(No Model.)

5 Sheets—Sheet 1.

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METALLURGICAL FURNACE.

No. 432,280. Patented July 15, 1890.

Fig. 1.

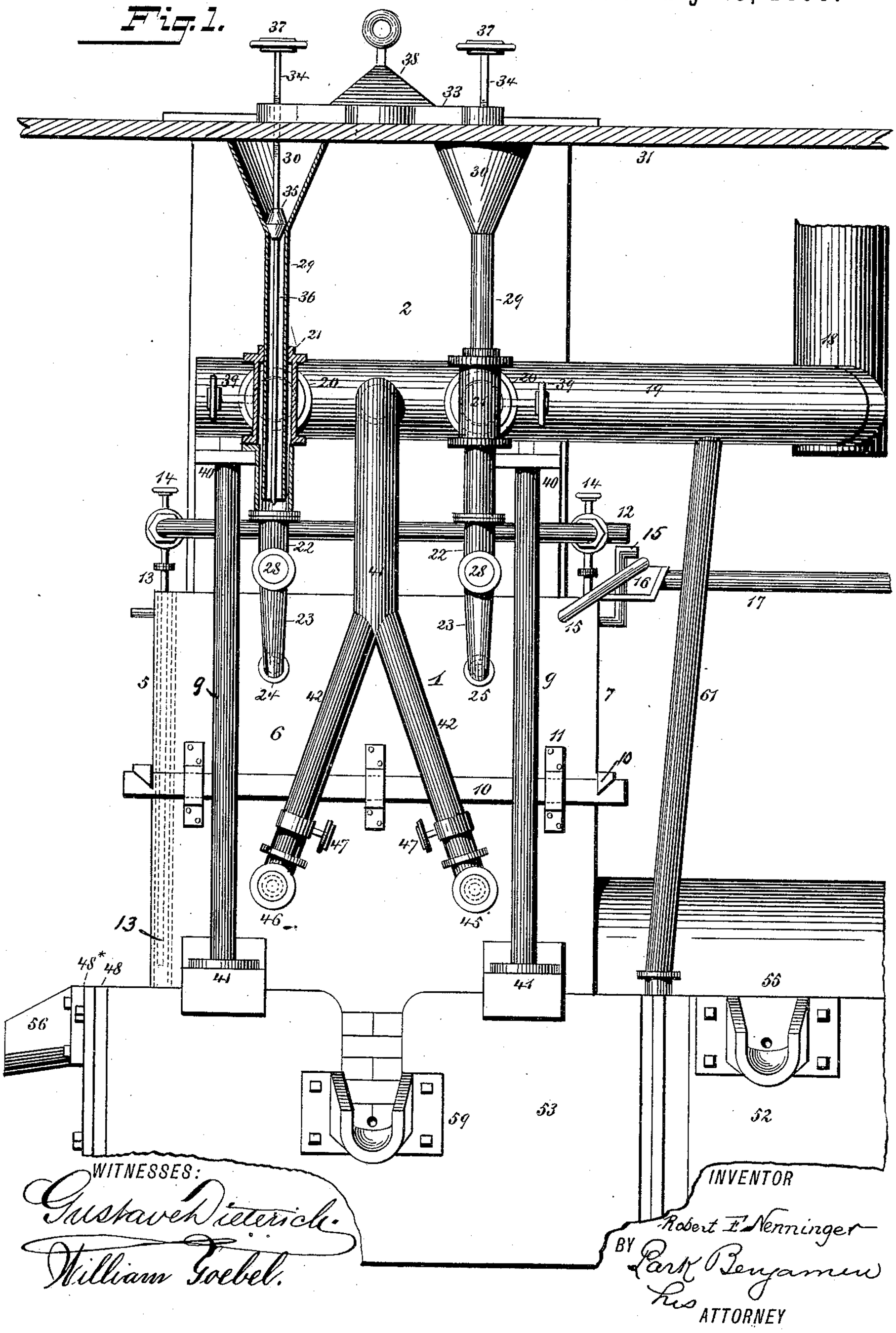

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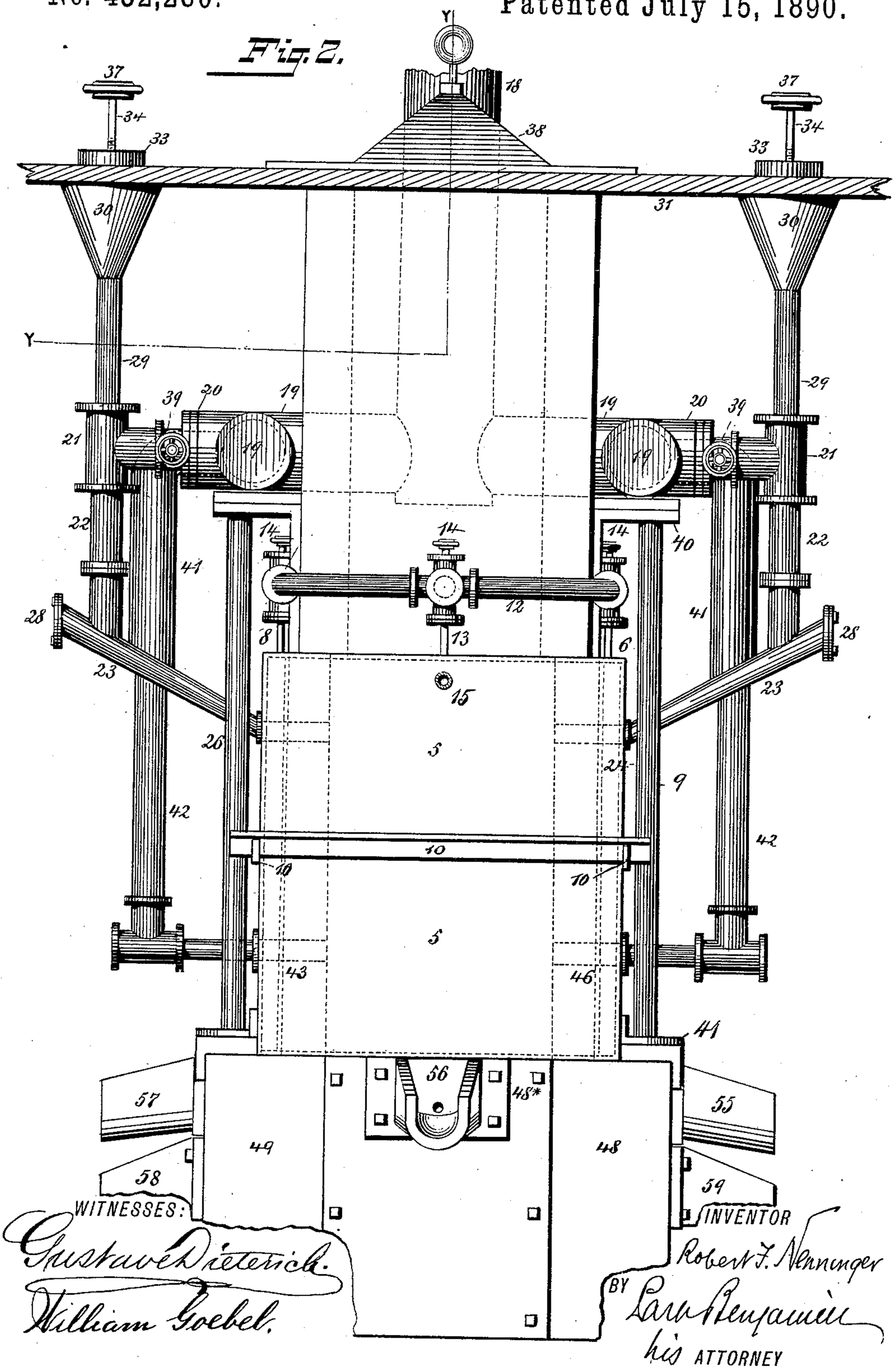
Fig. 2.



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(No Model.) 5 Sheets—Sheet 3.

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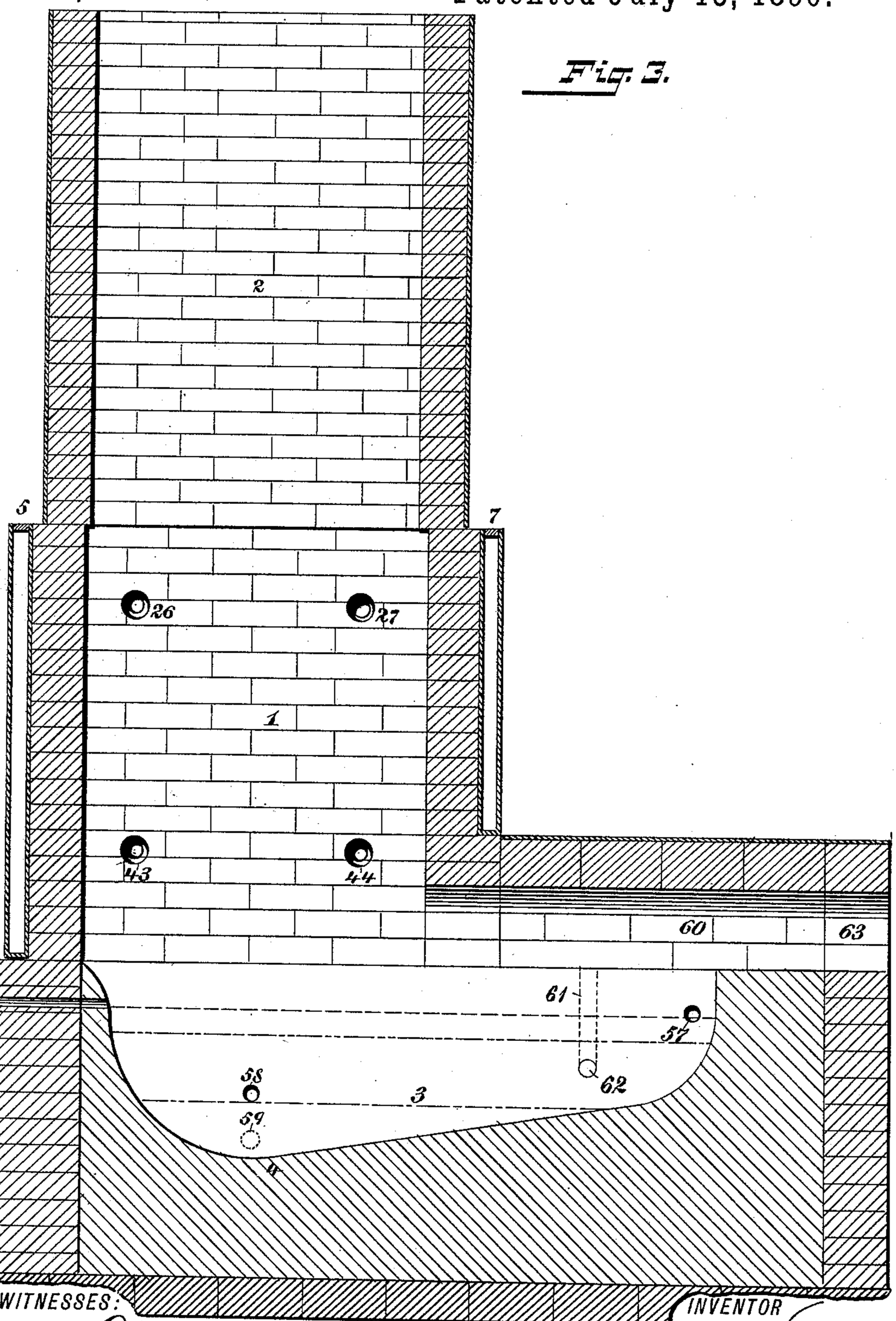
METALLURGICAL FURNACE.

No. 432,280. Patented July 15, 1890.

Fig. 3.



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(No Model.) 5 Sheets—Sheet 4.

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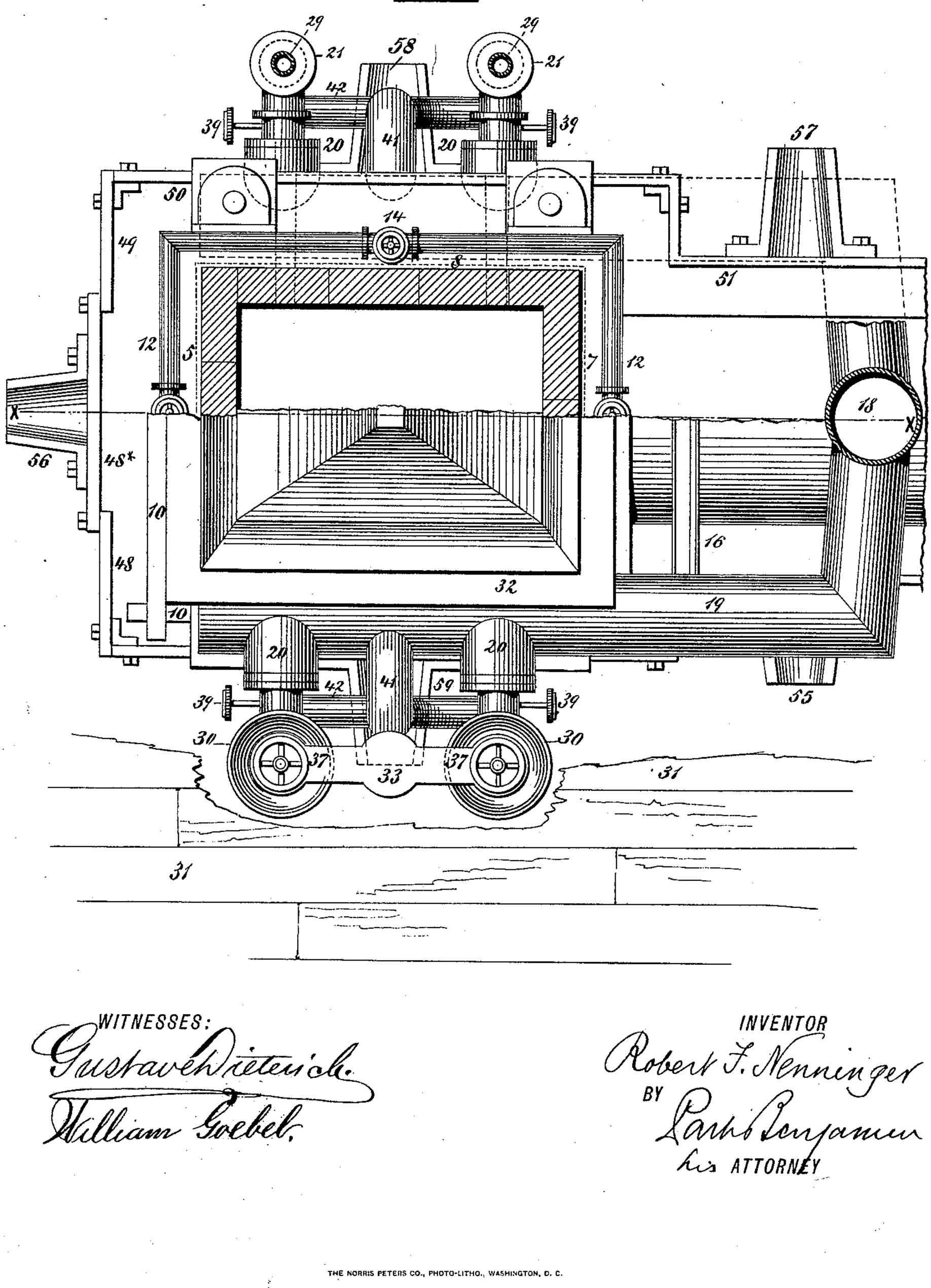
METALLURGICAL FURNACE.

No. 432,280. Patented July 15, 1890.

Fig. 4.



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5 Sheets—Sheet 5.

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METALLURGICAL FURNACE.

No. 432,280. Patented July 15, 1890.

Fig. 5.

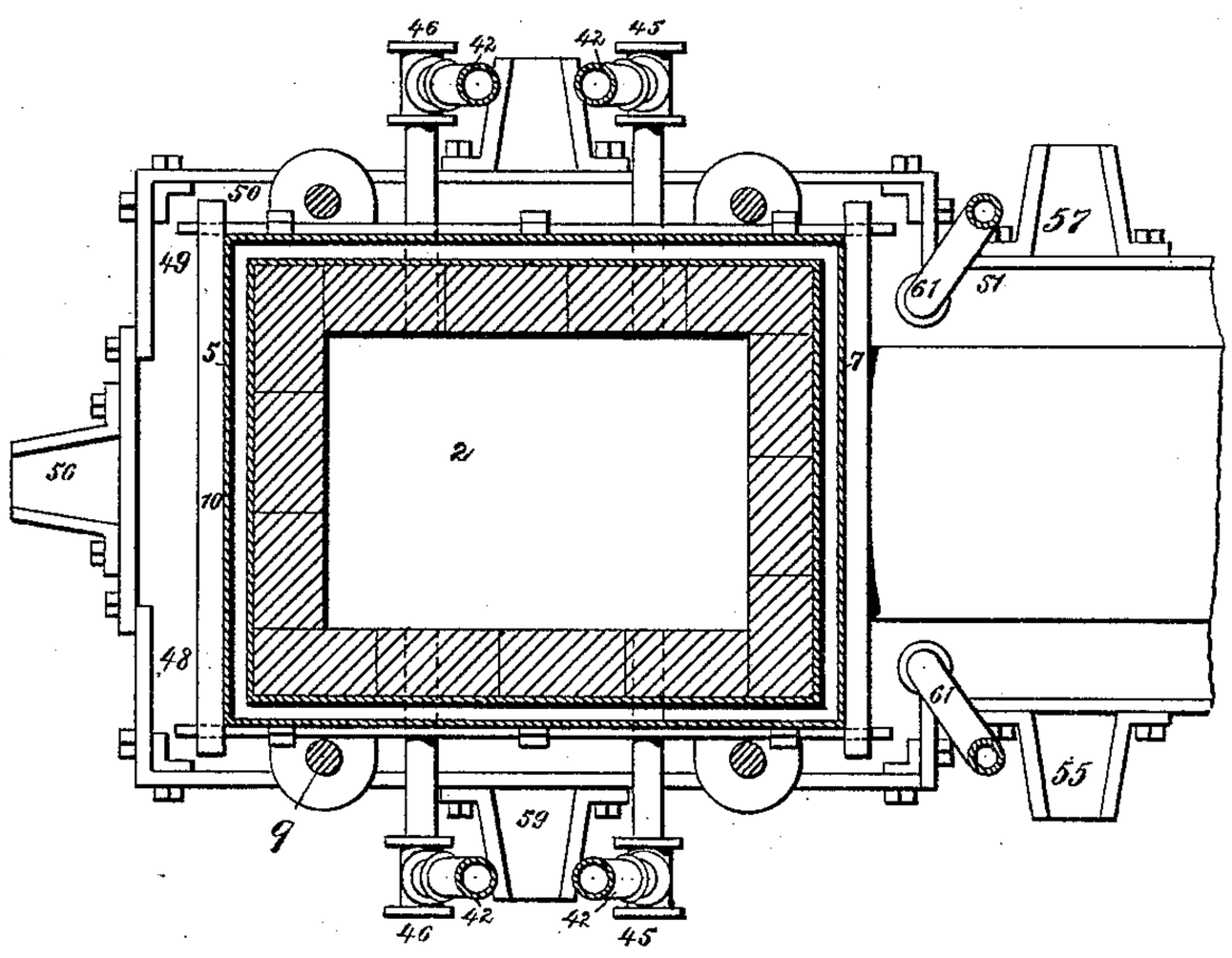
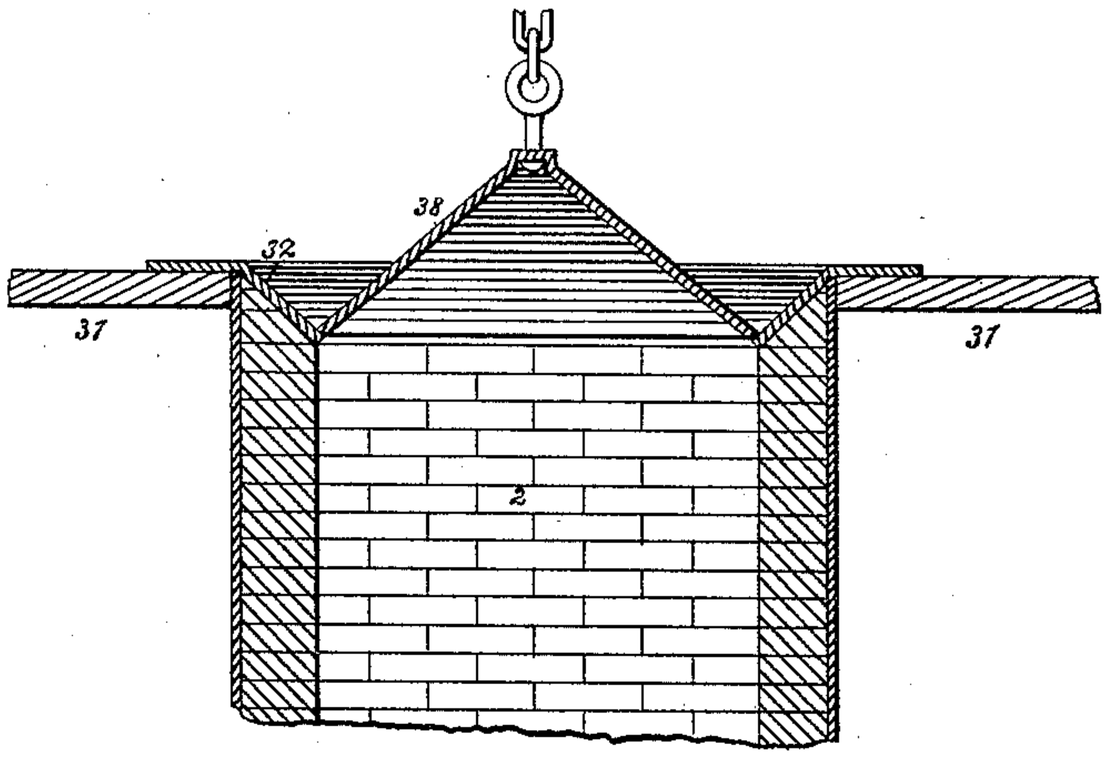


Fig. 6.



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UNITED STATES PATENT OFFICE.

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METALLURGICAL FURNACE.

SPECIFICATION forming part of Letters Patent No. 432,280, dated July 15, 1890.

Application filed November 29, 1889. Serial No. 332,056. (No model.)

To all whom it may concern:

Be it known that I, ROBERT F. NENNINGER, of Newark, Essex county, New Jersey, have invented a new and useful Improvement in Metallurgical Furnaces, of which the following is a specification.

My invention relates to a new form of furnace designed more especially for the treatment of fine ores, sweepings, concentrates, &c.

My invention consists in the construction and arrangement of the furnace embodying a depressed hearth, a smelting-stack disposed above one end of said hearth and opening over its entire cross-sectional area into said hearth, and a roof extending from said stack and covering the remaining portion of said hearth, an escape-opening being provided between said hearth at the end opposite to that covered by the stack and said roof, and two air-inlet openings in said stack disposed at different elevations above the point of junction of roof and stack, in combination with means for causing a downward draft to pass from said air-openings through said stack in said hearth and out at said escape-orifice, and means for forcing an air-blast into the metal accumulated on said hearth.

My invention also consists in the construction and arrangement of the water-jacket in combination with other portions of the furnace, and also in the apparatus for supplying pulverized fuel to the stack, all as hereinafter specifically set forth and claimed.

In the accompanying drawings, Figure 1 is a side elevation and partial section of my furnace. Fig. 2 is a front elevation. Fig. 3 is a vertical section, and Fig. 4 is a plan view, in partial section, on the line Y Y of Fig. 2. Fig. 5 is a horizontal section through the water-jackets, and Fig. 6 is a partial vertical section showing the hopper 32 and cover 38 in position.

Similar numbers of reference indicate like parts.

The body of the furnace consists of two principal parts—a smelting-furnace and a reverberatory furnace—these being combined in a single structure, and having the metal hearth and flue in common. The shaft of the blast-furnace consists of a lower portion or smelting-chamber 1 and an upper portion or shell 2, and is lined with fire-brick. The lower portion of the shaft rests upon a fire-brick foundation, which also forms the side walls of the metal hearth or crucible 3, Fig. 3, of the reverberatory furnace 4. The upper portion 2 of the shaft is a square wrought-iron shell supported by brackets 40 upon the columns 9, which in turn rest upon the supports 41. The upper part of said shell is fastened to the charging-floor 31. Surrounding the lower portion of the shaft are four non-communicating water-jackets 5 6 7 8, resting upon the walls and arch of the furnace 4 and bound together by the bars 10, which pass through straps 11 on the sides of jackets and are locked together, as shown in Fig. 1.

12 is a water-pipe leading from any suitable source of supply. It communicates with each jacket by a tube, as 13. Each tube extends downwardly nearly to the bottom of the jacket and delivers water therein. In the pipe 12 are valves, as 14, by which the supply to each tube 13, and hence to each jacket, may be regulated. From the upper portion of each jacket extends a water-pipe 15, which delivers into a trough 16, and from said trough a pipe 17 may lead to a condenser (not shown) for the furnace-fumes or to any suitable outlet.

It will be apparent from the foregoing that the water from the supply-pipe 12 constantly circulates through the jackets 5 6 7 8 and finally escapes at the pipe 17.

18 is an air-trunk leading from a blower or other source of air-supply, and having branches 19 supported on the columns 9 on each side of the upper portion 2 of the shaft. Extending from each branch 19 are two lateral pipes 20, which enter cylindrical chambers 21. From the lower extremity of each chamber extends downwardly a tube 22, and this tube enters the side of the inclined tube 23, which communicates with a tuyere which passes through the water-jacket and enters the lower portion of the shaft, Fig. 4. There are four of these tuyeres, two on each side of the shaft, at 24, 25, 26, and 27. The outer end of each inclined tube 23 is plugged or provided with a removable cover 28, so that a rod can be thrust down through the tuyere to clear out obstructions.

Extending downward into each chamber 21 and tube 22 is a charging-pipe 29, which pipe

is carried upwardly and terminates in a funnel 30 set in the charging-floor 31. There are therefore two funnels 30 located on each side of the hopper 32, which forms the charging-opening of the shaft.

Resting upon the charging-floor and extending over the funnels are bars or plates 33. The ends of said bars receive the threaded stems 34 of the double cone-valves 35. The object of the rods 36 is to prevent the tubes 29 and 22 from becoming clogged with the comminuted charge. A valve 35 is arranged in each funnel 30, and closes the opening of the latter into the pipe 29. Extending downward through said pipe 29 and secured to the lower apex of each valve 35 is a pointed metal rod 36.

At the upper extremity of each valve-stem 34 is a hand-wheel 37.

The charging-hopper 32 is provided with the usual bell-cover 38.

It will be seen that from the above-described construction the tuyeres 24, 25, 26, and 27 act both as blast and charging openings. Fine ores, sweepings, tailings, concentrates, &c., are placed in the funnels 30, and the valves 35, being opened, descend through the pipes 29 and enter the tuyere-pipes 23. Valves 39 in the pipes 20, then being also opened, the blast enters said pipes, meets said fine material as it falls from the charging-pipes 29 and drives it through the pipes 23 and tuyeres 24, 25, 26, and 27 into the shaft. From each branch 19 of the air-trunk a vertical pipe 41 communicates with branches 42, which lead to the lower tuyeres 43, 44, 45, and 46, these tuyeres also passing through the water-jackets. Valves 47 are provided in the pipes 42. Eight tuyeres therefore enter the shaft, four (24, 25, 26, and 27) being disposed above the remaining set of four, 43, 44, 45, and 46.

The reverberatory hearth is inclosed in cast-iron plates 48, 49, 50, 51, 52, and 53, and the plate 48*, which is fastened to the front plates 48 49. In said plates are five tap-openings provided with slag-spouts 55, 56, and 57, a matte-spout 58, and a metal-spout 59. As shown in Fig. 3, the matte-tap 58 is at a higher level than the metal-tap 59. The inside of the hearth-walls and bottom has a lining 4, preferably composed of a mixture of powdered limestone and fire-clay, which, after being moistened, is firmly rammed in place. Above the hearth is an arch 60. Extending down from the branch 19 of the air-trunk are pipes 61, which open into the hearth-chamber through the side walls, as shown at 62, Fig. 3. The gases from the hearth may be led to a condenser or any suitable stack after escaping from the opening at 63.

Various smelting processes can be carried into effect in the apparatus above described, one of which I will now specify in order to exhibit its operation. A coke fire is started in the bottom of the shaft. When incandescent, a quantity of metallic lead is thrown in until the hearth is filled with melted metal above the tap 58, as shown in Fig. 3. Coke is then put into the shaft up to the level of the charging-floor, and as soon as the charge becomes incandescent up to the upper set of tuyeres the furnace is ready to receive its ore and blast. Let it be supposed that a mixture of sweepings and ore concentrates (pyrites) pulverized and combined with proper fluxes is to be treated. A weighed quantity of the mixture is placed in the funnels 30, and the valves 35 being opened and the blast turned on, this is projected in the manner already described through the tuyeres 24 25 26 27 into the incandescent coke in the shaft. Fusion immediately begins, and before the mass reaches the lower set of tuyeres 43 44 45 46 it is in a molten state. At said lower tuyeres the liquefaction of the mixture is completed and the separation of metal, matte, and slag takes place, while the air furnished by said tuyeres causes a thorough combustion of the gases. In this way the carbonic oxide due to the passage of the carbonic-acid gas through the large body of incandescent coke between the two sets of tuyeres is reconverted into carbonic acid and a large saving of fuel effected. This operation is carried on until sufficient matte is formed in the reverberatory hearth above the tap-opening at 58, Fig. 3, and then air is admitted into said matte through the blast-openings at 62. The air coming in contact with iron matte (the matte supposed contains the reducible metals, gold, silver, copper, &c.,) oxidizes the sulphur and iron, and the sulphur may be carried off into a condenser as sulphurous-acid fumes, while the iron is absorbed by the slag as oxide, the slag being silicious for this purpose. The reducible metals then collect in the lead bath at the bottom of the hearth. The time of tapping the rich lead at the spout 59 will depend upon the richness of the material smelted. The slag and matte are drawn off from the remaining spouts.

It is of course to be understood that I do not limit myself to the use of my furnace as herein described, in which fine ores are charged through the upper tuyeres, because obviously I can insert the charge in the shaft through the hopper in the usual way, and the valves 35 being closed simply deliver air through the tuyeres 24 to 27. Where it is desired to restrict the furnace to such employment, the chambers 21 may be permanently closed above, and the funnels 30, tubes 29, and associated parts for charging in ore dispensed with, thus saving expense in construction. So, also, instead of delivering blast through the air-trunk 18, I may apply any suitable exhausting apparatus to draw air and fumes out at the flue-opening 63.

I claim—

1. A depressed hearth, a smelting-stack disposed above one end of said hearth and opening over its entire cross-sectional area into said hearth, means for closing the top of said stack,

and a roof extending from said stack and covering the remaining portion of said hearth, an escape-opening being provided between said hearth at the end opposite to that covered by the stack and said roof, and two air-inlet openings in said stack disposed at different elevations and above the point of junction of roof and stack, in combination with means for forcing the air through said openings, and thereby causing a draft to pass downward through said stack, over said hearth, and out at said escape-orifice, and means for forcing an air-blast into the metal accumulated on said hearth.

2. A depressed hearth having an inclined bottom, a smelting-stack disposed above the deepest portion of said hearth and opening into the same over its entire cross-sectional area, means for closing the top of said stack, and an arched roof extending from said stack and covering the remaining portion of said hearth, an escape-orifice being provided between said hearth at the end opposite to that covered by the stack and said roof, two tiers of air-inlet openings in said stack disposed at different elevations and above the point of junction of roof and stack, and a water-jacket surrounding said stack, in combination with means for forcing air through said openings, and thereby causing a draft to pass downward, through said stack, over said hearth, and out at said escape-orifice.

3. In combination with a smelting-shaft 1, the air-supply pipe 23, charge-supply pipe 29, terminating within said air-pipe, funnel 30, pipe 29, conical valve 35 in said funnel-opening, and rod 36, attached to said valve and inclosed in said pipe 29, substantially as described.

4. In combination with a smelting-shaft 1, the bent air-supply pipe 23, having a detachable cover 28, and the charge-supply pipe 29, terminating within said air-supply pipe and above the angle thereof, substantially as described.

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