J J′ J″.

Z⁗ is a pier, upon which the arched stones forming the passage O rest.

The operation is as follows: The valve, whose stem is indicated by *m*, is opened, allowing the access to the stove of the blast-furnace, hot gases coming through the flue *e* and pipes *d* D into the valve box B, and thence into the stove by pipe *c*. Simultaneously the cold-air valve *b* is opened in the pipe E to secure perfect combustion of these gases in the stove. The valves H and M′ being closed at this time, the hot gases will go vertically through chamber I, be deflected by the arch into the flues *a a a*, composing chamber J, thence through arched passage O into the bottom of the chamber J′, through flues *a a a* of that chamber, again deflected by a similar arch, and thence out through flues *a a a* of chamber J″ into pipe R, valve-box C″, pipes U U′, flue C, and thence to the chimney with or without intermediate utilization. The gases traversing the walls and flues at a temperature approximately 2,500° Fahrenheit, and a velocity regulated by the position in a vertical plane of the valve C′, deposit their heat, to a greater or less amount, according to the velocity, in the walls W Z Z′ Z″ Z‴ and the tubes A A A in the chambers J J′ J″, which serve as storage-reservoirs for this heat. When the stove has been raised to the desired temperature, the valves *b* C″ and that in the box B are closed, and the valves M′ and H in the pipes F M opened, which lead, respectively, to the blast-furnace and the blower. The cold air then traverses the stove in an opposing direction to that pursued by the hot gases, and takes up the heat previously deposited there by the gases.

As the flues are hexagonal in their cross-section, instead of round, square, or parallelogrammatic, as heretofore, more heat is abstracted from the gases than possible with the round flue, first, because of a decrease in velocity, owing to the shape of the path; and, second, on account of an increase in the convex surface which takes up the heat, because the convex surface of a prism is measured by the product of the perimeter by the altitude, while that of the cylinder is measured by the product of the circumference by the altitude, the altitude and diameter being taken, respectively, the same; but the area of the polygon circumscribed about a circle is greater than that of the circle; hence the area of the prism having the same diameter and altitude as the inscribed cylinder is greater than that of the latter.

Having thus fully described my invention, what I claim, and desire to secure by Letters Patent of the United States, is—

1. In apparatus for feeding heated air to blast-furnaces, a stove having its walls and tubes shaped hexagonally in their cross-section, for the purpose specified.

2. In apparatus for feeding heated air to blast-furnaces, a stove, S, having hexagonally-shaped partition-walls Z Z′ Z″ Z‴, and hexagonal tubes A, the walls forming chambers I J J′ J″, substantially as described.

3. In apparatus for feeding heated air to blast-furnaces, a stove, S, having flue *e*, pipes *d* D, box B, containing a valve, pipe *c*, pipe E, containing valve *b*, hexagonal tubes A, partitions Z Z′ Z″ Z‴, forming chambers I J J′ J″, passage O, pipe R, valve-box C″, containing valve C′, pipes U U′, and flue C, for the purpose herein fully set forth.

4. In apparatus for feeding heated air to blast-furnaces, a stove, S, pipe M, provided with a valve, hexagonal tubes A, partitions Z Z′ Z″ Z‴, forming chambers I J J′ J″, passage O, and pipe F, containing valve H, for the purpose described.

5. In apparatus for feeding heated air to blast-furnaces, a stove, S, having a flue, *e*, pipes *d* D, box B, containing a valve regulated by a weighted lever, *m*′, attached to stem *m*, pipe *c*, pipe E, containing valve *b*, hexagonal tubes A, partition-walls Z Z′ Z″ Z‴, forming chambers I J J′ J″, passage O, pipe R, valve-box C″, containing valve C′, whose vertical reciprocation is regulated by counter-weights P P′, attached to one end of a cord or chain, *i*, whose other end is affixed to the handle *k* of the valve-stem K, the cord *i* passing over pulley-

wheel *f*, suitably supported on or over the valve-box by a standard, G, pipes U U′, and flue C, for the purpose herein fully specified.

6. In apparatus for feeding heated air to blast-furnaces, a stove, S, having a flue, *e*, pipes *d* D, box B, containing a valve regulated by a weighted lever, *m′*, attached to stem *m*, pipe *c*, pipe E, inclosing valve *b*, hexagonal tubes A, partition-walls Z Z′ Z″ Z‴, forming chambers I J J′ J″, passage O, pipe R, valve-box C″, containing valve C′, whose vertical reciprocation is controlled by counter-weights P P′, attached to one end of a cord or chain, *i*, whose other end is affixed to the handle *k* of the valve-stem K, the cord *i* passing over a pulley-wheel, *f*, suitably supported on the valve-box by a standard, G, pipes U U′, flue C, pipes M F, and their inclosed valves M′ H, for the purpose herein described.

In testimony that I claim the foregoing as my own I affix my signature in presence of two witnesses.

JOHN F. BENNETT.

Witnesses:
M. E. HARRISON,
ALEX. RANDOL.