J. B. McKENNAN.

REGENERATIVE FURNACE.

APPLICATION FILED MAR. 7, 1908.

936,930.

Patented Oct. 12, 1909.

4 SHEETS—SHEET 1.

Fig. 1.

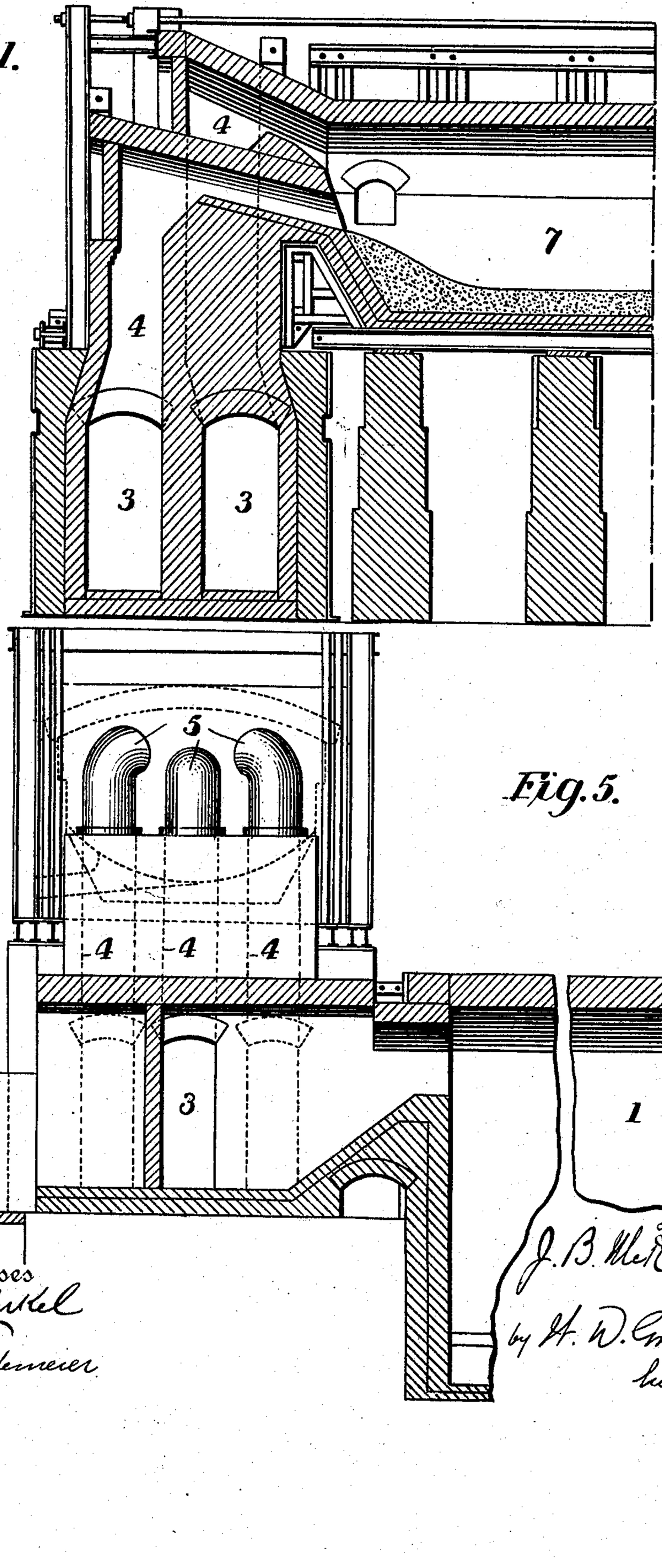

Fig. 5.

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4 SHEETS—SHEET 2.

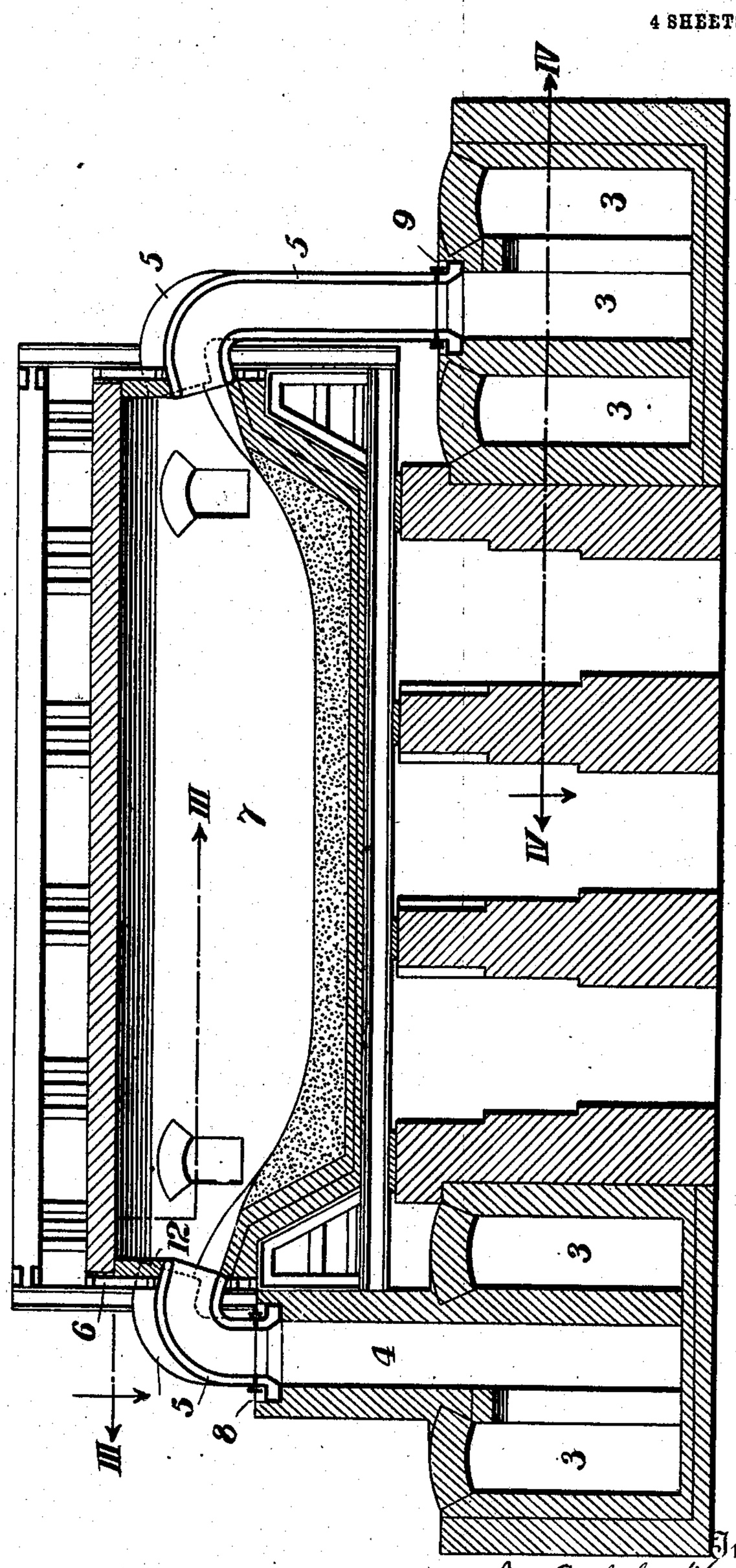

Fig. 2.

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4 SHEETS—SHEET 3.

Fig. 4.

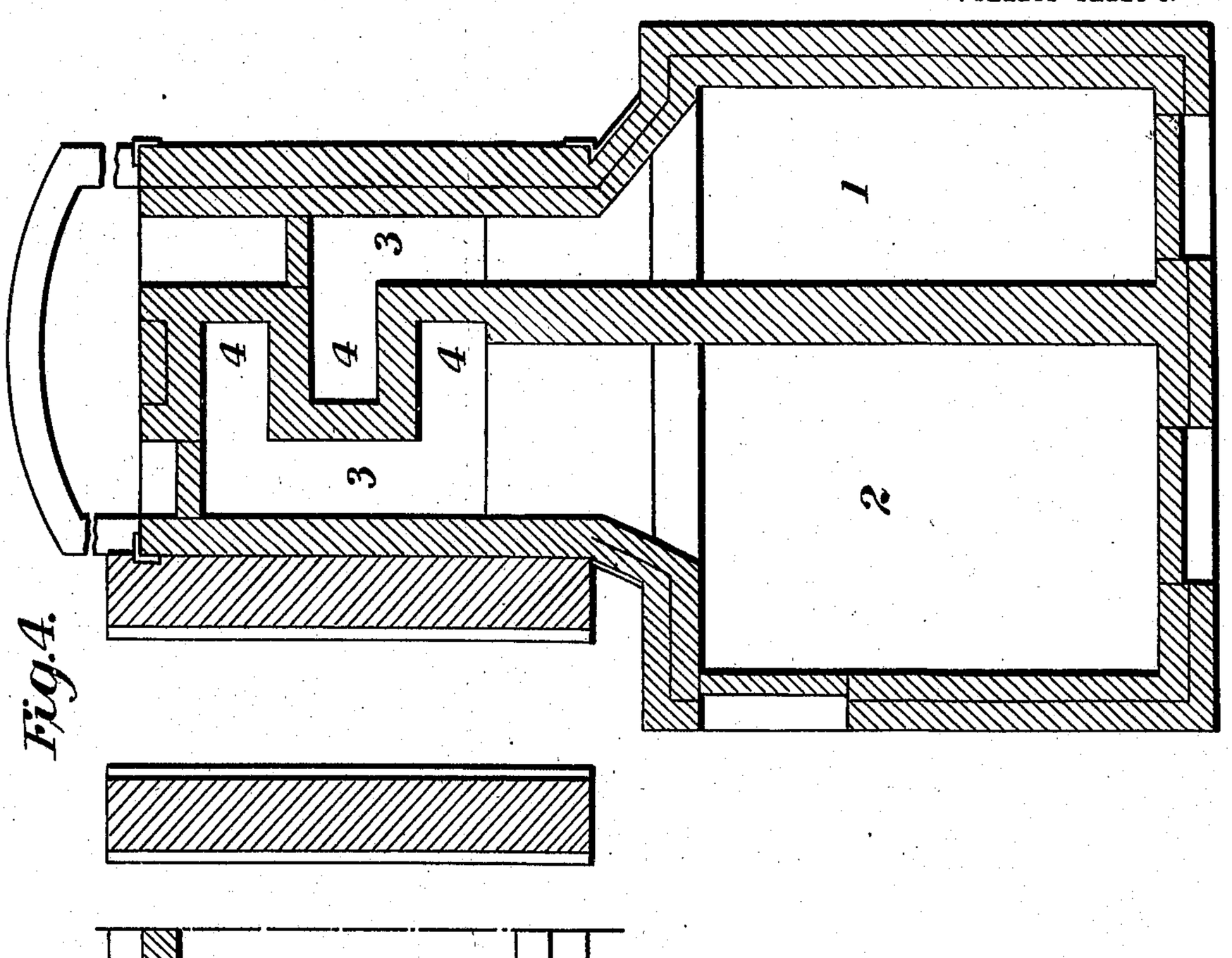
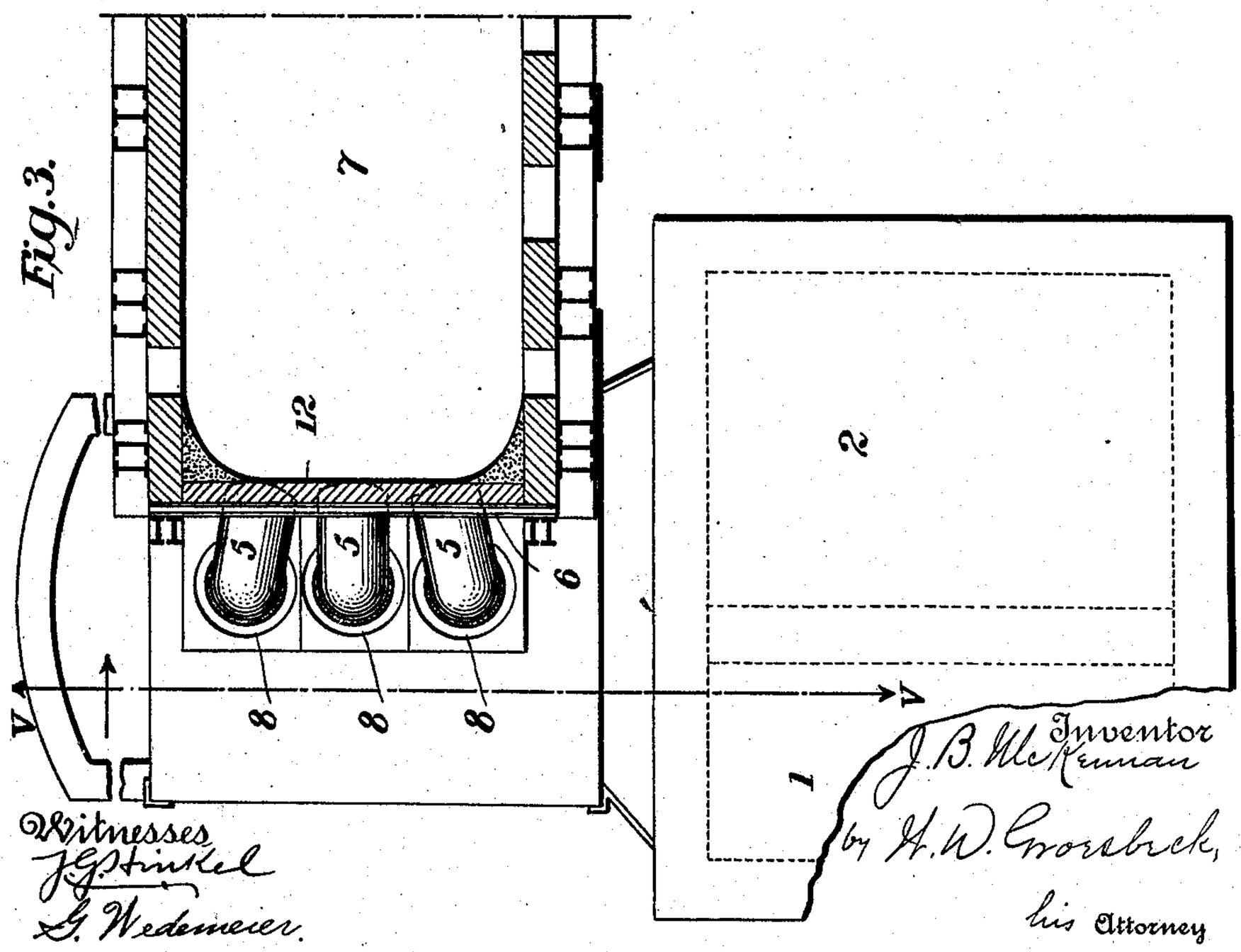


Fig. 3.



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4 SHEETS—SHEET 4.

Fig. 6.

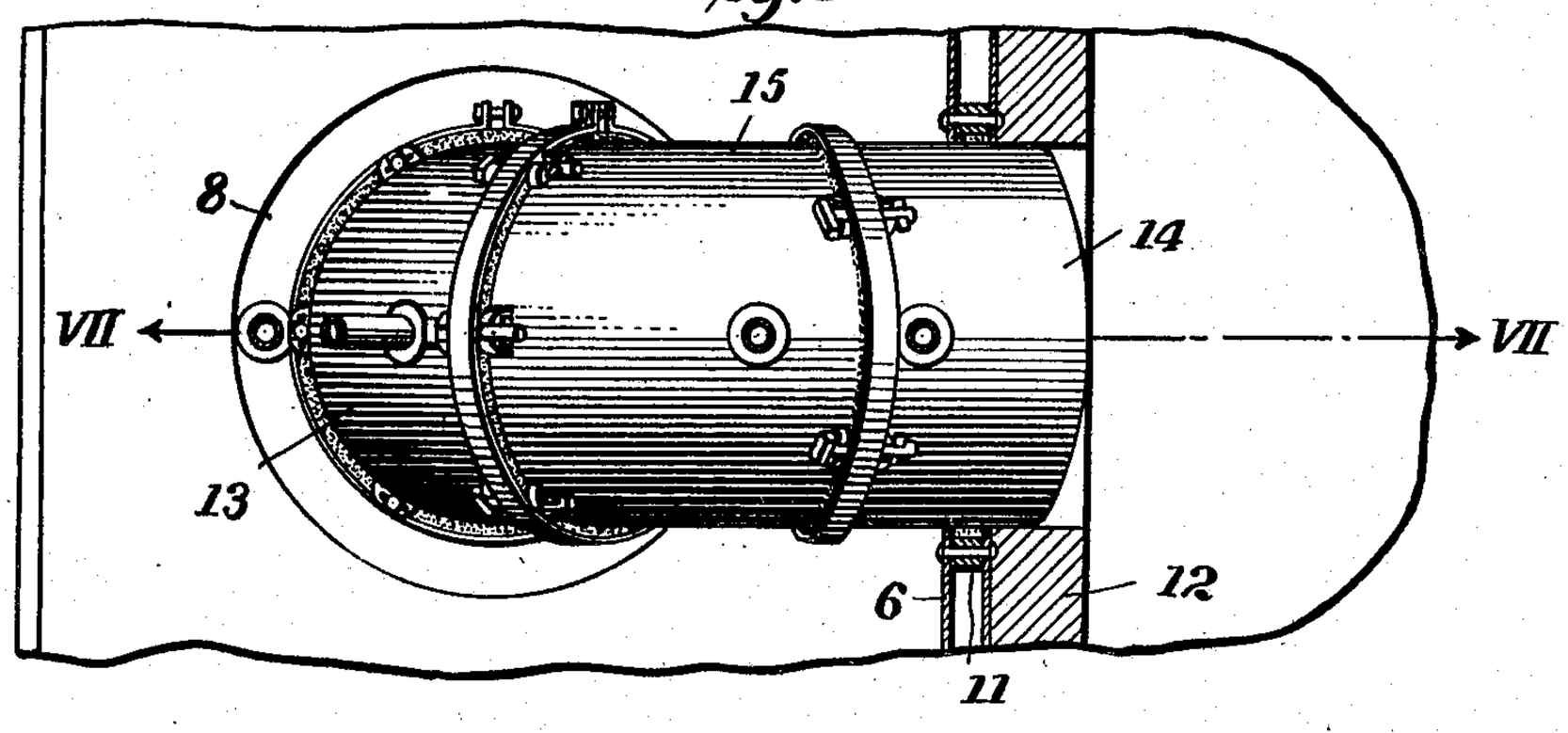
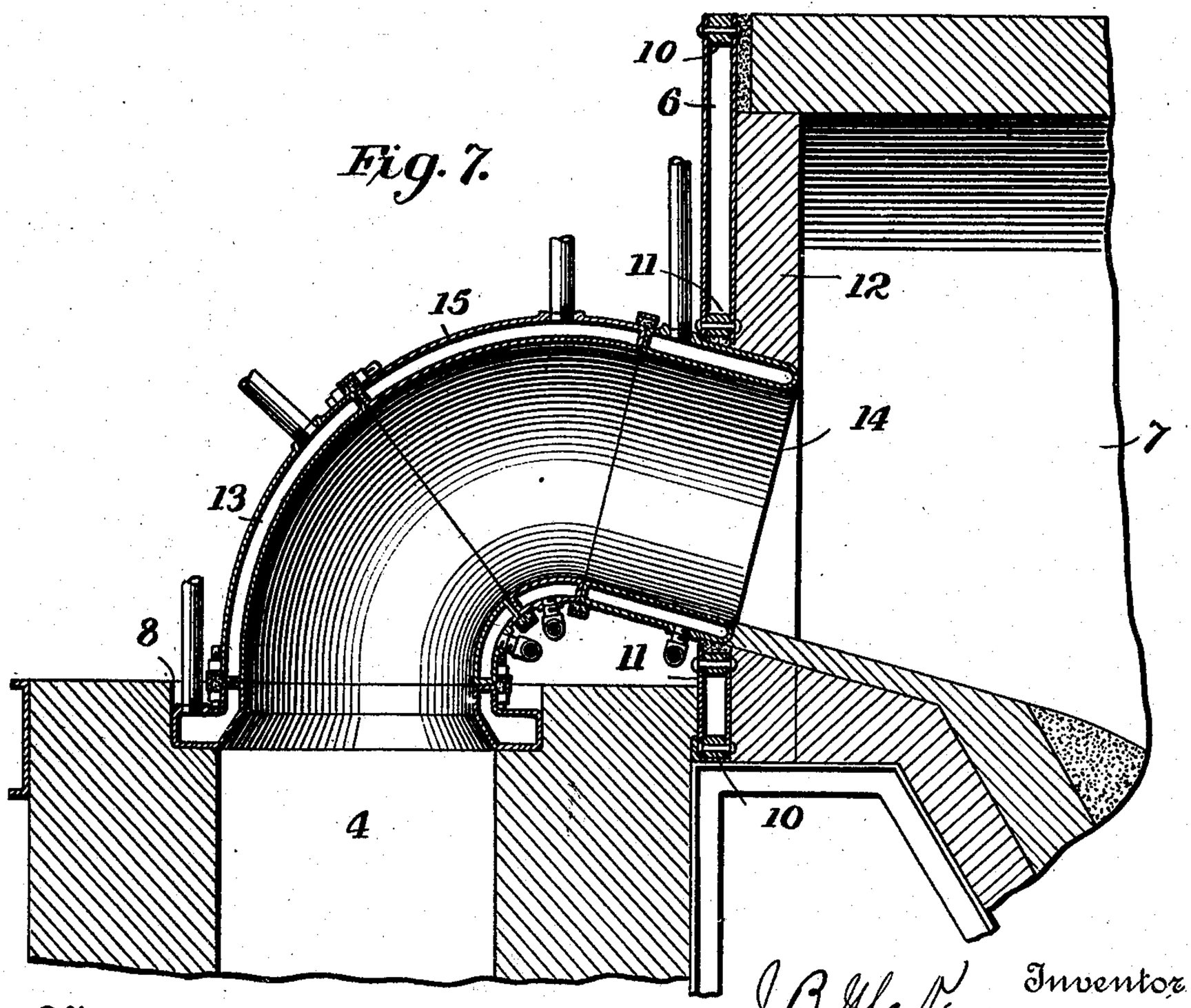


Fig. 7.



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UNITED STATES PATENT OFFICE.

JACOB B. McKENNAN, OF PUEBLO, COLORADO.

REGENERATIVE FURNACE.

936,930. Specification of Letters Patent. Patented Oct. 12, 1909.

Application filed March 7, 1908. Serial No. 419,690.

To all whom it may concern:

Be it known that I, JACOB B. McKENNAN, a citizen of the United States, residing at Pueblo, in the county of Pueblo and State of Colorado, have invented certain new and useful Improvements in Regenerative Furnaces, of which the following is a specification.

My invention relates to metallurgical furnaces, more particularly to regenerative furnaces, and the objects of my improvements are to provide a construction which shall obviate the gradual destruction by fusion of the ports and uptakes, the falling of their fused linings into the furnace or into the slag-pockets or regenerator flues and the frequent and expensive repairs necessitated thereby; and to secure a furnace in which the points of admission and the direction of flow of the fuel and air into the furnace and the points of exit and the direction of the flow of the products of combustion out of the furnace, may be definitely established and maintained constant from the time the furnace is first put in operation, as long as desired. I attain these objects by the construction shown in the accompanying drawings, in which;—

Figure 1 is a vertical central section of one half of a regenerative furnace of standard construction; Fig. 2 is a longitudinal vertical section through a furnace, its slag-pockets and uptakes, showing my invention applied thereto; Fig. 3 is a half plan of the furnace with one set of regenerators, portions being shown in section; Fig. 4 is a horizontal section on the plane IV—IV of Fig. 2; Fig. 5 is a vertical section on the plane V—V of Fig. 3; looking in the direction of the arrows; Fig. 6 is a partial plan of a modification, and Fig. 7 is a section on the line VII—VII of Fig. 6.

Heretofore, regenerative furnaces, their ports, flues and combustion chambers have been constructed of or lined with refractory material. Despite the refractory character of these walls, they are gradually fused in the high temperatures developed; causing the walls to waste away into the furnace or into the uptakes or slag-pockets and the port ends to cut back under the flow of the heated gases, particularly the outgoing products of combustion; so that in ordinary furnace construction the points of admission and direction of flow of the incoming gases are uncertain, except when the furnace is new or newly repaired. On account of this comparatively rapid destruction of the refractory walls, it is a not uncommon practice to make the walls of the ports rather longer, and the openings more constricted at the furnace ends, than is consistent with the maximum efficiency of operation. Therefore, a new furnace, or one newly repaired, does not work as rapidly or as efficiently as it does after some fusing or cutting has taken place in the passages. However, after this fusing has progressed beyond a certain degree, the efficiency then begins to decrease by reason of the fact that the gases can no longer be directed upon the bath to the best advantage. Such construction is illustrated in Fig. 1. A further disadvantage of such compromise construction is that the furnace performance is never uniform for any considerable period.

In my improved construction, I nearly or entirely dispense with refractory walls for the furnace-ends and the gas and air-ports and uptakes; substituting for the port and uptake walls metal conduits, preferably water-cooled or water-jacketed, and providing at the furnace-ends metal breast-plates which have, preferably, a comparatively light lining of refractory material, which is accessible to repair through the furnace doors while the furnace is in operation.

In the drawings, 1 and 2 are, respectively, gas and air regenerators, 3 the slag-pockets, 4 the uptakes 5, 5, 5 the water-cooled conduits or ports, 6 breast-plates, and 7 the furnace chamber.

The preferred conduits of my construction are double-walled and entirely of metal; such as iron, steel, copper or bronze, each having provision for circulating water between the inner and outer walls, and preferably provided with a water-seal or mud-joint 8 at the top of the uptake, (as shown at the left of Fig. 2), or just above or arranged to replace the arches of the slag-pockets, (as shown at 9 at the right of the same figure). The breast-plates 6 are also of metal, preferably of plates, suitably spaced by separating members 10, at their outer edges, and by rings 11, at the points of entrance of the ports. The thin lining 12, of refractory material is provided as a partial protection for the flat breast-plates

against the high heat of the products of combustion discharged toward them when the furnace is reversed.

In the modification shown in Figs. 6 and 7, the gas- and air-conduits are each made in sections (three such sections being shown; although any convenient number may be used); the lower sections, as 13, having the water or mud joint, the upper one, as 14, being suitably secured to the furnace end and the intermediate ones, as 15, being adapted for ready attachment to the outer ones or to each other by readily made joints: to facilitate the opening, examination and repair of the ports. This sectional construction also minimizes the effect of the strains and distortion due to temperature changes and permits the variation of direction of gas and air in the furnace by the substitution of a single inner or upper section, instead of an entire port. As is usual, the single gas-port is located between and somewhat lower than the air ports to effect the better mixture and promote the combustion of the fuel. With these provisions for controlling and directing the flow of air and gas, it will be noted that I can entirely dispense with the usual combustion chambers; the ports discharging directly into the furnace chamber but a few feet from the edge of the bath. Moreover, the deflecting or reverberatory roof may be dispensed with, as well; both changes securing considerable economies in first cost.

The arrangement of the converging and downwardly inclined deflecting ports, shown in plan in Fig. 3, in end elevation in Fig. 5 and in sectional side elevation in Figs. 2 and 7, illustrates the manner in which the air and fuel may be concentrated upon or directed toward any desired part of the hearth; and when once thus directed, it will be maintained there; because no fusing or cutting back can occur at the discharge ends of the ports to dissipate or deflect the incoming currents.

The general arrangement of flues and regenerators shown is a common one in furnaces of this type, and my improved port construction can be readily applied to existing furnaces; but I do not intend to limit myself to the arrangement shown; as it is evident that my construction readily lends itself to the introduction of the gas and air at any other point of the furnace chamber which may be found desirable.

The advantages of my invention result from the lower first cost, increased durability, ease of repairs, and certainty of operation; but principally from the uniformity of working, at a maximum efficiency, for much longer periods than in furnaces of ordinary construction.

I am aware that furnaces have been provided with movable ports of refractory material, some of which have been provided with partial water-jackets; but such constructions in no degree obviate the ultimate destruction of the lining, which results in the clogging of the uptakes and dispersion or deflection of the incoming currents.

I am also aware that water-cooled metal twyers have been used in blast-furnace practice: but such twyers have no deflecting action, are not subjected to the high heat of outflowing gases upon reversal and are not made sectional, for purposes similar to those above set forth.

What I claim is:—

1. A regenerative furnace having metal ports provided with a smooth and even interior contour and deflected in such a manner as to direct the air and gas upon the bath at any desired point.

2. A regenerative furnace having water-cooled metal end walls and water-cooled metal deflecting ports entering through said walls.

3. A port construction for regenerative reversing furnaces, composed wholly of metal, and having means for circulating cooling fluid about said port.

4. A double-walled port for regenerative reversing furnaces, composed wholly of metal, and having means for circulating cooling fluid between said walls.

5. A deflecting double-walled port for regenerative reversing furnaces, composed wholly of metal, and having means for circulating cooling fluid between said walls.

6. A sectional port for regenerative reversing furnaces, each section being composed wholly of metal and having means for circulating a cooling fluid about said section to protect it from the heat of the furnace.

7. A double-walled, sectional metal port for regenerative reversing furnaces, said sections each having interfitting ends, and means for circulating water between the walls of said sections.

8. A furnace having converging ports opening directly into the furnace chamber; said ports being composed wholly of metal, having double walls, and being provided with means for circulating water between said walls; whereby the direction of the fuel and air supplies may be maintained constant within the furnace chamber.

9. A furnace having water-cooled breast-walls and sectional, metal ports entering through said breast walls.

10. A furnace having water-cooled breast-walls, said walls having a comparatively thin coating of refractory material; in combination with double-walled, water-cooled metallic deflecting-ports entering directly into the furnace-chamber through said breast-walls.

11. A metallic port for a regenerative reversing furnace, composed of metal sections.

12. A sectional metallic port for a regenerative reversing furnace, each of said sections having a periphery coincident with the periphery of the port.

13. A sectional metallic port for a regenerative reversing furnace, each of said sections having a periphery coincident with the periphery of the port, and having means for circulating a cooling fluid about the walls of said section.

14. A deflecting, double-walled, water-cooled metallic port for regenerative reversing furnaces.

15. A sectional, deflecting, double-walled, water-cooled metallic port for regenerative furnaces, the metal walls of the port-sections each having a periphery coincident with the periphery of the port.

16. A metallic port for a regenerative, reversing furnace composed of metal sections and arranged to permit of variation of the delivery angle of the air or gas entering the furnace therethrough.

In testimony whereof I affix my signature in presence of two witnesses.

JACOB B. McKENNAN.

Witnesses:
JOHN G. HINKEL,
W. D. GROESBECK.